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BIG BRUTE technique

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Latest tow target techniques in both the T-33 and the "hard wing" F-86F are discussed on page 20, this issue.

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FLYING SAFETY magazine is available on subscription for $3.00 per year domestic; $4.25 foreign; 25c per copy, through the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Changes in subscription mailings should be sent to the above address. No back copies of the magazine can be furnished.

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USAF PERIODICAL 62-1

LETTERS TO THE EDITOR

Incident Reports

Two recent incidents have occurred at this base that may be of interest to pilot personnel at other bases.

The first involved a malfunction of a supercharger in a B-25 aircraft due to heavy deposits of sludge. The accumulation of the sludge was due to pilots' failing to exercise the superchargers on each flight, in accordance with Dash One operating instructions. It points out graphically the result of a small omission by each pilot, over a period of several weeks. The supercharger should be placed in the high blower position for fifteen minutes. for each two hours of operation in the low position, and vice versa. The mixture and power settings to affect this change are listed in the Dash One operation instructions. Also, in the event of a mental omission on some flights (IFR weather conditions have occasionally allowed us all to forget), then the superchargers can be exercised on high for 30 seconds and then back to low for 30 seconds, repeat this operation five times. Probably, this alternate procedure is not as effective (it is listed in the Dash One postflight check), but it is better than not exercising the supercharger controls at all, allowing sludge deposits to accumulate and accumulate. It's a repeat of that old story — know the correct procedures, and then faithfully follow them.

The other incident involved GCA's radar channel failure, during low ceiling and visibility conditions. So many of us utilize and depend upon radar control, either approach or GCA, that we are prone to forget that all radar is a series of wires, cables, tubes and rectifiers, and consequently is subject to failure. "Back up" channels are available, but these can fail simultaneously also, as they did recently at this base. The aircrew had a few tense moments orienting themselves, because they had relaxed their vigilance after being told they were in "positive radar contact." The tense moments were further intensified by precipitation static that retarded reception of the low frequency range. Forwarding this tale is intended to remind all pilots that radar is subject to periodic failure and we must have complete knowledge of the emergency procedures to be followed in the event of radar or radio failure.

Capt. Joseph J. Walsh
FSO, Griffiss AFB, NY

Words of wisdom on the B-25 supercharger and the orientation problem during a radar approach. Incidentally, don't miss the article entitled "Shifting To High," concerning the single-stage, two-speed supercharger, starting on page 10.

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Safety Record

Since 21 July 1952, the 512th as of 22 October 1954, has flown 10,744 accident-free jet fighter hours. It is interesting to note that during the period 21 July 1952 through 10 November 1953, the squadron was flying F-84E Thunder-jets with one-half of the pilots having to be transitioned into this aircraft and upon receipt of F-86F Sabre-jets it was necessary to transition 26 pilots who had never flown Sabres before. Three pilots had previous F-86 time.

The reader may wonder how this enviable record was accomplished. First it was felt that some method of standardized briefing procedure was needed for the pilots. This was accomplished to insure that all flights were thoroughly briefed and debriefed by originating separate mission cards for all flight leaders. Next, due to inclement weather surrounding our English local flying area, special emphasis was placed on insuring that each pilot was familiar with the requirements of a solid instrument training program. Link training was stressed as well as a thorough refresher of all instrument flying regulations.

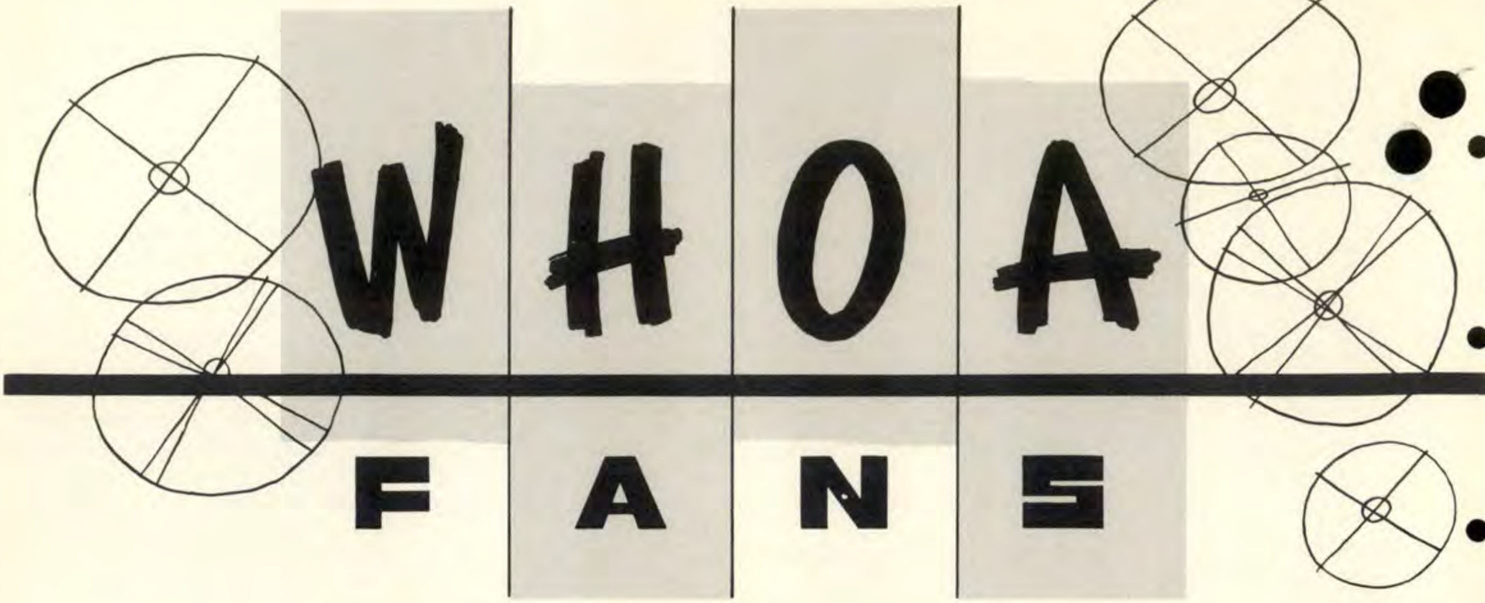
Another basic reason for the success of this unit is the healthy attitude toward new personnel entering the squadron. Each man is welcomed heartily and made to feel he is as important as the oldest member of the squadron. On the other hand the more experienced pilots maintain an open mind for suggestions from new people and often their ideas are made an integral part of the operation.

Each pilot is proud of the fact that he is a professional and is willing to assume the responsibility of his position.

To say that any one section of the squadron is responsible for the successful completion of the mission would be impossible; however, without a top-notch maintenance section our flying safety record would never have been established. Fortunately, for the 512th, the maintenance section maintains an exceptionally high level of espirit de corps. As the new men enter the squadron, they are sent through an OJT program which enables them to become familiar with maintenance procedures used. Our engineering officer, Lt. George Erema, is well qualified both as a pilot and in his field of maintenance. After his men complete inspections or any maintenance requiring a test hop, he often assumes the responsibility to test the aircraft and clear the discrepancy before turning the airplane over to the squadron.

The squadron Commanding Officer, Lt. Col. Frank M. Haynie is always happy to discuss the subject of flying safety. Combined with 3800 hours of flying time, Col. Haynie previously commanded a maintenance squadron enabling him to possess first hand knowledge of maintenance problems. Upon surpassing the 10,000 hours of accident free flying time, he was quoted as saying that "the 512th's motto from now on will be double or nothing." Our goal is now 20,000 accident-free hours.

512th Ftr. Day Sqdn.
406th F-I Wing.



WHOA FANS

Here is an explanation of the latest innovation designed to prevent inadvertent reversals. It's known as "lift-to-reverse."

PILOTS find reversible propellers mighty handy in any season, but the reversible prop really shines when winter's ice, snow and slush cut the bite of normal brakes.

Any motorist who has ever driven in severe winter weather knows what happens if you stomp automobile brakes on an iced-up road. However, the "whoa!" action of reversibles has nothing to do with the conditions of the runway surface, slippery or dry.

Reversible propellers are mighty handy devices, but it has been quite an uphill job to design a foolproof mechanism, which brings us up to the main point of this article.

The Air Force's latest innovation in the field of back-up fans is a device that practically eliminates the possibility of unintentional manual reversing. This is accomplished by the introduction of a lift-to-reverse method of throttle operation. The system, as now approved, is in keeping with the basic instincts of most pilots. It's a natural movement to pull anything aft to stop.

Obviously a pilot must control his aircraft, and he'd prefer to do it with a minimum of gadgetry in between his fist and the plane's response. As nearly as possible, he wants positive control in his own hot mitts.

Unless a system has been proved perfectly reliable, he is dubious of complicated machinery in which "the music goes down and round—and it comes out here." And who's to say him no? After all, he flies the aircraft.

In line with that thinking, you'll soon be seeing these new throttles on C-123Bs, C-130s and many other planes designed in the future which have reversing props. These will include turbo-propeller jobs coming up which lend themselves perfectly to this new system.

The big idea behind these controls is to make it almost impossible for a pilot to reverse *without being completely conscious of the fact.* These controls are a built-in design to prevent inadvertent reversals. Mechanically simple and sturdy, they end reliance on such potential trouble makers as scissor switches in the landing gear and solenoids in the throttle console or pedestal.

To reverse the fans, the pilot must vertically lift his throttles approximately an inch over a positive metallic stop. Pulling back from the forward position, the power levers come to a complete, definite halt. There's no mistaking it and there's no sliding or bumping over this obstruction. The only way to continue into reverse is to lift the throttles along the path of a completely inclosed cam track. When the driver has done that, he is bound to know that he is pulling into reverse.

This gives the pilot manually-powered, mechanically-simple, one-man, single-handed control over reversing at all times. And "at all times" can get important when a split second decision must be made.

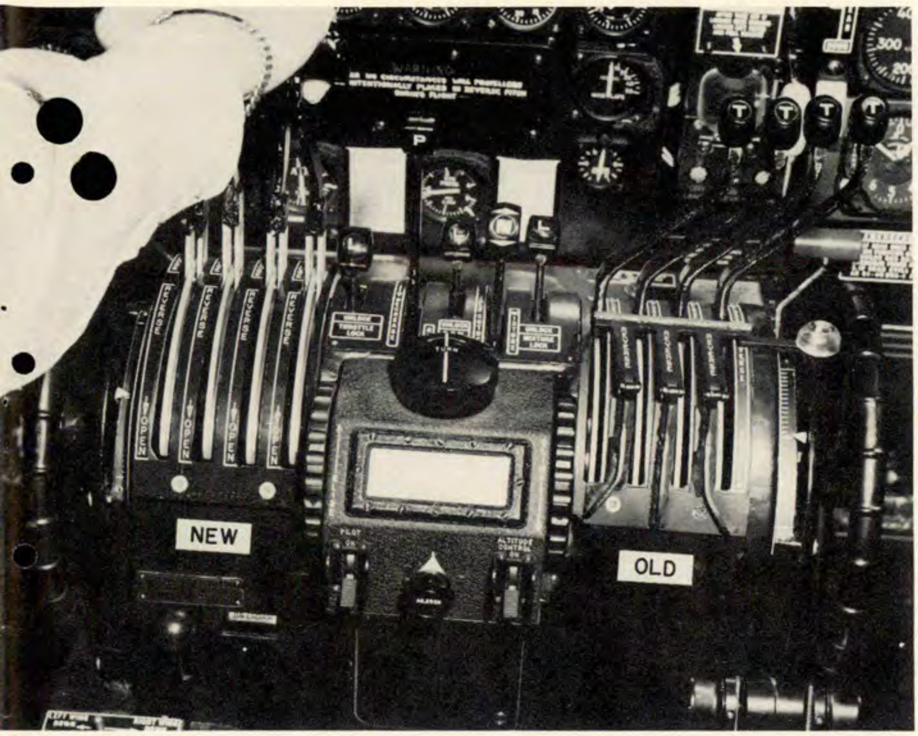
Furthermore, if reversing in the air for special purposes is ever approved by the Air Force, these throttles will do the trick without modification. Meanwhile, experts contend, this outsized solid-stop, vertical-lift provision will keep pilots from unwittingly reversing while airborne.

Although just now coming into field use, the lift-to-reverse idea has been in the mill for many a long year. As early as 1951 at the Wright Air Development Center, where the bugs were ironed out, propeller lab technicians thought the "reverse sense" throttles in use could be simplified for greater efficiency.

Pilots' reports of inadvertent reversals gave strong impetus to the hunt for something better.

The propeller laboratory initiated a study for a design that would be simple to manufacture and maintain and would permit lift-to-reverse control from pilot's or copilot's console.

The combined talents of WADC



Using the new arrangement, left, in order to reverse the propellers all that the pilot is required to do is lift the throttles approximately one inch and move them back into the reversing position.

pitched in on a high priority basis, and after much study, experimentation and testing, these basic standards were agreed upon:

- A simple mechanical device to be manually powered.
- A near vertical lift of one and one-eighth inches to move back into the reversing position.
- Mandatory use of an inclosed cam track.
- Maximum lift of one pound per lever for single controls, and of three pounds per lever for double controls.
- A power knob configuration in which four throttles would feel like a comfortable solid round bar in the hand, putting one finger around each knob.

Douglas designed an experimental unit which was thoroughly flight tested in a C-124. After several modifications, test pilots expressed satisfaction with the configuration.

Boeing also built a model and gave it a thorough workout on a C-97. Literally hundreds of reversals went into these tests.

Finally, basic requirements were approved by the Air Force and were written into the Handbook of Instructions for Aircraft Designers.

How throttles progressed to this point should interest mechanics as well as pilots. When reversibles were first introduced, they were operated by the old conventional throttle. To get maximum results, either in forward or reverse pitch, you shoved the controls forward.

The aircraft response, of course, was completely opposite for identical throttle settings, depending on whether you were in forward or reverse. Kids who built soap-box "cars" in the early days discovered a delightful trick. They reversed the steering wheel—turn it right to go left and vice versa. Then they put an unsuspecting victim in the contraption and shoved him down a steep hill. The results were always hilarious — and often disastrous.

Probably the first pilots to use reverse props with standard forward throttles felt something like these victims, although forewarned. Which reminds us of one we witnessed back in 1930. The hapless soul in this little caper was flying an old Navy Vought bi-plane, complete with a P&W mill, bird cage wires *and* an experimental reversible prop.

The pilot came charging up to the field one day at about fifteen feet, saw he was going to undershoot and poured on the coal. Unfortunately he forgot that he'd already reversed the blades. The immediate and end result was instantaneous.

The poor old Vought descended vertically as power was applied, struck a fence amidship and broke in half. Splinters and fabric flew in all directions, and as the dust settled, the pilot came scrambling out of the wreckage, unhurt physically but deeply wounded spiritually.

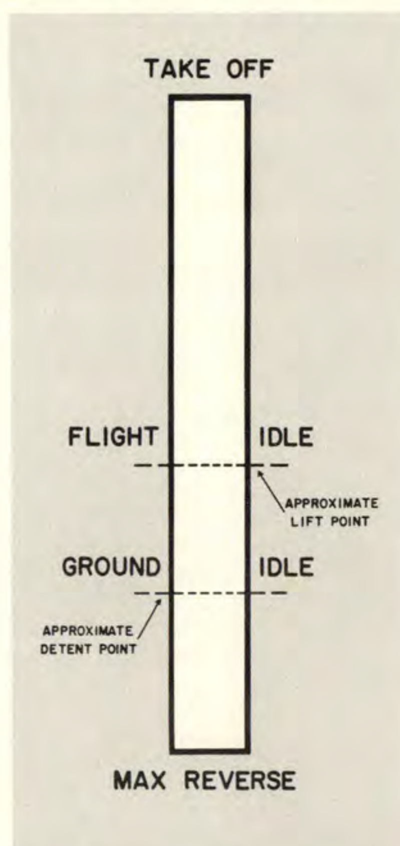
However, enough in retrogression.

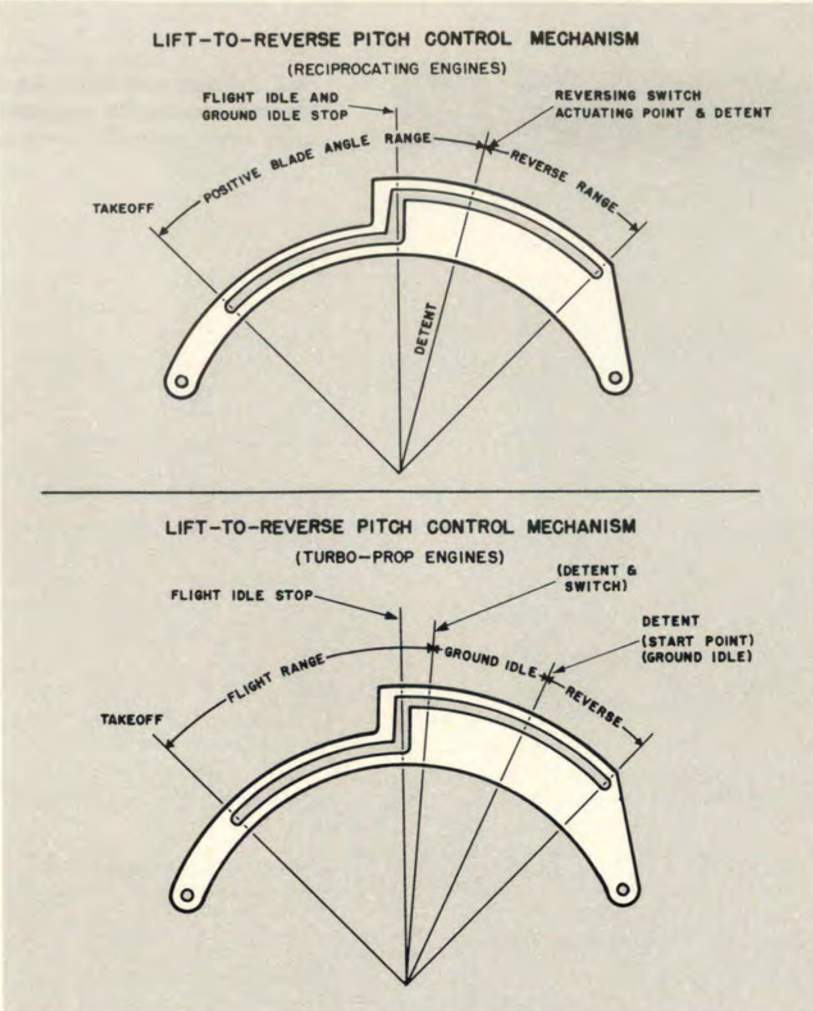
As we all know, pilots guide their aircraft on the ground by jockeying the power knobs. On takeoff, if you are yawing to the left, advance the left throttle. When in reverse with the old throttles, you had to do exactly the opposite to correct left yaw.

Certainly this was no good—diametrically opposed rules to remember for throttle steering on the ground.

Why not make this system consistent—forward for giddy-up and back for whoa? Or, for the non-horse types, just push to go and pull to stop. Reversible props were just a special and added bit of throttle whoa, and as such belonged toward the rear. It wasn't very long before such an arrangement was worked out. This one did the trick. Even the fist action in jockeying the knobs worked

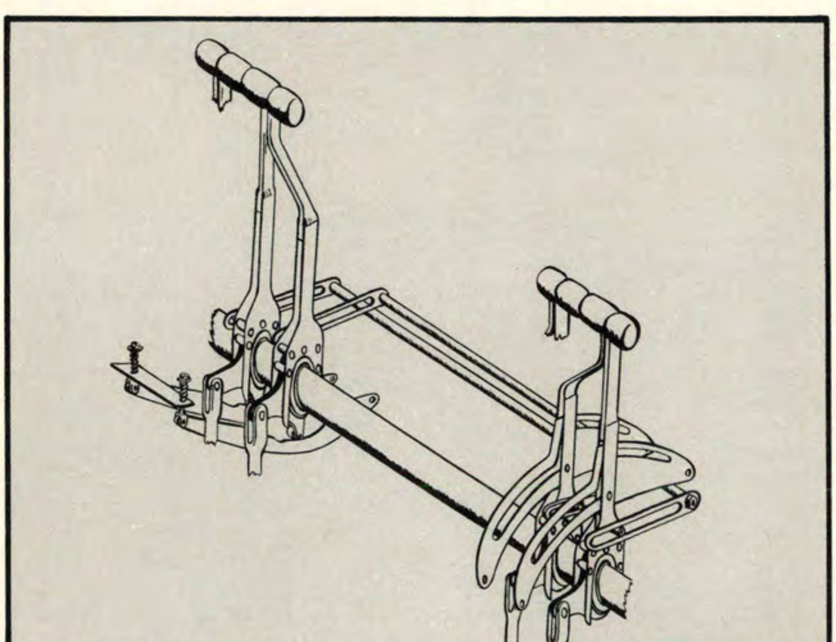
The drawing indicates approximate throttle positions on the lift-to-reverse quadrant.





On reverse control mechanism, the lift must not be more than ± 5 degrees from the vertical.

This diagram shows the current production configuration of the new lift-to-reverse sense throttle.



out the same in forward and reverse.

Refined, this system came to be known as "reverse sense throttles," and they were first used militarily on the C-74.

In this method, the forward pa of the quadrant controls positi thrust, and the behavior is identical to that of the conventional throttle. Backward movement past the mid-point, however, trips the reversing switches, and increasing negative thrust is obtained as the power lever is pulled aft.

A "feel" detent is provided which the pilot recognizes as a signal that reversing has taken place. Hesitating at this spot for a one-two-three count permits the propeller to reach the reverse angle without overspeeding. The location also provides sufficient power to prevent stalling the engine.

It was necessary to add another measure to prevent reversals when airborne. A micro-switch was fitted into the landing gear strut scissor. When the strut was compressed, the switch operated and a solenoid in the cockpit quadrant withdrew a stop, permitting reversal. Thus one could only reverse on the ground—if all of these added works worked!

This reverse sense configuration had one weakness. If a pilot decided to abort a takeoff and the aircraft weight was carried by the wing, could not reverse because the soleno stop, actuated by the strut scissor, would not be withdrawn. An override had to be provided.

It was decided that such an override must be purely mechanical to guard against failure of the circuit, the solenoid or the scissor switch.

With such a reversing control the pilot could make a normal landing, and when the aircraft was on the ground, the throttles could be moved aft and reversing occurred.

It wasn't long after the reverse sense controls came into service that pilots started to depend on them. This dependence took the form of "crowding" the throttles, or "riding them down" on the landing; i.e., keeping them against the stop so they could be pulled into reverse as soon as the solenoid was thrown.

In some aircraft, even today a few pilots will crowd the throttles and then override the stop by cooperative action between the pilot and copilot. Such a landing is made by the copilot pulling the override when he hears the tire bark on the runway. The pilot, having crowded the throttles, quicl moves them aft, and reversing occurs. Thus they use the mechanical override to sidestep the original system of gear switch and solenoid.

If that's what they prefer, lift-to-reverse does just that in an even simpler manner, making a one-man job out of it.

With the experience of the years, it is easy to point out the weaknesses in the reverse sense arrangement. These are:

- The normal reversing and emergency cases require different actions by the pilot.
- The solenoid operated latches and the associated mechanisms are subject to both wear and adjustment.

Long ago this led WADC laboratories to conclude that a new objective approach was in order. With the objective stated as "a system of least complication which permits the pilot freedom of action and yet provides notice of reversing," the lift-to-reverse throttles were evolved.

Numerous systems are in use now, including sequence gate, arm and actuate and others, but it looks from here as though many future aircraft designed for the Air Force will incorporate lift-to-reverse propellers as standard equipment.

The surest way to get positive operation is to design it very simply into the equipment, minimizing the mental pain and strain on the human operator. And that, say its backers, is the beauty of lift-to-reverse. ●

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Reversal in Flight

This article reprinted from the MATS FLYER.

THERE'S a feeling that creeps into the minds of pilots: what would happen if one of those fans suddenly reversed up there at cruising altitude—or even worse, while on the final approach?

Because of a series of tests under the direction of National Airlines the question mark can be erased. We now know what will happen when one propeller is reversed in flight. These tests were conducted on a DC-7 equipped with R-3350 engines and Hamilton Standard Hydromatic constant-speed propellers with full feathering and reverse pitch features.

The tests were conducted because of an incident which happened to a National Airlines flight landing at Tampa, Fla., 18 June 1954.

A DC-7 was rolling out of a left turn on final approach when the flight engineer observed the No. 1 "Reverse" light on bright and steady. The flight engineer immediately called this to the captain's attention and observed that all tachometers were at approximately 2400 rpm. The copilot continued to fly the aircraft down the final.

The captain reduced power on the No. 1 engine, then advanced it to about 35 in. Hg.; RPM responded accordingly between 1800 and 2800 rpm. The copilot stated that it felt like the prop was in reverse and that he had to push right rudder about six inches to correct for yaw during the captain's throttle manipulation.

Crewmembers stated that there was no vibration, buffeting or other unfamiliar sounds.

Just before touchdown the prop was feathered. No. 2 and No. 3 were reversed after landing.

This incident was reported by the crew to their supervisors who, in turn, decided to set up a series of controlled tests to determine just what would happen should reversing occur during flight.

Representatives from Civil Aeronautics Administration, Civil Aeronautics Board, Douglas Aircraft Co. and Hamilton Standard personnel attended a conference wherein National Airlines personnel outlined their prop reverse test procedures.

Special switches were installed. One permitted unfeathering into reverse by pulling out either No. 1 or No. 2 feathering buttons, another permitted the reverse light of No. 1 propeller to come on when the prop was at the approximate 35-degree forward thrust blade angle.

Gross weight at takeoff was approximately 82,980 pounds, and preliminary tests began at 8000 feet involving various rates of descents and airspeeds. During these maneuvers, which simulated final approaches, the No. 1 throttle was moved back and forth duplicating the action taken by the captain on the approach at Tampa.

The reverse light came on at 135 knots indicated airspeed, 110 brake mean effective pressure (BMEP) and $24\frac{1}{2}$ in. Hg., indicating the prop was at approximately a 35-degree forward thrust at 2400 rpm. Speed and power were varied several times to fix this condition. No unusual or abnormal actions were observed, including yaw.

For the reversing test the aircraft was climbed to 10,000 feet with BMEP set at 80 (manifold pressure, 20 in. Hg.), 2500 rpm, gear up, flaps

30 degrees and airspeed 110 knots stable. A 500 fpm rate of descent was established. Next, No. 2 throttle was closed. RPM slowed to 2000, with the propeller windmilling on the low pitch stops. Outside air temperature was +10°C.

The No. 2 feathering button was held out 4-5 seconds with the special switch ON to provide a ground so the prop could reverse. The RPM increased from windmilling at 2000 to approximately 2080 in a matter of one to two seconds.

As the prop reversed, RPM fell off rapidly and throttle advancement was started at about 1500 rpm to keep the engine running in reverse thrust. The No. 2 throttle was advanced to its approximate original position in relation to the other three throttles. Manifold pressure read 23 in. Hg. The RPM slowed to 975 and held.

Rate of descent increased from 500 to 1300 fpm while holding the same airspeed of 110 knots.

Although RPM increased only approximately 80 going through flat pitch into reverse, the flat pitch or reversing sound was easily distinguished. This sound lasted about three seconds, and, as it quit, moderate to severe buffeting commenced, which continued as long as the engine was running with the prop in reverse.

Buffeting was of greater magnitude than that produced by cowl flaps full open on all four engines, but less severe than that associated with a full stall. The buffeting was not of control surface nature. Neither the wheel column or rudder pedals buffeted; instead, it was of a general nature and pronounced throughout the ship.

Those who observed the left wing tip during the test stated that the wing did an oval gyration followed by a yaw movement as the prop went into reverse position.

The pilot pointed out that the yaw effect was not severe, in fact the ship flew straight with feet off the rudders (no rudder trim) with only slight aileron applied. He believed that more rudder pressure would be required during climb-out at maximum power with No. 2 engine dead and windmilling on the low pitch stop.

When the prop was feathered into forward thrust, the maneuver was discontinued and the aircraft climbed back to 10,000 feet.

Maximum power with No. 2 in reverse thrust was applied this time. But first, the aircraft was set up as before except airspeed was increased to 125 knots with power at 90 BMEP, manifold pressure 21 to 22 in. Hg. on Nos. 1, 3 and 4 engines to maintain 500 fpm rate of descent.

Then No. 2 was reversed in the same manner as before. Initial reverse indications were the same. When maximum power was applied, which resulted in 100 BMEP, 22 in. Hg. and 900 rpm on No. 2, power on 1, 3 and 4 was increased to maintain the 500 fpm rate of descent. Buffeting, wingtip gyration and control pressure were the same as in the previous maneuver.

After unreversing and climb to 10,000 feet were accomplished, the No. 2 propeller was reversed for the third time, but with airspeed indicating 140 knots. The engine stalled on the first attempt (throttle was not advanced quickly after reversal) and rotated approximately one revolution backwards.

No. 2 was feathered out of reverse, and at 140, windmilling 2400 rpm against the low pitch stops, it was again reversed. The surge while going into reverse was approximately 2500.

At 7000 feet, 100 BMEP and 24 in. Hg. turned No. 2 at 840 rpm. Nos. 1, 3 and 4 engines were set at 192 BMEP and 2500 rpm to maintain 140 knots.

Full throttle on No. 2 produced 127 BMEP, 27 in. Hg. and 1100 rpm and 650 fpm rate of descent. At 6000 feet the flaps were fully retracted and level flight maintained at 150 knots indicated. And No. 2 engine RPM slowed to 980.

No. 2 was then throttled back to 70 BMEP, 24 in. Hg., where it turned 500 rpm. The aircraft then climbed 300 fpm, still indicating 150 knots with power on engines 1, 3 and 4 still at 192 BMEP and 2500 rpm.

Similar tests were conducted on No. 1 engine. Slightly higher power settings were used on No. 2, 3 and 4 engines to maintain 165 knots than those used with No. 2 propeller in reverse. Power setting on No. 1 engine while in reverse was 760 rpm, 110 BMEP, with manifold pressure 23.5 in. Hg.

As the propeller reversed, the left wingtip again did an oval gyration followed by the yaw movement. This oval gyration was considerably more pronounced than it had been when the No. 2 propeller was reversed.

On this reversal, as in the others, the sound during reversing and buffeting while in reverse was approximately of the same magnitude.

As was anticipated, No. 1 engine in reverse produced more yaw than No. 2. However, the aircraft at this speed was not difficult to control. The test pilot estimated that less rudder pressure was used here than would be used on a maximum power climb out with No. 1 engine dead and windmilling on the low pitch stop.

These tests provided a wealth of information about this heretofore "unknown." In summary it was concluded that:

• An in-flight reversal produces a definite "reversing" sound, even with little or no power on the engine (throttle closed).

• While the aircraft is operating with a prop in reverse, moderate to severe buffeting will be encountered.

• The engine will stall and windmill backwards in a matter of seconds after the prop reverses if considerable throttle is not quickly applied.

• The RPM on the reversed engine and prop will be very low even at full throttle, and will decrease inversely proportional to airspeed.

• To unreverse, the throttle should be closed and the feathering button pushed. After the prop goes from reverse to forward thrust, pull the feathering button to neutral and advance the throttle.

• Yaw effect of a propeller in full reverse at full throttle appears to be moderate with the aircraft definitely directionally controllable.

It was further concluded that the incident at Tampa described in the beginning of this article, was not caused by propeller reversal because no reversing sound was heard by the crew, the propeller in doubt continued to operate in normal RPM range, the engine continued to run normally and no buffeting was encountered. ●

Propeller reversal tests were made by National Airlines with a Douglas DC-7

WELL DONE

1st Lt. Lloyd J. Kelly

332d Fighter-Interceptor Sq.
New Castle County Airport, Del.

SHORTLY after 1st Lt. Lloyd J. Kelly took off on a day navigational flight from Selfridge AFB, Michigan, the engine of his F-94C surged and then the RPM fell off to 12 per cent. At the time the power loss occurred, Kelly's aircraft was over the center of Detroit, Michigan, at 3500 feet. He immediately initiated a 180-degree turn back toward Selfridge, but after rolling into the turn, realized that he could not make it to the base.

He then saw Detroit City Airport and set up a downwind leg for the longest runway (4600 feet). Selfridge relayed a message to the Detroit tower to the effect that Kelly was making an emergency landing at that airport. As he turned on base, the engine flamed out completely.

Lt. Kelly was unwilling to jettison the two practically full 250-gallon tiptanks because of the heavily populated area below him. Kelly had many obstructions in the traffic pattern that he had to maneuver his aircraft to avoid, including several tall smoke stacks, a butane storage tank 315 feet high and numerous small planes in the immediate area around the field. His final approach was made over houses and high tension wires that extended right up to the end of the runway.

Touchdown was made in the first 1000 feet of the runway and the drag chute deployed at once. Although the right main tire blew, causing the aircraft to veer off the side of the runway into the mud, Kelly brought it to a successful stop with only slight damage. Neither crew member was injured, and there was no damage to any privately owned property.

Through his quick thinking, excellent judgment and superior flying technique, Kelly turned what could have been a tragic accident into an incident that reflected much credit to himself and to the U. S. Air Force.

The city of Detroit voted Lt. Kelly a letter of commendation and thanks for his actions. If Lt. Kelly had bailed out or jettisoned his tiptanks over the heavily populated area,property damage and probable loss of life would have resulted. Well Done!

ANYMOUSE  *and his hairy tales*

EVERY now and then one of us is called upon to perform some duty with which he is not too familiar, just like the crew in the following story. Their particular mission, though not routine, could hardly be considered hazardous. They were assigned the duty of performing a parachute drop of dummy figures during "open house" on Armed Forces Day.

A competent, experienced NCO from the parachute department was given the responsibility of preparing for the flight. The actual crew performing the drop consisted of a pilot, copilot, dropmaster, assistant dropmaster and three airmen from flight operations. The dropmaster and his assistant were briefed on ejecting the dummies. One of the operations airmen was to withdraw the arming cable for the automatic release of parachutes immediately prior to throwing out the dummies.

The C-47 assigned to the flight was equipped with electronic equipment that left little space between the para-door and the aft portion of the equipment. Following takeoff, the dropmaster placed himself just forward of the para-door and aft of the electronic equipment. The assistant was just aft of the para-door and was tied in by means of a safety strap. An operations airman manned the inter-com which is installed on the aft wall of the cabin. After the operations man had difficulty hearing the instructions relayed from the pilot's compartment, he and the dropmaster exchanged positions.

The first dummy was dropped, then, while reaching for the second one, the operations airman inadvertently pulled the emergency release on the cargo door. The door flew open, out flew the second dummy and along with it . . . the operations man. Fortunately, he cleared the aircraft and made a successful parachute descent and landed without injury.

— — —

It is well within the realm of possibility that you too may someday have to perform some duty that is not covered by SOPs, regs and the like. If such should happen, and you are certain there are no printed guides available, attempt to find someone who may have some experience even if that experience was gained from only one mission. Make some practice dry runs to work out all the bugs and prevent possible mishaps. There is more than one way to skin a cat. Don't leave anything to chance.

★ ★ ★

THE weather was reported to 300 feet with 1/3 mile visibility in light rain as I started my GCA approach. Upon reaching minimums (200 feet and ½ mile), I still could not see the runway, but I did see what appeared to be scud clouds, slightly ahead and below. I was tempted to descend a little more, when suddenly I realized that the "scud clouds" were actually white-caps of the waves washing up on the beach at the end of the runway. You can imagine what would have happened had I tried to get under the "scud."

— — —

GCA minimums mean just that . . . This is as low as you can descend until the runway is definitely sighted.

This pilot's experience may well tie in with the slant range visibility problem. (See "Slant Range Angles" in the August 1954 issue of FLYING SAFETY.)

This anymouse also brings up something on procedures. Experienced crews, when performing a GCA run, always rely on the copilot to watch outside for visual contact, wh

"The cargo door flew open, out flew the second dummy and along with it—the operations man."

the pilot concentrates on the instruments. Once the aircraft is definitely in the clear, the transition is made from the gages to VFR flight.

As our records indicate, attempting to fly contact under IFR or marginal weather conditions sets the stage for inadvertent descent below minimums. It's human to crowd your luck when you can almost see the ground.

★ ★ ★

FOR a number of years I have read articles in FLYING SAFETY and similar publications concerning thunderstorms in general and in detail, and the effects of lightning upon aircraft. I have never read of anyone being killed or injured by lightning while in inclosed cockpit type aircraft.

To the best of my knowledge, training schools still teach the theory that aircrew personnel cannot be injured by lightning (other than by momentary "flash" blinding), provided they are in inclosed cockpit type aircraft. The following personal experience therefore may be a rarity and of some value in future subjects your publication might run on the effects of lightning strikes.

On 2 September 1950 I was returning from a mission over North Korea in an RB-17 type aircraft, en route to my station at Johnson AFB, Japan. About 150 miles from landfall, over the Sea of Japan, just as I broke out of a moderate thunderstorm, my aircraft was hit by a bolt of lightning. The bolt entered the aircraft via the trailing antenna, bounced off the antenna reel in the waist section, ricocheted off a thermos jug, passed through the body of one of my waist gunners and followed the fuselage back to the tail section where it departed the aircraft, burning buckshot-size holes in the skin.

All radios except the VHF set were rendered inoperative, and the navigator informed me that he thought the magnetic compass was magnetized to a point where it was giving a false reading of 60 degrees or more. This fact was never definitely confirmed.

I immediately turned the controls over to my copilot, and checked on the gunner's condition. He was in a state of shock, unconscious and was burned around the eyes. At least one and possibly both of his arms were badly burned. We treated him for shock and put ointment on his various burns. Although we were not sure of it until he had received medical care on the ground, he was temporarily blinded but regained his eyesight some few days later.

To the best of my knowledge, no formal report was rendered on this incident because damage was confined to wiring and a relatively small amount of sheetmetal work.

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This incident certainly does fall into the bizarre category. In general, the incident followed standard lightning strike patterns for cargo aircraft. It hit an antenna, bounced around the interior of the plane and went out the tail-cone. What makes this one different is that a crewmember was injured. In 1953 a total of 25 lightning strikes were reported, none of which resulted in an injury.

He found his mistake; he had pulled the right oil by-pass button instead of the left cockpit heat.

I WAS returning to my home base in a C-45G after a three-hour night VFR flight and started a letdown from 7000 feet, about 30 miles out. The cockpit became warm as I descended, so I reached over and pulled what I thought to be the left cockpit heat knob. About a minute later, the oil temperature on the right engine hit the peg; I took off the power and the copilot and I started looking for the trouble. We found it easily enough. I had pulled the right oil by-pass button instead of the left cockpit heat. Recommendations hardly seem necessary at this point.

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Like the man says, recommendations hardly seem necessary. The old saying, "Look before you leap" certainly applies here.

The lightning hit the antenna, bounced around the interior of the plane, went out the tail-cone.

Check your altitude before you . . .

Shift to HIGH

THE C-82 took off and made two climbing 360's, reaching for altitude. At 5000 feet the pilot started off on course, still climbing. The aircraft cleared the first ridge of mountains by some 1000 feet, but higher terrain lay ahead and the climb was continued. The power settings were 42 in. Hg. and 2500 rpm when, at 7000 feet, the No. 2 engine started to backfire. The fuel flow on the No. 2 engine dropped to idle, and it became apparent that the aircraft would not climb fast enough to clear the oncoming 8000-foot mountain range. More power was needed on No. 1 engine, and the pilot quickly moved the supercharger controls to the high ratio position. With the engagement of the blower there was an immediate increase in manifold pressure, but what's this? The engine seemed to produce less power. Number 2 engine was stone cold dead, and No. 1 wasn't cutting the mustard. The pilot had to give the bailout order.

The above story is true, and it cost the Air Force an aircraft. Although there were other contributing factors to the accident, the cause of the power loss on No. 1 engine is the important one. It may bring out some forgotten facts concerning the correct operation of superchargers.

The C-82, like the B-26, C-46 and other aircraft, is equipped with single-stage, two-speed superchargers. This type of supercharger has a larger, more complex system than the single-stage, single-speed type. It incorporates a gear shifting mechanism by which the single impeller may be driven at one of two different ratios to crankshaft speed: Low or High.

At or near sea level the engine is operated in the low impeller gear ratio, thus keeping to a minimum the temperature rise through the supercharger and the power lost in rotating the impeller. At a specified altitude determined by the engine type and the operating conditions, the shift is made from the low to the high gear ratio. The increased airflow and higher manifold pressures available in the high ratio make possible continued high performance to still greater altitudes.

Maximum performance during climb will be assured only when the shift from low to high ratio is made at the proper altitude, as determined in the Operating Instructions. If the need for high performance at any given altitude is not required, the use of the low impeller may be continued if sufficient power is still obtainable.

If the shift from low to high ratio is made below the proper altitude, the *result is a loss of available power* even though the manifold pressure increases. Using this high position below the designated altitude will reduce the brake horsepower available to the propeller at any given RPM or manifold pressure because of the power absorbed by the impeller as its speed is increased. (See Figure 1.) A further objection lies in the greater temperature rise imparted to the fuel charge by the impeller in the high gear ratio. At low RPM this may not prove serious, but at high RPM it may lead to detonation.

When the proper shift altitude has been reached, the shift from low to high ratio is made as follows:

- Reduce the manifold pressure three or four in. Hg. (Do not change RPM setting.)
- Move the supercharger from LOW to HIGH without hesitation.
- Adjust the throttles to the desired manifold pressure setting.

The partial closing of the throttle that immediately precedes the actual shift is made to prevent excessive manifold pressure rise after the impeller has been engaged in the high gear ratio. A few trials should familiarize the pilot with the necessary throttle movement.

As you have probably surmised, the pilot of the C-82 experienced loss of power on No. 1 engine because he shifted to high blower about 5000 feet below the recommended altitude of 12,300 feet. This early shift from low ratio to high ratio operation resulted in a loss of nearly 200 thrust horse power to the propeller.

If the aircraft you fly is equipped with the single-stage, two-speed supercharger, familiarize yourself with its limitations as well as its advantages. Individual Pilots Operating Instructions should be your guide on checking and operating the supercharger on your airplane. However, there are a few general fundamentals that apply.

All ground operations of the engine, such as starting, warm-up, idling and taxiing should be performed with the supercharger in the low impeller gear ratio.

During preflight, when the oil temperature rises to at least 40°C., set the propellers at high RPM and open the throttles to 1700-1800 rpm. Mo

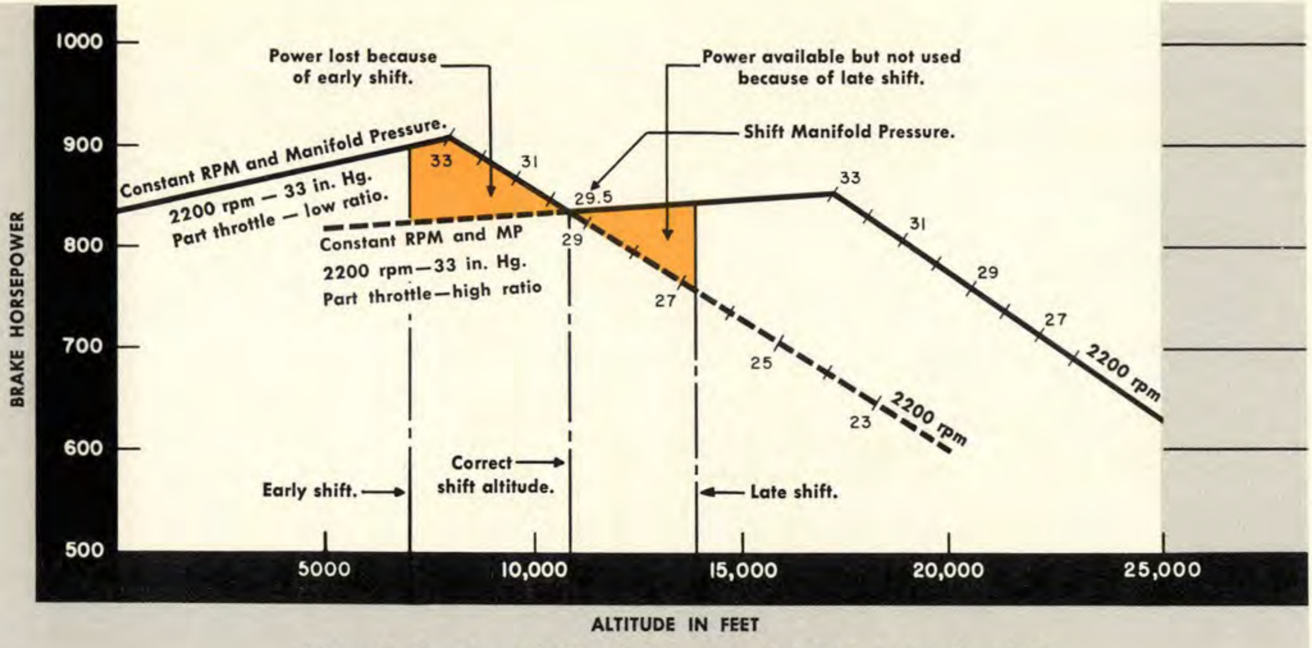


Figure 1. Results of shifting too early or too late during the climb.

the supercharger from LOW to HIGH. A slight drop in oil pressure and increases in manifold pressure and RPM will indicate that the selector valve is supplying oil to both clutches and that they are engaging properly. Open the throttle to 2000 rpm and return the control to LOW. Note a momentary drop in oil pressure and a decrease in manifold pressure and RPM.

Should erratic changes in oil pressures, manifold pressures or RPM occur, indicating improper operation, repeat the cycle after first idling the engine at 1000 rpm for two minutes to permit the clutches to cool. In making any shift, the control level must be moved quickly and without hesitation between positions.

Takeoffs, under all conditions, regardless of altitude, should be made in the low impeller ratio. The use of the high impeller at or near sea level will reduce the horsepower available to the propeller as well as increase the tendency of the vaporized fuel charge to detonate. Since the impeller lies between the carburetor and the intake pipes, no preheating is accomplished by using the high ratio, and the possibility of carburetor ice is not lessened thereby.

The impeller ratio for cruising is selected with reference to altitude and type of operation (percentage of horsepower) desired at that altitude. For maximum fuel economy it is generally desirable to operate in the low ratio whenever possible. However, there is actually little difference in cruising performance between full throttle operation in the low ratio at high RPM and full throttle operation in the high ratio at low RPM, provided the brake horsepower is the same in both instances. In general, after reaching the proper altitude, a half closed throttle in the high ratio indicates the desirability of shifting to the low ratio position.

On extended flights, clutch shifts should initially be made every two hours. At each of these times two or more complete shift cycles (i.e., LOW to HIGH or vice versa and return) should be made, and the clutch into which the shift has been made should be allowed to operate for about two minutes. This time interval is required between shifts to allow the heat to dissipate. If the exercising shifts are made during operation in the low ratio and RPM and manifold pressure and carburetor air temperature are sufficiently low, it will be unnecessary to climb to the shift altitude, because the operation in HIGH is of such limited duration.

The clutch shift is not necessary on short flights because the preflight clutch check performed prior to takeoff will serve to keep the clutches free of sludge accumulation.

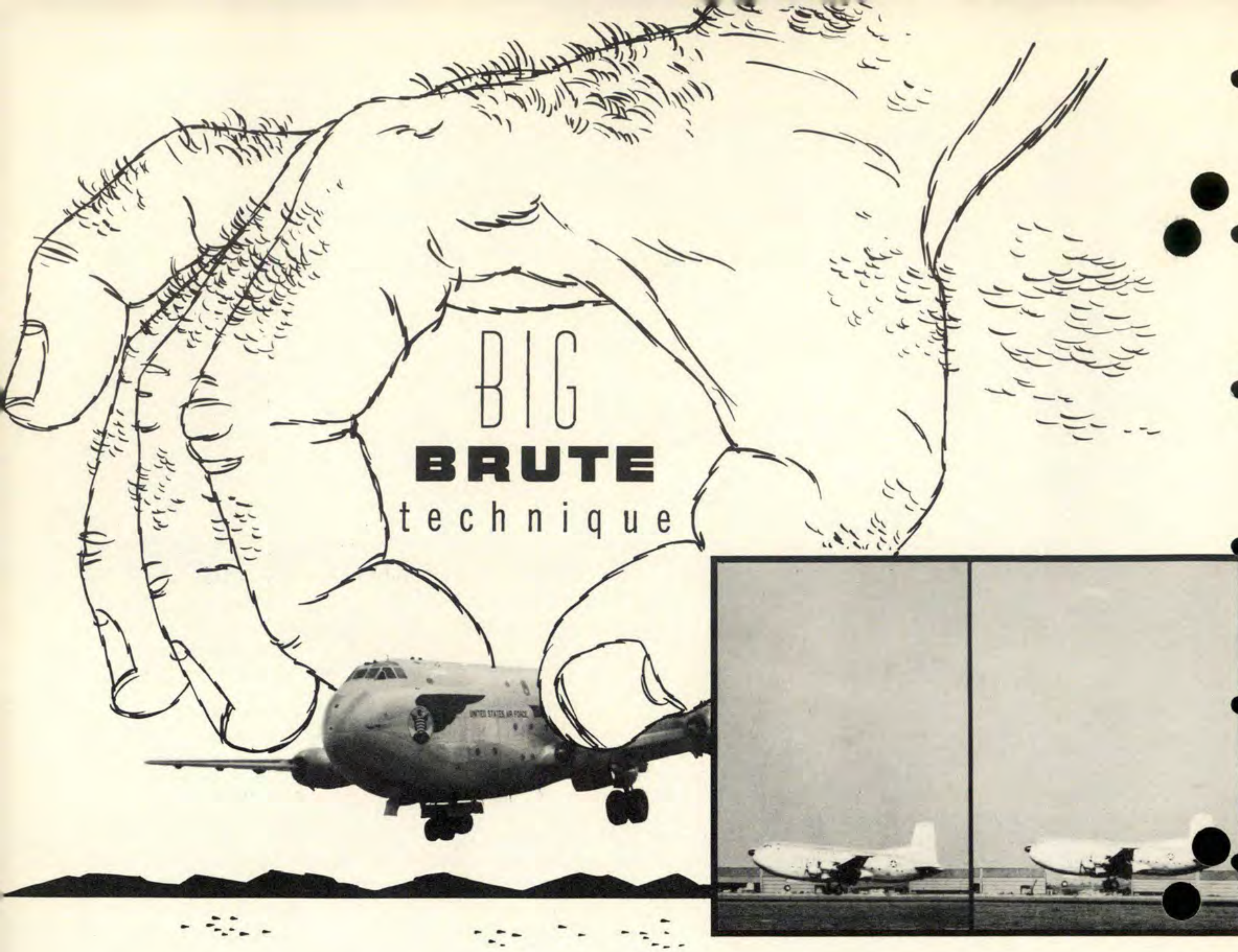
During a gradual cruising descent or when making a normal letdown from altitudes at which it has been necessary to use the high impeller ratio, the supercharger should be shifted to LOW as soon as practicable and regardless of altitude, unless, of course, you plan to level off above the proper shift altitude. However, if the need for maximum performance may be required during the descent, the shift from HIGH to LOW should not be made until the shift altitude has been reached.

Glide and approach for landing should be made with the controls in the LOW position. In the event of an emergency, the pilot will then have maximum power available.

Because the heat rise imparted to the fuel charge by the supercharger is normally greater in the high impeller ratio, the carburetor air temperature limits are lower. Care must be taken to observe these limits, otherwise detonation may result. Flight operations should be performed in the low impeller ratio, regardless of altitude, whenever the carburetor air temperatures are above 16°C.

The supercharger is an invaluable piece of equipment when properly utilized. Don't make it a detriment through improper operation. ●

BIG BRUTE technique



Here is a story prepared by Douglas Aircraft Co. test pilots on C-124 handling techniques in the traffic pattern.

ALTHOUGH parts of the following discussion may appear elementary, it is an established fact that we sometimes overlook elementary factors and as a result, come to a cropper.

Let's start then by a general review of handling characteristics and the factors that affect them. The elevator control forces and movements required vary throughout the speed range of the airplane. At high speed, the elevator is extremely effective and therefore requires a very small amount of movement to control the plane during normal maneuvers. At low airspeeds, such as during the landing approach, elevator effectiveness decreases, requiring a greater movement to obtain response.

During landing the center of gravity greatly affects the amount of elevator required. The further aft the CG the less elevator required. Moving the CG forward increases this control requirement. As in any airplane, loading aft of the CG limit will cause an unstable condition and if loaded ahead of the forward limit, the amount of elevator control available will probably be insufficient to flare the airplane.

Elevator requirements vary also with power. For example, as power is applied during an overshoot, forward stick is required to counteract for nose-up pitching; and conversely, as power is cut during the landing flare, back pressure is required.

The wing flaps provide the additional lift required for takeoff, and produce both extra lift and drag for approach and landing. At small angles (20° to 25°), the flaps act primarily as an added lift device, and at large angles (40° to 45°), as both an added lift and drag device. High drag resulting from maximum flap extension, is obtained primarily from the amount of extra surface exposed to the airstream.

In effect, as the flaps are extended, the camber of the wing is increased. This produces more lift at any given angle of attack and reduces the airplane's stalling speed. The changes resulting from flap extension are included in Figure 1.

At a given speed, the flight path can remain constant during flap extension or retraction if the attitude and power of the aircraft are properly controlled.

Final approach and landing per-

FIG. 1

Flap Position	Lift Increase % C_L Max.	Stall Speed @ 160,000 lbs.
0°	0%	108 knots
10°	12%	103 knots
20°	24%	98 knots
30°	35%	95 knots
40°	44%	92 knots
45°	48%	90 knots

With the airplane in proper attitude for touchdown, at 110 per cent of stalling speed with flaps full down, a problem to a pilot is that his eye level is approximately 34 feet above ground.

formance, as well as takeoff and initial climb performance, should be determined by reference to the appendix of the Flight Handbook (Pilot's Operating Instructions).

In order to remain consistent with the methods used in determining glide and landing performance, the Douglas Aircraft Company has recommended speeds for the various configurations used during approach and landing on the following basis:

• *Initial approach* with gear up and 10 degrees flaps — 140 per cent of the stalling speed.

• *Downwind and base legs* with gear down and 20 or 30 degrees flaps — 140 per cent of the stalling speed.

• *Landing approach* with gear down and full flaps — 130 per cent of the stalling speed.

• *Landing flare* (across the fence) with gear down and full flaps — 120 per cent of the stalling speed.

• *Touchdown* with gear down and full flaps — 110 per cent of the stalling speed.

Power-off stalling speeds for the specific gross weight and flap configurations are used as the basis for these recommendations. These speeds are high enough to provide the necessary margin above stall to withstand turbulence, and also to provide adequate maneuverability throughout the approach pattern.

• *Initial Approach:* Use the recommended initial approach configuration and speed for either four or three engine operation. Note that all of the speeds quoted provide almost maximum performance during a missed approach for the "one engine out" condition. If a missed approach should occur, first establish climb at the same airspeed used during the approach, then make the transition to the recommended climb configuration and speed.

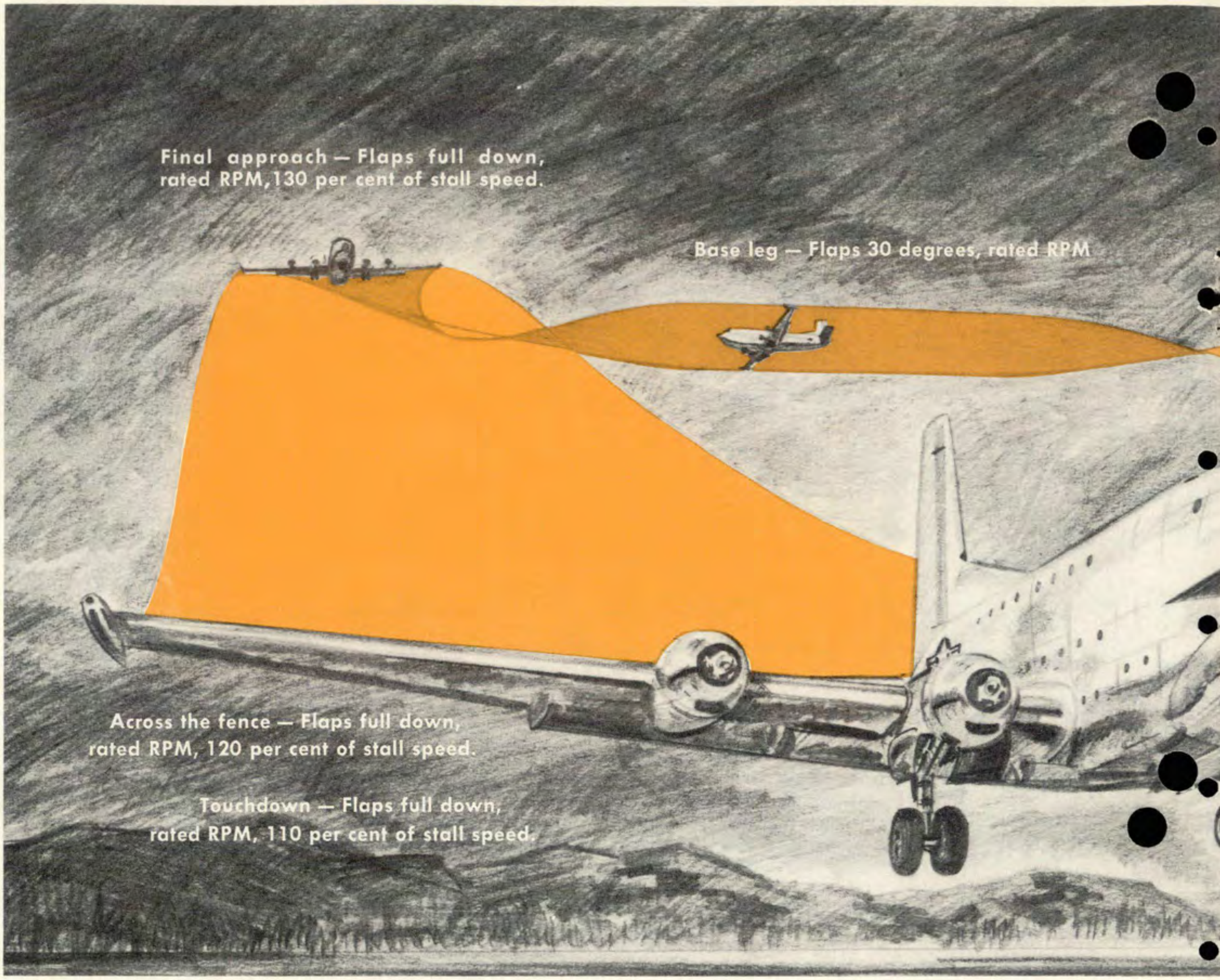
• *Downwind and Base Leg:* In making the transition from the initial approach to the downwind and base leg configuration, maintain constant power and altitude. As the gear and flaps are extended on the downwind leg, allow the airplane to decelerate to the downwind approach speed. With this technique, practically no change in power settings or trim will be required.

Proper speed-power control is one of the most important factors in executing a good approach. Therefore, it is felt that the pilot should control the throttles. The man flying the airplane is the one who most readily recognizes the power requirements and can make necessary power adjustments with minimum delay. The time interval between verbal orders and ultimate execution, along with the possibility of misunderstanding, are obvious hazards of indirect power control by interphone instructions.

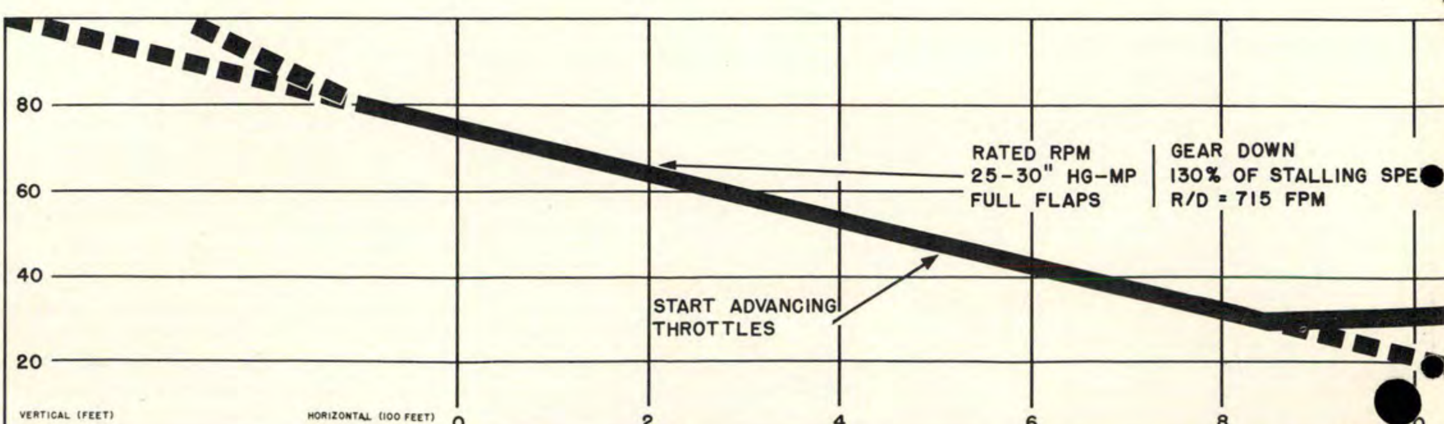
The pilot who does not have complete control of the power might wind up like the hapless soul who recently dropped a Globemaster in much too hard. In this case the driver saw that a go-around was fast becoming a necessity and called for "takeoff power!" The engineer did exactly as instructed. . . . He took off all the power.

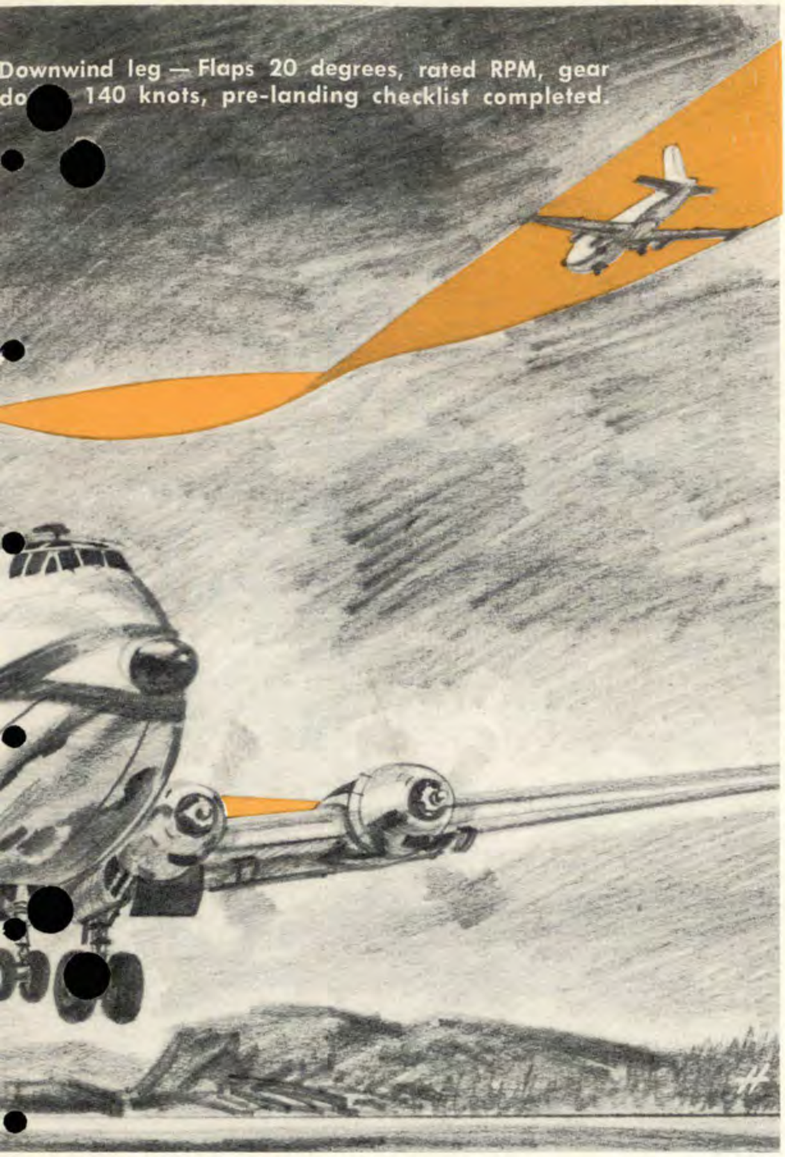
• *Final Approach:* Upon turning onto final, a glidepath of from three to five degrees provides a comfortable approach slope. It can be approximated by planning the approach so as to arrive at about 500 feet above the runway level when approximately one mile from touchdown. Power required will vary with wind, gross weight and flap setting, but should normally be between 25-30 in. Hg. of manifold pressure and rated RPM. When not more than one mile out, set up the landing approach configuration and speed for four or three engine operation. Control the rate of descent by variation in power rather than variation in airspeed. It is recommended that full flaps normally be used for the last half mile of the final approach. Flap setting should not be changed close to the point of touchdown.

• *Landing:* With a properly planned approach, a slight amount of power should be maintained until the landing flare is completed. If the throttles are closed prior to the flare, more elevator deflection is required to increase the angle of attack. An increase in angle of attack is neces-

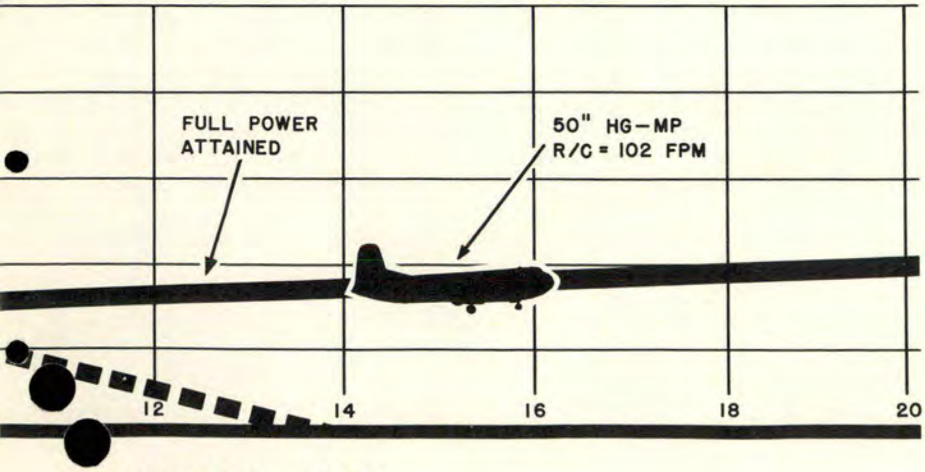


Above, a typical C-124 landing pattern.





Below, graph illustrates the approach and go-around flight paths.



sary in order to reduce the airspeed and to secure enough lift to change the glidepath of the airplane. Also, as the power is reduced, the propeller governors attempt to maintain the selected RPM. A windmilling propeller increases the total drag of the airplane and decreases the airflow over the wing and, consequently decreases the wing lift.

The angle of attack of the wing increases on the flare-out and varies with the steepness of the approach and the airspeed. A high airspeed on the final approach, coupled with a steep glidepath, requires a greater change in attitude, therefore more elevator deflection is necessary. As the rate of descent increases, the altitude consumed in completing the flare also increases. This rapid change in angle of attack will also cause a more rapid decrease in airspeed.

One of the more predominant problems facing any pilot of large, multi-engine aircraft is his position in relation to the ground. This is especially true in the C-124.

On the ground, in a three-point position, the normal eye level is approximately 24 feet above the ground. With the airplane in the proper nose-high attitude for touchdown, at 110 per cent of stalling speed with flaps full down, the eye level distance increases to 34 feet. Until one gets used to it, this attitude presents a bit of a problem.

The recommended speed for across the fence (120 per cent of the stalling speed in that configuration) provides adequate airspeed margin to properly flare the airplane, provided the glide angle is not too steep.

As the landing flare is completed, gradually reduce power and continue increasing the angle of attack to land the airplane on the main wheels with the nose held up. After touchdown gently but firmly lower the nose wheel onto the runway. Maintain directional control primarily through the use of nose wheel steering, because as soon as props are reversed the rudder is automatically snubbed.

For maximum effectiveness, apply reverse thrust as early in the landing roll as possible, because thrust decreases in effectiveness at the lower rolling speeds.

• *Engine Out Operation:* Although the approach and landing configurations and speeds are generally the same for three or four engine operation, there are a few exceptions that should be kept in mind. On three

Four Engine Reverse No Brakes	2600
Brakes Only	2430
Brakes plus Two Engine Reverse	1920
Brakes plus Three Engine Reverse	1710
Brakes plus Four Engine Reverse	1560

C-124 Table of stopping distances in feet. Based on a standard day, weight at touchdown 160,000 lbs.

engine operation, do not lower flaps more than 30 degrees until the landing is positively assured. With this flap setting less time is consumed transitioning to the recommended climb configuration and speed in the event of a missed approach or go-around.

For two engine approaches, remain in the clean configuration until the base leg is established. The landing gear should not be extended or flaps lowered more than 20 degrees until definitely committed to land. As power is reduced on final approach, remove excessive trim, make a normal round-out and touchdown. After landing, if reverse thrust is used, follow the recommended reverse thrust procedures.

Missed Approaches

• *Four Engine Operation:* If obstacle clearance is required during a four-engine overshoot, simultaneously apply maximum power, establish initial climb-out speed (110 per cent of stalling speed), retract the flaps to 20 degrees, retract the gear, and then proceed as during a normal takeoff.

If obstacle clearance is not required, the transition should be made directly to the climb configuration and best climb speed, as recommended by the Flight Handbook, using power as necessary for required rate of climb.

• *Three Engine Operation:* If a three-engine overshoot becomes a reality from a speed below the final approach airspeed, apply maximum power, accelerate to initial climb-out speed (100 per cent of stalling speed), then retract the flaps to the 20-degree position and retract the landing gear. Begin climb when initial climb-out speed is reached. Maintain initial climb-out speed until obstacles are cleared, then make the transition to the best climb configuration and speed.

Be alert to meet control requirements resulting from application of maximum power at low airspeed.

If a three-engine overshoot occurs from the final approach airspeed, simultaneously apply maximum power, maintain existing airspeed, retract the flaps to the 20-degree position and retract the gear. Climb as required for obstacle clearance at initial climb-out speed (110 per cent of stalling speed). As soon as obstacles are cleared, make the transition to the best climb configuration and speed.

For most effective deceleration after landing, use maximum braking possible and maximum reverse thrust on the remaining engines within the limits of directional control. Banking and turning tendencies encountered in reverse thrust may be controlled by the use of nose wheel steering and by the amount of symmetrical or asymmetrical reverse thrust applied.

During an aborted takeoff or a three-engine landing, before using reverse thrust, first obtain positive directional and lateral control of the airplane. Next, apply symmetrical reverse thrust, by simultaneously reversing opposite inboard or outboard engines. The third engine may be reversed as soon as speed has decreased below normal landing speed. As soon as corrective control action has been taken to compensate for a symmetrical reverse thrust, power on the remaining engine may be increased to the limits of directional control.

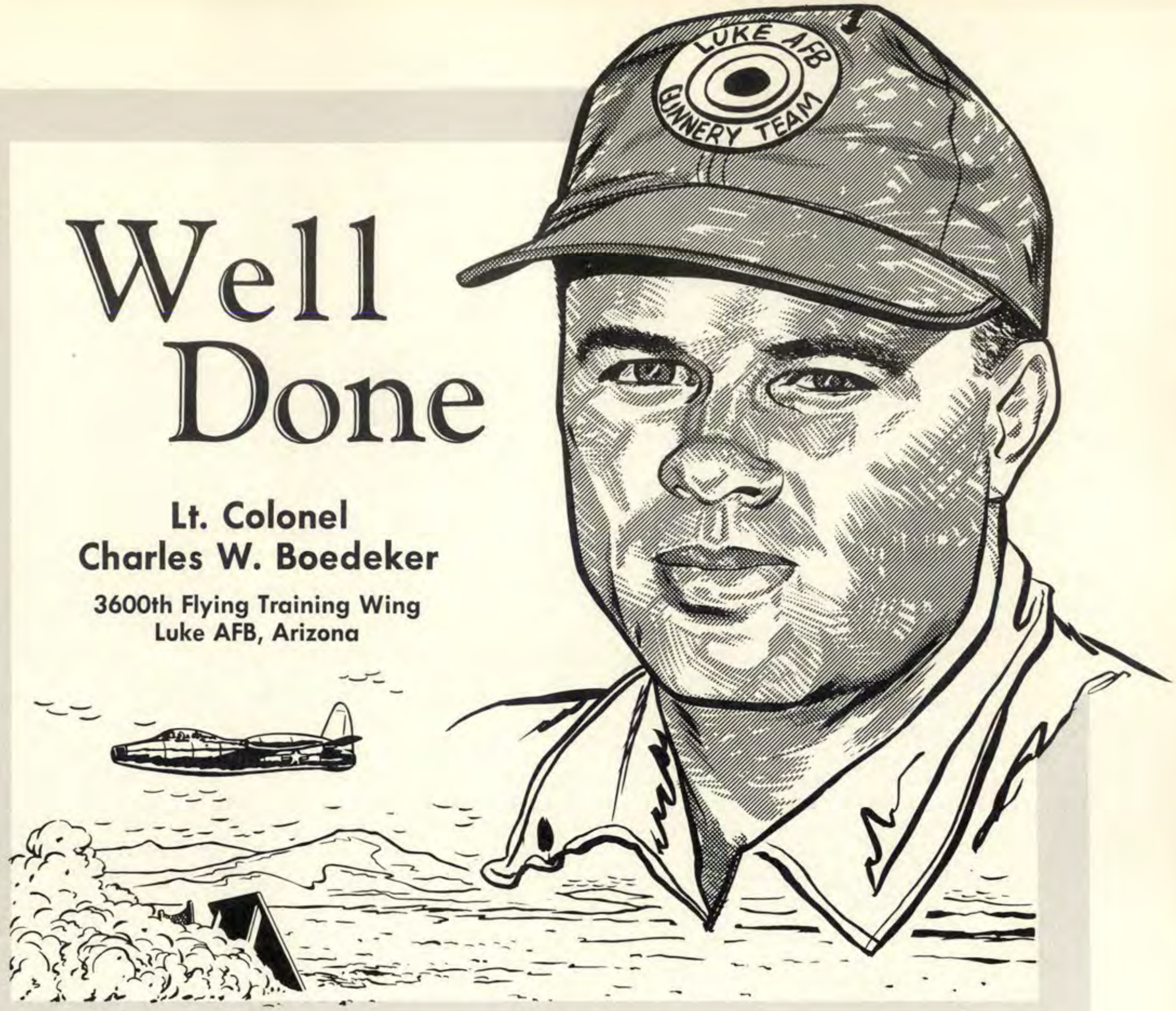
During a two-engine landing with two engines on the same side inoperative, before using reverse thrust, first obtain positive directional and lateral control of the airplane. Next, below normal landing speed, reverse the inboard engine, then after corrective control action has been taken, reverse the remaining engine. Increase power in reverse thrust slowly to prevent exceeding the limits of directional control.

A cross-wind will materially affect the amount of corrective control action required to compensate for bank and yaw tendencies during either symmetrical or asymmetrical reversing. In a cross-wind, apply symmetrical reverse thrust; as experience indicates that the pilot can maintain directional control by use of the nose wheel steering and by the amount of reverse power applied.

To obtain maximum braking, first apply reverse thrust (this increases weight on the wheels), then apply brakes by first partly depressing the brake pedals, then gradually increasing braking pressures up to the maximum possible without sliding tires.

In summary, it can be said that the Globemaster is a lot of airplane and should command your respect. But, it has good, dependable flying characteristics and the requirements for keeping out of trouble here are the same as when flying any other good airplane. . . . *Follow the Approved Procedures!* ●

Well Done



Lt. Colonel Charles W. Boedeker

3600th Flying Training Wing
Luke AFB, Arizona

LT. COL. Charles W. Boedeker was participating in a practice air to ground gunnery mission in an F-84G aircraft. He had started his turn and dive toward the target from an altitude of 7500 feet when he became aware of complete loss of elevator control.

Colonel Boedeker immediately applied full rudder and throttle and was able to bring the aircraft back to a straight and level flight attitude. Further testing revealed that forward and aft movement of the control stick had no effect on the attitude of the aircraft, however, by using the throttle and elevator trim tab control he was able to maintain a fairly constant altitude.

Keeping in mind that excessive use of the trim tab could result in burning out the electrical motor, Colonel Boedeker made the decision to attempt a landing using the throttle as an elevator substitute and the gunsight pipper as reference on the horizon.

With the instantaneous reaction of the pipper in regards to the aircraft's attitude he was able to note any deviation from level flight and counter with throttle.

Upon sighting the field, Colonel Boedeker lowered the landing gear and flaps. After the preflight check was accomplished, he lowered the nose of the aircraft until the gunsight pipper was superimposed over the end of the runway. By maintaining a constant airspeed and keeping the pipper on the end of the runway, he was able to effect an even rate of descent.

Over the runway, he cut the power, allowed the aircraft to settle to the ground and completed the landing.

Investigation revealed that a bolt had slipped out of the proper position and allowed the elevator control rod assembly to become disengaged from the elevator control bob weight.

The forethought, planning and superior skill displayed by Colonel Boedeker averted an almost inevitable major aircraft accident. Well Done!

Smoking FACTS

In order to select capable pilots, the Air Force performs one of the most careful and exhaustive physical examinations which can be given. As a result, the men who are chosen to fly are not only among the most healthy, but also among the most physically perfect human beings.

There is a great deal of importance in such careful selection. Today's pilots travel faster, travel farther and travel higher than any other living men, and for that matter, any men who have ever lived. And the accomplishments of tomorrow's pilots will be even greater.

In these remarkable conquests of time and space, man is pitting his physique and his senses against conditions that are new and demanding, and under circumstances where there is no tolerance for the unfit.

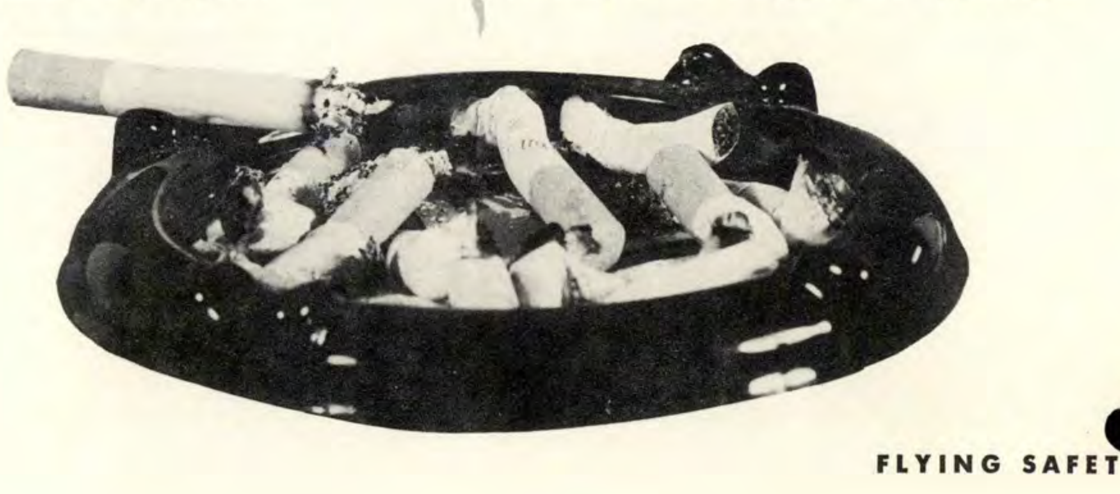
Consider the role of vision. A pilot who is traveling at 550 knots covers a mile in a little more than six seconds. Anything before him must be clearly and exactly detected while it is far away. A mile or more of vital space could be lost in the time it takes to give a second look.

And the need for clear vision is not confined to jet aircraft alone. At any speed in any aircraft a pilot must clearly see all adjuncts to flying, including cockpit instruments. He must readily perceive all objects of warning, such as navigation lights. And he must immediately recognize all threats to landing, whether it is a short runway or another aircraft in the traffic pattern. The clarity of thought which man uses in the guidance of his aircraft is based upon the clarity of his perception.

Not only vision, but all of man's senses, his hearing, his balance and even his sense of touch, must function with a high degree of perfection in aerial flight. And there must be a high degree of perfection in his physique. Consider the need for oxygen. From time immemorial man has been bathed in the heavy, dense air of the earth's surface where the oxygen he required was readily available. However, in the high, thin air, this vital element is so scarce that life can not be sustained. And even when oxygen is carried aloft and breathed 100 per cent pure, it loses its effectiveness when the atmospheric pressure drops low because it can not be pushed into the blood in the quantities to which man is accustomed. Under such circumstances, a pilot's stamina and his ability to react suffer from undernourishment. No substandard physique can meet these challenges.

Most pilots recognize the things which interfere with their health and avoid them. However, there are some things which a pilot may do inadvertently or through ignorance that seriously interfere with the proper functioning of his senses, his body, or his mind. Among these are attempting to fly when ill, when taking drugs or when slowed down by the aftermath of alcoholic indiscretion.

Also in the category of factors which may compromise the pilot's ability, are the effects of smoking. These effects are probably more deleterious than is commonly realized. The article by Dr. McFarland on this subject is something to which every pilot should give thought.



This article, written by Dr. Ross A. McFarland, is reprinted from Aviation Week Magazine.

SCARCELY anyone has missed the recent publicity given to the possible connection between heavy smoking and cancer of the lungs. Most of us have also been exposed to statistics which say that non-smokers tend to live longer than heavy smokers, or that heavy smokers more often develop heart disease.

Whether smoking is the culprit or not, the problems involved are long range ones, important for the longevity of all people in all walks of life. It is less well known that the immediate effects of smoking can be problems to those who fly in aircraft, immediate problems in terms of efficiency and safety.

Tobacco Smoke—Nicotine and carbon monoxide are the substances of chief concern in the smoke which enters the mouth and respiratory passages. Various irritants are also present which are responsible for the local effects of smoke on the eyes and mucous membranes. Tobacco tars may possibly influence the formation of cancer, but the evidence for this is not clear. The presence of lead and arsenic resulting from insecticides used on the tobacco plant is of unproved importance.

Nicotine—The tobacco in the average American cigarette is about two per cent nicotine. So-called "dinicotinized" brands containing about one per cent have thus eliminated only one-half of that originally present. When tobacco is burned, only a part of the nicotine is destroyed.

Much of it is volatilized into the smoke. If the smoke is inhaled, almost all of its nicotine is absorbed; if the smoke is not inhaled, about two-thirds of the nicotine present is absorbed through the mucous membrane lining the mouth.

The amounts of nicotine that are taken up by the body from smoking are comparable to the amounts known to have an effect when used in the drug form. The general net effect is to increase the load on the heart.

Carbon Monoxide—About one to two and one-half per cent of the total volume of cigarette smoke is carbon monoxide, while cigar smoke may contain five to eight per cent. The carbon monoxide content increases with the thickness of the cigar or cigarette, with the moisture and tightness of packing and with rapid smoking. Carbon monoxide is absorbed only if the smoke is drawn into the lungs, and inhaling one cigarette results in the saturation of one to one and one-half per cent of the blood.

If a person smokes 20 to 30 cigarettes per day, he may have on the average of four to eight per cent of his hemoglobin so saturated. This amount of smoking results in a 10 per cent saturation in some people. Some delicate functions, such as night vision, are affected at these levels even though headaches and other symptoms of carbon monoxide poisoning do not appear until higher concentrations are reached.

The Physiological Ceiling—Hemoglobin, the pigment in the red blood cells, normally combines with the oxygen in the lungs and transports it to the tissues. Unfortunately, hemoglobin also takes up carbon monoxide in the same way. In fact, when carbon monoxide and oxygen compete for space in the hemoglobin molecule, carbon monoxide is favored by odds of about 210 to one.

Very small concentrations of carbon monoxide can therefore inactivate a large amount of hemoglobin as an oxygen carrier. As a result, a state of oxygen deficiency is produced in the body, which has effects like those of high altitude.

Furthermore, the effects of carbon monoxide and altitude are additive. As a result, a pilot at sea level with a 10 per cent saturation of the blood by carbon monoxide shows the same effects on a sensitive functional test of oxygen deficiency as if he were at an altitude of about 12,000 feet. If he were at 10,000 feet, the combined effect would be equivalent to that of an altitude of 15,000 feet. His ceiling is thus lowered by about 5000 feet.

Furthermore, once carbon monoxide enters the blood, it leaves very slowly. Some 24 hours after heavy smoking, appreciable amounts are still present in the blood. This may partially account for some of the hangover effects of heavy smoking.

Smoking and Altitude Tolerance

Studies carried out in low pressure chambers show that subjects who could tolerate altitudes of 20,000 to 21,000 feet on days they refrained from smoking were able to reach only 16,000 feet when they smoked heavily before the test.

During 1943 the effects of smoking were observed on flight crews engaged in long range operations between Miami and the Far East. Having experienced much fatigue in these flights, air crews agreed to refrain from smoking on the ground and in the air on several trips. Most of the pilots were convinced that they felt less exhausted and more efficient in performing their duties at the cruising altitudes of 8000 to 12,000 feet when they didn't smoke.

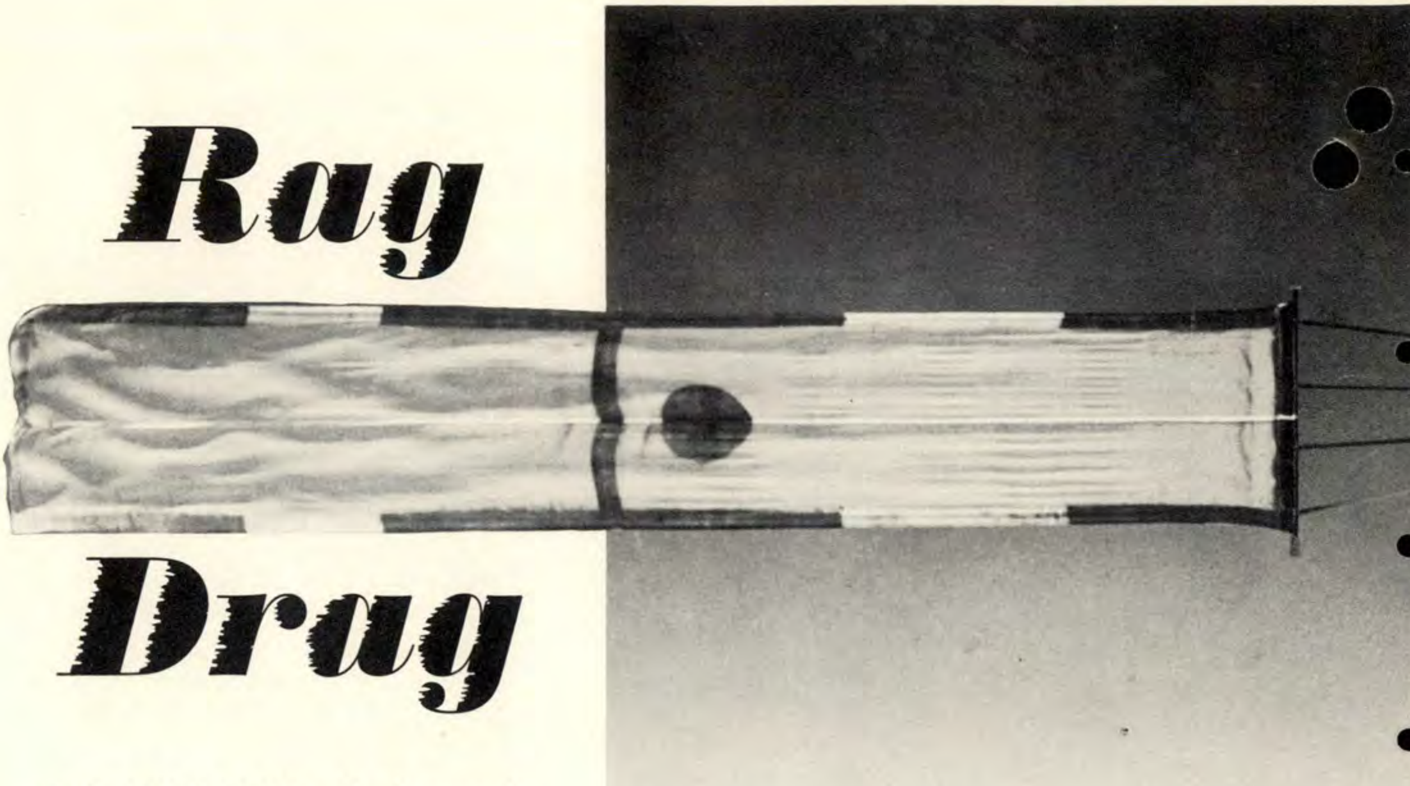
Another factor involved in smoking may also impair altitude tolerance. Nicotine increases the metabolic rate, or the requirement for oxygen, by about 10 to 15 per cent. It has been shown that greater tolerance for altitude accompanies slower metabolic rate. Nicotine also interferes with the action of the autonomic nervous system, the integrity of which is so essential for optimal adaptation to stress.

Smoking and Night Vision—Smoking has an appreciable influence on the ability to see at low levels of illumination; these effects would be of importance particularly on night flights. In my laboratory the sensitivity to changes in the brightness of dim lights was measured before and after three cigarettes were smoked in succession. Blood carbon monoxide increased about one and one-half per cent, the total uptake being about four and one-half per cent. Sensitivity decreased distinctly after each cigarette; That is, lights had to be brighter to be seen. The total effect on vision from only three cigarettes corresponds to that of an altitude of about 8000 feet.

The Airman and Smoking—Not even the tobacco manufacturer claims that the effects of tobacco on the body are beneficial. The question is whether the harmful effects are really serious and great enough to offset the pleasure of smoking. Available evidence indicates that the immediate effects of moderate smoking are probably not harmful to normal adults. Among airmen, however, the impairment of vision and lowered tolerance to altitude present an occupational hazard.

Thus, it would seem wise for pilots to avoid the excessive use of tobacco not only to prolong their useful flying careers, but also to maintain a high degree of fitness in flight. ●

Rag Drag



By Lt. Col. J. C. Giraudo, Commander
USAF Fighter-Weapons School, and
Major E. P. McNeff, Fighter Branch
Directorate, Flight Safety Research.

SINCE the inception of aerial gunnery the launching of a suitable target for gunnery practice has continued to harass fighter operations. The particular problem we are concerned with here is that of towing a target with an F-86F aircraft equipped with the extended (6-3) leading edge wing. The F-86F was equipped with the extended leading edge (hard wing) to improve the high altitude flight characteristics. This gave the Sabre more advantage over the MIG, which was evidenced by the excellent record established by the pilots flying it in Korea.

While the installation of the "hard wing" improved the airplane's maneuverability, it also added a few undesirable characteristics. These are increased takeoff distance, increased stalling speeds and decreased warning before a stall occurs. All of these characteristics increase the difficulties of taking off with a tow target attached. To date six "hard wing" F-86F aircraft have been involved in accidents while taking off with a target attached. In all cases the accidents have been attributed to a stall caused by an excessively nose high attitude immediately after takeoff.

As usual when we are confronted by a problem concerning a phase of aerial gunnery, we checked with the people who know; the USAF Fighter Weapons School at Nellis AFB, Nevada. The personnel at Nellis have been towing targets with the "hard wing" 86 for quite some time and have been very successful.

At Nellis they will tell you that air-to-air gunnery training above 25,000 feet is a definite requirement with today's high altitude interceptors. Not even considering the F-100 and other advanced types, the F-86F was produced to fly at high altitudes, and pilots must be trained in the flying and firing techniques required at those altitudes. The T-33 isn't satisfactory towing a target at 30,000 feet. When any particular T-Bird eventually reaches that altitude, the time required is not compatible with a heavy gunnery program.

The Fighter Weapons School people furnished FLYING SAFETY with the following procedures which they believe to be correct for setting up tow missions using the F-86F.

Pre-takeoff Procedures

• If takeoff is other than in the center of the runway, place the weighted end of the target bar toward the center of the runway. The weighted end

The target should be laid out straight behind the tow ship on recommended "snake-off" method.

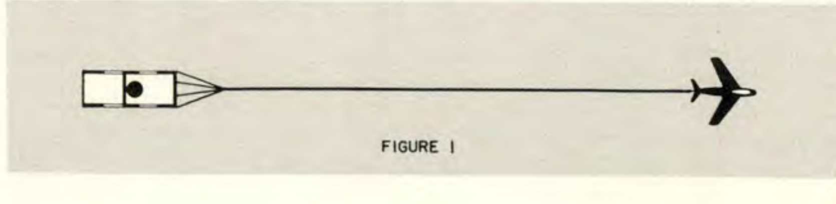
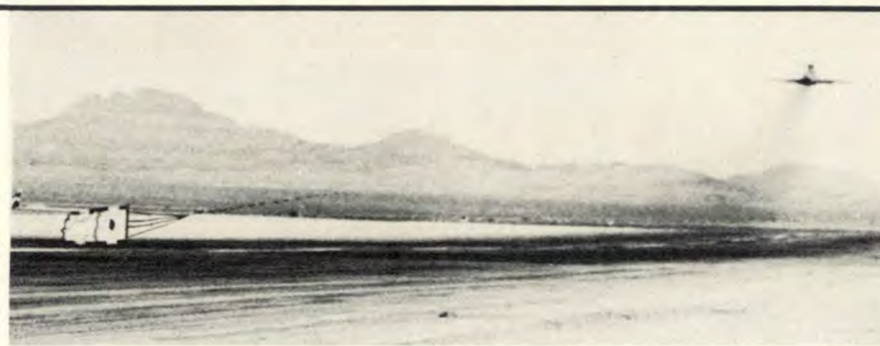


FIGURE 1

At Nellis, F-86F tow missions are flown with a standard 6 x 30-foot polyethelene target.

On any tow other than a centerline attachment, a pilot must anticipate a yaw toward the side to which the cable is attached. Before takeoff compensate for yaw by applying some rudder trim.

Ground crewman fastens the 750-foot single, one-eighth inch cable to the tow aircraft.



Establish a normal takeoff attitude. A clean aircraft will break ground at about 130 knots. "A pilot gets into trouble by trying to make his aircraft fly when it is not ready to do so."

of the bar will cause the target to drift in that direction during takeoff, and if improperly laid out, it can cause the target to drift off the near side of the runway, damaging runway lights, snagging or damaging the target, or causing a cable to break. Also, a target dragging through the dirt will impose additional drag on the aircraft, lengthening the takeoff roll and impeding the initial climbout.

• If the tow cable hook-up is any other than a centerline attachment, for example, a wing tow, a pilot must anticipate a yaw toward the side on which the target is attached. Before takeoff a pilot can compensate for this condition by applying rudder trim for two to three seconds in the opposite direction from the side of the tow rig.

• Lay out the target and tow cable in a straight line behind the aircraft for "snake-off" rather than using the 180-degree "snatch-off" method. There is less damage to the cable, harness and target with the "snake-off" method, it eliminates whipping the target experienced with the "snatch-off" method. (See Figure 1)

After a study of tow techniques in F-86F aircraft it was decided at Nellis that there was one main reason for accidents involving this aircraft on tow missions. *A pilot gets into trouble by trying to make his aircraft fly when it is not yet ready to do so.*

The following information on takeoff and climb procedures is based on using the standard 6 x 30 foot A6B polyethelene target with 100 feet of safety webbing and 750 feet of single, 1/8 inch armored cable. (At Nellis, use of 100 feet of webbing has reduced the number of targets lost because of shooting through the cable.)

These procedures, especially airspeeds, are used with average ambient temperatures and a clean aircraft (no external tanks). As temperatures increase, when external tanks are carried or when high altitude runways are used, the pilot must carefully cross-reference the takeoff tables in the Dash One prior to the tow mission.

• Apply 100 per cent power. During the takeoff roll angle gradually toward the center (or upwind) side of the runway.

• At 100 knots IAS, apply back pressure to begin establishing a *normal* takeoff attitude; at 120 knots IAS takeoff attitude is established. A clean aircraft will break ground normally at 130 knots; when wing tanks are installed, it will leave the ground at about 140 knots.

In all cases, allow the aircraft to fly off the ground in a normal takeoff

"Snatch-off" technique results in a whip which causes more damage to cable, harness and target.

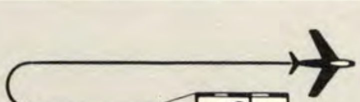


FIGURE I A

attitude. Do not pull the aircraft off the runway.

If an emergency occurs during takeoff, get rid of that target! With the F-86 tow rig as illustrated on page 23, have the bomb switches set up so that you can punch off that target right now, if necessary.

When definitely airborne, retract the gear and smoothly attain a 160-knot climb. Use rudder control to eliminate any yaw caused by the target. When 500 feet above the ground, milk up the flaps, anticipating the nose-up pitch change which will occur at this point. Trim the aircraft for the climb out.

For the climb to the target area allow the airspeed to build up to between 170-180 knots and maintain this speed to 15,000 feet. Above 15,000 feet the airspeed must be decreased to between 160-170 knots to maintain the rate of climb. When climbing to above 25,000 feet the airspeed must be further decreased to 155 knots to maintain the proper rate of climb, with 100 per cent power used throughout the climb to altitude.

It is important when climbing to altitude and the firing area to use a minimum number of turns, because the aircraft will not climb well during turns above 15,000 feet.

Tow and Descent

During firing at 30,000 feet the tow speed is 165 knots IAS. Remember, the aircraft flies quite nose high and must be handled gently. Any turns required should be smooth and power must be added to prevent excessive loss of airspeed or burbling.

During the descent do not exceed 180 knots IAS. Release the cable and target, when the tow rig illustrated on page 23, is used. Drop is accomplished over the DZ at 165 IAS. The demo bomb switches are set at MANUAL and ALL and the bomb button on the stick should be depressed when desired. If necessary, upon failure of the bomb circuit to release the cable, a pilot can use his panic button or the manual external stores release handle, or both.

An extensive F-86F towing project was conducted by the Nellis AFB Training Research and Development Section, and the following recommendations were made:

• The F-86F without external tanks installed is a satisfactory tow aircraft up to 30,000 feet. Its use in this configuration will be governed by each unit's distance to the aerial ranges. The closest coordination possible is required between towship and fighters to achieve maximum effectiveness during the towship's fuel-limited time on the range. This is the system used by the USAF Fighter Weapons School, with much success.

• The F-86F with one 120-gallon drop tank installed offers no advantage over a clean aircraft because of the additional weight during climb and additional drag during towing and letdown.

• The F-86F with two 200-gallon drop tanks is a satisfactory tow aircraft up to 20,000 feet maximum. The additional fuel allows double tows at low and medium altitudes. Full flaps *must* be used for takeoff in this configuration and lift-off speed increased to 140 knots IAS.

Experiments at Nellis resulted in adoption of napalm tank displacing strut tow assembly.

Standard bomb rack brace, a strut and locally made attaching leader comprise entire tow rig.

• Project tow flights varied in towing speeds from 160 knots IAS to 210 knots IAS using a single tow cable. Two hundred ten knots IAS is a maximum tow airspeed with a single cable, at and above which you can be assured that you will lose the target or cable. Experience here has established that 180 knots IAS is maximum while towing if you desire a satisfactory target return percentage. If you hold your airspeed down to 170 knots IAS for the entire flight, your return percentage increases further, especially during the letdown when the target, webbing and cable have been weakened by bullet impacts.

• A phase of the project incorporated the use of a double tow cable to determine how fast the target could be whipped through the air before it failed. The maximum speeds attained were 260 knots IAS. From 230-260 knots IAS, the target porpoised and leaned, tearing off at the bar near 260 knots IAS. You should not exceed 230 knots IAS, or the target will not remain steady and upright.

• A locally fabricated 9 x 45-foot target was also used during the project. At 20,000 feet, with a clean aircraft and this target, the primary disadvantage was an increase in fuel consumption. Above 20,000 feet, the tow aircraft became unacceptably unstable. Above 230 knots IAS with a double cable, the 9 x 45-foot target tended to fold in the rear one-third. Takeoff with this target and two 200-gallon drop tanks was critical because of the runway length (6500 feet), and the target tore off while dragging through the overrun. The use of the 9 x 45-foot target with the F-86F carrying 200-gallon drop tanks is not recommended.

• Nellis is approximately 27 nautical miles from the aerial ranges. The ranges are 30 nautical miles long and seven nautical miles wide. The approximate total distance covered during a tow mission is 140 nautical miles. To maintain a fuel margin for landing, under specific conditions, Nellis established that for clean aircraft the set-course fuel minimum on the range is 1500 pounds, and for aircraft carrying drop tanks the minimum is 1750 pounds. No jeopardy of the landing fuel minimum is per mitted, and pilots jettison targets if necessary to insure returning with sufficient fuel.

• Although not desired as a regular procedure, on occasion it has been necessary to land with the cable or target due to release malfunctions. If the approach areas to the runways are unobstructed, this poses no particular problem. A slightly steeper final approach, with 10 knots additional final approach speed, if the target is still along, will handle this situation nicely. However, the fact that targets can hang up re-emphasizes the need for good fuel planning to insure a successful mission.

If this procedure is followed, pilots should have no difficulty launching aerial targets with the F-86F. Towing targets in tactical units is considered a normal operation, and at times the tow pilot does not have sufficient information or experience to prepare him for his first tow missions. Squadron supervisory personnel can assist the gunnery program by carefully selecting tow pilots and insuring that they are adequately briefed.

FLYING SAFETY believes that a brief review of the T-33 towing procedures, as flown at Nellis, also may be of value to units engaged in gunnery practice. Towing with the T-33 is certainly not new, but a refresher on salient procedures may increase the success percentage of your present tow missions, as well as possibly precluding undesirable incidents occurring in new units just beginning to tow with the T-33.

The T-33 is an exceptionally satisfactory tow aircraft up to 20,000 feet. Above this altitude the rate of climb deteriorates to such an extent that the time-fuel factor becomes significant.

At Nellis, we use 175 gallons in each tiptank of the T-33 to allow for double-tow missions. With this load two fighter flights can complete their gunnery, and the T-33 still has plenty of fuel for return, drop and landing. The double-tow procedure is primarily one of maximum utilization of a limited number of T-33s. If your unit is not pressed by a shortage of T-33s, we strongly recommend single-tows for two reasons: First, you always stand the chance of the second flight on the target shooting it off. This loses the unit two flight gunnery missions, whereas on single-tows the first flight normally would have recovered its target. The second reason is the never-ending fighter pilot hassle that you get into from scoring a target loaded with eight-colored holes. Today's ammo paint is far from infallible; red can look like orange, brown can look like purple, and so on. Single-tows using your best painting colors virtually eliminate this confusion.

The attaching leader is passed through the guide and the release ring is hooked into the shackle. The aft end of the leader is temporarily wired around the guide, until tow cable hookup is made.

Takeoff, as with the F-86F, is with 100 per cent power and 30 degrees flaps. During the takeoff roll, angle toward the upwind side of the runway to save the runway lights, target and so on.

At 100-110 mph (87-96 knots), apply back pressure to ease the nose up, relieving the weight from the nose gear. At 130 mph (113 knots), consistent with runway temperatures, altitude and aircraft feel, fly the aircraft off. When 40-50 feet above the ground, retract the gear.

Smoothly establish a 150 mph (130 knots) initial climb, holding this until approximately 1000 feet above ground or when notified that the target is well clear of the runway.

At this time, milk up the wing flaps, anticipating the pitch change, and allow the airspeed to smoothly build up to 190 mph (165 knots) for the climb. Do not exceed 190 mph (165 knots) during the entire towing mission.

As with the F-86F, climbing airspeed must be decreased gradually with altitude in order to maintain a climb. At 15,000 feet you will be climbing at 170-180 mph (148-156 knots); at 20,000 feet the airspeed will be down to 165-170 mph (143-148 knots). Each pilot will recognize his best climb airspeed for his particular T-Bird at the increasing altitudes.

Again, hold the climbing turns to a minimum and make all turns gradual and smooth.

After level-off, allow the airspeed to increase to 190 mph (165 knots), and hold this for the entire firing period. In event that the fighters report a leaning target, a slight decrease or increase in airspeed usually rights the target. A decrease in airspeed will usually right a target which has lost its weight and is leaning. Notify the fighters of all significant changes in towing airspeed.

Upon completion of firing, a normal letdown is made, again not exceeding 190 mph (165 knots). The drop is made at 180-190 mph (156-165 knots), as it has been found that more successful releases are made at the higher airspeeds.

With the tow rig used at Nellis, target release is made by pulling the Jato Jettison Handle. When ready to drop, pull the handle and cable full out, giving a sharp pull during the last part of the cable travel. We have had much success releasing targets with our present procedures and rig.

In the event that a landing with the target is necessary, use a slightly steeper final approach, carrying 150 mph (130 knots) throughout the final. Aim for a spot about one-third down the runway and your landing should be uneventful. Don't hold the aircraft off until its dying breath, because as soon as the target hits, you decelerate in a hurry. ●

Keep Current

NEWS AND VIEWS

Another Foamite Save — Thirty-five hundred feet of foam, spread on a runway, saved over one-half million tax dollars, plus the possible loss of an F-94C combat crew, at Hamilton AFB recently.

The F-94C, piloted by 1st Lt. Ward G. Tuttle, 84th Fighter-Interceptor Squadron, was on alert, and was deployed to McClellan AFB. The landing at McClellan was completed without incident.

After being released to his home station (Hamilton), Lt. Tuttle noticed terrific vibration and experienced extreme difficulty in maintaining directional control of the aircraft during takeoff from McClellan. When airborne, Lt. Tuttle retracted the landing gear and the warning light on the panel gave him an unsafe indication. He immediately lowered the gear and radioed to his wingman to look over the aircraft to see if it was clean.

His wingman notified the pilot that the two main landing gears were twisted to a 90-degree position. Lt. Tuttle immediately reported the condition to "home plate" at Hamilton. Major Marvin W. Miller, commander of the 84th received the call and alerted the crash crew, requesting them to spread foam on the runway.

The squadron commander then proceeded to the mobile control unit and advised Lt. Tuttle of the preparations, and to land with cocked wheels on the foamed runway.

Lt. Tuttle touched down on the foam, skimming for 2500 feet to a stop. The instant the aircraft landed, the pilot blossomed the tail chute. This, of course, aided greatly in stopping the '94.

After inspecting the damage to the aircraft, it was announced that it would take approximately three man-hours for complete repairs. The tires were blown and two inches of the wheel rims were ground away.

After sliding 2500 feet with its main gears cocked at a 90-degree angle, this F-94C came to a stop with two tires blown. Landing was possible because of 3500 feet of foamite spread on runway.

Radar Height Finder—The development and production of a new radar height finder that will help strengthen defense networks of the United States, was announced by ARDC recently.

The new set was developed by ARDC's Rome Air Development Center in conjunction with the General Electric Company of Syracuse, New York. It meets the need for greater radar range, concentrates the radar energy in a narrow beam like the rays of a searchlight and can detect planes almost three times as far away as previous units of this type. The new set is used with search radar to detect high-flying aircraft, providing information on distance, altitude and direction of flight.

Magic Numbers — There are two magic numbers in this old world of ours. Two numbers that mean hope for the lost and aid for the stricken. The first is 500. The second is 8364. Both represent the life-saving kilocycles assigned to transmit SOS signals.

Ever since Professor Marconi put the wireless business into operab

The F-86K, a cannon-firing version of the F-86D interceptor, is an all-weather fighter featuring four 20-mm cannon instead of the 24 Mighty Mouse rockets of the 'D, powered by a J-47 engine.

reality, that one distress signal has been pretty much standardized the world around. The transmission of an SOS immediately gets results. Direction finders seek bearings, aircraft leap off and ships at sea swing onto new courses. An SOS demonstrates that man still has a lot of humanity in his soul.

False distress signals are inexcusable. Seldom does anyone send a phony SOS deliberately, for punishment is swift and sure. However, there have been occasions when distress signals were sent accidentally.

Recently an aircraft ditched in the ocean near the coast. Foul weather hampered the air and sea search considerably. Would-be rescuers hoped constantly for a distress signal, anything that could be used for homing in on the downed flyers.

Now here is where we get into the accidental transmission act. Searchers did receive a signal that apparently came from the vicinity of the ditched plane. Unfortunately it was not sent by survivors. Instead, Air Force personnel testing a Gibson Girl were the guilty ones.

The Gibson Girl (Radio Set AN/CRT-3) is a hand-cranked, two watt transmitter which automatically puts out SOS signals alternately on 500 and 8364 kcs. Obviously the set should not be allowed to put out a signal of any magnitude while being tested.

When testing, never connect the antenna with the antenna lead-in to the set. Without that little hook-up, the signals that are transmitted will carry but a few feet.

If there is still an element of doubt in your mind as to the hows and whys of the Gibson Gal, see your Personal Equipment Officer.

A New Record—A new record for high altitude parachute jumps has been set by two U. S. Air Force officers who parachuted safely from a modified B-47 at 45,200 feet.

The record jumps, which were made by Capt. Edward Sperry and 1st Lt. Henry Neilsen over the Gulf of Mexico, utilized the new type downward ejection seat. The temperature at 45,200 feet at the time of bail-out was —37°C.

The old parachute record of 42,000 feet was set in August 1950 by Major Vincent Mazza of the Wright Air Development Center.

Know Your Areas—Changes in the terminology describing airspace restricted areas became effective 9 December 1954. Part 60 of the Civil Air Regulations has been amended by the Civil Aeronautics Board to eliminate the terms *danger area* and *airspace restricted area* and replace them with the terms *restricted area* and *prohibited area*, respectively.

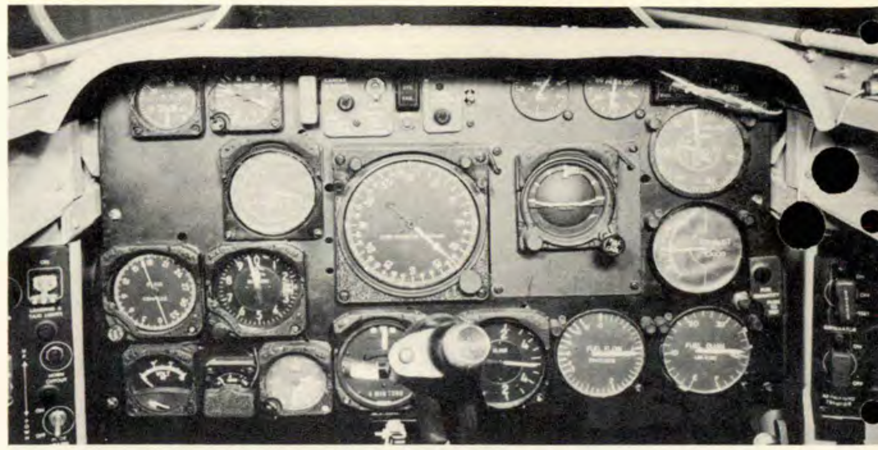
A *restricted area* is defined as: Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions.

The provisions provide that *prohibited area* be defined as: Airspace identified by an area on the surface of the earth within which flight of aircraft is prohibited.

Use of the J-44 engine may boost C-82 takeoff and load performance.

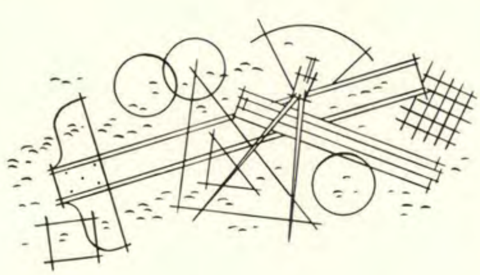
Boeing's 1000th B-47 built for the Air Force, makes initial test flight.

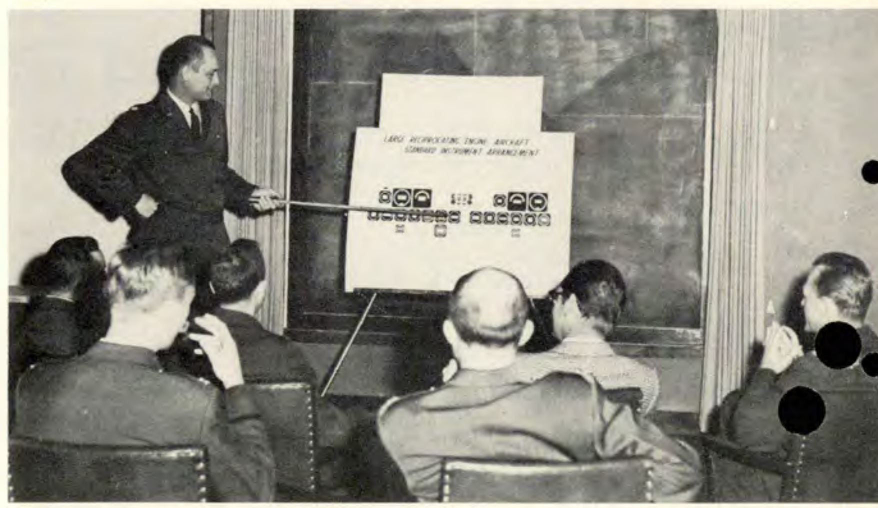
Specialists representing each of the major commands aid in . . .



Designing the Office—

Research and development are conducted to determine the criteria for aircraft crew stations with regard to the location of controls, lighting and arrangement of instruments, dimensions and vision.





BACK in July 1954 FLYING SAFETY devoted eight pages to what we thought to be a vitally important subject. Titled "Operation Standard," the article was a rather comprehensive discussion of the current efforts to standardize the cockpits of military aircraft.

Evidently this subject was of considerable interest to our readers, for we have received quite a bit of correspondence from the field requesting further information. Consequently, we're running this article about the people and organizations behind the standardization program.

Basically, the plan is to design our cockpits in such a manner that a pilot may switch from one type aircraft to another with a minimum of effort. Flight instruments should be the same in the B-47 as in the B-947 (whenever it arrives on the scene). Control knobs are being designed that simulate their functions. A wheel-shaped knob for the landing gear, an airfoil-shaped handle for the wing flaps, and so on.

This is a serious subject these days, particularly in view of our complicated cockpits in high-speed aircraft, and everyone who participates in the design or acceptance of a new airplane must take standardization factors into consideration.

Before fabrication of an aircraft begins, the cockpit, crew stations and many times the entire airplane are completely mocked-up in full scale to ascertain that everything will fit together as planned.

A formal inspection of the mock-up is made by representatives of the commands that will use the aircraft. Comments and requests for changes are submitted to the Mock-Up Board, which is composed of a member from each organization concerned.

At times the controversy wages hot and heavy, for the first airplane will be built in the configuration approved by the Board. The discussion usually gets the warmest when it concerns the arrangement and actuation of controls and instruments in the cockpit.

This controversy continues to a milder degree throughout the life of the aircraft, sometimes producing retrofit programs which might have been unnecessary if universal agreement had been reached in the original design.

In order for the functioning of the Major Commands Crew Station Advisory Group to be properly understood, it is necessary first to explain the procedure used in determining criteria to be followed in the design of aircraft crew stations.

It is the responsibility of the Aircraft Laboratory of Wright Air Development Center to conduct research and development to determine the optimum design criteria for aircraft crew stations with regard to the location and actuation of controls, instrument arrangement, instrument lighting, crew station dimensions and vision. These criteria are placed before a WADC steering committee in the form of recommendations. Items approved by the committee are published in ARDC Manual 80-1, The Handbook of Instructions for Aircraft Designers, commonly referred to as the HIAD.

The HIAD is the basis of design to which all USAF aircraft must be built and includes a multitude of details. It covers such subjects as desired aerodynamic characteristics, control systems, instruments and color of aircraft interiors — in brief, the entire plane.

The HIAD is sectionalized and contains referenced drawings which specify such criteria as:

- The distance of the control column or stick from the seat.
- The maximum amount of control throw allowed.
- The distance from seat to the rudder pedals.
- The amount of rudder pedal travel and adjustment.
- The arrangement of instruments.
- The location and actuation of engine controls.
- The location and configuration of the fuel controls.
- The location and type of the armament controls.

When the criteria for a control or an instrument are being set up, the following process usually is observed: The problem, with or without a proposed solution, is presented to a subcommittee composed of representatives of the pertinent laboratories and of Flight Test. If necessary, a research or development and flight test program is conducted. After a sound solution has been reached, appropriate recommendations are made to the WADC steering committee. The design criteria, as approved by the steering committee are incorporated in the HIAD.

To assist in discharging the responsibilities of WADC with regard to crew station design criteria, authority to establish the Major Commands Crew Station Advisory Group (MCCSAG) was given to WADC in April 1954. This group, which had its initial meeting in August 1954, advises WADC of requirements, preferences and opinions with regard to crew station design.

This group is composed of one member from each major command and has two WADC chairmen; the Chief of the Aircraft Lab and the Director of Flight and All Weather Testing. The group meets once every six months, and each member is requested to commit his command to agreements regarding criteria to be included in the HIAD.

Under the MCCSAG, three sub-groups operate; one each for fighter, bomber and cargo type aircraft. The sub-groups meet as required, at least once between each meeting of the MCCSAG, to discuss requirements and standardization in detail. Each sub-group is composed of members of commands that have special interest in that particular type aircraft.

The sub-group member is responsible for setting up within his command a program by which he can obtain pilot opinions, results of flight tests, field operational practices and recommendations. He prepares questionnaires and other aids which help him to reach a conclusion. His objective is to arrive at a command stand on any particular problem. Pertinent recommendations are then submitted by MCCSAG to the WADC Aircraft Crew Station Steering Committee for incorporation in the HIAD. Coordination between the steering committee and advisory group offers no problem, since the chairman of the two groups is the same individual.

It is evident that the requirements for crew station arrangement that are in the HIAD are not the result of snap decisions, but are the outgrowth of study, experience and many conferences. The project to standardize cockpits was authorized by Headquarters USAF in 1946 and has been continuous ever since.

Pilot opinions, UR recommendations, new concepts, new flying techniques and new requirements must all be tempered by a sound engineering approach applicable to all airplanes, with a view toward standardization. It is obvious that standardization between types of airplanes can only be carried to a certain degree. The inherent differences between fighter, bomber and cargo types, coupled with their different mission requirements, greatly influence all considerations of universal standardization. The similar controls, instruments, dimensional requirements and related functions for all types must be welded to the dissimilar configuration of each type. This must result in the best possible installation for each type, while retaining the basic ideas of location and actuation necessary to preserve standardization.

Before any item is added to the HIAD, it is approved by a committee composed of a representative from each Laboratory, and from Flight Test at the WADC. Since March 1954 the committee which approves standardization criteria to go in the HIAD has been known as the Aircraft Crew Station Steering Committee.

This steering committee inspects mock-ups to suggest necessary changes or to give its stamp of approval, as applicable. Another very important function of this committee is to make recommendations regarding the display or presentation of all instruments that go into the cockpit of an aircraft.

In addition to this committee, various standardization committees have operated for some years on an interservice and international level.

The Cockpit Layout Panel, formerly operating as a panel under the Munitions Board and presently operating under the auspices of the Aeronautical Standards Group, is composed of members from the Air Force, Navy, Army, Civil Aeronautics Administration and the Civil Aeronautics Board. Through the operation of this panel, interservice agreements regarding cockpit standardization are made.

International standardization agreements are achieved through Working Party 16 of the Air Standardization Coordinating Committee. This group is composed of members from the military services of the United States, Great Britain and Canada. Agreements reached in this group are published as ABC standards.

Continuity of action and agreement among these various committees is maintained by having the same personnel of the USAF serve on all committees, either as members or technical advisors.

Through the medium of the Major Commands Crew Station Advisory Group, the using commands can exert more influence in the establishment of design criteria to be published in the HIAD. It is hoped that this will eliminate much of the disagreement experienced in the past at mock-ups by providing criteria that will represent a satisfactory compromise to all interested agencies. ●

Concrete Ski Trails

Capt. Alvan Bruch, AWS

WELL, here we are with winter at least half gone and even the snow-bound are dreaming of spring flowers and green grass. The white stuff on the runways is a menace that we must continue to fight with all available equipment.

By now the story of snow removal is familiar to all of those who have to live and work in the northern areas of our country. The story will continue for the rest of the winter with the receipt of each advance warning from the weather forecaster.

Twelve hours notice guarantees that the equipment will be ready to roll before two inches have accumulated. Priorities are assigned so that the prevailing-wind runway is cleared first.

If the airport is a secondary field with little traffic and accustomed to quite a bit of snow, the snow may be compacted by rollers. If the precipitation has been sleet or freezing rain instead of snow, the sanders do the job instead of the snowplow. With proper alert and a good plan, the job is quickly and effectively done, and so ends the story.

It's a beautiful story, but it doesn't always work that way. The alert system might fail. The first sign of a developing storm is often the spreading out of a precipitation area. A well-developed storm may veer suddenly off its established track. A very slight difference in temperature above the station may mean the difference between a cold rain and snow.

There are other reasons why the story might not have a happy ending. Snow falling with temperatures well below freezing is usually dry and doesn't stick to runway surfaces or removal equipment. If it doesn't fall at too fast a rate, it can be removed easily. If it falls too fast or if it is accompanied by high wind, the removal operation is apt to run several hours beyond the end of the storm.

Snow falling with temperatures right around freezing is usually wet. Wet snow is heavy and sticks to runway surfaces. Equipment is slowed down by the sheer weight of the snow and breakdowns are frequent. If the temperature drops while the wet snow is still on the runways, an almost impossible situation results. The use of sand or chemicals is restricted to emergency conditions. Jets with low scoops will pick up the sand, and the particles will clog the runway drainage system. Chemicals will corrode the fuselage and damage the runway.

It seems realistic to assume that every pilot will at some time be faced with the problem of handling a plane on a runway loaded down with snow or ice. The problem has no exact solution, but a study of the effect of the variables and thoughtful flight planning minimizes the difficulties.

Most of us have seen a dog chasing a stick across a frozen pond. He flails madly at the icy surface trying to get going, then he usually slides right past the stick on his *derriere*. The point is, traction is not required for aircraft acceleration because the thrust is derived from the air and not the ground, but traction is required for bringing the plane to a halt before you run out of runway.

Traction, or wheel friction, does play some part in the takeoff. Deep, loosely packed snow gives increased drag—maybe so much drag that you reach the end of the runway before you reach flying speed. Hard, compacted snow or ice gives practically no drag but some wheel friction is required to help fight cross-wind. Usually the control surfaces will do the job and if you have more than one engine, power adjustments will see you through, but a little friction at the wheels is a lot of help.

The problems in landing are more varied. The glare of clean snow may reduce a pilot's ability to maintain the heading or bearing of the runway. Marker dye helps out here, but depth perception may also be affected. Initial contact in deep, loosely packed snow is far from desirable. The pitching moment may be increased to the point where it exceeds the moment of stability of your plane. When this happens, you nose over; or in an aircraft equipped with a tricycle gear you risk snapping the nosewheel strut.

Once on the ground you have the cross-wind problem again, and banks of snow cut down the allowable drift. Finally, you have to stop. When the friction at the brake drum exceeds the friction at the ground, you skid. Sounds a bit hairy, doesn't it? Well, it can be if you fail to plan ahead. A pilot who goes blundering into a field where landing conditions are unknown is really asking for it. It would appear that a few drivers were never exposed to the NOTAM system.

There are a few more things to consider also. You should make sure that you have braking action before you try to taxi. And watch those snow banks. Warm-up areas are usually sanded, but, if a jet preceded you, you may find that it melted the snow a little and that it's frozen again by the time you get there. Wet snow or slush is especially hazardous when it clings to your gear and freezes when you carry it aloft.

The operations officer at every base knows the condition of his runways. He isn't quiet about it, either. A check of the NOTAMS will tell you whether or not they are usable. He also estimates the amount of braking action you can expect. The weather forecaster will alert you to the possibility of fresh snow or other precipitation at your destination. Your last chance to check runway condition prior to landing is by contacting the tower.

Always do that before touching down on a strange field. You'll find that quick check with the tower may really pay off. ●

the Smoking Lamp is Lit ——

If you're like most of us, you probably gulp when you look at a little doll like this. Reflexes you know. And by the same token we'll bet you gulp down your share of smoke every day, too.

No, we haven't joined the bandwagon. We're not crusading against the filthy weed. Nor do we take issue with current claims both pro and con. Editorially speaking, we're completely neutral on the subject. However, the article on page 18 of this issue may cause you to pause and think.

Of course, if one could find anything as lovely as this lovelie . . . far removed from all sky chariots, one might be forgiven for smoking just a little.

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