DECEMBER 1956

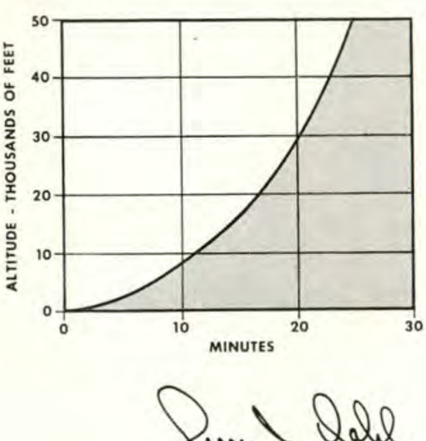
FLYING SAFETY

UNITED STATES AIR FORCE

1956 USAF GUNNERY MEET . . . Page Four

File Thirteen

Our cover this month is our artist's concept of the Fifth World-Wide Fighter Weapons and Gunnery Meet. It was accident-free this year and that, friends, is no small accomplishment. Read about it on page four. . . . There are still cases of getting JP-4 and 100 octane mixed up. In the latest incident, a regular JP-4 truck driver was assigned to a 100/130 truck. From force of habit, he pulled up to the JP-4 hose and proceeded to fill his gas truck with the stuff. So here we had a truck marked 100/130 filled with kerosene. He refueled a C-47 and was in the process of filling up a B-25 when the alert crew chief discovered the error. Fast footwork prevented the C-47 from trying to take off. . . On One December the Albuquerque ADIZ will be eliminated. The prohibited area around Los Alamos will remain. . . . The T.O. covering the installation of chaff in parachutes will soon hit the field. Its use, of course, is to facilitate easier radar pick-up following bailout. . . . If you want to land someplace before dark, the only safe way to do it is to determine the sunset time at your destination, then fly accordingly. For example, it may be twilight flying at 6000 feet but it is already dark on the ground. Take a look at the graph below and see for yourself. At 30,000 feet it could be daylight, while on the ground it has been dark for 20 some minutes.



Perry J. Dahl

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

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

Colonel Daniel M. Lewis
Supervisor of Flight Safety
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USAF PERIODICAL 62-1

How Well Can You Remember?

If you miss more than four you had better check those back issues.

October

1. If you clear to a base that is forecast to be clear and three or better, what are the odds that this forecast will be correct?
   (a) 50-50.
   (b) 3 to 1.
   (c) 10 to 1.
2. During pre-takeoff check in the F-102 in ambient temperature below zero the exhaust gas temperature may read as low as:
   (a) 90°C.
   (b) 120°C.
   (c) 200°C.
3. In straight and level flight your aircraft stalls at 100 kts. In a 60-degree bank requiring 2G the stalling speed is:
   (a) the same.
   (b) 105 kts.
   (c) 140 kts.
   (d) 200 kts.
4. Final approach airspeed in the KC-135 under normal landing weights is approximately:
   (a) 110 kts.
   (b) 125 kts.
   (c) 140 kts.
5. Which of the following does not apply to the new "Pilot's Handbook"?
   (a) 5 x 8 inches in size.
   (b) No obstruction will be shown along instruction approach tracks.
   (c) Aerodrome layout will be excluded.

November

6. In the APGC "Climatic Hangar" you can test all aircraft mechanism except the guns.
   (a) True.
   (b) False.
7. The "law" on snow removal (AFR 90-6) requires that snow be removed from runway overruns to a point .... feet from the end of the runway.
   (a) 100 ft.
   (b) 500 ft.
   (c) 1000 ft.
   (d) 1500 ft.
8. Traffic pattern airspeed for the F-104 is:
   (a) 175 kts.
   (b) 200 kts.
   (c) 225 kts.
9. The F-104 can operate out of a .... foot runway:
   (a) 6000.
   (b) 7000.
   (c) 8000.
   (d) 9000.
10. Winds in a typhoon are as high as:
   (a) 150 mph.
   (b) 200 mph.
   (c) 250 mph.

December

11. You can tell if a particular GCA glide path is 2½, 3 or 3½ degrees by referring to the Radio Facility Charts.
   (a) True.
   (b) False.
12. On a 1000/on top flight you must file IFR when such flights are over a cloud cover of:
   (a) 4/10 or more.
   (b) 5/10 or more.
   (c) 6/10 or more.
   (d) 10/10.
13. The visibility minimums for ADF approaches are:
   (a) Published in the Radio Fac Chart.
   (b) Published in the Pilot's Handbook.
   (c) One mile day and two miles night.
14. On air-to-ground, low-angle strafing, firing must cease .... feet from the target:
   (a) 800 ft.
   (b) 1000 ft.
   (c) 1200 ft.
   (d) 1400 ft.
15. Tire pressure has little effect on coefficient of friction values.
   (a) True.
   (b) False.

ANSWERS

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

LETTERS TO THE EDITOR

★ ★ ★

No Flashlights

The pilot is away from his home station. He expected to return during daylight but got delayed. And he forgot to bring a flashlight. Nobody'll come up with one. . . . Got to go anyway! So he goes.

If the generators don't fail, he'll get by with his oversight and violation. If they do fail, he ejects or crawls out.

Although he didn't have a flashlight, you can press a cinch bet that he had a buck or two in his pocket and would gladly have parted with a piece of it for said flashlight.

If the USAF "funders" could give each base a one-time shot of about a dozen dollars, the base ops officers could stock adequate flashlights for non-profit resale to hapless pilots. The dispatchers could be made responsible for restocking and controlling the limited funds and that six-bits flashlight just might keep some guy from pulling the handle when all goes black.

Major Wayne T. Plant
IG, 27th Air Div (Def)
Norton AFB, California

By George, not a bad idea!

★ ★ ★

Water Training

A few weeks ago I read with much interest the two articles on water survival (FLYING SAFETY, July), and remembered that in nightfighters in Korea we were told to "head for water" in case of difficulty . . . and the instructions got vague after that.

Dr. Llano's last sentences were, "Those stationed inland should not accept success in a swimming pool as a sign of proficiency; the sea is different. At night the sea and unfamiliar gear can be both different and strange."

These words jabbed me in a tender spot. The toughest water training I'd had so far was the classic leap into a calm pool to inflate the vest and climb into a raft. It had been a snap.

The question seemed to be: How can we throw the would-be water survivor into a really tight spot without risking his life? The next afternoon, accompanied by Major John Wrona, friend, pilot and parachutist, I walked up to the pool with an armful of gear. As I got into the flying suit, life vest and chute harness I thought of the trouble I'd be in in a few minutes. The situation:

Joe Doakes has bailed out and will land in water. He's been stunned; will only start operating after he's submerged. He has no dinghy. He doesn't know it but his CO_2 bottles are defective. The canopy won't quick-disconnect; he must get out of the harness. This is a heavy sea, not a mill pond. He can't see at all. It's dark, or he's blinded by a flash fire.

We held a brush-up briefing at the edge, then the Major blindfolded me and guided me out on the board. All at once the usually reassuring feel of the vest and harness seemed a little hostile with the blindfold on.

I leaped in and Major Wrona jumped in beside me. Fighting up and unbuckling the harness, I barely got to the surface when he shoved me back underwater. Up and down. Up again and down again. All according to plan but disconcerting to find my mouth full of water instead of air each time.

Now free of the chute harness, I got my hands on the oral inflation tube and it wouldn't open. Several (gasp) duckings later I realized that the mouthpiece retaining collar must be turned in the "tighten" direction to loosen it. Still blindfolded, and getting tired, I finally choked enough air into the vest to float. Off came the blindfold, and the big grin beside me said, "Had enough?" I had.

We went through the test twice more, though, and found that a little equipment trouble goes a long way in the water. Even a strong swimmer is hampered badly by clothing and malfunctioning gear. The inability to see makes familiar equipment harder to use, and may produce a degree of panic. Combine malfunction and loss of sight and the situation gets hairy, especially with the ducking.

Now consider that in an actual situation the downed airman may be a mediocre swimmer, or a non-swimmer. He won't have the reassuring pool-and-companion environment. He may not have such an ideal water temperature and he may be injured, or he may be in a state of shock. He will be wearing boots and maybe a jacket . . . and things get still tougher.

This experiment made me a believer in hard training. Sure, it was inconvenient . . . but it was sobering.

Know anyone who's complacent? Let him try this.

Lt. Dick Myers, USAF
Hq 31st Air Division
St. Paul, Minnesota

The extra attraction of having somebody shoving you under surely does add to the realism. Thanks for the tip on survival training.

★ ★ ★

Lost on Final

While working with the local AACS Detachment to solve some local problems we've come upon an item which I believe could be of importance to everyone. We were working surveillance approaches in the F-94C and were continually being lost on the final approach.

It now comes out that due to one of the intricacies of radar, the ANC/CPN-4 radar unit with Moving Target Indicator has a *blind speed*. This speed which causes a target blip to fade or completely disappear from the scope is a ground speed of 156 knots while working surveillance, and 177 knots while working precision approaches. It is important to note that this occurs while the aircraft is headed directly *toward* the antenna and that it is a *ground speed*.

In the F-94C the speed of 156 knots is right in the neighborhood of final approach speed, so it is easy to see this is a critical problem. I am sure there are other jet fighters that have a final approach speed close to this *blind speed*. When you're making a surveillance approach at this ground speed you can expect to lose contact on final and "that ain't good."

1/Lt Edwin V. Horn, USAF
97th FIS, New Castle Co Arpt
Wilmington, Delaware

As you say, "losing contact on final ain't good." It is letters like this that really get the ungarbled words around to the troops. Thanks much!

★ ★ ★

Pithy Advice

I have extracted some material from page 5 of the August issue of FLYING SAFETY and will be grateful for your permission to use it in "Air Clues" at some future date. It is a pithy piece of advice.

FLYING SAFETY is good stuff and we always look forward to it. I hope you are receiving "Air Clues" regularly; let me know if you are not. P.S. Have just heard of your devastating fire. Hope it is soon under complete control! c.h.

Flt. Lt. C. Horn, RAF
Air Ministry, DFS
Richmond Terrace
Whitehall, London, SW 1

To our British cohorts in the "let's-not-bust-'em-up" business. . . . Permission granted! We receive "Air Clues" and enjoy it very much.

P.S. The fire is out.

★ ★ ★

Experience

As I lay in traction in the base hospital with a broken back, I read Major Secor's letter in the July FLYING SAFETY. His theory is that there is no such thing as Night-VFR.

I disagree. Our night-VFR mid-air collision between two jets was pure and simple a case of not looking where you are going. In my opinion the present rules are adequate and safe. But, any rule must be complied with to serve a purpose. Restrictions and more restrictions are not the answer. It can eventually end in its own ultimate answer. Prevent all aircraft accidents by preventing all flying.

Our rules are sound and adequate. Our weakness is in compliance with the rules. Supervision, common sense, discipline are what we need. Even mandatory IFR at night will not prevent mid-air collisions if no one complies with the IFR rules.

Let's comply with the rules we have before we write more rules.

Maj. Douglas M. Montgomery, USAF
AFROTC Det 145, Florida State Univ
Tallahassee, Florida

Now this is what I call the voice of experience.

★ ★ ★

Crash-Rescue Manual

Being a Flying Safety Officer and a pilot, I am naturally interested in crash-rescue procedures. I want to know that the crash crews can get me out of my aircraft if I have difficulty whether it be at my home station or at another base.

What I would propose is a crash-rescue manual which would show emergency entrance procedures, seat and canopy safetying procedures and the like, for all aircraft which a base might come in contact with.

Perhaps this has been considered or even finalized without this base receiving a copy, but if it has not, I feel it is worth considering.

Capt. Herbert L. Byers
Perrin AFB, Texas

Your suggestion is a good one. A project is just getting under way to educate Air Force types in emergency exit procedures. Something will be out soon in the Flying Safety Officer's Kit, to be used at the accident-prevention meetings.

★ ★ ★

Bailout Trainer

We thought FLYING SAFETY would be interested in this photograph showing cockpit procedures for the bailout trainer, set up here at Craig AFB. The idea for this project was taken to the MTU section and its personnel built the trainer. The seats operate on a bungee and only move upward about a foot and a half when the ejection trigger is pulled. However, the procedure of pulling the handles is there and we feel this gives the student knowledge of ejection that he needs.

Perhaps other T-33 bases will find our idea worthwhile?

Capt. James P. McMullen
FSO, 3615th Flying Trng Wg
Craig AFB, Alabama

Real fine deal, Mac. Thanks for passing it along. I'm sure other bases will be very interested in the idea established at Craig.

The cockpit portion of a T-33 was set up for training students on correct ejection procedures.

The Fifth World-Wide Fighter Weapons and Gunnery Meet is history. Again it was an accident-free meet. This story is dedicated to the officers and airmen who did so much to make this possible.

Sharp Shooters'

With the dawn comes flight line activities.

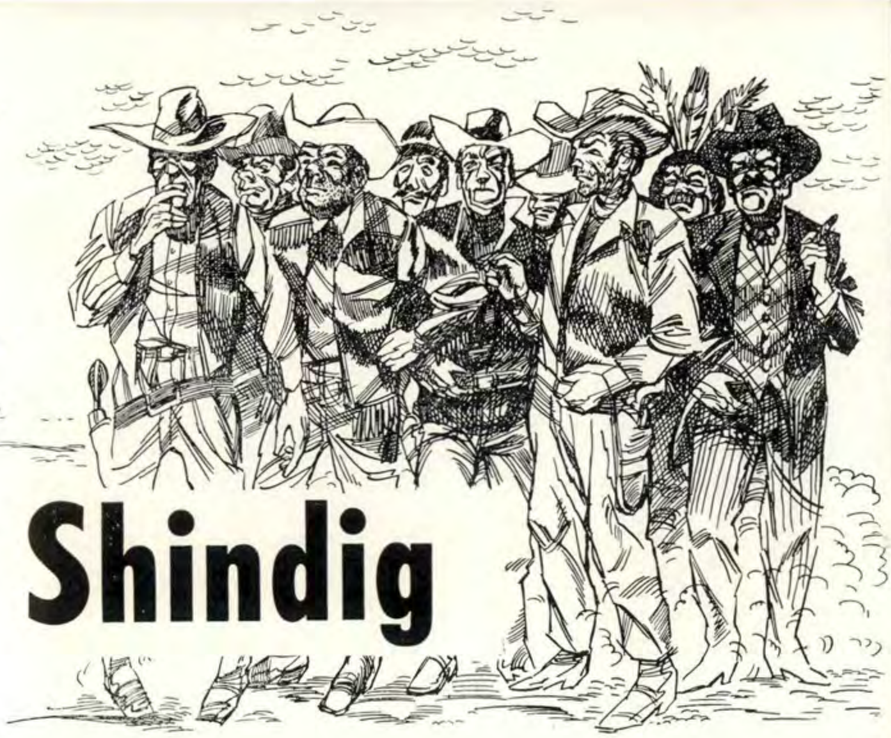
NOT SINCE the days of Wyatt Earp has there been so much gunplay out West.

Teams from each major command shot it out with everything from .50 calibers to high velocity rockets at the Fifth World-wide Fighter Weapons and Gunnery Meet.

Phase III of the meet was the air-to-air rocket competition between all-weather interceptors. It was held at Yuma's newly christened Vincent Air Force Base, Arizona, with the Eastern Air Defense Command, from Selfridge AFB, Michigan, walking off with the top honors in this phase.

Phases I and II was the scene of the day-fighter and special weapons shoot-'em-up at Nellis Air Force Base, Nev. The winners are listed on page 11.

At Nellis, as at Yuma, the fly-safe precautions paid off. Not a single participating team was involved in an accident, and this is no small achievement. When you have such fierce competition for top gun honors, you might think flying safety sometimes takes a back seat. Actually, it's safety at its best—the built-in kind.



Shindig

Gun harmonization, a must for sharp shooters.

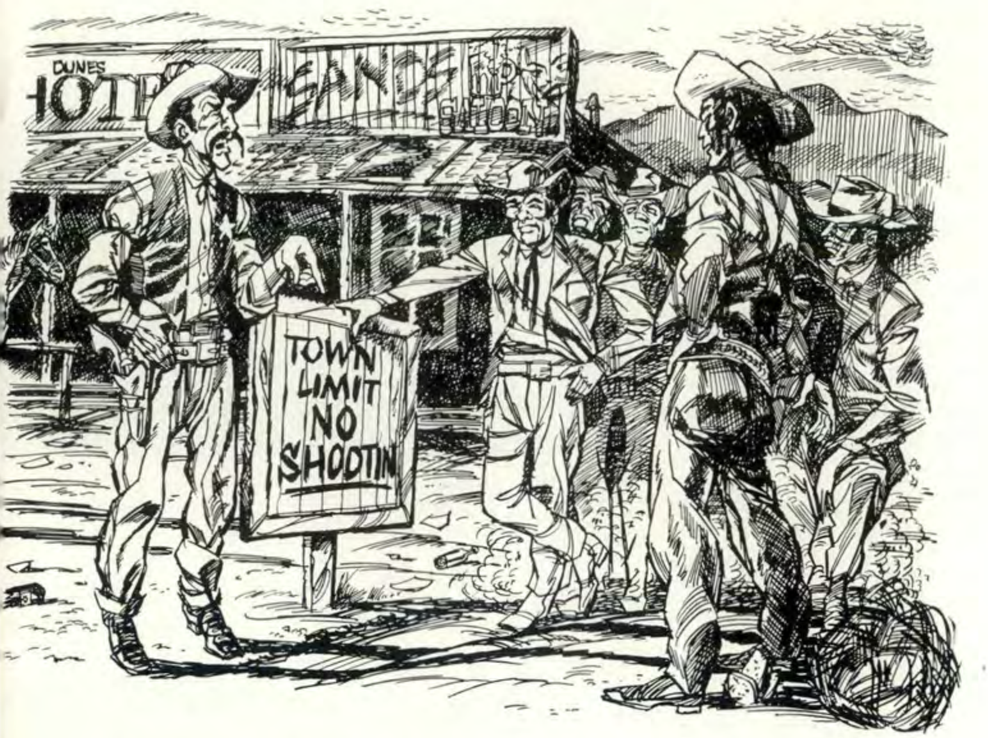
Competition for top gun honors is fierce.

The schedule of events fits into a tight timetable and every rule is directed toward keeping things going. If the schedule breaks down and crews have to rush-rush-rush, that's when ole devil "accident potential" has a ball.

But through good cooperation from team members, things at Nellis went like clockwork. Even Mother Nature contributed her bit to the flying safety effort. The weather could hardly have been better.

Although a few make-up missions always are inevitable, each team member did his utmost to comply with the schedule and the rules—rules that did so much to make this another accident-free gunnery meet.

At Nellis, each team consisted of four pilots and one spare, plus a crew of maintenance members. The number of authorized maintenance members depends on the aircraft type and ranges from 22 to 24. As always, the maintenance troops play an important part. When one of their birds gets airborne, then aborts for any reason, that team member is charged with a zero for that mission.



The main thing is that all firing should cease at the 1200-foot line. It is a safety precaution.

The carrying capability of today is varied.

Pilots are skilled in many attack methods.

Actually, all five aircraft taxi out to the takeoff position. If one of the members aborts before leaving the ground, the spare can fill in.

Following takeoff, the team climbs to a prescribed altitude, depending on the mission, and flies a special corridor to the firing range. Aircraft returning from a mission, fly another course and altitude—another facet of the flying safety precautions.

Upon arrival at the firing range each aircraft is required to have an operational radio. Otherwise the pilot is not allowed to fire, and must return via the return corridor and is charged with a big zero for that sortie.

Air-to-Ground

A typical air-to-ground mission runs something like this.

Each aircraft carries 400 rounds of ammo, 100 in each of four guns, for the low angle strafing phase. The rounds are carefully checked by specially appointed armament loading judges. They also check the four practice bombs loaded aboard the aircraft.

After arrival at the range, pilots prepare for, first, the skip bomb runs, then the low-angle strafing. After checking in with the range control tower and receiving proper clearance, they take up their pattern for the skip bombing. A rectangular pattern is flown and the aircraft are spaced evenly throughout.

The bombing targets are 10 feet high and 20 feet wide. Each team member is allowed five passes to get rid of the four bombs.

A team of judges with sighting devices are on hand to check minimum altitude violations. (RULE: At no time will an aircraft get below 35 feet.) If a violation should occur the pilot is immediately notified and he loses 10 per cent of his score. Two violations and he is disqualified from that sortie.

In addition to the minimum altitude requirements, judges also determine adherence to minimum airspeeds (350 kts or more). The reason for

Left, is today's air-to-air target. The newer Dart is a solution to supersonic gunnery practice.

The strong spirit and cooperative efforts of each team member, pilot and mechanic, is evident.

Out on the range qualified judges count the hits. Hits are then marked-up on scoring board.

this minimum airspeed requirement is to prevent one team from having the advantage. Two violations here also means disqualification.

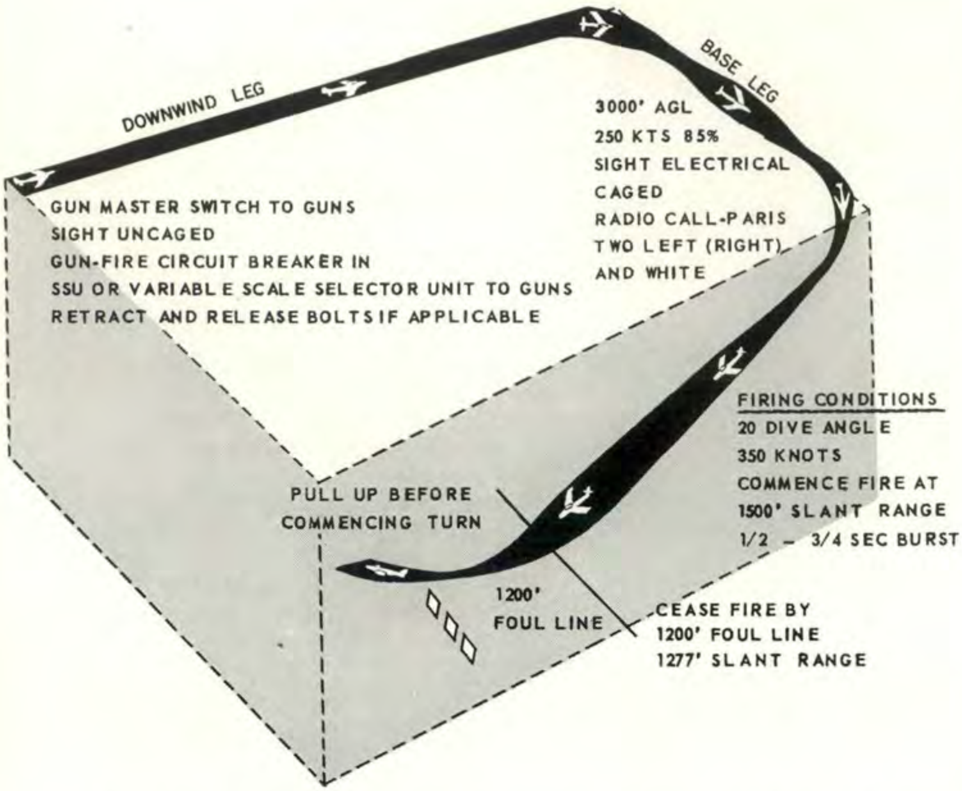
After completion of the skip bombing, the team gets set for the low-angle strafing, using 15′ x 15′ targets. On these runs the rules are simple but important. The range is set up with two foul lines. One is 800 feet from the target, the other 1200 feet. The idea is that firing should cease at the 1200-foot line, in order to eliminate the possibility of flying through the target and to reduce the possibility of damage from ricochet projectiles. The angle of attack and minimum altitude depends upon individual preference. Some come in steep while others prefer a flatter angle. The main thing is that upon reaching the 1200-foot line, the attack must be discontinued. One foul here costs 10 per cent of the score and two means a big goose egg for the mission. A single violation of the 800-foot line means immediate disqualification.

A minimum speed of 350 kts also is required for low-angle strafing.

Each pilot is allowed seven runs, with the first one being dry. There are five targets on each range and the leader may start firing on either target No. 1 or No. 5. Other team members fire on the rest in consecutive order (2, 3, 4 or 4, 3, 2).

Any ammo left in the guns is carried back to Nellis. The pilots are charged with 400 rounds total, and

Angle of attack depends on the individual.



A 1200-foot foul line is one of the safety features of the low-angle strafing traffic pattern.

Judges accurately count out the ammunition.

any ammo they carry back is lost for scoring purposes. They're charged with 400 rounds whether they shoot it out or not.

The same is true of the bombs. Any that are not dropped for any reason are still charged against that mission.

With this stipulation, not only must the pilot be a sharpshooter but the maintenance people must be well versed in gun and bomb-rack maintenance. Any malfunction can spoil a team's chances.

After clearing the range, the team returns to Nellis in formation. After flying the prescribed corridor and landing, they taxi to the cooling area. Here the ordnance is checked and the guns disarmed, under the surveillance of two judges. Just another little precaution that can mean so much.

The air-to-ground firing for day-fighters includes low-angle strafing, skip bombing, dive bombing and rocket firing.

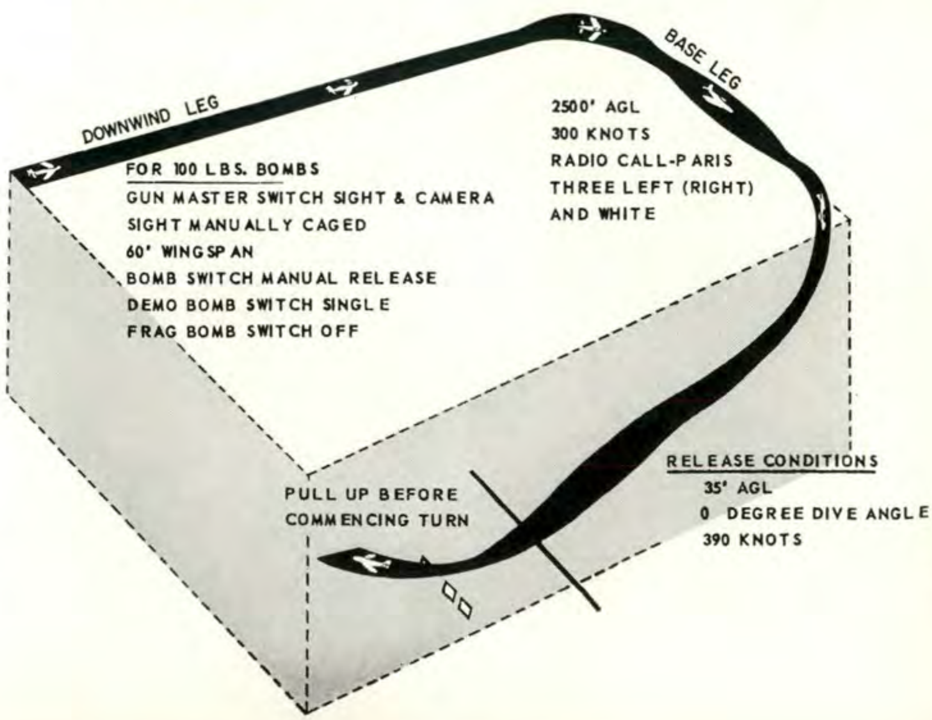
Air-to-Air

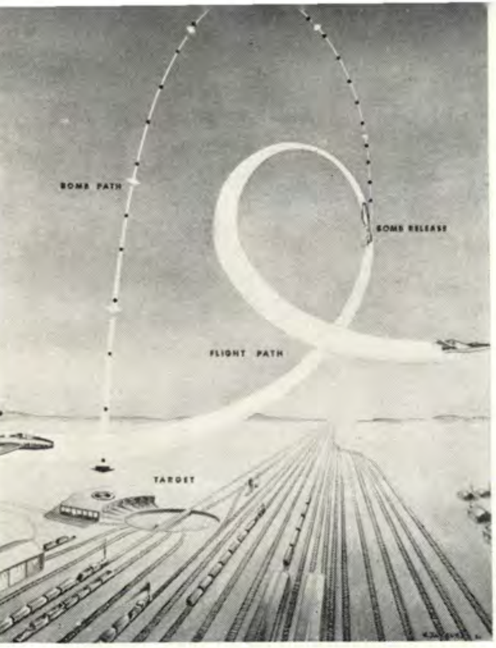
On the air-to-air competition, four guns are loaded with 100 rounds each. After takeoff the aircraft proceeds to the IP via a prescribed corridor. Firing takes place at 20,000 and 30,000 feet with four sorties for each. Judges rendezvous with the tow aircraft over a designated point to monitor the air-to-air runs. Each team member is allowed only six passes to fire his 400 rounds. They must not press the attack closer than 600 feet and the break-off angle must be in excess of 15 degrees.

The airborne judges fly 1000 feet above, 2000 feet behind and 2000 feet out from the tow aircraft's line of flight. They check target suitability, keep track of the number of passes made by each team member and notify each member when he initiates his last pass. They also notify each pilot of any fouls committed.

Flying at this altitude above all the activity, however, it is not always possible to spot the minimum angle fouls and/or make a firm decision on a

In the skip bombing pattern pilots must not descend below 35 feet during final bombing run.

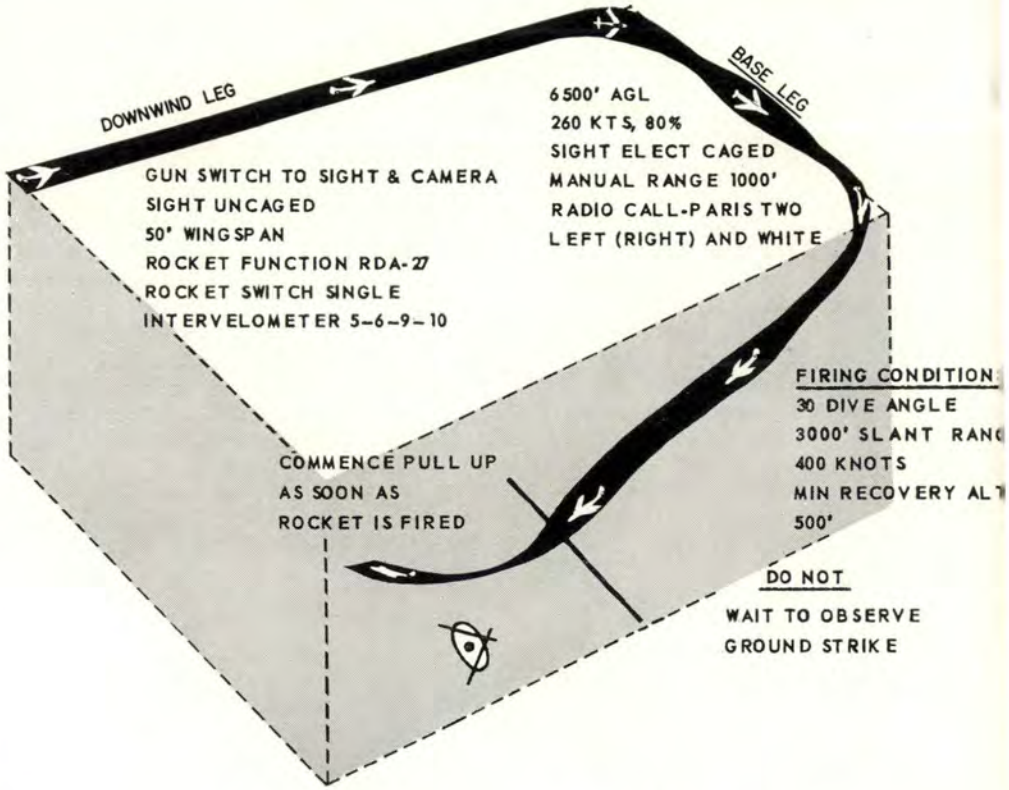




An over-the-shoulder, special weapons pass.

borderline situation. No problem here though. One look at the target in the scoring room tells one immediately whether such a foul was committed. The less the angle, the longer the hole. The rules for this event state that if ten strands of the net target are broken, a foul has been committed.

F-84Fs competed with the others at Nellis.



Above is illustration of the typical low-angle rocketry pattern. Fouls lead to disqualification.

A simple matter of trigonometry and arithmetic. Long hole equals foul.

Special Weapons

The Special Weapons (Phase II) includes low angle LABS, high angle LABS, dive bombing and a ground operation test.

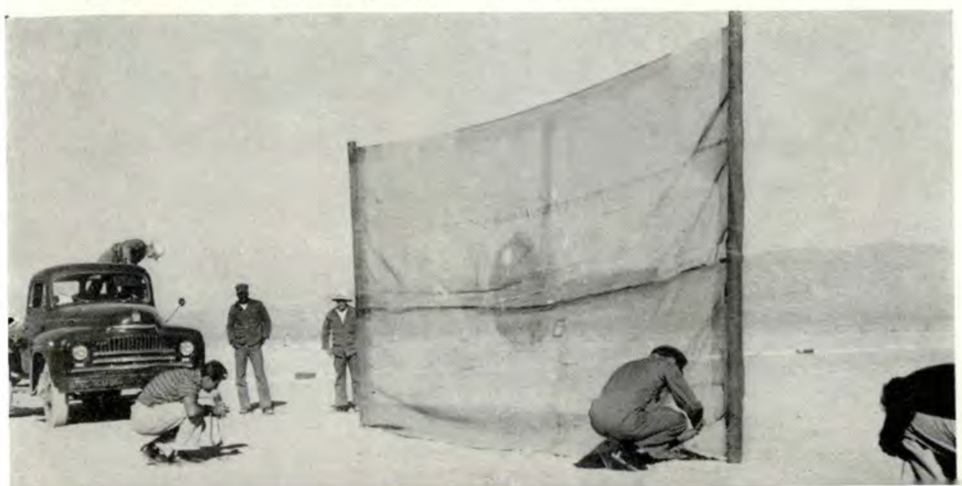
The rules here, as in all the other events, are specific and any violation results in a scoring penalty.

The Wrap-Up

So far we've made it sound as if the Fighter Weapons Meet began and ended in the formal competition and the shooting-off of all the guns. Far from it. Planning for the meet began long ago—probably at the end of the last one. Definite action was started on this meet way last winter. One man observed that, "Elimination shooting for top command honors and the right to shoot at Nellis or Yuma, created, in many cases, competition that was more intense than any displayed during the finals."

There are many reasons for the "accident free" meet, in addition to the stringent rules on and off the range. The teams arrive at least a week prior to starting competitive firing and are thoroughly indoctrinated on the safety procedures. Each man knows exactly what to do from engine start to shutdown.

The air-to-ground skip bombing target is 15 feet by 15. It looks much smaller from the air.



One of ADC's F-89s in a rocket pass at Yuma.

All in all, the keynote was planning and teamwork. It was demonstrated remarkably by the hosts of the meet, the support teams, the controllers, the judges and the aircrews themselves. Needless to say, it paid off—big! The most serious happening was scratching the paint on a wingtip.

But neither the planning, the shoot-offs, the competitive firing—even the presentation of the awards was the end-product of the meet.

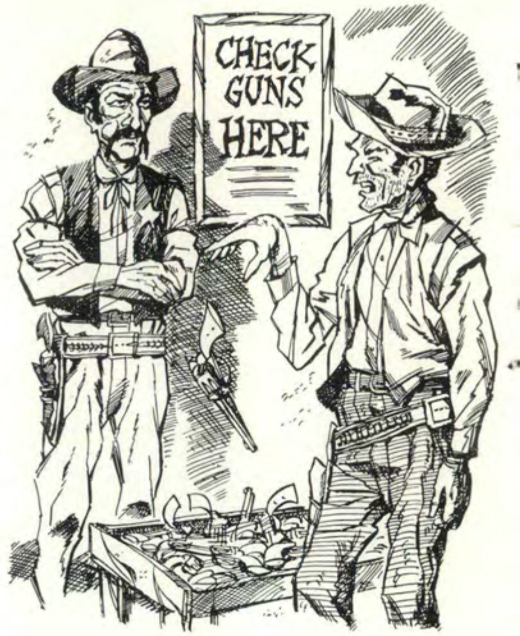
The Monday morning quarterbacking will continue for months to come, but the kickoff to the post-game affair came on the Monday morning following the meet. A two-day critique of the entire affair was held at the meet site. Attendance included representatives from all agencies interested in fighter weapons. There were the team captains, team members, representatives from Air Research and Development Command, Air Proving Ground Command, Air University and practically all aviation industries.

Their purpose was two-fold. First, to discuss and exchange information relative to fighter weapons delivery, training devices, techniques, range layouts, equipment requirements and new developments.

The second was to formulate recommendations for the planning and execution of future fighter weapons meets. Interested agencies should watch for the final report of this symposium. It's in the mill.

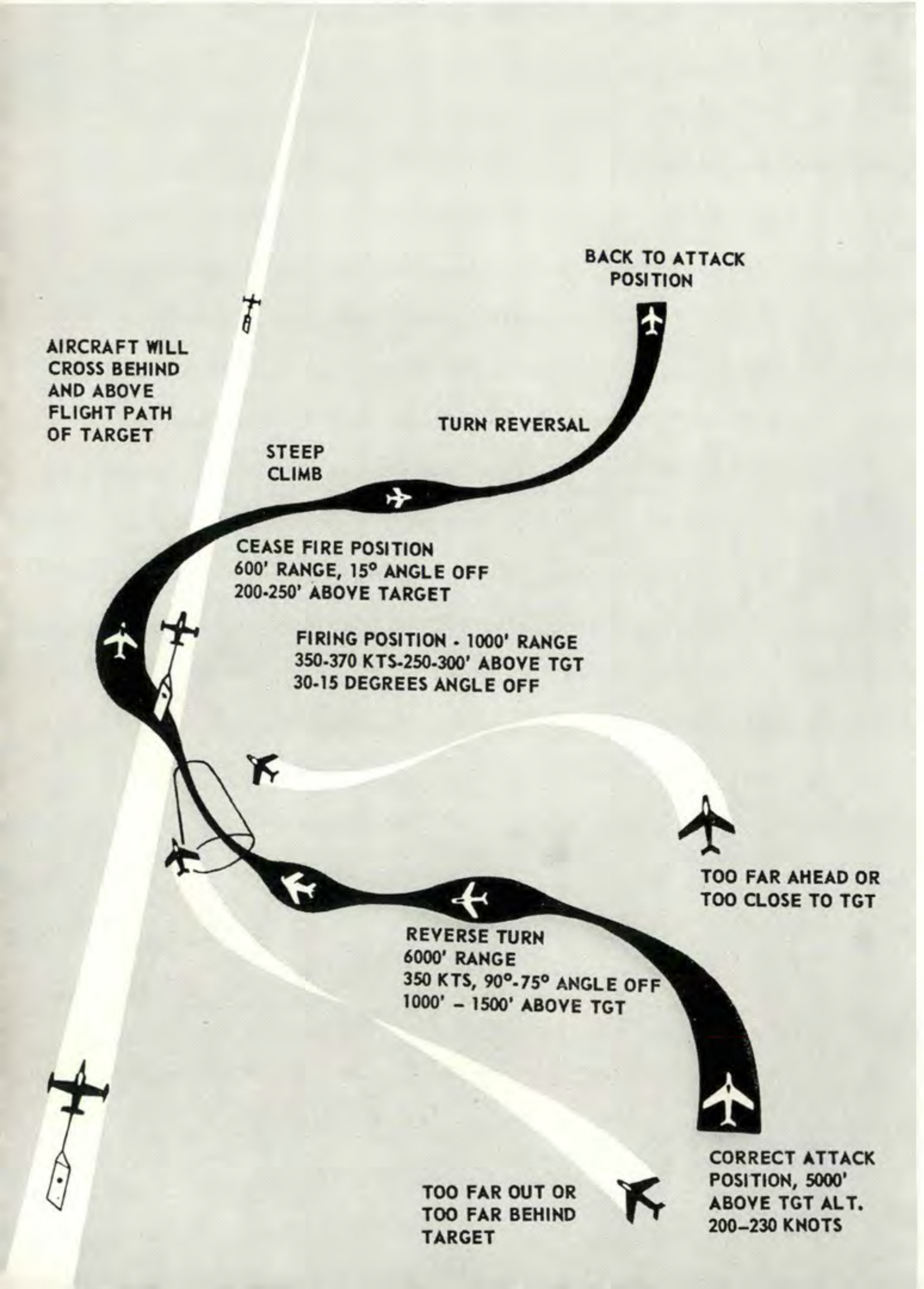
The division of the meet into three phases parallels normal combat functional designs of the aircraft. Although war remains the decisive test of combat effectiveness, the Fifth Annual Fighter Weapons and Gunnery meet provided the best available substitute. Underscoring the importance of the combat-simulated competition at this meet is the realization that decision in modern air war depends on the thoroughness of preparation.

Equally as important as a check on our combat capability is the realization that an "accident free" operation is not an accident. ▲



A special procedure was used for disarming.

Below, is the correct air-to-air firing pattern. Airborne judges on hand to assure compliance.



An air-to-air target is checked for all hits.

★ The Winners ★

PHASE I—DAY FIGHTERS

1st Place
ATC—3595th Combat Crew Training Wing (Fighter)

2nd Place
USAFE—50th Fighter Bomber Wing

3rd Place
FEAF—8th Fighter Bomber Wing

AIR-TO-GROUND

USAFE, 1st; ANG, 2nd

AIR-TO-AIR

ATC, 1st; FEAF, 2nd

OVERALL INDIVIDUAL

Capt. Asa Whitehead, ATC, 1st;
Capt. Calvin Davey, ATC, 2nd

INDIVIDUAL AIR-TO-GROUND

Capt. Asa Whitehead, ATC, 1st;
Capt. Calvin Davey, ATC, 2nd

INDIVIDUAL HIGH ANGLE ROCKETS

1st Lt. Robert Lilljedahl, FEAF, 1st;
Capt. Coleman Baker, USAFE, 2nd

INDIVIDUAL DIVE BOMB

Capt. Asa Whitehead, ATC, 1st;
Lt. Col. Chuck Yeager, USAFE, 2nd

INDIVIDUAL SKIP BOMB

Capt. Ralph Ashby, FEAF, 1st;
Captain Calvin Davey, ATC, 2nd;
Capt. Robert Pasqualicchio, USAFE, 2nd place tie

INDIVIDUAL PANEL STRAFE

Capt. Calvin Davey, ATC, 1st;
Col. Bruce Hinton, ATC, 2nd

INDIVIDUAL 30,000 FEET

Capt. Calvin Davey, ATC, 1st;
1st Lt. Tom Tapper, ATC, 2nd

INDIVIDUAL 20,000 FEET

Capt. Asa Whitehead, ATC, 1st;
Col. Bruce Hinton, ATC, 2nd

PHASE II—SPECIAL WEAPONS

1st Place
USAFE—81st Fighter Bomber Wing

2nd Place
FEAF—49th Fighter Bomber Wing

3rd Place
SAC—506th Strategic Fighter Wing

INDIVIDUAL AGGREGATE

Capt. Dee McCarter, USAFE, 1st;
Capt. William Ragon, TAC, 2nd

INDIVIDUAL HIGH ANGLE BOMB

Capt. Dee McCarter, USAFE, 1st;
Capt. Thomas Knoles, SAC, 2nd

TEAM LOW ANGLE LABS

USAFE, 1st; FEAF, 2nd

INDIVIDUAL DIVE BOMB

Col. William Chairsell, FEAF, 1st;
1st Lt. Joseph Hansard, TAC, 2nd

PHASE III—ROCKET MEET

1st Place
EADF—Selfridge AFB, Michigan

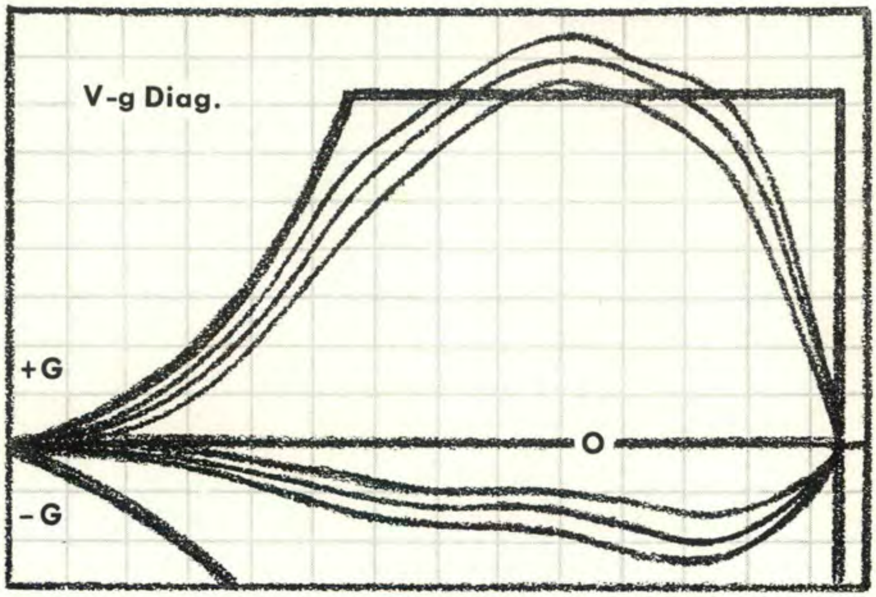
2nd Place
WADF—Oxnard AFB, California

3rd Place
NEAC—Pepperrell AFB, Newfoundland

Pilots go after top scores while other members of the teams sweat it out. Maintenance crews play a very important role in winning meet.

Dope for Doodlers

Designers of aircraft now have a new aid for building aircraft that can take it. Just how much is enough?



EVER WATCH your buddy doodle while he's answering the phone? Draws airplanes, huh? You do too? Most of us do. Fantastic things, sometimes. World of tomorrow stuff. Birds we'd like to see—or fly sometime. Or maybe even the one that we fly right now. Some of us even carry this nice little bit of diversion a little farther and draw in the stuff we'd like to see hanging on the bird or place the airplane in some sort of attitude suggestive of the maneuvers that we envision ourselves performing. Touch of realism, you know.

A lot of guys make a living this way. Just sit around designing air machines all day. But here the problem gets a little more binding because this type has to put the facts and figures on his masterpiece. Ever think about that? What will it do? Obviously it is fast. You can see from the streamlined planform. And if it's that fast, it had better be strong. Plenty strong. But *how* strong?

You think 7.33G would take care of it? Or maybe 8.6? How about the one you're scheduled to fly at two o'clock this afternoon?

The little placard there on the panel says don't pull more than this many G in this bird, and that you're supposed to write it up if you exceed the limits. But can you really perform your mission and stay within those limits, or could you do better if you could use just a little more G? In other words just how good should an airplane be for you to do the job you're assigned to do?

This little query has become a matter of major concern to the professional doodlers. And a little serious thought pretty well tells them that all the tests that we can run in wind tunnels and structural labs won't give them all of the answers. A little more thought tells them that all the answers will not come from the elaborate testing procedures that we put the plane through before it goes to you. What is really important is, what sort of demands are you, Joe Glotz, squadron type pilot, going to put on the machine?

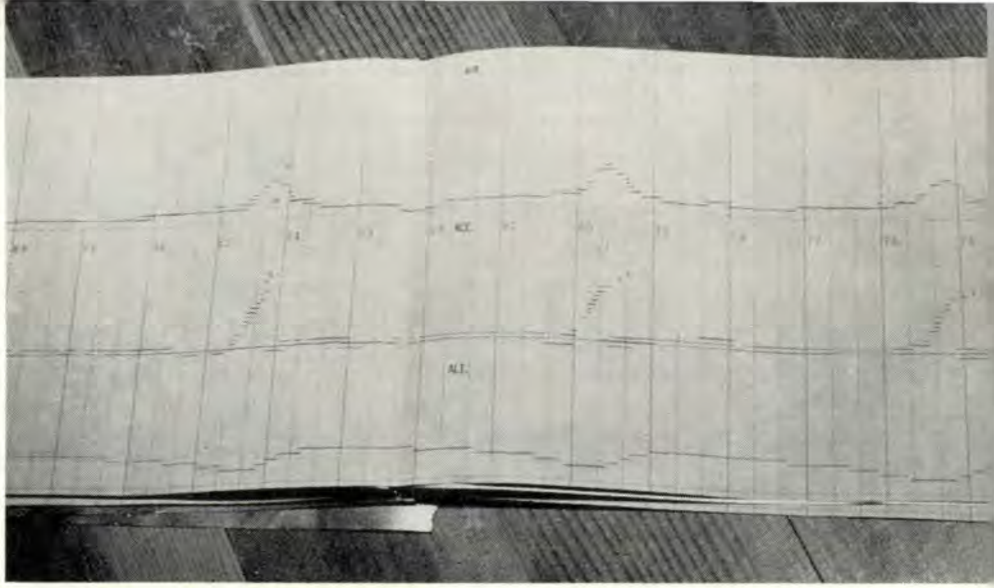
For years we've been finding out the hard way, but you sure have to pick up a lot of little pieces sometimes to get the answers that way. And sometimes those answers are not so accurate.

You guessed it. We've got a gimmick. It's that little black box in the radio compartment—or ammo compartment—or under the floor boards, or maybe even in the wheel well. Depends on what you're flying. You may or may not have seen them because they aren't on all the birds. At present there are something like 300 black boxes scattered throughout the Air Force, hooked on to all types of airplanes.

Flight Recorders

They are called Flight Recorders, and (depending on the model in use) various sorts of information is picked up by them. Some merely record airspeeds, altitudes and acceleration

Lt. Col. Yeager, left, and Col. Ascani confer with a WADC technician following a gunnery mission. The results, right, aid designers.



(G-forces). Others of a more elaborate type can record things like lift coefficient, Mach number, gust velocity, dive angles and so on. All of this is plotted on a continuous tape which rolls around at a given rate of speed and thereby gives all readings in terms of time. It will tell you exactly when you pulled 7G. Or for how many seconds during that dive you were doing this much airspeed and how long it took you to lose or gain this much altitude.

It isn't like the G meter you have installed now. It doesn't give you a false indication on landing and stuff of that sort. By the same token you can't reach down and punch off the reading. "The moving finger writes, and having writ, moves on."

Useful? This stuff is invaluable. The primary thing, of course, is to collect and analyze structural flight load data for use in formulating and /or revising structural design criteria. To do the most good, this information must come from the normal operation of aircraft that are in the field being used for their designed purpose. At least, that's the starting point. This gives us a clue on which to base our dream-planes.

But we have more. This same information can be used for revision of flight limitations on the birds we're flying, if need be. We can also use it as a basis for frequency curves, predicted V-G diagrams, gust analyses, mission studies, operational studies and fatigue cycling tests. And while it may not be necessary for you to know all this stuff to fly the bird, it is vital information for the guy who builds or tries to maintain it.

He has to have this data. From a predicted V-G diagram for instance, he could tell about how long or in what frequency (in terms of flying hours) it is going to take you to put maximum stresses on the airplane. He can foretell the time that you are going to exceed the limits of positive or negative G, and forecast the number of hours it will take for overstressing the bird due to sharp pullouts. In the end, it becomes a factor in those continued longevity pay increases—for you.

The whole idea is a concerted effort to keep the design as close as possible to the actual operational need. Faster speeds, higher altitudes, plus the ever-changing pilot techniques, airplane missions, airplane configurations and maneuvering ability demand data collected in this way to keep structural quality current.

The beautiful part of it all is that it doesn't add a thing to what a pilot normally has to do in flying his airplane. There are no instruments to watch, no buttons to push, no switches to turn on or off, nor an item added to any checklist. All you do is fly—the way you normally would.

This isn't a new program. Some of you who flew the Korean action hauled these gimmicks around in combat. And it has been going on since. To date, the people from WADC have recorded more than 31,000 hours of flight recorder time and are presently recording something like 5000 hours per year.

In last year's USAF Fighter Weapons Meet, eight of the airplanes taking part were instrumented with the Flight Recorders. The batch of data collected during the meet was the most concentrated ever recorded on operational aircraft, both in frequency and magnitude.

With all of that experience, the fellows from WADC were johnny-on-the-spot at Nellis and Vincent this year, with even more and better equipment. Planes were instrumented prior to the meet and readings were taken throughout the flying.

Example

Here's an example of how they used it. After one dive-bombing mission, a pilot looked over his bombing score and (with the aid of one of the WADC engineers) the tape from the Flight Recorder installed in his airplane. Comparing the two, he saw exactly why he had missed the target. While he was concentrating on the pipper he had allowed his altitude and airspeed to vary beyond the optimum for good bombing results.

But how do the designers use this stuff? The whole works is transferred to IBM cards and put through all sorts of statistical, computing and electronic gear. The information gathered is analyzed to predict the loads to be encountered by future aircraft in similar operations. Analyzed data are usually presented in the form of WADC Technical Notes. These are used extensively for studies by all branches of the Defense Department and by aircraft manufacturers. You can get them if you need them.

The information is valuable in the designing of gun tracking systems, autopilot systems and even the design of more efficient propellers for reciprocating engines. Perhaps stranger yet, the Flight Recorder has provided data to be used in formulating evasive maneuvers in combat.

There are a whole bunch of little black boxes that work for guys whose sole job it is to develop more dope for doodlers. ▲

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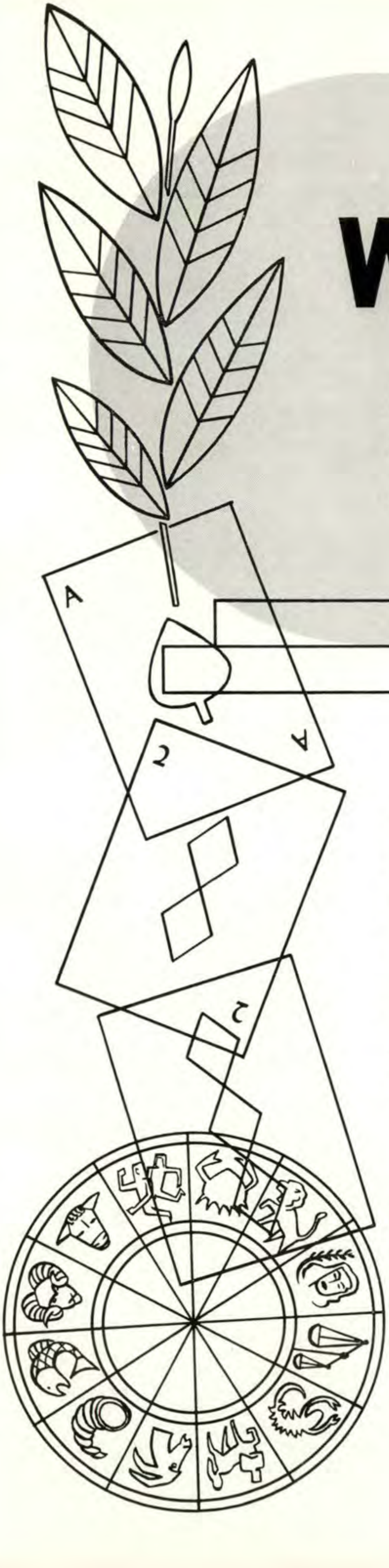


WHAT'S NEXT?

Here is an article reprinted from the MATS Flyer, their official publication. It is on a subject that should prove interesting to all those who fly Uncle Sugar's aircraft.

If THE accident rate is a yardstick of flying safety efforts, then MATS can be proud. Their rate for 1955 was the lowest in their 7½-year history. The 1956 record looks even better. But why all the bragging? As the saying goes, "It's not the whistle that pulls the train."

And so it is with the job of flying safety. It takes a lot of work—continued work—to keep accidents on the down grade. Once you let out slack, it's hard to take it up again, and often costly.

Epidemic

Accidents, like other forms of misfortune, come in bunches. Like a disease, if the cause and cure are not found quickly, there can be an epidemic. As you pause to regroup after one seige of tragedy is halted, there is an outbreak in another unguarded area. The trend isn't easily detected at first. Take the "Landing Short" plague for instance. It all started something like this:

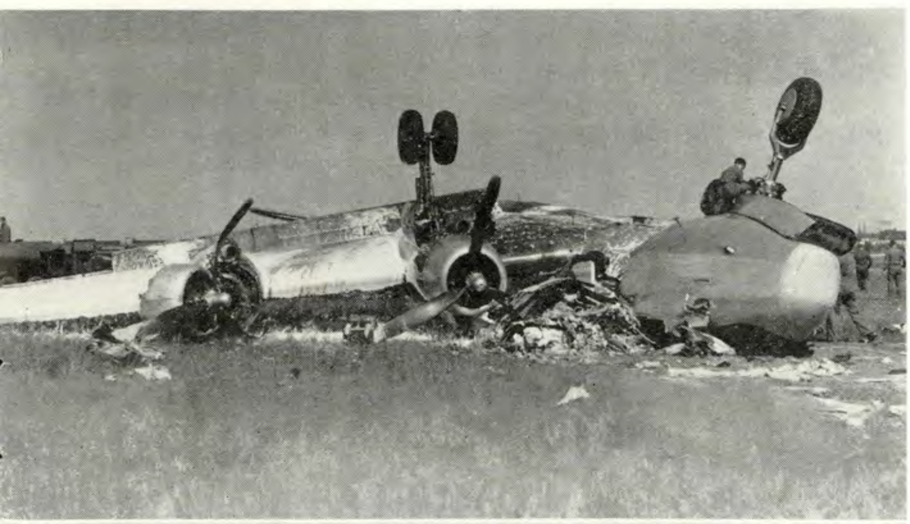
One of our northern bases reported ". . . C-118 No............ landed 200 feet short, sheared gear, bounced onto runway and burned. . . ." Within three weeks the Far East was heard from. ". . . C-124 No. .... landed short . . . hit sea wall . . . wrinkled all four engine nacelles and right wing. . . ." Then things were quiet for a couple of months.

Suddenly the epidemic hit. One "Landing Short" accident report came in every 30 days for the next four months. Within a 24-month period MATS pilots had stubbed their toes short of the runway 20 times, doing major damage to as many aircraft. The epidemic was on.

Then came the cure. The first approach was to make every pilot aware of the problem. Cockpit procedures were reviewed and changed where necessary. Power, airspeed, aircraft attitude and altitude requirements were altered to minimize the possibility of a short landing. By the end of May 1955 "cures" were in effect and the results were gratifying.

Within the last 12 months only three short landings have occurred, and one of these was under emergency conditions — quite a contrast from the previous 12 months wherein

All sorts of accident causes — landing short, collision and landing long. It's good to be able to get a headstart on a problem. Maybe we will be able soon to say that THIS is next.



eight aircraft fell victims to the landing short malady.

On the heels of the landing short problem came a new and weird tribulation: *Mountain Crashes.* Nine MATS aircraft were scattered among the peaks of the world in 1955. The same general attack was followed as in the landing short epidemic. First the question, "Why?" The primary reason seemed to be the effort of pilots to mix (or try to mix) VFR with IFR.

This deadly trouble area seemed inconceivable! It was like an epidemic of smallpox, a disease of the dark ages, breaking out today.

It didn't seem possible that nine aircraft commanders, with an average of over 4000 flying hours each would take chances with stuffed clouds. But facts are facts. The campaign was primarily one of education and admonition. This was the cure.

The reward in this case also has been gratifying—the "Mountain versus Aircraft" reports have been zero thus far in 1956.

Do we have any economists in the crowd? There are many theories on the reason for our business cycles. One is that the sun spots, which give an average periodicity of some 11 to 13 years, have important effects upon the weather. This affects crops. Good crops cause low incomes and bad business, or is it the other way round?

But beyond a doubt, in the flying business, weather can have its effect on the accident rate. For instance: In 1952 during January, February, March and April (our winter months) we crumbled 72 MATS aircraft. It's a known fact you cannot change the weather. *But you can prepare for it.* So that was the plan . . . prepare the crews both mentally and physically for these cold, gloomy months.

Wires and letters went out in the fall of 1952 with warnings of the coming winter's accident potential. The previous winter's infamous record was quoted as a reminder of what can, but must not happen again.

When the snows melted in the spring of 1953 there was reason for every airman in MATS to be proud, for in contrast to '52's record of 72 accidents, they had only 19.

The cure was simple yet effective. Aircrews and ground crews were made aware of the impending problems associated with winter and remained cautious and alert.

Probably the most surprising and exasperating of all our epidemics is the recent reluctance of pilots to lower their gear before landing. Five MATS accidents this year have been stamped "gear up."

It's a well known fact that every MATS pilot knows *how* to lower his gear; however, a few seem to forget exactly *when*.

Like to hear the most pathetic statement of the year? "As I heard a scraping sound I pushed the gear handle down. . . ." It looks like this will be another "Wake the town and tell the people" campaign.

Here are a couple of "Don'ts" that might prevent a skid landing in your squadron:

- Don't nullify the gear warning system by covering the gear warning light and silencing the horn.
- Don't over-concentrate on a minor mechanical difficulty at the expense of routine procedures.

An additional mechanical gear warning system is being tested at Travis AFB on a C-97. It is rigged so that if you lower more than 66 per cent flaps and the gear is up, the warning horn will sound. The conventional throttle warning system will still remain in effect.

But no matter how many warning gadgets engineers install, a complacent, careless pilot can always find a way to foul up the whole system.

And so it goes. As the trouble areas pop up, the struggle begins and the gap is plugged. Reducing accidents is like squeezing a balloon. As you press inward from all sides in an effort to reduce its size, it suddenly pops out as a blister in a weak spot between your fingers. If the blister is allowed to expand the balloon will burst—the whole operation will collapse.

As in the balloon analogy, accidents also will "pop out" in the system's weakest point.

It takes a lot of foresight and hindsight to spot the weakness. If you can discover it soon enough, the first accident won't happen. The man with this ability is a bona fide earn-your-pay accident prevention expert. He's worth his weight in per diem vouchers.

Have you ever heard of Janus of Greek mythology? What a safety man he would have made! You see, he had two faces; one to look forward, the other to look backward. History can foretell the future.

Clues

Many of our accident epidemics gave clues to their tragic potential months before the proverbial dam broke. You don't have to be a Sherlock Holmes or a psychologist to see the indications ahead of time.

Sometimes it's difficult to figure where the next blow will be struck. Often the clues stand out like a sore thumb. However, a complacent "it can't happen here" attitude can cover a multitude of clues.

The Trojans of old learned the hard way about complacency. Keep a watchful "fly safe" eye and be ready to toss out any strange wooden horses that may try to sneak onto your base.

Here are a few super safety-sleuth tips:

- Listen to your aircrewmen tell about a "close one."
- Read (and submit) operational hazard reports.
- If your equipment is unsatisfactory, UR it.
- Check the sick-call book with the flight surgeon. Are your pilots and airmen going on sick call more than necessary as a possible escape from flying fatigue?
- Tour your base. Are runways properly marked? Are aircraft being parked too close together? How are the overruns?
- Check the barrier. Is it in working condition?

Maybe the next weak spot will be fuel management, poor reversing techniques or will it be midair collisions?

It's always an advantage to get a head start on a problem. Instead of wondering "what's next?" a concerted effort might make it possible to say with confidence. "*This* is next." And who knows . . . the accident prevented may have been your own! ▲

AFR 60-16

Here are a few of the changes found in AFR sixty-sixteen.
This is one time you should be a "know-it-all."

the Book of thorough Knowledge

THERE'S one thing we can say about our Air Force, "We got reggalations."

There are regs on how to dress, how to work, when to sleep and what to eat. Fortunately, an Air Force gent need not know every reg in the index. The top brass folks are real understanding about this. They do, however, expect us to have a "kissin' cousin" relationship with a few regs and a "thorough knowledge" of some of the others.

Now if you don't happen to be in the iron bird business, read no farther; but if you are, this article is for you. It's on one of those regulations that falls into the "thorough knowledge" category. When you violate this reg, it's like leading with your right. You're wide open.

The regulation in question is, of course, 60-16. It's been called everything from the pilot's Good Book to a bucket of worms, but "don't fight it." It's a *must* for you.

Recently, sixty-sixteen underwent a face-lifting. She took on some extra pages and additional provisions and herein we've tried to cover a few of them. We realize that many of these new requirements are SOP for some pilots. But just remember, now they are mandatory. So let's get with it.

• Under the old reg, aircraft occupants were required to use safety belts during takeoffs and landings. Although it was good insurance against lumps, wearing the belts at all times was not required. No more. When you are in the office you must be strapped in at all times, both pilot and copilot.

• Paragraph 26 has a new twist. In addition to turning in your Form 175 and closing your flight plan, you are required to report to the weather people for debriefing whenever the weather was either unusual or not as originally forecast.

• By now everybody is pretty hep to the 1000/on top requirement. But the new reg also says that such flights conducted over a 6/10 or more cloud cover must be filed as IFR. Remember on these on/top jobs, you still must provide your own separation.

• Clearing VFR takes a little more planning now. The destination must be VFR at the time of departure or forecast to become so at least one hour before arrival and to remain VFR until one hour after arrival. Also, when filing a composite VFR-IFR flight, the point of change to IFR must be forecast to be VFR upon arrival at that point.

• The additional fuel requirement remains the same as before . . . at least 10 per cent but in no case under 20 minutes. The big change in this provision is in computing that 20 minutes. Many is the jet pilot who uses the 20,000-foot fuel consumption figure for computing his 20-minutes reserve. The requirement now is that the 10,000-foot maximum endurance chart must be used. In a T-33, for example, 20 minutes at 10,000 feet comes out to around a 106-gallon reserve requirement, while at 20,000 feet it is only 84 gallons. Also check those NOTAMS. Any known traffic delay must be considered as "time en route" when computing fuel.

• On the subject of flight planning, paragraph 44 states that pilots will complete an AF Form 21a before each flight. The exceptions are when VFR local or within 200 miles of the point of departure; if your major command prescribes the use of a more detailed form, or if you are lucky enough to have a rated observer who has prepared a Form 21a or a more detailed one.

• You will notice under paragraph 42 that a pilot with his own clearing authority may clear his formation . . . *IFR yet.* This is the first time a 2-1, for example, could clear an aircraft IFR when he was not actually at the controls. The reasoning here is: "Who is better qualified than a 2-1 to clear his own formation?" An Airdrome Officer? Hardly, for to pull AO you need but a total of 1000 hours and five years. And an AO need not necessarily be checked out in the aircraft he is clearing.

Speaking about clearing authority, it is a pilot's elective privilege. Clearance agencies will review and approve or disapprove flights when so requested by the pilot, even though he possesses his own clearing authority for that flight.

• Remember the old landing visibility requirements of "1 mile day and 2 miles night"? Forget 'em. The visibility minimums for range ADF, VOR and ILS are published in the Pilot's Handbook along with the minimum ceilings.

GCA minimums are still in the Radio Facility Charts and in no case will they be lower than 100-foot ceiling and ¼ mile visibility.

Well, there you have just a few of the changes in AFR 60-16. They should have proved informative. But more important, they should whet your appetite for more.

So, don't stop here. Pick up the P.I.F., find the new sixty-sixteen and have at it! ▲

The amount of braking action you can expect is indeed an elusive thing. This article, prepared for FLYING SAFETY, is designed to give you an insight to the braking problem. It is on the mechanisms of friction.

William M. Roberts, WADC

...the *Braking* point

NEXT TO a promotion the most elusive subject is coefficient of friction. Much is written about the first, promotion, without results. Let's discuss the second most fleeting subject, friction, and hope for some improvement.

The purpose of this article is to acquaint pilots with the basic mechanisms of friction and to give some impression of what figures may be expected under varying conditions.

The friction that occurs when you apply the brakes on today's aircraft produces heat with resultant destruction of one or both of the friction surfaces. Each time your aircraft is brought to a stop, a certain amount of destruction takes place.

Let's not consider the type of destruction that you read about in accident reports but the controlled type of destruction so necessary during brake application during maximum braking. What really happens when you stand on the binders to stop your aircraft? You may feel that the only limit in stopping is "how hard can I push." What then are the limiting factors? Surprisingly enough we find that the brake is completely by-passed in a discussion of this type. We must, theoretically, by-pass the brake and look at the tires, for here is the answer. The limiting factors of maximum stopping effort are:

a. μ—coefficient of friction between the aircraft and the ground. Mathematically: F/N.

b. N—normal aircraft weight available throughout the stop and supported by the braked wheels.

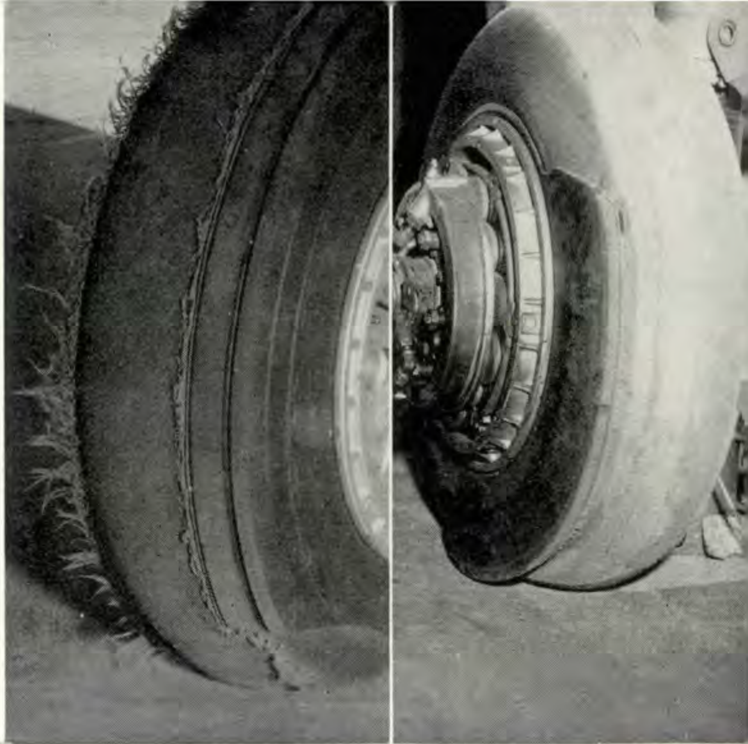
c. F—friction load when slipping impends.

Let's consider item (a) only. In order to discuss coefficient of friction we must squat on our haunches (lay on your belly if you want) and gaze at a spot on the ground. This spot is the place where the tire and ground meet and we shall call it the ground contact area. We are looking at this small area for the purpose of discussing friction. If we are to understand what happens we must first understand general considerations of basic friction mechanisms.

Basic Friction Mechanisms

Frictional forces are called into play at the common boundary of the tire and the runway when the tire is rolling or sliding. The friction is caused partly by the interlocking and shearing of the irregularities in the two surfaces and partly by direct cohesion between the molecules of the contacting surfaces. This is the basic mechanism of dry friction. If the surfaces are rough, the first cause will prevail and friction will be high, but if they are comparatively smooth, friction will be low. The shearing of a continuous film, or wet friction, is the phenomenon to be considered on wet runways. Wet friction need not necessarily be confined to wet surfaces in contact. For example, in a burning skid on a dry runway the leading edge of the contact area

The B-26, "Wingless Wonder" provided valuable data. The wings were clipped to eliminate lift.



Above, notice the condition of these tires after heavy braking.

would be under the influence of the basic mechanism of dry friction (tearing, shearing) while the trailing edge would be under the influence of wet friction due to molten rubber generated by the burning skid.

If the heat generated is not sufficient to melt the rubber, small particles torn loose by the shearing action will ball up, and acting as small rollers, will reduce the maximum friction value obtainable. On a wet surface the mechanisms of friction are reversed. The leading edge of the contact area is subject to a water film acting as a lubricant. The trailing edge by comparison is dry since the water has been wiped and squeezed out by the pressure into the grooves of the tread.

This is the briefest sort of discussion of wet and dry friction processes, but now let's go back to the ground contact area.

As mentioned previously, frictional forces are called into play at the common boundary of two surfaces (ground contact area); the tire, the runway. Let us look at these surfaces for factors which affect μ (coefficient of friction). It can be shown that μ varies with the type of runway construction, the condition of the runway itself (ice, snow or rain) the speed of the aircraft, the tread material and tread pattern of the tire, and the tire inflation pressure. We must look at each item individually for its particular effect on μ.

Runway Construction

It is obvious that for each type of runway construction whether it be concrete or asphalt, the coefficient of friction will vary. The selection of the individual aggregates used in runway construction will markedly affect μ. Asphalt compositions containing fine sharp sand in the surface will produce considerably higher friction values than a coarse broomed concrete surface. Coarse sand, crushed coral, slag or gravel add definite characteristics to the surface which affect the available friction. Certain fillers used in asphalt construction will alter the surface abrasiveness. These are Corps of Engineer considerations in runway construction, and in many cases the geographical location of the runway will account for use of aggregate common to a particular locale.

Runway Conditions

The coefficient of friction at best is elusive, but we all know that ice and snow has a low coefficient of friction because it is slippery. The condition of the runway surface ice, snow, rain, dust or sand all affect μ.

It is difficult to say exactly how and why the runway conditions vary but they do. The temperature is important in determining friction values especially near the freezing point.

A classification of expected runway coefficients is given below.

Coefficient of Friction .5 to .85

Dry concrete or asphalt runways.

Coefficient of Friction .1 to .4

Wet concrete or asphalt runways. This category is particularly susceptible to runway construction and tire design. No particular danger exists due to wetness and smeary film on coarse type runways since no continuous film can develop. However, on wet, smooth asphalt, utilizing smooth tires where no escape of displaced fluid or particles is possible, and where contact pressures are low, the coefficient may drop to below .1. There is little chance for the dry friction process to take effect.

Coefficient of Friction .25 to .35

Snow covered runways which have not been exposed to higher temperatures than about 25 to 29°F.

Coefficient of Friction .20 to .25

Snow conditions at temperatures just below freezing point. Snow covered runways at temperatures below freezing point exposed to sun.

Coefficient of Friction .075 to .2

• Slush or rain on snow or ice covered runways.

• Change from frost to temperature above freezing point.

• Change from mild to frost (not always).

• The type of ice that is formed after long periods of cold.

• A thin layer of ice formed by frozen ground having been exposed to humidity or rain at 32°F. or above.

The above classification is given only as a general guide to acquaint readers with the fact that the coefficient of friction, thus braking action, is indeed an elusive thing. There are so many variations in runway conditions that each condition must be measured separately. However, it might be well to illustrate the effect of μ in terms more readily visualized, stopping distance. For a particular aircraft and landing configuration minimum stopping distance would be 5300 feet with an average μ value of .1. Under the same aircraft conditions stopping distance would be decreased 43 per cent or to 3000 feet, with a μ value of .4. Remember that stopping distance will also depend on the per cent of aircraft weight available on the braked wheel throughout the stop (lift-drag) and is therefore not directly proportional to change in μ. "Northrop Service News" dated November, 1955, carries a complete article on stopping distance for F-89 aircraft and may be consulted for more detail on this type.

Now, back at the ground contact area, there are still other factors which affect coefficient of friction.

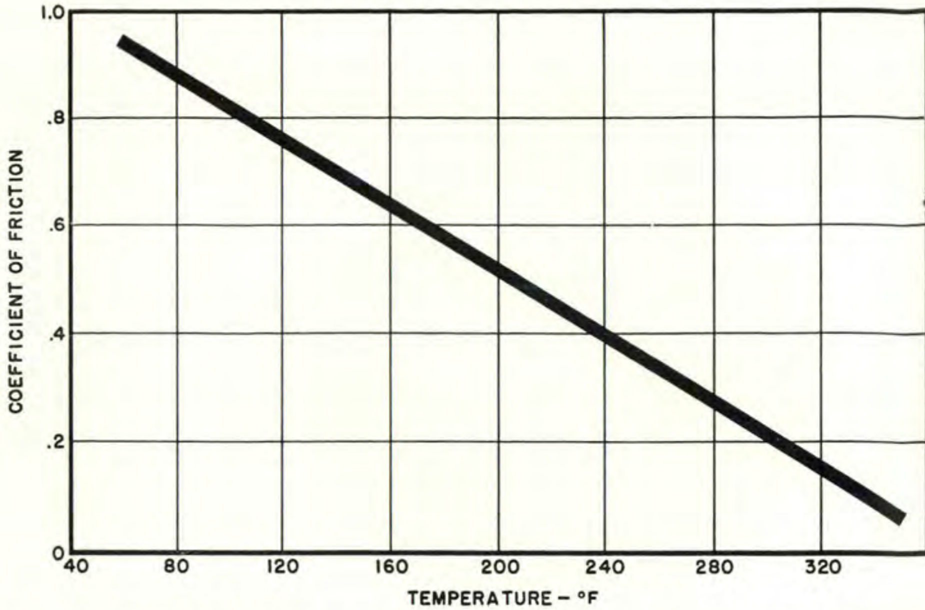


Figure 1. The coefficient of friction decreases as temperature of the tire rubber rises.

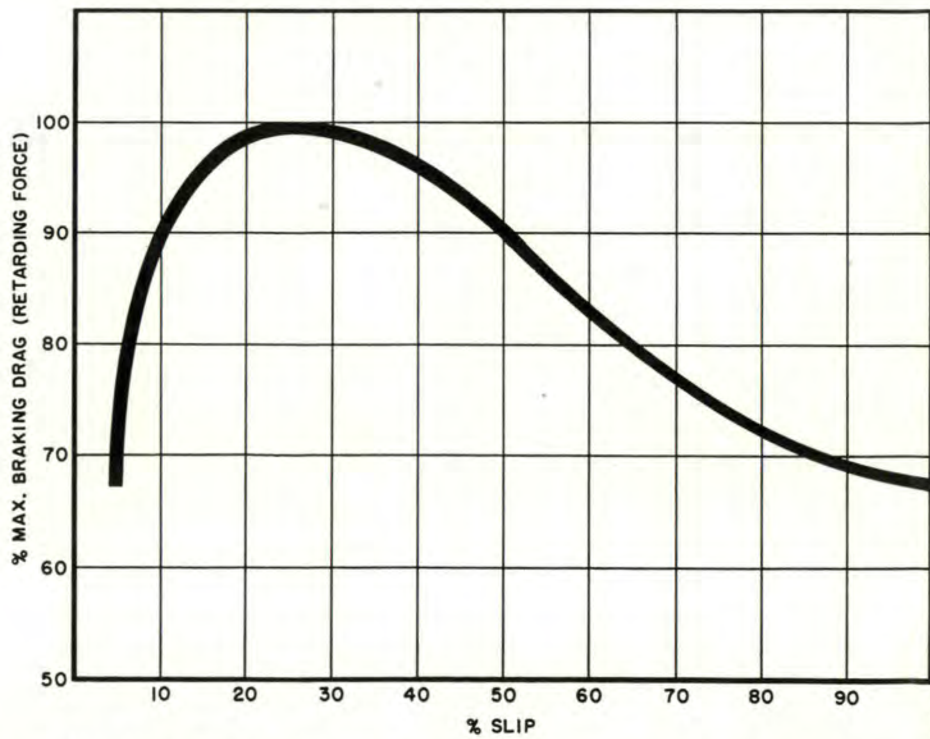


Figure 2. Note the effectiveness of braking versus tire slippage. Some slippage is needed.

Tire Pressure

Low tire pressures are more conducive to penetrability and interlocking of the irregularities in the two surfaces, thus the dry friction phenomenon is better able to come into play. High tire inflation pressures reduce the dry friction effect, as well as contact area, with resultant lowering of coefficient values by as much as 30 per cent.

Aircraft Tire Tread Design

Tread patterns are usually designed to meet the requirements of a specific application. Tread design for wet or slippery surfaces must include two basic provisions. First, provide for wiping action. The tire must act as a wiper to remove moisture in order that the predominately higher mechanism of dry friction can prevail. Second, a relief for water or loosened particles is required to aid and abet the wiping action. Tread designs of this type include countless small wipers and grooves which are unfortunately too weak and unstable for the rugged requirements of high-speed aircraft tires. Small sections tear and strip out under high contact pressure loadings associated with aircraft tires. High centrifugal effects, brake torque, spin-up loads, lateral scuffing and impact loads literally tear an unstable tread design apart. The choice of material or tread compound is important from the standpoint of physi-

With the installation of anti-skid brakes, getting tires into this condition is almost eliminated.

cal strength, hardness, elongation, resistance to cutting, cold temperature flexibility and heat conductivity, and a careful selection must be made when considering the material for application in a particular tread design. In short, aircraft tire tread design is a compromise of all factors and no one factor can be advanced at the total expense of another.

Speed

The effect of high speed on coefficient of friction is not too well known. All research papers on this subject show a general reduction in available coefficient with increase in speed, although at some points the coefficient appears to recover, then fall off. For the purposes here, it is not important and the significant fact is that μ at low speeds, near static, is appreciably larger than at high speeds. Temperature build-up in the tread due to high speed cannot be ignored and the effect of temperature on μ is as shown in Figure 1.

All of the original considerations given above have been discussed but yet there is still another. The last and final consideration to be discussed which affects μ is the phenomenon known as slip.

Slip

Slip is defined as the peripheral speed of a braked wheel divided by the peripheral speed of the free rolling wheel and is expressed as percentage. A non-braked wheel will have 0 per cent slip, whereas a fully skidding (locked) wheel will have 100 per cent slip. When slippage has been brought to about 20 to 25 per cent, the braking force—or F force is the maximum obtainable, and higher rates of slip does not increase, but rather reduces this retarding force. This is best shown in Figure 2. The phenomenon of slip is one of the salient features responsible for the development of anti-skid devices. A brief analysis of this figure clearly outlines two basic requirements for any anti-skid system.

1. Eliminate 100 per cent slip, sliding friction, locked wheel.
2. A system to operate satisfactorily under all conditions as close to the peak of the curve as possible.

Remember that anti-skid does not make, alter or reduce μ; it only utilizes effectively what is available.

Current Air Force aircraft equipped with anti-skid devices are capable of finding and utilizing old elusive μ. They are the B-47, B-52, B-66, KC-97 (MATS), SC-54, F-100, C-123 and the C-133 types.

And now that you have been sufficiently imbued with firm, well-fixed figures and ideas on the subject of braking action, the next time you are backed into a corner with specific questions, you can (intelligently) comment, "Well, it all depends!" ▲

the GCA angle

THAT'S GCA; it's an approach system and not a blind landing system. The equipment was designed to get you to the established minimum and continuing below this minimum should be accomplished only under emergency conditions.

Of course, you've flown some actual IFR precision GCA runs that you really grooved. In these "sno sweat" runs you had the feeling you could have flown right onto the concrete slab, and then there have been other runs. . . . Remember?

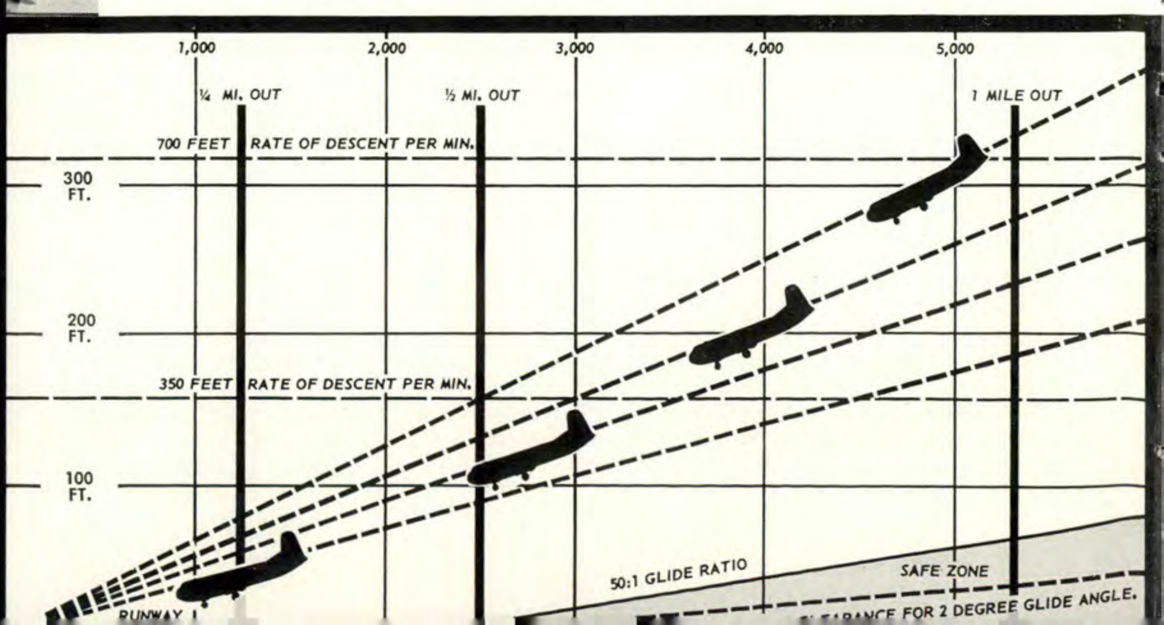
Even under the best conditions, radar is not yet a perfect system but it serves satisfactorily for making safe low approaches and we couldn't very well do without it at this stage of the game. It is not intended to put you on the runway in zero-zero weather. It has earned its keep when it places you in a position from which you can land your aircraft visually.

The GCA final controller will continue to give instructions until the aircraft reaches the touchdown point. However, as pilot, you fly the gages down until the runway is visible, then you make a visual approach and terrain clearance is your responsibility. When the established minimums are reached and the runway is not visible, that's the time to call off the dogs (there'll be other parties anyway), and make for your alternate. You've just had the best offered by a radar approach system.

Okay, you may say, "If I poke my nose down just a little more, that runway may pop out at me." Look out, son, you may never make another party. Here's why.

A precision approach radar glide path has an optimum setting of $2\frac{1}{2}$ to $2\frac{3}{4}$ degrees. The minimum is two degrees and normally the maximum is three. Now to obtain the minimum clearance for the final approach, an average glide path ($2\frac{1}{2}$) intersects the runway 750 feet from the approach end of the runway. This point of interception is referred to as the GCA touchdown point. This particular glide path clears the threshhold by some 33 feet, and at the 500-foot

The wheels hang somewhere below the glide path. They will hit short of the GCA touchdown.



There are a lot of reasons why GCA should not be considered a blind landing system. This article presents one that you may not have known about. The same applies for ILS runs.

Captain Ross A. Beckham
Investigation and Safety Engineering Div. D/FSR

mark it is 12 feet above the runway. Now that doesn't sound particularly alarming, but here is the pitch:

What clears the threshold by 33 feet? The landing gear? The nose of the aircraft? The tip of the vertical fin? This we gotta know before we go poking our nose down any more after passing through GCA minimums.

The radar blip that the controller sees on his scope is a reflection from your bird. The radar responds best to sheer mass and external activity.

So, let's take a big aircraft, say a C-124, on a GCA precision approach. You're on glide path, on centerline. You break out, runway's in sight and you round out and land. Did you notice how high you were over the threshold? Probably not, but remember, on a $2\frac{1}{2}$ degrees glide path and a 750-foot touchdown point, the center of the radar blip passed just about 33 feet above the runway threshold. Of course that is assuming the operator had a good target, the equipment was working right and was properly aligned, the controller was skilled and you were flying exactly as instructed.

Okay, the controller tries to keep the middle of the target in the centerline and on glide path. With most of the return coming from a point where the wings intercept the fuselage, where does that put your wheels? About 15 feet above the green lights.

Now if you are flying a 2 degrees glide path with a 500-foot intercept, things are even worse. And, try this on for size—you never know what glide path angle a particular unit uses.

But let's get back to a *nice, safe* $2\frac{1}{2}$ degrees glide path and a 750-foot GCA touchdown point. In the above discussion you will note that your wheels clear the threshold by 15 feet. *This is the figure, only if you and the controller are doing your jobs perfectly, and the equipment is functioning properly.*

Let's goof things up a bit. Depending upon the individual controller (particularly how he uses his gain control), your target may vary from the size of a pinhead to that of a skinny peanut. A good average would be the size of a grain of rice appearing vertically on the scope. The controller has to watch two pictures, one above the other on one scope. One is for azimuth, the other for elevation. You, in your 70-ton mass of hurtling machinery, will appear as a spot of light and you won't hold still. You just keep rolling along. He has to give oral directions to you as best he can to keep these little spots centered on the centerline and glide path.

When he says you are 10 feet low on the glide path, that's his honest conviction. But he can't be positive because the equipment does not provide the capability. That's what his interpretation of the scope tells him and he's doing the best he can with what he's got.

How About You

Next, let's talk about you, the pilot. We've already told you that neither the radar equipment nor the controller is perfect. Let's face it, you're not either.

The smoothness and finesse with which you handle your airplane can make a big difference. Remember, that boy on the ground is a sort of electronic-age parking lot attendant. He can tell you where to put your bird, but it's up to you to put it there.

Don't let yourself get so engrossed in his directions that you disregard his remarks upon reaching minimums. Or that you forget to fly your own aircraft. Don't be timid about using power in glide path corrections, if necessary. If you slip a little low you can usually ease it back with a little back pressure, but there's a limit to this easing back on the wheel. Without warning you could find yourself nose-high and hunting for airspeed on the backside of that infamous power curve.

I think by now that 33-foot threshold clearance has shrunk considerably. Between dangling wheels, equipment limitations and the controller/pilot inherent incapabilities, taking her down to the concrete just isn't the thing to do.

Incidentally, this also applies to an ILS approach, depending upon where the glide slope receiver antenna is positioned on the aircraft. If it is located on top of the vertical stabilizer, your wheels will be a fair distance below the glide slope.

ILS or GCA are fine approach systems but, are only intended to get you to a certain point on the approach to the runway. From there on, you have to land VISUALLY.

So when the man says "passing through GCA minimums," take over and complete your landing visually or give 'er the needle . . . make for the wagon . . . and here's hopin' you've picked New Orleans as your alternate. ▲

REX SAYS

THERE ARE a number of Air Force bases that rely either wholly or in part upon Military Flight Service for weather forecaster service. Many times, however, these bases do have an Airdrome Officer on duty for clearing purposes.

Normally the pilot calls the forecaster, receives the weather briefing and copies certain conditions for his destination and alternate. He then hands his clearance to the AO, who looks it over and clears the flight. The hair in the butter is that perhaps the forecaster relayed a hazardous en route condition that the pilot failed to enter on the Form 175.

REX SAYS*—If you're an AO at such a base, get in on the weather briefing. If you are the pilot, be sure to let the AO in on any hazardous conditions given by the forecaster. The AO can be of assistance to you only if he gets the whole picture. He is there to help you so why not use him?*

★ ★ ★

MORE ABOUT preflight inspections. Take a look at the picture here, showing a screwdriver which became lodged where it is only because it was too long to go into the engine of this F-84F.

Members of the Flight Safety Deficiency Task Group (at Mobile AMA) sent us this photograph and have requested FLYING SAFETY to print another reminder, urging better preflight inspection.

REX SAYS*—Much has been printed about preflight inspections, and foreign object damage to aircraft. I shudder to think what would have happened had the drive end of this screwdriver entered the engine.*

★ ★ ★

BACK in July FLYING SAFETY published a letter which argued that "There's no such thing as VFR night," and that such clearances should not be authorized. I would like to add my voice to this cry with the following tale:

One night in August we were on the return leg of a scheduled C-47 passenger run. The weather had been forecast as scattered, with visibility of 15 plus but, as per the SOP for this scheduled flight, we filed IFR.

About 45 minutes out, we hit a belt of thunderstorms and were pretty well beaten up by the time we got through. Contact was made with Radar Approach Control and we were in and out of moderate turbulence and rain as they vectored us during our descent. We broke out below the stuff in moderate to heavy rain at 3000 feet and entered a long dog-leg to final. All of a sudden, red lights went flashing by from right to left and from the speed, they *had* to belong to jets.

We screamed at Radar for not telling us about the other traffic and they told us they had nothing on the scope. Most likely, all the heavy rain storms in the area had them blotted out. We hit the GCA final. Three miles out, GCA said the tower cleared us all the way. The rain was now light to moderate, and with the windshield wipers going full blast we could see the runway easily. At about a mile and a half, more red lights were spotted by the other pilot, at our altitude and 180 degrees to our direction. Before he could say anything more about them they turned 90 degrees toward us and the first indication I had of another aircraft (I was making the GCA) was its landing lights shining in my face. At this instant, the other pilot grabbed the controls and broke.

Yep, you guessed it. The jets that passed us before were VFR (in the rain), and the tower was landing another aircraft VFR on Runway Left while we were making a GCA under what we thought was instrument conditions to the parallel runway.

The tower failed to inform GCA and us that they had other traffic in the pattern. The GCA operator later swore that he could not see the other aircraft on his scope. It never occurred to us that there might be VFR traffic churning around in the rain. Flight level visibility appeared to be less than three miles (although we were able to make out runway lights from three miles), and there had been scud clouds at 2000 feet before we intercepted the glide path.

Forward flight visibility was certainly less than five miles outside the control zone.

The weather station was reporting 3000 and 7, but therein lies a fallacy. Their reading was taken at station location and they had no idea what was happening in the rain squalls away from the field. Also, their reading was taken without benefit of rain-on-the-windshield and wipers that, at best, made visible objects a misty blur. Results:

- Fast moving aircraft were buzzing around a busy airport, in and out of rainstorms that they couldn't possibly pick out in the darkness, no matter who said they were VFR.

- Aircraft were making instrument letdowns and pilots must have thought they had a whole section of the sky to themselves.
- A weatherman was inviting disaster because he could stand in a sheltered area and see 7 miles through the rain.
- A control tower operator believed that because the weatherman said it was VFR, everyone else in the area knew it too. So he didn't advise GCA of other traffic.
- A crew that was pretty well shook when it got on the ground.

The passengers were already disgusted with this flying business by the time they got through the thunderstorms. The sudden break-off and application of power on the final was probably the touch that will send most of them to the train station the next time they want to go anywhere. In fact, if we (the crew) get shook any more than we did on this approach, we just might join 'em.

It all boils down to this. Keep the odds in the pilot's favor. File everybody IFR when the conditions warrant — especially marginal nights — instead of blandly holding up AFR 60-16 and quoting "when the visibility is greater than 3 miles and the ceiling . . ."

REX SAYS*—Got to go along with you. When the weather is marginal ALWAYS file IFR. Of course in this case the boys were clearing to this base on the forecast of scattered and fifteen. But by George, there is nothing wrong with changing to IFR when it becomes obvious that the weather has deteriorated to such.*

★ ★ ★

THEY just don't realize how much the injury potential increases whenever a crewmember or passenger unfastens his safety belt or leaves his seat. Take an incident that happened in our outfit the other day. On a round-robin IFR flight the aircraft commander of a C-119 went to the rear of the plane. While he was back there, the aircraft encountered turbulence causing him to fall to the floor and fracture his right knee and sprain his left ankle. Fortunately, the copilot was well qualified and he flew the remainder of the mission without further incident. The crew stated that there was no horseplay with the controls at the time of injury, and that the fall was caused by actual turbulence or by the copilot's making altitude corrections or both.

The point I want to stress is the ease with which even a man of exceptional reflexes can be upset in flight if he is not anchored to the aircraft, either by a safety belt or by grasping some part of the aircraft.

I suspect that most of us have been aboard an aircraft in which a pilot jokingly used uncoordinated control pressures to annoy another crewmember. I know of a pilot in another organization who was hospitalized for several weeks with a badly broken leg which resulted from horseplay with the flight controls while he was in the rear of the plane. What started as a well-intended prank, ended with the aircraft commander's requiring painful surgery. In addition, the aircraft and crew were subjected to unnecessary hazard while the inexperienced copilot made his first letdown under actual weather conditions.

Loss of balance is also very common during taxiing. Some passengers seem to feel a sense of accomplishment if they can sneak through a landing with an unfastened safety belt or if they can wander about the plane gathering belongings while the pilot is taxiing to the ramp. They hurry to save one minute and then wait five, while the crew chief opens the exit. But strangely enough, rated

REX SPECIALS

THE PILOT of an F-100A recently experienced an inflight emergency, the complete details of which would have been both interesting and highly instructive to every F-100A fighter pilot in the Air Force.

While flying at 27,000 feet the pilot noticed a drop in oil pressure. He reduced power and approximately one minute later the engine started to vibrate. The RPM dropped to 80 per cent, a loud banging noise was heard by the pilot and the oil pressure dropped to zero PSI. The engine was stop-cocked and the pilot then heard a loud grinding noise. Gradually the tachometer went to zero RPM indicating that the engine was frozen. The pilot was close to his home base and he successfully completed a dead-stick landing with only the ram air turbine pump supplying flight control system hydraulic pressure. Information on this emergency was obtained through the manufacturer's publication and consequently omitted the details of the techniques used by the pilot, handling characteristics of the aircraft, flight control pressures used or hydraulic pressures noted. These are items in which every F-100 pilot would be vitally interested.

REX SAYS*—Air Force Regulations do not presently require submission of incident reports on occurrences of this nature. It is contemplated, however, that 62-14 will soon be revised to require submission of incident reports on all forced landings and to encourage submission of reports on other unusual occurrences or near-accidents. In the meantime, all organizations are urged to forward incident reports or reports of unusual occurrences which might be of value to pilots of similar type aircraft. Help your buddy—by passing on what you have learned.*

"I really don't believe this qualifies you as an all-weather pilot, Gridley."

personnel are among the worst offenders. Sudden use of the brakes may at any time cause serious injury to a man who is not secured in his seat.

The aircraft commander must insist that passengers keep their safety belts fastened through all phases of ground operation while engines are running. Occasionally such firmness will make him unpopular with the inexperienced or immature passenger, but this procedure will surely pay off in fewer injuries.

REX SAYS*—You're right. I've seen reports on these things before. They're funny — like a rubber crutch! ACs neither run popularity contests nor allow their copilots to regress to the short pants department. Horseplay is for the horses.*

★ ★ ★

AFTER NORMAL preflight (taking for granted the crew chief would remove the gear pins and pitot cover) I taxied out for takeoff in an F-100. I noticed on the takeoff run that my airspeed was reading low, but with at least one-half of the runway gone I decided that to continue takeoff would be the safest procedure. After becoming airborne, I called another F-100 and he brought me back and assisted in the landing.

REX SAYS *— Anything said here would be old hat. What is most interesting about this incident is that such things are still happening. Don't become complacent. Always, and I mean ALWAYS, check visually to see that the pins and covers are removed prior to taxiing.*

★ ★ ★

ANY PILOT who doesn't know how to tune in an ADF set properly these days should be lashed smartly with a wet pitot tube cover. What follows actually happened in my squadron.

Three of my buddies were cruising along in formation with the leader of the flight doing the navigating. Weather at destination was VFR below an overcast. Penetration fix was a homing beacon.

About 10 minutes out, the leader cranked in the published kilocycle frequency of the beacon. He flipped the selector knob to COMP position without listening to the station identification signal. The needle swung over to 300 degrees and froze there. And that was that!

Only it wasn't that. A strong adcock range station some distance away whose frequency differed by only six kilocycles from that of the homer, attracted the ADF needle.

Rest of the story. The flight penetrated and broke out VFR with a menacing range of mountains just off to their left. Shook? You bet. They flew pilotage the rest of the way in.

What in the deuce were the other two pilots doing? Just riding. Not flying. If they had been, they would have been double-checking all along.

It is not unusual at all to find radio compass sets that are from five to six kilocycles off frequency.

REX SAYS *— Now "ear" this. It's basic and real important to get positive identification regardless of the type of radio equipment you have.*

★ ★ ★

THE ELEVATOR trim tab coupling on a C-119G was changed during a periodic inspection. Upon completion, the elevator trim was run through several times and checked okay. It was inspected by the pilot before the test hop and was run through full up and full down limits. Seemed all right. On takeoff the aircraft climbed sharply and both pilots had to get on the controls to keep the nose down. They were able to land, however, without damage to the aircraft. Inspection revealed failure of a bearing in the system caused the erratic operation of the trim mechanism.

The pilot stated that the knowledge gained from reading the "Well Done" article in FLYING SAFETY for March 1956 aided him in controlling the aircraft. He said that had he not left the gear lowered, he doubts if it could have been controlled.

REX SAYS*—These gents did a nice bit of work in getting this big bird down in one piece. What with Playboy and Esquire on the PX newsstands it is sometimes a chore to work FLYING SAFETY reading in. But I figure I'm safe in saying I'll bet this fella's glad that he took the time to read that "Well Done" feature.*

Something for Uncle

This month marks the end of the year 1956. You of the Air Force have presented Uncle with the best Christmas present of all—a reduced aircraft accident rate. This year was one of real advancement in the field of military aviation. The century fighters swung into full action, jet bombers finally replaced the World War II birds and turbo-props entered the aircraft scene.

★ ★ ★

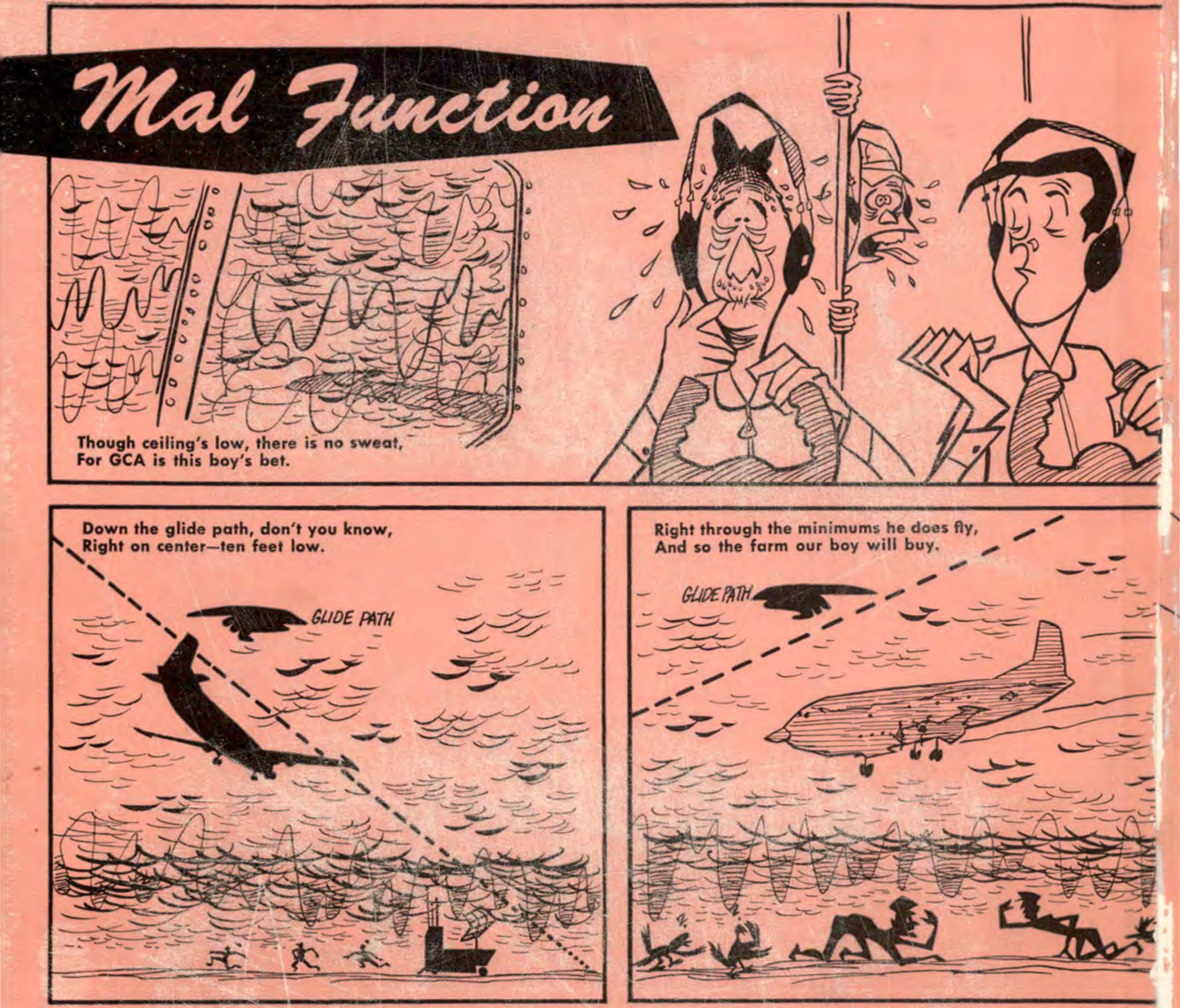
In this day, conservation of personnel and materiel, through the prevention of aircraft accidents, presents a new challenge. Aircrews must be just a little sharper, supervision takes on a new impetus and maintenance procedures must be keyed to meet the new designs. You of the Air Force possess the finest fighting equipment in the world. Let's start our Christmas shopping early and next year present Uncle with an even better present for 1957—"The lowest accident rate yet."

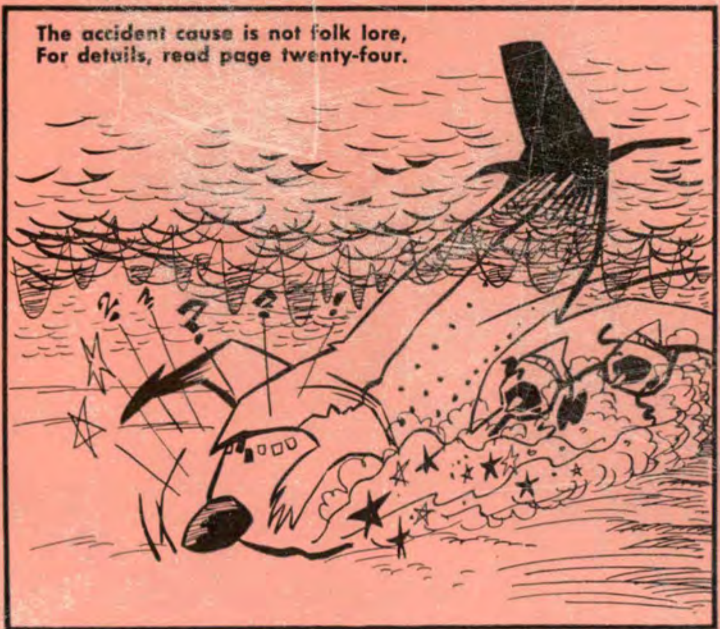
★ ★ ★

During the coming year FLYING SAFETY will concentrate on known problem areas in the field of accident prevention. Past experience will serve as our guide. The majority of accidents are caused by:

- Pilot Error........................49 per cent
- Materiel Failure............23 per cent
- Supervisory Error.......... 6 per cent
- Maintenance Error....... 5 per cent

For the first 6 months of '57 we will hit supervision, the new pilot, new aircraft, flight planning, emergency procedures and aircraft crew station.





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