RESTRICTED

HILL [illegible] B.
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JAMES B. HILL, JR. O-

PILOTS'



Information

FILE

HILL, JAMES B.
O-823581

RESTRICTED

NOTICE: This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act, 50 U.S.C., 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

THIS BOOK CONTAINS THE REVISIONS LISTED BELOW

REVISION NO.	DATE	REVISION NO.	DATE
1	MAY 20, 1943		
2	AUG. 1, 1943		
3	OCT. 1, 1943		
4	DEC. 1, 1943		
5	JAN. 1, 1944		
6	FEB. 1, 1944		
7	MARCH 1, 1944		
8	APRIL 1, 1944		
9	MAY 1, 1944		
10	JUNE 1, 1944		
11	JULY 1, 1944		
12	AUGUST, 1944		
13	SEPT. 1944		
14	NOV 1 1944		
15	JANY 1945		

AS YOU PLACE REVISIONS IN THIS BOOK,
WRITE REVISION NUMBERS AND DATE IN SPACE ABOVE

AAF REGULATION)
NO. 62-15)
EXTRACT)

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON, 24 NOVEMBER 1944

FLYING SAFETY

Information Files

(This Regulation supersedes AAF Regulation 62-15, 28 February 1944 and 62-15A, 1 May 1944.)

1. **General.** To promote safe flying and operational efficiency, AAF pilots, navigators, bombardiers, flight engineers, flight surgeons, aviation medical examiners and airborne radio operators who are on flying status must be familiar with many items of a general nature, with the results of current research, and with other instructions and information found in a variety of War Department, AAF, and other pertinent publications which are not always readily available to them. These items will be selected, organized, and presented in simple, non-technical form in loose-leaf books, to be designated as follows:

a. For pilots, flight surgeons, aviation medical examiners who are on flying status, and flight engineers: The "Pilots' Information File" (PIF).

* * * * * *

2. **Publication of PIF, NIF, and BIF.** The Office of Flying Safety will be responsible for the selection of items, the coordination of the material, the form and treatment of the subject material, the proper illustration of the text, and the publication of the Files. That office will be responsible for the publication of necessary revisions. It is authorized to deal directly with all AAF organizations and establishments in gathering and coordinating instructions and information for the Files. All AAF establishments will submit items which they desire to have included in the Files directly to Office of Flying Safety, Information Files Branch, Buhl Building, Detroit 26, Michigan.

3. * * * * * *

4. **Table of Contents.** A table of contents, listing, numbering, and dating all current subjects, will be published for each File. Each table of contents will be revised every three months. The use of the tables of contents is outlined in AAF Reg. 15-24.

5. **Distribution in Continental United States.** These Information Files and revisions thereto will be distributed by the Chief, Office of Flying Safety on the following basis:

a. PIF: Through Base Operations Officers, one copy to each pilot, each flight surgeon, each aviation medical examiner who is on flying status, and each flight engineer in the domestic area. One copy to each aviation cadet. Two copies to each base operations office, group, and squadron. Copies as required to the regularly established files of AAF organizations and establishments. Copies to AAF schools and training establishments as necessary for the training program, and such copies as the Chief, Safety Education Division shall determine as necessary for the accomplishment of his basic directive.

* * * * * *

6. **Distribution in Overseas Theaters.** If commanding officers in overseas theaters and "alerted" areas so direct, PIF, NIF, BIF, ROIF, and revisions thereto will be procured by requisition to the Director, Air Technical Service Command, Wright Field, Dayton, Ohio, through Air Service Command distribution centers located in the theaters concerned.

7. **Compliance.** Commanding officers will be responsible that personnel specified in paragraph 5 certify that they have read and understand all instructions and information contained in their respective Files; and that they place the revision sheets issued to them in their personal copies of the Files so that their Files are currently correct. Compliance with this directive will be recorded as follows:

a. For pilots, flight surgeons, aviation medical examiners on flying status, and flight engineers: Form 24 (the PIF table of contents) will be signed and used as a permanent record of compliance. When PIF and revisions thereto are distributed, they will be accompanied by compliance forms (AAF Form 24A), which will provide temporary records of compliance. The use of AAF Forms 24 and 24A is set forth in AAF Reg. 15-24.

* * * * * *

e. For all other personnel authorized to receive PIF, NIF, BIF or ROIF as set forth in paragraph 5 and for whom no Form 5 files are maintained, the record of compliance will be as directed by commanding officers.

8. **Retention of Permanent Forms.** Commanding officers will be responsible that permanent forms referred to in paragraph 7 are retained for record as directed in AAF Reg. 15-24.

9. **Familiarity with Instructions Regarding Equipment.** In addition to the provisions of this Regulation, commanding officers are responsible for insuring that pilots are thoroughly familiar with all instructions and information pertaining to equipment to be flown, as provided in AAF Reg. 50-16.

10. **Activities Exempt from These Provisions.** AAF activities operating in overseas theaters and AAF activities operating in domestic areas under "alert" orders will be exempt from the provisions outlined herein to the extent determined by the commanding officer concerned.

11. **Definitions.**

a. The term "pilot" will be construed to mean any individual who holds a currently effective military aeronautical rating of Command Pilot, Senior Pilot, Pilot, Service Pilot, Liaison Pilot, or Glider Pilot.

* * * * * *

d. The term "flight engineer" will be construed to mean any individual who holds a currently effective military aeronautical rating of aircraft observer (Flight Engineer).

e. The term "flight surgeon" will be construed to mean any Medical Corps officer who is currently designated as a flight surgeon by the Commanding General, AAF.

f. The term "aviation medical examiner" will be construed to mean any Medical Corps officer who is currently designated as an aviation medical examiner by the Commanding General, AAF.

* * * * * *

By command of General ARNOLD:

OFFICIAL SEAL

HQ AAF

BARNEY M. GILES

Lieutenant General, United States Army
Deputy Commander, Army Air Forces and
Chief of Air Staff

AAF REGULATION)
NO. 15-24)
EXTRACT)

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON, 23 NOVEMBER 1944

BLANK FORMS

AAF Form 24 —PIF Table of Contents
AAF Form 24A —Temporary Compliance Certificate for PIF
AAF Form 24N —NIF Table of Contents
AAF Form 24NA—Temporary Compliance Certificate for NIF
AAF Form 24B —BIF Table of Contents
AAF Form 24BA—Temporary Compliance Certificate for BIF
AAF Form 24R —ROIF Table of Contents
AAF Form 24RA —Temporary Compliance Certificate for ROIF

(This Regulation supersedes AAF Reg. 15-24, 28 Feb. 1944 and AAF Reg. 15-24A, 2 Aug. 1944.)

TABLES OF CONTENTS OF INFORMATION FILES

1. AAF Form 24 is the table of contents for the Pilots' Information File.

* * * * * *

Each has two uses:

a. As a part of the Information File for which it is the table of contents for a three-month period (until it is replaced by a revised current table of contents). Each will list, date, and number all current subjects in its pertinent Information File. An asterisk (*) prefixing any subject will indicate that the subject has been revised or added since the previous table of contents was issued.

b. As a compliance certificate for its pertinent Information File: Personnel specified in AAF Reg. 62-15 as being required to comply with pertinent information files and for whom a Form 5 file is maintained will sign the Form 24, 24N, 24B, or 24R (whichever applies). When a new table of contents is issued, it will replace the one in the Information File, and the replaced Form (24, 24N, 24B or 24R), properly signed, will be placed in the Form 5 file of the individual concerned, where it will remain as a record of compliance until the next issued Form (24, 24N, 24B or 24R) replaces it. Compliance records for personnel authorized to receive pertinent Information Files and for whom Form 5 files are not maintained will be kept as directed by Commanding Officers.

2. **Publication.** Under the authority contained in AAF Reg. 62-15, the Chief, Flying Safety will revise and publish AAF Form 24, 24N, 24B and 24R every three months. In order to facilitate identification of the date of issue, there will be a color band along one border of the respective Forms as follows:

Form 24 Issue of 1 August (any year)—Blue
Issue of 1 November (any year)—Yellow
Issue of 1 February (any year)—Red
Issue of 1 May (any year)—Gray

* * * * * *

3. **Distribution.** AAF Form 24, 24N, 24B or 24R will be distributed by the Chief, Office of Flying Safety through Base Operations Officers:

a. As a part of every complete volume of the Information File for which it is the table of contents.

b. As one sheet of revisions to the Information File to which it belongs, issued as follows:

Form 24: PIF Revisions dated 1 August, 1 November, 1 February, and 1 May.

* * * * * *

c. Upon letter request to: Office of Flying Safety, Information Files Branch,
Buhl Building, Detroit 26, Michigan.

TEMPORARY CERTIFICATES OF COMPLIANCE

4. Since Forms 24, 24N, 24B, and 24R are retained in their respective Information Files for the three-month period for which they are the current tables of contents, it is necessary to use temporary certificates of compliance for revisions which may be issued in the interim. Such temporary certificates will be issued as follows:

Form 24A for Pilots' Information File

* * * * * *

Each such temporary certificate of compliance form consists of two sections; a small detachable bottom section, the use of which is described in sub-paragraph a, below and a main upper section, the use of which is described in sub-paragraph b, below:

a. The detachable section at the bottom of each form is provided as a receipt for revision sheets (or for the complete volume of the pertinent Information File issued to any individual entitled to it). The individual receiving any Information File material will indicate by signature thereon that he has received it. Operations Officers will hold such receipts for their records until the compliance (main upper section of Form 24A, 24NA, 24BA or 24RA) is received. Whenever Information File material is issued to any individual entitled to it at any station other than his home base, his receipt (the lower detachable section) will be forwarded by the issuing agency to the base operations office of the recipient's home station.

b. The main (upper) section of Forms 24A, 24NA, 24BA and 24RA will list in red the revision number and the page numbers for which each is to serve as a temporary compliance certificate. When issued with the complete volume of the Information File, it will indicate that it applies to the complete volume of the pertinent Information File and indicate (in red) the revision numbers contained as an integral part of that edition of the Information File. An individual concerned will sign this portion of the Form to certify that:

(1) He has read and understands the Information File material listed therein.

(2) He has **removed** from the Information File and **destroyed** all sheets that specific instructions printed on the envelope which contains the Information File material direct him to remove and destroy.

(3) He has placed each revision sheet listed in the compliance certificate in its proper place in the Information File.
When the individual concerned has complied with (1), (2), and (3) above, **(and not before)**, he will sign the compliance certificate (the upper section of Form 24A, 24NA, 24BA or 24RA) and return it to the base operations officer at his home station.

5. Operations Officers will be responsible that the properly executed compliance certificate (upper section of Forms 24A, 24NA, 24BA, or 24RA) is returned within a reasonable time (but in no case longer than 30 days after receipt) and, in the case of personnel for whom Form 5 files are maintained, placed in the Form 5 file of the individual concerned. It will remain there until the individual has executed the next dated table of contents (Form 24, 24N, 24B, or 24R, whichever applies) and turned it in, when all previously dated compliance certificates (Forms 24A, 24NA, 24BA or 24RA) and the previous table of contents will be removed and destroyed. Compliance certificates for personnel for whom Form 5 files are not maintained will be retained for record as directed by commanding officers.

6. **Distribution.** AAF Forms 24A, 24NA, 24BA and 24RA will be published by the Chief, Office of Flying Safety and distributed:

a. Through Operations Officers, automatically inclosed with each set of revisions and each complete volume of any Information File.

b. Upon letter request from Operations Officers to:

Office of Flying Safety, Information Files Branch
Buhl Building, Detroit 26, Michigan

7. **Destruction of Unused Forms.**

a. Unused Forms 24, 24N, 24B and 24R become obsolete and will be destroyed six months after the date of issue.

b. Forms 24A, 24NA, 24BA and 24RA held in excess of the material to which they apply will be destroyed.

By command of General ARNOLD:

OFFICIAL SEAL
HQ AAF

BARNEY M. GILES
Lieutenant General, United States Army
Deputy Commander, Army Air Forces and
Chief of Air Staff

WAR DEPARTMENT
A.A.F. FORM No. 24
APPROVED 4-1-43

TABLE OF CONTENTS *Pilots' Information File*

When you place this form No. 24 in your PIF, remove the old form 24, dated Aug., Sept., Oct., 1944, sign it, and give it to your base operations officer.

In accordance with the provisions of AAF Regulation 62-15, and 62-15a, all AAF pilots, designated flight surgeons, designated aviation medical examiners, and flight engineers in the United States will certify that they have read and understand all instructions and information contained in Pilots' Information File. They will do so by signing in the space provided at the end of the Table of Contents. Remove the old Table of Contents for Aug., Sept., Oct., 1944 now. Sign it and give it to your Operations Officer for placement in your Form 5 file.

Subjects preceded by an asterisk (*) have been revised or added to PIF since Aug. 1, 1944. Be sure your copy of PIF contains all amendments. Read them carefully before signifying compliance on Form 24A.

Check with operations offices regularly to be sure you have all current amendments to PIF and Table of Contents. The Table will be revised quarterly and distributed on the same basis as the Pilots' Information File.

Blank spaces at the end of sections are for your convenience. Enter new subjects in their proper place as you receive them.

AUTHORITY FOR PIF—AAF REGULATION 62-15
TABLE OF CONTENTS—AAF FORM 24:

Subject and Date	PIF No.	Initials Note Compliance
SECTION ONE—GENERAL		
*Pilots' Responsibilities (Nov. 1, 44)	1- 1	
Flying Safety (July 1, 44)	1- 2	
Safeguarding Classified Material (May 1, 44)	1- 3	
How to Use PIF (Feb. 1, 44)	1- 4	
Technical Orders (May 1, 43)	1- 5	
Unsatisfactory Reports (Oct. 1, 43)	1- 6	
Flying on a Red Diagonal (May 1, 44)	1- 7	
Transition Flying Training (May 1, 43)	1- 8	
Instrument Flying (May 1, 44)	1- 9	
Time Credit (Aug. 1, 44)	1-10	
Aeronautical Ratings (Aug. 1, 44)	1-11	
Reporting Aircraft Accidents (Aug. 1, 44)	1-12	
Forms (Aug. 1, 44)	1-13	
SECTION TWO—FLIGHT		
AAF Flight Control (June 1, 44)	2- 0	
Air Traffic Rules (July 1, 44)	2- 1	
Clearance for Aircraft (July 1, 44)	2- 2	
Radio Change in Flight Plan (July 1, 44)	2- 3	
Passengers in Aircraft (July 1, 44)	2- 4	
Air Space Reservation and Flight Hazards (Feb. 1, 44)	2- 5	
Low Flying (April 1, 44)	2- 6	
Crew Requirements for Multi-engined Airplanes (May 1, 43)	2- 7	
Taxiing—Ground Crew Signals (Oct. 1, 43)	2- 8	
*Takeoff, Landing Precautions (Sept. 1, 44)	2- 9	
*Check Lists (Nov. 1, 44)	2-10	
Marking Obstructions (June 1, 44)	2-11	
Runway Markings (June 1, 44)	2-12	
Camouflage (Oct. 1, 43)	2-13	
*Radio Equipment (Sept. 1, 1944)	2-14	
*Instrument Landing System (Sept. 1, 44)	2-15	
*Radio Procedure (Sept. 1, 44)	2-16	
Visual Signals for Formations (May 1, 43)	2-17	
Tower Light Gun Signals (May 1, 44)	2-18	
*Flight Limitations (Sept. 1, 44)	2-19	
*Spins and Stalls (Sept. 1, 44)	2-20	
*High Speed Dives (Sept. 1, 44)	2-21	
Engine Failure on Multi-engined Aircraft (July 1, 44)	2-22	
SECTION THREE—WEATHER FLYING		
Weather Symbols (Jan. 1, 44)	3- 1	
You and the Weather (April 1, 44)	3- 2	
Rules for Flying Weather (Jan. 1, 44)	3- 3	
Summer Flying (Jan. 1, 44)	3- 4	
Winter Flying (Oct. 1, 43)	3- 5	
Icing—Carburetor (Feb. 1, 44)	3- 6	
*Icing—Wings, Props (Sept. 1, 44)	3- 7	
*Flight Instruments (Sept. 1, 44)	3- 8	

NOVEMBER . . . DECEMBER . . . 1944 . . . JANUARY . . . 1945

WAR DEPARTMENT
A.A.F. FORM No. 24
APPROVED 4-1-43

Subject and Date	PIF No.	Initials Note Compliance
SECTION FOUR—MAN GOES ALOFT		
Effects of High Altitude (Oct. 1, 43)	4- 1	
Oxygen Equipment (Aug. 1, 44)	4- 2	
G Forces (Aug. 1, 44)	4- 3	
Physical Fitness (Aug. 1, 44)	4- 4	
Vision at Night (Oct. 1, 43)	4- 5	
Dangerous Gases (Aug. 1, 44)	4- 6	
Heat and Cold (Aug. 1, 44)	4- 7	
The Flight Surgeon (Aug. 1, 44)	4- 8	
Sense of Position in Flight (Aug. 1, 44)	4- 9	
SECTION FIVE—POWER PLANT		
Ground Operation of Engines (May 20, 43)	5- 1	
Flight Operation of Engines (Oct. 1, 43)	5- 2	
Engine Instruments (Dec. 1, 43)	5- 3	
Fuel Systems (Oct. 1, 43)	5- 4	
Oil Systems (May 1, 43)	5- 5	
Hydraulics (May 1, 43)	5- 6	
Propellers (Aug. 1, 44)	5- 7	
Electrical Power System (Jan. 1, 44)	5- 8	
SECTION SIX—THE AIRPLANE		
Tricycle Landing Gear (May 1, 43)	6- 1	
Landing Wheel Brakes (May 1, 43)	6- 2	
Flaps (Feb. 1, 44)	6- 3	
Surface Control Locks (May 1, 43)	6- 4	
How to trim Your Plane (May 1, 43)	6- 5	
Care of the Airplane (May 20, 43)	6- 6	
Emergency Exits (May 1, 43)	6- 7	
Safety Belts (April 1, 44)	6- 8	
*Safety Precautions (Nov. 1, 44)	6- 9	
*Weight and Balance (Nov. 1, 44)	6-10	
SECTION SEVEN—NAVIGATION AIDS		
*Flight Preparations (Nov. 1, 44)	7- 1	
*Aeronautical Charts (Nov. 1, 44)	7- 2	
*Dead Reckoning (Nov. 1, 44)	7- 3	
*Wind (Nov. 1, 44)	7- 4	
*Radio Aids (Nov. 1, 44)	7- 5	
*Night Navigation (Nov. 1, 44)	7- 6	
*What to do When Lost (Nov. 1, 44)	7- 7	
SECTION EIGHT—EMERGENCY		
To Bail or not to Bail (May 1, 43)	8- 1	
Forced Landings (May 1, 43)	8- 2	
Ditching (Dec. 1, 43)	8- 3	
*Parachutes (Nov. 1, 44)	8- 4	
Pyrotechnic Pistols (May 1, 43)	8- 5	
Smoke Grenades (May 1, 43)	8- 6	
Panel Signals (May 1, 43)	8- 7	
Body Signals (May 1, 43)	8- 8	
Emergency Kits (Oct. 1, 43)	8- 9	
*Life Preserver Vest (Nov. 1, 44)	8-10	
Life Rafts (April 1, 44)	8-11	
Fire Fighting (May 1, 44)	8-12	
Kits, First Aid, Aeronautical (April 1, 44)	8-13	
First Aid in Flight (April 1, 44)	8-14	

I certify that I have read and understand all subjects in the Pilot's Information File listed in Form 24, dated Nov., Dec. 1944, Jan. 1945.

When you receive your new Form 24, dated Feb., March, April 1945, remove this form, sign it, and give it to your operations officer to put in your Form 5 file.

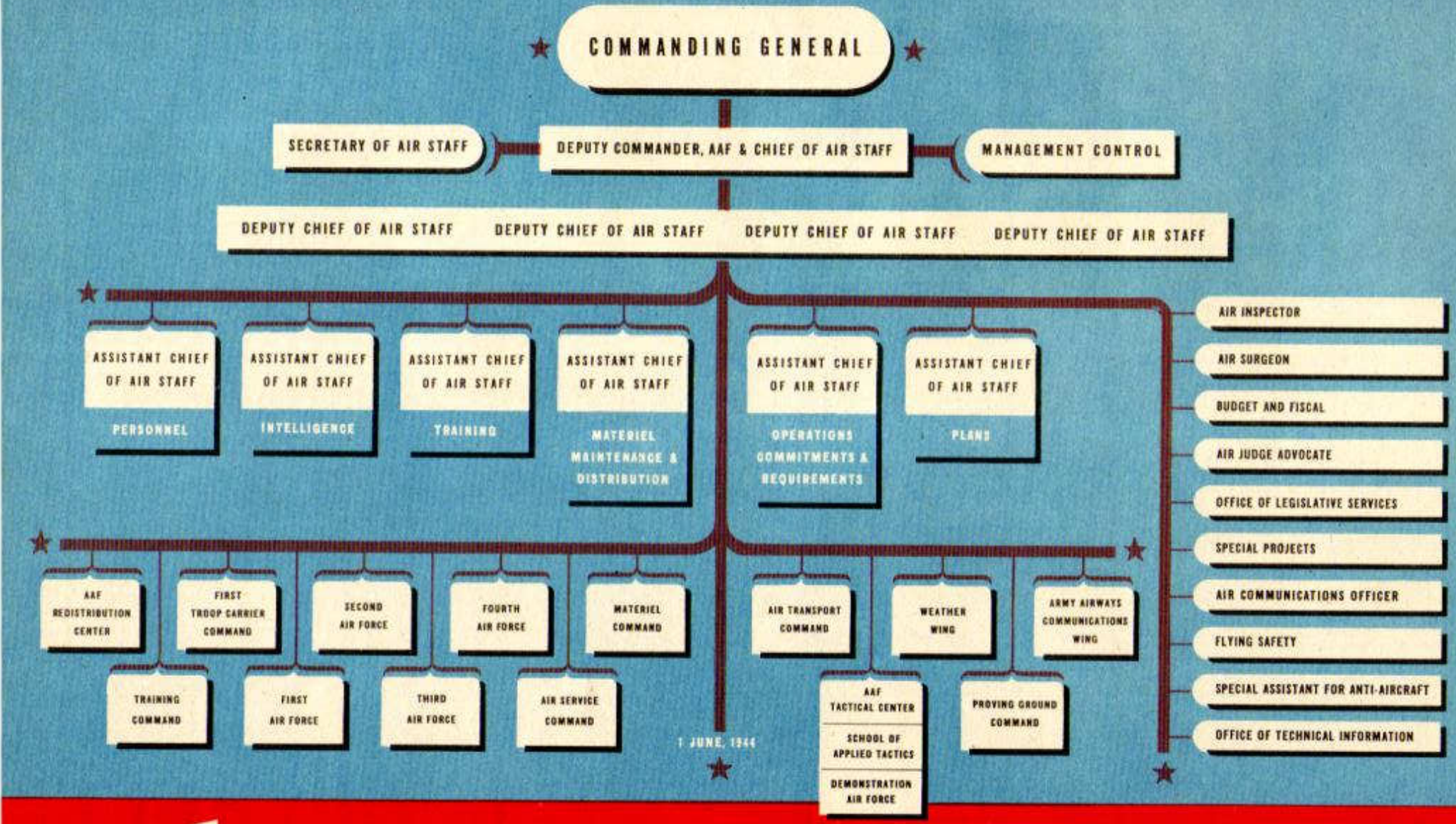
SIGNED_____

RANK_____

ORGANIZATION_____

DATE_____

Directory Chart, Headquarters Army Air Forces



SECTION 1 GENERAL

PIF 1-1-1
REVISED July 1, 1944

PILOT'S RESPONSIBILITIES

★ The success of any flying mission, whether in training or combat operations, depends primarily upon the pilot. As commander of the airplane you carry heavy responsibilities. The majority of your responsibilities, however, involve only good, sound judgment.

★ All of your duties make up a long and formidable list; but you can discharge each of them by systematic planning, step by step. Don't overlook anything. Establish a routine. Memorize and follow a check list of your responsibilities.

Before Flight

PLAN

FORM 23

★ Plan your flight on Form 23.
★ Remember that the shortest distance between two points is not always a straight line.
★ Check terrain features on your line of flight: maximum altitude of mountains, facilities for emergency landings.
★ Airways, radio facilities, check points.

WEATHER

★ Talk to the forecaster, don't be satisfied with the brief forecast on your Form 23.
★ Know the over-all weather picture. Study the latest weather map.
★ Read the weather sequences yourself.
★ Check winds aloft, and plan your flight to take advantage of the best altitude.
★ Know temperatures, dewpoints, and barometric readings along your line of flight.
★ Altimeter setting at point of departure and destination.

CHARTS

★ Secure the latest sectional and regional maps.
★ Check them against the chart in the operations office for changes.
★ Look up the latest information in NOTAMS on danger and caution areas.
★ Draw a pencil line along your intended route, and mark it off in 20-mile intervals.
★ Don't start any flight without proper charts!

PIF 1-1-2
REVISED July 1, 1944

EQUIPMENT

AIRPLANE

★ Check and know the condition of your plane.
★ Visual check.
★ Freedom of movement of all controls.
★ Check Form 1A and Form 41B.

FUEL

★ Servicing crews fuel the airplane but the pilot is solely responsible for his fuel supply.
★ Check fuel tanks visually; don't rely solely on fuel gages.
★ If flying a long mission, be sure to study cruise control charts for best power setting at your predetermined altitude.

WEIGHT AND BALANCE

★ Check the loading of your airplane.
★ Be sure the Form F is properly executed and the final index is within the allowable center of gravity range.
★ Read and understand the provisions of AAF Reg. 55-3.

★ The Weights and Balance officer is charged with the responsibilities of compliance with the regulations; but remember you have to fly the airplane.

RADIO

★ Test the frequencies you will use.
★ Be sure your modulation is correct.
★ Tune in your nearest radio range.
★ Check command, liaison, interphone, and call.
★ See that your radio compass is working.

FLIGHT RESTRICTIONS

★ Check and know all flight restrictions and special orders concerned with the type of airplane in which the flight is to be made.

EMERGENCY EQUIPMENT

★ Check the equipment necessary for the flight:
★ Oxygen.
★ Life rafts.
★ Mae Wests.
★ Parachutes.
★ Emergency kits.
★ First-aid kits.

CREW

INSPECT CREW'S CLOTHING AND EQUIPMENT

★ Proper clothing for altitude, temperature, and season.
★ Oxygen masks, properly fitted and in good condition.
★ Parachutes—harness properly fitted. Each crew member instructed in how to inspect and use his parachute.

DUTIES IN FLIGHT

★ See that each crew member knows his place in the airplane, and his duties in flight.
★ Assure yourself that each crew member understands emergency procedures; that he knows what exit to use in bailout; and is trained in ditching procedure, and forced landing routine.
★ You are responsible that the crew has been properly briefed for the flight.
★ See that each has made the proper preflight inspection of everything he is responsible for.

PIF 1-1-3
REVISED November 1, 1944

Pilot's Basic Responsibility

On every mission it is up to you to get there and back! So plan, inspect, and check thoroughly. Be absolutely sure of every pertinent item listed above to make certain of a successful flight.

During Flight

COMMAND OF THE AIRPLANE

★ During flight you will ordinarily be in command of your airplane, the crew, and any passengers aboard. Army Regulation 95-15 directs that, "The senior member of the operating crew of an aircraft who holds an appropriate military pilot rating will command the aircraft, except when the organization commander responsible for the aircraft specifically designates who shall command."

CHECK LISTS

★ Use check lists in cockpit for takeoff, cruise, and landing procedure.
★ Use cruise control charts for airplanes in which they are provided.

FOLLOW YOUR FLIGHT PLAN

★ Adhere strictly to your flight plan as outlined on Form 23, except in an emergency.
★ If it's necessary to change your flight plan, get the necessary approval by radio.

CHECK POINTS

★ Report your position frequently over radio check points, giving:
★ Point of takeoff.
★ First intended landing.
★ ETA (Estimated Time of Arrival).
★ Altitude.
★ Time of report.
★ Any unusual weather encountered.

NAVIGATION

★ Consult your charts regularly; know your position all the time.
★ Don't navigate solely by radio aids. Check and double check your position frequently.
★ Check your wind drift; don't take it for granted that the winds aloft information you get at the weather office is correct, or that the wind hasn't changed.
★ Check time, speed, and distance, frequently.
★ If flying airways on CFR, maintain the correct odd or even altitude depending on your direction of flight.

LISTENING WATCH

★ Keep your radio tuned to the range and maintain an alert listening watch for "Army Flight Control advises - -". They may be trying to call you.

WEATHER

★ Check weather reports along your line of flight.
★ Ask by radio for weather reports whenever in doubt.
★ Watch for any change in sky or cloud conditions that may indicate weather change.

FUEL CONSUMPTION

★ Make periodic checks of your fuel supply.
★ Check all your fuel gages.
★ Check indicated consumption against speed, time, and distance.
★ Calculate indicated fuel remaining and distance to go.
★ Know most economical power setting.
★ Make certain you have fuel reserve.

After Landing

★ Complete Forms 1 and 1A before you leave the cockpit.
★ Hand the yellow copy of Form 23 to the line chief to turn in at the operations office. It is your responsibility to see that the arrival record is properly filled in.

REQUEST SERVICE REQUIRED

★ Fuel, oil, repairs.
★ If fuel and oil must be secured from a commercial contractor, you must sign Form 81. Keep a copy to file at your home station.
★ If you have secret or confidential equipment aboard your plane, see that it is properly guarded or removed to a safe.
★ Report to the weather office to execute Form 37 (Weather Interview).

IF OTHER THAN HOME BASE, REPORT:

★ Where you will stay.
★ Proposed time of departure.
★ Proposed next destination.
★ Make sure your crew is properly cared for.
★ Send, or arrange for operations to send, RON message to your home station. This is the proper form; it may be sent government telegram, collect, TWX, or AACS.

Commanding Officer
Attention Operations Officer
Randolph Field, Texas
Army 43-7436 R.O.N. Pampa AAB
Pampa, Texas, 13 April 1944
DORAN

PIF 1-2-1
REVISED July 1, 1944

FLYING SAFETY

PILOT ERROR IS THE CAUSE OF
70 TO 80 PERCENT OF ALL AIRCRAFT ACCIDENTS

PILOT ERROR RESULTS FROM —

- ★ Ignorance
- ★ Carelessness
- ★ Poor physical condition
- ★ Disobedience
- ★ Poor judgment

In the campaign to defeat these enemies of safety, authorities have prescribed rules, regulations, and standard practices; but they can only point the way—



SAFETY OF FLIGHT DEPENDS UPON YOU

- ★ Know the rules
- ★ Abide by the rules
- ★ Keep constantly on the alert
- ★ Use considered judgment
- ★ Keep yourself physically fit
- ★ Plan in advance for possible emergencies and work out in your own mind procedures you propose to follow for each

General check-out procedure requires a pilot to demonstrate his proficiency on any type of aircraft before being cleared to fly it.

Check-out procedures are prescribed locally by Commanding Officers, setting forth minimum time in cockpit familiarization, taxiing, and minimum number of landings. Careful study of the Handbook of Flight Operating Instructions of the particular model of the airplane to be flown is required.

Do not be satisfied with minimum requirements for check-out. No pilot was ever too familiar with his plane.

If you are not certain that you know and understand the airplane you are about to fly, **it is your right and duty to request further instruction and more time.**

Do not be satisfied merely with check-out. After you have been certified as qualified for a type of aircraft, **watch constantly for new information, flight restrictions, and special instructions issued from time to time.** All these will be found in the Transition Flying Training Index.

Finally, you must always check the particular airplane you are about to fly and **make certain that you are familiar with all modifications, special equipment, and the present condition of the airplane.**



The most important rule of safety is:

KNOW THE AIRPLANE YOU ARE ABOUT TO PILOT

KNOW AIR TRAFFIC RULES AND REGULATIONS



There are uniform traffic rules for flying the airways.

Know the rules.

Plan your flight in accordance to the rules.

Adhere strictly to your flight plan (except as provided for in the rules).

Keep on the lookout for other traffic.

On local flights, be sure you know the local regulations and restrictions. When in doubt, use common sense and courtesy.

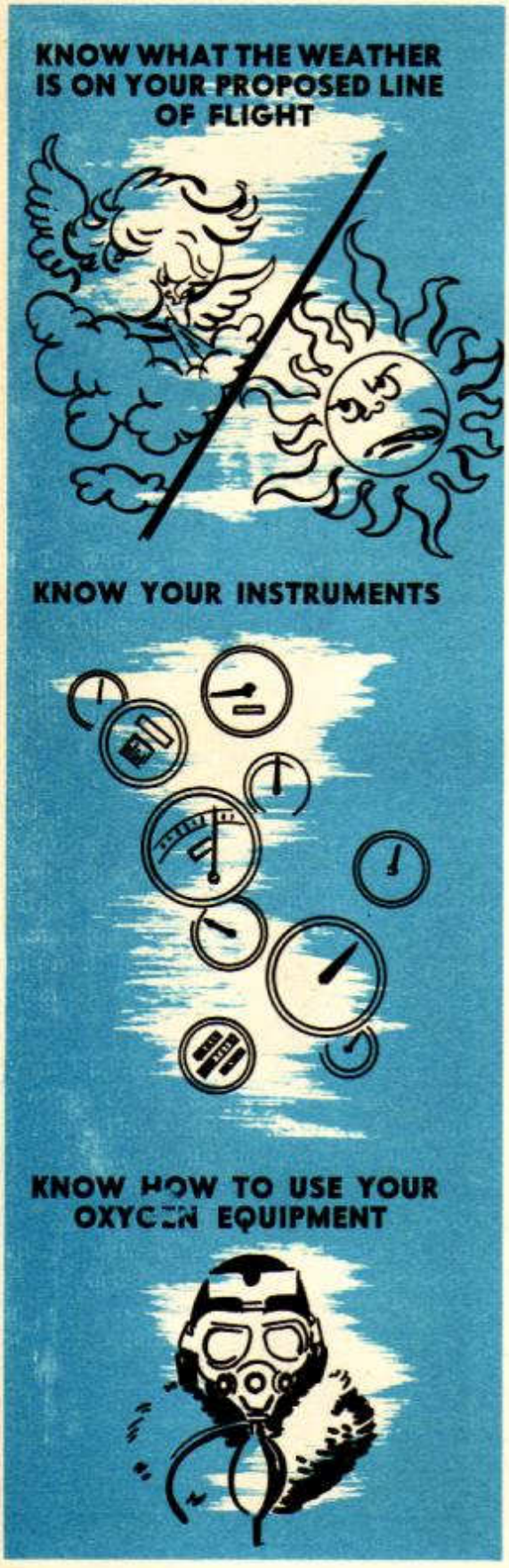
If possible, ask for traffic information.

Conform to local traffic pattern.

Keep constantly alert.

Keep away from other aircraft in flight.

Don't be an Air Hog!



In almost every case where weather is the cause of an aircraft accident, it is chargeable to **Pilot Error:** because the pilot didn't know what kind of weather he was going to encounter.

Do not take a chance on doubtful weather.

Beware of icing conditions.

Remember that your carburetor may ice under almost any temperature conditions, summer or winter. All it needs is moisture.

If you run into bad weather conditions **go around, not through,** or turn back.

The safest maneuver in doubtful weather is the 180-degree turn!

Instrument Failure seldom causes aircraft accidents. When it is a contributing cause, it is usually the pilot's fault for not using them correctly.

Know how to check your instruments.

Know instrument procedures.

Trust your instruments.

The most important safety rule in instrument flying is: **have confidence in your instruments, in yourself, and in your ability to fly instruments.**

Such confidence can only be developed by practice; take advantage of every opportunity to use the Link Trainer, to make hooded flights, and to fly on instruments under proper supervision.

Do not be satisfied with the minimum requirements for an instrument rating.

Accidents that are chargeable to lack of oxygen are usually due to **Pilot Error.** There is always more than one source of oxygen. If you know your equipment, you can avoid trouble.

Be sure your oxygen mask fits properly. Adjust it before take-off.

Know how to switch from one source of oxygen to another.

Begin the use of oxygen soon enough.

Remember that even a short period of oxygen starvation ruins your judgment.

KEEP CONSTANTLY ALERT IN TAXIING



More than half of all aircraft accidents occur on the ground. Practically all taxiing accidents are 100% carelessness.

Keep your eyes open. Look ahead of you, look behind you, look above you.

If you are taxiing a "blind" airplane, zigzag enough to know what is in front of you.

Keep your radio tuned to the tower, listen for warnings.

Do not taxi within 100 feet of the line without a crew man in full view in front of you, guiding you by hand signals.

Taxi slowly.

Be sure you know how to operate the emergency brake system on your plane.

USE EXTRA PRECAUTION ON TAKE-OFF



The chief hazards on take-off arise from engine failure and poor piloting technique.

Be sure your engines are properly warmed up and functioning perfectly before beginning a take-off.

Do not take a chance on an engine that doesn't "rev up" on the ground.

If an engine fails on take-off **get the nose down** and decide instantly on your procedure:

Is there enough landing field left to stand a chance of getting down?

Can you find a spot approximately straight ahead for a forced landing?

Do **not** try to stretch your glide.

Above all do not bank. Remember your plane stalls at higher speed on a bank than in level flight.

If you must crash land, be sure to get the landing wheels up.

ON LANDINGS, PUT YOUR WHEELS ON THE FIRST THIRD OF THE LANDING STRIP

Most landing accidents are due to overshooting.

On your approach, **keep your plane enough above stalling speed to have full control.**

If you have misjudged on your approach, **there is no disgrace in going around again.**

At all Times

Do not try to show off.

Never try maneuvers with an airplane unless and until you know such maneuvers are permitted in that type of airplane.

Remember that **altitude above you will never help you get out of trouble.**

Finally

FLYING IS AN EXACTING, SERIOUS BUSINESS. IT DEMANDS EVERYTHING YOU HAVE OF KNOWLEDGE, ATTENTION, EFFORT, JUDGMENT, AND SKILL. IF YOU GIVE IT ANY LESS THAN YOUR BEST, IT EXACTS A HIGH PRICE FOR YOUR MISTAKES.

PIF 1-3-1
REVISED May 1, 1944

SAFEGUARDING CLASSIFIED MATERIAL

Military information is classified as secret, confidential, or restricted. Its classification is clearly marked on every page. If it is not so marked, it is unclassified. Treat all classified material as follows:

Secret

Only persons directly concerned should read it. It should be discussed only with those who may read it. It must be kept in a 3-combination safe when not in use. It must be mailed in two envelopes, an inner envelope addressed properly and marked or stamped **Secret; an outer envelope addressed properly, but with no marking to indicate its classification. Send it by registered mail.**

To destroy secret or confidential material, burn it, or use an approved shredding machine. Until you can do one or the other, tear it in small pieces, and safeguard it as you would the original material.

Confidential

May be read only by persons in the military establishment and by civilians whose duties require that they read it. It may be discussed with those authorized to read it, **but never over the telephone.** Mail and guard it the same as secret material.

Restricted

May be read by, and discussed with anyone whose loyalty is unquestioned. It is never to be released for publication, or discussed with the general public. It is to be kept in a guarded area, behind locked doors, or in a safe.

Mail by first class mail unmarked.

To destroy, tear up the material before throwing it into a waste basket.

Inspection

At every Headquarters an inspection will be made each day immediately before closing to insure that classified material is properly taken care of.

CLASSIFIED EQUIPMENT

As a member of an air crew you are charged with the proper care and handling of all classified equipment on your plane, such as: Certain radio equipment, some instruments, armament, etc. If any such classified equipment is installed in your plane, you must safeguard it as follows:

1. When landing at an Army Air Field, either post an armed guard or remove the equipment and place it in a locked safe or vault.
2. When landing at fields other than Army Air Fields, make sure that an armed guard is continuously assigned to your plane. **Locking the airplane is not a substitute for an armed guard.**
3. When forced down in or near enemy-held territory, destroy all classified equipment, either by using detonators if installed, or by manual means. Make certain that the essential parts of such equipment are destroyed beyond recognition.

REFERENCE: Army Regulation No. 380-5



WHEN FORCED DOWN IN ENEMY TERRITORY, GUARD YOUR EQUIPMENT UNTIL IT IS COMPLETELY DESTROYED

HOW TO USE PIF

Your PIF Responsibility

When you receive PIF revisions you are required by AAF Regulations 62-15 and 15-24 to do the following:

1. Sign the receipt portion of Form 24A (which is always enclosed as the first sheet of every revision). Hand this receipt at once to the operations office where you receive the revision.

2. Read the directions on the envelope which contains the revision.

3. **Remove from your PIF and destroy** the pages which are listed on the envelope. Don't try to short-cut and place the revision pages in at the same time you remove the replaced pages. You are sure to make mistakes. Do it one step at a time. Go clear through your book and take **all** pages out that are listed on the envelope. **This is vital.**

4. Read and study the revision sheets until you understand them.

5. Place the revision sheets in **their proper place** in your copy of PIF.

6. When you have done all of the above, **and not until you have done it all properly,** sign the compliance section of Form 24A and return it to your operations officer so that it may be placed in your Form 5 file.

You have 30 days (by AAF Regulation 15-24) in which to do all of the above. If you have neglected any of the steps above you have violated Regulations and are subject to disciplinary action.

The duties outlined here require perhaps two hours a month. If you shirk or neglect these duties your PIF cannot be useful to you. It must be currently correct or you cannot add new revisions properly.

Pilots' Information File is your book. It was designed to save you many hours of work. You would have to search and read through thousands of pages of War Department, AAF, and miscellaneous publications to get the information which you have to have to keep up-to-date with your duties and responsibilities, if it were not for PIF.

General

The Pilots' Information File is a manual of instructions and information of a general nature, with which all AAF pilots in the continental United States are required to comply, in accordance with the provisions of AAF Regulation 62-15.

PIF is designed to keep you informed of matters affecting flying safety and operational efficiency. It contains basic material not discussed in detail in Handbooks of Flight Operating Instructions and other publications comprising the Transition Flying Training Index.

Familiarize yourself with both the Pilots' Information File and the Transition Flying Training Index. Check frequently to be sure that you have read and understand the information in each.

How Subjects Are Numbered

Each subject listing is numbered. **The first number** indicates the section. For example, 2, which is Flight. **The second number** refers you to the subject. For example, 2-20, "Stalls and Spins." **The third number** lists the page. Thus, the third page of "Stalls and Spins" will be marked 2-20-3.

Revisions

Revised sheets bear a new date line in the upper right hand corner thus: REVISED February 1, 1944. If the page is new and does not replace an old one, it will bear a line thus: ADDED February 1, 1944.

Often a whole subject will be revised completely and the revised pages may number more or less than the pages they replace. In such a case all the pages

will merely bear the REVISED notation, with the date. So don't be confused if you have more or fewer pages than you have removed.

To Comply with Revisions

When you receive a set of revision sheets from your operations office, you will find in the envelope a temporary certificate of compliance (Form 24A).

Before you sign it to certify that you have read and understand all the revisions, be sure you have read and have complied with each item you are certifying to.

You will find that often only minor changes have been made on some pages. There is no special indication to show what sentences or paragraphs have been revised. It is felt that you should re-read the whole page in order to get the context of the old material in relation to the new.

Distribution of Revisions

Revisions are distributed to individual pilots by the Base Operations Officer, who receives revisions automatically from the publisher of the File.

If any Operations Officer does not receive the correct number of revisions (plus a 10% overage) he will communicate at once with:

Office of Flying Safety, Information Files Branch,
Buhl Building, Detroit 26, Michigan.

stating number of revisions required at his station. He will also send letter request to the above for any copies he may need of the complete File.

Operations Officers will also report promptly on the activation or deactivation of any station.

The Table of Contents (Form 24)

Every three months you will receive a new Table of Contents in the envelope with the revisions of that month. In order that you may identify it, and be sure that you have the current table in your PIF. the following color key is used.

February	: Red	May	: Gray
August	: Blue	November	: Yellow

Subjects preceded by an asterisk (*) have material revised or new since the last Table of Contents was issued.

You will find that all the pages of any one subject do not bear the same date. But the date following the subject listing in the Table of Contents is the **latest revision date for any of the pages included in that subject.**

Don't Destroy Table of Contents

When you replace the Table of Contents with a new one, **don't destroy the old one.** Sign it to show that you have read and understand all the subject matter it lists. Then turn it over to your Operations Officer to be placed in your Form 5 File.

Operations Officers Responsibilities

1. Operations Officers are responsible that every pilot attached to his base receives a copy of PIF and all revisions.

2. That every pilot on his base signs a compliance form certifying that he has read and understands all material contained in PIF and revisions.

3. That the compliance certificates (Form 24A and Form 24) are placed in the Form 5 Files of the individuals concerned.

When pilots turn in their Forms 24 at the end of the three-months period for which the Forms are the current Tables of Contents for PIF, the Operations Officer will see that previously dated Forms 24 and 24A which are in the Form 5 Files are removed and destroyed.

WANTED: Your Criticisms of PIF

May we call your attention to AAF Regulation 62-15, which directs all AAF establishments to submit items they desire to have included to the address given below. This also means any criticism of material already in PIF—corrections, questions of interpretation, and mistakes.

Our aim is to keep PIF accurate, current, and fully useful. If you can help us do that, we will appreciate it. Write direct to:

OFFICE OF FLYING SAFETY
Information Files Branch, Buhl Bldg.
Detroit 26, Michigan

TECHNICAL ORDERS

All pilots must know how to use the Technical Order files. Use of the Pilots' Information File does not obviate the need for using Technical Orders. The Pilots' Information File contains material of a general nature, and does not attempt to supply the specific engineering, maintenance and supply information contained in Technical Orders.

For detailed information on specific pieces of equipment, or how to operate types or models of airplanes, propellers, carburetors, generators, etc., you should read and follow the instructions found in Technical Orders.

What are Technical Orders?

AAF Technical Orders are directives published by order of the Commanding General, Army Air Forces, for the purpose of issuing specific instructions and information of a technical nature covering the operation, maintenance, storage, inspection, etc., of AAF equipment and materials, and for the establishment of a uniform system of files wherein such data will be readily accessible.

T. O. Numbering System

Every Technical Order has a series of three numbers separated by dashes, which identify the T. O. This identification number tells you three things about the T. O.:

The first number always has two digits. It corresponds to the AAF property classification number. For instance, if the first number in the T. O. designation is 05, the T. O. is concerned with instruments; if it is 02, it is something about engines and engine maintenance parts.

The only number that does not correspond to a property classification is 00, which is used for Technical Orders of a general nature, such as the Technical Order Index (which is 00-1), distribution of Technical Orders, inspection system, kits and such matters.

The property classifications which correspond to the initial number on Tech Orders are:

01- Airplanes and Maintenance Parts.
02- Engines and Maintenance Parts.
03- Aircraft Accessories.
04- Aircraft Hardware and Rubber Materials.
05- Aircraft Instruments.
06- Fuels and Lubricants.
07- Dopes, Paints and Related Materials.
08- Electrical Equipment and Supplies.
09- Aerial Targets and Gliders.
10- Photographic Equipment and Supplies.
11- Aircraft Combat Material.
12- Fuel and Lubricating Equipment and Supplies.
13- Clothing, Parachutes, Equipment and Supplies.
14- Hangars and Demountable Buildings.
16- Balloon Equipment and Supplies.
17- Machinery, Shop and Warehouse Equipment.
18- Special Tools.
19- Flying Field and Hangar Equipment.
21- Cordage, Fabrics and Leathers.
22- Woods.
23- Metal and Composition Material.
24- Chemicals.
25- Office Equipment and Supplies.
26- School Equipment.
27- Excess and Surplus Property.
29- Commercial Hardware and Miscellaneous Supplies.
30- Publications, Processed Motion Picture Films and Film Strips.

Complete breakdown of these classes is listed in T. O. 00-35A-1.

The second number of the Tech Order's identification represents the airplane or engine model, or the sub-division of the general property class identified by the first number. It is impractical to list here all the sub-divisions of each property classification; but to show how the system works, here is a breakdown of one classification, 03, Aircraft Accessories:

03-1 General
03-5 Electrical Equipment
03-10 Fuel System
03-15 Oil System
03-20 Propellers and Accessories
03-25 Wheels, Brakes and Struts
03-30 Air and Hydraulic System Accessories
03-35 Ice Eliminating Equipment
03-40 Control Units
03-45 Fire Extinguishers
03-50 Oxygen Equipment
03-55 CO_2 Inflation Equipment
03-60 Skiis
03-65 Accessory Power Plant

Such a breakdown for every property classification will be found in the T. O. Index (00-1) as the first item under each property classification number.

Sometimes the second number still does not give enough identification for you to find the equipment

you are looking for, and it is necessary to use a letter after the number. For example: 03-10 identifies Fuel Systems. If you are looking for carburetors, however, you will find they are further separated by using B after 10—thus, 03-10B.

The third number usually is merely the serial number of the T. O. concerning the general subject identified by the first two numbers. There is one place, however, where the third number is an important addition to the identification, and that is in the series of airplane model manuals of operation, maintenance and repair, and parts catalogs.

These series of basic Tech Orders are identified as follows:

FIRST NUMBER	SECOND NUMBER	THIRD NUMBER
01 (the airplane)	–40A (the airplane model)	–1 (Handbook of Flight Operating Instructions)
01	–40A	–2 (Erection and Maintenance Manual)
01	–40A	–3 (Structural Repair Manual)
01	–40A	–4 (Parts Catalog)

Technical Order Index

The Technical Order Index, T. O. 00-1, is the first T. O. in the complete library. In the front of the Index you will find data listing the airplane and its engine, (airplane and engine cross-reference table) with identification of the manufacturer of each, and the Technical Order series covering each. Immediately behind it is the numerical index of Technical Orders.

Hunt first, in numerical sequence, for the basic number (for example, 01), then the second number (for example, 40A), then run through the serial numbers and titles until you find the title of Tech Order you are looking for. Go to the book containing the corresponding number to get your information. All Tech Orders are listed numerically.

Suppose you want to find a list of all the radio compasses in service and all of the Technical Orders pertaining to them. Turn to T. O. 00-2, "Alphabetical Index of AAF Equipment." Under "Compasses, Radio," you will find all types listed, together with numbers of applicable Technical Order Handbooks.

Where to Find a T. O.

Each Station, Base, or Sub-Depot has four complete files, assigned to the supply office, engineering office, technical inspector's office, and transient aircraft crew.

Complete information about T. O. files in overseas theaters is listed in T. O. 00-25-3.

Aircraft Files

The following Technical Orders and current amendments thereto must be maintained in each operating airplane:

1. T. O. 00-20A, Visual Inspection System for Airplanes.
2. T. O. 00-20A-2, Airplane Maintenance Instruction Form.
3. Pilot's Handbook of Flight Operating Instructions for the particular airplane model.
4. Erection and Maintenance Manual for the particular airplane.
5. Engine Handbook of Service Instructions for the particular engine.
6. Handbook of Weight and Balance Data.
7. T. O. 08-15-1, Radio Facility Charts.
8. T. O. 08-15-2, Radio Data and Aids to Airways Flying.
9. T. O. 08-15-3, Instrument Approach Procedures.

Compliance in Combat Areas

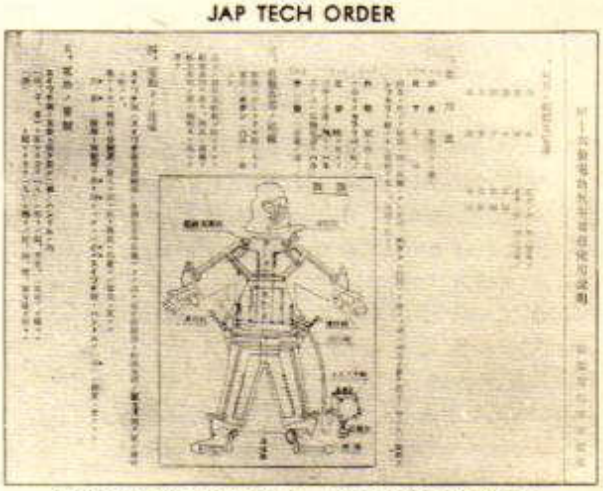
Compliance with Technical Orders and Technical Radiograms in combat areas will be subject to local conditions involving tactical employment of the equipment and at the discretion of the respective Air Force or Task Force Commanders concerned.

Remember

1. In this business, **nobody knows all the answers.**
2. The airplane is as important as you are. **Know your plane. Study everything you can find about it.**
3. Ignorance is dangerous. **Read your Handbook.**
4. One of the best ways to know your plane is to **keep tab frequently on new Technical Orders about the model you are flying.** It might save your neck some day.

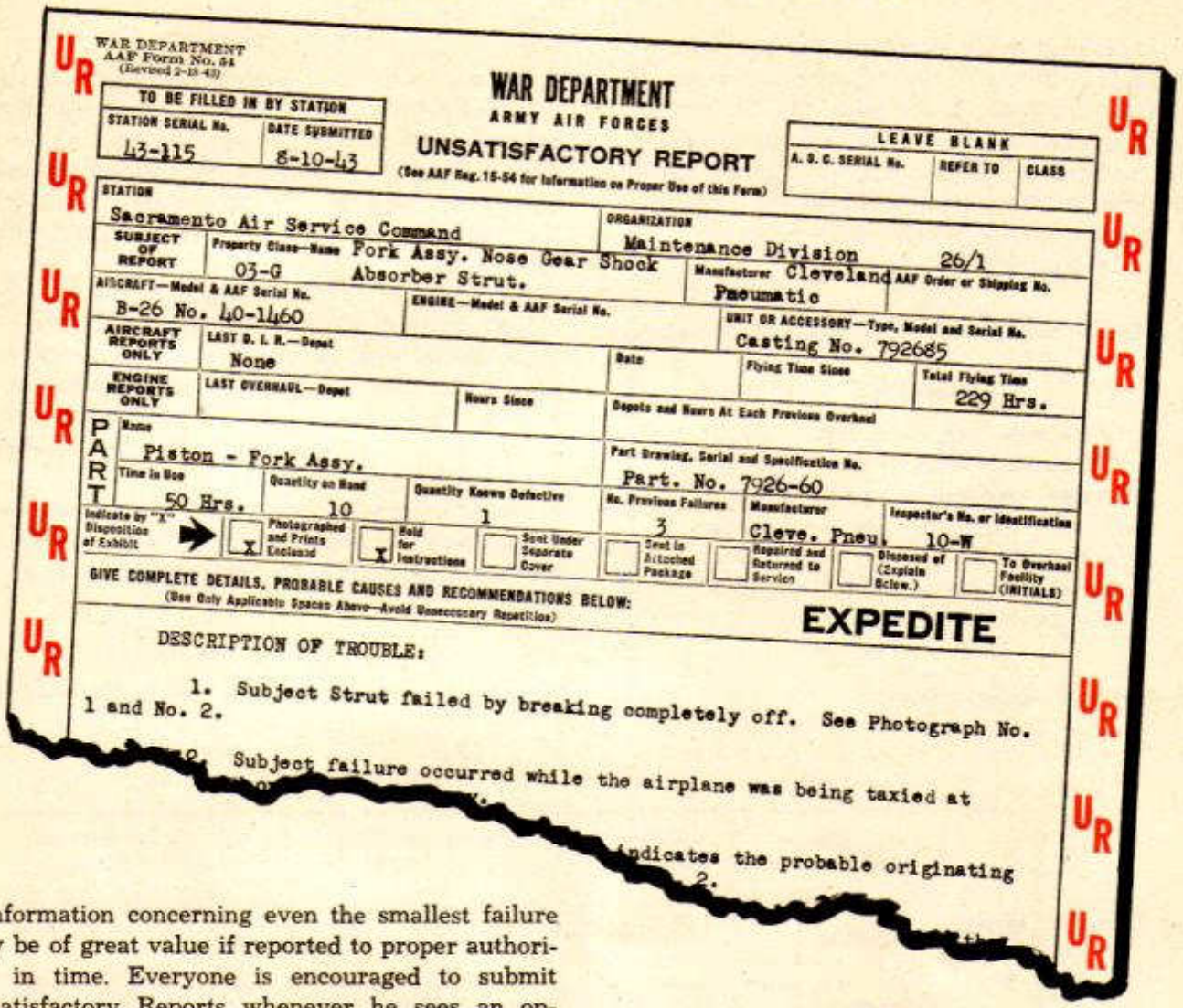
REFERENCE: Technical Order 00-5, dated October 7, 1942.

JAP TECH ORDER



IF YOU THINK OUR T. O.s ARE HARD TO READ—

UNSATISFACTORY REPORTS



WAR DEPARTMENT
AAF Form No. 54
(Revised 2-18-43)

WAR DEPARTMENT
ARMY AIR FORCES
UNSATISFACTORY REPORT
(See AAF Reg. 15-54 for Information on Proper Use of this Form)

TO BE FILLED IN BY STATION
STATION SERIAL No. 43-115
DATE SUBMITTED 8-10-43

LEAVE BLANK
A. S. C. SERIAL No. | REFER TO | CLASS

STATION: Sacramento Air Service Command
ORGANIZATION: Maintenance Division 26/1
SUBJECT OF REPORT — Property Class—Name: 03-G Fork Assy. Nose Gear Shock Absorber Strut.
Manufacturer: Cleveland Pneumatic
AAF Order or Shipping No.:
AIRCRAFT—Model & AAF Serial No.: B-26 No. 40-1460
ENGINE—Model & AAF Serial No.:
UNIT OR ACCESSORY—Type, Model and Serial No.: Casting No. 792685
AIRCRAFT REPORTS ONLY — LAST D. I. R.—Depot: None
ENGINE REPORTS ONLY — LAST OVERHAUL—Depot:
Hours Since:
Date:
Flying Time Since:
Total Flying Time: 229 Hrs.
Depots and Hours At Each Previous Overhaul:

PART
Name: Piston - Fork Assy.
Part Drawing, Serial and Specification No.: Part. No. 7926-60
Time in Use: 50 Hrs.
Quantity on Hand: 10
Quantity Known Defective: 1
No. Previous Failures: 3
Manufacturer: Cleve. Pneu.
Inspector's No. or Identification: 10-W

Indicate by "X" Disposition of Exhibit:
[X] Photographed and Prints Enclosed
[X] Held for Instructions
[ ] Sent Under Separate Cover
[ ] Sent in Attached Package
[ ] Repaired and Returned to Service
[ ] Disposed of (Explain Below.)
[ ] To Overhaul Facility (INITIALS)

GIVE COMPLETE DETAILS, PROBABLE CAUSES AND RECOMMENDATIONS BELOW:
(Use Only Applicable Spaces Above—Avoid Unnecessary Repetition)

EXPEDITE

DESCRIPTION OF TROUBLE:

1. Subject Strut failed by breaking completely off. See Photograph No. 1 and No. 2.

2. Subject failure occurred while the airplane was being taxied at

ndicates the probable originating

2.

Information concerning even the smallest failure may be of great value if reported to proper authorities in time. Everyone is encouraged to submit Unsatisfactory Reports whenever he sees an opportunity to contribute to greater efficiency by suggesting correction of faults.

As a pilot, you are in close touch with both methods and machines. A great ground organization is behind the men who fly. But both flying and ground operations always can be improved. **Unsatisfactory Reports** are designed to speed improvements and to permit the individual to present a maintenance problem and his suggested correction, through channels.

Unsatisfactory Reports usually fall into these general classes:

1. Failure of equipment.
2. Unsatisfactory design.
3. Defects due to faulty material, workmanship, or inspection.
4. Unsatisfactory maintenance or supply methods, systems, or forms.

How to Prepare a U. R.

AAF Form No. 54, obtainable from the Engineering Officer, is used for Unsatisfactory Reports.

Each report must be a complete description of an individual case. It must explain the unsatisfactory condition, including all pertinent information, to enable investigation and correction of the trouble reported without the need for further requests for information. See AAF Regulation 15-54 for details about how to file different types of U.R.'s.

Coordination

All Unsatisfactory Reports originating at a station are routed through the Engineering Officer, who investigates and enters his endorsement. He sends the U.R. to the Commanding General, Air Service Command at Patterson Field, Fairfield, Ohio.

FLYING ON A RED DIAGONAL

Before takeoff check all information on Form 1A. If "STATUS TODAY" is indicated by a red diagonal or red dash, make sure that a properly authorized officer has signed the exceptional release.

This exceptional release may be signed by the Engineering or Maintenance Officer. If it is impractical for such officer to sign the release, the Pilot is authorized to sign it.

Warning

Don't sign the exceptional release until you know exactly what is wrong with the airplane or its equipment. Make sure that you know what is represented by the red symbol. Check Form 41B for additional information on the condition of your plane.

Other Warnings

When an airplane is undergoing work or has parts removed for repair and such status is not readily apparent without careful inspection, appropriate tags will be used by squadron engineering officers in some cases. This applies particularly when work of this nature is performed at other than regularly established air bases.

A red tag secured conspicuously on the control column or ignition switch will bear a notation, "Not to be flown until generator (or radio, carburetor, etc., as the case may be) has been replaced or repaired." This will warn any pilot who might attempt a takeoff without knowledge that the airplane is not ready for tactical flight.

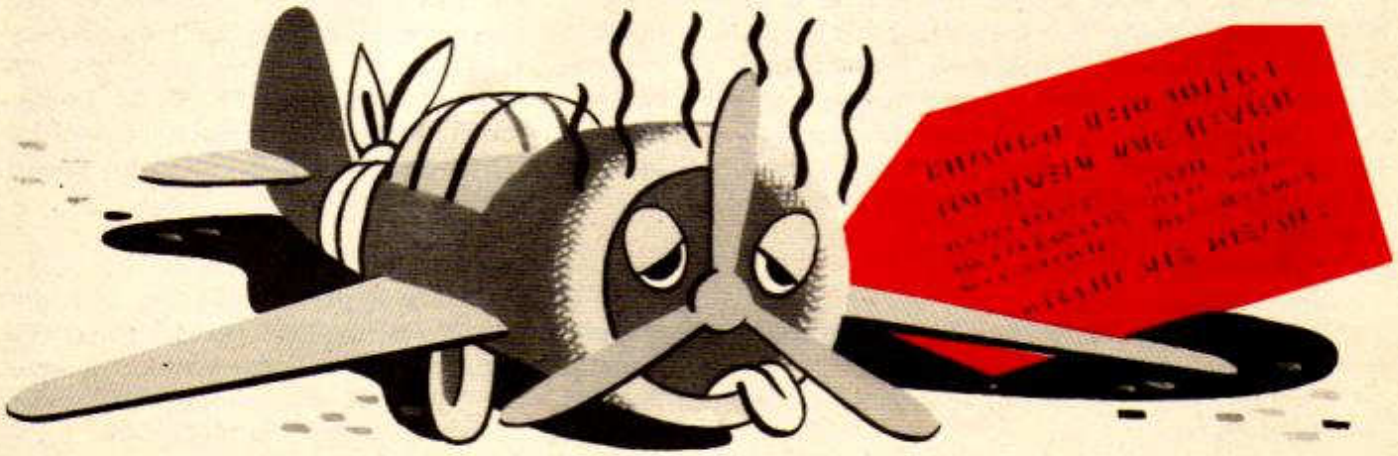
Another tag will be secured at or near the location from which parts have been removed. This will permit ready identification for service crew or mechanic.

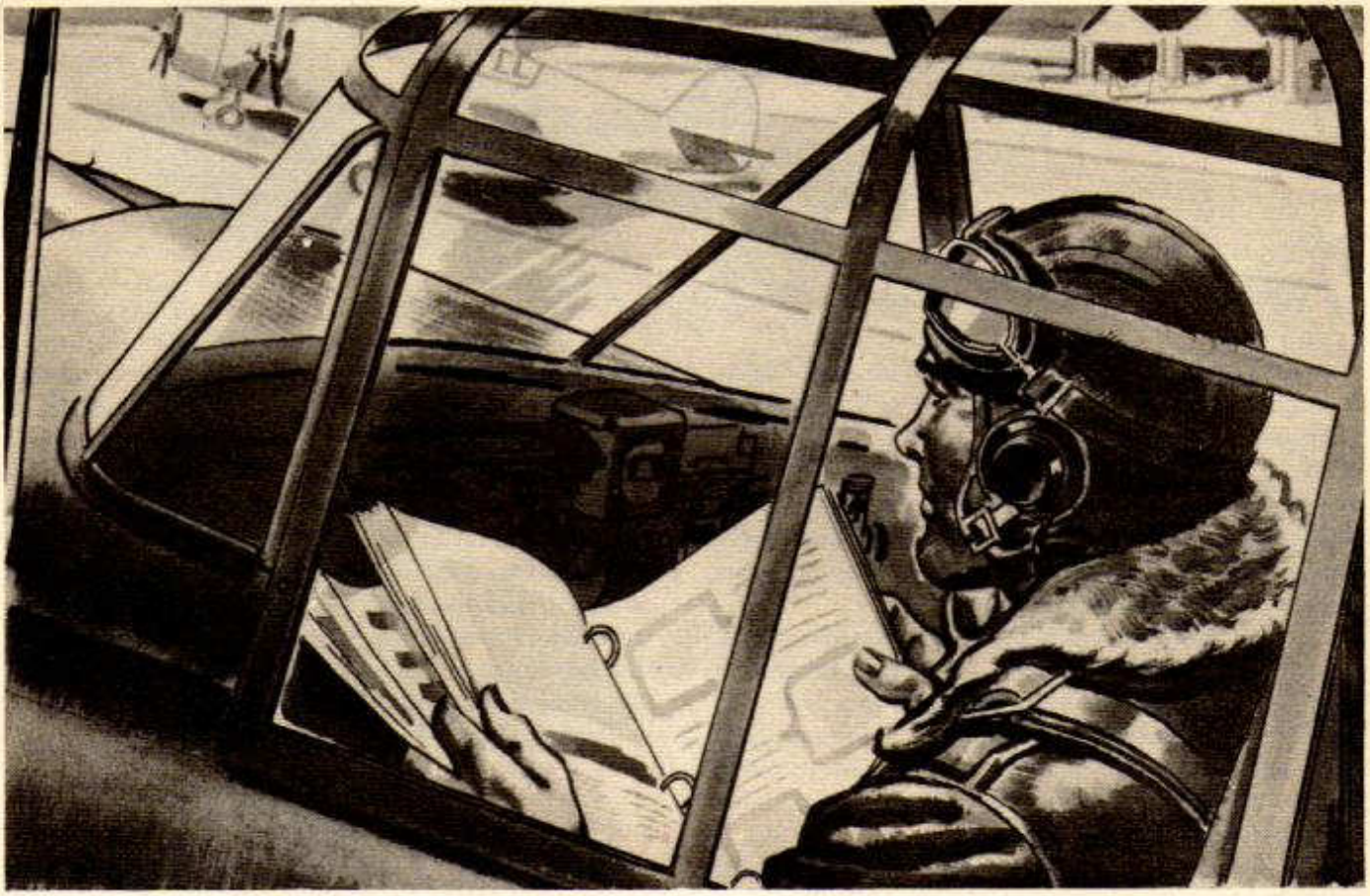
A Word to the Wise

Red means danger. Get the facts before you fly.

What Symbols Mean

	A red diagonal shown under "Status Today" on 1A indicates that the airplane is flyable, but is not in perfect condition.
	A red cross indicates that a major defect exists and the airplane must not be flown.
	A red dash indicates required inspection has not been made.
Like red traffic lights, these symbols are primarily for your protection.	





Transition Flying Training

Commanding officers of Army Air Forces stations and organizations will make available to pilots Handbooks, Technical Orders, Operation and Flight Instructions, Special Instructions on Equipment, and all other such publications; and will require that all pilots under their control pursue a prescribed course of transition flying instruction, fitted to the pilot's previous experience, and pass definite tests, when initially assigned to fly aircraft having flying characteristics and controls or equipment with which the pilot is not thoroughly familiar. The scope and duration of this course will be such as to thoroughly qualify the pilot to operate the aircraft safely and efficiently. This course of transition training will cover all maneuvers essential for the safe and efficient operation of the aircraft; in the case of multi-engined aircraft, this course will include flying on the minimum number of engines required to maintain flight during an emergency.

Pilots reporting to an Army Air Forces station other than their home station or to an aircraft factory for ferry duty will demonstrate satisfactory operative knowledge of the type to be flown, to the commanding officer or his representative at that station or to the Army Air Forces representative at the factory. The pilot's statement that entry has been made on his Form 5 to the effect that he is qualified on the type of airplane to be flown, may be accepted provided he has flown the type within the last 30 days.

Pilots operating aircraft in an organization or at a station other than their own will be required to comply with these instructions.

A certificate recording the action taken as directed above, will be prepared under the direction of the commanding officer and filed with the pilot's Form 5 record.

REFERENCE: AAF Regulation 50-16, dated October 26, 1942. This regulation supersedes AC Circular 50-4, dated May 9, 1941

PIF 1-9-1
REVISED May 1, 1944



Instrument Flying

A twin-engine airplane operating on one engine is only half an airplane. A pilot not proficient in instrument flying is only half a pilot. There is no place in the AAF today for a pilot who can fly merely by contact rules. Contact flying is part of the game, but by itself it has become an increasingly small part. The majority of all tactical missions require instrument proficiency.

To be of any real value to your organization and to safeguard your own life, you must become a proficient instrument pilot. Weather does not wait for war, nor war for weather. Sooner or later you will encounter conditions in flight where you will be paid back in full for whatever effort you have expended on instrument training.

Regulations demand that you have a certain amount of instrument training. Consider these requirements only the beginning of your instrument experience. Remember, there is nothing superhuman about flying an airplane by instruments. **If you are already a competent contact pilot, it will take only personal initiative and perseverance to become a competent instrument pilot.**

The Attitude System

Attitude may be defined as the relation of the airplane to the horizon. Maintaining a desired attitude in contact flight is easy because you can see the horizon. Through the proper use of instruments, however, **you can reconstruct the horizon on your cockpit panel, and know the exact attitude of your airplane at any moment.**

The old 1-2-3 system (needle, ball, airspeed) of instrument flying proved inadequate because the pilot flew mechanically. **Today's attitude, or full-panel, system teaches you to read all of your instruments in relation to the attitude of your airplane. Thus, you obtain a clear mental picture of your condition of flight.** This may prove difficult in the early stages of instrument training, but later it becomes as automatic as the handling of your controls.

You will learn not to depend on any single instrument if it fails to operate correctly. Instead you will depend on your **flight instruments as a coordinated whole** and realize it is possible to cross-check the attitude of your airplane by **combinations of instruments.** For example, your artificial horizon, which indicates most realistically your airplane's attitude, is not the only picture of attitude. You can further check banks by the turn indicator and directional gyro, and pitch by the altimeter and airspeed indicator. Hence the expression "full-panel."

Instrument Certificates

The AAF issues two certificates, one white, one green to denote instrument pilot proficiency ratings.

If you are a rated pilot on active duty, assigned to the pilotage of Army aircraft, you must obtain a currently valid white instrument card (AAF Form 8). If you do not already hold one, this rating is obtained by taking the Instrument Flying Course and passing the Instrument Flight Test and Oral Examination prescribed in AAF Reg. 50-3.

Read AAF Reg. 50-3 carefully in order to understand details of the course and the test.

The attainment of a green card (AAF Form 8A) is not demanded by regulation. It may be regarded as a goal to be reached by the pilot with long instrument experience. Under no circumstances will a green card be issued to a pilot with less than 1500 total hours which must include 100 hours of actual instrument time. These are bare minimums and station commanders must use great care in proving the applicant's proficiency once he has filled these basic requirements.

The table on PIF 1-9-3 shows the relative tests which must be passed to attain either card. Either flight test is given only after the pilot has pursued the prescribed Instrument Flying Course or that part of it necessary to complete the test.

PIF 1-9-2
REVISED May 1, 1944

THESE ARE YOUR BIBLES OF INSTRUMENT FLYING

GET THEM! READ THEM! KNOW THEM!

T.O. 30-100A-1

TECHNICAL ORDER NO. 30-100A-1

INSTRUMENT FLYING *Basic*

T.O. 30-100B-1

TECHNICAL ORDER NO. 30-100B-1

INSTRUMENT FLYING *Advanced*

T.O. 30-100C-1

TECHNICAL ORDER NO. 30-100C-1

INSTRUMENT FLYING *Instrument Trainer*

Below are your navigational aids to instrument flight. Be sure they are in your airplane before flying cross-country on instruments.



T.O. 30-100D-1

TECHNICAL ORDER NO. 30-100D-1

INSTRUMENT FLYING *Technique in Weather*

1 JAN 1944

PIF 1-9-3
REVISED May 1, 1944

INSTRUMENT FLIGHT TESTS AND REQUIREMENTS FOR RATINGS

A board of competent instrument pilots delegated by the Commanding Officer of each AAF station or equivalent unit will give the flight tests and oral examinations.

FOR WHITE CARD

(AAF Form 8)

1. Instrument Flying Course and Oral Examination (prescribed in AAF Reg. 50-3)
2. Basic Maneuvers
   a. Spiral Climbs
   b. Level Flight
   c. 90° and 180° Turns
   d. Steep Banks
   e. Stalls
   f. Recovery from Unusual Positions
   g. Glides
3. Radio Range Employment
   a. Orientation
   b. Beam Bracketing
   c. Let-Down and Low Approach

FOR GREEN CARD

(AAF Form 8A)

1. Prerequisites: 100 hours flying in actual instrument weather conditions, airplane flown manually. (On top flight cannot be logged for green card time.) A minimum of 1500 hours as pilot.
   PLUS
   The same as for white card
2. The same as for white card
   PLUS
   Instrument Take-Off
3. The same as for white card
   PLUS
   a. Position Plotting by Intersection
   b. Aural Null Orientation, and Homing to station
   c. Radio Compass Low Approach

Certificate Renewals

Instrument certificates must be renewed yearly. To renew the green card the pilot must have flown 12 hours during the year under actual weather conditions, but it must be divided so that he has flown 6 hours in each six months' period of the year. There is no weather requirement for renewing white cards.

On top flight cannot be logged as actual weather time for a green card renewal.

Revoking Ratings

Organization Commanders may revoke instrument certificates at any time if a pilot's instrument proficiency is not satisfactory.

All green certificates issued before March 6, 1944, are rescinded. To requalify pilots must obtain them under provisions of the current AAF Reg. 50-3.

Maintaining Instrument Proficiency

There are three ways to maintain instrument proficiency:

1. Actual flights under instrument weather conditions.
2. Hooded Flight (as governed by the safety precautions prescribed in AAF Reg. 60-4).
3. Instrument Trainer.

Use all three, but make the gaining of actual weather flying experience your first choice.

The instrument trainer will keep you familiar with procedure. Hooded flight is valuable to familiarize you with your own type of equipment. However, neither of them can replace the self-confidence and relaxation that grow out of **actual instrument flight.**

Increase your proficiency to its utmost. Do not be satisfied with merely qualifying for a certificate.

PIF 1-10-1
REVISED August 1, 1944



TIME CREDIT

Official military flying time and time spent in training devices is recorded on AAF Forms 1, 1G, 5 and 5S. Form 1G is used for Glider pilots.

For detailed information on Form 1 study AAF Reg. 15-1 carefully, and see the sample on PIF 1-13-1. Your Form 5 is accomplished from the information you enter on Form 1. Check it regularly, however, to be sure you are receiving proper credit.

To Compute Time

For the purpose of computing flying time, an aerial flight begins when the airplane starts to move forward on the takeoff run, and ends when enough momentum is lost so that the airplane either stops completely or power must be applied to continue the motion. **It does not include taxiing.**

As pilot, you enter on Form 1 or 1G the time in flight, the duty symbol, and the symbol indicating the type of flight for each person accompanying you on each flight. After landing, be sure you have made all necessary entries before you leave the airplane.

The following information is a guide to use of duty symbols. For situations not covered here refer to AAF Regulations 15-1 and 15-5. Read them in conjunction with each other.

★ FIRST PILOT TIME (P)

First Pilot Time is given all qualified pilots at the controls of the airplane and actually flying in the capacity of first pilot. In addition, it is given to any qualified pilot who is at one set of controls of a dual control airplane giving any type of dual instruction, such as transition training, instrument training, or check time, etc., to another qualified pilot. If your co-pilot, or other rated pilot, takes your place as first pilot, he will be given the credit for First Pilot Time for the time he is actually in full control of the ship. Only one pilot in an aircraft may claim First Pilot Time for the same time interval.

★ CO-PILOT TIME (CP)

Credit Co-pilot Time to all qualified pilots flying in the capacity of co-pilot at co-pilot controls, in airplanes equipped with dual controls, side-by-side arrangement only.

★ COMMAND PILOT TIME (C)

Use this symbol for any person holding an effective Command pilot rating if he is directing the flight operations of one or more aircraft but not flying as pilot or co-pilot. This time may not be credited in single-seater aircraft, nor for more than one individual in the same aircraft for the same time interval.

★ ACTING COMMAND PILOT TIME (CA)

Credit Acting Command Pilot Time to any qualified pilot not holding Command pilot rating but performing the duties of Command pilot.

★ QUALIFIED PILOT DUAL TIME (QD)

Use this symbol for any qualified pilot who is receiving any type of dual instruction such as transition training, instrument training, or check time. Qualified Dual Time may be logged only in aircraft having dual controls, either side-by-side or tandem; such time may be logged only for time actually spent at the controls.

★ FLYING INSTRUCTOR TIME (S)

Use this symbol for all qualified pilots for the time spent instructing non-rated student pilots. Any Instructor Time (S) appearing on the Form 1 will be credited on the Form 5 both as Instructor Time (S) and First Pilot Time (P).

★ STUDENT FIRST PILOT TIME (SP)

Use this symbol if you are a student pilot engaging in a solo flight. You may be credited with solo time, even if the instructor is present but not participating in any way except as passenger.

★ STUDENT DUAL TIME (SD)

This time will be recorded for all student pilots flying with and receiving dual instruction from an instructor in the same aircraft.

★ STUDENT CO-PILOT TIME (SC)

Student Co-pilot Time will be recorded for student pilots flying in the capacity of co-pilot, under the same conditions required for Qualified Co-pilot Time.

★ NON-PILOTS AND NON-PILOT STUDENTS

Time symbols used for non-pilots and non-pilot students will be found on the inside front cover of all Forms 1 and 1G.

★ DUTY CHANGE ALOFT

Whenever an occupant of an airplane changes his duty position in flight he will enter the time spent in his first position under that symbol, then enter the new duty symbol in the next column on the Form 1.

★ SYMBOL FOR TYPE OF FLIGHT

The following symbols indicate the type of flight performed. They will be entered on the Form 1 along with the number of hours and minutes flown under each condition. The symbol N covers night flying; I is instrument flight; NI indicates instrument flight at night; the symbol AI is used for flight in actual instrument conditions, and the symbol NAI will be used for flight in actual instrument conditions at night. Contact flight requires no symbol. Each time you change the symbol for type of flight enter it for each occupant except passengers.

Actual instrument time will be logged for flight conducted "in the soup," that is, when the attitude of the plane cannot be controlled by visual reference to the ground, clouds, or in any way except actual reference to your instruments. **Flight over a solid overcast, for example, would constitute instrument flight (I), but could not be logged as actual instrument time (AI). Actual instrument time cannot be logged unless the aircraft is being flown manually.**

AERONAUTICAL RATINGS

Officers, warrant officers, flight officers, and enlisted men of the AAF and officers, warrant officers, and enlisted men of the AUS assigned to air observation of the Field Artillery, who have demonstrated the required qualifications may, under prescribed regulations, be given aeronautical ratings.

Flying Officers—A flying officer is an officer who has received an aeronautical rating as a pilot of aircraft, as an aircraft observer, or as any member of a combat crew. For duration and 6 months this includes Flight Surgeons, and commissioned officers and warrant officers while undergoing flight training.

Flight Officers—An aviation cadet, at the completion of training may, if not selected for appointment as Second Lieutenant, be appointed a Flight Officer, with pay and allowances of Warrant Officer, Junior Grade, on flying status. After three months he may be appointed by selection to Second Lieutenant.

Command of Flying Units—Any flying officer on duty with the AAF who has an aeronautical rating as a pilot of service types aircraft is competent to command flying units.

Only an officer with an aeronautical rating of Command Pilot, Senior Pilot, Pilot, Senior Balloon Pilot, or Balloon Pilot may command tactical units of the AAF where a comprehensive knowledge of flying on the part of the commander is necessary. A Service Pilot officer may command air transport units or units equipped solely with liaison or glider aircraft. A Liaison Pilot officer may command only organizations equipped solely with liaison aircraft. A Glider Pilot officer may command only organizations equipped solely with glider aircraft.

Flight Status—To retain flight status, one of the following categories must be filled periodically, as minimum flight requirements:

1. Monthly: 10 flights totaling 3 hours, or a total of 4 hours in the air. Or

2. During 2 consecutive months: 20 flights totaling 3 hours, or a total of 8 hours in the air. Or

3. During 3 consecutive months: 30 flights totaling 9 hours, or a total of 12 hours in the air.

Suspension from Flying Duty

Suspensions from flying status are of three types:

1. Grounding—anticipated to last 30 days or less. A pilot may be grounded or returned to flying duty from that status by his Commanding Officer.

2. Temporary suspension—anticipated to last 6 months or less. May be initiated by a pilot's Commanding Officer, but must be confirmed or removed by the Commanding General of the air force or independent AAF Command having jurisdiction over the pilot.

3. Indefinite suspension—anticipated to last over 6 months. May be initiated by the Commanding Officer but must be confirmed and can be removed only by the Commanding General of the AAF.

Suspensions may be removed only by revoking or rescinding them. If revoked, the pilot can draw flying pay for the period of suspension if he meets flight requirements. If rescinded, he cannot draw flying pay for the period of suspension. Suspension for sickness or injury ordinarily will be revoked; in other cases usually it will be rescinded.

A pilot injured in an aircraft accident is entitled to flight pay for a 3-month period without meeting flight requirements. This period begins on the first of the month of injury if flight requirements have not been met, on the first of the month following if flight requirements have been met by the pilot at the time of the accident. The pilot will not be suspending from flying status until the end of the 3-month period. If, at the end of such period, he is still unable to perform his flying duties, he will then be given an indefinite suspension.

Applications and Rerating

When an individual determines he is eligible for an aeronautical rating, he should forward his application through channels.

A Service Pilot or Senior Service Pilot may apply to the rating board of his station for a Pilot rating. The board determines, without a flight check, if the applicant is qualified for rerating. It forwards its report through channels to the headquarters of the Air Force or Command having jurisdiction. That headquarters acts on the application; if favorable, the applicant is notified when and where to report for a flight check.

Computing Flying Time

Credit flying time when making application for aeronautical ratings, as follows:

In military or naval heavier-than-air aircraft, as pilot or copilot ..... 100%.

Acting in capacity of command pilot, though not rated as such and not at the controls, in unit operations of two or more aircraft ..... 100%.

All other flying time in military or naval aircraft ..... 50%.

Military or naval lighter-than-air aircraft ... 25%.

Pilot or copilot in commercial heavier-than-air aircraft, power rating at least 400 hp ..... 100%.

Applying for Ratings

Submit complete information to show that you possess all the qualifications for the rating requested. Include a copy of your latest AAF Form 5, certified by the operations officer, to substantiate flying time for which you claim credit.

Flying time in non-military aircraft powered with engines of at least 400 hp will be credited only when the number of hours for which you claim credit is entered in the correct horsepower column on Form 5, or if a certificate by the operations officer, indicating the number of hours claimed, is placed on the face of the Form 5.

Include a statement of service, to substantiate service while holding an aeronautical rating. If you left the service at any time, then re-entered the service, claim credit only from the date of rerating. This may differ from the date of recommission.

Qualifications for New Ratings

Here is a brief summary of the qualifications for higher aeronautical ratings. Before you apply for rerating, refer to the detailed requirements in AAF Regulation 50-7. To obtain the rating of:

Command Pilot—You must hold the rating of Senior Pilot or Pilot and have one of the following:

1. 15 years active duty as a rated pilot, with 2000 hours of flying time.
2. 10 years active duty as a rated pilot, with 3000 hours of flying time.
3. 20 years Reserve or National Guard service as a rated pilot, with 2000 hours of flying time.
4. 15 years Reserve or National Guard service as a rated pilot, with 3000 hours of flying time.

Senior Pilot—Hold the rating of Pilot, with at least 5 years Regular Army, Reserve, or National Guard service and have 1500 hours flying time.

Pilot, Conversion from Senior Service or Service Pilot—You must be at least 18 but not over 38 years old, not above the rank of Captain, and hold a rating of Senior Service Pilot or Service Pilot. In addition, have 500 hours of pilot time, 400 hours of that in airplanes with engines of at least 400 hp, 300 hours alone except where a copilot is required, 100 hours or more in AAF aircraft with 400 hp engines, with 50 hours in the last 12 months. Board recommendation and flight test also are required.

Aircraft Observer—If you hold the rating of Command Pilot, Senior Pilot, Pilot, Senior Balloon, or Balloon Pilot you may qualify for Aircraft Observer if you:

1. Have served as a regular member of a combat crew in observation or reconnaissance aviation units of the AAF or National Guard as a commissioned officer and a pilot for not less than one year. Have at least 100 hours in observation or reconnaissance, at least 50 hours of which were as observer. Qualify as expert aerial gunner or aerial sharpshooter. Be certified by your Commanding Officer.
2. Aircraft Observer (Navigator)—Complete a course in aerial navigation. Qualify as expert aerial gunner or aerial sharpshooter. Be certified as qualified by your Commanding Officer.
3. Aircraft Observer (Bombardier)—Qualify as Bombardier, 1st class, 2nd class, or 3rd class, in prescribed bombing courses. Qualify as expert aerial gunner or aerial sharpshooter. Be certified as qualified by your Commanding Officer.

Other Ratings—Complete qualifications for other ratings and for rerating may be found in AAF Regulation 50-7.

Warning

Submit your application for rating or rerating through the proper channels. You are not rated until you have been notified officially. You must be able to present official proof of your rating before you are entitled to wear the wings of that rating.

REFERENCES: AR 95-60; AR 35-1480; AAF Regs. 50-7 and 35-16; TM 14-250.

PIF 1-12-1
REVISED August 1, 1944

REPORTING AIRCRAFT ACCIDENTS



Duty Required

The Flight Commander or senior member not incapacitated will, after an aircraft accident involving military personnel only:

1. Secure necessary medical attention or undertaker services.

2. Report to the Commanding Officer of the nearest Air Forces station: location of accident, nature and cause of accident, assistance required, extent of injury to personnel, action taken to care for injured, place at which injured can be reached, and any other pertinent information.

3. Secure all available evidence and testimony of witnesses, etc., which may serve to determine the cause of the accident.

4. See that the wreckage is not moved or tampered with in any way until an investigation has been made, except when necessary to assist persons injured or trapped in the wreckage, or in the interest of public safety.

5. Secure the necessary guard for the aircraft.

When an accident has occurred at or near an Army station, secure the guard from the C. O.

If the accident has occurred at a distance from any Army station, secure the guard from civilian sources at the local rate of pay for each caretaker. (The pay of civilian caretakers will be handled on AAF Form 15, and will be forwarded promptly to the home station of the airplane for payment.)

6. Take necessary action for the disposition of the airplane and the return of personnel to their stations.

7. In case of damage to private property the investigation will be made by the claims officer of the home station or the station nearest the scene of the accident. In reporting the accident ask that the claims officer be notified.

8. Upon return to home station, submit a full report to the Commanding Officer.

Public Relations Policy

Make no statement to the press about any accident. The C.O. of the station or base nearest the scene of the accident will issue whatever information is to be released for publication. Don't talk to unauthorized persons about the accident nor the flight involved.

While in charge of wreckage not on Government property, do not interfere with representatives of the press who may take photographs or cover the news story, provided they do not disturb the wreckage. The use of material they gather or photos they take is covered by the censorship code and is not your responsibility.

REFERENCE: AAF Reg. 62-14, AAF Reg. 62-14A, AR 95-120, WD Circular 230.

Forms

The pilot is responsible for the proper execution of a number of forms, and shares responsibility in others. In order that you may know how to fill them out properly and recognize what is of importance to you on forms that others fill out, these typical forms, properly executed, are presented.

You will enter each flight you make, with all necessary details, on a Form 1. A book of Form 1's belongs in every airplane.

6-15-44 (DATE) — PATTERSON FIELD, OHIO (STATION) — 38th BOMB Gp. (H) (GROUP NO. AND TYPE) — B 17 G (AIRCRAFT MODEL)

T/Sgt Edward J Marcus (CREW CHIEF OR AERIAL ENGINEER) — 71st BOMB SQ. (SQUADRON NO. AND TYPE) — 43-7333 (AIRCRAFT SERIAL NO.)

PERS CLASS	— PRINT PLAINLY — NAME — RANK — ORGANIZATION	USE AS DIRECTED LOCALLY	ALWAYS ENTER DUTY SYMBOLS WHEN APPLICABLE. ENTER N - NIGHT OR I - INSTRUMENT. ENTER TIME FLOWN THEREUNDER						FLIGHT DATA	
			DUTY	N OR I	DUTY	N OR I	DUTY	N OR I	TERMINALS AND MISSION	
1	2	3	4		5		6		8	9
00	29th BOMB Gp. 19th BOMB SQ. HENDERSON, DAVID H, 056321, CAPT, MITCHELL FIELD		P	N	P	NI	CP	NAI	FROM: MITCHELL FLD. L.I., N.Y.	03:15
			1:05		1:00		:55			
01	29th BOMB Gp. 14th BOMB SQ. GALLOWAY, CHAS. R., 0576925 CAPT, MITCHELL FLD		CP	N	CP	NI	P	NAI	TO: PATTERSON FLD. OHIO	06:15
			1:05		1:00		:55			
38	29th BOMB. Gp. 14th BOMB SQ. LEDBETTER, JOHN W, 13175688 T/Sgt MITCHELL FLD.		E	N	E	NI	E	NAI	MISSION: T	3:00
			1:05		1:00		:55			
00	WHARTON, CHAS. T., 02412, Lt. Col. PATTERSON FLD.		P						FROM: PATTERSON FLD. OHIO	08:00
			3:35							
01	RUTHERFORD, DONALD L, 0334791, MAJ. PATTERSON FIELD		CP						TO: SALINA KANS.	11:35
			3:35							
38	AAF CFTC 21st SCH. SQ. HANKS, JOHN K., 14056490 T/Sgt. AMARILLO FLD, ARF, TEX.		E						MISSION: A	3:35
			3:35							
			P		P	I			FROM: SALINA KANS.	13:00
			2:50		1:05					
			CP		CP	I			TO: PATTERSON FLD. OHIO	16:55
			2:50		1:05					
			E		E	I			MISSION: A	3:55 / 7:30
			2:50		1:05					
00	NEWLON, FRANK C, 04698 Capt, PATTERSON FLD, OHIO		P	N					FROM: PATTERSON FLD.	20:05
			1:05							
00	ALDRIDGE, HOWARD R. O1064, Lt. C.I.S. SIG. ENG. Gp. RANDOLPH FLD. TEX.		CP	N					TO: LOCAL PATTERSON FLD.	21:10
			1:05							
38	GOODWIN, WILLIAM G, 37587TH T/Sgt. PATTERSON FLD., OHIO		E	N					MISSION: A	1:05
			1:05							
38	FRANCISCO, WELLING P, 14056811, T/Sgt. PATTERSON FLD, OHIO		R	N					FROM:	
			1:05							
18	MITCHELL, DONALD M, 0065911, MAJ. AC		X						TO:	
			1:05							
									MISSION:	

WAR DEPARTMENT A.A.F. FORM NO. 1 2-8-43 — FLIGHT REPORT - OPERATIONS — CHECKED: LEGIBLE AND CORRECT — W.A.W. OPER. CLERK — TRANSCRIBED: TOTAL FLIGHT TIME ENTERED ON FORM 1A — F.S.C. CREW CHIEF — TOTAL FLIGHT TIME 11:35

The crew chief ordinarily fills out the top lines. Check the entries as soon as you enter the cockpit. Fill in data required on each member of the flight, and as much data on the flight as possible before takeoff.

Each time you land, and before you leave the cockpit complete the Form 1. For instance, if you are on a cross country flight, fill in the information on each leg of the trip. Don't wait until you reach your destination and then try to remember all the details of time credit and duty status. **Every time you come to a stop on the ground you have a date with your Form 1.**

Be sure that all enlisted men on flying status are properly credited with the right duty symbol, so they will receive credit for their time.

Use column 3 as directed locally. Your C.O. may direct you to write your organization there, instead of as shown.

For details on time credit and duty symbols see PIF 1-10.

WAR DEPARTMENT
A. A. F.
FORM NO. 1 A
2-2-42

FLIGHT REPORT - ENGINEERING

INSPECTION STATUS

	DATE OF OR HOURS DUE	INSPECTED TODAY BY	INSPECTED TODAY STATION
PREFLIGHT	8-26-44	K	F.A.D
DAILY	8-26-44	M	F.A.D
25 HOURS	148:00		
50 HOURS	150:00		
100 HOURS	200:00		

SERVICING AT STATION OF TAKE-OFF
(CHECK IMMEDIATELY BEFORE TAKE-OFF)

SERVICE	FUEL (GALLONS) SERV-ICED	FUEL (GALLONS) IN TANKS	OIL (QUARTS) NO. 1 SERV-ICED	NO. 1 IN TANKS	NO. 2 SERV-ICED	NO. 2 IN TANKS	NO. 3 SERV-ICED	NO. 3 IN TANKS	NO. 4 SERV-ICED	NO. 4 IN TANKS	RADIATOR CHECKED
1ST	1150	2100	15	100	20	100	22	100	18	100	
2ND											
3RD											
4TH											
5TH											

INSPECTION OF AUXILIARY EQUIPMENT

EQUIPMENT	SYMBOL	INSPECTED BY	STATION
BOMBARDMENT			
GUNNERY			
CHEMICAL			
COMMUNICATIONS	B	Sgt. Burns	F.A.D
PHOTOGRAPHIC			
NAVIGATION	S	S/Sgt. Smith	F.A.D

STATUS TODAY

1.	2.
3.	4.

EXPLANATION: LEFT MAIN TANK
FUEL GAUGE INACCURATE

EXCEPTIONAL RELEASE

WHEN THE "STATUS TODAY" IS INDICATED BY A RED SYMBOL, AND AN "EXCEPTIONAL RELEASE" HAS NOT BEEN GRANTED BY AN AUTHORIZED ENGINEERING OFFICER, THE PILOT OF THE AIRCRAFT WILL SIGN THIS RELEASE BEFORE FLIGHT.

RELEASED FOR FLIGHT { 2. Henry Crane Capt A.C. 4.

REMARKS: PILOTS AND MECHANICS - SEE INSTRUCTIONS INSIDE FRONT COVER.

#1 Left Brake Weak - William Staggs 1st Pt. A.C.
#1 Serviced by Sgt. A. Ross - F.A.D. 8/26/44

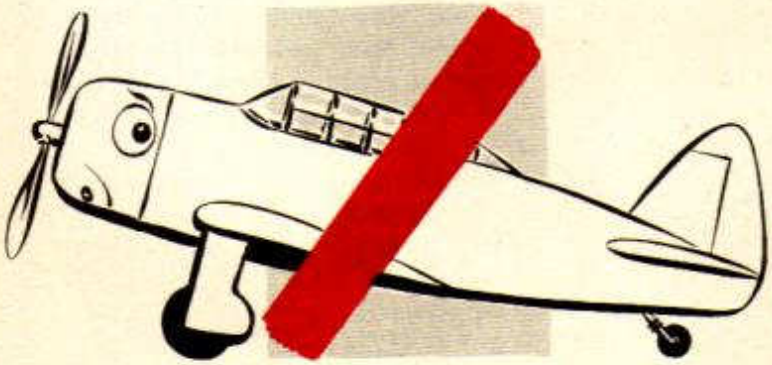
AIRCRAFT AND ENGINE TIME RECORD
(ENTER IN HOURS AND MINUTES)

ENGINE	NO. 1	NO. 2	NO. 3	NO. 4
HOURS TO DATE	143:55	143:55	143:55	143:55
HOURS TODAY	5:00	5:00	5:00	5:00
TOTAL	148:55	148:55	148:55	148:55
OIL CHANGE DUE	H.T.	H.T.	H.T.	H.T.
CURO. CLEARING DUE	150:00	150:00	150:00	150:00

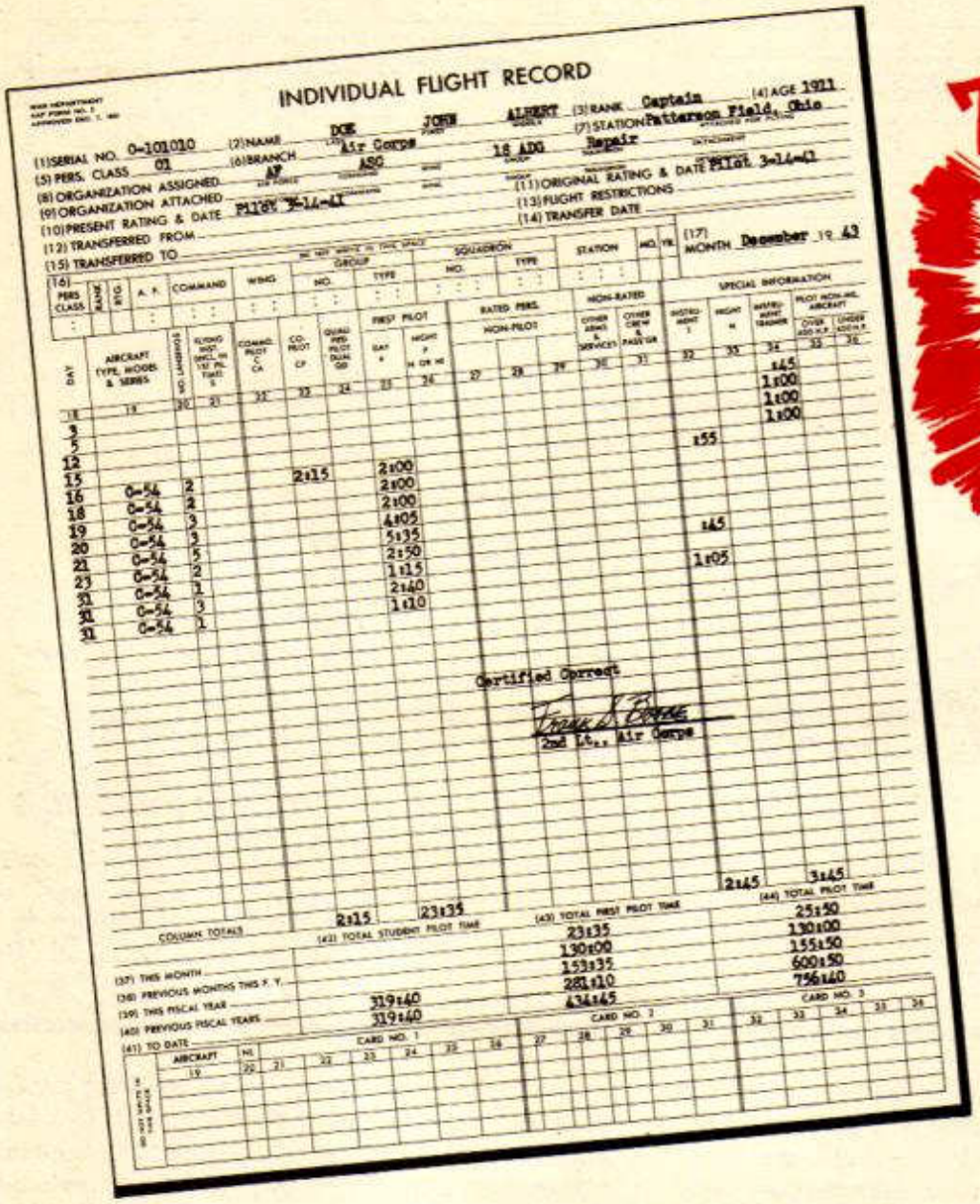
AIRCRAFT		
	HOURS TO DATE	143:55
	HOURS TODAY	5:00
	TOTAL	148:55

Form 1A will be executed by the crew chief, and should be in the airplane when you get in it. Check it carefully for the fuel and oil service, and watch for any **red diagonal.** This mark indicates that something is not functioning properly, but that the airplane is flyable.

The Engineering Officer has released the airplane for flight when he signed the Form 41B. If the Engineering Officer has not also signed the exceptional release on Form 1A, the pilot will sign it before he flies the airplane, to indicate that he knows what is not functioning properly.



Warning!



INDIVIDUAL FLIGHT RECORD

(1) SERIAL NO. 0-101010 (2) NAME DOE JOHN (3) RANK Captain (4) AGE 1921
(5) PERS. CLASS 01 (6) BRANCH Air Corps (7) STATION Patterson Field, Ohio
(8) ORGANIZATION ASSIGNED AF ASC 18 AOG Repair
(9) ORGANIZATION ATTACHED
(10) PRESENT RATING & DATE Pilot 3-14-41 (11) ORIGINAL RATING & DATE Pilot 3-14-41
(12) TRANSFERRED FROM (13) FLIGHT RESTRICTIONS
(15) TRANSFERRED TO (14) TRANSFER DATE

(17) MONTH December 19 42

DAY	AIRCRAFT TYPE, MODEL & SERIES	NO. LANDINGS	FLYING TIME (INCL. IN 1ST PIL TIME)	COMMAND PILOT C or CA	CO-PILOT CP	QUALIFIED PILOT DUAL GD	FIRST PILOT DAY	FIRST PILOT NIGHT D or N OR NE	RATED PERS. NON-PILOT	NON-RATED OTHER ARMS & SERVICES	NON-RATED OTHER CREW & PASS'GR	INSTRUMENT	HOOD	SPECIAL INFORMATION: WEATHERMENT TRAINER	SPECIAL INFORMATION: PILOT NON-INS. AIRCRAFT OVER 400 H.P.	SPECIAL INFORMATION: PILOT NON-INS. AIRCRAFT UNDER 400 H.P.
1															:45	
3															1:00	
5															1:00	
12															1:00	
15					2:15		2:00							:55		
16	O-54	2					2:00									
18	O-54	2					2:00									
19	O-54	3					4:05							:45		
20	O-54	3					5:35									
22	O-54	5					2:50							1:05		
23	O-54	2					1:15									
30	O-54	2					2:40									
31	O-54	3					1:10									
31	O-54	1														

Certified Correct

2nd Lt., Air Corps

COLUMN TOTALS	2:15	23:35		:45	3:45
(37) THIS MONTH			23:35		25:50
(38) PREVIOUS MONTHS THIS F. Y.			130:00		130:00
(39) THIS FISCAL YEAR		319:40	153:35		155:50
(40) PREVIOUS FISCAL YEARS		319:40	281:10		600:50
(41) TO DATE			434:45		756:40

(42) TOTAL STUDENT PILOT TIME
(43) TOTAL FIRST PILOT TIME
(44) TOTAL PILOT TIME

CARD NO. 1 — AIRCRAFT (19) | NO. (20) | 21 | 22 | 23 | 24 | 25 | 26
CARD NO. 2 — 27 | 28 | 29 | 30 | 31
CARD NO. 3 — 32 | 33 | 34 | 35 | 36



Form 5 will be executed for you. Your responsibility is merely to check that you have received proper credit for your flights, and for your time in the Link Trainer.

WAR DEPARTMENT
AAF FORM NO. 15
(REVISED 1 JAN. 44)

WAR DEPARTMENT
ARMY AIR FORCES

INVOICE

DATE 24 March 1944

THE UNITED STATES, DR.

TO Dallas Aeronautics Inc.

ADDRESS (Write plainly name and address of firm or individual from whom supplies or services were obtained)
Arlington Airport, Arlington, Texas

Airplane Number	ARTICLES OR SERVICES	Quantity	Unit	Unit Price	Total
44-2354	(1) Aircraft gasoline, 100 Octane	200	Gal	18	36 00
	(2) Aircraft Engine oil, Grade 120	25	qt.	12	3 00

WHEN it is necessary to procure emergency services or supplies you will execute an AAF Form 15, a supply of which will be found in an envelope (AAF Form 15A) in your airplane. Mailing envelopes are also included. You must prepare the form in quadruplicate. Use pencil (indelible if possible), ink, or a typewriter. All copies must be signed by both the dealer and yourself at the time of purchase.

Give the quadruplicate copy to the dealer. Immediately mail the original and remaining two copies to the contracting officer of the airplane's home station.

TOTAL

VENDOR'S CERTIFICATE

STATE TAX 0.05 LOCAL TAX NONE FEDERAL TAX 0.02 X (is not) included.
Strike out words not applicable. Always insert unit tax for fuel and oil, percentage or other basis, if any tax is included for other commodities or services.

I certify that the above bill is correct and just; that payment therefor has not been received; that all statutory requirements as to American production and labor standards, and all conditions of purchase applicable to the transactions have been complied with; and that state or local sales taxes are not included in the amounts billed.

NAME OF FIRM	BY (Print or Type)	TITLE	SIGNATURE
DALLAS AERONAUTICS Inc.	M. L. SMITH	SALES MANAGER	M. L. Smith

PURCHASER'S CERTIFICATE

Pursuant to authority vested in me, I certify that the supplies enumerated above or on attached list have been received in good condition and in quantities as stated; that the services enumerated have been satisfactorily performed. That the supplies or services were purchased in an emergency for the maintenance, operation, or protection of government equipment and were necessary for the public service. I further certify that the aircraft for which the supplies or services were purchased to maintain and operate, is engaged on an authorized cross country flight or is assigned at the point of purchase under proper authority.

PRINTED NAME	ASN	GRADE	STATION	SIGNATURE
E. D. JONES	0-484533	CAPT. AC	BOLLING FLD, D.C.	E. D. Jones

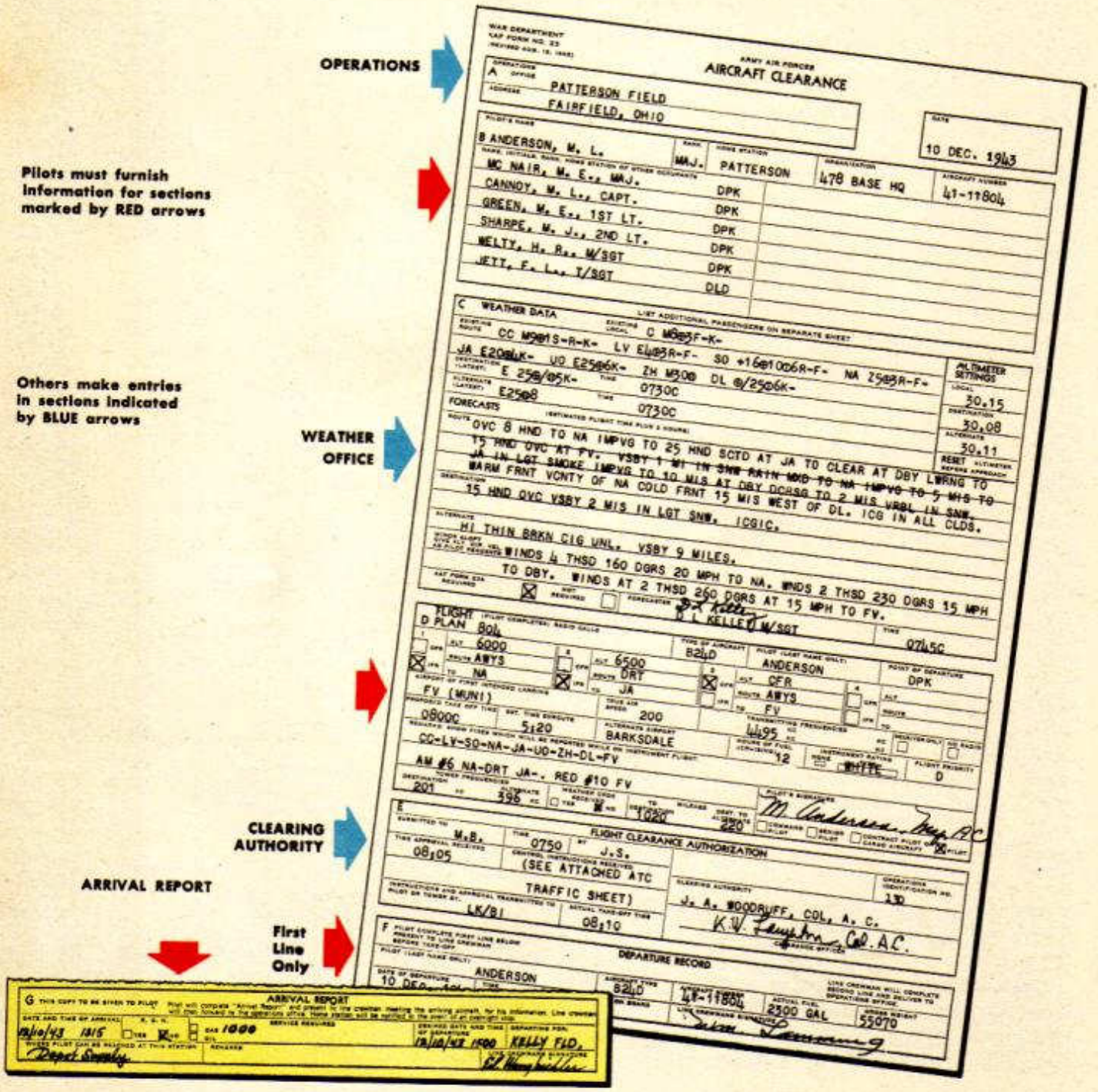
CAUTION: BE SURE TO INCLUDE BOTH THE SERIAL NUMBER OF THE AIRPLANE AND THE NAME OF ITS HOME STATION IN FILLING OUT THE FORM

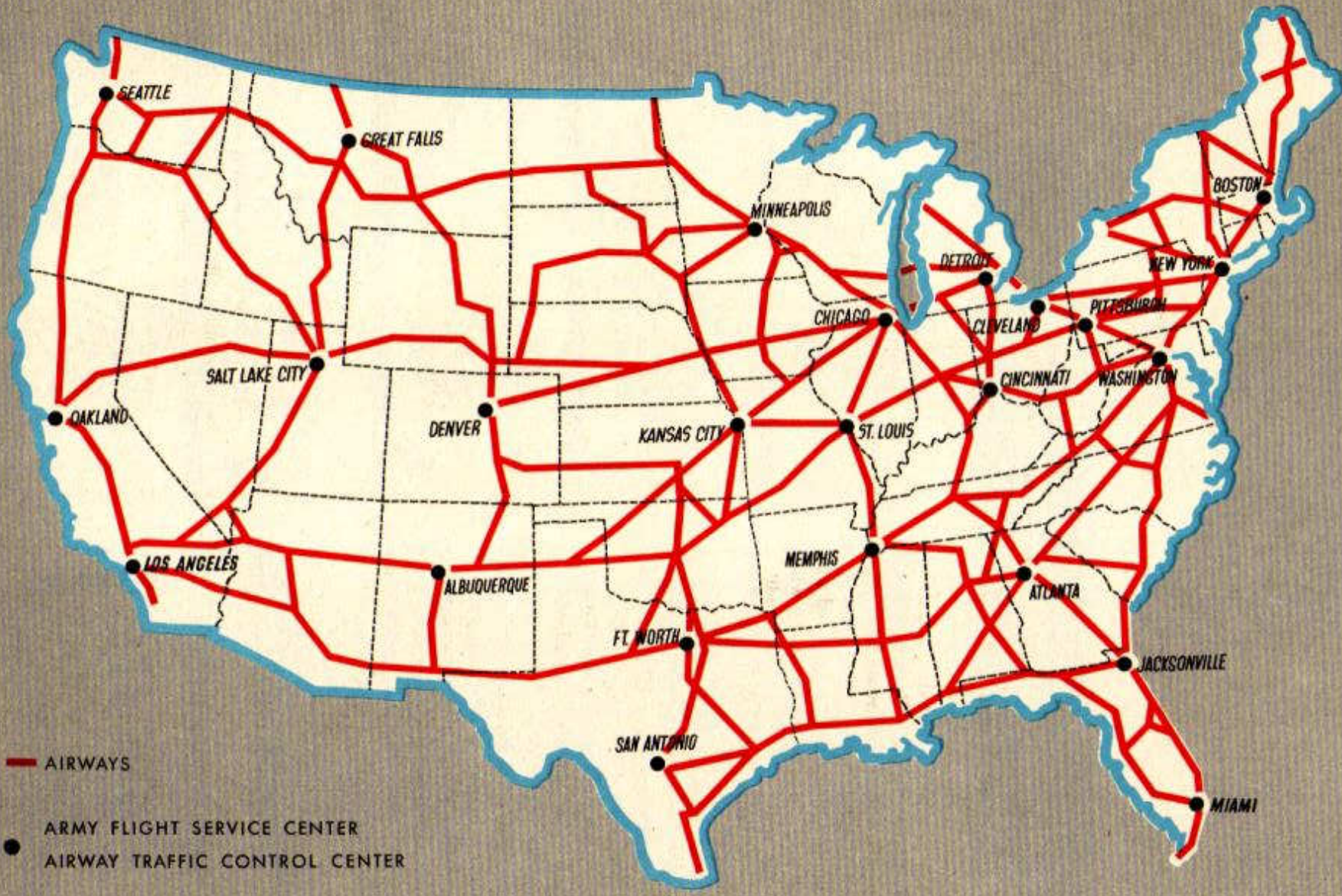
AAF Form 23 is the clearance form. It is used for all flights except those listed in AAF Reg. 15-23, which may require different forms or be governed by other regulations. For more detailed information on clearances and the use of the Form 23 see PIF 2-2.

You are responsible for information entered in Sections "B" and "D" and the first line of Section "F." Other sections will be filled in by operations, weather office, and Clearing Authority.

The original copy (white) is retained by operations. Section "F" is detached and given to you. After you have filled out the first line give it to the crew chief just before departure. Retain the carbon copy (yellow).

Upon landing complete the "ARRIVAL REPORT" (Section "G") at bottom of the yellow copy and give the form to the crew chief of the alert crew which meets your airplane.





SECTION 2 FLIGHT

PIF 2-0-1
REVISED January 1, 1945

AAF FLIGHT SERVICE

Army Flight Service operates under the Assistant Chief of the Air Staff, Training.

It provides a continuous dispatch, flight, and advisory service to pilots while en route, thereby increasing the number of completed missions with the greatest possible safety.

At present, Flight Service does this through:

1. Clearance of Form 23 Flight Plans at fields where no AAF Operations exist. (PIF 2-2)
2. Approval of all changes in Form 23 Flight Plans made while in flight.
3. Pilots' Advisory Service.

Pilots' Advisory Service

Pilots' Advisory Service is nationwide and available to all Army and Navy pilots on point-to-point flights. Army Flight Service Centers operate in conjunction with CAA Airway Traffic Control Centers.

Your flight plan is transmitted from your point of departure to the Flight Service Center in your area. Trained officers, on duty 24 hours a day:

1. Follow your flight from takeoff to landing.

2. Analyze known weather and traffic conditions: anticipate weather hazards which might affect your flight as you have planned it.

3. Advise you of such hazards and conditions.

4. Answer your specific requests for information or suggestions concerning your flight.

If unforeseen weather, other flight hazards, or field conditions at your destination or alternate develop, Flight Service will advise you. If you're guarding the frequency of the nearest communications station you will hear a series of code dits. Then, "Army Flight Service advises" followed by the message.

IT'S YOUR SERVICE

. . . . . USE IT!



1 **FILL OUT FORM 23 CAREFULLY.**



2 **FOLLOW YOUR FLIGHT PLAN.**



3 **MAKE POSITION REPORTS FREQUENTLY.**



4 **KEEP AN ALERT LISTENING WATCH.**



5 **REQUEST INFORMATION FROM ARMY FLIGHT SERVICE AT FIRST SIGN OF TROUBLE.**



Air Traffic Rules

1. **General:**

a. Reckless Operation. An AAF pilot will not operate aircraft in a reckless or careless manner, or so as to endanger friendly aircraft in the air, or friendly aircraft, persons, or property, on the ground.

b. Proximity to Other Aircraft. No aircraft will be flown closer than 500 feet to any other aircraft in flight, except when two or more aircraft are flown in duly authorized formation. On authorized formation flights, aircraft will not be flown closer to each other than the distance of one-half the wingspan of the largest aircraft concerned.

2. **Airspace Reservation.** An AAF pilot will not operate aircraft within any airspace reservation set aside by order of the President of the United States.

3. **Air Traffic Control Procedures.** AAF pilots will comply with air traffic control procedures established by competent authority and Standard Airport Traffic Control Procedures as approved by Army, Navy, and CAA, effective 1 January 1944.

4. **Over-the-top Flight.** No flight of aircraft, unless conducted under instrument flight rules, will be made over broken clouds or stretches of solid overcast, unless the attitude of the aircraft and its flight path can at all times be controlled by visual reference to the ground or water and unless ascent or descent can be made to or from the flight level without approaching closer than 2,000 feet horizontally to the cloud formation.

5. **Right-of-way.** The following rules will govern aircraft right-of-way:

a. Order. Aircraft in flight will have right-of-way in the following order:

Balloons, fixed or free (an airship not under control is classed as a free balloon).

Gliders.

Airships.

Airplanes, including rotorplanes.

b. Crossing. When two aircraft are on crossing courses at approximately the same altitude, the aircraft which has the other on its left will have right-of-way, and the other aircraft will give way.

c. Approaching head-on. When two aircraft are approaching head-on, or approximately so, and there is danger of collision, each will alter its course to the right so that they will pass each other at a distance of at least 500 feet.

d. Overtaking. An overtaken aircraft will have right-of-way and the overtaking aircraft will keep clear of the overtaken aircraft by altering its own course to the right.

e. Landing. Landing aircraft while maintaining a straight approach course for the last 1,000 feet before crossing the airport boundary will have right-of-way over all other aircraft, except aircraft landing in distress.

f. Distress landing. An aircraft in distress shall have right-of-way in attempting to land.

g. Duty to give way. When landing, or maneuvering in preparation to land, it will be the duty of the aircraft at the higher altitude to avoid the aircraft in the lower altitude.

6. **Right side traffic.** Aircraft or formations of aircraft operating along an airway will keep to the right of the radio range course projected along the airway, or if no radio range course is projected along the airway, will keep to the right of the center line of the airway, except:

a. When impracticable for reasons of safety;

b. When otherwise instructed or authorized by an airway traffic control center.

7. **Landing Area Rules:**

a. No aircraft will be taxied until the person in charge has ascertained that there will be no danger of collision with any objects in the immediate area. Aircraft being taxied within 100 feet of the parking area (except in established taxi lanes) or within the parking area will have a man to one wing tip to direct and assist in the taxiing operation. When this is impractical, due to the size or type of aircraft, a man will precede the aircraft at such distance that he is at all times within the view of the person taxiing the aircraft.

Station commanding officers are authorized to establish taxi lanes which will be clearly marked. Taxiing speed and procedures at any station will be as directed by the commanding officer or other competent authority and will be such as to insure reasonable and safe operation. Aircraft operation and movement on the ground will be governed by the provisions of AAF Reg. 62-10.

b. Landings and takeoffs will be made on the runway or landing strip most nearly aligned with the wind or when winds are light in the direction indicated by a controlled T or similar device, if available, unless local or operating conditions make landings and takeoffs in any direction inadvisable or unless exceptions are authorized by an air traffic control tower operator.

c. No takeoffs will be commenced until the pilot has ascertained that there is no danger of collision with any object in the takeoff path.

d. No turn will be made after takeoff until the airport boundary has been reached and the pilot has attained an altitude of at least 500 feet and has ascertained that there will be no danger in turning into the path of a following aircraft, unless exceptions are authorized by an air traffic control operator.

e. During and after a takeoff or when approaching, the pilot of an aircraft equipped with a functioning radio receiver will guard the air traffic control tower frequency until the air traffic control operator signs off.

8. **Flight in range approach channel, unless on an approved flight plan:**

a. Flight in a range approach channel will be below 1,500 feet except to enter the channel on the right side as determined by the direction of flight along such channel, and then continue along the channel in normal cruising flight.

b. Flight below 1,500 feet within the range approach channel will be confined to crossing the channel at an angle of not less than 45°, and to those maneuvers incidental to takeoffs and landings.

9. **Aircraft departing from or arriving at a controlled airport.**

Aircraft departing from or arriving at a controlled airport will take precedence over other air traffic within the control zone of such airport.

10. **Acrobatic flight.** No pilot will perform acrobatics:

a. At any height whatsoever over a congested area of any city, town, or settlement, or over any open-air assembly of persons.

b. Within the area included within the radius of five miles of the center of any airport except when such airport is within an established local flying area; or within the limits of a civil airway except within that portion lying adjacent to, but outside of, a range approach channel.

c. At any place other than unrestricted areas.

d. Unless the maneuvers can be completed and the aircraft under complete control at or above 1,500 feet (altitude above the surrounding terrain).

e. At any place, unless the visibility is at least 3 miles and the ceiling at least 3,000 feet, and unless the pilot has first ascertained that there is no danger of collision with other aircraft.

11. **Light and signal rules.** Between sunset and sunrise all aircraft in flight, or stationary, and likely to cause a traffic hazard, will show the regulation position lights.

12. **Fog signals.** Unless military necessity requires otherwise, an aircraft on the water in navigation lanes in fog, mist, or heavy weather will signal its presence by a sound device emitting a signal for about five seconds at one-minute intervals.

13. **Distress signals.** The following signals, separately or together, will, where practicable, be used in case of distress. a. The international signal, SOS by radio: In radio-telephony, the spoken expression MAYDAY (corresponding to the French pronunciation of the expression "m'aider"). When, owing to the rapidity of the maneuvers to be accomplished,

an aircraft is unable to transmit the intended message, the signal PAN not followed by a message retains such meaning. **b.** The international code flag signal of distress, NC. **c.** A square flag having a ball, or anything resembling a ball, above or below it.

14. **Aircraft on water.** Seaplanes on the water will navigate according to the laws and regulations of the United States governing the navigation and operation of watercraft, except as otherwise specifically authorized.



FLIGHT RULES

15. **Aircraft approaching and circling:**

a. Aircraft approaching and circling for a landing or making contact flight below 1,500 feet above the ground or water within three (3) miles horizontally of the center of an airport or landing area will circle the airport or other landing area sufficiently to observe other traffic, unless the pilot receives other instructions from the air traffic control operator. All circles, whether approaching for a landing or after takeoff, will be made to the left, unless the pilot receives other instructions from the air traffic control operator, or unless in the interest of safety a different procedure has been prescribed for the particular airport or landing area.

b. Aircraft approaching for a landing will, unless impracticable, or unless exceptions are authorized by an air traffic control operator, maintain a straight approach course for the last 1,000 feet before crossing the airport boundary.

16. **Minimum altitudes of flight:**

a. Except during takeoff and landing, aircraft will not be operated:

(1) Below the following altitudes:

(a) 1,000 feet above any building, house, boat, vehicle, or other obstructions to flight.

(b) At an altitude above the congested sections of cities, towns, or settlements to permit an emergency landing outside of such sections in the event of complete power failure.

(c) 1,000 feet above any open-air assembly of persons.

(d) 500 feet above the ground elsewhere than as specified above.

(2) Within 500 feet of any obstruction to flight.

b. Any maneuver may be conducted at such altitude above the ground or water as is necessary for its proper execution in places other than specified above, when such maneuver is required to accomplish an ordered tactical flight, engineering, or training mission.

17. **Contact flight.** Pilots of military aircraft flying under contact conditions, except when engaged (1) in practicing takeoffs and landings under contact flight rules at an altitude of not more than 1,500 feet above the airport from which such practice is conducted, or (2) in flight in established local flying areas, will:

a. File a flight plan as defined in paragraph 41 with an airway traffic control center. In case of a formation flight, only one flight plan need be filed, which plan will indicate the number of aircraft making the flight.

b. Except for necessary ascent and descent, maintain flight altitudes on civil airways as nearly as existing conditions permit, as follows:

Eastbound flights on green and red civil airways and northbound flights on amber and blue civil airways will be conducted at the odd 1,000 foot levels (such as 5,000, 7,000, and 9,000 feet). Westbound flights on green and red civil airways and southbound flights on amber and blue civil airways shall be conducted at the even 1,000 foot levels (such as 4,000, 6,000, and 8,000 feet).

Do not cross a civil airway at an angle of less than 45° unless otherwise instructed.

18. **Proximity to cloud formation.** Aircraft will not be flown closer than 500 feet vertically to an overcast or cloud formation nor closer than 2,000 feet horizontally to a cloud formation.

19. **Weather minimums.** The following weather minimums will govern flights made in accordance

with contact flight rules, provided that, in the interest of safety, an airway traffic control center may restrict or suspend contact flight operation within the airway traffic control area of such center:

a. Within control zones. Aircraft will not be flown within a control zone (or within 3 miles horizontally of the center of a military airdrome) unless the ceiling is at least 1,000 feet and the visibility is at least 3 miles: **Provided**, that an airport traffic control-tower operator on duty in an airport control tower may authorize flight at altitudes of 1,000 feet or less above the ground or water when the visibility is less than 3 miles but not less than 1 mile.

b. Outside control zones. Aircraft will not be flown at or below 1,000 feet above the ground or water unless the visibility during the hours of daylight is at least 1 mile and during the hours of darkness is at least 2 miles and will not be flown above 1,000 feet above the ground or water, unless the visibility (forward) is at least 3 miles at flight altitude.

c. Ferry Flights of Military Necessity. Notwithstanding any of the foregoing provisions of this section, AAF aircraft making ferry flights, in case of military necessity, may, in compliance with all other contact flight rules:

(1) Take off from, or fly over airports where the local visibility conditions are below the minimum hereinbefore established for operations under such flight rules, provided the visibility elsewhere along the civil airways to be flown is equal to or above such minimum.

(2) Be cleared to fly above an overcast in the clear, provided: (a) The pilot holds a currently effective instrument rating. (b) The aircraft is equipped with a radio receiver capable of tuning through the 200 to 400 kilocycle range. (c) Flight on top of the overcast does not exceed one hour. (d) Visibility at flight altitude is at least two miles. (e) The ceilings at the points of departure and destination are unlimited, and the weather forecasts indicate that the ceiling at the point of destination will remain unlimited until the arrival of the flight thereat.

d. Requests for authority to deviate from minimums specified in **a** and **b** above when deemed necessary because of peculiar local conditions, will be submitted to the Commanding General, AAF, Attention: Chief of Flying Safety.

20. **Weather changes.** If weather conditions below the minimum prescribed in paragraph 19 are encountered en route, a landing will be made at the nearest airport at which weather conditions are equal to or better than those prescribed in paragraph 19, or the flight may be altered so that it may be made in weather conditions as good as, or better than, such minimums, unless such flight can and does proceed in accordance with the instrument flight rules prescribed in "INSTRUMENT FLIGHT RULES."

Instrument FLIGHT RULES

21. **Pilot.** A pilot may, and will be encouraged to, engage in instrument flight provided he holds currently effective Instrument Pilot Certificate AAF Form 8 (white) or AAF Form 8A (green). Currently effective Certificates of Competency, signifying qualification to engage in flight under instrument conditions, issued by the Royal Air Force Transport Command, or the Royal Canadian Air Force, and held by pilots of such air forces, will be considered as equivalent to Instrument Pilot Certificate AAF Form 8 (white). (As to pilots of the Royal Canadian Air Force, see paragraph 8, AAF Regulation 61-2B.)

22. **Weather Minimums.** The following weather minimums will govern:

a. For holders of Instrument Pilot Certificate, AAF Form 8A (green):

No takeoff will be made when the ceiling is less than 200 feet or the visibility is less than one-half mile, except that Commanding Officers of OTU, RTU, Tactical and Training Units, may authorize takeoffs at minimums less than 200 feet and one-half mile visibility, provided such takeoffs are under the direct supervision of competent and duly authorized instructors of the training organization. (Training under these conditions is considered

necessary because tactical pilots will be required to take off under actual weather conditions of less than 200 feet and one-half mile visibility during combat missions.)

No landing weather minimums are applicable to pilots who hold a currently effective Instrument Pilot Certificate, AAF Form 8A (green), and clearance will depend upon the judgment and be the responsibility of such pilot.

b. For holders of Instrument Pilot Certificate, AAF Form 8 (white):

(1) No takeoff will be made when ceiling is less than 500 feet or visibility is less than one mile.

(2) No clearance will be issued for a flight to a destination at which ceilings or visibilities are reported to be less than those established by standard Instrument Approach Procedures, TO 08-15-3, for the particular station cleared for and forecast to remain steady or improving until the expected arrival thereat, and in no circumstances will any clearance be authorized for flight to a destination where visibility is reported or forecast as being less than one mile. In case no weather minimums for the particular station to be cleared for are published in TO 08-15-3, the following minimums will apply:

DAY		NIGHT	
Ceiling	Visibility	Ceiling	Visibility
800	1	1000	2
700	1½	800	3
600	2		
500	3		

c. In the case of Army contract air transportation service, weather minimums will be those set forth in the air carrier's operations manual and approved by the Air Transport Command. At stations where weather minimums have not been previously submitted by the air carrier and approved by the Air Transport Command, the minimums will be those specified in subparagraph **b**, above.

23. **Flight rules.** In addition to general flight rules or any special air traffic rules which apply, instrument flight rules will govern the following:

a. Flight in closer proximity to cloud formation than 500 feet vertically to an overcast or cloud formation, or closer than 2,000 feet horizontally to a cloud formation.

b. Flight in weather conditions worse than those described in paragraph 22.

24. **Aircraft Clearances and Flight Plan.** Aircraft clearances and flight plans will be governed by AAF Reg. 15-23.

25. **Alternate airport.** No takeoff of aircraft will be made unless:

a. The alternate airport named in the flight plan has a landing area suitable for the aircraft to be used, and

b. Weather reports and forecasts indicate that the weather conditions at the alternate airport will remain at or above the minimum specified in **c** or **d** of this paragraph, until the arrival of the aircraft thereat.

c. The alternate airport is equipped with a radio directional aid to air navigation in operation and there is at such alternate airport a ceiling of at least 2,000 feet and a visibility of at least three miles if an overcast exists; or a ceiling of at least 1,500 feet and a visibility of at least three miles if broken clouds exist; or

d. If the alternate airport is not equipped with a radio directional aid to air navigation, there is at such alternate airport an unlimited ceiling and a visibility of at least three miles.

e. In the case of Army contract air transportation service, weather minimums for alternate airports will be those set forth in the air carrier's operations manual and approved by the Air Transport Command. At stations where weather minimums have not been previously submitted by the air carrier and approved by the Air Transport Command, the minimums will be those specified in subparagraphs **c** and **d**, above.

f. The aircraft is provided with fuel and oil sufficient, considering the wind and other weather conditions forecast for the flight:

(1) To complete such flight to the point of the first intended landing, and thereafter.

(2) To fly to and land at the alternate airport designated in the approved flight plan, and thereafter.

(3) To fly, at normal cruising consumption, for a period of 45 minutes.

26. **Communication contacts.** The pilot will maintain a continuous listening watch on the appropriate radio frequency and will contact and report as soon as possible to the appropriate communications station the time and altitude of passing each radio fix or other check point established within the civil airways or specified in the flight plan.

27. **Communications failure.** In the event of failure of aircraft two-way communication equipment or in the event that the pilot does not receive radio signals sufficient to permit him to maintain instrument navigation, one of the following procedures

will be observed:

a. Proceed in accordance with contact rules.

b. Effect a landing at the nearest suitable airport at which favorable weather conditions exist.

c. When sufficient radio signals are received, proceed according to flight plan, including any amending instructions issued and acknowledged en route.

28. **Crossing an airway.** Unless otherwise instructed, a civil airway will not be crossed at an angle of less than 45° to such airway.

29. **Flight altitude.** Exclusive of taking off from or landing upon an airport or other landing area, aircraft making an instrument flight will not be flown below 1,000 feet above the ground or water nor within 1,000 feet of a mountain, hill, or other obstruction.

30. **Let-down procedures.** Descent through an overcast to contact flight condition at other than a range station for which a let-down procedure has been established, will not be attempted unless the pilot can specifically identify his position by means of navigational aids and has definite knowledge of the terrain.

Definitions

31. **Airport control tower.** An airport control tower is an establishment equipped to allow the operator thereof to control air traffic in the immediate vicinity of an airport.

32. **Airway traffic control area.** An airway traffic control area is an area within the limits of an airway designated by the Administrator of Civil Aeronautics, or by competent military authority, over which an airway traffic control center exercises control.

33. **Airway traffic control center.** An airway traffic control center is a station operated by the Administrator of Civil Aeronautics, or by the military forces, for the purpose of controlling air traffic on established airways.

34. **Airway communications station.** An airway communications station is an airway radio, teletype, or other communications station operated by the Administrator of Civil Aeronautics, or by the military forces.

35. **Alternate airport.** An alternate airport is an airport, other than the point of first intended landing, specified in the flight plan, and to which the flight may proceed in case of emergency.

36. **Ceiling unlimited.** A ceiling is considered unlimited when clouds cover less than one-half of the sky or when the base of the clouds is more than 9,750 feet above the point of observation.

37. **Control airport.** A control airport is an airport where, in the interest of safety, air traffic is controlled from the ground by means of radio communication or visual signals.

38. **Contact flight.** Contact flight is flight conducted in such a manner that ground and water within gliding distance of the aircraft can at all times be used for visual reference.

39. **Control zone.** A control zone is the airspace above that area on the surface of the earth within 3 miles horizontally of the center of an airport designated by the Administrator of Civil Aeronautics as a control airport, and within one-half mile of a line extending from the center of such airport to the radio range station established for the purpose of directing air traffic to such airport.

40. **Cruising altitude.** Cruising altitude is a flight altitude, measured in feet above sea level, proposed for that part of a flight from point to point during which a constant altitude will be maintained.

41. **Flight plan.** A plan of flight filed with an Army Airway Control Center, or the Administrator of Civil Aeronautics, in such manner and containing such information as may be required by Section D of AAF Form 23.

42. **Instrument flight.** That portion of any flight which cannot be made by visual reference to ground or water within gliding distance of the aircraft, or which approaches closer than 500 feet vertically to the base of an overcast, or 2,000 feet horizontally to a cloud formation.

43. **Radio fix.** A radio fix is a geographical location on an airway above which the position of an aircraft in flight can be accurately determined by

means of radio only, such as: a cone of silence marker, Z type marker, fan type marker, or intersection of radio range "on course" signals.

44. **Radio range station.** A radio range station is a radio station from which radio signals are emitted for the purpose of assisting an aircraft to maintain a course.

45. **Range approach channel.** A range approach channel is the airspace above the ground or water below 17,000 feet above sea level located within 2 miles of either side of the center of the "on course" signal of any designated leg or legs of a radio range station serving a control airport, and extending along such leg or legs from such radio range station for a distance of 15 miles.

46. **Visibility.** Visibility is the greatest mean horizontal distance toward at least 50 per cent of the horizon at which conspicuous objects can be readily identified by the naked eye.

47. **Zone of intersection.** A zone of intersection is that part of a civil airway which overlaps and lies within any part of any other civil airway.

48. **Parking area.** Those portions of airport aprons, ramps, lines, or other spaces, so designated by the commanding officer and reserved for the open-air parking of friendly aircraft.

NONAPPLICATION OF AIR TRAFFIC RULES

49. These air traffic rules will not apply in the following cases:

a. When special circumstances render nonobservance necessary to avoid immediate danger, or when such nonobservance is required because of stress of weather conditions which could not reasonably have been foreseen, or for other unavoidable causes. Such nonobservance, including the emergency making the nonobservance necessary, the results accomplished by such nonobservance, and when regular observance was resumed after the emergency had passed, will be reported in writing in full detail within 24 hours to the operations officer at the point of first landing after such nonobservance, which report will be transmitted by the operations officer without delay to the commanding officer of the pilot's home station. The commanding officer's remarks will be placed upon such reports, and the report forwarded to the Commanding General, AAF, Attention: Chief of Flying Safety.

b. When military necessity requires. If the military necessity is such as to endanger other aircraft operating on airways, the appropriate airway traffic control center will be notified.

c. When in the interests of safety. C.O.'s are authorized to prescribe more stringent regulations for any airport under their control.

d. When Necessary to Carry out Training Directives. Aerial reviews and parade flight formations, unless in the form of a tactical combat maneuver or demonstration, will not be deemed as necessary to carry out training directives, and will not be authorized. The provisions of this sub-paragraph will not be invoked to authorize deviations from the provisions of paragraphs 1 and 2 above. When deviation from the provisions of these regulations is deemed necessary for flying training activities, commanding officers will be responsible for: (1) the coordination of such training with all other activities concerned in the local area involved, (2) the notification of the appropriate airway traffic control center and (3) an entry, "Authorized Deviations" being made in the Remarks column of Section D, "Flight Plan", on the AAF Form 23 for the flight.

REFERENCE: AAF Regs. 60-16, 6 March 1944; 60-16A, 15 April 1944; 60-16B, 1 May 1944; 60-16C, 16 May 1944.

RESTRICTED

PIF 2-2-1
REVISED July 1, 1944

CLEARANCE FOR AIRCRAFT

THE STORY OF THE FORM 23



Procedures governing the clearance of aircraft are contained in AAF Reg. 15-23, along with directions for filling out your individual clearance, the AAF Form 23. A sample of this form is shown in PIF 1-13-6.

Contact Flight Rules (CFR) and Instrument Flight Rules (IFR) published in AAF Reg. 60-16 (See PIF 2-1) and rules published in AAF Reg. 15-23 will govern all aircraft clearances.

All pilots will use Form 23 for clearance on all flights except those specifically exempted by AAF Reg. 15-23.

Weather Data and Flight Plan

Step by step procedure in filling out Form 23 is shown in the accompanying illustrations.

If there is no qualified weather personnel on duty, check the available weather information, insert a statement in Section C that you have done so, and initial same.

If you are a pilot with clearing authority, you may either present your Form 23 to the weather office in the usual manner, or simply initial Section C, signifying that you have current weather information.

After completion of Section C complete Section D by indicating whether your flight will be CFR or IFR.

If your flight is to be on instruments you must pick

an alternate airport at which weather conditions meet alternate airport weather requirements. You must also have enough fuel to (1) fly to airport of first intended landing, then (2) proceed to alternate airport if first airport is closed, and (3) remain aloft over alternate for at least 45 minutes.

Clearance

Clearances will normally be valid for one hour from proposed takeoff time unless cancelled by competent authority.

Command Pilots, who for purposes of clearance will be considered to possess a green Instrument Pilot Certificate (AAF Form 8A) are authorized to:

1. Act as their own clearance authorities for IFR or CFR flights.

2. Clear individuals for CFR flights which they accompany or which are under their control.

Senior Pilots, Senior Service Pilots, and Civilian Contract Pilots of Air Transport Command may act as their own clearance authorities, or may clear individuals on flights they accompany, or which are under their direct control, for CFR flights. These three classes of pilots may, if they hold valid white Instrument Pilot Certificate (AAF Form 8), clear only themselves for IFR flights.

Pilots holding valid green cards may clear themselves on CFR or IFR flights.

In all other cases pilots can be cleared only by the authorized clearing authority.

You cannot be cleared for instrument flight if you don't hold a valid white certificate.

Even if you hold a white certificate, but it shows total pilot time less than 500 hours, you cannot be cleared for instrument flight if ceiling or visibility is at or near instrument flight minimums.

No matter what your rating nor the extent of your clearing authority, don't taxi nor take off until authorized by the tower.

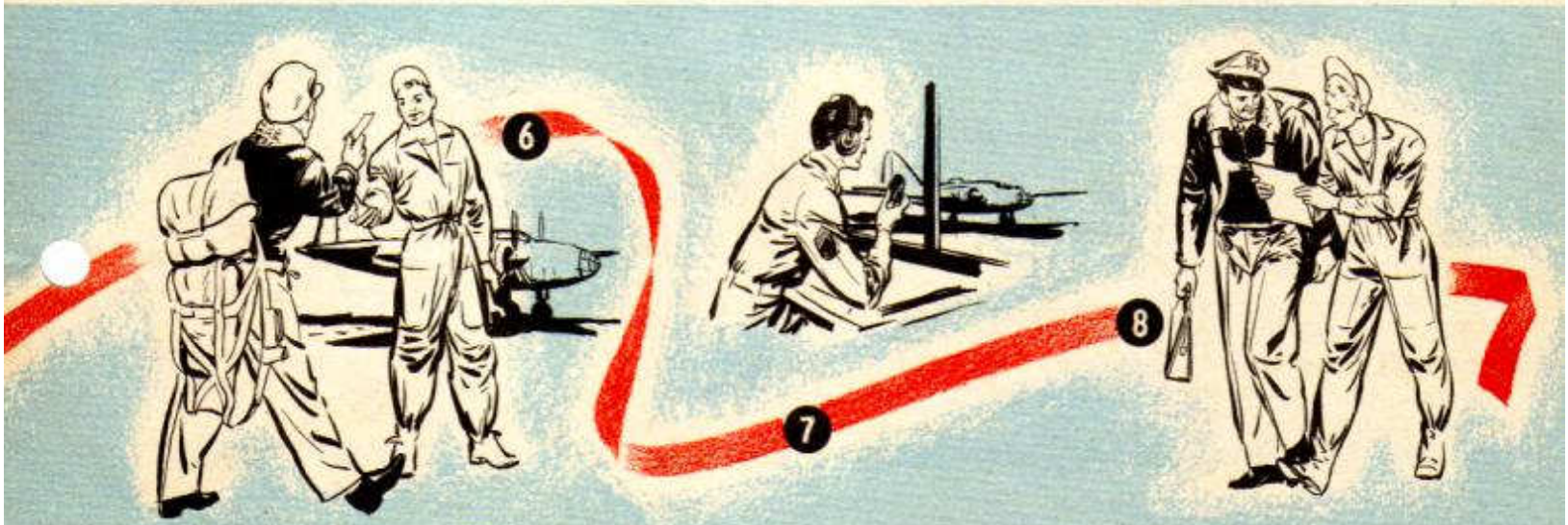
No AAF Operations

Before departing from a location where there is no AAF operations office you must file a flight plan with an AAF Flight Control Center, using any Army approved communications facility. Army Flight Control Centers are located at all CAA Airway Traffic Control Centers. Unless you are your own clearance authority, you must wait for Army Flight Control's approval before taking off. **All pilots are urged, however, to wait for any further information from Army Flight Control.**

If approved communications facilities are not available, you may take off under CFR flight conditions only, and fly to the nearest practicable point where they are available. You may then request a change of flight plan in flight, or land and file a flight plan in the usual manner.

Formation Flights

If you are the Flight Commander of a formation flight, make out a Form 23 for your own airplane. Put the words "Flight Commander" after your signature, and on the form or an attached list enter: model and serial number of each plane in the formation; name, rank, serial number of each crew member in the flight; name, rank of other occupants. Then brief pilots and see that they have proper maps and instrument ratings. Certify to this action under "Remarks."



FILL IN SECTION F, "DEPARTURE RECORD," HAND IT TO LINE CREWMAN. HOLD DUPLICATE YELLOW FORM, "ARRIVAL REPORT."

DON'T TAKE OFF UNTIL TOWER GIVES YOU FINAL GO-AHEAD

AFTER ARRIVAL FILL IN G (YELLOW FORM), "ARRIVAL REPORT," HAND TO CREWMAN

PIF 2-3-1
REVISED July 1, 1944

RADIO CHANGE IN FLIGHT PLAN

Any deviation from the original flight plan you have filed on your Form 23 requires a new clearance by radio. Note: Changing your altitude or route under CFR conditions is not considered a deviation.

Unless you are a pilot with clearing authority, here is what you must do:

Request approval for your intended change **before you make it,** using the nearest available radio facility (consult radio facility charts).

Report (1) your position, (2) details of the change you wish to make, (3) remaining hours and minutes of fuel aboard, and (4) estimated time en route from current position to destination.

The reply you get, after your request has been processed and approved by the proper agencies, will begin with either the words "Army Flight Control approves - -" or "Airway Traffic Control approves - -". This is all you need to remember, as the approval you receive is final unless specifically stated otherwise.

If you are a pilot with clearing authority and flying under CFR conditions, you can make the change without approval. However, you must report your change and give same information as outlined above. **All pilots, regardless of their rating, will make no change in flight plan when flying under IFR conditions without first obtaining approval.**

In case of an emergency, you will use your own good judgment and take whatever action is necessary. You are required by regulation, however, to report such action as soon as possible through the nearest available radio communications facility.

How Approval Is Granted

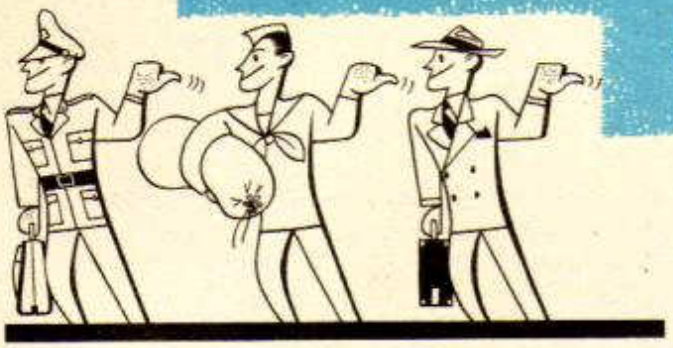
The following information, although you need not remember it in flight nor let it confuse you in any way, is given so that you can better understand how radio requests for changes in flight plan are handled.

A pilot in flight is subject to two types of clearances by radio. One is concerned with **traffic separation** on the airways and is always subject to the approval of CAA Airway Traffic Control Centers. The other is in the nature of a **dispatch clearance** and is granted (or refused) by Army Flight Control.

These two agencies are always located in the same office and coordinate closely. Your request through your nearest available radio facility is relayed by interphone to an Airway Traffic Control Center where the two agencies process it. Airway Traffic Control is concerned only with change of flight plan on the airways under IFR conditions. However, Army Flight Control is concerned with all changes of flight plan, on or off the airways, under CFR or IFR conditions. The approval involved is something that will be determined for you automatically on the ground, depending on the nature of your intended change. Thus when you hear either "Army Flight Control approves - -" or "Airway Traffic Control approves - -" you need not worry whether or not the proper agency has received your request.

PIF 2-4-1
REVISED July 1, 1944

PASSENGERS *in aircraft*



Number of Passengers

The number of persons carried in Army aircraft will not exceed that for which the aircraft is designed, except when necessary in cases of emergency:

1. Involving great physical hardship or possible loss of life.
2. In the performance of urgent military duties.

In the absence of specific instructions from higher authority, the character of the emergency will be determined by the commanding officer of the Army Air Forces station where the flight originates, except when the emergency arises elsewhere than at such a station, in which case its character will be determined by the senior Army Air Forces officer on duty with the flight.

Travel by Army Aircraft

Passenger space on routine interstation flights of Army aircraft may be utilized for authorized travel of members of the Army of the United States on official duty for the purpose of reducing the expense to the Government of the travel involved or to save time.

Under no consideration will this type of travel impose an added burden in the way of additional flights or the alteration of previously planned flying schedules.

Any exception to these regulations will be made only after a presentation of the case and action thereon by the Commanding General, Army Air Forces.

Commanding officers of AAF stations are authorized to grant exceptions in case of civilians who are to be flight-tested for a military aeronautical pilot rating under the provisions of AAF Reg. 50-7. No release is required.

On Leave or Furlough

Military, Naval, Marine Corps, and Coast Guard personnel, while on leave of absence, furlough, or on detached service, may be permitted by commanding officers of AAF stations or higher authority to ride as passengers on flights in Army aircraft when such flights are incident to a regularly scheduled mission, and **provided such transportation does not involve additional expense to the Government.**

Passengers on ATC Aircraft

AAF Reg. 75-3 establishes special regulations for the transportation of passengers on aircraft operated by the Air Transport Command. All aircraft of the Air Transport Command engaged in air transport operations, whether flown by civilian crews under contract or by military crews, are military aircraft and as such are authorized to transport only those passengers who are in possession of military orders expressly authorizing or directing travel by military aircraft or those whose travel will facilitate the prosecution of war activities.

Passengers will be carried on such aircraft only when priority for transportation has been established by the Commanding General, ATC, Washington, D. C., or his authorized representative.

Releases will be required from such passengers as would be required to sign releases in case of travel in other military aircraft.

No Release Required

Commanding officers of AAF stations or higher authority in the chain of command are authorized to permit the persons listed below to ride as passengers in Army aircraft under their control under proper orders and clearance **without signing a release.**

1. Military personnel of the Army, Navy, Marine Corps, Coast Guard, Women's Army Corps, and commissioned officers of the U. S. Coast and Geodetic Survey.

2. Civilian employees of the War Department, of other Government agencies, of Government contractors, and technical advisors to military authorities engaged in activities for the Army which require such flight.

3. Students, foreign or otherwise, undergoing instruction with or under supervision of the AAF, when such flights are a part of the authorized course of instruction.

4. Red Cross personnel when serving with the armed forces of the United States in the field either at home or abroad.

5. Subject to the approval of the Commanding General, AAF, members of the Cabinet and certain other officials of the Government, members of Congress, and governmental employees.

Release Required

Commanding officers of AAF stations or higher authority in the chain of command are authorized to permit the persons listed below to ride in Army aircraft under their control, **only, in the case of civilians, upon signing the injury or death release.**

1. Military and civilian personnel of foreign nations in cases involving war activities, including projects carried out under the Lend-Lease Act.

2. On flights which will not extend beyond the local flying area: wives, mothers, and children of military personnel of the U. S. who hold aeronautical ratings and who are required in the performance of their duties to participate in regular and frequent flights. Such children must be ten years of age or over and have the permission of a parent. These flights must not exceed two in number for any person during any calendar year.

3. Subject to the approval of the Commanding General, AAF, representatives of the pictorial and news disseminating agencies on flights which will benefit the War Department. Such flights may be conducted within the continental limits of the U. S. and its territorial possessions.

4. The commanding general of any theater, or any department, base command, defense command, or task force, **outside the continental limits of the United States** may authorize any person to ride as passenger in Army aircraft under his control when this action is necessary or desirable in the Government interest.

5. AAF members of the U. S. Military missions in Latin America are authorized to carry as passengers, on local flights, within the jurisdiction of the mission, distinguished nationals of the country in which they are stationed, on the approval of the U. S. ambassador or minister. At the discretion of the chief of the mission, members of the armed forces of the country in which they are stationed and students who are under their instruction may be carried as passengers only after signing a release.

Release Required, When Practicable

Commanding Officers of AAF stations or higher authority in the chain of command may permit any person to ride as passenger in Army aircraft, in case of emergency involving catastrophe or possible loss of life, when other means of transportation is not available. **Civilians will be required to execute releases, when practicable.**

REFERENCE: Army Reg. 95-90, AAF Reg. 50-7, AAF Reg. 60-20, AAF Reg. 75-3.

IMPORTANT

Whenever you clear from a station or airport where there are no AAF facilities, you are required to leave with the local operations officer, airport manager, or other suitable person a list of all passengers, showing name and home station of each.

PIF 2-5-1
REVISED February 1, 1944

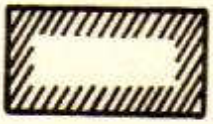
AIR SPACE RESERVATIONS AND FLIGHT HAZARDS

Before making a flight, study the map in the Operations Office and ascertain whether your projected flight plan will bring you close to any areas shaded or marked as shown below. If it does, consult the **Weekly Notice To Airmen** and current **Notams** for specific details and familiarize yourself with the location and limits of the area as well as the conditions that apply within it.

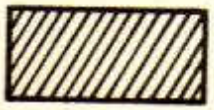
These are the types of shadings and warnings you will find:



Never Fly Over Prohibited Areas



Keep Sharp Lookout in Caution Areas



Get Authority to Cross Danger Areas



Tunneled Airway



Red Flag



Orange Flag

1. **Prohibited Areas (Air Space Reservations) are areas from which all aircraft, except those engaged in actual defense missions, are prohibited.** At present there are two such areas established in the United States by executive order: **Washington, D. C. and Hyde Park, New York.** The former may be avoided by flying close on course when near the Capitol.

2. **Caution Areas** are areas in which under CFR there are **visible** hazards. These areas should be avoided if practicable.

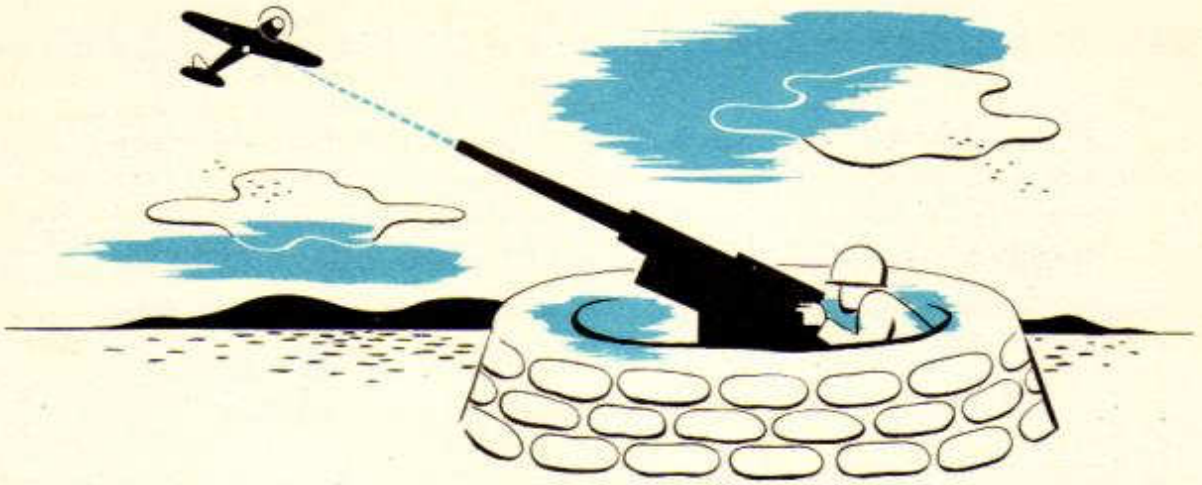
3. **Danger Areas** are reservations in which there is an **invisible** hazard such as might exist over an artillery or bombing range. No flight of aircraft shall be conducted in this area without specific authority issued by the agency having jurisdiction over the danger area.

4. **Where a Tunneled Airway is indicated on charts, through traffic must utilize airspace between 1500 and 3500 feet above ground.**

5. **Red Flagged Items, or Warnings.** This symbol indicates an airport flooded or otherwise closed; range frequency changed; range not operating or course swinging badly; field lights out of commission; special flight restrictions; any decommissioning of a navigational aid.

6. **Orange Flagged Item, or Caution.** Indicates airport under partial construction; field soft; control inoperative; etc.

NOTE: When entering Vital Defense Areas on contact flight, it is desirable that you contact the nearest radio station and report your position and receive pertinent instructions.



HAZARDS TO AIR NAVIGATION

Commanding Officers of AAF stations at which there is flying activity, are charged with reporting local conditions affecting flying safety to the proper authorities, so that the information will reach pilots as quickly and easily as possible.

Some of the hazards which you may encounter include: unsafe conditions of landing fields or runways due to construction, repairs, snow, floods, etc.; installation or changes of lighting systems; failure in servicing facilities; congested training areas; aerial, bombing, and gunnery ranges; barrage balloon, searchlight, and certain construction areas; changes in operation of control towers and Army operated radio range or radio beam facilities.

Chief source of information on the existence of hazards or their removal through corrective action is "Weekly Notice to Airmen." Further information can be found in "AAF Radio Facility Charts," "AAF Radio Data and Flight Information," CAA "Danger Areas in Air Navigation", and regional maps. Local operations offices are directed to call your attention to them in issuing clearances. Teletype and Army Airways Communication System facilities are also used to bring them to your attention, and by using Pilots' Advisory Service you can get current news of hazards in the area.

The system used in marking hazards at air fields is discussed in full in "MARKING OBSTRUCTIONS," PIF 2-11-1.

REFERENCE: AAF Regulation 63-1, dated January 1, 1943.

Caution

Don't ignore the precautions taken to safeguard you in flight. Learn everything you can, in advance, about what you will be flying over or the field you will be landing on.



PIF 2-6-1
REVISED April 1, 1944

LOW FLYING

Over Cities

In flying over cities and towns, observe all safety precautions possible to eliminate danger to persons and property on the ground.

Except in taking off from fields located in or near populous areas and in climbing immediately thereafter, always maintain sufficient altitude to glide to a landing field in the event of engine failure.

When a mission prescribed by proper authority requires low-altitude flying, the above instructions may be disregarded; but every precaution will be taken to insure perfect functioning of engines, instruments, etc., and the amount of low flying will be strictly limited to that which is necessary to accomplish the mission.

Over Crowds

No flying by any type of aircraft will be done at any altitude over or in the immediate vicinity of stadiums, ball parks, fair grounds, or other localities where crowds are gathered, except those around the borders of flying fields witnessing flying demonstrations. When flying from a field where there is a large crowd of people, take precautions to maintain such position and altitude as will insure the safety of persons on the ground. **Never dive lower than 1,000 feet over or in the direction of crowds of people.**

Over Water

Buzzing water is a particularly dangerous violation of the regulation against unauthorized low flying. It is extremely difficult to judge exactly the distance you are flying above water, particularly when the surface of the water is calm.

An elementary fact about vision is that your judgment of distance is determined largely by the relative size of objects. You make the judgment subconsciously and it is based upon experience accumulated during a lifetime.

A smooth body of water, however, contains no patterns or objects which you can use as points of reference. It is, therefore, easy to misjudge your clearance over water by as much as fifteen or twenty feet—enough to let a propeller strike the water.

The tip of a propeller moving at high speed does not knife through the water, it hits violently, and causes an immediate loss of power; the plane is thrown out of control, and a major catastrophe is almost inevitable.

Remember

Unauthorized low flying over cities and towns, diving over crowds, buzzing of any kind, and flying through or over Prohibited Areas are subject to disciplinary action.

PIF 2-7-1
May 1, 1943

CREW REQUIREMENTS FOR MULTI-ENGINED AIRPLANES

Multi-engined aircraft, the cockpits of which are arranged for side-by-side seating of pilot and co-pilot, ordinarily will be operated with a co-pilot. However, commanding officers may authorize the operation of such aircraft with a minimum pilot crew of one pilot, provided the pilot is accompanied by a crew chief or aerial engineer who is thoroughly familiar with the mechanical operation of the airplane.

Two-engined aircraft with a single pilot cockpit and two-engined advanced training type aircraft may be operated by the pilot only, when in the opinion of the commander concerned other crew members are not required to perform the mission.

Commanders may authorize changes in these requirements in cases of military necessity.

REFERENCE: AAF Regulation 55-5.

PIF 2-8-1
REVISED October 1, 1943

Hand Signals for Taxiing

THESE SIGNALS, PRESCRIBED BY AAF REGULATION 62-10, DATED 2 AUGUST 1943, REPLACE ALL FORMER TAXI SIGNALS. THEY WILL BE USED BY CREWS OF AAF, USN, USMC, RAF, RCAF, AND RN.

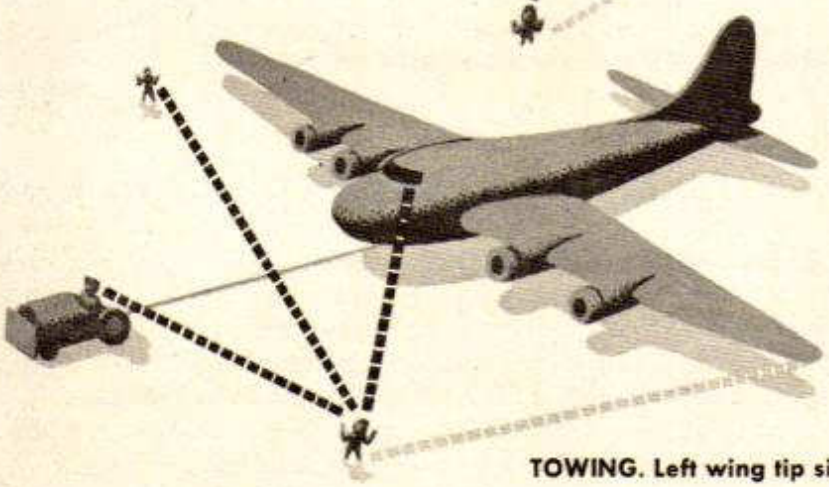


A FLAGMAN with checkered flag will meet aircraft on any landing space where the nature of traffic demands it. He will direct the pilot toward the taxi signalman who will stand with both arms extended full length above his head.

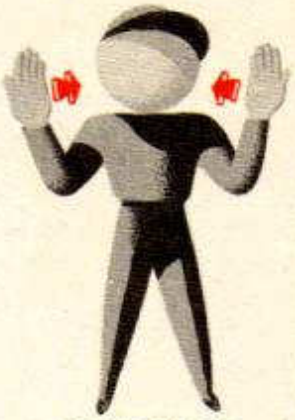




THE SIGNALMAN will direct taxiing from a position forward of the left wing tip of the airplane, where the pilot can see him easily all the time.



TOWING. Left wing tip signalman gives all signals to tractor driver.



COME AHEAD

To signal turns, signalman will beckon "Come Ahead" with hand on the same side as the wing to be brought around, and point with other hand at wheel to be braked.



RIGHT TURN



LEFT TURN

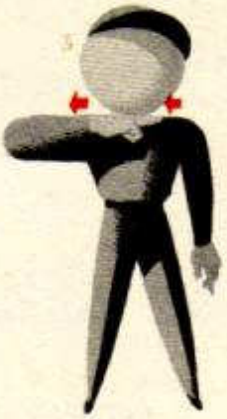
PIF 2-8-2
REVISED October 1, 1943



STOP



EMERGENCY STOP



CUT ENGINES



INSERT CHOCKS

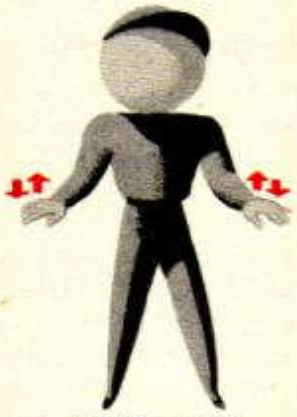


START ENGINE

First signal "Emergency Stop." Then point one hand at engine to be started. Rotate other hand.



PULL CHOCKS

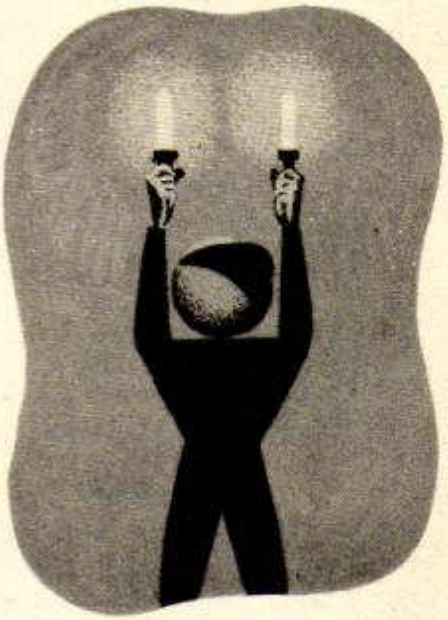


SLOW DOWN



ALL CLEAR (O.K.)

NIGHT OPERATION



Where illumination permits, signalman will move in lighted area and use above signals. Out of lighted area, he will use flashlights or, if available, Lucite wands. All signals same as above except "Emergency Stop," which will be given by crossing lights in front of face.



Takeoff and Landing Precautions

Be alert all the time: On the ground, in the air, every minute you are in an airplane. As a pilot you are responsible for **your airplane and everybody on board.**

To be alert all the time develop a simple routine habit of looking **automatically in the right places** under all conditions. If you maneuver your airplane around its three axes while looking around you can eliminate all blind spots.

Any maneuver that may result in excessive loss of altitude **demands extra alertness.**

If tower orders you to clear the runway, taxi off unless checks are complete. Never take off until ready.

Taxiing

1. Before leaving ramp contact control tower for proper taxiing instructions.
2. **Taxi slowly** and on hard surface areas unless otherwise advised.
3. Don't drag your brakes. If you overheat them they may lock in the air.
4. Use your upwind engine if taxiing multi-engine airplanes crosswind.
5. **Take nothing for granted.** If you can't see, fishtail right and left far enough to **see everything in front of you.**
6. If your radio fails, watch the control tower for instructions by biscuit gun.
7. Remember, over fifty percent of all airplane accidents occur **before takeoff or after landing.**

Takeoff

1. **Use your checklist prior to takeoff.** Run up your engine or engines with the tail of your airplane pointed **away from other equipment,** and, if possible, where the ground is free from sand and gravel.
2. Don't stand with your engine or engines running for a long period of time. If you must wait for takeoff any length of time, **turn off your engines.**
3. Stay clear of the prevailing runway until the tower says "clear for takeoff."
4. Observe airfield conditions and all boundary obstructions in the proposed takeoff lane.
5. **Look backward, above, and forward** before pulling onto the runway for takeoff.
6. **Use all the runway.** There is never too much runway if an engine fails on takeoff.
7. Be sure your crew is properly stationed and ready for takeoff.
8. Adjust your seat to the proper position. **Check and double check your seat lock.**

Entering Traffic and Landing

1. Contact tower for landing instructions.
2. **Use your checklist before entering traffic.**
3. **Be alert.** Maintain traffic altitude.
4. Be sure your crew is properly stationed and ready for landing.
5. **Land on the first one third of the runway.** If this is impossible, **go around.** It's no disgrace.
6. Don't relax after landing. Remember, your mission is not complete until you have **parked your airplane on the ramp and turned off the engines.**
7. **Be alert.** Stay within the bounds of safe taxiing, but, **clear the runway as soon as possible.**
8. Follow instructions of the alert crew in parking your airplane. Advise the control tower that your mission is completed.
9. **Except in cases of extreme emergencies** don't land on a flying field which is under the process of

construction, until that field has been declared officially open by the proper authorities. Do not construe this order as preventing the landings, when necessary, of aircraft carrying inspection personnel on official business.

Precautions on Muddy or Snow-Covered Fields

When airplanes are operated from muddy or snow-covered fields, the landing gear and tail wheel sometimes clog with mud or wet snow which freezes at the lower temperatures encountered after takeoff. When the gear is retracted, there is danger of its freezing in the retracted position. To avoid this retract and lower landing gear several times after takeoff. If it seems likely that the gear will freeze in the retracted position even after the above precautions have been taken, leave the gear lowered.

Landing with Gear Retracted

Remember that landing wheels-up always results in more or less damage to the airplane, so try everything else first. Then, if the gear won't function properly, and you have fuel enough, try to make the wheels-up landing at a depot or station where there are facilities for extensive repairs.

If you see that you must land with the gear up, and have time, take the following precautions:

1. If carrying bombs, release them in "SAFE" over uninhabited area, at an altitude above 500 feet.
2. If carrying bomb bay tanks, drop them over a suitable area. Leave the bomb bay doors open long enough to get rid of gas fumes.
3. **Close bomb bay doors before landing.**
4. Though flares are not likely to ignite when landing wheels-up, you may drop them from 2000 feet, or at any altitude over suitable terrain.

In emergencies, when you have to land on questionable terrain, or on a field too short for a landing run, extend flaps and land wheels-up.

Exception: In making a forced landing with a B24 the recommended procedure is to **land with gear extended on any type of terrain.**

In case of engine failure with single-engine aircraft on takeoff, if there is not runway enough left, retract wheels and land straight ahead.

Wheels-up Landing on Paved Runways

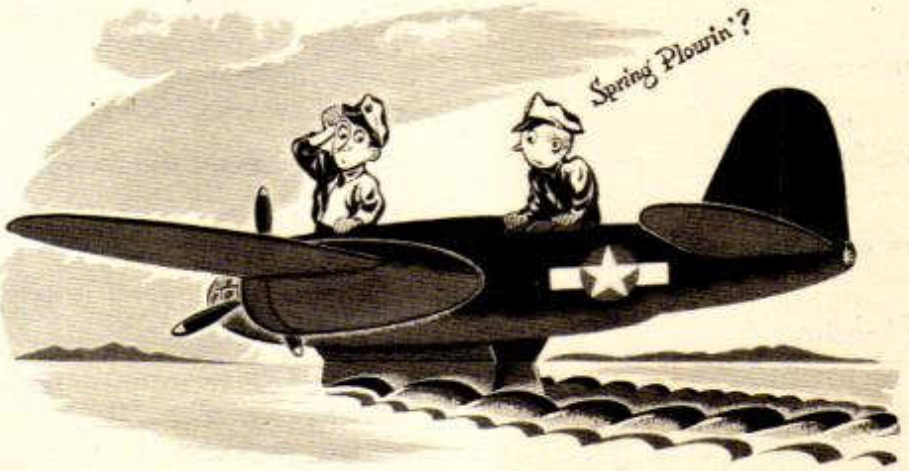
Experience has shown that **it is better to make a wheels-up landing on a paved runway** (where available) than on unpaved terrain. A belly landing on soft ground may result in nosing-up, or digging in and stopping abruptly, which may endanger personnel and cause severe damage to the airplane.

Runway Shoulders

Stay on the runways. Shoulders along runways and taxi-strips have been treated to withstand occasional emergency use; but they are not constructed for hard usage, such as parking, taxiing, or landing.

The lights along the outer edge of the runway pavement indicate the full area to be used for all operations. On fields where no lights have been installed stripes have been painted six inches wide and parallel to the outer edge of the pavement. **The areas outside these stripes are for emergency use only.**

REFERENCES: AAF Regulation 60-6; Technical Order 00-25-6; and Technical Order 01-1-10.



PIF 2-10-1
REVISED November 1, 1944



CHECK LISTS

Use the check lists in the cockpit of your airplane. No matter how familiar you become with your plane, there is always a chance that you'll forget something. Do not rely on your memory. Always use check lists.

Check Lists In Cockpit

EVERY AIRPLANE HAS CHECK LISTS PROVIDED FOR THE FOLLOWING:

1. **Before starting engine or engines.**
2. **During warm-up.**
3. **Before takeoff.**
4. **During flight.**
5. **Before landing.**
6. **After landing.**

If the check lists are not in the airplane, report it at once to the crew chief and see that the proper lists are provided before you prepare for flight.

These check lists are required by regulation, and are to be used not only by pilots who are unfamiliar with the operating procedures of the aircraft, but also by experienced pilots as a continuous refresher in essential operations.

Check List Habit

In training type airplanes it may seem unnecessary to use the check lists, but it is during your training that you form your flying habits.

The Check list habit is a must in combat equipment. There is too much to remember, and every item is important. One mistake, one switch improperly set, one instrument overlooked, may spell disaster. Make the check list habit a part of your procedure on every flight whether it's in a PT or a VHB.

Don't Use Memory Checks

The standard memory checks which some pilots use, are no substitutes for the printed check lists in the airplane.

Every model has its own specific check procedure, so don't try to learn a general check list. It will not be applicable to every airplane and may lead to improper procedure. So don't use any standard memory check system.

REFERENCE: AAF Regulation 62-2

PIF 2-11-1
REVISED June 1, 1944

MARKING OBSTRUCTIONS

Obstructions in the vicinity of landing fields are marked so that they will be easy for pilots to see as they approach or take off. A standard system of marking is now used by the Army, Navy, and CAA for all uncamouflaged airports in the United States.

Permanent structures are painted orange and white for daytime recognition, marked by red lights so that they are easily spotted at night. Temporary hazards on landing fields are indicated by yellow markers by day and also lighted at night.

Watch for obstructions and hazards when you approach a field, particularly a field new to you. Recognize the markings and appreciate obstruction hazards.

Standard Markings

Radio towers, masts, flag poles, smoke stacks, water standpipes and other similar structures are painted in alternate bands of orange and white. Mounted water tanks are painted in a checkerboard design of the same colors. The tops of tanks and standpipes are divided into eight segments, which are painted alternate orange and white.

Where hangars or other buildings are situated within a normal landing area or landing approach, so that they constitute a hazard, the roofs are painted with an orange and white checkerboard design so that they stand out clearly.

Marking by Lights

From sunset to sunrise, and at other times when visibility is poor, obstructions are marked with bright red lights so that they are easy to spot. The lights outline the obstructions from every angle of approach.

Guy cables for structures in the immediate vicinity of landing fields will be marked with a danger cone at the midpoint of each cable.

Hazardous Areas on Airfields

Holes, soft spots, construction, or other conditions which make any area of a landing field unsafe for use, are marked with yellow flags or pyramids during the day and with red lights at night. The unsafe portions are outlined; and if the area is large, it is also marked with a cross of flags or lights placed in the center of the area.

A large cross of flags, colored material or red lights at each end of a runway, marks it as unsafe for use at the time.

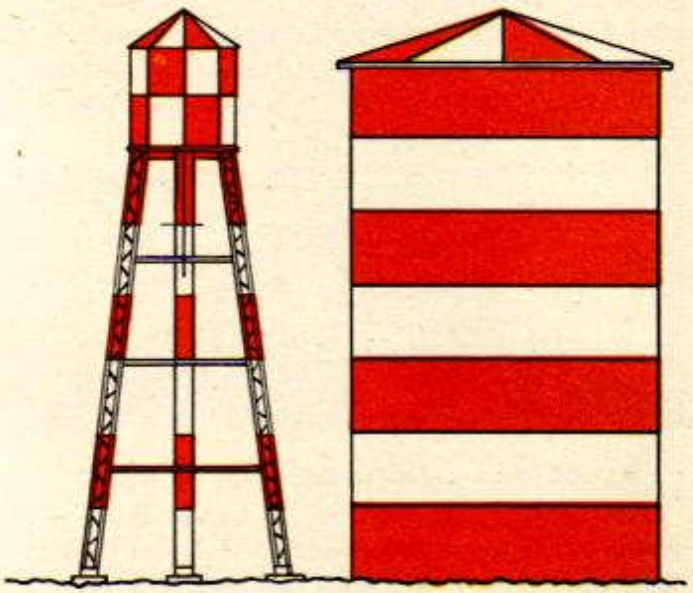
Along Airways

Any structure which projects above the surrounding terrain so that it can be considered a serious hazard, is marked according to the same system of orange and white markings and red lights, whenever it is possible to do so. However, often it is impractical to mark some structures, so allow altitude sufficient to clear all obstructions and variations in the terrain while in flight.

Exceptions

Although every attempt is being made to standardize marking and lighting, local conditions and camouflage or blackout requirements make deviations necessary. Until you are familiar with local marking procedure, use extra caution while in flight.

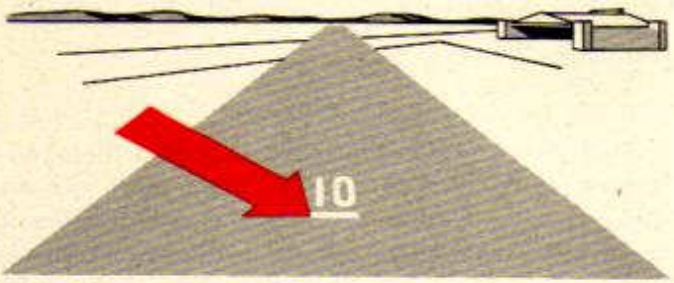
REFERENCE: Army Regulation 95-35, AAF Regulation 62-5, and Technical Order 19-1-20



PIF 2-12-1
REVISED June 1, 1944

DOMESTIC RUNWAY MARKINGS

Runway and landing strips on uncamouflaged airfields in the zone of the interior are marked to aid in the control of traffic and to help the pilot. Runways are marked in black or white, the color having the greatest contrast to the runway surface. Taxiways are marked in yellow.



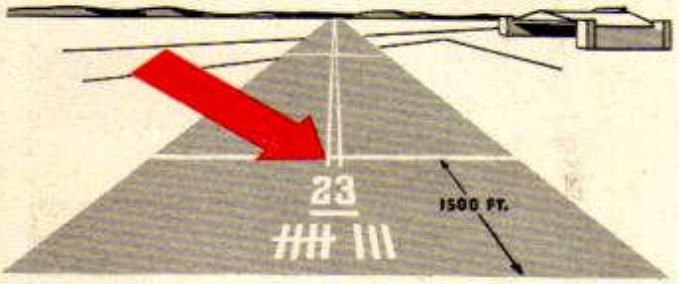
EACH RUNWAY IS NUMBERED

The numbers indicate, in units of ten degrees, the approximate magnetic bearing of the runway. A large "R" for Right and "L" for Left, designates parallel runways.



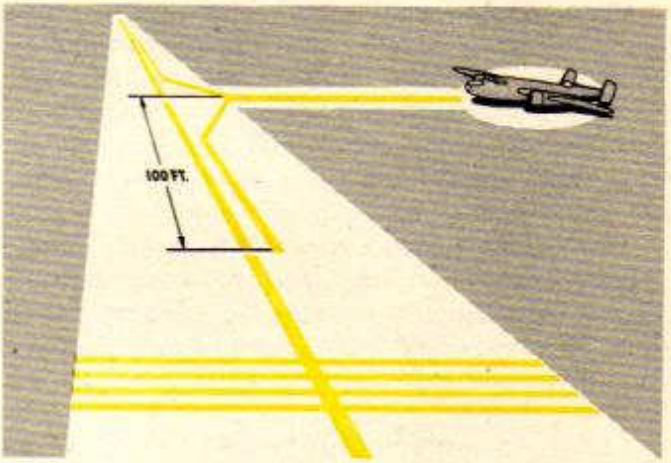
RUNWAY LENGTH SHOWN BY VERTICAL BARS

Up to 4500 feet, each vertical bar represents a thousand feet, a half bar, 500 feet. Each five thousand feet is indicated by four vertical bars with a cross bar intersecting the verticals. Length over 5000 feet is indicated to the nearest thousand by additional vertical bars.



BANDS RUN LENGTH OF EACH RUNWAY

They extend down the center to within 25 feet of the numerals on each end. A band is painted across the runway 1500 feet from each end.



YELLOW STRIPES FOR TAXIWAYS

Taxiways are marked by a single yellow center stripe, with guide stripes for turns into hardstands, aprons, etc. A yellow cross band warns of approach to within 100 feet of a runway. Where taxiways intersect runways, the yellow taxiway stripe extends to the adjacent runway stripe.

Camouflaged airfields in the zone of the interior will be marked as authorized by the Commanding General, Army Air Forces.

Airfields in the theater of operations will be marked as authorized by the Theater Commander.

REFERENCE: Technical Order 00-25-7.

PIF 2-13-1
REVISED October 1, 1943

CAMOUFLAGE



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Lack of strict camouflage discipline at an airdrome can ruin the whole camouflage scheme. The simplest human activities leave marks on the earth which are visible from the air. Men around an airdrome leave distinctive marks, easily identified by aerial observers as being the "spoor" of an army flying field. To keep this "spoor" at a minimum everyone must obey strictly the rules laid down by camouflage authorities on the airdrome.



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Camouflage is designed to reduce visibility and conceal identity. It is accomplished by disruption, disguise, and concealment.

Officers charged with the layout and execution of camouflage will do everything possible to protect you and your plane; but as a pilot you have a special responsibility. You are in command of your plane on the ground as well as in the air.

Protect Your Aircraft

Just because your plane is normally taken care of by your crew chief after you have landed, don't forget that the safety of your plane is still your responsibility.

The necessity of thinking about your plane while it is parked on a continental airfield may seem unimportant to you, but when you set down at an airfield in a Theater of Operations, it will become vital. Then you will realize the importance of having trained yourself to think about your plane all around the clock.

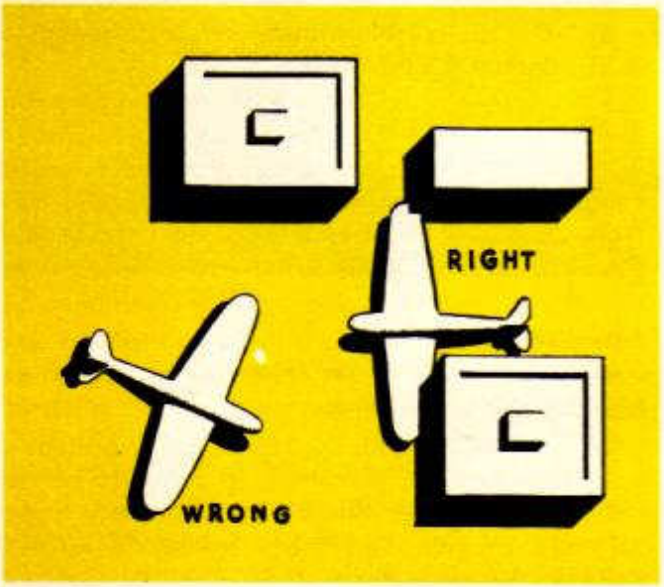
The enemy likes nothing better than to find a group of planes standing in a line, wing tip to wing tip—an ideal target! If you have unthinkingly contributed to creating such a target you may suddenly find yourself without a plane. This means that upon landing in any theater of operations you must automatically take additional precautions in parking your plane—just in case the enemy starts bombing or machine gun strafing.

Here is a check list to remember:

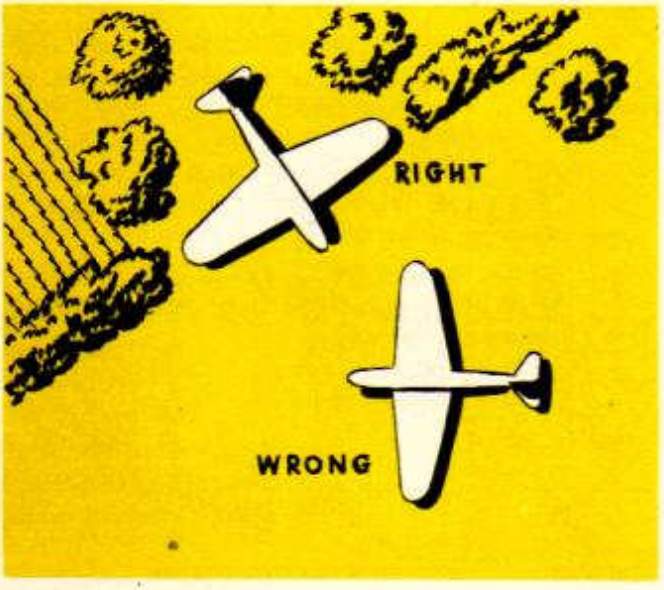
1. See that your plane is parked a reasonable distance from runways; they invariably are primary objectives for bombing attacks.

2. See that it is parked at least 400 feet from any other plane; all other things being equal.

3. Park your plane near to trees, buildings or any other objects which make it less conspicuous and break up the distinguishing shadow cast by any airplane.



4. If it is in an open field, a plane parked along a hedgerow, at the junction between two or more fields, or near low scrubby bushes is more difficult to see from the air.





5. Anything thrown over the cockpit greenhouse, windows or Plexiglas nose will kill the reflections which might be a dead give-away.

6. Park it so you can taxi out quickly in an emergency.

Don't park your plane close to and in line with other planes.

When you are operating from a dispersed position on an airfield in a theater, always think about these precautionary measures:

1. Always taxi to your designated dispersal point immediately upon landing.

2. Don't leave that position until you know you can take off soon after reaching the runway.

3. Don't jam up behind other planes on a taxiway leading to the take-off position. The unexpected might happen, resulting in a string of dead ducks.

That is just the sort of target the enemy likes—where he can eliminate planes and combat crews with a minimum of effort.

Make it tough for the enemy if he does sneak in! Just remember these simple facts:

1. If your plane is in a dispersed position he will have more trouble finding it.

2. Even if he does bomb or strafe, the chances are good that you will still have a plane when the attack blows over.

3. Follow the instructions of your camouflage officer in all matters of dispersion and discipline.

4. Make your crew members conscious of this problem also.

5. If necessary ask your camouflage officer to request suitable nets from the Theater Service Center for further protections of your aircraft.

Continually train yourself so that it becomes second nature to **think about the safety of your plane on the ground as well as in the air.**

Radio Equipment

Turn on radio equipment by switching on:

1. **The airplane battery switches.**
2. **The master switch.**

THE JACKBOX

The pilot and crew members use the jackbox to connect microphones and headsets to various pieces of radio equipment in the airplane. Following is a list of jackbox positions and their uses:

Compass

The "COMP" position is used to listen to the radio compass receiver. You cannot transmit with jackbox in this position. The compass does not include transmission facilities.

Liaison-VHF

Use "LIAISON-VHF" to transmit and receive with VHF equipment. To transmit, press microphone button-switch. To receive, release microphone switch.

If your jackbox does not have a "VHF" position, the liaison equipment will be connected to that position. Use the same procedure for operating both.

Command

Operation in the "COMMAND" position is the same as in the "LIAISON-VHF" position, except that the medium frequency command equipment is controlled. If the jackbox has no "VHF" position, a separate "MED FREQ-VHF" or "274-522" switch is provided for switching the microphone circuit to either of the command sets.

Inter

Use "INTER" when you want to communicate with any other crew member, whose jackbox is also on this position. Press microphone button-switch to talk. Release it to listen.

CAUTION: Interphone operation is seriously impaired if more than one microphone switch is depressed at the same instant. Don't attempt to speak while someone else is using the system, unless your message is urgent.



Jackbox and Range Filter

Call

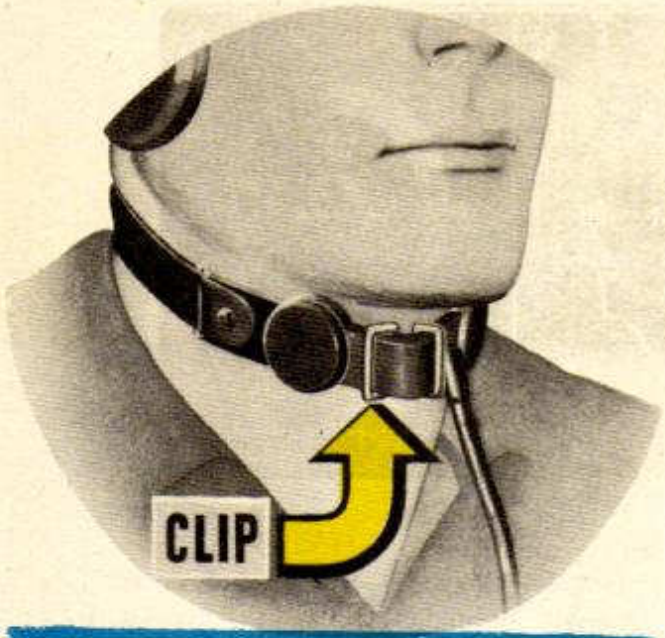
When you want to call another crew member to the "INTER" position, use "CALL". To operate you must hold the jackbox switch in the "CALL" position, and at the same time press the microphone switch. After calling, immediately return the jackbox switch to "INTER" while awaiting an answer, since "CALL" position blocks all other reception and gives precedence to the person calling. To answer, the person called switches to "INTER" and proceeds with normal interphone communication.

RADIO RANGE FILTER

The radio range filter system is used by the pilot or copilot to select either voice or range signals, when both signals are being transmitted simultaneously by the radio range station. When the selector is on "RANGE" position you can listen only to the 1020 cycle A and N signals. When the switch is on "VOICE" the A and N signals are filtered out to facilitate reception of speech. When switch is on "BOTH" the filter is out of the circuit, and you can hear both speech and A and N signals.

Remember, when the filter system is in "RANGE" position interphone operation is blocked. Never allow both pilot's and copilot's filters to be in this position at the same time.

PIF 2-14-2
REVISED September 1, 1944



Use your microphone PROPERLY

1. The microphone should fit firmly about the throat, with the buttons spaced equally on each side of your Adam's Apple and slightly above it.
2. Place the strap slightly higher than the microphone level to maintain this position.
3. Don't allow clothing to get between the buttons and your throat.
4. You will get better reception by placing the positioning clip between the buttons.
5. Be sure the proper sides of the buttons are against your throat.
6. Speak as loudly as you can, but don't shout.

T-17 Hand Microphone

If your airplane is equipped with the T-17 hand-held microphone, observe the following steps for proper operation:

1. Hold the microphone squarely in front of your mouth, with your lips slightly touching the mouthpiece when speaking.
2. Speak as loudly as you can, but don't shout.

When flying at high altitudes always use the oxygen mask microphone. Always make sure the connecting plugs fit firmly.

LIAISON EQUIPMENT

The liaison equipment includes a high-powered long range transmitter and receiver. It is operated primarily by the radio operator. In some airplanes the pilot can operate the liaison equipment by switching the interphone jackbox to "VHF-LIAISON" or "LIAISON" position. If it is necessary for you to use the liaison equipment, ask the radio operator to tune it to the proper frequency. Don't use the liaison transmitter to contact stations within the range of your command equipment, unless it is absolutely necessary.

IFF RADAR EQUIPMENT

Operation of IFF Radar equipment is automatic, once it is turned on. "ON-OFF" switches are provided for the pilot and also the radio operator in airplanes which carry one. The "EMERGENCY" switch, under a springed guard, operates an emergency channel. This switch is usually safety-wired to the "OFF" position. Details of its operation are given at briefing.



Detonator Switches



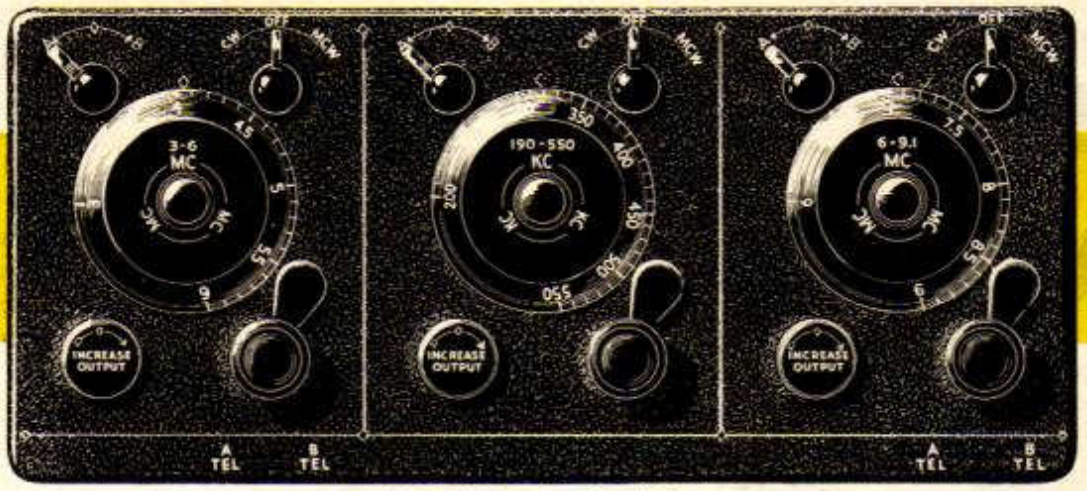
IFF Control Switches

Warning

Your IFF equipment contains two detonator push-buttons.

If you must abandon your airplane in enemy territory, push both buttons simultaneously. They will set off a detonator which destroys the equipment internally, and without danger to you.

There is also an intertia switch that sets off the detonator automatically, if you have to make a crash landing.



SCR- 274N Receiver Control Box

COMMAND EQUIPMENT

Command equipment is of two classes; medium frequency and very high frequency. It is used chiefly by the pilot for voice communication from plane to plane, or from plane to ground when requesting operational instructions. Command equipment is used also to receive radio navigational aids.

SCR-274N Medium Frequency Set

The SCR-274N command set is used for medium frequency command communication. Most airplanes are equipped with two transmitters and three receivers. They are remotely controlled. The two transmitters are usually tuned to the most frequently used channels. With three receivers available, the pilot can use one for receiving navigational signals, and the other two for monitoring stations along the planned route.

Receivers

All three receivers are controlled from the same remote control unit. The operating frequency ranges of the receivers are found on the calibrated dials of the control unit. These dials are calibrated either in kilocycles or megacycles. A megacycle is 1000 kilocycles. The receivers are capable of receiving continuous wave or modulated signals. Their outputs are fed into an "A TEL" or "B TEL" line. The "A" line feeds into the "COMMAND" position of the interphone jackbox. The copilot may plug his headset into the "B TEL" jack on the control unit if it is ever necessary to receive two stations simultaneously. If the "B TEL" line is used, the "A"-"B" selector switch on the control of the receiver being used must be in "B" position.

To operate receiver:

1. Turn "CW-OFF-MCW" switch to the type of reception desired. For voice reception turn to "MCW" position.
2. Place "A"-"B" switch to desired channel. Remember the "A" channel feeds the "COMMAND" position of the interphone jackbox.
3. Turn the dial crank to the desired frequency.
4. Adjust the volume to a level comfortable in your headset.

Transmitters

The remote control unit which operates the transmitters has a "TRANSMITTER SELECTION" switch to enable the use of four transmitters. Since there are, however, usually only two transmitters installed in an airplane you will use only number "1" and "2" positions. By turning to position "4" you can use the sidetone of the modulator unit for an **emergency interphone.**



SCR-274N Transmitter Control Box

To operate transmitters:

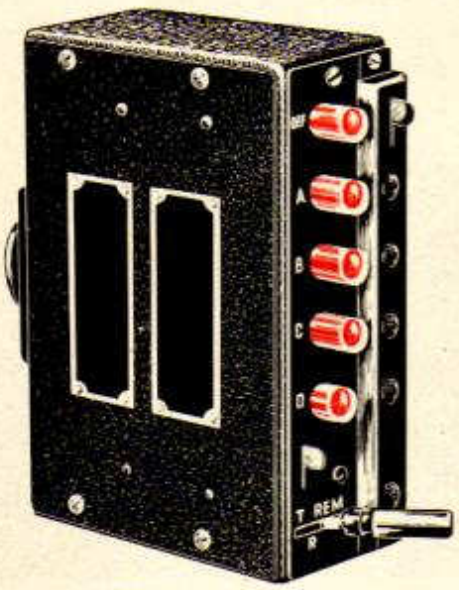
1. If the VHF command set is not connected to the "VHF-LIAISON" position of the interphone jackbox be sure the "MED FREQ-VHF" or "274-522" switch is in "MED FREQ" or "274" position.
2. Select the proper transmitter with the "TRANSMITTER SELECTION" switch.
3. Select the type of emission desired; "TONE-CW-VOICE".
4. Turn "TRANS POWER" switch "ON".
5. Allow the tubes about 10 seconds to warm up before pressing microphone push-button.

A key is mounted on the top of the transmitter control unit so that you can transmit either tone or CW. The normal transmitting range of the SCR-274 is approximately 25 miles. However, in the absence of atmospheric and local disturbances, you can obtain ranges up to 100 miles.

SCR-522 Very High Frequency Set

The SCR-522 set is used for VHF (line of sight) command communication. The transmitters and receivers operate on four pre-tuned crystal controlled channels. You can select any one of these four receiver or transmitter channels from the pilot's compartment. Consult your communications officer for the functions of the four channels.

The "A-B-C-D" push-buttons turn the equipment on, and select the respective channels. The green lights alongside the buttons indicate the channel selected. The lever tab directly above these lights controls a dimmer mask. The "OFF" button turns the equipment off.



SCR-522 Control Box

To operate the SCR-522:

1. Press the desired channel push-button.
2. Place "T-R-REM" switch in "REM" position. The lever tab directly above the switch must be up to allow it to be placed in this position. The switch is usually safety-wired or permanently fastened to "REM". With the switch on "REM" the receiver will be in operation at all times, unless the microphone button is depressed. While the button is held down the set will be in "TRANSMIT" position. If there is no "VHF" position on your interphone jackbox be sure the "MED FREQ-VHF" or "274-522" switch is in "VHF" or "522" position. This connects the microphone to the input circuit of the transmitter. The distance range obtainable with the SCR-522 is limited to line of sight transmission (i.e. at an altitude of 5000 feet the line of sight distance is approximately 90 miles, at 10,000 feet 120 miles).

Operating Tips, Command Sets

274N Set: Transmission on frequencies at which this set operates vary from month to month and from day to day, because of changes in atmospheric conditions. Signals are stronger in the winter than in the summer, and may vary from hour to hour on a summer day.

At certain times of the day signal fading is so rapid it produces severe distortion of voice signals. Signal fading increases with an increase in distance of transmission.

522 Set: Occasionally you will observe dead spots when the metal structure of another airplane gets between the antenna radiation pattern of the communicating airplanes. You can correct this by maneuvering the airplane so that the disturbing structure is removed from between the airplanes.

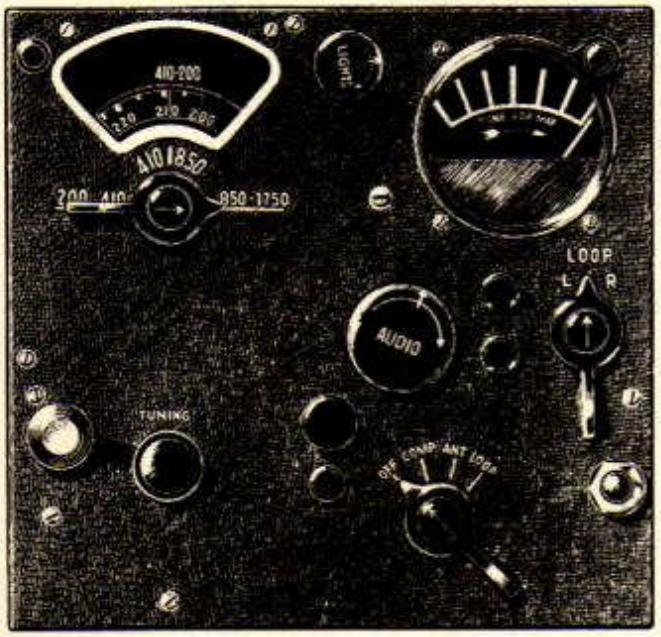
RADIO COMPASS RECEIVER

You may use the radio compass for radio reception, for homing, or for taking bearings on a radio transmitting station. Two antennas are used with the receiver, one of them directional, the other non-directional. Complete controls for operating the radio compass are located in the pilot's compartment, and also in the navigator's or radio operator's compartments. As a pilot you are primarily concerned with homing, and using the radio compass receiver to receive navigational signals, when static or other interference prohibits the use of command receivers.

Operation for Homing

1. Place the interphone jackbox switch in "COMP" position.
2. Place "OFF-COMP-ANT-LOOP" switch in "ANT" position.
3. Push "CONTROL" switch, hold in for a few seconds until green light comes on.
4. Select the proper frequency range either "200-400", "410-850", or "850-1750" kilocycles.
5. Turn the tuning crank to the frequency desired, rock it back and forth over this setting until you obtain a maximum reading on the "TUNING METER".
6. Place the "OFF-COMP-LOOP-ANT" switch on "COMP".
7. Maneuver the airplane until the radio compass indicator reads zero. The airplane is now headed for the transmitting station. Remember, when homing on a station you are heading for the transmitting towers, which are usually located outside of towns.

If the indicator points to the right of zero, the station is to the right. If it points to the left the station is to the left. The homing operation of the instrument is such that the airplane will arrive ultimately over the radio station, regardless of drift. The flight path, however, will be a curved line and coordination with ground fixes or landing fields will be difficult. By trial and error you can fly the airplane on a relatively straight line course by offsetting the heading to compensate for wind. A decreasing magnetic bearing indicates a wind from the left, an increasing bearing a wind from the right.



Radio Compass Control Box



Radio Compass Indicator

Operation for Range Reception

1. Place "OFF-COMP-ANT-LOOP" switch to "ANT".
2. Tune in radio range station. Keep the interphone jackbox volume control turned fully clockwise, and the volume of the radio compass as low as possible.

If reception on "ANT" is poor because of precipitation static, switch the function switch to "LOOP". Rotate the loop antenna by means of the "LOOP L-R" switch for maximum volume in the headsets. Keep compass volume control as low as possible.

If the loop is in the null position when flying on a radio range course, the signal may fade in and out and be mistaken for a cone of silence.

Cone of silence indications are not reliable on loop type range stations when the receiver is in "LOOP" position. Directly over the station the signal may increase in volume to a strong surge instead of a silent zone.

Never use "COMP" position for flying the radio range. The course might appear much broader than it actually is.

For details of radio compass operation see Technical Order 30-100B-1.

MARKER BEACON RECEIVER

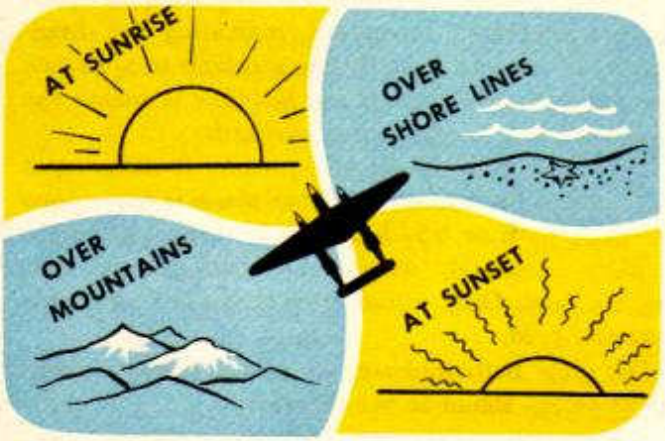
The marker beacon receiver indicates visually to the pilot that the airplane is passing through the radiation field of a marker beacon transmitter. These transmitters are used to mark locations of radio range stations, to indicate range course intersections, boundaries, and position when making an

instrument approach landing. The length of visual indication depends upon the type of marker station and the altitude of the airplane. A station marker indication lasts approximately one minute at 10,000 feet, if the airplane is flying at 150 mph.

Marker beacon transmitter locations and keying data are found in your Radio Facility Charts.

To operate: Turn on radio compass, as it furnishes the power for the marker beacon receiver.

POLARIZATION ERRORS



The radio compass was designed to serve primarily as a navigational aid in flying. So long as it is used in this capacity and its limitations recognized, it is a useful and valuable device. Unfortunately, in actual flight, there are certain periods when the instrument's indications are not correct. This is caused by radio wave polarization errors. Failure to recognize these errors can throw you far off course, and make you mistrust the compass.

The principal polarization error is **night effect.** Other causes of faulty bearings are **mountain effect, shore-line effect, and magnetic disturbances,** such as those found in auroral zones of polar regions.

Ordinarily, for homing, the radio compass receiver depends on reception of vertically polarized radio waves. However, when these waves are reflected from the sky they may change polarity and become horizontally polarized. These horizontally polarized waves conflict with the vertically polarized waves and cause fluctuations in the reading of the radio compass indicator.

Night Effect

Since radio waves are reflected in greater strength by night than by day, the opposition of horizontally opposed waves is stronger at night. Errors caused by this phenomenon are called night effect.

Polarization errors may flare up for a few seconds at intervals through the day, and cause the needle to hunt more than normally about the bearing. Real night effect causes hunting of more than 30 seconds' duration. Variations in the intensity of this hunting may be conveniently classified into two types.

In less severe form, the indicator hunts over a total angle of 15° or less around the true bearing; and often a bearing with an accuracy of 5° can be taken by computing a mean reading. In more severe cases the indicator moves constantly, usually through a wide angle and not around the proper bearing. Therefore taking an average of the fluctuations is not possible. You sometimes encounter short periods of nearly normal operation during these periods of extreme instability.

The times at which night effect begins vary considerably, even on the same station. Usually, the first and last disturbances appear during the periods just before sunset and just after sunrise. The errors increase with an increase in frequency, or in the distance of the airplane from the station.

Remedies

Night effect recurs frequently. However, there are definite steps with which to combat it. First, recognize it by remembering that a period of fluctuation in the bearing indications lasting more than 30 seconds is a sure sign. Then try the following:

1. Use other methods of navigation to check the bearings.
2. Increase altitude.
3. Average the fluctuations if possible.
4. Select a station of lower frequency.
5. Remember that comparatively large errors are tolerable for purposes of homing, since accuracy increases as the distance diminishes.

Other Effects

You may notice fluctuations when flying across coast lines when the radio waves cross the coast at acute angles. Errors may occur, also, when you are flying over certain mountainous regions, and, to a limited extent, through cold fronts.

RADIO ALTIMETERS

There are several types of radio altimeters. Consult the operating instructions for the particular equipment installed in your airplane.



Instrument Landing Indicator

The SCS-51 Instrument Landing System provides the pilot with a straight line glide path and a localizer or on-course guidance. Some installations include marker stations to provide a further check on location of the airplane in relation to the airport. The airborne equipment consists of a localizer receiver, a glide path receiver, a visual indicator, and a control box.

Visual Indicator

The visual indicator shows you the position of your airplane with respect to the localizer and glide paths. The vertical needle registers the blue and yellow localizer course. The horizontal needle registers the glide path course.

Localizer Indications

The vertical needle of the indicator registers the area of the localizer transmitter signal in which the airplane is flying. If the airplane is in the blue-shaded area when making an approach, the needle swings to the left, indicating you are to the right of the runway. The yellow area indicates you are to the left of the runway. These areas do not necessarily indicate the proper landing direction, since the course is transmitted down the approach of front beam and the downwind or back beam. If the airplane is approaching from the back beam the indications are reversed. When they are reversed the needle swings further away from the center as you fly toward the direction indicated.

Contact the control tower for instructions if in doubt. By keeping the needle within a one-quarter scale deflection you are assured of landing within a safe portion of the runway.

Glide Path Indications

The horizontal needle of the indicator indicates the position of the airplane in relation to the glide path signal.

If the airplane is above the desired glide path the needle points downward, indicating the direction in which you must fly the airplane to approach the desired glide path. If the airplane is below the glide path the needle points upwards.

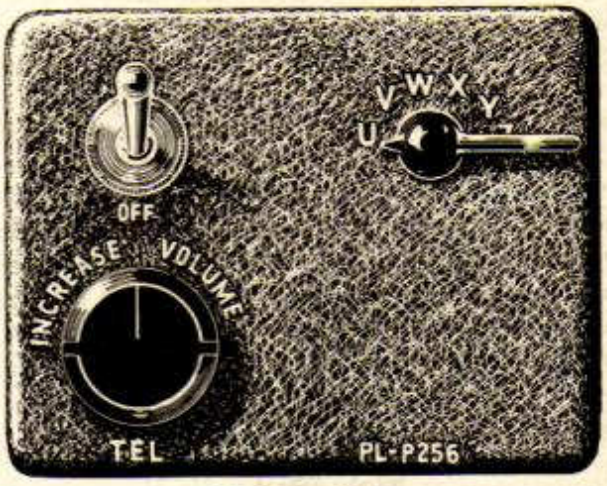
The glide path needle is sensitive. It indicates a full scale deflection when the airplane is 0.3° above the glide path or 0.5° below it. You must align the airplane accurately on the glide path before nearing the field. Only minor corrections are allowable near the field.

The glide path (horizontal) needle points straight up when no signal is being received.

Control Unit

The same unit controls both the localizer and glide path receivers. **To operate:**

1. Turn "ON-OFF" switch "ON".
2. Select the proper channel for the field you are approaching: "U", "V", "W", "X", "Y", or "Z".



SCS-51 Control Box

For complete instructions on the SCS-51 system see Technical Order 30-100F-1.

PIF 2-16-1
REVISED September 1, 1944

Radio R/T Procedure

The use of standard radio telephone procedures is the responsibility of all pilots.

Operating Tips

1. Transmit in a concise and business-like manner. Make only necessary official transmissions.
2. Speak slowly. Pronounce each word and number distinctly.
3. Know your message. Group your words so the idea is clear.
4. Don't hesitate. Don't say "uh" and "er".
5. Speak loudly enough to be heard above the surrounding noises.

PHONETIC ALPHABET

When necessary to identify any letter of the alphabet or to spell a word, use the standard phonetic alphabet.

Letter	Spoken as	Letter	Spoken as
A	Able	N	Nan
B	Baker	O	Oboe
C	Charlie	P	Peter
D	Dog	Q	Queen
E	Easy	R	Roger
F	Fox	S	Sugar
G	George	T	Tare
H	How	U	Uncle
I	Item	V	Victor
J	Jig	W	William
K	King	X	X-ray
L	Love	Y	Yoke
M	Mike	Z	Zebra

Difficult words will be both spoken and spelled, for example: "Solved—I spell—Sugar Oboe Love Victor Easy Dog—Solved."

Radio Telephone Terms

"Roger" means "Received your message."

"Wilco" means "Received your message and (where applicable) will comply." Use "Wilco" to acknowledge you will carry out landing, takeoff, or other instructions.

"Say again" means "Repeat."

"I say again" means "I will repeat."

"Wrong" means "That is incorrect. The correct version is --"

"Correction" means "An error has been made. The correct version is --"

"That is correct" is self-explanatory.

"Wait", if used by itself, means "I must pause for a few seconds." If the pause is to be longer than a few seconds use "Wait. Out." If "Wait" is to be used to prevent another station from transmitting, follow it with "Out."

Pronunciation of Numbers

When you transmit numbers by radio telephone use the following standard pronounciation:

NUMERAL	SPOKEN AS	NUMERAL	SPOKEN AS
0	Ze-ro	5	Fi-yiv
1	Wun	6	Six
2	Too	7	Seven
3	Thuh-ree	8	Ate
4	Fo-wer	9	Niner

Statement of Numbers

Speak all numbers in serial form, as "wun ze-ro" for 10; "ate niner too" for 892.

An even hundred or thousand is spoken as "Hund-red" or "Thow-sand". An exception is made for ceiling and flight levels of ten, eleven and twelve thousand feet. For example:

FLIGHT LEVEL	STATEMENT
1,200	Wun Thow-sand Too Hund-red
12,000	Twelve Thow-sand
13,000	Wun Thuh-ree Thow-sand
15,500	Wun Fi-yiv Thow-sand Fi-yiv Hund-red

Radio Call Signs

Call signs for airplanes are composed of the last three numbers of the airplane serial number. If further identification is necessary, the ground station will request four or more numbers.

Establishing Communication

To establish (or reopen) communication make the initial call-up once, as illustrated in the following example. If you get no reply within 30 seconds make a second call-up, this time making it twice. Repeat this double call-up at 1 minute intervals until communication is established.

Item	Example
Station called	"Scott Army Airways
Introduction	"this is
Station calling	"Army ate wun fo-wer.
Invitation to reply	"Over."

After communication is established you can continue without further call-up, but each message should begin with the airplane's identification and end with the proper termination.

Termination of Message

All messages will end in "Over" or "Out", depending on which is appropriate.

"Over" means "My transmission is ended. I expect a response."

"Out" means "This conversation is ended and no response is expected."

For all frequencies see your
RADIO FACILITY CHARTS

Contacting Ground Stations

Various ground radio communications facilities are at the disposal of the pilot. They include Army Airways Communications System stations, Army or CAA radio range stations, and Army or CAA control towers (See Radio Facility Charts for listings). Examples of call-ups are:

AACS stations	"Scott Army Airways"
Radio ranges	"Scott Radio"
Control towers	"Scott Tower"

AACS

Army Airways Communications System operates control towers, Army airways and radio navigational aids. AACS stations will relay traffic to any point, including CAA or Navy, via telephone, telegraph, teletype, or interphone.

To Prearrange a Channel

Before departing from a base where an AACS station is located a pilot can file a radio message to notify airways stations along the route and at destination to stand by on any air-ground channel.

RADIO DIALOGUE

Takeoff Instructions

Contact the tower for taxiing and takeoff instructions before moving from the line or parking area. Towers should give: (1) Wind direction and velocity and direction of takeoff traffic. (2) Runway clearance. (3) Special instructions for local conditions. (4) Taxi clearance. (5) Takeoff clearance. (6) Altimeter setting. (7) Time. For example:

Plane: "Washington tower, this is Army one five seven, over."

Washington: "Army one five seven, this is Washington tower, over."

Plane: "Washington tower, this is Army one five seven, taxi clearance, over."

Washington: "Army one five seven, traffic northwest, cleared to runway three three. Taxi to front of terminal building, turn right and follow taxi strip. Altimeter three zero zero four, over."

Plane: "Army one five seven, wilco, out."

Plane (in takeoff position): "Washington tower this is Army one five seven, over."

Washington: "Army one five seven, this is Washington tower, over."

Plane: "Washington tower, this is Army one five seven, takeoff clearance, over."

Washington: "Army one five seven, cleared for takeoff, over."

Plane: "Army one five seven, wilco, out."

Washington: "Army one five seven, off at zero five, over."

Plane: "Army one five seven, roger, out."

Remain tuned to the tower frequency for at least 5 minutes after departure, unless cleared to another frequency by the control tower.

Landing Instructions

When approaching a field, contact tower when approximately 10 minutes out, or in time to receive an answer before entering the control zone. Give your position, and stand by for landing instructions. Call tower again about 1 minute from the field and give position.

Clearance to enter traffic pattern is issued to the pilot when it is desired that you approach in accordance with current traffic patterns, and when traffic conditions are such that a clearance authorizing actual landing cannot be given. Information is given concerning landing direction and runway, so you may plan your entry into the traffic pattern. Don't confuse clearance to enter pattern with clearance to land. Landing instructions should include wind direction and velocity, altimeter setting, traffic information, landing sequence, observation of landing gear, and field conditions. For example:

Plane: "Waco tower, this is Army five nine two, over."

Waco: "Army five nine two, this is the Waco tower, over."

Plane: "Waco tower, this is Army five nine two, position one five miles northwest, time zero eight one five at four thousand. Request landing instructions, over."

Waco: "Army five nine two, roger. Cleared to enter right traffic pattern. Traffic south, runway one seven R. Make an overhead approach at one thousand five hundred indicated. Call tower on base leg, over."

Plane: "Army five nine two, wilco, out."

Plane (on base leg): "Waco tower, this is Army five nine two, on base leg, over."

Waco: "Army five nine two, wheels down and locked, cleared to land, over."

Plane: "Army five nine two, wilco, out."

Plane (now on ground): "Waco tower, this is Army five nine two, on ground, taxi instructions, over."

Waco: "Army five nine two, make a right hand turn at first taxi strip. Taxi north on ramp to center control tower, alert crew will park you, over."

Plane: "Army five nine two, wilco, out."

Remain tuned to the tower frequency until you have taxied airplane to parking position and shut off the engines.

CAA Range Stations

Contact CAA radio range stations to report your position, request weather and traffic information, file flight plans, or make changes in flight plans. Report position to range stations in this sequence: (1) Plane's call. (2) Position. (3) Time. (4) Altitude. (5) Flight conditions, such as contact or instrument flight, on top, between layers (include visibility), icing, or turbulence. (6) Estimated time over next fix. For example:

Plane: "Denver radio, this is Army five zero eight, over."

Denver: "Army five zero eight, this is Denver radio, over."

Plane: "Denver radio, this is Army five zero eight. Crossing northeast leg Denver range one five miles northeast, time one six four zero at nine thousand on instruments. Estimate Cheyenne time one seven one five, over."

Denver: "Army five zero eight. Crossing northeast leg Denver range one five miles northeast, time one six four zero at nine thousand on instruments. Estimate Cheyenne time one seven one five, over."

Plane: "Army five zero eight, that is correct, out."

Change of Flight Plan

Give: (1) Plane's call. (2) Position. (3) Time over position. (4) Altitude. (5) Flight conditions. (6) Details of change in flight plan. (7) Remaining hours and minutes of fuel aboard. (8) Estimated time en route present position to destination. (9) Alternate airport. (See PIF 2-3-1.)

Plane: "Washington radio, this is Army three zero eight, over."

Washington: "Army three zero eight, this is Washington radio, over."

Plane: "Washington radio, this is Army three zero eight. Over Washington, time one six one five at six thousand on instruments. Request change in flight plan, six thousand red airway two zero to Pittsburgh. Fuel supply three hours and three zero minutes. Estimate Pittsburgh one hour and one five minutes. Alternate Columbus, over."

Washington: "Army three zero eight, roger, wait, out."

Washington: "Army three zero eight, this is Washington radio, over."

Plane: "Washington radio, this is Army three zero eight, over."

Washington: "Army three zero eight, Washington Airway Traffic Control clears you to two five miles northwest Martinsburg, to cruise at six thousand. Contact Martinsburg radio for Pittsburgh clearance, over."

Plane: "Army three zero eight, roger, out."

PIF 2-17-1
May 1, 1943

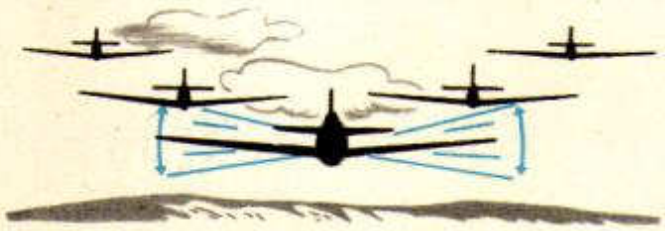


VISUAL SIGNALS FOR FORMATION FLYING

Wartime use of airplanes often will not permit the use of radio to control the formations in which they are flying. The majority of formation training flights also require partial or total radio silence. Consequently, a system of signals is required in order that a commander may exercise proper control of his formation during flight.

Because each type of flying employs formations peculiar to itself and because variety in formations also is caused by non-uniformity of airplane types, it is not considered expedient to prescribe all signals to be used in formation flying.

To insure uniformity throughout the Army Air Forces in certain items of control common to all formations of airplanes, the following visual signals are prescribed:

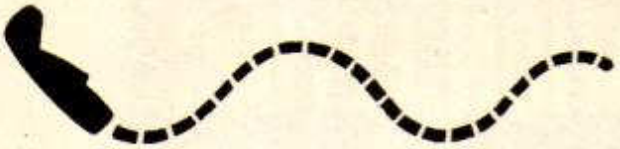
SIGNAL	SIGNIFICANCE
FLUTTER AILERONS: Repeated and comparatively rapid movement of ailerons.	
	**ATTENTION:** Used on the ground or in the air to attract attention of all pilots in the formation. Stand by for radio message or further signal. When on ground and in proper position to take off, this signal will normally mean "Ready to take off."

FISHTAIL OR YAW: By rudder control during flight, move the tail of the airplane alternately and repeatedly right and left.



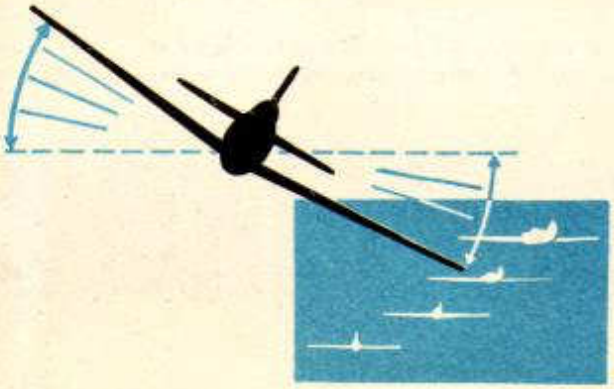
OPEN-UP FORMATION: Where applicable, this may be used to order a search formation.

SERIES OF SMALL DIVES AND/OR ZOOMS:



PREPARE TO LAND: An order to each pilot in the formation to prepare to land. In the absence of further signals the landing will be made in the normal landing formation of the unit, which should be predetermined. Any change in formation for landing will be ordered by supplemental signal by radio.

DIP RIGHT (LEFT) WING:



From any formation other than echelon go into echelon of flights to the right (left).

Being in an echelon of flights to the right (left), go into echelon of individual airplanes to the same side. Being in an echelon of individual airplanes, if wing is dipped on the side to which airplanes are echeloned, form echelon of flights to the same side. Being in an echelon of flights or individual airplanes, if wing is dipped on the side away from the echelonment, form same echelon) to the opposite side.



KEEP YOUR EYE ON YOUR COMMANDER

ROCK WINGS:

Slow, repeated, rocking motion of airplane about longitudinal axis, by gradual use of ailerons.
Wing movement to be slower and of greater amplitude than in "Flutter of ailerons."



ROCK WINGS *Slowly*

ASSUME NORMAL FORMATION:

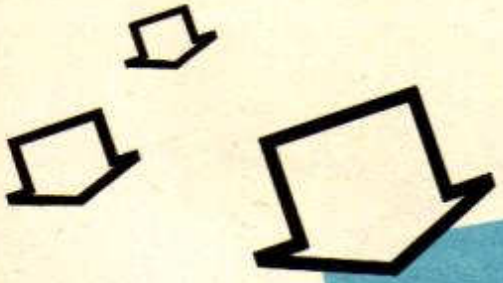
From any other formation, go into the normal closed-up formation for the unit concerned. This formation is to be prescribed in each group and/or squadron.

Hold hand to headset and then swing hand up and down in front of face several times, as in "cease firing."



RADIO OUT OF COMMISSION:

When necessary or desirable this signal may be given by an occupant of the airplane other than the pilot.



These signals may be augmented as required by any group or larger unit or by separate squadron or flight. In such case, however, care will be taken to avoid confusion of added signals with those herein prescribed and the number of signals added will be kept to a minimum.

REFERENCE: AAF REGULATION 60-15 DATED JULY 9, 1942

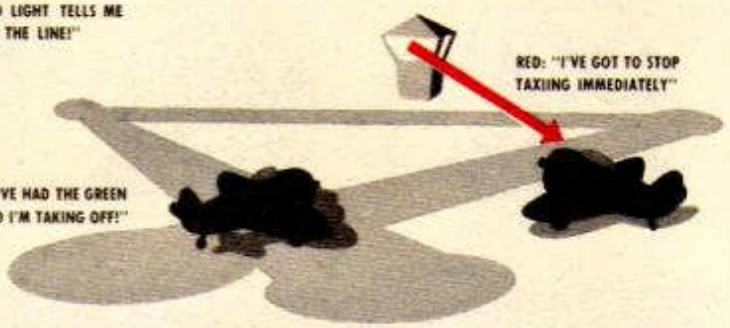
PIF 2-18-1
REVISED May 1, 1944

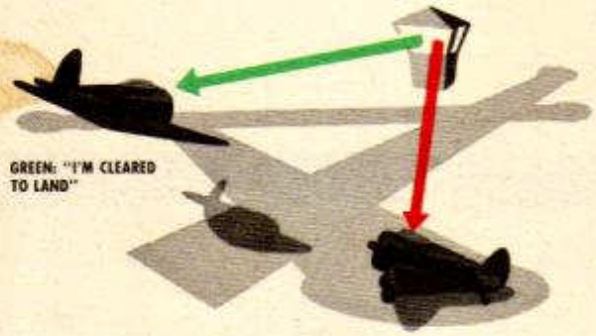
TOWER LIGHT GUN SIGNALS

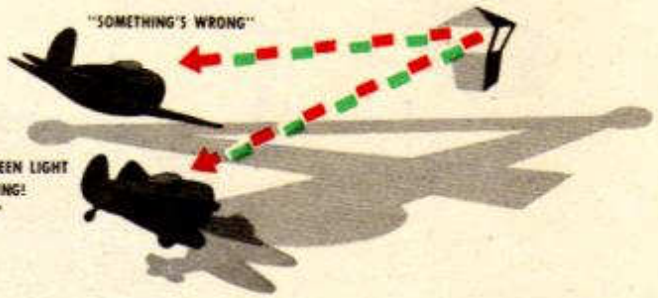




PILOT ACKNOWLEDGES SIGNALS BY MOVING AILERONS OR RUDDER







NIGHT AIRPLANE-TO-TOWER SIGNALS



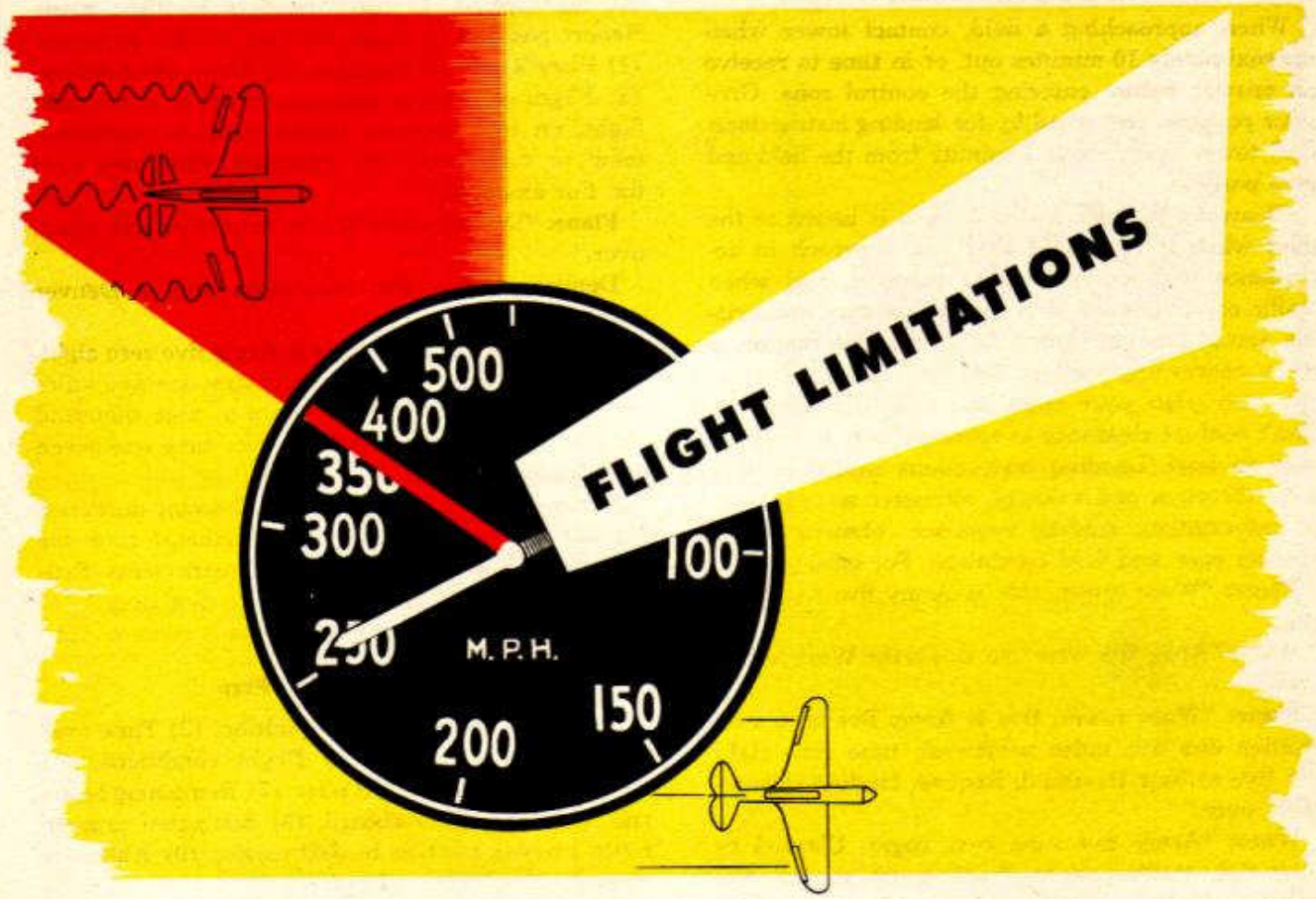
TURN ON YOUR LANDING LIGHTS AND KEEP THEM ON, THIS MEANS: "I WANT TO LAND."



ONE FLASH OF YOUR LANDING LIGHTS MEANS: "I HAVE RECEIVED YOUR SIGNAL AND WILL COMPLY."



BLINKING LANDING LIGHTS MEAN: "TURN OFF FLOOD LIGHTS!" IF ON. "TURN ON FLOOD LIGHTS!" IF OFF



Don't exceed the red line speed on your airspeed indicator. If you do, structural or control failure may result.

The structure and flight characteristics of any type of aircraft limit its performance. In actual flight tests these limits are carefully determined, then each type is redlined at a point within its safety limits.

The red line has a definite purpose. It represents what the airplane was built to do. When you exceed the red line, you are demanding more performance of the airplane than it was designed to accomplish.

You will find that the red line is much nearer to cruising speed on heavy bomber and cargo aircraft than on lighter fighter and attack aircraft. A heavy bomber was designed to carry heavy loads for great distances, to fly at high altitudes, and to defend itself against fighters and flack. It can withstand safely approximately 5 Gs when empty, but not more than 2 or 3 Gs when fully loaded.

A fighter normally is built to withstand up to 12 Gs before permanent deformation or structural failure results. Its primary functions entail high speed and great maneuverability.

Factors influencing flight limitations are:

1. Type of work to be done. (Bomber—Fighter).
2. Design of the airplane. G forces it can withstand without permanent deformation or structural failure.
3. Size and load-carrying capacity of the plane.
4. Point of compressibility. (PIF 2-21-1.)
5. Special equipment (external fuel tanks, bomb racks, rocket tubes, etc.)

Know Your Airplane

1. **Read all TOs and Pilot Operating Instructions that apply to your airplane.**

2. **Don't experiment with prohibited speeds or maneuvers** unless authorized to do so by competent authority for a specific purpose.

3. **Take it easy** in recovery from any unusual position or speed. Don't jerk or manhandle your airplane. No plane is built that can't be torn up by rough handling of controls, especially at high speeds or in unusual maneuvers.

4. **Use pressure, not movement** of the controls for smooth, uniform recovery.

Your airspeed indicator is your only indication of your true airspeed. Never forget or underestimate its importance. Use the table given here to figure True Airspeed from the Indicated Airspeed shown on your airspeed indicator:

Figuring True Airspeed

At	5,000	feet	increase IAS by	7½%	to get TAS
At	7,500	feet	increase IAS by	10%	to get TAS
At	10,000	feet	increase IAS by	15%	to get TAS
At	15,000	feet	increase IAS by	25%	to get TAS
At	20,000	feet	increase IAS by	35%	to get TAS
At	25,000	feet	increase IAS by	50%	to get TAS
At	30,000	feet	increase IAS by	65%	to get TAS
At	35,000	feet	increase IAS by	80%	to get TAS

Vibration and Flutter

If there is any flutter or unusual vibration in your airplane, reduce airspeed and engine speed to minimize it until you can land. In particular, any persistent oscillation in which relative motion can be observed between the wings and ailerons, or stabilizer and elevator, or fin and rudder, is likely to be dangerous.

Don't take off in an airplane if the engine is rough on ground run-up.

Small, high frequency vibrations existing over long periods of time may cause fatigue failures.

Factors likely to set up excessive vibrations in an airplane in use are:

1. Propeller—Unbalance, incorrect setting, improper mounting, etc.
2. Power Plant—Missing of one or more cylinders, improper adjustment, unsatisfactory mounting, etc.
3. Control Surfaces—Reduction in rigidity, loose hinge fittings, bearings, or balance weights, etc.
4. Control Systems—Excessive play in tab-control systems, insufficient tension in control cables, loose bearings, and attachments, etc.
5. Wings and Fuselage—Reduction in bending or torsional rigidity through damage, slack, or defects in the covering or truss systems.

Loading Airplanes

Use extreme care in loading airplanes. Additional loads, other than those normally carried in the plane, alter the balance and stability. In some airplanes so burdened, the response to the controls may be sluggish and recovery from spins difficult or impossible.

Conditions Governing Maneuvers Permitted

The permissible maneuvers and load factors for any airplane do not apply when the airplane is loaded in excess of its designed gross weight. **Never load your airplane in excess of its permissible gross-weight condition.**



PIF 2-20-1
REVISED September 1, 1944

Stalls and Spins

STALLS

Airplanes with high wingloadings require considerable altitude to recover from a stall.

Using aileron to lift the dropping wing increases the stall and a spin may develop unless the airplane is inherently stable against spinning.

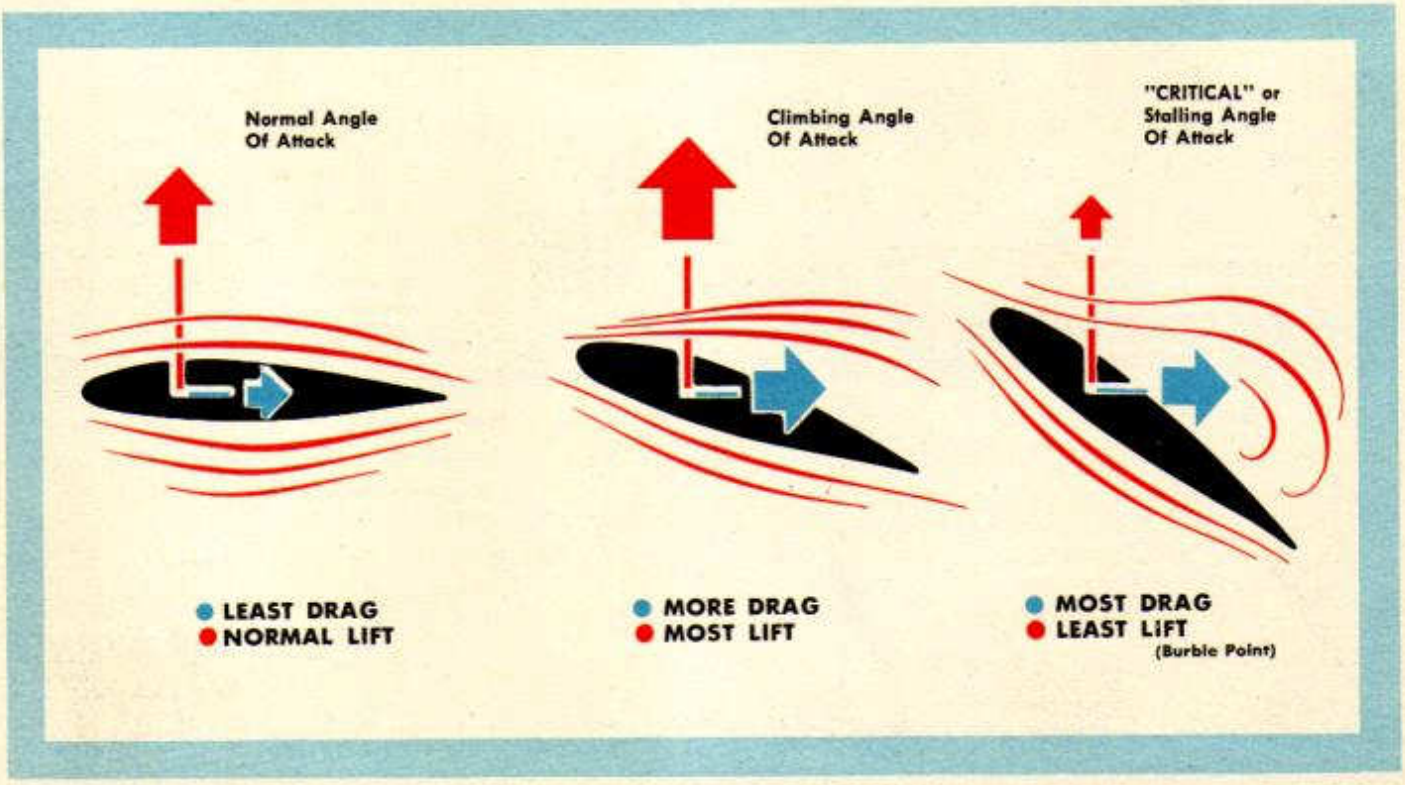
To correct stall, **reduce the angle of attack and get flying speed by diving.** The most dangerous feature is that so much altitude must be lost to regain control.

Most maneuvers, including banks, increase the effective gross weight of an airplane. **Be sure you have enough flying speed to provide for the increased stalling speed created by banks or other maneuvers which impose greater than normal loads on your plane.**

Don't make sloppy turns; skids at low speeds will stall your plane.

Don't make side-slip landings, particularly with flaps down. Flap shadow, or wake, is likely to blanket vertical surfaces at low speeds, and reduce rudder control.

Watch for warnings of an approaching stall.



AERODYNAMICS OF A STALL

PIF 2-20-2
REVISED September 1, 1944

HIGH-SPEED STALLS

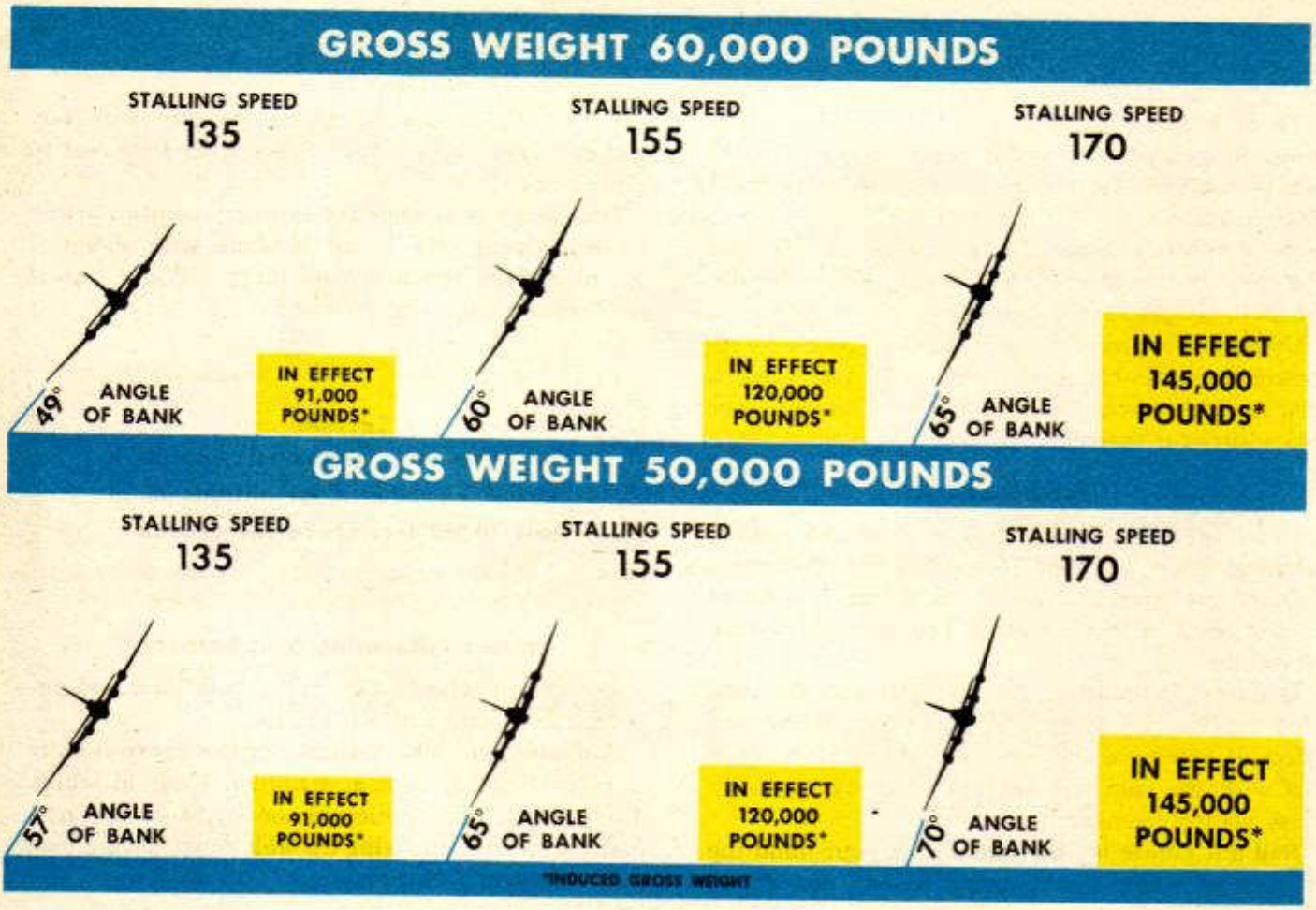
You know that as the gross weight of an airplane goes up the stalling speed increases. When an airplane is turning in a banked attitude, centrifugal force has the same effect as increasing the gross weight, and the stalling speed of the airplane is thereby raised.

1. For example, if a B-17G airplane weighing 60,000 pounds is turned in a 60° bank, the pilot is in effect flying an airplane weighing 120,000 pounds and the stalling speed has been raised to 155 IAS. A 60,000 pound B-17G can be stalled at normal cruising speed merely by entering a steep bank, but the stall thus encountered is not a normal stall. The speed and high induced gross weight may cause a violent stall which endangers the airplane's structure. Stalling the airplane in a banked attitude may throw it into an inverted attitude from which several thousand feet will be required for recovery.

2. To show the degree of bank at which a B-17G stalls at 60,000 and 50,000 pounds for 135 IAS, 155 IAS, and 170 IAS, see the charts below:

3. Note that for a particular IAS the induced gross weight at the stall point is the same for both gross weights. As the stalling IAS is raised the induced gross weight at the stall point increases rapidly. The maximum induced gross weight which can be sustained without permanent deformation to the wing structure is 148,000 pounds. This corresponds roughly to a stalled bank at an IAS of 172 mph for any gross weight.

INCREASED STALLING SPEED AND EFFECTIVE GROSS WEIGHT OF B17 AT VARIOUS ANGLES OF BANK



Degree of Bank	Percent Increase in Normal Stalling Speed	Approximate Stalling Speed Based on 100 mph Normal Stalling Speed
0°	0	100
10°	.5	101
20°	3.0	103
30°	7.0	107
40°	14.4	115
50°	25.0	125
60°	41.4	142
70°	71.0	171
80°	140	240
90°	Infinity	Infinity

The figures in the table show how banking an airplane with a stalling speed of 100 mph increases the stalling speed. The table may be used for any airplane by adding the percentage of increase in the second column to the known stalling speed of the airplane. Note particularly the sharp increase in steep banks.

SPINS

There is no infallible method for recovery from spins. In general, apply full rudder against direction of rotation. Follow by full forward stick until rotation stops.

Move controls briskly to a position full against the spin. Don't move controls slowly or cautiously, for that may permit the spin to continue indefinitely.

Using the ailerons as an additional means of recovery is debatable. In general, hold the ailerons in a neutral position unless otherwise instructed in procedures for specific airplanes.

Precautions

Don't spin an airplane that is restricted against spinning. There are good reasons for the restriction.

Don't get excited. Mental confusion sometimes causes pilots to move controls opposite to intended procedure.

Don't get impatient. Give the controls at least five turns to take effect. Then, if still in the spin, and you have sufficient altitude place controls full with the spin and attempt recovery again by brisk control movement.

Bail out before it's too late. Fix in your mind the altitude at which you're going to bail out if you get into a spin. Never attempt to stay with any tactical airplane in a spin closer than 5000 feet to the ground.

Get plenty of altitude for recovery before starting an intentional spin in an airplane with doubtful spinning characteristics. Your plane will lose a great deal of altitude during recovery.

Caution

Complete any intentional spin in a tactical airplane at an altitude of at least 10,000 feet above the ground.

Factors Influencing Spin Recovery

Position of wheels. Generally, both spin and recovery are better with wheels up.

Ammunition loads in wings. Spin recovery usually is more sluggish with ammunition loads in wings. The effect is more noticeable on airplanes that normally spin with one wing tip well down; such a load may endanger recovery.

Using the throttle in an attempt to recover from a bad spin is effective at times. Use throttle for spin recovery only if normal recovery procedure is ineffective. Either short bursts or steady applied power may be necessary.

Technique

The following techniques apply to most airplanes. **However, you must learn the specific procedure that applies to your airplane.**

Usually, if you hold the ailerons neutral and the elevator and rudder controls all the way with the spin, the spin will be more steady. Also, moving the controls from one extreme to the other (against the spin) gives a snappier and more forceful reaction for recovery.

Generally, use rudder first, then elevators because:

1. Reversed rudder checks the rate of rotation and causes the nose to go down.
2. Blanketing of the rudder by the elevator is usually less, and rudder is more effective when the elevator is up.
3. Hold the stick back while you hold the rudder opposite to the spin. As you slow down the rate of the spin, your elevators become progressively more effective.
4. The comparative effectiveness of rudder and elevator during spin recovery varies greatly. The elevator may be a more positive control than the rudder. Even then, don't change the sequence of control movement unless specifically instructed.

The first few turns of a spin are a transition period from straight and level flight to the final steady spin. During this time recovery often grows progressively more difficult. When spinning a strange airplane, use this period for testing the ease of recovery at various stages of the spin. In the first trial, for example, attempt recovery after ¼ turn, and in succeeding trials, recover after ½, ¾, 1, 1½, 2, 3, etc., turns. Thus, you can learn the spinning characteristics more gradually.

Uncontrollable spins are not necessarily flat spins. In a flat spin the controls are probably less effective than in a steep (or normal) spin.

In general, an airplane spins differently in a right than in a left spin, because of rigging to overcome propeller torque and slipstream effects. An airplane may have satisfactory characteristics for a spin in one direction and unsatisfactory spin characteristics in the opposite direction.

Changes in weight and center-of-gravity position are likely to effect spinning characteristics. It is difficult to predict the effect of a definite center-of-gravity position on these characteristics.

Don't spin an airplane intentionally when the CG position is rear of normal. It is much more difficult, and sometimes impossible, to recover under this condition.

Caution

Check your position in the cockpit before takeoff. Be sure that you get full travel and can apply full force all the way on all controls.

Remember these Tips

1. Be sure you can get full control movement and can apply force on the controls.
2. Don't get excited.
3. Don't be impatient. Leave the controls in recovery position long enough.
4. Fix in your mind beforehand the altitude at which you must bail out.
5. Get plenty of altitude before starting an intentional spin in tactical airplanes.
6. Don't spin with a rear of normal CG.
7. Don't spin an airplane restricted against spins.

REFERENCE: AAF Memorandum 62-4.

PIF 2-21-1
REVISED September 1, 1944



COMPRESSIBILITY

When a fighter airplane approaches the speed of sound, it reaches a point where it loses its efficiency. Some or all of the following things happen:

1. Lift characteristics will be reduced or entirely destroyed.
2. Intense drag develops.
3. Stability and control characteristics change.
4. The tail buffets; the airplane may develop uncontrollable pitching and porpoising; it may develop uncontrollable rolling and yawing; or it may have a combination of these effects.
5. Severe vibration of the ailerons or of the entire plane may develop.
6. Trim changes in almost every case.

These are known as compressibility effects. The point at which an airplane enters compressibility varies with different models of aircraft; it varies on the airspeed indicator with changes of altitude, just as the speed of sound varies at different altitudes.

Compressibility is caused by a change in the physical behavior of air as it passes over any curved surface which is travelling at high speeds through the air mass. The continuity of the airflow breaks down; compression or shock waves develop on the wings or other surfaces and ahead of the airfoils; the air seems to split apart, shooting off at a tangent on both the upper and lower surfaces.

Mach Number

The Mach (pronounced mock) number is the speed of an airplane divided by the speed of sound. The critical Mach number is the point at which a given airplane goes into compressibility. Because of design limitations, a plane actually goes into compressibility **before it reaches the speed of sound.** With some airplanes this point is reached at a speed 65% that of sound, others as high as 80%, depending upon the design of the model. Know the limiting speeds or critical Mach number of your plane before you attempt high speed maneuvers.

Airspeed and Speed of Sound

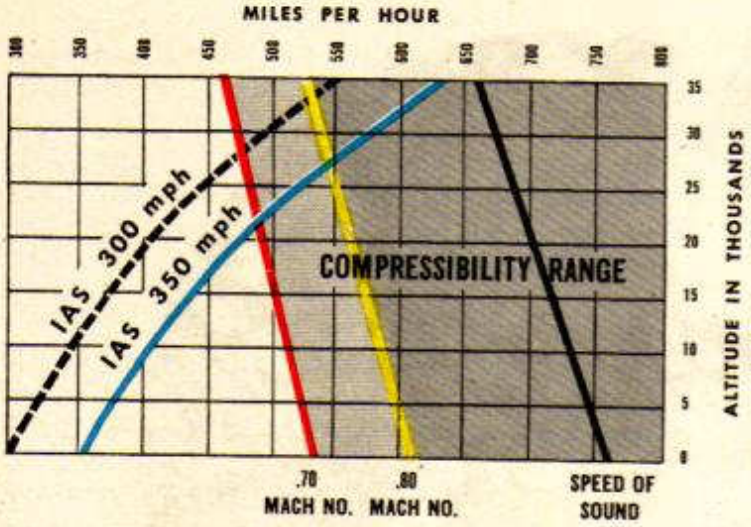
True airspeed and indicated airspeed are identical at sea level. TAS is greater than that shown on the airspeed indicator as you reach higher altitudes. The higher you climb, the greater the discrepancy, until at 35,000 feet when your airspeed indicator registers 300 mph you're actually travelling more than 500 mph true airspeed.

The speed of sound is 760 mph at sea level and gradually drops to 660 mph at 35,000 feet. Your plane goes into compressibility when the percentage of TAS to speed of sound at any given altitude exceeds the critical Mach number.

Avoid Speeds Within Compressibility Range

1. Know the critical Mach number or limiting airspeeds of your plane. Know TAS and IAS ratios at approximate altitudes where you intend to carry out maneuvers. Know the speed of sound at those altitudes.
2. Never attempt high-speed dives with external tanks until you are familiar with their effect.
3. Avoid violent use of ailerons in high-speed maneuvers and dives.
4. Keep rudder and elevator trim in relative position for level flight. Use trim tabs only if necessary. Make minute adjustments in trim only with great caution and, above all, observe the specific operating procedures for your airplane.
5. Never roll into a vertical dive above 30,000 feet, when it's possible to avoid it.
6. Use controls gently at high speeds and high altitudes. Do not attempt to recover from dives too quickly. Rough handling of the controls may cause entry into the compressibility range much more easily above 20,000 feet than below it.
7. Do not have a routine procedure for all fighter types as a group. Each type has its own peculiar high-speed dive and compressibility effects.

Note! **Observe the Placard of Limiting Airspeeds posted in the cockpit of your airplane.**



Compressibility

The chart shows how easy it is to get into compressibility at high altitudes, with your airspeed indicator still well under the red line.

For example, if your airplane has a Mach number of .70 it will enter compressibility at 22,000 feet if the IAS is 350 mph (intersection of blue and red lines). With an IAS of 300 mph it would enter compressibility at 28,000 feet (dotted line and red line). Likewise shown are the points where it would enter compressibility if it had a Mach number of .80.

Vertical Dive Recovery

Don't dive too close to the ground. Modern fighter airplanes require plenty of altitude for safe recovery from high-speed dives. Not only do you lose altitude rapidly; you must have a lot of air under you if you black out by exceeding the acceleration you can withstand in recovery.

The average pilot cannot withstand more than 4 G acceleration for periods (10 to 20 seconds) required for pullouts from high-speed vertical dives without blacking out. Accelerations higher than 4 G for extended periods will result in blacking out and loss of consciousness. **Don't get into a diving position which will require more than 4 G acceleration for safe recovery.** (See PIF 4-3-1.)

Unless you have an instrument showing acceleration, the best way to judge it is by the pressure on the seat of your pants. If you have ever blacked out, recall that pressure.

Minimum Safe Altitudes

The chart on the opposite page shows the minimum safe altitude for recovery from vertical dives at various speeds, altitudes, and accelerations. These curves are based upon certain idealized conditions which make them applicable to all airplanes. However, they are not strictly accurate in all cases. For this reason, a safety factor of 25% is included.

The altitude required for recovery from a vertical dive at constant acceleration is a function of true speed and not indicated speed. Different losses in altitude occur at different altitudes for the same indicated airspeed. This accounts for the difference in scales for the different altitudes.

Using the Chart on Next Page

The curves are plotted in terms of **indicated airspeeds** at several altitudes to facilitate their use in conjunction with the airspeed indicator.

Remember altimeter readings usually lag several hundred feet behind the actual altitude in dives.

The curves for accelerations higher than 4 G are given only to show the effect of variations in accelerations.

A chart, showing altitude required for recovery with an acceleration of 4 G, will usually be included in the operating instructions of all airplanes for which vertical dives are not prohibited.

Caution

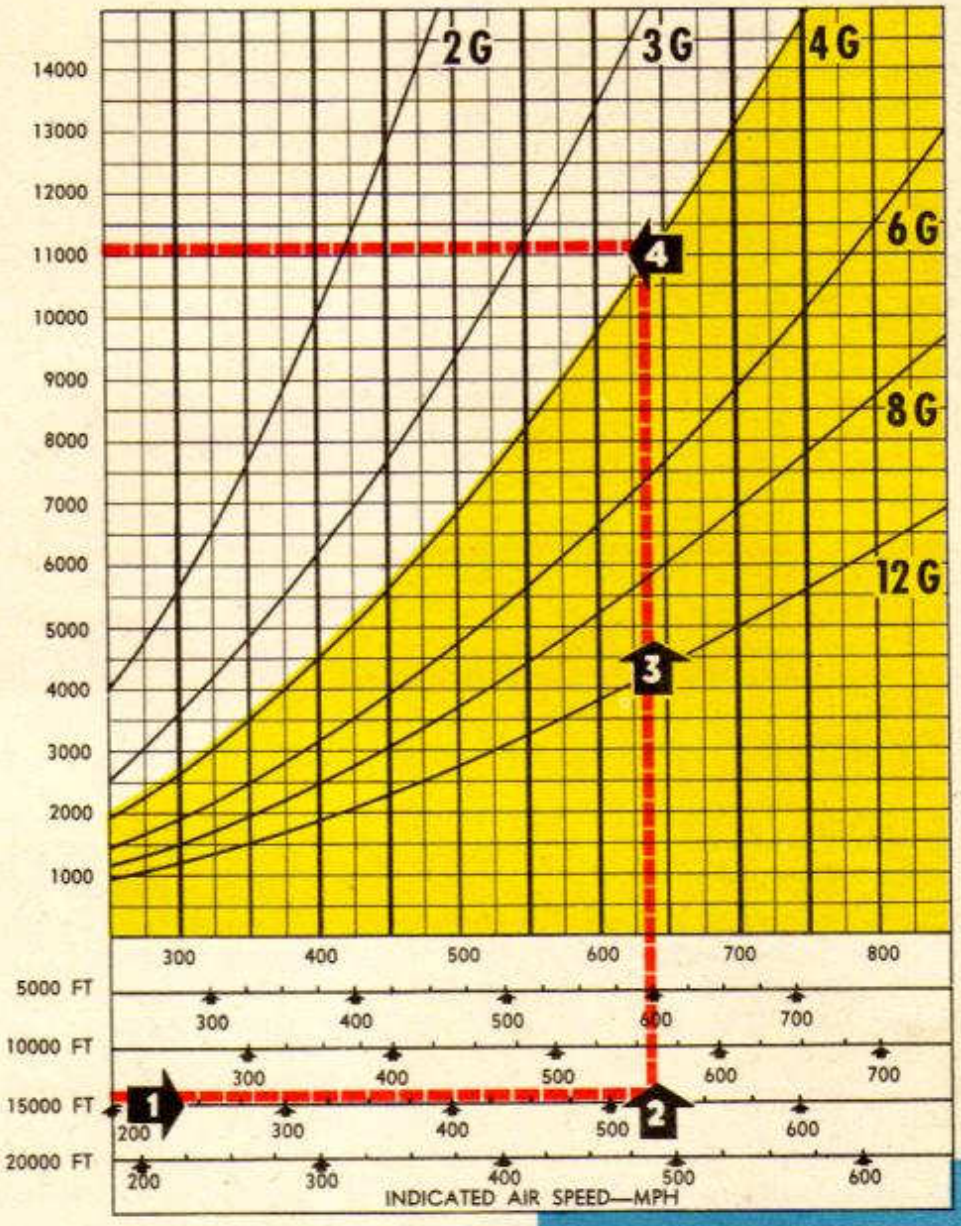
When diving at high speeds from high altitudes, avoid abrupt pullouts. Make special efforts to avoid them by proper handling of your trim tabs, control stick, and rudder. Such pullouts place dangerous strains on your airplane and your own body.

In high-speed dives bring your trim tabs back to approximately the neutral position when you reach an altitude of about 20,000 feet. Excessive use of trim tabs in these dives causes overload on the plane structure in excess of its designed load limits when you reach the lower altitudes where they become effective.

PIF 2-21-3
REVISED April 1, 1944

MINIMUM SAFE ALTITUDE REQUIRED FOR PULL-OUT FROM A VERTICAL DIVE

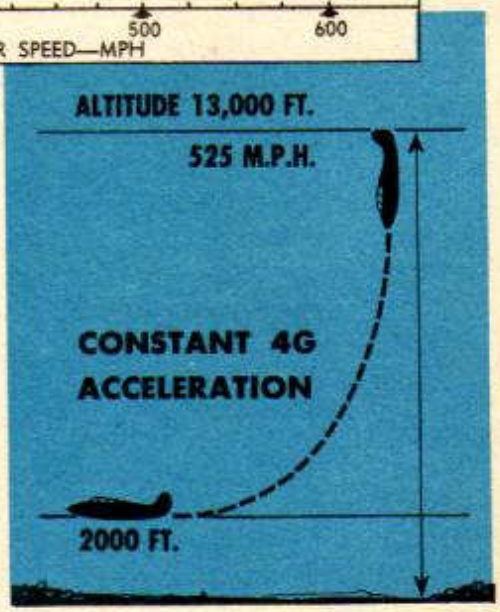
ALTITUDE AT START OF PULL-OUT



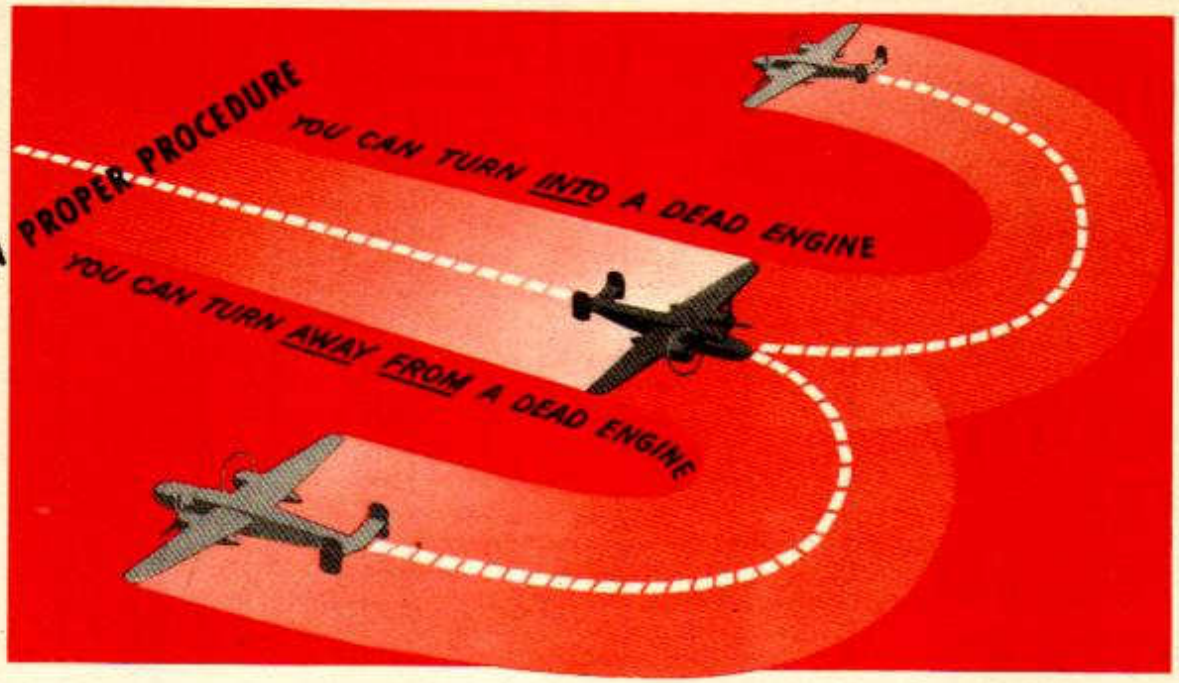
PROBLEM Find altitude remaining after making a pull-out from a vertical dive, starting the pull-out at 13,000 feet and 525 mph IAS and maintaining a constant acceleration of 4 G.

SOLUTION 1 13,000 feet is nearest to the 15,000 feet altitude line. 2 Mark the 525 mph point on the 15,000 feet altitude line. 3 Sight up the vertical lines to point on 4 G line which is directly above point obtained in (2). 4 Sight back horizontally to scale on left to find minimum safe altitude required for pull-out (approximately 11,000 feet). 5 Subtract this figure from the 13,000 feet at which pull-out was started to find altitude remaining.

13,000 feet
11,000
altitude remaining = 2,000 feet



PIF 2-22-1
REVISED July 1, 1944



ENGINE FAILURE ON MULTI-ENGINE AIRCRAFT

The loss of one engine in multi-engine aircraft is not serious if you will remember to do four things immediately. In sequence, they are:

1. Establish necessary airspeed and directional control. (Trim as necessary.)
2. Increase power (but don't exceed engine operating limits).
3. Reduce drag.
4. Reduce fire hazard.

Details of applying this procedure differ widely for various airplanes. You must consult the handbook of operating instructions for your particular plane. See these instructions also regarding engine failure at takeoff.

Turns with One Dead Engine

Get this straight: turning into a dead engine is a simple and logical procedure, **after you have established necessary airspeed and directional control.** Failure to realize this has probably given rise to the old superstition that turns into a dead engine are disastrous. That belief is one of the commonest fallacies of hangar flying. The sooner you realize it is not true the safer you'll be.

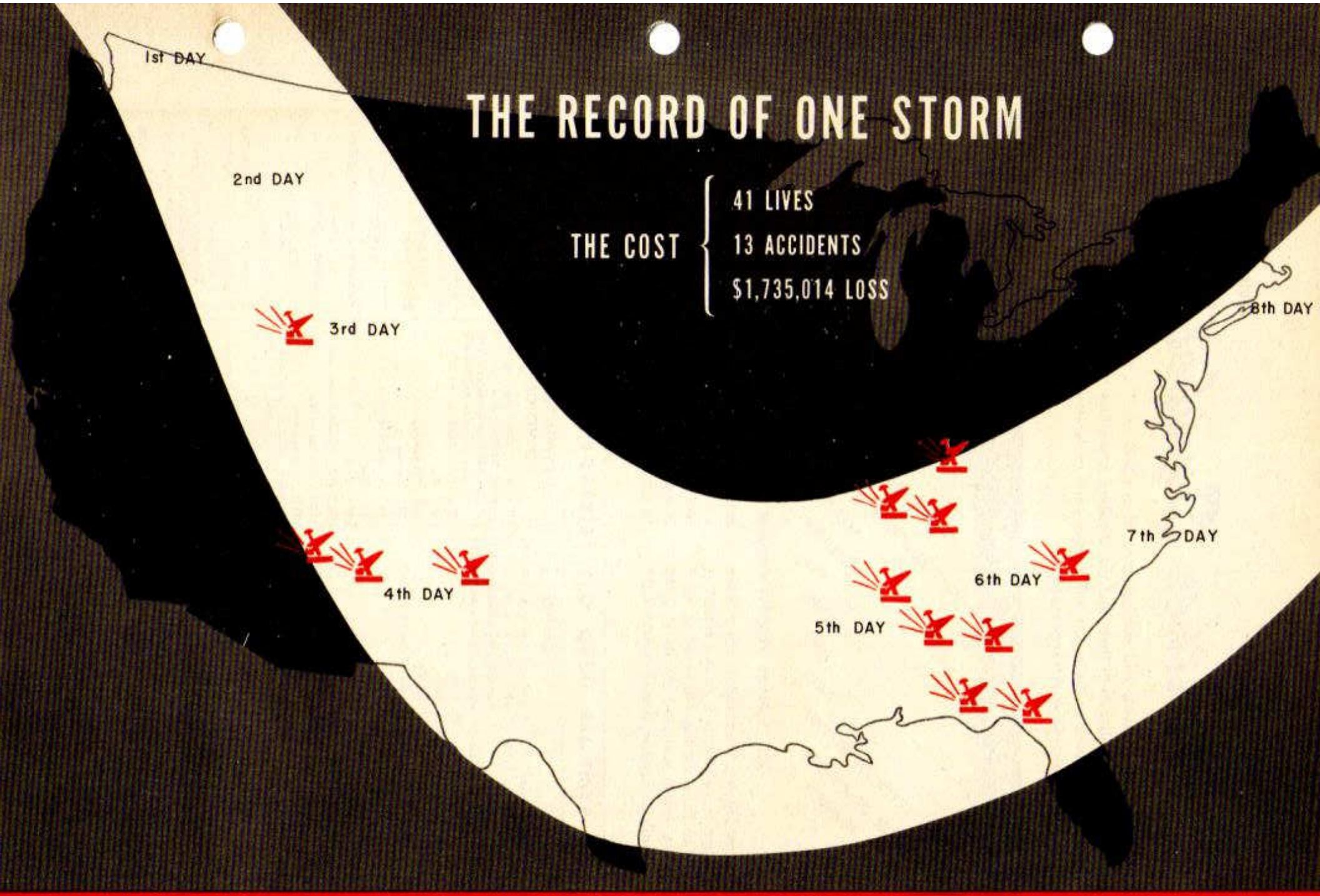
If you can make a smoothly coordinated turn into a live engine, or engines, you can turn into a dead engine just as easily if you observe the same rules exactly. Remember:

1. Holding constant the airspeed prescribed (or greater) for your airplane with one engine not operating is the most important factor in making turns. You must trim the airplane for this prescribed speed before attempting the turn.
2. As long as airspeed is constant the thrust of the live engine, or engines, is balanced by the effect of the trimmed rudder.
3. In turns there is always increased wing loading. Without additional power from the good engine, or engines, you will have to sacrifice some altitude in order to maintain airspeed.

Warning

Avoid sudden and violent applications of power while making turns with one dead engine. Such action requires compensating change in trim, and results in an uncoordinated turn and possible loss of control over the airplane.

Don't attempt any turn without proper trim.

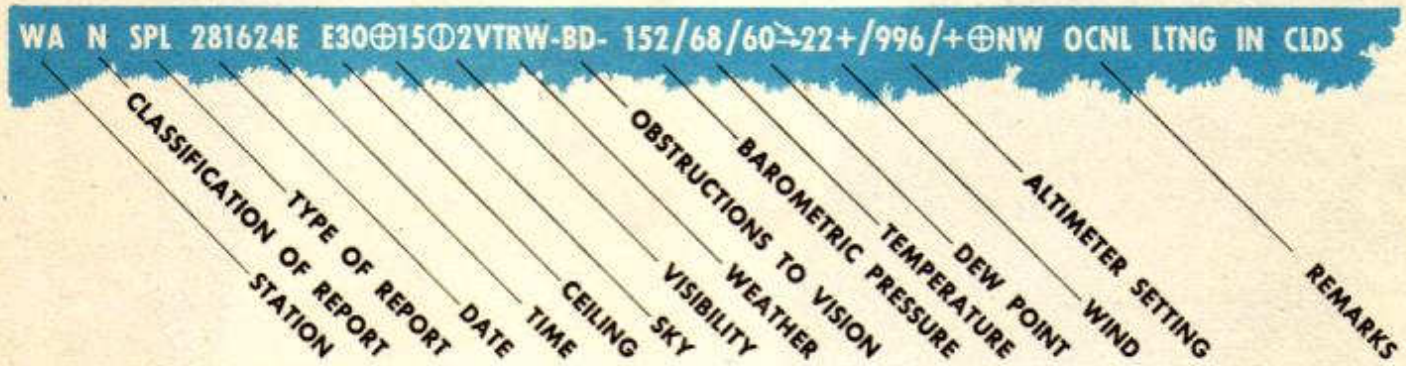


SECTION 3 WEATHER FLYING

PIF 3-1-1
REVISED January 1, 1944

Weather Symbols

There are many symbols and combinations of symbols used in reporting weather by teletype. Being familiar with them and the standard procedure used in placing them in their proper sequence in the report will hasten your understanding of the weather picture. A typical teletype report appears below:



ALL TELETYPE REPORTS FOLLOW THE ABOVE EXAMPLE

It is deciphered as follows: Washington; observance of instrument flight rules required; special report at 1624, Eastern War Time; ceiling estimated at 3,000 feet; sky overcast, lower scattered clouds at 1,500 feet; visibility 2 miles, variable; thunderstorm; light rain shower; light blowing dust; barometric pressure 1015.2 millibars; temperature 68°F; dewpoint 60F°; wind, west northwest 22 miles per hour, strong gusts; altimeter setting, 29.96 inches; dark overcast to northwest, occasional lightning in clouds.

SYMBOLS USED ON TELETYPE SEQUENCES

SKY

○ Clear (less than 1/10 covered)
◑ Scattered clouds (1/10 to 5/10 covered)
◍ Broken clouds (6/10 to 9/10 covered)
⊕ Overcast (more than 9/10 covered)

No more than two sky symbols are grouped together. When there is no slant / all cloud bases are below 9,751 feet. When a sky symbol precedes a slant / those cloud bases are above 9,750 feet; when a sky symbol follows a slant / those cloud bases are below 9,751 feet.

◑/, ◍/, ⊕/ high scattered, etc.
◑/◑, ◑/◍, ◍/◑, ◍/◍, ⊕/◑, ⊕/◍ high scattered with lower scattered; high scattered with lower broken; etc.
◑◑, ◑◍, ◍◑, ◍◍, ⊕◑, ⊕◍ (no slant) scattered, with lower scattered; scattered with broken; etc.

The plus (+) or minus (−) sign preceding the cloudiness symbol indicates "dark" and "thin", respectively.

WEATHER

A plus (+) sign following indicates HEAVY, a minus (−) sign following indicates LIGHT, no sign indicates MODERATE

R Rain
S Snow
L Drizzle
ZR, ZL Freezing rain, etc.
E Sleet
A Hail
AP Small hail
SP Snow pellets
SQ, RQ Snow squall, etc.
T Thunderstorm (no −)
SW, RW Snow showers, etc.
TORNADO (always written out in full)

CLASSIFICATION

C Satisfactory for contact flight
N Requiring observance of IFR
X Take-off and landing suspended
(none) Station not at a controlled airport

OBSTRUCTIONS TO VISION

A plus (+) sign following indicates HEAVY, a minus (−) sign following indicates LIGHT, no sign indicates MODERATE

F— Damp haze (no +)
F Fog
GF Ground fog
IF Ice fog
H Haze (no + or −)
K Smoke
D Dust
BS, BD Blowing snow, etc.
BN Blowing sand
GS Drifting snow
(figures) Miles and/or fractions of miles
(none) Visibility 10 miles or more
V (Following visibility figures) variable visibility

MISSING DATA

Indicated by the letter M entered in the place of the missing data.

WIND

The velocity is indicated by figures representing its value in miles per hour, calm being indicated by the letter **C**. Signs shown below, following velocity figures, indicate:

+ Strong gusts
− Fresh gusts
E Estimated

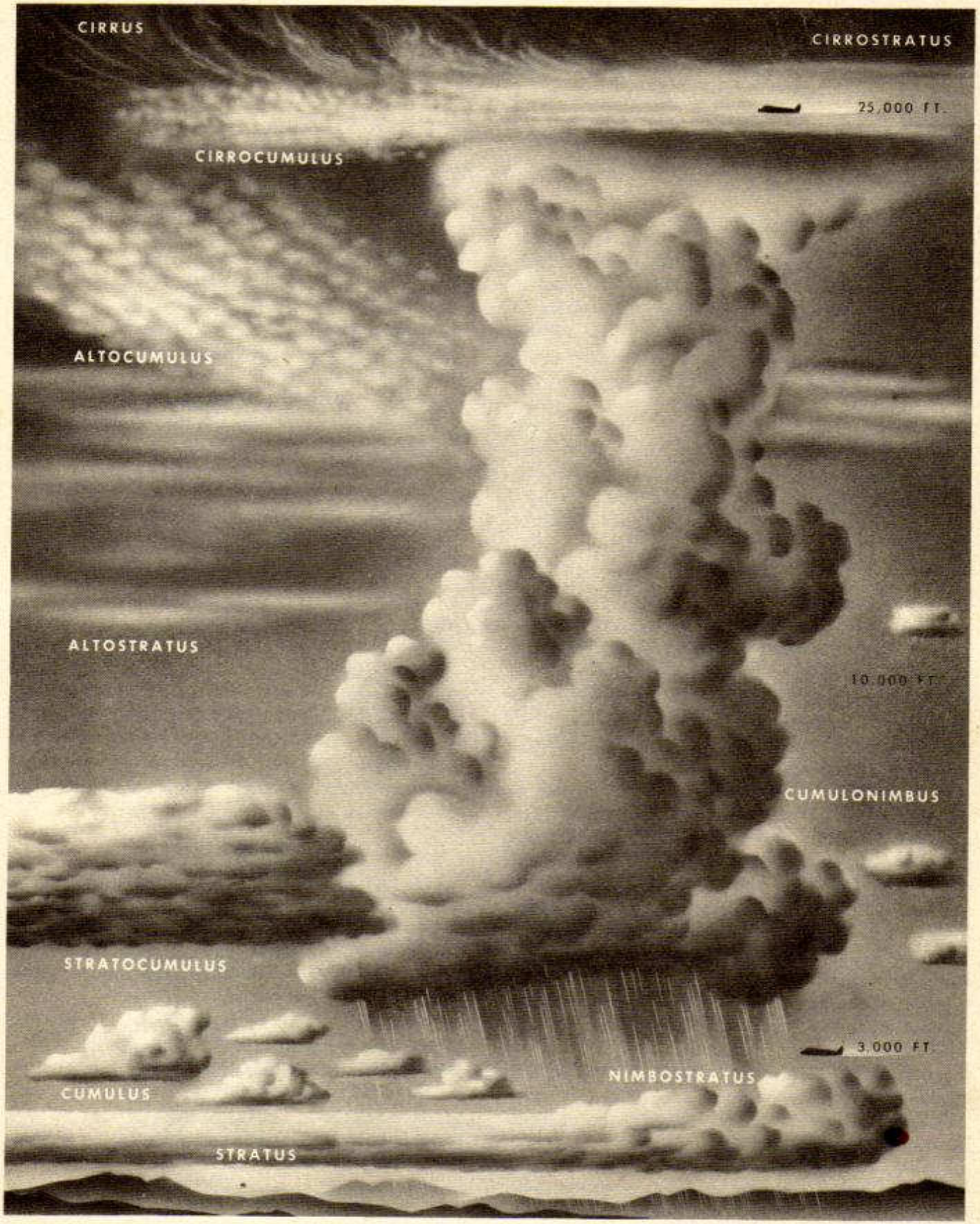
DIRECTION

Arrows flow with the wind as:
↓ North
↓↙ NNE ↙ NE, etc.

CEILINGS

Preceding ceiling figures

E Estimated **M** Measured
W Indefinite **A** Aircraft
P Precipitation
V (Following ceiling figures) variable ceiling
O (Figure naught) ceiling is below 51 feet
(no figures) Ceiling above 9,750 feet


CIRRUS
CIRROSTRATUS
25,000 FT.
CIRROCUMULUS
ALTOCUMULUS
ALTOSTRATUS
10,000 FT.
CUMULONIMBUS
STRATOCUMULUS
3,000 FT.
NIMBOSTRATUS
CUMULUS
STRATUS

PIF 3-2-1
REVISED January 1, 1944

You and the Weather

There are three major weather hazards which every flyer is bound to encounter: Fog, thunderstorms, and icing.

The purpose of this information is to emphasize the conditions which lead to the formation of **Fog** so that you may anticipate it and take advance precautions against it, to show you **Thunderstorms** as you will encounter them in actual flight and what to do about them; to remind you of the nature and types of **Icing Conditions** and how to anticipate, recognize and analyze them.

The object of this discussion is not to make you a weatherman or a forecaster, but to offer you some "Cockpit Meteorology" based on Army, Navy, and Airline experience, to assist you in estimating weather during flight and to supplement your own good judgment, for which no formula or advice can be substituted.

The Flight Plan

You are planning a flight. From take-off to landing, you will have control of practically everything **except** the weather. It makes little difference whether your flight is local or cross-country, you must fit your procedure into the pattern of winds and weather. If you don't, you may lose the opportunity to fly again.

First, check the weather map if one is available. It is a small scale picture of the weather in which are included the clues of weather trends. A weather map scales down the atmosphere to such an extent that symbols are necessary to represent measured quantities. It is to your advantage to know these symbols and to read them as you would a book.

Second, check current weather on latest teletype, radio and pilot reports. Correlation of the latest weather map and weather reports will give you a "motion picture" of flight conditions.

Third, be sure enroute weather is flyable. Icing, thunderstorms, strong head winds, extensive low ceilings and poor visibilities can keep you from reaching your destination especially if a few of these factors occur simultaneously.

Fourth, be sure both ceiling and visibility at your destination will be ample for landing procedures. Fogs, low clouds, drizzle, rain, snow, dust, smoke, blowing snow; all limit vision near the ground where you need it most.

Fifth, use every available means in estimating winds for your flight. It is much safer to have enough fuel for a 50 mph head wind which turns out to be only 30 mph, than to run out of gasoline because winds were 20 mph stronger than estimated.

Sixth, plan one or more alternate procedures against the possibility of flying into unforeseen or suddenly developing weather that makes your original plan impossible.

Seventh, work with a forecaster. Check your ideas against his and have him estimate enroute as well as terminal weather. He's there to help you make your flight a safe one. When your forecaster suggests you postpone your trip, you'd better double-check the weather before taking off against his advice because you're the one who will be up there battling the elements.

Fogs

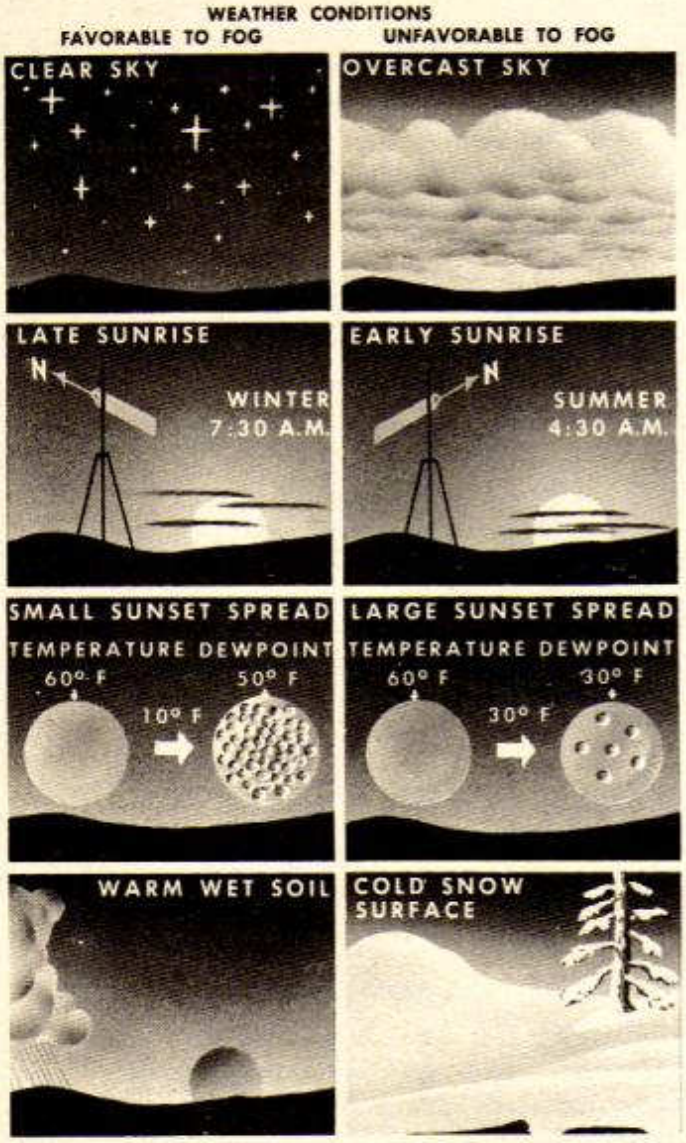
Fog may be defined as a cloud on the ground. It usually forms at night, as a result of the air being cooled by its contact with the ground, causing the air to become saturated. It also forms when surface winds carry air over terrain that permits slight super-saturation or when rain or snow falls into colder surface air.

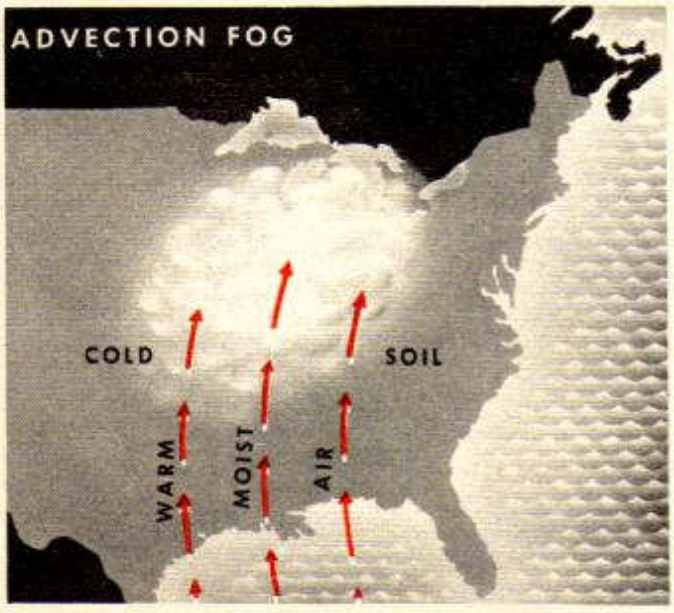
Ground Fog

This type of fog forms in nocturnally cooled surface air. It first appears in valleys and depressions as isolated patches, or, if terrain is level, where saturation of air is greatest. Patches of fog join to form a layer which deepens until an hour or two after sunrise.

If you are planning a night flight, particularly if arrival at your destination is planned near sunrise, a careful search for factors favorable to ground fog in the destination area is mandatory. When doubt exists as to presence of fog, arrival a few hours after sunrise should be the alternate plan. Do not exhaust fuel circling an airport, waiting for fog to lift.

Airports on hill tops are last to become foggy; airports in moist valleys tend to fog-in early.





Advection Fog

This fog develops in winter or early spring as a result of warm moist air drifting over cold ground or snow. Winds blowing northward off the Gulf of Mexico cause normal advection fog. This is likewise true in Spring over the cold Great Lakes.

Normal type advection fog is usually extensive. If you get caught over a region where it is forming or drifting you may not be able to reach an alternate airport, therefore exercise extreme caution in flying over or toward regions where there is any chance of advection fog.



Sea Breeze Fog

Monsoon (sea breeze) fog is a feature of coastal areas where cool water lies close to sunheated land and is associated with a sea breeze. Inland from the shore the fog usually lifts into a layer of low clouds and then clears.

Monsoon fog often forms and spreads along coastal land in less than an hour. Because of the tricky nature of this fog, your flight plan to a coastal airport where a vigorous sea breeze is blowing, should include an alternate procedure to an inland field.

Precipitation Fog

Precipitation (rain) fog is the result of relatively warm rain or snow falling into a layer of colder air. Precipitation fogs are usually associated with temperate zone cyclone fronts, particularly warm fronts. Precipitation fog frequently is preceded by broken low scud clouds or by stratus which thickens to the ground. Sometimes, fog forms rapidly at ground level and extends quickly over large areas. If there is any possibility of precipitation fog at your destination, an alternate plan is your safety factor.



Upslope Fog

Upslope fog develops in uphill winds. It is a cloud resting on a slope or hill top. Upslope fog, therefore, is confined to hilly terrain, particularly in the western half of the United States and the Appalachian Mountain region.

Upslope fog often forms rapidly and over large regions. An alternate airport on the lee side of a hill, preferably as far down the base of the hill as possible, is a good alternate plan if you are going to fly where upslope fog is a possibility. If you have no alternate, don't fly blind; landing on hilly fogged-in terrain is disastrous.

Fog Warnings

1. When temperature and dewpoint are only a few degrees apart.
2. A widespread precipitation area.
3. Within 200 miles of seacoast—if the wind is from the water.
4. In the Fall and Spring if the airport lies near a large river or lake.
5. If the flow of air is directed up a broad, fairly steep slope.

Estimating Weather in Flight

Cumulus Clouds & Thunderstorms

Cumulus clouds are billowed in appearance as the result of vertical currents. A pilot seeing cumuli is warned immediately that vertical currents are present in and below the clouds. For practical purposes, cumuli can be classed in three categories:

1. Flat cumulus usually having considerably more lateral development than vertical.
2. Towering cumulus frequently having more vertical development than lateral.
3. Cumulonimbus, or the shower and thunderstorm cloud.

Flat Cumulus

Flat cumulus clouds are usually associated with favorable weather. They are readily identified by their lack of vertical development.

Air is mildly to moderately rough in and below the clouds but smooth above. Precipitation does not fall from them. Icing is light, occasionally moderate when their temperatures are below freezing. There is no particular need for staying out of flat cumulus unless light turbulence must be avoided or there is icing in the clouds.

Towering Cumulus

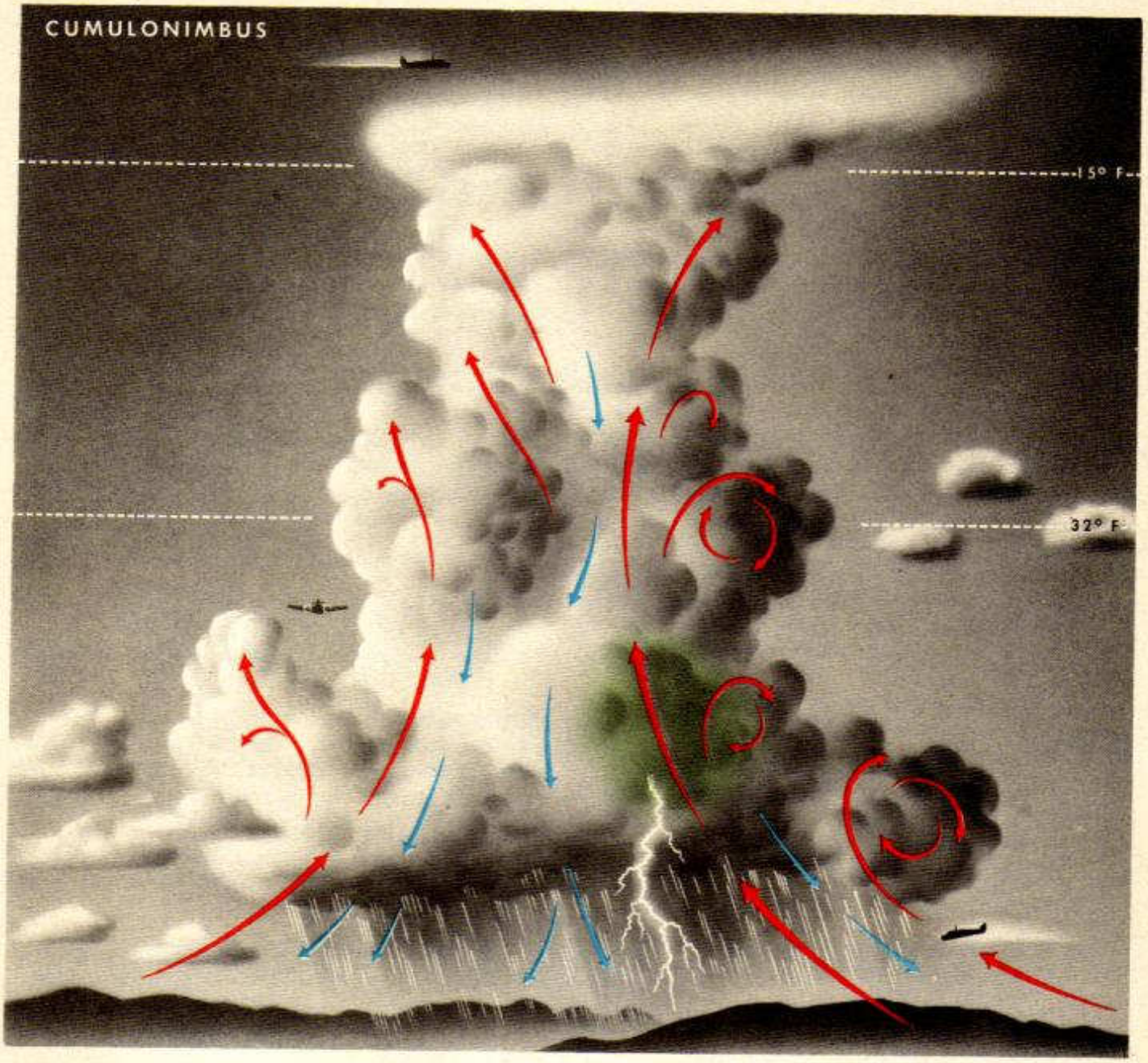
Towering cumulus has considerable vertical development and a great tendency toward turret-type finger tops each of which contains a strong vertical current. Towering cumuli are forerunners of showers and thunderstorms.

Turbulence in the towering cumulus is normally moderate and occasionally severe. Turbulence below the cloud is mild to moderate. Rain or snow does not fall from this type of cloud. Its presence, however, indicates that rain or snow fall is imminent. Icing in towering cumulus is moderate to heavy where temperatures are 32°F or less, particularly in the towering fingers and domes.

Avoid towering cumulus. A flight around the cloud will take only slightly more time than one through, and in flying around it you can avoid exposing your plane and yourself to danger.

Cumulonimbus

Cumulonimbus clouds are showers or thunderstorms. They assume many shapes and sizes but, in general, they appear as a massive towering cloud of great vertical and lateral development from which



rain or snow is falling. A thunderstorm is a typical cumulonimbus.

Turbulence is moderate to severe in the cumulonimbus. Updrafts and downdrafts are of such strength that aircraft, if caught, can be lifted thousands of feet upward or pushed downward against the ground. Icing in cumulonimbus where temperatures are 32°F and less is moderate to heavy. Hail, lightning, static in receivers, and St. Elmo's Fire in addition to icing, up and down drafts, and severe turbulence are characteristic dangers of the thunderstorm.

It is mandatory that cumulonimbus be avoided in all your flights; only when trapped with no alternative plan should you proceed through a massive cumulonimbus. Several procedures are possible upon encountering thunderstorms or very large showers. In order, they are:

1. Circumnavigate, preferably about that side from which the storm came.

2. Fly over the top of a saddleback between two towering clouds.

3. Fly underneath when (1) and (2) are impossible but only when the base is several thousand feet

above highest terrain. Turbulence is moderate to severe and downdrafts are dangerous below the storm base. Hail might also be present.

4. Land at an airport and await the storm passage on the ground if there is an airport or suitable field available.

If it is necessary to fly through the storm clouds, you have several choices.

1. Enter a thunderstorm preferably through the thin spots where you can see sunshine or blue sky. Storm clouds, however, shift continuously and sometimes imprison a plane before it can get through a thin spot.

2. In flying through black spots you are likely to find rough air, hail, up and down drafts, and lightning. Black spots certainly are not pleasant but also not extremely dangerous.

3. Avoid greenish and slightly off-color spots. They are usually regions of severe turbulence. Off-color is due in part to presence of electrical charges.

4. Flying at altitudes above the freezing level is sure to cause moderate to heavy icing.

5. Never land at an airport during a thunderstorm. Wind shifts may be disastrous.

No flight through a thunderstorm is safe; some flight paths are only less dangerous than others.

HAZE LEVELS, OVERCAST BASES AND TOPS

Haze level is the top of a layer of air in which dust, smoke, haze and other debris are present. If impurities are numerous as they are in a dust storm, the haze level is as definite as the ground and horizon itself. Above the haze level, air is clear.

Fly above the haze level if you can. You have more visibility on top and there is no danger of getting dust into the engine. Air is smooth and carburetor icing is less likely.

Flights on Top of Cloud Layers

Advantages:

1. If a temperature inversion caps the cloud layer, air is smooth on top and usually carburetor icing will not occur.

2. If the cloud top is flat little icing will occur.

Disadvantages:

1. You cannot estimate ceilings from on top a solid cloud layer. Rather than guess, call ground stations for weather report.

2. If the cloud top is undulating and has a tendency to tower, icing is certain at or below 32° F.

Flights Under Cloud Layers

Advantages:

1. Contact procedure.

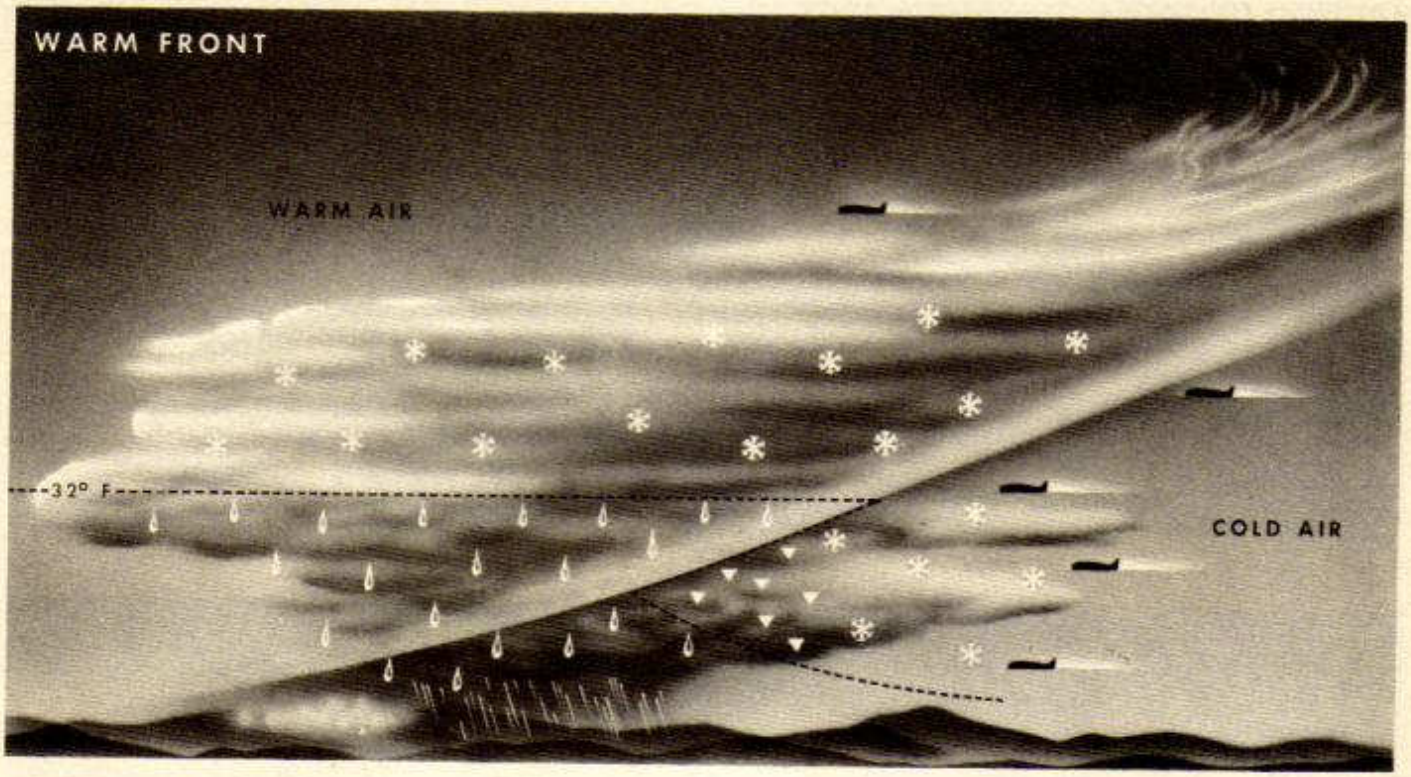
2. Icing in flat-based clouds is likely to be less than in undulating-based clouds.

Disadvantages:

1. You cannot estimate the top of a solid cloud when flying underneath. Pilot reports or sounding data must provide you with the necessary information.

2. Contact flights are dangerous in rough or hilly terrain; peaks sometimes merge with cloud bases causing zero-zero conditions.





Fronts

Warm Fronts

Warm Fronts form when a warm air mass moves into a region occupied by a cold air mass, the warm air causing mass cooling as it rises. When you fly toward the front from the cold air side, warm front clouds will first appear as cirrus. Cirrus merge with cirrostratus which descend and merge with altostratus from which rain or snow falls. In the rain region, scud, stratus and stratocumulus lie below the altostratus, and higher clouds and fog frequently cover a considerable area near the surface front.

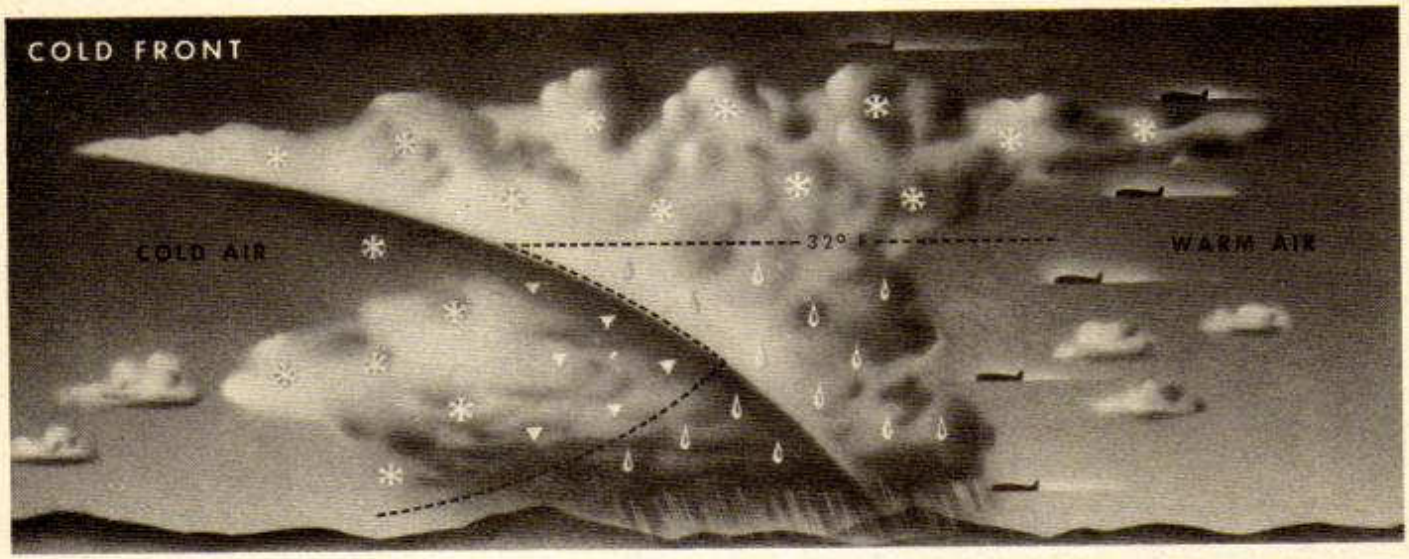
You will often find rough air in the cold air below the frontal surface; mild or moderate turbulence is frequent in the warm air clouds above the frontal surface. There is also moderate turbulence in the frontal surface itself.

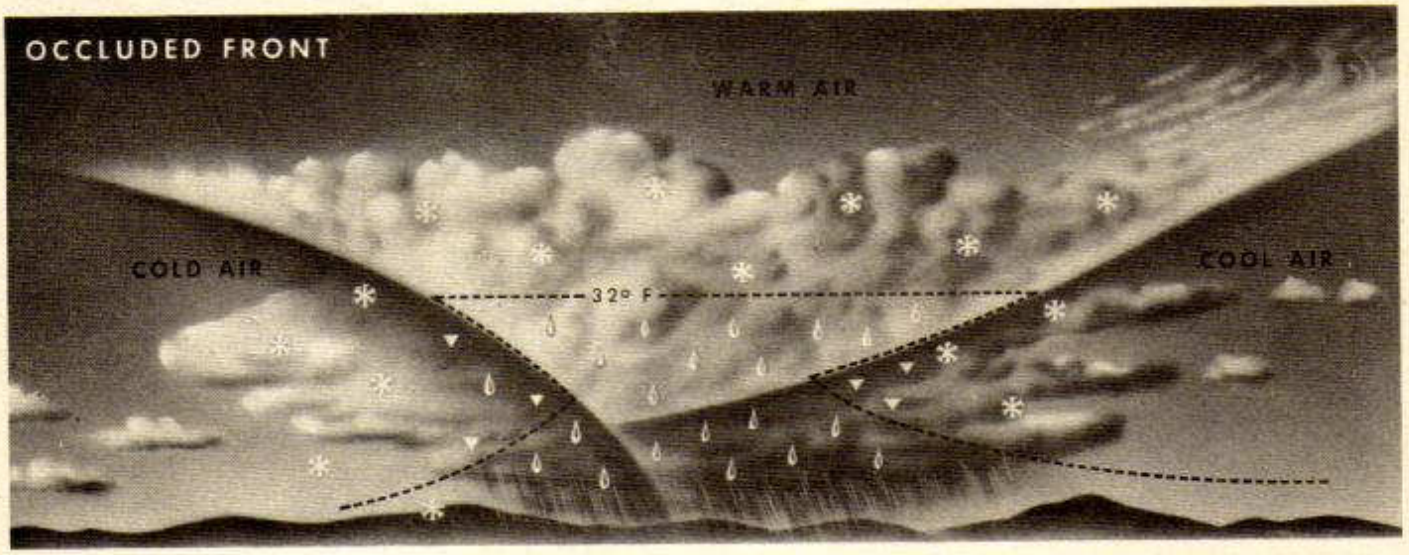
Expect precipitation static in a frontal cloud. It sometimes is too harsh to permit voice communication and may smother reception from radio ranges.

Choice of flight paths through warm front clouds are numerous. Five are illustrated in the warm front sketch above.

1. Over the top is smooth and ice free but it is often too high to be practical or even possible.
2. You may encounter limited icing in clouds at sub-freezing temperatures in both the cold and warm air; you are certain to find considerable static and may find turbulence of moderate degree in warm-air clouds.
3. If you fly at an altitude just less than the freezing level in the warm air you eliminate serious icing possibilities, except for a relatively narrow band in the cold air before crossing the front. You must, however, expect rough air and static.
4. Altitudes somewhat below the freezing level of the warm air are free of icing in the warm air but present a very serious hazard in the cold air where sub-cooled rain droplets are present.
5. Contact flying in the frontal zone is dangerous. Clouds in nearly every well developed warm front include fog and scud at tree top heights.

The best choice is over-the-top. When you cannot get on top at some distance from the heavily clouded region your next best choice is a flight just below the freezing level of the warm air. Estimate the possibilities and plan your altitude accordingly. **Remember, it is usually easier to pick the right altitude approaching the frontal zone from the warm air side rather than the cold.**


COLD FRONT
COLD AIR
32° F
WARM AIR


OCCLUDED FRONT
WARM AIR
COLD AIR
32° F
COOL AIR


COLD FRONT LINE SQUALL

Cold Fronts

Cold Fronts form when a wedge of cold air moves into a region of warmer air. The warm air is forced upward and undergoes the process of cooling that may cause thunderstorms. These are generally concentrated in a zone 15 to 50 miles wide but may extend hundreds of miles in length.

Choose your flight path through Cold Fronts on the same basis as for Warm Fronts. Several flight paths with the plane approaching the Front from the warm side are indicated in the illustration above.

Line Squalls

Line squalls are intense cold fronts along which unstable air and cumulonimbus occur in a line for hundreds of miles. Towering thunderstorms in Summer and snow showers in Winter are the usual features of a line squall. Summer time prefrontal line squalls are vicious and violent thunderstorm lines. They lie some distance ahead of a cold front and travel with greater speed than the front which is reduced to a partially clouded windshift line.

Avoid both cold front and prefrontal line squalls. Only when trapped with no other alternative should you attempt to go through the squall clouds. Choice of path through line squalls:

1. Best choice is find an airport nearby and wait on the ground for it to pass.
2. Fly through a saddle back between two towered clouds but be sure this is in the clear.
3. Pick the clearest spot between two storm centers and head directly into the squall at 90 degrees to the line. It will be rough but don't turn back when halfway through or you might get lost.
4. Fly through a thin spot where blue sky or sunshine is discernable through the break.
5. Enter through a dark spot, it will be rough but not as bad as other spots.
6. Fly underneath, turbulence will be moderate to heavy with possibility of hail, also up and down drafts.

Avoid off-color greenish or other off-hue spots, they are extremely turbulent and highly charged.

Remember that line squalls are violent by comparison with ordinary airmass thunderstorms. They often appear in an hour or two without warning. Be on the alert when flying in the warm sector of a temperate zone cyclone especially near the cold front. These are the places where line squalls usually first appear.

Occluded Fronts

Occluded front clouds occur when a warm front collides with a cold front. The weather along an occluded front contains a combination of warm and cold front characteristics.

When an occluded front winds up into a low pressure center, that has been intensifying, be prepared to look for weather that will combine the worst features of both cold and warm fronts.

Plan flight paths through occluded front clouds with the characteristics of both fronts in mind.

Cloud Features

Cloud features often help identify the cloud type and its probable origin, but you should never put full faith in what you can see from the ground or cockpit unless evidence is absolutely complete.

In general, frontal clouds will come across the sky in bands and in regular sequence from high types merging with and obscured by lower types.

Layers of stratus and stratocumulus not associated with fronts usually occur over somewhat irregular areas without smoothly cut edges. In contrast to frontal clouds they are not orderly. Stratocumulus clouds often occur in regions of thunderstorm activity. They may hide a thunderstorm if you are flying beneath them. Flying conditions are generally good over the top of stratocumulus, away from a front. When they occur alone, they do not indicate a front.

Cumulus clouds not associated with fronts occur at random. If you are unable to identify unexpected clouds properly in your flight path, proceed cautiously until you are sure they are harmless. Moisture in the air and clouds that result are responsible for practically all unfavorable and dangerous flying weather.

Getting the Weather

1. Weather in flight is no longer confidential. In an emergency, you can get any weather information you ask for "in the clear" during one transmission.
2. You may request Terminal or Landing Weather from Range Stations or Control Towers. Reply will be limited to any two stations "in the clear" for any one request.
3. You may transmit such weather information during flight as is requested.

PIF 3-3-1
REVISED January 1, 1944

Rules for Flying Weather



1. When approaching a thunderstorm, analyze it before you encounter the surrounding clouds. They may obscure important characteristics of the storm after you get into them.

2. Before attempting to fly any thunderstorm, study the situation thoroughly.



3. Whenever possible, circumnavigate a storm. Always fly around isolated air mass thunderstorms.

4. In coastal regions, where thunderstorms prevail along the mountains, fly a few miles to seaward and avoid them.

5. Thunderstorms over islands may be thousands of feet higher than those over the open sea. Fly around them.

6. Cold front thunderstorms generally stretch too far to fly around. Remember, the storm front is a series of individual storms linked by intervening clouds. If you must go through, fly between the storm centers or over the saddlebacks.



7. If you can't see blue sky beyond the storm and must go through, determine the direction the storm is taking and head in at a right angle.

8. Once you have headed into a storm, don't turn around on account of turbulence, rain, or hail. If you do, you'll have to fly through the same condition twice, and you may get lost. Hold your original course.



9. In entering the front of a thunderstorm, you will encounter updrafts. Go in low, and if conditions permit, fly underneath the base of the storm.

10. Entering a storm from the rear, you will experience downdrafts first. Go in high.

11. In flying under a storm, the higher the flight level, the rougher the trip. Fly about one-third of the distance from the ground to the base of the clouds if you can; but don't go underneath unless you can maintain contact flight.



12. Don't try to fly underneath a storm along mountain ranges unless there is a good ceiling and you can see peaks and ridges clearly. At sea you can usually count on being able to fly under any thunderstorm in daylight.



13. Never land at an airport when a thunderstorm is advancing toward the field. Shifting surface winds make it too hazardous. Wait until the storm center has passed, and the winds have stopped shifting, before you land.

14. When you expect to try level flight in flying a storm, get altitude before approaching it, so that you can inspect the storm line before selecting your course.



15. The altitude necessary to fly around the tops and over the saddlebacks of a thunderstorm will vary with the seasons and the latitude in which you encounter the storm. In high latitudes, 12,000 to 15,000 feet is generally sufficient. In the tropics, the tops of the saddlebacks may be above the ceiling of your aircraft and you may have to fly through the saddlebacks on instruments, a procedure recommended only for high performance aircraft. Over the open sea, 15,000 feet of altitude usually will clear the saddlebacks.

16. Lightning is of little consequence when you are flying an all metal, closed-cockpit plane, which acts as a perfect conductor. Don't worry about it. Switch on the cockpit light and keep your eyes on the instrument panel, so that the bright flashes won't blind you. If you are flying an open cockpit plane, or a plane with a plywood or plastic fuselage, better keep away from the lightning.



KEEP YOUR HEAD, KEEP YOUR COURSE—YOU'LL COME THROUGH

Remember This

1. Don't fly cross country over a low cloud layer which extends for hundreds of miles even though ceilings may be 1000 feet and the top is only a few thousand feet. Get your cross country instrument practice when the cloud layer is less extensive.

2. When an active warm front is approaching, delay your take-off until the front has passed, and even then, check to be sure you will not cross the warm front.

3. In winter be on the lookout for snow. If the temperatures are near, or below freezing, the precipitation is likely to be in the form of snow. If it is, remember that snow can cause a low effective ceiling in just a few minutes where before there was only an intermediate cloud layer with unlimited visibility. Snow static often makes your radio useless, and it is much easier for heavy snow to fall than heavy rain.

4. Carefully consider the intensity of each cold front before you attempt to fly through it. If there is any doubt in your mind, sit down and wait until it passes.

5. Avoid flight where icing conditions are likely to be found.

Special conditions you should watch for in Spring:

1. Formation of secondary storms on cold fronts.
2. Widespread low cloud area is still a hazard.
3. Cold fronts may be at their most violent stage.

During Summer, there is one paramount rule:

Thunderstorms are dangerous.

If your flight plan and forecast work out as expected, and they will most of the time, you know what you are encountering. If, on the other hand, your forecast of winds and weather and your flight plan do not turn out as planned, you have no foolproof method of knowing actually what is ahead from what you can observe from the cockpit. Contact ground stations often for weather reports, ask for advice or revised forecast, call other pilots in the same area if possible, **consult Pilots' Advisory Service.** If you don't like the looks of what you are seemingly encountering, turn around while you still have time and proceed to your point of departure or some convenient field. Remember, you must play along with the weather and it's no disgrace to admit you are out-maneuvered.

No formula has ever been devised to fly bad weather nor has any substitute for experience and good judgment been discovered. The information offered here is intended merely as a guide; for detailed information study Technique in Weather T. O. No. 30-100 D-1.

PIF 3-4-1
REVISED January 1, 1944

SUMMER FLYING

Before Starting

Check status of airplane on Form 1A.

Be familiar with check list for the airplane you are flying.

Don't over-prime the engine.

Warm-Up

If no oil pressure shows on the oil pressure gage within 30 seconds after starting, stop the engine and have it checked.

Run the engine at 600 to 800 rpm until oil pressure is steady. Don't exceed 1,000 rpm until oil temperature reaches 40°C (104°F).

Keep the warm-up time to a minimum, and nose the airplane into the wind for better cooling, as cylinder head temperatures will rise very rapidly during warm weather.

Prior to Take-Off

Keep full-throttle engine and instrument test as short as possible during the summer.

Remember that take-off distances will be longer because of the thinner air encountered in warm weather.

Care During Flight

Do not climb the airplane at less than the specified climbing speed for that particular airplane. Low flying will result in higher temperatures than normal.

Landing

In hot weather the air is not as dense as in cold weather, other things being equal; so your true stalling speed is greater in summer than in winter—but your indicated stalling speed is the same.

Therefore, don't expect to land in the same distance that you would during the winter, as the airplane will come in hotter than usual.

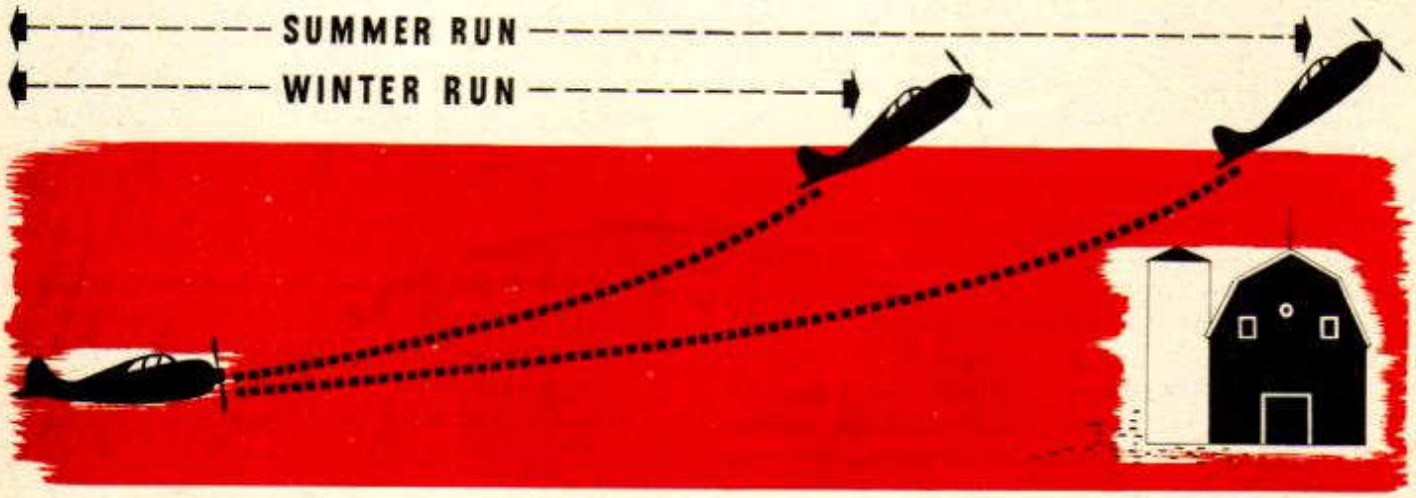
Caution

Remember that although the air-speed indicator reads the same the ground speed will be increased because of the thinner air.

Care of the Airplane

Keep canvas covers on the windshield and windows when they are exposed to the sun. If this is not done the heat of the sun will soften and bend the Plexiglas and will also cause malfunctioning of radio equipment, gyro equipment, and instruments.

Keep doors and hatches open so that air can circulate through the airplane, except when it is necessary to keep the airplane locked.



WINTER FLYING

To Start Engines

1. Before starting the engine, check the "Y" drain and oil tank sump drain to be sure that fluid oil is present at these points. If ice or congealed oil prevents flow at either point it will have to be thawed out.

2. In winter, prime the engine more than in warm weather—before the starter is engaged and **after** the engine fires. Turn the electric primers "ON" just prior to engaging the starter and hold "ON" until the engine fires steadily.

3. If the engine fails to start in three or four attempts, moisture may have accumulated on the plugs. To remove this moisture, take at least one plug from each cylinder, heat the plugs until warm, and replace.

4. If the engine fails to start after a reasonable time, inspect for probable causes and consult the Handbook of Service Instructions for that engine.

Warm-Up

If no pressure shows on the oil pressure gage within 30 seconds after starting, stop the engine and have it checked.

Run at 900 to 1,100 rpm until oil pressure is normal. Do not exceed 1,200 rpm until oil temperature reaches 20°C (68°F). However, emergency take-offs may be made as soon as the oil pressure is normal, oil temperature begins to rise, and the engine is smooth. Refer to Handbook of Operating Instructions for your engine.

With tightly baffled air-cooled engines, nose into the wind for the warm-up as the cooling of cylinders will be poor on the ground. Keep cowl flaps or engine shutters full open for all ground operation.

Use necessary carburetor heat. See "Carburetor Icing" in "Weather Flying" section.

Take-Off

1. Do not take off with frost or snow on the wings. **Ice must be removed completely. The thinnest film of ice forms a base upon which more ice can rapidly form.** Pay special attention to control hinges and surfaces. Use alcohol for cleaning frost from windows and windshields. Steel wool may be used on plate glass windshields.

2. Moisture condensation may cause ice accumulation **inside** the wings. **It must be removed with heat before take-off.**

3. If frosting is severe, taxi to the take-off position with frost covers in place.

4. Use carburetor heat in extreme cold for take-off because fuel does not vaporize sufficiently for good combustion at low temperatures. **Use only enough heat to insure smooth engine operation.** Do not exceed +40°C (104°F) carburetor air temperature at any time.

5. Don't take off on soft snow. Taxi along the runway a few times to pack the snow.

Care During Flight

1. Following a take-off from snow, wet, or slush-covered fields, operate the landing gear, flaps, and bomb bay doors through several complete cycles to prevent freezing in the UP position.

2. **You will not see, hear or feel carburetor ice until it is too late. Watch your instruments so you will detect carburetor icing conditions. For complete instructions see ICING—CARBURETOR, PIF No. 3-6.**

3. **Icing of surfaces, wings, and propellers may occur under conditions of high humidity or visible moisture near freezing temperatures. See ICING—WINGS—PROPS, PIF No. 3-7 section for complete instructions.**

4. Increase propeller speed by about 200 rpm every half hour to assure continued governing. Return at once to the desired cruising rpm.

5. If carburetor icing is expected, move the throttle frequently to prevent freezing in one position (throttle ice).

6. Stay on a prearranged flight course so searchers will be able to find you if you are forced down. Except in extreme emergency, it is better to land or crash-land than to bail out.

7. Ice formation can cause engine failure by clogging the air filters. Remove or by-pass filters before long flights or before flights over water even though take-off must be made from a dusty field. **See ICING—CARBURETOR, PIF No. 3-6, for complete instructions.**

8. While letting down for a landing, watch engine temperatures closely. Temperature inversions are likely in winter and the ground air may be 15 to 30°C (50-86°F) colder than at altitude.

9. If oil temperatures continue to rise with the oil cooler shutters open, close shutters fully. The oil in the cooler may have congealed.

When to Dilute Engine Oil

During cold weather, dilute (thin) the engine oil with gasoline after each engine run to aid starting and reduce starting wear on the engine. Engine oil should be diluted before stopping the engines if the expected temperatures are 5°C (41°F) or below. The amount of dilution will depend on the number of minutes the dilution switches are held "ON."

How to Dilute Engine Oil

1. Run engine at 1,000 to 1,200 rpm. **Oil cannot be diluted unless engine is running.**
2. Maintain an oil temperature less than 50°C (122°F) and an oil pressure above 15 lb. sq. in. **If oil temperature rises or oil pressure falls beyond these limits, shut down and allow engine to cool.**
3. If the airplane has an automatic dilution switch installed follow dilution instructions on the placard.
4. If the airplane has the manual dilution switch hold the switch on for the period given in the instructions for that particular airplane. At the end of that period keep the switch on until the engine is stopped.
5. Proper operation of the dilution system is indicated by considerable drop in fuel pressure. If fuel pressure does not drop off investigate the dilution system.
6. A complete redilution of the engine is required only after one half hour or more operation at normal oil temperature, as this is the time required to boil off the gasoline.
7. If it is necessary to service the oil tank split the dilution period in half and service between the two periods.

General Rules

If specific dilution instructions are not available, follow these general rules:

Anticipated Lowest Outside Air Temperature	Dilution Time Minutes (One Period)
+4° to −12°C	3
−12° to −29°C	6
−29° to −46°C	9

For each 5°C below −46°C add one minute to the time given.

How to Dilute Propeller Oil

If the engine is equipped with Hamilton Standard Hydromatic propellers, near the end of the dilution period depress the propeller feathering button long enough to give a maximum of 400 rpm drop. Then pull out the button. Repeat three times to insure proper feathering and governing after the next start.

Turbosuperchargers

If the airplane is equipped with turbosuperchargers regulated by engine oil, move the turbo contact handles back and forth during the last two minutes of the dilution period.

NOTE: After dilution, drain all moisture from the "Y" drain and oil tank sump drain.

Winter Care of the Airplane

Winterization.—Check with your crew chief to see that all necessary winter changes have been made on your airplane.

Preheat the Engines.—Portable ground heaters should be used, if available, to preheat engines and compartments prior to starting.

Preheat the Oil.—Under extreme conditions Oil Immersion Heaters may be used. But they should not be necessary if the oil is properly diluted. For details on the use of Immersion Heaters see the Handbook of Cold Weather Operations for your particular airplane.

NOTE: The oil tank must not be filled to capacity when the oil system is cold.

Conserve Batteries.—Use an auxiliary power source for starting or for any power required when engines are not running. Batteries must be filled in a warm place and the charge maintained at 1.275 to 1.300 specific gravity. If auxiliary power is not available put the airplane batteries in a warm place until just before the start.

Use Protective Covers.—Use wing and engine covers to prevent the accumulation of snow, ice, and frost.

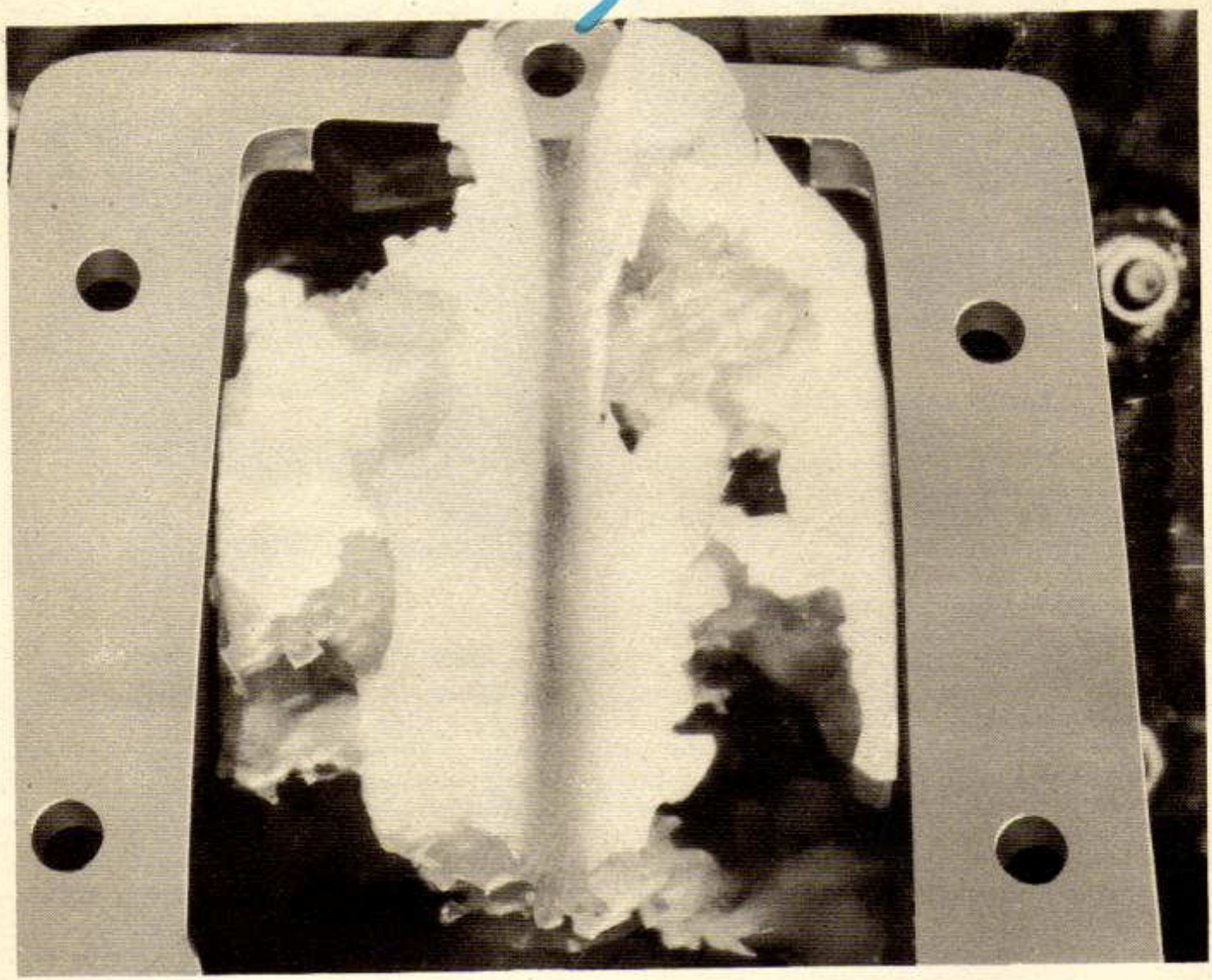
Protect Your Tires.—Place insulation under the tires to prevent them from freezing to the ground.

Parking Brakes.—May be set after they have cooled. Wait until after the oil has been diluted and the brakes have had plenty of time to cool before setting them. Otherwise they may freeze in locked position.

Prevent Frosting.—When parked, leave a hatch or panel open to prevent windows and windshield from frosting. Do not open a panel that will permit snow to enter and accumulate in the airplane.

PIF 3-6-1
REVISED October 1, 1943

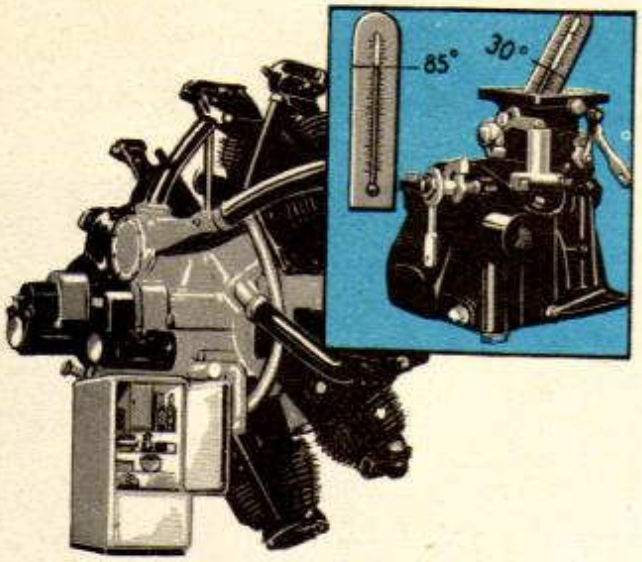
Icing - CARBURETOR ICING



There is no such thing as a NON-ICING CARBURETOR

Basically, a carburetor functions a great deal like the expansion valve in a mechanical refrigerator with the result that a temperature difference as great as 60°F can exist between the free outside air temperature and the carburetor-mixture temperature. A carburetor literally can manufacture its own ice . . . and at any season of the year—winter or summer.

Your carburetor can ice when the free-air temperature is as high as 95°F (+35°C).



Induction-System Icing

Cause

Induction-system icing is likely to occur when flying in clouds, rain, fog, sleet, wet snow, or when relative humidity is high. Ice is formed by a cooling effect on the evaporated fuel after it has been introduced into the carburetor air stream. Under humid conditions ice has been known to form when the free air temperature is as high as 95°F.

Symptoms

Normally, if the airplane has a fixed pitch propeller, the formation of ice in the induction system can be detected by a gradual loss of rpm and/or a gradual loss of manifold pressure. This may be noted without any change having been made in the throttle position or in the attitude of flight.

Under most conditions, the formation of ice is a slow process. Therefore, a pilot not on his guard might advance the throttle gradually to maintain constant rpm or manifold pressure without realizing that carburetor ice is forming.

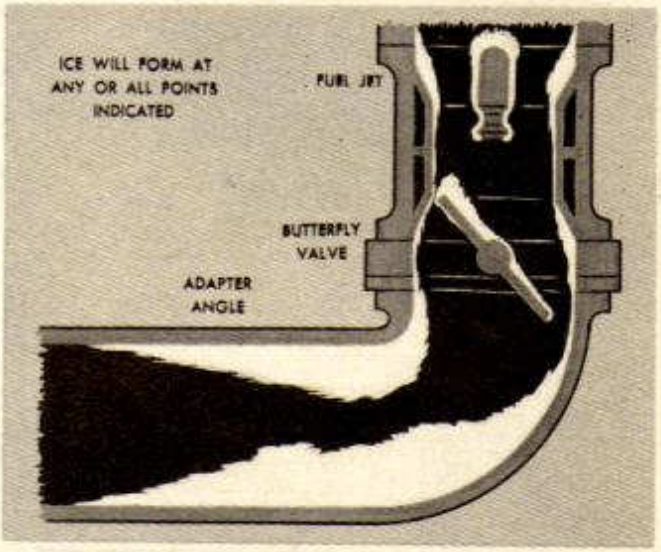
Rare, local conditions may change these indications somewhat, so be on the alert. Under extreme conditions, ice may form so rapidly that power loss will be abrupt.

When an airplane has automatic boost control as well as a governing propeller, the pilot will have no warning of ice formation until it is so bad that the regulator can no longer maintain the boost. In such aircraft, **use carburetor heat when any possibility of icing exists.**

Cures

Carburetor Heaters. The function of the carburetor air heater is to prevent or eliminate the formation of ice within the carburetor, around the throttle valve adapter, or elsewhere in the passages of the induction system.

De-Icing Equipment. In addition to carburetor air heaters, alcohol carburetor de-icing equipment is also installed on certain types of aircraft for use in emergencies and when descending through an overcast with reduced power.



Carburetor Ice

Types of Carburetor Air Heaters

Carburetor air heaters may be divided roughly into the following classes:

Exhaust—utilize heat from the exhaust piping and have an adjustable control.

Alternate air inlet—provide two-position selection of air inlets.

Hot spot—found only on early Pratt & Whitney engines. Located between the carburetor and the engine. Mixture-temperature reading is affected by such heaters, so temperatures of 50°F higher must be maintained.

Warmed air from behind the cooling radiators may also be utilized. Intensifier tubes employing this principle may be operated the same as exhaust heaters.

Turbo supercharged engines may use intercooler shutters for carburetor heating. Some later models use hot exhaust gas introduced directly into the carburetor.

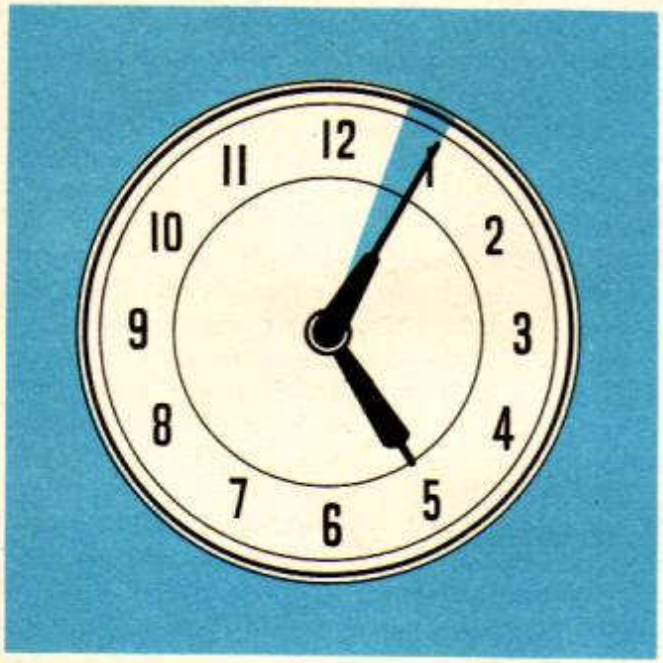
When Ice Forms

With a fixed pitch propeller, if rpm or manifold pressure begins to drop for no apparent reason **put your carburetor heat full on.**

There will be a slight loss of power when heat is applied. If the manifold pressure, or rpm, continues to drop:

Adjust the mixture until you have obtained smooth operation. However, be sure to avoid getting too lean a mixture, as this may cause detonation.

Always act quickly under these conditions. Don't delay. The accumulation of ice is progressive and often you may have only a minute to do something about it.



As a Last Resort. Turn on the alcohol de-icing pump if the plane is equipped with one. Or put the carburetor heat on full cold and lean the mixture until backfiring occurs. The backfire may loosen the ice and shake it clear of the intake passages.

This is a dangerous procedure, however, and should be used only as a last resort and then only with the carburetor heat on COLD.

Don't cause a violent backfire by extreme overleaning. Lean the mixture just enough to cause normal backfire.

Prevention

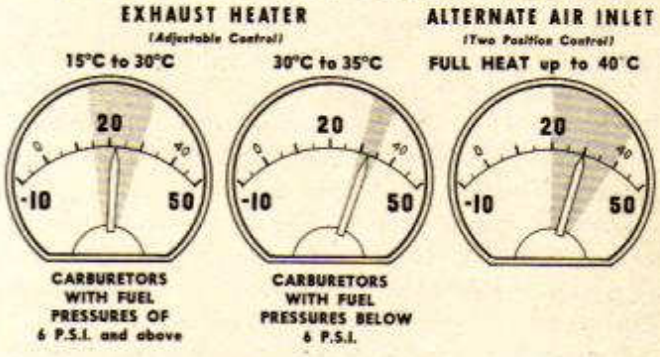
If icing conditions prevail, don't wait for engine troubles to warn you of carburetor icing. **It is easier to prevent ice formation than to remove it.**

Prevent ice by using whatever carburetor heat is necessary. Remember, the control may have to be **nearly full on** to add much heat. Also bear in mind that an automatic boost control will give no warning

Manifold Pressure Drop

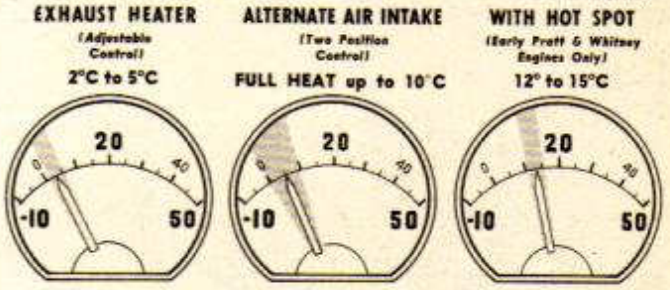
When the carburetor heat is turned on, a slight loss of power will be indicated by a drop in manifold pressure due to the reduced air-intake pressure and the lower density of the warm air. This loss of power is no sacrifice in engine efficiency when operating with the carburetor mixture control in the automatic position, since an increase in carburetor air temperature does not enrich the mixture. **However, when operating with manual mixture control** any increase in carburetor air temperature will enrich the mixture so **it will be necessary to readjust the manual control whenever the carburetor heater control setting is changed.**

CARBURETOR AIR THERMOMETERS



CARBURETOR MIXTURE THERMOMETERS

(Installed only with Carburetors having Fuel Pressures below 10 p.s.i.)



of ice until nearly too late. So turn on the heat as soon as any icing conditions are indicated.

Be conscious of moisture in the air. Check for moisture by applying heat. Note the effect on the engine's operation. With precipitation near the freezing range, under icing conditions, use full carburetor heat. Make sure the ice is eliminated. Then maintain the following temperatures (at the proper range for the model involved and conditions encountered). If these temperatures cannot be maintained, place the control in the **full cold** position.

Exhaust Turbine-Driven Superchargers. With inter-cooler shutters and/or carburetor air heater control, adjust to above temperatures. Without intercooler shutters, adjust to the above temperatures using carburetor air heat control.

When There Are No Carburetor Thermometers. Play safe. Place carburetor air heater control in one-half to two-thirds "HOT" position under all icing conditions. Do not exceed engine manifold pressure of 2" Hg less than normally allowed for take-off. (If no manifold pressure gage is installed, limit maximum rpm to 200 less than rated take-off rpm.)

When There Is No Manual Heat Control. Certain types of primary training airplanes have no cockpit control for the carburetor air heater. The air-heater valve will be wired in the "ON" position unless excess loss of rpm is experienced in hot weather. During such periods the heater valve may be wired in the "OFF" position. WARNING—check the plane before take-off.

Starting. Carburetor air heaters should always be in full "COLD" position when starting. This will eliminate heater valve damage due to backfire (except in airplanes having no manual heat control).

Ground Running. Ordinarily, the carburetor air heater control should be in the "COLD" position during ground running. However, during extended ground operation under icing conditions and before take-off preventive measures should be used to stop ice formation and eliminate all ice from the induction system. At outside air temperatures below −20°C (−4°F) sufficient carburetor heat should be used to vaporize fuel properly and insure smooth operation.

Take-off. When outside air temperature is below −20°C (−4°F) use enough carburetor heat to prevent rough running. Some carburetor heat may be used at take-off under severe icing conditions, but carburetor air temperature should never be allowed to exceed 40°C (104°F).

Cruising. When cruising under severe icing conditions at least 75 percent engine power should be used and the mixture control set on the rich side for best power. Seek an altitude where precipitation can be avoided and where the temperature is farther from the freezing range.

Landing. In cold climates it is especially important that carburetor heat be FULL ON during the approach glide and landing. Otherwise, if power is applied, the cool engine will sputter. It may die. Many crashes have been caused when a cold engine refused to pick up because the fuel was too liquid to burn properly. Do not allow the carburetor air temperature to get into the icing range or to exceed 40°C (104°F). Remember that the carburetor heat control setting for a given carburetor air temperature will vary with the power output.

Carburetor-Mixture Thermometers. Stratification of hot air and intake air ramming conditions may make it necessary to move the exhaust heater control two-thirds of its travel before the hot air strata affects the thermometer bulb. However, once the bulb temperature is affected, a large range of temperature change will occur with small movements of the heater control.

Changing Flight Level. If free air temperature is below 20°F (−7°C), danger of ice formation is lessened because the quantity of water vapor in the air is slight except in extreme northern latitudes, such as Alaska, Canada, and the North Atlantic where moisture has been found in the atmosphere during a super-cooled condition of —40°C. Since ice formation depends partly upon humidity, the mere act of flying into a less humid region (such as leaving a

Be ice conscious

cloud bank or climbing above a fog) may arrest the ice formation.

Alcohol De-Icing Equipment

On airplanes equipped with alcohol carburetor de-icing systems, the following additional operational instructions must be followed:

Take-off. When icing conditions prevail the alcohol pump should be turned on immediately before the take-off and the carburetor heat control placed in the **full cold position.** Due to the richer carburetor mixture caused by the alcohol, a slight loss in engine power may be expected. When a safe altitude has been reached, the carburetor air heater should be adjusted and the alcohol pump turned off.

During Flight. Except in emergencies, the alcohol system should not be used in flight.

Emergencies. When the alcohol system is used, remember—the alcohol supply is limited to about one hour of continuous use. Attempts should be made periodically to adjust carburetor temperature.

WARNING—The use of the alcohol de-icing system at very low power and low engine idling speeds produces a rich mixture which may choke the engine.

Air Filters

Under icing conditions, airplanes equipped with air filters other than those installed in the auxiliary cold-air intake system or on the pressure side of the turbo-supercharger should be operated without filters unless they are operating regularly from dusty fields. This precaution is particularly important on long ferry flights and flights over water. The filters should be removed and stowed.

The following is a list of the various filters used on Army Air Forces airplanes together with instructions in case of icing difficulties:

Temporary Expedient Filters

Hood Type. This filter consists of a sheet-metal hood containing a filter screen. It is mounted by means of rapid-acting fasteners directly in front of the existing carburetor air scoop. The joint between the hood and the air scoop permits sufficient air to enter the engine in the event that the filter does become clogged. If icing is encountered, no difficulty is experienced other than some loss of power. Use carburetor heat as outlined.

Insert Type, Automatic. This filter consists of a screen inserted in the existing cold-air intake duct on the airplane. An automatic spring door installed in the air duct on the engine side of the filter opens automatically if the filter becomes clogged. The operation of this type of filter under icing conditions is identical with that described for the hood type.

Insert Type, Non-automatic. This filter consists of a screen inserted in the existing cold air intake scoop. The only means of making air available to the engine without passing through the filter is to open the hot-air door (carburetor heat **full on**). If air-filter icing is indicated, adjust the carburetor air-heater control valve to obtain necessary engine air and reduce engine power. **Avoid icing conditions with this type of filter.**

Insert Type, Hot-Air Replacement. This filter consists of a screen installed over the hot-air door in the air intake system of the airplane, thereby eliminating the original hot-air system. Air is drawn from the accessory compartment through the filter and into the engine. This air is at a slightly higher temperature than the air obtained from the ramming cold-air intake, but is not as hot as the air previously obtained with the original hot-air system. Use filtered air only during ground operations under severe dust conditions. **Use the cold ramming air normally for all flights.** If icing occurs in flight when the ramming cold air is being used, a small amount of carburetor heat can be obtained by using filtered air.

Permanent Filters

Filters Installed in Ramming Cold-Air Intake. This filter installation consists of a standard type flat-panel filter in the cold-air intake system, the only other source of air to the engine being the hot-air system. If filter icing occurs, adjust the carburetor air-heat control valve to obtain necessary engine air and reduce the engine power.

Filters Installed in Auxiliary Cold-Air Intake System or on Pressure Side of Turbo-Supercharger with Cockpit Control. This installation consists of a standard flat panel-type filter installed in a third air intake system entirely independent of the ramming cold-air intake or hot-air intake system. Use filtered air normally only for landing, take-off, and ground operations under dusty conditions, or when dust is encountered in flight and the mission is such that reduced power is permissible. Filters installed in the auxiliary cold-air intake system with a cockpit control will eventually be provided on all production airplanes.

Filters Installed in Auxiliary Cold-Air Intake System and Controlled by Landing Gear. This installation consists of a standard flat panel-type filter installed in an auxiliary cold-air intake system. The valves for the selection of filtered air or ramming air are controlled by raising or lowering the landing

gear. If an icing condition may exist, do not conduct extensive operation with the landing gear in the "DOWN" position.

The pilot should be thoroughly familiar with the type of air filter installed on his plane and the possible ways of eliminating engine stoppage due to ice on the air filters. Report any engine stoppage which may be attributed to icing of the air filters immediately through channels by radio to the Commanding General, Air Service Command, Patterson Field, Fairfield, Ohio; Attention: Maintenance Division.

REFERENCE: T. O. 02-1-5, dated June 16, 1942; T. O. 01-1-13, dated Sept. 2, 1942.

Warning

Pilots should consult the Technical Orders and Technical Order Operation and Flight Instruction Handbooks for information on specific airplane models.

CONVERSION TABLE
CENTIGRADE TO FAHRENHEIT

(Formula: °C × 9/5 + 32 = °F)

Centigrade	Fahrenheit	Centigrade	Fahrenheit	Centigrade	Fahrenheit
−60°	−76°	30°	86°	120°	248°
−55°	−67°	35°	95°	125°	257°
−50°	−58°	40°	104°	130°	266°
−45°	−49°	45°	113°	135°	275°
−40°	−40°	50°	122°	140°	284°
−35°	−31°	55°	131°	145°	293°
−30°	−22°	60°	140°	150°	302°
−25°	−13°	65°	149°	155°	311°
−20°	− 4°	70°	158°	160°	320°
−15°	5°	75°	167°	165°	329°
−10°	14°	80°	176°	170°	338°
− 5°	23°	85°	185°	175°	347°
0°	32°	90°	194°	180°	356°
5°	41°	95°	203°	185°	365°
10°	50°	100°	212°	190°	374°
15°	59°	105°	221°	195°	383°
20°	68°	110°	230°	200°	392°
25°	77°	115°	239°	205°	401°

PIF 3-7-1
REVISED September 1, 1944

ICING ON AIRCRAFT



Icing can be a hazard to flying. You can fly safely during icing conditions if you know your plane's limitations under these conditions, if you know icing formations and how to remove ice when you do encounter it.

Avoid flying through icing zones when possible. Know the correct procedures for removing ice.

Ice accretion may occur whenever there is visible moisture in the air at temperatures from near-freezing down to more than 40° below zero. A small accumulation, concentrated on critical surfaces of aircraft with high wingloading, may alter the normal airflow so that their flight characteristics are greatly affected.

EFFECTS OF ICE

1. Reduces the efficiency of the airfoil, adds drag, and raises the stalling speed.
2. Makes the airplane difficult to control and maneuver.
3. Increases the drag of struts, fuselage, radio masts, fixed landing gear, etc.
4. Increases the load.
5. Causes certain flight instruments to give false indications or to fail completely.

TYPES OF ICE

Ice which forms on an airplane in flight is of two general types, rime and glaze or clear ice. Often, it is difficult to classify as one or the other, but usually one predominates.

Rime Ice

Rime is a granular, translucent crust, generally encountered in stable air, such as that marked by stratus cloud formations. It is formed when droplets of supercooled moisture hit the airplane.

Rime builds out from the leading edges of wing and

tail surfaces, spinners, props, and fuselage. Even a light coating on the leading edges of the wings, by altering the airfoil, may raise the stalling speed.

Glaze or Clear Ice

Glaze is a crystalline coating of hard ice which tends to conform to the airfoil of wing and tail surfaces. It occurs generally in regions of turbulence, in freezing rains, and frontal regions where the temperatures range from 20°F (−7°C) to freezing. It is formed when drops of supercooled moisture splash and spread out on the airplane, then freeze.

It forms a continuous shell, sometimes hard to detect, building back from the leading edges. Often it completely covers the wing and tail surfaces. Occasionally, glaze builds forward from each rivet head or protuberance, forming cones of ice that stick out into the airstream. Glaze ice, if allowed to build up, often is difficult to remove from the airplane, even when de-icing facilities are provided.

Use caution when flying at a high angle of attack; large quantities of ice can form on the lower surfaces of the wings. Such ice can be hazardous because you cannot see it and because of its weight.

OTHER FORMS

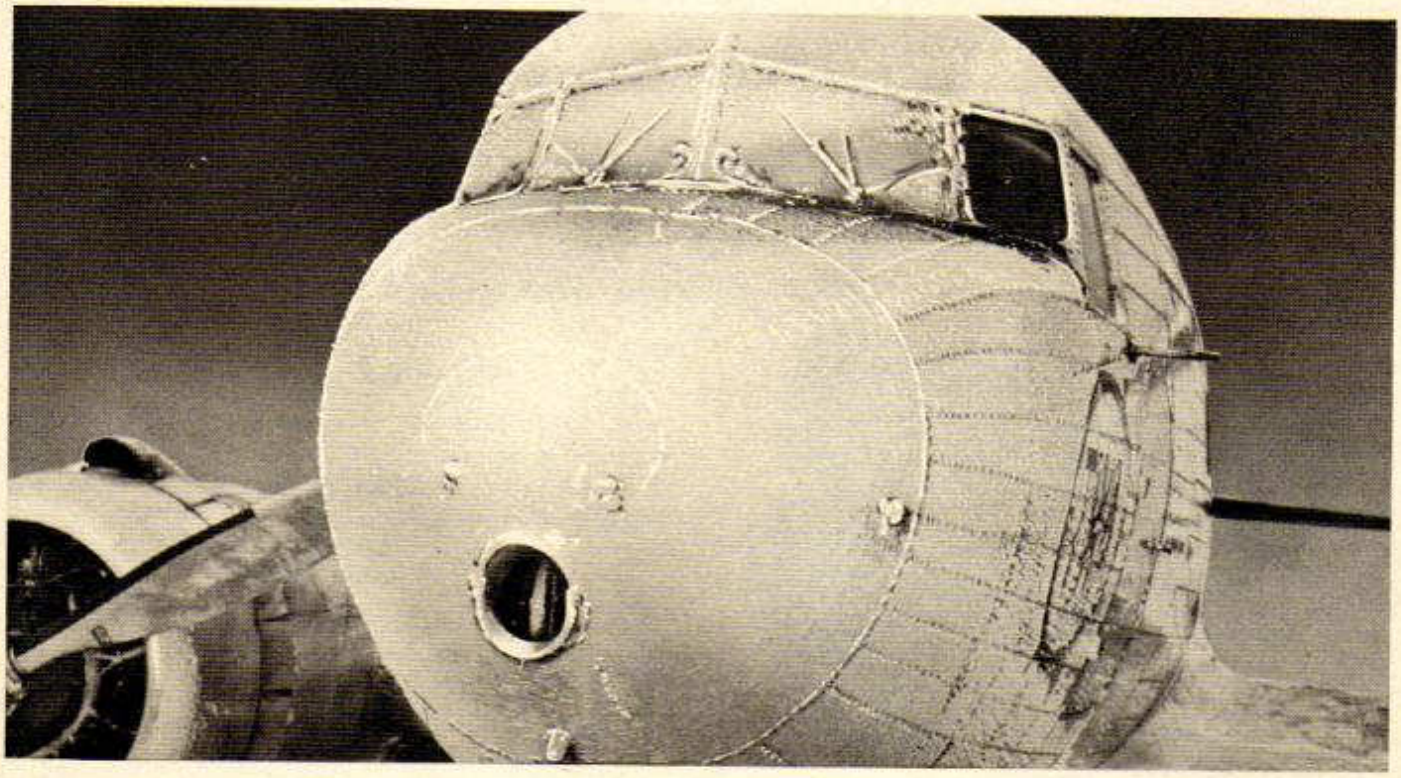
Frost is dangerous for takeoff, but not on an airplane in flight. Remove it from the wings and tail surfaces just before any takeoff. Use wing covers on the ground when conditions are favorable to frost; remove them just before takeoff.

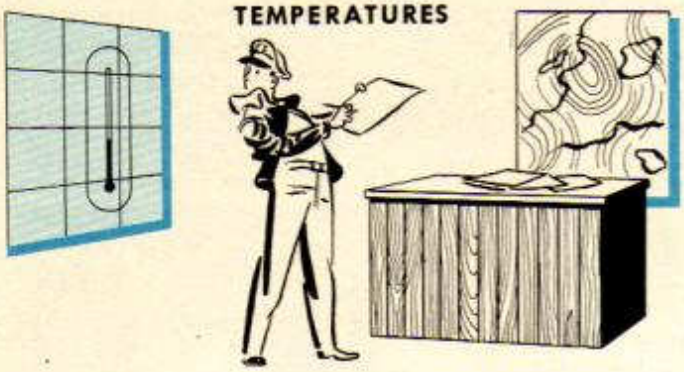
Fog, Clouds, Etc. Minute particles of moisture in the air rarely cause icing of the wings, fuselage or tail. They are too small to break through the surface friction but follow the airstream without contact with the skin. **They may cause propeller icing.** It is possible to have propeller icing without icing on other parts of the airplane.

WHERE ICING OCCURS

Prepare for icing whenever there is visible moisture in the air at temperatures approaching or below the freezing level:

1. In freezing rains, in all frontal zones.
2. Sleet itself may not be hazardous, but if there is sleet on the ground, somewhere aloft there is usually a layer of freezing rain and above that, a layer above freezing. Such temperature inversion is a condition favorable to icing.
3. In cumulus clouds and others with vertical development, wherever they occur.
4. Along fronts, in stratus and strato-cumulus cloud formations.
5. In mountain (orographic) clouds, formed when moisture laden air is forced upward over hills and mountain ranges.





Look for most severe icing when the temperature is between freezing and 18°F (–8°C). Icing may occur down to –40° or colder. Low pressure areas on the airfoil may cause mild icing at temperatures a few degrees above freezing when other conditions are favorable to icing.



Avoid icing where possible. Plan your flight to go around or over frontal formations when conditions are favorable to icing. **Consult your forecaster before taking off.** Analyze reports of icing carefully before following a flight plan similar to one where icing was encountered. And plan your flight accordingly.

Icing conditions never remain constant. The pilot ahead of you may have reported light icing; a few minutes later, in the same spot, you may find the icing severe.

PROCEDURE

If you encounter severe ice at a given altitude, try at once to get out of it:

1. Climb above it, if icing levels do not extend too high. If it is impossible to get on top, remember that most ice occurs at temperatures between freezing and 18°F (–8°C). Figure a free-air temperature drop of 3° for each thousand feet you climb. There will be less icing where the temperature is 18°F (–8°C) or colder. If the icing zone is shallow, get above it as rapidly as possible.

2. Descend below the icing level if you will still have plenty of altitude left for safe instrument flight when you get below the icing.

3. Change your course and fly out of it. If you enter a zone of severe icing from one comparatively free from icing, make a 180° turn before making your climb or descent. Then resume your original course when you reach the desired altitude. **Always get out of severe icing zones as soon as possible.**

4. **Go around or over mountain clouds, never under them; you'll need all the altitude you can get.** Icing can be dangerous if you don't know what to do to avoid it or can't remove ice from critical surfaces when it occurs. **Know the limitations of your airplane in icing conditions.**



STALLS

A stall caused by ice does not feel the same as a normal stall. It occurs at a higher speed and is preceded by noticeable sloppiness of the controls. Also, the stall will not break cleanly; there is a gradual transition from normal flight, through heavy, mushy flight, to the full stall. The airplane will fall off on one wing or the other, according to the individual characteristics of the plane. As your stalling speed in straight and level flight increases because of ice accretion, it increases even more in banks.



PREVENTING AND REMOVING ICE

If your airplane has de-icing equipment, use it when needed. But don't fly into icing zones when you can avoid them, simply because you have this equipment. De-icing equipment is for safety when icing is unavoidable. Know how to use it.

Wings and Tail

De-Icing Boots are installed over the leading edges of the wing and tail surfaces of many airplanes. They are flexible rubber sheets containing inflatable fabric tubes. The tubes inflate and deflate from air pressure supplied to them by pumps. Distorting and stretching of the surface of the boots cracks and loosens the ice. The ice then is blown away by the airstream.

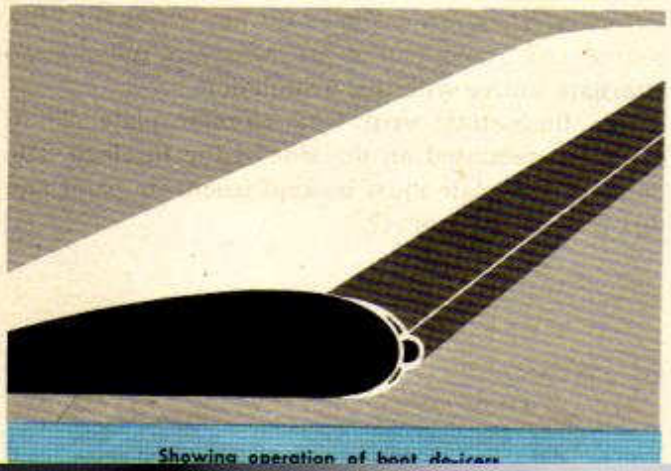
The de-icing system operates through a 40-second cycle. When you encounter icing, wait until a coating approximately ¼" thick builds up on the leading edge of the wing, turn your de-icers "ON" to break it loose, then turn "OFF." Every time a thin coating of ice builds up, repeat the process. **Test on the ground before takeoff when you anticipate icing in flight.**

Never operate boot de-icers during takeoff or landing. They act as spoilers.

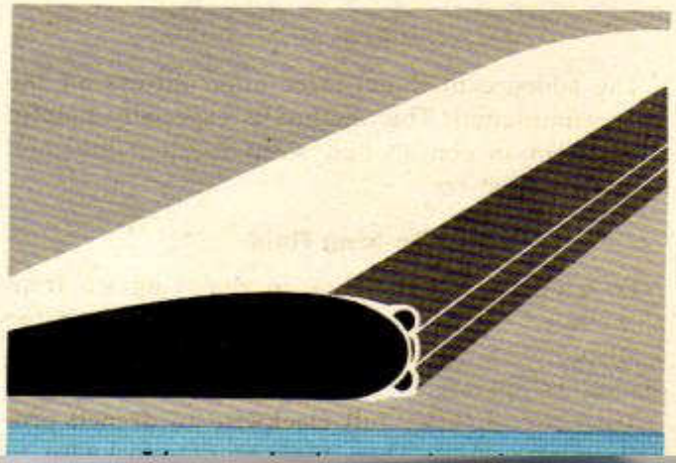
Don't use de-icers when heavy ice forms behind the boots back on the wings.

Anti-Icing Systems, heated wings and tails, are built into some planes for preventing ice formation. Air is heated and then passed through ducts to the leading edges of the wings and empennage; to the cabin and windshield. The surfaces are heated enough to prevent the formation of ice. When not in use, the air passes on out through a dump valve.

If you anticipate icing immediately, turn the system "ON" just before takeoff. Leave it on as long as you encounter icing conditions. In flight turn "ON" whenever you notice or anticipate icing. Allow about 30 seconds for surfaces to heat up; ice will seem to explode off the wings and tail surfaces. If your airplane is not equipped with either system and you



Showing operation of boot de-icers

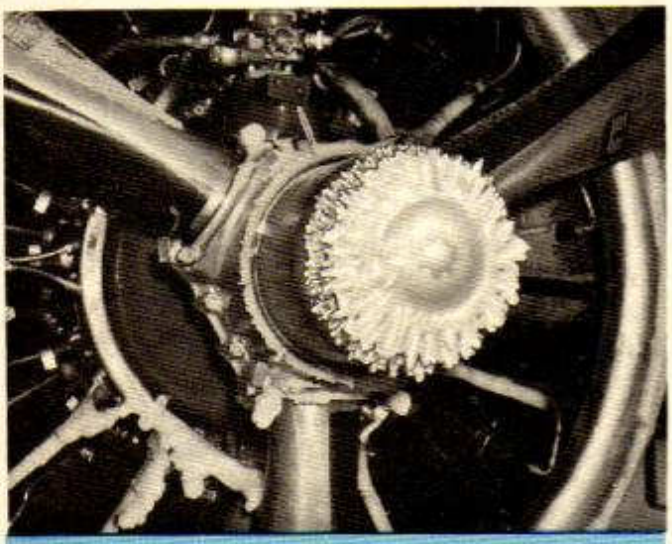


encounter icing, change your course and altitude at once. You may be able to dislodge rime ice from leading edges by increasing speed, but leave the icing zone before trying this method of removing ice.

Airplanes with high wingloading or critical control characteristics may be seriously affected by even a small amount of wing ice. **Know the flight characteristics of your airplane in icing conditions.**

PROPELLER

Icing on propellers reduces propeller efficiency and causes vibration. It may occur in any condition favorable to icing on wings and in below-freezing zones where there is fog or very stable clouds, consisting of extremely small moisture particles.



Ice on propeller spinner

Remove ice from propellers by one or more of the following methods:

Increase RPM of Propeller

The added centrifugal force often throws off the ice accumulation. This method is especially helpful when used in conjunction with de-icing fluid and anti-icing spinners.

De-Icing Fluid

De-icing fluid is effective in removing ice from propellers. The fluid is pumped from a tank in the airplane to a slinger ring, which distributes it to the blades. To operate:

Turn the rheostat full clockwise to drench propellers with fluid. Then turn counterclockwise to "NORMAL." If rheostat is not marked for normal setting, turn it counterclockwise approximately half way to deliver normal output to blades.

Approximately 4 quarts of fluid per hour, for each propeller, are required for normal operation of the propeller de-icing system. Fill the tank before takeoff on any flight which may encounter icing. Turn on propeller de-icer just before you enter a zone of anticipated icing. **Test the system on the ground before a flight when conditions are favorable to icing.**

Anti-Icing Spinners

Some pitch-control mechanisms are provided with anti-icing spinners, usually coated with rubber. When covered with an oil before takeoff on flights where icing is anticipated, they will help keep the propeller hubs free from ice.

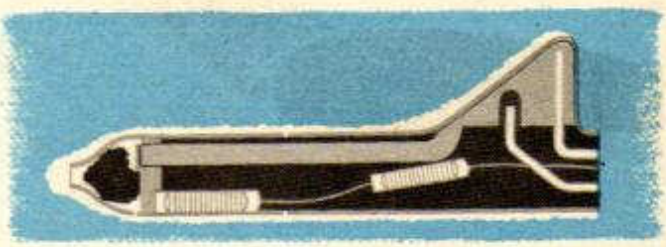
PITOT TUBES

Ice on the pitot-static head affects readings of the altimeter, rate-of-climb, and airspeed indicator. There is a heater in the pitot head to keep it free of ice. Whenever the free-air temperature is near or below freezing and there is visible moisture in the air, turn the pitot heater "ON."

An alternate source of pressure is provided so that the altimeter and rate-of-climb indicator will continue to function should the pitot static source fail. However the readings will differ. So when you start out on a flight, check the difference in readings at normal cruising speed, by switching from normal pitot static source to "ALTERNATE SOURCE." Then, should it be necessary to use the alternate source, you will be able to figure satisfactory readings. **The air speed indicator will not operate at all if the pitot-static tube fails.** (See PIF 3-8.)

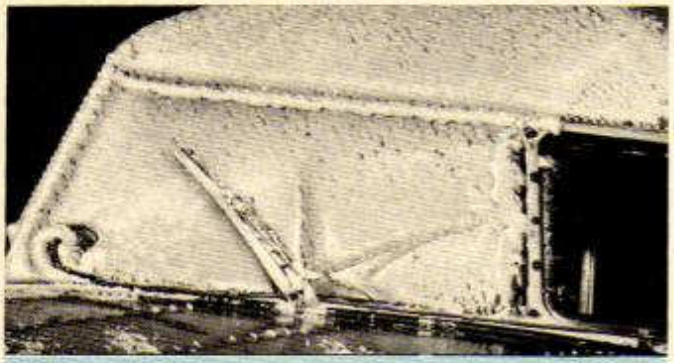
Flush-static vents are installed on many tactical airplanes. They are designed for use where the pitot source and static source are separate; there is no alternate source with this installation.

The flush-static vent is a circular plate, 2″ in diameter, mounted on the side of the fuselage. The holes in this plate must be kept free from paint and dirt to function properly.



PIF 3-7-6
REVISED September 1, 1944

WINDSHIELDS



Conserve de-icer fluid for propellers

De-Icing Fluid Systems

Fluid de-icers are installed on the windshields of some airplanes. When windshields so equipped begin to ice up, turn the rheostat full clockwise for maximum output, then adjust to the minimum output at which it will operate effectively. Don't waste de-icing fluid. You may need it for the propellers if icing gets more severe.

Heated Windshields

Heated windshields, with double panes, are installed on many airplanes. Heat is supplied from the cabin heater or, when planes are equipped with heated wings, through special ducts connected to the heat exchangers. If normal vision is possible with the inner pane in place, leave it in position at all times. If inner pane is stowed normally, put it in place before taking off when icing is anticipated. Leave windshield heaters "ON" at all times in weather favorable to icing. The system also is satisfactory for defrosting.

PILOT REPORTS



When you encounter icing unexpectedly, report it at once by radio. The information may help other pilots to avoid that area. Give location, upper and lower limits of the icing levels if you know them, and the amount of ice encountered.

ICING SAFETY NOTES

On the Ground

1. Check the weather. See your forecaster. Don't plan a flight into known hazardous icing conditions.
2. Check de-icing equipment before takeoff when conditions are favorable to icing.
3. **Remove all frost before takeoff.**
4. Before takeoff into known icing conditions cover props with de-icing fluid.
5. Avoid slushy and icy spots when taxiing. Be easy with your brakes; you may skid.
6. During a winter fog or rain, watch for icing on wings from propeller blast during warmup.
7. Don't take off in wet snow, in borderline temperatures if you can avoid it. It may freeze before you can gain altitude.
8. Carburetor Heat—Read PIF 3-6.

In the Air

1. Following takeoff from a wet or slushy field, operate landing gear, flaps, etc., through several cycles, when possible, to prevent freezing.
2. Turn pitot heater "ON" if you anticipate ice.
3. Make your climb or descent through icing zones as fast as possible.
4. Exercise controls occasionally when flying in icing conditions. Otherwise, they may freeze.
5. Avoid turbulent areas. Fly above or below clouds when possible. Look for temperatures below 0°F (−18°C) or well above freezing. You'll find less ice there.
6. Radius of action drops when ice forms on your plane. Plan your flight accordingly.
7. **Avoid ice where possible.**

In Landing

1. Fly in with plenty of power for a wheel landing. Remember that stalling speed increases with ice. Approach from a safe altitude.
2. Make wide turns. Increase airspeed in all turns over normal. Avoid steep turns with icy wings.
3. Turn wing de-icers "OFF" on base leg. They act as spoilers if left on.
4. Use flaps with care. They may aggravate the condition if there is ice on the airplane.

Know the Handling Characteristics of Your Airplane Under Icing Conditions. Don't Take Chances With Ice!

REFERENCE: Technical Order 30-100D-1

PIF 3-8-1
REVISED June 1, 1944

FLIGHT INSTRUMENTS

PITOT-STATIC SYSTEM

The readings of the airspeed indicator, altimeter and rate-of-climb indicator depend upon two different pressures. One is called pitot (impact or dynamic) and the other is called static (atmospheric). Actually the only instrument affected by both types of pressure is the airspeed indicator. The altimeter and rate-of-climb indicator depend solely upon static pressure.

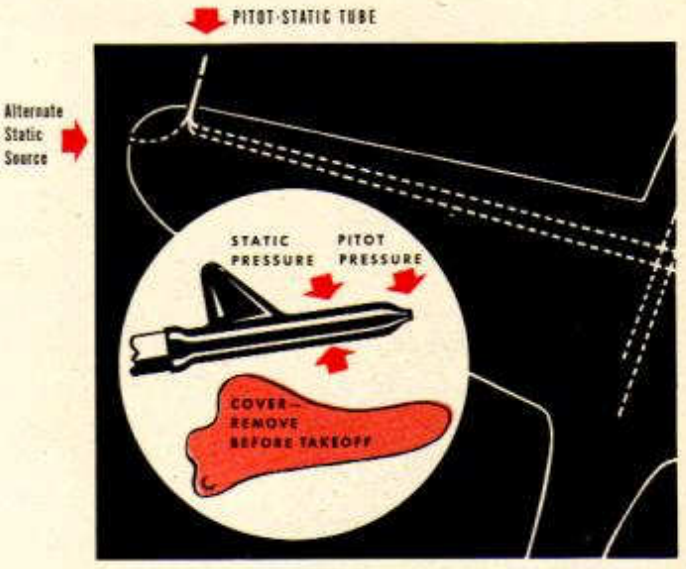
Pitot-Static Head

A pitot-static head supplies both pitot and static pressures to the airspeed indicator and static pressure alone to the altimeter and rate-of-climb indicator.

The pitot pressure opening is on the forward end of the head, while the static pressure openings are located a short distance behind the forward head.

The head is so designed that any moisture or dirt entering it is trapped and kept from reaching the instruments themselves. A heating element is provided inside the head to prevent icing.

To deliver true pressure to the instruments the pitot-static head must be streamlined with the airflow. This can be accomplished usually only at cruising speed. Thus, inaccuracies may develop at other than cruising speed, but they are negligible except during takeoff, sharp pullouts, level-offs, and landings.



REMEMBER—Always make sure the pitot-static head cover is removed before takeoff. Don't leave the pitot heater turned on for extended periods on the ground. Except for testing purposes, turn it on only in flight when icing conditions are anticipated.



Flush Static Source

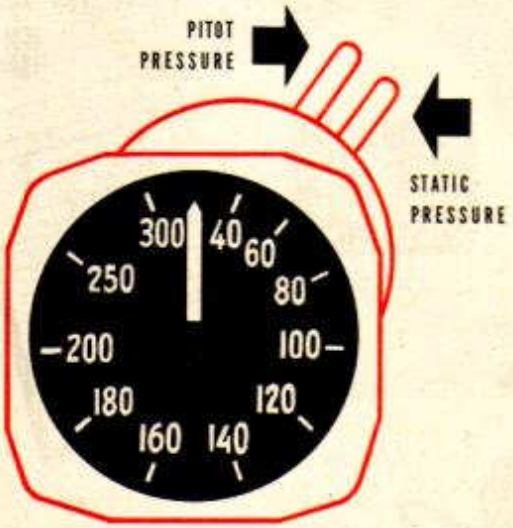
Static pressure is sometimes derived from a flush static pressure source, by means of a perforated flush-mounted plate, located usually well back on the airplane's fuselage. Pitot pressure in this system, however, is still obtained from a pitot head.

Alternate Static Source

Some airplanes have an alternate source of static pressure controlled by a switch or valve in the cockpit provided in case the usual source fails. For example, if the pitot-static head were broken off or the openings became iced, all three instruments in this group would become unreliable. By switching to the alternate you regain use of the rate-of-climb indicator and the altimeter but not the airspeed indicator, depending as it does on both pitot and static pressure.

The static pressure provided by the alternate source is usually lower than true or actual pressure. Thus, upon first switching to it, you find the rate-of-climb indicator ordinarily indicating a climb, while the altimeter ordinarily indicates an increase in altitude, though none has occurred. The rate-of-climb indicator returns to a normal indication shortly. The altimeter, however, continues to indicate an altitude other than actual.

Try the effect of the alternate source of your own airplane if so equipped, so you can be prepared for an emergency.



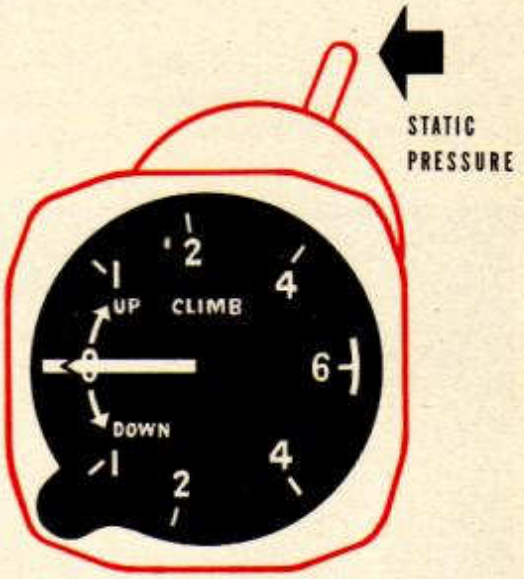
AIRSPEED INDICATOR

The actuating mechanism of the airspeed indicator is a metal diaphragm housed in an airtight case. Pitot pressure is admitted to the inside of the diaphragm. Static pressure is admitted to the case around the outside of the diaphragm. The difference between these two pressures causes the indications of this instrument and gives indicated airspeed (IAS). Any change in either pitot or static pressure causes a change in the IAS.

You can estimate true airspeed (TAS) roughly by adding 2% of the IAS for each 1000 feet of altitude. For example, if the reading is 140 IAS at 20,000 feet of altitude, add 40% of 140 to 140, which gives an approximately correct reading of 196 TAS. For more accurate calculations use a computer.

REMEMBER—With the exception of your having wing ice or an increased load, the IAS at which your plane will stall is the same, no matter what the altitude or temperature. The airspeed indicator tells you accurately your safe airspeed limits, maximum or minimum. Make corrections for stalling speed if you have picked up wing ice or increased your normal load. See PIF 3-4-1 and High Speed Stalls, PIF 2-20-1.

RATE-OF-CLIMB INDICATOR

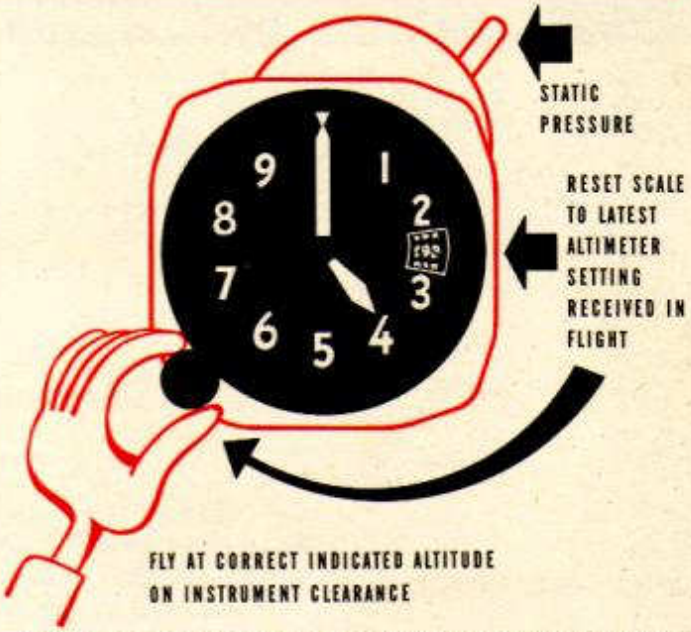


The rate-of-climb indicator has the same actuating mechanism as the airspeed indicator. A diffuser valve simply restricts the flow of the air from the case to the inside of the diaphragm. Only static pressure is admitted to the inside of the case and the outside of the diaphragm.

You get a reading when there is a difference in pressure between the inside and the outside of the diaphragm. The difference occurs chiefly in climbing or descending, when pressure inside and outside the diaphragm tend to equalize, but this takes some time because of the restriction in the flow of air between the diaphragm and case. Because of this restriction the instrument has a lag in its indications of several seconds.

Depend on the instrument only when establishing a constant rate of climb or descent in relatively smooth air. Use it in conjunction with the altimeter at all times as it indicates the **rate of change** and not the **amount of change** in altitude. The instrument is relatively useless in turbulence.

ALTIMETER



The actuating mechanism of the altimeter is called an aneroid, which is a device for measuring absolute pressure. It is housed in an airtight case. Static pressure is admitted to the inside of the case, and acts on the aneroid so as either to compress it or allow it to expand. This compression or expansion causes movement of the hands on the face of the instrument.

The altimeter actually measures the weight of the air column (barometric pressure) above it and is so calibrated that a decrease in pressure causes an increase in its indication of altitude. The weight of the air column measured by the altimeter will vary because of changes in the air's density, which in turn is affected by variations in temperature. These factors often cause incorrect altimeter readings.

The altimeter is calibrated according to standard conditions of temperature and pressure, but these conditions seldom prevail. In order to correct for non-standard conditions modern altimeters are provided with a barometric scale.

Standard Altimeter Setting

Remember this system will always give you your height above sea-level, not above the terrain. Use these steps:

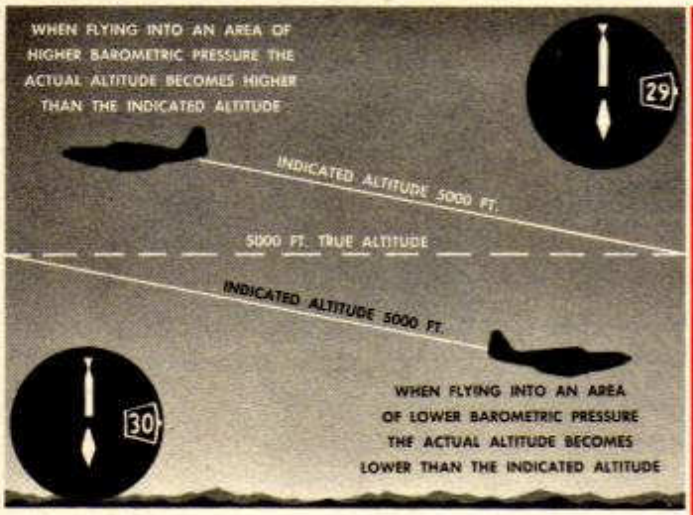
1. Before takeoff obtain the **latest altimeter setting** for the field from the tower. Then set the barometric scale on the instrument to this setting. The hands of the altimeter should then indicate the surveyed altitude of the field above sea-level. (If they do not, within the limits allowed on the scale-error card on your instrument panel, ask a mechanic to find the trouble. Often a small adjustment is enough to correct the error).

2. During flight you must continually correct the altimeter by resetting the barometric scale according to the latest altimeter setting of the area in which you are flying. Request it from the nearest radio facility.

3. Before landing again request the latest altimeter setting from the tower, and reset the instrument accordingly, so that you can depend on its accuracy.

Effects of Pressure and Temperature on Altimeter

Standard atmospheric conditions at sea-level exist when the barometric pressure is 29.92 and the temperature is 15°C. The standard temperature for any altitude above sea-level decreases at the rate of 2°C for each 1000 feet of altitude. Remember these two rules:

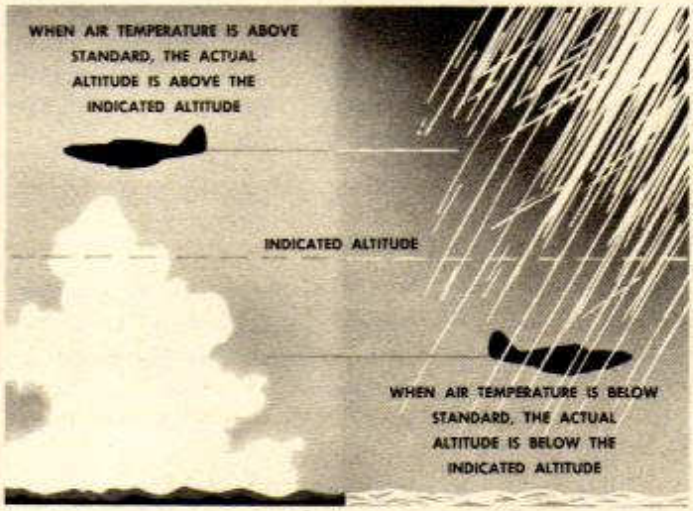


ALTITUDE AND TEMPERATURE

Rule 2—When flying through air colder than standard the actual altitude becomes lower than the indicated altitude. WHAT TO DO: Calculate your true altitude by use of a computer.

ALTITUDE AND PRESSURE

Rule 1—In flying from an area of relatively high pressure into an area of lower pressure the actual altitude will become lower than the indicated altitude. This is a dangerous situation.



WARNING

Before clearing for an instrument flight, be sure the altitude you have requested gives you sufficient terrain clearance over your entire route. Then keep your altimeter reading at this altitude. Don't make mental corrections and try to figure your true altitude. Keep your indicated altitude corrected by resetting your altimeter from settings given you over your radio check points.

PIF 3-8-5
REVISED January 1, 1945

MAGNETIC COMPASS

The magnetic compass is the basic navigational instrument. It consists of an airtight case filled with a special fluid in which a compass card assembly is pivoted. It is subject to many errors; mainly deviation and the errors produced by turning, accelerating or decelerating the airplane.

A compass correction card mounted on the instrument panel shows the amount of deviation.

Note the following errors in turning:

When turning toward North the indication of the compass lags considerably. In most sections of the United States this lag amounts to approximately 30°. When turning toward South the compass indication leads the airplane's direction on the heading by the same amount. These errors decrease as you make a turn toward East or West, becoming approximately zero on those headings.

The rule becomes, then; **Overturn the heading when turning toward directions on the Southern half of the card** (points between East and West through South). **Underturn the heading when turning toward directions on the Northern half of the card** (points between East and West through North).

Example

For instance, if you are flying a heading of 280° and want to change your heading to 360°, your magnetic compass lags approximately 30° behind your turn; so straighten out when your compass reads 330°. Your compass will catch up shortly.

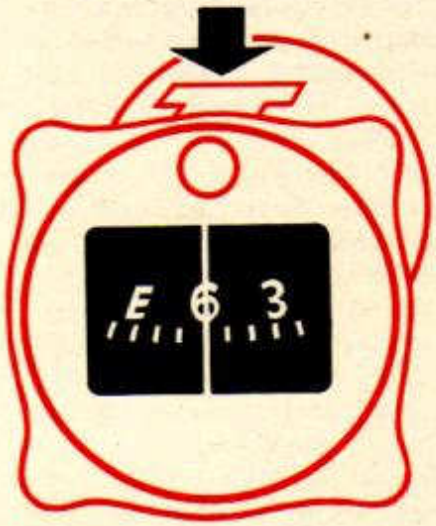
If you are flying a heading of 100° and make a turn to a new heading of 180°, continue your turn until your magnetic compass reads 210°, that is, 30° more than the heading you want. In a few moments the compass swings back to its proper reading.

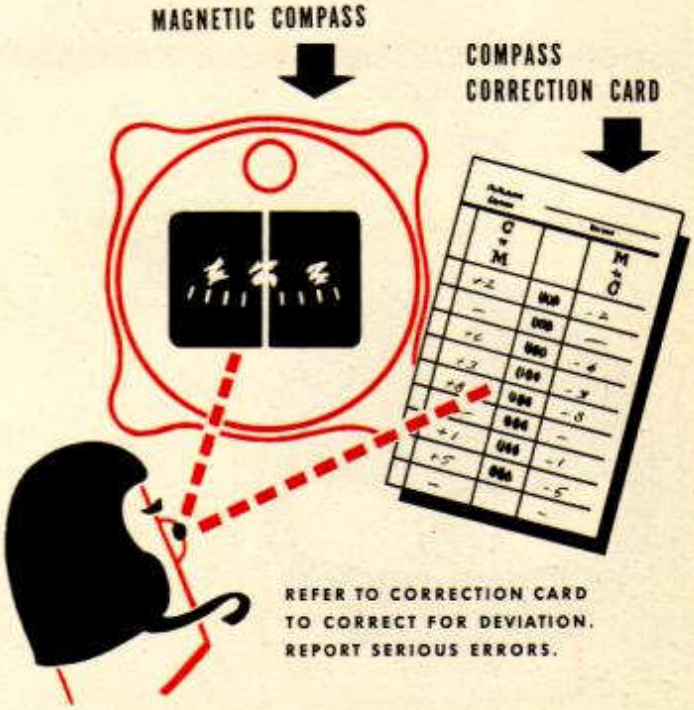
When you accelerate or decelerate the airplane in an Easterly or Westerly direction you will notice an error as the compass turns off the direction in which you are flying. When heading East or West acceleration causes the compass to indicate a turn toward the North. You get the same effect by going abruptly into a dive on these headings.

Deceleration on a heading of East or West causes the compass to indicate a turn toward the South. You get the same effect by going abruptly into a climb on these headings. These rules apply only in the Northern hemisphere. They are exactly the opposite in the Southern hemisphere.

The magnetic compass is difficult to use in turbulence.

The compass should be swung frequently in order to keep the compass correction card up to date. If you notice serious compass errors report it on your Form 1-A. Keep metal objects and electrical equipment (such as headphones) away from the compass.





GYRO FLUX GATE COMPASS SYSTEM

The Gyro Flux Gate compass system is a remote indicating earth-inductor compass consisting of gyro-stabilized flux gate transmitter, an amplifier, a master indicator and from 1 to 6 remote indicating repeaters. It is not subject to the error of the magnetic compass except when the gyro flux gate is caged. A true heading is always indicated by the master and the repeater indicators, because of compensation for variation and deviation.

Its upset limits are 65° climb, glide and bank.

Although the responsibility for the operation of this compass rests on the navigator, you should know how to use it, and it is your responsibility if there is no navigator in the airplane.

Follow these steps in operation:

1. Be sure the amplifier switch is always left "ON."
2. Turn on the inverter after starting engines.
3. Cage the gyro after the compass has been in operation 5 minutes.
4. Leave it caged for 45 seconds.
5. Uncage, and it is ready for use.

If you exceed the upset limits of 65°, cage and uncage the instrument just as you did before.

Leave the gyro uncaged at all times except those indicated above.

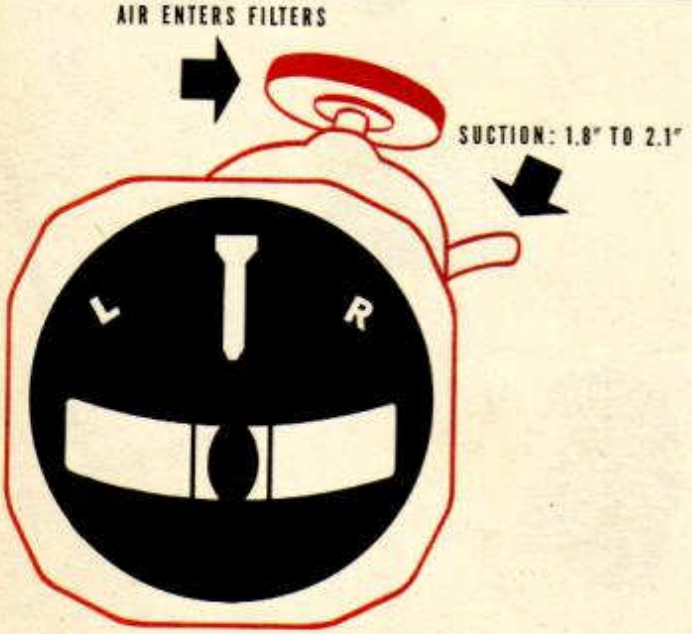
On the newer models the gyro is designed so it cannot be left in the caged position. Follow this procedure for erecting the gyro: After gyro motor has been operating 5 minutes, hold push button in until red light is on, then release push button. When red light goes out an erection cycle has been completed.

THE SUCTION SYSTEM

Gyro instruments are operated normally by suction, supplied by a vacuum pump driven by the airplane engine. Actually each gyro instrument works on the same principle as a turbo. A gage is provided to indicate amount of suction.

On modern single-engine airplanes there is no alternate source of suction. On multi-engine airplanes there are usually two or more suction pumps. A selector valve in the cockpit allows you to switch from one suction pump to another in case of engine or suction pump failure.

If your suction system fails completely you have approximately three minutes dependable use of the gyro instruments.



BANK-AND-TURN INDICATOR

The bank-and-turn indicator is a combination of two instruments; the bank indicator and the turn indicator. Since you use them together, however, they are housed in one case. The bank indicator consists of a ball free to move back and forth in a tube filled with a special liquid. It shows the relation between angle of bank and rate of turn. When a turn is properly executed the ball will remain in the center of the tube between the two reference lines. If the ball is on the low side you are making a slipping turn, if on the high side a skidding turn. You may use the ball in level flight to determine whether you are skidding or slipping, or if the airplane is properly trimmed.

The standard bank-and-turn indicator shows rate of turn and does not show the amount of turn. A needle width's deflection means that with a properly functioning instrument you are turning at the rate of 180° per minute. This is a standard rate turn used in instrument procedure.

The standard bank-and-turn indicator indicates rates of turn up to 1080° per minute.

The rate of turn is the result of two things—airspeed and angle of bank. The greater the airspeed the greater must be the angle of bank to produce a given rate of turn.

For a one needle-width standard turn (180° in one minute) the following speeds and angles are required:

MPH	Angle of Bank
100	13.5°
150	19.8°
200	25.6°
250	31.0°
300	35.75°

It is obviously impossible to make angle-of-bank readings with sufficient accuracy in instrument procedure turns. But any of the above can be read on the bank-and-turn indicator as a single needle-width turn.

At speeds above 200 mph make only one-half needle widths turns in order to avoid a dangerous angle of bank, providing the instrument has the standard calibration. To read the rate of turn in turbulence average the oscillations of the needle.

DIRECTIONAL GYRO

Use the directional gyro in connection with the magnetic compass. It is not a direction seeking instrument, and because of precession, must be checked every 15 to 20 minutes against the magnetic compass, and reset.

Set the desired heading by the caging knob underneath the dial.

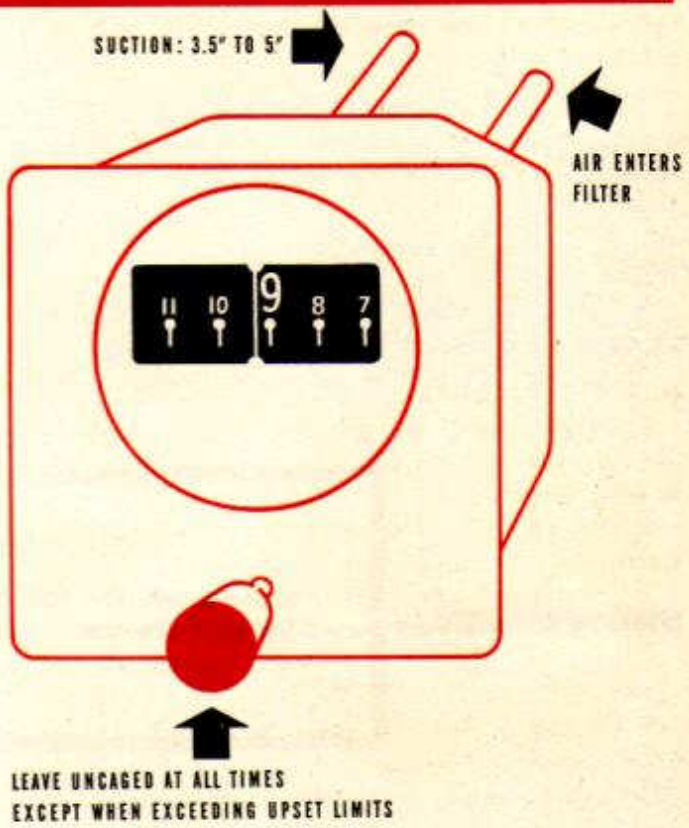
Its approximate upset limits, are 55° bank, climb, and glide. When these limits are exceeded the card generally begins to spin; level the airplane, cage the gyro and reset by reference to the magnetic compass.

The instrument is reliable in turbulence, in contrast to the magnetic compass.

In ground checking the instrument turn the caging knob gently and pull out in one smooth operation. The card should stop and hold its position. This is a check on the rigidity of the gyro. **Do not twist the knob sharply and pull it out at the same time.**

If the instrument drifts off cardinal headings more than 3° in 15 minutes report it on your Form 1-A.

Leave the instrument uncaged at all times except in maneuvers which exceed its upset limits.



GYRO-HORIZON INDICATOR

This instrument indicates realistically the attitude of the airplane.

The upset limits of the instrument are 100° bank and 70° climb and glide.

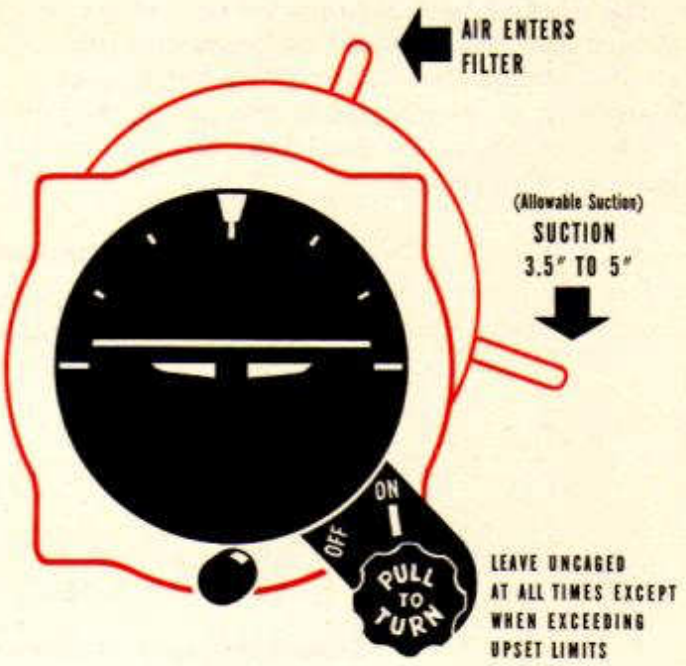
After starting engines allow at least 5 minutes at sufficient rpm before takeoff for the instrument to obtain proper speed. Be sure before takeoff the horizon bar has settled into its proper 3-point position. This may be speeded up by caging and uncaging the instrument after engines are started. **This is the only time the instrument should be caged while on the ground.** Leave it uncaged at all times except in maneuvers which exceed its upset limits.

When caging and uncaging the instrument in flight always make sure the airplane is level both longitudinally and laterally at the moment of uncaging. Always cage the instrument gently to avoid damaging it.

When using the gyro-horizon be sure it is locked in the full "ON" position (uncaged).

Whenever you make a turn the gyro-horizon develops a small error in indication, known as turn error. After straight and level flight is resumed the error will disappear shortly. Therefore, during turns and immediately thereafter refer to the altimeter and airspeed indicator to maintain altitude and compensate for the error in the gyro-horizon.

During flight do not depend solely on the gyro-horizon. Cross-check it with the other instruments.



AUTOMATIC PILOT

Two types of automatic pilots are in general use: suction driven or electrically operated. Operating instructions for each vary widely. Consult instructions for the equipment installed on your airplane, and don't try to operate both types if you are familiar with only one.

In operating either type remember to trim the airplane for hands-off flight before engaging.

Make sure all indices or control indices are in alignment or neutral before engaging the instrument.

Some slight adjustments of the automatic pilot to correct for small changes of load balance are permissible. However, any large change of load balance (such as transfer of fuel, dropping bomb loads, or dropping auxiliary tanks) necessitates your disengaging the pilot and trimming the airplane for hands-off flight before you attempt to use the instrument again.

WARNING

Never use the automatic pilot for locking the controls while the airplane is parked, or while you are warming up.

SECTION 4 MAN GOES ALOFT

EFFECT OF OXYGEN-WANT ON HANDWRITING DURING ASCENT

ASCENT TO 25,000 FEET WITHOUT OXYGEN	EXPLANATORY REMARKS
A sample of normal handwriting in flight at 2000 ft	Control specimen of normal handwriting.
10000 ft - breathless	No apparent effect.
15000 ft - feel uneasy generally numb feeling some numbness in leg and hands	Beginning muscular incoordination.
18000 ft very bad	Definite physical and mental inefficiency.
20000 ft: faint - numbness in legs: vision fading	Last zero off both 18,000 and 20,000—marked incoordination.
22000 ft. pain in rod- lastic pain to me Feel better	Feeling better? Evidence of false feeling of well-being.
23000 ft: feel good stop for deep breathing open legs numbness	Feel good. Insight, judgment and coordination very faulty.
24000 feet - Cyanosis Mental ca-	Mental and physical helplessness.
25000 ft oxygen turned on -	Improvement with few breaths of oxygen.
3000 ft. theory test brighter - Hearing returns feel O.K. Nose -	Last zero left off—general improvement, but not completely normal.

EFFECTS OF HIGH ALTITUDE

General

The effects of high altitude flying on the human body include:

1. Oxygen want (Anoxia).
2. Expansion of gases in the body.
3. Need for clearing (equalizing pressure in) the middle ear and nasal sinuses.
4. Escape of dissolved blood gases in the form of bubbles ("Bends", "Chokes", "Creeps").
5. Increasing cold with altitude. (See PIF No. 4-7.)

All but the last of these effects are due to a decrease in the total barometric pressure with higher altitudes. The atmospheric pressure at 18,000 feet is one-half that at sea level; at 27,000 feet, one-third, and at 40,000 feet, one-fifth.

Oxygen Want (Anoxia)

Oxygen want means lack of oxygen in the body tissues due to a decrease in the quantity of oxygen in the air breathed. Oxygen want increases with altitude, since as the air becomes less dense, a given lungful of air contains less oxygen (and, of course, less of all other gases as well).

In flight, oxygen want begins at about 5,000 feet, but, except for less ability to see in dim light, it is not noticeable to the flyer until an altitude of about 10,000 feet is reached. Healthy persons may occasionally become unconscious while breathing air at 18,000 feet after short exposure, and unfit persons may suffer collapse at lower altitudes.

The chief symptoms of oxygen want are:

1. Loss of insight and lack of realization of danger.
2. An early false sense of well-being.
3. Lessening of judgment, inability to think clearly, and tendency to make errors.
4. Smaller field of vision and decreased hearing.
5. Sluggishness and clumsiness.
6. Lack of emotional balance.
7. Greatly reduced ability to see in dim light, or at night.

Know What Happens

All practical rules for the use of oxygen equipment and the probability of your having "bends" or oxygen want depend on the reading of the altimeter in the airplane (indicated altitude above sea level). That is, regulations call for your use of oxygen at any time you fly above an indicated altitude of 10,000 feet **above sea level,** not above a zero setting for a given field.

Become thoroughly familiar with the various stages of oxygen want. In the first stages the senses are dulled and you have a false feeling of well-being. This may start at 10,000 feet or less. At any altitude above 10,000 feet the effects of anoxia may develop without warning. Always judge your need for oxygen by the altimeter. Never wait for symptoms.

At 10,000 feet, the effects of oxygen want are definitely present, but they may be subtle and insidious. You may not be aware that anything is wrong. Use oxygen, however, at this altitude if you are going higher, and under all circumstances, **start it on the ground for night flying, except for low level training flights such as those routinely encountered in primary, basic, and advanced training.**

At 15,000 to 18,000 feet the first effects on the brain become marked, and you may experience loss of judgment, dulling of the mind, loss of emotional balance, and the development of fixed irrational ideas. Muscular control is impaired, memory fades temporarily, and the ability to solve navigational and other problems is impaired seriously.

At 20,000 feet there may be fits of laughing or crying, impatience, rage, or other emotional disturbances, and great muscular weakness or paralysis. Vision is affected at this altitude. Depth perception may become faulty, and double vision occur. With some there is a feeling of high efficiency, even though unconsciousness is approaching. Others get sleepy and pass into a stupor.

Above 20,000 feet most people lose consciousness within a short time and death follows.

These symptoms may, of course, develop in different sequences and in various forms, depending upon:

1. Rate and duration of ascent to altitude.
2. Activity or excitement, cold, and the presence of dangerous gases. (See PIF No. 4-11.)
3. Differences in the individual's reaction.

If oxygen has been supplied up to **30,000 feet,** sudden removal of the supply produces great mental and physical inefficiency in from 30 to 60 seconds, and unconsciousness in 30 to 90 seconds.

After having suffered from oxygen want, see your flight surgeon.

Maintain physical fitness. This has a great deal to do with your ability to withstand high altitudes. (See PIF No. 4-4-1.)

If you must fly at altitudes in excess of 40,000 feet, be absolutely sure that your oxygen equipment is functioning perfectly, that you know how to use it, and that you know what to do in an emergency.

Body Gases

Expansion of body gases in the stomach and intestines occurs as the atmospheric pressure decreases. At about 18,000 feet the stomach might contain more than a half-pint of air; normally it contains one-quarter pint. The expansion of gases in the intestinal tract may cause some discomfort, but only rarely serious difficulty in a normal person. Relief usually can be obtained by belching and the passing of flatus. In severe cases descent to a lower altitude may be necessary.

When you are flying frequently, avoid foods that tend to produce gas. Beans, cabbage, beer and other carbonated beverages are likely to make trouble. There probably are others that affect you. Notice which they are and save yourself distress.

Practice clearing your ears rapidly by swallowing, yawning, or closing your mouth and nose and gently attempting to exhale while swallowing. This will considerably increase the rate of descent you can stand comfortably.

Do no flying when you have a head cold unless it is absolutely necessary. Congestion of the lining of the nose and throat causes difficulty in the equalization of pressure, and pain in the ears or sinuses often results. Infection sometimes spreads to the sinuses and ears.

Aeroembolism ("Bends", "Chokes", and "Creeps")

Decreasing the pressure on the body not only affects the gas already present, but allows the gases dissolved in the body fluids (carbon dioxide, oxygen, and especially nitrogen) to escape and form bubbles. Trouble seldom develops below 30,000 feet, but the likelihood of it increases the higher you go, the longer you stay, the colder you get, the more you exercise, and the faster you ascend, particularly if you have not taken oxygen from the ground up.

Bubble formation usually is indicated by pain in or near the joints (bends). A feeling of oppression in the chest or tightening and pain in the throat (chokes), and itching and irritation of various parts of the skin (creeps) sometimes are felt. Any of these symptoms may gradually or suddenly become worse and force you to descend. The symptoms then become less noticeable, and descent to 20,000 feet usually brings complete recovery.

If you have had any physical difficulties, especially with your ears or sinuses, during a flight, see your flight surgeon as soon as possible.

Four Golden Rules For Oxygen:

1. Use oxygen for all flights above 10,000 feet.
2. Use oxygen from the ground up for all night flying, except for low altitude training flights.
3. Judge your need for oxygen by your altimeter, not by your sensations.
4. Check all oxygen matters with your oxygen officer.

REFERENCE: "Your Body in Flight," T. O. 00-25-13, dated July 20, 1943; T. O. 03-50-1, dated July 1, 1943; "Physiology of Flight."



OXYGEN EQUIPMENT

General—Oxygen Systems

Aircraft oxygen systems in use by the Army Air Forces consist of two general types:

1. **Demand system.**
2. **Continuous flow system.**

The demand system is automatic and furnishes the oxygen on demand in just the right quantities for all altitudes. Every time the user inhales, a shot of oxygen with the proper mixture of air is supplied. The demand system is now being installed in all Army Air Force combat aircraft.

The continuous flow system, on the other hand, supplies the oxygen in a continuous flow. In use, an altitude dial on the regulator must be manually adjusted to correspond with the reading of the altimeter to insure the delivery of the proper amount of oxygen for that altitude. Until recently, Army Air Forces aircraft were provided with this type of equipment.



The A-14 demand oxygen mask is the latest type of demand mask available.

Demand System

The demand oxygen system includes a demand type mask, A-12 type regulator, pressure gage, pressure indicator lamp, and ball or blinker type flow indicator. In addition, a portable recharger hose is supplied at each crew position in heavy bombardment aircraft for recharging portable (walk-around) oxygen equipment from the oxygen system of the airplane.



The A-10 Revised demand oxygen mask. Fit is important in all demand masks. Let your Oxygen Officer check the fit.

Three types of demand oxygen masks are available—type A-10, type A-10 Revised, and type A-14. They are used with the demand type regulators, the A-12 regulator for permanent installations within the airplane and the A-13 regulator for portable use.

The demand regulator (A-12) is essentially a diaphragm-operated flow valve which is opened by suction when the user inhales and closed when he exhales.

The demand regulator (A-12) is provided with two manual controls for use under special conditions—the AUTO-MIX lever and the EMERGENCY VALVE.

With the AUTO-MIX lever in the normal ("ON") position, the A-12 demand regulator automatically mixes just the right amount of oxygen with the air for the altitude at which the plane is flying. This is accomplished by an evacuated metal bellows like the aneroid control used in the altimeter. At sea level, the bellows is fully contracted and the air intake port is wide open while the oxygen port is closed. However, as the altitude increases and the pressure decreases the metal bellows expands and as it does so it gradually closes the air intake port. Finally, at an altitude of approximately 30,000 feet, the



air intake port is entirely closed and the oxygen port is wide open to deliver pure oxygen to the mask.

Remember, the normal position for the AUTO-MIX lever is "ON." When it is in that position the regulator automatically furnishes the proper amount of oxygen for all altitudes. **When the AUTO-MIX lever is in the "OFF" position, the air intake port is closed and pure oxygen is supplied at all altitudes.**

Note: It is not necessary to turn the AUTO-MIX lever to the "OFF" position above 30,000 feet.

When the red colored EMERGENCY VALVE knob on the regulator is turned on, the oxygen by-passes the demand mechanism in the regulator and enters the mask in a steady flow, regardless of breathing and of altitude. The valve, therefore, should not be opened except in case of emergency, as the oxygen supply will be quickly exhausted.

Use the AUTO-MIX lever in the "OFF" position ONLY in the following cases:

1. Below 30,000 feet to give a wounded man pure oxygen as treatment for shock due to wounds.
2. In special cases where the flight surgeon may advise breathing pure oxygen on the ground before flight and from the ground up as a protection against bends.
3. As protection against poison fumes, like carbon monoxide, or poison gas used by the enemy.

Turn on the EMERGENCY VALVE only:

1. To revive an unconscious crew member.
2. In the case of failure of the regulator. (Watch the flow indicator!)
3. In case of obvious failure of oxygen. In this case, turn on the emergency until the cause of the failure is discovered and corrected.

Precautions

Before Take-Off:

1. **Make sure mask fits properly.** Check for leaks by holding thumb over end of hose and breathing in gently. **Have Oxygen Officer check size and fit, with special Oxygen Officer's Test Set whenever possible.**
2. Check the pressure of the oxygen system. It should not be less than 400 pounds per square inch.
3. Crack the emergency valve on the regulator and see that you get a flow. (Caution: When the emergency valve is open do not pinch the hose or block the outlet or the regulator diaphragm will blow out.) Then be sure to close the valve tightly.
4. Check knurled collar at outlet end of regulator. It should be tight.

5. Check rapid-disconnect fitting on mask hose. Be sure rubber gasket is in place. Make sure male end of fitting fits snugly into the regulator hose. If it is too loose, pry open the prongs to get a tight fit.
6. Clip oxygen-supply hose to clothing or parachute harness close enough to your face to allow movement of the head without kinking or pulling the hose.
7. Be sure the AUTO-MIX lever is in the "ON" position.

In the Air:

1. When the mask is first put on, check for leaks by holding your thumb over the end of the mask hose and breathing in gently.
2. Manipulate the mask at frequent intervals when the temperature is low, to free it of any ice that may form.
3. Check the oxygen pressure gage frequently. Note: the regulator does not function properly with a pressure of less than 50 pounds per square inch.

After A Flight:

1. Wipe the mask dry. Wash it frequently with soap and water, rinse well, and dry thoroughly. Note: Masks with microphones should not be immersed in water; they should be washed with a cloth.
2. Inspect mask for cracks and possible punctures.
3. Don't lend your mask to anyone except in an emergency.
4. Take care of your mask and it will take care of you.

Continuous Flow System

Three types of masks—the A-7A, A-8A, and A-8B—are used with the continuous flow oxygen system.

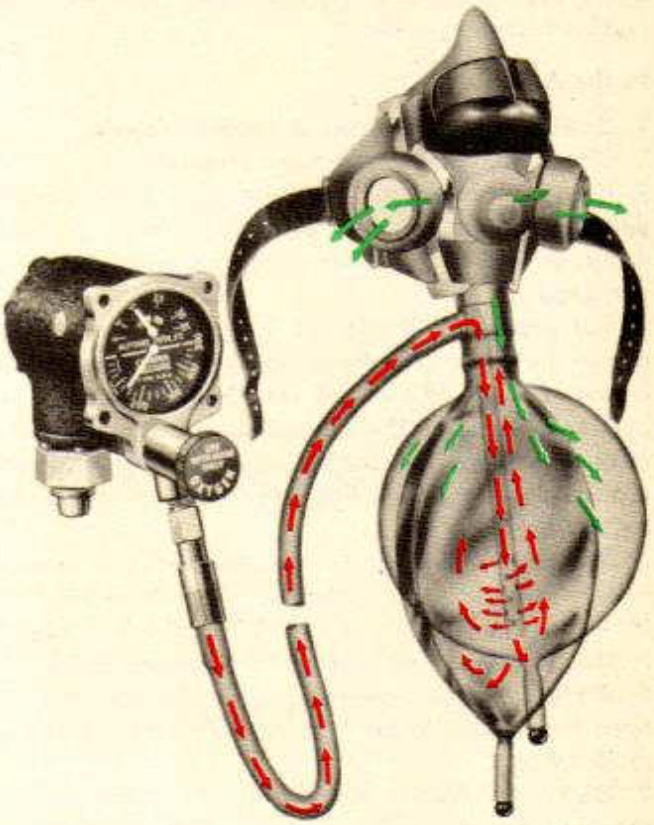
These are rebreather types of masks. The function of the bag is simply to conserve useful oxygen from the exhaled air. These masks must be used with the oxygen regulators A-9 and A-9A. The A-9 and A-9A regulators consist of an altitude flow indicator and a pressure gage. The flow indicator must be set at the altitude at which the plane is flying.

The A-7A mask, used with the A-11 regulator, is procured for use in cargo aircraft only. Since it leaves the mouth uncovered, it would be dangerous for general use above 20,000 ft.

Precautions

Maintenance:

1. Have rate of flow checked every ten days with a flow meter.



2. Never apply oil to any part of your oxygen equipment.
3. See that all parts are free of dirt.
4. Check entire system for leaks. Pressure should be maintained overnight with all regulators in the "OFF" position, if there has been no appreciable change in temperature.
5. Make sure that the valve adjustment knob of the regulator has fair resistance against turning to prevent any possibility of its being accidentally moved during flight. If it is loose, tighten the valve gland packing nut.

Before Take-Off:

1. Check the cylinder pressure. It should show 400 to 450 pounds per square inch for A-9 or A-11 regulators.
2. Check connections between mask, bag, and plastic connecting tube.
3. Check the rebreather bag for holes. Be sure plug is in bottom of bag.
4. Check to see that the exhalation disks are in proper position.
5. Know where your regulator is located.
6. Carry extra sponge rubber discs and protective shields for the exhalation turrets, or a protective

fabric bag for the entire mask. Take along an extra mask whenever possible.

In the Air:

1. Be sure regulator is set at proper altitude.
2. Check the cylinder pressure occasionally.
3. Breathe normally; overbreathing accomplishes nothing. In fact, it is dangerous; it may produce dizziness and other more serious consequences, if persisted in.
4. Put protective shields on the exhalation turrets or use the fabric bag whenever the temperature falls below 10°F (−12.3°C). If shields and bag are not available, examine the sponge discs at intervals and remove any ice that forms by squeezing them, or change the sponges. Whenever possible carry an extra mask.
5. Above 30,000 feet, the rebreather bag should never be completely collapsed when breathing in. If it does collapse, the valve should be opened further no matter what the flow indicator reads.
6. When exercise is necessary, be sure the valve is open far enough to prevent the bag from collapsing at 25,000 feet.
7. When you change your station at altitude be sure the new cylinder valve is **FULL ON and that the bayonet fitting is locked.**

After a Flight:

1. Shut all flow valves and make sure they are tightly closed.
2. Wash mask frequently with soap and water, rinse well, and hang up to dry.
3. Don't lend your mask to anyone except in an emergency.
4. Keep your mask in a safe place and away from sunlight.
5. Check the bayonet connection to see that the rubber seat is in place.

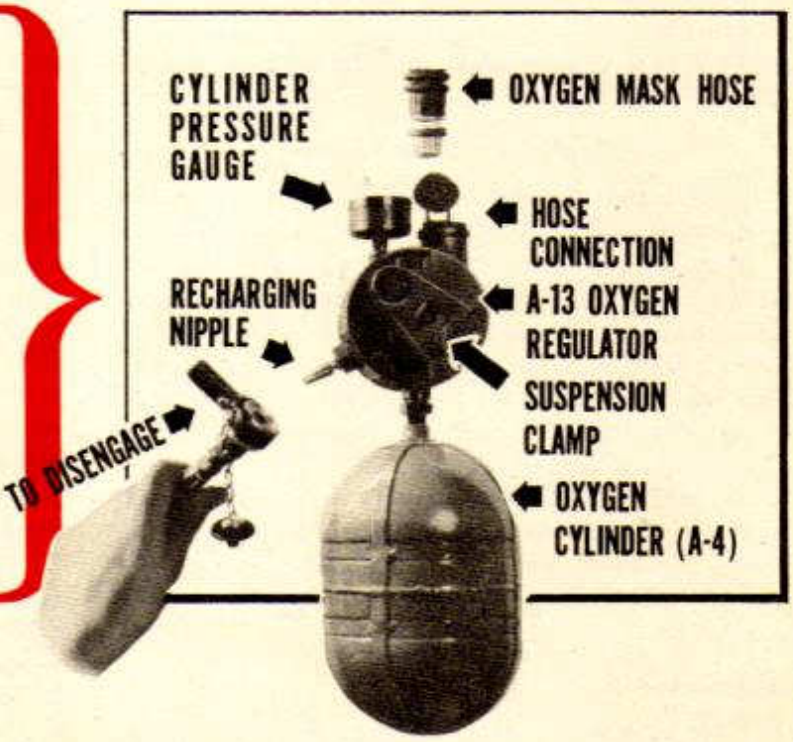
Warning

Extreme caution must be exercised in the use of oxygen equipment to insure that none of it becomes contaminated with oil or grease. **FIRE OR EXPLOSION** may result if slight traces of oil or grease come in contact with oxygen under pressure. Be sure that all lines, fittings, instruments and other parts are free of oil, grease, and other foreign matter. **NEVER USE LUBRICANTS ON ANY PART OF THE OXYGEN SYSTEM.**

WHEN RECHARGING BOTTLE BE SURE TO SEAT NIPPLE COMPLETELY HOME IN HOSE. AFTER RECHARGING DISENGAGE HOSE BY TURNING LEVER CLOCKWISE

RECHARGER HOSE AT EACH STATION IN PLANE

WARNING
Keep Oil Away From Recharging Nipple



PIF 4-2-5
REVISED August 1, 1944

Portable OXYGEN EQUIPMENT

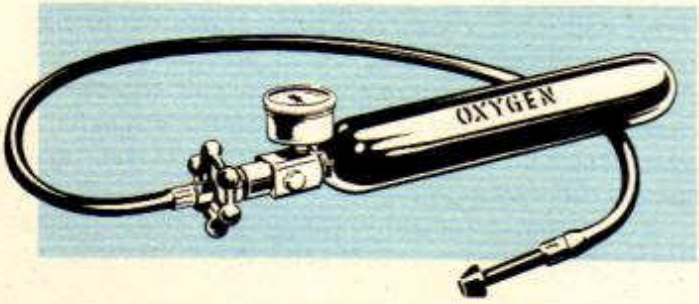
Walk-Around Bottle

In large airplanes, portable oxygen equipment in the form of a walk-around bottle fitted with an A-13 pure demand regulator is provided for use by the crew when changes of station are necessary. When movement from one part of the airplane to another is necessary, the mask hose is simply disconnected from the regular oxygen system hose and connected to the outlet on the A-13 regulator.

The walk-around bottle holds about a six-to-eight minute oxygen supply. The supply may last a shorter or longer time, depending on the altitude, depth of breathing, and the pressure in the bottle. The bottle can be replenished directly from the airplane oxygen system, but obviously only up to the remaining pressure in the system. The bottle is replenished by means of the portable recharging hoses at each station in the plane.

To Use the Portable Unit:

1. Before using, check the pressure gage. If pressure gage shows less pressure than that of airplane oxygen system, the cylinder should be refilled.
2. Inhale deeply, hold your breath, then disconnect mask from regular oxygen system hose.
3. Quickly open the spring cover of the regulator connection on the walk-around bottle and snap in the male fitting on the end of the mask hose.
4. Clip the portable unit to your clothing or parachute harness by means of the spring suspension clamp attached to the regulator.
5. During use, watch the pressure gage and refill cylinder from oxygen system whenever pressure falls below 100 pounds per square inch.





Bail-Out Oxygen Cylinders

Two bail-out oxygen cylinder assemblies are used for parachute descents from high altitudes. Both are completely self-contained units with pressure gage and release valve.

Either cylinder must be tightly fitted and securely tied in a pocket sewn to the flying suit or harness.

Before takeoff, check the cylinder's pressure gage. It should read at least 1800 pounds per square inch. Either cylinder assembly can be used in parachute descents above 30,000 feet, and as an emergency oxygen supply in fighter aircraft if the regular oxygen supply suddenly fails.

Type H-1: Before jumping, grip pipe stem between your teeth and completely open flow valve.

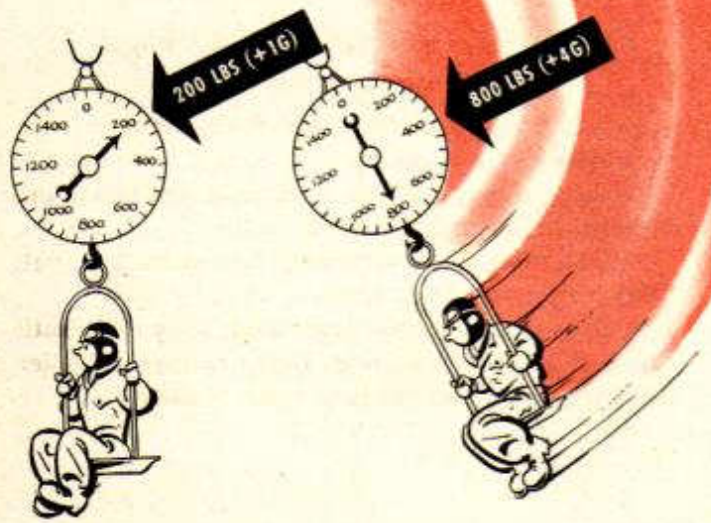
Type H-2: Before jumping, pull the release to open flow valve. Then, disconnect the main oxygen tube and jump.

PIF 4-3-1
REVISED August 1, 1944



The symbol "G" is used to compare any given force with the pull of gravity. Under normal conditions your body experiences a force of 1 G, the pull of gravity. A force of 4 G is a force four times the pull of gravity. If you weigh 200 pounds under ordinary conditions, you weigh 800 pounds during exposure to 4 G.

In level flight you can endure any speed if you are protected from the windstream. During changes of direction in high speed maneuvers, however, centrifugal force imposes increased G forces. The increase in G forces results in proportionately severe stress on you and your airplane.



Positive G (+G)

When you pull out from a dive or make a spiral turn, your head is toward the center of the circle which your airplane describes. Centrifugal force acts from your head to your seat. Force acting in this direction is called positive G; it pushes you down into the seat and seems to pull you downward.

The physiological effects of positive G result from a decrease in the heart's efficiency.

1. The pumping action of your heart may not provide sufficient pressure to raise the blood to your brain, since the blood is heavier under increased G.

2. The blood tends to be forced to the lower parts of your body and must return to your heart against the G force. As a result less blood gets back to your heart, and like any pump it loses efficiency with this decreased intake.

The decrease of the blood supply to the eyes and brain brings on serious effects: dimming or loss of vision, and unconsciousness. With less blood supply the eyes and brain do not receive their normal supply of oxygen and cannot function properly.

These effects vary with the intensity and duration of the G force. You can withstand a moderate G force with clear vision. A slightly greater force may produce visual dimming, called graying. With the increase of G in successive steps you experience temporary blindness at the sides of your visual field, then blackout, or complete inability to see, and finally, unconsciousness.

If you remain conscious, recovery of vision occurs within one or two seconds after the G declines. If

you lose consciousness, you may suffer loss of memory and of muscular coordination lasting up to 20 seconds, and may remain confused for a minute or more. The danger in this situation is obvious.

Besides the magnitude of the G force, its duration is also a critical factor. If G is applied suddenly, it takes approximately 3 to 5 seconds for visual symptoms to develop. Therefore, you may withstand successfully for 2 or 3 seconds a force which, if prolonged, would result in unconsciousness.

On the other hand, at any particular G level, all your difficulties develop within the first 10 seconds of exposure. In fact, some improvement in your first visual impairment occurs after about 15 seconds. **This means that if you ease off on the stick as visual graying occurs, your blood vessel system adjusts to the situation and you can withstand more G in the latter part of a long spiral turn than at the beginning.**

Men differ in their reaction to G forces. The average man blacks out at 5 G, if maximum G is reached in 2 or 3 seconds and maintained for 10 seconds. Some men black out at 3½ G, while a few retain some vision until they reach 7 G. Most men experience some visual dimming between 3½ and 4 Gs, held for 10 seconds.

Tolerance to "G" Force

While standing, your tolerance to G force is greatly reduced. **If possible, warn your crew before you perform any sudden maneuver, so that they won't be caught standing up.** Otherwise, even a relatively low G force may cause a man to lose consciousness and to injure himself by falling.

Your own G tolerance is characteristic for you and remains constant. Practice by frequent exposure to G neither raises your tolerance nor lowers it. In some flight maneuvers you are able to tolerate higher G levels than you could otherwise because the G force is of short duration.

There are ways in which you can increase your tolerance for G forces. If you can manage to crouch slightly, you decrease the height your heart must pump blood against the G force up to your brain. You can also employ the muscle straining technique described in this section.

A man with a high G tolerance who is an expert at using the muscle straining technique can withstand forces which exceed the safety limits of his airplane. You should know the limits of your plane and never exceed them. If you are going to experiment with G limits, install an accelerometer in the cockpit of your plane during the tests. Watch the accelerometer and learn how your own G tolerance compares with the stressing on your airplane.

Negative G (—G)

Negative G is the force you experience during inverted flight, outside turns, and push downs. In these maneuvers, centrifugal force operates from your seat to your head, driving the blood upward and increasing the pressure within the blood vessels of the head.

At the relatively low force of −2 or −3 G, you feel fullness or throbbing pain in your head, a gritty sensation in your eyes. Prolonged stresses of −3 G may cause hemorrhage in the eyes and, in certain cases, fatal hemorrhage into the brain tissue.

Unlike the situation with positive G, the disorders caused by negative G may outlast the stress by several minutes, or even by several hours.

Neither you nor your airplane are as well equipped to withstand negative G forces as you are to withstand positive G forces.

Play Safe

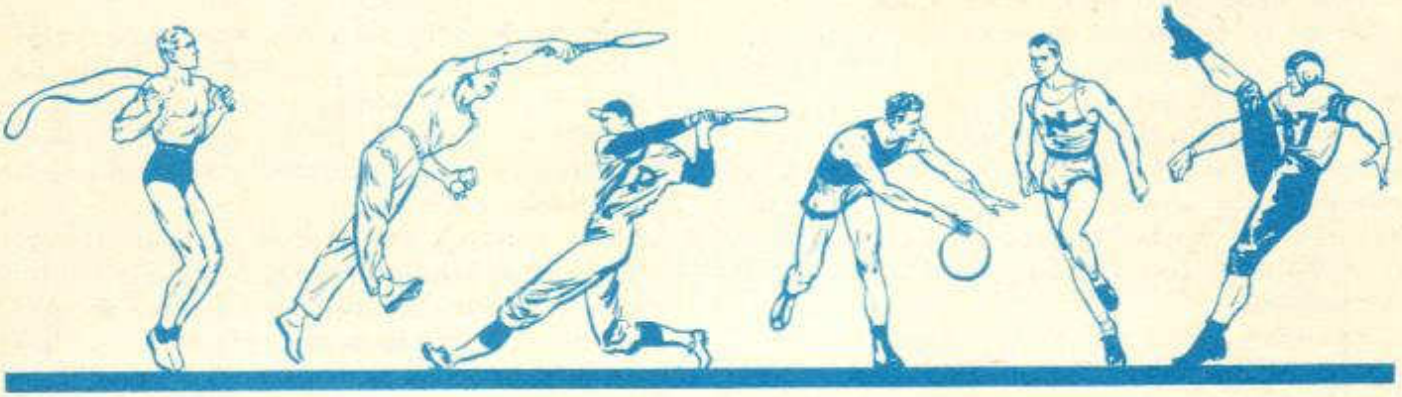
1. Stay within the safe load limits of your plane's structure and safe limits of your capabilities. Consider graying as a warning signal of excessive +G.
2. Learn to perform the muscle straining maneuver properly so that you will be able to use it when you need it.

Raise Your +G Tolerance by Proper Muscular Straining

1. Pull your head and neck down between your shoulders like a turtle.
2. Tense the muscles of your abdomen, arms, and legs. Strain against the safety belt.
3. **You must keep breathing!** To insure this, yell "Hey" over and over again.
4. Once you begin this maneuver, **keep it up until the +G is past!** You may have reached a higher level than you can tolerate when relaxed.

PIF 4-4-1
REVISED August 1, 1944

Physical Fitness



You are responsible not only for your own physical fitness but also for that of your crew. **This means daily exercise for all of you.** Exercise can take the form of sports and games, or of conditioning calisthenics, but it is essential, whether or not an exercise period is provided during duty time.

Haphazard exercise is of little value. It must be regular, intense, and of proper duration to do you any good. You should be really tired out when you are finished.

Of course physical exercise alone will not keep you fit. **It must be supplemented with good food, and with sufficient sleep, rest, and relaxation.** Otherwise the fatigue and strain will ultimately wear you down.

The importance of physical fitness is obvious. You wouldn't take out a plane in poor condition. Neither should you fly with a crew in anything less than perfect physical shape. **Flying requires perfection.** You cannot attain perfection nor maintain it without daily exercise. If you can't get in a game, get a half hour of conditioning exercises each morning, and some running during the day. Join in at least one or more of the following activities as the occasion and facilities permit. Above all make exercise a **daily routine.**

Some of the sports listed here can always be used as part of your personal physical conditioning program:

Team Activities: touch football, basketball, soccer, speedball, volley ball, softball, baseball.

Dual Activities: badminton, tennis, handball, squash, medicine ball.

Individual Activities: Swimming, cross-country running, weight-lifting, rope skipping, setting-up exercises.

Mix these up as practical needs require. The main thing is to get a maximum of fun and hard physical exercise out of them. In this way they become literally recreational.

Remember your physical condition is, in the last analysis, strictly up to you. You can and should check up on your physical fitness from time to time by giving yourself the work-out prescribed in the AAF Physical Fitness Test. The test is simple, practical, and specific, and you and your crew can find out how you compare with men in top physical shape by trying your own ability against the standards. Use the sit-ups, chinning, and 300-yard shuttle run as you would use a scale to keep yourself informed of your physical state.

A man takes justifiable pride in knowing that he is trim and fit; when he is fighting a war as a member of a team like the AAF more than pride is involved. He has a direct responsibility to himself and to other members of his fighting team to keep himself ready for high precision physical performance at all times.

PIF 4-5-1
REVISED October 1, 1943



VISION AT NIGHT

To Develop Night Vision

1. Insure adaptation to dark preceding any night operation by staying in a dark room or by wearing red lensed goggles, (Goggles, Assembly, Polaroid Type D. A., Class 13, Stock No. 8300-343575), for 30 minutes.

2. Protect this adaptation by not exposing your eyes to any bright light, either inside or outside the aircraft.

3. Keep all nonessential lights within the aircraft turned out, and all essential lights dimmed.

4. Use red light within the airplane whenever possible.

5. Read instruments, maps, and charts rapidly; then look away. Or, use only one eye; the other eye will retain its dark adaptation.

6. Use oxygen from the ground up on all night flights, except in low altitude training.

7. Keep all windows scrupulously clean.

8. Avoid casual paper or unpainted spots on the instrument panel—they reflect light.

Be sure to adapt your eyes to night vision before taking off. The sense organs for night vision become insensitive under strong light and require time for "adaptation to dark." During this period nothing brighter than candlelight should be used. If a dark room is not available, red goggles will do almost as well. Then when you take off a 10,000 fold increase in sensitivity will have been achieved.

9. Experience brings much improvement in night vision. Practice off-center seeing on dark nights whenever possible.

Keep goggles, enclosure windows, and windscreens clean and free from scratches. Scattered light reduces the contrast between faint lights and their backgrounds; reflected light from windscreens does the same.

Be sure you have an adequate supply of oxygen from the ground up. Without it, night vision is impaired at an altitude of only 5,000 feet, and is only one-half as efficient at 12,000.

Eat food rich in vitamin A. This is a chemical factor essential to good night vision. Eggs, butter, cheese, liver, apricots, peaches, carrots, squash, peas, and especially cod liver oil and all types of greens are rich in vitamin A. Too much vitamin A will neither help nor harm you.

Remember that in dim light, or at night, you cannot see what you look at directly. A night blind spot, unrecognized by most people, lies at the center of the eye. **Therefore, in the dark, look to one side of the thing you want to see.**

For reading maps and instruments, or when caught in searchlight beams, close one eye and avoid looking at the source of light. The eye which is kept closed will retain its power to see in the dark independently.

Use roving vision when searching the night sky. Keep your line of sight fixed in one direction for about one second, then move on a short distance to another position, thus covering your entire field in a series of eye movements and pauses. Small adjustments of the line of sight are sometimes made more easily by moving the head than by moving the eyes alone.

REFERENCE: "Physiology of Flight" and AAF Memorandum No. 25-5.

PIF 4-6-1
August 1, 1944

dangerous Gases

In Flight

The air you breathe while in flight should be free of all other gases except the oxygen from your mask. Exhaust gases, fumes from hydraulic fluid or coolant fluid, smoke, and poison gas may contaminate the cockpit air. In sufficient concentration, any of these gases is dangerous. You can protect yourself from them by knowing when to suspect their presence and by observing the necessary precautions.

Exhaust gas is a mixture of several substances. Among these are carbon monoxide and oxides of nitrogen, both of which are poisonous. Carbon monoxide acts by combining with the red cells of the blood and making them useless for carrying oxygen to the body tissues. This results in oxygen want or anoxia. As you ascend from sea level the dangers resulting from carbon monoxide increase, even below 10,000 feet, unless you use your oxygen mask.

The results of carbon monoxide poisoning are similar to those caused by oxygen lack—shortness of breath, headache, nausea, dizziness, dimming of vision, poor judgment, weakness, unconsciousness, and death. The higher the concentration of the gas, the longer you breathe it, and the higher the altitude (unless you use your oxygen mask), the more severe are the symptoms.

Like anoxia, carbon monoxide poisoning may give no warning. The gas itself has no odor, but you can be pretty sure of its presence if you smell exhaust gases. **The only safe rule for protecting yourself against carbon monoxide in flight is to wear your oxygen mask with the Auto-Mix "OFF" whenever you smell exhaust gas. In this way you get pure oxygen to breathe and are completely protected from any gases in the cockpit. As soon as you safely can, land your plane and report the trouble to your engineering officer.** If you had any unpleasant sensations while in flight see your Flight Surgeon as soon as possible.



Don't use your exhaust heater during combat. Enemy gunfire may cause dangerous leaks of the exhaust gas into the cockpit.

Be sure to wear your oxygen mask with the Auto-Mix "OFF" whenever you notice smoke or any unusual odor, such as that from gasoline, oil, hydraulic fluid, or coolant fluid, in the cockpit. If you are exposed to war gas and do not have your gas mask with you, wear your goggles and oxygen mask— **but be sure to have the Auto-Mix "OFF".**

On the Ground

Carbon monoxide is always present in exhaust gases. It occurs in poorly ventilated hangars and garages when motors are running. It is important, therefore, not to keep any kind of engine running any longer than necessary inside closed hangars and garages, and to ventilate such buildings as much as possible. If the hangar or garage must be kept closed do not stay inside any longer than necessary.

In cold regions, where gasoline or oil stoves and lamps are used in closed building or tents, carbon monoxide is formed whenever fuel is burned. Cross-ventilation is your only reliable protection.

First-Aid

If a person is overcome by carbon monoxide or any other gas, begin first-aid at once:

1. Remove him from the source of the gas.
2. Give him pure oxygen to breathe, if available (turn on EMERGENCY flow).
3. Begin artificial respiration immediately (see PIF 8-14-4).
4. Keep him warm.
5. Send for a medical officer.
6. Never exercise a person who has been poisoned by gas. This only makes him worse.

PIF 4-7-1
August 1, 1944



In flying operations extremes of temperature ranging from more than +130°F to less than -50°F may be encountered. It is important to know the precautions necessary to protect yourself against these wide thermal variations. The specific measures which must be adopted vary in different regions. Consult your Flight Surgeon for special information pertaining to health safeguards in unfamiliar regions. Knowledge of certain generalizations, however, is useful wherever you may be.

HEAT

Clothing

In the desert you must protect yourself from the severe burns which may result from exposure to the intense rays of the sun. This protection can be accomplished by wearing a sun helmet and lightweight clothing which leaves as little of the body surface as possible exposed to the sun. You can protect exposed surfaces of the body from sunburn by the use of sunburn protective ointments. Clothing should be loose-fitting and porous, to permit the evaporation of sweat. Tinted goggles or sunglasses will protect your eyes from the glare of the sun as well as from dust and sand.

Despite intense heat on the ground, it will be much cooler while flying and extreme cold will be encountered at high altitudes. Be prepared to increase or decrease the amount of clothing worn, according to the temperature met with in flight.

Even on the ground, desert nights are frequently cold. Be prepared for rather rapid changes in temperature by having available warm clothing for use at night. Woolen socks are most suitable for general use; they provide the greatest comfort because of their ability to absorb moisture and their good insulating properties. You will be troubled less by sand in your shoes if you wear the high-top variety. Oxfords have no place in the desert.

In the jungle or in regions where mosquitoes are prevalent, keep your body covered as much as possible and wear a head net for protection of your face and neck.

Water

In most warm-weather operations, water supplies are limited. If water is rationed, use it sparingly for purposes other than drinking. You will be surprised at how little water you can get along on in relative comfort if you are careful. Cut down on your smoking; better still, don't smoke at all—for smoking increases your thirst. When your water rations are limited chewing gum will help decrease your thirst. Water from streams or sources of questionable purity should always be boiled for at least 15 minutes before drinking. This will kill any dangerous organisms which may be present. Water also can be purified by chemicals such as Halazone tablets, which are included in the Kit, First-Aid, Aeronautic. Add 1 Halazone tablet to a pint of water; wait a half-hour before drinking.

Food

Food spoils quickly in warm climates. If canned rations are used they should be eaten soon after opening the cans or stored in a cool place. Food obtained from natives should be thoroughly cooked before eating. Thick-skinned fruits which can be peeled need not be cooked. Never use milk or milk products, such as butter, cheese, and ice cream, which are sold by the natives.

Exercise

In warm regions, physical exertion should be kept at a minimum. Exertion increases your sweating; sweating results in increased thirst.

Warm Climate Health

Sunstroke usually is caused by prolonged exposure to the direct rays of the sun, although it may occur even in cloudy weather. This is a serious condition. The symptoms may include headache, dizziness, red spots before the eyes, and vomiting. Even unconsciousness may occur. Heatstroke is a similar condition resulting from exposure to excessive heat from any source. Heat cramps in the various muscles of the body may develop following profuse sweating and the resulting loss of salt.

All of these conditions can be prevented by avoiding sun, sweat, and toil. Since this is usually impractical, do the next best thing: whenever possible perform your heavy work in the late afternoon, evening, or early morning when the temperature is lower. Provide all possible ventilation. Salt your food liberally and take salt tablets daily.

If your water rations are extremely limited, however, salt tablets may do more harm than good. Consult your Flight Surgeon before using them. He will instruct you as to the necessity for taking salt tablets and advise you concerning the dosage.

If sunstroke or heatstroke occurs, prompt treatment must be given. This should consist of cooling the body—immersion in cold water, covering with wet sheets, or simply pouring cold water over the patient's clothes, and fanning him.

In certain regions where malaria is prevalent it may be desirable to take atabrine or quinine to suppress the symptoms of this disease.

Take these drugs, however, only upon the advice of your Flight Surgeon. He alone can tell you when you need them and in what amounts.

COLD

The principal hazard in cold weather operations is frostbite. Protect yourself against this condition by observing a few simple principles.

Clothing

All clothing should fit loosely. This applies particularly to your socks, boots, and gloves. Tight-fitting clothing interferes with the blood circulation and makes you more susceptible to frostbite. Individual garments should be light and porous. It is desirable to wear several layers. Two light garments afford better insulation than a single heavy one. Long woolen underwear should be worn on all flights over cold regions. Wear several layers of woolen socks in sub-zero climates, but be sure that your boots fit loosely over them.

Leather shoes are of little value in Arctic regions. They not only afford poor protection, but may cause harm if they fit tightly over your socks.

Don't wear ordinary GI shoes inside your winter flying boots. Use woolen socks and felt liners or electrically heated shoes instead.

If possible wear two pairs of gloves or mittens—a rayon or other light pair inside heavier ones (either A-9's or electric gloves). Mittens are better than gloves, for they allow your fingers to come in contact with each other. This helps keep them warm.

Keep your socks and underwear clean. After they have become soiled by body oils and secretions, they lose a great deal of their insulating properties.

Keep Your Clothing Dry

Wet clothing is almost worthless in protecting you from the cold. If any part of your clothing should become moist, either by accident or through perspiration, take it off and dry it over a fire or change to dry clothing immediately. Wet feet and hands are particularly dangerous in cold climates for they will fall easy prey to frostbite.

Exercise to keep warm but guard against overexertion in extreme cold. Overexertion makes you perspire and the perspiration may turn to ice inside your clothing. This is dangerous. If necessary to perform much physical work, open or remove some of your clothing in order to prevent perspiration. Don't put on a heavy suit until just before takeoff. Wipe your body dry; then dress slowly. Once dressed, exercise no more than necessary.



Your complete F-2 wardrobe should contain the following items of clothing:

1. Jacket
2. Jacket Insert, Heated
3. Trouser
4. Trouser Insert, Heated
5. Helmet
6. Shoes, Felt
7. Shoe Insert, Heated
8. Gloves, Heated
9. Rayon Glove Inserts
10. A-12 Mittens
11. Scarf
12. Lead Cord
13. Woolen Shirt
14. Light Socks
15. Long Underwear

F-2 ELECTRICALLY HEATED FLYING SUIT

Electrically Heated Flying Suits

Electrically heated flying suits have the advantage of eliminating bulkiness and permitting greater ease in manipulating the controls of the airplane. However, there is a great disadvantage in wearing them on flights over cold regions. If your electrical system fails, if you are forced down, or if you have to bail out, you are left without protection.

Know how to use your electrically heated suit and treat it carefully. The electric heating elements are fragile. Dry your suit between flights, if possible, and have it tested by your Personal Equipment Officer.

1. Wear your F-2 electrical suit over long woolen underwear. (If your suit is the F-1 type, you should wear additional clothing over it as well.) The F-2 suit will afford adequate protection down to –40°F. If lower temperatures are encountered, add other flying clothing.

2. Put on the shoes with inserts over lightweight woolen socks. Then connect the snap fastener tabs on the trouser leg to the corresponding snaps on the shoe insert. Be sure that **both pairs** of snaps are properly connected.

3. Connect the tab at the top of the trouser to the corresponding snap fasteners on the inside of the jacket at the right. Make certain both pairs of

snaps are securely snapped together. Connect six-foot lead cord to jacket pigtail.

4. Put on regulation flying helmet and auxiliary equipment. Protect your neck from the cold by wearing a wool or silk scarf.

5. Put on lightweight rayon gloves. Snap the tabs on the jacket sleeves to the corresponding snaps on the heated gloves. Then put on the electrically heated gloves.

Connect your extension plug in the left receptacle of the built-in rheostat before takeoff and be sure that the suit is working properly. The plug can be locked into position by a simple clockwise twist. When in flight, keep the rheostat at the lowest comfortable heat. Don't ride hot; it will make you sweat.

Never rely on electrically heated suits alone when flying over cold regions. They are safe for use over temperate or tropical zones where cold is experienced only at high altitudes.

In extremely cold weather never touch cold metal with your bare hands, even for a moment. Your skin may freeze to it. If by accident this should happen, thaw your skin loose from the metal by warming the latter or by urinating upon it—don't pull your fingers loose.

Frostbite

Frostbite occurs most commonly in the fingers, toes, nose, ears, chin, and cheeks. It may set in gradually and painlessly and without your being aware of it. Numbness, stiffness, and a whitish discoloration of the affected part are among the first signs. Wrinkle your face frequently when exposed to cold air. If you experience a sensation of numbness, warm the affected part with your ungloved hand until sensation returns.

Crew members should watch each other's faces and be on the alert for areas of blanching. In this way serious trouble can be prevented. Frostbitten tissues may later become painful. Such tissues should never be rubbed. Never apply snow or ice to a frostbitten part. If your hand becomes cold or numb, warm it by placing it inside your clothing or under your armpit. Frostbitten tissues should always be thawed gradually. When possible, thaw them at ordinary room temperature. They should never be placed near a heater or immersed in warm water or in kerosene. Any of these procedures may cause irreparable damage. If frostbite occurs, cover the frostbitten area with a loose sterile bandage; keep the patient comfortably warm with blankets or a sleeping bag and by giving him hot drinks; and give him 100 per cent oxygen to breathe (Auto-Mix "OFF"). Report to your Flight Surgeon immediately after returning from your flight.

Snowblindness

This condition may result from exposure of your eyes, even for brief periods, to the glare which exists in snow-covered regions. The resultant damage to your eyes may cause intense pain and seriously interfere with your vision for several days—sometimes even longer. The hazard of snowblindness is particularly great on sunny days, but the glare which results from a bright overcast is almost as dangerous. Always protect your eyes by wearing colored goggles or sunglasses. In the Arctic, snowblindness may be brought on by merely lifting your goggles a half dozen times.

Body Heat

Eat an abundance of fatty foods while in cold regions. Fats are rich in calories, which help you maintain body heat. Take hot drinks such as coffee, tea, cocoa, or soup along with you in thermos jugs on all flights. These also add to your body warmth. Never drink whiskey or other alcoholic beverages to keep warm. They give you a false sensation of warmth but may do great harm by actually robbing you of your body heat, since they cause flushing of the skin. This loss of heat, together with the false sense of security which alcohol produces, makes whiskey, brandy, and the like dangerous for anyone who is exposed to the hazards of cold. Don't eat snow. If it is necessary to use snow for drinking water, melt the snow first.



PIF 4-8-1
REVISED August 1, 1944

The Flight Surgeon AND THE PILOT

Examination for Flying

Your Flight Surgeon can help you maintain your physical health, as well as your mental well-being. Consult him whenever you feel sick, tired, or run-down. Be sure to see him if you are injured. He is responsible in a large part for your flying status, as governed by AR 40-110. This regulation requires that you have a new physical examination for flying (Form 64) after:

1. Hospitalization for serious illness, or injury related to flying.
2. Grounding or removal from flight status, for cause other than minor illness or injury.
3. Return from sick leave.
4. Head injury with actual or suspected damage to the brain.

Protection from Venereal Disease

Sexual relations outside of marriage are likely to result in infection with venereal disease. Abstinence is the best method of prevention. The next best way to prevent venereal disease is to use proper protective methods **each time** you have sexual relations. It is impossible to tell in advance whether you are exposing yourself to venereal disease. If you fail to protect yourself, you are apt to become infected.

Adequate protection consists of wearing a condom and taking a prophylactic as soon as possible (within an hour) afterwards. Prophylactic kits can be obtained from your Flight Surgeon or PX.

If you have been exposed and failed to protect yourself, don't wait for symptoms to develop. Consult your Flight Surgeon as soon as possible. Remember that he is neither a moralist nor a judge. He is interested only in preventing and curing disease and in keeping you in the best possible physical condition.

Disciplinary action will not be directed against military personnel who have acquired venereal disease or who have failed to take prophylaxis. **Appropriate action is authorized, however, if you try to conceal infection.** Treatment with quack medicine is dangerous, so don't take chances—**report to your Flight Surgeon.**

Benzedrine

Benzedrine is a drug which may temporarily postpone sleep. The responsibility for the use of benzedrine on tactical missions rests with your Commanding Officer, who must decide what situations require it. Distribution and administration of benzedrine tablets, however, is the responsibility of your medical officer. Never take benzedrine on your own.

Benzedrine will not make you a superman. It merely postpones for a relatively short time your body's demand for sleep. Benzedrine is not a substitute for sleep, so be sure that you have a proper amount of rest after using it.

Sulfa Drugs

The sulfonamides are potent drugs for the prevention and treatment of many infections. These drugs, however, may sometimes cause temporary mental confusion, difficulty in seeing and hearing, clumsiness, and other difficulties.

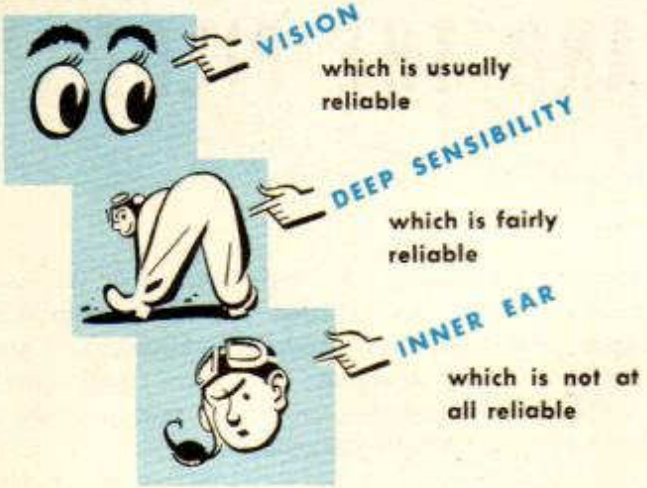
No one will be permitted to participate in aerial flights while receiving sulfa drugs or for six days following the last dose. Temporary grounding need not apply where sulfa drugs have been used for **external application only.**

The instructions and provisions of this regulation do not apply to passengers or patients being transported or evacuated by air, nor to the emergency use of sulfa drugs as supplied in the individual first-aid kits (AAF Regulation 25-13).

PIF 4-9-1
REVISED August 1, 1944

SENSE OF POSITION IN FLIGHT

Your sense of position, both on the ground and in the air, is governed by:



1. Vision is the all-important sense in contact flying. Vision furnishes your natural horizon. It is loss of vision which makes the transition from contact to instrument flight difficult, unless you learn to trust your gyro-horizon and other flight instruments with as much confidence as you do the natural horizon. In instrument flight, rely only on what you see in the cockpit.

2. The combination of sensations of pressure and tension on the skin, muscles, tendons and internal organs is known as deep sensibility.

When your feet are on the ground, sensations from your soles and the muscles of your legs tell you what position your feet are in. This deep sensibility is an important factor in helping you maintain your bodily balance.

In flight you get the effect of deep sensibility in the seat of your pants, since gravity and centrifugal force exert their action there. Changes in the position of your plane make you feel heavier or lighter, or as if you were being forced sideways in your seat.

3. When you can't check your position by visual reference, you rely mainly on your inner ear. The inner ear has two parts. The semicircular canals, which are placed in three different planes, are responsible for the sensation of rotation or turning, pitching and rolling. The static organ tells you the position of your head in relation to the ground.

INSTRUMENT FLIGHT

The sensations provided by deep sensibility and the inner ear lead to confusion when you are flying on instruments. Never trust your feel or sense of position when you are flying on instruments or at night; if you do, you'll get into trouble since the sensations from the seat of your pants and your inner ear do not indicate the true position of your airplane.

You often get false impressions when on instruments even during straight and level flights and especially in turns.

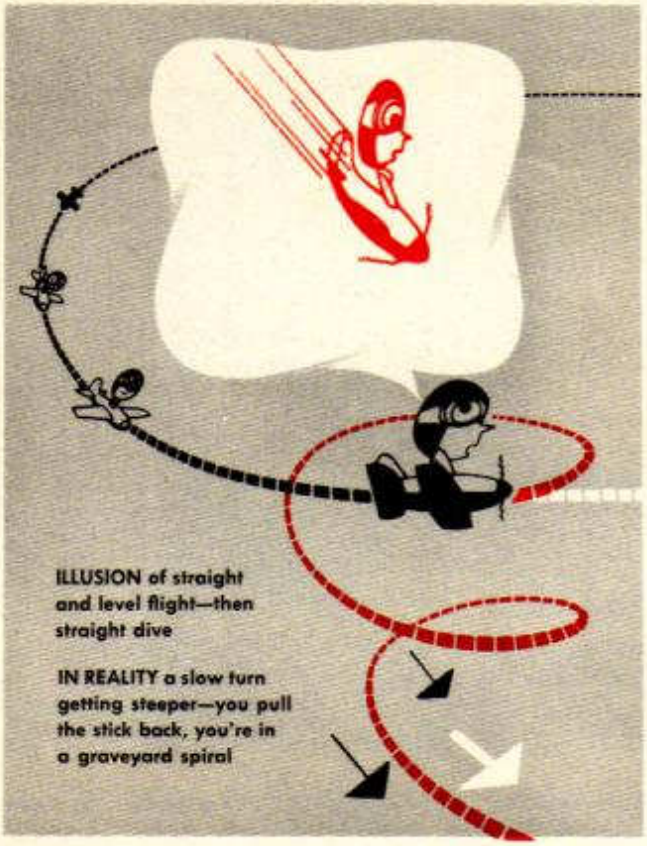
Sensory Illusions in Straight Flight

1. If your airplane tilts or tips suddenly in rough air and recovers slowly, you may not know when recovery is complete. Your inner ear retains the impression that your aircraft is still tipped or tilted. This impression may be so strong that you may lean to one side in an attempt to remain upright. **The leans** is one of the most common sensations experienced during instrument flight.

2. If you don't check your instrument readings every few minutes, your airplane may turn from the desired heading so slowly that you won't notice it. Then when you check with your instruments and correct your heading and position, you will feel that you are continuing your turn in the opposite direction.

3. The greatest single danger to an inexperienced pilot flying at night or on instruments is the **Graveyard Spiral.** This is a diving spiral which gets progressively tighter and steeper, and which is accompanied by a rapid loss of altitude.

Such a spiral results directly from relying too much on your sensations and too little on the instruments which indicate bank and turn. The spiral starts when the airplane gradually enters a turn without your realizing it. In such an involuntary turn the angle of bank and the rate of turn both increase so slowly that you have no sensation to warn you that the position of your airplane has changed. You retain the positive impression that you are still flying straight and level. Your first indication that anything is wrong is a change of noise, an increase in airspeed or a loss of altitude.



Under these circumstances, unless you look at and believe the instruments which indicate turn and bank, you may merely pull back on the stick, under the impression that by so doing you are recovering from a straight dive. If you do, this impression of being in a straight dive increases, since pulling back on the stick gives you the same feeling you have in a normal straight pullout from a dive.

Once you start to pull back on the stick, the turn gets tighter, the nose drops lower, and there is a great increase in airspeed and the rate of descent. After a few seconds the airplane may have more than doubled its original speed, and the rate of descent may have increased to several thousand feet per minute.

You can recover easily and quickly from such a spiral. **Remember: when anything seems to be going wrong, when the airplane is starting to lose altitude and gain speed, first look at the instruments which indicate bank and turn.** In all probability the airplane is banked and is turning, although your sensations make you feel it is in straight and level flight. Don't act according to your sensations. **Check and cross-check your instruments.**

4. The feel on the seat of your pants (deep sensibility) may make you think you are climbing when your airplane enters an updraft, or that you are diving when it enters a downdraft. You feel heavier in an updraft and lighter in a downdraft.

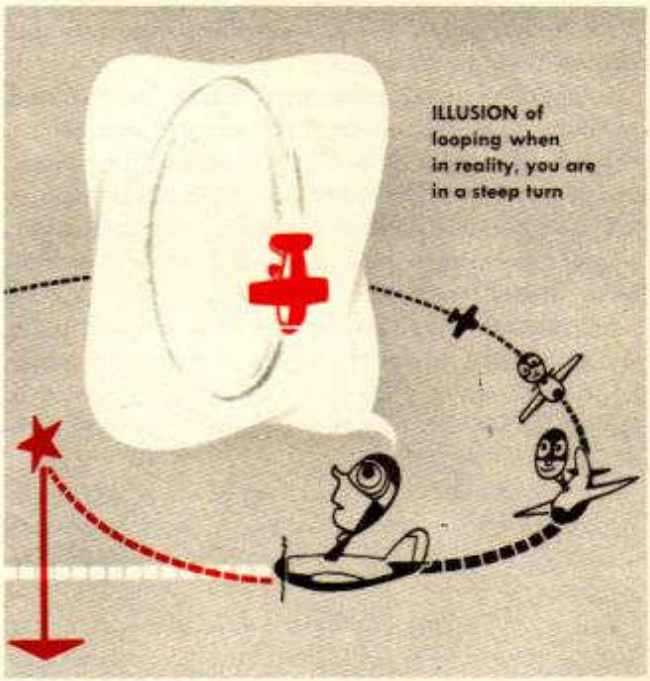
Sensory Illusions in Turns or Spins

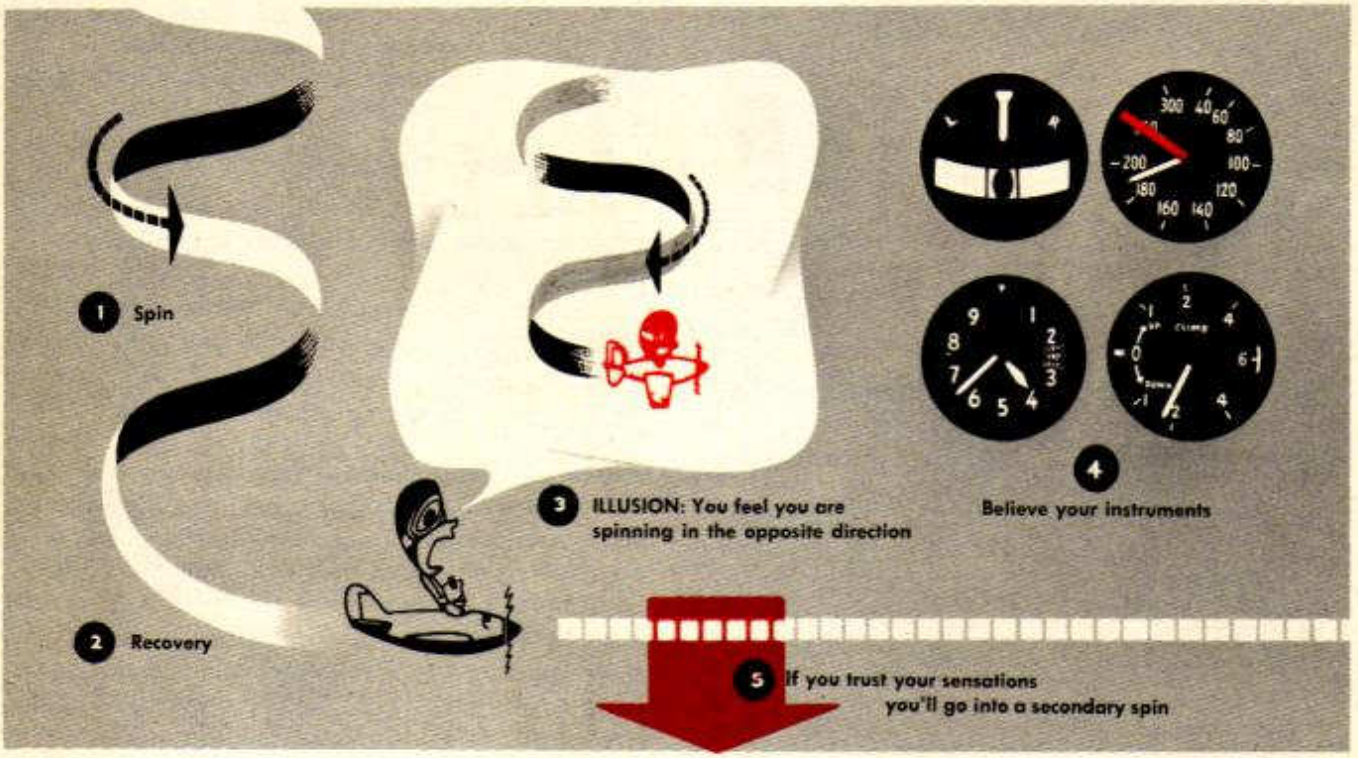
1. The standard rate turn is a slow turn. In it you experience much the same sensations you do in straight flight.

2. While performing steep turns, especially at high speed, your deep sensibility and the static organ of your middle ear may give you the sensation that you are in a loop rather than in a banked turn. When you come out of a steep turn your impulse may be to climb, because you begin to feel light. The force that has been pulling you hard against your seat lets up, so you think you are diving. If you trust your senses, you will stall the airplane.

3. If you hold your head steady in a turn, you have little sensation of turning. If, however, you move your head to look down or to the side in the cockpit, you will experience the sensation of doing a rapid roll, or of snapping around in the turn. You get this feeling because the new position of your head places another semicircular canal in the plane of rotation of the airplane.

4. During a spin you are subjected to high rotational speeds. If the spin is continued for more than an extremely short time, you will have, upon recovery, a marked sensation of falling off into a turn





in the opposite direction. In attempting to correct for this sensation, you may fall into a secondary spin. **Check spin recovery by your instruments, and trust them.**

NIGHT FLYING

Many of the accidents in night flying result from the fact that pilots rely too much on vision, rather than on their instruments.

At night the inexperienced pilot may look around continually to find some light on the ground by which he can orient himself. Unless he is flying near a large city where there are enough lights to make a good pattern, this habit is extremely hazardous.

Any experienced pilot can tell how he has mistaken a star for a light beneath him and how he thought lights were moving past him, when actually he was turning about the lights. A pilot can easily get so confused that he doesn't know which way is up, or whether the airplane is turning, diving, rolling, or climbing.

Most confusing and dangerous of all is the situation in which the pilot attempts to look backward to see lights behind him, such as after a takeoff into unlighted territory.

You may become confused easily in night flying because your eyes deceive you. You have no definite horizon to use as a plane of orientation; you have only isolated points of light. Your senses may mislead you if you depend solely on these lights for orientation, and you may become greatly confused in handling your airplane.

The one solution for this is to watch the instrument panel, with only occasional glances at the lights. If you get the habit of using your instruments as a major reference and of using lights only as a secondary reference, you will not get into trouble.

AIRSICKNESS

Airsickness is one form of motion sickness, like sea sickness and train sickness.

Contributing factors are: rough air, fatigue, poor ventilation, prolonged cold or heat, vibration, emotional tension, and poor physical condition.

The following aids in preventing or minimizing airsickness have been suggested by the Air Surgeon. Pass them on to your crew members:

1. Keep the horizon in full view except when tactical consideration, such as searching the sky for enemy fighters, dictates otherwise.
2. Sit as near as possible to the center of gravity of the airplane, where least motion will be felt.
3. Concentrate thoroughly on your mission to its termination.

Reference: Technical Order 30-100A-1, Section 2.



SECTION 5 POWER PLANT

GROUND OPERATION OF ENGINES

Starting of Aircraft Engines

First

Make sure ignition is off, then turn engine over four or five revolutions if engine has been idle for over two hours, or if excessive priming has been used during starting attempts.

Second

Open cowl flaps.

Third

Move carburetor air heat control to "COLD" position.

Fourth

Make sure fuel valve is turned on to a tank that contains fuel. On multi-engined airplanes, set fuel cock to supply fuel to all engines.

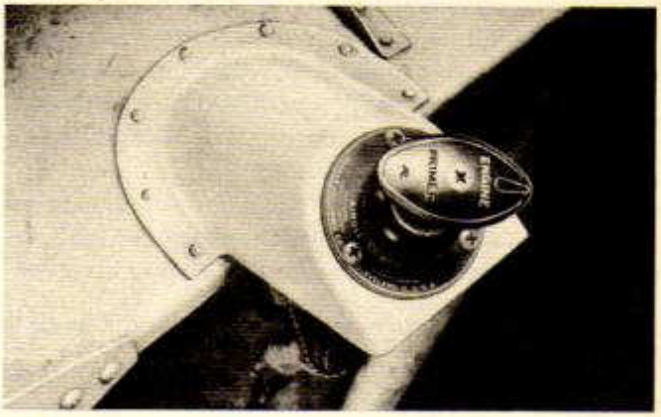
Fifth

Be certain that the cross-feed fuel shut-off cock is in "OFF" position on twin-engined airplanes. This cross-feed fuel cock permits the fuel pump on one engine to supply fuel to both engines in case of a fuel pump failure on the other engine.

Sixth

Move throttle almost to closed position—600 to 800 rpm. With low-pressure carburetor, put Fuel Mixture control in "RICH." With high-injection carburetor keep in "IDLE CUT-OFF" until engine fires.





Seventh

Make sure that the propeller controls of two position and Hamilton Standard propellers are set in the "LOW" rpm position, where they should be upon stopping the engine. About one minute after starting shift into "HIGH" rpm as this reduces the load on the engine and improves cooling.

Other constant speed propellers should be in the "HIGH" rpm position when stopped, so they will be properly set for starting and warm-up.

Eighth

Prime engine while energizing starter by using either hand type priming pump or electric type priming pump. Three or four strokes are usually adequate but up to 10 strokes may be used on large radial engines when cold. (One second on electric primer is equal to one stroke of the hand primer.) Avoid excessive priming as it washes the oil off of the cylinder walls causing scoring of the barrels and seizing of the pistons. **Throttle priming is not authorized for any engine** except where special instructions issued in Technical Orders pertaining to a particular engine advise this method.

Ninth

Turn ignition to "BOTH" position. Energize the starter, then hold meshing switch "ON" until engine fires. Open the throttle slowly to the desired warm-up speed.

On installations using the combination inertia direct cranking starters **engage both the meshing switch and energizing switch at the same time** after the starter has been energized.

Supercharger Control

Engines equipped with turbo-driven superchargers should be started with the waste gate open and supercharger regulator in "OFF" position.

Engines equipped with two-speed superchargers should in all cases be started and take-off made with supercharger in low blower.

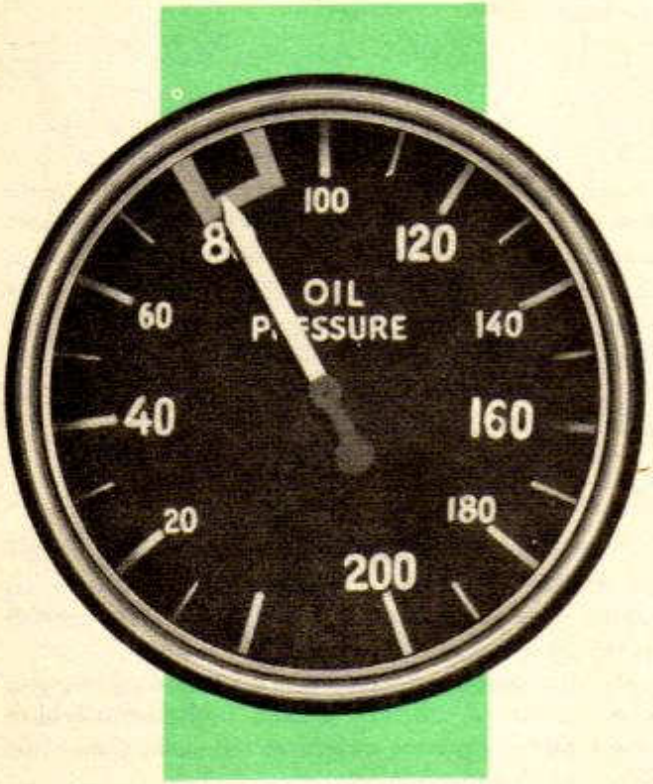
Engines equipped with two-stage superchargers should be started in accordance with the flight operating instructions for the specific engine involved.

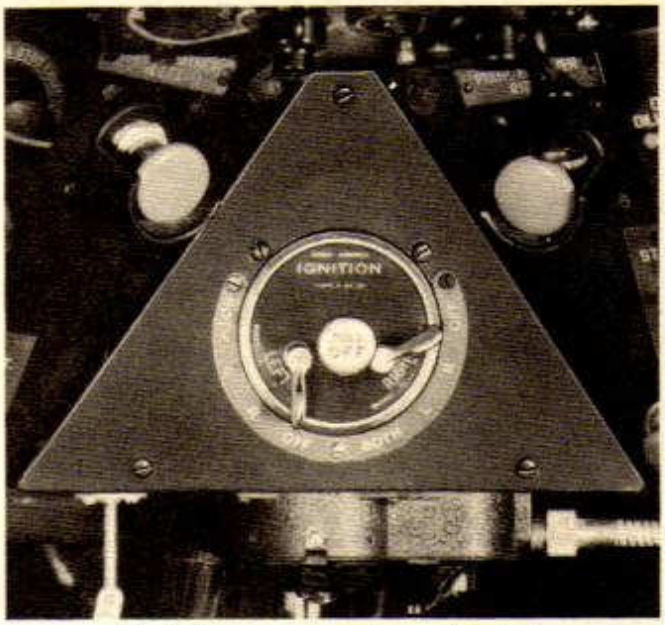
Warm-Up Procedure and Oil Pressure Check

Aircraft engines will always be warmed up on the ground until proper lubrication and engine operation for the take-off and flight are assured. Excepting in an emergency, engines will not be run on the ground for warm-up or test unless chocks are placed in front of the wheels of the airplane regardless of whether or not the airplane is equipped with brakes.

Be sure to watch the oil pressure gage. If it does not indicate pressure within 30 seconds, shut off the engine and have an investigation made.

After the oil gage indicates pressure, shift propeller to take-off setting and run engine at 600-800 rpm until oil pressure is normal (30-65 lb sq in.) for this speed.





Use both magnetos except on engine check.

Do not permit engine rpm to exceed ½ of the maximum permissible ground rpm during the warm-up period. When the engine maintains at least ⅔ of the minimum full power oil pressure specified for the particular engine, and the oil temperature gage shows a definite increase in oil temperature, the engine rpm may be increased to check for proper functioning of the engine and engine instruments, except that the maximum permissible ground rpm will not be maintained for periods in excess of 20 to 30 seconds on the ground.

Ignition System

Switch from one magneto to the other and note the loss of revolutions or manifold pressure. The normal loss in rpm on one magneto should not exceed 100 rpm.

NOTE: Whenever an engine is operating on only one magneto, the manifold pressure must not exceed maximum cruising manifold pressure to avoid detonation when firing on only one set of plugs.

If the airplane is not equipped with a manifold pressure gage, the magneto check will be made with not more than 85 per cent of the rpm developed when the throttle is opened to the throttle stop.

If the engine is equipped with an "Idle Cut-Off" carburetor, it is necessary to check the "OFF" position of the ignition switch to assure the proper connection of the ground wires. This check, made at idling speeds, need only be made at the start of the day's flying.

Controllable Propellers

Check the operation of the controllable propeller. During ground operation, the manifold pressure must not exceed the specified maximum cruising manifold pressure, to prevent overheating of the engine while operating in the low rpm (high pitch) position.

Fuel Supply

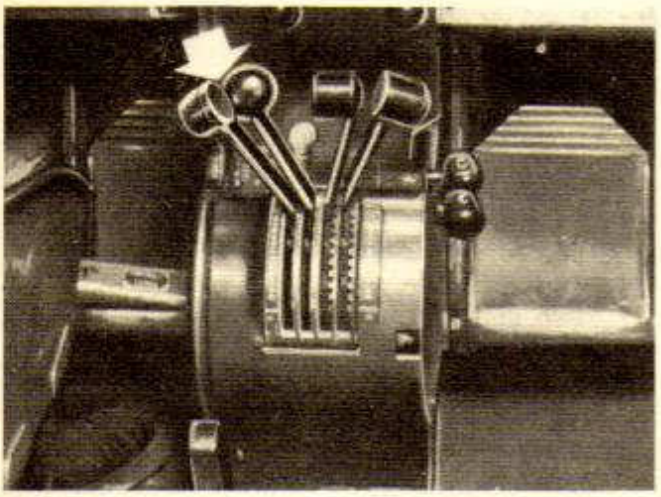
Check the functioning of all fuel tanks during the warm-up by switching the fuel valve to each tank long enough to insure that the fuel from that tank has a chance to flow to the engine.

Superchargers

Check the operation of the two-speed supercharger by shifting the clutches immediately following each engine warm-up.

1. Set propeller governor in low pitch (high rpm).
2. Set engine speed at 1,500 rpm.
3. Move supercharger control lever to the "HIGH" position and lock.
4. Open throttle to obtain not more than 30 in. Hg.
5. Check manifold pressure.
6. Immediately shift to "LOW" position. A sudden decrease in manifold pressure shows the two-speed supercharger drive is operating properly.

Check flight operating instructions for specific engines for check on two-speed and two-stage superchargers.



Supercharger controls.

Taxiing

Taxi from the line for take-off or to the line after landing with propeller controls in "HIGH" rpm (low pitch) position.

Set engine and cowl flaps "FULL OPEN" to prevent overheating the engine.

Changing Power Condition

To avoid excessive pressures within cylinders with resultant detonation and possibility of failure, use the following procedure when changing condition of power:

Increasing Engine Power

1. Adjust mixture control to obtain fuel-air ratio specified for power condition desired.
2. Adjust propeller control to obtain desired rpm.
3. Adjust throttle control to obtain desired manifold pressure.
4. Readjust mixture control, if necessary.

Decreasing Engine Power

1. Adjust throttle control to obtain desired manifold pressure.
2. Adjust propeller control to obtain desired rpm
3. Readjust throttle controls, if necessary.
4. Adjust mixture controls to obtain desired fuel air ratio.

Stopping Aircraft Engines

This preliminary procedure applies to all engines regardless of the type of carburetor or fuel system installation:

1. Mixture control in "FULL RICH."
2. Throttle in normal idling position.
3. Propeller controls of two position and Hamilton Standard will be in "LOW" rpm; other constant speed propellers in "HIGH" rpm.
4. Nose cowl or radiator shutters (if installed) fully opened at normal idling speed until engine temperature has cooled below cruising temperature.

The following procedure applies to engines equipped with float type carburetor WITHOUT idle cut-off.

1. Turn the fuel valve to "OFF" position.
2. Idle engine at 800-1,000 rpm until fuel pressure drops to zero.
3. As engine dies, move throttle slowly forward. When engine stops, cut ignition.
4. Turn fuel valve "ON" after engine has stopped, and operate wobble pump until fuel pressure gage indicates pressure showing that carburetor and fuel lines are filled with fuel.

The following procedure applies to engines equipped with float type carburetor WITH idle cut-off.

1. Leave fuel valve "ON."
2. Idle engine at 800-1,000 rpm.
3. Set mixture control at "IDLE CUT-OFF."
4. Set throttle at "FULL OPEN."
5. Cut ignition after engine stops.

The following procedure applies to engines equipped WITH fuel injectors (no carburetor).

1. Leave fuel valve "ON."

NOTE: Fuel cock will never be shut off except in emergency.

2. Idle engine at 600-800 rpm.
3. Set mixture control to maximum lean without moving the throttle.
4. Cut ignition after engine stops.

CAUTION

On high output engines it may be necessary to idle at a higher speed than normal to prevent overheating and fouling of plugs.

Oil Dilution

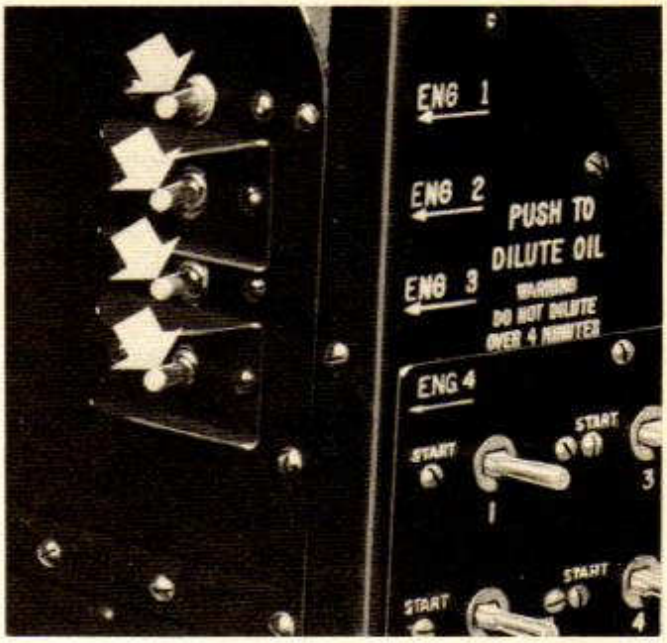
To operate oil dilution system before stopping the engine:

1. Turn oil dilution control "ON," when a cold weather start is anticipated, for four minutes at 1,000 rpm, then stop the engine.
2. Repeat the oil dilution after approximately 15 minutes.

NOTE: Dilution is ineffective while oil temperatures are above 70°C (158°F).

If oil temperatures are too high, stop engine and wait for it to cool to 40°C to 50°C (104°F to 122°F), then restart it and proceed with the oil dilution.

A normal start should be made without regard to the oil dilution system. If a heavy viscous oil is indicated by oil pressure too high, or by fluctuating oil pressure when engine rpm is increased, push dilution control "ON." This method should be used only if time and extreme temperature conditions do not permit engine warm-up in the usual manner. Over-dilution is likely to occur under these conditions because of low oil flow and a cold engine which



Oil dilution switches.

results in little evaporation until engine warms up. If dilution is used, close observation of oil pressure is necessary to determine whether or not the oil has been over-diluted, resulting in low oil pressure.

NOTE: If necessary, immediate take-off may be made after oil dilution without the normal warm-up, provided there has been a rise in oil temperature and the oil pressure is steady.

Over-dilution will not occur usually if the diluting operation is done immediately after flight, while the engine and oil are warm. Over-dilution has no serious effect on engine bearings if the oil pressure remains normal.

To Eliminate Engine Failure

Excessive ground running time of airplanes is one of the main reasons for early failure of the engines. Reduce the ground running time by the following procedures:

1. Hold ground tests and warm-up periods to a minimum.
2. Do not taxi away from the line for take-off until the control tower operator gives the necessary instructions.
3. Shut off the engine when it appears that take-off will be delayed due to other planes landing or other causes.
4. Use proper judgment in taxiing to position to prevent long periods of ground running of engines.

REFERENCE: Technical Order 02-1-29, dated Nov. 23, 1942

PIF 5-2-1
REVISED October 1, 1943

FLIGHT OPERATION OF *Engines*

Operating Limits Depend Upon Grade of Fuel Used

Military aircraft engines designed to use 100/130 grade of fuel will be operated in combat and on certain missions with the grade of fuel for which they were designed; but much of your flying within the domestic area will be on a lower grade fuel than that for which the engines were designed.

You must be absolutely certain of the grade of fuel you are using and accommodate the operating range of your engines to it.

To conserve 100 octane aircraft fuel, 91 octane is now specified for most military aircraft operating in continental United States on training or routine flights.

Missions On Which 100 Octane Will Be Used



All flights over salt water (such as coastal patrol).



Operations involving the towing of gliders or targets.



Other missions which require operations above the limits authorized in T. O. No. 02-1-38.

All aircraft which require and are serviced with 100 octane fuel will be operated at all times using the most economical power and cruising conditions.

Mixed Grades of Fuel

On any mission named above, never mix 100/130 octane with a lower grade fuel. If your tanks contain any 91 octane, have them fully drained before servicing with the higher grade fuel.

It is permissible when occasions demand to mix fuels of grade 91 and grade 100/130. But when these grades are mixed, you must observe operating limits for grade 91.

Reduction of Full Rated Power

When fuel grade of Spec. No. AN-VV-781, amendment 5, AN-F-27, or AN-F-28 is used, full rated military power is allowed. When fuel grade of Spec. No. AN-VV-781, amendment 4, is used, you will reduce maximum boost by 10% below full rated power.

Watch Your Operating Limits

In using the lower grade fuel, pilots must use special care in flight operations of engines to avoid any condition that may lead to detonation, which is always a danger in engines operating on a grade of fuel lower than that for which they were designed.

All aircraft serviced with the lower grade fuel will have attached to the control column or ignition switch a red warning tag bearing the following notation:

Warning To Pilot

This airplane serviced with fuel, grade 91, Specification No. AN-F-26. Operate engine within the maximum limits prescribed in T. O. No. 02-1-38.

Detonation in Aircraft Engines

Detonation may be indicated by unusual engine roughness, cylinder temperature increase, erratic fuel-air ratio, and by the exhaust flame.

Engine roughness does not necessarily indicate that there is detonation, but when unusual roughness is present it may be due to detonation.

Cylinder temperature increase cannot be relied on as a definite indication of detonation but since

detonation liberates an unusual amount of heat to the cylinder walls an increase in cylinder temperatures may be due to detonation.

An erratic fuel-air ratio reading may indicate detonation. If, as the mixture is leaned out, the needle does not show a leaner mixture or backs up the scale towards the rich side, detonation has probably occurred and the mixture should be richened.



Exhaust flame is the most reliable indication of detonation when exhaust stacks are visible. Intermittent puffs of dense black smoke, often accompanied by sparks or glowing carbon, indicate detonation. Black puffs occurring with great regularity indicate severe detonation. A rich mixture is indicated by full red flames with steady black smoke. Black smoke and red flame may also be caused by high oil consumption, ice in the carburetor, or other causes of poor fuel distribution. Light blue flames, almost invisible, indicate a mixture setting which produces maximum power.

Detonation may be caused by use of fuels of low octane number, low fuel-air ratio, and engine operating conditions.

Use of fuels of low octane number will cause detonation since **fuels are rated in terms of their resistance to detonation.** The greater their resistance to detonation the higher the octane number of the fuel. A higher octane number fuel than that specified may safely be used but a lower octane number must be used only when specified in technical orders or in an emergency. In this case the engine instructions covering the use of a lower grade fuel must be strictly followed.

The greatest tendency for fuel to detonate occurs near the fuel-air ratio for best power. Leaning the mixture increases the detonation, while rich mixture increases anti-knock value and cools the cylinders.

A change in engine operating conditions which increases the pressure or temperature in the cylinder increases the chance of detonation. Therefore, detonation may be caused by the following:

1. Increasing the manifold pressure.
2. Advancing the ignition timing or by operating on one spark plug.
3. Increasing intake air temperature by use of the carburetor air heater.
4. Increasing fuel-air mixture temperature, as by using high blower gear ratio instead of low blower to obtain a given manifold pressure.
5. An increase of cylinder temperature.
6. Building up of engine deposits which tend to decrease the rate at which heat is conducted away from the combustion chambers.
7. Operating engine for an excessive period on the ground.
8. Leaning fuel-air mixture.

Results of detonation are loss of power, overheating, preignition, and damage to the engine.

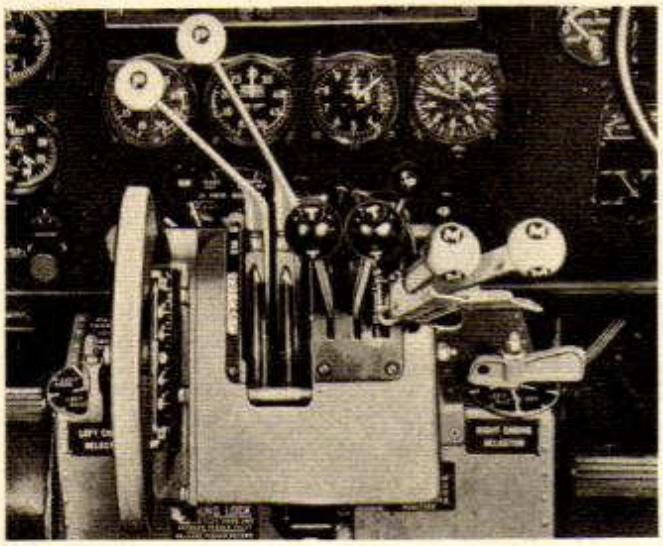
To obtain detonation-free operation immediately reduce the manifold pressure, richen the mixture, and reduce carburetor air heat to the minimum at which icing may be prevented.

Changing Power Condition

To avoid excessive pressures within cylinders with resultant detonation and possibility of failure, use the following procedure when changing condition of power:

Increasing Engine Power

1. Adjust mixture control to obtain the fuel-air ratio specified for power condition desired.
2. Adjust propeller control to obtain desired rpm.
3. Adjust throttle control to obtain desired manifold pressure.
4. Readjust mixture control, if necessary.



Propeller, throttle, and mixture control quadrant.

Decreasing Engine Power

1. Adjust throttle control to obtain desired manifold pressure.
2. Adjust propeller control to obtain desired rpm.
3. Readjust throttle controls, if necessary.
4. Adjust mixture controls to obtain desired fuel-air ratio.

Fuel-Air Ratios

The fuel-air ratio values are the absolute minimum with which dependable engine operation can be expected. Use fuel-air ratios somewhat richer than the minimums specified except when extreme ranges are essential. This increase will help prevent sticking and burning of piston rings.

Air Speeds During Climbs

To obtain proper cooling, maintain a calibrated IAS of at least the best climbing speed specified for the particular airplane, with at least a 10 per cent greater IAS desirable unless the tactical situation prevents, or unless maximum altitudes are desired.

NOTE: **Under no circumstances** will airplanes be climbed for protracted periods at calibrated IAS less than the best climbing speed when using rated engine power.

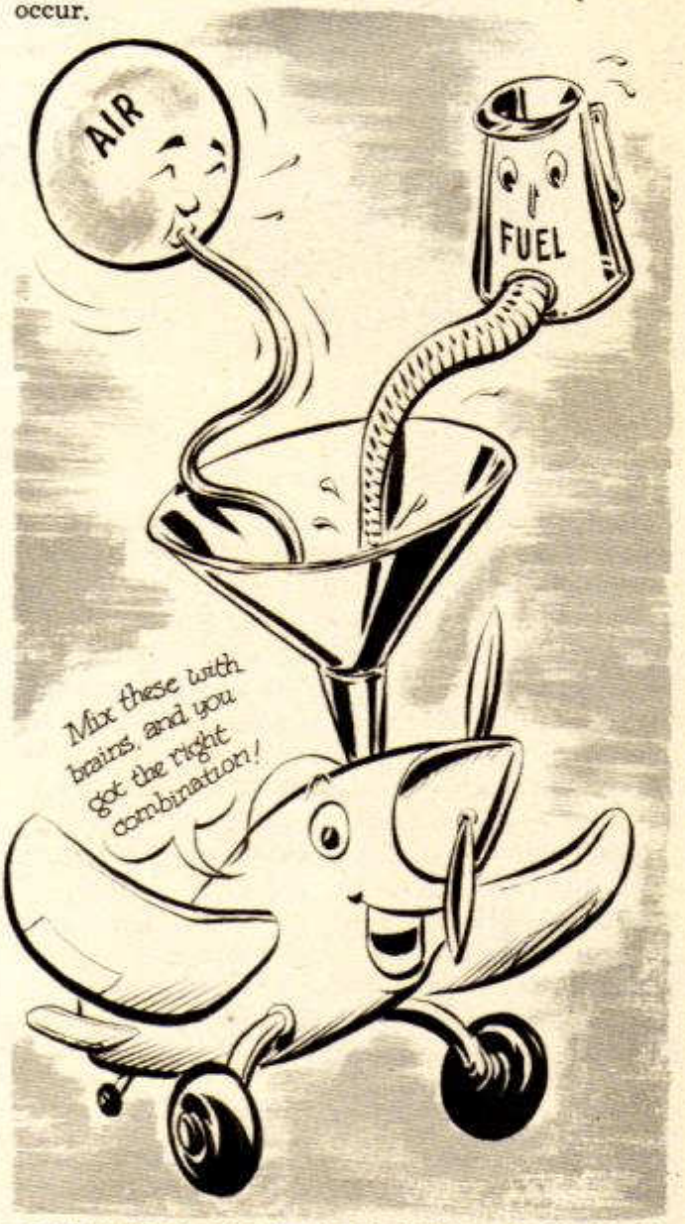
The true climbing speeds for all later model airplanes appear in Flight Characteristics Section of the Handbook of Flight Operating Instructions for each type of airplane.

Overspeeding of Aircraft Engines

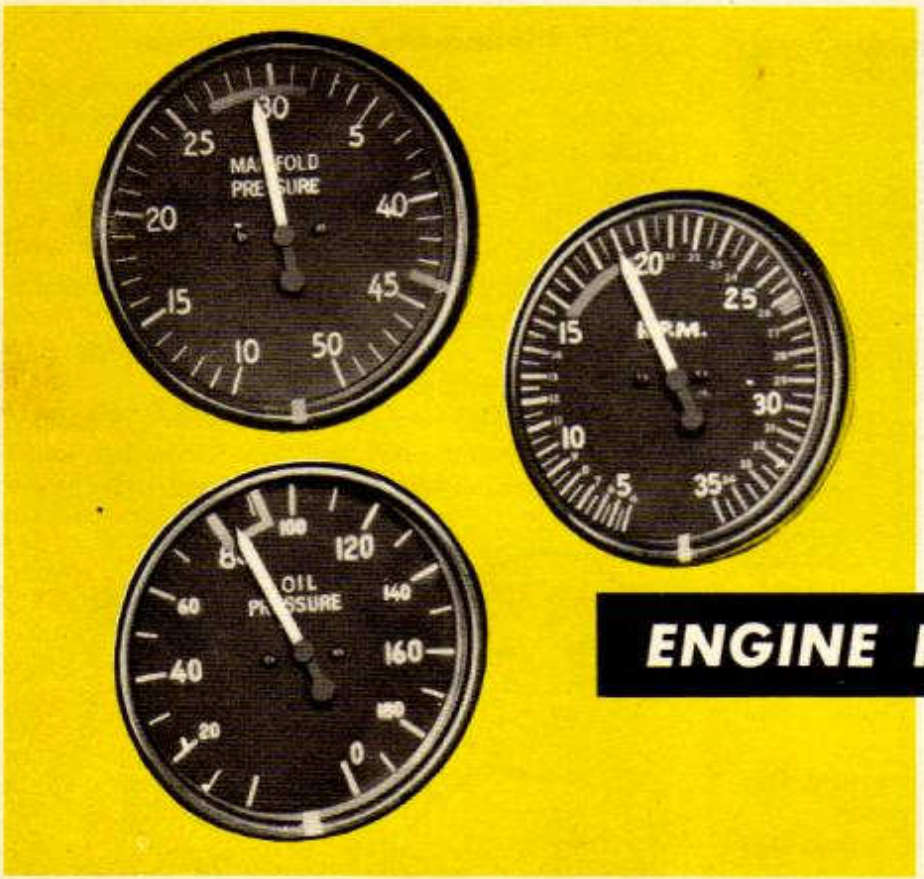
When manifold pressures and engine speeds have exceeded those specified, follow this procedure, without exception.

Report the following information to the Squadron, Station, or Sub-Depot Engineering Officer, as the case may be, immediately upon landing.

1. The maximum rpm and manifold pressure which was obtained during flight.
2. Duration in minutes of the overspeed and overpower operation.
3. Reason for overspeed and overpower, if known.
4. Total engine time and time since last overhauled when overspeed or overpower operations occur.



REFERENCE: Technical Orders 02-1-29, dated November 23, 1942, and 02-1-69, dated May 22, 1943.



ENGINE INSTRUMENTS

Manifold Pressure Gage

Manifold pressure gages should be checked before every flight and after every 50 hours of service:

Preflight—Check the instrument by gunning the engine with the supercharger off, if it is of the turbine type. The needle should move freely toward the high side of the scale. Check against barometer, if practical. Be sure manual, automatic, or balance line drain has been operated properly during first warm-up. Drain for 30 seconds at 800 to 1,000 rpm to obtain proper setting.

In the case of any sign of malfunction, all connections should be checked for leaks.

50-Hour—The reading of the instrument should be checked against the station barometer every 50 hours. If the reading differs more than 0.4 inches Hg, the instrument should be removed for a bench test and resetting of the pointer.

Fuel Mixture Indicator

The fuel mixture indicator shows the fuel-to-air ratio and is used as a visual guide for setting the mixture control. When making mixture adjustments, allow at least one minute to elapse before reading the instrument. This will provide time for the change in the carburetor setting to evidence itself.

The fuel-air indicator has a uniform degree of accuracy over a wide range, provided there is no detonation. If there is detonation, the indicated fuel-air ratio will be higher than the actual value.

If, as the mixture is leaned out, the indicating needle does not show a leaner mixture, or backs up toward the rich side of the scale, **detonation is taking place** and the mixture should be made richer.

If, as the mixture control is shifted from position to position, the indicating pointer remains near the "A" point (air point), the instrument is inoperable.

Oil-Pressure Gages

During the operation of aircraft in temperatures below 32°F, engine oil congealing in the oil-pressure gage line may cause the gage to react sluggishly. When this condition exists, the oil-pressure gage line should be drained and refilled with petroleum base hydraulic fluid.

Normally, the fluid will mix with the engine oil very slowly. From 60 to 90 days may elapse before the gage will begin to operate sluggishly again.

PIF 5-3-2
REVISED December 1, 1943

MARKING OF INSTRUMENTS

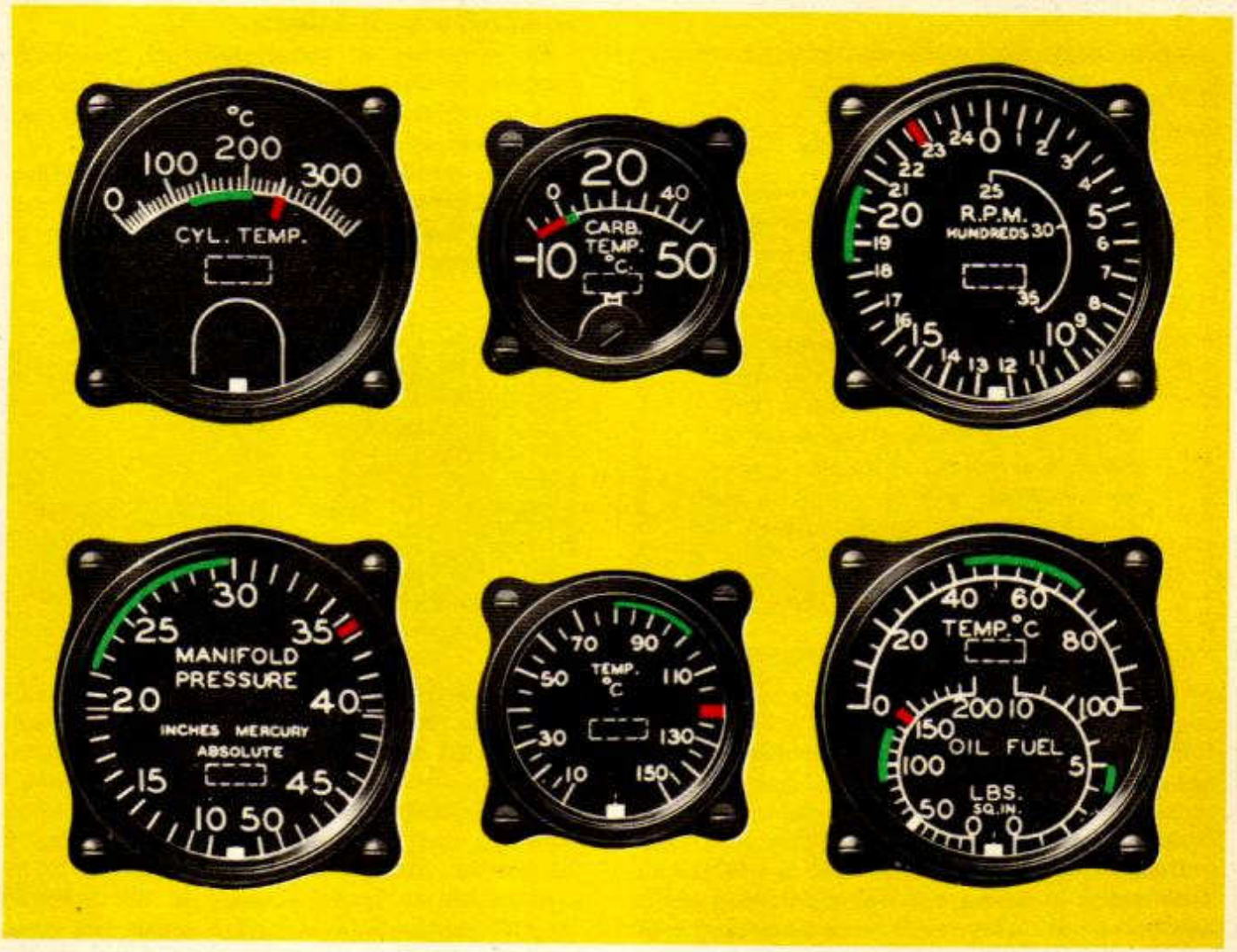


The operating limits and ranges of engine instruments and the airspeed indicator are marked on the face of the instruments to facilitate reading these instruments.

The engine instruments are marked with short radial lines in red to indicate limits which should not be exceeded. Operating ranges are shown by green arcs. A white radial line at the bottom of the cover glass is used as an index to show rotation of the glass.

The maximum permissible indicated airspeed is marked with a red line extending from the center of the dial and passing directly over the point corresponding to the maximum permissible indicated airspeed.

REFERENCE: Technical Order 05-1-17, dated November 3, 1943



PIF 5-4-1
REVISED October 1, 1943

Fuel Systems



Standard Fuels

The standard fuels of the Army Air Forces are:

Grade 62	Grade 87
Grade 73	Grade 91
Grade 80	Grade 100
	Grade 130

You'll find the correct grade to be used marked on your airplane.

For Combat Use Only

100 octane fuel is needed in combat. Therefore, fuel, Grade 91, conforming to Spec. AN-F-26 is authorized for use, within the Continental United States, in practically all aircraft engines originally designed for 100 octane fuel. This substitution must be made only under operating conditions specified in T. O. 02-1-38. **A Red Warning Tag, noting the substitution and listing specific operating conditions, will be placed on the control column or ignition switch of the airplane.**

Commercial Fuels

When buying commercial fuels for normal operation, grades must be equal to or higher than required AAF grade, to obtain safe engine operation. Fuels having higher grade ratings than that specified for a given engine may be used as a substitute, if necessary. **If commercial fuel is procured, obtain only enough to enable you to reach a source of AAF specification fuel.**

Aromatic Fuels

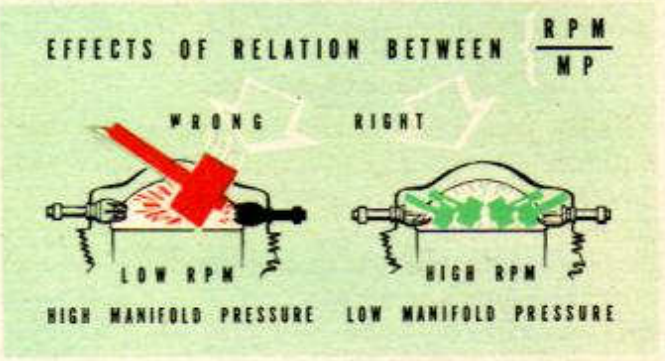
All fuels of grade 100 or higher are aromatic. In using them observe carefully the markings on all fuel tanks. **Do not use aromatic fuels in tanks not treated for their use.**

Detonation

In using lower grade fuel you must take every precaution to avoid detonation.

Be sure that all spark plugs are functioning, particularly when using a fuel of lower grade than that for which the engine was designed. One dead spark plug may cause detonation.

Remember that operation at higher manifold pressure and lower rpm is more likely to cause detonation than lower manifold pressure with higher rpm —in the same range of operation.



Detonation can be reduced by placing the mixture control in "MANUAL RICH" as no compensation is made for altitude and the mixture will become richer as altitude is gained. If the carburetor is equipped with automatic mixture control, richer mixtures can be obtained by having control in "MANUAL RICH" than in "AUTOMATIC RICH" position. **Never fly the airplane in "AUTOMATIC LEAN" position when using low octane fuel except when specific Technical Orders so direct.**

Fuel System Operation

Fuel system failures and forced landings will result if you do not know the operating characteristics of the fuel system, and the proper operations to be performed to insure its normal functioning.

IMPORTANT

Before flying any type of airplane, be sure you know:

1. Fuel consumption of engine, at cruising and full throttle.
2. Capacity of each fuel tank in airplane.
3. Location of each fuel valve in pilot's compartment and its function with reference to operation of the engine.
4. Location of the sight gages, if so equipped.

Reserve Fuel Supply

Reserve fuel supply is provided by two methods: a standpipe in the main fuel tank, or by auxiliary tanks. **When a standpipe is used as a reserve supply, and it is necessary to take off or land on a reduced fuel supply, use the "RESERVE" position.** All current model airplanes are designed to provide a reserve fuel supply of approximately 20 minutes of full throttle operation. As this requirement was not in effect at the time some of the older airplanes were built, **determine before take-off the amount of reserve supply carried.**

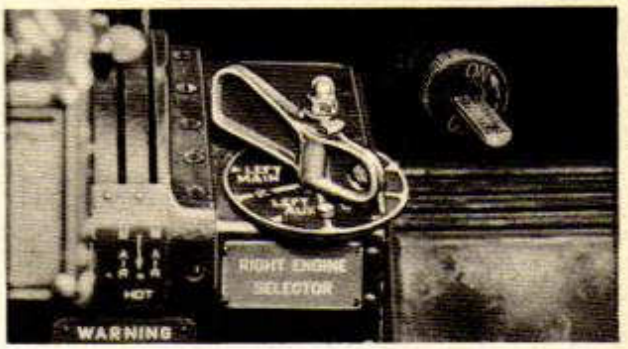
Fuel Tank Change-Over

Do not permit fuel tanks to run dry at any time, particularly in the case of airplanes equipped with gravity systems or high pressure carburetors. The change from one tank to another will be made at the pilot's discretion but must be made before any loss of pressure is apparent.

Change-over from one source of supply to another will be made as follows, while the engine is still running:

1. Hold the airplane in level flight position, throttle unchanged.
2. Mixture control "FULL RICH."
3. Switch fuel valve to required position.
4. Operate wobble pump slowly, if any decrease in pressure is noted.

If the engine has stopped, nose the airplane down to maintain flying speed and follow the same procedure.

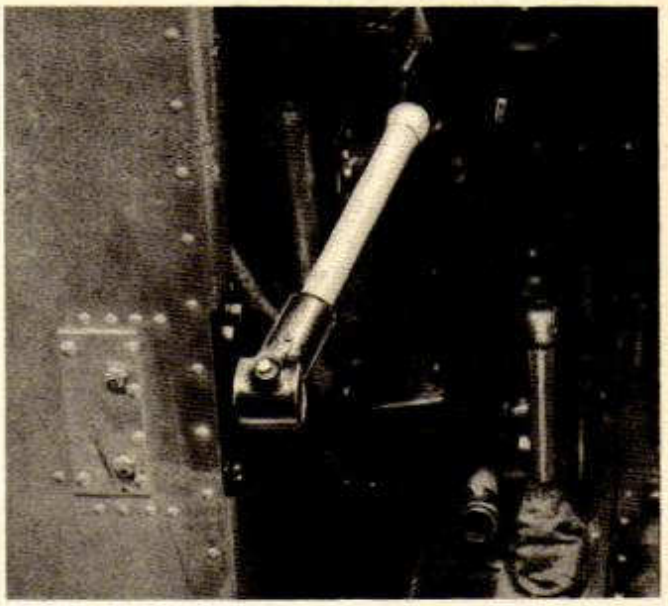


Check fuel cock settings by "click" or "feel."

Some airplanes may be equipped with cross-feed valves to permit one fuel pump to supply pressure to both engines, in case fuel pressure fails or becomes low on one engine. If this happens, turn cross-feed valve "ON."

Airplanes having independent fuel systems for each engine have a cross suction line provided with a shut-off valve. Normally this valve is "OFF" with engines operating from their respective tanks. To operate both engines from the right wing tank, for instance, open the shut-off valve and close the left wing tank selector valve.

Don't trust fuel cock settings. Determine either by the "click" or "feel" method and not merely by the position of the control handle of the valve.



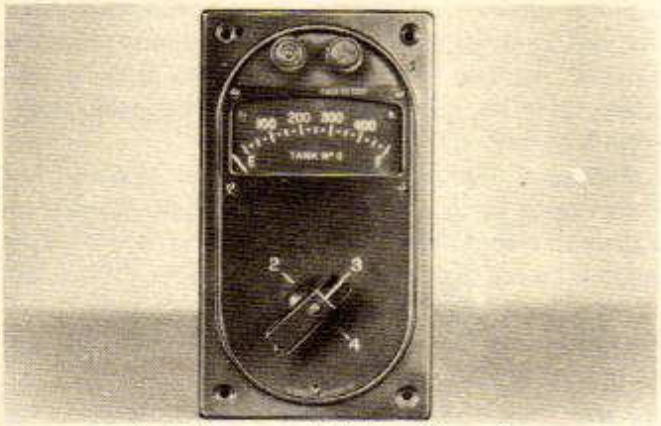
Operate wobble pump slowly.

Fuel Gages

Fuel level gages usually are designed to show the quantity of fuel in the tanks only when the airplane

is in flight position. **Gages should only be read in this position.** When gages having scales showing amount for both ground and level flight position are used, **do not confuse ground readings and flight readings.**

There are several types of fuel level gages: sight gage, float and lever gage, and the electric liquidometer gage. The electric liquidometer gage makes possible accurate measurement of the fuel in any number of tanks on a single indicator dial in the cockpit. By turning the switch connected to the gage, the amount of fuel in any tank may be read directly from the gage.



Read fuel gages in flight position only.

Fuel Booster Pumps

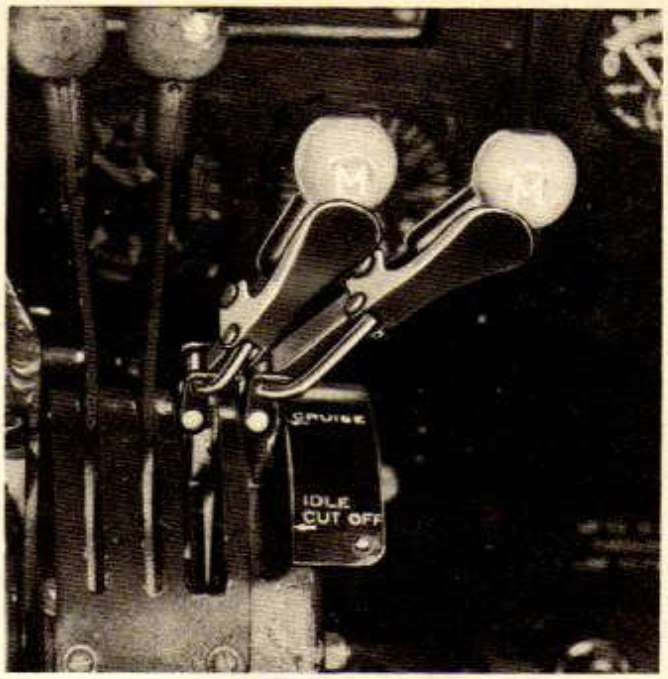
Use fuel booster pumps

1. At all times during take-off and landing. If pumps have two speeds, use lower speed.
2. At all altitudes below 1,000 feet. If pumps have two speeds, use lower speed.
3. At all altitudes above 10,000 feet.
4. Between 1,000 feet altitude and 10,000 feet altitude when conditions warrant their use.

On airplanes having separate booster pump connections to each tank, the pump will be used only for the tank from which fuel is being drawn. When using fuel from a tank which has no booster pump connection, turn all pumps "OFF."

Carburetor Mixture Controls

Mixture controls will be used in conjunction with specific instructions for various engines. They are manually adjusted when a fixed pitch propeller is used. A constant speed propeller requires the use of a fuel-air ratio gage for manual adjustment of the mixture. Automatic mixture controls do not require manual adjustment unless specified in engine operating instructions.



Mixture control.

The one-position automatic mixture control automatically controls mixture with changes in altitude and temperatures without regard to throttle setting, and in no way controls the power output of the engine. The need for manual control is done away with when it is set in "AUTOMATIC" position. If it becomes damaged, mixture may be operated manually by shifting lever from "AUTOMATIC" to the desired manual position.

The two-position automatic mixture control may be set in "MANUAL," "AUTOMATIC RICH," or "AUTOMATIC LEAN" position.

In "MANUAL" position, mixture is adjusted manually.

In "AUTOMATIC RICH" position, mixture is automatically adjusted for safe engine operation up to normal rated power, manifold pressure, and speed.

Use "AUTOMATIC LEAN" position only if manifold pressures and speeds are below those specified, and only with specified fuel.

Caution

For operation at maximum cruising power and above, always set mixture in "AUTOMATIC RICH" position or adjust manually for proper mixture.

Caution

When operating an engine with mixture control in "MANUAL LEAN" position at high altitudes, it is important that the mixture be richened during descent. When airplane is leveled off, readjust mixture control for proper operating conditions.

Engines equipped with fixed pitch propellers should be run up for take-off as follows:

1. As near take-off manifold pressure and rpm as possible.
2. Mixture leaned enough to increase speed 50 to 70 rpm.

Engines equipped with constant speed propellers cannot be adjusted on the ground, since fuel-air ratio gages are not sensitive enough to permit adjustment of mixture during run-up and take-off. They should be flown at the approximate altitude of the field from which take-off will be made as follows:

1. At take-off manifold pressure and rpm.
2. Mixture leaned enough to eliminate rough engine operation or adjusted for proper fuel-air indicator reading.
3. Mark setting on the mixture quadrant for use in take-off from that field.

Engines equipped with automatic controls will be set for take-off above 3,500 feet as follows:

1. One-position automatic type set in "AUTOMATIC."
2. Two-position automatic type set in "AUTOMATIC RICH."
3. Power control type set in "EMERGENCY" and adjusted manually.

REFERENCE: Technical Orders No. 06-5-1, dated August 18, 1942; No. 01-1-118, dated June 29, 1942; No. 03-10-15, dated May 19, 1942; No. 03-10-28, dated September 17, 1942, and No. 03-10G-1, dated February 6, 1939.

OIL SYSTEMS

Oil Grades

No one grade of oil can be specified for use in all airplanes under all climatic conditions. Oil becomes cold and viscous in cold weather and it is difficult to start and obtain proper oil circulation in the engine prior to take-off. This can be eliminated by using oil dilution.

The grade of oil most satisfactory at low temperatures begins to break down at high temperatures. When this happens it will be difficult to maintain oil pressures within prescribed limits, and oil consumption will become excessive. These factors in high temperature operation necessitate a maximum limit for oil temperatures. The exact point at which oil film will break down has not been accurately determined, but maximum allowable "oil-in" temperatures specified are selected within safe limits. **Avoid operation for long periods above maximum temperatures.**

The oil grades under present and future specifications, now being procured, and the equivalent commercial grades are shown in table I.

Table I

Grade Designation Spec. AN-VV-O-446 Present	Grade Designation Spec. AN-VV-O-4462 Future	Commercial SAE No.
1080	1080	40
1100	1100	50
1120	1120	60

No one grade of oil will meet all conditions, but most operations fall within the ground temperature range of 4°C (40°F) and above, for which grade 1120 is specified. This grade will be considered standard except where starting or warm-up difficulties are found during operations at low temperatures. For engines using oil dilution, grade 1100 will be used.



Commercial Oil

Whenever it becomes necessary to procure engine lubricating oil during cross-country flights, the best available quality of commercial oil of one of the well-known brands, equal in viscosity to the specification oil required, and containing no "additives," will be obtained. The SAE viscosity ratings corresponding to the specification grade numbers are indicated in table I.

Temperature Ranges

Table II lists three grades of lubricating oil with recommended operating temperature ranges. Overlapping of ground temperatures is to avoid setting up a requirement for changing from one grade to another when frequent temperature changes occur locally.

Temperatures of 4°C (40°F) and above, cover generally the range prevailing in the summer throughout the country.

Temperatures of −7°C to +27°C (20°F to 80°F), cover generally the range encountered during winter months in the southern part of the United States.

Temperatures of 10°C (50°F) and below, cover the winter range encountered in the northern portion of the United States.

Airplanes using oil dilution for starting in cold weather may operate in most temperature conditions with grade 1120 oil, but use grade 1100 when ground temperatures are below 4°C (40°F). **Oil lighter than grade 1100 never should be needed for airplanes using the dilution system.**

Oil Levels

Filler openings and level cocks (when the latter are used) are located on aircraft oil tanks and indicate proper oil levels for corresponding fuel loads.

Oil level for the maximum fuel load is indicated when oil overflows from the filler neck when the tank is being serviced.

When airplanes use level cocks, the lowest one indicates the oil level for the smallest fuel load and the highest one indicates the oil level for the greatest fuel load.

Table II

	1120 GRADE OIL	1100 GRADE OIL	1080 GRADE OIL
Air Temperature at Ground	4°C (40°F) and above	−7° to +27°C (20° to 80°F)	10°C (50°F) and below

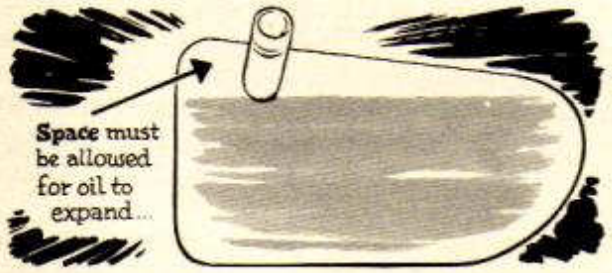
Low ground temperatures listed for each grade are sufficiently high that starting and warm-up difficulties should not ordinarily result. If airplanes are stored in heated hangars, the various grades may be used at still lower temperatures. Starting difficulties may occur below −15°C (5°F), unless the engine is started immediately upon removal from a heated hangar or after being serviced with warm oil.

	1120 GRADE OIL	1100 GRADE OIL	1080 GRADE OIL
Safe Max. "Oil-in" Temp.	95°C (203°F)	85°C (185°F)	76°C (167°F)

Temperatures above those listed should not be the cause of forced landings **unless they are accompanied by low oil pressure.**

	1120 GRADE OIL	1100 GRADE OIL	1080 GRADE OIL
Safe Min. "Oil-in" Temp.	20°C (68°F)	10°C (50°F)	0°C (32°F)

Temperatures listed are conservative, **but avoid continued operation below limits specified.** A steady oil pressure reading is a more reliable indication of proper lubrication at low temperatures than oil temperature readings.



Agitation of the oil under normal operating conditions results in foaming of the oil in the tank. Therefore, when checking the oil supply when there is foam present in the oil tank, use the utmost caution to ascertain the true level of the oil. Using the measuring stick to determine the oil supply will be inaccurate under these conditions as it is difficult to tell where the true oil level begins. Use the measuring stick only when no other means of judging the oil level is possible.

CAUTION

In no case will aircraft be serviced with fuel without servicing with oil, if necessary.

On most AAF aircraft the best way to fill the oil tank is to add oil until the oil level is apparent at the neck of the filler opening into the tank.

When the oil is heated to engine operating temperature, it expands Space in the tank must be allowed for this expansion.

Oil Temperature Regulators

Increased engine power and bearing loads, higher cooling temperatures, and other factors cause increased oil temperatures. Therefore, it is necessary to provide oil coolers with sufficient area to cool the oil under conditions of high temperature operations. For low temperature conditions, regulation is obtained by a valve that by-passes the oil cooler. This by-passed oil flows around the cooler jacket to keep the core from freezing up.

Adjust regulator shutters, as necessary, during cold weather operation to restrict the air flow through the regulator. If oil congeals in the regulator core, the cooling effect of the core is lost and high oil temperatures will result.

Variations in cooling capacity, regulator sizes, and oil flow in different installations vary the conditions of shutter closings. Shutter adjustments are dictated by experience with individual airplanes, and will reduce to a minimum difficulties resulting from excessive oil temperatures.

REFERENCE: Technical Orders No. 06-10-1, dated November 27, 1942, and No. 01-1-25, dated April 29, 1941.

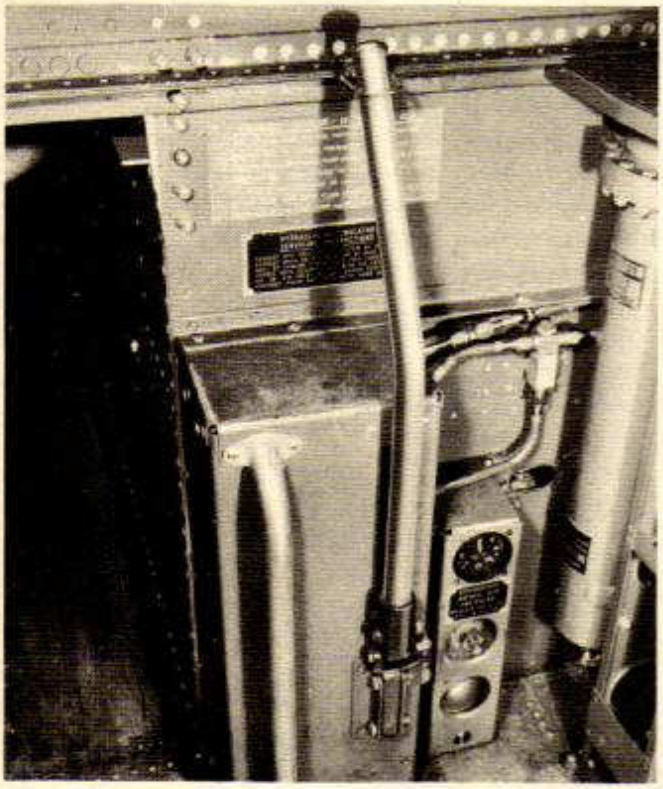
HYDRAULICS

Operation

The principle of the hydraulic system is that fluid is used to transmit a force to operate a mechanism. This mechanism may be the bomb bay doors, landing gear, cowl flaps, wing flaps, brakes, or some accessory.

The fluid used is either a specially prepared mineral oil containing red dye, or a fluid consisting of a mixture of alcohol and castor oil containing blue dye. This dye is placed in the fluid for identification purposes and also to facilitate the detection of leaks.

The system designed for mineral oil utilizes a different packing material than the system designed for alcohol and castor oil. **Interchanging of fluids will cause malfunctioning of the systems because of detrimental effect on packings and gumming of the fluids.**

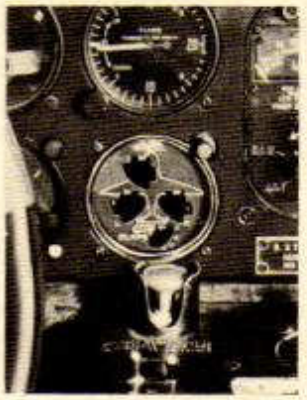


Emergency hydraulic hand pump.

In operation, force is developed either by a power or hand pump and is transmitted through a column of fluid, confined in tubing, to a piston against which the force is directed. In general, the piston is attached to a mechanism so that movement of the piston will operate the mechanism.



Hydraulic pressure gage.



Position indicator.

The Handbook of Flight Operating Instructions for each airplane shows where the selector valves are located that control the different mechanisms. Move the selector valve to the desired position for operation of the mechanism.

The force of the fluid is measured in pounds per square inch by a pressure gage, mounted on the instrument panel in most airplanes.

At the first sign of malfunctioning, look at the pressure reading. If the gage reads zero, it may be because of malfunctioning of the gage and not the system. To check:

1. Operate wing flaps by use of the normal system.
2. Observe the wing flap position indicator.

Emergency Operation

To lower landing gear, if there is no hydraulic pressure:

1. Operate the selector valve and let the landing gear drop down by its weight.
2. Observe the landing gear indicator to see if the gear is down and locked.

To operate a mechanism if the hydraulic system has failed:

1. Move selector valve to operating position.
2. Use the hand pump to operate the system.

If the power pump will not operate a mechanism because of the low level of the fluid in the reservoir, use the hand pumps as there will be enough fluid in the standpipe.

Remember that the Handbook of Flight Operating Instructions contains detailed instructions in case of hydraulic system failure. Be familiar with these instructions for the different types of airplanes flown.

PIF 5-7-1
REVISED April 1, 1944

PROPELLERS

General

The blade angle of a fixed pitch propeller cannot be changed. The blade angle of an adjustable pitch propeller can be changed only on the ground. The useful blade angle of both of these propellers is a compromise between the high rpm needed for takeoff and the low rpm that is best for cruising. These propellers are used only on training airplanes.

A two-position propeller provides both a high rpm setting for takeoff and a low rpm setting for cruising efficiency.

The constant speed propeller permits an engine to develop full horsepower for takeoff, and allows automatic readjustment of the blade angle during flight for particular power and altitude conditions.

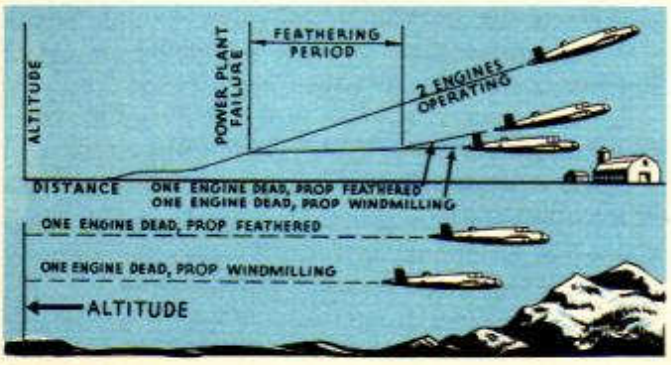
Feathering

Some constant speed propellers incorporate a feathering feature. Feathering a propeller permits the stopping of a disabled and vibrating engine, decreases the drag of the propeller and increases the performance of the airplane with the remaining good engine.

A feathered propeller on a twin-engined airplane increases the single engine ceiling appreciably over that which can be maintained with the useless propeller windmilling.

If necessary to maintain level flight, increase the propeller and throttle settings of operating engine, but don't exceed maximum permissible operating limits of the engine except in an emergency.

Maximum performance at all altitudes with a feathered propeller is obtained by trimming the flight controls for level flight.



Operating Tips

1. Observe engine operating instructions.
2. Increase rpm first, then manifold pressure.
3. Decrease manifold pressure first, then rpm.
4. Keep throttle closed when unfeathering.

For maximum endurance select airspeed and reduce rpm to lowest permissible value for the manifold pressure required to maintain selected airspeed. Adjust mixture as specified by engine operating instructions.

For economical cruising reduce manifold pressure to approximate cruising value then reduce rpm to value specified by engine operating instructions. Readjust manifold pressure to specified limits.

Featheritis

Don't jump for the feathering switch the minute you think you have engine trouble.

Check these things first:

1. It may be that your tachometer is registering incorrectly.
2. Look at your airspeed.
3. Listen to sound of suspected engine.
4. Look at the exhaust.
5. Make sure the trouble is not caused by inverter failure (See PIF 5-8-3).

Remember, unless you are practicing feathering you don't want to lose an engine if you don't have to.

CURTISS ELECTRIC PROPELLER

Starting Engine

1. Before starting engine, set circuit breaker to "ON" position. Leave it "ON" at all times during flight.
2. Set selector switch to "AUTOMATIC". If propeller is not already in low pitch, the electric motor will decrease the angle when the engine is started until the minimum is reached.
3. Start engine.

Preflight Check

Manual Operation:

1. Safety switch "ON" and selector switch "OFF" (center).
2. With engine running at approximately 2000 rpm check the manual propeller operation with the selector switch first in "DECREASE" then in "INCREASE RPM," noting that the engine speed responds accordingly, **but do not decrease rpm excessively (200 rpm maximum).**

Automatic Operation:

1. Safety switch "ON" and selector switch to "AUTOMATIC."
2. Propeller control to takeoff rpm.
3. Open throttle to obtain 2000 rpm.
4. Pull propeller control back until you notice approximately 200 rpm reduction in engine speed.
5. Return propeller control to takeoff position noting that you again attain 2000 rpm.
6. Close throttle.

If your airplane is equipped with a feathering Curtiss Electric Propeller, immediately following the manual and automatic operation checks, and before you close throttle, perform the following **feathering check:**

1. Feathering switch to "FEATHER" until you notice approximately 200 rpm reduction in engine speed. (This takes only one to two seconds. Don't reduce rpm excessively.)
2. Return feathering switch to "NORMAL," noting that you again attain 2000 rpm (because of automatic operation).
3. Close throttle.

These propeller checks can be made in sequence and concurrently with the magneto check without shutting the engine down between each check.

Takeoff, Climb, and Level Flight

1. Set selector switch to "AUTOMATIC."
2. Adjust propeller for takeoff rpm.
3. Adjust throttle to obtain desired manifold pressure. During climb and level flight, with selector switch in "AUTOMATIC", the governor holds engine speed constant by varying the pitch of propeller to suit different engine powers or flight conditions.

If a different engine speed is desired during flight, adjust the propeller slowly until tachometer registers the proper speed.

Any combination of engine rpm and manifold pressure is obtained within the operating limitations of the engine by independent adjustment of throttle and propeller.

When cruising altitude is reached, set throttle for cruising, adjust propeller to cruising rpm.

If your propeller governor fails, you may still maintain satisfactory performance by placing the selector switch in "FIXED PITCH."

Feathering

1. Close throttle.
2. Set feathering switch to "FEATHER."
3. Move mixture control to "IDLE CUT-OFF."
4. Shut "OFF" fuel supply to engine.
5. Leave ignition switch "ON" until propeller stops, then turn switch "OFF."

Unfeathering

1. Turn ignition switch "ON" with throttle closed.
2. Set propeller control to "DECREASE RPM."
3. Turn "ON" fuel supply.
4. Move mixture control to "FULL RICH."
5. Set feathering switch to "NORMAL."
6. Hold selector switch to "INCREASE RPM" until tachometer reading reaches 800 rpm; then release switch.
7. Allow engine to operate at this rpm until required operating temperature is obtained. Otherwise you may damage the engine.
8. Set selector switch to "AUTOMATIC" position and open throttle gradually to speed for which governor is set.
9. Adjust mixture, throttle, and governor to desired power and engine rpm.

Approach and Landing

Place propeller in maximum cruising rpm position to prevent overspeeding of engine if throttle is opened in an emergency. If necessary to interrupt the glide and make another landing approach, adjust throttle first, then place propeller control in "INCREASE RPM."

After landing, before stopping engine, place control in "INCREASE RPM."

Run-Away Propeller

In case of a run-away propeller, that is, one which allows engine to overspeed, check:

1. Circuit breakers.
2. Switch settings.
3. Try to reduce rpm by propeller control.
4. Hold selector switch in the "DECREASE RPM" position.

If this fails to reduce the rpm, turn the feathering switch on, then quickly off again to reduce rpm to the correct setting. Be careful not to reduce the rpm too much when using this method.

Power Failure

The battery and generator are your sources of electric power. If the generator fails in flight place the selector switch in "FIXED PITCH" to conserve electric energy. Switch it back to "AUTOMATIC" before landing, so that you will have automatic operation if you have to go around again.

Selective Fixed Pitch Operation

If you desire selective fixed pitch operation, or if the constant speed control fails:

1. Move selector switch to "FIXED PITCH".
2. Hold switch momentarily on "INCREASE RPM" or "DECREASE RPM" (as required) to obtain the rpm setting you want.

Reset Circuit Breaker

If the circuit breaker opens because of an overload on the propeller circuit let it cool for 10 or 15 seconds, then reset it to "ON". Otherwise, the propeller blades will remain at a fixed angle setting.

In emergencies hold the circuit breaker button full in if a continuous overload exists. It will carry extremely high loads.

REFERENCE: Technical Order 03-20B-3 and Technical Manual 1-412

HAMILTON STANDARD COUNTERWEIGHT TYPE PROPELLER

Starting Engine

Before starting engine, place propeller governor control in "DECREASE RPM" position. Then start engine and run for at least 1 minute. This is done to avoid starving the engine thrust bearing of oil immediately upon starting. **This is opposite to the setting used for all other propellers.**

Warm-up

Shift propeller control to "INCREASE RPM" position for warm-up in accordance with operating instructions for the particular type of engine.

Takeoff and Climb

Place governor control in "INCREASE RPM" position for takeoff and climb. As airplane accelerates, engine speed increases until it reaches governor setting. Setting has been adjusted previously and should be within 25 rpm of the red line on the tachometer. From this point on, rpm is held constant by the governor. As soon as safety permits, reduce manifold pressure and rpm. **Always reduce manifold pressure and then rpm. Move throttle and governor controls slowly.**

Level Flight

Set rpm for normal level flight. It will be held constant by the governor within close limits.

Engine Failure

In event of engine failure, place governor control in "DECREASE RPM" to reduce drag.

Approach and Landing

Place governor control in maximum cruising rpm position. If necessary to interrupt glide and make another landing approach, first adjust throttle, then place governor control in "INCREASE RPM."

Before stopping engine make sure that propeller has shifted to low rpm to prevent exposure and corrosion of the propeller piston.

REFERENCE: Technical Order 03-20CB-1 and Technical Manual 1-412.

HAMILTON STANDARD HYDROMATIC PROPELLER

Preflight Check of Feathering System

1. After engine is warmed up set governor control to approximately 1,400 rpm.
2. Open throttle until governor is functioning, i.e., engine operating at constant rpm with slight increase in manifold pressure.
3. Depress feathering button until the engine speed drops to 1,200 rpm.
4. Pull feathering button out. Engine speed should return to original governing value in a few seconds.
5. If propeller does not respond as above, feathering system should be checked immediately.

Takeoff and Climb

Place propeller governor control in "INCREASE RPM" for takeoff and climb.

As the airplane accelerates, engine speed increases until it reaches the governor setting. This setting has been previously adjusted and should be within 25 rpm of the red line on the tachometer. Thereafter, rpm is held constant by governor. As soon as safety permits, reduce manifold pressure and rpm. **Always reduce manifold pressure, then rpm. Move throttle and governor controls slowly.**

Level Flight

Set rpm desired for normal level flight. The governor will hold it constant within close limits.

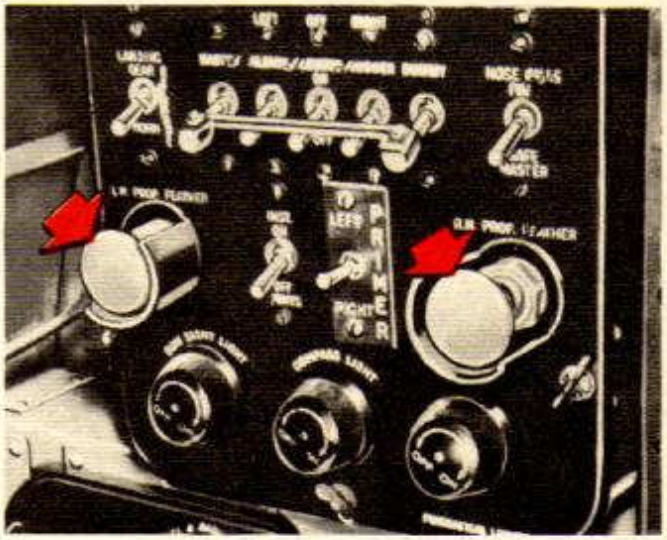
Approach and Landing

Place governor control in maximum cruising rpm position for approach and landing. If necessary to interrupt the glide and make another landing approach, adjust throttle first, then place governor control in high rpm position.

Feathering

1. Close throttle.
2. Depress feathering button.
3. Move mixture control to "IDLE CUT-OFF."
4. Shut "OFF" fuel supply to engine.
5. Leave ignition switch "ON" until propeller stops, then turn switch "OFF."

In case of practice feathering while flying, don't leave propeller feathered for more than 15 minutes. Longer periods of feathering may allow enough oil to seep past the piston rings of the lower cylinders to damage the engine when you unfeather the propeller and restart the engine.



Practice feathering only between 5000 and 10,000 feet above terrain over which you are flying.

Unfeathering

1. Turn ignition switch "ON" with throttle closed.
2. Set propeller control to the minimum rpm position.
3. Turn "ON" fuel supply.
4. Depress propeller feathering button. Keep closed until tachometer reading reaches approximately 1000 rpm; then release.
5. Adjust mixture control.
6. Allow engine to operate at this rpm until required temperature is obtained. Then open throttle gradually, causing engine to speed up to the minimum rpm or the speed for which governor is set.
7. Adjust throttle, mixture, and governor setting to desired power and engine rpm, and synchronize.

In flight, the propeller begins to windmill and crank engine as soon as it starts to unfeather. Engine speed increases rapidly as power is applied and automatic unfeathering proceeds.

When unfeathering a propeller after engine has cooled, idle at slow speed until engine is thoroughly warmed up. Otherwise serious damage may result. Windmilling action of unfeathering acts as a powerful cranking force and may overspeed engine beyond safe idling speed unless unfeathering is stopped while propeller still is at a high angle.

If the engine idles at too high a speed, you can reduce rpm by depressing the feathering button briefly. Pull out button when desired rpm is reached.

If you don't pull the button out, the propeller will

continue to the full feathered position at which time the button pops out.

If you hit the feathering switch accidentally, pull it out at once. **Do nothing more** as the propeller will return shortly to governor control.

REFERENCE: Technical Order 03-20-14 and Technical Manual 1-412.

AEROPROP

Starting Engine

Start engine with propeller control in "INCREASE RPM." This reduces the load or drag of the propeller and results in easier starting and warm-up of the engine. Also, this is normally the position of propeller prior to stopping engine.

Takeoff and Climb

Place propeller in high rpm position for takeoff and climb. As the throttle is advanced, engine rpm increases until it reaches the amount for which the high rpm stop has been set. From this point on, rpm is held constant by the governor.

As soon after takeoff as safety permits, reduce both manifold pressure and rpm. Always reduce manifold pressure first and then rpm. Move throttle and propeller controls slowly.

Level Flight

Set rpm desired for normal level flight. The governor will hold it constant within close limits.

Approach and Landing

Place propeller in maximum cruising rpm position for approach and landing. If necessary to interrupt the glide and make another landing approach, adjust throttle first and then place propeller control in "INCREASE RPM."

Stop engine with control in "INCREASE RPM."

Aeroprop Purging

If you suspect poor governing, purge the propeller by changing the manifold pressure from 20" Hg to 37" Hg (for the P-39Q-10) several times in succession. Always consult the Technical Order for the airplane operating instructions.

Dual Rotation Propellers

The operating instructions for the dual rotation Aeroprop are the same as for conventional rotating propellers; move propeller control forward for increased rpm, backward for decreased rpm.

REFERENCE: Technical Order 03-20E-2.

PIF 5-8-1
May 1, 1943

Electrical POWER SYSTEM

Description

The Electrical Power System consists of a Generator, Voltage Regulator, Reverse Current Relay, Battery, Battery Switch, Generator Switch, Ammeter, and Voltmeter. In multi-engined airplanes, this complete set of equipment is duplicated for each engine.

1. The Generator is the primary source of power for all electrical equipment.
2. The Voltage Regulator keeps the generator voltage constant at all times.
3. The Reverse Current Relay automatically disconnects the generator from the main circuit when the engine stops or when the generator ceases to operate.
4. The Battery is a **small** power reserve to supply extra power for momentary peak loads. **Don't use it as a primary source of power** except in emergencies.
5. The Battery Switch connects and disconnects the battery from the main circuit.
6. The Generator Switch connects and disconnects the generator from the main circuit.

Starting Engines

When an external power source is available, always use it to start engines.

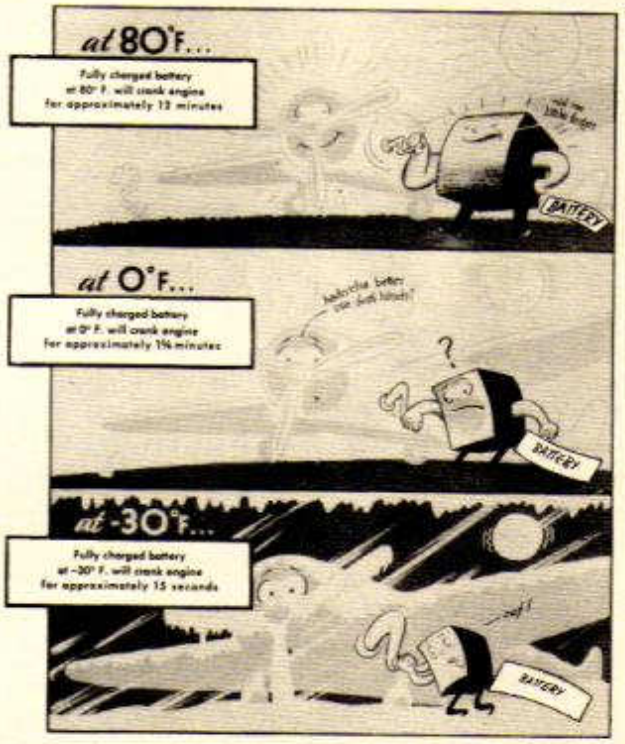
If no external power is available and the airplane is equipped with an auxiliary power unit, start the auxiliary unit and use it to start the engines. Stop the auxiliary unit as soon as the engines are running normally.

Caution

Don't use the battery to start engines except when auxiliary source is not available.

If necessary to start an engine on the battery, crank it for short, intermittent periods only. This allows the battery to recover slightly between starter loads.

On multi-engined airplanes, start only one engine on the battery. Allow that engine to warm up sufficiently, then run it at 1,600 rpm to 1,800 rpm while cranking the other engines with the starter. In this way, the generator of the one engine supplies current for starting the others.



Checking Electrical System

Run the engine at 1,600 rpm to 1,800 rpm and check the generator output voltage on the ship's voltmeter. On multi-engined airplanes, repeat this process with each engine.

NOTE: Voltage of each generator must be between 13.5 and 14.5 volts on 12-volt systems, and between 27.0 and 29.0 volts on 24-volt systems, with not more than 0.3 volts variation between any two generators on multi-engine airplanes. If greater variation is shown, don't take off until qualified maintenance personnel make necessary adjustments.

On multi-engined airplanes, check equalizing of generator loads. With all engines running at 1,600 rpm to 1,800 rpm, turn on an electrical load equal to 10% to 20% of the total capacity of all generators. Then compare the reading of all ammeters. Readings must not vary more than 10%. If the variation is greater than 10%, don't take off until maintenance personnel make necessary adjustments.

On multi-engined airplanes, also check the batteries by turning the battery switches to "ON," one at a time. If the total of all ammeter readings increases

more than 60 amperes when any one battery is turned "ON," have that battery checked, and replaced if discharged.

Ground Instructions

While on the ground, keep all "ON-OFF" switch-controlled electrical units turned to "OFF," unless the unit is being used or tested.

Always use external power source when available for testing electrical equipment to conserve battery energy.

After each flight, first turn off all electrical equipment. After this is done turn the battery switches off. This procedure is necessary to protect the battery switches, as they are not designed to interrupt the entire load.

Flight Instructions

During flight, whenever the voltmeter reading is greater than 15 volts for 12-volt systems, or more than 30 volts for 24-volt systems, turn electrical accessories "OFF," and land at the first opportunity.

In multi-engined airplanes, turn the generator switch "OFF" on any generator whose ammeter indicates excessively high or low current in comparison with others in the airplane.

When flying a multi-engined airplane with one or more engines inoperative, always turn enough electrical equipment "OFF" to make sure that the total load does not exceed the capacity of the operating generators.

In case of generator failure (usually indicated by zero ammeter reading), the battery will supply energy for the electrical system for only a few minutes of normal flying.

Under these conditions:

1. **Turn all electrical units "OFF"** and operate them manually or mechanically as far as possible.

2. **Avoid use of the radio except when absolutely necessary,** and then only for brief, intermittent periods.

Conservation of Electrical Power

Conserve electric power in every way possible by observing such economies as these:

1. Always start engines and test electrical equipment with an external power source when one is available. Exceptions to this rule may be made only in emergencies.

2. Avoid unnecessary use of electrical current at all times by keeping every unit turned "OFF" unless it is needed at the moment or is being tested. This will conserve the generator and other electrical equipment for their maximum life. For example, do not turn landing lights "ON" until actually coming in for a landing.

3. Take particular care to conserve electrical power at high altitudes. Low air pressure at these altitudes reduces cooling efficiency so greatly that the generator should not be operated at full load.

4. Do everything possible in cold weather to hold the **battery load** to the very minimum. The efficiency of any battery falls sharply as temperatures go down. Since the battery of an airplane is not designed to carry the normal electrical load even when conditions are most favorable, you cannot rely on it without the generators for more than a few minutes' operation, particularly at sub-zero temperatures.

When airplanes are to stand idle, in sub-zero temperatures, for more than a few hours, the batteries should be removed and stored in as warm a location as possible (normal room temperature preferred). This procedure is necessary because the efficiency of cold batteries is low and a partially discharged battery cannot be effectively charged while flying in an airplane at sub-zero temperatures.

Caution

1. Keep all generator switches "ON" at all times during flight except when failure of a generator makes it necessary to turn its switch "OFF." Turning one generator "OFF" tends to overload the remainder of the system.
2. Pay particular attention to generator readings when flying at high altitudes, since generator brush life is extremely short under these conditions.
3. Reduce the electrical load whenever ammeter indicates that the capacity of operating generators is being exceeded.
4. **Always** turn "OFF" all battery switches before attempting a crash landing to reduce danger of fire.

REFERENCES: T. O. No. 03-5B-1, dated February 5, 1942.
T. O. No. 01-20EF-2, dated December 1, 1942.
T. O. No. 01-1-61, dated October 24, 1942.

ELECTRICAL INSTRUMENT FAILURE

Inverters are used in multi-engine airplanes to change direct current (delivered by the battery system) to alternating current suitable for use in the Autosyn instrument system. Autosyn instruments, which are electrically powered, include certain engine instruments as well as landing gear and flap indicators.

Always check batteries and make sure generators are working before take-off. Failure of either will cause inverter failure, which will cause Autosyn instruments to fail, since they are dependent on inverter power.

Two inverters are supplied in most airplanes. (Exceptions are: The B-25, B-26 and C-47A.) Power can be drawn from either one.

CAUTION

Don't flick the switch from one inverter to another in flight. Run on one inverter only. Save the spare until you need it.

If instruments do not function normally, or cease to function, flick the inverter switch to the spare inverter.

In the event your Autosyn instruments still will not function—even after trying the spare inverter—do not become alarmed. You will be able to make a normal landing after reaching a suitable landing field if you will:

1. Reduce power and set engines by eye and ear, using flight instruments, which are not dependent on the inverters, to maintain approximate cruising conditions.

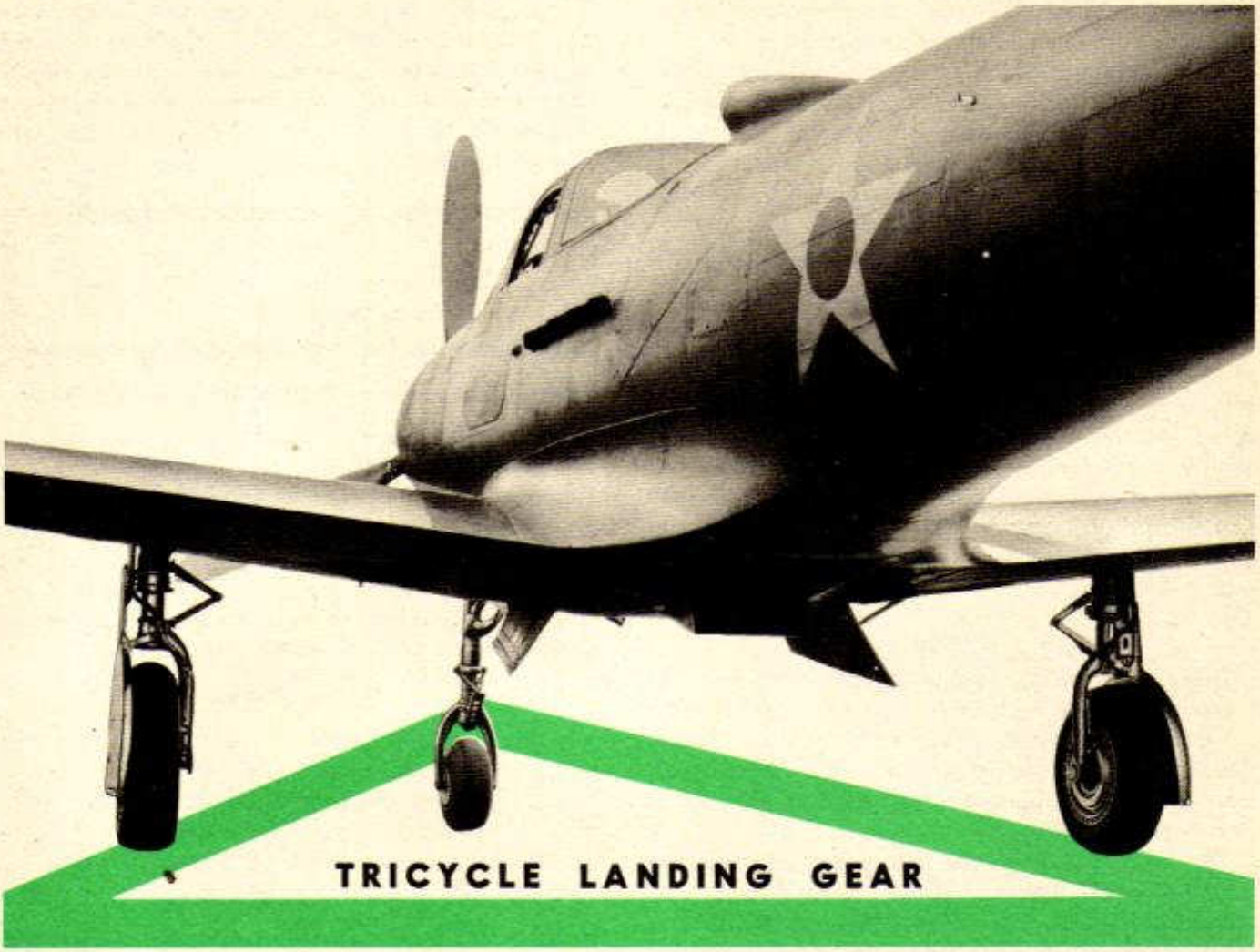
2. Extend landing gear and flaps and check them visually.

In case of inverter failure, remember your engine instruments will remain in the same position as at time of failure, or will indicate "INCREASE" or "DECREASE" if affected by vibration. For instance, on take-off with 2700 rpm, reduction of rpm would not be indicated, although it is actually occurring each time the "DECREASE RPM" control is moved. This is also true of the manifold pressure gauges and other instruments. The sound of your engine will tell you whether you are having merely inverter failure or actual engine trouble.



DON'T BAIL OR FEATHER BECAUSE YOUR INSTRUMENTS FAIL - YOU CAN STILL MAKE A NORMAL LANDING!

SECTION 6 THE AIRPLANE



TRICYCLE LANDING GEAR

Tricycle landing gear has several advantages over the conventional type:

1. It will not let the airplane ground loop.
2. It gives the airplane an approximately normal flight attitude on the ground.
3. It protects the airplane from nosing over when the pilot applies the brakes too heavily.
4. It provides better visibility while taxiing.

Because the tricycle gear has to be handled differently from conventional gear in ground operations, you should become familiar with its characteristics.

The nose wheel is not "steerable," that is, it is not connected with the rudder control. It tends to roll straight like a bicycle ridden "hands off."

The suggestions which follow are of a general nature and are not to be construed as conflicting with the Handbook of Flight Operating Instructions for the particular type airplane being operated.

Taxiing

When an airplane equipped with tricycle gear moves very slowly, it has little stability. Difficulty, therefore, may be encountered in maneuvering at low speed.

Caution

Get the airplane rolling before attempting a turn. Don't use brakes and engines to turn the airplane from a position at rest.

Take-Off

Because the center of gravity is forward of the main wheels and the airplane is in a flat attitude on the ground, it tends to hug the ground regardless of speed, particularly if no flaps are used. There-

fore, it is necessary to "pull" the airplane off when sufficient airspeed for take-off is attained.

At minimum take-off speed the angle of attack of the wings is just at the stalling angle. This angle feels unsafe and the natural tendency is to wait until sufficient speed is attained to produce full lift at a lesser angle of attack. Consequently, take-offs often are made at speeds much higher than necessary, imposing abnormal stress on tires and gear.

Best Take-Off Procedure

The most desirable setting of the center of gravity is such that the nose wheel can be raised from the ground at approximately 80 per cent of the take-off speed. At this speed you can raise the nose sufficiently to produce a convenient angle of attack less than the stalling angle, and the airplane will break away from the ground freely when the proper velocity is reached without giving you an "uncertain feeling."

Landing

Don't land unduly fast. Airplanes with tricycle landing gear may be landed at various speeds from normal landing speed to 150 mph or more. When the airspeed indicator registers more than the normal landing speed, unnecessary strains are placed on landing gear.

The best landing is one where the nose of the airplane is well up, and the main wheels touch the ground before the nose wheel. This landing attitude is equivalent to that of a landing with conventional gear in which the main landing gear wheels touch while the tail wheel is approximately 6 inches in the air. **Don't land so "tail low" that the emergency skid or tail bumper strikes, as this produces excessive shock loads on the empennage.**

Immediately after landing, the airplane has a large amount of momentum. Due to aerodynamic drag this momentum is quickly dissipated during the initial part of the ground run. This is especially true if the nose wheel is held off after landing, as the angle of attack is greater, thus producing more drag. **Let the airplane roll some distance before applying brakes.** This is much easier on the brakes and will save them for the time you need them most.

Caution

Don't apply brakes before the nose wheel is on the ground.

Taxiing, Landing, or Taking Off on Soft Ground

1. When taxiing on soft ground or sand, be sure you know which way the nose wheel is headed. For example: if it is headed to the left when stopped, don't try to steer it either straight ahead or to the right until it is moving. Doing so would cause the nose wheel to dig in deeper.

2. Keep as much weight off the nose wheel as possible, as the nose wheel may not run true.

Slippery Terrain

Sliding the wheels on ice or very slippery sod may cause the main wheels to skid and the airplane to turn sideways exactly as an automobile would with locked wheels on icy pavement. This is not a ground loop. Control can be regained almost instantaneously by releasing the brakes.

Caution

Don't slide your wheels. You can stop quicker under any conditions, slippery or not, by braking just short of the point where wheels will slide.

REFERENCE: Technical Order No. 01-1-33, dated December 16, 1942.



PIF 6-2-1
May 1, 1943

LANDING WHEEL

Brakes



Repeated excessive application of brakes without allowing enough time for cooling between applications causes temperatures to increase dangerously. This may result in brakes freezing, complete breakdown of the brake structure, failure of the brake drums and wheels, blowing out of tires and tubes, and in extreme cases destruction by fire of wheel and brake installations.

Excessively short stops from high speeds and dragging brakes for an appreciable distance while taxiing at low speeds will produce the same results.

To Maneuver on Ground

Control multi-engined airplanes by use of the engines and single engine airplanes by steerable tail wheel, when provided. If necessary to use brakes to steer airplane, use them as little and as lightly as possible.

Precautions

1. Don't drag brakes while taxiing. Avoid applying toe pressure inadvertently while operating rudder pedals.



2. Don't use the brakes for speeding up turns unless a sharp turn is necessary to avoid obstructions.

3. Don't stop the airplane as quickly as possible when it is unnecessary. Take advantage of the full length of the runway during the landing roll, using brakes as little and as lightly as possible.

4. Apply brakes firmly but without jamming them.

5. **Don't set parking brakes while brakes are hot.** They may "freeze."

6. **Don't set and lock brakes during flight;** you may land with them on. However, vibration caused by rotation of landing wheels after take-off may be stopped by applying brakes lightly for a short period.

7. If making successive landings, leave the landing wheels extended in the slipstream for at least 15 minutes between landings to allow adequate cooling. If landing wheels are retracted, allow 30 minutes for cooling.

Caution

Don't overheat your brakes. Brakes which get too hot during taxiing may "freeze" after take-off.

Emergency Brakes

Know the location of your emergency brake control before take-off. You may need it in a hurry.

Refer to the Handbook of Flight Operating Instructions for instructions on their use.

REFERENCE: Technical Order No. 01-1-27, dated April 24, 1942.

PIF 6-3-1
May 1, 1943

FLAPS

General

Using flaps increases the lift of a wing by changing its effective camber, or increasing its area, or both; and also reduces length of roll upon landing by providing a resisting surface to the passing air.

The increase in lift is accompanied by a large increase in drag and by an increase in virtual angle of attack. If the airplane remains in the same attitude when flaps are used, it will approach dangerously near to the stall.

Use

Correct use of flaps in flight is to steepen the gliding angle and *not to decrease the gliding speed.*

A depressed flap increases the wing diving moment, generally neutralized by increased downwash on the tail. Simultaneous use of elevator trim tabs may be necessary to maintain longitudinal balance.

Take-Off

Using flaps for take-off increases drag, tending to increase the run, while the increase in lift tends to reduce the run These two effects combine to give a minimum take-off distance for a definite flap setting.

A split or bent type flap may be lowered from one-fourth to one-half (usually 10 to 20 degrees) to improve take-off. Within these limits the exact setting will vary with the individual type of airplane and can be obtained by experiment.

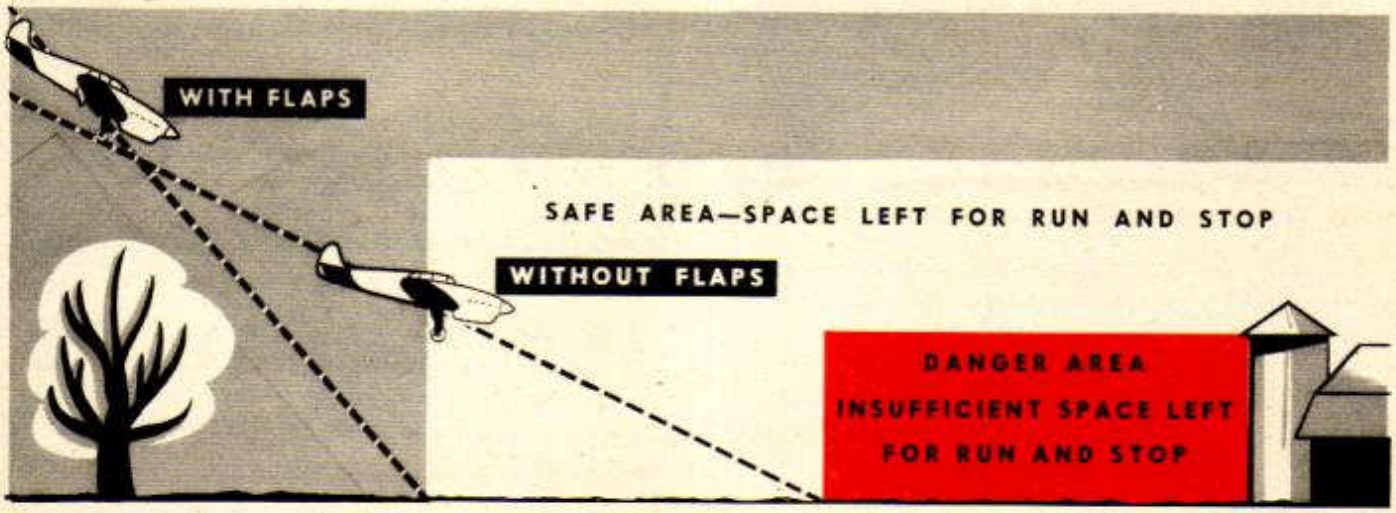
In general, an airplane with flaps in take-off position will clear an obstacle by a greater margin than it will if flaps are not used. The take-off run itself may be increased. There is no general rule which can be applied. Information determined by test will be in the operation instructions for each type of airplane.



In event of engine failure following take-off in a maximum performance climb using flaps, the danger of stalling is greater than when flaps are not used due to more abrupt stalling characteristics.

CAUTION

If engine fails when flaps are down, **keep flaps down.** Sudden raising may result in an excessive loss of lift.



Forced Landings

In the event of a forced landing made from an altitude which permits maneuvering and where there is insufficient or unsuitable terrain for rolling to a stop, **have landing gear retracted and flaps extended.**

Flaps will provide normal drag and lift with which you are familiar in normal landing routine. Don't worry about the damage caused by landing with flaps extended, since it will be relatively slight compared to what might ensue if they were not used.

Landing

Split or bent type flaps limit maneuverability of the airplane and eventually stall it more abruptly. The following recommendations are made for landing:

1. With flaps down, **glide at a speed not less than 10 to 15% above the stalling or landing speed** listed in the operation instructions of the airplane to provide sufficient margin of safety against inadvertent stalls and to provide sufficient kinetic energy to force the tail into position for landing.

2. **Be sure to maintain gliding speed to the point of leveling off for landing. Using flaps causes an airplane to stall rapidly when leveled off.** Consequently you must level off at a lower altitude than when flaps are not used.

3. The effect of a cross wind on a landing airplane is to apply a yawing force which tends to swing the nose into the wind. This effect is greater when using flaps. The resultant effect upon the airplane is to increase lift on the up-wind wing and to decrease it on the down-wind wing. This tends to tip the airplane over in a down-wind direction. Since both wings stall rapidly, the tipping force, though strong, is of short duration. This effect is especially critical in a short coupled airplane.

Unless extreme caution is used, you may overcontrol and lose control. Use caution and sufficient excess speed to insure adequate control. In crosswinds of appreciable velocities, use no more flap than is necessary.

Precautions

1. **Don't raise flaps immediately after take-off** or at other times when near the stalling speed. An appreciable interval of time may be required for speed and angle of attack to become adjusted to the new condition.

2. **Raise flaps gradually** to avoid a sudden loss of lift.

3. When controllable pitch propellers are installed, **use the maximum cruising rpm position whenever the flaps are depressed.** This makes available the maximum thrust under the resulting low speed and high drag condition.

4. **Don't lower flaps at an indicated air speed higher than the limiting air speed for flaps** posted in the cockpit.

5. After flaps have been lowered, keep air speed below the limiting speed to avoid overstressing the structure.

6. **Avoid rapid or otherwise violent maneuvers,** including steep banks, when flaps are extended.

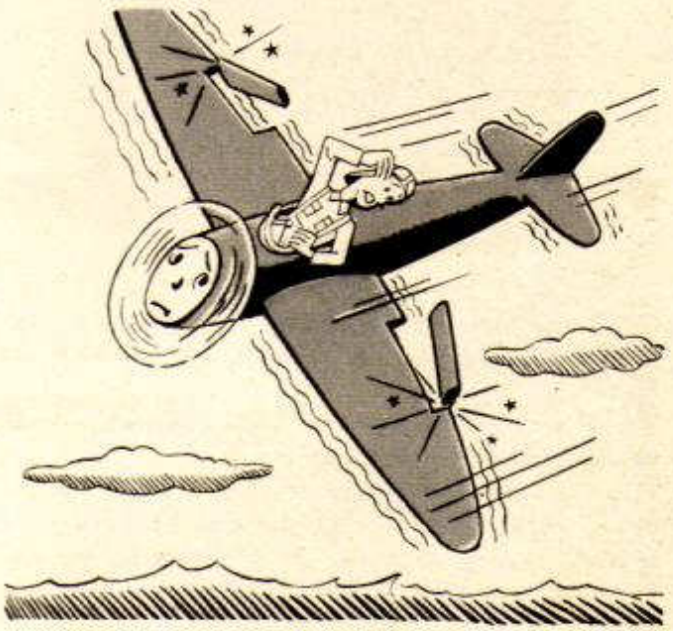
7. Use flaps only for normal maneuvers necessary for landing or take-off.

8. Avoid long flight or glides with flaps lowered.

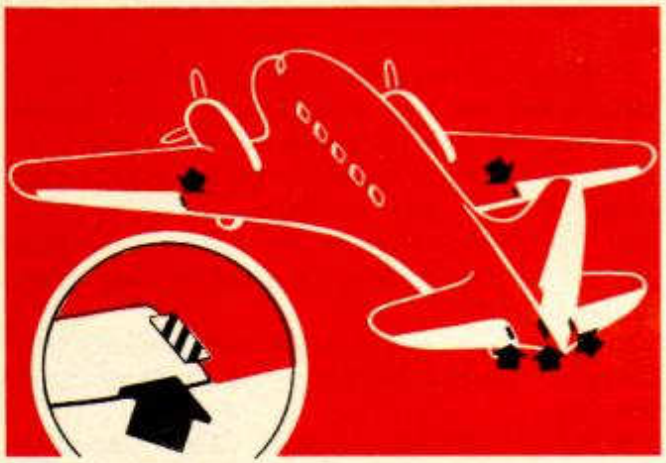
9. Be cautious when using flaps on low winged airplanes on rough ground or on fields that are covered with mud, water puddles, or slush. Don't taxi such airplanes with flaps down because of the limited ground clearance and the possibility of damage to the flaps by objects being thrown against them by the wheels and propeller.

10. Avoid water puddles and slush wherever possible when making landings or take-offs with flaps extended. If water or slush may be encountered on the ground when landing, extend flaps only partially if landing conditions permit.

REFERENCE: Technical Order 01-1-60.



SURFACE CONTROL LOCKS



GET THESE CONTROL LOCKS OFF BEFORE YOU REV HER UP

Several cases of serious damage to aircraft control surfaces, etc., have been caused by failure to use control locks when the airplane was exposed to high winds or propeller blasts from other airplanes.

To minimize the danger of an airplane taking off with such damage undetected, and possibly losing or impairing the surface control mechanism in flight, observe the following precautions:

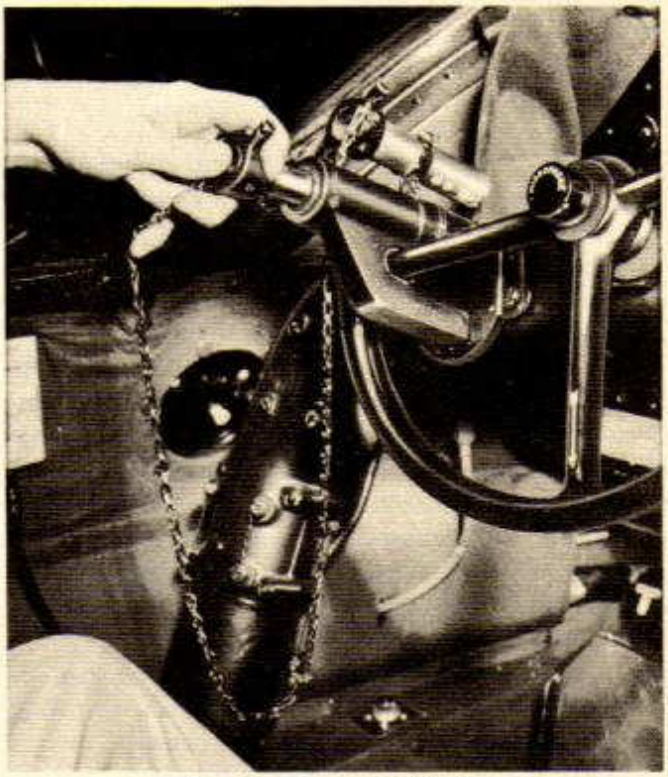
Check all flight controls for free movement before take-off to insure that all control locks are released or removed.

1. **Don't run the engines at high speeds during ground check or taxiing with the surface controls locked.**

2. If possible, **keep the movable tail surfaces in a neutral position during engine test.**

3. On airplanes having internal surface control locks, **engage the locking devices whenever the controls are not manned.** On airplanes having external surface control locks, install the locks whenever the airplane is unattended. Follow this procedure regardless of whether or not there are high winds.

4. Some older types of airplanes may have neither internal nor external locks. Some method of locking the surface controls will be improvised locally and applied in accordance with instructions given in (3) above.



Internal surface control lock.

Inspection of Surface Controls

If the control surfaces are caught by the wind or propeller blasts and moved violently against their stops or to the limit of their travel when taxiing, awaiting take-off, maneuvering to a parking position, etc., a special pre-flight inspection will be made before the airplane is flown again.

Inspect all control surfaces, hinges, hinge brackets, control horns, attachment of surfaces to torque tubes, etc.

A similar pre-flight inspection will be made, if during the preceding night or since the last flight, unusually violent or gusty wind conditions have occurred in the vicinity of the parked airplane.

REFERENCE: Technical Order 01-1-29, dated July 9, 1942.

HOW TO TRIM YOUR PLANE

Because the loading of an airplane is never uniform—the load changing with the number and placing of the crew, the placing of the cargo, the power used, and the continually changing weight of the gasoline in the tanks—some means must be employed to keep the ship flying naturally in a straight line with its wings level and its nose neither up nor down. This aerodynamic counterbalancing for load change is accomplished by offsetting the natural flight positions of the control surfaces through the use of "trim tabs." The number of trim tabs varies with the size of the airplane, ranging from a single tab on the elevator of a small airplane to tabs on the ailerons and rudder as well as the elevator of larger airplanes.

For Take-Off

MAKE SURE THAT ALL TRIM-TAB ADJUSTMENTS ARE IN THE TAKE-OFF POSITION.

In Flight

When trimming a small airplane fitted only with a "nose up" and "nose down" trim-tab adjustment:

FIRST—climb to the desired altitude. If there is too much forward pressure on the control column during a normal climb, adjust the elevator trim tab to bring the nose up.

SECOND—adjust the engine to its rated cruising power.

THIRD—move the wheel or control stick back and forth and determine by feel if the ship is "nose heavy" or "tail heavy." If continual back pressure is needed to keep the rate-of-climb indicator at zero, the airplane is "nose heavy." If forward pressure is required, it is "tail heavy."

FOURTH—adjust the trim-tab adjustment control to counteract this tendency, being careful to follow the direction of turn indicated to bring the nose "down" or "up."

To trim a large airplane equipped with tabs on ailerons and rudder as well as elevator:

FIRST—climb to desired altitude and adjust engine to its rated cruising power.

SECOND—adjust for "nose up" or "nose down" as indicated for small ships as above.

THIRD—adjust for low left or low right wing by adjusting aileron trim-tab control.

FOURTH—adjust for right or left yaw (turn) by adjusting the rudder trim-tab control.

FIFTH—recheck the "nose up—nose down" and low-wing trim-tab adjustments.

Landing

Most airplanes must be trimmed for the best gliding speed when coming down for a landing.

Warning

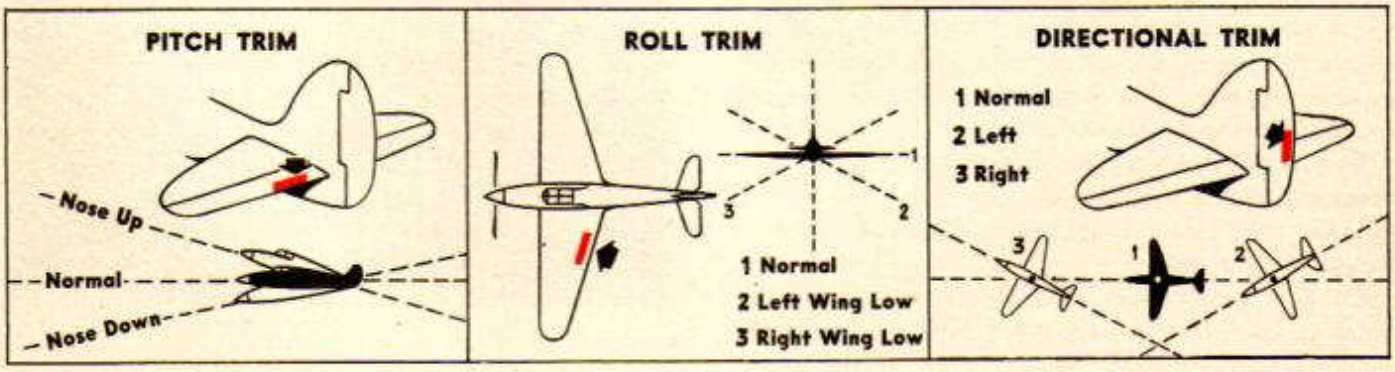
The placing of the trim-tab adjustment controls and the direction in which the tab controls are turned for a desired trim-tab reaction varies with the airplane. Check the indicated directions before taking off.

Trim-Tab Don'ts

Don't adjust the trim tabs too rapidly. Cases have been reported where a too rapid adjustment of the tabs has thrown the airplane into a snap roll.

Don't forget that as your gasoline supply decreases the balance of the airplane may change and further tab adjustments may be necessary.

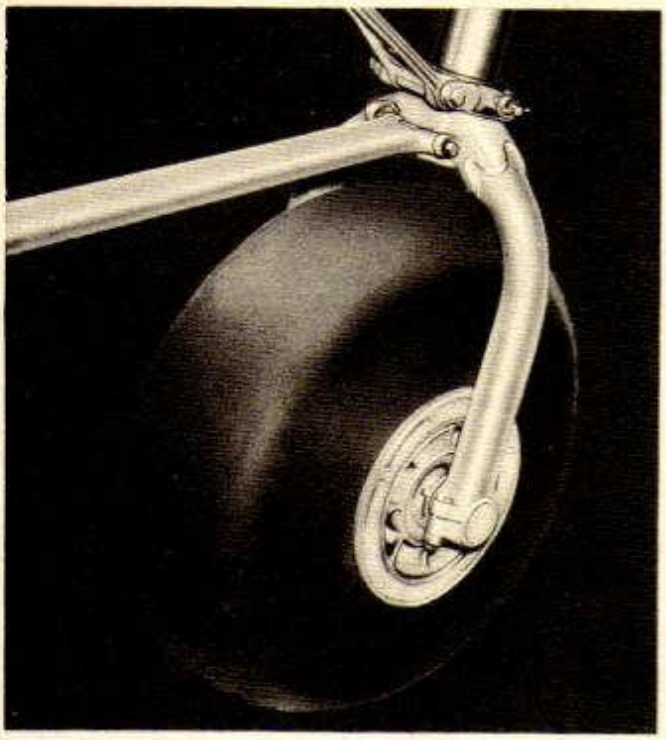
REMEMBER—the main function of the trim tabs is to ease the pressure on the controls and save the pilot work. If that is not accomplished the adjustments are not correct.



CARE OF THE AIRPLANE

Make it a point to see that the airplane is properly handled by the ground crew and be familiar with the routine of handling the plane on the ground. This is necessary when using emergency fields where no qualified ground crew is available.

Be certain that the ground crew gives the exterior finish of the airplane proper attention. If operating near the sea, **make sure that all spray and salt deposits are washed away promptly.** See that all oil and soot accumulations are removed frequently. Have all Plexiglas surfaces properly cleaned. Keep the cockpit clean and in good order at all times.



Towing

See that the ground crew uses towing rings, towing bars, or similar devices for towing when the airplane is equipped with them. If other methods of towing are used, towing lines must be attached in such a manner that they will not damage streamlines or other parts of the airplane.

Use a length of towing rope approximately 3½ times the distance between the wheels of the main landing gear. If towing over soft ground, use a longer towing rope.

On a large airplane equipped with dual wheels on each landing gear leg, use a separate source of power to operate the brakes, and station one or more men at the tail wheel steering handle. When maneuvering near hangars, airplanes on the ground, or other obstacles, assign a man to each wing tip. **A man will go in front of and facing the airplane when it is being towed.**

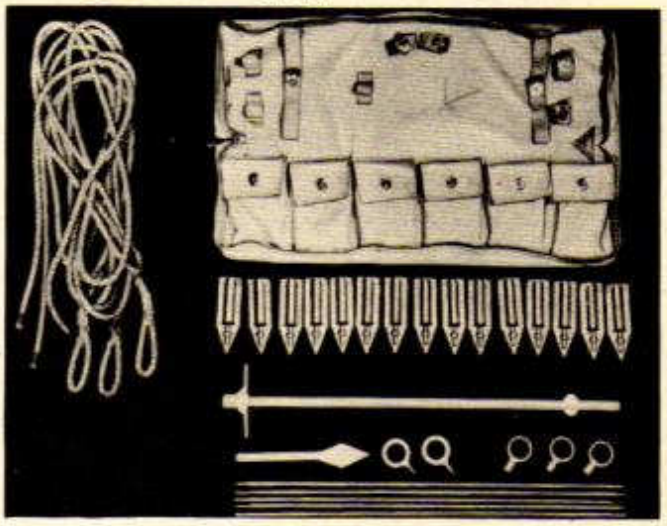
When a tow bar is attached to the nose wheel assembly, always check to be sure that the tow bar pin is in place and locked, and that the nose wheel snubber is unlocked. Pay particular attention to this precaution if the tow is to be made over soggy or rough ground.

If in doubt as to the method of towing to be used, consult the Handbook of Flight Operating Instructions for the particular airplane. **Avoid high speeds and sudden stops when towing.**

Mooring

When mooring an airplane, use the following sizes of ropes or cables according to the weight of the airplane. If the airplane is under 5,000 lbs., use ½-inch rope or 3/16-inch cable; from 5,000 to 16,000 lbs., use ¾-inch rope or ¼-inch cable; and if over 16,000 lbs., use 1-inch rope or ⅜-inch cable. Leave enough slack in ropes to prevent them from putting a heavy strain on the airplane's structure in case they tighten because of absorption of moisture.

Lock the surface controls with locks when they are available. If there are none, lock the controls in the cockpit by the use of the built-in locks. Place elevators parallel to the ground, rudder and ailerons in neutral position, and automatic pilot "OFF," if the airplane is so equipped. Lock the tail or nose



Mooring kit.

wheel in fore and aft direction, and head the airplane into the wind with chocks in front and back of each wheel. Apply parking brakes on all but B-18 series airplanes.

Emergency Moorings

For emergencies, or when warnings of storms or high winds are received, take the following additional precautions in mooring:

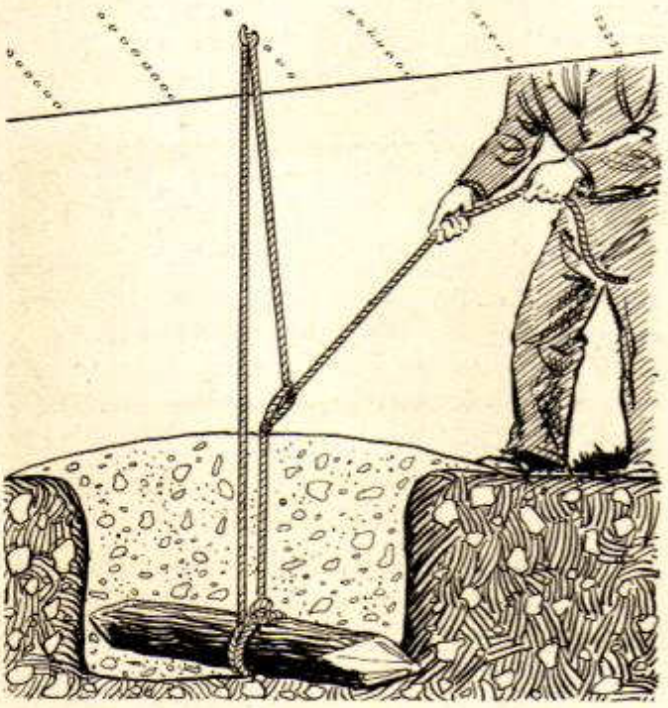
Clamp a spoiler on the wings to avoid damage to fabric covering of the wing or to the controls. The spoiler may consist of a wooden two-by-four with a length equal to approximately 75 percent of the wingspan. Locate it 10 to 15 percent of the average chord aft and parallel to the leading edge of the wing. Put the four-inch dimension perpendicular to the wing surface, with little or no space between the spoiler and the wing surface.

Install felt-padded wooden clamps to lock all movable control surfaces securely. These clamps can be made on the spot and will be used in addition to inbuilt surface control locks.

Special Mooring Equipment

The type D-1 mooring kit provides mooring points for temporary purposes. Instructions for assembling and inserting these anchor rods in the ground are included in each kit.

A "dead-man" mooring anchor may be used for semi-permanent and temporary mooring in the field.



1. Secure a cable, by splicing or with a cable clamp, around a wooden block at least 12 inches long and 3 inches by 3 inches square (if wood is not available, other material of at least equal strength may be used)
2. Form free end of the cable into a loop.
3. Bury the "dead-man" 3 to 6 feet deep (depending on the firmness of the soil)
4. Attach mooring ropes to the cable loop.

Stakes similar to tent pegs may be used to moor the airplane. They should be 2 inches to 3 inches in diameter, and 3 feet to 5 feet long. Drive them into the ground at an angle not greater than 30 degrees from vertical. Position each stake so that the mooring rope will tend to pull it into a vertical position.

Precaution When Lifting Tail Section

The underside of metal-covered stabilizers may be damaged if mechanics put their backs or shoulders under the stabilizer to lift the tail. Never permit this method of indiscriminate lifting. **Insist that the ground crew lift only at points provided in the structure of the airplane which are clearly marked by the builder.**

Plexiglas

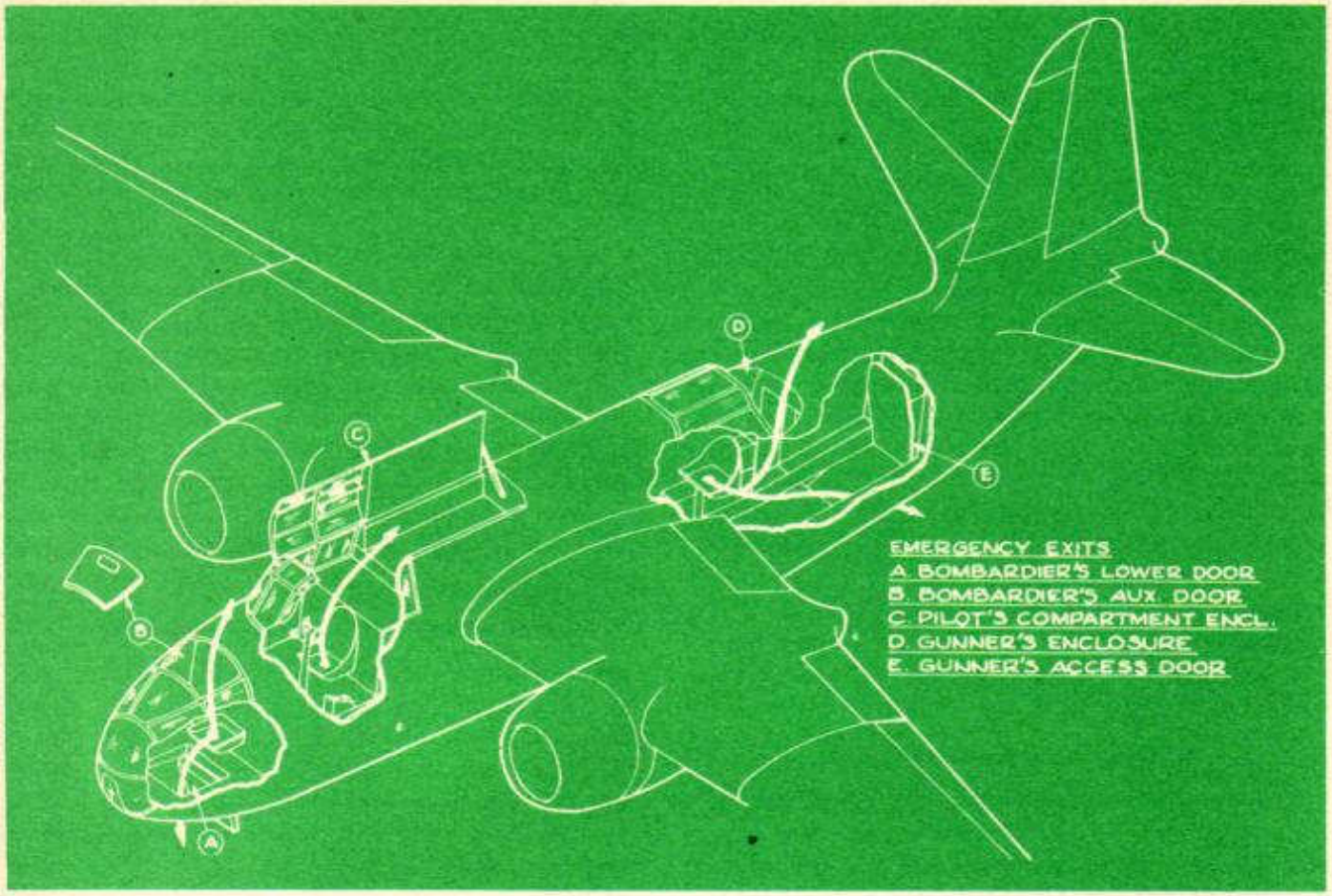
Plexiglas is used for gun turrets, windshields, nose pieces, cabin windows, blisters, etc., on all combat planes of the Army Air Forces. **Cover Plexiglas with canvas covers when exposed to the sun,** as extreme heat will soften and bend the Plexiglas.

Clean all Plexiglas surfaces frequently with plenty of pure water. The bare hand is preferable as a wiper, since a cloth might contain gritty particles that will scratch the plastic. Kerosene will remove grease and oil. Do not apply strong soaps or any type of solvent as they will "cloud" this material.

In sandy and windy regions, cover Plexiglas surfaces when parking the airplane to prevent scratches which will reduce the transparency.

An automobile type wax, free from any abrasive material, will remove the majority of light scratches. Several applications with a small grit-free cloth may be necessary. Do not rub too hard or too long on one spot as the heat generated may be enough to soften the plastic.

REFERENCE: Technical Order 01-1-50, dated November 30, 1942.



Emergency Exits

All Army Air Forces airplanes contain means for quick exit, in the air, on the ground, or water.

Before you fly, be sure everyone aboard knows:

1. What exit to use.
2. How to use it.
3. When to use it.

Hold frequent practice drills on the ground. Teamwork and speed mean a lot in an emergency.

What Exit?

In flight, upper exits are dangerous due to the possibility of being caught by a propeller or of striking the tail. Use lower or side exits whenever possible. Study Handbook of Flight Operating Instructions to learn how to bail out of your particular airplane.

On the ground or water, fasten all lower hatches before landing. Dump all upper ones. They may jam upon impact and delay is dangerous. In an emergency, you can knock a hole in the skin of the airplane. If a handaxe is provided on the airplane, know where it is and how to remove it.

How To Escape

Emergency exits are provided with quick release red handles. Usually the door or hatch will be blown away by the windstream, after release and a light push.

For a crash landing on land or water, don't dump lower hatches. Dump the upper hatches, but remember that they may damage the tail assembly.

Hold practice drills before flight. Be sure each man knows his exact duties and the meaning of emergency signals by interphone, call light, or warning bell.

What To Escape

Any emergency is unexpected and unusual, so keep your wits about you. Be deliberate, even though hurried. Consider the situation; make a decision; then give definite orders.

PIF 6-8-1
REVISED April 1, 1944

Safety Belts

Fasten your seat belt on entering the plane and be sure that belts of all passengers are properly secured. The safety belt has two purposes:

1. To keep you in the airplane.
2. To protect you in case of a crash.

Keep belts fastened at all times except when duties require free movement about the plane. Replace the belt at once upon resuming seat.

Before acrobatics, check your belt and **see that the belt is tight.** The catch may have loosened. Always check with your passenger just before performing acrobatics. He may have a loose belt or a loose catch.

Always put belt over, not through, parachute harness. You may want to bail out.

Don't wear a twisted safety belt. It cuts.

Safety Shoulder Harness

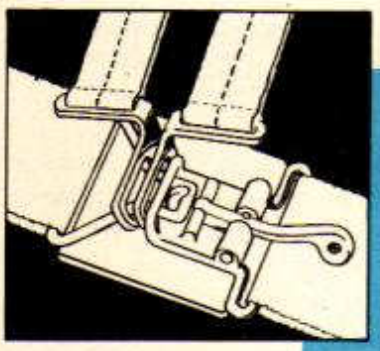
Always wear the safety shoulder harness when it is available.

It can be adjusted in two ways: to give freedom of movement (unlocked), or to prevent the wearer from being thrown forward on crash impact (locked). **Have it locked during all take-offs and landings (crash or otherwise), and in acrobatics.** Upon crash impact the shoulder straps prevent your head and chest from being thrown forward against the cowling, instrument panel, or gunsight. Experienced pilots and medical officers are convinced that a properly used shoulder harness has prevented many serious injuries and saved many lives. The shoulder harness will not break your neck.

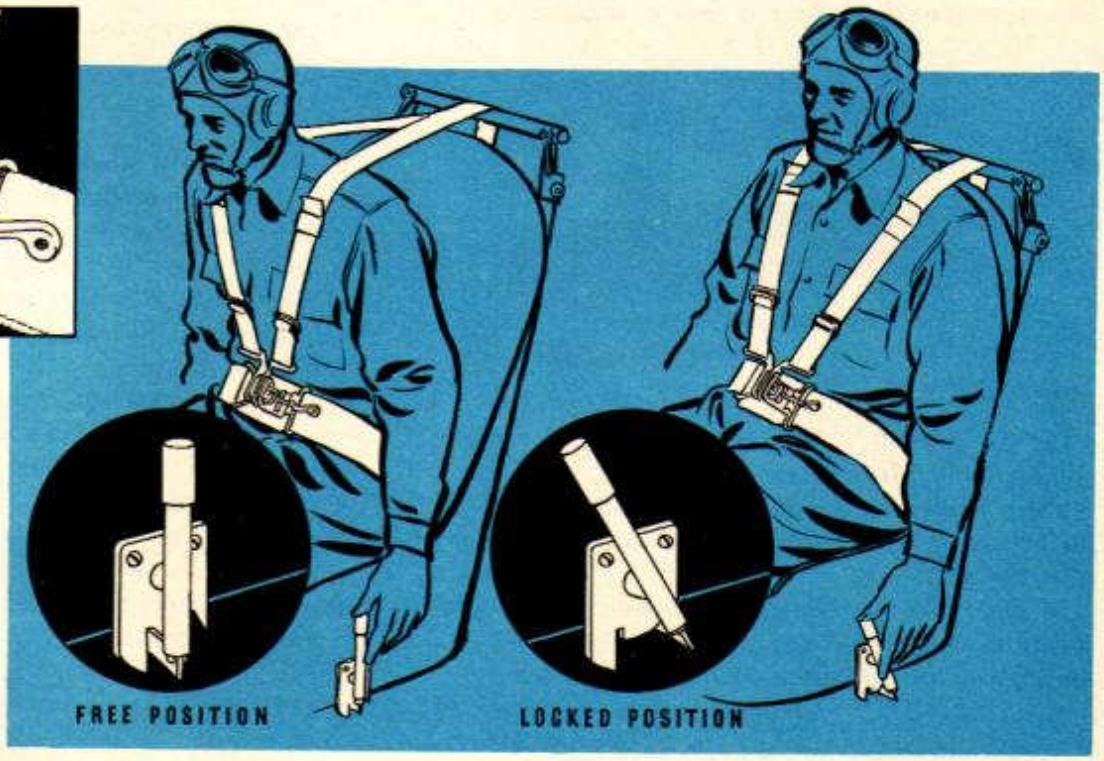
To adjust, be sure straps are over crossbar at the top of seat where a crossbar is installed. Insert metal ends into tongue of seat belt lock. Pulling the latch handle to the right in the usual way releases both belt and harness.

Harness is locked by adjusting lever at left of seat base. When lever is upright (or to rear), harness is unlocked and allows you to lean forward. Pressing down on the top of the lever and shifting it forward sets a catch which allows the harness to lock when the wearer leans back against the seat. **To adjust the harness for fit, wear your parachute and adjust the straps to fit snugly in the locked position.** Otherwise the straps may be too short to allow the lock to catch when you lean back.

REFERENCE: Technical Order 03-1-2, AAF Regulation 62-18.



Note attachment of ends of shoulder harness to the standard seat belt lock. Harness and seat belt are released together by pulling the latch handle towards the right in the usual way.



PIF 6-9-1
REVISED November 1, 1944

Safety Precautions



LOOSE EQUIPMENT

Loose equipment or accessories, carelessly stowed in your airplane, may create a serious hazard to safe flight.

They may jam the controls.

They may cause injury by shifting during violent maneuvers or forced landings.

There's a place for everything in your plane:

Replace accessories where they belong and be sure that they are fastened securely.

Tape the extra length of microphone wire to a convenient part of the airplane so that it cannot jam the controls in case the microphone is dropped.

Secure oxygen equipment when not in use. Don't drop it in the plane.

Keep the front cockpit free of loose equipment; store all cargo, tools, baggage, and other loose articles so that they will not shift in flight.



On the ground. Don't open or close bomb bay doors blindly. Have a man on watch signal "Clear".

Close bomb bay doors before starting engines on the ground unless you desire to blow gasoline fumes from the bomb bay.

In flight. Bombardier must get pilot's permission before opening bomb bay doors. Notify radio operator to reel in antenna before opening doors.

After takeoff from a muddy or slushy field in cold weather, operate bomb bay doors through several cycles to prevent freezing.

Doors open automatically when salvoing bombs.

Don't drop bombs in the normal manner unless you know the bomb bay doors are open.

Know exactly how long it takes to open doors, salvo bombs, and close doors.

Know how long emergency means will keep the bomb bay doors open to allow escape.

Don't crash land with bomb bay doors open.

Study emergency methods of bomb release, learn how to use each, and know whether the bombs will be armed or safe.



Many practices that are relatively harmless in trainers are hazardous in higher speed airplanes.

Don't extend hands or arms—or anything—out of windows or above the canopy.

Never attach streamers or other objects to any flight or control surfaces, for identification.

Have all control surfaces, trim tabs and hinges clean of mud, waste or ravelings of cleaning cloths or mooring lines. They may affect seriously the flight characteristics of the airplane.

Close cockpit windows tightly; otherwise they may throw the airplane out of trim.

Use particular care in takeoffs and landings on sandy or gravelly fields. Scratches or dents made by gravel or weeds may injure control surfaces, air foils, or propellers.

Don't attempt to lower flaps or landing gear at high speeds.

PIF 6-10-1
REVISED November 1, 1944

WEIGHT AND BALANCE



NOTICE

AAF Regulation 55-3 directs that "No pilot will accept and operate any aircraft without satisfactory evidence of correct gross weight and balance. This is a matter of safety of personnel and equipment and will be strictly enforced."

There are two things a pilot must know about the weight and balance of any airplane he is going to fly.

1. The gross weight.
2. The location of the center of gravity (CG).

High Gross Weight



Loading above recommended maximum gross weight results in a high gross weight condition.

Every model of aircraft is designed to do certain work efficiently. Among other things it is built to fly within specified load limits. The upper limit is figured with a factor of safety great enough to allow for the stresses and strains of all ordinary operations and permitted maneuvers.

If, however, you try to fly an airplane with a greater load than it was designed to carry, you decrease its range, you increase its stalling speed, you require more runway to take off and land. If you lose an engine in multi-engine equipment, these loads are particularly hazardous.

At high gross weight, an airplane may suffer structural damage in turbulence or under rough handling.

With any high gross weight you have a reduced factor of safety. If you get into trouble, you may not have enough margin.

The term "overload" commonly used for the above condition actually means unflyable gross weight.

Unbalanced Load



The effect of balance on an airplane's performance may be even more critical than the effect of overload. If you take off with an airplane even slightly out of balance (with the CG outside the allowable limits), you have difficulty with your control; it changes the spin and stall characteristics of your plane, it handles badly in turbulence, and puts undue strains on the pilot.

An airplane badly out of balance is erratic to the point of uncontrollability. If you get into trouble in the air, you may not be able to recover—especially from a spin. A tail-heavy spin is usually a flat or erratic spin.

There is less danger from a nose-heavy unbalanced condition; but you'll have your hands full landing an airplane that is excessively nose-heavy.

Pilot Responsibility

Since you are responsible for knowing the gross weight and balance condition of any airplane you fly, you must understand the simple basic principles upon which load conditions are figured. You do not have to do it all, your Weight and Balance Officer is charged with many of the duties; but you must know enough to check his work. Your signature on Form F certifies that the airplane is loaded as shown.

Gross Weight

Gross Weight is figured by knowing the basic weight, and adding to it the disposable weight for any particular mission.

Basic Weight is the weight of the airplane with its modifications and the operational equipment that stays in the plane. This information is supplied to you in airplanes requiring it. (Certain airplanes in Class 1 are exempt from these requirements. Check with your Weight and Balance Officer.)

Disposable Weight is everything else in the airplane — the crew and their equipment, fuel, oil, ammunition, cargo, etc. Anything that is not permanently (or semi-permanently) in the airplane.

When you have figured your disposable weight and added it to the basic weight of plane, the total must not exceed allowable gross weight for takeoff.

Landing Gross Weight

Remember that for bombers and cargo aircraft there is also an allowable **landing gross weight.** Be sure that you will be at or under allowable landing weight before your first landing.

Determining the Balance

With the gross weight figured within the allowable limits, you must next be sure that the load is properly distributed in your plane.

The Center of Gravity (CG) of an airplane and its load is that point at which, if suspended, the airplane would balance itself. Airplanes are so designed that you can fly them safely if the actual CG varies several inches fore or aft.

The performance of the plane within these limits is fully satisfactory. Flight tests have proved that cruising speed, climbing, and other normal operations are so slightly affected within the allowable CG range, that there is no need to spend the time and effort required to load an airplane to an exact CG point. **But it must fall within CG limits.**

The principle of figuring the CG of an airplane is the same as the principle of the steel-yard scale or the see-saw. Weight near the CG has less effect than weight farther from the CG.

Weight multiplied by its distance from a CG point equals **moment.** The sum of all the moments on one side of the CG equals the sum of all the moments on the other side of the CG.

There are various aids provided to simplify the process of figuring the load condition of your plane:

The **Load Adjuster,** found in most Class 2 airplanes, is comparatively simple to operate. You will find full directions in the data case, or ask the Weight and Balance Officer to instruct you in its use.

Loading Graphs (Chart E) supplied in some airplanes not equipped with load adjusters. By following directions carefully you can determine the CG condition with the graph.

Weight and Balance in Flight

Both the Gross Weight and the CG condition of your airplane change in flight as you:

1. Use up fuel and oil.
2. Drop bombs and expend ammunition.
3. Fly into icing conditions.

Figure before takeoff on the normal changes expected in flight and provide for keeping the load in balance.

Know where your crew and passengers are all the time. This is important. Don't let them shift about the airplane or move heavy cargo without reporting change of positions to you.

If you know the disposition of load, passengers, and crew, you can figure quickly the proper moves necessary to keep your CG condition within safe limits at all times.

Forms

The "Weight and Balance Data" book (AN 01-1B-40) is in the data case of the airplane. Below are listed the forms you will find in the book and your responsibility for them:

Airplane Weighing Form. You are not responsible for it, but check it. The airplane should be reweighed:

1. After major modification or repair.
2. If you find its balance condition unsatisfactory during flight.
3. If you suspect error in the basic data.

Chart A lists operational items and their location in the plane. From time to time such items are moved, taken out, or others put in. See that it is up-to-date.

Chart C, the basic weight and balance record, gives the latest basic weight, moment, and CG index. From this chart you get the figures for basic weight entry on Form F.

PIF 6-10-3
REVISED November 1, 1944

FORM F

Lists weight, location, and index of all disposable or transient weight on Class 2 airplanes. Use with load adjuster or Chart E (Loading Graph). One chart for Transport and Cargo Types, one for Tactical Types. The person who supervises the loading is responsible for filling out the Form F. You are responsible for seeing that it's correct when complete.

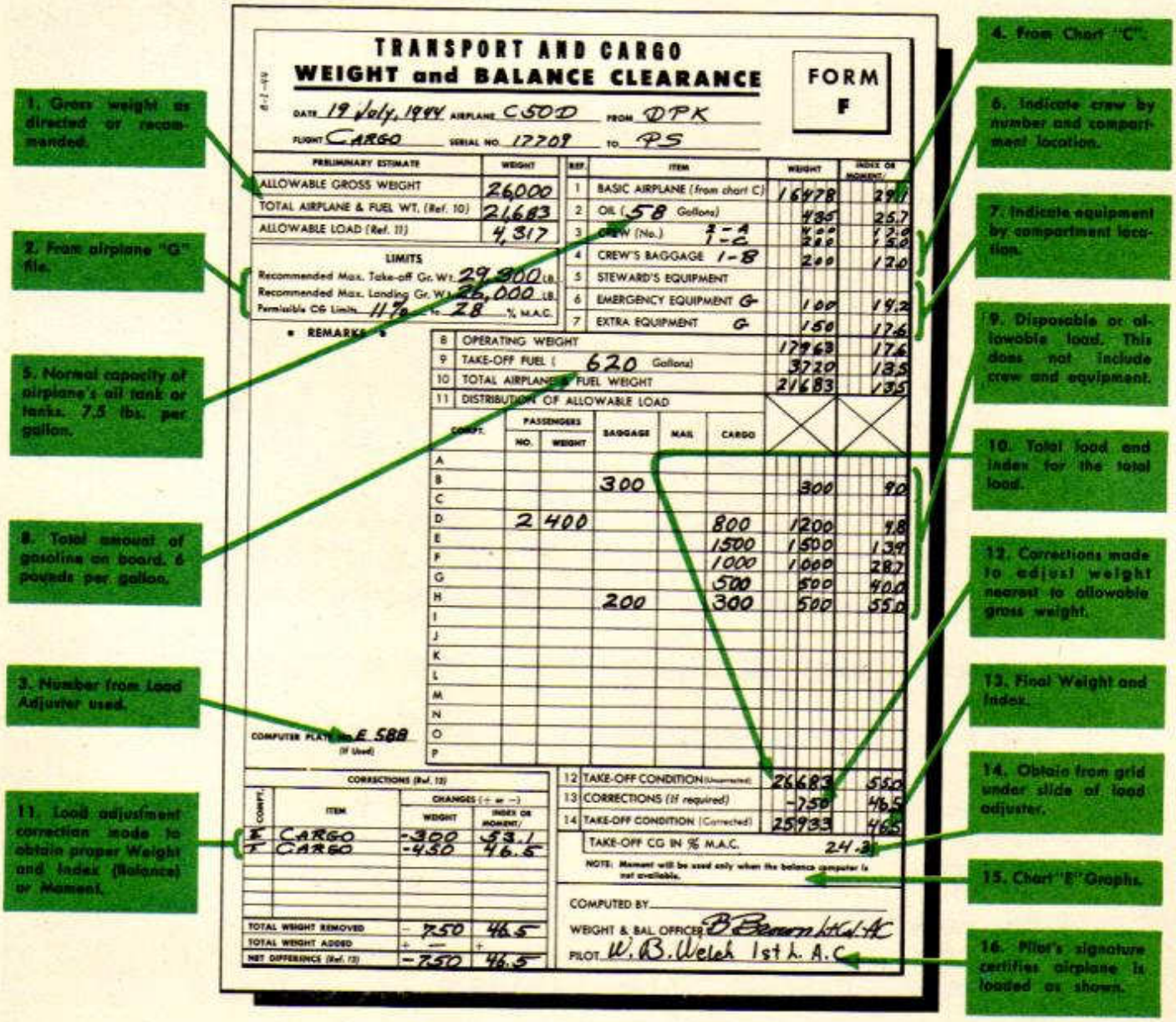
Attach to Form 23 when you file your flight plan.

You need not file a Form F on a Class 2 airplane:

1. When load is identical with one on which a Form F has been filed previously (check duplicates in Handbook of Weight and Balance Data).

2. If you land en route, take on fuel, and other disposable or transient weights remain the same.

In either case, certify that a Form F was filed previously, giving date and place.



TURN PAGE TO SEE SPECIMEN FORM F FOR TACTICAL AIRPLANES ▶

TACTICAL
WEIGHT and BALANCE CLEARANCE

FORM F

DATE 18 July, 1944 AIRPLANE B 17 G FROM Lowry
MISSION Bombing SERIAL NO. 19422 TO Colo. Springs

* REMARKS *

REF.	ITEM	WEIGHT	INDEX OR MOMENT/1000
1	BASIC AIRPLANE (from chart C)	37035	48.9
2	(144 Gallons	1080	40.9
3	DISTRIBUTION OF LOAD		

COMPT.	CREW NO.	CREW WEIGHT	BAGGAGE	CARGO AND MISC.		
A	2	400		300	700	25.4
B	2	400		50	450	20.2
C	1	200		100	300	17.8
D						
E	1	200		50	250	19.9
F	1	200			200	23.1
G	1	200			200	28.1
H						
I	1	200			200	39.2
J						
K						
L						
M						
N						

COMPUTER PLATE NO. E 624 (If Used)

This weight and index or moment must be within limits for landing. If this is impossible, pertinent instructions to the pilot for shifting load and crew should be noted above. Particular care must be taken when parachutes are evacuated.

REF.	ITEM	WEIGHT	INDEX OR MOMENT/1000
4	MINIMUM LDG. GR. WT.	40415	39.2
5	AMMUNITION (By Compartment) A (600 Rds. .50 Cal.	180	35.2
	C 1200 .50	360	32.4
	F 1000 .50	300	37.2
	G 800 .50	240	43.1
	I 600 .50	180	53.2
6	BOMBS FORWARD 2—2000#	4130	46.5
	AFT		
	EXTERNAL		
7	FUEL BUILT IN (1500 Gal.	9000	44.2
	BOMB BAY ( ) Gal.		
	EXTERNAL ( ) Gal.		
8	TAKE-OFF CONDITION (Uncorrected)	54805	44.2
9	CORRECTIONS (If required)	-800	46.6
10	TAKE-OFF CONDITION (Corrected)	54005	46.6

TAKE-OFF CG IN % M.A.C. 29.5 %

CORRECTIONS (Ref. 9)

COMPT.	ITEM	CHANGES (+ or −) WEIGHT	CHANGES (+ or −) INDEX OR MOMENT/1000
A	CARGO	-250	49.7
C	600 RDS-50	-180	51.1
F	500 RDS-50	-150	48.8
C	CARGO	-100	49.5
G	400 RDS-50	-120	46.6
	TOTAL WEIGHT REMOVED	-800	46.6
	TOTAL WEIGHT ADDED	+ —	+
	NET DIFFERENCE (Ref. 9)	-800	46.6

LIMITS
Recommended Max. Take-off Gr. Wt. 54,000 LB.
Recommended Max. Landing Gr. Wt. 50,000 LB.
Permissible CG Limits 19 % to 35 % M.A.C.

COMPUTED BY
WEIGHT & BAL. OFFICER B.B. Brown Lt.C.A.C.
PILOT W. B. Welch 1st Lt. A.C.

1. Number of load adjuster used.

2. From Chart "C".

3. Normal capacity of airplane's oil tank or tanks. 7.5 lbs. per gallon.

4. Crew by number and weight. By compartment, plus baggage, cargo and miscellaneous by compartment and weight.

5. Ammunition distribution by compartment, amount, and type.

6. Bomb distribution by amount, type, and location. Weight includes shackles.

7. Total amount of gasoline on board, and distribution. 6 lbs. per gal.

8. Load adjustment correction made to obtain proper Weight and Index (Balance) or Moment.

9. From airplane "G" file.

10. Obtain from grid under slide of load adjuster.

11. Pilot's signature certifies airplane loaded as shown.

RULE-OF-THUMB FIGURES FOR DISPOSABLE ITEMS:

Each crew member or passenger (with parachute) ..... 200 lbs.

Fuel, per gallon ..... 6 lbs.

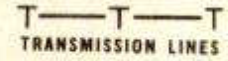
Oil, per gallon ..... 7.5 lbs.

.30 cal. ammunition, 100 rounds ..... 6.5 lbs.

.50 cal. ammunition, 100 rounds ..... 30.5 lbs.

.20 mm ammunition, 100 rounds ..... 55 lbs.

Aeronautical Chart Symbols



TRANSMISSION LINES


MAIN ROADS & HIGHWAYS


SECONDARY ROADS, BRIDGES


STATE & INTERNATIONAL BOUNDARIES


RAILROADS SINGLE & DOUBLE TRACK


TUNNELS RAILROAD OR HIGHWAY


DAMS

CANALS


CITIES (OUTLINE) ALSO IN YELLOW


TOWNS

VILLAGES


RACE TRACKS


MINE OR QUARRY


LOOKOUT TOWERS


OIL WELLS


TANKS

MISCELLANEOUS


RIVERS AND STREAMS

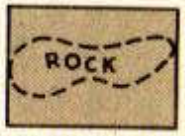

INTERMITTENT STREAMS


INTERMITTENT LAKES


SAND AREAS



PROMINENT PEAKS AND RIDGES



UNUSUAL FEATURES



CONTOURS WITH ELEVATION


MILITARY AIRFIELD


CIVIL AIRPORT


FLIGHT STRIP


SEAPLANE BASE


EMERGENCY FIELD



OBSTRUCTION, WITH HEIGHT ABOVE GROUND

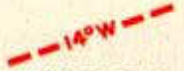

ROTATING BEACON


ROTATING BEACON WITH COURSE LIGHTS


ROTATING BEACON WITH FLASHING CODE


FLASHING BEACON


FLASHING CODE BEACON



LINES OF EQUAL MAGNETIC DECLINATION

SECTION 7 NAVIGATION AIDS



EVERY pilot knows basic navigation. This section, therefore, is not designed to teach you pilot navigation nor instrument flying techniques. It contains information and tips on pilotage, dead reckoning, and the use of radio to aid you on all flights.

The types of navigation you use on most flights are not difficult to master if you plan your flights carefully before takeoff. Practice using all forms of navigation. Don't depend on one method.

Remember, you have little time for additional planning and figuring in the air. Your ability to plan your flight correctly—and to follow the plan through to the end—should become as natural as flying itself.

FLIGHT PREPARATION

BEFORE YOU TAKE OFF

Careful flight planning simplifies your navigation problems. This is a good check list:

Get proper charts covering flight and number in the order you'll use them.

Check NOTAMS. Note changes on charts.

Draw course line. Note elevations of highest points along and near your route. Pick a safe altitude.

Plan the legs of your flight. Plan to make all turns over check points when possible.

Note location, frequency, and call letters of all radio ranges along your course.

Mark course line in 20-mile increments to help you check distance travelled. They may not fall on check points.

Mark all check points plainly and boldly.

Note distance between check points.

Make a log of check points on a sheet of paper indicating the distance between them.

Get all necessary weather information.

Study winds-aloft charts carefully. Get a winds-aloft forecast.

Figure wind drift for each leg of your flight.

Compute true airspeed and probable groundspeed.

Compute time between check points.

Add information to log.

Figure total elapsed time to destination.

Compute fuel consumption and range.

Note and check all emergency landing strips on each side of your course.

Check compass and radio before takeoff.

Each base operations office has on file all the navigational information you require for any flight. There need be no question marks on your course if you know where to look for this data.

Use it in connection with complete and current weather information. The following guide will tell you where to look for what you need. Make good use of the USAAF Airport Directory, Continental U. S.; it contains much excellent information, including photographs of landing fields.

	DATA	WHERE TO FIND IT
AIRPORT FACILITIES	Runways information Weather station facilities Type of operations Radio facilities and hours of operation Closed or open to army transients? Servicing (repairs & fueling) Distance of airfields from adjacent towns Obstructions and markings Field elevations	USAAF Airport Directory, Continental U.S. Less detailed data on most items also found in Army-Navy Directory of Airfields
RADIO NAVIGATIONAL FACILITIES	Radio range frequencies and call letters Tower frequencies and call letters Distance between range stations	Radio Facility Charts T. O. 08-15-1
	Instrument let-down procedures	T. O. 08-15-3
	Complete detailed information on let-down procedures, obstructions, and location of buildings	Instrument Approach and Landing Charts
	Commercial broadcasting stations	T. O. 08-15-2
EMERGENCY LANDING FIELDS		Regional Aeronautical Charts
NAVIGATIONAL HAZARDS	Danger and caution areas Changed lighting facilities No servicing facilities Closed fields Fields under construction No lighting facilities	Weekly Notices to Airmen (use in conjunction with Notams)

CHECK WEEKLY NOTICES TO AIRMEN AND NOTAMS FOR LATEST GENERAL FLIGHT AND FIELD INFORMATION

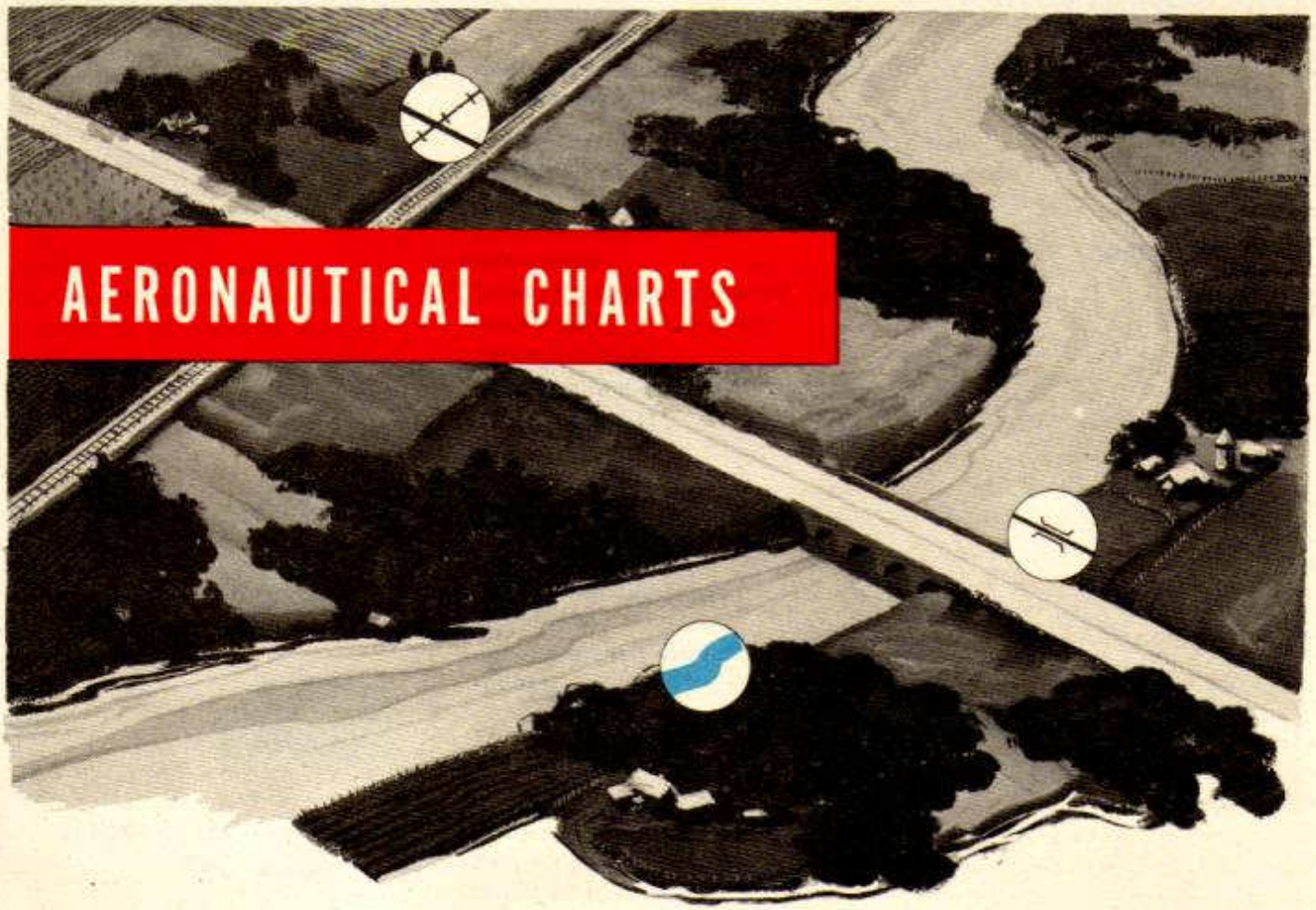
IAS to TAS

Before takeoff get temperature at cruising altitude from adiabatic charts in weather office. Then correct IAS for temperature and altitude.

If you have no computer, consult the table on PIF 2-19-2 which converts IAS to approximate true airspeed at various altitudes.

Log

Keep a log of your flight. Write down pertinent information to use during your flight. Never trust your memory.



AERONAUTICAL CHARTS

Charts are maps which contain navigational data. You need them on every flight you make, contact or instrument.

Be familiar with all the information on the charts.

Learn the meaning of the symbols on aeronautical charts so you won't have to refer to the legend.

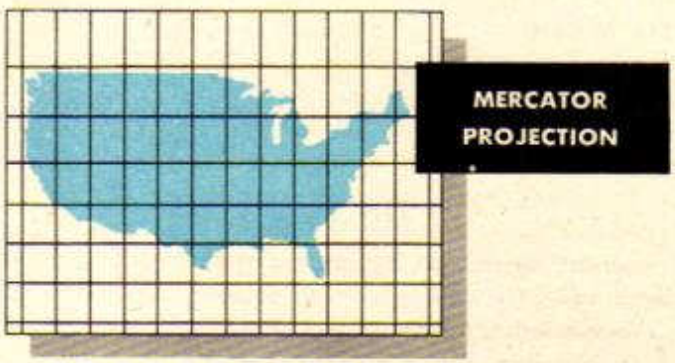
Plan your flight carefully before takeoff.

Then use the charts when you're in flight.

Lambert Conformal and Mercator Projections

Most aeronautical charts used in the AAF are Lambert Conformal Projections. This type of chart represents a portion of the surface of the earth as a section of a cone, laid out flat. The cone intersects the surface of the earth along two lines, called Standard Parallels, which are parallel to the lines of latitude. The area between the Standard Parallels,





indicated on the upper right-hand corner of the chart, has almost no distortion; meridians converge toward the nearest pole.

Lambert Conformal projections closely resemble a portion of the globe as you see it. There is little distortion; land and water areas are shown in their correct proportion. A straight line drawn between two points on the chart represents approximately the shortest distance between those points. The graphic scale along the margin is an average for the chart. Use it for scaling distances.

You use Lambert Conformal projections on most flights.

Mercator Projections show all meridians as parallel lines and all lines of latitude perpendicular to the meridians as parallel lines. There is considerable distortion on all parts of these charts except at the Equator. They may be issued to you in some combat theatres, **so know which projection you have, before you start flight preparations.**

Types of Lambert Conformal Charts

Sectional Aeronautical Charts: Scale, 8 miles to the inch (1:500,000). 87 charts cover the U.S.

Many important features are shown: villages, towns, and cities; railroads, roads, highways, and transmission lines; rivers, streams, ponds, and lakes; prominent structures, underpasses, water towers, and race tracks; coastal and terrain features with elevations; light-lines and beacons with their code symbols; airways and caution or danger areas; airports, emergency and auxiliary fields; radio ranges with frequencies, codes, and magnetic headings; larger commercial radio stations with call letters and frequencies; and much other information of value to you in flight. Sectional charts are desirable for most flights.

Regional Aeronautical Charts: Scale, 16 miles to the inch (1:1,000,000). 17 cover the U.S.

Only the most prominent check points are indicated. These charts cover more territory but show few details. In flight, Regionals may be more satisfactory to use when you are flying fast airplanes.

Check the scale of all charts and don't mix them.

Radio Direction Finding Charts: Scale, 32 miles to the inch (1:2,000,000). 6 cover the U.S.

Use these charts especially for plotting radio bearings. Compass roses on the charts are oriented to magnetic north. Use the compass roses for plotting bearings.

Aeronautical Flight Charts: Scale, 16 miles to the inch. For established flight routes.

Aeronautical Planning Charts: Scale, 80 miles to the inch (1:5,000,000) and 47 miles to the inch (1:3,000,000). 1 Chart for the U.S. in two sizes.

This chart is accurate for measuring distances between widely separated points in the United States. An overprint on the chart shows the limits of the Sectional charts. First, get the overall picture of your flight on the Planning chart, then get the Sectional charts you need.

Radio Facility Charts (various scales): These charts contain all radio and communications data. All are contained in T.O. No. 08-15-1, issued monthly. Be sure the copy in your airplane is the latest.

Aeronautical Planning Charts: World coverage.

Long Range Navigation Charts: World coverage.

World Pilotage Charts: Partial world coverage.

Aeronautical Approach Charts: For limited strategic areas.

Miscellaneous Charts: There are other charts, of various scales, that you may use in combat. They will be issued and explained by your Briefing or S-2 Officers.

British Charts: In the ETO you may be issued British charts. They are similar to ours in many ways, but have different symbols and color gradients. If you know the charts used by the AAF, you'll have little difficulty in understanding the British charts.

CHECK POINTS

Aeronautical charts show prominent landmarks and terrain features to aid you in flight. Learn which check points to use for different flight conditions.

Check points must stand out clearly from surrounding features.

They must be distinctive—so you won't confuse them with similar points.

They must be easy to recognize under the conditions and time of day of your flight.

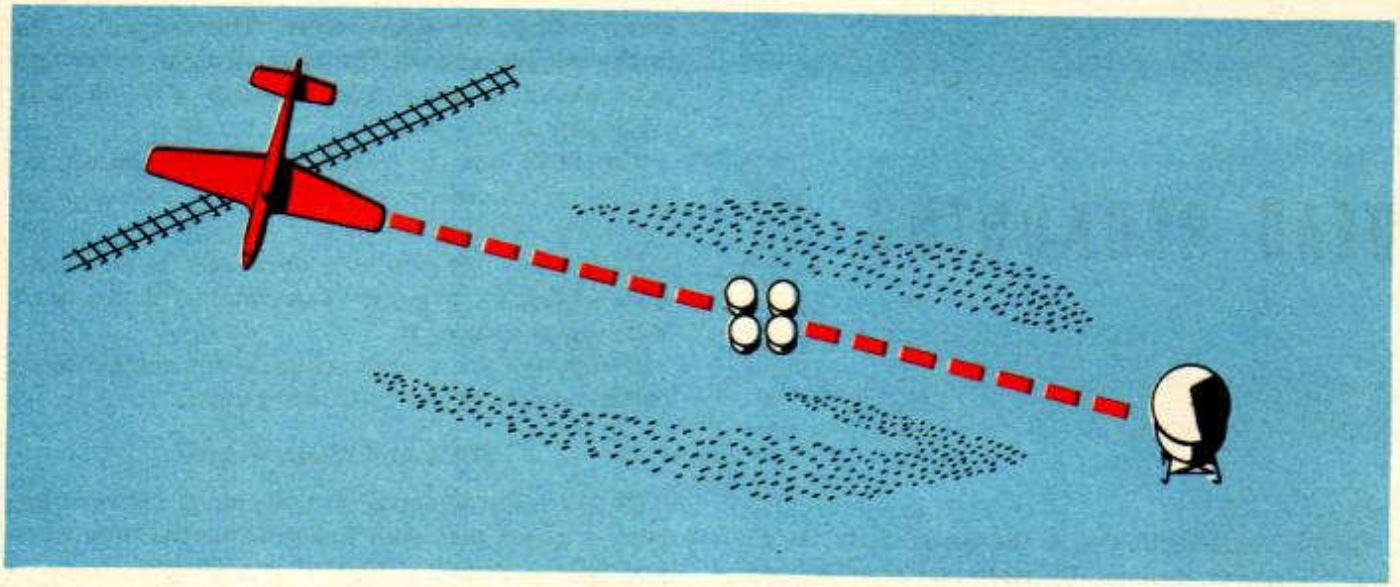
They should be spaced conveniently along your course, close enough to keep you on course—far enough apart so that you won't be completely occupied picking out check points.

Don't get into the habit of looking for check points only on one side of your course.

A positive check point should be at the point of each turn you make in flight.

CONDITIONS	GOOD CHECK POINTS	POOR CHECK POINTS
HEAVILY POPULATED AREAS 	Large cities with definite shape. Small cities with some outstanding check point; river, lake, structure, easy to identify from others. Radio aids, prominent structures, speedways, railroad yards, underpasses, rivers and lakes. Race tracks and stadia, grain elevators, etc.	Small cities and towns, close together with no definite shape on chart. Small cities or towns with no outstanding check points to identify them from others. Regular highways and roads, single railroads, transmission lines.
OPEN AREAS FARM COUNTRY 	Any city, town, or village with identifying structures or prominent terrain features adjacent. Prominent paved highways, large railroads, prominent structures, race tracks, fairgrounds, factories, briges, and underpasses. Lakes, rivers, general contour of terrain; coastlines, mountains, and ridges where they are distinctive. Radio Aids.	Farms, small villages rather close together, and with no distinguishing characteristics. Single railroads, transmission lines and roads through farming country. Small lakes and streams in sections of country where such are prevalent, ordinary hills in rolling terrain.
FORESTED AREAS 	Transmission lines and railroad right-of-ways. Roads and highways, cities, towns and villages, forest lookout towers, farms. Rivers, lakes, marked terrain features, ridges, mountains, clearings, open valleys. Radio Aids.	Trails and small roads without cleared right-of-ways. Extended forest areas with few breaks or outstanding characteristics of terrain.

CONDITIONS	GOOD CHECK POINTS	POOR CHECK POINTS
MOUNTAINOUS AREAS 	Prominent peaks, cuts and passes, gorges. General profile of ranges, transmission lines, railroads, large bridges over gorges, highways, lookout stations. Tunnel openings and mines. Clearings and grass valleys. Radio Aids.	Smaller peaks and ridges, similar in size and shape.
COASTAL AREAS 	Coastlines with unusual features. Light houses, marker buoys, towns and cities, structures. Radio Aids.	General rolling coastline with no distinguishing points.
SEASONAL CHANGES 	Unusually shaped wooded areas in winter. Dry river beds if they contrast with surrounding terrain. Dry lakes.	Open country and frozen lakes in winter unless in forested areas. Small lakes and rivers in arid sections of country—in summer—when they may dry up. Lakes (small) in wet seasons in lake areas, where ponds may form by surface waters.
IN GENERAL 	Some general features, often as far as 40 or 50 miles away, may make good check points, especially in flat country. Abrupt changes in physical appearance: mountainous to flat areas, forests to farms, etc.	



Lines of Position

In flight, establish as many lines of position as possible. For example, the pilot in the illustration above, as he crosses a railroad, lines up distant tanks and a tower as an off-course position check, in addition to on-course check points.

Correcting Charts

Note errors or important features not shown on your charts. This is important, especially in some of the remote theatres, because charts covering these areas have been compiled from meager and sometimes unreliable information. New information will be valuable in compiling new charts.

Turn in corrected charts to operations. They will forward the information to Aeronautical Charts Service, Washington, D. C.

Memory Pilotage

If you operate over a certain section of the country frequently, study the outstanding characteristics of the terrain in relationship to your charts. Know this territory well so that you won't have to refer to your charts so frequently.



PIF 7-3-1
ADDED November 1, 1944

DEAD RECKONING

Simple dead reckoning is the basis of all navigation. To use it successfully **make accurate calculations before your flight.** Then keep working during the flight. Because you hit one or two check points on the nose doesn't mean your destination is in the bag. Good navigation depends on checking your position constantly until you are over the field or target for which you set out.

Computers

Use of a computer is advisable for making accurate and speedy calculations.

The D-4 type computes speed, time, and distance; fuel consumption; true airspeed; and corrects altimeter readings for temperature. This computer fits in the pocket, and can be read at night under any light including ultra-violet. Consult T.O. 05-35-24 for details of operation.

The E6-B type is useful for all calculations, including groundspeed and wind drift. Details of its operation for pilots are in T.O. 05-35-9.

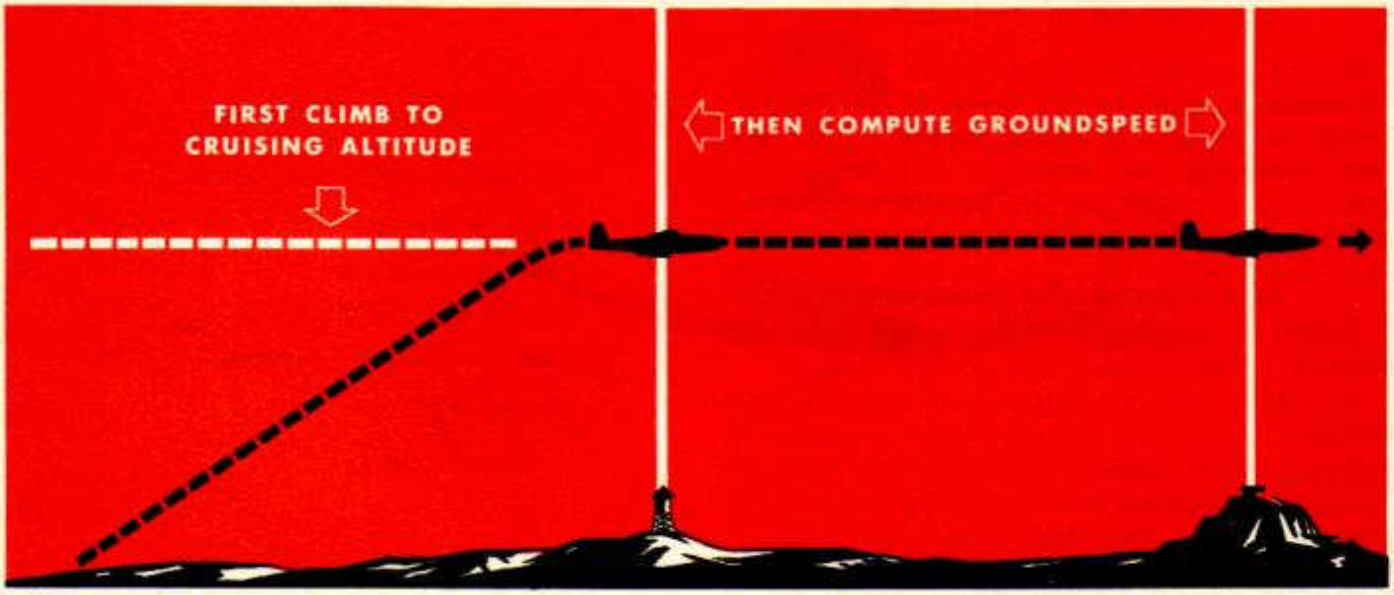
Both types are available ordinarily in all operations offices for pre-flight calculations, if you don't have one of your own.

Computers are always valuable for contact flight and indispensable for instrument flight.

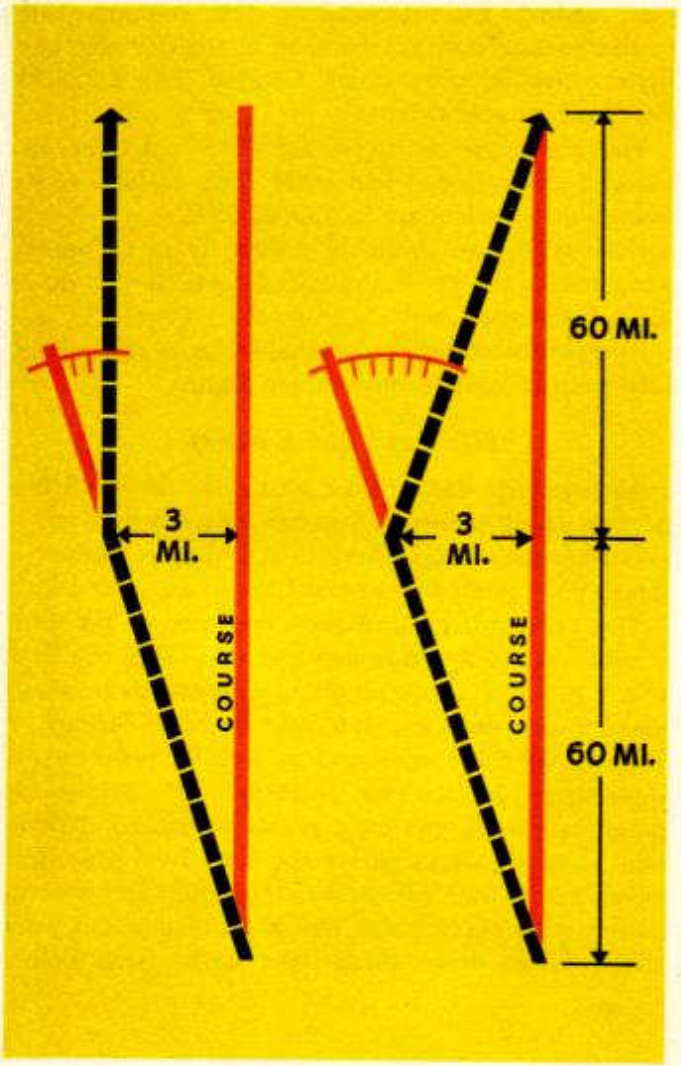
ETA'S and Check Points

Measure the distance on your chart between important check points, so you can note the time when you pass each point. Then it is a simple matter to figure your groundspeed and ETA to the next point.

Don't compute groundspeed, however, on the time it took you to fly from point of takeoff to the first check point. You use climbing airspeed to traverse part of this distance, and pass through regions of varying wind direction and velocity to reach cruising altitude. By the time you reach your first check point, ordinarily you have reached cruising altitude and airspeed. Mark down the time over this first check point; then compute immediately the time to your second check point, and so on throughout your flight. **Write down times over each check point.**



PIF 7-3-2
ADDED November 1, 1944



GETTING BACK ON COURSE

If you have flown for 60 miles, each mile you are off course is equal to one degree off course. For every mile you are off course, correct 1°. You are then paralleling your course. By correcting 2° for every mile off course you will be back on your intended course in 60 miles. This works proportionately.

Time, Distance, and Groundspeed

Failure to recognize the relationship of time and distance to groundspeed is a common error.

Naturally, you can't compute your ETA correctly without first having computed your groundspeed correctly. If the distance between check points is large, some pilots start worrying too soon about the next check point. Then they begin to circle around aimlessly, and get lost.

Never confuse true airspeed with groundspeed when considering your ETA over a check point.

Remember these Tips

Deviation

Deviation in compass error. **Apply it to magnetic course** on every flight. Ordinarily you are interested only in the "M to C" side of the compass card.

Variation

East variation is a minus correction. West variation is a plus correction. Remember: "East is least."

Fuel Consumption

Work a fuel consumption problem on a computer as you work a time, speed, and distance problem, except substitute gallons for miles, and gallons per hour for miles per hour.

Compass Course

Correct true heading for variation to get magnetic heading. Using your compass card, apply deviation to magnetic heading to obtain compass heading, the one you fly.

Groundspeed in Flight

To compute your groundspeed in flight, check time accurately between check points. Divide distance travelled by time in hours. To obtain accurate groundspeeds check your position over such features as rivers, railroads, roads, and water towers.

DON'T WANDER

When your ETA over a turning point is up and that point is not yet in sight, continue on-course for a reasonable time. If you still can't see it, return to your last positive check point. Don't wander aimlessly.

PIF 7-4-1
ADDED November 1, 1944

Wind



Compute wind drift for each leg of your flight. The difference between your ETA and your actual time of arrival is a variable influenced mainly by wind. You can control airspeed but not the effect of wind on your airplane. Therefore, in addition to obtaining winds aloft information before takeoff, check winds continually during flight, and each time you land during a cross-country.

In flight, you are not only moving over the ground, but through an air mass. Air is always in movement, and it is this fact which makes proper wind drift calculations so important.

Wind Triangle Principle

Draw a wind triangle for each leg of your flight if you are not using a computer to figure wind drift.

In a wind triangle the elements always pair up, each pair representing a side of the triangle.

The elements combine as follows:

True Course (Track) and Groundspeed
True Heading and Airspeed
Wind Direction and Velocity

The angle between true course and true heading is the angle of drift. Always correct this number of degrees **into the wind.**

Wind Over Land

Most flights are over or within sight of land.

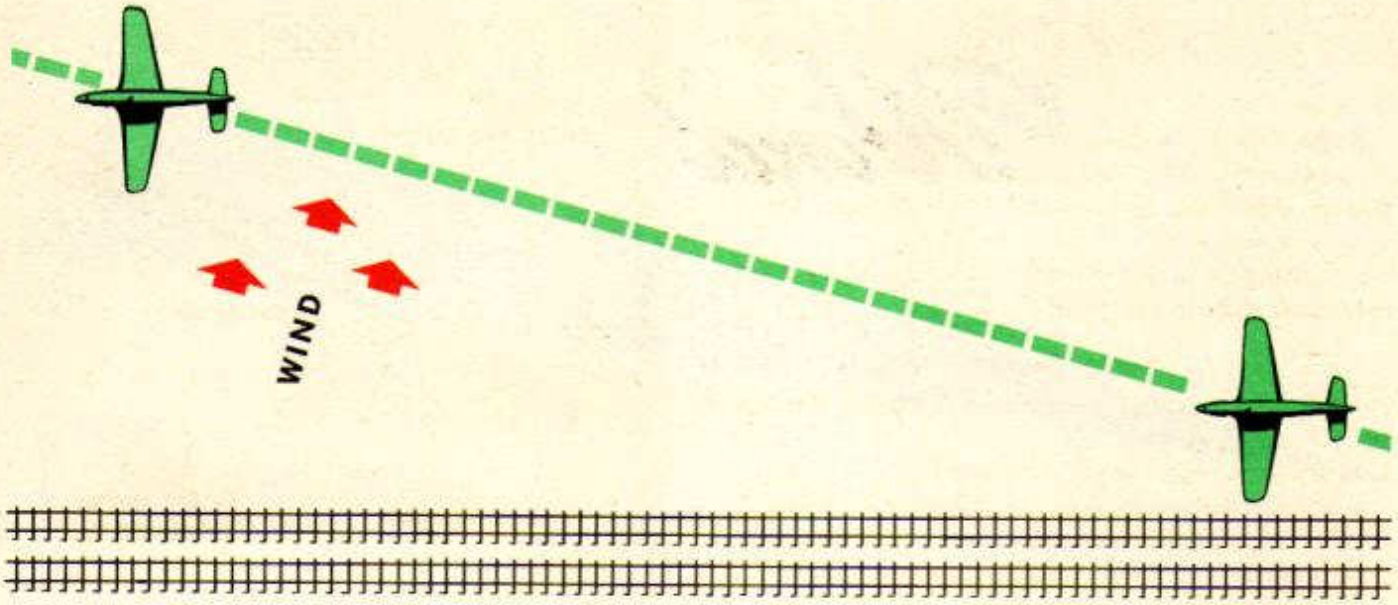
A good way of determining wind direction is by watching smoke drift. If it is calm smoke rises vertically.

Direction of cloud shadows moving across the ground gives a good indication of wind direction at the level of the clouds.

Do not consider smoke from trains unless you allow for the movement of the train.







To Find Drift at a Desired Altitude

1. Find a road, railroad, or power line that heads in the general direction of your flight.
2. Use the magnetic heading of the object to steer a parallel course.

Wind and Temperature

Watch for abnormal changes in temperature. They are accompanied always by a change in wind direction. Consequently they change your airspeed and drift.

Wind Over Water

Find wind direction and velocity by watching the surface of the sea. At an altitude of 2000 feet or less, with no cloud formations between the airplane and the surface of the sea, the direction and velocity of the wind (for all practical purposes) is the same as the surface wind.

Wind Direction

Crest lines of the smallest ripples on the sea surface are perpendicular to the direction of the wind. The foam or white caps that form on the water always appear to slide into the wind. Actually the foam is left on the water by the white caps; as the waves advance, the foam is left behind them.

Check wind direction by noting crest lines on the surface of the water. Obtain true direction of the wind by noting its relative bearing from the true heading of the airplane.

Wind Force

Keep in mind the following sea descriptions. Use them as a guide, but change them if experience dictates.

Wind force is divided into six phases:

1. 0-4 mph; When there is no wind the sea is calm and the surface is glassy. Ocean currents look like long winding rivers on the surface of the sea. As the wind increases, the sea is rippled in patches. These rippled patches stand out as clearly as a green field surrounded by brown foliage.
2. 5-7 mph; Entire surface of the sea is rippled.
3. 8-13 mph; Scattered white caps make their first appearance with the entire surface having a definite wave formation.
4. 14-18 mph; The surface of the sea looks rough. There are enough white caps on the surface to give it a spotted appearance. The foam made by these white caps now stays on the water for the first time.
5. 19-24 mph; The foam is blown over the top of the waves in the form of a spray. This spray is easy to see, and marks a definite phase in the force of the wind.
6. As the wind increases above 25 mph the sea becomes foamy and the spray gets thick.

RADIO AIDS

Radio aids are valuable in all navigation, contact or instrument. Most information concerning radio aids is contained in sectional, regional, and radio facility charts.

Following is a list of radio aids and their most important uses to the pilot.

Radio Ranges

200-400 kc frequency band. A few ranges use the 400-550 kc frequency.
Identification signal every 30 seconds.
Use ranges and stations as check points in pilotage. Obtain frequencies, identifications, and headings from charts and radio facility charts.

Cone of Silence

Directly over range station. Use as radio check point.

Station Location Marker

Reference check point to identify location of cone of silence. 75 mc visual indicator signal.

Fan Markers

75 mc visual indicator signal on legs of radio ranges. Positive position indicator. Shown on charts. **Make position reports to range station from this point.**

Air Traffic Control Towers

Various frequencies. Voice broadcasts. Can be used as homing device with radio compass in emergency upon request.

Commercial Stations

Various standard frequencies. Frequency and call letters shown on charts. Use in plotting fixes or as check points. Use with radio compass as homing device.

AACS Stations

Indicated on charts and radio facility charts. Obtain latest flight information from these stations.

PRECAUTIONS

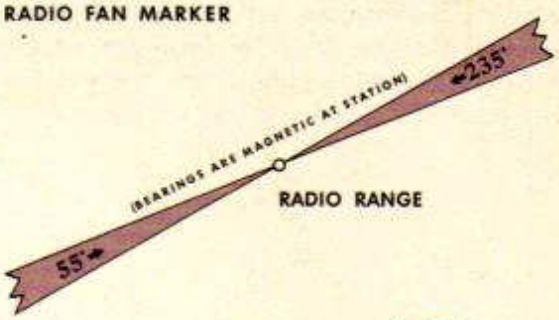
Never rely on radio navigation alone. Always use radio ranges with other methods of navigation.

Then, if your radio goes out you can still follow your flight plan. Radio facility charts are no substitute for aeronautical charts.

Static is the greatest hazard to radio navigation.



RADIO FAN MARKER



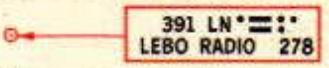
RADIO RANGE



RADIO RANGE NOTE



RADIO RANGE (WITHOUT VOICE)



RADIO RANGE (WITH VOICE)



RADIO RANGE (SIMULTANEOUS)



AIRPORT CONTROL TOWER



RADIO DIRECTION FINDER STATION



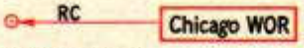
RADIO BEACON



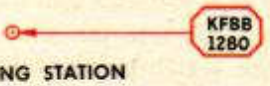
RADIO COMMUNICATION STATION



RADIO COMMUNICATION STATION
(WITH RADIO BEACON)



RADIO COMMUNICATION STATION
(WITH DIRECTION FINDER)

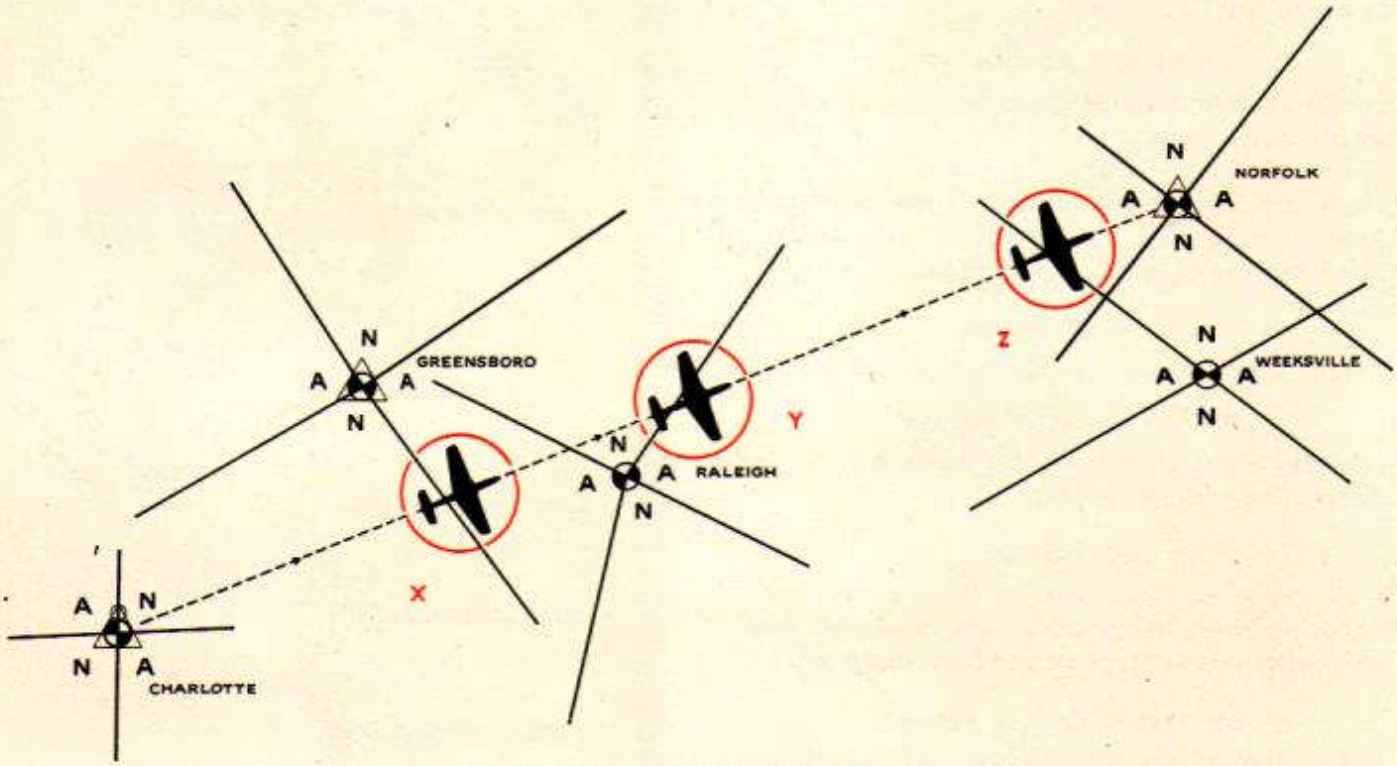


RADIO BROADCASTING STATION

During electrical storms radio reception is sometimes impossible, making it necessary for you to use other methods. Rain may short out some receivers.

Sometimes you can't make contact with range stations more than ten miles away because of atmospheric conditions. Don't get panicky or think immediately that your radio is out. Fly out your ETA over the station and try contact again before concluding you are off-course.

Most range stations are equipped for voice broadcasts. Whenever conditions are favorable to reception, use your receiver on "BOTH." For normal use keep receiver volume as low as possible. In severe static conditions switch filter to "RANGE" or "VOICE" (whichever you desire) and increase the volume until you make contact or receive signal.



RADIO NAVIGATION

Use radio range beam legs just as you use visual check points. Use them at all times on both instrument and contact flights.

This method of navigation, when used in conjunction with other aids at your disposal, makes the most routine flight interesting; and assures accuracy and safety on all cross-country flights.

Here is an example:

A pilot takes off from Charlotte for Norfolk. After takeoff he tunes to Greensboro range. He determines his position in area of X thus: if west of Greensboro southeast leg he hears Greensboro N signal; if east, the Greensboro A signal. In both cases strength of the background (on-course) signal determines his proximity to Greensboro southeast leg. Solid on-course signal of Greensboro southeast leg indicates general position along line of flight.

After crossing Greensboro southeast leg he tunes to Raleigh range, receiving Raleigh A signal. As he progresses he hears first the on-course signal of the Raleigh northwest leg, followed by the Raleigh N signal, then the on-course signal of the Raleigh northeast leg. This establishes his position in area Y.

Flying from area Y, and until he crosses northwest leg of Weeksville range, he can tune to either Raleigh A signal or Weeksville A signal. After crossing Weeksville northwest leg he tunes to Norfolk and hears Norfolk A signal. He can also tune to Weeksville and get Weeksville N signal.

If he were far off-course to the south he would hear Weeksville or Norfolk N signal. If in doubt as to whether off-course to the north or south he could make a leg identification check on either the northwest or southwest leg of the Norfolk range.

IMPORTANT

Use the following four steps in solving any orientation problem. They work for any range station, using any orientation procedure and, if worked in sequence, guarantee successful arrival at station.

1. **Identify the range station.**
2. **Identify your position as N, E, S, or W of the station by fade or build.**
3. **Intersect and identify a beam leg.**
4. **Fly this beam leg to the station.**

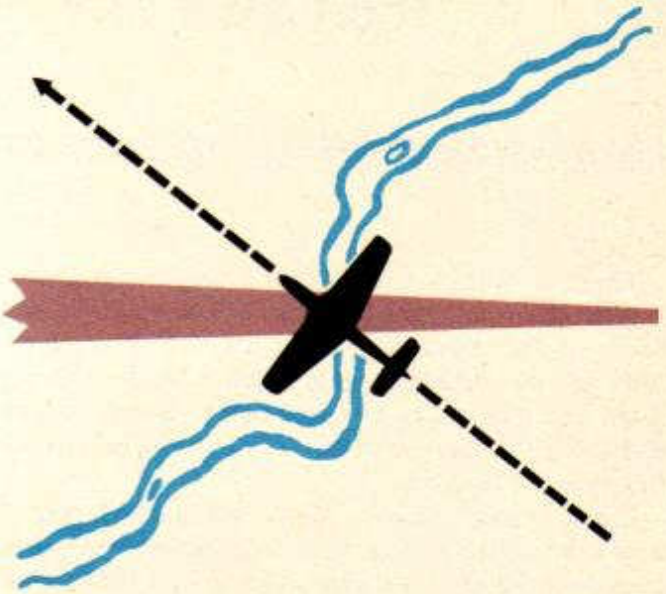
International Morse Code

International Morse Code is used for all code signals in radio navigation.

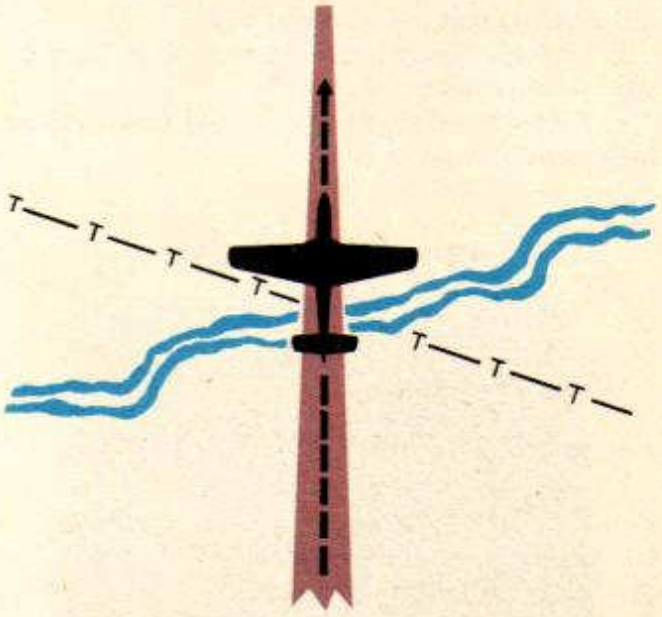
A	•−	M	−−	Y	−•−−
B	−•••	N	−•	Z	−−••
C	−•−•	O	−−−	1	•−−−−
D	−••	P	•−−•	2	••−−−
E	•	Q	−−•−	3	•••−−
F	••−•	R	•−•	4	••••−
G	−−•	S	•••	5	•••••
H	••••	T	−	6	−••••
I	••	U	••−	7	−−•••
J	•−−−	V	•••−	8	−−−••
K	−•−	W	•−−	9	−−−−•
L	•−••	X	−••−	0	−−−−−

Radio and Visual Check Points

Use radio aids in connection with visual check points as an easy method of determining position.



Pilot flying off airways knows exact position at beam intersection by using both beam and river as check points.



Pilot flying beam knows exact position by watching for transmission line.

Numerous similar examples occur on any cross-country flight.

PIF 7-6-1
ADDED November 1, 1944

NIGHT NAVIGATION

There is nothing difficult about night navigation if you plan your flight carefully before you take off. Many of the check points you use during the daytime are not visible at night. But to replace them, there are other aids to night flying. Sometimes at night radio navigation is the only method of navigation that can be used.

Prepare your charts. Most aeronautical charts now are treated so that they will show up at night under ultra-violet, red, or amber cockpit lights. Use treated pencils for making charts for night use so that lines will stand out prominently under ultra-violet cockpit lights.

1. Prepare a timetable showing what headings to fly and how long to fly them.
2. Study your charts and mark the prominent check points that are visible at night.
3. Use radio navigational aids constantly. They are your most valuable aid at night.
4. Take a flashlight on every night mission. Your instrument lights may fail.

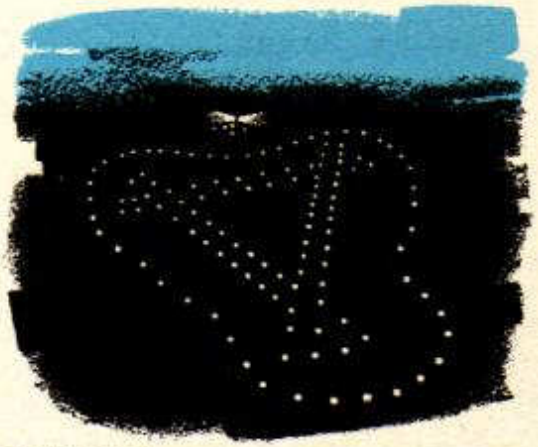
GOOD CHECK POINTS



Light Lines



Beacons



Airports (Lighted)



Prominent towns and cities in open regions with a concentration of lights.



Highways along your flight path: Headlights of cars are easy to see.



Prominent terrain features; ridges and mountains silhouetted against the horizon.



Coastlines, lakes, and rivers on clear nights—water reflects light.

Radio Aids at Night

Radio aids are among your best check points for night navigation. Often they are indispensable, but get into the habit of using visual check points also. Your radio may not always work.

Light Lines

Light lines are your best visible check points for night flying. They consist of beacons, 10 to 15 miles apart along airways, some of them with rotating beacons and code signals. If you are reasonably sure of your heading and general location when you first sight a light line, you can follow it easily with little chance of straying.

Code signals are red and are visible six times each minute **along the airway.** They are easy to see if you look for them; if you know your general position, look for a light line, identify a code letter and look for it on your chart. It will indicate your exact position. Light lines are coded in a sequence of ten signals, then start over again. Use the following key for checking the order of signals. The initial letter of each word is the signal:

•– –	••–	•••–	••••	•–•
When	Undertaking	Very	Hard	Routes
–•–	––••	––•••	––––•	––
Keep	Direction	By	Good	Methods

The series keeps rotating from an arbitrary starting point on the chart.

If you follow the light line from the opposite direction, code signals will appear in reverse order.

Beacons displaying a green signal in addition to the rotating beacon have lighted landing facilities near them.

POOR CHECK POINTS

Small towns in fairly congested areas which do not stand out clearly.

Roads, transmission lines, most structures easy to recognize in daytime.

Railroads.

General features of terrain—they seem to melt into the contour of the land.

PIF 7-7-1
ADDED November 1, 1944



WHAT TO DO WHEN LOST

Daniel Boone, the great wilderness scout, was being interviewed by a writer assigned to do a story of his life as one of America's great pioneers. "In all your wandering around in the wilderness, Dan'l, didn't you ever get lost?"

The old woodsman thought awhile, checking through his experiences of a lifetime, then looked up at his interviewer. "No, don't ever recollect bein' lost," he answered thoughtfully. "Been **bewildered** four or five days."

Lost is a relative term. You started somewhere. You know how long you've been on your way. You know what general direction you've travelled. So you must be within a general area that you can outline on your charts.

You passed some known check point at an estimated if not exact time. And you flew in a general direction for a distance that you can approximate since you passed that check point. That further cuts down the area where you're bewildered.

Remember, you're not lost until you say you are.

Don't get excited.

Don't wander; hold your heading.

Use one of the following procedures to locate your position:

Contact Flight (Day)—Radio Not Operating

1. Estimate flying time on remaining gasoline.
2. Hold original heading.
3. Estimate position from last known check point based on TAS and elapsed time.
4. Try map orientation to locate next check point.
5. If unable to establish position definitely, set course from approximate position to intersect such prominent running landmarks as a river, coastline, mountain range, double-track railroad, etc.

If gas supply is not sufficient to reach destination from established position, set course to nearest airport or auxiliary field.

Night Flight—Radio Not Operating

1. Estimate flying time on remaining gasoline.
2. Estimate position from last known check point based on TAS and elapsed time.
3. Hold straight course which will eventually intersect a beacon line; follow line to auxiliary field.

Location by Radio—Day or Night

1. Estimate flying time on remaining gasoline.
2. Turn radio to "MANUAL". Tune in loudest station; identify it with Radio Facilities Chart. Try two-way communication; request assistance from AAF Flight Service. All stations guard frequencies of 4495, 3105, and 6210.
3. If two-way communication cannot be established, use Radio Facilities Chart; by tuning in three or four ranges in succession, noting A or N quadrants, locate general area in which you are flying. Attempt to contact radio range every 15 to 20 minutes. Listen to radio range for instructions.

Finally

When gas is down to twenty minutes supply, locate a large field and make a wheels-up landing. If at night or on instruments, pull up to 2000 feet or over, and bail out.



SECTION 8 EMERGENCIES

PIF 8-1-1
REVISED January 1, 1945

TO BAIL OR NOT TO BAIL



It is obviously impossible to give a definite set of rules on when to bail out and when not to. Every emergency presents a different set of conditions. The final decision is always up to the pilot.

In an emergency, try to save your plane by bringing it in for a normal or forced landing if it is reasonably possible. Engine failure on a multi-engine airplane is not an automatic signal for bailout. Jettison cargo, bombs, or auxiliary tanks if necessary, and try to continue under power to a safe landing place.

In general, make a forced landing rather than bail out under the following conditions:

1. When you have wounded men aboard.
2. When your airplane and its equipment are needed for survival after you are down—in the Arctic, jungle, or desert.
3. Over water, in airplanes except fighter types, ditching has the advantage of keeping the crew together in one or more dinghies. The dinghy radio, flares, rations, water, and other emergency equipment increase your chances of survival.

In general, when you are faced with the immediate decision of whether to bail out or try a forced landing, choose bailout under the following conditions:



1. **Loss of control**—When for any reason you are unable to control your airplane, bail out when you reach your predetermined critical altitude.



2. **Unfavorable terrain**—Bail out when in trouble over mountains, wooded areas, or flat terrain that appears too rough for a safe forced landing.

Over water, bail out from a fighter plane rather than try to ditch it.



3. **Uncontrollable fires**—Use all available equipment to try to put out a fire, but don't fight it too long. As soon as you find you can't control it, get out as fast as you can.



4. **Limited visibility**—If you have flying power but know you must land or bail out soon, try to determine type of terrain below and location of emergency landing fields. If unsatisfactory, gain sufficient altitude and prepare to bail out. If flying power is not available, bail out, unless you have at least a 1000 foot ceiling and terrain is satisfactory for a forced landing.

When leaving on any flight that will take you over the jungle, the desert, the Arctic, or any rugged country, wear shoes that you can walk home in, and wear clothes for the climate.

PIF 8-2-1
REVISED January 1, 1945



Forced Landings

Any crash landing that you can walk away from is a good one. Forced landings in which there is a minimum of damage to the airplane or injury to the crew are the result of forethought, calm execution, and adherence to a few fundamental principles. The following suggestions will help you. Think them over. Plan in advance for that day when you are confronted with a forced landing.

1. Start looking for a spot where you can land while you still have fuel enough to be choosy.

2. Jettison bombs, fuel, cargo, and unnecessary equipment. Lightening the airplane lowers the landing speed, and also may keep you in the air long enough to make an airfield. Throw out all loose objects to prevent injury to crew on impact.

3. Open emergency escape hatches, otherwise they may jam on impact and delay exit. Do not open windows that may slam shut and jam at the time of the impact.

4. Land as nearly into the wind as you can, never over 90° from the wind.

5. Don't attempt turns near the ground; a stall may result.

6. Keep ample flying speed until the airplane is on the ground. There is a general tendency to stall out while making a forced landing.

7. Use flaps as you would in a normal landing.

8. Land wheels up on any type of terrain except a known airfield. If you land with the wheels down on rough ground the airplane is almost certain to nose over, increasing damage to the airplane and danger to the crew. (Exception: always crash land B-24 with wheels down.)

9. If you have power available, use it. Fly the airplane right down to the ground with ample speed. Don't try a stall landing.

10. Warn your crew in plenty of time so that they can get in position for the crash. Warn them again a few seconds before the actual contact with the ground so they can get braced. In general, positions of all crew members for a crash landing are the same as those for ditching.

11. Just before the crash, cut all switches and turn fuel selector valves off to avoid fire.

12. Try to land so the airplane has a chance to slow down instead of stopping suddenly. For instance: if there is a solid obstruction ahead, ground-loop your airplane to kill the speed and get the wing in a position where it can absorb the blow.

13. After the airplane has stopped, grab first-aid kits and any other necessary equipment and get out fast. Get at least 50 feet away. There may be danger of fire and explosion.

In case of forced landing immediately after takeoff, land straight ahead. Don't try to turn back. Turning back to the field has killed many good pilots.

SURVIVAL AFTER FORCED LANDINGS

Your chances of survival after a successful forced landing in uninhabited areas depends upon the amount of preparation you have made for this emergency. Learn as much as you can about the area in which you are flying. You must know such things as:



Type of terrain, and any prominent landmarks that can help you orient yourself.



Kinds of foods you should look for.



Attitude of natives.



Natural dangers.



Health and first-aid precautions.



Approximate location of the enemy.



Rescue organization and procedure.

Your airplane and its equipment provide you with plenty of material to improvise shelter, signaling equipment, cooking utensils, etc.

Study your manual, "Survival". It gives a complete story of how to live off the land and make your way back home.

PIF 8-3-1
REVISED January 1, 1945



Some day you may be forced down at sea. You won't have time to look up the answers then, so now's the time to start preparing for such an emergency. Here's how to do it:

1. Know the proper procedure for ditching your airplane.

2. Know the use of emergency equipment provided for ditching purposes.

As pilot, you must not only learn your own ditching duties thoroughly, but must make sure that your crew members know theirs. Success depends on the speed and efficiency with which each member of the crew executes his assigned job, and upon the coordination of all efforts.

Conduct ditching and dinghy drills regularly. Your Personal Equipment Officer will help you work out a drill procedure.

Inspections

Before taking off on an over-water mission, make the following checks:

1. **Emergency equipment**—See that it is complete, properly stowed, and that it has been inspected as required.

2. **Escape hatches**—Make sure that they operate properly.

3. **Life vests**—Check your own and your crew member's. Blow the vests up by mouth and check the adjustment of waist and leg straps. Inspect CO_2 cartridge and see that valves are closed.

As soon as you have the slightest doubt that you can make land, give the order: "Prepare for ditching." Give your crew as much time as possible to



carry out their ditching duties and get in position.

In addition to verbal warnings over the interphone, use the standard ditching signals: six short rings—"Prepare for ditching"; one long ring—"Brace for ditching."

Radio Procedure

Start emergency radio procedure immediately. Your best chance of being rescued lies in early and correct emergency radio procedure.

Specific radio procedure differs in various theaters of operations. Learn the instructions for your theater and make sure your radio operator knows them. If you have transmitted ditching signals and then find you can make land, notify the Air/Sea Rescue Unit as soon as possible so as to prevent useless search.

Jettisoning

Lighten the plane by jettisoning bombs, guns, ammunition, extra fuel and anything not essential to operation of the airplane. Throw out any objects lying loose or likely to be torn loose by the impact. Hold or firmly secure emergency equipment that you are going to take with you.

Emergency Exits

Close bomb bay doors after jettisoning bombs. Close all lower hatches to keep water out. Keep open top or upper side emergency exits through which you will escape. If closed, they may jam on impact. Close all bulkhead doors to stop the flow of water through the plane.

General Crew Preparations

Remove oxygen masks as soon as you are below 12,000 feet. Take off neckties and open collars. Remove heavy boots, but keep on flying clothing and helmet for protection.

Remove parachutes, except when you need the one-man life raft attached to the harness.

Do not remove life vests. Keep them on at all times. **Do not inflate until out of the airplane.**

If you inflate your life vest while you are still in the airplane, you will find it difficult, if not impossible to get out through the hatches.

Ditching Positions

All crew members must follow the standard ditching positions recommended for various combat planes in the AAF ditching posters.

If there is no poster on your airplane, or you can't use the positions recommended because of differences of stowage or structural variations, remember the following:

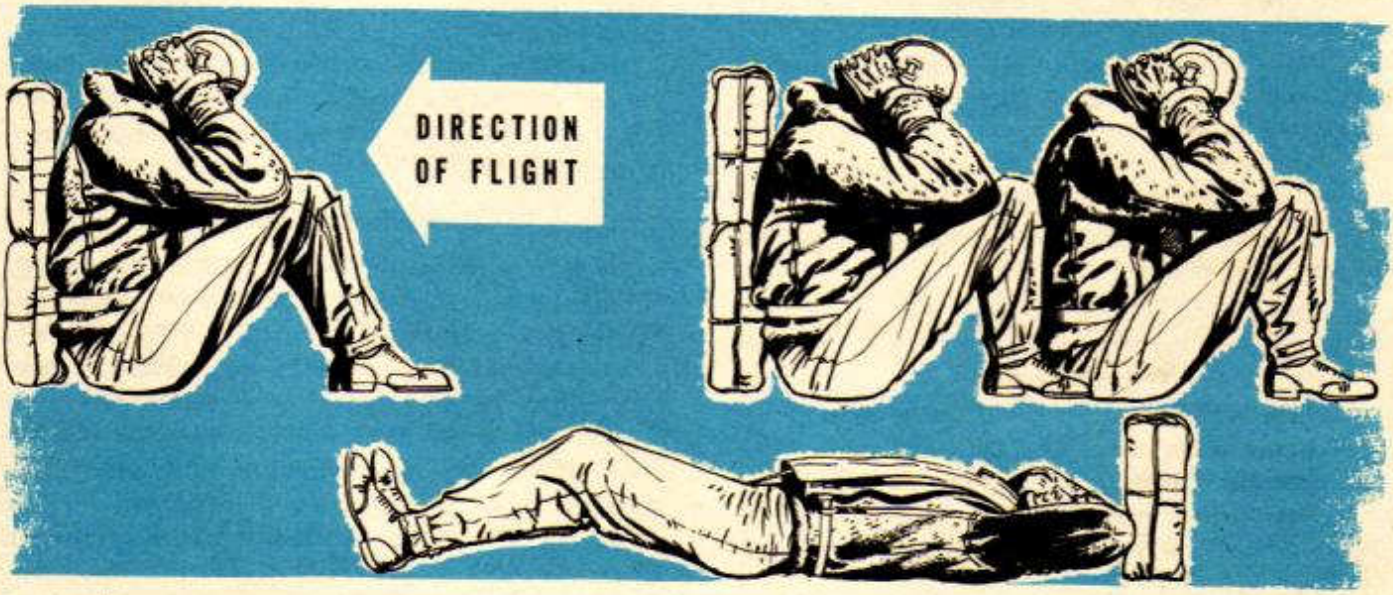
General Rules

1. The best ditching position is to sit facing the tail of the plane, knees drawn up, back and head braced against a solid structure. If your head extends above the support, clasp your fingers tightly behind it to hold it from being snapped back.

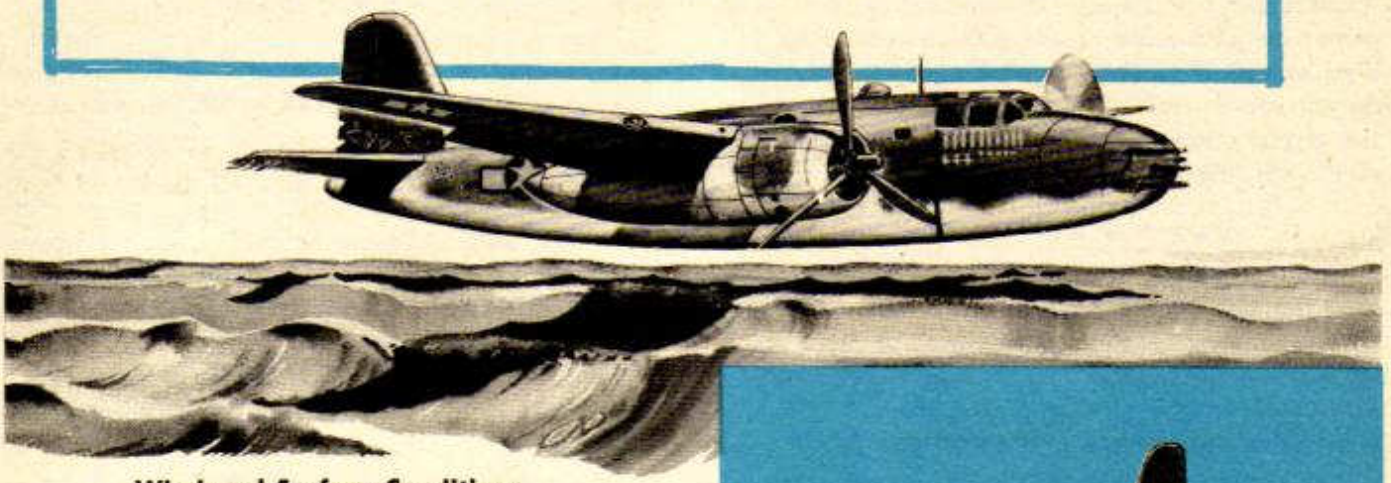
2. The second position is to lie on the floor of the plane, head to the rear and feet firmly braced against a solid structure. Bend the knees slightly. The best position for an injured man is the seated one. If such a position is not the injured man's regular one, have him trade places with someone. If there is not enough bulkhead room for all to brace against, if there are extra people in a compartment, it will be necessary for some to sit, facing aft, back braced against forward man's shins, feet and knees drawn up, hands clasped behind head.

3. Another position, in airplanes which are equipped with ditching belts, is to brace against the belts.

4. Pilot and copilot must have seat belt and shoulder harness fastened. Warn the crew five seconds before the impact so that they can brace for the shock. Stress that positions must be held until the airplane comes to a stop; casualties occur when men relax immediately after the initial impact.



DITCHING THE AIRPLANE



Wind and Surface Conditions

The sea is a tricky landing strip. So it is important to determine the wind's direction and velocity for a successful ditching. This is not easy to do, and it requires practice. Get in the habit of studying wave and swell formations on every flight, so that you'll become adept in estimating wind and sea conditions by surface disturbances.

Wind Direction

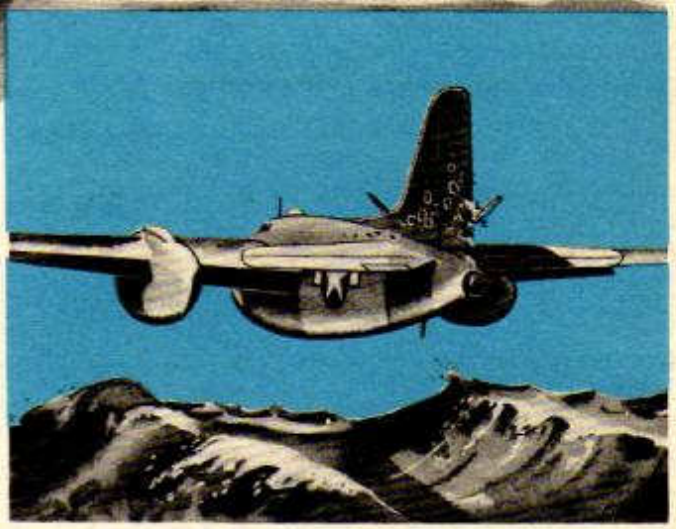
Waves are created by the wind and move downwind. Thus the line of the wind lies at right angle to the waves. Watch for white caps, or breaking waves. Waves break downwind. But the foam and spume of the breaking wave has the appearance of sliding down the **upwind** side of the wave. Usually you cannot determine wind direction unless the wind is strong enough to form white caps.

Look for wind lanes—series of alternate strips of light and shade. These are parallel to the wind.

It is easy to misjudge the direction of the wind by 180°. If possible, fly the plane parallel to the waves and watch the direction of the drift.

Wind Velocities

Few white caps	**10 to 20 mph**
Many white caps	**20 to 30 mph**
Streaks of foam	**30 to 40 mph**
Spray from crests	**40 to 50 mph**



Altitude

Altitude is extremely difficult to estimate over a calm, glassy sea.

One way to judge altitude is to have the radio operator reel out the trailing antenna until the weight hits the water. The radio operator advises when the current drops.

Use of Flaps

The amount of flaps to use depends upon the type of airplane and its condition. In general, when you have sufficient power to maintain control, you can safely use full flaps. When ditching without power, use lesser flap settings, particularly crosswind.

In aircraft with Fowler Type flaps, which usually do not tear off on the initial impact, the use of full flaps may cause severe diving tendencies.

The ideal flap setting is that which gives minimum rate of descent with minimum forward speed.

Use of Engines

The value of power in ditching cannot be overemphasized. Always plan to ditch before your fuel is exhausted.

Use engines to flatten the approach. If you have power on both sides of the airplane, use it to full if necessary. If power is available on one side only, do not use to such an extent that you cannot turn the airplane against the engine, right down to the stall with a margin of rudder power.

Approach and Touchdown

Maintain control so that you can choose the best spot for setting the airplane down on the water. Two fundamental rules for setting an airplane down on water are:

1. Ditch crosswind if wind is under 35 mph—no spray or streaks of foam on the sea.

2. Ditch into wind if its velocity is over 35 mph.

To ditch crosswind: line up with the crests, adjust power, flaps, and trim, and fly down with the minimum rate of descent and minimum forward airspeed until final contact with the water. Land on a crest if possible, crabbing if necessary.

When ditching into the wind, try to execute a spot landing on the upslope of a wave at or near the crest. **This is an extremely difficult maneuver.** Ditch crosswind instead whenever possible.

After choosing the best point at which to ditch, hold off if possible until you lose all excess speed above the stall. Set down aircraft with conventional landing gear in a 3-point attitude. Set down aircraft with tricycle landing gear in the normal landing attitude for such airplanes.

There will be a primary impact as the tail strikes the water. This will be followed by a severe impact with violent deceleration as the nose goes in.

ABANDONING THE AIRPLANE



Do not operate the manual raft release until the airplane comes to rest. Don't hold on to the manual release before or during ditching. You may inadvertently pull it.

Take out raft accessories kits, emergency radio, extra signalling equipment, navigation kit, extra rations and water, and anything else you need. The items each man will take should be designated in the dinghy drills.

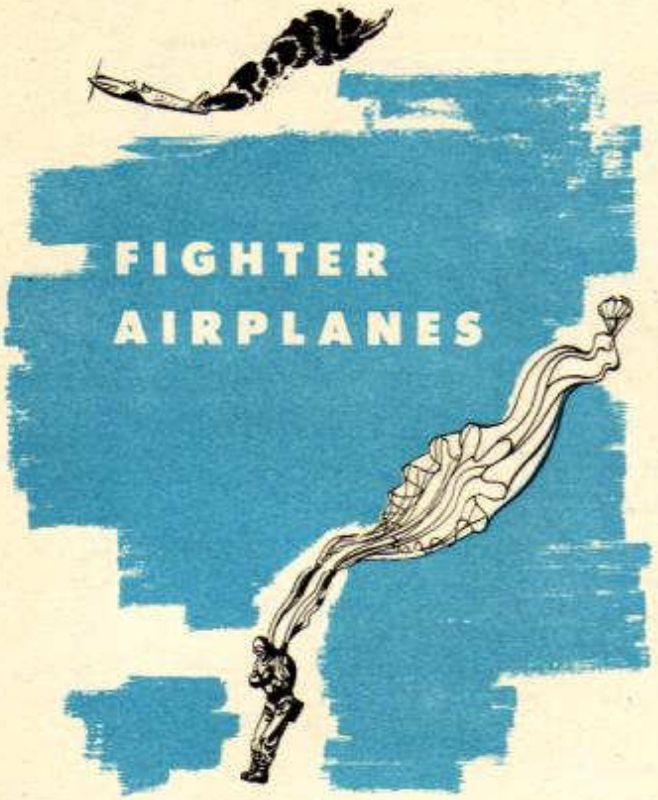
Inflate your life vest as soon as you are out of the airplane.

Boarding the Life Raft

Launch and board rafts from the wing tips if possible, to avoid damaging rafts on jagged edges.

Don't jump into the raft; you'll go right through the fabric. If the raft is inverted, don't jump on it. You will only expel the air underneath and make the raft more difficult to turn over. Right it from the wing of the plane if you can.

Paddle away from the plane and tie the rafts together if there are more than one. Stay near the plane as it is easier for rescuers to spot you.



It is better always to bail out of a fighter if you can, as the risk in ditching a fighter is greater than in jumping. Most fighters do not stay afloat more than a few seconds. Also, ditching does not provide you with any more equipment than you have when bailing out.

If your airplane is damaged at a low altitude you may not be able to gain enough altitude to bail out. In this case you have to ditch; you haven't any choice. Follow specific instructions for ditching the type of fighter you are flying.

RADIO PROCEDURE

Definite radio procedures are necessary when you have decided to bail out over water. Each theater has its own radio procedure. You will get the full details when briefed for a mission.

If there is opportunity and time, try to gain altitude, especially if below 5,000 feet. This increases the range of your transmission and helps Air Sea Rescue Units get a good VHF fix. How quickly you are rescued is determined by the accuracy of the fix. Given below is a typical radio procedure for bailout over water:

a. Gain altitude if possible.

b. Notify wingmen that your airplane is in trouble.

c. Turn IFF to **"emergency."** This transmits an IFF distress signal until the ship hits.

d. On operating channel, if there is time, call operations control, giving altitude, course and airspeed.

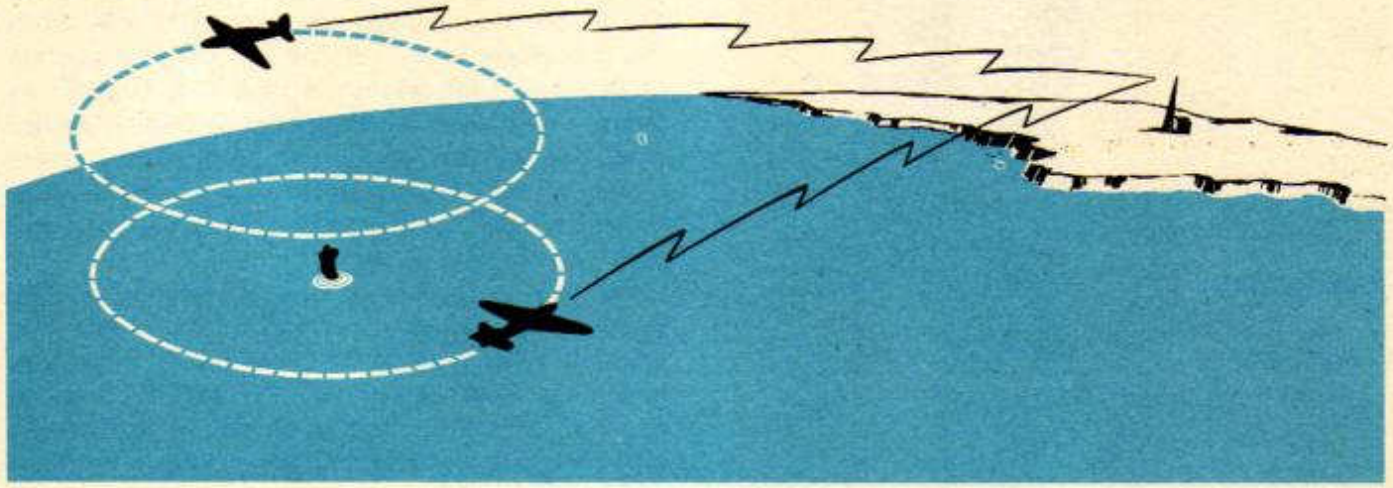
e. Switch to "Mayday" channel.

f. Call "Mayday."

g. Repeat call sign three times (it is essential that the airplane be identified by squadron call and airplane number after calling Mayday). If time permits after calling Mayday, listen out on the Mayday channel for a reply from the controller.

Leave radio on Mayday channel. Get continuous transmission by switching the toggle switch on the radio control box to "T." Transmission continues until the airplane crashes. Do this only as the last resort before you bail out.

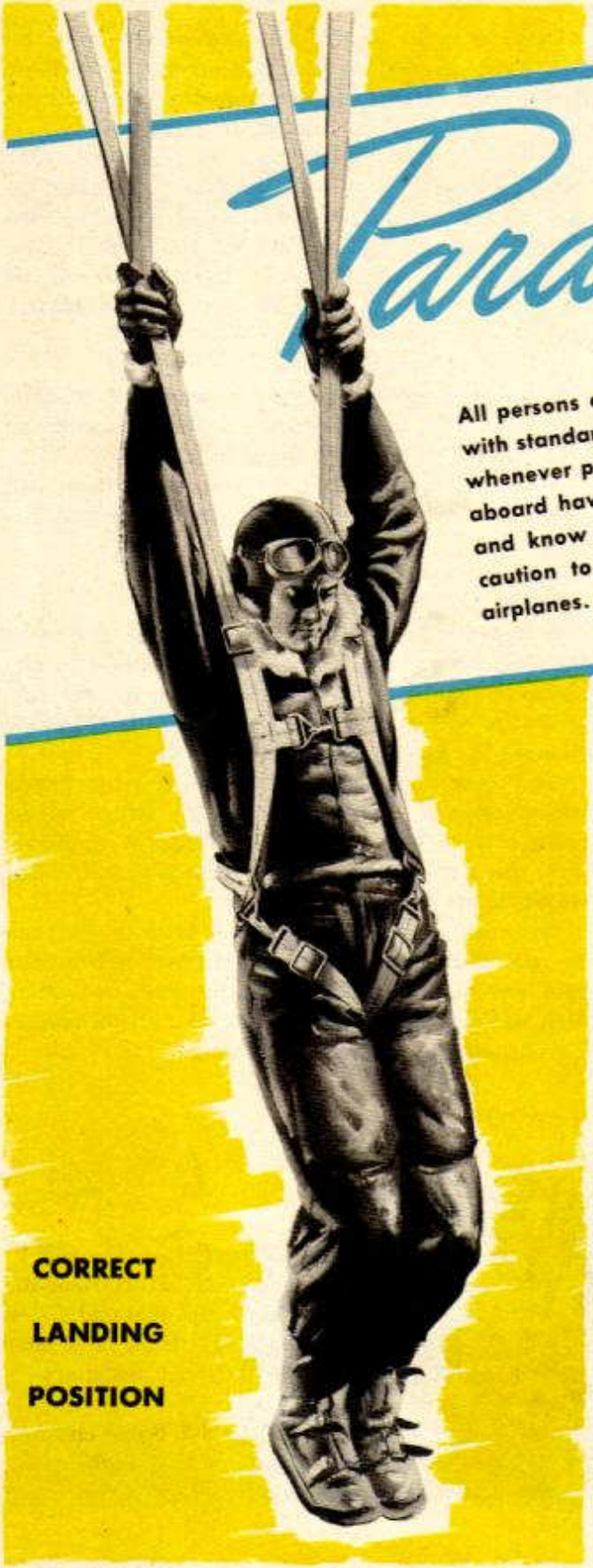
Wingmen or flight members, on hearing your call on operations channel, should if possible orbit the spot, one ship going down low, the other remaining high and continuing transmission of distress signals. This insures that a good fix is obtained.



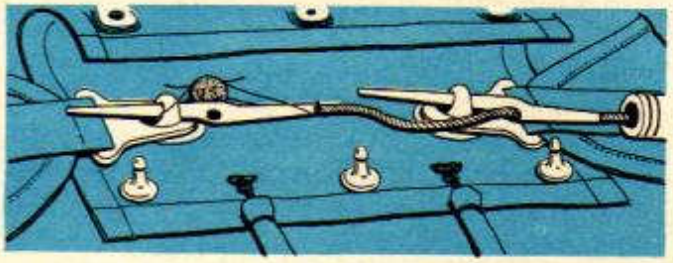
PIF 8-4-1
REVISED March 1, 1944

Parachutes

All persons aboard Army airplanes will be equipped with standard-type parachutes. Wear your parachute whenever possible. The pilot will see that all persons aboard have parachutes, are instructed in their use, and know the bail-out plan. It is an excellent precaution to carry an extra parachute in multiplace airplanes.



CORRECT LANDING POSITION



BEFORE THE FLIGHT

Inspect your parachute. Remember, you may have to jump with it! Check the date of the last inspection. The packing interval should not exceed 60 days in the United States or 30 days in the tropics. Open the flap; make sure that the ripcord pins are not bent and that the seal is not broken. A bent pin or jammed wire may make it impossible to pull the ripcord. See that the corners of the pack are neatly stowed so that none of the silk is visible. See that the six or eight opening elastics are tight. Inspect each parachute you draw.

Put your parachute on and be sure the harness fits properly. The shoulder and chest straps should be snug without play; the chest buckle should be twelve inches below the chin. The leg straps should be snug. In fact, the harness should be comfortably snug when you are seated and disagreeably tight when you stand up.

IN FLIGHT

If you find yourself in serious trouble, prepare to put your bail-out plan in operation. The plan will depend to some extent on whether you are alone or carrying a crew.

If you are alone:

1. Note your altimeter reading.
2. Estimate the altitude of the terrain below.
3. Decide on a minimum altitude or altimeter reading at which you can safely bail out, taking into consideration the flight characteristics of the plane and the kind of trouble you are having.
4. If you are still in trouble when you reach that minimum altitude—bail out.

With a crew, consider these additional points:

5. Remember that in general it is safer to jump your crew than to attempt a forced landing on hazardous terrain with a fully loaded plane.
6. Whenever there is serious question about a safe landing, warn your men that they may have to jump. Get them ready. If the situation improves, so much the better.
7. If the situation does not improve, pick the best available spot, slow the plane, and bail them out.
8. If necessary, bail out yourself. Whenever possible, set the automatic pilot to take the abandoned airplane away from inhabited areas in a prompt descent.

THE BAIL-OUT

Every pilot should know the emergency exits provided for the airplane he commands and should see to it that his crew knows them and understands how and when to use them. Bail-out posters are supplied for most bombardment types and are now being prepared for other aircraft.

Practice making exits while wearing full equipment when the airplane is on the ground. It is the direct responsibility of the pilot to drill his crew in a standard bail-out procedure, including warning signals and exit signals.

DRILL IS ESSENTIAL

Each crew member must know when, where, and how he is to leave the airplane.

Jumping from Single-Engine Trainers and Fighters

1. Dump the cockpit canopy, or open the emergency exit, or pull the side window as low as possible.
2. Slow the airplane as much as possible.
3. Disconnect your radio headset, etc.
4. Release safety belt and shoulder harness.
5. Dive out and down. Often you can go out flat, onto the wing, and slide head first off the trailing edge.

In certain types of fighters it is sometimes desirable to turn the airplane upside down:

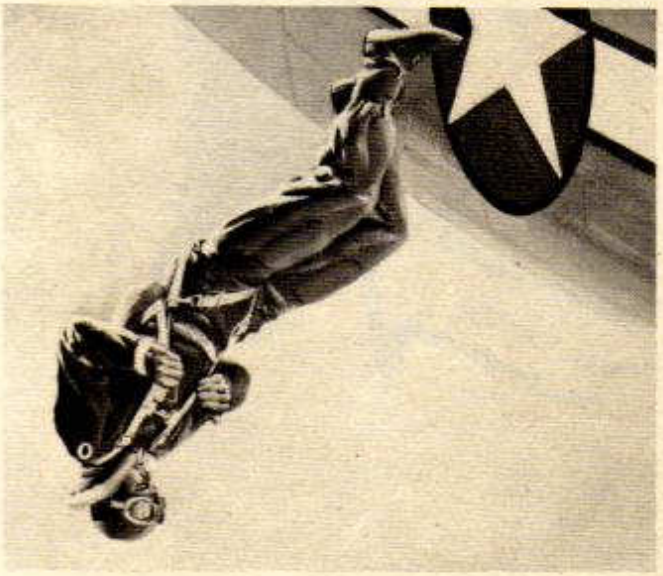
1. Dump the canopy.
2. Invert your plane.
3. Disconnect equipment.
4. Release safety belt and shoulder harness and dive straight down.

Jumping from Twin-Engine Trainers, Bombers, and Transports

You will normally use an escape hatch, the bomb bay, or a door, depending upon circumstances. Slide yourself to the edge of the opening and go out head first and straight down.

CLEARING THE AIRPLANE

Probably the most important single act, in any parachute jump, is opening the parachute only **after you are clear of the plane. Wait** until you are well away from the airplane before you pull the ripcord. Keep your eyes open. Look around. If you have enough altitude, wait at least five to ten seconds before pulling the ripcord.



PIF 8-4-3
REVISED March 1, 1944

PULLING THE RIPCORD



There is nothing complicated or difficult about getting your parachute safely open. Just:

1. Straighten your legs and put your feet together to reduce the opening shock, and to avoid tangling your harness.
2. Use both hands to grasp the ripcord pocket.
3. Grab the ripcord handle with the right hand, and yank! Keep your eyes open and look at the ripcord as you pull it.

THE DESCENT

About two seconds after you have pulled the ripcord, you will feel a sharp, strong tug as the canopy opens and bites the air.

Look up to see that the chute is fully open. If a suspension line traverses the top, or the lines are twisted, manipulate the lines to remedy the fault.

Do not worry about oscillations. They will almost certainly occur on your way down, but are of minor consequence. Do not attempt to check them or to slip the parachute, as such maneuvers are useful only to experts, and are dangerous below 200 feet.

Make a quick estimate of your altitude by looking first at the ground below and then at the horizon.

You will descend approximately 1000 feet per minute.

Observe your drift by craning your neck forward and sighting the ground between your feet, keeping your feet parallel and using them as a driftmeter.

Face in the direction of your drift.

While you cannot steer your chute, you can turn your body in any desired direction. **The body turn is the most useful maneuver you can learn because with it you can make certain that you land facing in the direction of your drift. It is simple and easy. Note carefully exactly how it is done.**

STUDY THE PICTURES. Practice the body turn in a suspended harness if you get the chance. This description may sound backward to you. Note with special care how these turns are executed and simply say to yourself:

"To turn right, right hand behind my head."

"To turn left, left hand behind my head."

PIF 8-4-4
REVISED March 1, 1944

HOW TO MAKE BODY TURNS

TO TURN YOUR BODY TO THE RIGHT:

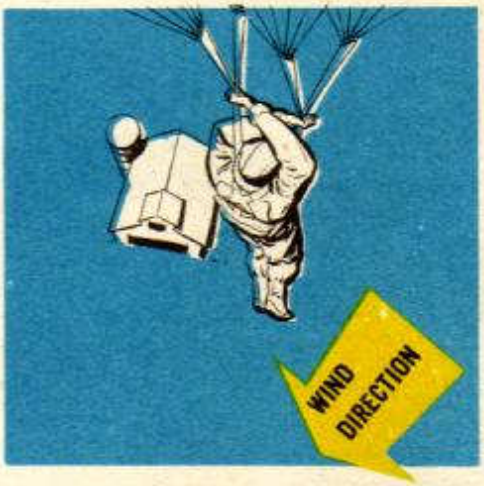




1

Reach up behind your head with your right hand and grasp the left risers.





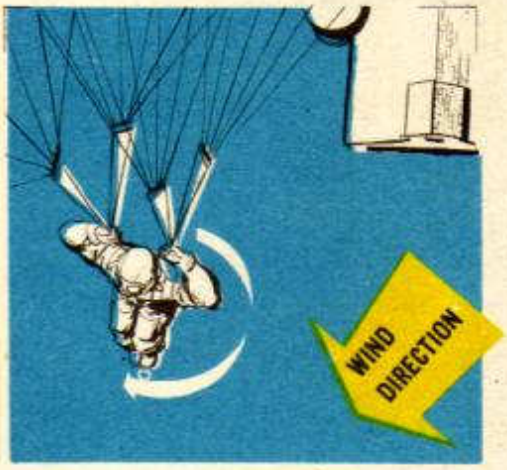
2

Reach across in front of your head with your left hand and grasp the other risers. Your hands are now crossed, the right hand behind, and in each you have two risers.



3

Pull simultaneously with both hands; this will cross the risers above your head and turn your body to the right. You can readily turn 45°, 90°, or 180° by varying the pull.



To turn to the left, reverse this procedure.

In the descent, start your body turn high enough to allow you to master it. Once you have made the turn, you will find that you can control your direction of drift perfectly. Hold the turn, or slowly ease up if necessary, to bring you in facing downwind. Continue to hold the risers, whether you have had to twist them to make a body turn or not, and ride right on into the ground this way.

PIF 8-4-5
REVISED March 1, 1944

THE LANDING



NORMAL LANDINGS

Whether you have made a body turn or not, keep your hands above your head, grasping the risers.

Look at the ground at a 45-degree angle, not straight down.

Set yourself for the landing by placing your feet together and slightly bending your knees, so that you will land on the balls of your feet.

Don't be limp; don't be rigid.

Relax, and keep your feet firmly together with your knees slightly bent, and your hands grasping the risers above. Now hold everything and ride on into the ground, drifting face forward.

At the moment of impact, fall forward or sideways in a tumbling roll to take up the shock.



ABNORMAL LANDINGS

If there is a strong wind blowing across the ground when you land, do two things.

First, make certain that you carry out the procedures described above for a normal landing, **including the body turn to face you exactly in your direction of drift.**

Second, once you are down, roll over on your abdomen and haul in hand over hand on the suspension lines nearest the ground. Keep right on pulling them in until you grab silk. Then, drag in the skirt of the canopy to spill the air and collapse the chute. If you can't manage this maneuver on your face, go over onto your back, but haul in the suspension lines until you have got the bottom edge of the canopy, then spill the chute.



Tree landings are usually the easiest of all. If you see that you are going to come into a tree, drop the risers, cross your arms in front of your head, and bury your face in the crook of an elbow. You can see under your folded forearm. Keep your feet and knees together. If you get hung up high in a tree, consider first the possibility of immediate rescue before you try to climb down. Failing that, get out of the harness and cut the lines and risers to make a rope for climbing down.

Water landings are safe if you know what to do. The ability to swim is an advantage but not a prerequisite if you are properly equipped and trained. Follow the procedure outlined here for all types of parachutes except the QAC AN6513-1A (which has no risers on pack or harness) and the single point quick release, instructions for which are given separately. Prepare for the water landing as soon as the parachute is open.

1. Throw away what you won't need.
2. Pull yourself well back in the sling by hooking your thumbs in the webbing and forcing the sling downward along your thighs.
3. Undo your chest strap by hooking a thumb beneath one of the vertical lift webs, pushing firmly across your chest to loosen the cross webbing so that you can undo the snap. **This must be done before you inflate the Mae West, as the chest strap cannot be released over an inflated life vest.**
4. When chest strap is undone and you are well back in the sling, unsnap the leg straps by doubling up first one leg and then the other. Then keep your arms folded, or hang onto the risers, so you won't fall out of the harness. If you are unable to unfasten leg straps in the air, remove them in the water by unsnapping them or by working them down over your feet.
5. As soon as you are in the water, inflate your Mae West, one half at a time (either half will support you) and shrug out of the harness. **Remember, never inflate your life vest until you have unfastened your chest strap.**
6. Get clear of the parachute promptly, and stay clear.



Procedure for Single Point Quick Release Harness

Modify the standard procedure as follows:

1. Before reaching the water, turn the locking cap 90° to set the release mechanism for immediate operation.
2. As soon as you are in the water, but not before, pull the safety clip, and press hard on the cap to release the lock. The harness will then slide off.
3. Inflate the Mae West, one half at a time, but never until the harness has been released.
4. Stay clear of the parachute.

See Life Vest, PIF 8-10-2 and Life Rafts, PIF 8-11-3.

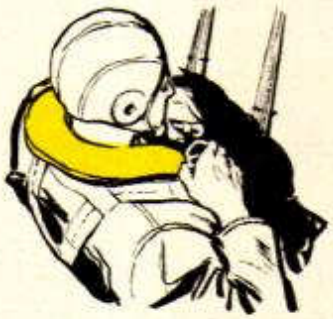
WARNING: The canopy and shroud lines, **not the harness,** may dangerously tangle you after landing in water. When equipped with any quick attachable chest pack, first unsnap the entire pack from the harness, then get away from the canopy and lines before you stop to take off the harness. **Think it through now and you'll be safe later.**

On over-water flights, **always** carry a sharp, serviceable knife where it is easily accessible. If you experience difficulty releasing yourself from the harness after landing in water, stay calm and cut yourself free.

Procedure for QAC AN6513-1A (no risers on pack or harness)

Modify the standard procedure as follows:

1. Reach under the pack cover and unfasten the chest strap.



2. Pull yourself well back in the sling and undo the leg straps, if you have time.
3. As soon as you are in the water, release both sides of chest pack from harness and immediately swim **upwind**, away from the canopy and lines.
4. Inflate the Mae West, one half at a time, but never until the chest strap is unfastened.
5. When clear of the canopy and shroud lines, you can slip out of your harness at leisure.

NIGHT JUMPS

As soon as you are in the chute, prepare for a normal landing. Since you cannot see the ground on a dark night, you want to be ready to make contact at any moment. **Get your feet and knees together, your legs slightly bent. Hang onto the risers above your head and wait for contact.**

HIGH ALTITUDE JUMPS

Bail-outs from high altitudes present special problems. The higher the altitude, the greater the dangers in bailing out. Stay with the airplane as long as you safely can; down to 15,000 feet if possible. If you must leave the airplane at altitudes above 15,000 feet and if you do not have bail-out oxygen equipment, take a deep breath of pure oxygen and hold your breath. Dive out and continue to hold your breath as long as you can before pulling the ripcord.

Except in extreme emergency, do not attempt a bail-out without bail-out oxygen equipment above 30,000 feet.

The chief hazards of high altitude jumping are:

1. Intense cold.
2. Lack of oxygen.
3. High G forces induced by the parachute opening at high altitudes.

If it is necessary to bail out at high altitude, you can reduce the hazard by making a long free fall to about 10,000 feet before pulling your ripcord. A free fall enables you to reach warmer regions more rapidly; it reduces the hazard of anoxia, and insures less shock when the parachute opens.

At high altitudes the opening shock of the parachute develops excessive G forces. The higher the altitude, the greater the shock.

Judging Altitude in Free Falls

Do not depend upon counting or timing to judge distance above the ground. In the excitement it is difficult if not impossible to judge time.

Look at the ground and judge your altitude. For instance, at 5,000 feet the earth begins to look green, you can distinguish details, the horizon spreads, and the ground rushes up at you.

Changing Your Falling Attitude

If your falling attitude is such that you can't see the ground, you can alter your position by extending an arm and the resulting turn will give you a look at the ground. Then pull in your arm and legs and straighten out your knees to stop tumbling before you pull the ripcord.

Terminal Speed

Remember that in many emergency jumps you may leave the airplane at speeds so high that an immediate parachute opening would be dangerous. Hence, if you have sufficient altitude, you should wait 5 to 15 seconds to slow down before pulling the ripcord. This will avoid injury to yourself or damage to your parachute. You actually slow down during the first 10 to 15 seconds in a free fall until you reach terminal velocity. The lower the altitude, the lower the terminal velocity. So in making a free fall you do not tend to fall faster the longer you fall. You actually fall slower and slower the lower you get because the air becomes denser. With your parachute open, the rate of descent is also slower the lower you get.

Notice

In all jumps from above 10,000 feet, fall free to 10,000 feet or less before pulling the ripcord if you can. This will reduce your exposure to cold, anoxia, enemy action, and lessen the opening shock of the parachute. If you do not have bail-out oxygen equipment, just hold your breath and dive out. Then continue to hold your breath as long as possible before pulling the ripcord.

PIF 8-4-8
REVISED June 1, 1944

Parachute Types





BACK-TYPE PARACHUTES

Type B-7 (AN6512). The chest straps and leg straps have bayonet type or snap fasteners. Note that parachute belt is worn outside harness to hold webbing snug.

Type B-8. Flexible back pack with bayonet type fasteners on chest and leg straps. Older type B-8 parachutes have snap fasteners.

Type B-9. Flexible back pack on single point Quick Release harness. To get out of Quick Release harness turn the cap clockwise 90°, pull safety clip, and strike the cap a sharp blow with the hand.



Cap is shown in safetied position.





SEAT-TYPE PARACHUTES

Type S-1, S-2, AN6510, and AN6511. Harness has back and seat pad. Chest and leg straps have snap or bayonet fasteners.

Type S-5. Same chute as S-1 with single point Quick Release harness.

ATTACHABLE CHEST-TYPE PARACHUTES

Group 1 Assemblies

Type QAC (AN6513-1). Quick attachable chest-type parachute with square pack. Harness has snap fasteners on chest and leg straps. It has D-rings for attachment of pack.

Type QAC (AN6513-1A). Quick attachable chest-type parachute with barrel-type pack. Harness has snap fasteners on chest and leg straps. It has D-rings for attachment of pack.

Note: On both AN6513-1 and AN6513-1A parachute assemblies the snaps are on the pack and the D-rings are on the harness. Either of these packs can be used with the harness shown.

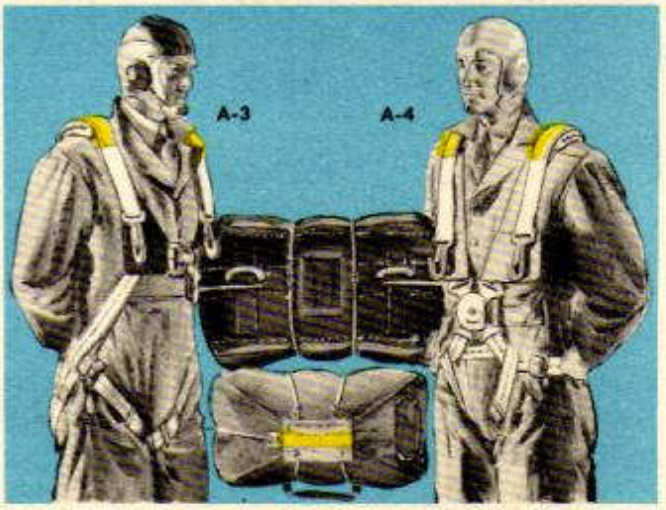


Group 2 Assemblies

Type A-3. Quick attachable chest-type parachute with barrel type pack. Harness has bayonet type fasteners.

Type A-4. Quick attachable chest-type parachute with barrel-type pack and single point Quick Release harness.

Note: On the A-3 and A-4 parachute assemblies the rings are on the pack and the snaps are on the harness. This pack can be used with either of the harnesses shown.



Caution!

Parachutes in Group 1 are not interchangeable with parachutes in Group 2.

Each pilot is responsible for the prevention of mismatching quick attachable parachutes in his airplane.

Before taxiing for takeoff the pilot should:

1. Inspect all attachable parachutes to see if the pack will fit the harness. Snap each pack to its harness to make certain.

2. Inspect all attachable parachute assemblies (packs and harnesses) in the airplane and make certain that all are in Group 1 or that all are in Group 2.

This will prevent danger of mismatching.

Group 1 parachutes and harnesses are marked with red webbing.

Group 2 parachutes and harnesses are marked with yellow webbing.

Make sure all packs and harnesses in your plane are the same color.

REFERENCE: Technical Order 13-5-39

PYROTECHNIC PISTOLS



When radio communication is inadvisable or when radio equipment has failed, brief coded messages may be sent with pyrotechnic signals. Do not use pyrotechnic signals to control important operations unless no other means is available. The various colored signals which are available for use with M2 and AN-M8 pyrotechnic pistols are assigned different meanings under a code that will be changed at frequent intervals in each edition of Signal Operation Instructions. The M11, red star parachute signal, however, is always used as a distress signal to be fired from the ground or from a life raft.

M2 Pistol

The M2 pyrotechnic pistol has a strong recoil. Use both hands to fire it if practicable. The signals themselves burn with an extremely hot flame; observe every reasonable precaution while handling or firing them.

1. **Fire signals only from airplane in flight** with the exception of the M11 distress signal.
2. Point the pistol in such a way as to prevent signals from striking any part of the airplane.
3. If a signal fails to ignite on the first attempt, try at least twice more. **If third or final try fails, keep the pistol pointed overboard and clear of all parts of the airplane for at least 30 seconds, then discard signal.**
4. **Discard a misfired signal, if possible, without handling the signal itself.** One method is to hold the pistol over an opening in the airplane and release the cartridge by pressing on the latch and allowing the signal to fall clear under the force of gravity. The force of the air blast prevents holding the pistol on the outside of most airplanes. **Be careful to prevent discarded signal from striking any part of the airplane.**
5. Do not discard misfired signals when flying over populated areas.
6. Fire the M11 distress signal as nearly straight up as is practicable.

AN-M8 Pistol

The AN-M8 pyrotechnic pistol is replacing the M2 pistol. It is fired by inserting and locking the barrel in a type M-1 mount. This mount is really a little "door," fastened rigidly to the airplane, that permits the pistol barrel to extend through the airplane outer skin. The mount absorbs the recoil of the pistol. Observe these precautions in using this pistol:

1. Place cartridge in chamber after pistol is inserted in mount, and only when immediate use is anticipated.
2. Since the pistol is cocked at all times when the breech is closed, **never leave a live signal in the pistol when it is removed from the mount.**

SMOKE GRENADES



Airplanes to be flown over sparsely settled regions on cross-country, patrol, or ferry missions will be equipped with either an M8 or an M3 smoke grenade. In the event of a forced landing, use the grenade as a marker to aid searching parties in locating the airplane which otherwise might be difficult to find.

Pilots observing smoke of the type produced by M8 or M3 smoke grenades will immediately attempt to locate the source.

The M8 smoke grenade burns about 3½ minutes, giving off a dense **gray** smoke, and is intended to be used primarily in heavily forested regions. It is easily distinguished from wood fires which give off a blue-gray or black smoke.

The M3 smoke grenade is designed to be used in snow-covered regions. It gives off a dense **red** smoke for 2 minutes which can be distinguished against a white snow background for about 4 miles by a person in an airplane.

Method of Firing M8 Smoke Grenade

1. Grasp the grenade with lever held firmly against grenade body.
2. Withdraw safety pin, keeping a firm grip around the grenade and lever.
3. Either throw the grenade with a full swing of the arm, or place on the ground and release.
4. As the grenade is released from the hand, the lever drops away, allowing the striker to fire the primer.

Method of Firing M3 Smoke Grenade

1. Pull the 3 vanes on the side of the grenade up and away from grenade body.
2. Place grenade in snow so that it is supported by the vanes in an upright position.
3. Keep lever held firmly against grenade and withdraw safety pin.
4. Release lever.

Safety Precautions

To avoid a fire, do not throw or place the grenade within 5 feet of dry grass or other readily inflammable material.

After the grenade is ignited, **stay at least 5 feet away from the burning grenade,** as heavy smoke develops and there is a tendency to throw off hot particles of residue.

Keep these smoke grenades dry. If the chemical contents of a grenade become wet, it will ignite. Future procurement of these grenades for the Army Air Forces will be packed in individual waterproof containers.

All smoke grenades will be shipped and handled in accordance with Interstate Commerce regulations. These regulations prohibit the shipment of these smoke grenades in personal baggage.

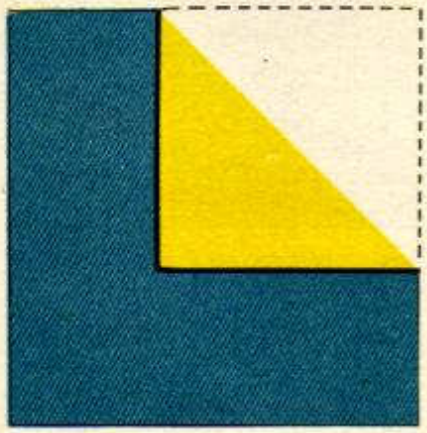
REFERENCE: T. O. 01-1-38, dated April 14, 1942

PIF 8-7-1
May 1, 1943

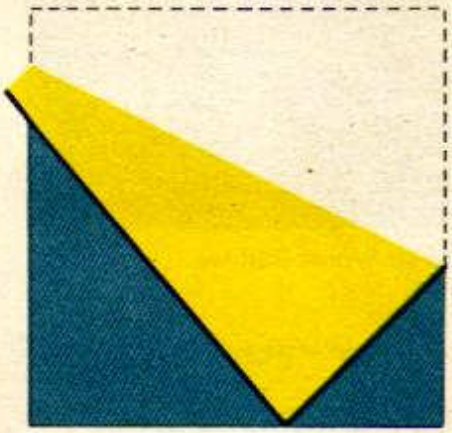
Panel Signals

Many of the emergency kits now supplied contain a large signal panel (roughly 10 ft. by 10 ft.). It is arc fluorescent yellow on one side and blue on the other. Immediately after you are forced down this panel should be spread out on the ground flat—yellow side up on dark backgrounds and blue side up on light backgrounds—the color will help rescue pilots to find you. Once a rescue pilot has located you, messages can be transmitted by folding the panel as indicated in the illustrations on these pages. If it is windy, hold the folds in place with rocks, sand, sticks, or improvised stakes if it is necessary. If several messages are to be transmitted don't change the folds too quickly—allow enough time for the pilot of the rescue plane to read each signal and indicate that he understands it (generally by dipping the nose of his plane several times). These same signals can be transmitted with the square yellow-and-blue sail now a part of the equipment supplied with the large inflatable rubber life raft.

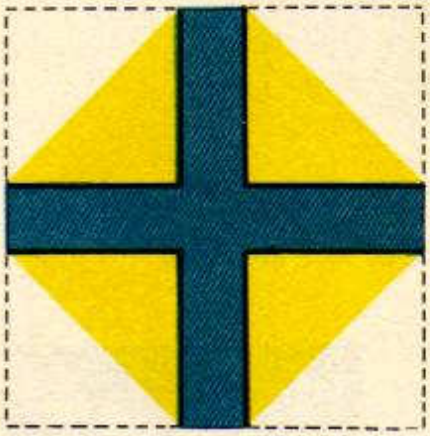
The emergency signal panel also can be used as a tent since its blue side is coated with a waterproof compound. Also, the blue side can be used as an excellent camouflage cover for a life raft if enemy aircraft are sighted.



Need Gasoline and Oil, Plane is Flyable



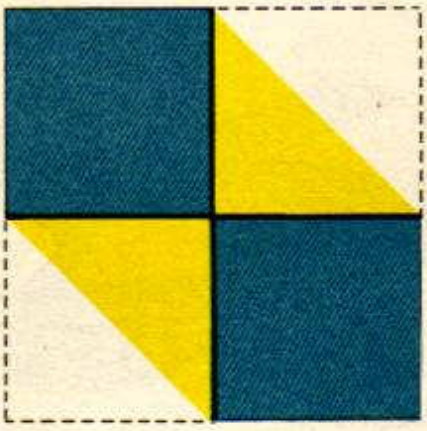
Need Tools, Plane is Flyable



Need Medical Attention



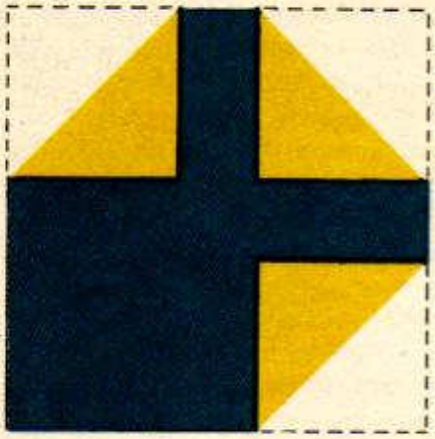
OK to Land, Arrow Shows Landing Direction



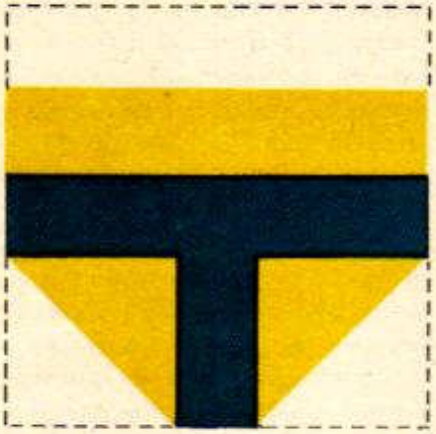
Do Not Attempt Landing



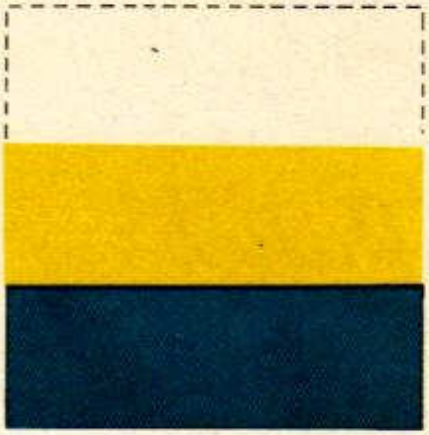
Indicate Direction of Nearest Civilization



Need First-Aid Supplies



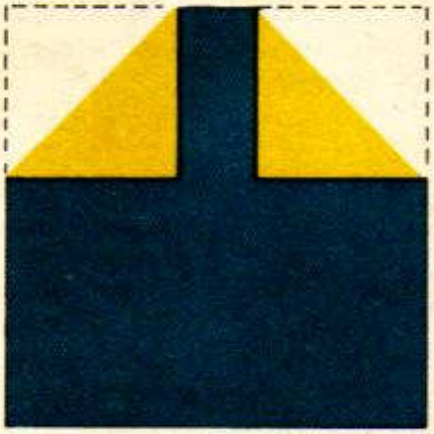
Need Quinine or Atabrine



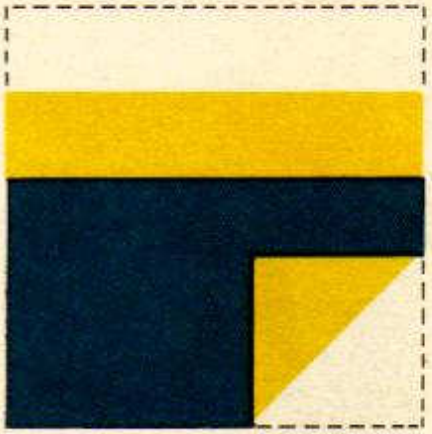
Should We Wait For Rescue Plane?



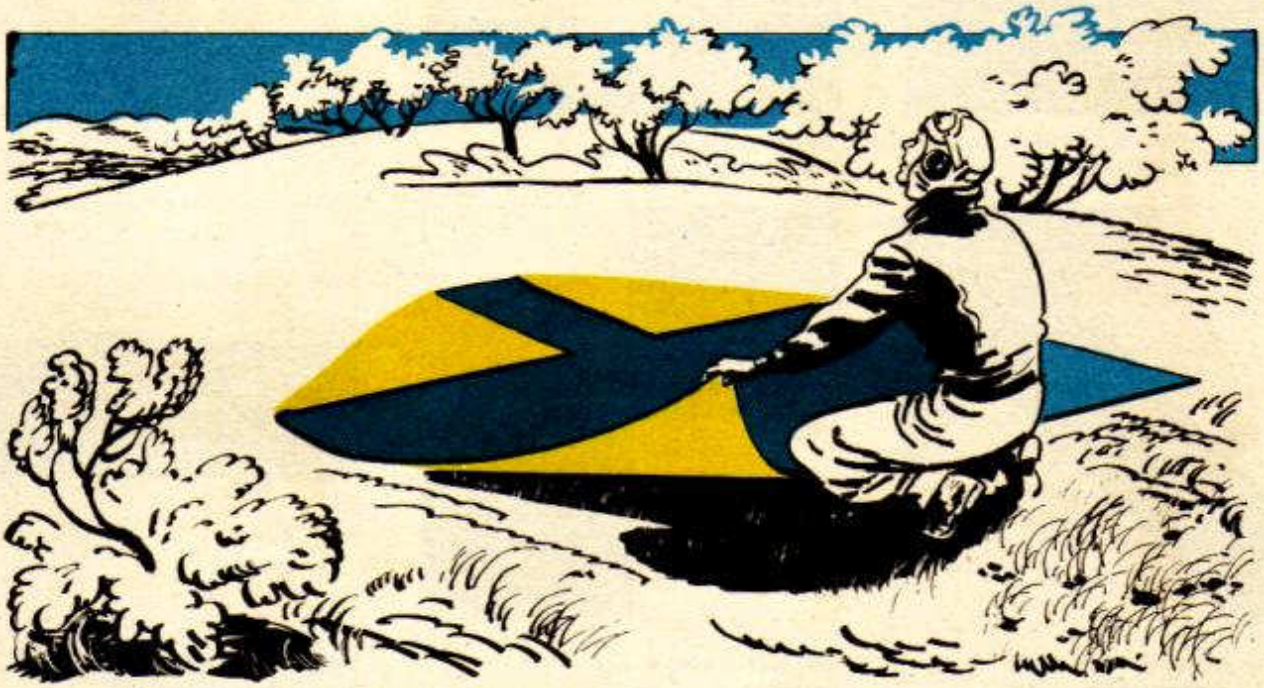
Need Food and Water



Need Warm Clothing



Have Abandoned Plane, Walking in This Direction ➡



PIF 8-8-1
May 1, 1943

Body Signals

If a rescue plane flies low and circles your location and you are sure that you have attracted the pilot's attention, messages can be transmitted by the emergency body signals shown on this page. When performing the signals stand in the open, make sure that the background as it will be seen from the plane is not confusing, make the motions deliberately and slowly, and repeat each signal until the pilot indicates that he understands.



NEED MEDICAL ASSISTANCE—URGENT (Lie prone)



ALL O K
DO NOT WAIT



CAN PROCEED SHORTLY—
WAIT IF PRACTICABLE



NEED MECHANICAL HELP
OR PARTS—LONG DELAY



PICK US UP—
PLANE ABANDONED



DO NOT ATTEMPT
TO LAND HERE



LAND HERE (Point in
Direction of Landing)



OUR RECEIVER
IS OPERATING



USE DROP
MESSAGE



AFFIRMATIVE (Yes)



NEGATIVE (No)

HOW PLANE ANSWERS

The pilot of the rescue plane will answer your messages either by dropping a note or by dipping the nose of his plane for the affirmative (yes) and fishtailing his plane for the negative (no).



AFFIRMATIVE (Yes) DIP NOSE OF PLANE



NEGATIVE (No) FISHTAIL PLANE

PIF 8-9-1
REVISED January 1, 1945

VEST TYPE EMERGENCY KIT



The following items of equipment are carried in the pockets of the vest:

- 1 hat (yellow on one side, OD on the other)
- 1 pair polaroid sun goggles
- 1 signal mirror, with lanyard
- 1 sharpening stone
- 1 fishing-sewing kit, in plastic container
- 1 collapsible spit and gaff
- 1 plastic water canteen (3-pint capacity)
- 1 Boy Scout knife
- 1 large knife (with 5-inch saw and blade)
- 1 package toilet tissue
- 10 yds bandage (with sulfa powder)
- 1 waterproof match-box with compass
- 20 matches
- 14 fire starting tabs
- 1 burning glass
- 1 signal whistle
- 1 oil container
- 1 waterproof cover for .45 cal. pistol
- 20 .45 cal. shot cartridges
- 1 First Aid Kit
- 1 Survival manual
- 2 vest-kit rations in tin containers
- 2 five-minute signal flares
- 1 mosquito headnet
- 1 collapsible container for boiling water
- 1 pair woolen insert gloves
- 1 pair leather outer gloves

Vest, Emergency Sustenance, Type C-1 was developed for the use of pilots and crew members forced down in isolated regions. It consists of an adjustable vest-like garment, fitted with pockets into which the items of the kit are conveniently stowed. The vest is to be worn under the life preserver vest and parachute.

PROTECT YOURSELF Before taking off on a flight over inaccessible or mountainous country, the arctic, jungle, desert, or ocean, check your vest and be sure it contains all the necessary equipment. If it does not, check with your Personal Equipment Officer.

PIF 8-10-1
REVISED November 1, 1944

LIFE PRESERVER VEST



Wear your life vest whenever you fly over water.

When the vest is issued to you, put it on, inflate it by the mouth tubes. Adjust the straps. **With the vest inflated the waist strap should be tight, the crotch and back straps snug. After adjusting the back strap hand tack it to the waist strap.** Deflate the vest by opening the valves at the base of the mouth tubes. Roll the vest up to deflate completely. Be sure to close the valves tightly to prevent leak on automatic inflation. Wear the vest over the clothing and **under the parachute harness.** Tuck the vest under the collar of your flight jacket.

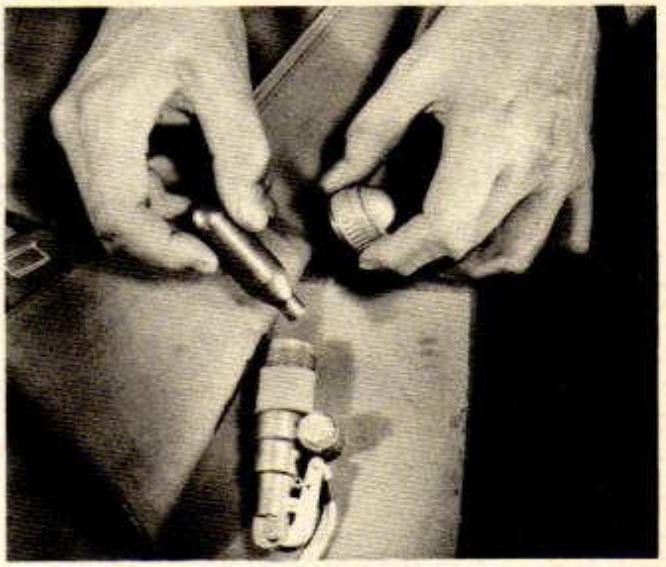
To inflate, pull one cord at a time so that if the mouth valves have been left open you will discover the error before you have discharged both CO_2 cartridges. One compartment will support you and will interfere less with swimming.

If the vest leaks, or fails to inflate completely from the CO_2 cartridge, fill by blowing into the mouth tubes. Open the valves while filling the vest by mouth, then reclose the valves tightly.

Note: cutting off or bending the mouth tubes flush with the retaining loop will prevent possible injury to your eye at the time your parachute opens.

Before each flight remove the cap from the inflator cylinder and inspect the CO_2 cartridge. If the seal at the tip is punctured replace the cartridge. With the lever which actuates the puncturing pin in the up position, parallel to the container, insert the new cartridge, seal end down. Always check the cap to be sure it is screwed down tightly.

REFERENCES: Technical Order 13-1-3 and Technical Order 13-1-17.



Inserting CO_2 inflator. Screw cap down tight.

PIF 8-10-2
REVISED July 1, 1944

Sea Marker Packet

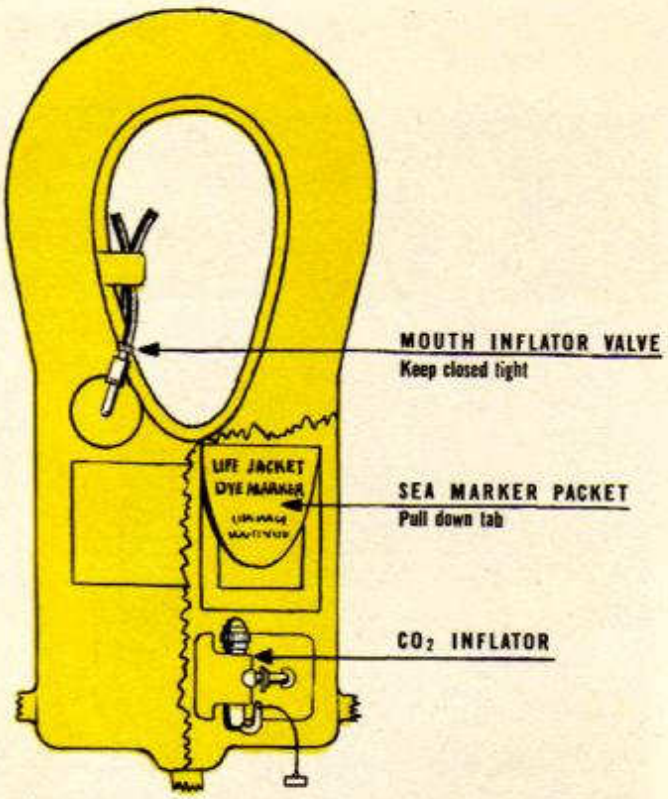
A sea marker packet is cemented to the life vest. When friendly airplanes approach, release the packet by pulling down on the tab. The dye will form a large green area lasting three to four hours. This will help airplanes to find you.

Caution

Before takeoff be sure your life vest cartridge containers are loaded with live CO_2 cartridges, **and that the container caps are screwed down tightly.** (See illustration.)

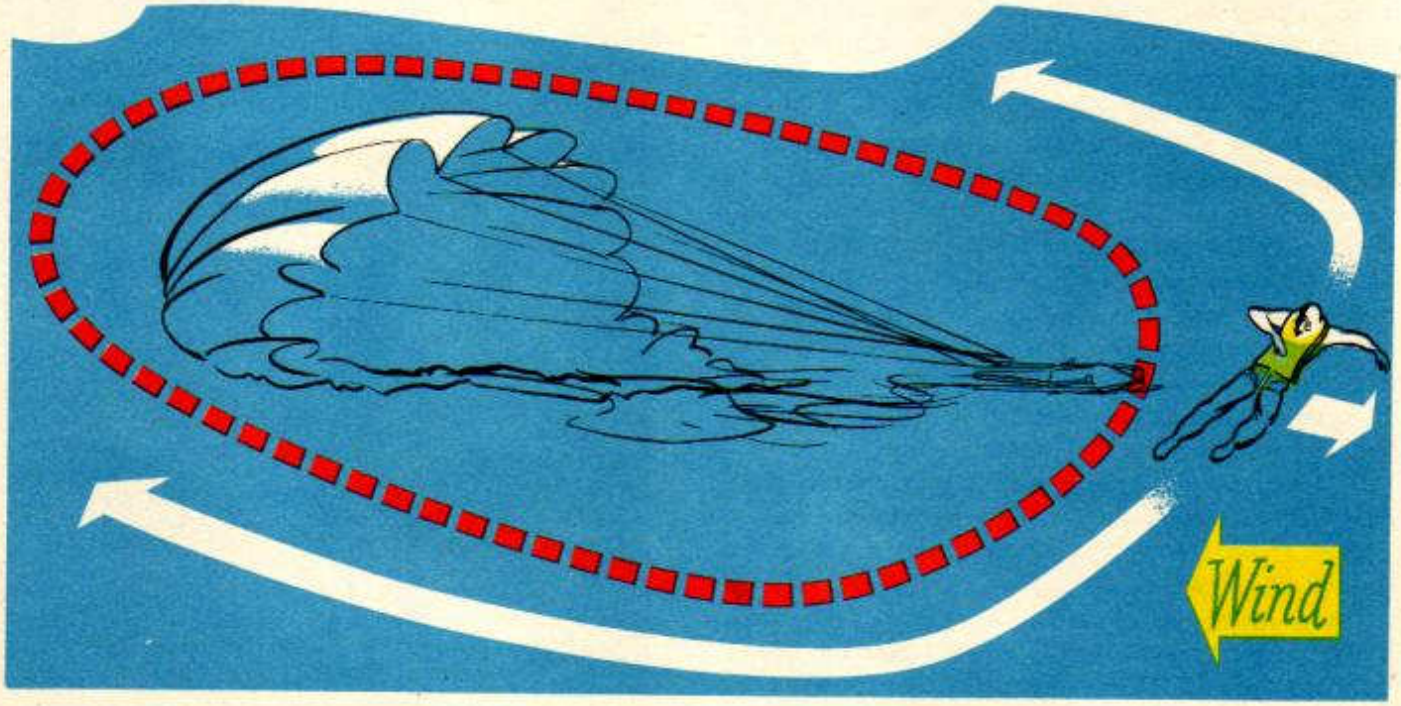
Always make certain that the mouth inflator valves are tightly closed before pulling the inflating cords.

Turn in your life vest for inspection every six months.



WARNING: STAY AWAY FROM YOUR CHUTE IN THE WATER

After parachuting into water you will have a tendency to drift downwind into the fallen parachute as soon as you inflate your life vest. To avoid entanglement with harness and shroud lines, work upwind, away from the chute, and stay clear. If you have a raft, salvage your parachute for sail, cover, and extra lines. If not, get away from the chute and stay away.



PIF 8-10-3
ADDED October 1, 1943

SWIMMING THROUGH FIRE

When an airplane is ditched at sea there is always the possibility that a smashed wing tank and engine will spread flaming oil and gasoline on the water. By using the following procedure, however, you can swim to safety through such a fire, even when you wear a life vest.



1. Jump feet first upwind of your airplane. Cover your eyes, nose and mouth with both hands. Take a deep breath. Hold breath until you rise to the surface.



2. Just before you reach the surface, make a breathing hole in the flames. Swing your arms overhead to splash flames away from head, face, and arms.



3. Swim into the wind. Use the breast stroke. Before taking each stroke splash water ahead and to the sides. Keep mouth and nose close to the water. Duck your head every third or fourth stroke to keep it cool. If there are several men, swim single file. Let the strongest swimmer splash a path so the rest can follow safely in his wake.



Swimming Under Water

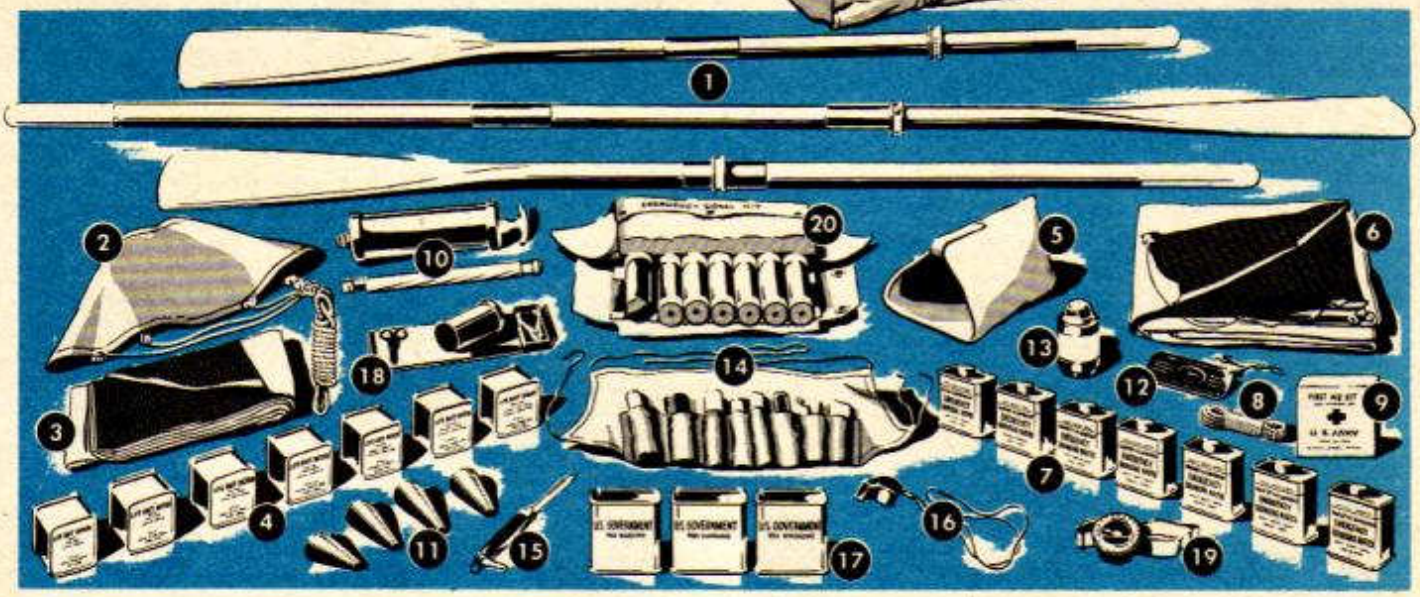
If the heat is too intense or flames too high, swim underwater —out of the danger area. To do this:

1. Splash flames away from body.
2. Hold head near water level.
3. Deflate life vest by releasing valves.
4. Take a deep breath but do not inhale fumes.
5. Sink beneath the surface, feet first.
6. Swim upwind as far as possible.
7. Splash away the flames as you come to the surface. Take a deep breath and submerge again. Repeat procedure until you are beyond the fire.
8. Re-inflate life vest by mouth.

LIFE RAFT KIT



LIFE RAFT KIT
(Closed)



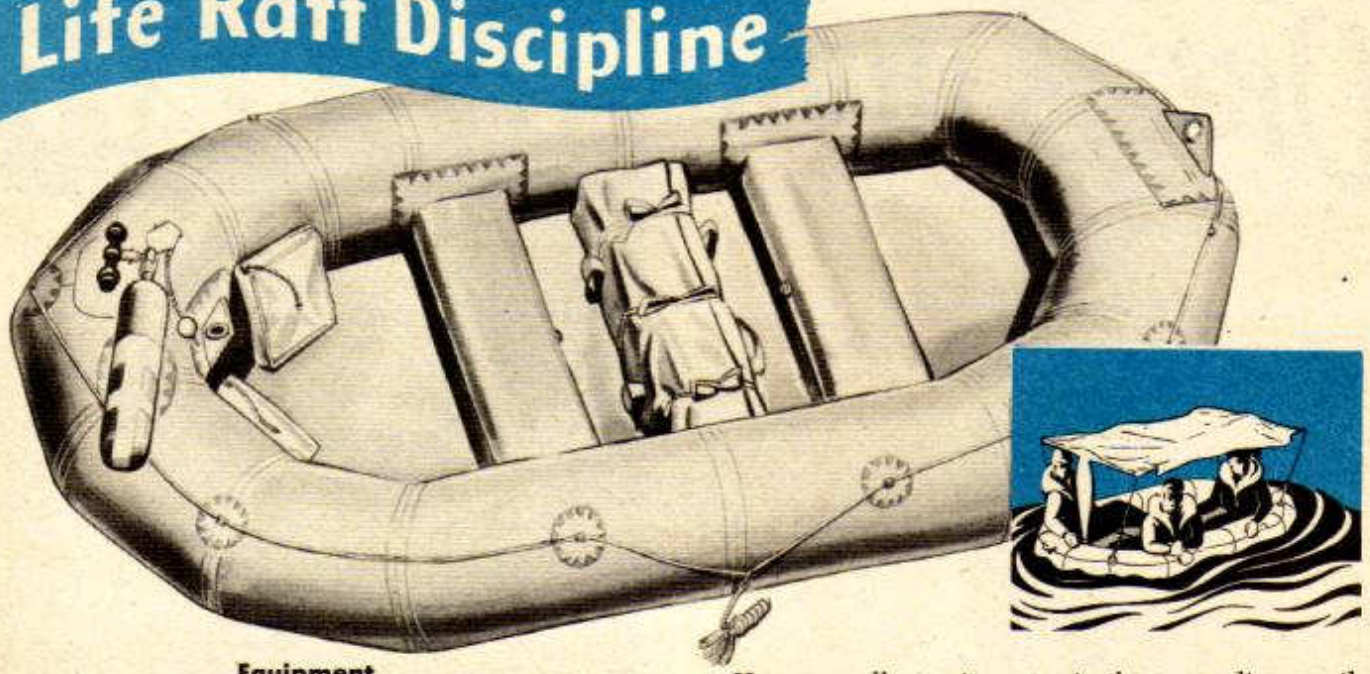
1. Oars. Use also as masts for sail.
2. Canvas Bucket Sea Anchor.
3. Sail. Use also for catching water if it rains.
4. Ration A.
5. Bailing Bucket. Use also for urination; don't try to stand in raft.
6. Shade and Camouflage Cloth. Yellow side for signal, blue for camouflage. Use it also for sun, wind, and spray protection and for catching rain water.
7. Emergency Drinking Water. Don't open or refill cans before flight. This water has been sterilized. Ordinary water will not keep. Save the cans for storage of rain water. Chemical sea water purification kits may replace some of the water cans.
8. Line. Tie down all loose equipment.
9. First-Aid Kit. Use as directed.
10. Inflating Pump. To replace with air the CO_2 lost by leakage and to inflate seats.
11. Puncture Plugs. Screw in plugs to seal leaks.
12. Signal Mirror. Best bet for signalling plane in daytime. Instructions for use on back of mirror.
13. Flashlight. Floating water-proof type. Tie it to the raft with the cord provided. Let it float as a night signal when an airplane is sighted. The battery will last 24 hours.
14. Fishing Tackle. Instructions included. Don't let hooks puncture raft. Dry lines and hooks.
15. Knife.
16. Whistle. Use to attract attention if ship or plane is near. Don't bother shouting.
17. Sea Marker. When you see a plane, pour the marker on the water. It will form a large colored slick which will last one to two hours. Get it overboard quickly when a plane is sighted as it takes a while for the color to spread. Stir the chemical with an oar to hasten spread.
18. Repair Kit.
19. Wrist Compass.
20. Signal Kit. Contains flare pistol and five or six flares. Fire proper flare (day or night) when plane is sighted. Aim high and ahead of plane.

Warning

When deflating life raft before storing it away in the airplane, use the deflating pump for that purpose. **Be sure the life raft is completely deflated.** If any air or CO_2 is left in the raft it will expand at altitude and become a dangerous hazard.

PIF 8-11-2
REVISED April 1, 1944

Life Raft Discipline



Equipment

Familiarize yourself now with the use of the equipment provided with the various life rafts. Ask your Personal Equipment Officer for demonstrations and instruction in its use.

If there are two or more rafts, connect them with the line provided to keep from becoming separated. Remain in the vicinity of the plane if it stays afloat, but not so close that the raft might be damaged by tossing against a sharp projection. Securely fasten the kit and all loose gear to the raft, with tight but easily untied knots.

Get the emergency radio into operation as soon as weather permits. Instructions are on the set. Keep all signalling equipment where you can get at it quickly. Keep flares and Very Pistol and cartridges as dry as possible. Use the flares only when a ship or plane is near. Fire the pistol almost vertically for maximum height, ahead of the plane so that the shot will be within the visibility range of the pilot.

Use the tarpaulin yellow side up for a signal, blue side up for camouflage from enemy.

Keep the sea anchor out. It will head you into the wind or check your drift.

Water and Food

Take no food and water for 24 hours. Then ration it carefully. The pilot is in charge of rationing. In general don't eat food if you have no water.

Have all members of the crew drink all the water they can before any over-water flight. Don't take chances on starting your raft expedition thirsty.

You can collect rain water in the tarpaulin or sail. Drink as much as you can and store the remainder in empty water cans and other containers.

Never drink sea water or urine.

Take good care of your fishing kit.

Protection

In the tropics protection from the sun is vital. Rig the oars and tarpaulin as a canopy and stay in the shade. Keep arms, legs, and head covered. Wet yourself, clothes and all, with bucket, sponge, or by immersion, but be careful to keep salt water out of your mouth.

Don't overexert. Perspiration will result and you will require more water.

Continued exposure to cold sea water plus loss of circulation may bring about a condition known as "Immersion Foot." To guard against it, keep your feet as dry as possible. Move your feet around and wriggle your toes to encourage circulation. If feet become swollen and sore, don't rub them. Rubbing will make the condition worse. Sprinkle open sores with sulfanilamide powder.

Large salt water burns or boils should be covered with sulfanilamide ointment and a light bandage. Don't prick or squeeze boils.

Don't worry about the absence of bowel movement or urination. It is a natural situation. Never take a salt water enema or a laxative.

If there is more than one man aboard, establish a watch routine. Keep a man on alert at all times. **Tie the man to the raft with at least ten feet of slack.**

PIF 8-11-3
REVISED April 1, 1944

One man LIFE RAFT



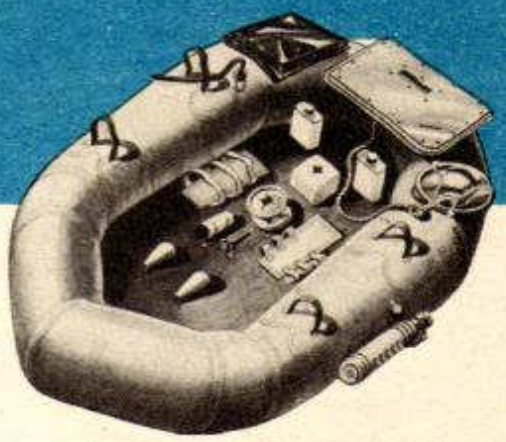
Raft lanyard goes under harness and clips to life vest ring.



To inflate raft pull out locking pin and open valve slowly.



Board raft from small end by pulling it under you.



Pre-Flight

The one-man life raft is stowed in a seat pack attached to the parachute harness. It is inflated after the jumper strikes the water.

When you put on parachute and life raft pack, **clip the lead strap from the raft to the ring of the life vest waist strap under the harness.** Otherwise you will lose the raft pack when you get out of the harness.

Before flight unsnap the pack cover far enough to expose the CO_2 cylinder. Test the locking pin.

In the Water

Pull open pack cover. Pull locking pin out of valve handle and open valve to inflate. Enter raft from small end by grasping hand straps and pulling.

Aboard the Raft

Keep your life vest on.

Top off inflation by blowing in the rubber mouth tube. Tighten valve after inflating.

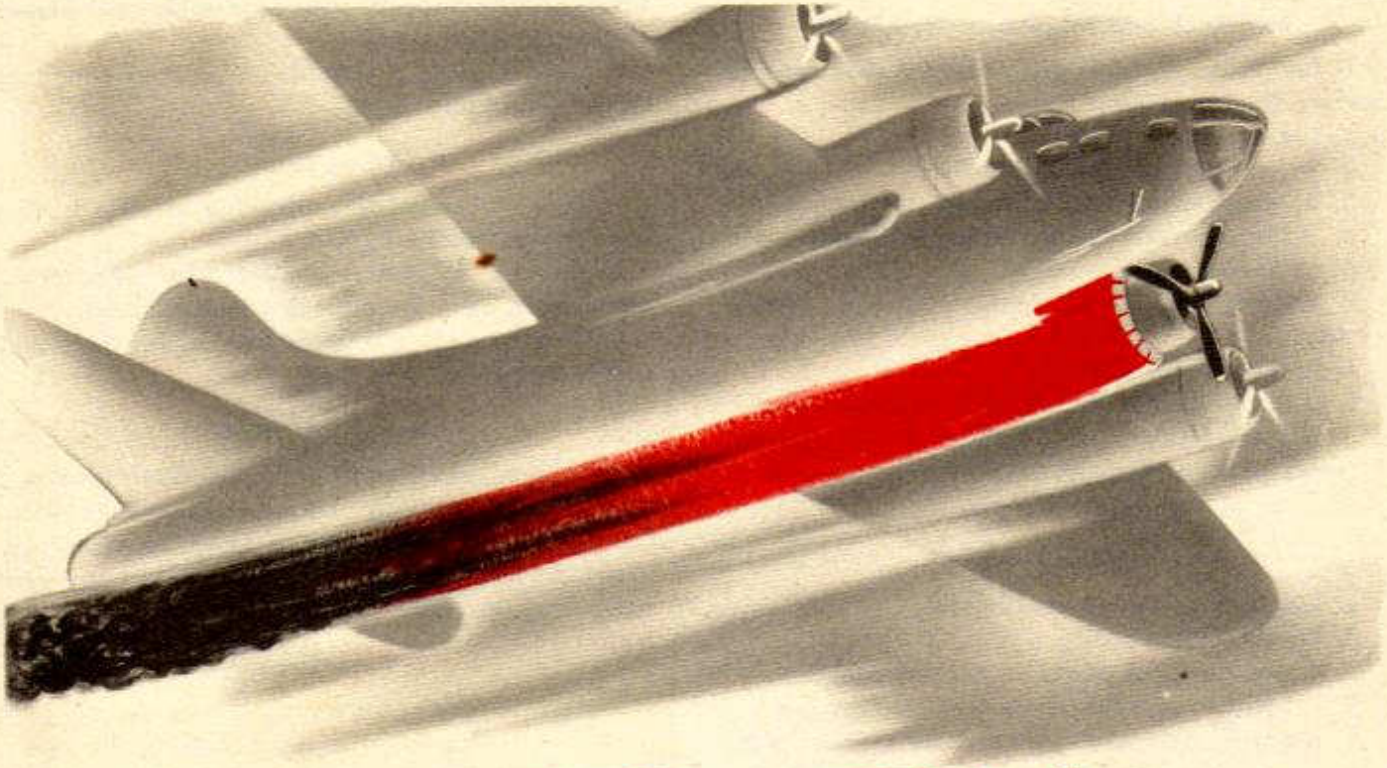
Keep the CO_2 cylinder on the valve. The valve might leak if exposed.

Keep the lead strap from raft clipped to yourself.

Fasten down everything aboard.

The raft contains sea marker, sea anchor, bailing bucket, bullet-hole plugs, blue and yellow cloth, first-aid kit, repair kit, paddles, and water. The water may be replaced by a chemical sea water purification kit in some rafts.

PIF 8-12-1
REVISED May 1, 1944



Fire Fighting

KNOW THE HAZARDS OF FIRE IN AIRCRAFT—BE FAMILIAR WITH THE PROCEDURE FOR FIGHTING FIRES ON THE GROUND AND IN FLIGHT

In Flight

Use all fire extinguishers applicable and follow proper procedure at once.

Prepare for emergency. Warn every man on the airplane to attach his parachute and to move to his proper position for bailout.

Determine whether a landing will be attempted or the airplane abandoned.

If airplane is to be abandoned, climb to a safe altitude, if possible, then give the order to bail out.

Engine Fires

At the first sign of a fire, if conditions permit, use the following procedure on the affected engine:

With built-in carbon dioxide system:

1. Cowling flaps "OPEN".
2. Shut fuel "OFF".
3. Feather propeller.
4. Turn ignition "OFF".
5. Set extinguisher selector valve.
6. Release carbon dioxide charge.
7. Do not start engine again.
8. Land as soon as possible, determine cause of fire, and correct condition before continuing flight.

Without carbon dioxide system:

1. Shut fuel "OFF".
2. Turn ignition "OFF".
3. Feather propeller.
4. Cowling flaps "CLOSED".
5. Land as soon as possible, determine cause of fire, and correct condition before continuing flight.

Fuel Tank and Amphibian Hull Fires

If fuel tanks or hulls are equipped with built-in carbon dioxide system:

1. Locate source of fire.
2. Set extinguisher selector valve.
3. Release carbon dioxide charge.
4. If fire is accessible, use hand equipment.
5. Land as soon as possible.

If not equipped with built-in carbon dioxide system:

1. Locate source of fire.
2. If fire is accessible, use hand extinguishers.
3. If fire is on side of hull attempt to control flame by sideslipping away from fire.
4. Land as soon as possible.

Cabin Fires

1. Close windows and ventilators.
2. Locate source of fire.
3. If electrical, cut power to affected part.
4. If fuel line is leaking, cut flow through line.
5. Use all extinguishers available. (Open windows and ventilators as soon as possible after flames are extinguished.)
6. Land as soon as possible and correct condition before continuing flight.

Wing Fires

1. Turn all switches controlling electrical wing installations "OFF".
2. Attempt to extinguish flame by sideslipping the airplane **away from the fire, when possible.**
3. Land as soon as possible and correct the condition before continuing flight.

Drop Tank Fires

Airstream usually will extinguish fires involving all types of externally mounted drop tanks, without damage to wing structure. Drop the tanks only if fire persists. If your plane has a bomb bay type tank, drop immediately.

Flare Fires

If flares in the racks ignite, release the flares at once. Pry them loose if they stick in the racks.

In case of fire, don't open emergency hatches or bomb bay doors in the air, except for bailout. External fires may be drawn into the cabin. Drafts will cause cabin fires to flare up.

Open emergency hatches just before landing if fire makes a crash landing necessary, to permit escape or rescue without delay.

On the Ground



See that a member of the ground or air crew stands by with adequate, portable fire extinguishing equipment while your engines are being started.

Starting an engine is a critical fire moment. Backfiring sometimes ignites excess priming fuel in the induction system. If a fire starts it may spread rapidly.

In case of fire while starting engines:

1. Allow engine to continue running. Fire often is sucked through the engine and extinguished.
2. Signal crew to use portable fire fighting equipment at once.
3. **Notify tower to rush crash equipment.**
4. If fire persists, shut off the ignition and fuel supply.
5. Use the built-in CO_2 system if you have one.

IN CASE OF FIRE ON THE GROUND, USE YOUR CO_2 SYSTEM. THAT'S WHAT IT'S FOR!

PIF 8-12-3
REVISED May 1, 1944

Fire Fighting Equipment in Airplanes

LEARN THE LOCATION AND PROPER USE OF FIRE EXTINGUISHING EQUIPMENT INSTALLED IN YOUR AIRPLANE.



"Fyr Fyter", hand-type fire extinguishers, having a carbon tetrachloride base, are found in most airplanes. Use this extinguisher primarily for fighting fires in the cockpit or cabin. It is unsuitable for extinguishing fires outside the fuselage during flight.

Aim at the base of the fire, remembering that your supply is limited and must be used effectively. The "Fyr Fyter" extinguisher in your plane has enough fluid to last for about one minute of continuous use. Its effective range is approximately 20 feet.

"CO_2", hand-type fire extinguishers, using carbon dioxide, also are found in large airplanes. Use this extinguisher for fighting fires inside the airplane.

The CO_2 extinguisher has an effective range of only 3 feet. The charge will last only 15 to 30 seconds, according to size of the unit. So aim at the base of the fire and move in close, on the upwind side. **Then pull the trigger release, directing the CO_2 straight at the base of the fire.** Move the discharge nozzle slowly across the flame area.



AIM AT BASE OF FIRE

Know the location of all extinguishers, their limitations, and how to use them.

AIM BEFORE PULLING TRIGGER

Both of these extinguishers are effective in combating fuel, electrical, and wood or fabric fires. CO_2 is rapid, clean, and easy to use. However, because of the small quantity in the cartridge, it might not be final in action.

Built-in CO_2 (carbon dioxide) systems are installed in some types of airplanes, so that engines, hulls of amphibians, gasoline tank compartments, or even cargo sections may be flooded with carbon dioxide gas in case of fire. First, set the extinguisher selector valve to direct the CO_2 charge to the desired location. Then pull the release handle. The operating controls are marked clearly to indicate their method of use.

Precautions

Stand back, but within effective range, when using the "Fyr Fyter", carbon tetrachloride extinguisher. Open windows and ventilators after fire is extinguished. **The fumes generated are poisonous.** See a doctor as soon as you land if you have inhaled excessive amounts of the gas or have swallowed even a small quantity of the liquid.

Don't touch any portion of the discharge nozzle of the CO_2 extinguisher. The extremely cold temperature of the carbon dioxide may cause severe burns.

CREW FIRE DISCIPLINE

Be sure that your air and ground crews are instructed in fire fighting procedures and methods of fire prevention.

RELEASE DROP TANKS BEFORE A WHEELS-UP LANDING

PIF 8-13-1
REVISED October 1, 1943



KIT, FIRST-AID, AERONAUTIC

Installed in Military Aircraft

Medical Supply Catalog No. 97765



SEAL: Not to be broken except in case of an actual wound or injury.

EXTERNAL POCKET: Contains iodine and adhesive compresses for minor injuries.

CONTENTS

1. Tourniquet, (1)
2. Morphine syrette (2)
3. Wound dressing, small, (3)
4. Scissors, (1 pair)
5. Sulfanilamide crystals, envelope, (1)
6. Sulfadiazine tablets, (1 box of 12 tablets)
7. Burn ointment, (1 tube) (Boric or 5% Sulfadiazine)
8. Eye dressing set
9. Halazone tablets
10. 1" Adhesive compresses (1 box) (Contents of small outer pocket)
11. Iodine swabs (10) (Contents of small outer pocket)

1. In the case of a wound, first stop the flow of blood. The clothing should be cut away and a compress or wound dressing applied after the sulfanilamide powder has been sprinkled into the wound. If a firmly applied dressing will not cause the bleeding to stop, or if there is actual spurting of blood from an artery, the tourniquet should be applied. A tourniquet must be released every twenty minutes and removed as soon as hemorrhage stops.
2. To relieve severe pain open the small cardboard container and follow directions given there in the use of the hypodermic syrettes of morphine. Do not hesitate to use the hypodermic to relieve suffering.
3. In case of head injury have the man lie quietly with head slightly elevated.
4. In the event of marked blood loss with shock and/or unconsciousness have the man lie horizontally or lie with the head down, if possible.
5. An adequate supply of oxygen is doubly important in case of serious injury. Use it generously.

NOTICE: Drugs Contained in This Kit are Potent and Must Be Used Correctly. Follow Directions!



TOURNIQUET: To be used to stop flow of blood but use only if blood flow cannot be stopped with a wound dressing. *Caution:* Release tourniquet every 15-20 minutes and remove as soon as hemorrhage is controlled. (See PIF 8-14.)



MORPHINE SYRETTE: To be used to relieve pain and should be employed without hesitation to prevent suffering. *Directions for use:* Remove transparent hood, grasp wire loop and push wire in to pierce inner seal, turning if necessary. Pull out and discard wire, thrust needle through skin at least half its length and inject solution by slowly squeezing the syrette from the sealed end. In extreme cold, warm syrette by holding under clothing next to skin.



WOUND DRESSINGS: Apply dressing with firm pressure into the wound and tie securely.

SCISSORS: Do not hesitate to cut away clothing and flying garments from the wound so that the dressing may be applied without hindrance.



SULFANILAMIDE POWDER: Sprinkle on the wound to prevent infection.

SULFADIAZINE TABLETS: To be taken internally if wounded. *Directions for use:* Take two tablets with water every five minutes until all twelve tablets are taken. Swallow whole without chewing.

7



BURN OINTMENT: To be used on skin surface for all burns from any cause. *Directions:* Apply ointment liberally and without friction to all burned surfaces.

8





9

EYE DRESSING SET: Use for burns of the eye. Apply Metaphen ophthalmic ointment directly to the eyeball. Then apply the boric acid ointment to the inner surface of the eyelid. Cover the eye with a dressing and secure in place with adhesive strips.

HALAZONE TABLETS: For the disinfection of water. *Directions:* Add one tablet to a canteen full or a pint of water. After tablet dissolves wait 30 minutes before drinking. If water is greatly polluted use two tablets.

10



EXTERNAL KIT POCKET: Contains iodine swabs and adhesive dressings for minor injuries. Do not use iodine in serious wounds. (Use sulfanilamide powder.)



11

KIT, FIRST-AID, FOR PNEUMATIC LIFE RAFT

Medical Supply Catalogue No. 97769

This is a part of the life raft kit. (See PIF No. 8-11.) Contains morphine syrettes, bandage compresses, sulfanilamide powder, sulfadiazine tablets and burn ointment as illustrated in photos Nos. 2, 3, 5, 6, and 7.





PACKET, FIRST-AID, PARACHUTE

Medical Supply Catalogue No. 97785

To be attached to the parachute harness or Mae West life vest for constant availability. Should be carried in Gun Turrets and other cramped spaces where the larger Kit, First-Aid, Aeronautic, is not accessible. Contains tourniquet, morphine and wound dressing as illustrated in photos Nos. 1, 2, and 3. Packet can be opened by tearing either end of the outer container at the notch.

PIF 8-14-1
REVISED April 1, 1944







Your airplane is a good first-aid station. You have the Kit, First-Aid, Aeronautic, and the Packet, First-Aid, Parachute. Oxygen is frequently available. Splints, or splint materials, are at hand. Hot drinks are often carried in thermos jugs. In certain bombers you will be provided with blood plasma. Familiarize yourself thoroughly with the first-aid supplies which you carry, and get clearly in mind just what you can do with them.

Wounds and Injuries

Wounds and injuries involve one or more of these problems: **pain, cuts, bleeding, broken bones, burns, frostbite, shock, and unconsciousness. Generally you** will have to deal with combinations of these, such as cuts which are bleeding, burns that cause pain, broken bones associated with cuts or burns, and so on. Shock usually comes on after a good deal of blood has been lost either inside the body (where you may not be able to see it), or on the outside. Shock also accompanies deep or extensive burns. Unconsciousness may be produced by a head injury, may follow shock, or may occur as a result of failure to get enough oxygen.

In giving first-aid, try to size up the general situation accurately. Then attend to the most serious problems first. Above all, use common sense.

Cuts and Bleeding

1. Expose wound by cutting nearby clothing with scissors.
2. Cover cuts with sterile dressings and apply firm pressure.
3. If this does not stop the bleeding, elevate the bleeding part.
4. If these measures fail to stop bleeding in arms or legs, apply a tourniquet in the middle of the upper arm or middle of the thigh. The tourniquet must be released every 15 minutes for at least a few seconds, depending upon the amount of bleeding.

Tourniquet (Warning)

A tourniquet must be removed, or temporarily released, every 15 minutes. **Failure to release the tourniquet often enough or long enough to provide an adequate circulation to the blocked portion of the arm or leg may necessitate amputation later.**

PIF 8-14-2
REVISED April 1, 1944

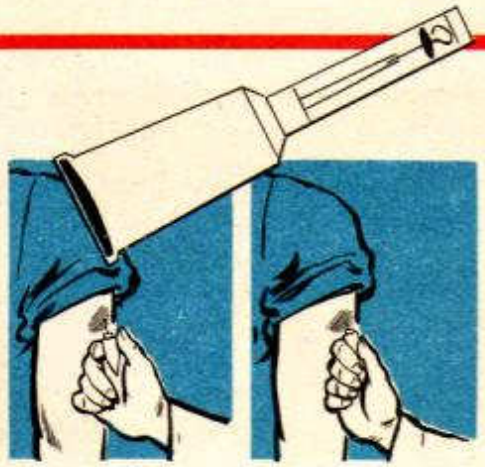
Pain

Use morphine at once for severe pain. This makes it possible for the patient to lie quietly, preventing aggravation of the injuries. Do not use more than one tube (½ grain) of morphine at any one time.

When giving morphine, mark down the time and dose on the patient's forehead or clothing with a pencil. Remember that an excess of morphine can be fatal. Do not give morphine to a person who is unconscious, who has a head injury, or who is breathing less than 12 times per minute.

To Give Morphine

1. Paint any small area of skin with iodine.
2. Remove the transparent cover from the morphine syrette.
3. **Push in the wire loop to puncture the inner seal;** then pull the wire out.
4. Thrust the needle through the skin, using care not to press morphine out of the tube while doing so.
5. Squeeze the tube slowly to inject the morphine.



Give Morphine:

1. To stop pain.
2. To decrease shock.
3. To facilitate moving the patient.

Don't Give Morphine:

1. To an unconscious person.
2. To a person with a head injury.
3. To a person who is breathing less than 12 times per minute.

Shock

You can tell when a patient is in shock by the total picture he presents rather than by any single sign. Usually he will have:

1. Lost considerable blood, or
2. Suffered severe burns, or
3. Been subjected to intense pain, or
4. Received a head injury.

His skin is pale, cold, clammy, or moist.

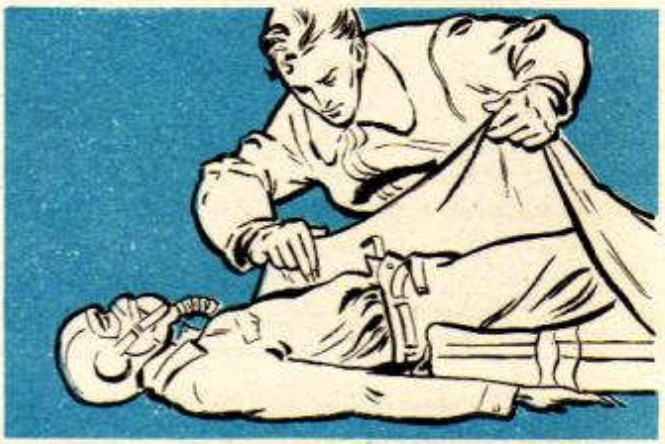
His breathing is shallow, and may be irregular.

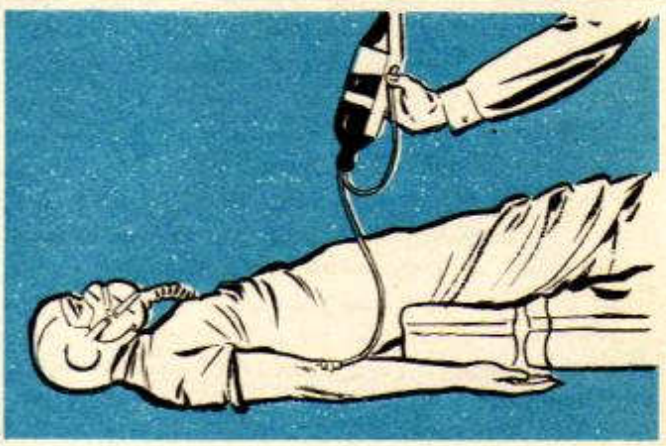
His pulse is weak, rapid, thready, and often difficult to find.

Sometimes there is nausea and vomiting.

Treat shock by doing the following things as promptly as possible:

1. Stop any obvious bleeding.
2. Give pure oxygen to breathe. (Automix "OFF.")
3. Give morphine. (Exception: Head injury.)
4. Keep the patient warm with blankets, extra clothing, or a sleeping bag, but avoid excessive heat.
5. Loosen any tight clothing.
6. Place the patient with his head slightly lower





than his feet, to promote better circulation to the brain.

7. Inject plasma, when it is available, in accordance with the directions on the plasma package.

Fractures

1. If a broken bone is associated with a cut, sprinkle with sulfa powder and cover with a sterile dressing. If the dressing is firmly bound in place it will almost always stop the bleeding.
2. Give morphine.
3. Apply a temporary splint to the part, using wood, strips of metal, heavy cardboard, or any convenient pieces of equipment such as a machine-gun barrel or fire ax.
4. **Do not attempt to set the bone. Manipulation causes shock.**

Burns

For minor burns:

Squeeze burn ointment onto a sterile dressing. Then cover the burn gently with the dressing.

For severe burns:

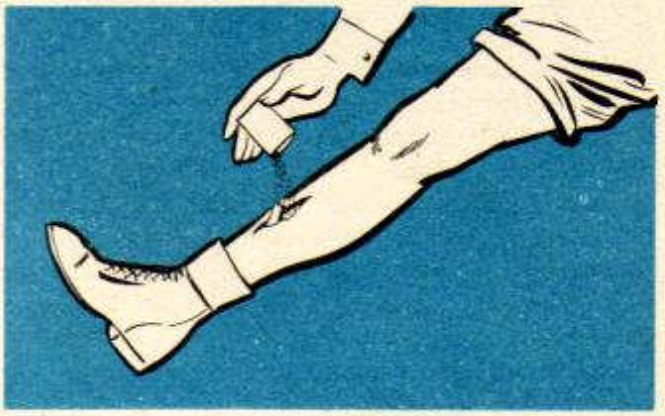
1. Give morphine.
2. Treat shock. (Oxygen; plasma, if available.)
3. Apply burn ointment on sterile dressings, **and bind the dressings gently but firmly in place.**
4. Never open blisters resulting from burns.

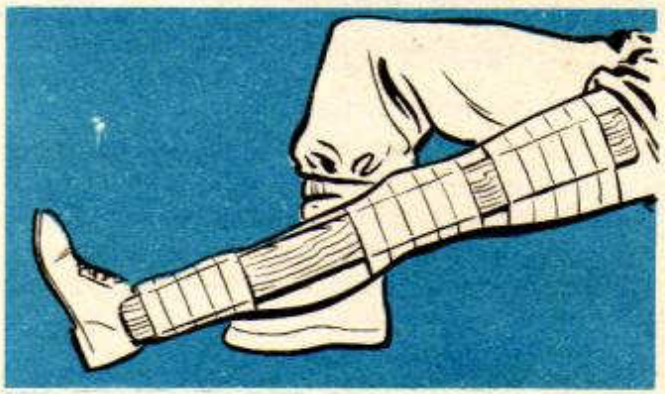
For eye burns

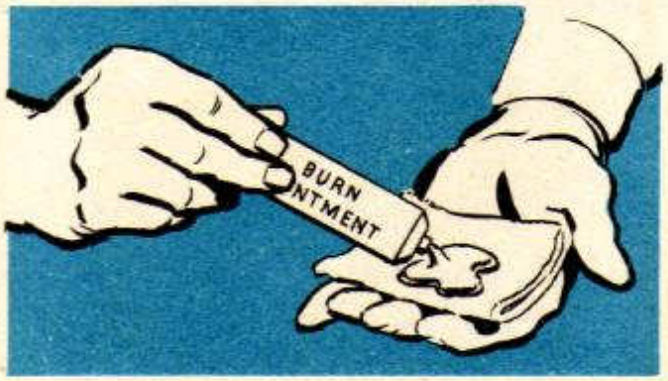
Apply Metaphen ophthalmic ointment directly to the eyeball. Then apply the boric acid ointment to the inner surface of the eyelid. Cover the eye with a dressing and secure in place with adhesive strips, provided the skin around the eye is not burned. Do not touch the eye with your fingers, and do not rub it—either before or after the ointment has been applied.

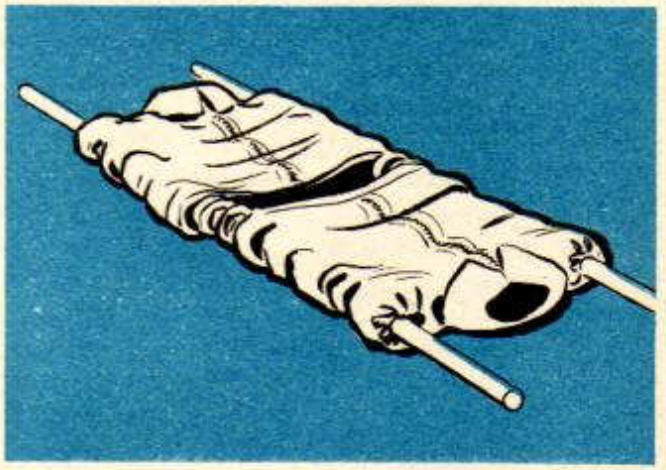
Transportation of Wounded

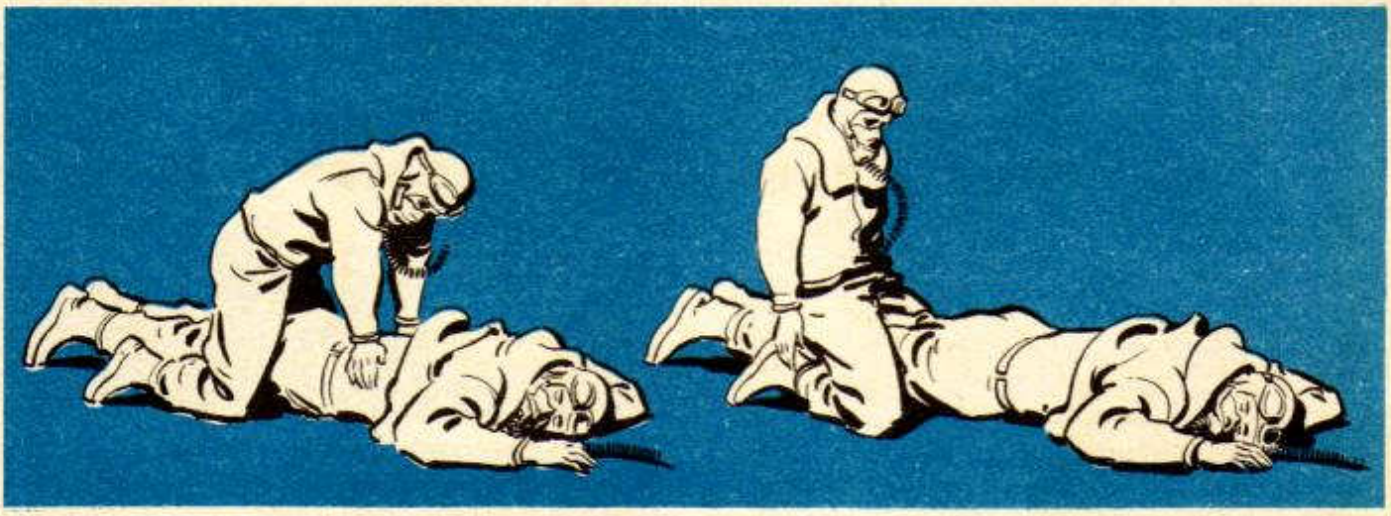
If it becomes necessary to move an injured crew member improvise a litter with 2 poles and a pair of flying jackets. Turn the sleeves inside out and insert the poles through them. Then close the jacket over the outside of the poles. Additional support can be obtained by using boards or cardboard splints inside the jackets. Litters can also be improvised with poles and blankets. Take great care to be as gentle as possible in moving an injured person onto a litter. Keep his body as flat as possible at all times. Have 3 or more persons move and support him by placing their arms under his legs, buttocks, back, shoulders, and head.











Unconsciousness and Near-Unconsciousness

Oxygen lack, carbon monoxide poisoning, and head injury are important causes. Immediate treatment is vital, especially if breathing has stopped.

1. Give artificial respiration:

First, lay the patient face down with one arm bent at the elbow, his face resting on his hand, and his other arm extended beyond his head.

Second, open his mouth and remove all foreign substances such as false teeth and chewing gum. If his tongue has fallen back into his mouth, grasp it with your fingers and pull it well forward.

Third, give him pure oxygen. (Automix "OFF.") **If the patient has stopped breathing, turn on the emergency flow.**

Fourth, kneel astride the patient's thighs with your knees about even with his. Place the palms of your hands against the small of the patient's back, with your little finger over the lowest rib.

Fifth, with your arms stiff, swing your body forward slowly so that your weight is applied over the patient's back. This should take about 3 seconds.

Sixth, release your hands with a sudden snap and swing backward to remove all pressure from the patient. After about 2 seconds repeat the cycle.

Continue giving artificial respiration without stopping for 2 hours or longer, unless the person to whom it is being given begins to breathe normally.

2. Keep the patient warm.
3. Do not give morphine.

Frostbite

1. Fingers, toes, ears, cheeks, chin, and nose are the parts most frequently affected.
2. Numbness, stiffness, and whitish discoloration are the first symptoms.
3. Wrinkle your face to find out if it is numb; watch for blanched faces of your crew mates.
4. If frostbite occurs, warm the affected part gradually. Never rub or attempt to thaw it rapidly.
5. If blisters develop, do not open them. (See HEAT AND COLD, PIF 4-7-3.)

Failure of Oxygen Supply

If a crew member's oxygen supply fails above 10,000 feet, make every effort to replace his equipment or give him an emergency supply. If this is not practicable, descend to 10,000 feet as fast as safe operation permits. Loss of oxygen above 20,000 feet is critical, but there is no need for panic. **Get oxygen, or get down.**



Wound Disinfectants

1. Sprinkle Sulfa powder in open wounds.
2. Use iodine only for small cuts and scratches, which should not be covered by a dressing.
3. Never put iodine on or into large or deep wounds.

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