APRIL • 1957

FLYING SAFETY

UNITED STATES AIR FORCE

Flight Planning Today

File Thirteen

The subject for April, as depicted by our cover, is *Flight Planning*. Faulty flight planning is often the mistake that starts the chain reaction ending up with a smashed aircraft. . . . The T. O. on how to pack chaff in parachutes has been published and disseminated. (T. O. 14D1-2-81, dated 1 Nov. 56.) Packing the chaff in the chute rather than in the seat has its advantages. One is that chaff in the chute more accurately marks the location of the pilot. Another is in case you go over the side, sans seat, you still have the chaff going for you. . . . There have been a few incidents lately of the plexiglas in canopies blowing out. During the walk-around, it's a good idea to check the canopy carefully for cracks and nicks. They tend to weaken the plexiglass to the blowing point. . . . It appears that the B-25, reluctant to bow out of this modern Air Force, is trying to prove that it can do anything a jet can. At Andrews recently, one made a successful landing barrier engagement after the pilot landed long and was unable to stop via the normal method. The barrier cable actually engaged the undercarriage and the aircraft was stopped at 273 feet. Chalk up another save for landing barriers. . . .

A note from Kirtland AFB informs us that they do not have PFSV on UHF as stated in our Feb. issue. They have it on VHF only.

Recently two pilots requested *practice* D/F fixes when they were actually lost. In one case the pilot carried his practice so far that he had to bail.

Perry J. Dahl

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Use of funds for printing this publication has been approved by the Director of the Bureau of the Budget, 18 July 1956. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accidental stories are fictitious. No payment can be made for manuscripts submitted for publication in the *Flying Safety Magazine*. Contributions are welcome as are comments and criticism. Address all correspondence to Editor, *Flying Safety Magazine*, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Prior to reprinting by non-Air Force organizations, it is requested that the Editor be queried, advising the intended use in order to obtain the most recent developments and to insure complete accuracy. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

USAF PERIODICAL 62-1

FLIGHT SAFETY AWARDS

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Coveted FLYING SAFETY PLAQUES have been awarded the units listed on this and the following two pages. The awards were presented for the period 1 July through 30 December, 1956.

FLYING SAFETY salutes the officers and men of the receiving organizations for their outstanding effectiveness in preserving the Air Power of the Nation through Safety of Flight—Guardian of Air Power.

11th Air Division (Def.)
Ladd AFB, Alaska
Alaskan Air Command

Operating in Alaska, under the worst possible conditions, this unit performed defense duties flying F-89s. Below-freezing temperatures prevailed from October through April, accompanied by fog and long hours of darkness. The mission of the 11th is to provide active air defense.

•

460th Ftr-Intr Sq
Portland, Ore. International Arpt
Air Defense Command

This squadron flew 14,403 hours during the reporting period, with only one minor accident. Missions were performed in both the F-89 and F-86D aircraft. Additional operational handicaps resulted from having to operate out of a busy international airport. Air defense scrambles were performed around-the-clock regardless of weather conditions.

•

355th Ftr Group (Def.)
McGee-Tyson Arpt, Tenn.
Air Defense Command

Flying F-86Ds, this unit flew 10,645 accident-free hours. As an active Air Defense Group, operations were conducted around-the-clock. The aircraft operated from alert hangars situated at the end of the runways and, in the event of an alert, were required to be airborne in five minutes—or less.

•

Hill AFB
Ogden, Utah
Air Materiel Command

Over 14,000 hours were flown in a variety of aircraft, which included F-89s, F-84s, F-101s and C-124s. Most of the flying was in executing test flights. Despite the high accident potential involved with test flying, the only accident marring a perfect record involved an F-101 performing spin tests.

•

3575th Pilot Trng Wg
Vance AFB, Oklahoma
Air Training Command

This wing flew 63,243 hours without an aircraft accident or incident. Sixty per cent of the operation involved maximum performance maneuvers such as simulated forced landing, no-flap landings and such. A large part of the flying was performed by students with less than 150 hours total time.

3603rd CCT Sq
Luke AFB, Ariz.
Air Training Command

The mission of this organization is to train pilots in all phases of fighter-bomber operations. During this period the pilots, including instructors, transitioned to a new aircraft, the F-84F. This transition was completed without a single mishap. The student pilots were basic school graduates.

•

35th Ftr-Intr Wg
Yokota AB, Japan
Far East Air Forces

This fighter-interceptor wing has the responsibility of defending Central Japan and maintaining an alert status. Maintaining an operational readiness requires operation in all types of weather. The unusual conditions prevalent in this area such as mountainous terrain are hazardous.

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51st Ftr-Intr Wg
Naha AB, Okinawa
Far East Air Forces

This unit is stationed in a typhoon area that has rapidly-changing and often severe weather conditions during most of the year. Limited communications and navigation facilities add to the risk of operation from the island. The wing made 10,800 landings, and flew 791 hours of weather.

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1254th Air Trans. Gp (Med.)
Wash. Nat'l Arpt, Wash. D.C.
Military Air Transport Service

This organization, since its inception, has flown 83,632 accident-free hours. Types of missions ranged from world-wide air transportation for the President of the United States, Cabinet Members and Members of Congress, to light aircraft operation for shorter hauls. Much of the flying involved uncharted areas.

4060th Air Refuel. Wg
Dow AFB, Maine
Strategic Air Command

During the award period, tankers of the 4060th transferred 2854 gallons of fuel to jet receivers. This unit has been accident-free for a period of over four years. Regardless of conditions, the tankers must be airborne to fulfill the requirements of tactical fighter and bomber missions.

•

825th Air Division
Little Rock AFB, Ark.
Strategic Air Command

This Division flies B-47s and KC-97s. They operated without an accident for this reporting period. One wing participated in a North African deployment exercise without even an incident. All types of tactical operations were employed in maintaining the striking power of the USAF.

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341st Bombardment Wg
Dyess AFB, Tex.
Strategic Air Command

In maintaining the capability to execute assigned emergency war plans, this unit did not experience accidents in either B-47s or KC-97s. Inexperienced crews, poor instrument landing aids and runway construction during periods of severe weather, greatly increased the accident potential.

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312th Ftr-Bomb. Gp
Clovis AFB, New Mex.
Tactical Air Command

The mission of this organization is to attain and maintain the capability to deliver atomic weapons on designated targets. Practice delivery missions included flights at low altitudes in supersonic fighter aircraft. The unit transitioned from the F-86H to the new, supersonic F-100D aircraft.

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464th Troop Carrier Wg
Pope AFB, No. Carolina
Tactical Air Command

The wing airlifted 5,552,000 pounds of cargo, 52,190 passengers. 3,526,000 pounds of cargo and 43,669 paratroopers were dropped by parachute. Operations included Alaska and Panama in support of Army airborne troops. Cold weather operational tests were performed in minus 53-degree Alaska weather.

48th Ftr-Bomb Wg
Chaumont, France
U. S. Air Forces in Europe

This wing operated F-86s and later in the period transitioned to F-100s. One of the training missions is prolonged, low-level, simulated strikes over unidentified towns and terrain often omitted from available charts. There is no GCI coverage at home plate and the weather is often severe.

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562nd Ftr-Bomb Sq
Etain AB, France
U. S. Air Forces in Europe

This unit operates F-86F aircraft and did so without an accident during this period. The primary mission is to deliver special weapons. The unit accomplished a flight across the North Atlantic. Deployments to fields having little or no facilities were accomplished in readiness drills.

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91st Ftr-Bomb Sq
Bentwaters, England
U. S. Air Forces in Europe

During this period, the 91st Squadron flew 480 navigational sorties, logged 6194 instrument approaches, 746 hours of actual weather and 542 hours of night flying in F-84F aircraft. There were no major or minor accidents. The home station was IFR over 37 per cent of the time, necessitating instrument approaches during these periods.

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124th Ftr-Intr Sq
Des Moines, Iowa, Mun. Arpt
Air National Guard

This squadron operated during this period without an accident or incident. It is located at a civilian airfield with only one operational runway that has heavy civilian air traffic. The unit participated in the USAF World-Wide Gunnery Meet, placing second in air-to-ground and fourth over-all.

•

127th Ftr-Intr Sq
McConnell AFB, Kansas
Air National Guard

In the execution of fighter missions [illegible]d actual scrambles, this unit has not had a major accident in over 18 months. The high density traffic is a constant threat to this accident-prevention accomplishment. During alert commitments, the aircraft have never failed to be airborne in less than five minutes.

319th Ftr-Bomb Wg
Memphis, Tenn. Mun. Arpt
Air Force Reserve

This unit, composed of week-end warriors, has operated accident-free for the award period. They participated in one two-weeks active duty tour and one encampment at Eglin Air Force Base. The majority of the pilots were multi-engine qualified but transitioned to fighters without a mishap.

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433rd Troop Carrier Wg
Brooks AFB, Texas
Air Force Reserve

This wing trains to effectively airlift personnel and equipment, using air landing and parachute techniques during simulated combat operations. Seventy-five per cent of its sorties on a tour to the Caribbean area were under IFR conditions. This unit has operated without an accident since May, 1955.

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Medallion Winners

These organizations are repeat winners of the Flying Safety Plaque and are awarded bronze medallions.

Pacific Division—MATS
July-December 1952

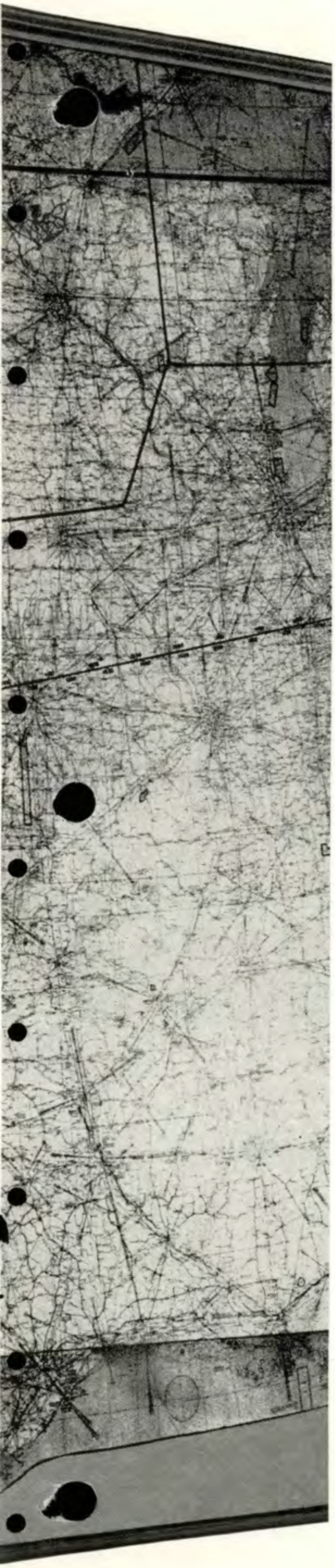
67th Tactical Reconnaissance Wg
July-December 1954

AF Cambridge Research Center
Jan-June 1955

Safety is not an inherent quality in any profession. It is one that you build in as you go and is based largely on accumulated knowledge and experience. Without adequate knowledge the experiences can get a little hairy, and safety can become a nebulous bit of fiction. To a greater extent than is generally realized, unhappy experiences can be avoided by increasing knowledge and familiarity. In short, know what you have to work with.

With this thought in mind, FLYING SAFETY Magazine presents in this issue, an up-to-date revision of a feature article which appeared several years ago (May, 1950): "Flying Safety on the Airways." The revision of this feature not only answers the numerous requests from pilots in the field, but rounds out the discussion of "Planning Your Flight"—this month's contribution to the 1957 Program.

Flight planning—or the lack thereof—has been responsible for a large share of USAF aircraft accidents. Thorough flight planning can contribute immeasurably to the all-around safety, comfort and success of any flight and to the task of preventing aircraft accidents.



Flying Safety on the Airways

AIRWAYS ARE the highways of the air. An airway is a navigable airspace extending upward from 700 feet above the ground, stretching between designated points. The administrator of the Civil Aeronautics Administration establishes airways by designating definite points, such as radio ranges and omni-stations, and then connects these points by a line of definite width to be used by aircraft in flight.

Domestic IFR traffic each year amounts to thousands of flying hours. With so much air traffic, it is obvious that definite, predetermined flight paths and procedures are vital to safety and efficiency. Airways provide identified flight paths equipped with aids to air navigation. Aircraft flying IFR within these flight paths operate at altitudes and on schedules controlled by the civil airway traffic control centers.

Airway procedures are safe procedures. They have been carefully evolved from years of flying experience. Every military pilot should understand and follow them. You owe it to yourself to insure your own safety. In addition to that, you have a grave responsibility to the government which has a large investment in you and the plane you fly. You are responsible to your crewmembers and passengers and to other pilots and planes in the air. You can protect this investment and carry out your responsibilities by learning how to fly the airways safely and by living what you have learned.

As a military pilot, you have an assigned mission. Your mission fits in with the overall Air Force mission in maintaining the desired state of operational readiness. Basically, your mission is to fly. But the sky is no longer your own.

ATC and YOU

With the thousands of airplanes that are this moment in the sky, the problem of air traffic control becomes an increasingly complex one. Firm rules must be laid down. Firm procedures must be established and adhered to by all who fly. One agency must be designated to monitor and control all air traffic regardless of whether it is civil or military. For pilots who fly the airways, these things have been done. The controlling agency is called Air Traffic Control. Its mission is to expedite the flow of traffic along and across civil airways during all weather conditions in a manner consistent with safety. The rules and procedures are complex and they can be confusing. They are written in many places and generally speaking, all of them are available to the pilot in flight.

The intent of this feature is to consolidate a lot of these points and to clarify some that have confused pilots in the past. Due to the many combinations of problems that could arise, all of them cannot be covered here. If

further study is desired, the following publications may be consulted:

- Radio Facility Charts.
- Supplementary Flight Information Document.
- USAF Pilots Handbooks.
- ANC Manual "Procedures For The Control of Air Traffic."
- ANC Manual, "Criteria for Standard Approach Procedures."
- CAA Manual, "Flight Information Manual."

As ATC does not, in most cases, have direct communications with the pilot, CAA communications facilities relay the messages. In this article, therefore, whenever a contact with ATC is mentioned, it should be understood that the radio contact will be made with a CAA communications station or an ATC Center.

The following pages will emphasize that when you're going to fly IFR on the airways, you'll be all right if you:

- Obtain a good weather briefing.
- File your Flight Plan accurately.
- Copy ATC clearances right.
- Follow the takeoff and climb instructions.
- Maintain prescribed altitudes and specified airspeed.
- Report passing compulsory reporting points.
- Use correct radio procedures.
- Follow letdown instructions.
- Know emergency procedures.
- Close out your Flight Plan.

Flight Planning

Section "C" of the DD Form 175 is transmitted to ATC and is the basis for control of the flight. The information it contains must be correct. It is important that no misunderstanding exist between you and ATC concerning the proposed route of flight specified in the flight plan. Your route may be adequately described by indicating the color abbreviation and number of the airways to be flown when on LF/MF airways. Civil airways which cross or merge for short distances with the airway being flown need not be indicated. Intermediate reporting points along an airway need not be indicated, thus "Green 5 to New York" can describe an entire flight from Los Angeles to New York. All alternating portions of VFR or IFR flight along an airway must be accurately described however, and great care must be taken to avoid confusion, especially when flying through congested areas. Compliance with the provisions of AFR 60-22 regarding ADIZ procedures is, of course, a *must*.

You can file a flight plan which incorporates both airways and direct off-airways routes, but you should define clearly an off-airways route.

Generally speaking, you will find that following airways is the best procedure. Little distance will be saved by short cuts off-airways. It is always advisable to file an IFR flight plan if VFR conditions are not assured, but a flight plan can be filed that has both IFR and VFR portions. If the first portion of the flight is IFR and the latter portion VFR, an ATC clearance will be obtained only for the first portion. If the latter portion of a flight is IFR, you will be instructed to contact a communications station to receive an ATC clearance before entering the IFR portion of the flight. Often times, varying delays will occur in filing composite flight plans, the last portion of which is to be IFR. Delays can be caused by ATC's being unable to work you in immediately or by errors in transmissions from base operations, Flight Service or others.

True airspeed is specified in the Form 175. ATC expects you to make good this airspeed, as it is used in computing the longitudinal separation between aircraft flying on the same airway at the same altitude. All speeds must be given in knots. Your flight plan should indicate the TAS you expect to make good. You must familiarize yourself with the procedures for maintaining this airspeed. Any deviation of true airspeed in excess of 10 mph constitutes a change in flight plan and ATC must be informed of the change. If it becomes apparent during the flight that the original ETE is in error, it is usually easier to file a corrected ETE than to adjust the airspeed to make good the original estimate.

You must indicate the type of airways you intend to fly. Low frequency airways are identified by a color. Red, green, amber and blue. VOR airways are identified as Victor airways by number. Aircraft on IFR flight plans must be flown at not less than the established minimum altitude for the airway over which the flight is conducted. The one exception to this rule concerns operation along a VOR airway. Minimum obstruction clearance altitudes are established between radio fixes on VOR airways which meet obstruction clearance requirements for the entire route segment, but assure acceptable navigation coverage *only* within 25 miles of the VOR station. These altitudes are published, along with minimum reception altitudes in the Radio Facility Chart. They may be used as emergency altitudes anywhere along the route segment and as a minmum en route altitude within 25 miles of the station. The flight plan must indicate the even or odd thousand-foot altitude above sea level that is appropriate for the direction of flight along civil airways.

Even-Odd Rules

ATC may and does clear aircraft to operate at altitudes different than that indicated in the Radio Facility Charts. For example, the Chart indicates that traffic flying northbound on Amber One will operate at "Odd" altitudes. Normally, all traffic will. When necessary, however, ATC may specify that certain aircraft will operate at an "even" altitude northbound. Thus, a pilot flying in VFR conditions, following the "Even-Odd" altitude indicated in the chart might find himself on a collision course with another aircraft legally operating at the same altitude flying an opposite direction.

Knowing that this can and does happen is especially important when flying the airways at night. The separation that is desired and implied by the "Even-Odd" rule cannot be assumed to exist in VFR conditions.

When you request a "1000 feet on top (10/otp)" clearance, you are expected to fly the altitude prescribed (odd or even) for flight along civil airways, except when operating above 29,000 feet. In such cases, odd thousand-foot levels must be used unless specific ATC clearance has been obtained. This applies also to aircraft flying VFR at 3000 feet or more above the terrain. These altitudes are not always the same as the quadrantal separation altitudes for off-airways flights, especially on southeasterly and northwesterly headings. It is your direct responsibility to avoid other traffic when flying under VFR conditions even if your flight is being conducted on an IFR clearance at an assigned altitude. Flights cleared by ATC to operate 1000 feet on top may operate *between cloud layers* provided VFR weather conditions exist between the layers. Normally, on-top clearances will contain information on the reported tops. When aircraft capabilities will not permit climb to the top, an amended ATC clearance will be requested. All flights cleared to operate on-top must fly at or above the minimum en route altitude.

Generally, on Green and Red airways, and on even numbered VOR airways, east-bound flights should be conducted at odd thousand-foot altitudes, westbound at even thousand-foot altitudes.

On Amber and Blue airways, and odd numbered VOR airways, northbound flights should be conducted at odd thousand-foot altitudes and southbound flights at even thousands.

The following rules apply on segments where color airways and VOR airways overlap:

- Where a color airway coincides with a VOR airway, the odd or even rule for the appropriate color airway will apply.
- Where no color airway is involved and even numbered and odd numbered VOR airways coincide, the rule for even numbered airways will apply.

NOTE: These rules are the basis for requesting en route altitudes on IFR flight plans. If possible, when flying "at least 1000 on top (10/otp)", you should conform to the above altitudes. These rules will apply although forward flight visibility is unlimited.

ATC Clearance

Before takeoff, the tower will obtain your ATC clearance. It will be relayed to you and you should be prepared to copy the clearance quickly and accurately. It should be read back to the tower to eliminate any misunderstanding. It is always good practice to check the clearance against the flight plan on the duplicate copy of the Form 175 and note any variations. Some pilots make a copy of the expected clearance prior to receiving it, then make the changes.

Most clearances will include climb instructions such as "climb on course," "climb on a heading of 150 degrees," and some clearances may even include the direction of takeoff as "take off southeast, right turn after takeoff, climb on a heading of 270 degrees, report when reaching 1000 on top." Usually, these instructions will be issued by word description, but at several major terminals a system of coded departure routes has been initiated. You should study the possible routes of departure while planning your flight to eliminate delay and confusion after receiving your clearance.

Climbing instructions will occasionally specify a somewhat devious route of departure but these routes are the only possible method of expediting arrivals and departures at busy terminals. VFR flight may be specified in climbing instructions, such as "climb VFR" or "maintain VFR for five minutes on a heading of 225 degrees before starting climb." It should be noted, however, that VFR departures will be given only when you indicate in the Form 175 that you will accept a VFR climbout.

In the event the clearance for all or any portion of the flight is identical to the route you have filed, the term "via flight planned route" may be given by the controlling agency. When used, this phrase will be preceded by sufficient detailed route of flight information to get the flight on the filed route. It is important to remember that this clearance phraseology *does not include* approval of altitudes filed in the flight plan. Specified altitude assignments will be issued in each clearance.

The initial clearance will normally authorize flight to the point of intended landing, but in some cases the clearance will be to some intermediate point due to traffic conditions. In such case, the clearance for the remainder of the flight is usually received before reaching the intermediate point.

In the event that you arrive at your clearance limit without having received either a clearance beyond, or holding instructions at this fix, you are expected to begin holding in a standard race track pattern. You should hold on the course on which you approached the fix, maintaining the last assigned altitude. You should also request further instructions immediately through the nearest air/ground station. Your altitude at this clearance limit will be protected so that separation will exist in the event you do have to hold at this point.

During your flight planning, you will find that flying the established airways is generally best.

Position Reporting

The safety of all planes in the air and the effectiveness of ATC depend on accurate position reporting by pilots. To provide proper separation and to expedite the movement of aircraft, ATC must be able to make accurate estimates of the progress of every aircraft operating on an IFR flight plan. Unless you make all required position reports promptly and accurately, it is difficult for controllers to compute your actual and future positions, with the result that traffic conflicts cannot always be accurately foreseen. An error in position reporting can result in delays,

1. Identification: (The last five digits of the aircraft's serial number preceded by the service designation and jet, if applicable.)	**Air Force (Jet) 19890**
2. Position:	**Litchfield**
3. Time:	**Five Six**
4. Altitude:	**Eight thousand**
5. Type	**Instrument Flight Plan**
6. ETA over next reporting point:	**Pullman, One Eight**
7. Name only of the next succeeding reporting point along the route of flight:	**Milwaukee**
8. Remarks	

Instrument Flight Rule position reports must include this minimum essential information.

or in separations which are less than the required minimum.

To insure accuracy, check your aircraft clock before each flight and the time of passing a fix given to the nearest minute. Be careful to identify the reporting point correctly. When an aural or visual indication is used to determine the time of passing a reporting point such as a fan marker, "Z" marker, cone of silence or the intersection of two range legs, the time should be noted when the signal is first received and again when it ceases. The mean of the two times should be taken as the actual time over the fix.

On an IFR flight plan, make position reports as outlined on the back cover of the Radio Facility Charts. Compulsory reporting points are depicted by solid triangles in the Radio Facility Charts. Non-compulsory points are shown as outlined triangles. Another symbol consisting of a black triangle with a circle inscribing the letter "L" attached indicates that a position report is required below 15,-200 feet but not above.

Present requirements for position reporting are that on a VFR flight, a position report is made at least every 60 minutes or 200 nautical miles. On an IFR flight below 17,200 feet, reports are made over compulsory reporting points and as requested by ATC. On an IFR flight above 17,200 feet, you should report over fixes named in the flight plan and as requested by ATC. These reports will be made at least every 60 minutes or 200 nautical miles, whichever is less. Under either IFR or VFR conditions, you are required to maintain a listening watch on a CAA frequency. On an IFR flight, you must notify ATC before changing to another frequency.

All position reports should be preceded by an initial call to establish contact. The last five digits of the aircraft's serial number, preceded by the service designation (and the word jet, if applicable), should be used for the initial call.

Position reports should be made as soon as possible after passing a fix but it is not necessary to report when directly over the fix. Before initiating the call, the time should be noted, the estimate for the next fix computed, and the radio monitored to avoid breaking in on another conversation. Exact time over the fix is the time given in the report, hence the importance of setting the clock accurately. The position report contains estimated time of passing the next reporting point along the route of flight. If you see that this estimate will be in error by more than three minutes, relay a corrected estimate to ATC.

IFR position reports must include the information contained in the boxed illustration above. (Bold type indicates actual phraseology.)

All superfluous words are eliminated to save time. The required information should be given in proper sequence. Don't talk too fast. Allow the range station operator time to copy the report accurately. The ground station designation, "Washington Radio; Shreveport Approach Control," and so on, may be deleted after contact is established.

The CAA station will receive and file VFR position reports received from you. They will also receive and transmit to Military Flight Service Centers inflight changes which are of operational interest to either flight service or air defense. CAA stations will transmit flight advisories as requested by Military Flight Service. These will include "flash advisories."

Change of Flight Plan

Any change from the original IFR clearance must be approved by ATC. You may change from IFR to VFR by informing any communications agency that has direct contact with ATC that you are canceling your instrument flight plan at a stated time.

VFR Flight Plan. When you want to change your route or point of first intended landing on a VFR flight pl[an] en route, contact a CAA communic[a]tions station or military communications facility. Submit the change in accordance with the outline on the inside back cover of the Radio Facility Charts.

Change of IFR Flight Plan or VFR to IFR. To change a flight plan en route you must obtain a clearance from ATC through a CAA communications facility. The facility obtaining the traffic clearance will notify Flight Service of the change only if requested.

When a change of destination and/or route is desired, you should make a normal position report followed by the details of the requested change in flight plan.

If you want a change in altitude, make your request immediately following a normal position report. If an emergency exists (icing conditions, loss of power and so on), make your request and give only the information required. To get immediate action on such a request, you must "Declare an Emergency." Don't wait until it's too late. If your declaring an emergency causes ATC to alter traffic, they will request a report. If no traffic is involved, no report will be necessary. The inside back cover page of Radio Facility Charts contains information on what data must be transmitted in requesting a change in flight plan.

Closing Flight Plan. At locations with an established military base operations, you must close your flight plan with base operations upon landing. At non-military installations, close your flight plan with the nearest Flight Service Center by interphone "drop" line, if available. At "P" fields with the CAA facility after landing, or at "PC" fields this can be done through the nearest CAA Radio station before landing. If you are unable to close your flight plan by any of the above methods, call Flight Service by long distance telephone, collect.

Holding

Holding is the flight path made by an aircraft with a definite time, heading and altitude relationship to a prescribed fix. Some holding is required on nearly all IFR flights. To follow the standard holding flight path, fly the specified course inbound to the holding fix, make a 180-degree, one-needle-width turn to the right; fly a parallel course outbound from the holding fix for two minutes, correcting for known drift; turn 180 degrees to the right and again follow the specified course inbound. When holding at an approach control fix and instructions are received specifying the time of departure from the fix, you should adjust your flight path so that you may leave the holding fix at the specified time. This you can do by shortening or lengthening the legs of the holding pattern as required. A procedure turn need not be executed, as the aircraft may proceed to the new fix or to the final approach directly from the holding pattern. All turns required in connection with entry or exit from a holding pattern should be made on the same side of the prescribed course as the holding pattern.

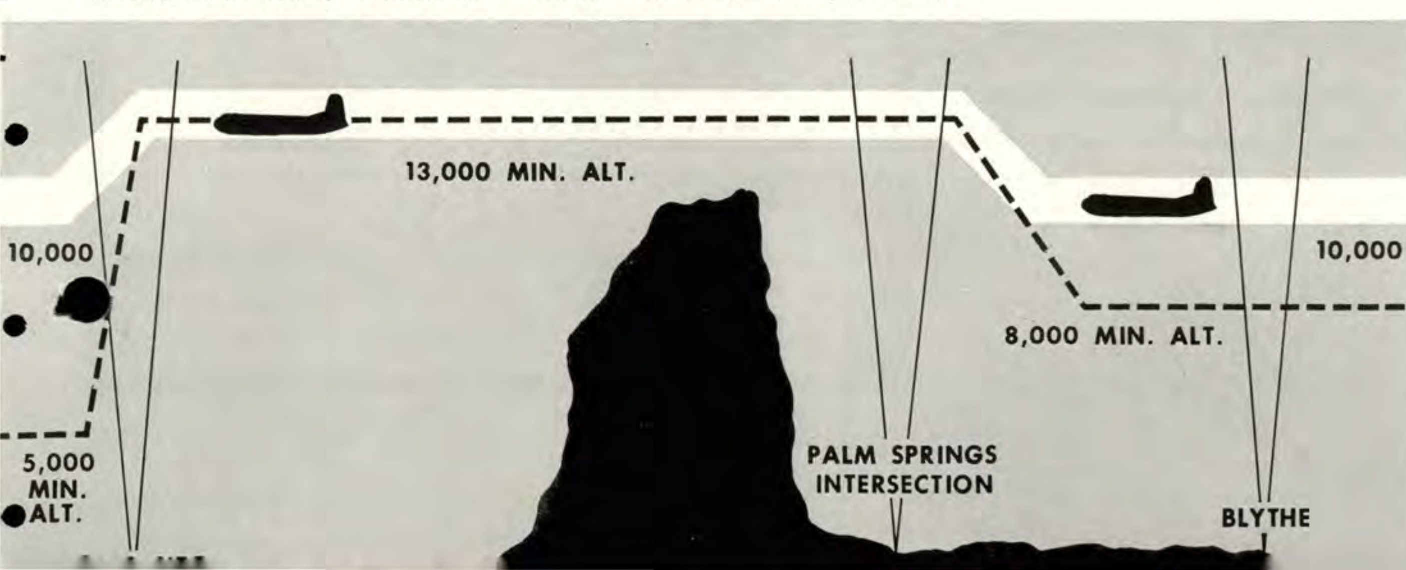
You will be expected to adhere as closely as possible to the assigned holding pattern. If at any time you are requested—or for any reason it becomes necessary for you to hold at a speed greater than 180 miles per hour (155 knots), notify ATC. Holding pattern buffer zones are established for this speed, and separation is predicated on the assumption that no one will exceed 180 mph in the holding pattern. Generally speaking, arrangements are made so as to double the dimensions of the holding pattern airspace for jets when holding between 19,000 and 29,000 feet and triple the dimensions for holding above 29,000 feet.

Due to the location of facilities in congested areas and in order to expedite air traffic, non-standard holding patterns are used at some locations. These non-standard pattern are depicted on Radio Facility Charts. Clearances for holding in non-standard patterns will contain a brief description of the non-standard features of the pattern. Absence of instructions regarding the direction of turns will mean that right-turns should be flown. Absence of instructions regarding the length of the patterns will mean that two-minute legs should be flown.

A clearance for holding in a right-hand, one-minute pattern will only contain the length of the pattern, i.e., "one-minute pattern." A clearance for holding in a left-turn, two-minute pattern will only contain the direction of turns, i.e., "left-turns." A clearance for holding in a left-turn, one-minute pattern will contain both the direction of turns and length of pattern, i.e., "left-turns, one-minute pattern."

Holding instructions will include the expected approach time to allow you to plan a course of action. If you are issued instructions to hold at a point en route and no expected approach clearance time is issued, the holding clearance will contain a time limit, using the phrase "Expect Further Clearance at (time)."

An aircraft cleared through Blythe to Los Angeles to cruise and maintain 10,000 feet until further advised, loses his transmitter before reaching Blythe. Proceeding on course he maintains 10,000 feet until reaching Palm Springs, where he climbs to 13,000 feet (the minimum altitude). After reaching Riverside, he immediately descends to the original altitude.



Approach Clearance

Approach Control. This is a service whereby specified CAA and military control towers direct IFR flights arriving at, departing from, and operating in the vicinity of airports, by means of direct communications with all aircraft under their control.

Approach control is the controlling authority in a zone which usually consists of one or more airports and its approach and departure instrument flight patterns. Approach Control towers are responsible for providing separation between departing aircraft and all other aircraft under their jurisdiction. The clearance to departing aircraft includes the clearance limit, including altitude, route and other control. Time of takeoff, direction of turn, altitude restrictions after takeoff and other specific restrictions necessary to effect separations from aircraft under its jurisdiction are determined by approach control. The time of takeoff is specified in the ATC clearance only if necessary to coordinate the departure with traffic not under approach control jurisdiction. A "clearance-void-time" will be specified by the ATC center if a delayed departure would result in conflict with traffic not released to tower control. A "clearance-void-time" determined by the tower will never be later than that issued by the ATC center. Close coordination is essential between approach control and the ATC center and is maintained to prevent traffic conflict. After coordination with the tower, a center may clear arrivals to hold at holding points until advised by approach control.

Limit of Clearance

An air traffic clearance from an Air Traffic Control Center ordinarily clears aircraft on IFR flights to a holding point. This is normally a radio range station, ILS outer marker, fan marker or other radio fix and is used as the limit of the ATC clearance. Instructions to hold may be included by the Air Route Traffic Control Center and they will tell you on what frequency to contact approach control when you arrive over the holding point.

You should not contact approach control until over the specified holding point unless directed to do so. The Air Route Traffic Control Center will tell you when to contact approach control or where. Approach Control will usually issue the approach clearance for an instrument approach to an airport. An approach clearance is usually good for one approach, only. This approach may be either a standard range approach, ADF, GCA or ILS approach or combination thereof and will be specified.

Approach Sequence

Each pilot in an approach sequence will be given advance notice as to the time he should leave the holding point on approach to the airport. When the time of leaving the holding point has been received, you should adjust your flight path to leave the point as closely as possible to the designated time. On receipt of a fixed departure time, use up the intervening time in holding flight by adjusting your path within the limits of the established holding patterns so as to arrive over the fix inbound at precisely the specified time or as soon thereafter as possible.

The pilot's timing calculations are relatively simple and are based on the fact that a 180 degree turn should use up one minute of flight time. Thus it is possible to vary the holding pattern time with precision. Experience in using these procedures indicates that with a little practice, pilots can consistently cross the fix inbound within 20 seconds of the specfied time.

Missed Approach

In the event landing is not completed after one standard instrument approach, follow the standard missed approach procedure (outlined in the Pilot's Handbook) or advise the traffic controller of your intentions and receive further clearance. If you want to make a second approach, Air Traffic Control will determine whether you will be cleared for another *immediate* attempt. You may be directed to stand by on a designated leg of the range at an assigned altitude until another aircraft in line has landed or taken off. This decision will be based upon existing traffic conditions unless an emergency traffic condition exists. A decision to go to an alternate airport must be made by you and clearance to the alternate airport must be obtained.

The minimum ceilings and visibility requirements for instrument approaches are listed in the Pilot's Handbook. When weather is below the landing minimum and you decide to hold for improvement in weather, Air Traffic Control may direct you to proceed to an adjacent holding point or to a position higher in the approach sequence. Here is an important point. When your flight plan is transmitted, the alternate airport you have speci-

ALTIMETER SETTINGS

Civil Air Regulations prescribe that flight altitudes shall be in feet above sea level. Accordingly, altimeters should be set to the current setting of the nearest station reporting official altimeter settings along the route of flight. All altitudes used in connection with the control of air traffic are based on indicated altitude, since any temperature error will affect all altimeters in the same vicinity and relative separation between aircraft will be approximately maintained. Pilots should consider temperature error only with respect to insuring that actual altitudes of the aircraft permits ample clearance of terrain and obstructions.

fied is not included in the transmission. Therefore, ATC will not know the alternate you've selected and have therefore made no clearance arrangements for you from your original destination to that alternate. This means that if you must proceed to your alternate airfield, under IFR conditions, you must obtain a further ATC clearance to the alternate destination. This, of course, is not necessary if the flight does not involve airways.

Compulsory Reports

The following reports should *always* be made to Air Traffic Control:

- The time and altitude of reaching a holding point or the point to which cleared.
- When vacating any altitude for a newly assigned altitude.
- The time of leaving an assigned holding point.
- When an approach has been missed.
- Jet Aircraft report over final approach fix (low cone).
- When visual reference to the ground is established.

The following reports should be made *when requested* by Air Traffic Control:

- Time of starting procedure turn on final approach.
- Time over range station or outer marker inbound on final approach.
- Altitudes when climbing or descending.
- Time when reaching a newly assigned altitude.
- Any other information which may aid in the control of air traffic.

Emergency Procedures

Emergencies and the circumstances surrounding them are so varied that exact rules to be followed in all cases cannot be established. If possible, the procedures outlined in this article should be followed, but you must always use your own judgment if an alternate course of action seems to be advisable.

Emergency communication procedures using distress, urgency or safety signals are contained in the inside back cover of the Supplemental Flight Information Document.

In the event of radio failure, either transmitter, receiver or both—or inability to receive radio signals because of static, you should follow one of the following procedures:

- If operating under VFR conditions proceed VFR and land as soon as possible.
- Proceed according to the latest ATC clearance.

The inside back cover of the Supplemental Flight Information Document shows the procedures that may be used to provide radar emergency interception within an ADIZ and surrounding areas.

If you proceed IFR according to the last received and acknowledged traffic clearance and other instructions to the contrary are not received and acknowledged, you will be expected to observe the following rules. The procedure followed by ATC is based on the assumption that you are following these rules:

1. If you have received and acknowledged a clearance to the destination airport or the radio facility serving that point, you should continue flight at the altitude(s) last assigned by ATC or the minimum instrument altitude (whichever is the higher) to the radio facility serving the destination airport.

2. If you have received and acknowledged a clearance to a point other than the destination airport or the radio facility serving the destination airport, you should continue flight at the altitude(s) last assigned by ATC or the minimum instrument altitude, (whichever is the higher) to the radio facility serving the destination airport.

3. If holding instructions have been received and acknowledged, you should comply with these instructions until time to continue the flight so as to arrive at the radio facility serving the destination airport at the expected approach time last received and acknowledged. Maintain the last assigned altitude or the minimum instrument altitude, whichever is the higher.

4. If holding instructions have been received, but no expected approach time has been received, follow the holding instructions until the time ATC has specified that further clearance may be expected. Then continue the flight, maintaining the last assigned altitude or the minimum instrument altitude, whichever is the higher.

NOTE: The minimum instrument altitude referred to is the minimum established for that portion of the route over which you are flying, regardless of the direction of flight. If you have to climb to a higher altitude, higher than that assigned by ATC in order to comply with a higher minimum instrument altitude, you may later have to descend in order to comply with a lower minimum instrument altitude. In this case, you should not descend below the altitude last assigned by ATC.

Descent from the altitude maintained should start over your destination radio facility at the expected approach time last received. If no expected approach time was received, start your descent at the last estimated arrival time you specified, or as soon as possible thereafter. A full, standard instrument approach should be executed unless a VFR approach can be made. ATC will hold all altitudes below the clearance altitude open for you at the destination radio facility. These altitudes are held vacant for any unreported aircraft until 30 minutes after the last expected approach time acknowledged by you, your ETE or last estimated arrival time, or the estimated time of arrival computed by ATC, whichever is later.

If you have received and acknowledged a clearance to the tower at the airport of intended landing, you will be expected to comply with any special instructions contained in that clearance and make a normal descent for landing.

NOTE: ATC may issue appropriate instructions to be broadcast "blind" over suitable radio range facilities. Instructions will not be broadcast unless ATC authorizes such broadcast.

Upon receipt of information that an aircraft in flight within a control area or control zone has encountered an emergency which may affect other air traffic, ATC will act to give the emergency aircraft priority over any other aircraft involved.

Should it become necessary for you, while holding, to make an emergency descent through other traffic areas, you should advise ATC immediately.

Upon receipt of information that an aircraft is making an emergency descent through traffic at assigned alti-

EVER BEEN LOST?

Personnel at all communications stations are trained to assist pilots in establishing positions by:

(a) Visual reference to terrain features.
(b) DF fix by triangulation.
(c) Low Frequency and Omni-range orientation.

tudes over the airport, ATC will immediately broadcast, or cause to be broadcast, the following:

Emergency To All Concerned
Emergency Landing at .... Airport.
All Aircraft Below .... Thousand Feet
Within ....Miles of ....Radio Range
Leave............Course(s) Immediately.

Upon hearing such a broadcast, you should clear specified areas in accordance with the emergency instructions. ATC will issue further directions through the various communications facilities immediately following the emergency broadcast.

When terrain, traffic or other factors make it impractical for you to maintain the last assigned altitude, ATC will issue specific directions.

If all radio navigational equipment should fail or become inoperative, you should climb to and maintain the emergency altitude for the surrounding area. Use DR navigation to reach an area where a VFR letdown can be made.

In an emergency situation which results in a deviation from the rules prescribed in Civil Air Regulations, Part 60, you must make an immediate report to the nearest CAA regional office. When the emergency situation results in no deviation from CAR 60, but requires ATC to give priority to the aircraft, you must make a report to the nearest CAA regional office within 48 hours. Compliance with this does not eliminate your responsibility to notify your commanding officer and the Flight Service within 24 hours of a violation in accordance with AF Reg 60-16, par 55.

Altimeter Settings

Civil Air Regulations prescribe that flight altitudes shall be in feet above sea level. Accordingly, altimeters should be set to the current setting of the nearest station reporting official altimeter setting along the route of flight. All altitudes used in connection with the control of air traffic are based on indicated altitude, since any temperature error will affect all altimeters in the same vicinity. Thus, relative separation between aircraft will be approximately maintained. Consider temperature error only with respect to insuring that actual altitude of the aircraft permits ample clearance of terrain and obstructions.

Weather Broadcasts

All airways communications stations having voice facilities on continuously operated radio ranges or radio beacons broadcast weather reports and other airway information at 15 and 45 minutes past each hour. The 15 minutes-past-the-hour broadcast is an "airway" broadcast consisting of weather reports from important terminals located within approximately 400 miles of the station.

The 45 minutes-past-the-hour broadcast is an "area" broadcast consisting of weather reports from stations within approximately 150 miles of the broadcasting station.

The broadcast consists of the local weather report and the latest available surface reports from other locations. Reports more than one hour old are not broadcast. Local winds aloft are broadcast two times daily when available in addition, the Weather Bureau broadcasts a local terminal forecast covering the next two hours. This forecast is broadcast immediately following the local weather report. If possible, you should avoid calling airway communications stations at or about 15 and 45 minutes-past-the-hour (which are the scheduled times) to request weather information. Such calls may delay starting of scheduled broadcasts and cause inconvenience to other persons who are depending on the broadcasts for weather reports.

The best way to get both current weather observations and up-to-the-minute forecasts is to use the Pilot-to-Forecaster Service provided at many Air Force bases throughout the country. The bases providing this service are listed in the data pages (Remarks Section) of your Radio Facility Charts.

When you encounter weather conditions which have not been forecast, you are required to report such conditions to the closest CAA Radio Facility. Report in this sequence. (It is listed on the inside back cover of the Radio Facility Chart.):

- Any usual or hazardous weather.
- Turbulence.
- Icing, altitude encountered.
- Precipitation, type and intensity.
- Clouds, amount, type and height.
- Temperature.
- Type aircraft.

Jet Letdown

In order to standardize instrument approach procedures, the USAF, the Navy, the Coast Guard and the Civil Aeronautics Administration have published an ANC Manual, entitled "Criteria for Standard Instrument Approach Procedures." Air Force Regulation 55-24 requires the use of this ANC Manual in establishing instrument approach procedures.

The primary purpose in the establishment of the special jet letdowns was to permit jet aircraft to accomplish penetration and standard instrument approaches with the least possible delay in time and the minimum number of turns. These jet penetration procedures are established so as to provide the least interference with conventional type aircraft. They also provide for the accomplishment of jet letdowns when conventional aircraft are held on the primary fix where the jet aircraft is executing a letdown. The following criteria for jet penetration and approach has been extracted from the ANC Manual, titled "Criteria For Standard Instrument Approach Procedures. In most cases the low cone altitude and the procedure turn altitude published in the jet instrument procedure is identical to the standard range approach.

Jet Aircraft Penetration

• *Initial Penetration Altitude* — The altitude at which the aircraft crosses the radio facility for beginning the penetration and approach procedure. This altitude is established for each procedure and is normally specified as 20,000 feet mean sea level or 1000 feet on top. Although an initial penetration altitude is established, ATC may permit you to make your initial penetration from en route altitudes, providing air traffic conditions and terrain do not prevent such action.

• *Penetration Turn*—A turn made during the jet penetration procedure which will return the aircraft to an inbound heading to the radio facility being used for the penetration procedure. The terrain clearance in this turn is based upon a one and one-half degree per second turn. The published procedure will indicate whether the penetration turn is a descending or level turn.

• *Minimum Penetration Altitude*—The minimum altitude over the radio facility prior to transition to final approach. This altitude provides a clearance of at least 1000 feet above all obstructions within a radius of 10 miles of the radio facility, and five miles to either side of all penetration courses for a distance of 25 miles from the radio facility.

In those areas designated as mountainous areas, a clearance of at least 2000 feet is provided. In instances where this is impracticable for any reason, deviations have been authorized but in no case is the clearance less than 500 feet, and this only when some radio fix is along the penetration course within 12 miles of the radio facility.

A straight-in penetration without first crossing the radio facility is permissible, provided that a satisfactory radio fix is available within 40 miles on which to start descent. Descent at distances greater than this is considered en route operation. En route clearances are provided up to within 12 miles of the radio facility.

• *Initial Approach Altitude*—The initial approach altitudes when applicable, are the same as those established for the standard instrument approach procedure.

• *Emergency Altitude*—The emergency altitude will clear all obstructions within a radius of 100 nautical miles of the radio facility by 1000 feet except in mountainous areas. In these areas clearance will be 2000 feet clearance.

• *Missed Approach Procedure*—A missed approach procedure is formulated for each procedure. The recovery is normally made on a course which most nearly approximates a continuation of the final approach course. Due consideration of obstructions, terrain and other factors influencing the safety of the operation is given in designing these procedures. You will initiate the missed approach procedure:

(a) At the point where you have descended to authorized landing minimums at the specified distance from the facility if visual contact is not established;

(b) If the landing has not been accomplished, or,

(c) When directed by Air Traffic Control. Time limitations are not to be used because of the variations in the approach speed of different types of aircraft. The "specified distance" under (a) may not be more than the distance from the facility to the nearest part of the landing area.

• *Altitudes*—The altitude to which you have to go on the missed approach provides at least 1000 feet clearance above all obstructions within five miles on each side of a specified course for a distance of 25 miles or to a specified fix within 25 miles of the facility. Obstruction clearance during climb are at least equal to that required for takeoff.

• *Standard Penetration* — Normally, you should start your penetration procedure over the radio facility at the initial penetration altitude. The penetration procedures are established in the direction from the radio facility which is most acceptable, considering controlled airspace and terrain features. Start the penetration when over the radio facility or a given distance after passing the radio facility, and continue it until the minimum penetration altitude or the initial approach altitude is reached, whichever is applicable.

The penetration turn is started normally when one half of the difference between initial penetration altitude and minimum penetration altitude or initial approach altitude is lost.

When the penetration turn is completed, track on the heading to the radio facility or intercept the radio range course, depending upon the procedure specified. In either case, the minimum penetration altitude or initial approach altitude must be reached before arrival over the radio facility. The penetration procedure terminates over the radio facility at the minimum penetration altitude or initial approach altitude. If visual contact is not established upon reaching the minimum penetration altitude over the radio facility, then a straight-in approach to the airport may be started, provided the bearing from the facility to the end of the runway to be used does not diverge more than 30 degrees from the direction of that runway.

For the straight-in approach, the minimum altitude provides a minimum clearance in accordance with paragraphs (a), (b) or (c), following:

(a) Obstruction clearance of at least 300 feet will be provided when the facility is within 7 miles of the airport.

(b) Obstruction clearance of at least 400 feet will be provided when the facility is within 7 to 10 miles of the airport.

(c) Obstruction clearance of at least 500 feet will be provided when the facility is within 10 to 12 miles of the airport. ▲

★ ★ ★

Credits

Source material for Flying Safety on the Airways includes the following:

- ***Radio Facility Charts***
- ***Supplemental Flight Information Document***
- ***USAF Pilots Handbook***

The efforts of the 1229th AACS Sq (Flight Service) in reviewing the contents of this article for technical accuracy are gratefully acknowledged.

An important key to flying safety is accurate flight planning. It requires many flying hours to build up a good record but it takes only one "poor" plan to wipe it out. Too often a pilot permits carelessness and inaccuracy to "sit in" on a haphazard flight plan and a decision to leap off. Here are a few briefs of some accidents where inadequate flight planning was a cause factor.

•

THE AIRPLANE—A T-Bird—with pilot and passenger, was on a night, IFR, cross-country flight between two air bases that were 1190 nautical miles apart. The pilot's ETE was three hours and 10 minutes and he had fuel for three hours and 35 minutes.

Two hours and 24 minutes after takeoff, radar contact was made with a GCI station near an intermediate air base 350 miles short of the destination. The position of the T-Bird was established as being on course, 135 miles from the station. Seven minutes later, the pilot requested a change of flight plan to land at the intermediate air base. He didn't say so but it was assumed that the reason for the request was that he was falling behind on his ETAs over the reporting points. He was told that the weather at the air base was deteriorating rapidly, with low ceilings and rain, and was advised to proceed to one of two bases (less than 200 nautical miles away) where the weather was much better. The pilot replied that he didn't have enough fuel to continue, although, at the same time, he stated he had 172 gallons remaining.

The flight plan was changed with ARTC and penetration instructions were received shortly. After the aircraft entered the GCA pattern, radio contact was maintained on "Guard" channel, since the pilot was experiencing radio difficulty. He didn't follow GCA's instructions on the first approach and another was initiated.

The second approach was controlled by search radar as contact could not be established on the precision scope. The aircraft was seen to pass over the runway at approximately 300 feet by ground witnesses and the pilot said that he could see lights through the side of the canopy but not through the windshield—evidently because of frosting. The search radar malfunctioned after this second approach and the pilot then attempted an ADF approach.

As the aircraft passed over the field on the third approach, radar contact was established on the precision scope.

GCA instructed the pilot on turns to make for a close-in pattern; however, the pilot said that he would proceed to the range station outer marker homing beacon and enter the GCA pattern from that position. He said, also, that he had only 20 gallons of fuel remaining. As he started the fourth approach from the homing beacon, he reported five gallons.

The aircraft was in good precision radar contact when it disappeared from the scope after the engine flamed out from fuel exhaustion. It crashed approximately four miles from the base. Neither the pilot nor his passenger ejected —both were fatally injured.

This pilot had 1337 total flying hours, including 170 hours of instrument weather and hood time, and 142 in the T-33 aircraft.

•

THIS ONE involved a VC-47 aircraft, cleared for an IFR flight, with an ETE of five hours and 30 minutes. The fuel was listed as seven hours plus 30 minutes. During the flight, light rime icing conditions were encountered intermittently. After flying approximately three-fourths of the route and about 10 minutes before reaching one of the key check points, the pilot discovered that he was 20 minutes behind time. He contacted the control center for a change in flight plan, calling for a shorter remaining route and a lower altitude for better wind advantage. The flight from this point was estimated to be one hour and 30 minutes, and fuel, at this time, was indicated to be two hours, plus.

Light icing was again encountered, with considerable turbulence. The next check point was identified through a hole in the clouds as the radio compasses were erratic and beginning to get unreliable. Shortly after this, a climb to 7000 feet and descent back to 6000 was accomplished because of traffic.

After flying headings and ETA to the destination without getting positive radio compass identification of station passage, the pilot declared an emergency. At this time all radio contact was lost between the C-47 and ground station. A few moments later the pilot noticed lights on the ground and decided to see if he could recognize the area. He descended into a valley but didn't recognize any familiar features. The fuel quantity was becoming critical now so the pilot elected to make an emergency landing. He landed in a flat area with gear up, and the copilot received minor injuries.

•

AN L-26B, WITH ITS CREW of two, took off from home base on an administrative cross-country flight that had been planned as a non-stop to designated destination. About an hour's flying time short of destination, the fuel gage indicated insufficient fuel to continue flight, so they landed to refuel.

After the L-26B was parked, the pilots noticed that the gage indicated enough fuel that should have allowed them to continue flight. Well, anyway, the aircraft was fully serviced and they took off again. At destination, the scheduled passenger boarded the aircraft for return to home base. No fuel was added at this time since they estimated a sufficient supply for four-hour endurance with a computed time en route of two hours and 45 minutes.

The flight was uneventful—up to about 100 miles from home base, when the fuel gage again indicated a marginal reading. The crew assumed this to be a recurring error in the gage which would clear itself as it had done before. Shortly afterwards, the reading became normal.

About seven miles from home base, the pilot requested and received clearance for a straight-in approach to the runway. No sooner had he acknowledged the transmission when both engines — simultaneously and suddenly — stopped! There was no area suitable for landing so the L-26 was ditched in the river that lay in the flight path. Only one of the crew survived this ditching.

•

AN F-86E WAS ALL READY for an IFR ferry flight and during flight planning, the pilot designated an alternate which happened to be unsuitable because of weather conditions. A suitable one was therefore selected but this correction was not noted on the Form 175 until the Airdrome Officer called it to the pilot's attention.

While en route the pilot managed to get 48 miles off course so he contacted a GCI station and flight following was exercised to vector his aircraft to its destination. The GCI controller advised the pilot that weather conditions at his destination were below minimums and that the next suitable field would be his alternate. The pilot decided, however, that he didn't have sufficient fuel to divert to the alternate and elected to proceed to the destination field. Three unsuccessful approaches were attempted by this pilot before he was forced to eject. The aircraft was destroyed. The pilot (fortunately, he was not injured) had a total of 1664 flying hours and 169 were in F-86 type aircraft.

SOMETHING NEW has been added to make our flying safer—another step toward proving that Mark Twain's famous weather remark isn't really true anymore.

On 1 March, the U. S. Weather Bureau and the Civil Aeronautics Administration started an experimental "Inflight Weather Safety Service" to warn us of previously unforecast, hazardous weather.

There is only one pilot I've ever heard of who has deliberately tried to fly into tornado-bearing clouds (Jim Cook of the U. S. Weather Bureau, in his P-51). Very few of us even fly into a thunderstorm or severe icing or turbulence, deliberately. Mostly we find ourselves in stuff like that as a result of a bad forecast.

Usually when we do get into one of those hairy situations we're too busy to cuss the forecaster really effectively, and when we get out, we're too thankful to care.

The fact is that if every weather forecast we received was 100 per cent accurate, most stratus clouds would probably be full of CR Terror and me, getting in our 60-2 time. I won't belabor the point but if you've missed the dissertation on busted forecasts, check page 3 of the October 1956 issue of FLYING SAFETY.

Next to the guy up there in the murk, the character who worries most about you and the weather is, believe it or not, your weatherman.

Pull up a chair at base weather some morning and listen to the conversation. Chances are good, if the weather is a mite ticklish, one of the night forecasters will still be hanging around on some feeble pretext or other, waiting for the pilots he briefed to reach their destinations.

There's nothing really new about all of this. I suspect the guy who made the wind forecast for Moses on his Red Sea maneuver did a bit of perspiring too. What we really need is a flight-following system so that every time we get up in the wild blue, some guy on the ground knows exactly where we are, what we're going to run into and, equally important, has the communications to get the word to us if it looks like we're headed for any trouble.

This is a far cry from the present situation where, because of personnel and communications limitations, from the minute you head out of base operations for your bird, you're on your own until the alert truck meets you at the other end. (Individual actions of weather forecasters, operations officers and flight service duty officers are occasionally successful in giving

Advisory · Flash Advisory · Flash Advisory

Maj. Lewis J. Neyland, Hq AWS

us inflight advisory messages.) Since this is just as tough a problem for civil aviation and since our ZI en route air-ground facilities are a "common system" (i.e., for joint civil-military use), representatives from the Air Force, Army, Navy, U. S. Weather Bureau, Civil Aeronautics Administration, and ATA, got together to solve the problem. They met as members of the President's Air Coordinating Committee set-up.

First, it was agreed that the newer the forecast, the better it will be. (This holds true in most everything but wives.) Further, it was obvious that with present facilities it would be impossible to advise pilots individually of every change made in the weather forecast after he took off. Therefore, it was agreed to try issuing *Flash Advisories* using the old shotgun technique to warn of hazardous, en route weather. Effective the first of March, the U. S. Weather Bureau Flight Advisory Weather Service centers (FAWS) began preparing Flash Advisories on hazardous en route weather conditions, and the

Flash Advisories

Warn of Hazardous EN ROUTE weather presently existing or forecast to occur within 2 hours:

TORNADOES	HAIL
THUNDERSTORMS	DUSTSTORMS
ICING	TURBULENCE

Widespread unexpected LOW CEILING or rapidly deteriorating VISIBILITY

STRONG SURFACE WINDS

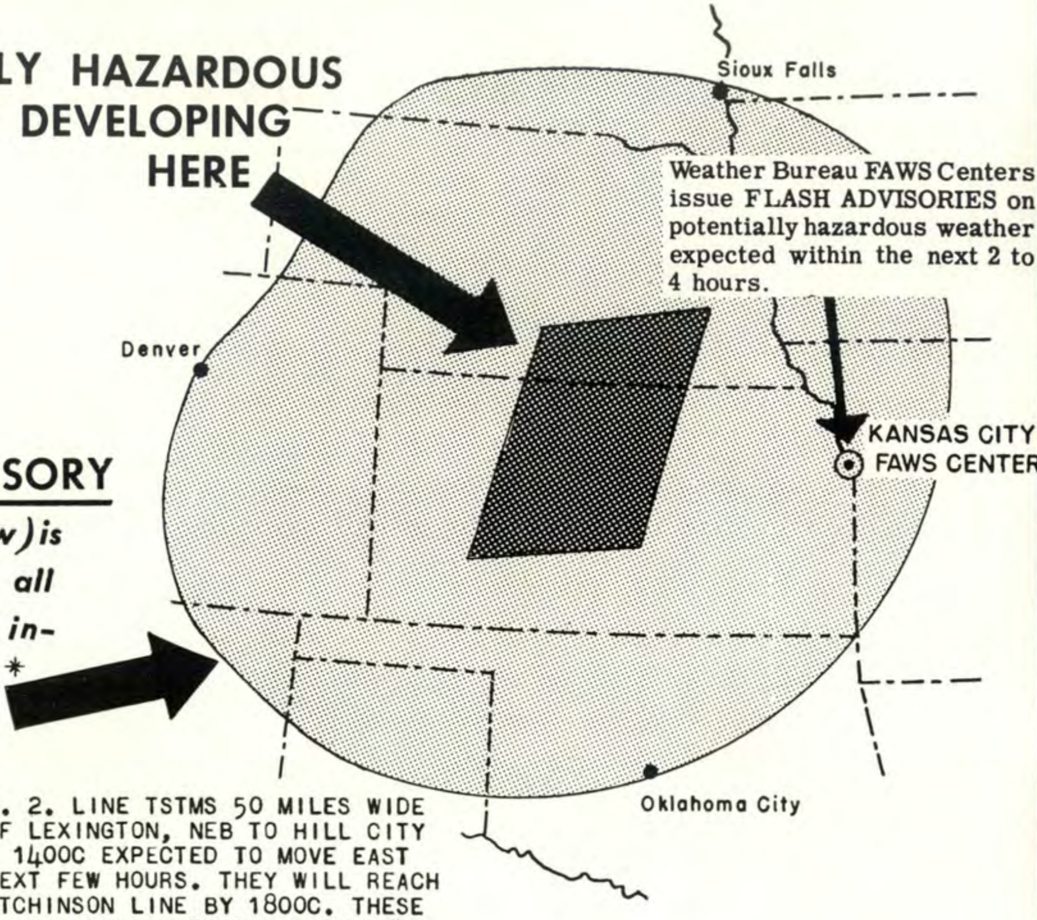
Figure 1

Example of the

WEATHER BUREAU IN-FLIGHT WEATHER SAFETY SERVICE

(Provided in Co-operation with C.A.A.)

POTENTIALLY HAZARDOUS WEATHER DEVELOPING HERE



FLASH ADVISORY *(quoted below) is broadcast by all CAA stations inside this area**

"FLASH ADVISORY NR. 2. LINE TSTMS 50 MILES WIDE FROM JUST SOUTH OF LEXINGTON, NEB TO HILL CITY TO GARDEN CITY AT 1400C EXPECTED TO MOVE EAST 35 KNOTS DURING NEXT FEW HOURS. THEY WILL REACH LINCOLN-SALINA-HUTCHINSON LINE BY 1800C. THESE THUNDERSTORMS WILL BE LOCALLY SEVERE WITH HALF INCH HAIL AND SEVERE TURBULENCE."

* FLASH ADVISORIES also given enroute aircraft when radio contact is made.

U.S. DEPARTMENT OF COMMERCE - WEATHER BUREAU
Feb. 1957

CAA took on the job of getting them from the FAWS centers to the cockpit.

Here's an important point to remember: Flash Advisories pertain only to weather hazardous to en route aircraft. They make no pretense of being terminal landing advisories. The types of weather that we'll get advisories on is shown in Figure 1. (By the way, the Air Weather Service Severe Weather Warnings are considered by the FAWS forecaster when he prepares his Flash Advisories.)

It is important to "sound off" when you see a severe weather indication.

New Program

The new program works like this: When hazardous, en route weather is reported or forecast to develop within two hours, a FAWS center forecaster prepares a Flash Advisory. CAA sends the advisory to all INSAC stations within 200 miles of the hazard area. As soon as they receive the message, the INSAC operators broadcast it immediately on their voice channels. Furthermore, they rebroadcast it (on the range and VOR) as part of the scheduled weather broadcast at H+15 and H+45, and, when possible, will relay it to you when you make your position report if you're going toward the bad weather area. This continues until the Flash Advisory expires or is superseded (they will usually be good for less than four hours).

Like many of the more interesting cross-country activities, there are a few things that you need to remember about this program if you don't want to end up feeling frustrated, or worse.

First, this is not a "Red Flag" service. Don't make the mistake of thinking that "no flagman at the crossing means no train is coming." It may be *your* pilot report of moderate icing that is the first clue the FAWS forecaster has on which to base a Flash Advisory.

Second, the Flash Advisory service must help all of us—from flying flivvers to B-52s. Obviously then not all advisories will be of interest to every pilot, so if you are cruising at 50,000 feet and get an advisory of turbulence at 5000 feet, grin, man, and be glad that you're not down there.

Third, you can save both yourself and the INSAC operator a lot of time by keeping your ears open. Here's how. You remember a few paragraphs back I told you *how* and *when* these Flash Advisories were broadcast? Each is identified by the name of the FAWS center that prepared it and a serial number starting with No. 1 at midnight local time. Here are some examples:

"Flash Advisory, Kansas City number six . . ."

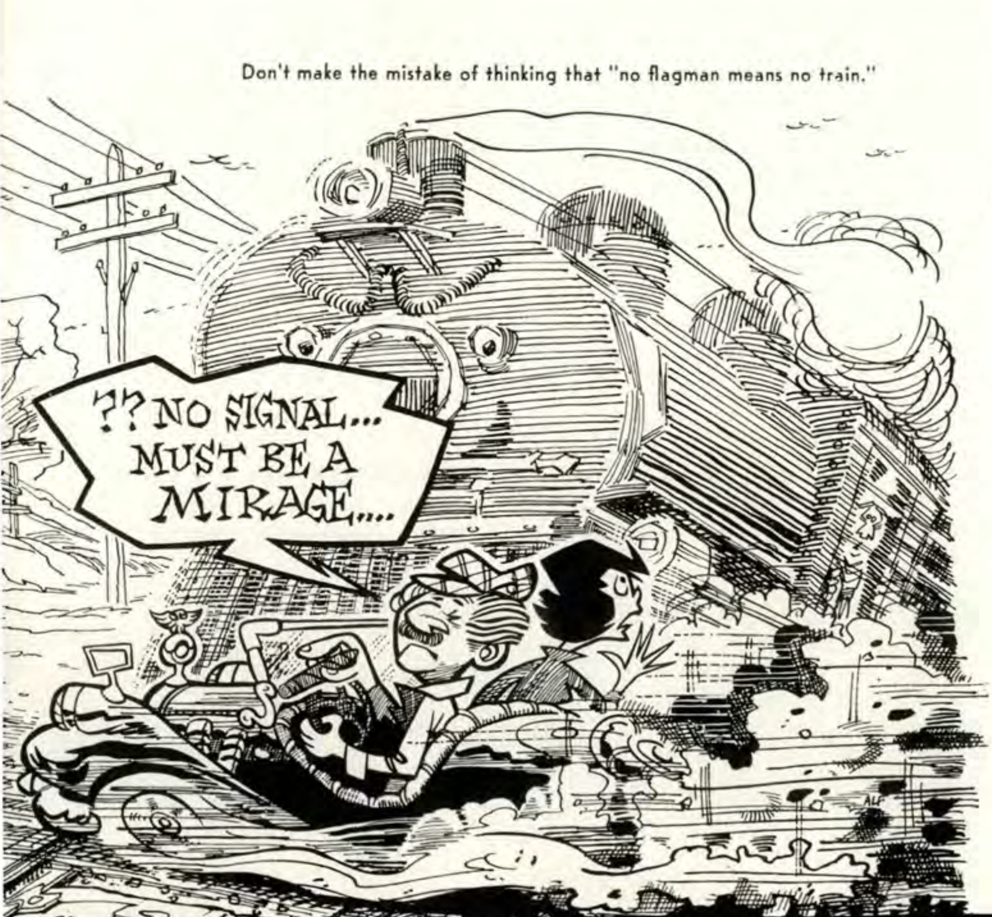
"Flash Advisory, Boston, number three . . ."

You can help to make the program a success by telling the INSAC operator that you have heard "Denver Flash Advisory No. 10" (or whatever other comment is appropriate) when you make your position reports. This way we can keep these things from completely jamming our air-ground channels through needless repeats.

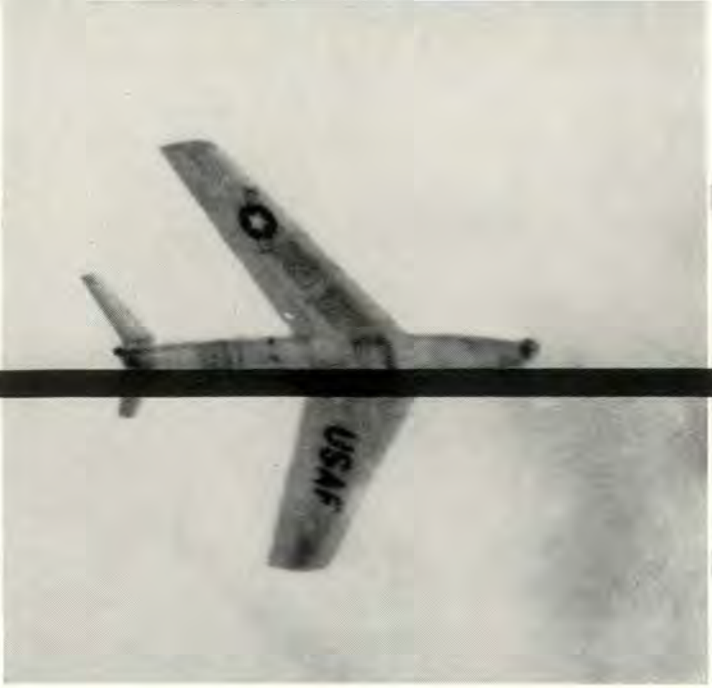
Fourth (this is an oldie but none-the-less valid), the more pilot reports, the better the Flash Advisory service. With as many planes as there are flying within the ZI, it should be impossible for severe weather to develop without *someone* seeing and reporting it. Yet, it does.

There you are, gentlemen. One more step has been taken toward the day when no one will get caught in a weather situation he doesn't like. The Flash Advisory program has some built-in handicaps but we think it will make everybody's flying safer. ▲

Don't make the mistake of thinking that "no flagman means no train."



No SHORT Cuts



The purpose of this tale is not to present a war story but to point out what might happen to a pilot who does not use good flight planning in preparing himself to accomplish a mission when the chips are stacked against him.

I TOOK OFF in an F-86F from Hill Air Force Base at 0900. And like the beginning of many a hairy tale, "the flight was uneventful until—."

I knew that Portland was reporting 4000 feet and five miles, which was good enough but the book says you should have an alternate for a report like that. So I picked Paine AFB—it was even better, with 5000 overcast and five miles. Things didn't look bad, but with 4800 hours behind me, I'm not one to count chickens.

This uneventful flight continued until approximately three minutes from the Portland high cone. When passing over Boise, I requested the latest Portland and Everett weather, and at that time Portland was reporting 2000 feet overcast and three miles and was not expected to get any worse. There was no change at the alternate.

Upon arriving at Portland, I was advised it had gone to ceiling zero and visibility 1/8 mile in blowing snow and freezing rain. I realized immediately that landing there would be impossible so I turned towards my alternate. I requested the weather at Paine AFB but because the sequence was garbled I was told to standby.

At this time I continued north towards my alternate and when approaching McChord, I decided to try a letdown there, weather permitting. I was advised that McChord had 300 feet, one mile and no GCA.

As I was approaching Seattle, I was advised that my alternate (Paine) had gone to 100 feet obscured and 1/4 mile in blowing snow and freezing rain. I requested information immediately regarding another alternate in the area. (In the back of my mind, I had mentally calculated my fuel requirements to return to Boise, Idaho, just in case a landing was not successful at any other field in the immediate vicinity.) I was advised that Whidbey Island Naval Air Station had 300 feet overcast and one mile visibility and light snow. I decided that I'd have enough fuel to make one approach at Whidbey Island and still be able to pull up in the event of a missed approach and return to Boise.

As I approached Whidbey Island, I was advised that a Navy R-5-D was in the GCA pattern and I would be cleared down as soon as he landed; however, that Navy plane had previously missed two approaches while attempting a GCA. It occurred to me then that the weather certainly couldn't be as good as reported since this transport type aircraft had missed two approaches. Finally I was advised that the R-5-D was on its final and I'd be cleared to start peneration. Penetration was commenced and when approaching procedure turn altitude, I was advised that the Navy transport had crashed on the runway and I would have to divert.

I knew then that my only other alternative was to return to Boise which I knew to be clear because I had flown over the area previously. I immediately initiated the climb to altitude; however, this was a case where it was better to level at 30,000 feet and capitalize on the existing tailwinds rather than use the extra fuel to climb to 40,000 where the winds were better.

I remained at 30,000 feet on a direct heading from Seattle to Boise. By this time I was in the soup and unable to receive any assistance on my radio compass. I knew my exact position, however, and the approximate heading. I flew time and distance until I was able to pick up the Pendleton, Oregon, range station. A bit of calculating indicated that I would be able to make a successful landing at Boise. I had further anticipated what I would do if I lost my radio compass or was unable to receive any signals. I knew that the ceiling from Pendleton to Portland was not below 20,000, and the height of any mountain in the United States is not over 14,800 feet. In view of these facts, I could make a successful penetration to get below a cloud layer and find myself by pilotage. This last recourse was not necessary, however, as all radio facilities came in loud and clear, and a successful landing was made at Boise. ▲

This narrative can certainly point out to all pilots, regardless of experience level, what can occur when circumstances start to snowball and the mission cannot be accomplished as originally planned. This demonstrates the need for good sound flight planning—with no short cuts.

... even high-flying jet jocks should look for the SPEED SIGNS

Capt. Robert A. McCauley
509th Fighter-Bomber Sq
Langley AFB, Virginia

THE JET STREAM could someday be a lifesaver for you. This would be more probable under combat conditions but it could conceivably come your way during peacetime, should you be in an outfit which realistically practices tactical training. Say, for instance, you're on one of those long range overwater navigation missions with aerial refueling, and it so happens that you can't find your tanker or—because of a malfunction—you can't take on fuel. It would be a shame if you were sitting under a jet stream with all the signs and didn't know it.

You—in your snug, little gold mine—don't have a free air temperature gage so you can't pick out the telltale temperature gradient (maximum westerly winds are located immediately on the warm side of the front). And you don't have the new APN-66 and APN-82 radars which use Doppler effect to permit radar tracking. But you do have a pair of eagle eyes and ample gray matter to look for, to find and evaluate *The Speed Signs.*

As I see it, you have six clues (visible or physical) which will help you locate the core or bore of the jet stream. The actual value of each factor might vary to some degree, depending on your flight altitude. I shall try to cover all the factors in such a manner as to permit easy and complete understanding. Your clues are:

- Haze Layer.
- Contrails.
- Cloud Types.
- Sky Color.
- Fluctuations of Airspeed Indicator.
- Clear Air Turbulence.

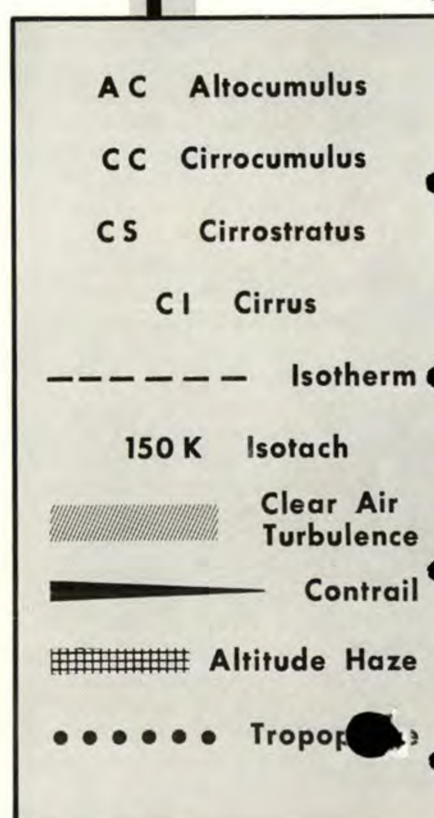
(The illustration should help you visualize what we are discussing. Remember that for the sake of simplicity and presentation, this cross-section contains all possible clues. The real thing doesn't necessarily have such a "pat" arrangement.)

Altitude Haze

This obstruction to visibility occurs near the top of the troposphere and greatly restricts the horizontal visibility but leaves vertical visibility unimpaired. As with contrails, altitude haze disappears when the tropopause is penetrated, indicating that it results from a collection of pollution particles trapped at the top of the tropopause. It is impossible to detect from surface observations. So it remains very important to remember that the full value of this clue cannot be realized until your aircraft reaches altitude. Once you are there, altitude haze can add precision to your altitude selection.

Contrails

Contrails usually start forming from 5000 to 7000 feet below the tropopause. They become more dense as the tropopause is approached, then tend to disappear immediately when it is penetrated. Their formation depends on temperature and moisture content. Notice on the cross-section how the contrail (exaggerated) thins out and disappears in area of dryer air. If this particular jet stream flows East, the aircraft would be on a heading of North. The moisture in the air, which is in a vapor state, is changed into ice crystals by agitation or addition of moisture and nuclei from combustion by-products or combinations of these.



Contrails disappear when the tropopause is penetrated. Better rear-view mirror arrangements would facilitate frequent contrail check without aircraft maneuvering. I think that a mirror rigged on the side of the front windshield near the canopy rail might be the answer.

Cloud Types

Cloud forms may provide a useful clue when properly interpreted. Four high and middle altitude cloud types frequently are associated with strong winds aloft. They are cirrus, cirrostratus, cirrocumulus and altocumulus. A rule of thumb for determining whether the jet stream is near states:

- At least three of the four basic cloud types must be present.
- The high clouds must be moving at jet stream velocities.
- The clouds must exhibit a coherent pattern extending for a considerable distance along the axis of the jet stream.

A broad sheet of feathery or tufted cirrus stretching from horizon to horizon along the path of the jet stream often can be found immediately to the South of the core.

The classic cirrus is characterized by rapid movement parallel to the course of the jet stream and by a finely barred structure with the bars perpendicular to the jet stream.

Curved "mare's tail" formations in the cirrus are cited as evidence of a horizontal line of violent wind shear just above the cloud level.

At lower levels, the jet streams are often accompanied by the lenticular (lens shaped) altocumulus clouds which usually are associated with vertical standing waves in the lee of mountain ranges. Time lapse photographs show that the clouds are actually at the crest of the waves made up of air moving at about twice the speed of the wave itself.

Cirrocumulus and billow type altocumulus also are frequently present and may stretch in parallel bands along the course of the jet stream from horizon to horizon.

The value of the cloud interpretation system is limited because sometimes no clouds develop in the vicinity of jet streams.

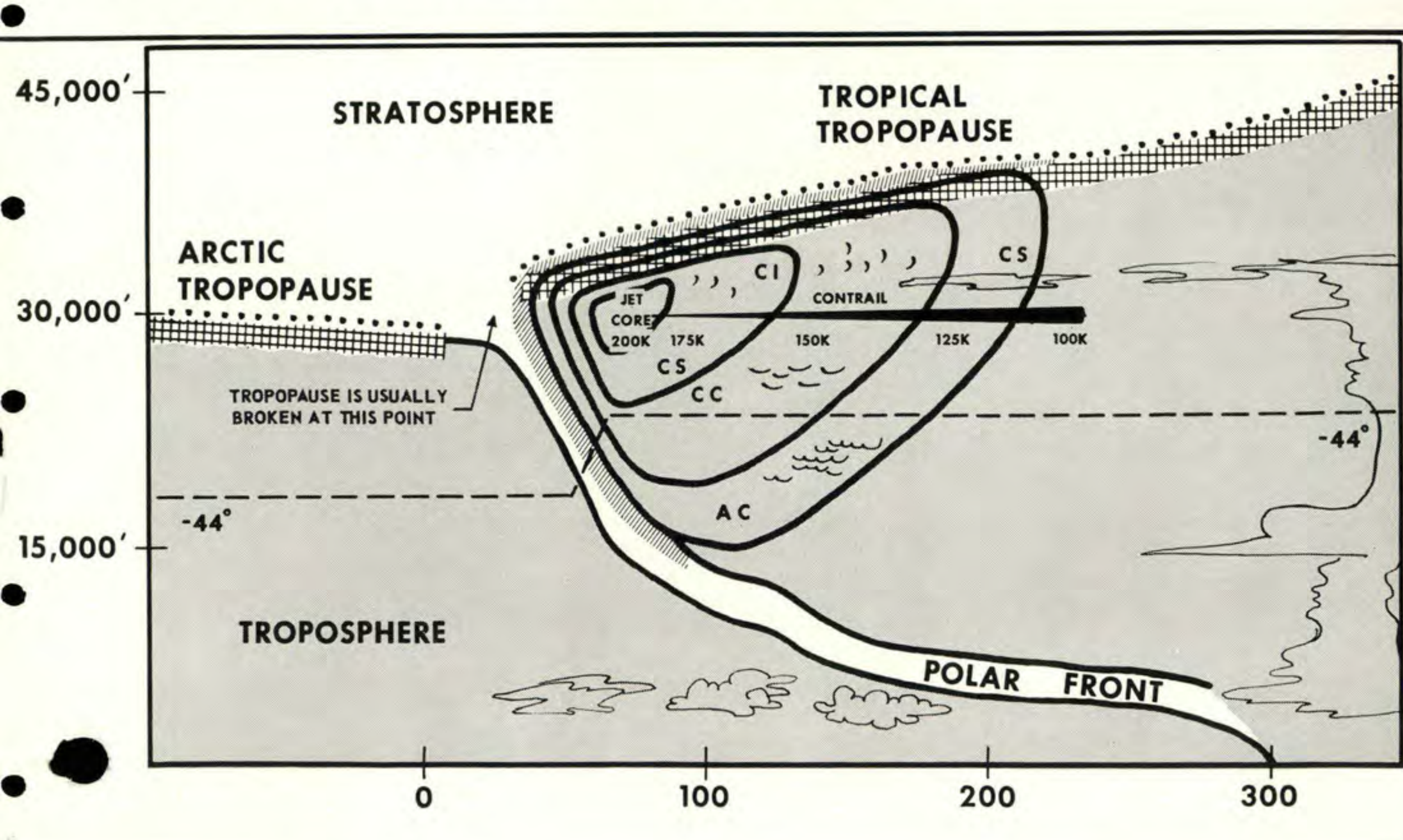
Sky Color

The air to the north of the core is usually perfectly clear and the sky is dark blue. Refer to the cross-section and it will be easy to see why.

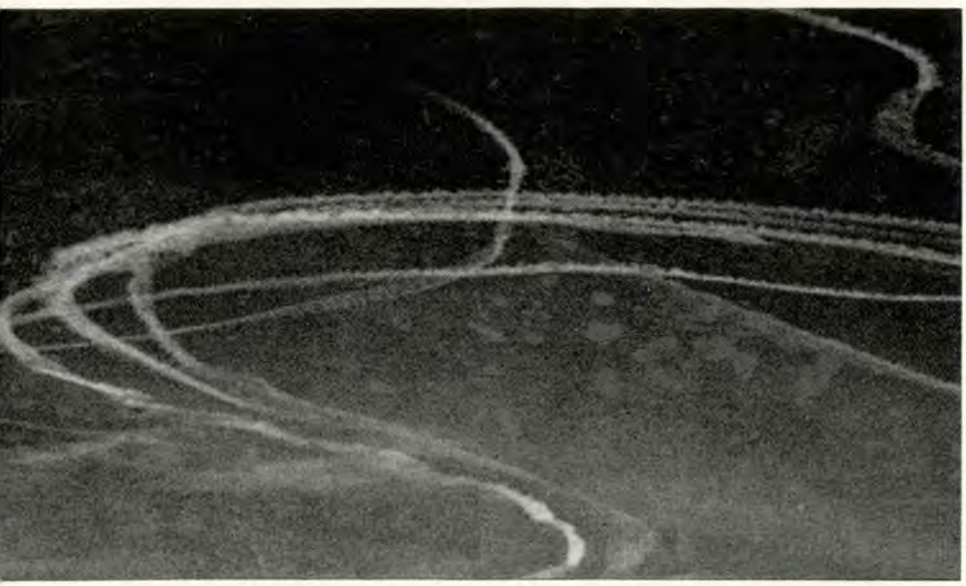
Airspeed Fluctuations

Get used to the sensitivity of your airspeed indicator needle. The advance notice that this clue could give

Notice how the core of the jet stream is situated in relation to the tropopause and polar front.



The turbulence around the stream feels like driving over a washboard road.



Contrails become more dense as tropopause is approached, then disappear.

you of nearby clear air turbulence might be worthwhile. You could include it in your instrument cross-check with no sweat.

Clear Air Turbulence

Let me use CAT for short. The best method of pilot inflight recognition of the jet stream, other than abnormal ground speeds, is the presence of CAT. This turbulence has been described in various manners, e.g., driving a car fast over a washboard or cobblestone road, as a series of irregular vibrations. CAT seldom results in a change of aircraft attitude. There is little pitching or rolling as the bumps follow one another. This is readily acceptable when we remember that we are dealing with the wind shear of an active cold front aloft. (Don't confuse CAT with any built-in buffet which some aircraft have at altitude at certain speeds.)

Wind values build up slowly across the peripheral regions to reach a maximum velocity at the center or core of the jet stream. Where the lines of equal wind speeds (isotachs) are close together, the rate of wind speed change (generally called *wind shear*) is much stronger. The wind shear is fairly severe on both sides of the jet. CAT is caused by turbulent eddies in regions of marked wind shear, that is, wherever wind velocities (speed and direction) vary sharply over short distances. Hence, it is generally associated with the tropopause and the edges of the jet stream.

Jet streams have nothing in common with jet aircraft. The name came from the similarity which exists between jet streams in the upper atmosphere and those studied for many years in hydraulics. They were so named in 1947.

Jet stream movement is most difficult to determine because the jets separate like an ocean current into smaller streams or fan out and get lost in the local circulation.

It seems ironic that even though the operational ceiling of your aircraft is getting higher and higher, the 35,000-foot level remains the best altitude for maximum jet stream winds. So don't get "steamed" if some second smoke in his T-Bird passes you up on your next cross-country. He just might know the high signs a little better than you do.

Where to Look

It is true that the maximum speed is generally found near the 250 millibar surface which is approximately 35,000 feet above sea level. Even so, jet streams have been found at all levels from 15,000 to 50,000 feet. Jet streams are believed to be a key part of the prevailing westerlies. Consequently, they are not found in the northern hemisphere north of the 70th parallel or much south of the 20th parallel. It is important that you learn the seasons for jet stream occurrence. This will depend on *where* you're flying on this globe. Check it!

Besides the gradual seasonal shift southward in summer and northward in winter of the mean position of the jet, each individual jet also exhibits a slow but definite shift southward during its life history. This shift is not necessarily steady but may be marked by periods of northward shift or by periods of almost no movement which lasts for several days or even weeks.

The jet stream is plotted by a heavy black line on the facsimile constant pressure chart for any wind velocity over 50 knots. In the weather station it is your most direct indication of possible jet stream activity. This heavy black line *only* locates *a zone*.

With the speed signs described herein, you might be able to pinpoint the jet core, or at least come closer than the heavy line.

Let the weatherman and fellow pilots in on your results, with pilot reports and/or a personal visit to the weather station upon landing. ▲

REX SAYS

TWO PILOTS of the 39th Fighter Interceptor Squadron have developed an idea which promises to reap large dividends. Captains David E. Davenport and Robert K. Milbrath, flight commanders in the F-86D All-Weather Interceptor Unit, are the pilots-turned-engineers.

The problem for which they have found an excellent solution was caused by the inclement weather. During periods of rain, snow and frost, the Dogs on air defense alert weren't provided adequate protection from the elements. Alert hangars like those found in ZI bases are not available at Komaki and standard aircraft tarpaulins were far from adequate. So, these pilots decided that a light, highly portable and economically constructed shelter was needed.

After much experimenting and planning they presented their idea to Lt. Col. Delair A. Clark, Commander of the 39th Fighter Interceptor Squadron. He gave them his full support and a test unit was constructed by the 6101st Field Maintenance Squadron.

The unit is a pipe frame, covered with light, waterproof fabric, mounted on large casters. It is positioned over the nose section of the '86D, completely covering the cockpit and compartments housing vital electronic equipment. It can be put in place by one man in a few seconds.

Further testing and modification is being carried on by Captains Davenport and Milbrath in conjunction with 39th maintenance personnel. At present, more units are being constructed to provide protection for all aircraft at the alert pad.

Through their efforts, a large savings in materiel and manhours should be realized by eliminating water damage to aircraft electronic equipment.

***REX SAYS**—This is a brief example of how two line pilots contributed to the Air Force effort. In this day of electronics, missiles and rocket aircraft, we sometimes feel as if our contributions are so insignificant that they are not worthy of consideration. I hope this article will erase any doubt you may have as to the importance of the ideas originated by you. Get them in the mill. The Air Force can use them.*

The two officers responsible for the protective canopy device are pictured with the end product.

TACAN is here!

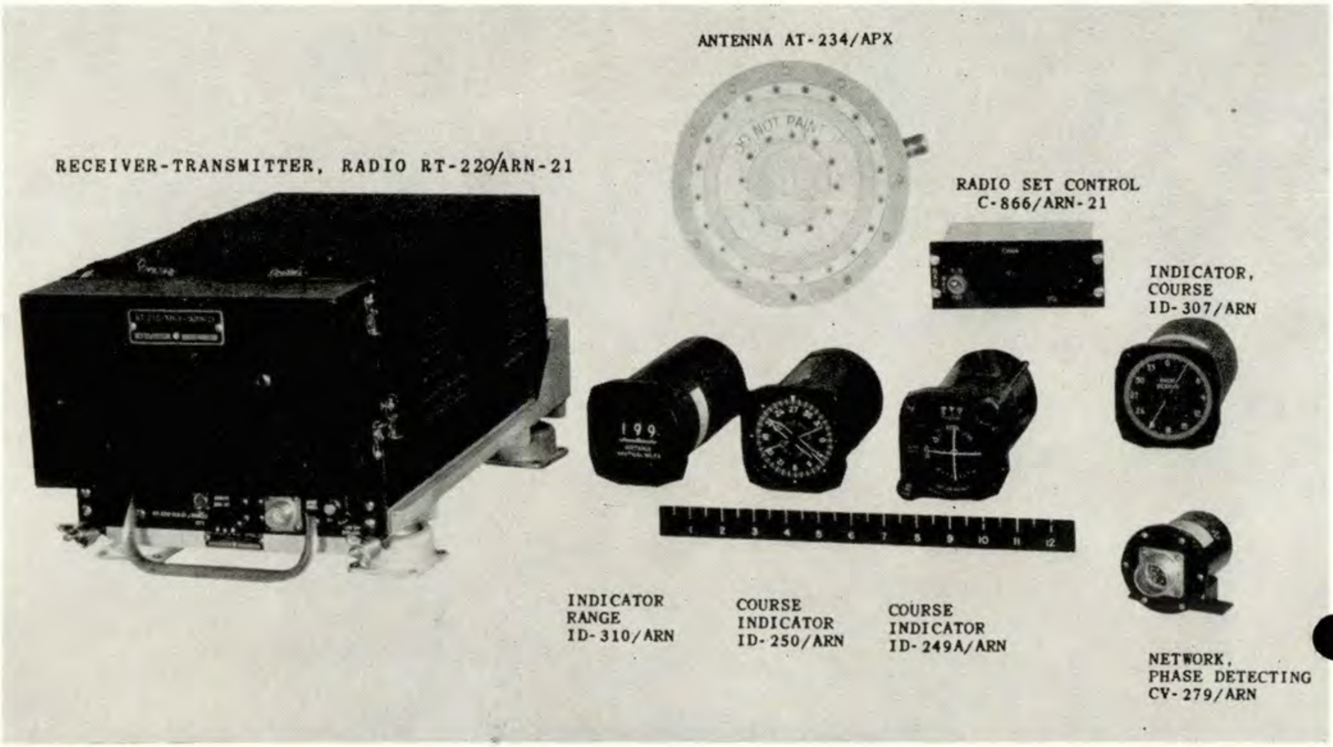
Major Robert C. Anderson, USAF

The recent adoption of TACAN by the President's Air Coordinating Committee as an element of the U. S. Common System of Air Traffic Control and Navigation marks an important milestone in the progress towards a truly "common" system. Major Anderson worked at WADC in testing and evaluating the TACAN equipment.

DO YOU ALWAYS know where you are? Have you ever said "I was not lost—just misplaced." Has ATC ever put you in a dither by asking your position before you were ready to answer? If these questions hit close to home, perhaps the information given here will give you hope for the future.

A new navigation system is being implemented. It's called TACAN. When the word was first coined, it meant "Tactical Air Navigation." Since that time, however, its use has become more universal. It is no longer restricted to tactical use. The Air Coordinating Committee decided recently to adopt TACAN as an element of the U. S. Common System of Air Route Traffic Control and Navigation. This means that the Civil Aeronautics Administration will have the responsibility for furnishing TACAN beacons for all but purely military requirements. These CAA-furnished beacons will be coaxially located with VORs at CAA's existing or programmed VOR sites. Such a facility will be called a VORTAC and will provide distance and azimuth and VOR azimuth. The DME portion of VOR/DME, due to its frequency conflict with TACAN, will be phased out as TACAN is implemented.

Figure 1, below, shows the airborne components of the system.



The instrument shown above presents the heading, bearing and distance.

All of the possible questions regarding this system cannot be answered here; however, answers to the following will be attempted.

- What is TACAN?
- How does it work?
- What will it do for me?
- How do I use it?
- What are its limitations?
- When will I have it to use?

Many volumes of a technical nature have been published on this subject; however, our objective is to avoid gobbledegook and discuss it as it affects us in an airplane.

What is TACAN? It is a short range, omni-bearing, distance-measuring, navigation system. From the pilot's viewpoint, it is identical to the VOR system, except that the function of distance has been added. In fact, some 295 TACAN stations will be installed at the locations now used for VOR.

Figure 1 shows the airborne components (AN/ARN-21) of the TACAN system. The AN/ARN-21 weighs approximately 65 pounds and occupies one cubic foot of space. It incorporates receiving equipment for both azimuth information and distance information in one package and the results are displayed on three indicators. Of the three indicators which appear on the panel, two are very familiar (ID-248 and ID-250). The third, called the ID-310 or DME, is a new one which indicates the distance from the aircraft to the ground station in nautical miles, between zero and 200. These three instruments are planned for most USAF aircraft.

The crosspointer (ID-249) instrument is not absolutely necessary, although very desirable. Without it, bearing and distance to the station are still available, and for some aircraft with limited panel space, a new instrument will be used. This instrument, called the ID-416 (Figure 2), presents heading, bearing and distance—all on its three-inch face. As presently planned, it will only be used on space premium aircraft.

How does it work?

Like all electronic brainstorms, TACAN is loaded with tubes, resistors, condensers, and stuff like that.

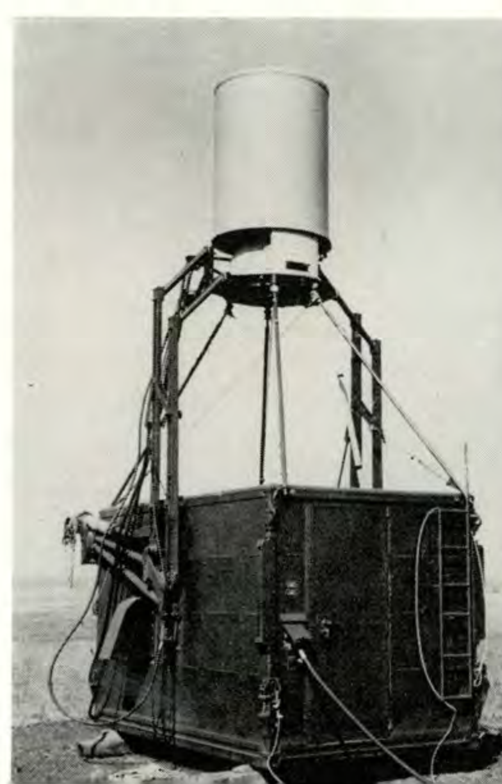
Figure 3 is a picture of the TACAN ground station. The cylinder on top is the antenna cover. Inside this cover the antenna spins at a constant speed, and radio energy is sent out in a manner very similar to the light beam from a revolving airport beacon. Suppose an airport beacon light were to blink each time it swept past magnetic north and you measured the time from that blink until the beam swept past your aircraft. You could then determine your position anywhere around the beacon. If the beacon revolved at a speed of one degree per second, and you measured 120 seconds between the north blink and your aircraft, you would be on the 120-degree radial.

The bearing part of TACAN does exactly the same thing with a radio beam, and then it presents the picture on an instrument in the cockpit.

The distance measuring part of TACAN is another time function, very similar to radar. The black box in the aircraft sends a pulse of energy to the ground station and waits for an answer. The ground station receives the query and sends an answering pulse back to the airplane. The round trip time is translated by the airborne equipment into nautical miles and presented on the instrument. Don't worry about the ground station being busy answering other aircraft. Recent tests showed that more than 122 aircraft can get answers at the same time.

What will TACAN do for me? Any time you are within range of a ground station, it will tell you your bearing and distance to it. The bearing will be accurate to plus or minus one degree, and the distance to within two-

Below, shows the TACAN ground equipment.



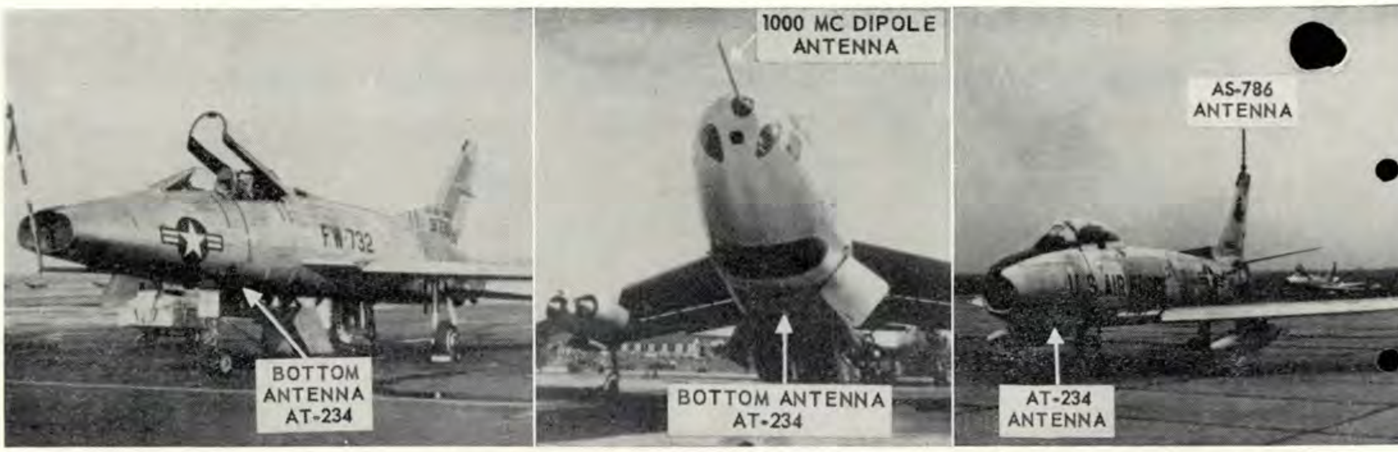
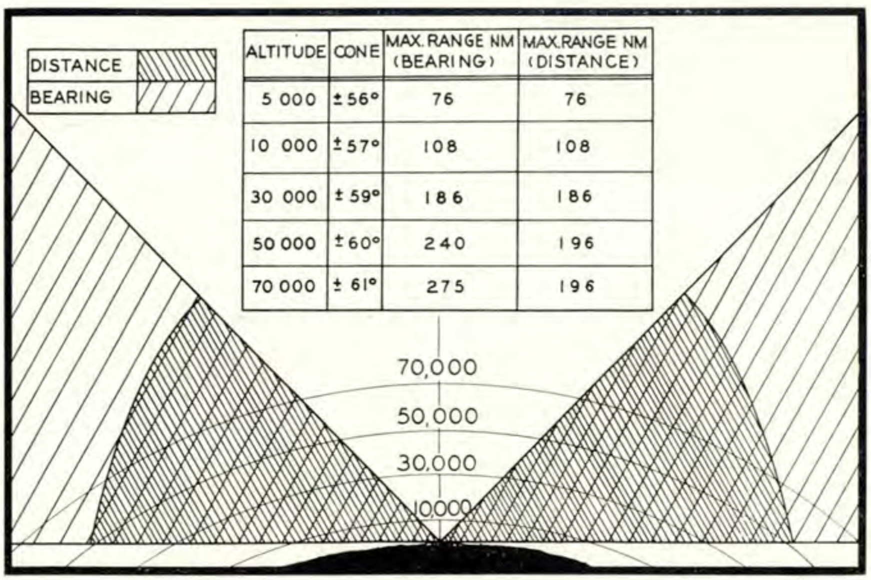


Figure 4. Above are pictured aircraft showing some of the experimental antenna locations.



ALTITUDE	CONE	MAX. RANGE NM (BEARING)	MAX. RANGE NM (DISTANCE)
5 000	±56°	76	76
10 000	±57°	108	108
30 000	±59°	186	186
50 000	±60°	240	196
70 000	±61°	275	196

Pictured above is graphic illustration of TACAN coverage. Like OMNI, the higher the better.

tenths of a nautical mile. When ATC requests your position, you can tell them immediately and be sure that you are right. That is something!

It can be used to check radar fixes and help the radar operators identify specific aircraft. Some Alaska flyers are doing this every day. It will permit straight-in approaches from 200 miles out. It will make possible letdowns on fixes located many miles from the ground station. A computer, which may be added, permits approaches to bases with no letdown or approach facilities. Operational use will, no doubt, uncover many other uses for this system.

The next two questions, *How do I use it?* and *What are its limitations?*, can best be answered together.

Let's take an imaginary flight and explain TACAN as we go along.

First, on the ground in the cockpit, we locate the control box. (Figure 1.) There are 126 possible channels spaced one megacycle apart from 962 to 1213 mcs. These channels are represented by number from one to 126 on the control box. From the Facility Chart we select the channel number of the station located near our base. The power switch has three positions: OFF, REC and T/R. Normally, the T/R position will be used. The REC position disables the distance function. It is used whenever it is not desired to radiate energy from the aircraft (for instance, over enemy territory).

While the unit is warming up, the number two needle on the RMI (ID-250) will rotate clockwise, the vertical crosspointer on the ID-249 will move from side to side and the DME (ID-310) will count from zero to 200 repeatedly. When the unit has warmed sufficiently, these movements will stop and the set will lock on to the station. This means that the instruments now indicate the bearing and distance to the ground station. At some locations, the set may not lock on on the ground because TACAN is a line-of-sight system. This will be the case if the ground station is shielded from the aircraft antenna by any obstruction, such as a hill, a hangar or the aircraft itself.

Figure 4 shows the experimental antenna locations used on several different aircraft. If the ground station is located on a hill and the aircraft antenna is mounted on the underside of the aircraft, there's a chance that the wing or fuselage will shield the two antennas and the set will not lock on. But in most cases it will.

Back to the flight. The set has locked on, we're airborne and climbing on course. The desired course is set in the window of the ID-249 and to stay on course, we fly to keep the vertical needle close to the center, just as we do the VOR. We're not far from course if it isn't exactly in the center but that doesn't mean that we can get sloppy. The complete sweep from full left to full right represents 18 degrees, and that means 18 miles when 60 miles out from the station. Stay close to course.

We level off at 30,000 with everything working beautifully. We're on course and the distance indicator shows an increase until it reads 196

miles, but it doesn't go any higher. No sweat, however, this is a normal quirk of the system. Even though the distance stops working at 196 miles, the course indicator continues to operate for several more miles and then everything starts to spin. This means that we are out of range of the station so we tune in the next one on our flight plan and continue.

An experimental airway was used to test the system about one year ago. As we approach the second station, the bearing needle starts to rotate, or search, but the distance continues to read correctly and as we fly over the station, the distance never gets less than 5.2 miles, and then it starts to increase. The bearing continues to search until we are well past the station and then it locks on again.

Why do these things happen? The distance never reads zero miles from the station because we were never zero miles from it. When we were directly over the station at 30,000 feet, we were 5.2 miles away, in a vertical direction. This point must always be kept in mind when flying near a ground station: TACAN measures the slant range between the aircraft and the ground station and not the horizontal distance. At first thought, this might seem like a serious deficiency in the system, but a second look tells us that all radars read slant range and for good traffic control, both of the systems must measure distance in the same terms.

While passing the station, we noted that the bearing indicator searched for an unusually long time. The cause of this phenomenon is another characteristic of the system. The cone of confusion (cone of silence) is 120 degrees in width. This is twice the size of the confusion zones on most earlier systems. At 30,000 feet, you will be in this area for a distance of about 18 miles, and at 50,000 for a proportionately greater distance. To compensate for this feature, Air Traffic Control's reporting and letdown procedures will probably be changed. Rather than reporting over a station, pilots will probably report at a given distance and on a given radial from the station.

Continuing our imaginary flight, we climb to 51,000 feet and note that the set stops working. This happens because a barometric switch automatically turns the equipment off whenever it is above 50,000 feet. Later models will be pressurized which will eliminate this situation.

It is not necessary to pass over the station at destination to get a positive fix, so we can start a straight-in letdown from any point and thereby save time and fuel. (Letdown procedures have not been definitely established; however, they'll be published as soon as the necessary coordination with CAA and other agencies has been completed.) Now, let's land and continue this discussion.

There are a couple of remote possibilities which might cause abnormal operation of TACAN. The odds are about 10,000 to one that they'll ever happen, but the more we know about a system, the more use we can get out of it. The basic principles of the system make possible a bearing error of 40 degrees or any multiple of 40 degrees. If you ever see an error of this magintude, it will be near the maximum range of the ground station or near the cone of confusion. Ordinarily these errors last for less than one minute. They will correct themselves—except in that 10,000th time and then you will recognize the situation because the error will be so large.

The other possibility is that the set may try to lock on to two stations at the same time. This again is a remote possibility because stations operating on the same channel will be located as far from one another as possible. In congested areas, however, it may become necessary to locate two stations on the same frequency within 400 miles of each other. At high altitudes, halfway between the two stations, the TACAN will become confused. Don't let this shake you, just hold your heading for a few minutes and it will point to the station that is nearest.

Much of this may seem like fault-finding. I've flown the system throughout its development, and believe me, it's the most. The only reason for explaining some of its oddities is to make all flights safe, through the understanding of equipment.

The last question read, *When will we have it to use?*

Some ground stations are being installed today and the system is expected to be ready in the ZI by 1959. Overseas installations will be phased in, some before and some after that date. New aircraft will receive the equipment on the production line and older aircraft will be retrofitted as soon as practicable.

In summary, TACAN is the new short range, omni-bearing, distance measuring navigation system which will be available for military and civilian use in 1959. ▲

CROSS FEED

LETTERS TO THE EDITOR

Bouquets and Brickbats

Many thanks for Lt. Col. Mulholland's articles. Not only was each article individually the greatest, but the combination of all was the best presentation of subject matter I have seen in FLYING SAFETY to date. And you've sure had some fine ones through the years! Although an officer of Colonel Mulholland's qualification, experience, and professional ability must be in great demand, let's hear from him again on occasions for the benefit of the system and all concerned. Many of the flying safety anecdotes that I have discussed in Instrument School presentations for pilots of ADC Headquarters have been gleaned from your publication. Col. Mulholland's articles are at the top of my recommended reading list.

Now for a brickbat instead of a bouquet. In reference to the November issue, "Chart Chatter," page 27, second from the last paragraph: "—snip off a small triangular square—." This is readable writing? I just cut off the corner in the shape of a triangle and it works good. I'm still trying to find a triangular square. Maybe it's me.

One more comment from this writer. A recent article in Air Force Times concerned a lost T-33 due to complete inverter failure. This boy apparently didn't know because nobody told him all the answers on VOR equipment.

With both inverters "out," the Course Deviation Indicator in relation to the course selected and the ambiquity (To-From) window still are operational. No need for great panic here. Major W. E. Preble of ADC recently, ably returned to Colorado Springs from out of the West, under similar conditions. Using the VOR equipment he had left in connection with stand-by compass and ILAS, the flight was methodically completed with no radar in the area.

Know the aircraft and equipment, and fly it accordingly. Knowing what you have left and how to get the most from it may save an aircraft. The lad in Air Force Times lucked out through aid from GCI. I don't mean, however, to take any praise from GCI for a job well done.

Capt. George E. Kammerer
Asst Base Ops Officer
Peterson Field, Colorado

Thank you for your gracious comments on Col. Mulholland's articles and FLYING SAFETY, in general.

Our apologies for having you attempt to cut a square circle, correction—triangular square. And, lastly, thanks for your comments on the OMNI. There is no substitute for knowing your equipment.

★ ★ ★

Rain Repellent

Several months ago, FLYING SAFETY published an article entitled "The Forward Look." It discussed in detail the merits of a rain repellent for use on windshields and canopies of aircraft. The article, however, did not include information as to the procurement of such a rain repellent.

We fly the B-50 and this, in itself, should explain why we are interested in any product or theory that might improve the forward visibility from the pilots' positions. The plexiglass nose of this aircraft, even when dry, presents some serious handicaps to visibility. When that same "nose" is covered by any precipitation, visibility is dangerously affected.

The most desirable solution, from a pilot's point of view, would be for the whole nose section to be modified to permit proper visibility forward without all the obstructions caused by the reinforcing frames around the many "little windows." We realize that it is very unlikely that the Air Force would undertake such a project on an outmoded aircraft, but it certainly would be a great step towards flying safety in the B-50.

Now, back to the original subject of this letter. We request that we be provided with the name, stock number and specifications for the rain repellent discussed in your article. We'd like to requisition some of this rain repellent. Also, we would appreciate it greatly if you could arrange to have a sample quantity sent to us as soon as possible. Operating under the type of weather typical of the Rhein Main area, we can certainly use anything at all that will aid in the improvement of visibility from this aircraft. I am sure you realize that the flying weather in this area is comparable to the worst in the United States (i.e., Pittsburgh area).

We'd like to suggest, if possible, you make it a practice to include the name, specifications and stock numbers for new products reviewed or cited in your magazine. We'll be very much interested in your reply to this letter and will appreciate any information you may forward to us.

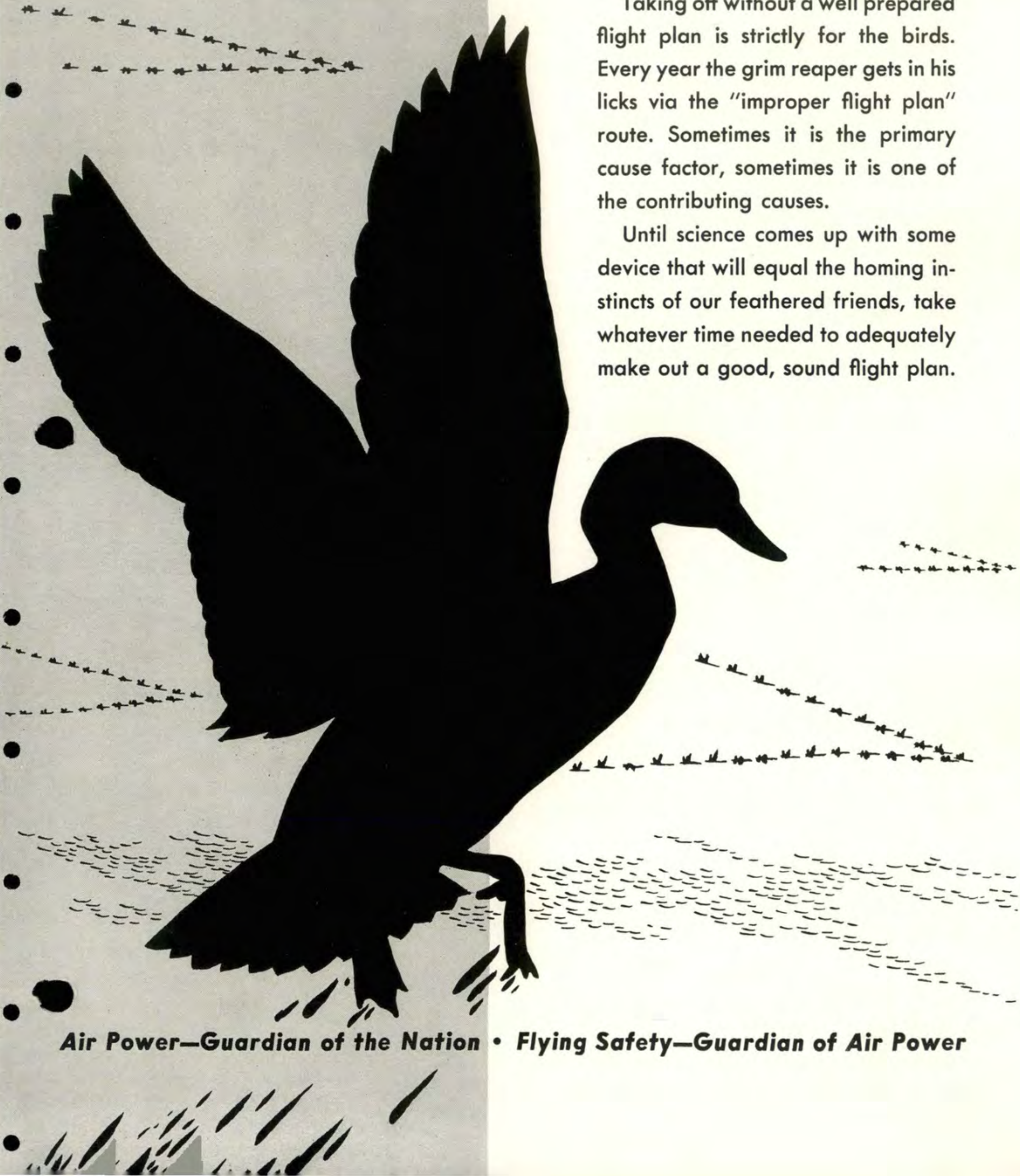
Captain Edwin R. Gardner, Jr
7406th Support Sq USAFE

Rain Repellent Kits come in two forms. Kit Type One is made by Foster D. Snell, Inc., under Stock No. 29110-17288. Type Two is put out by the Canadian Research Council, AF Stock No. 6850-341-8430. T.O. 42D 1-4 may be used as authority for requisitioning kits, via channels, through the Topeka Depot.

.....for the birds!

Taking off without a well prepared flight plan is strictly for the birds. Every year the grim reaper gets in his licks via the "improper flight plan" route. Sometimes it is the primary cause factor, sometimes it is one of the contributing causes.

Until science comes up with some device that will equal the homing instincts of our feathered friends, take whatever time needed to adequately make out a good, sound flight plan.



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