
TAC ATTACK
AUGUST 1967
turning...again!
HARRISON

for efficient tactical air power

TAC ATTACK

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TACTICAL AIR COMMAND

COMMANDER
GENERAL GABRIEL P. DISOSWAY

VICE COMMANDER
LT GEN ALBERT P. CLARK

Published by the Chief of Safety
COLONEL H. B. SMITH

CHIEF SAFETY PUBLICATIONS
LT COL CARL E. PEARSON

editor
Maj John D. Shacklock

art editor
Stan Hardison

layout & production
SSGT James E. Fields

editorial assistant
SSGT Richard D. Reid

printing
Hq TAC Field Printing Plant

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Angle of ATTACK

TODAY'S TIGER

Today's tiger is a thinking tiger!

His aggressiveness, skill, and success in combat come from his knowledge of how to use his equipment. He maintains complete control over a complex and powerful weapons system because he understands it. He knows how and when it performs at maximum . . . and he knows its limitations.

In recent months we have suffered a series of incidents, accidents . . . and fatalities . . . that makes me wonder if some of us are confusing tiger aggressiveness with unthinking ham-fistedness.

In our current high-performance airplanes there is often only a narrow margin between safe maneuvering and out-of-control. The pseudo-tiger who thinks he can slam the airplane around without regard for airspeed, fuel load, or asymmetrical wing loads is asking for trouble . . . and he usually finds it!

You must understand the varying effects of these critical factors. And you must control the airplane to stay within the limits that these factors dictate. You don't use high roll rates and rapid application of G forces when you are slow or heavy, or in the traffic pattern . . . and retain control of the bird.

There are times when you can . . . and want to . . . really lean into the controls. And there are other times when the best technique is a fine-feathered, precise touch on the stick.

The thinking tiger knows when.

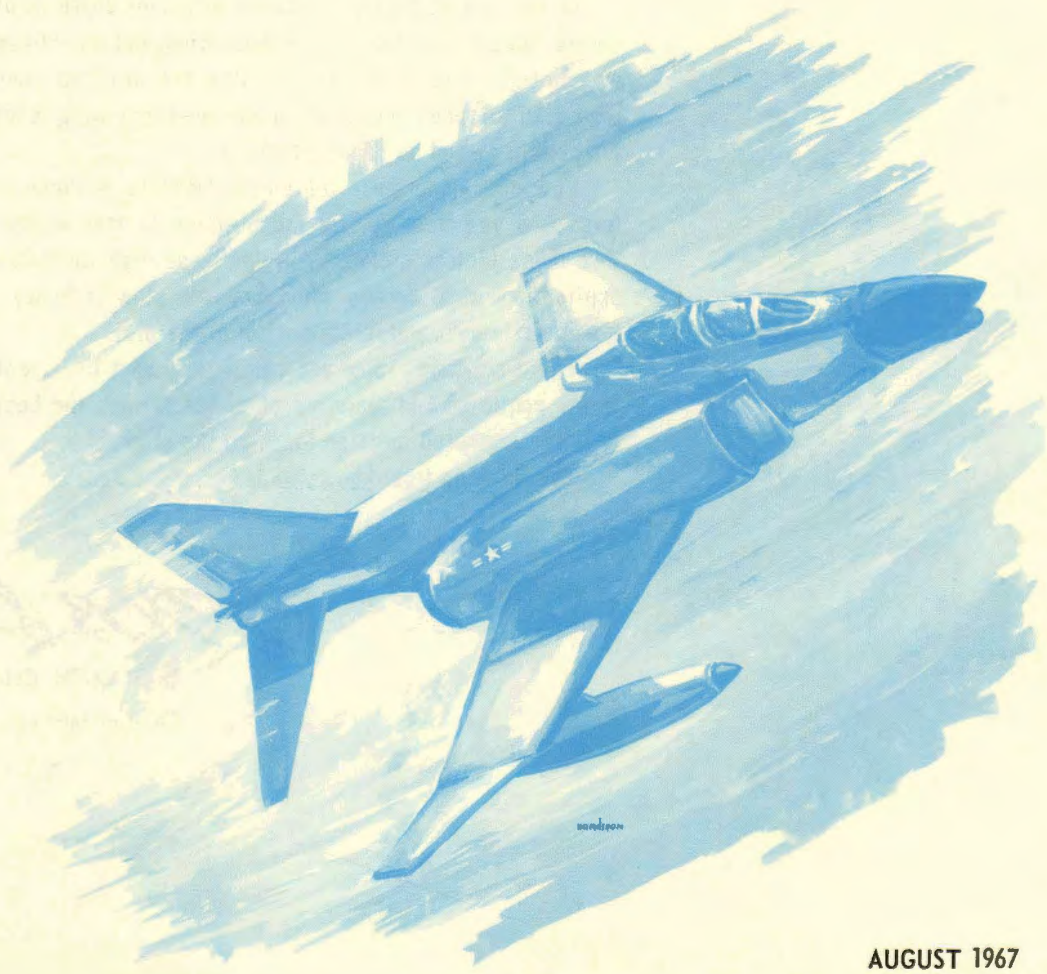
H. B. Smith

H. B. SMITH, Colonel, USAF
Chief of Safety

. . .a status report

We have been operating the F-4 in Tactical Air Command for four and one-half years. During this time it suffered 35 major aircraft accidents. In 18 of these accidents the investigators determined positive cause factors such as inflight fire, short landing, or mid-air collision.

The remaining 17 accidents involved loss of control. Ten of these 17 accidents occurred when the aircraft was definitely in an aft center of gravity (CG) condition. In the remaining seven accidents, CG conditions and poor stall warning are highly suspect.



TURNING THE PHANTOM-II

The memo on the opposite page recently passed between offices in the Headquarters at Langley. It accompanied an updated list of the F-4 accidents in TAC and their cause factors. And it shows the mounting concern over the problem of controlling the F-4 under aft CG and high angle of attack conditions. It also marked the close of the first six-month period since the loss of control problem in the Phantom was fully identified.

So now, six months after our first article on the subject,* we decided to take another look at the subject and attempt to clear the air as much as we can.

DOES THE F-4 HAVE A SERIOUS CONTROL PROBLEM?

Not really.

Is it too sensitive for the average pilot to control safely? If you listen to some of the talk on the subject ... and don't get the full picture, or fly the bird yourself ... you might get that idea.

Let's put the whole subject in its proper perspective right here.

The Phantom is a highly sophisticated weapons system. It operates over a greater range of airspeeds than perhaps any other airplane we have flown. Because of its sophistication and speed range, it is tremendously versatile. And because of that versatility, it is fast proving itself one of the most effective weapons we have ever employed.

But it's not a Piper Cub ... or a T-bird. It takes a little more sophisticated handling to get the full value of this speed, technical sophistication, and versatility out of the Phantom. It takes a complete understanding of the forces that make it fly. And it takes a solid understanding of the forces ... they're the same ones ... that make it sensitive to control in some regimes of flight.

This characteristic of sensitivity that requires special attention is not new to us. We've been living with it almost since we took the pistons and propellers off our fighters.

Remember the whifferdill that the T-33 used to do over the desert near Willy? And the stall strips we glued onto the wing roots?

And few who've flown the F-100 will deny that you must understand adverse yaw and dihedral effect before you can turn it to maximum advantage.

How about stick lightening, ... nose rise pitchup ... in the F-101 and the F-104? Again, you have to understand the aerodynamics of these birds before you can fly them right up to the edge of their operational envelopes. If you don't understand and stay ahead of these birds, you just shouldn't try to take them very close to maximum performance.

It's the same with the Phantom. The bird has a peculiar control characteristic. When the conditions of external load, fuel distribution, and airspeed are within certain limits, the bird displays some less than desirable traits. When these conditions are met, it becomes more susceptible to stall because it takes less stick force to increase angle of attack. At the same time, aerodynamic stall warning or buffet becomes less noticeable. In fact, the mechanical warning of the rudder pedal shaker is sometimes masked by airframe buffet. We end up with an aircraft capable of slipping rapidly through stall at low airspeeds and into post-stall gyration.

But this is only when those factors of fuel and stores load (CG), and airspeed are all in the right place. So let's examine them:

When the F-4C was undergoing Category II flight testing the pilots noticed a tendency toward pitch instability at high G loads. They found that in the transonic and subsonic airspeed ranges it required less stick force per G, and less elevator movement per G, than we normally expect in our fighters. This was with no external stores. When they hung assorted stores

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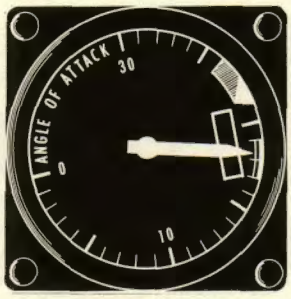
* *See "Turning the Phantom," TAC ATTACK, Feb '67.*



on the bird, they found that these stores further decreased the stick force required by an average of 50 percent.

The test report commented that the pitchup tendency should be corrected ... it could degrade the F-4's capability in an air superiority role that demands maximum maneuvering.

At just about the time that the report was published, we were starting to commit the F-4 to combat in SEA ... primarily in a ground attack role. And it performed very well. The acid test of combat didn't reveal any overriding control problems. The people who flew the airplane over there came back mighty proud of it.

But at the same time, we had been experiencing loss of control accidents during training. As a trend, it went almost unnoticed until last fall. The discrepancy between the F-4's performance in combat and in training puzzled many of us. We started looking at pilot experience levels and training syllabi. And we asked the people out at Edwards to run through the stability and control tests for us again ... with the external store load that we normally carry on our training sorties.

These tests were flown in February and March of this year. When we got the preliminary test results, we noticed a lot more talk about CG in relation to pitch control than we had noticed before. And that finally gave us the clue to the discrepancy between stateside and SEA experience.

Basically, it boils down to the fact that when you load heavy stores under the wing, or missiles in the missile bays of the F-4, the CG moves forward. Most of these sorties in SEA are flown with heavy stores, or missiles ... or both! In training we don't fly with those loads. We carry fuel tanks and training dispensers, but there's not enough weight in the right places to move the CG forward. With the light stick force condition, aft CG becomes a serious consideration.

In our training configuration, fuel distribution has the most significant effect on CG movement. And the significance of that effect is that CG runs to the aft limits for that configuration. The report from Edwards told us that when the CG is aft of about 32 percent of the chord (MAC), rapid stick movement under high G loads and low airspeeds becomes precarious at best.

The worst aft CG condition occurs in our training configurations when the Number 5 and 6 fuselage fuel tanks are full. If you have fuel in only 1, 2, 3, and 4 tanks the CG moves ahead of the 32 percent mark. This may be an oversimplification, but it's about all you need to know in the cockpit. And that's where the guys most concerned with the problem are sitting.

Right now we don't have much control over fuel distribution in the F-4. As a matter of fact, we can't even tell where it is once it gets there! So knowing that empty 5 and 6 tanks will move the CG forward doesn't help a lot. Internal wing fuel isn't supposed to feed into Tanks 5 and 6. But we find that in some cases it does.

How, or why it gets there is a matter for the engineers. Sitting in the cockpit, all we need to know is that internal wing fuel does get into 5 and 6 in some aircraft. We are trying to identify which ones, right now. And of course, the external tanks feed into all the fuselage tanks. At present, we can't reach that desired condition where we have 5 and 6 empty and carry fuel in only the first four.

So how do the fuselage tanks feed? Do 5 and 6 feed out before 3 and 4 start feeding? They're not supposed to. As far as we can tell, 3, 4, 5, and 6 should all feed together. Fuel level should decrease evenly in all four of them.

Now, that's based on the understanding that the transfer pumps in Tanks 4 and 6 are rated at the same capacity. But being practical, we know that the actual output of no two pumps is going to be exactly the same. So it can happen that the pump in Tank 6 is stronger, feeding all the fuel out of 5 and 6 before 3 and 4 start to feed. And it can happen the other

way around. If the pump in Tank 4 is just a few pounds stronger than the Number 6 pump, it would empty Tanks 3 and 4 before 5 and 6 start feeding.

... and you'd never know it in the cockpit!

Before it all starts looking too doggone dark, let's explain that the machinery is in motion to clear up this fuel sequencing business. There are proposals to add a capability to the fuel quantity system that will allow you to read 5 and 6 tank fuel alone. This would be a great boon!

There is a modification coming which will give you a switch in the cockpit that will close off 5 and 6. It would allow you to direct all external and internal wing fuel to the first four tanks when your mission makes that the smart thing to do. When you don't plan to drop your tanks and want the CG forward for optimum maneuvering, you keep 5 and 6 empty. But when a combat situation dictates that you transfer as much fuel to internal tanks as you can, you fill 5 and 6 ... if you're carrying bombs or missiles, they will help control the CG.

Adding forward ballast to training configurations to keep the CG where we want it has been suggested and considered. But that means adding dead weight, something you never need more of in an airplane. Better control over fuel sequencing appears to be the best answer.

And finally, a fix is in the making to plug up the hole between 4 and 5 that is allowing internal wing fuel to fill 5 and 6 ... which it isn't supposed to do.

Unfortunately, all these improvements take time. And we have an airplane to fly.

There are two other factors affecting the pitch control problem ... airspeed and angle of attack. And you can reach both of them from the cockpit. Angle of attack, of course, because it gives you a direct reading of how close you are to the stall ... at any airspeed. We know that at seven or eight units you're usually in a nice, comfortable cruise condition. At 19 units you can turn the Phantom as tight as it will turn at any given airspeed. At about 23 units you should be getting the pedal shaker ... and it may be masked by prestall buffet. At 25 units you've passed the stall. And at 30 units you're not flying the airplane anymore ... it's spinning you!

Notice how things begin to happen pretty fast after you pass 19 units angle of attack? You can call that area "maximum performance." When you're operating the machine close to ... or beyond ... that magic number, your control actions change.** You use rudder for roll and turn. And you go to great lengths to avoid adverse yaw by keeping ailerons neutral.

Yes, things happen pretty fast when angle of attack gets up to the max performance area. But airspeed determines how fast. This, because as airspeed increases you have more G available to you before stall. Or, to put it another way ... as airspeed increases, you get less increase in angle of attack with each G you pull.

At 370 knots with a 41,000 pound airplane at low altitude, you can pull about 5.2G before your angle of attack reaches a 20-plus figure. At 250 knots with the same airplane, by the time you pass 2.5G, you're up to about 23 units.

And the rate at which you apply the G has a good deal to do with it. Rapid application of G at any airspeed can put you beyond stall angle of attack before you know it.

So what do we do about maneuvering the F-4 when we know the CG is farther aft than we'd like it ... but don't know exactly where it is?

Watch the airspeed! And watch angle of attack. They are inseparable!!

In this vein, a lot of people have suggested that the angle of attack indication in the F-4 needs improvement. We couldn't agree more. The present indicator, buried down in the middle of only the front

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***See "More On Turning the F-4," TAC ATTACK, May '67.*

panel, could surely be better. And the guy who decided to make the F-4's angle of attack the only meter that reads counter-clockwise must have had something against fighter pilots.

The engineers tell us the present angle of attack system won't support a repeater ... a second indicator in the back seat. We're still hoping they figure out a way to do it. The guy back there could help us a whole lot if he could monitor angle of attack while the guy up front is busy turning the bird. The indexer lights are being wired to stay on all the time ... that's a move in the right direction.

Some people have suggested that the stall warning in the airplane be improved. The pedal shaker at 22.3 units angle of attack is sometimes masked by airframe buffet to the point where you don't realize it's there. The idea of a tone in the headset has been discarded because it could easily be confused with other audible warnings in the airplane. Other warning devices in the form of stick shakers or pushers are under study. There is also a good possibility that we will have a rate sensor before too long that will warn of too-rapid stick or slab movement.

But at present, it's best to just keep in mind that you have more G available ... more maneuvering room ... when you keep your airspeed up. And that you can't use the brute strength and awkwardness technique with this airplane.

There's nothing wrong with flying the airplane at 300 knots, or even 250. That is, if you understand that it takes much more careful control at that speed than it does at 350 or 400.

During your first couple of passes on the range you should be very conscious of this. Your weight may still be in the 40,000-pound bracket. This means that your CG can be far enough aft to give you a pretty light stick. And if you have 300 knots as you start to roll into final, you'll have those 19 units when you've put about 3G on the airplane.

And, at the risk of oversimplification again, you can assume that the heavier you are, the farther aft your CG ... and the touchier the airplane. So on the way to the range ... or in the early part of any mission ... you have an airplane that takes very light forces on the stick to add G. And when you add G, you increase angle of attack, and ...

The test reports emphasize that you can't rely on aerodynamic stall warning. In the subsonic tests, they found that heavy buffet occurred at about 15 units angle of attack ... this runs about 35 knots before stall. When you're trying to get the most out of the bird, you want to use as much of that 35 knots as you safely can. But you can't tell how much you've got by buffet intensity alone. You must know your angle of attack.

In the transonic region, the tests revealed that stick lightening started before significant buffet developed. The test pilots also noted a deceptive decrease in buffet noise level, on most maneuvers, at nose-rise and just before the wing-rock and yaw of poststall gyration.

The report of the most recent tests at Edwards concluded with the statement: "If aircraft stall warning is not detected because of buffet or if the control inputs are too rapid, loss of control ... can result." The report recommended these four items to assist in "minimizing undesirable flight conditions ..."

- Avoid rapid stick rates during aft CG conditions to prevent dynamic overshoot into the stall.
- Have the pitch damper on and operational for all flights.
- Use the angle of attack indicator as your primary maneuvering instrument at subsonic speeds.
- Limit subsonic maneuvering angle of attack to 20 units in the training configuration. (TAC has limited it to 19 units except when specifically required during syllabus training. That's best turn and there's no need to ever exceed it.)

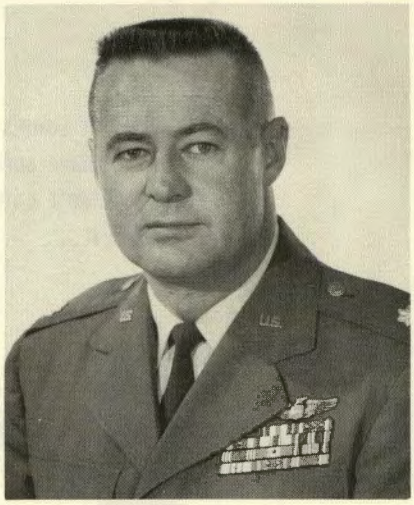
We said earlier that the Phantom is a sophisticated fighter that has been doing a tremendous job for us in combat. And nothing we've said since then is intended to change that. It has a control characteristic that demands understanding and precise, intelligent handling. Happily, this pitch control characteristic is the least troublesome when the bird is loaded for combat.

But in any configuration, on any mission, you must treat the airplane with respect. You must understand it and work with its peculiarities if you're going to get the most out of it ... max performance.

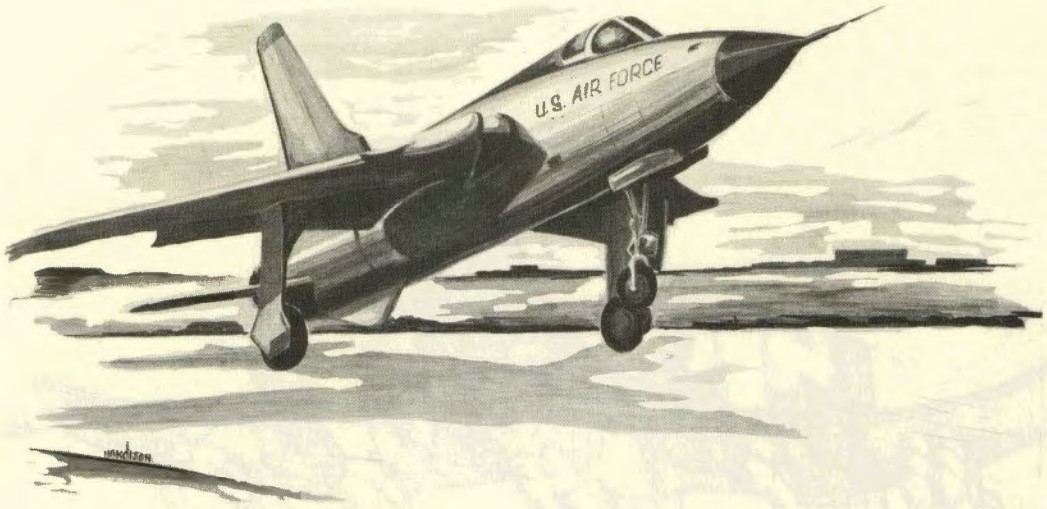
And that's what we're here for, isn't it?

TACTICAL AIR COMMAND

PILOT OF DISTINCTION



Major Neil L. Eddins



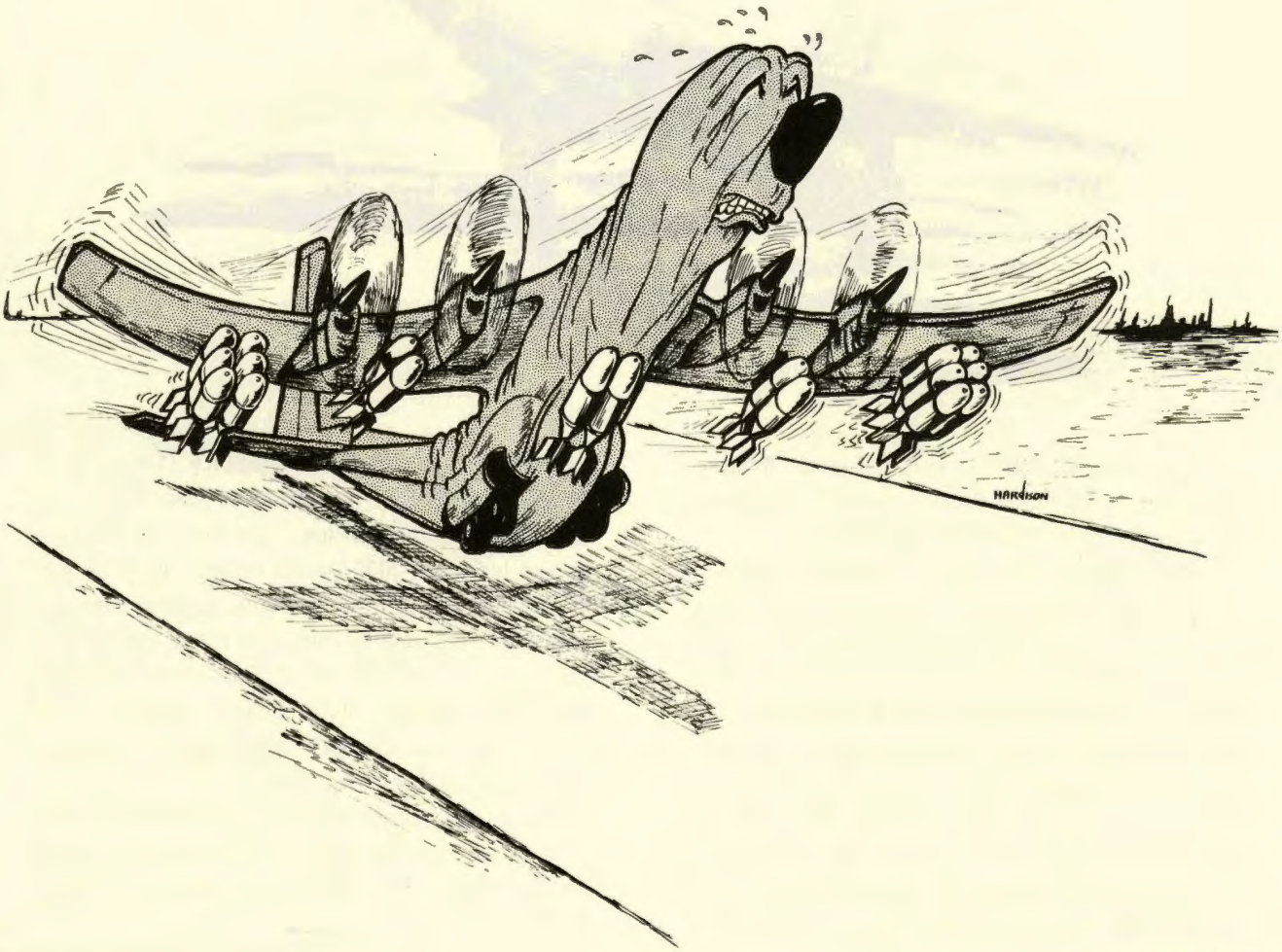
Major Neil L. Eddins, 4525th Fighter Weapons Wing, Nellis Air Force Base, has been selected as a Tactical Air Command Pilot of Distinction.

Major Eddins experienced a massive fuel loss in an F-105 aircraft during a low-level test flight. His excessive fuel vent light came on and his wingman confirmed that fuel was venting. A fuel check with his wingman revealed that Major Eddins' fuel was 1100 pounds low. He immediately started a climbing turn toward home while fuel quantity continued to drop at an abnormal rate. After 180 degrees of turn, his fuel had decreased from 3500 to 2000 pounds. At 10,000 feet he was down to 1800 pounds. He dropped external stores, continued to climb, and declared an emergency. Leveling at 18,000 feet, he saw the aft boost pump light come on followed by the fuel low level light. At this time he had less than 1000 pounds of fuel. While he was in an idle descent to a down-wind landing, the inlet pressure light and all the fuel boost pump lights came on. Five miles out, at 240 knots, with gear and flaps extended, Major Eddins' aircraft flamed out. He extended the RAT, continued his approach, and landed 500 feet down the runway.

Major Eddins' professional airmanship and cool, precise judgment during a serious emergency readily qualify him as a Tactical Air Command Pilot of Distinction.

Great stacks of paper pass across an editor's desk each month. Some serious, some funny, and some awful! This one we couldn't categorize, so we pass it on the way we received it...

B-130...?



REPORT OF TEST CONDUCTED TO EVALUATE THE PERFORMANCE OF THE C-130 HERCULES AS A TACTICAL BOMBER

It has come to the attention of this office that a number of aircrews assigned to C-130 wings have been conducting informal and unauthorized tests of the capability of the C-130 to perform as a tactical bomber. These tests have included the dropping of various items of equipment, and aircraft components in a manner not prescribed in TACM 55-130.

Although these tests were not authorized, the results have been carefully evaluated. The type of bombing being conducted in these tests has been found unsuitable for effective tactical application, for the following reasons:

1. Unpredictable ballistics of test weapons, i.e. (hatches, inspection plates, dust excluders, wheel chocks, para-drop loads, etc.) preclude an acceptable degree of accuracy.

2. These weapons, while highly effective against such light targets as barns and runway lights, would be ineffective against fortified military targets.

This study is considered to be completed, and additional data is neither required nor desired. To preclude the accumulation of additional data, it is directed that these unauthorized tests cease immediately.

To facilitate compliance with this directive, all aircrews are advised to comply with the following procedures:

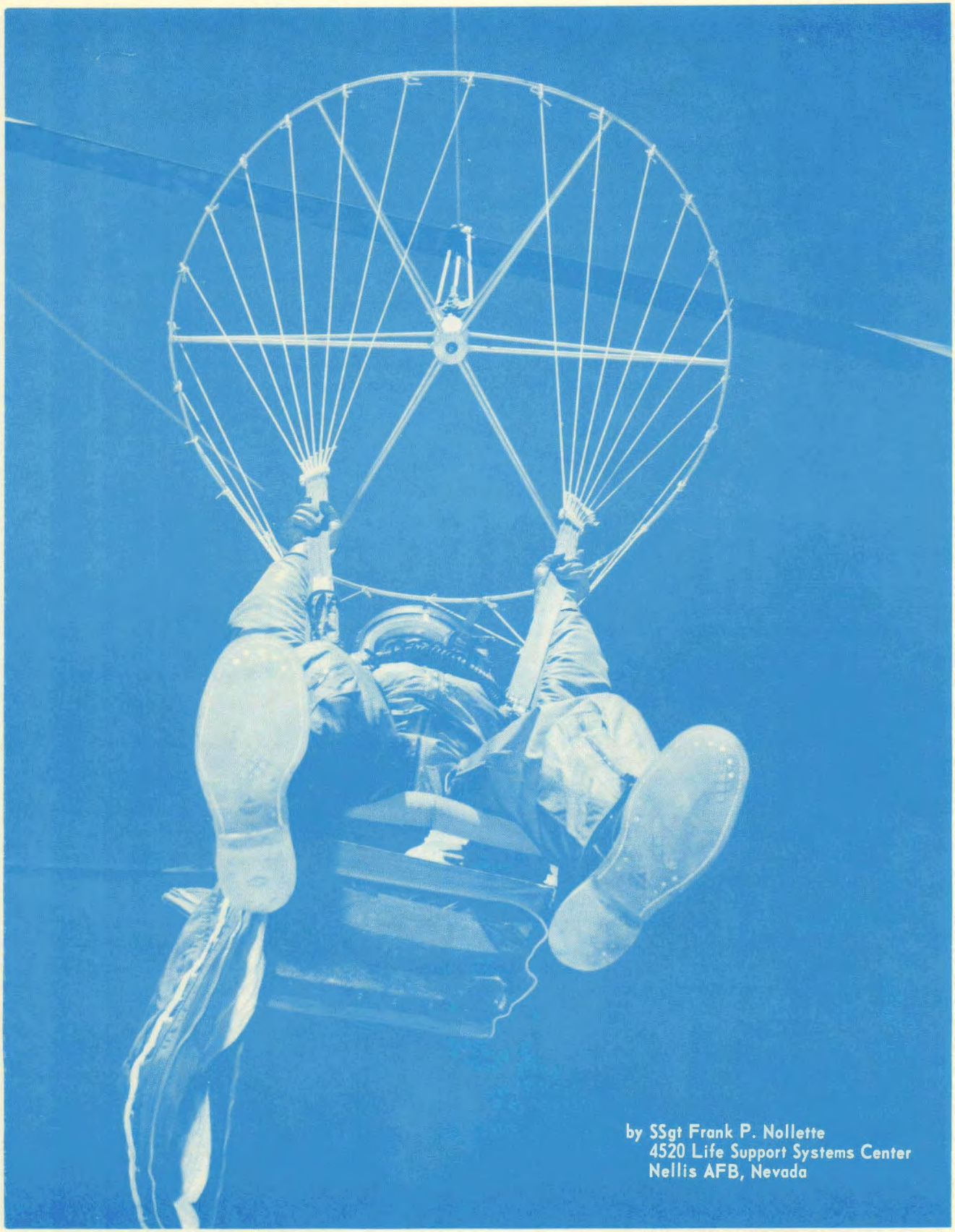
1. Proper installation and security of all doors, hatches and cowlings should be CAREFULLY checked prior to flight.

2. On aerial delivery missions, extreme care must be taken to preclude inadvertent loss of equipment located near open doors. All equipment normally stored in the rear of the aircraft must be CAREFULLY secured, or stored in the forward end of the cargo compartment.

3. Flight with doors open should be minimized. As soon as practicable after completion of a drop or upon the decision for NO DROP all doors should be closed. If a race track pattern is contemplated, doors should be reopened only when the aircraft is re-established on the inbound track to the drop zone.

Jack H Smith

JACK H. SMITH, Capt, USAF
Flying Safety Officer
64th Tactical Airlift Wing



by SSgt Frank P. Nollette
4520 Life Support Systems Center
Nellis AFB, Nevada

SURVIVAL for SWINGERS

We've heard some recent "I was there" reports to the effect that oscillating survival kits are still presenting problems after ejection. The problems arise when, after getting a good chute, you pull the kit handle and all the goodies drop away on their 25-foot nylon lanyard. With the heaviest portion of the kits at the low end (we're talking specifically Phantom and Thunderchief), it takes only a little wind to start the rig swinging. You may call it wild or mild, depending on the pucker-factor present.

One of the hairy ones we've heard of concerned Phantom phlyer. His kit somehow oscillated enough to foul in his shroud lines. It gave him quite a few bad moments before he got things squared away.

The problem revolves around the pendulum effect of the 30 to 40 pounds hanging 25 feet below you. Once you've dampened out your chute oscillations or used the four-line cut (film TF 5720 shows it), you pull your kit handle and the kit drops away. As soon as the raft inflates, the winds start playing hob with you.

The simplest remedy, short of cutting away a wild kit, is to slowly pull the lanyard up to you and hold the raft between your legs until you can get the heaviest part up. Then SLOWLY let it all down again. Chances are, you'll lick the oscillations. If they start again, repeat the process.

If the winds are tricky before you pull the kit handle, you may be able to delay deployment until you're closer to the deck. But make sure you deploy the kit!! Riding the kit in, with its 40 to 60 pounds dangling against your thighs and knees, can result in all sorts of broken bones. With luck, you might get away with only a sprained ankle ... or a knee ... or a hip. But potentially more serious injuries are likely.

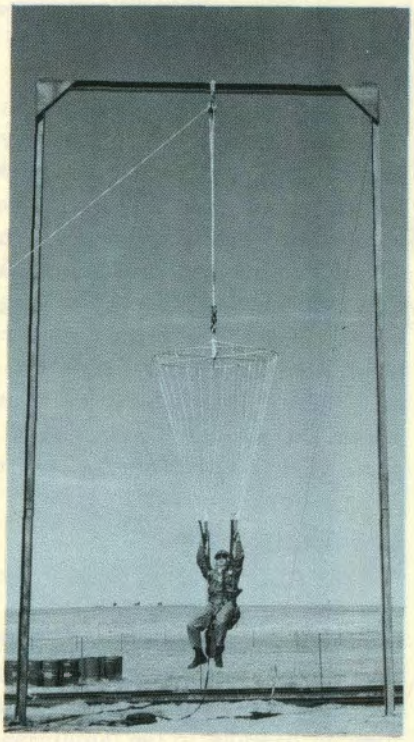
Try this:

● In the local PE shop, don your chute and have a PE man strap a kit on you. Now fake a PLF in any direction and note the points of contact with the kit. Smarts, don't it? While you're at it, notice where the handle moved to. Not warmly tucked against your thigh any more, is it?

Various sources and experiences make 2000 feet above the terrain the best altitude to deploy your kit. Pop it any lower, and you may not have time to stop the oscillations that can put you in a bad landing position. Any higher, and you'll have more winds to contend with. Over VC territory, you may have to delay to present a smaller target, too!

Finally, again, deploy the kit. Don't ride it in!

Photos courtesy Colorado ANG



Practice hanging in the harness is invaluable. This rig, in use by the Colorado ANG at Buckley Field, gives excellent training.

CHOCK TALK

. . .incidents

whodunit?

The F-4 crew had been airborne for about an hour when they suddenly found they couldn't move the stick back more than about one-half inch from neutral. Checking their ability to control the bird for landing, they found they could maintain level flight with the gear down. But with either half or full flaps, and AFCS engaged, the bird nosed over. However, the aircraft commander was able to fly it with control stick steering.

At about three miles out on final, he couldn't maintain the nose-up attitude he needed to continue his approach. He quickly retracted his flaps, pushed the power up, and managed to continue the landing.

Quality control inspectors checked the controls as soon as the airplane landed. They found a 1/4-inch drive speed handle socket binding the stabilator bellcrank. From its corroded appearance, the socket had been floating around inside the airplane for some time. The report concluded by saying that the area where the socket finally lodged is very difficult to see . . . but that isn't much of an excuse, is it?

one little bolt

The Phantom crew taxied into position for takeoff and started their engine check. When the aircraft commander chopped his left throttle, the engine stalled at about 91 percent. He shut it down.

When they tore it down, the engine folks found extensive damage to the compressor. A steel bolt had gone through the engine. And what was left of the bolt was in such small bits that there was no way of identifying when or how it got there.

They had no trouble figuring out that it had cost us $21,967.68!!

overlooked

Returning from a normal mission, the overseas F-100 pilot entered traffic for landing. His pattern felt good and he landed 500 feet down the runway . . . right on the recommended airspeed. When he pulled the drag chute handle, it moved only about half an inch. It was jammed.

Since the runway was only 7700 feet long, the far end was moving toward him rapidly. He decided to take the barrier instead of attempting to stop without it. There was no overrun.

He got his tail hook down early and the barrier brought him to a smooth stop.

When maintenance investigators took a look at the bird, they found the drag chute quick-disconnect cable disconnected. The aft section had been removed and replaced just prior to this flight.

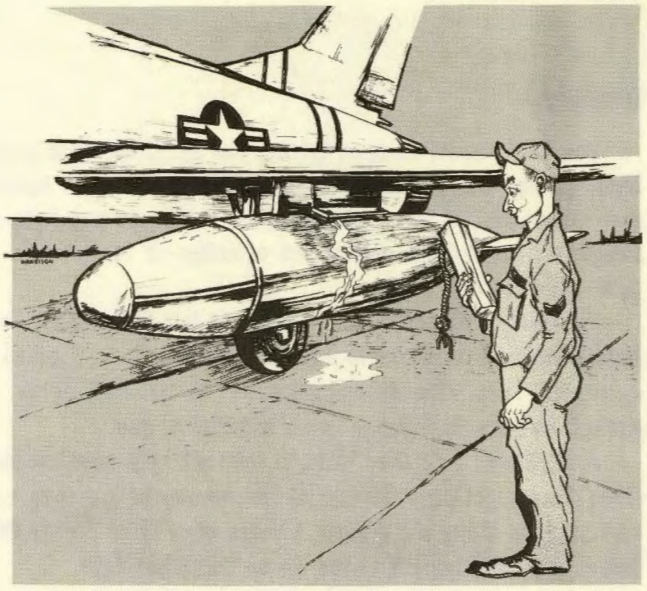
how close

The F-100 had just become airborne when the pilot felt the stick go slack in his hand. The nose of his Hundred pitched down toward the runway. With little choice left him, he snatched the throttle out of afterburner and lowered the hook. His high-speed abort ended in a successful barrier catch.

Investigation centered on the stabilizer linkage. It wasn't long before inspectors learned the stabilizer actuator had been improperly installed. A cotter key had not been installed in the control arm bolt.

The unit concerned is placing much stronger emphasis on identifying disconnected flight controls with a Red-Cross write-up. And they're talking about using bolt keepers to preclude the loss of a critical bolt when cotter keys or nuts are omitted, come loose, or fail.

and incidentals with a maintenance slant.



murphy

The pilot had no normal trim after takeoff. He tried auxiliary trim and found that it worked backwards! When he trimmed the nose down, it came up ... and vice versa. He decided he could land the bird without trimming the stabilizer any more. And he left the aileron trim carefully alone. He landed without any further incident.

Maintenance investigators found that the stabilizer trim actuator motor was wired in reverse. Someone had murphied a repair job and overlooked a functional check of his work.

This time it happened in an F-104. But it could happen in any bird when people forget that even little errors can sometimes kill the guy who's going to fly the airplane.

cry wolf

The RF-101 pilot had been in the air for almost an hour when he saw his right fire warning light come on. Although it went out as he retarded the throttle, he went ahead and shut down the engine and came home.

The maintenance folks who looked into the system after landing found the fire loop improperly installed. It had been chaffing against the high pressure cabin air manifold.

Ten days earlier, the same bird had the same write-up on the same engine. But that time the false fire warning was caused by a crushed seal allowing a hot air leak near one of the sensing elements. Whatever the exact cause, two more pilots lost a little more faith in a warning system that is vitally important to them ... all because some airplane fixers didn't take their jobs seriously enough.

aw, c'mon guys

The crew chief's Supersabre was in pre-takeoff position when he discovered a 450-gallon tank leaking fuel. Picking up a nearby wheel chock, he hit the pylon near the leak. The impact excited a pylon relay, fired the cartridges, and smartly jettisoned the tank...

...and again!

On his first hot strafe pass of the day, the Phantom pilot fired a very short burst. He noticed several rounds impact on the range unusually short of the target. And then the people in the range tower told him they thought something had fallen from his bird as it went by. That was enough. He quit and went home.

On the ground, armament folks soon found his SUU-23 gun pod diffuser was missing. And there was sheet metal damage to the underside of the aircraft.

The cause ... ?

SUU-23 diffuser not locked or correctly torqued!

and again...!!

The F-4 was at 15,000 feet, about 350 knots, pulling 4Gs on an air combat tactics mission. Suddenly the crew felt the bird shudder. It was almost like a stall warning buffet ... they even got some wing roll. But when their wingman called, they learned what the trouble was. An AIM-9B missile rail had fallen from their bird.

Inspectors on the ground found that it dented the left leading edge flap and tore the outboard flap at the wing fold. And it punctured a small hole in the underside of the outboard wing.

What caused the rail to tear loose ... ?

Mounting bolts not fully tightened and torqued!

SORRY

Dear Mom -

You know how I've been telling you about the heat over here. Well, it's been getting worse instead of better. Maybe it's the humidity, too. It just presses in around you until you don't think you can take another step. My fatigues always look wilted. As a matter of fact, that's about the way I feel most of the time.

This afternoon after chow it was so hot that nobody in the outfit could hardly move. And the little airplanes we have . . . I guess they can't take it either. They were drooping as bad as the rest of us. The big birds I worked on back in Arizona never acted this way.

A couple of airplanes tried to take off on a mission about two o'clock. They barely got past the end of the runway before they came back down and skidded along the ground. I heard the Flying Safety Officer saying that there just isn't any lift in the air on these hot days.

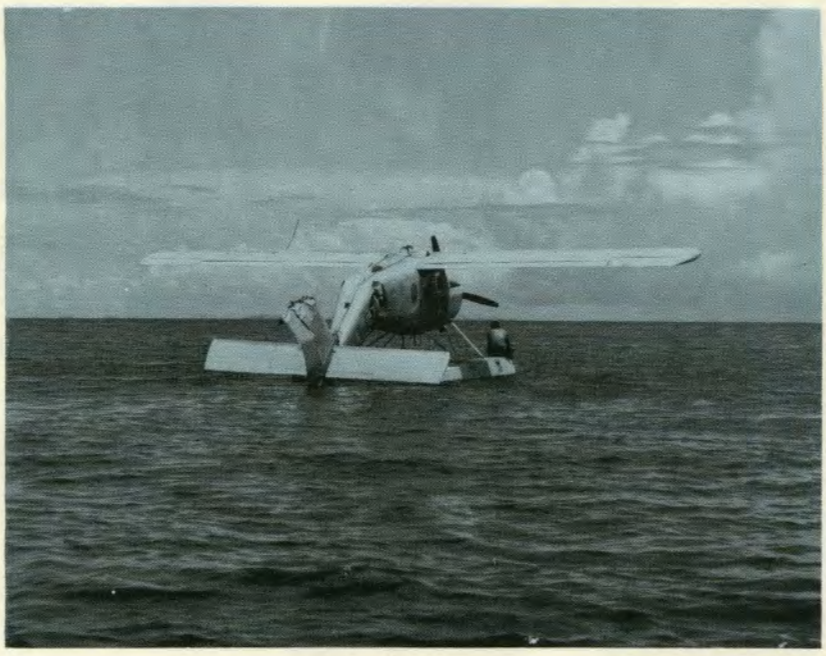
Later we took one of the airplanes and put it out on the bay to see if that would cool it off a little bit. Maybe it'll perk up some after a couple of hours.

It's too hot to write any more. I'll try again when the weather changes.

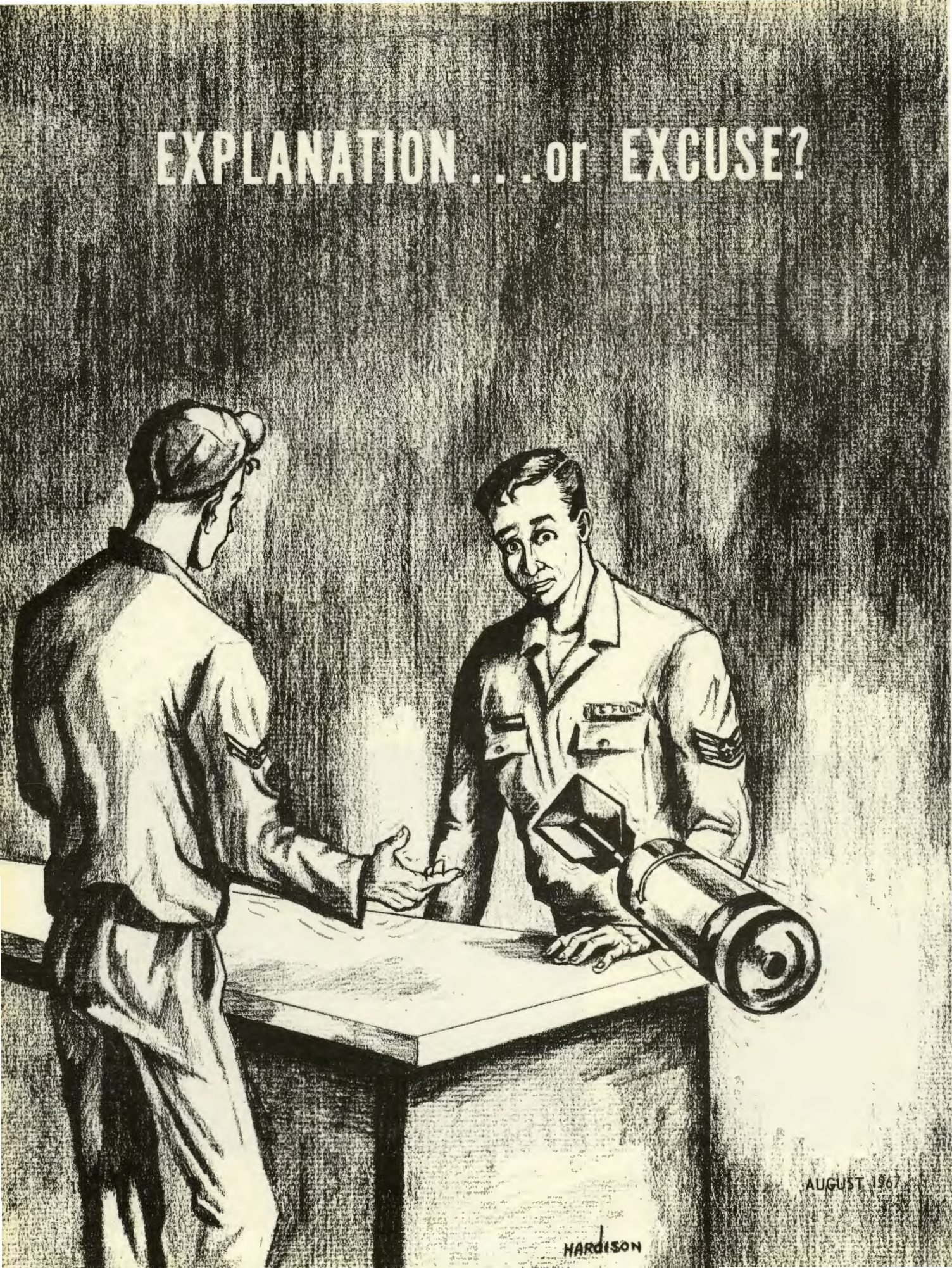
With love,

Johnny

'bout that



EXPLANATION . . . or EXCUSE?



by Lt Col B. B. Benigno
HQ TAC (OSMEN)

"He said he had a sure way of making this bomb unserviceable. And before I could stop him, he picked it up and threw it. When it exploded, blood spurted from his head. Looked like he might've lost an eye. What made him throw that loaded MK106? Why didn't he follow proper procedures? I wish I knew!"

The assembly crew supervisor continued. "Of course he knew the spotting charge was in it. The airman just ahead of him on the assembly line had put the signal charge into the bomb. He knew the striker plate had broken as it was fastened. When his buddy left to get a better tool, he just couldn't wait. He broke the rules ... and he paid the penalty. With explosives, you have to follow the book!

"I guess we did call it 'inadvertent actuation' at first. I'm afraid you're right ... negligence is a better word."

Explosives incidents similar to this one occur too often in TAC. And this supervisor's remarks are fairly typical, too. The word inadvertent keeps popping up as an explanation or an excuse.

Here's another example:

An A-1E pilot came home with a hung 2.75 rocket. He also brought back some practice bombs and 100 rounds of 20mm ammunition. The de-arming crew secured the rocket and the bombs for the night. But they didn't clear the guns. The pilot hadn't signed off the expenditure block of the 781A because he brought some ordnance home.

The following morning the armament crew downloaded the hung rocket and practice bombs. Then they cleared the 781 ... without checking the guns. The A-1E carried the stowaway ammo on a scheduled non-ordnance mission without anybody knowing it.

About 0430 on the third day a sleepy A-1E crew chief ran through his preflight without a check list. Then he went on to make a functional check of the guns, a procedure he was not authorized to perform. In the cockpit, he flipped the switches, squeezed the trigger, and rattled off a burst of inadvertents. Fortunately, the rounds missed people and places.

A Thunderchief was featured in another inadvertent explosives incident. The day shift rolled the F-105 into a hangar to trouble shoot a gear warning horn malfunction. They disconnected the battery, pulled circuit breakers, and made their 781 entry. They did not disconnect the arresting hook plug even though the Dash Four requires it.

The electrical specialist needed power on the bird so he re-connected the battery and reset the circuit breakers. He didn't record these actions in the 781. His corrective action decision: Night shift, change the throttle. When he left the job, the 781 said the battery was disconnected. But it wasn't.

The night crew started with the 781, believed the battery-disconnect entry, and didn't check any further. Actually, the battery was connected, all circuit breakers were reset, and the arresting hook plug was inserted. In the throttle repair process the tail hook switch was tripped. Inadvertently ... so the report stated ... the explosive bolt fired and the tail hook hit the hangar floor. Hard! Again fortunately, no injury to personnel.

TAC suffered 36 similar personnel-error explosives mishaps in the past year. The people responsible? Five pilots, seven supervisors, and 24 ground crewmembers failed to follow proper procedures ... and ended up wondering, "Why didn't I follow the book?"

You just can't take short cuts with explosives. When the careless, the impatient, the violator ignores proven procedures and safeguards, the result is accident. Sometimes it's tragedy. Explosives handling procedures are the product of experience as reviewed by experts. They insure equipment working as advertised. And they insure your survival ... provided you follow their guidance.

And what about the overworked adjective "inadvertent"? It's mainly used as a screen or a substitute. It suggests that something other than inattention or negligence is the real cause of the incident. If we'd stop using "inadvertent" as a crutch we'd go a long way toward licking the explosives accident problem. So, let's start calling inattention: INATTENTION.

Whether you're a handler, supervisor or manager, attention to detail is the heart of explosives safety. Your life ... and the lives of many others ... depends on it!

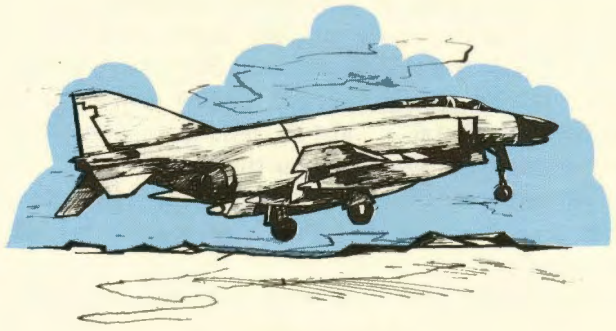
TAC TIPS

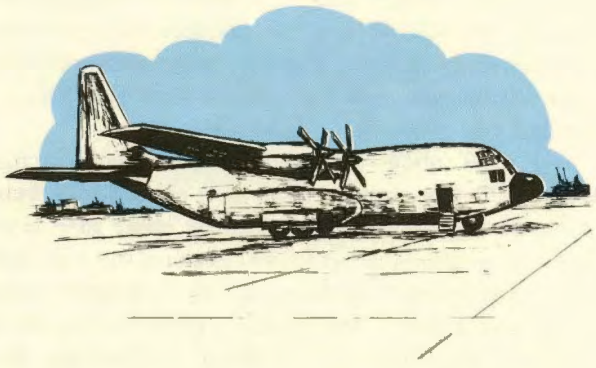
THOUGHTLESS

When the F-4 pilot leaned over into the cockpit to check the seat during preflight, he noticed something strange about the lower ejection D-ring. It was sitting at a 90-degree angle to the front of the seat ... with the guard in place!

When the egress people took a look at it, they found the handle had separated from the tongue attaching points which had sheared from the D-ring. If the pilot had tried to use the lower handle to eject himself in an emergency, it would have come loose in his hand. The seat would not have fired!

The investigators decided that this damage was the result of someone stepping on the D-ring handle while he was entering or leaving the cockpit.





LOOK-AROUND

The crew had parked their bird at an enroute base the night before. When they came back to it the next morning, it looked ready to go. But during the walk-around, one of them found a small round hole in an engine access panel. It hadn't been there before!

Checking, they found no exit hole on the other side. And there was no damage inside the engine. They were unable to find the projectile that had caused the hole, but decided it must have entered at a low velocity. Whatever caused the hole had entered on an almost level path, about 45 degrees from the left.

Sighting back in the direction it came from, they looked across the perimeter fence, a highway, and into some woods. The projectile must have been a stray bullet from a hunter's gun.

Of course, they couldn't be sure of that ... but they all decided that it sure pays to make a walk-around!

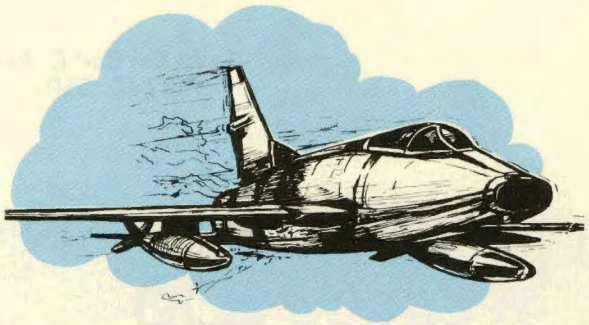
. . .interest items, mishaps with morals, for the TAC aircrewman

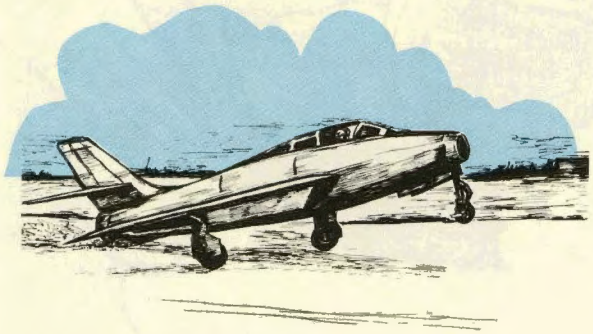
OOOPS!

The overseas F-100 pilot pulled up from his fourth dive bomb run. As he pulled through level flight, with about 400 knots, he was twisting around in the seat to see his bomb. He had pushed the throttle up to full military. Then his hand bumped the gear handle ... just forward of the throttle ... and the gear started to come out of the wells.

He immediately realized what he had done and returned the gear handle to the UP position. It had been down no longer than two or three seconds. He felt a slight buffet during the time that the handle was down, but the rest of the flight home was normal. His gear extended and locked down with no unusual indications.

When he taxied in, the crew chief saw that his outer segment gear doors were missing.





CABLE CAUTION

The F-84 pilot had experienced no trouble during the mission until he tried to release the target he was towing. After several tries, he decided the release system wouldn't work and dragged the target off on the range. But the cable didn't pull off with the target!

Returning to the field, he set up a higher than normal approach, hoping he wouldn't drag the cable across the public highway off the end of the runway. His intentions were the best, but he misjudged the flare from his steep approach, stalled, and scraped the drag chute compartment on the runway.

That was only minor damage. The serious part of it was that his cable had dragged across the highway after all ... and damaged a civilian vehicle.

The report talks about making downwind landings under these circumstances, and computing downwind landing distances. It doesn't say whether there was enough time to send the APs out to barricade the road while he landed ... or whether anyone even thought about it!

ONE for the BOOK

by Lt Col Carl E. Pearson
HQ TAC (OSP)

"Hey Will! I have a rare one for you today. I monitored the safety award committee meeting at..."

"Look Orv, you're getting out of hand. Being a self-appointed patron saint doesn't give you the right to flap your wings around any old airbase you choose."

"Aw, Will! I'm not bothering the folks. I just listen, and when

things get twisted out of shape I offer a little guidance . . . spiritual that is."

"Orv, quit fooling around with other people's consciences. You're not fully qualified yet. You've still got to get by that Standboard in the Sky."

"I know, I know! Quit preachin, Will. I'm just trying to help an old friend."

"None of your friends are still driving airplanes! How could they be up for flight safety awards?"

"I've been trying to tell you, Will! That is . . . until you got up on a small cloud and started lecturing me."

"Okay, Orv. You win . . . again. I'm listening."

"Well, it's like this. I heard about a young air evac pilot who made a pretty shiny save while he was carrying a load of litter patients. Got the story straight from my buddy who monitors the crash phone."

"He was on duty when the phone went off. It sounded a little grim so he joined the crowd around the sick bird on the runway. Well, it all started when the left main gear on the C-118 wouldn't retract after takeoff. It was only a short haul. And he had to get his patients where they were going. So he pressed on.

Enroute, his hydraulic pressure dropped to zero. Normally, the gear should free-fall down and locked. He was figuring on that as a backup. But when he called for gear down before landing, the right main and nose gear fell full down and locked as advertised. On the left he had a red light, barber pole, warning horn . . . the works."

"Orv, I told 'em years ago to quit fooling with retractable undercarriage. Weld it down and leave it there, I said. But they wouldn't listen. I knew they'd get in trouble some day . . . hate to say 'I told you so!'"

"Will, you're too conservative. This was just routine for this pilot."

"Routine? Unsafe gear? You're kidding!"

"This lad had done his homework, Will. He read the good book. He was ready!"

"Yeah. I've heard that prayer can move mountains . . ."

"Will, I didn't mean that book. I'm talking about the flight manual. Some folks call it a Dash One. You know . . . it took the place of the hangar flying we used to do. All the old heads tell their hairy tales to newcomers and wrap it up in one neat book."

"Oh, I get it Orv . . . instant experience."

"Rog, That's it, Will. Don't have to take all the lumps yourself . . . like we did.

"Well, this young flyboy set the bird down light as a feather . . . like I used to . . . and used left brake and reversed his right outboard propeller as soon as he could. That way he maintained back tension on the bad gear and kept it from collapsing. He held left brake and reverse thrust on number four engine until the folks there got jacks under the bird . . . the rest was easy. His passengers really appreciated it.

"The maintenance troops found that a cable failure had let the bungee spring jam the drag link. It split his hydraulic actuator too. The gear wasn't full down and would've failed if he didn't know his procedures. Will, can you imagine this young man figuring that one out for himself? Without the good book!"

"You're right, Orv. He couldn't have made enough hangar sessions in a lifetime to pick up that one. Say, Orv . . . I'm a little worried about calling it the good book up here. Let's say Dash One or Flight Manual. Okay?"

"Okay, okay! You're sure a worry-wart, Will."

"Hey! Almost forget, Orv. What were you doing at the award meeting? You weren't trying to keep this pilot from getting some recognition, were you? Even though he borrowed someone else's experience, he did a good job!"

"Heck no! I was trying a little mental telepathy. Hoped I could talk 'em into a dual award. One for the pilot; the other for the unknown old-timer who had the experience and good sense to put it down on paper . . . for pilots of the future. His foresight saved an airplane and some people."

"Orv, you can't pick one man out of the thousands who . . ."

"I know, Will. That's what the board decided. They gave the pilot an award for professionalism . . . and figured they'd just chalk up another save for the old pros who wrote the book."

"Too bad the boy who figured out that one for the manual can't hear about the committee's pat on the back, Orv."

"I just told him, Will. Now he's really floating on Cloud Nine."

Airplanes, bless them all, were designed mostly for flying through the air and not so much for road running. Until we go completely VTOL, most of our birds will have to spend a certain amount of time taxiing along, across, around, by, near, and hopefully not into, through, over, or against other airplanes, buildings, huts, trees, and assorted obstructions. Avoiding the taxi-traps found on most airbases is so basic it hurts... it starts with your first lesson in Primary. Maybe that's part of the problem. We're afraid that talking about taxi accidents is insulting to people beyond Primary level.

So try your hand at the little quiz here. The answers which you'll find on page 31, are from AFR 60-11.

...and don't feel insulted until you get 100 percent correct!

TACQUIZ

Major Billy McLeod
HQ TAC (OSF)

1. Aircraft engines may be started without available parking brakes set and chocks installed. (T or F)

2. Aircraft position lights will be on (both night and day) whenever engines are about to be started. (T or F)

3. When sufficient electrical power is available or external power is being used, the tower or ground control____be monitored before the start.

a. may
b. can
c. will
d. need only be monitored during actual engine operation.

4. In all cases the person at the controls of the aircraft will monitor either the tower or approach control when engines are being operated. (T or F)

5. Aircraft will not be taxied within_____feet of runways on which any aircraft are landing or taking off.

a. 100
b. 200
c. 500
d. 300

6. Aircraft may not be taxied closer than_____ feet to an obstruction.

a. 10
b. 20
c. 25
d. 15

7. Aircraft being taxied near an obstruction that requires a signalman for clearance

a. will have a signalman at each wing tip before taxiing.
b. will have a signalman at the wing tip(s) for which a hazard exists before taxiing.

8. An aircraft being taxied within____feet of an obstruction will have a signalman for clearance purposes.

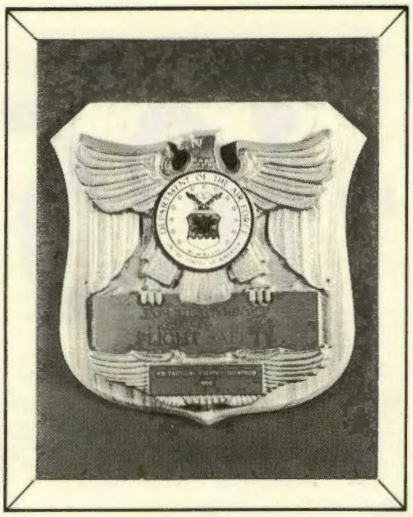
a. 15
b. 25
c. 20
d. 10

9. Flight check lists need not be accomplished prior to engine starts provided there exists no planned intent for flight and the individual making the engine start is fully qualified. (T or F)

10. Air Force Visual Aid (AFVA) 60-1 must be displayed for all personnel having a requirement to know the aircraft marshalling signals. (T OR F)

11. Transient Alert aircraft marshallers can be identified by their sleeveless garment of flourescent international orange which covers the shoulders, extends to the waist in front and back, and is tied by ribbons at the waist. (T or F)

1966 USAF FLIGHT SAFETY AWARD



178 TACTICAL FIGHTER GROUP, SPRINGFIELD, OHIO

349 MILITARY AIRLIFT WING, HAMILTON AFB, CALIFORNIA

913 TROOP CARRIER GROUP, WILLOW GROVE, PENNSYLVANIA

WE GOOFED !!

...in the article by Capt Bob Remey, "Would You Believe This...," July 1967 issue. In the middle of page 5 there is a sentence which reads, "Smoothly retard the power to idle and ask your friend in the back seat to pull the drag chute handle."

Bob didn't write it that way.

It was supposed to say something like...have your friend in the back seat remind you to pull the drag chute handle.

You see, there ain't no drag chute handle in the back seat of the F-4!! Bob Remey certainly knows that. And we knew it. How it got garbled during the retyping, we're not sure.

Maybe we need more proofreaders.

Sorry Bob... JOS

...an up-to-date analysis

stopping the F-105

by Maj John M. Lowery
HQ TAC (OSF)

With a reliable drag chute and 10,000-foot runways available, many pilots have developed some misunderstanding of the F-105 braking system. This is especially true when speaking of the anti-skid system. In 1966, TAC had one major accident and 10 incidents caused by the pilot failing to get the aircraft stopped in the available runway.

For discussion purposes, let's assume that you are in dire need of maximum brake effectiveness. This may be because you're aborting a heavyweight takeoff, you just had a chute failure, or you're involved in a minimum run landing. Regardless of the cause, you need maximum brake effectiveness to get stopped.

The first requirement for safe use of heavy or maximum braking in the F-105, is anti-skid. This system is designed to help the pilot in two ways. First, the locked wheel protection feature prevents a landing touchdown with the brakes locked (inadvertent pilot pressure). Secondly, the anti-skid feature prevents locked wheels and skidding tires as a result of pilot over-braking.

To obtain maximum braking action, pedal pressure must be a constantly increasing value, light at high speeds and heavier as speed decreases. You get maximum brake effectiveness at a point just short of a skid. With anti-skid this is just short of a point where cycling occurs.

Skidding tires will not give you maximum performance stops. The skidding surface of the tire starts to shred or tear off into small pieces. These particles in turn melt and act as a lubricant. As an example, if you happen to lock one wheel, you'll find the aircraft turning away from the locked wheel, instead of into it.

To get maximum brake effectiveness using anti-skid, regardless of your rollout speed, you must use careful pedal pressure to a point just short of the cycling range. You may even get an occasional cycle, however, you will get maximum brake effectiveness (known as maximum coefficient of friction).

If you abuse the brakes by excessive pedal pressure at high speed, say on touchdown, you will get a succession of rapid or continuous anti-skid cycles. You will notice very little initial deceleration because the excessive pedal pressure will cause the anti-skid system to provide more dumping than braking. This technique will substantially lengthen your rollout.

This is the point where many F-105 pilots get into trouble. Rapid or continuous anti-skid cycling is not a malfunction. Rather, it indicates that you are misusing the brakes by applying too much brake pressure. When this occurs, release some brake pressure and reapply to a point just outside the cycling range.

A true anti-skid malfunction results in a long dump signal in excess of three seconds. A condition of this sort requires you to turn the system off or allow it to time out (drop off the line). Another type malfunction is failure of the anti-skid to cycle or dump upon reaching a skid. This can happen in one or both wheels.

Don't get caught with your brake pedals depressed when the system times out or you'll lock the wheels and blow both tires. Turning off the anti-skid switch, or pulling the emergency brake handle, with the brakes depressed will do the same thing... that is, blow both tires. If you do feel that you have an anti-skid malfunction, release your brake pedal pressure and turn the anti-skid switch off. Then reapply the brakes.

Another case for depending on your anti-skid for maximum braking effectiveness is tire condition. A bald or worn tire skids very easily. This makes it even harder for the pilot to detect a skid.

A new tire on a dry runway surface provides a coefficient of friction up to .15. A bald tire, say with 1/16 inch of tread remaining, provides a friction coefficient of about .06.

As you can see, tire condition can greatly affect your stopping distance. Again, the only way you can get safe maximum performance from the tires is with anti-skid.

A common misconception about the F-105 anti-skid system is that it is not effective below 100 knots. Not so! It can provide maximum braking AND anti-skid protection at any speed down to 10 knots.

If you jump on the brakes hard at say 60 knots, you may get puffs of smoke and a momentary dump cycle. The dump signal is the anti-skid protecting your tires from damaging skids. The puffs of smoke are caused by quarter-second wheel lock-ups which are normal below 60 knots.

A defective system under heavy braking conditions at slower

speeds will be readily apparent. It causes severe gear walking. Best procedure is to get off the brakes, turn the anti-skid switch off, and reapply. Severe gear walking can cause structural damage.

Now, a word about the before-taxi "thump" check. To get a good pedal pulse check requires heavy brake pressure and a delay of two or three seconds before flipping the anti-skid switch "on." If you continue to move the anti-skid switch on and off without waiting a couple of seconds between thumps, each succeeding pedal pulse will get weaker. This is because each switch application depletes the anti-skid hydraulic system faster than the utility system can replenish it. The thump check does not guarantee a good system. It does, however, tell you that the anti-skid system is energized.

Sharp turns with anti-skid on can cause the system to time out. If, during a turn, you have the outside wheel rotating at 10 mph and the inside wheel going say, four knots, the slow wheel will dump. Tests at Republic have shown that a succession of rapid dumps will usually occur rather than a single long dump signal. However, should you get a three second dump signal, the fail safe circuit will cause the system to time out. This is the reason for switching the anti-skid switch to ON just before takeoff and OFF before leaving the runway after landing.

Other factors which affect your landing roll are water, ice, snow and slush. These all serve to make your brakes less effective.

Under these conditions, aerodynamic braking is the most effective means of slowing the F-105. This involves use of full flaps, speed brakes, and a nose high attitude. Each one of these items produces an increase in aerodynamic drag. This high drag causes the aircraft to slow down without use of wheel brakes.

Of course, when the nose falls through, you must rely on the brakes and anti-skid. Remember, though, to keep the stick full back in your lap. This gives you the benefit of some additional aerodynamic drag from the slab.

Hydroplaning is a condition where the tires actually go water-skiing. A lot has been written about this phenomenon. Basically, you can expect it anytime the water depth exceeds tire tread depth. It will continue to a speed that equals 7.2 times the square root of your tire pressure. In the F-105 that means 96 knots with the usual two tank configuration. If you are landing on slush, your minimum hydroplaning speed will be even lower depending on the viscosity of the slush. On ice, of course, you get no braking at all. A thin film lubrication skid is first cousin to hydroplaning. It can occur as low as 35 percent below hydroplanning. This problem appears to be linked with smooth or rib-tread tires on very smooth, wet runway surfaces.

Reverted rubber skidding can occur to almost stopping speed, (reported down to five kts). It begins with hydroplaning or thin film lubrication skids. The tire reaches a temperature where chemical reaction starts. The rubber then reverts to an uncured state, and steam starts coming from under and around the skidding tire. A look at the tire will show a scalded area where the tire was skidding. White streaks may be left on the runway. Most puzzling of all, some of the rubber will have disappeared.

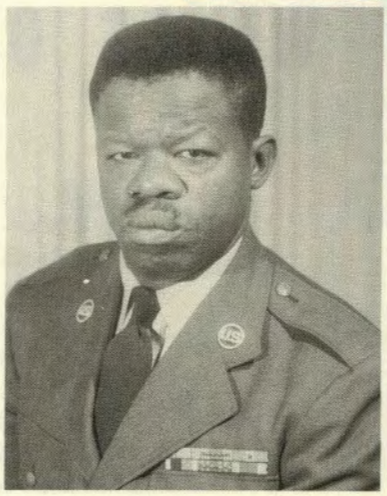
One explanation for the vanishing rubber is that it is composed of carbon and hydrogen. The heat and steam cause a heat-liberating chemical reaction where the tire and runway meet. This self-perpetuating (due to continued heating) reaction changes the rubber into carbon dioxide and water vapor... thereby accounting for the vanishing rubber.

To prevent these hazards, the FAA has been working on runway grooves. These small slits in the runway surface, which are perpendicular to the landing roll, effectively break up the water film. This allows the tires to touch the runway. In addition the grooves also help drain off standing water.

To prevent these hazards, tires must be properly inflated and in good condition. The lower the tire pressure, the slower the hydroplaning speed. If your tire is over 85 percent worn, it is for all practical purposes smooth.

Flying the F-105 you won't use the brakes very often. But when you need them, use them with the knowledge that they are the best in the business. Used correctly, they will always get you stopped on the runway.

MAINTENANCE MAN OF THE MONTH



Sgt John H. Williams

Technical Sergeant John H. Williams of the 27th Tactical Fighter Squadron, Cannon Air Force Base, New Mexico, has been selected to receive the TAC Maintenance Man Safety Award. Sergeant Williams will receive a letter of appreciation from the Commander of Tactical Air Command and an engraved award.

CREW CHIEF OF THE MONTH

Sgt Gerhard Loeffler

Technical Sergeant Gerhard Loeffler of the 4410th Combat Crew Training Wing, Hurlburt Field, Florida, has been selected to receive the TAC Crew Chief Safety Award. Sergeant Loeffler will receive a letter of appreciation from the Commander of Tactical Air Command and an engraved award.

CASEY writes one up

by Major Vince Hughes
APO San Francisco 96307

"Major Casey, that's the worst landing I've ever seen you make! Are you gonna buy one or be one?"

"Hold your hat rack Henry, I'll spring, but I've still got to publicize my lack of skill and cunning to the world."

"You mean you're going to write it up in the Form as a hard landing. I've never seen anyone do that before. And I've ridden through some that were worse than yours."

"You bet your sweet life I am. The next guy who flies this bird is entitled to know this gear is sound. The only way to be sure is to really look it over. Besides, I might be the next guy to fly it."

"Couldn't you just get away with having the engineer give it a good once-over on his postflight?"

"Sure I could. But if you were the next guy to fly it, wouldn't you feel better if the gear had a thorough inspection instead of a quick once-over?"

"I sure would. But this will probably get back to the ops people, and you'll be asked to explain."

"I doubt it. The bosses in our squadron and wing are too smart to do that. They know that if they bear down too hard ... check ride and all that stuff ... people will stop writing up hard landings. In the end it'll result in a large bash, with maybe some people hurt when the gear folds.

"And if I have too many of these hard landings," Casey continued, "then I deserve to be rechecked. I may be getting too old, need my glasses changed ... or something else. These supervisors are airplane drivers themselves. They know that every pilot makes a hard landing once in a while."

Casey finished his write-up and headed off across the ramp with the junior jock in tow.

"Okay, Major, you've convinced me. Now tell me, what is a hard landing? How do you know when it's bad enough to write up?"

"You've hit on a tough one there, I admit. Probably no two pilots would define it the same way. The problem is not so much defining what is a hard landing, as knowing when to write it up. I write it up any time I feel the bird could have been damaged. A solid thump with the gear pointing straight down the runway shouldn't cause any damage. A bounce usually means you had a roughish landing, but also had excess airspeed on touchdown. This usually isn't a problem. If you stall it in, you're asking for trouble. After one of these, the gear needs a good shakedown. The worst landing is a prang job when you're in a crab. You can usually bet on damage with one of these. The gear isn't designed to take excessive side loads."

"I've got the message. Now about that beer ... y'know, it must have been that the wind quit all of a sudden ..."

36th & 50th Tactical Fighter Wings

ANNUAL REUNION

Editor
TAC ATTACK Magazine
Langley AFB Va 23365

Dear Sir:

It would be greatly appreciated if you would print the following announcement in your next publication:

"The annual reunion of the 36th and 50th Tactical Fighter Wings will be held at the Riviera Hotel in Las Vegas, Nevada, on 6, 7, and 8 October 1967. All former officers of these wings are urged to attend. Personnel desiring reservations and/or further information should contact: '36th Reunion' or '50th Reunion' at the Riviera Hotel, Las Vegas, Nevada 89109."

Sincerely

FLOYD WHITE, Colonel, USAF

We're glad to help pass the word, Colonel White. Have a good one!
- Ed.

ANSWERS TO
TAXI QUIZ (Pg 24)

1. False, for very obvious safety reasons.
2. True.
3. c, answer is will.
4. False. It's ground control, and this was a trick question.
5. a.
6. a.
7. b.
8. b.
9. False.
10. True.
11. True.

PEANUTS


DON'T WAIT
UNTIL
TOO LATE !!
USAF
U.S. AIR FORCE
Fields