RESTRICTED

PILOT TRAINING MANUAL FOR THE THUNDERBOLT

P-47

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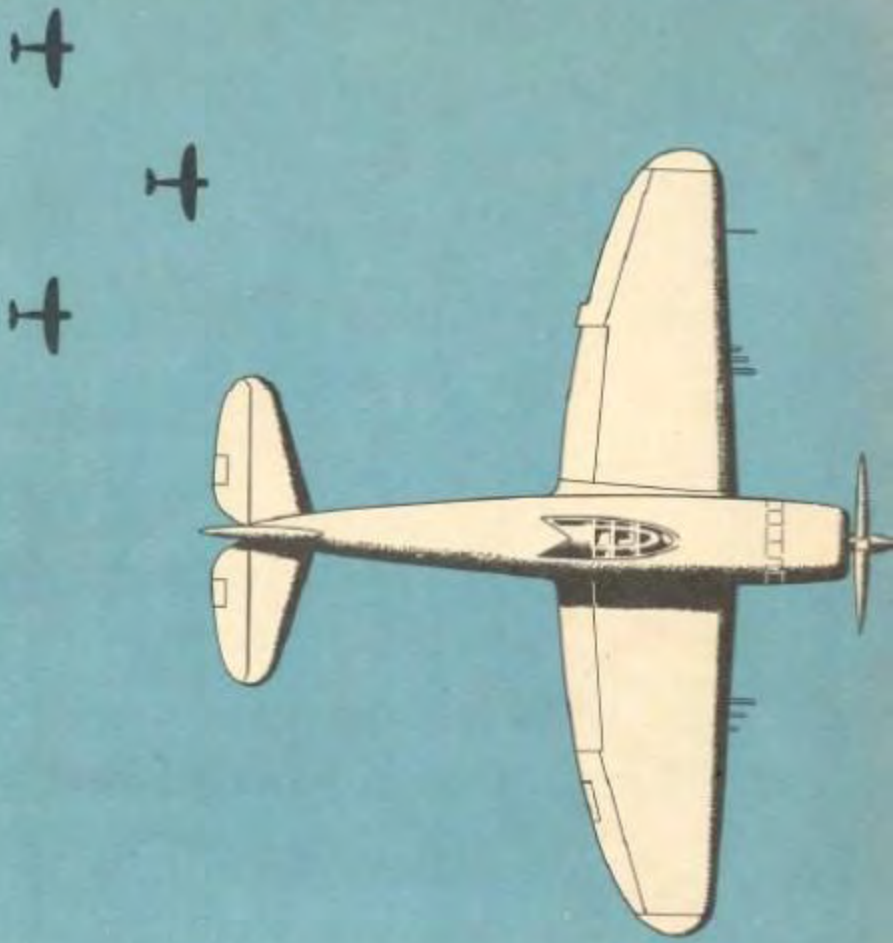
AAF MANUAL No. 50-5



PILOT TRAINING MANUAL FOR THE THUNDERBOLT

P-47

PUBLISHED FOR HEADQUARTERS, AAF
OFFICE OF ASSISTANT CHIEF OF AIR STAFF, TRAINING
BY HEADQUARTERS, AAF, OFFICE OF FLYING SAFETY

AAF MANUAL No. ~~50-5~~

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U.S.

Foreword

THIS MANUAL is the text for your training as a P-47 pilot and airplane commander.

The Air Forces' most experienced training and supervisory personnel have collaborated to make it a complete exposition of what your pilot duties are, how each duty will be performed, and why it must be performed in the manner prescribed.

The techniques and procedures described in this book are standard and mandatory. In this respect the manual serves the dual purpose of a training checklist and a working handbook. Use it to make sure that you learn everything described herein. Use it to study and review the essential facts concerning everything taught. Such additional self-study and review will not only advance your training, but will alleviate the burden of your already overburdened instructors.

This training manual does not replace the Technical Orders for the airplane, which will always be your primary source of information concerning the P-47 so long as you fly it. This is essentially the textbook of the P-47. Used properly, it will enable you to utilize the pertinent Technical Orders to even greater advantage.

COMMANDING GENERAL, ARMY AIR FORCES

CONTENTS

ADDITIONAL COPIES OF THIS MANUAL MAY BE OBTAINED UPON REQUEST TO HQ. AAF, OFFICE OF FLYING SAFETY, SAFETY EDUCATION DIVISION, WINSTON-SALEM 1, NORTH CAROLINA

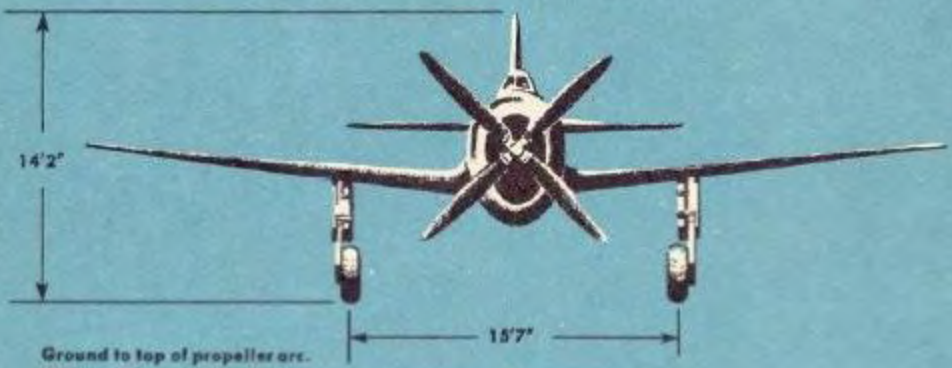
THUNDERBOLT

While in Advanced Flying School you doubtless formed an opinion of the type of tactical plane you wished to fly. The plane may or may not have been the Thunderbolt. There are many good planes in the AAF. In any event, you drew the P-47. And in the words of the old-timer, you got "a mighty good airplane."

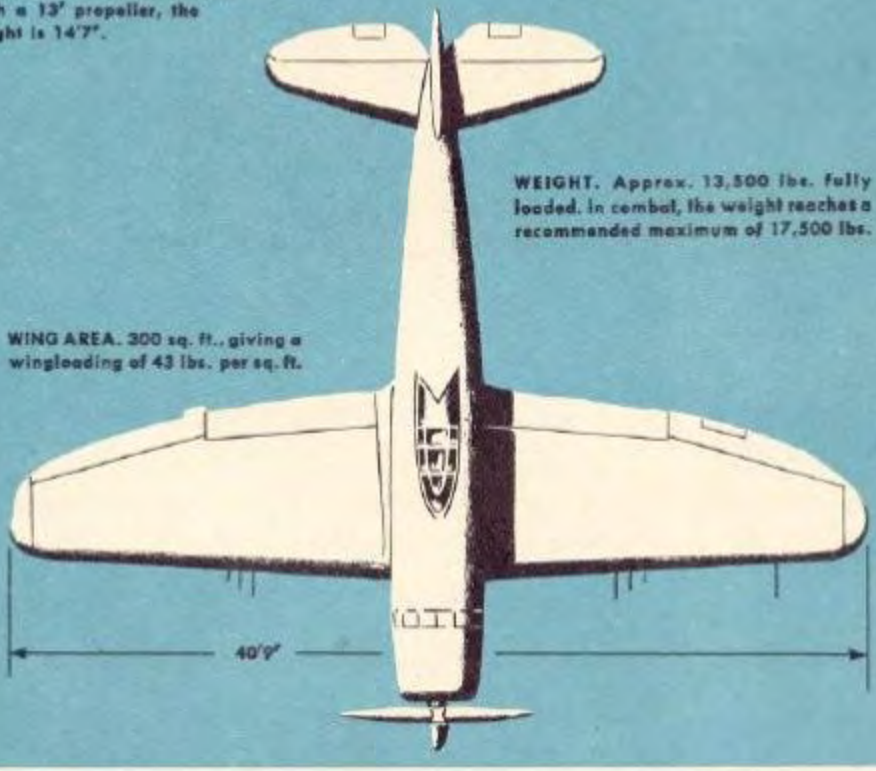
The P-47 is a jack-of-all-trades, and, contrary to tradition, a master of all. The plane was designed originally as a high-altitude fighter, but the exigencies of war brought it downstairs. The Thunderbolt now does dive bombing, skip bombing, strafing, and rocket launching, as well as flying high-altitude escort. It does them all superbly well.

As the air war reaches a climax, fighters will make an increasing number of attacks on ground targets. The enemy simply won't have enough planes to keep the fighters employed in aerial combat. The P-47 is a grand plane for this type of warfare. Terrific firepower keeps the enemy ducking, and the plane's heavy construction withstands savage punishment. Plenty of pilots in the ETO call the P-47 the best fighter in the world for low-altitude work.

This manual places a good deal of emphasis on emergencies of various kinds. Don't draw the inference that something is likely to happen every time you climb into the cockpit. The P-47 is a sturdy, sound plane. But to be safe in this plane, as in any other airplane, you've got to know how to meet unforeseen circumstances.



Ground to top of propeller arc. With a 13' propeller, the height is 14'7".



WEIGHT. Approx. 13,500 lbs. fully loaded. In combat, the weight reaches a recommended maximum of 17,500 lbs.

WING AREA. 300 sq. ft., giving a wingloading of 43 lbs. per sq. ft.

The new Thunderbolt carries more gasoline, double the quantity of water (for war emergency power), and more oxygen than earlier planes. The additions raise the weight about 560 pounds, gives the plane a higher stalling speed. Airspeed must be kept slightly higher.

THE THUNDERBOLT

The P-47's wingloading, about average for U. S. fighters, is high because of extra protection afforded by self-sealing gas tanks, armor plate, and devastatingly heavy armament. The landing gear is conventional, with the main gear retracting inward. The tailwheel retracts fully and is enclosed in flight. The wide tread of the main wheels and the lockable tailwheel make the P-47 easy to land and practically ground loop-proof.

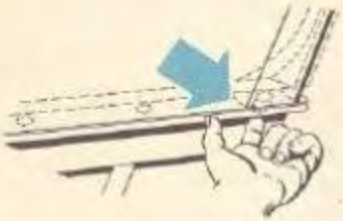
CANOPIES

The streamlined version used in combat affords 360 degrees of vision. Utilize every single degree in scanning the sky for an enemy.

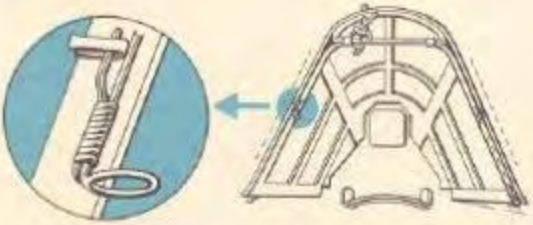
The old-style "greenhouse," used in training. While under this canopy, develop the "swivel-neck" that'll prevent unpleasant surprises later.

On series prior to the D-25, the canopy is similar to that of a trainer. The canopy is held in position by spring-loaded pins which seat in holes along the sliding track. A lever on the upper edge of the canopy lifts the pins by means of a cable. This lever is both inside and outside the cockpit.

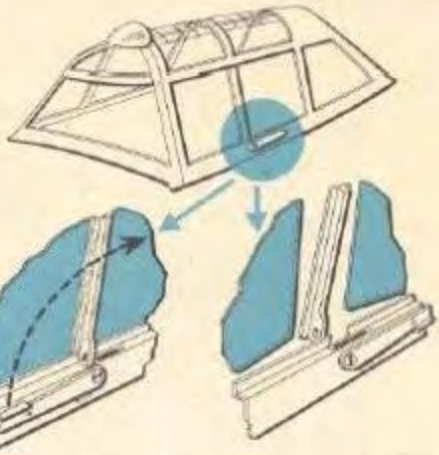
To open the canopy from the outside, move the lever to the right. When you are seated in the cockpit, the canopy is manipulated most handily by grasping the moving bar with the left hand and pushing the lever with the thumb.



After closing the canopy, feel beneath each track to insure that the pins are seated. If you neglect the check, the canopy may come open during takeoff, with the moving bar cracking your head.



On series prior to the D-15, you cannot jettison the canopy. In an emergency, if excessive speed makes the canopy hard to open, pull the ring on the side. The ring releases small flaps that catch in the slipstream and help force the canopy back.



The side panels may be removed to afford an emergency escape on the ground. Pull the lever on each side of the canopy back 180°. This permits the panels to be pushed out. Similar levers on the outside of the cockpit make it possible for outside rescuers to release the panels.

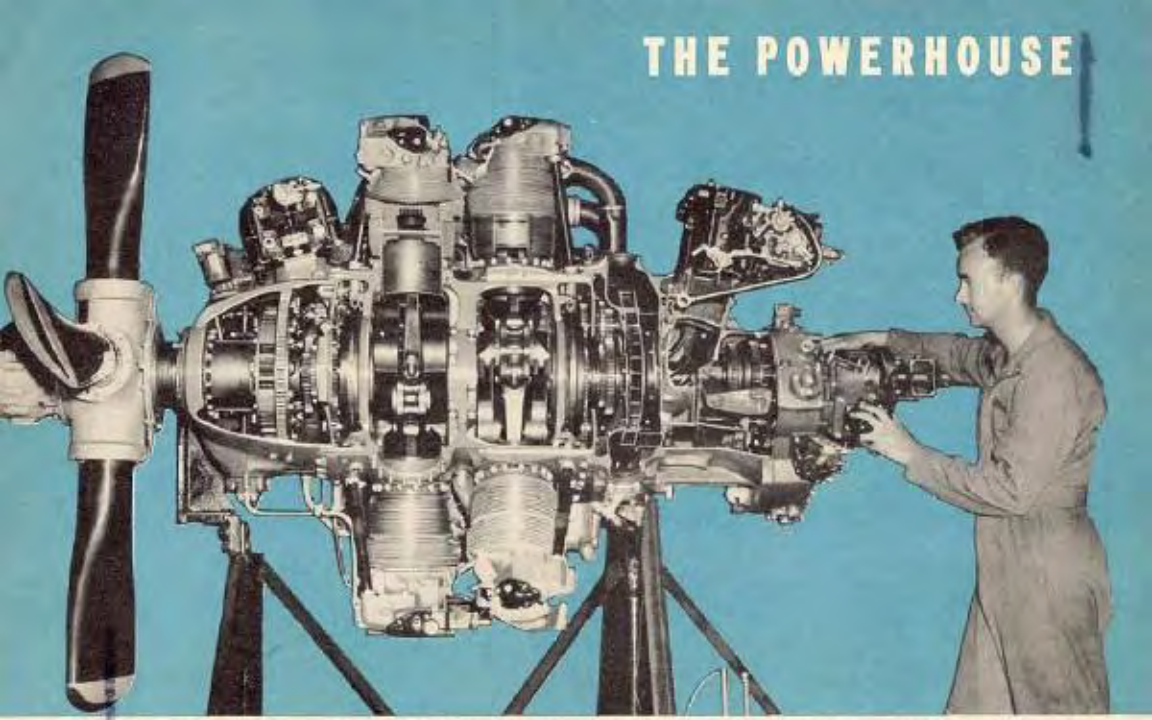
From the D-15 on, the canopy is jettisonable. To jettison it on series up to the D-25, pull down on the T-shaped handle in the upper center of the canopy above the canopy lock release latch.

The bubble canopy on the D-25 and subsequent series is operated electrically. It is controlled by a toggle switch in the cockpit. Engaging the switch moves the bubble backward or forward. When you release the switch, the canopy automatically locks in position.

To operate the bubble manually, use knobs on each side of the frame. The left-hand knob releases the clutch on the motor. On the left side of the fuselage outside of the cockpit, a small flush-mounted handle also disengages the clutch. Pull this handle to move the canopy from the outside.

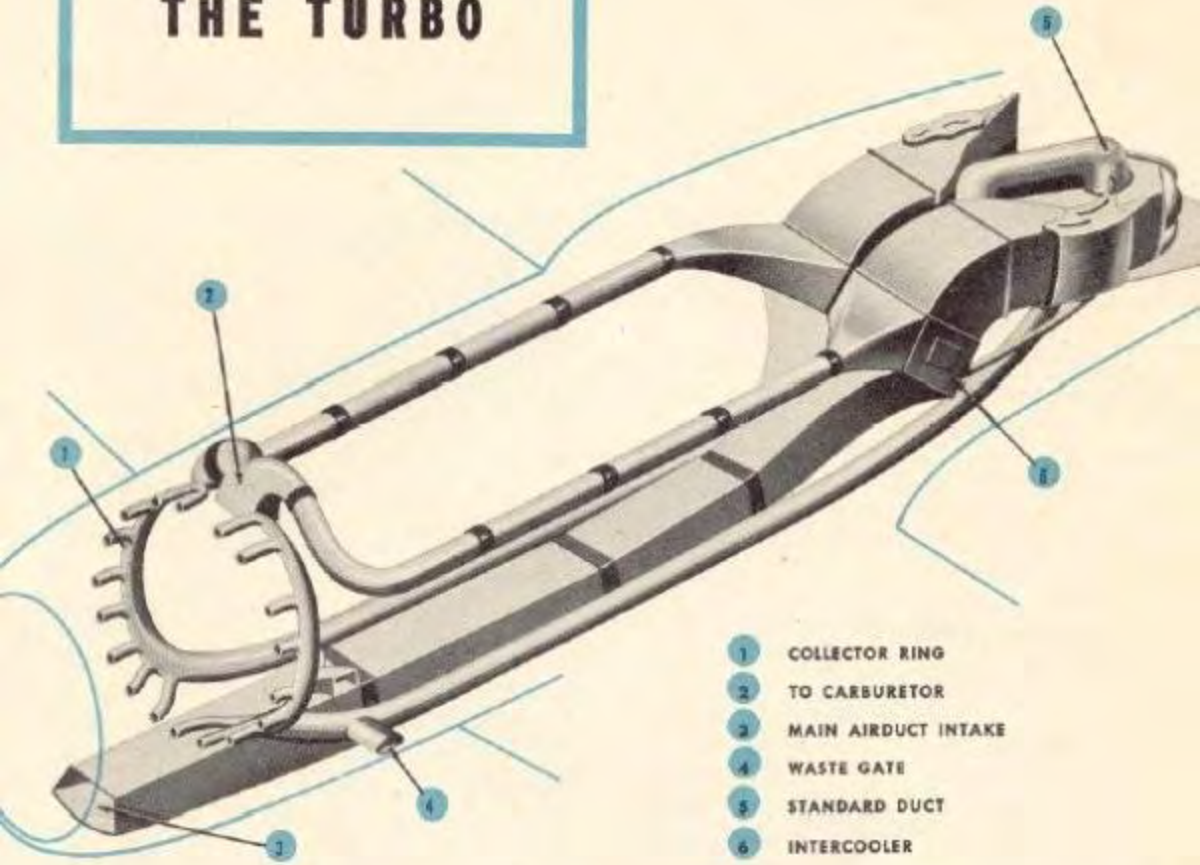
A red T-handle in the cockpit serves to jettison the canopy. Pull it and the bubble flies off in the slipstream.

THE POWERHOUSE



HERE IS A CUTAWAY OF THE P-47's POWERPLANT. IT'S AN R-2800 SERIES, 18-CYLINDER PRATT & WHITNEY DOUBLE WASP ENGINE. THIS GIANT DEVELOPS 2000 HP PLUS

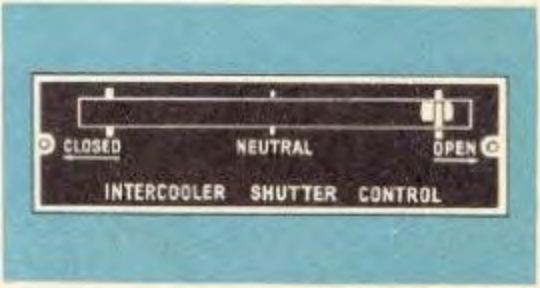
THE TURBO



The P-47 has two superchargers: a geared device which is an integral part of the engine, and a turbo-supercharger, installed just forward of the tail section.

The P-47's fame as a high-altitude fighter stems from the turbo. It gives the plane maximum performance at 27,000 feet. On the latest series maximum performance is obtained at 30,000 feet.

The supercharger's operation is quite simple. Air is compressed by an impeller which is spun by exhaust gases blowing against a bucket wheel attached to the same shaft. The supercharged air is then forced into the intake via the intercoolers.



An indicator showing the position of the intercooler shutters (panel doors on each side of the fuselage) is on the upper left of the cockpit. It is marked CLOSED, NEUTRAL, and OPEN.

The shutters, electrically operated, are controlled by a toggle switch on the main switch panel. On the D-25 and subsequent series, the toggle is beside the indicator.

Normally, you fly with the intercooler doors OPEN, but in cold weather you may need the doors in NEUTRAL or CLOSED to give correct carburetor air temperature. Doors must be in NEUTRAL for any speed above 350 mph.

A lever on the throttle quadrant controls the turbo. The lever regulates waste gates, which either direct exhaust gases against the bucket wheel, or permit the gases to escape.

When the P-47 is serviced with grade 100 fuel, the turbo control can be inter-connected with the throttle by means of a link.

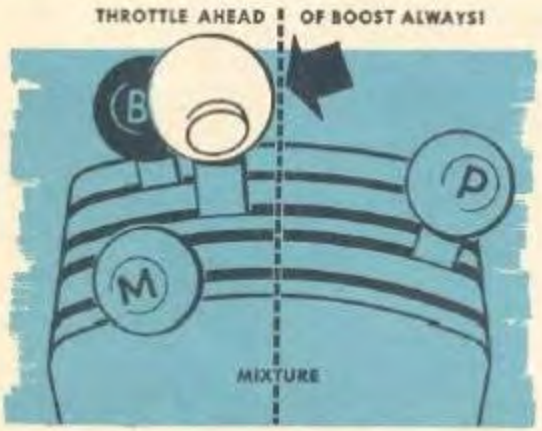
Disconnect the controls for starting, to enable you to crack the throttle while leaving the turbo off, and at high altitudes, when with the throttle full forward, it's necessary to pull back on the turbo to avoid overspeeding.

However, when grade 91 fuel is used in training, disconnect the link below 7000 feet. The precaution is in force to lessen the danger of exceeding allowable manifold pressures.

Above 7000 feet, the link may be connected to assist you in remaining in formation. Disconnect it when you descend.

When the link is not connected, use the turbo control as a second throttle.

In other words, after the throttle is full forward, use the turbo to maintain the desired manifold pressure. The turbo usually is needed at about 12,000 feet.



Always pull the supercharger back first. Under no circumstances, let the throttle get back of the supercharger lever, or the turbo will be damaged by building up pressures that have no means of escape.

Your plane, depending on the series, has a turbo tachometer or warning light on the panel.

The turbo tachometer is red-lined at 18,250 rpm. Do not exceed this limitation.

The turbo warning light goes on the instant you start the engine. It glows steadily unless you use the turbo. In this case, the light starts to flicker and continues to flicker until a speed of 18,250 rpm is reached. Then it glows steadily again. When this happens, reduce the rpm. The turbo is over-speeding.

When using the turbo, the rule is **keep the light flickering.**

The D-25, and later series, have both a turbo tachometer and warning light. The light goes on at 22,000 rpm to indicate overspeeding when war emergency power is being used.

GIVING A JAP THE WATER TREATMENT

WAR EMERGENCY POWER

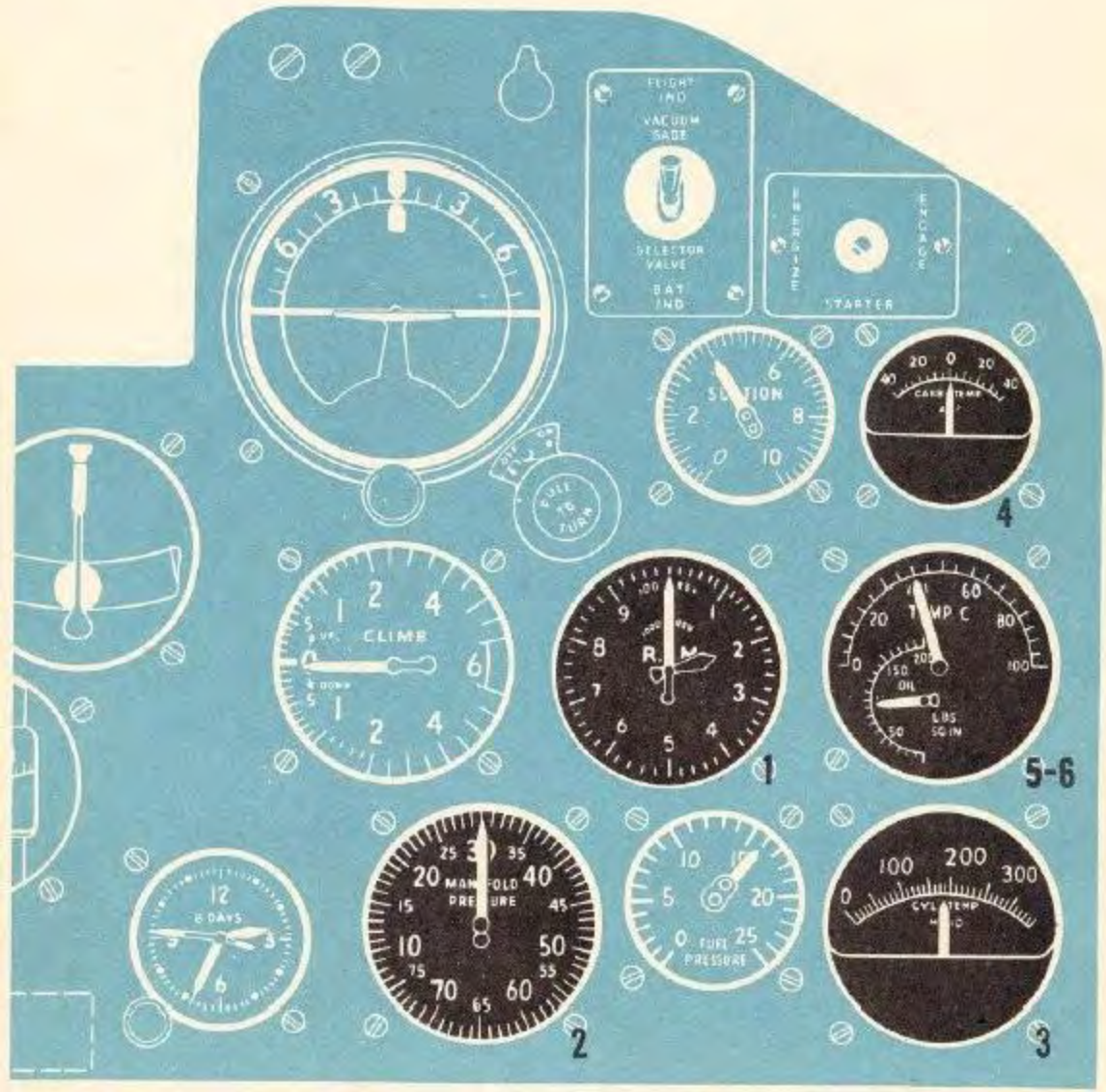
The P-47 has a tank holding a solution of water and alcohol to prevent detonation while drawing war emergency power. Series from the D-5 on have the system.

The capacity of the tank is 15 gallons on planes up to the D-25. On this and subsequent series, the capacity has been doubled. On most planes the solution is set flowing into the fuel discharge nozzle by a switch on top of the throttle. However, from the D-11 through the D-20, the flow starts automatically when the throttle is approximately ⅛ inch from full forward.

Water injection increases the power about 15%, and when it goes on it really gives a plane a boot in the pants. The water supply on the latest series is sufficient for about 15 minutes of operation, so be sure an emergency is real before tapping the tank. Like ammunition, water should be hoarded until needed, and then used unhesitatingly.

You won't be using water in training because you don't need such power.

ENGINE INSTRUMENTS



The P-47's giant powerplant has the reputation of being the most dependable in the fighter business. It's still an engine, however, and exacts the customary penalty for abuse. You'll read G-2 reports of pilots drawing excessive power for long periods. These reports are true. But that's in combat, where engines, like everything else, are expendable. No combat pilot purposely abuses his engine. In fact, he does everything possible to conserve it, so that the extra power is there when needed. To use an engine properly, you must understand what your engine instruments have to tell you. The P-47's instruments are grouped on the right side of the panel. Shown is a typical grouping. Different series may vary slightly.

A word to the wise

Engine instruments provide an X-ray view of your powerplant in operation. Train yourself to use them—all of them—and you'll receive advance notice of any impending engine trouble in time to take corrective action.

1. Tachometer

Records engine rpm. It is red-lined at 2700 rpm. Normal operating range extends from 1700 to 2550 rpm.

On planes with an electric propeller:

Rpm is regulated by the propeller control handle on the throttle quadrant when the propeller selector switch is in the normal operating position AUTOMATIC.

If necessary, rpm may be regulated by placing the selector switch in MANUAL, or fixed pitch, and varying the rpm by moving the toggle to INC. RPM or DEC. RPM.

On planes with a hydromatic propeller:

Rpm is regulated entirely by the control handle on the throttle quadrant.

2. Manifold Pressure Gage

Records pressure in manifold intake, showing power being used. Military power is red-lined at 42" Hg. with grade 91 fuel, and 52" Hg. for grade 100 fuel.

When using grade 91 fuel, normal operations extend from 25" Hg. to 40" Hg.

With grade 100 fuel, the normal operating range extends from 25" Hg. to 52" Hg.

3. Cylinder-head Temperature Gage

Correct operating temperatures are about 150°C on the ground, 200°C in the air. Never exceed 232°C continuously. The gage is red-lined at 260°C.

Excessive temperature may be caused by:

(a) Increasing the manifold pressure without an appropriate increase of rpm.

(b) Increasing power before increasing rpm, or decreasing rpm before decreasing power. (This does not apply to slight changes in power settings used to remain in formation.)

(c) Climbing at low speeds, especially with cowl flaps closed.

Excessive cylinder-head temperatures usually are a sign of detonation.

Inadequate temperatures may be caused by:

(a) Dives with cowl flaps partially open.

(b) Long power-off glides.

4. Carburetor Air Temperature Gage

Operating limits are 12° to 35°C. Control the temperature with the intercoolers.

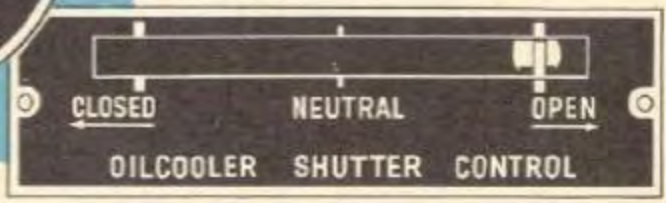
5. Oil Pressure Indicator

Operating limits in flight are 60-90 lbs. Best operation is 75-85 lbs. When engine idles, pressure is about 25 lbs.

6. Oil Temperature Indicator

Operating limits are 40° to 95°C. Best operation is 50° to 70°C.

Regulate temperature with a switch, on the main switch panel, which adjusts the oil cooler shutters. On the D-25 and subsequent series, the switch is next to the indicator on the left of the cockpit. The indicator shows the position of the shutters as CLOSED, NEUTRAL, and OPEN. Except in cold weather, the coolers are left OPEN.



POWER SETTINGS

The P-47's engine was designed to burn grade 100 fuel. Overseas demands, however, have made widespread use of grade 91 fuel necessary in training.

The engine operates just as well on grade 91 fuel, but the critical limits are lower. Don't exceed the limits. Otherwise, you invite detonation and engine failure, or a damaged engine which will fail during some future flight.

MAXIMUM ALLOWABLE MANIFOLD PRESSURE AND RPM USING GRADE 91 FUEL

	SEA LEVEL	6000 ft.	12000 ft.	18000 ft.	
TAKEOFF	40" Hg. 2700 rpm	40" Hg. 2700 rpm			Limited to 1½ minutes
CLIMB	35" Hg. 2550 rpm	35" Hg. 2550 rpm	35" Hg. 2550 rpm	33" Hg. 2550 rpm	Continuous high-speed cruise
CRUISE	32" Hg. 2400 rpm	32" Hg. 2400 rpm	30" Hg. 2400 rpm	28" Hg. 2400 rpm	Continuous All normal operations
MINIMUM CRUISE	27" Hg. 2100 rpm				Continuous—Used only below 8000 ft. with AUTO LEAN

HERE IS A TABLE FOR GRADE 100 FUEL

	SEA LEVEL	25,000 ft.	29,000 ft.	33,000 ft.	35,000 ft.	
TAKEOFF	52" Hg. 2700 rpm					Limited to 15 minutes
CLIMB	42" Hg. 2550 rpm	42" Hg. 2550 rpm	42" Hg. 2550 rpm	36" Hg. 2550 rpm	33" Hg. 2550 rpm	Continuous High-speed cruise
CRUISE	32" Hg. 2250 rpm	32" Hg. 2250 rpm	30" Hg. 2250 rpm	28" Hg. 2250 rpm		Maximum in AUTO LEAN All normal operations
MINIMUM CRUISE	31" Hg. 2150 rpm	31" Hg. 2150 rpm				Continuous Used below 25,000 ft. with AUTO LEAN

Fuel Consumption

The P-47 burns between 90 and 130 gallons of gas an hour during normal cruising operations, depending on the age and condition of the engine. The plane consumes about 25 gallons during warmup and takeoff.

When drawing full military power the gas consumption reaches 275 gallons an hour. War emergency power, an even greater gas hog, eats up around 315 gallons an hour.

In training, you will use AUTO RICH and a relatively high rpm on most of your missions.

The reasons are:

Grade 91 fuel restricts the safe operating limits on an engine.

These settings, although resulting in a greater fuel consumption, are easier on an engine and simplify the maintenance problem.

Training missions are sufficiently short to enable you to use such settings without danger of running out of fuel.

Bear in mind, however, that the habits thus formed are not intended to be your guide in combat. In these days of long range strikes and escort missions, your major problem will be economic use of fuel.

That means learning how to make intelligent use of AUTO LEAN and reduced rpm settings.

Long range cruising for maximum range is not a matter of guesswork. And it's not a matter of accepting the word of a hangar theorist who has a system that "worked OK for him."

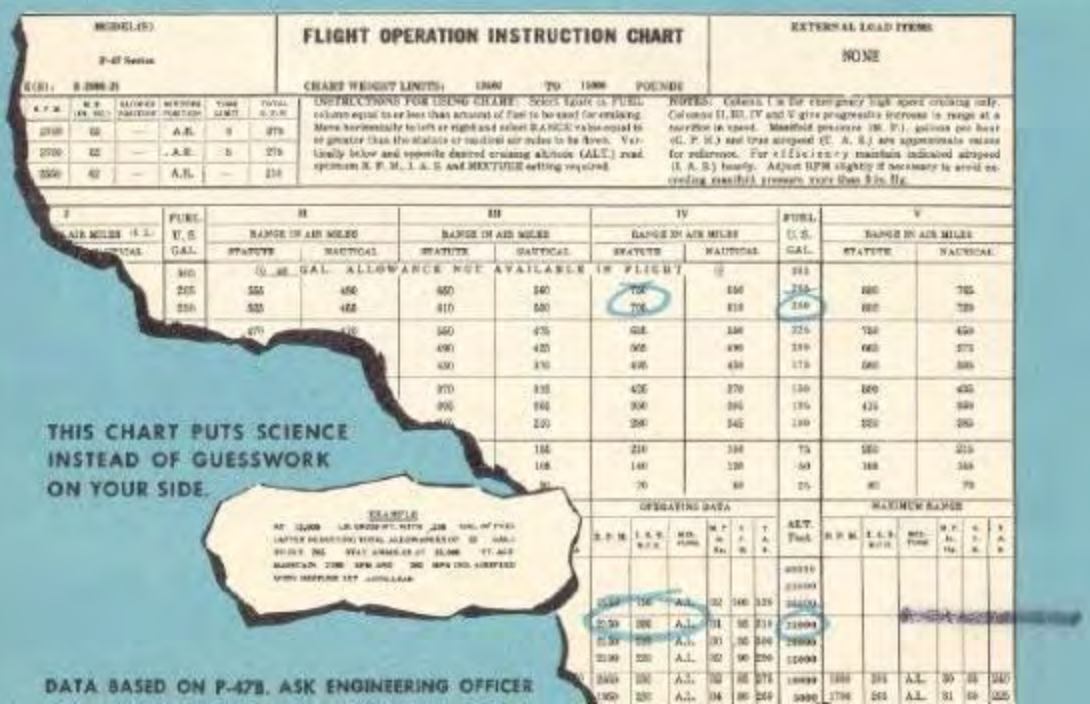
For a given gross weight, external load, and altitude there is usually one indicated airspeed which delivers the most miles per gallon, with one combination of rpm and manifold pressure achieving that speed most economically.

Your airspeed may be predetermined by the mission or by the formation, but in obtaining this airspeed you must select the power settings that make the best possible use of your fuel supply.

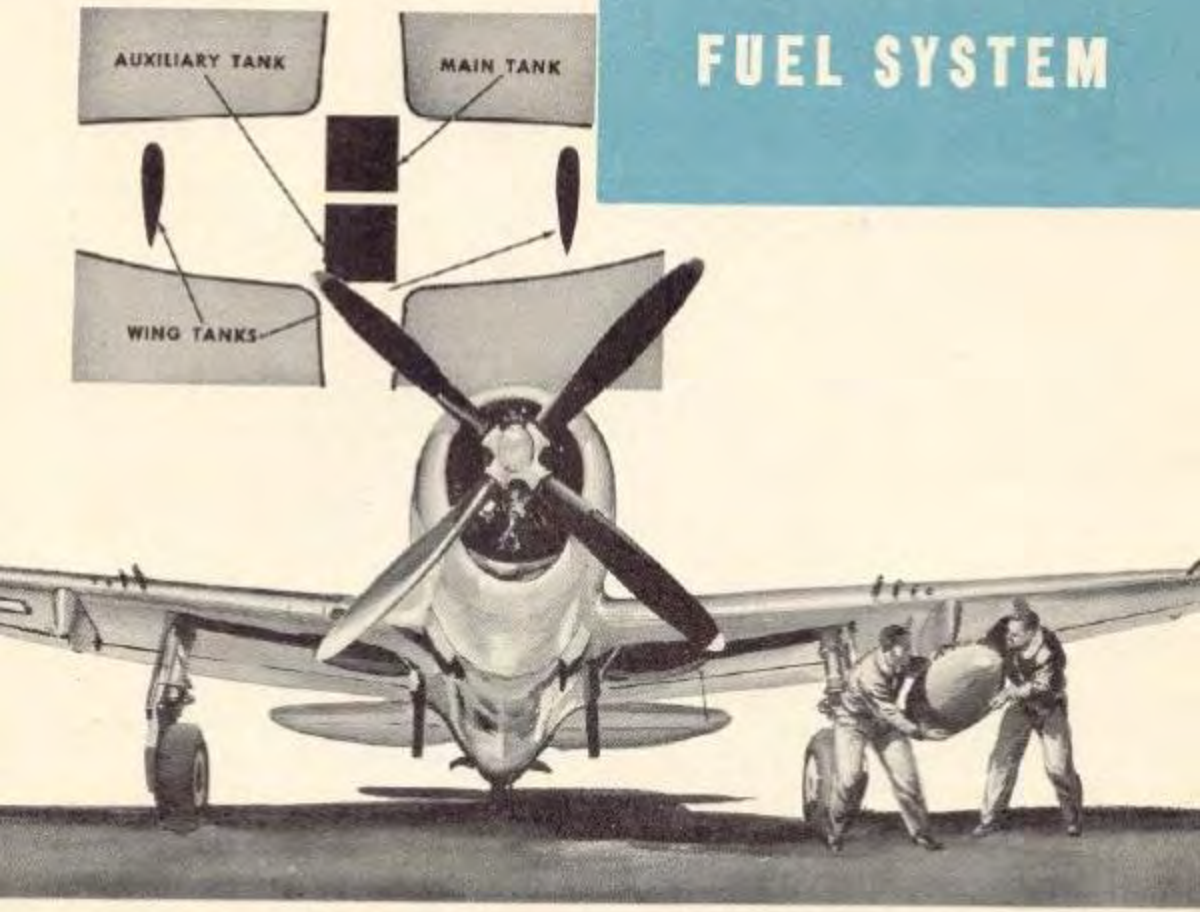
Don't guess at these values. Get them from a reliable source such as the Pilot's Flight Operating Instructions, 01-65BC-1 or 01-65BC-1A. A facsimile of one of the charts is reproduced.

The chart, while formidable in appearance, is quite simple. You can get the hang of it by spending a few minutes reading the instructions at the top and working out a couple of hypothetical problems.

Time spent in study of the chart will be a long stride toward providing you with a round trip ticket for each combat mission.



FUEL SYSTEM



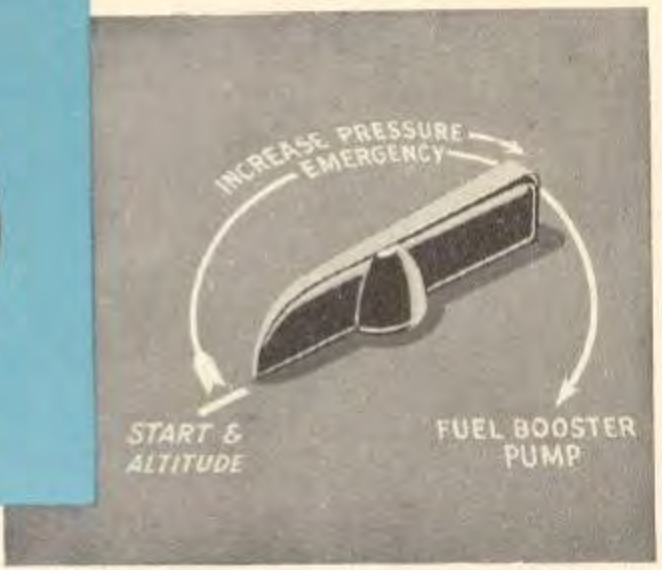
GAS IS YOUR PLANE'S LIFE BLOOD. STUDY THE FUEL SYSTEM

The position of the P-47's tanks is shown above. The main tank is L-shaped, is below and in front of the cockpit. On series prior to the D-25, the tank has a capacity of 205 gallons. On later series, the capacity has been increased to 270 gallons. The auxiliary tank holds 100 gallons. The tanks, self-sealing, afford a secondary protection against enemy gunfire.

The filler neck for the main tank is on the right side of the fuselage in front of the cockpit. The auxiliary tank filler neck is in the right wing root below the cockpit.

An electric gage on the instrument panel records the quantity of fuel in each tank. The gage is accurate in level flight only. It is unreliable for the main tank when the supply is less than 20 gallons. A correction card for the fuel gage when the plane is on the ground is in the plane. No gasoline gage is infallible. Keep in mind fuel consumption and elapsed time when drawing gas from any tank.

A fuel level warning light, on the instrument panel, goes on when approximately 40 gallons remain in the main tank. There are no lights for other tanks. The hand primer is conventional and to the right of the instrument panel.

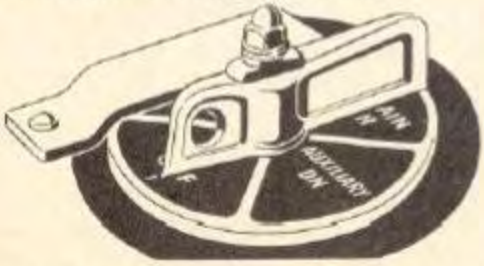


FUEL PRESSURE GAGE

A fuel pressure gage on the instrument panel, reads 16-17 psi when the engine is running properly. With the engine idling, the gage should record at least 7 psi. Any other reading is a sign of trouble.

Fuel is drawn from a tank by an electric variable-speed booster pump and forced into the carburetor by an engine-driven pump.

The fuel selector cock turns on the proper booster pump automatically. The booster pumps have an emergency speed controlled by a rheostat on the main switch panel, to take care of any falling off of pressure. Normally, the indicator points to START & ALTITUDE. To get emergency boost, turn the rheostat to the right until the pressure rises to normal.



The fuel selector cock on series from the D-2 to the D-5. The blocked-off space, which formerly provided for RESERVE, is no longer needed.

These planes have a belly tank control switch on the main switch panel. To use the belly tank, turn the switch ON, and place the fuel selector valve in OFF. To drop the belly tank, release the lock and pull up lever on floor on the right side of the cockpit.

The fuel selector and the wing tank cocks on series from the D-5 to the D-15. Note the provision for a belly tank. To use, simply set the selector on BELLY TANK.

When you desire to draw gas from a wing tank, set the main cock on BELLY TANK, and the secondary cock either to LEFT ON or RIGHT ON, depending on the tank wanted.

The fuel cocks on series from the D-15 on.

To use the drop tanks, place the main selector on EXTERNAL TANKS, and the other cock to the tank desired.

Time Drop Tanks

Fuel from the external tanks is forced into the system by a special constant-speed booster pump, or on series from the D-15 on, by air pressure supplied by the exhaust of the vacuum pump.

There are no gages for the external tanks. Time your consumption and when you figure a tank is about to run dry, watch the fuel pressure gage. Switch tanks the instant the indicator oscillates. Never take off or land using an external tank. Use these tanks above 3000 feet and drain them first.

You jettison the tanks by an upward pull on T-shaped control handles to the left of the seat on the floor of the cockpit. Each tank has a separate handle.

Drop all external tanks before making a wheels up landing.

Switching Tanks

Never let a gas tank run completely dry before switching. Anytime the fuel pressure gage indicates a drop, switch tanks at once. Its best to time your consumption and change tanks before the pressure drops off. Switch while flying level and with the throttle retarded to approximately 20" Hg. Above 15,000 feet, use the fuel pressure rheostat to maintain pressure during the operation.

If a tank has run completely dry, in addition to using boosted pressure it may be necessary to prime until the engine catches on the new tank.

Once you have switched tanks, leave the selector on the new tank long enough for the engine to take hold. By switching back and forth, you create vapor locks in the system.

DROP EXTERNAL TANKS BEFORE MAKING A BELLY LANDING. THEY CATCH FIRE.

When a tank runs dry, the engine becomes exceedingly rough, emits black smoke, and the propeller tends to run away trying to maintain rpm. Its easy to gain the initial impression that your trouble is a runaway prop, instead of a dry gas tank. (See Propellers Section)

Switch Tanks when:

SAYS { TIME IS RIPE

OR

SAYS { PRESSURE IS DROPPING

OR

SAYS { SOMETHING'S WRONG

*See "Power Settings" For Auto-Lean Limits

The FULL RICH position has been blocked off by a safety wire. To employ, break the wire by pressure on the mixture control lever. Return to the field in such case as the automatic metering unit is defective.

In training, AUTO RICH normally is employed. When AUTO LEAN is used to conserve fuel, keep a close watch on the cylinder-head temperature. If the engine starts to overheat, shift the control to AUTO RICH and reduce the throttle setting until the temperature goes down.

Take Off on Main Tank

Take off on the main tank and fly for 10 minutes before switching tanks. Carburetor overflow drains into the main tank at the rate of 10 gallons an hour. Unless you provide space to accommodate the overflow, you lose the gas through the overflow vent. In flight, use the main tank at least 10 minutes each hour for the same reason.

Break That Siphon

Once gas has started through the overflow vent a steady siphoning is likely. If not checked, you can lose all of the gas in your tanks.

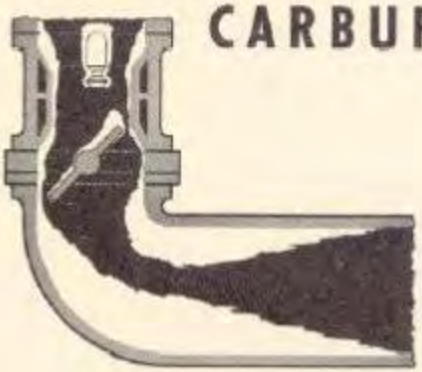
The procedure for breaking the siphon is simple, once abnormal fuel consumption makes you suspect the condition or a member of your flight advises that you are trailing gas.

Turn to the auxiliary tank and draw full power for a minute or two. This develops a counter-suction in the fuel system that does the trick.

If not carrying external tanks, use the gas in the auxiliary tank first. The plane flies better with this load lightened. When the auxiliary tank is down to 25 gallons, switch to MAIN, leaving the 25 gallons as a reserve.

to Counteract

CARBURETOR ICING



1 CHECK AIR FILTER CONTROL

2 CLOSE INTERCOOLER SHUTTERS

3 CUT IN TURBO IF NECESSARY

Carburetor Icing

Carburetor icing can occur at any time, winter or summer, when the temperature and dew point are within 12° of each other. (See: Carburetor Icing Section in PIF)

The P-47, except in cold climates, hasn't a carburetor heater. A heater is not needed to eliminate icing.

Carburetor icing is evidenced by a loss of power, airspeed and a decrease in the carburetor air temperature. To counteract, check to see that the carburetor air filter is in the bypass position, and close the intercooler shutters. If the carburetor air temperature doesn't rise to above 12°, cut in the turbo-supercharger. Apply the remedies as long as icing persists.

The supercharger is not effective in eliminating carburetor icing with reduced power settings. When letting down from altitude, keep up your power and reduce speed by lowering the landing gear and using partial flaps.

On planes equipped with a heater, turn the heater on when you suspect carburetor icing. If there is no ice, the manifold pressure drops slightly. If ice is present, the manifold pressure rises, then decreases as the ice melts.

(See: Extreme Weather Operation)

OIL SYSTEM

A 28-gallon tank, with pendulum installed for inverted flight, is in the upper part of the accessories section. The filler is behind a cowl door marked OIL on the upper left of the fuselage in front of the cockpit.

The normal oil load is 19 gallons. You can check it by opening a petcock set at this level on the tank.

The oil coolers, an arrangement of split doors, are in the lower part of the engine compartment. (The oil pressure and oil temperature indicators are described in the Engine Instruments Section.)

The oil tank pendulum allows 7 seconds of inverted flight. When the pendulum is functioning properly, oil pressure drops, then rises to 50 psi as the plane completes a maneuver involving inverted flight. If this doesn't happen, the tank is defective. Write it up in Form 1A.

An oil dilution switch is on the main switch panel. With this switch ON, the oil is thinned by gasoline. Be certain the switch is OFF at all times except when actually in use.

ELECTRICAL SYSTEM

THE LOAD IS ENOUGH WITHOUT CARRYING A SLEEPY PILOT

The electrical system is built around a generator and 24-volt storage battery. An astounding amount of equipment, more than 25 separate items, draws power from the system.

Under the circumstances, make every effort to preserve your battery. The generator keeps the battery charged if you use a little care, but it's not foolproof.

The generator does not cut in until the engine speed reaches 1100 rpm. While taxiing, cut off the radio if it appears that your takeoff entails a delay of, say, about 20 minutes. Or if it's necessary to keep constant contact with the tower, run up the engine occasionally to allow the generator to recharge the battery.

The radio affords a check on a weak battery while you are taxiing. If the radio goes out (that is, if all voice and static noise cease) stop your plane and run up the engine. If the radio comes back on, you know that the radio is OK, but that the battery is too weak for the takeoff. Return to the line.

In flight, if the ammeter registers zero, your generator is out. (Don't worry about a low reading. It merely indicates that your battery is fully charged.) If the prop starts to hunt in AUTO, your battery is weak. In either case, notify your flight leader and start for home.

PROPELLERS

Most P-47's have a 4-bladed, Curtiss Electric, constant-speed, non-feathering propeller. The diameter is 12 feet 2 inches.

The propeller has two controls: the propeller governor control on the throttle quadrant, and the propeller selector toggle switch.

The propeller control handle sets the rpm for automatic operation. Move forward to increase rpm and back to decrease rpm. The selector switch has four positions (shown in drawing).

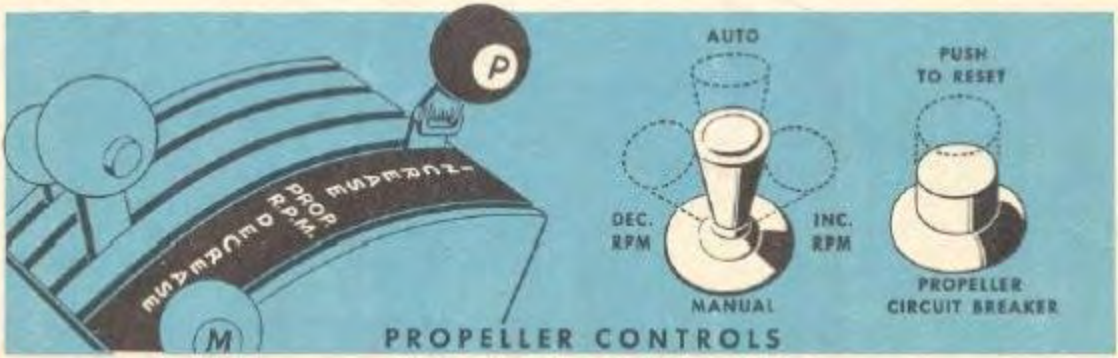
Leave the switch in AUTO for all normal operations. In emergencies, control the propeller with the selector switch.

A circuit breaker (small black button next to the selector switch) pops out, exposing a red collar, when the circuit is overloaded. When the

button is out, no current reaches the propeller motor and the propeller remains fixed in its last position. In your cockpit check, see that the breaker is in.

Propeller trouble usually is caused by faulty operation of other equipment. A weak battery, or one with corroded terminals, causes the prop to hunt while in AUTO. If this happens, place the selector switch in MANUAL, and obtain the desired rpm with the toggle. Cut off the generator if it is not charging. This prevents the battery from draining back through it. Return to the field at normal cruising speed.

If your generator goes out, your situation is slightly different. You still have a battery which lasts about an hour when nursed along. Turn off the generator and the radio, using the radio only for landing instructions.



PROPELLER CONTROLS

If you are only a few minutes from the field, leave the propeller in AUTO and make a normal landing. If you are farther away, place the prop in MANUAL and switch back to AUTO for your landing.

If the circuit breaker pops open, reset it immediately. Should the breaker stay in, leave the propeller in AUTO. Otherwise switch to MANUAL operation to obtain the desired rpm. It is necessary to hold the breaker in while manipulating the selector switch or no current reaches the propeller motor.

Whether a reset circuit breaker will or will not stay in, return to the field. Something is wrong with the system.

If the battery goes dead during flight, and the failure is sudden, the propeller holds the setting it had when the power failed. A gradual decrease of battery output causes the prop to run away slowly. Catch the prop with the selector switch. Before landing, manipulate the selector switch to give you landing rpm. Even a battery that has gone completely dead should come up enough for this purpose.

Check the fuel pressure before concluding you have a runaway prop. As a gas-starved engine loses power, the blades decrease pitch to maintain rpm.

WHEN LANDING IN ***MANUAL***
USE 2550 RPM AND 32" HG.
THIS SETTING ENABLES YOU
TO GO AROUND IF NECESSARY

Check the fuel pressure before concluding you have a runaway prop. As a gas-starved engine loses power, the blades decrease pitch to maintain rpm.

If a "runaway" prop is due to the engine losing power for lack of fuel, the rpm returns to normal after the engine takes hold on a new tank. First, the prop overspeeds, probably flat against the stops, but don't let that worry you. The rpm will drop as the propeller governor becomes effective.

13-Foot Props

Some D-25's and subsequent series have a 13-foot, paddle blade type propeller. The props are either Curtiss Electric, or Hamilton Standard Hydromatic.

The hydromatic propeller is actuated by engine oil which is supplied to the system by the regular engine-driven pump.

The control handle on the throttle quadrant adjusts the rpm. The prop is constant speed, with the governor holding rpm steady. The rpm settings used are the same as with an electric prop.

When your plane is in a level flying position on the ground, a 13-foot propeller has a clearance of about 6 inches.

The larger props have little effect on the handling characteristics of the plane, except for a marked additional thrust when throttle is applied.

When cutting off an engine, always leave the prop control handle full forward (high rpm).

RADIO EQUIPMENT

The P-47 has four radio sets: VHF (SCR 522), Detrola (SCR 438), IFF (SCR 695), and pip-squeak (RC-96).

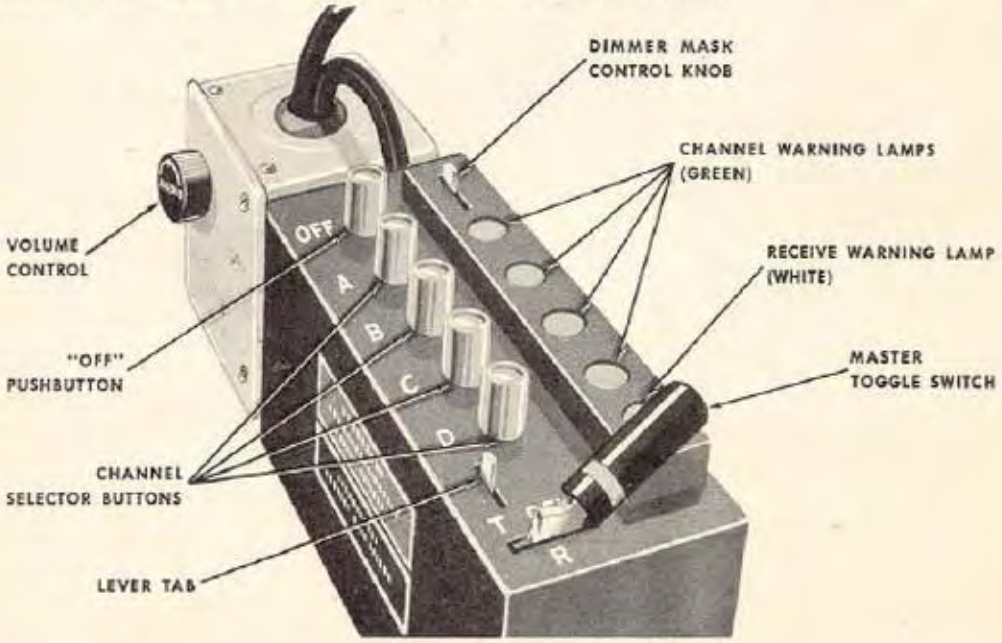
The VHF (very high frequency) is a command set for voice communication only. The range increases with altitude. Mountains or other obstructions in the line of transmission impede or cut out communication completely.

The set's controls are pictured below. The four channels, or frequencies, designated by letters, are tuned by radio men on the ground. To use a channel, push the appropriate button. When down, the adjacent green pilot light glows. Push the OFF button to break contact.

The toggle switch has three positions: T for transmit, R for receive, and REM for remote. Keep the switch in REM. In this position, you transmit by pressing the mike button on the throttle and are tuned to receive at all other times.

If the mike button is defective, transmit by holding the toggle in T and receive by holding it in R or REM. Do not leave the toggle in T or you transmit continuously and jam the channel. If you move the lever tab near the D channel button backward, the toggle stays in T only while you hold it.

The receive warning lamp beside the toggle glows when the set can receive and goes out when you transmit.



1. Plane-to-plane communication on local flights.

2. Communication with controller in your own region.

Think of the number of planes which are using channel A when tempted to chatter. A plane in serious trouble can be shut out by one pilot singing "Mairzy-Doats."

1. Homing.

Use homing if you are lost or desire to return to the field by the shortest possible route.

If possible, maintain a straight path above 5000 feet while making your homing call. If you fail to make contact, try again from a higher altitude. Practice homing frequently. The system provides you with an infallible navigator.

1. Communication with the tower.

2. All cross country flights.

3. Communication with controller outside of your own region.

4. Communication with aircraft of other groups or commands.

This channel is on the frequency employed by all VHF-equipped towers in the country. When talking with the tower, be clear and concise. It's the mark of a good pilot.

1. Plane-to-plane contact between a pilot practicing fighter instrument flying and his safety pilot.

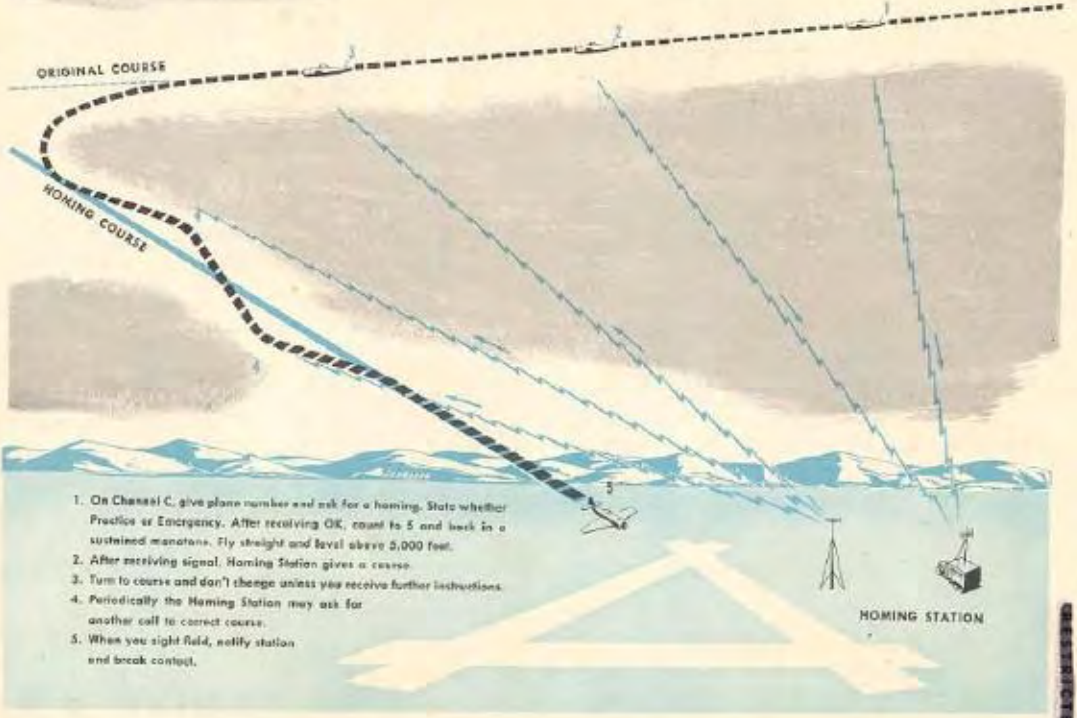
2. Plane-to-ground contact with D/F stations.

The pip-squeak (contactor), used in conjunction with D/F fixing provides controllers and intercepts officers with an accurate minute-by-minute position report of your plane.

The contactor clock consists of a dial and two switches. The needle on the dial makes a com-

USE OF THE FOUR CHANNELS MAY VARY SLIGHTLY AT DIFFERENT STATIONS

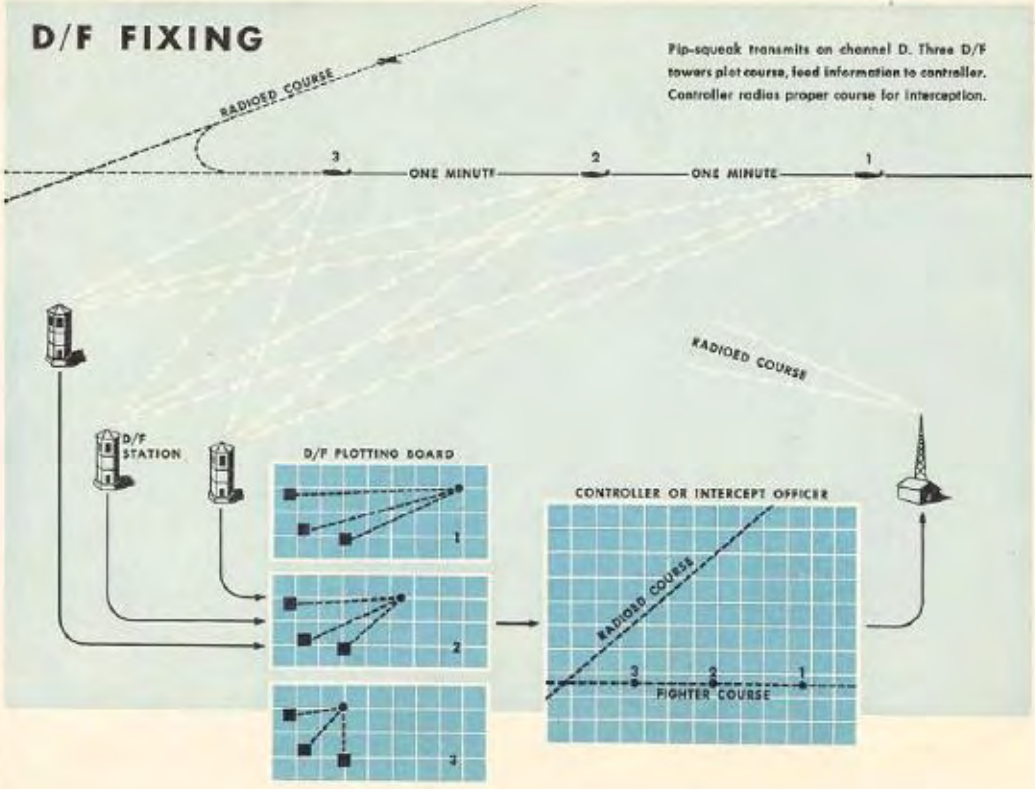
VHF HOMING



1. On Channel C, give plane number and ask for a homing. State whether Practice or Emergency. After receiving OK, count to 5 and key in a sustained monotone. Fly straight and level above 5,000 feet.
2. After receiving signal, Homing Station gives a course.
3. Turn to course and don't change unless you receive further instructions.
4. Periodically the Homing Station may ask for another call to correct course.
5. When you sight field, notify station and break contact.

D/F FIXING

Pip-squeak transmits on channel D. Three D/F towers plot course, feed information to controller. Controller radios proper course for interception.



CONTACTOR CLOCK

plete circuit in one minute. For 13 seconds during each revolution the needle passes through a marked-off space. In this period a continuous tone is transmitted. D/F stations obtain a bearing from the tone. You receive or transmit when the needle is outside the space.

To connect the clock to the VHF set, place the switch IN. Place the clock master switch at RUN. Keep both switches off when the clock is not in use.

The clock is wound by turning the knob marked WIND in a counter-clockwise direction. The radio man ordinarily does this because the winder has no stop and it's easy to ruin the spring.

The contactor has a heater for use in extremely cold weather.

IFF equipment is used to identify your plane to ground radio stations. This equipment is confidential and will be explained by the communications officer.

Detrola

The Detrola, a receiver only, covers a range of 200 Kc to 400 Kc. Most U. S. range stations operate within these limits. Use:

1. To receive signals from radio range stations—for training, navigation, or orientation.
2. To receive transmission from control towers operating between 200-400 Kc. This may be necessary if your VHF is out of order or the tower doesn't contain VHF equipment.

The Detrola is located to the rear of the VHF set. It has its own switch and a tuning knob. To operate, turn ON; and with the tuning knob, move the needle on the face of the dial to the frequency of the radio range or tower you desire to receive. Check the Detrola during each flight by tuning in on some station.

Two types of microphones are used:

1. The **throat mike** worn around the neck.
2. The **oxygen microphone** mounted in the oxygen mask.

Attach the throat mike to the radio set by connecting it to the proper lead on the right side of the cockpit.

Attach the oxygen mask microphone by joining the microphone and headset plug to the receptacle on the lower right side of the cockpit. Depress the push-to-talk button to talk over either mike.

The headset, used with both mikes, consists of receivers placed in cups in the helmet over each ear, joined by connecting wires. When using the throat mike, connect it to the proper lead on the right side of the cockpit.

For use with the oxygen mike, connect the headset to a separate lead attached to the microphone and headset plug.


DETROLA

OXYGEN EQUIPMENT

Clip oxygen hose to shoulder harness, not parachute harness, to afford a quick getaway.

The P-47's oxygen equipment is the demand type. The system includes:

1. The demand type regulator (A-12) on the right side of the cockpit.
2. A panel to the right and below the instrument panel; flow indicator, and oxygen pressure gage.
3. Oxygen lines, check valves, and a filler valve.
4. Four oxygen cylinders (six cylinders from the D-25 on), each containing 720 cubic feet of oxygen when charged to a pressure of 450 psi.
5. Demand type (A-14) mask.
6. Mask hose and regulator hose, joined by a rapid-disconnect assembly.

Read PIF for an explanation of use and care of the demand type system. Here are a few additional tips:

1. Your mask is fitted and tested by the personal equipment officer. At high altitudes, it's as much a part of you as your lungs. Except in an emergency, never lend or borrow a mask.
2. When connecting the mask and the regulator hose, make certain the disconnect assembly is firmly joined. It should require a 10-pound pull to separate. If the hoses are loosely joined, your natural movements may pull them apart. This can be fatal.
3. Fasten the clip on the regulator hose on your shoulder harness. The clip holds up the hose, relieving tension on the connection. Do not fasten it to the parachute harness.
4. The flow indicator, either the blinking eye or bouncing ball, does not tell you how much oxygen is flowing through the system.
5. Do not take off on an altitude mission with the gage reading less than 350 psi. This is an absolute minimum. You should have about 400 psi.
6. There's only one foolproof way to remove a mask briefly at high altitude.

Trim your plane for straight and level flight. Hold your stick between your knees. Unhook the mask on the right side. While pressing the mask tightly against your face, take three or four deep breaths. Hold your breath and drop your head, allowing the mask to fall and dangle from the left side of the helmet.

Do not breathe outside air. When you need another breath, place the mask tightly against your face with one hand, take a few deep breaths and drop again.

Rehook the mask when ready.

NEVER LEND OR BORROW A MASK

Use oxygen from takeoff to landing on any flight scheduled above 10,000 feet unless specifically directed otherwise. Do not perform a high-altitude mission alone.

HYDRAULIC SYSTEM

The main hydraulic system, pressurized by an engine-driven pump, actuates:

Cowl flaps
Landing gear
Wing flaps

There is an emergency hand pump for use if the engine-driven pump fails. If pumping fails to raise the pressure, there's a leak in the system.

A hydraulic pressure gage, mounted on the instrument panel, indicates the pressure when the engine is running. It also registers increases in pressure created by the hand pump.

Proper operation requires a pressure of 1000 psi.

The hydraulic brakes have a separate system. The hand pump is not connected with it. The system has no gage and the only way you can check your pressure is by the action of the brakes.

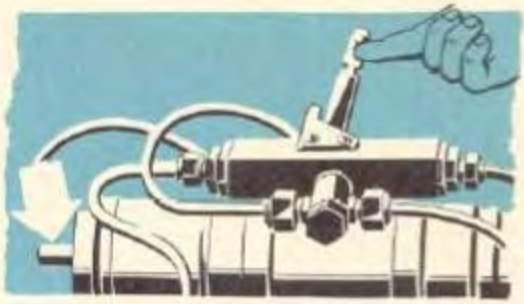
If the pressure is down, you may be able to get a slight increase by pumping the brakes (as in an automobile), but it won't last long. The system is defective.

The landing gear control, on the left side of the cockpit, has three positions: UP, NEUTRAL and DOWN.

To move the lever, depress the button on the end with your thumb, and push down slightly to release the lock before raising. Before you can raise the lever from the DOWN position, you must also move a safety catch.

The wing flaps control, immediately behind the landing gear control, has three positions: UP, NEUTRAL, and DOWN.

The landing gear and flaps control levers are set at an angle of 90° from each other to help you avoid confusing them.



Series prior to the D-10 contain a hydraulic flap equalizer. When the flaps are equalized—that is, when they raise and lower evenly—a plunger on the forward end of the cylinder extends between 5/16 inches and ¾ inches.

To adjust the plunger to this condition, raise the lever on top of the equalizer and hold it in the vertical position for about 10 seconds.

FLIGHT CONTROLS

The flight controls are the conventional stick and rudder pedal type.

The pedals are adjustable. Push out the adjustment locking lever with the foot. Move the pedal to the desired position, then jiggle until the lever snaps back. You can hear the locking pin snap into position. Always adjust the pedals to the same length.

A lever with red knob at the base of the stick locks the stick and rudder pedals when the plane is on the ground. To lock the controls, push the stick forward, hold the pedals even. Pull up the lever until it engages a small hook on the stick. The lever is attached to a rod, which also locks the pedals.

To unlock the controls, push the knob forward and down. It is possible to unlock the stick and leave the rudder pedals still locked.

CONTROL LOCK

That happens if the spring fails to pull the lever all of the way down. Check against this by waggling the controls during your cockpit check.

TRIM TAB CONTROLS

1. Ailerons. Only the left trim tab is adjustable. Turn the wheel clockwise to force the right wing down. Indicator marked L (left), N (neutral), and R (right) shows the position of the tab.

2. Elevator. Rotate the crank or wheel clockwise to force the nose down. The indicator is marked TH (tail heavy), N (neutral) and NH (nose heavy).

3. Rudder. Turn the wheel clockwise to add pressure to right rudder. The indicator is marked L (left), N (neutral), TO (takeoff), and R (right).

Be careful in using the trim tabs. They are extremely sensitive. It is difficult to overcome the tremendous pressures exerted by trim tabs improperly set. Have your plane in proper trim when doing any maneuver.

"TRIM AND RELAX"

BRIEFING

You are briefed before each mission. As in combat, this briefing carries the force of a field order. Your flight leader may talk in a casual, impersonal way, but he is issuing orders. If you disregard his remarks, you place yourself in the position of directly disobeying orders.

Obviously, you can't execute orders you don't understand. While it is the flight leader's responsibility to tell you what you need to know, he is entitled to assume you understand him unless you ask questions.

DO NOT SMOKE IN THE P-47

There is always a fire or explosion hazard because of the likelihood of gas fumes in the cockpit.

ASK QUESTIONS!

YOU MUST UNDERSTAND THE WHO, WHEN, WHERE, WHAT, AND HOW OF EACH MISSION.

WHO:

Number of aircraft, position of each in formation, alternates and deputy leader.

WHEN:

Time of takeoff, rendezvous and landing. Also coordinated operational time.

WHERE:

Runways to use, distances, sectors, alternate airfields available, restricted area, and traffic patterns.

WHAT:

Type of mission, altitudes, course, formations, power settings, radio channels, pertinent regulations, and weather.

HOW:

Acrobatics, changing formations, landing patterns.

Take advantage of the critique period after each mission to learn your mistakes and advance your knowledge.

You are expected to know flying regulations. As you are an officer, ignorance no longer is an excuse. Your PIF sets forth AAF regulations in the sections dealing with air traffic rules, air space reservations and flight hazards, and low flying.

You are exposed to local regulations in the form of circulars and memoranda. It's your duty to see that the exposure takes.

Any deliberate violation of flying regulations calls for a court-martial. A recent letter by General Arnold leaves a local commander no alternative. You may hear criticism of the flying restrictions placed on you during training. These criticisms usually are voiced by one of the few "hot-rock" pilots not yet killed. Each training limitation is the outgrowth of tragically acquired experience. Abide by the rules and you may be certain that any maneuver taught is within the limit of your present capabilities. Try to rush things, and trouble is certain.

During briefing, pay particular attention to weather. You can become lost almost in sight of the airfield if you're ignorant of the winds aloft.

As you gain experience, you begin to comprehend the all-important role weather plays in aviation. In the Southwest Pacific, ignorance of the weather costs more pilots their lives than enemy action. The same is true in other theaters.

MOST P-47 ACCIDENTS ARE CAUSED BY THESE FORMS OF PILOT ERROR

COLLISIONS WHILE TAXIING

LANDING WITH WHEELS UP

RUNNING OUT OF GAS

BECOMING LOST

NOSING UP BY SLAMMING ON BRAKES

PERSONAL EQUIPMENT

ON ALL FLIGHTS, WEAR:

1. Helmet
2. Goggles
3. Gloves
4. Life vest
5. Parachute
6. Oxygen mask
7. First aid and emergency kit
8. One-man life raft (when flying over water)

The mask is worn on all flights to protect your face in case of fire and to accustom you to it. You wear gloves as a fire protection and to prevent skinned knuckles, which are inevitable without them. Use your goggles when needed. Do not wear commercial polaroid glasses. Use only government issue.

(During transition, you do not wear the oxygen mask. You use a throat mike instead of the microphone in the mask.)

PILOT'S PREFLIGHT CHECK

The preflight check starts before you reach your airplane. Survey the proposed taxiing route for any possible future obstruction, such as a fuel truck about to move. Study the ramp area for stray equipment, or rubbish and rags that might be blown into the airscoop or tail assembly by prop blast.

Remember the veteran pilot's apparent casualness in approaching his plane is based on a thorough knowledge of what he is doing.

See that the crew chief is on hand with a fire extinguisher and portable battery cart.

If the plane has been standing for more than 2 hours, instruct the crew chief to pull the prop through four blades. One complete revolution is needed to clear the lower cylinders of oil.

A complete circuit of the plane, starting at the left wingtip, is required to check the P-47.

The sketch shows your route as you check the following items:

1. Pitot tube—Cover removed.
2. Guns—Plugs inserted and blast tubes snug.
3. Wheels—Chocked.
4. Tires—For proper inflation and alignment on wheels.
5. Oleo strut—1⅝ inches to 2¼ inches of oleo visible.
6. Inspection plates—All closed.
7. Cowling—Securely fastened.
8. Propeller—For nicks.
9. Leading edge of wings—For dents.
10. Ailerons—For foreign objects.
11. Radio antenna—For proper tension, and security of fastening.
12. Tail surfaces—For rust, damage, or dirt.
13. Inside of supercharger flight hood—For accumulated oil or dirt.
14. Camera glass—For cracks, scars, or yellowed appearance.
15. Navigation lights—For cracks and cleanliness.
16. Landing light—For cracks and cleanliness.
17. Canopy—For scratches, scars, dirt, and oily film.

The outside bead of the tire tread, under normal loading, should just touch the ground. A line painted from the rim to the tire indicates proper alignment. If the line has parted, strain is being placed on the inner tube valve stem. Write up the lack of a line in Form-1A.

OLEO

Lack of proper oleo extension to cushion a landing places a terrific strain on the tires. A blowout, or a weakened wing structure may result. Any time the oleos are down therefore, instruct the crew chief to pump them up.

Test the antenna by twanging the wire. If it's not tight enough to vibrate, call in the radio man.

FIRE PREVENTION

To inspect the supercharger hood, you must squat and look inside. A film of oil doesn't matter, but wipe up any large drops or small pools. Hot exhaust gases ignite such accumulations every time. Extinguish any such fire by blasting the engine.

See that all three drain holes in the hood are unstopped. The holes prevent oil from collecting.

As a new pilot you may not know whether nicks in the prop, dents in the wing, oil on the plane, or other defects are serious. If you are in doubt, call the engineering officer. You are entitled to be satisfied with the condition of your plane before taking off.

Here's a tip: If a plane is generally dirty, inspect it with utmost care. Such a condition denotes sloppy maintenance.

BATTERY DRAIN JAR

The first pilot of the day has an additional check: The battery drain jar, reached by unfastening cowling on right side of accessories section.

See that the inch-thick pad in the bottom is well saturated with neutralizing fluid—sodium bicarbonate and water. The fluid neutralizes battery acid that burbles up during flight. It must be renewed every four to six flights.

Inspect tubes leading from the battery for kinks or bends. Battery acid causes these tubes to kink easily. See that the opening of the impact tube, protruding from the lower right side of the accessories section, faces to the front. The tube keeps the proper air pressure in the jar.

Unless the drain jar is properly maintained, excess acid creates combustible gases in the battery, or weakens other parts by corrosive action.

COCKPIT CHECK

Enter the P-47 from the left, using the built-in hand and footholds. Don't step on the wing flap.

Settle in the seat and remove Form 1 and Form 1A from the data case. Form 1A is your bible on the plane's condition. If the form bears a red cross, do not fly the plane. If you don't

HOW TO AVOID THE WING FLAP

know what a red diagonal or red dash means, get the crew chief or engineering officer to explain. Nobody has been killed yet for asking questions.

Before signing an exceptional release, know what you are signing.

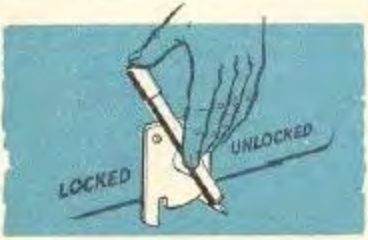
Unless the preflight box has been initialed, don't start the engine. The plane hasn't been preflighted.

The servicing section shows the quantity of fuel aboard. Here is where you get the accurate information.

The "Remarks: Pilots and Mechanics" section contains the comments of the preceding pilot. Note what he says, and when in turn you make an entry, be clear and concise. If necessary, elaborate on the trouble when talking with the crew chief, but do not omit any important point from the Form 1A.

When returning the forms, examine the case for the following publications:

Maps of the local flying area
Radio Facilities Charts
Instrument Let-down Procedures
T. O. 01-65-BC-1.



HARNESS LOCK

Fasten your safety belt and shoulder harness. Tighten the harness straps sufficiently to keep them on your shoulders during normal movements. A lever on the left side of the seat enables you to lock and unlock the harness. Lock the harness for the takeoff.

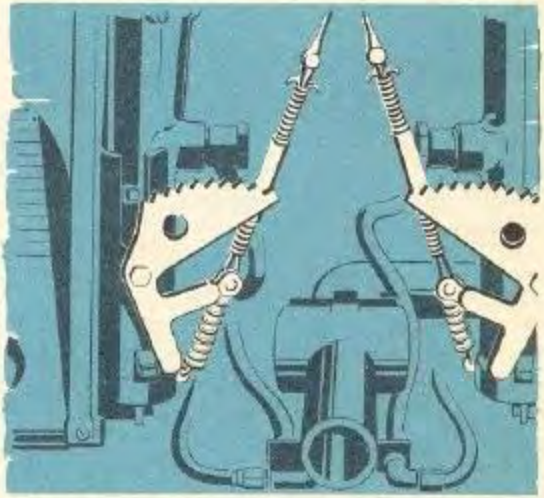
Adjust the seat, with the lever on the right side, to maximum height for taxiing. When ready to take off, readjust as desired.

Regulate the rudder pedals for comfort.

Unlock the controls. Waggle for freedom of movement.

Arrange the mirror for rear view.

Lock the brakes by pulling out the parking brake handle (on the lower center edge of the instrument panel) and depressing the toe tread of each rudder pedal. Check the ratchet on the inside of each pedal to determine the extent that each brake has been engaged.



BRAKES UNLOCKED

To release the brake, further depress the toe treads, disengaging the ratchet.

MAKE THE COCKPIT CHECK FROM LEFT TO RIGHT, PERFORMING IT IN THE SAME MANNER EACH TIME UNTIL IT BECOMES SECOND NATURE.

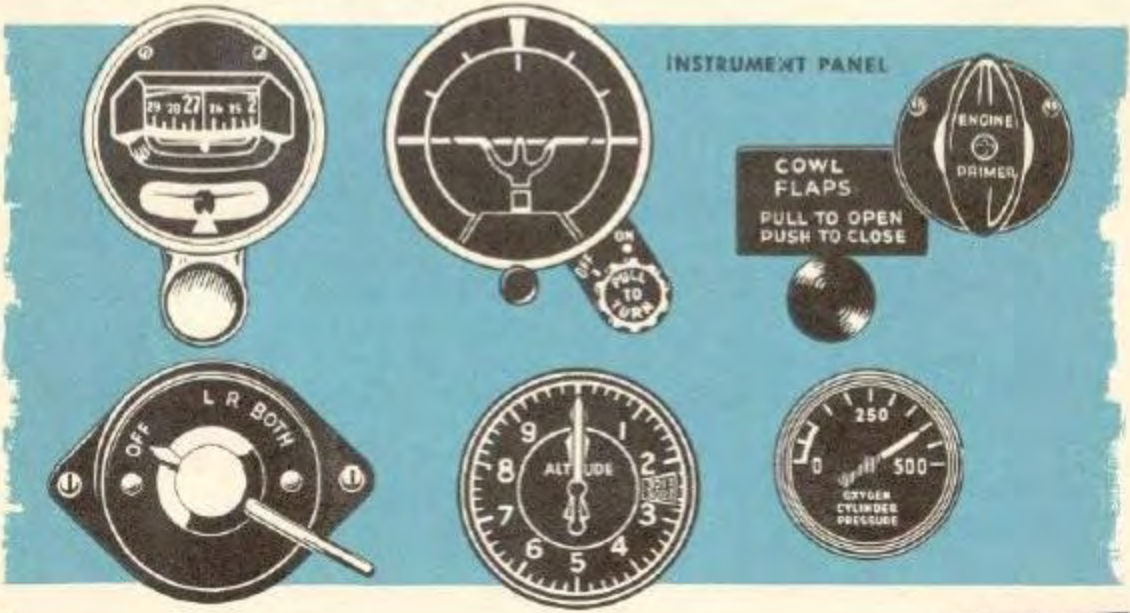
COCKPIT — LEFT SIDE

Check:

EQUIPMENT		PROPER SETTING
TRIM TAB CONTROLS	AILERONS	N *(neutral)*
	RUDDER	TO *(takeoff)*
	ELEVATOR	N *(neutral)*
FLAP CONTROL HANDLE		UP *(full forward)*

EQUIPMENT	PROPER SETTING
LANDING GEAR CONTROL HANDLE	DOWN *(with safety latch in place)*
INTERCOOLER SHUTTERS	*OPEN
OIL COOLER SHUTTERS	*OPEN
GUN SWITCH	OFF *(safety hood up)*
FUEL SELECTOR VALVE	MAIN
THROTTLE QUADRANT	
SUPERCHARGER CONTROL	OFF *(full rear)*
THROTTLE	*Cracked 1" to 1½"*
PROPELLER CONTROL	INCREASE RPM *(full forward)*
MIXTURE CONTROL	IDLE CUTOFF *(full rear)*
SWITCH PANEL	
GENERATOR SWITCH	ON
PROPELLER SELECTOR SWITCH	AUTO *(constant speed)*
FUEL BOOSTER PUMP	START & ALTITUDE
ALL OTHER SWITCHES & RHEOSTATS	OFF
ALL CIRCUIT BREAKER BUTTONS	*All the way in*

(*See Extreme Weather Operation section.)



EQUIPMENT	PROPER SETTING

INSTRUMENT PANEL

IGNITION SWITCH.....**OFF**

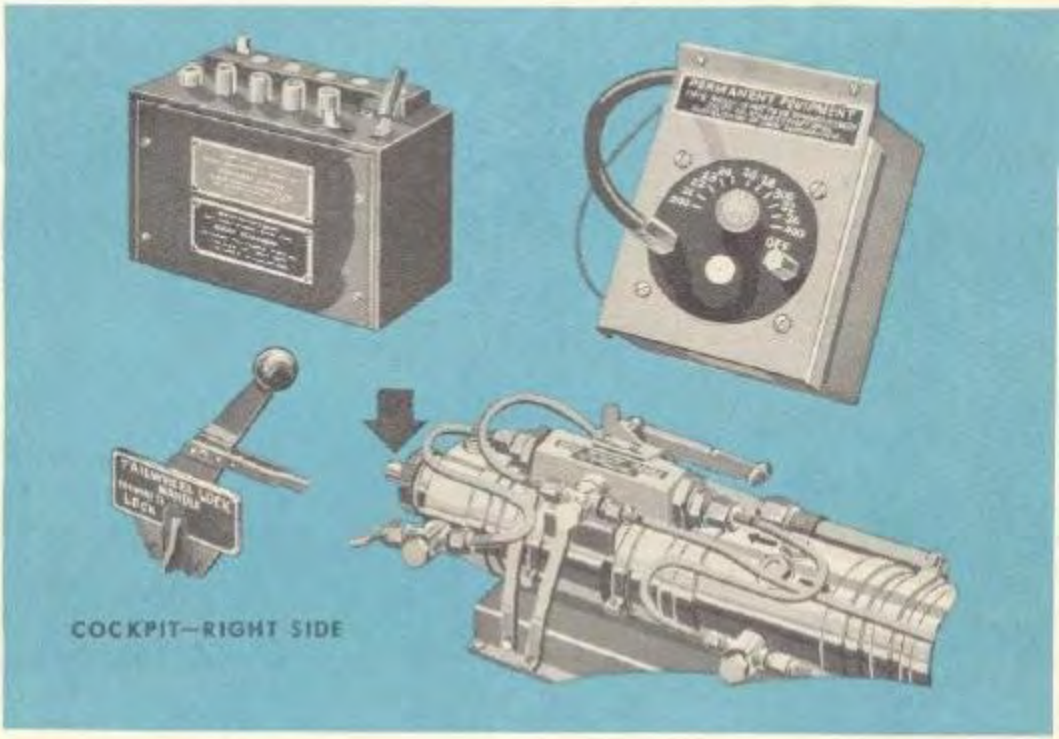
GYRO INSTRUMENTS.....*Uncaged*

ALTIMETER.....*O for local flights, field elevation for cross country*

OXYGEN PRESSURE GAGE.....*At least 350 lbs. (for high altitude mission)*

COWL FLAPS.....**OPEN**

PRIMER.....*Closed and locked*



RADIOS.....**OFF**

TAILWHEEL.....*Unlocked*

FLAP EQUALIZER (WHERE INSTALLED)....**Cylinder plunger exposed 5/16" to 3/4"*

(*If not within limits, equalize after engine starts.)

A cockpit check isn't an ironclad guarantee that everything is O.K. Use your eyes, ears and nose to detect any unusual condition. Don't fly a plane with hydraulic fluid on the floor, a sure indication of a leak. Don't take off with gas fumes, or raw gasoline, in the cockpit. This is a fire or explosion hazard. While inspecting the cockpit, examine the fume boot at the base of the stick. A tear permits toxic gases to enter.

If gasoline fumes are detected in flight, turn the AUTO-MIX lever of the oxygen system to OFF (to give yourself pure oxygen uncontaminated by the fumes) and open the cockpit ventilator. Do not open the canopy, or you may draw raw gasoline into the cockpit, thus creating an extremely hazardous condition. Return to the field immediately.

Check the landing gear warning light by turning the switch on the switch panel ON. If the light doesn't glow, ask the crew chief to investigate. You need the light to tell when your gear is operating satisfactorily. Turn the ventilating tube toward the floor so air won't blow in your face during the takeoff. Check the position of the push-pull controls of the ventilator and defroster for desired cockpit temperature.

STARTING

To start the engine:

Shout "Clear."

Get acknowledgement. The crew chief may be adjusting a chock, or he may have wandered off, leaving you no fire protection.

Turn ignition switch to BOTH.

Prime 2 to 4 strokes. Lock the primer carefully, turning it all the way to the right. A partially locked primer shoots a steady stream of raw gas into the fuel system. This causes an

excessively rich mixture during takeoff, resulting in heavy smoke and an occasional fire. The crew chief usually can give you sound advice on the number of strokes an engine requires. Don't overprime. But if you should, have the prop pulled through three or four blades. It helps rid the engine of excess gasoline.

TIME THE PROCESS

Energize by holding the toggle switch to the left position for at least 15 seconds; never more than 20 seconds. Time the operation by the clock's sweep second hand.

Again shout: "Clear!"

Move the toggle switch to the right to engage the engine. The instant the engine fires, move the mixture control to AUTO RICH.

Keep the toggle switch in ENGAGE for a few seconds after the engine fires. This provides a hotter spark and is a starting aid.

If the engine quits, return the mixture control to IDLE CUT-OFF without delay. Raw fuel pouring into the engine, unless it's firing, creates a serious fire hazard. However, if the engine is taking hold but fire is noticed, persist in starting. Once the engine is running, it will blow out the flames.

KEEP ENGINE RUNNING

Don't hold in ENGAGE after it's obvious the engine won't start. To do so drains the battery. Let the fly wheel run all the way down, then ENERGIZE again.

After the engine takes hold, adjust the throttle for 800 to 1000 rpm.

Turn on the main line battery switch as soon as the engine catches and signal the crew chief to unplug the power unit.

IF THE OIL PRESSURE DOESN'T COME UP WITHIN 30 SECONDS, STOP THE ENGINE AT ONCE.

Lack of pressure can destroy an engine in an incredibly short time. (On a cold engine, the oil pressure climbs quickly to 200 psi.) Keep the engine below 1000 rpm until the oil temperature is above 40 degrees C, and until the oil pressure is below 100 psi. Ordinarily you require a warmup period of about 3 minutes.

Before leaving the line, check the engine instruments for desired readings. (See Engine Instruments Section.)

Turn on your radio and get taxi instructions from the tower.

Signal the crew chief to remove the chocks.

TAXIING

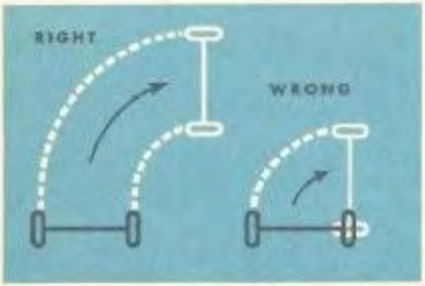
After releasing your brakes, test them while moving slowly forward. On the P-47, the brakes are your chief means of steering. Depress both pedals to check for pressure and for leaks around the packing gland nut at the base of each master cylinder. If there's bubbling, do not move the plane any farther. Otherwise you stand a chance of losing your fluid, with subsequent brake failure.

If your P-47 is parked in a congested area, as it is likely to be, don't start rolling until a man is stationed at each wingtip. The wing walkers must stay with you until you are 100 feet from the parking area.

The crew chief guides you out of the congested area, using the universal taxiing signals, as set forth in PIF. But keep your eyes moving; the crew chief is merely an aid. You are the commander of the airplane and are responsible for any collisions.

Know what's behind you before opening the throttle to start rolling. Nobody appreciates being caught in prop blast, particularly superior officers, and it's awfully easy to blow stones or debris into other equipment. You can avoid this by a little thoughtfulness.

Always acquire forward motion before turning. If you turn on a dime, with one wheel



A FLIGHT TAXIING PROPERLY

locked, you're certain to damage a tire.

You're likely to find the brakes touchy, that is, you get a sudden reaction to slight pressure if your plane has been standing idle for some time with the parking brakes set. Use caution for 100 yards or so, and the brakes will return to normal.

While taxiing, use only one brake at a time, applying pressure with a gentle pumping motion. You invite trouble by using both brakes simultaneously.

Use between 800 and 900 rpm. This keeps your speed down sufficiently to avoid having to jam on the brakes, and enables you to stop almost in place.

Taxi as slowly as you like in the P-47. Simply run up the rpm every few minutes to keep the engine from loading up.

Keep far enough behind the plane ahead to avoid the necessity of slamming on the brakes. S in the opposite direction from that plane.

DON'T BLAST OUT

This keeps it on your open side. If you ever lose the plane, or there is doubt in your mind as to its exact position, stop. Cut off the engine and get out and look, if necessary.

Judge the location of your wheels on the taxiing strip by referring to the inboard guns. The guns are approximately over the wheels. If you run off the strip, and 1000 rpm won't move your plane, don't try to blast clear. You probably couldn't control the plane after it broke out. Cut your throttle and call for a tug.

If it requires continuous pumping to get brake action, return to the ramp. Call a tug if you get no pressure on either or both brakes. Something is wrong with the hydraulic system, a leak, low fluid supply, or air in the line.

The P-47's brakes are of the shoe type. They must hold a lot of weight. If they're abused, the surfaces of the lining and drum become glazed and ineffective. Write up the slightest brake trouble in Form 1A.

The P-47 handles easily on the ground because of its weight, widespread wheels, and centrally located CG. But it is a **blind** airplane. To see ahead you must S. Don't make the mistake of allowing your eyes to follow the course of your plane while S-ing. Look into the area opened up.

Keep both wheels rolling at all times.

Keep your head and eyes out of the cockpit and constantly roving.

Do not taxi with the flaps extended.

If you slam on the brakes, you nose up, even if you are taxiing no faster than a man walks.

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TAKEOFF

Last Minute Checks

When lining up for the takeoff check, park so that your prop blast won't affect other planes. Head upwind to keep dust from blowing back into your engine. This also helps keep the engine cool.

Depress the brakes. Run up the engine to 2000 rpm. If brakes won't hold, return to the line, by tow if they're extremely weak.

Check the ammeter. Any rise shows the generator is charging.

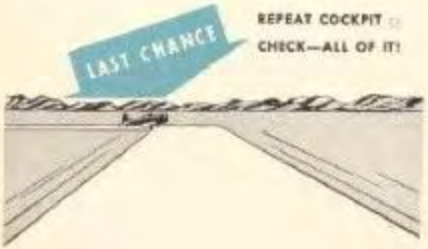
With the prop control handle full forward and the prop selector switch in AUTOMATIC, check the mags. The drop on each mag must be less than 100 rpm. (Normal drop is about 60 rpm.) If the drop is abnormally high, but the engine is not running rough, continue the run-up a minute or so and try again. The mags may check O K after you clear the engine. If you still get an excessive drop, return to the line.

Pull back the prop control handle until you get a drop of 200 rpm. Leave for a moment to insure that the tachometer does not oscillate more than 100 rpm. Return the handle full forward. If the prop check is unsatisfactory, return to the line.

On planes with a hydromatic instead of an electric propeller, the checks are identical.

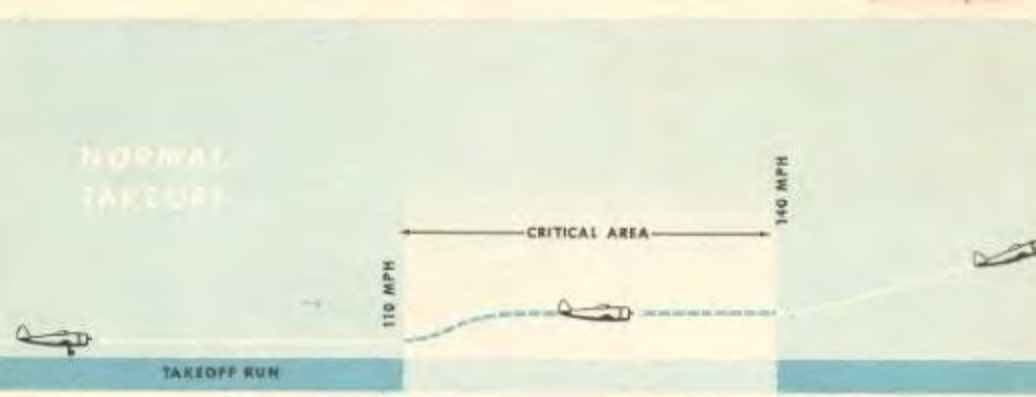
Repeat the cockpit check. Be sure that the fuel selector is on MAIN and that the plane is properly trimmed. If the trim tabs are improperly set you have difficulty controlling the plane.

Call the tower for final clearance. If the radio is out, don't take off.



In a word, check:

1. Brakes
2. Ammeter
3. Mags
4. Prop
5. Cockpit
6. Radio



NORMAL TAKEOFF

Make certain the runway is clear, then line up in the center. Close the canopy (open with bubble), lock the tailwheel, and raise the safety catch on the landing gear lever so you won't have to duck your head in the cockpit during the takeoff run. Half close the cowl flaps, then apply power smoothly.

PENALTY PAID FOR DETONATION

The P-47 requires a longer run than you are used to. You may be tempted to exceed the red line to work up speed. Don't do it! Your plane gets off the ground OK using prescribed power limits—thousands do every day. When you draw too much power, you risk detonation and engine failure.

The P-47 flies off the ground from a 3-point position at about 100 mph. However, raise the tail about 6 inches. Stay on the ground until reaching a speed of around 110 mph. Then lift the plane off the runway. The raised tail and added speed give you much better rudder control in case of trouble.

Use rudder, not brake, to correct for torque on takeoff. It's brutal on the tires to use brakes.

Develop climbing speed before starting to climb. Be easy on the back pressure until you have at least 140 mph, then climb gently. The plane is sluggish before reaching its best climbing speed 155-160 mph.

If not pushed, the P-47 picks up climbing speed quickly. You reach altitude more rapidly by getting climbing speed first than by having your plane labor in a climbing attitude without sufficient speed.

When definitely airborne, touch the brakes to stop the spinning wheels, and raise the landing gear lever. The landing gear warning light goes on and burns until the gear is up and locked.

Except in an emergency, once you have started the wheels up or down let them go all

the way before reversing the action. Changing the direction while the wheels are in motion destroys the timing and crushes the wheelwell doors.

If the landing light doesn't go out, something is wrong. Occasionally the switch (on top of the main switch box) operated by the throttle cable, sticks. Flick it back and see if the light goes out. If that's not the trouble, work the hand pump until it's solid.

If the light stays on, ask the tower, or another member of your flight, whether your wheels are up. If they are, continue your mission, but have the tower check for wheels in down position before landing.

The hydraulic pressure gage, which shows 1000 psi, with the engine running, drops 100 to 200 psi while the wheels or flaps are in motion. Once they are in place, the gage returns to 1000 psi.

After setting your power for climb, close the cowl flaps. Regulate the cowl flaps thereafter to keep the cylinder-head temperature normal.

Always S while climbing, or letting down. Any time you fly into the altitude of another plane, particularly a fast fighter, without scanning the sky, you run the risk of a collision. In any event, you need the training for combat, where you must keep watch for hostile aircraft.

EMERGENCIES

Runaway Prop

If there's enough runway ahead, stop the takeoff. But if you are too far committed, continue the takeoff. Once airborne, place the prop selector switch in MANUAL and regulate for the correct rpm. Circle the field and make a normal landing. There is no reason to get rattled. **Regard flying in MANUAL as merely a different procedure. It's not an emergency unless you make it one.**

Blown-out Tire

Fight to keep the plane straight on the runway. Cut the switches if there is any possibility of nosing up or leaving the runway.

Engine Trouble

If the engine misses, backfires, detonates or gives any evidence of supplying less than full power before the wheels are off the ground, cut the switches and return the mixture control to IDLE CUT-OFF. Apply the brakes by pumping. Hold the plane straight on the runway. In case you are running out of field, but your speed has been reduced to 70 mph or less, unlock the tailwheel, and attempt a groundloop by holding one brake. However, if your speed is too great, collapse the landing gear and skid to a stop. This is preferable to nosing over or a collision.

In case you are already airborne, retract the wheels and land straight ahead. Keep up your airspeed to 110-130 mph. Don't stretch your glide. Lower the flaps and cut all switches before landing. Don't try to turn. To do so is fatal.

LANDING

Landing Checks

On entering the landing pattern, contact the tower for instructions. Use the correct pattern, and obey the tower unless you are in trouble. In this case you are the boss.

PROCEDURE:

Switch to the fullest interior tank (do not use an external gas tank).

Reduce airspeed to 150-200 mph.

Landing gear lever DOWN. When the gear starts down, the warning light burns until wheels are down and locked. While the gear is in motion, hydraulic pressure falls off sharply.

but returns to 1000 psi, when the operation is complete. As a further check, work the hydraulic hand pump until it is solid.

Check the tailwheel lock.

Check flap equalizer rod for proper extension —5/16 inch to ⅜ inch. (When installed.)

See that mixture control is in AUTO RICH.

Advance propeller to 2550 rpm at 30" Hg.

Close cowl flaps.

If your plane has a bubble canopy, open it.

Keep your head out of the cockpit, and keep your eyes moving except for the brief glances required to complete checks.

KEEP YOUR EYES MOVING WHEN LANDING

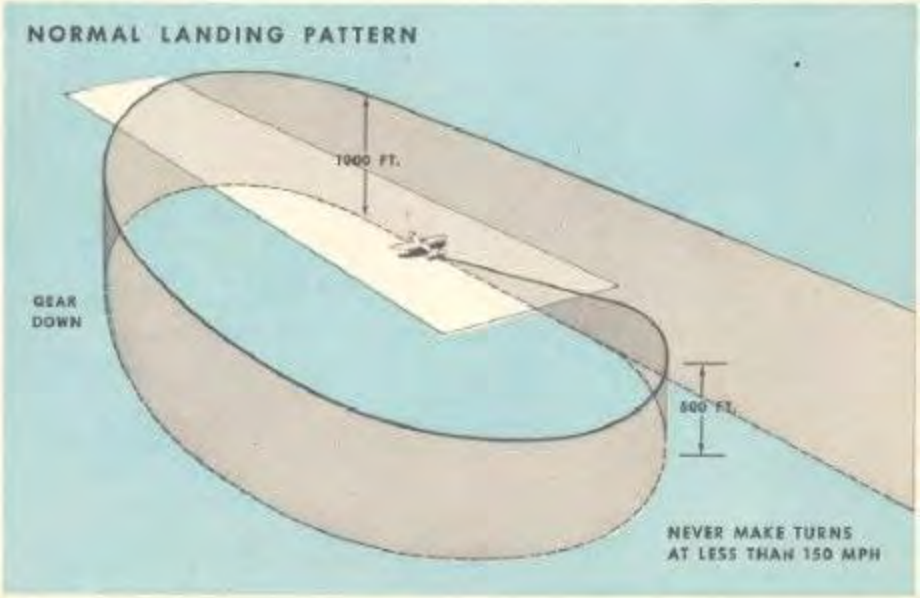
NORMAL LANDING

Fly your landing pattern at 150-200 mph. **Never make turns below 150 mph.** Keep your base leg in close, and stay above 1000 feet. Complete the roll-out for the final approach at 500 feet, or more, with an airspeed of 125-135 mph. Keep the nose down when landing a P-47 until you start to break your glide.

Do not advance your throttle while actually in a turn. It makes the turn too steep. If you need additional power, apply throttle before turning or after the turn has been completed.

Avoid a long, flat approach with power. Such approaches are dangerous in case of power failure, and result in poor landings.

Start the flaps down about halfway around the final turn. The P-47 is designed to land with full flaps. However, you may lock the flaps in any intermediate position by returning the flap control to NEUTRAL. Check the flaps visually for extension, if the plane has an equalizer.



When you throttle back to start your glide, either keep your engine turning over at 1000 rpm or clear out at least once. This keeps the engine from quitting if you need sudden power.

Try for a 3-point landing in the center of the runway. Land in the first 1000 feet. Do not level off too high. The P-47 has no tendency to drop a wing when stalled out, but it settles fast when the speed drops below 110 mph. If you level off too high, add a little power and settle slowly.

There is no harm in a wheels landing, although a longer landing roll results.

As soon as the plane is in a 3-point position, apply gradual brake pressure. This slows the plane and informs you of the condition of your brakes early in the landing.

A crosswind landing in the P-47 is not difficult. Apply the methods learned in flying school. It's easy to get your plane lined up with the center of the runway and to keep it there.

After landing, open the cowl flaps, raise the flaps (not to be confused with the landing gear), and when the plane is under control unlock the tailwheel for taxiing.

Clear the runway quickly, but if you have made a short landing, don't swing into an intermediate taxi strip unless you have received permission from the tower. Go to the end of the runway before turning off.

While preoccupied with landing or taxiing, don't go deaf. Remain conscious of your radio. The tower, at any moment, might have an urgent message for you.

Open the canopy, and keep your eyes moving while returning to the parking area.

When parked, hold the brakes, run the engine up to 1000 rpm, move the mixture control to IDLE CUT-OFF and ease the throttle forward. Turn off the ignition and main line battery switches. Shout, "Switch Off."

Turn the fuel selector cock to OFF.

Run through the cockpit check to determine that the plane is set for the next flight.

In windy weather lock the controls.

Don't set the brakes; have the crew chief chock the wheels. The brakes may stick if they're set while hot.

Fill out Form 1, calculating your flying time as the period when you were actually off the ground. Compute your takeoff and landing times to the nearest 5 minutes.

A Pilot's Golden Rule

When filling out Form 1A, note all defects you observed. Don't undertake to judge whether any defect is important. The crew chief and engineering officer are on the field for that purpose.

LANDING EMERGENCIES

Bad landings in a P-47 almost always are man-made. If you're not sure your approach is 100% correct, or that your gear is down and locked, go around. Give yourself a chance to work out your problem, or to discuss matters with mobile control or the tower.

WHEN GOING AROUND—APPLY POWER SMOOTHLY TO AVOID EXCESSIVE TORQUE

When going around, apply power smoothly, remembering that the torque caused by a sudden surge of power causes your left wing to drop. Always be ready to apply the necessary right rudder.

After opening the throttle, raise your wheels. Don't forget you must spring the safety latch before the landing gear lever will come up.

Acquire a safe airspeed before starting to raise the flaps. Milk the flaps up slowly by shifting the control from NEUTRAL to the UP position, leaving in the UP position for approximately 1 second during each operation. If you spill the flaps suddenly, the plane will stall out.

Equalizer

On P-47's with a flap equalizer, you may encounter a situation you won't find on any other airplane—that is, flaps coming down unevenly. If, while you are lowering your flaps, your plane starts to roll, your flaps aren't equalized.

To meet the situation: Immediately move the flap control handle to the LOCK position, climb to a safe altitude, and milk the flaps up. Equalize the flaps, make another approach, lower the flaps and land.

Or: Continue with your landing, holding the equalizer handle vertical, attempting to get both flaps down evenly. There is no risk in landing with one flap fully extended and the other not at all, provided you compensate with rudder and stick. Be careful to keep your plane straight, or you strike the ground in a crabbing position, with consequent damage to the gear.

When you start your flaps down, be ready to anticipate your plane's roll if the flaps aren't equalized.

Hydraulic Failure

If your wheels won't come down, don't try to pump them down with the hydraulic hand pump. It isn't necessary, and you need the remaining hydraulic pressure for your flaps.

ROCK GEAR DOWN

Place the landing gear lever in the DOWN position, rock your plane and execute turns, dives, and pull-outs until your wheels are down. Fly over the field and ask the tower for a check.

LANDING GEAR NEUTRAL

Before pumping the flaps down, place the landing gear control lever in NEUTRAL. If you don't, you dissipate the remaining hydraulic pressure throughout the landing gear system.

After your flaps are down, return the flap handle to NEUTRAL. Move the landing gear

lever to the DOWN position. Work the hand pump in an effort to raise the pressure.

The tailwheel has no mechanical lock. Any hydraulic pressure you create reduces the chances of a collapse of the tailwheel.

After landing, don't turn or taxi. Call a crew to examine the gear. Taxiing may cause the gear to fold.

FORCED LANDING

If you are threatened with, or experience, loss of power, decide quickly whether to fly the plane down or bail out.

To get maximum glide, with no power, place your propeller in the full decrease rpm position. This presents the edge of the blade forward, reducing drag in the same manner that feathering a prop does on a multi-engine plane.

Unless you are on the way to a field of your choosing, with a definite plan of action in mind, bail out when you get as low as 3000 feet. Once you have decided on a course, stick to it, unless a new emergency, such as fire, causes you to reach a new decision.

For trouble developing below 4000 feet, make one quick check—if a solution isn't available instantly, bail out.

Make a forced landing with wheels up, unless you have first-hand knowledge that the terrain is suitable for a landing with gear down.

The plane has a built-in skid for belly landings. You are safer with your wheels up and nine times out of ten the damage is less.

3 RULES FOR ANY FORCED LANDING

1. DON'T STALL
2. DON'T EVER STALL
3. DON'T NEVER EVER STALL*

* Ungrammatical, but still true.

When making a forced landing, keep your speed up even though the terrain is rough or wooded. A P-47, which is built like a bulldozer, will plough right through. If your safety harness is locked you'll be all right. Stall out above the ground and you'll have 13,500 pounds falling on you.

Land with full flaps. The increased diving angle enables you to see what's ahead. Open or jettison the canopy, remembering to keep your head down to avoid being hit. Lower your seat and duck your head in the cockpit before hitting the ground. Once your plane has come to a full stop, get out as quickly as possible.

Gas Tanks

If an engine sputters or quits, change gas tanks! Make this your first action.

TRANSITION

The P-47 handles much like the AT-6. Some fighters are aileron planes. Others are handled mainly by the rudder. But the P-47, like a trainer, requires coordination of the two controls to keep the ball centered.

Don't let the Thunderbolt's size give you the notion that it possesses any mysterious qualities. Once the wheels and flaps are up, the size and weight are not noticeable.

You'll be given prescribed missions for your transition. Don't short-change yourself by skimping any assignment. You must master the fundamentals before you can fly with your head out of the cockpit, or in other words, before you can call yourself a fighter pilot.

While performing the mild zooms and dives, Lazy 8's and level flight at varied power settings which make up the exercises, study your engine, airspeeds and the way the plane trims and handles.

Stalls

Try a few partial stalls to identify the approach of a stall, recovering when the plane starts to shudder. Perform the maneuver with power on and off, with wheels and flaps up, wheels down, and finally with wheels and flaps down. Execute the series in turns to the right and left.

High-Speed Stalls

The approach to a high-speed stall is the same as a normal stall; the plane shudders. Such stalls are brought about most commonly by trying to make a turn too tight.

At high altitudes, high speed stalls result from using too much back pressure to recover from a dive. Light stick pressure has little effect and there is a tendency to overcontrol, resulting in a change of the angle of attack sufficient to break down the airflow.

(See: Compressibility Section.)

Spins

Never spin a P-47 intentionally. There's no percentage in putting a needless strain on your plane.

Recovery from an accidental spin is relatively simple. By following the normal spin recovery procedure, you should come out within ½ turn. If you don't, apply additional throttle. Don't experiment with different control positions until you have made three turns with no change in spinning attitude.

You lose approximately 1000 feet a turn with wheels up, 3000 feet with wheels down. So you can see why it's important to keep at least 8000 feet altitude during acrobatics.

SPIN RECOVERIES

NORMAL SPIN

Full opposite rudder
Slight back pressure on stick
Aileron against spin
Throttle if needed

FLAT SPIN

Opposite rudder
Throttle
Aileron in direction of spin

FLAT INVERTED SPIN

Apply hard aileron pressure in direction you appear to be turning
Slight back pressure on stick

While flying the D-25 and subsequent series, it is particularly important to maintain a slight back stick pressure during spin recovery. On these late planes, if the stick is permitted to get forward of neutral the plane may go into a flat spin.

A flat inverted spin is a thing to avoid. Fortunately, there is only one way to get the P-47 into this condition. That is by exaggerated use of the ailerons while the plane is stalling on its back. This speed is anything less than 120 mph IAS on models prior to the D-25, and 135 mph IAS for the later series.

Note that the recovery is different from the procedure used for most airplanes, which calls for hard back pressure on the stick, and hard opposite rudder. This won't work on the P-47, because you can't push the rudder.

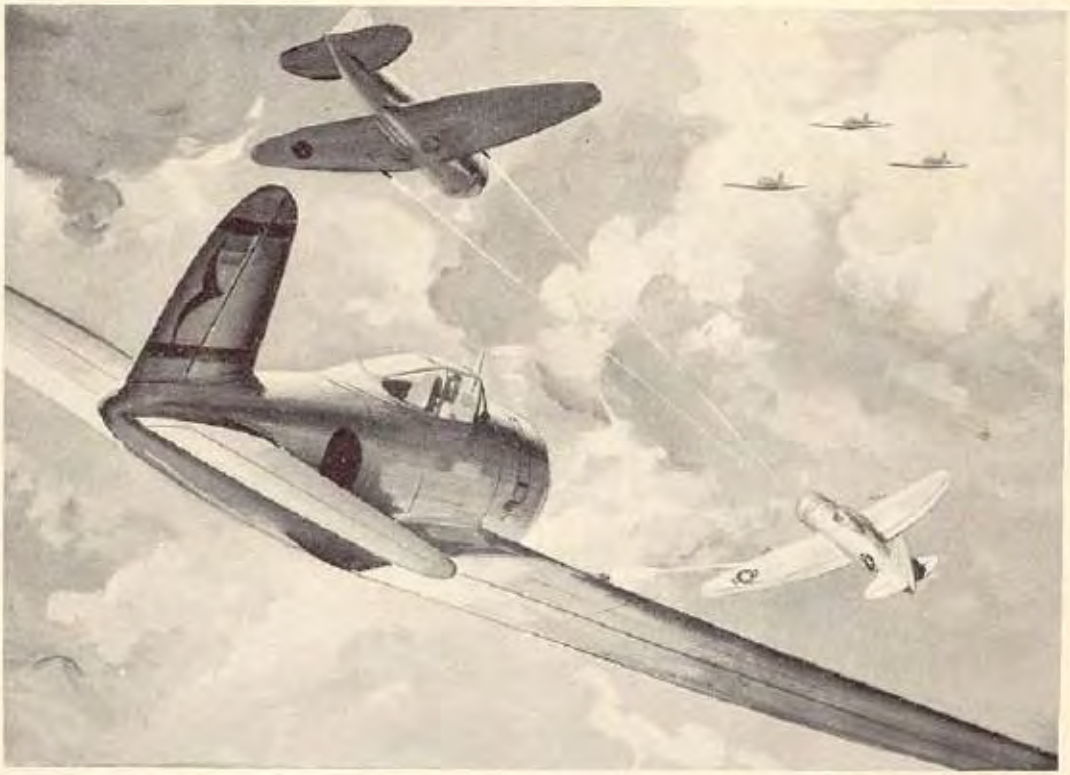
If your P-47 gets into an inverted spin, you are in for a hard, violent tussle.

Hold onto that stick. If it should be jerked from your hand before you are aware of the situation, it will move around the cockpit. If you can't catch it any other way, wrap your legs around it.

Keep your feet on the rudder pedals to eliminate as much oscillation as you can.

Do not attempt recovery from either a flat spin or a flat inverted spin if the condition is encountered below 10,000 feet. Bail out.

Remember this: **ANYTIME YOUR AIRPLANE GOES OUT OF CONTROL OR IS STILL OUT OF CONTROL BELOW 4,000 FEET: JUMP**



STAY IN FORMATION—OR ELSE

FORMATION FLYING

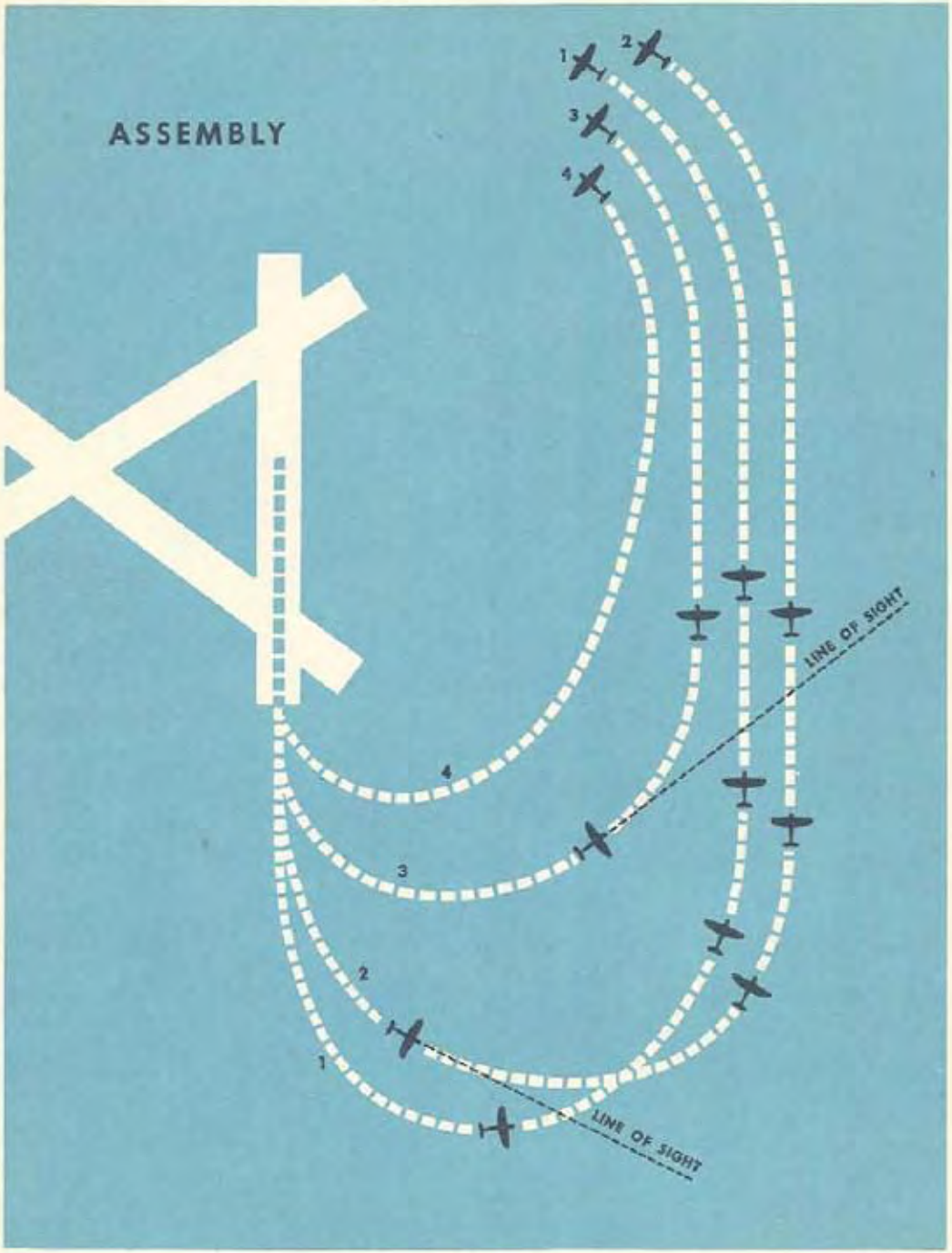
Formation flying is hard work for a beginner, but the reward is great. If you learn to stay in formation, you become a member of a hard-hitting, invincible team. If you don't, some day you'll find yourself a sitting duck.

Keep radio chatter to a minimum. Use the standard visual signals (described in PIF) whenever possible. The signals are universal. By practicing them you are preparing yourself for the radio silence imposed by combat. Signals must be repeated by all planes in a flight, including the last plane.

Never leave formation without notifying your leader, unless you can't contact him by radio or signal when experiencing trouble or when you must draw excessive manifold pressure to maintain position. In this case, return to the field and land. But don't return alone unless absolutely necessary.

Your flight leader assists you in every way possible. If you're having engine trouble, in order to advise you, he must know your cylinder-head and oil temperatures; manifold, oil, and fuel pressures, and the tachometer readings.

The P-47 tends to keep going after you retard the throttle, and picks up slowly after you open the throttle. Watch for these characteristics at first in formation flying. You soon grow accustomed to them.


ASSEMBLY
1
2
3
4
LINE OF SIGHT
4
3
2
1
LINE OF SIGHT

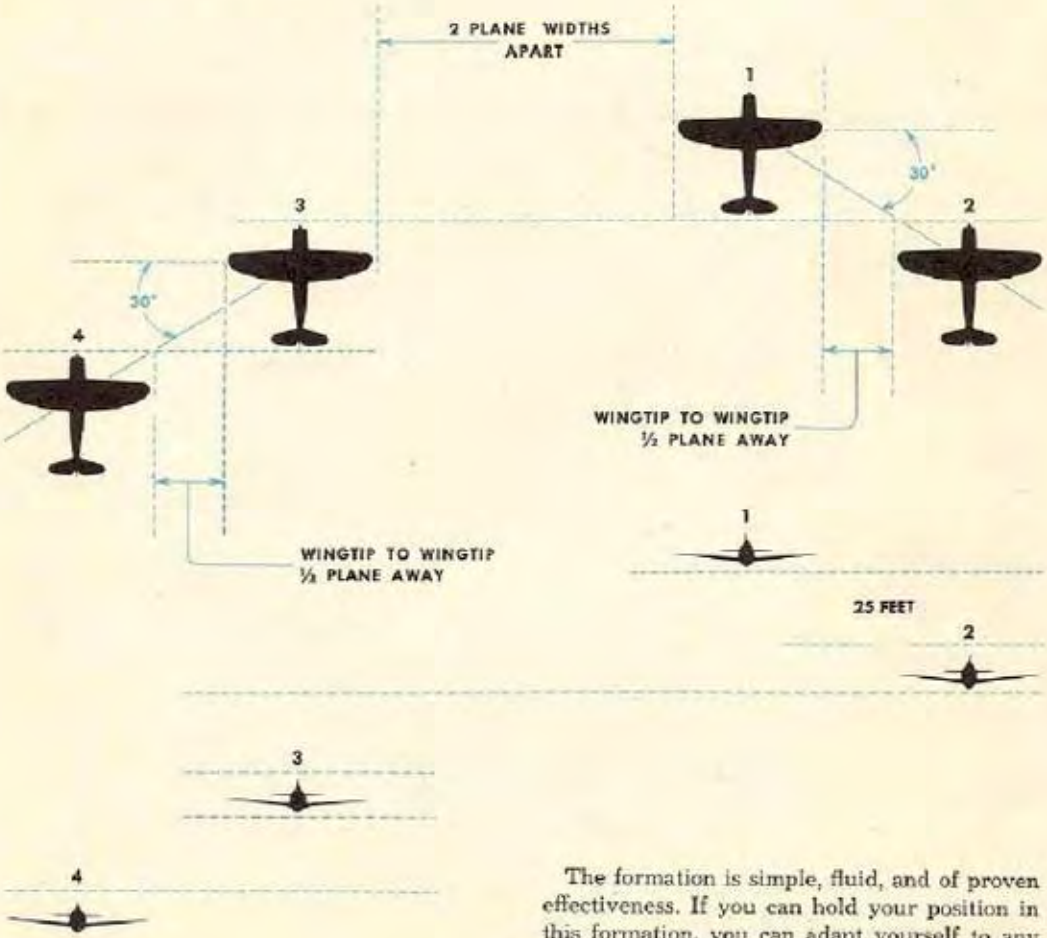
ASSEMBLY

Be ready to take off the instant the plane ahead becomes airborne. Take one last look to insure that no plane is coming in for a landing, taxi on to the runway, lock the tailwheel, and take off.

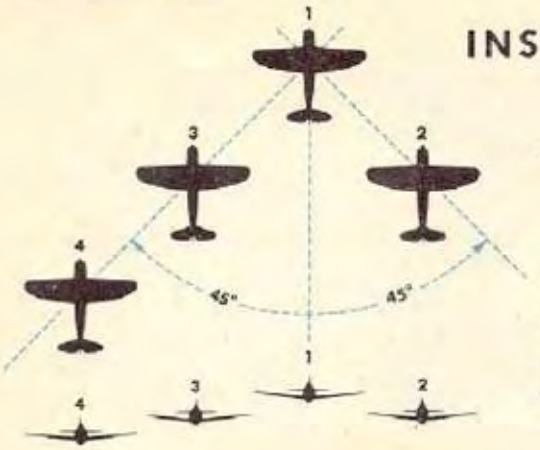
Note how each plane cuts inside to save distance. Observe also how the gunsight may be used to get the proper lead on the plane ahead.

If you fly in the path of your leader, you can't catch up without using excessive power. When you are flying correctly, normal power settings get you into position quickest.

BASIC COMBAT



The formation is simple, fluid, and of proven effectiveness. If you can hold your position in this formation, you can adapt yourself to any combat grouping.

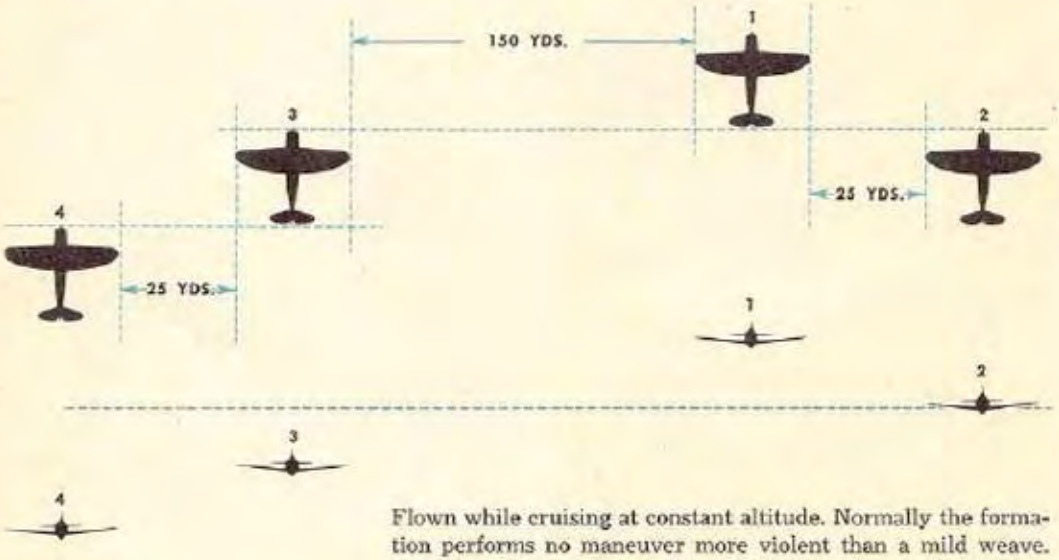


INSTRUMENT (OR SHOW)

The Most Important!

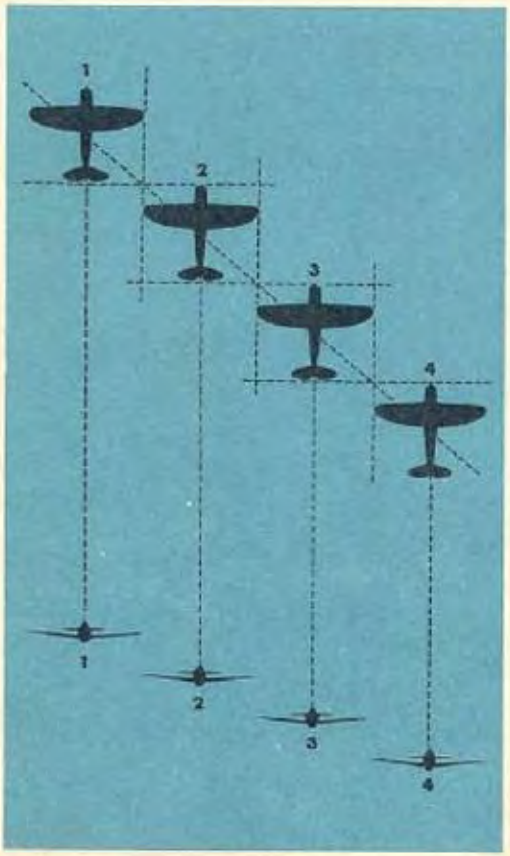
This is the basic combat formation, pulled in close. To fly a good basic formation, you need to master this one. When ascending or descending through an overcast, the leader goes on instruments. The other planes fly on the leader by visual reference. More pilots are lost in combat by losing contact in an overcast than by enemy action.

MODIFIED LINE ABREAST



Flown while cruising at constant altitude. Normally the formation performs no maneuver more violent than a mild weave. In combat, it provides excellent visibility and mutual tail cover.

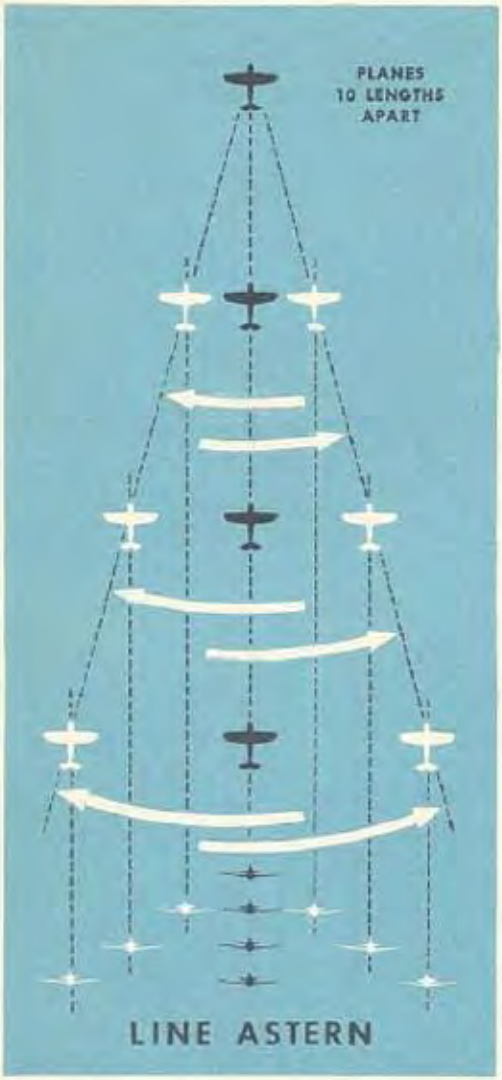
CROSS-OVER



If a cross-over is forced by the leader while flying modified line abreast, the flight reverts to the basic combat formation. The unit turned into (either an element or single plane), crosses under and behind the leader. The planes maintain the original relative altitude to avoid the possibility of collision.

ECHELON

Used primarily for landing. Also employed in entering into or as an aid in dive bombing by flights.



Flown in gunnery patterns or rat races. Strive to keep the interval uniform. The position of the No. 2 plane dictates whether you fly dead astern or slightly echeloned to one side.

Obey Orders

If you experience trouble and cannot make radio contact, use the standard re-form signal executed violently. To attempt further radio contact, hold up one finger to indicate use of A channel; two fingers, B channel; three fingers, C channel, and four fingers, D channel.

The flight leader announces by radio the appropriate time to change gas tanks, or employs a hand signal consisting of a twist of the hand and forearm, held vertically.

Failure to follow instructions, whether delivered by visual signal or by radio, is a **direct disobedience of orders.**

The leader uses less gas than other members of the flight because wingmen require higher power settings to stay up. It is your responsibility to keep from running out of gas. Notify your leader when you have no more than 25 gallons in the auxiliary and 50 gallons in the main tank, or if your fuel gages are out.

When you raise the manifold pressure to stay up, always increase the rpm. If your leader uses 2300 rpm, and you are No. 4 man, use 2400 rpm. This saves the engine and makes it easier to remain in position.

If at any time you are blanketed from the plane you are flying on, turn away in the direction you can see is clear. Never attempt to regain position by maneuvering into airspace you are not positive is free of other planes.

If you are about to over-run the formation in catching up, pull up to the side until you have lost the necessary airspeed, then slide into position.

Remember that constantly jockeying in and out of position in formation eats precious gas. The pilot who pumps his throttle in combat runs the risk of being sent home early from every mission.

High Altitude

Because of the thinner air density, high-altitude maneuvers require much more airspace than those at lower levels. It is difficult to regain a position once lost, and it is possible to lose your entire flight by making a wrong turn. The immense circle required for a turn carries you far away.

Your speed is higher, the wind velocity is higher, and it is quite easy to get lost. The answer is to stay on the ball and stick in formation. A little diligence is all that's required.

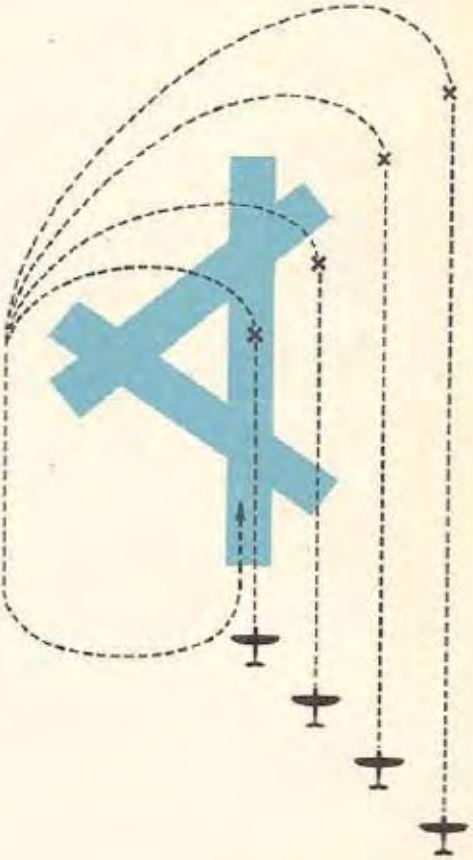
BELOW 100 FEET

Notice that the wingmen fly above instead of below the leader, as in all other flights. The purpose is to keep the leader from inadvertently forcing a wingman into the ground. The formation is loose and flexible, to enable each individual plane to avoid possible obstructions.

LANDING

The flight passes over the landing runway at 1000 feet. The leader's breakaway signal is repeated through the last man. Then he makes a sharp 90° turn. If the flight turns with the leader, the landing is snafued. No. 2 man must continue straight (assuming the role of leader). He continues course for a count of two or three, then turns. The other planes repeat the process.

The number of counts may be decided upon in advance or by the leader holding up the necessary fingers. The timing here helps regulate the landing intervals.



FORMATION EMERGENCIES

Collision with another plane:

If your plane is out of control, bail out.

If you retain control and believe you can make a landing, fly to a safe altitude and check the plane's flying characteristics at the low speed required for a landing. Should the plane display dangerous characteristics, try to establish radio contact with the nearest station, pick out a sparsely populated area, and bail out.

ACROBATICS

While you rarely use acrobatics in combat, the maneuvers teach you to control your plane in the unusual positions produced by aerial warfare. The exercises do you little good, however, unless you strive for precision and coordination of controls.

Acrobatics in the P-47 are limited to:
Chandelles
Lazy 8's
Slow rolls
Barrel rolls
Split-S (when carefully supervised)
Some organizations also permit:
Loops
Immelmanns

All other maneuvers are prohibited. They teach nothing and are extremely dangerous. For example, you may damage the structure of a P-47 if you try a snap roll.

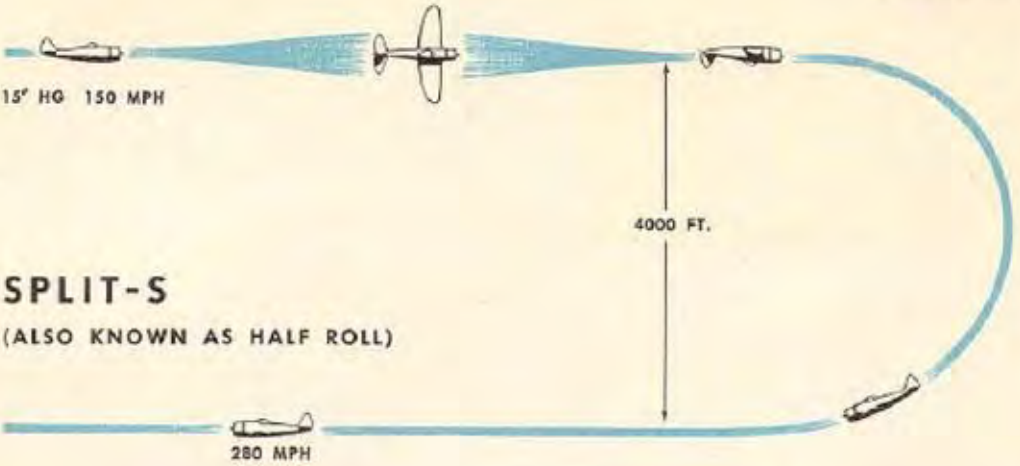
Maximum cruising power settings are sufficient for all acrobatics. The illustrations show proper speeds for each maneuver.

CHANDELLE

Zoom to right or left from level flight, climbing in a 180° turn. Chandelles to the left require little initial rudder force, but apply slight right rudder as speed decreases. Chandelles to the right require increased right rudder as the speed decreases. Do not stall in the turn.

LAZY 8

Requires no unusual control movements. You need good coordination to keep the ball centered.



SPLIT-S

(ALSO KNOWN AS HALF ROLL)

You must have specific authorization to perform this maneuver. It has been found that the average pilot has difficulty comprehending the great loss of altitude he experiences if he enters the maneuver with a little too much speed.

Some organizations prohibit the Split-S on the grounds that it has little or no training value. If you are allowed to practice the maneuver, understand and obey to the letter briefing concerning altitudes, airspeeds and loss of altitude during the dive. Perform in this fashion:

Reduce manifold pressure to about 15" Hg. Roll the plane on its back from level flight, either to the right or left. Pull the nose down with light stick force to prevent stalling. Recover either straight and level or by climbing. The final speed should be about 280 mph.

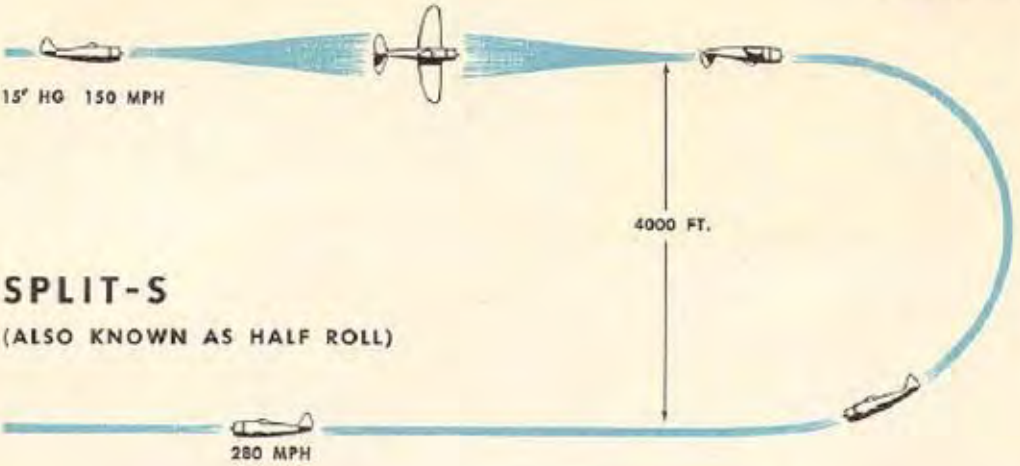
With an initial speed of 150 mph, you experience an altitude loss of less than 4000 feet. With an initial speed of 200 mph, you lose about 6400 feet. Do not go into a Split-S with greater speed. The altitude loss is tremendous.

Under no circumstances perform a Split-S with power on. The speed builds up at a dizzy rate. You lose as much as 15,000 feet of altitude entering a Split-S at 250 mph.

SLOW ROLL

Enter the roll with the nose about 10° above the horizon. Move the stick to right or left, using the necessary rudder to keep the nose on a point. As the plane rolls on its back, use forward stick to keep the nose up.

You require little rudder control while executing the maneuver at about 200 mph. Perform climbing slow rolls with an initial speed of around 300 mph. Little rudder control is required for a climbing roll.



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IMMELMANN

Needs an initial speed of at least 350 mph. When you reach the position of level flight upside down, coordinate the rudder and ailerons either to the right or left to execute the roll over.

Do not attempt to roll over by using ailerons alone. Unless you coordinate with the rudder you are in danger of going into an inverted spin.

If you are below 130 mph, on your back, do not attempt to roll over. There is danger of an inverted stall. Complete a normal loop.

Complete all acrobatics above 8000 feet. If you disregard this warning, you run a real risk of spinning in or of facing a court-martial.

DIVES

Start dives in a P-47 from level flight by pushing the nose down. Do not start a dive from a Split-S. Trim the plane slightly tail heavy so that you need a little pressure to hold the plane in the dive. Have cowl flaps closed for a dive. Decrease manifold pressure to keep from over-boosting the engine.

In a high-speed dive, do not retard the throttle suddenly. The nose becomes heavy and the dive steepens.

Recover gradually from a high-speed dive. A sharp pullout places unnecessary loads on the wings and control surfaces.

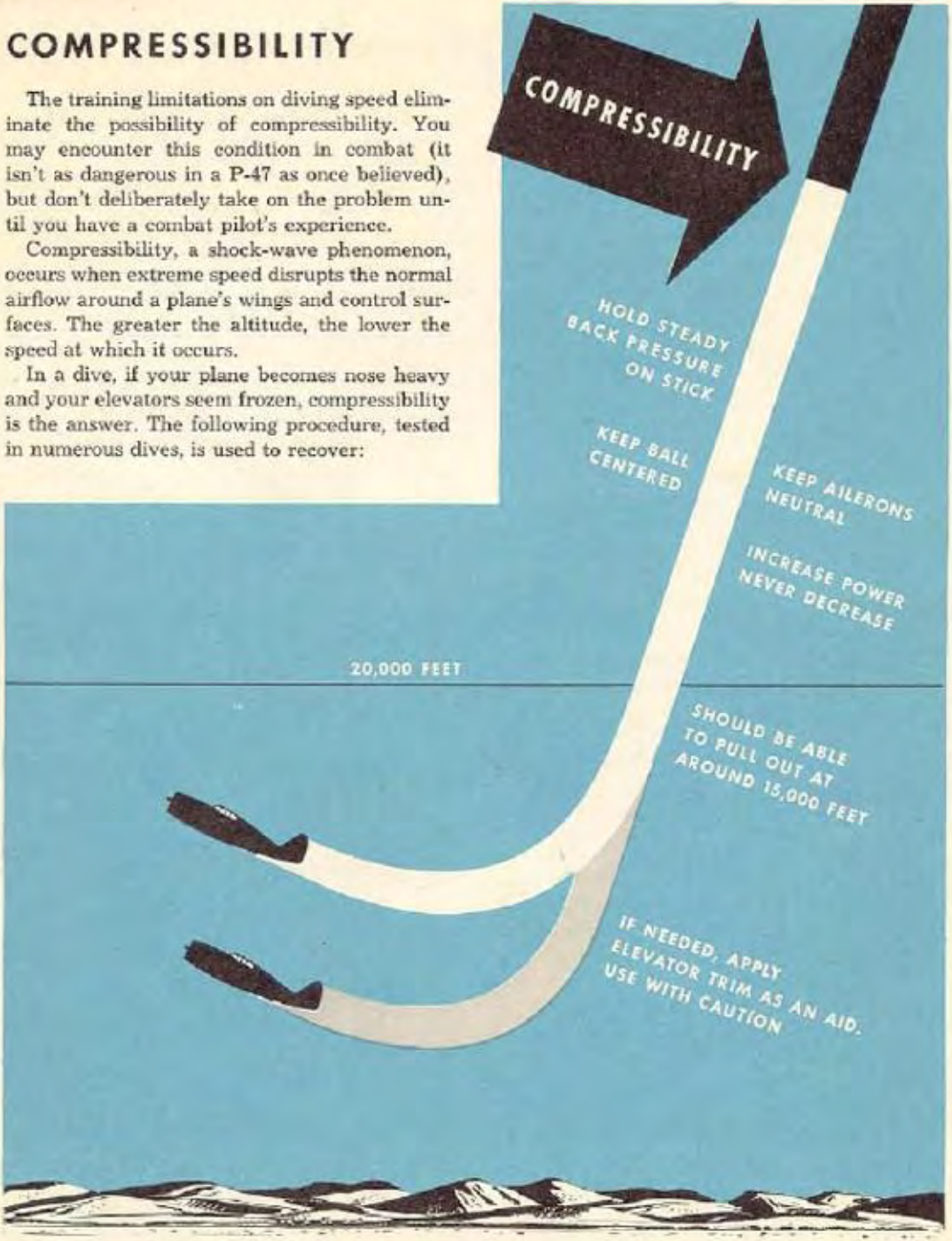
Dives in the P-47 during training are strictly limited. The chart shows the limitations.

COMPRESSIBILITY

The training limitations on diving speed eliminate the possibility of compressibility. You may encounter this condition in combat (it isn't as dangerous in a P-47 as once believed), but don't deliberately take on the problem until you have a combat pilot's experience.

Compressibility, a shock-wave phenomenon, occurs when extreme speed disrupts the normal airflow around a plane's wings and control surfaces. The greater the altitude, the lower the speed at which it occurs.

In a dive, if your plane becomes nose heavy and your elevators seem frozen, compressibility is the answer. The following procedure, tested in numerous dives, is used to recover:



Hold steady back pressure, about 50 lbs., but don't attempt to haul the stick back. You probably can't succeed, but in any case it would merely aggravate the situation.

Keep ailerons neutral. If you try to use them, there is a rapid reversal of aileron forces.

It is of the utmost importance to keep the ball centered. In fact, if the plane is slipping or skidding tremendous torque forces make it impossible to effect a recovery. Use rudder trim to get the ball lined up. While in compressibility, ordinarily a neutral (N) setting on the rudder trim tab control does the trick.

Watch the altimeter, and between 18,000 and 15,000 feet apply strong back pressure until the elevators become effective. You should be able to get the stick back at around 15,000 feet.

If for some reason, you can't get the stick back at this altitude, apply elevator trim to bring the plane out of the dive. Use the trim sparingly, because it results in a violent pull-out. One turn should be sufficient.

Do not throttle back, or your plane's nose will drop under you. On the contrary, increase power if the dive tends to steepen.

In order to have additional power for this emergency, never start a dive while pulling more than 40" Hg. This gives you a margin of additional power without danger of exceeding the red line. The added air ram of a high-speed dive greatly increases your manifold pressure and makes it mighty easy to exceed the limits.

Always Trim For A Dive

Because of the sensitivity of the controls, it is always important to have the P-47 properly trimmed before entering into a dive.

This is doubly true for the D-25 and subsequent series. These planes are subject to rudder lock during any uncoordinated movement of controls.

This comes about when the rudder trim is improperly set and hard rudder is applied while the plane is traveling in excess of 250 mph IAS.

To free the rudder, pull back on the stick to reduce the speed to below 200 mph IAS. The control then operates normally.

An addition to the dorsal fin is being installed on these planes to eliminate the trouble altogether.

NAVIGATION TIPS

Prepare yourself for cross country flight during local missions. Learn your groundspeeds, your fuel consumption at various power settings, and firmly fix local landmarks in your mind. When returning from a cross country, an airfield is a fairly small target, but if you know local landmarks your target extends for miles.

PLAN YOUR FLIGHT CAREFULLY

Know in advance:

1. HEADINGS
2. DISTANCE
3. ARRIVAL TIME OVER CHECKPOINTS
4. WEATHER OVER ROUTE

Clock the Checkpoints

The clock is one of your most important navigation instruments. Do not spend an hour looking for a 10-minute checkpoint. If you miss the point, look for the next one. If this point doesn't show up, orient yourself with the map.

Watch your gas supply. Carelessness with power settings results in an excessive consumption and reduces your margin of safety.

When using a map, look at the ground first. When you locate a traffic circle, bridge or highway, the symbol is comparatively easy to find on a map. But when you try to find some object you have located on the map first, you must

LOOK AT GROUND FIRST,

THEN CONSULT MAP, NOT VICE VERSA

scan the vast expanse of terrain beneath you.

There is no disgrace in becoming lost. The pilot doesn't live who hasn't been lost at some time or other. The disgrace comes from milling around in a panic taking no decisive action.

When you are lost, use a planned procedure and stick to your plan long enough to give it a chance while you use minimum cruising power to save fuel. Tune in on a range station with the Detrola and work out a range orientation problem. Use VHF homing. In short, use your head.

SIMULATED COMBAT

The accompanying diagram shows simulated combat as performed in training. The planes reach altitude as a unit. Combat starts when the opposing forces come abreast, not before. The exercises also may be performed by giving one element initial altitude advantage.

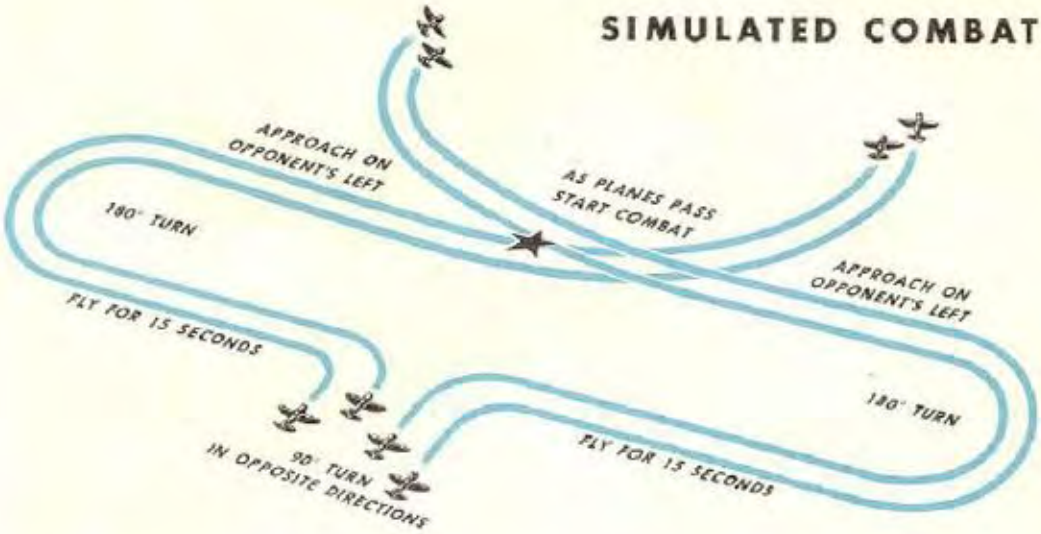
The goal is to achieve an immediate advantage by rapid and preconceived maneuvering. Do not engage in long stern chases.

The exercises do not necessarily prove who is the better combat pilot. In actual combat, opposing aircraft are different, and there are many methods of joining battle.

THE FLIGHT LEADER BREAKS OFF THE COMBAT BY RADIO WHEN:

1. One force wins an obvious advantage.
2. Combat is stalemated (as in a Lufberry).
3. Altitude falls below 8000 feet.

SIMULATED COMBAT



Develop a swivel neck. The ranking officers at your base may launch an attack to determine your alertness any time you are above 4000 feet. When jumped, take only enough evasive action to indicate you were not caught napping. Do not dog-fight.

Do not employ the Split-S as an evasive maneuver.

THESE EXERCISES DO NOT NECESSARILY PROVE WHO IS THE BETTER PILOT

ARMAMENT

The P-47 bristles with eight .50-cal. machine guns, four in the leading edge of each wing. The ammunition is carried outboard of the guns. The design load is 300 rounds per gun, though a maximum load of 425 rounds per gun may be carried.

A gun camera is in the right wing.

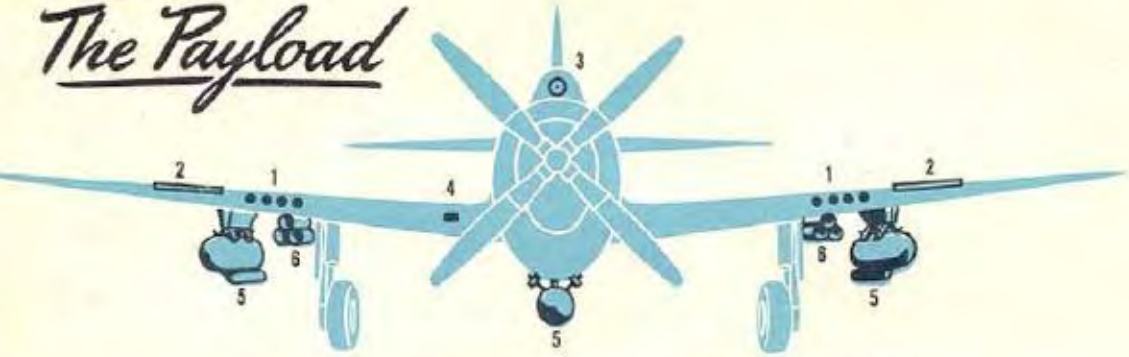
A Mark VIII gunsight is mounted in the cockpit above the instrument panel.

The plane can be outfitted to carry a 1000-lb. bomb under each wing and a 500-lb. bomb under the belly—virtually the load of an attack bomber.

Jettisonable rocket tubes or chemical spray tanks may be installed beneath the wings.

You are protected by a face-hardened steel plate behind and in front of the cockpit seat and bullet-resistant glass in front. The engine,

The Payload



supercharger and gas tanks are an added shield.

The guns can be charged on the ground only. If a gun jams in flight, it is out of action until you land. The other guns continue to fire. You are taught proper loading and care of your guns; see that the teaching takes. A jammed gun is serious in combat. Faulty guns won't bring down an enemy and they won't bring you home.

Your guns are boresighted, or aligned, to obtain the proper pattern of fire as viewed through the gunsight.

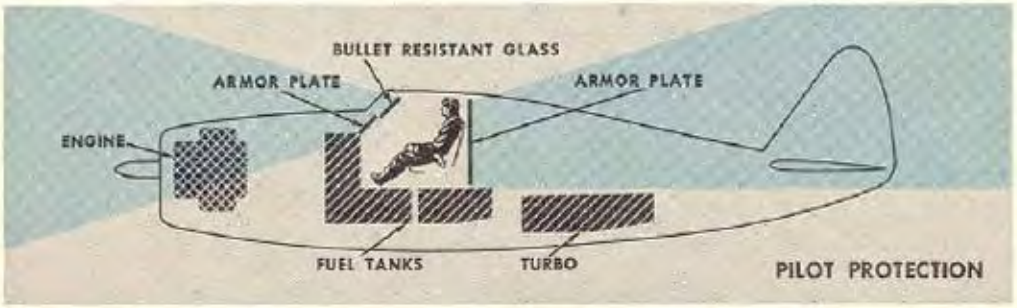
TO KEEP GUNS LINED UP:

1. Do not use gunsight as a handle.
2. Do not permit anyone to take hold of a blast tube when climbing on a wing.

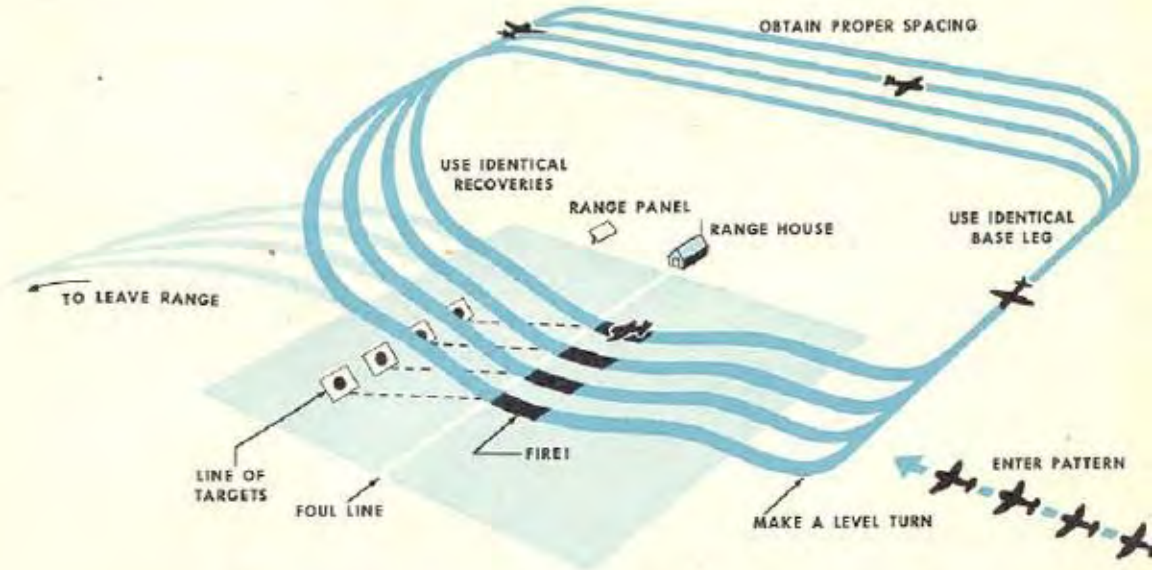
A rheostat on the switch panel turns the gunsight ON and OFF and regulates brilliance of the sight ring.

1. .50 CAL. MACHINE GUNS
2. .50 CAL. AMMUNITION
3. GUNSIGHT
4. GUN CAMERA
5. BOMBS—CHEMICAL TANKS
6. ROCKET TUBES

A gun switch on the left side of the cockpit has three positions: **CAMERA ONLY**, **OFF**, and **GUNS & CAMERA.** Keep safety hood closed. A squeeze trigger on the stick operates both the camera and the guns.



GROUND GUNNERY



GROUND GUNNERY RANGE (RIGHT HAND PATTERN)

A ground gunnery pattern is flown at an altitude of 1200 to 1500 feet. The first passes are dry runs. Check the range panel during the dry runs and on all subsequent passes. The panel has two sides. One side, usually red, indicates the range is closed. The other side, usually white, means the ranges are open. If the range is closed, do not fire or dive at the target. Maintain altitude.

Keep Trimmed for Dive

During your dry runs, trim your plane for the dive on the target, and keep it so trimmed while flying the pattern. This assists you in keeping the ball centered during your dive. If your plane is skidding, you won't hit where you aim.

Strive to maintain proper spacing in the pattern. When the plane ahead is firing, you should be on your final turn into the target. If one plane gets out of position, it disrupts and wastes the time of the entire formation.

Dive at the speed for which your guns are boresighted. This speed customarily is 270 mph. Turn on your gun switch during the dive. Fire your burst as near as possible to the foul line. Keep your burst short, not more than 5 or 6 rounds.

Start recovery as soon as you see the bullets strike. Do not become hypnotized by the target and risk flying into the ground. Once you have squeezed the trigger (a mere touch is sufficient), forget about firing and devote your attention to the airplane. Complete your recovery

above 75 feet. A lower pull out is unsafe because of the mushing tendencies of the P-47.

After leveling off, make a fast 90° turn with shallow climb to avoid richochets. (In combat, stay on the deck and to hell with richochets.) Turn the gun switch OFF by closing the hood.

Never point your guns at another plane.

Pay particular attention to the radio instructions of the range officer. He corrects your faults and lets you know when you're in the groove.

If the range officer can't contact you by radio, he may fire a red flare as a signal for you to stop firing.

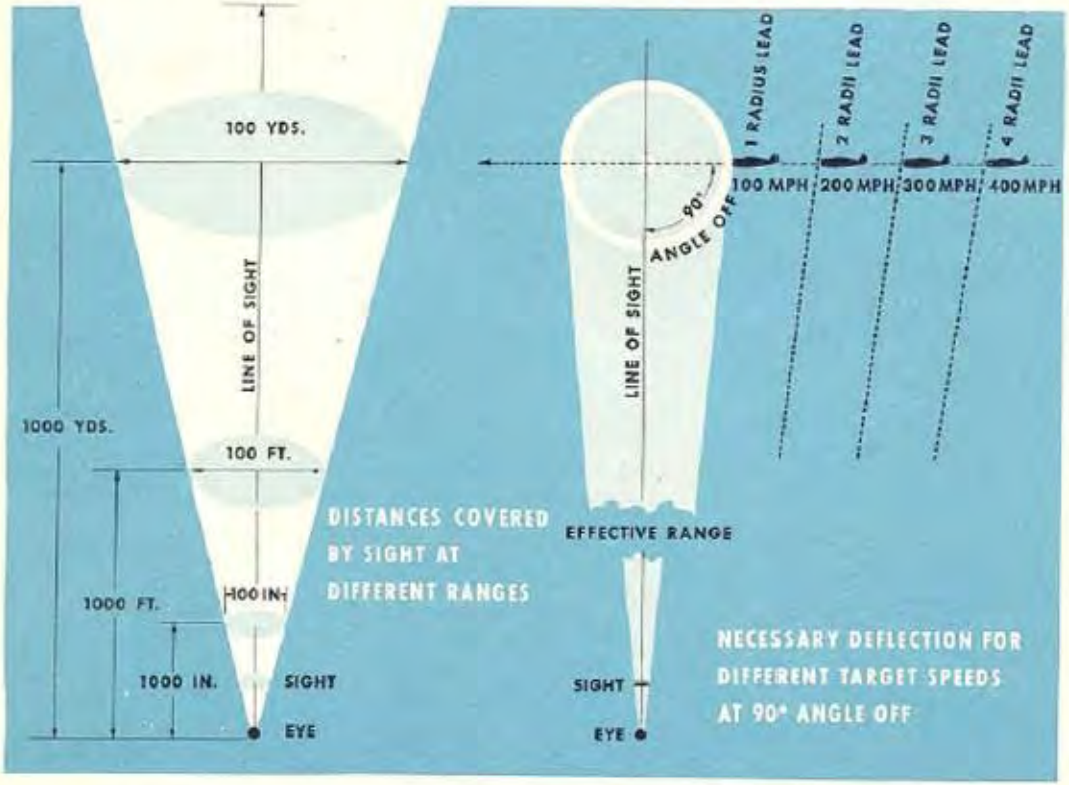
CAMERA GUNNERY

Camera gunnery teaches you to estimate:

1. **RANGE**
2. **CORRECT LINE OF FLIGHT OF TARGET**
3. **DEFLECTION**

Master the three fundamentals, learn to fly smoothly, and you can bring down an enemy airplane every time. Be weak in one of the fundamentals and you miss the target.

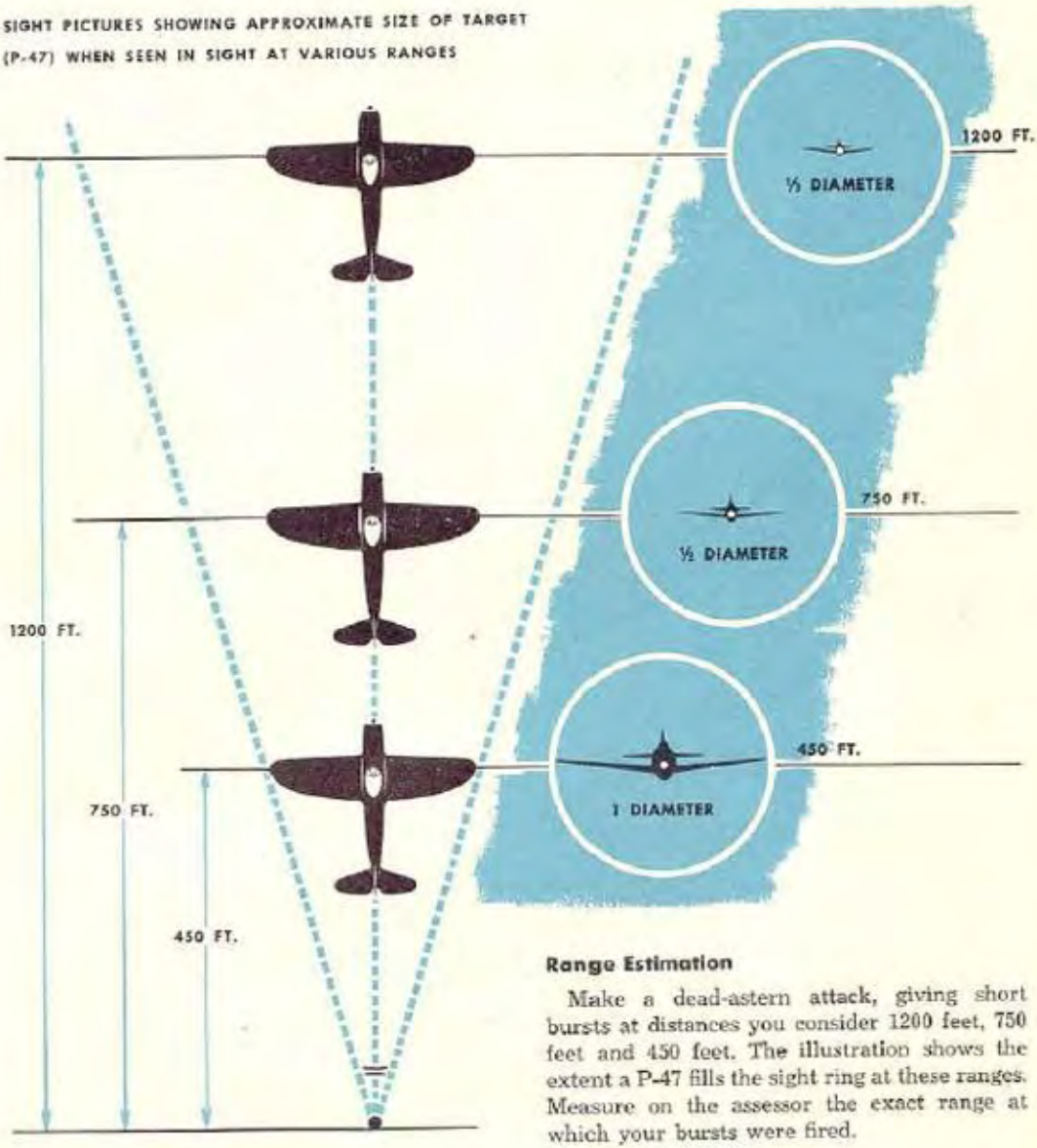
The P-47's Mark VIII gunsight is termed a 100 mph sight. That is, a 90° deflection shot requires one radius lead for each 100 mph speed of the target. When you are looking through the ring, at 1000 yards distance, the ring covers an area 100 yards in diameter; at 1000 feet the ring covers 100 feet, etc.



You fly camera gunnery missions with another plane, taking turns as the target. Perform the mission at the assigned area and altitude. Avoid abusing your engine during the maneuvers. High-speed cruising provides the best power setting.

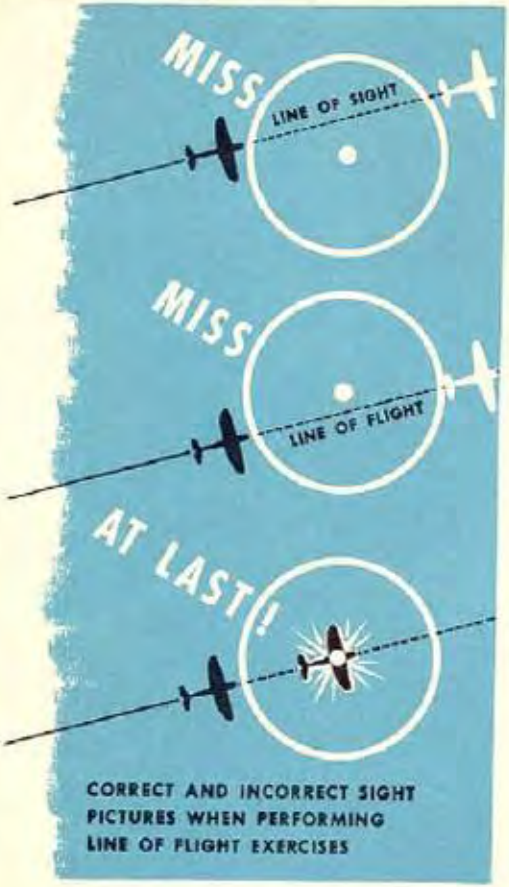
Before attacking, take a 5-second sighter burst with your camera. You need the footage to enable you to line up your film correctly in the exact assessor. Fire the burst after you have centered the pipper squarely on a distant object, usually the target plane.

SIGHT PICTURES SHOWING APPROXIMATE SIZE OF TARGET (P-47) WHEN SEEN IN SIGHT AT VARIOUS RANGES



Range Estimation

Make a dead-astern attack, giving short bursts at distances you consider 1200 feet, 750 feet and 450 feet. The illustration shows the extent a P-47 fills the sight ring at these ranges. Measure on the assessor the exact range at which your bursts were fired.



CORRECT AND INCORRECT SIGHT PICTURES WHEN PERFORMING LINE OF FLIGHT EXERCISES

NECESSARY DEFLECTION TO HIT TARGET USING CORRECT RANGE AND LINE OF FLIGHT AT VARIOUS ANGLES OFF

Line of Flight

The target flies in steady circles, both to the right and left. Position yourself to fire using a one-radius lead. Deliver your bursts at the ranges used in the range estimation exercises. Assess the film for the correct line of flight and correct range.

Deflection

The target plane flies in circles at 200 mph, varying the needle-width of the turns. Attempt to give the target the necessary radii lead for the angle off while using the correct line of flight and range. The assessor judges your success.

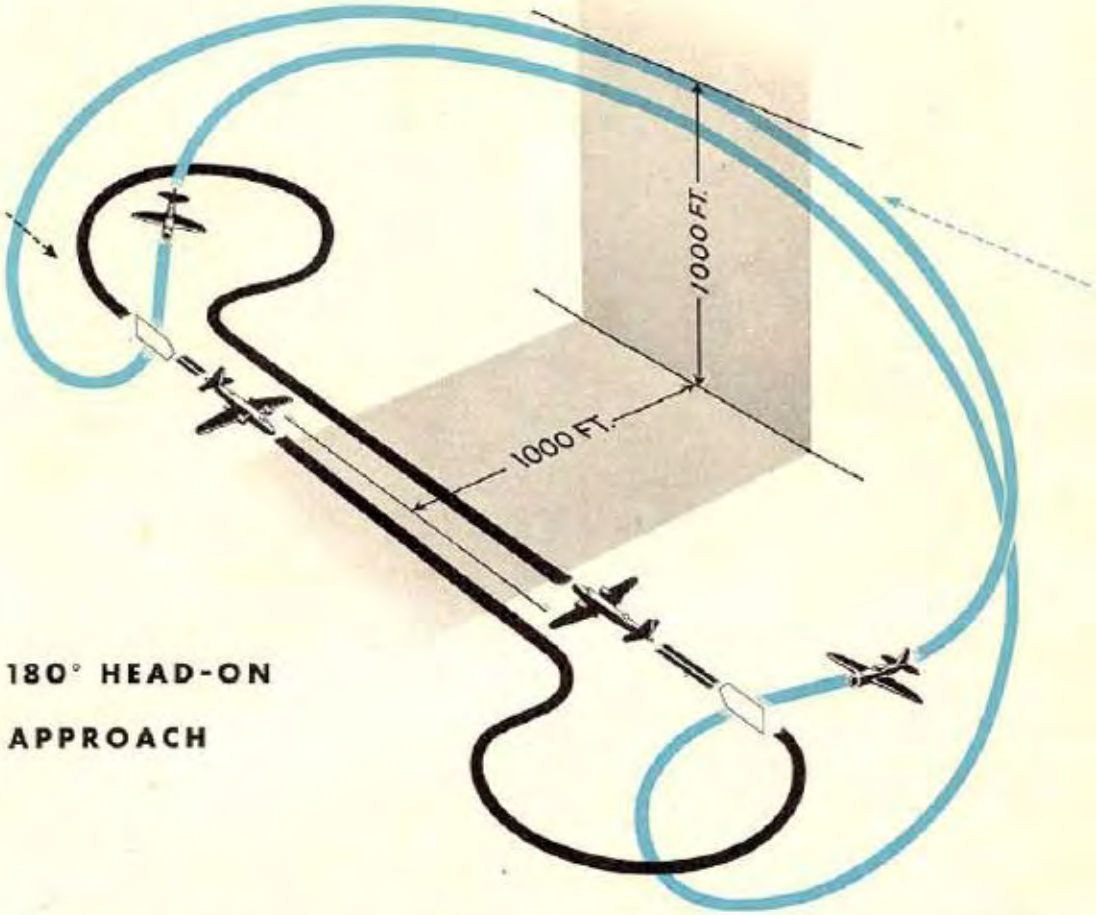
As in ground gunnery, keep the ball centered. Fly a smoothly coordinated curve of pursuit without slip or skid.

Pictures Don't Lie

Assess your pictures as soon as possible after a mission. Pester the camera gunnery officer, if necessary. You get twice the value out of camera gunnery when you assess results with the mission still fresh in your mind.

Before starting a camera gunnery mission, check with the Form 1A and the crew chief to insure the guns are uncharged. Use the gun selector switch on CAMERA, not on GUNS & CAMERA. Keep the switch OFF and the safety hood closed except when actually shooting.

AERIAL GUNNERY



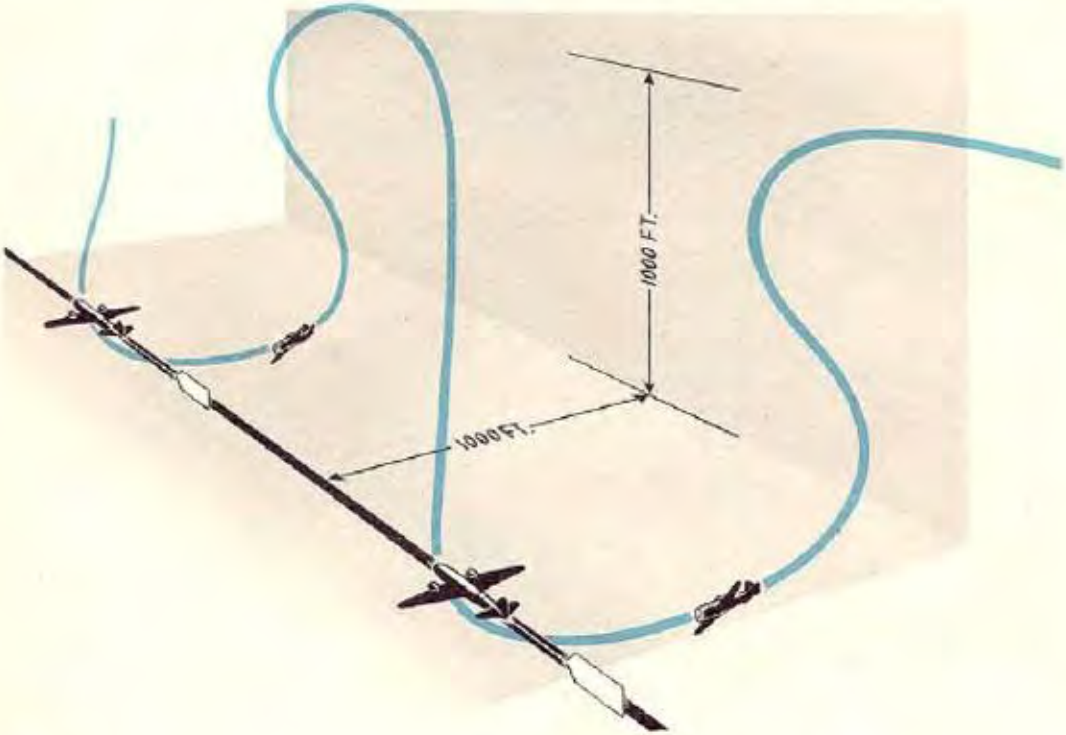
180° HEAD-ON APPROACH

The two basic patterns employed in aerial gunnery training are the "180° Head-on Approach" and the "Parallel Approach."

Proper spacing in both of these patterns is essential.

The exercises are not intended to teach the tactical approach to enemy aircraft, but to instruct you in the final run on the target. The attacks involve simple deflection shooting, basis of all successful aerial combat.

PARALLEL APPROACH



You fly several dry runs to space your plane in the pattern, and to take your camera sighter burst. During the dry runs, trim your plane for the attack angle. Although you dive on the target, try to fire while flying level with it.

Use the camera on all missions as an aid in assessing results.

Turn your gun switch to GUNS & CAMERA only when firing. Turn the switch OFF when you recover from the attack. Test your sight before taking off for the mission.

Fire longer bursts than in ground gunnery, but do not fire more than 20 rounds. This keeps your guns from overheating.

Your flight leader controls the gunnery pattern. Follow his instructions implicitly.

Do not:

1. Fire on the target while the towplane is turning.

2. Fire when the angle between you and the towplane is less than 20°.

3. Blanket out the plane ahead, or the towplane when making an attack.

4. Make a pass at the target when another plane in the pattern is making a pass.

5. Bring your sights to bear on an airplane in the pattern or on the towplane.

Assume that you will shoot off the target on each pass, and be alert to take evasive action. Flying into a target is extremely dangerous.

Keep your eyes open when making your approach and landing after an aerial gunnery mission. The towplanes drop targets and occasionally a cable on the field.

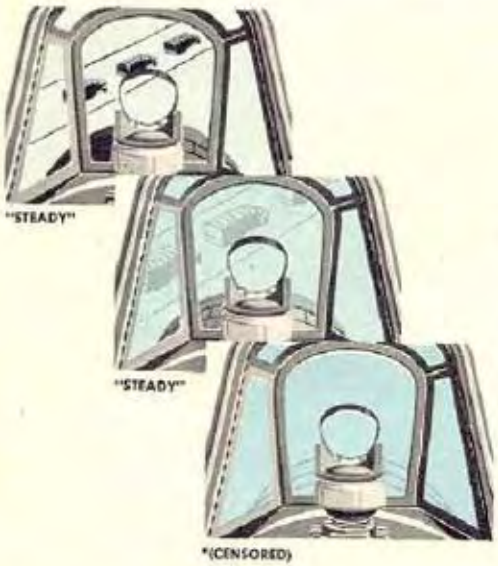
Do not park your airplane pointing in the direction of other aircraft, hangars or building.

When you shout "Switches Off," check to see that your gun switch is in the OFF position.


6-8000 FT.—ARM BOMB
TURN ON GUNSIGHT
150 MPH. RETARD THROTTLE
START WINGOVER TO KEEP
TARGET IN SIGHT
WIND
LINE SIGHT PIPPER
ON THE TARGET
DIVE BOMBING
GIVE PROPER LEAD
BY RAISING THE NOSE
3000 FT.
RELEASE BOMB
ADVANCE THROTTLE
START RECOVERY
1000 FT.

Clear for Action

Your flight approaches the target in line astern at from 6000 to 8000 feet. The leader obtains the clear-to-bomb signal from the range officer.



*HE FORGOT TO TURN ON DEFROSTER

Turn on your defroster. This prevents your windshield and canopy from becoming clouded, because of rapid changes of outside temperature during your dive.

ARM YOUR BOMB

On most P-47's the bombs are armed by three T-shaped controls adjacent to controls used to jettison external tanks. Turn a control counterclockwise, pull and then twist clockwise to arm. To safety a bomb, reverse the steps. To drop the bomb, pull the appropriate TANK RELEASE handle.

Approach the target slightly to one side. Trim your plane for the maximum speed you will attain during the dive. As the target starts to disappear under your wing, wing over. Keep the target in sight at all times.

Turn 90° to place your diving run on the target. Put the pipper right on the target. Near the dropping point, slowly drag the nose up. When you estimate you have the correct lead, hold the plane steady and drop the bomb.

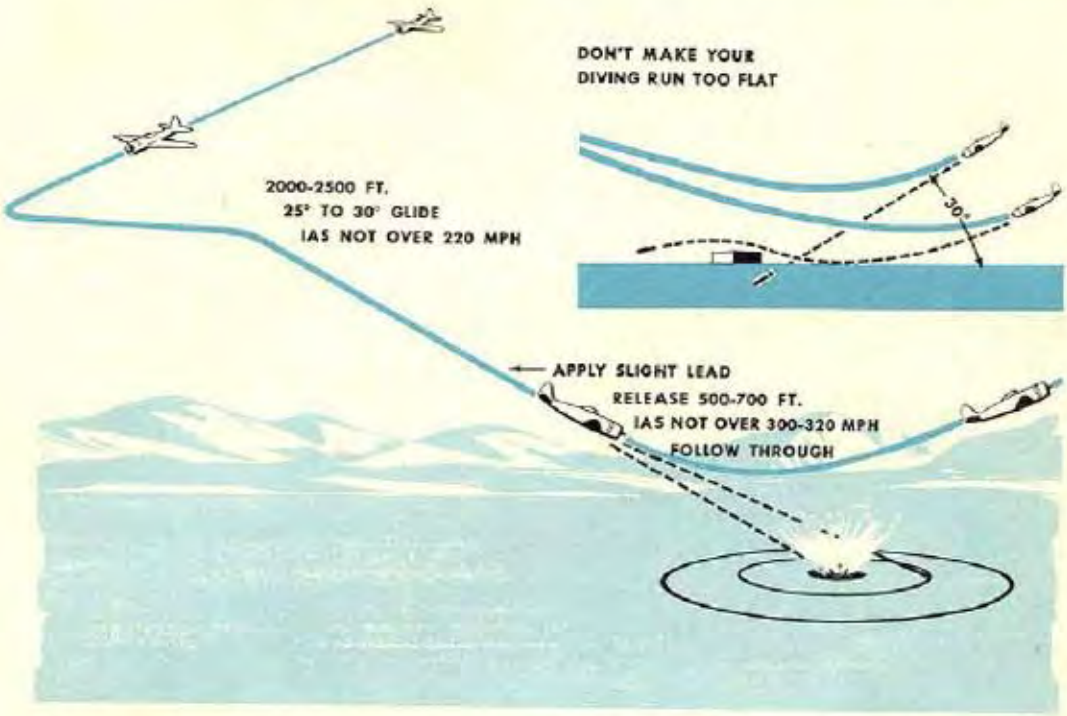
Use ailerons for deflection corrections and elevators for range. Avoid the use of the rudder except to stop skids.

Eliminate excessive diving speed by keeping the entry speed down and retarding throttle. Dive at an angle of between 45° and 60°. Avoid overboosting the engine during the pullout.

Pull out above 1000 feet to eliminate the danger of mushing. When you climb, make sure you are in no danger of a collision, and do not look back to see where your bomb hit. It's a bad habit to develop for combat. Your leader, or the man following you, notes the results you obtain.

In case your bomb fails to release, safety it, and skid and slip your plane over the target area to shake it loose. If this fails, return to the field and notify the tower of your difficulty before landing.

GLIDE BOMBING



The proper way to glide bomb is illustrated above. This type of bombing provides the most accurate form of attack on small targets having little or no vertical height. With practice, it is easy to develop great accuracy.

By starting the approach at 2000 to 2500 feet, it is simple to spot the target, and you have time to line up and trim your plane for the dive.

Keep your entry speed below 220 mph, using normal cruising power settings, to avoid a final speed in excess of 320 mph. Higher speed destroys accuracy.

The best diving angle is 30°. The bomb ricochets if you use a flatter angle. The bomb must stick to get effective results.

You must overcome a tendency to come in too flat. A slight lead is required when using your gunsight. A little experimentation teaches you the proper lead and angle.

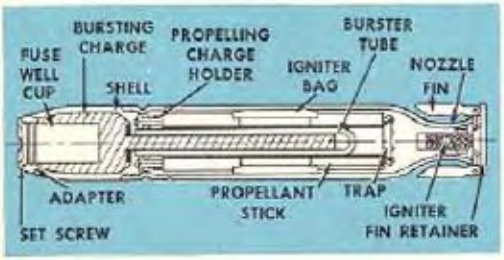
Do not begin your pullout prior to or during release of the bomb or you will produce a ricochet.

A properly dropped 500-lb. bomb with delayed action fuse penetrates 6 to 10 feet before exploding. The effect of the subsequent explosion is terrific.

ROCKETS

When rockets are installed, drop fuel tanks, or bombs, may be carried at the same time.

The tubes are made of steel or thin plastic material and may be jettisoned either before or after the rockets have been fired. The rockets are about the same size as a 105 mm shell. When you fire six, it's comparable to six rounds delivered by a 105 mm howitzer, a gun that weighs 2 tons.



M8 ROCKET

The rocket has three sections:

Fuse, which can be set for an impact explosion or set to explode the rocket at a given range.

Head, which carries the explosive in the first third of the projectile.

Motor, which contains a powder propellant. When ignited, gases shoot out at a high velocity from the tapered end of the motor case.

The rocket contains collapsible fins which open up in flight and stabilize the projectile. You launch the rocket by pressing the trigger or a button on the stick. The trigger ignites the rocket electrically.

A small fire control box in the cockpit enables you to fire the rockets individually or in train, with the projectiles leaving the tubes at intervals of 1/10 of a second. The tubes are bore-

ROCKET FIRE CONTROL BOX

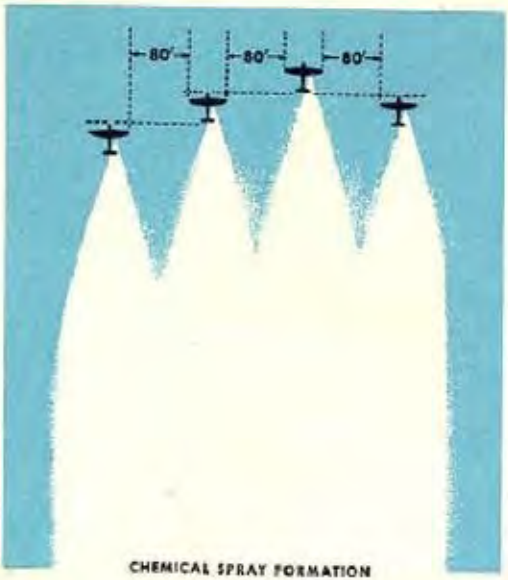
sighted with the guns. You use the gunsight for firing both rockets and machine guns.

Carrying rockets has little effect on the flying characteristics of the plane.

CHEMICAL SPRAY

The tank is mounted on a bomb rack.

The chemical (smoke, tear gas, etc.) comes out the nozzle at the rear and fans out and down over the target area.



CHEMICAL SPRAY FORMATION

The sketch shows a flight of four spraying an area. The planes fly line abreast, stacked up slightly, with an interval of two plane spans between them. As the leader releases his spray, the other planes follow suit.

Area covered by the average pattern, with planes flying from 170 to 350 mph, is 40 by 650 yards. The minimum altitude at which this mission is flown is 150 feet.

COMBINED OPERATIONS

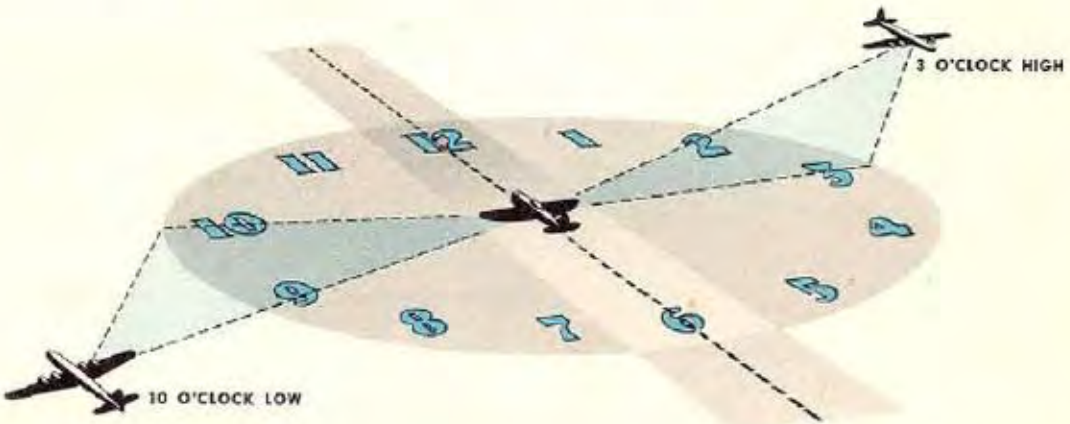
The object of a combined mission with a single bomber, or flight of bombers, is to accustom you to combat conditions. When working with a single bomber, a flight of four fighters makes passes while the bomber tries evasive maneuvers.

Your flight is vectored to the bomber by the controller or intercept officer. You fly a loose line-abreast formation to enable you to scan the sky.

The clock system of locating aircraft is universal with fighter pilots. The elevation is given as either high, low, or level.

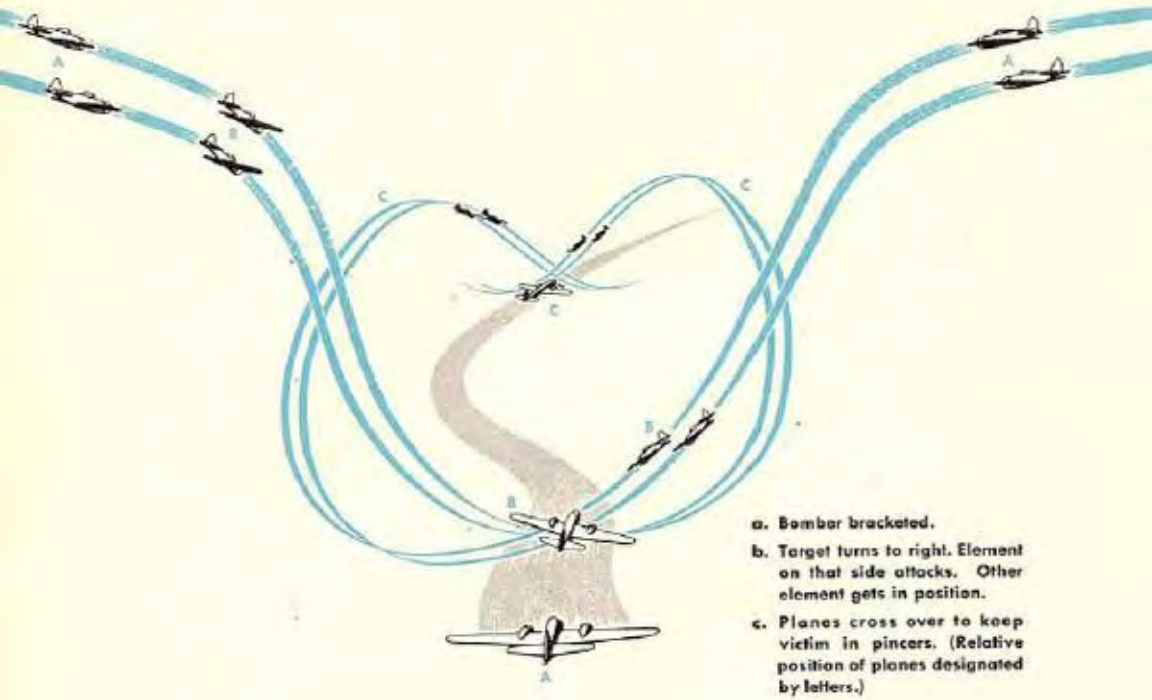
When the target is sighted, the flight draws into the basic combat formation. The target is approached from at least 2500 feet above.

The elements separate in order to bracket the bomber. The second element leader, without signal, takes the side left open by the flight leader. After being bracketed, the bomber can



CLOCK SYSTEM

END OF A BOMBER



a. Bomber bracketed.

b. Target turns to right. Element on that side attacks. Other element gets in position.

c. Planes cross over to keep victim in pincers. (Relative position of planes designated by letters.)

continue straight, letting the fighters get in position for a run, or can turn, trying to beat off one element while distancing the other.

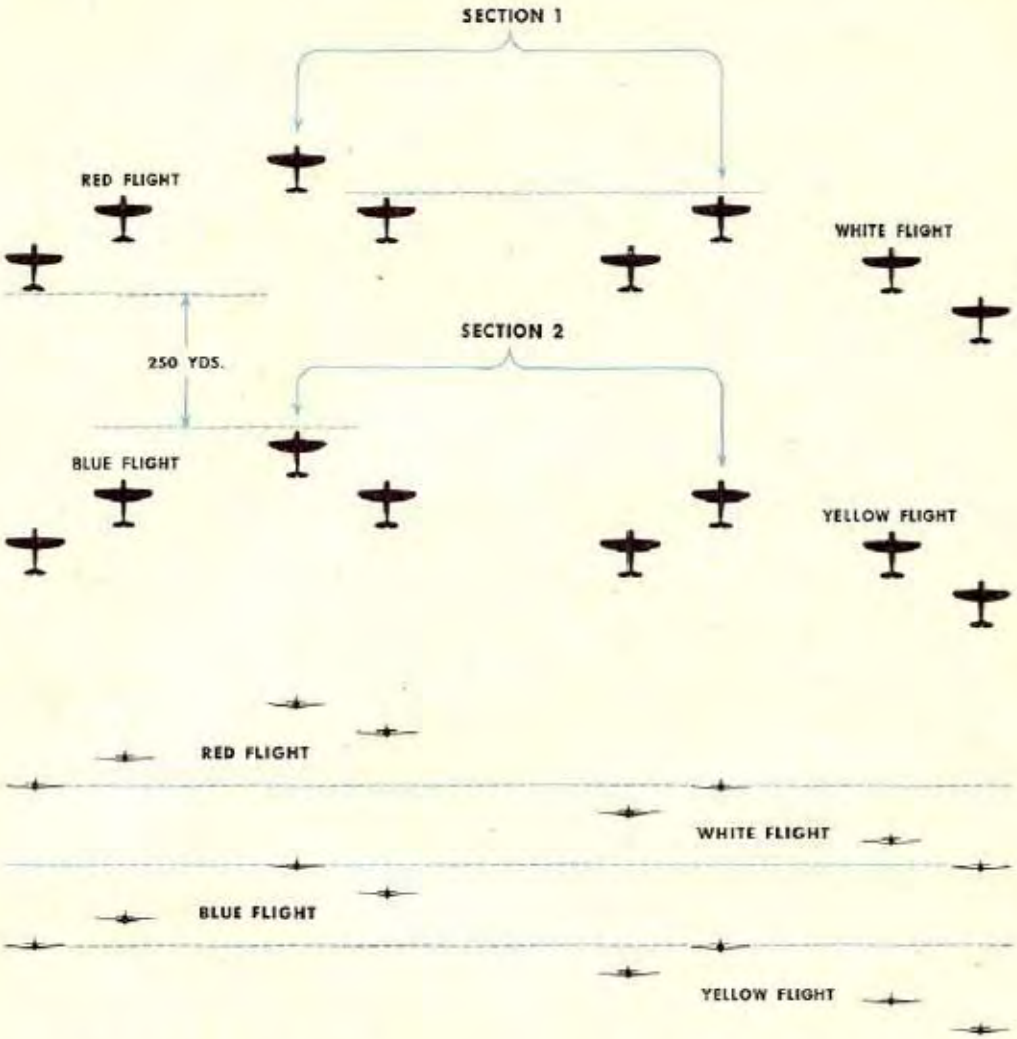
A turn provides the critical moment. As the bomber wheels, the element on that side must quickly launch an attack. A high side or overhead run is most effective if the bomber has altitude. For a bomber flying low, a high side run with a breakaway above the target is safest.

Break away to the opposite side of the bomber. The other element, if in position, makes a run following the first element. If not in position, the element simply crosses over. The main objective is to keep the bomber bracketed until it is shot from the sky.

You make individual runs on the bomber. The wingman stays close enough to his leader to avoid losing element unity, but far enough away so the planes don't offer a single target.

In combat, it is essential to temper eagerness with calculation, seeking every possible advantage. Stay out of range of a bomber's guns until in position for an effective pass, then press home your attack with all possible speed and force. Take careful aim, and after breaking away, place yourself in position for another run. Don't ever make a climbing turn while in range of a bomber's guns. You become a sitter.

During training, utmost caution is necessary to eliminate the possibility of a collision. In this type of mission, follow your briefing and the flight leader's instructions to the letter.



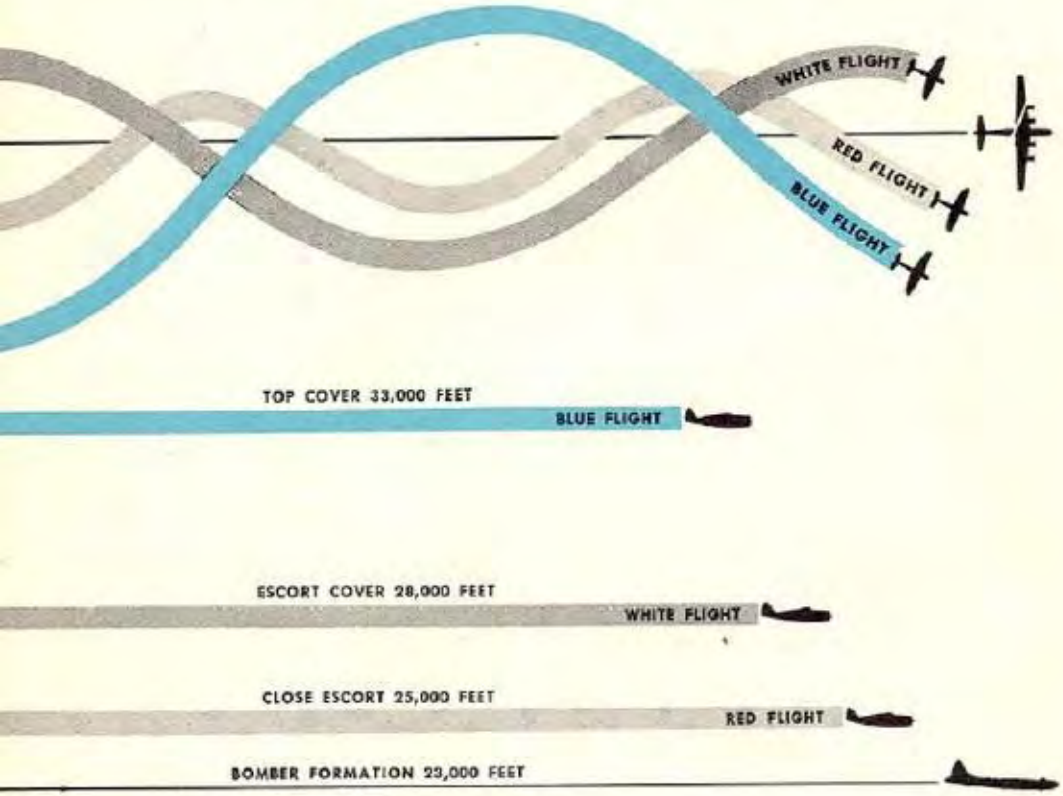
SQUADRON BOX

With a formation of bombers, combined missions are flown with a four-flight squadron of fighters, divided into two sections of eight. You are taught how to escort and attack.

While being vectored to the bombers, each flight spreads out in a loose modified line abreast. Once the bombers are sighted, the formation pulls into a Squadron Box, as shown in the illustration.

One method of providing escort cover also is

SQUADRON ESCORT OF A BOMBER FORMATION



illustrated. The bomber formation determines the route flown. The formation must be in close in order to get complete protection. The duty of the fighters is to keep enemy fighters from filtering through.

The fighters weave or S to maintain sufficient airspeed and keep from over-running the bombers.

When attacking a formation of bombers, you are briefed on the method of attack, signals, and which bombers are to receive major attention.

When a squadron attacks a formation, the enemy is bracketed in the same way that a flight attacks a single plane, with a section instead of an element covering each side.

The squadron leader controls the attacks of the flights by radio.

Concentrate on the exposed bombers on the flanks and bear down on stragglers.

Careful timing, constant alertness and obedience of briefing instructions, are your best safeguard against a mid-air collision.

INSTRUMENT FLYING

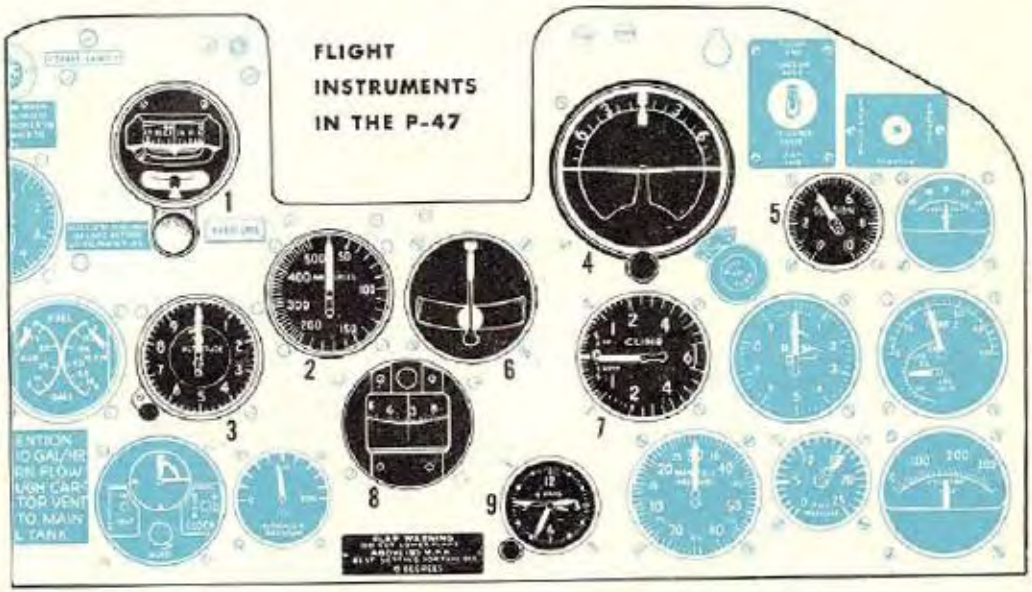
Combat requires a fighter pilot to be able to climb, locate a designated geographical point, and descend through a solid overcast.

The P-47, a nice instrument plane, trims easily and handles as well as it does when you fly contact.

As a matter of fact, while flying contact you use most of the instruments needed to fly on instruments; the airspeed indicator, needle and ball, and compass; the tachometer and manifold pressure gage to stay within operating limits, the clock and fuel gages to check fuel supply; the cylinder-head and oil temperature gages to check engine heat, and the altimeter.

Actually, the only difference under a hood is that you replace the natural horizon with the artificial horizon and the needle and ball.

Your instruments were correct before, and they are correct when you fly under a hood. The only trick to instrument flying is: Believe your instruments, regardless of your physical sensations.



1. Gyro-compass
2. Airspeed indicator
3. Altimeter
4. Gyro-horizon
5. Suction gage
6. Turn and bank indicator
7. Rate-of-climb indicator
8. Magnetic compass
9. Clock

The P-47's instruments are sufficient for any problem, except a "blind" landing.

TRUST YOUR INSTRUMENTS

The gyro instruments operate by suction from an engine-driven vacuum pump. If while the engine is running the gage gives a reading of 3.8" to 4.2", your gyro instruments are getting sufficient suction. Don't practice instruments if the suction gage is not working. If the suction system fails completely in flight, the gyro instruments remain dependable for approximately 3 minutes.

Check with the magnetic compass and re-set the gyro-compass every 15 to 20 minutes. The instrument has a limitation of 55° for banks, climbs and glides.

The gyro-horizon has a 100° bank limitation, and 70° for climbs and glides. Ice, water or any foreign object in the pitot tube destroys the accuracy of the altimeter and rate-of-climb and airspeed indicators. Turn on the pitot tube heater when in icing conditions or when entering clouds for any extended period.

To practice instruments in a P-47, you must have a valid instrument card. (Form 8 or 8A.)

A safety plane flies loose formation with you.

Abide by these Rules

1. Establish radio contact before taking off, and exchange calls with the safety plane every 5 minutes.

2. Maintain a minimum altitude of 5000 feet above the terrain.

3. Practice no spins, stalls, acrobatics, or unusual maneuvers.

The safety plane will not permit you to go into an overcast or clouds if it can be avoided.

Perform the Following Exercises

1. Hold given headings over a long period. A tolerance of 5° either way.

2. Half-needle-width turns at cruising speed to given headings; 90° and 180° turns.

3. Climbs at 160 mph of 1000 feet or more to given altitudes. Tolerance of 100 feet either way.

4. Glides at 160 mph of 500 feet per minute down to given altitudes. Tolerance of 100 feet either way.

5. Glides with wheels lowered at 150 mph at 500 feet per minute.

6. Gliding turns with wheels lowered to definite headings and given altitude. (Half-needle-width turns.)

7. Emergency pullouts from wheel-down glides, retracting wheels and assuming a climb at 160 mph to definite altitudes.

Do the exercises using the gyro instruments and with gyros caged, using the rate instruments only.

Since it is possible for any mission to encounter instrument conditions, check your instruments before every flight.

While checking the gyro instruments, cage them momentarily if necessary to speed the process.

Check the suction gage for a reading of 3.8" Hg. to 4.2" Hg. The turn and bank indicator is sluggish if the reading is less.

While taxiing:

Check the gyro-compass for movement when you turn the airplane.

Check the magnetic compass for free movement and adequacy of fluid.

Check the turn and bank indicator. The needle should sway with turns.

Check the gyro-horizon for rigidity. If it moves or bounces around, it may not be completely uncaged, there may be an obstruction in the suction line, or parts may be worn.

Write up all instrument defects in Form 1A, despite their seeming triviality. Examples:

Excessive lag in the gyro-horizon.

Excessive precessing of gyro-compass. (More than 5° in 15 minutes.)

Less than 3.8" Hg. suction.

Faulty clock.

While practicing instruments, do not return to contact flying unless:

The safety pilot fails to call every 5 minutes.

You are below 5000 feet.

You are beginning to feel drowsy.

Your plane is in a spin or violent maneuver.

NIGHT FLYING

Night flying in the P-47 is the same as in any other airplane—it's relatively simple if you know your business and take the simple precautions used while crossing the street on a dark night.

Before undertaking a night mission, know and understand:

All radio aids, particularly homing.

Latest information in the Radio Facility Charts.

Lighting of your airport.

Light lines.

Visual light signals.

Possible taxiing hazards.

The weather.

Equip yourself with a flashlight. It's an aid to taxiing and indispensable if the lighting system fails. Use a flashlight briefly in a dark cockpit. A single sweep across the panel causes the instruments to glow for several minutes.

Do not wear goggles with colored lenses.

Before entering your plane, adapt your eyes for night vision using the method described in PIF. At the very least, stay away from lighted areas for 30 minutes prior to the flight.

At night, as part of your cockpit check, include:

Instrument light switch.

Cockpit lights switch.

Landing light switch.*

Running lights switches.*

Compass light.

*Have a ground crew man verify the operation of outside lights.

Memorize the location of these switches. You should be able to operate them blindfolded. Remember, you'll be hunting for them in the dark.

Keep your fluorescent lights dim and use other cockpit lights only when necessary. Use the night flying hood to shield the instrument lights. Close the plastic hoods over the warning lights on the panel. Pull the dimmer mask over the radio channel lights with the small knob on the control box. Any bright light in the cockpit is an annoyance.

Be certain that the gyro instruments are uncaged. Set the directional gyro and the artificial horizon before takeoff. Ground-check the instruments.

Be prepared for an instrument takeoff. If you lose the boundary light on your takeoff run, make an ordinary instrument takeoff. Hold your takeoff power settings until certain you have cleared all obstructions.

When flying night formation, you cannot properly judge the position and distance of a nearby airplane unless at least two points of light are visible. The P-47 affords the following: wing lights, tail light, and waste gates.

The wing lights of another plane are not visible from below unless you are well forward. Nor can you see the wing lights from the rear between 5 o'clock and 7 o'clock.

The waste-gate flare of another P-47 is visible only when you are well below, above, or sufficiently forward when on the same level to prevent the wing from obstructing the view.

From dead astern, nothing is visible on another plane except the tail light. This light is dim and easily confused with lights on the horizon. Accordingly, the best wing position is at about 5 o'clock, slightly below.

Elements and wingmen must use caution when crossing over to avoid losing the plane dead ahead upon passing through the astern position.

Before landing, orient yourself carefully. It is easy to be confused by other lights near the runway lights. If you use your landing light, do not turn it on until you are on your final approach at a speed of less than 200 mph. Use the landing light as an aid to taxiing, if necessary.

Use the landing light sparingly. Three minutes of continuous operation burns out the bulb. It also is a heavy drain on the battery.

Flying done between official sunset and official sunrise is logged in Form 1 as night flying time.

When flying at night consult your flight instruments frequently. Go on instruments at the first sign of vertigo. When flying night formation, don't stare too long at the lights on the plane ahead. Shift your gaze occasionally to avoid self-hypnosis.

Never try a forced landing away from the field at night. If you have trouble you can't lick, bail out above 3000 feet.

DON'T FORGET

EXTREME WEATHER OPERATION

Hot Weather

Hot weather means anything above 90°F up to and including the blast-furnace atmosphere of the desert. When starting the engine, these items on your checklist assume paramount importance:

Cowl flaps .....OPEN
Intercooler shutters .....OPEN
Oil cooler shutters .....OPEN
Carburetor air heat.....COLD

The engine requires little priming. If the airplane has been flown once during the day, 1 stroke (or at most 2 strokes) should be sufficient.

Heat plays havoc with tires. It softens and weakens the rubber. Avoid grinding a tire by locking one wheel on a turn.

Make a normal takeoff as described in the takeoff section, but don't wrap the tail around your neck.

An unnecessarily long run with excessive speed, coupled with the heat of the surface of the runway, brings early ruin to a set of tires. A tire may blow out on your next landing.

Use your brakes judiciously. Unwise application not only wears the tires, but heats the brake drums. On a plane that has made a number of landings during the day, the heat radiating from the drums injures the tires when the wheels are retracted.

While climbing or using additional boost to stay in formation, keep a steady watch on the cylinder-head and oil temperatures. It's easy to exceed the limits.

Hot weather often is accompanied by dust and sand. Use the air filter to keep flying particles out of the induction system. Except when in use near the ground, or in dusty atmosphere, leave the filter in the bypass position. It interferes with the efficiency of the engine.

Remember: Hot weather is no guarantee against carburetor icing.

Cold Weather

When making your preflight inspection:

Check for snow, frost or ice on the surfaces.

The slightest accumulation of frost affects the aerodynamic characteristics of the plane and may cause loss of control during takeoff. The thinnest film of ice provides a foundation on which other ice quickly forms.

Check for snow, frost, or ice on the antenna. Any one of the three interferes with the range and reception of the radio.

Operate all ailerons, elevators, rudders, trim tabs and flaps through their complete cycle of travel three or four times, noting the forces required. If the forces are excessive, check the system.

Before starting the engine, have the prop pulled through three or four times to loosen the oil. Have this done if the plane has been standing a short time, even though the prop previously had been pulled through during preflight.

Set these controls as follows:

Cowl flaps	**OPEN**
Intercoolers	**CLOSED**
Oil coolers	**CLOSED**
Carburetor air heater	**COLD**

After starting, readjust the controls to keep the engine within proper operating limits.

You have been instructed to use an outside power source when starting the engine to preserve your battery. This is doubly important in cold weather. In zero weather, the engine is 2½ times as hard to turn over, while the battery has less than ½ of its normal energy.

Considerable priming may be necessary to start a cold engine.

After energizing and when you are ready to engage, not before, prime 3 or 4 strokes. Then after engaging, if the engine doesn't take hold, prime with short, sharp strokes until it fires with regularity.

While aloft, remember that temperature inversions are common in winter. The ground air may be 60 to 90° F colder than at altitude. Be careful to avoid excessive cooling of the engine during your let-down.

If necessary to prevent excessive cooling, lower the landing gear and use partial flaps to reduce the airspeed. Keep on considerable power and regulate the intercooler shutters.

Try to maintain the cylinder-head temperature above 100°C and the oil temperature above 40°C during your let-down. The engine may cut out or fail when you advance the throttle if you let the temperatures drop too low.

If during flight you feel woozy, turn off the cockpit heater. It's not a bad idea to keep the ventilator cracked a little to provide fresh air.

When leaving your plane, under no circumstances set the parking brakes. Condensation in the drums will freeze, locking the brakes solid.

Oil Dilution

Dilute the oil if the plane is to remain standing for any length of time. Hold the oil dilution toggle switch ON for about 4 minutes while the engine is turning over at 800 rpm. This thins the oil with a mixture of gasoline. The fuel pressure drops when gasoline is actually being delivered.

Do not dilute when the oil temperature is more than 70°C. The hot oil evaporates the gasoline before it mixes. Let the oil cool before starting the process.

On planes with a hydromatic prop, it is necessary to dilute the oil in the prop as well as the engine. To achieve this, during the last 2 minutes of the dilution period increase the manifold pressure to 26" Hg., and move the prop control handle slowly from INC. to DEC. RPM 2 or 3 times.

Pull back the throttle for normal operation with 800 rpm, and after a moment repeat the

process at least once more. Always leave the prop in INC. RPM after applying the procedure.

When diluting oil, always keep the switch engaged until the engine stops turning, otherwise part of the gasoline will be flushed out by new oil.

The canopy and windshield defroster, operated by a push-pull rod above the instrument panel, provides preheated air which flows along the windshield and from an adjustable tube on the left side of the cockpit. The tube, popularly known as an elephant's trunk, has been replaced by a T-shaped heater on the floor between the rudder pedals on the D-25 and subsequent series.

Gun-bay heaters, operated by a control on the lower left cockpit wall, loosen sluggish oil in the gun mechanism.

Propeller fluid anti-freeze shoes may be installed to distribute fluid along the propeller blades. The flow is turned on by a switch in the cockpit. Use only for a few seconds at a time while seeking a non-icing altitude.

The battery is an airplane's Achille's heel in cold weather. Protect it at all times. The charge decreases proportionately with the temperature. Normally, during flight with the generator out, a battery lasts about an hour when babied. In cold weather, the time is cut to about 48 minutes.

It is difficult to lay down hard and fast rules for bailing out of the P-47, or any airplane. While emergencies follow a general pattern, the possible combinations of circumstances are innumerable.

Read PIF for general bailout practices and use of the parachute. The following section, based on the bailout experience of P-47 pilots in both the AAF and RAF, outlines specific procedures for this airplane.

Many factors must be considered in the problem: "To bail or not to bail." The principal ones

are: Altitude, airspeed, and condition of the plane. Normally, in a P-47, a controlled forced landing is preferable to bailing out.

But if you have any doubts about your ability to make a landing, jump. Save your plane if possible, but nobody expects you to do so at the risk of your life.

The important thing is to reach a decision. Then act on it without faltering. Change your mind only if a new set of circumstances arise.

In the initial excitement of a bailout, it is possible to overlook the most obvious first step —that is, to unfasten all connections linking you to the airplane.

Disconnect: Radio leads
Oxygen tubes
Safety belt
Shoulder harness

Unhook the mask by disconnecting the alligator clamp at the base. Continue to wear the mask. It protects your face from fire and cold.

BAILOUT PROCEDURES

1. Plane Under Control

Gain altitude if it is necessary. Call **Mayday** (international distress signal) on frequency or channel designated for distress. Switch on emergency IFF. If time permits, contact controller and give pertinent information, such as altitude and course.

Open the canopy (jettison canopy on D-15 and subsequent models). Disconnect your shoulder harness, intercom leads, oxygen tubing, and safety belt. Keep oxygen mask on to protect face from cold and fire. Pull up into a slow climb, bank the ship gently to the left, and go off the right wing as from this side the slipstream will aid in clearing the tail. If you prefer you may roll the plane on its back, release the safety belt, and fall out with the plane inverted.

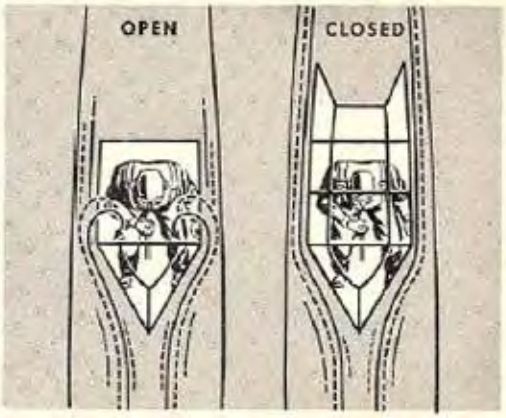
WHEN RELEASING CANOPY IN FLIGHT—DUCK

2. Plane Under Control but on Fire

Follow the normal procedure but **do not** open the canopy until last possible moment in order to keep flames and smoke out of the cockpit.

3. Plane Out of Control Not on Fire

Follow the normal plane under control procedure as far as possible but **never** release your safety belt until you are ready to leave the plane as in most cases you will be pulled or thrown clear by suction or some other force.



HOW FIRE IS SUCKED INTO COCKPIT

If altitude permits, wait until you slow down before pulling the rip-cord.

4. Plane Out of Control and on Fire

Follow the normal out of control procedure, remembering not to open the canopy until the last possible moment.

MAKE A NORMAL 3-POINT LANDING

Ordinarily, it's better to bail out over water than to ditch a P-47. The equipment you need is fastened to your 'chute and you escape the risk of a crash landing.

However, if you can't bail out because of lack of altitude, follow the general ditching instructions contained in PIF, plus certain specific procedures for the P-47.

If inclined to get panicked, remember that the P-47's sturdy construction and oval-shaped fuselage have enabled many pilots to make successful ditchings.

Before setting down on the water:

Jettison external tanks and any loose equipment.

Unfasten parachute. Refasten safety belt and shoulder harness. Lock the harness.

Open or jettison the canopy.

Use a flap setting giving minimum rate of descent with speed slightly above stalling.

Just before the impact, completely close the throttle.

Raise the left arm to protect your face and absorb the shock.

When the plane has stopped:

Release the safety belt and harness.

Remove the dinghy from the parachute.

Jump out.

Inflate the life vest.

Inflate dinghy and wriggle in.

Salvage parachute, if possible.

Make a normal landing with nose high, though slightly less than when in the 3-point position. When the nose settles into the water, the plane bucks violently two or three times, then comes to a halt.

The landing is rough. Cushion yourself as much as possible until the plane stops completely. With flaps up, the landing is smoother, but the forward speed is greater. For that reason, a flap landing is preferable.

When the plane stops, it starts sinking by the nose. The tail disappears in about 1 minute. But it only takes a few seconds to get clear.

Make sure you throw the shoulder harness aside after unfastening the safety belt.

Dive out and back toward the tail.

If you failed to unfasten the parachute harness in the air, do not inflate the life vest until you rid yourself of the harness. The expansion makes the harness hard to remove.

The proper way to mount a dinghy is to half inflate it, climb in, then complete the inflation. If fully inflated the dinghy is difficult to board.

Spread your parachute on the water, if you saved it, as a signal to rescuers. The white expanse is much easier to see than a small dinghy. Rescuers will be on their way if you gave a radio call.

Stay clear of the plane as it goes down. There is no danger of suction, but your equipment might become fouled with the sinking plane.