LANDING

On approaching the field for a landing, your best bet is to make a before-landing check before getting into the landing pattern. Anything you can do at this time in setting controls or making adjustments allows you that much more time to concentrate on the actual landing later.

As you approach the field, make the following checks:

1. Fuel—check tank gages and select fullest internal tank for landing.
2. Fuel booster—put fuel booster pump switch at ON (if your plane has a three-position switch, set it at EMERGENCY).
3. Mixture control—if it isn't already there, move mixture control to RUN or AUTO RICH.
4. Landing gear—move control to DOWN. Check indicator to see that gear is down and locked.
5. Shoulder harness—lock harness and check by leaning forward against it.
6. Prop control—forward to 2700 rpm.
7. Flaps—full down. You'll usually wait until the turn into final approach before lowering flaps.

The traffic pattern you use depends upon the local situation. Every field has its own traffic pattern, and this pattern may vary from time to time, depending upon local conditions and limitations. Therefore, no set traffic pattern is recommended or given in this manual.

There are two general rules to follow in every case, regardless of the traffic pattern. Never forget them:

1. Keep the pattern in close enough to the field and at sufficient altitude so you can bring your airplane in safely even with the power off, if necessary.

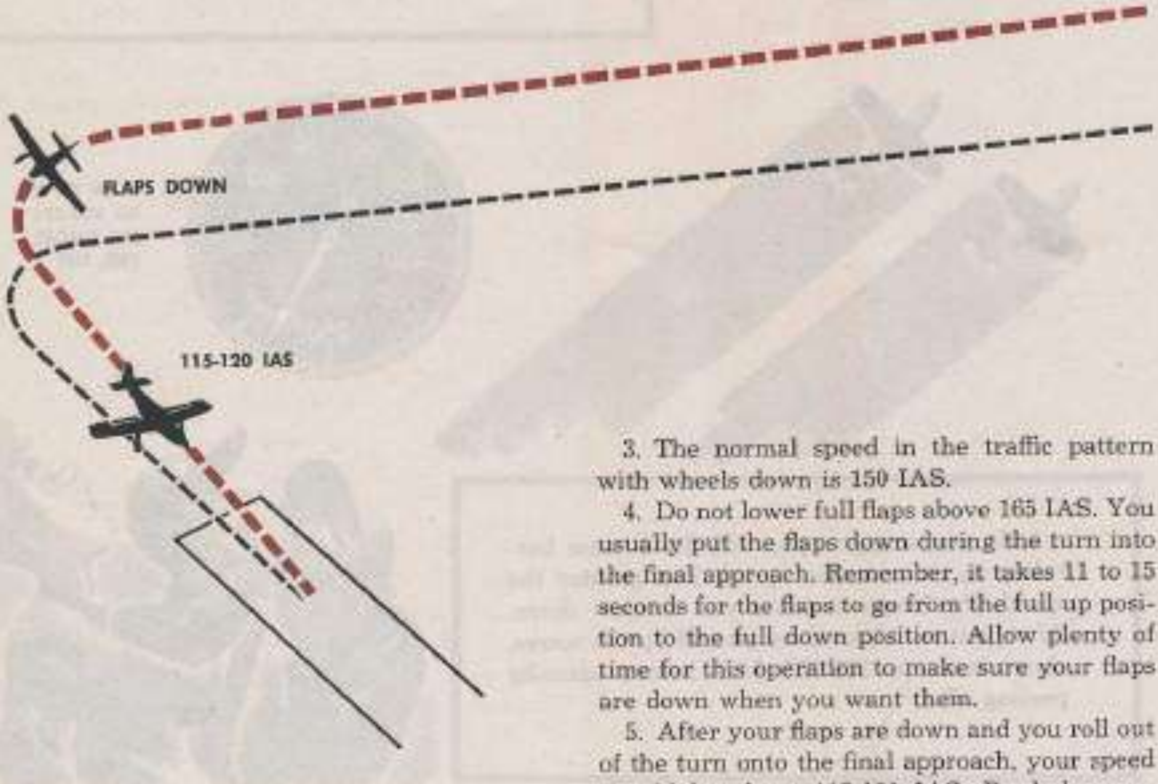
SLOW DOWN TO 200-225 IAS BEFORE PEEL OFF

2. In preparing to peel off, don't come barreling in at excessive speed. The greater the speed, the longer it takes you to slow down. After you are cleared for peeloff by the tower, slow down to 200-225 IAS before actually peeling off.

The detailed procedure for a landing depends, of course, upon the traffic pattern. Speeds should conform to this pattern. However, here are some things to remember in any normal landing:

1. Slow down to 170 IAS before lowering your landing gear.

2. In lowering the landing gear, make sure the control handle is **DOWN and locked.** Check the landing gear indicator lights. Be sure the hydraulic pressure returns to 1000 psi. You should definitely feel each landing gear snap into position. When the landing gear comes down, the airplane gets quite nose heavy. However, you can easily adjust the trim tabs to take care of this. Don't forget that the gear takes 10 to 15 seconds to go down.



3. The normal speed in the traffic pattern with wheels down is 150 IAS.

4. Do not lower full flaps above 165 IAS. You usually put the flaps down during the turn into the final approach. Remember, it takes 11 to 15 seconds for the flaps to go from the full up position to the full down position. Allow plenty of time for this operation to make sure your flaps are down when you want them.

5. After your flaps are down and you roll out of the turn onto the final approach, your speed should be about 115-120 IAS. Don't keep so much power on that you'll be making a power

approach. However, maintain sufficient power to keep your engine clean.

6. Just before getting to the runway, break your glide, make a smooth roundout, and approach so as to land within the first third of the runway, in a 3-point attitude, as shown above.

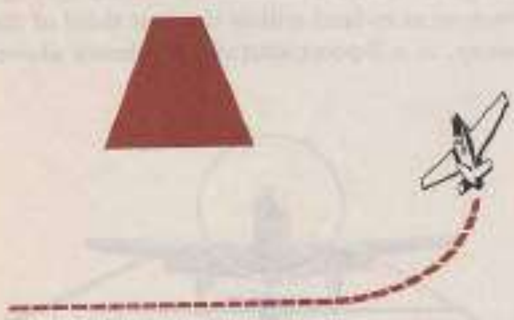
7. Hold the plane off in the 3-point attitude just barely above the runway until you lose flying speed and the plane sets down. The P-51 doesn't mush but stalls rather suddenly when you lose flying speed. So have your plane close to the runway at this point.

8. Since the tailwheel is locked when the stick is in neutral or to the rear, your tailwheel is automatically locked as you approach for landing. On rolling on the runway, therefore, keep the stick back until you slow down enough and are ready to turn off the runway.

9. Never attempt to push the stick forward and unlock the tailwheel in a turn. Release the tailwheel before starting the turn.

COMMON ERRORS IN LANDINGS

There are several common errors which new pilots make in landings:



Coming in Too Low

Another common error is making the final turn too low and too far out. In such a situation you have to use excessive throttle to drag the plane in and have to put it into a nose-high attitude to keep out of the trees. If your engine sputters once in such an attitude, you just won't glide far.

Coming in Too Fast

You will come in too fast if you fail to cut your throttle soon enough, if you fail to lower your flaps in time, or if you dive the plane at the end of the runway in attempting to land it in the first third. If you're coming in too fast when you level off, you will float—and find yourself too far down the runway by the time you lose flying speed.

Coming in Too Slow

If you bring the airplane in too slowly, it tends to fall out from under you when you break your glide. You may lose your flying speed completely.

If you see you are coming in too slow, don't wait too long to use the throttle. In a high-speed airplane like the P-51, don't hesitate to use the throttle if necessary even after you have once cut it back. Your engine is there to give you power when you need it—**use it.**

Ballooning

Ballooning is a result of overcontrolling. You will start ballooning if you try to break a steep glide by jerking back on the stick, or if you come in fairly fast and lower your flaps too late. The airplane balloons up and you are in the embarrassing position of making a landing 10 feet off the ground.

If you ever get into this situation, ease on a little throttle and, if there is sufficient runway, land in a 3-point attitude. If there isn't sufficient runway, go around.

Catch the ballooning before you get up too high and lose flying speed. If you don't, you may drop a wing or otherwise pile up your airplane.

Bouncing

Bouncing is another result of overcontrolling. You will get into this situation if you break your glide too late, bounce on the tires, and then attempt to recover by pushing forward on the stick. You find yourself pulling back on the stick when you should be pushing forward, and pushing forward when you should be pulling back—using the right controls but at exactly the wrong time. This causes you to bounce higher and slower until you settle down permanently, the hard way.

The way to recover from such a situation is to use a little throttle at the top of the bounce. If you can't recover with the throttle and proceed with a normal landing, **go around.** Don't just pull back on the stick and sit there.

Remember, the P-51 is extremely sensitive on the elevator controls.

Forcing the Tail Down

Another common error is in attempting to force the tail down after a wheel landing while still rolling on the front wheels. If you have enough speed to keep the tail up, don't pull back on the stick, since this may cause ballooning.

If you do make a tail-high, wheel landing, the recommended procedure is to let the airplane roll until the tail settles through loss of speed.

TIPS ON LANDING

1. Check all the instruments and make all the adjustments you can while circling in the traffic pattern. This will give you more time to concentrate on the actual landing during the final approach.

2. Flare out from your approach glide into a 3-point attitude over the end of the runway. From this position you can make either a 3-point or a wheel landing.

3. Always make 3-point landings unless a wheel landing is justified by unusual weather conditions.

4. Bring the airplane down as close to the ground as possible before stalling out. The perfect position to grease it in is 1 inch off the ground.

5. Never try to land with so much speed that you have to use the stick to hold your airplane on the ground in a nose-low, tail-high attitude. Propeller clearance with the fuselage in **level flight** is only 7¾ inches.

CROSSWIND LANDINGS

The recommended procedure for crosswind landings is:

1. Drop the wing into the wind slightly to counteract the drift, and keep the plane straight with the runway.

2. Just before touching the runway, level your wings.

3. Be sure to keep the stick back after contact, so that the tailwheel will remain locked.

Make a wheel landing if the crosswind is excessive, gusty, strong, or otherwise doubtful.

Use about half flaps for any appreciable crosswind.

If you have to crab at any time, be sure to straighten out before landing. Never land in a crab as it is very hard on your landing gear.

GUSTY LANDINGS

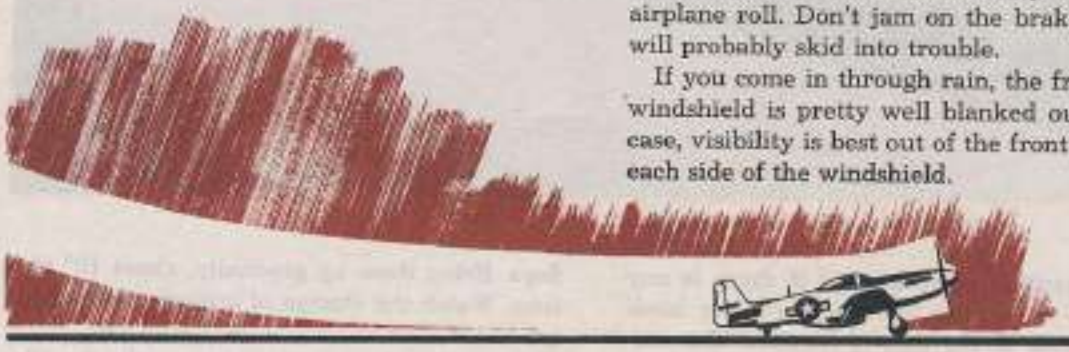
In a gusty wind, come in slightly faster than normal.

Watch for the effect of a gust on the airplane. The gust tends to have a ballooning effect. Then, when the gust quits, the airplane is apt to drop out from under you—and you may get a wing in the ground.

Keep enough flying speed to cushion this drop.

Use about half flaps.

WET LANDINGS



The important thing about wet landings is to be especially cautious in using your brakes. Line up straight with the runway and let the airplane roll. Don't jam on the brakes, or you will probably skid into trouble.

If you come in through rain, the front of the windshield is pretty well blanked out. In that case, visibility is best out of the front panels on each side of the windshield.

MUDDY FIELD LANDINGS

The thing to remember when landing in a muddy field is to keep a definite 3-point attitude and stay off the brakes.

If you land in a tail-high attitude, your wheels will sink or drag in the mud and you'll probably nose over.

GO-AROUND PROCEDURE

Don't hesitate to go around if there is any possibility of getting into trouble while landing. It's done in the best of families. The recommended go-around procedure is:

1. Advance the throttle quickly but smoothly to a manifold pressure of 46" at 2700 rpm.
2. At the same time, counteract left torque by using right rudder and right trim tab.
3. Then trim the airplane to relieve the elevator pressure.
4. Raise the landing gear.
5. After your IAS reaches 120 mph, and you have attained an altitude of 500 feet, raise the flaps. Bring them up gradually, about 10° at a time. Watch the change of attitude as the flaps are raised.

Remember: Don't jerk or jam on the throttle. Use all controls smoothly, and pull up gradually to avoid risking a stall.

If you have rolled the elevator trim tab back for the intended landing, it may take considerable forward stick pressure to keep the nose down until you can re-trim the plane.

Most important of all in going around, continue on a **straight** course. Don't attempt any turns until your flaps are up.

FLIGHT CHARACTERISTICS

The P-51 is one of the sweetest-flying fighter planes ever built. It is very light on all controls and stable at all normal loadings.

Although light on the controls, it is not so sensitive that you would call it jerky. Light, steady pressures are all you need to execute any routine maneuver.

At various speeds in level flight or in climbing or diving, the control pressures you have to hold are slight and can be taken care of by slight adjustments on the trim tabs. However, the trim tab controls are sensitive; use them carefully. The rudder and the elevator trim change slightly as the speed or the power output of the engine changes.

The airplane is entirely normal in its flying characteristics. If you've trimmed for normal cruising speed, the airplane will become nose heavy when you raise the nose and decrease airspeed.

Under the same normal cruise conditions, when you lower the nose and increase speed, the airplane becomes tail heavy in direct proportion to the speed.

When you lower the flaps, the airplane becomes nose heavy.

When you raise the flaps, the airplane becomes tail heavy.

When you retract the landing gear, the airplane becomes tail heavy.

When you lower the landing gear, the airplane becomes nose heavy.

MAX. TAKE-OFF MANIFOLD PRESSURE— 61 IN. HG (155 CM. HG)
OPERATING RANGE 26-36 IN. HG
(6604-91.44 CM. HG)

MAX. PERMISSIBLE OIL TEMPERATURE 90°C (194°F)
OPERATING OIL TEMPERATURE 70-80°C (158-176°F)
MIN. PERMISSIBLE OIL PRESSURE 50 LBS./SQ. IN.
OPERATING OIL PRESSURE RANGE 70-80 LBS./SQ. IN.

MAX. FUEL PRESSURE 19 LBS./SQ. IN.
MIN. PERMISSIBLE FUEL PRESSURE 14 LBS./SQ. IN.
OPERATING FUEL PRESSURE RANGE 16-18 LBS./SQ. IN.

MAX. TAKE-OFF RPM 3000
OPERATING RANGE 1600-2400

MAX. PERMISSIBLE INDICATED AIRSPEED 505 MPH
(808 KM PH, 440 KNOTS)

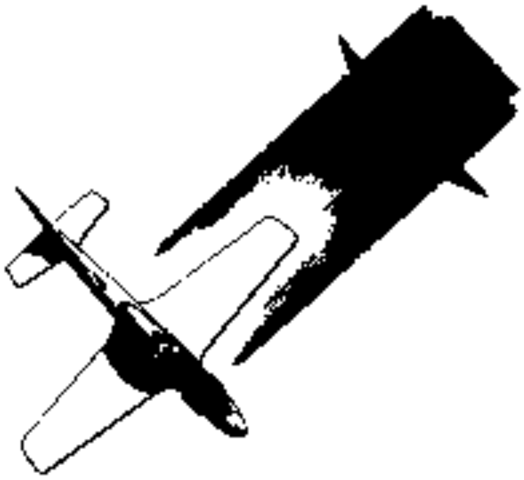
CARB. AIR
DESIRABLE CARB. AIR TEMP. RANGE 15-30°C (59-86°F)
MAXIMUM 40°C (104°F)

MAX. COOLANT TEMPERATURE
121°C (250°F)
OPERATING RANGE 100-110°C
(212°F TO 230°F)

Limitations for the airplane are given in the illustration above. These limitations are for all normal flying.

For your convenience, maximums and minimums for the engine are given in the airplane on a placard on the right side of the cockpit. Flight limitations for the airplane are also given on this placard.

The P-51 does not hold a sustained sideslip. The aileron control is not sufficient to hold the airplane in a sidestipping angle. However, you can sideslip it long enough to avoid enemy fire in combat. When any sideslipping is attempted, be sure to recover completely above 200 feet.



CAUTION

In designing the later models of the P-51 and adding new equipment such as radio units and an additional gas tank, the center of gravity of the airplane has been moved back. The effect is that the amount of back pressure necessary to move the stick has been reduced. Instead of a force of 6 pounds per G of acceleration, you exert a force of only 1½ pounds, the stick forces reversing as acceleration exceeds 4 G's.

This means that you'll have to be careful in sharp pullouts and steep turns. You can easily black out—and you can also put greater loads on the airplane than its structure was designed to withstand.

FULL FUSELAGE TANK

Be especially careful in handling the stick when the fuselage tank contains more than 25 gallons of gas. In this case the flying characteristics of the airplane change considerably—increasingly so as the amount of fuel in the tank is increased.

When you are carrying more than 40 gallons of fuel in your fuselage tank, do not attempt any acrobatics. The weight of this fuel shifts the center of gravity back so the airplane is unstable for anything but straight and level flight.

Be sure you are accustomed to the changed flying characteristics of the airplane before engaging in any maneuvers with a full fuselage tank. You need at least one or two hours of flying with the plane in this condition to accustom yourself to it.

REVERSIBILITY

With the fuselage tank full, the center of gravity of the airplane moves back so far that it is almost impossible to trim the airplane for hands-off level flight. Also, as soon as you enter a tight turn or attempt a pullout, the stick forces reverse.

For example, in a turn you naturally start out by holding back on the stick. But soon you find the airplane wanting to tighten up, and you have to push **forward** on the stick to prevent this.

The same thing happens in a dive. The airplane tends to pull out too sharply, and you have to change from holding back on the stick to pushing **forward** on it to keep the airplane in a proper pullout.

This is called reversibility. You'll encounter it in the P-51 only when the fuselage tank has a considerable quantity of gas in it. Be prepared in this situation. It is easily handled; just don't be surprised when it happens.

The stability of the airplane improves rapidly as you use up the gas in the fuselage tank. By the time the tank is half empty, only a slight tendency to tighten up is noticeable. It still is impossible to trim for hands-off level flight at this time, but this condition rapidly disappears as the fuel in the tank drops below the half-full level.

The P-51D's reversibility characteristics have been improved by the addition of a 20-pound bobweight to the elevator control system bellcrank. This weight reduces the amount of forward pressure you'll have to exert to overcome the reversibility tendency.

WITH EXTRA WING TANKS

When the airplane is carrying droppable fuel tanks, only normal flying attitudes are permitted. Don't try anything but normal climbing turns and let-downs when you're carrying extra wing tanks.

LOW LEVEL FLIGHT

When you're flying on the deck, trim the plane for a slightly tail-heavy condition. By doing so you'll avoid the risk of flying into the treetops if your attention is momentarily distracted from the controls.

HIGH-ALTITUDE CHARACTERISTICS

The high-altitude characteristics of the P-51 are equal to those of any other fighter plane, and in many respects are superior. With the 2-stage, 2-speed supercharger in operation, there is plenty of power up to well above 35,000 feet.

As in any airplane, the higher you go, the farther you have to move the controls to get the same results. To make a turn at 35,000 feet, for example, you have to move the controls considerably farther than to make the same turn at 10,000 feet, if your true airspeed is the same in both cases. The air up there is so thin that it takes a lot more of it to exert an equal pressure on the control surfaces.

The supercharger blower will automatically shift into high speed at between 14,500 and 19,500 feet. This change will be accompanied by a momentary power surge and increase in manifold pressure, until the manifold pressure regulator catches up.

There is no noticeable effect when the supercharger shifts back on the let-down. Therefore, below 12,000 feet notice the amber light next to the supercharger switch. If the light isn't out below that altitude, raise the cover and turn the switch to LOW.

When the supercharger is in high blower, be especially careful to handle the throttle smoothly. Any rough handling causes the engine to surge. And any surging of power above 35,000 feet greatly decreases the efficiency of the airplane and increases the effort that you have to make in controlling it.

TESTING HIGH BLOWER ON THE GROUND

HIGH-SPEED DIVING

The diving characteristics of the P-51 are outstanding. Because of its clean-lined design, laminar-flow wing, exceptional aerodynamic characteristics, and small frontal area made possible by the single in-line engine, the P-51 outdives just about any airplane built.

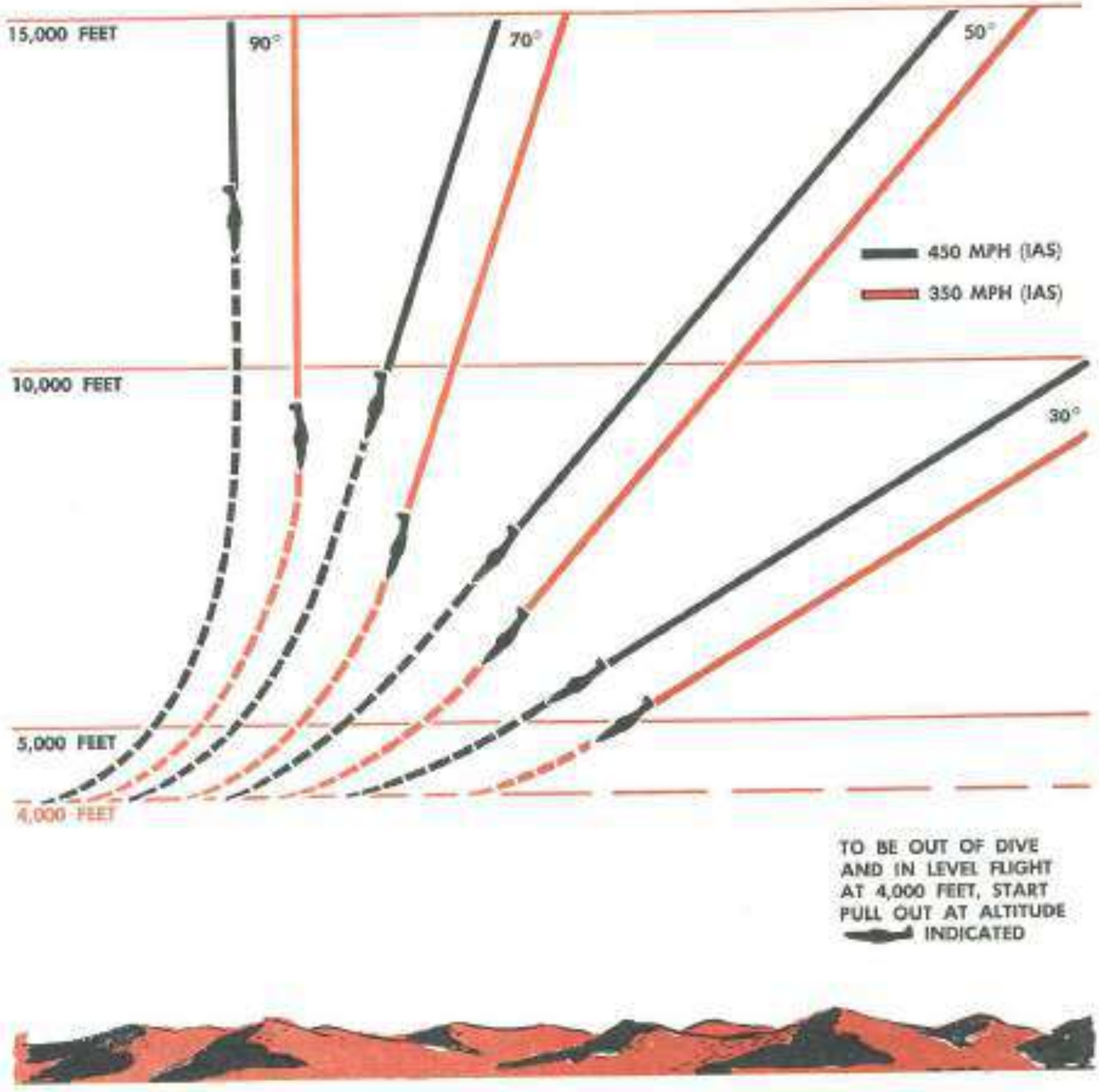
It is capable of developing terrific speeds which makes it no toy to be played with. Yet its handling, even in high-speed dives, is not difficult if you know what you're doing.

In making a high-speed dive the most important thing is to take it easy.

Since the dive, from beginning to end, is over in a matter of seconds, you don't have much time to think things out. So know exactly what you're going to do, and then do it carefully and cautiously. Above all, don't get excited.

As the ground comes up toward you terrifically fast, allow yourself plenty of altitude for the recovery. Don't dive too close to the ground.

Note the accompanying table which shows the minimum safe altitude required for pullout from dives of various degrees. These figures are based on a constant 4G acceleration, which is about what the average pilot can withstand without blacking out.



TO BE OUT OF DIVE AND IN LEVEL FLIGHT AT 4,000 FEET, START PULL OUT AT ALTITUDE INDICATED

DIVE RECOVERY PROCEDURE

The recommended procedure for recovering from a high-speed dive is:

1. Reduce the power. Don't attempt to pull out of a dive with the power on. With power on, the airplane continues to pick up speed.

2. Maintain a straight course by use of the rudder. The airplane has a tendency to yaw slightly to the right in a dive so you have to counteract this with slight use of left rudder. Don't allow the airplane to yaw, and never attempt to slow down your airplane by **deliberately** yawing it.

3. Ease the stick back. **Don't jerk the stick or otherwise overcontrol at this time.** Be sure you **don't pull out abruptly.**

NOTE that in this recommended dive recovery, you don't use the trim tabs. It isn't necessary to use the tabs, and since they are extremely sensitive, it is recommended that you don't use them. With the airplane trimmed for normal cruise, you can control the airplane in a high-speed dive with only the stick and rudder pedals.

In extremely high-speed dives, you can use the trim tabs intentionally, if you desire, but use them carefully.

If you use the tabs, the following procedure is recommended:

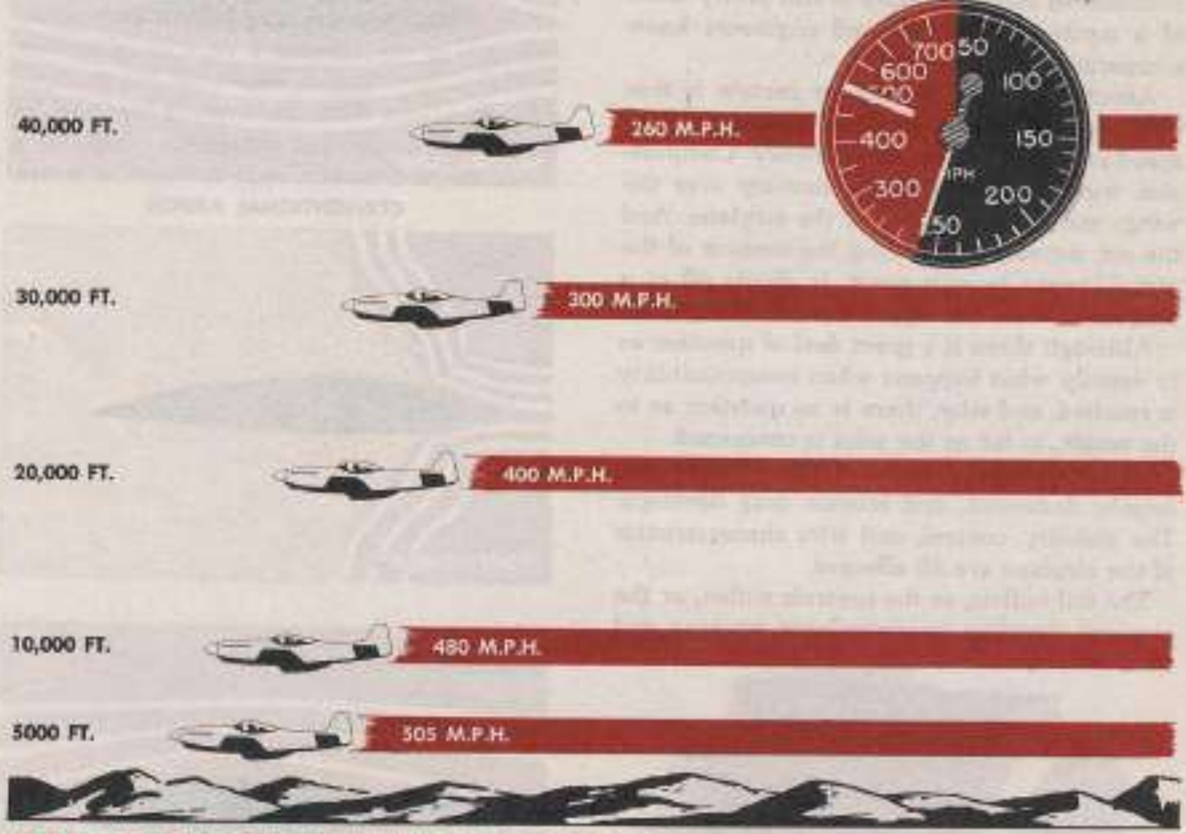
1. Trim the airplane for normal cruising.

2. About halfway through the dive, use slight elevator and rudder trim, but be careful not to trim the airplane nose heavy.

3. As the airplane continues to accelerate, it again becomes tail heavy—increasingly heavy as speed increases. However, make no further adjustment of the tabs. After having made this one adjustment, you can control the airplane easily with the stick and rudder. The ailerons become increasingly heavy as the speed of the airplane increases.

MAXIMUM ALLOWABLE IAS

The maximum safe airspeeds for the P-51 at different altitudes are given in the accompanying graph. Note that the figures given are IAS (indicated airspeed) figures



NEVER EXCEED THESE SPEEDS

If you do, you're asking for trouble

Notice that at altitudes above 5000 feet the figures are **less** than 505 IAS (the red-line figure on the airspeed indicator of the airplane). At 40,000 feet, for example, the maximum safe speed is 260 IAS.

In other words, the red-line figure for the P-51 is not a **fixed** figure but a **variable** figure—variable with altitude. The higher you go, the lower the maximum allowable IAS. This is true of all ultra-fast, high-altitude fighter planes used for high-speed diving.

The **usual** red-line speed for an airplane (the one marked on the airspeed indicator) is the speed at which the airload on the wings and other structural members reaches the maximum that these members are designed to carry. Above this speed, the wings and other structural members cannot safely carry the extreme airloads that develop.

In the case of high-speed fighter planes, however, a new factor enters the picture which makes diving unsafe at high altitudes long before the usual red-line speed is reached. This new factor is compressibility. It is the reason—and a good one—for the variable red-line speed above 5000 feet.

COMPRESSIBILITY

Since extremely high airplane speeds have been developed only in recent years, the phenomenon of compressibility is still pretty much of a mystery. Scientists and engineers know comparatively little about it.

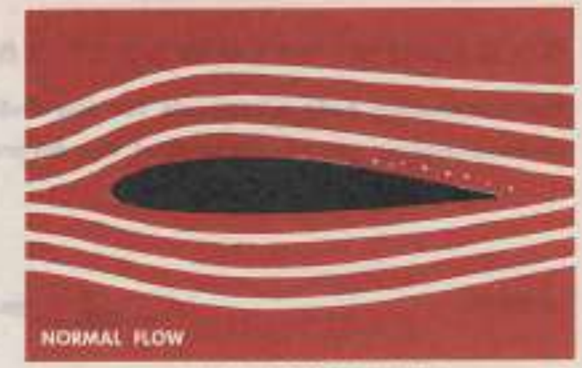
About all that is known for certain is this: Just as soon as an airplane approaches the speed of sound, it loses its efficiency. Compression waves or shock waves develop over the wings and other surfaces of the airplane. And the air, instead of following the contour of the airfoil, seems to split apart. It shoots off at a tangent on both the upper and lower surfaces.

Although there is a great deal of question as to exactly **what** happens when compressibility is reached, and **why,** there is no question as to the **result,** so far as the pilot is concerned.

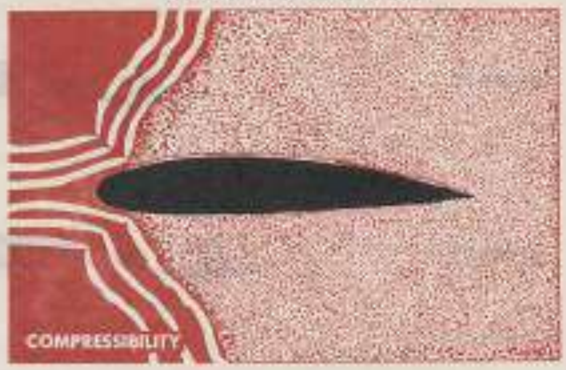
The lift characteristics of the airplane are largely destroyed, and intense drag develops. The stability, control, and trim characteristics of the airplane are all affected.

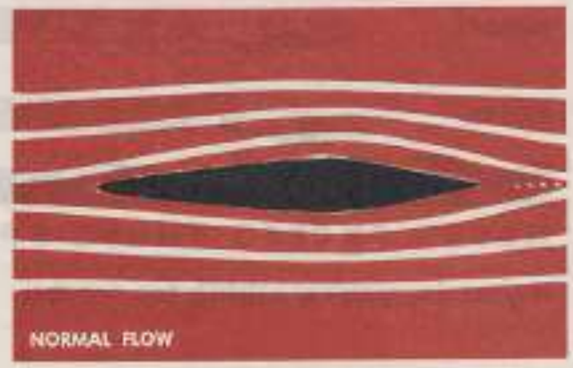
The tail buffets, or the controls stiffen, or the airplane develops uncontrollable pitching and porpoising, or uncontrollable rolling and yawing, or any combination of these effects. Each type of high-speed fighter plane has its own individual compressibility characteristics.

If the speed of the airplane isn't checked and the pilot doesn't regain control of it, either the terrific vibrations of the shock waves cause



CONVENTIONAL AIRFOIL





LAMINAR FLOW AIRFOIL

structural failure or the airplane crashes while still in the compressibility dive.

In your P-51, the first effect of compressibility that you feel is a "nibbling" at the stick—the stick will occasionally jump slightly in your hand. If you don't check the airspeed, this will develop into a definite "walking" stick—the stick will "walk" back and forth and you won't be able to control it. At this stage the airplane is beginning to porpoise—that is, to pitch up and down in a violent rhythm like a porpoise. As the airplane accelerates further, the porpoising will become increasingly violent.

Once the airplane begins to porpoise, you won't be able to anticipate its porpoising movements by any counter-movements of the stick. Anything you do in this regard merely makes the situation worse. Or you may develop an aggravated case of reversibility—the control forces reverse, as they do when your fuselage tank is full and you have to push forward on the stick in a dive to keep the airplane from pulling out too abruptly.

It is possible to come out of compressibility safely if you don't go into it too far. But before discussing the recovery procedure, here are some additional facts about compressibility.

MACH NUMBER

An airplane goes into compressibility before actually reaching the speed of sound. Some airplanes go into it when they reach 65% of the speed of sound; some when they reach 70% of the speed of sound. It all depends on the design of the airplane.

The percentage figure at which any particular airplane goes into compressibility is known technically as its critical Mach number (named after the man who discovered this relationship between true airspeed and speed of sound).

The P-51 has one of the highest critical Mach numbers of any airplane now in combat. It can be dived to beyond 75% of the speed of sound before going into compressibility.

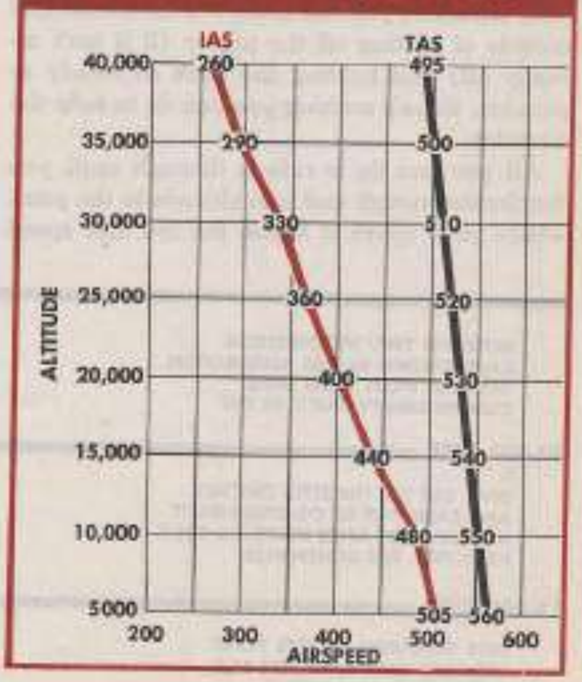
One of the most important factors to remember about compressibility is that the speed of sound varies with altitude. Note these approximate figures:

At sea level, sound travels 760 mph.

At 30,000 feet, sound travels 680 mph.

The higher you are, therefore, the sooner you approach the speed of sound. And, the higher you are, the lower your safe IAS

MAXIMUM ALLOWABLE DIVING SPEEDS



When you get above 5,000 feet in the P-51, the maximum safe IAS is less than the 505 IAS red line of the airplane. Above that altitude, you go into compressibility before you reach the red line on your airspeed indicator. That's the reason for the variable red line speed as given in the graph.

The accompanying illustration shows the maximum allowable safe speeds in terms of TAS as well as IAS. Notice how much these two figures differ. At 35,000 feet, for example, an IAS of 290 mph means you're actually traveling 500 mph (TAS)!

Many a pilot fails to realize this great difference between IAS and TAS at high altitudes. Don't be fooled—study these figures carefully.

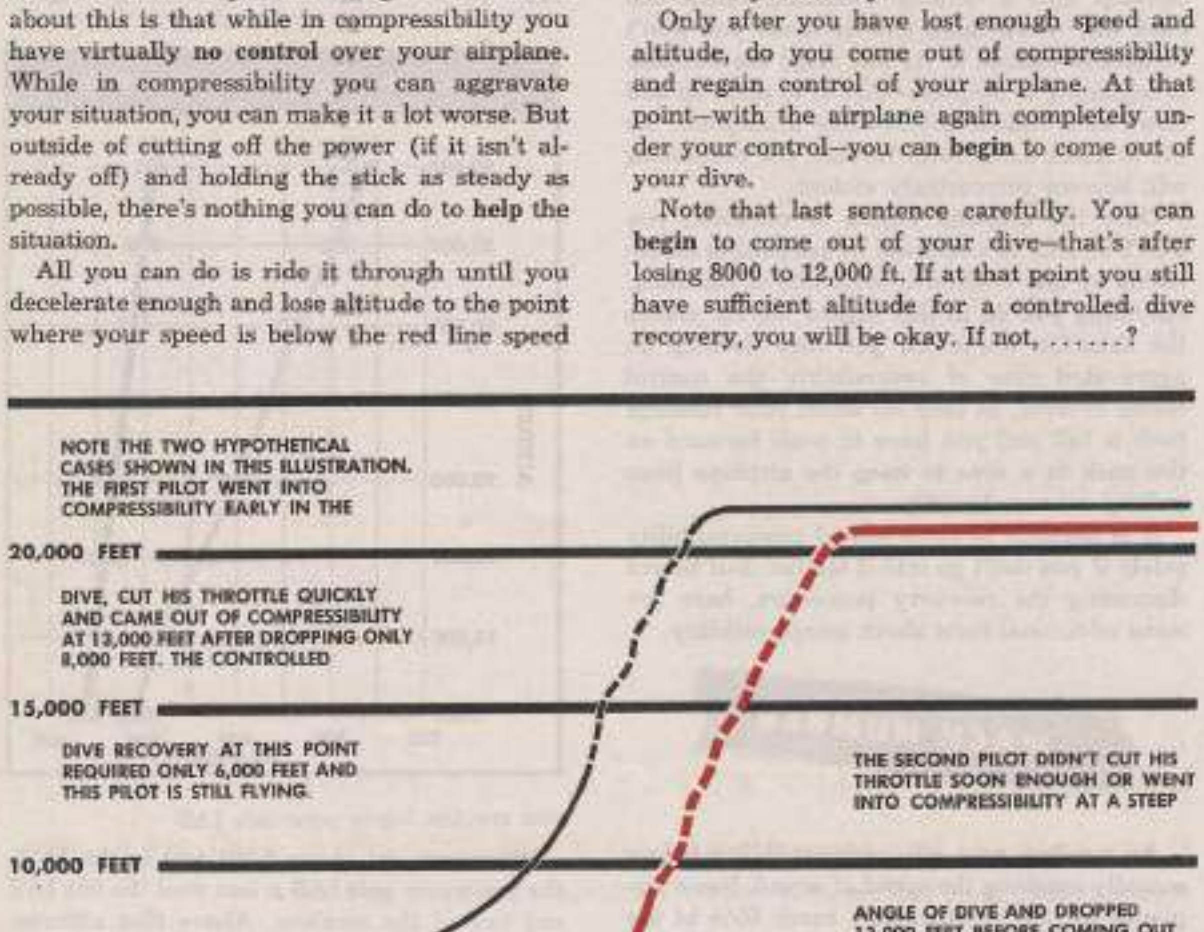
UNCONTROLLED DIVE

As noted earlier, it is possible to come out of compressibility safely if you don't go into it too far. The most important thing to remember about this is that while in compressibility you have virtually **no control** over your airplane. While in compressibility you can aggravate your situation, you can make it a lot worse. But outside of cutting off the power (if it isn't already off) and holding the stick as steady as possible, there's nothing you can do to **help** the situation.

All you can do is ride it through until you decelerate enough and lose altitude to the point where your speed is below the red line speed as given in the table. **This usually means an uncontrolled dive of between 8000 and 12,000 feet, depending upon circumstances.** The exact distance you drop and the length of time you are in compressibility depend to a great extent upon the angle of dive in which you **encountered** compressibility.

Only after you have lost enough speed and altitude, do you come out of compressibility and regain control of your airplane. At that point—with the airplane again completely under your control—you can **begin** to come out of your dive.

Note that last sentence carefully. You can **begin** to come out of your dive—that's after losing 8000 to 12,000 ft. If at that point you still have sufficient altitude for a controlled dive recovery, you will be okay. If not, ...?



NOTE THE TWO HYPOTHETICAL CASES SHOWN IN THIS ILLUSTRATION. THE FIRST PILOT WENT INTO COMPRESSIBILITY EARLY IN THE DIVE, CUT HIS THROTTLE QUICKLY AND CAME OUT OF COMPRESSIBILITY AT 12,000 FEET AFTER DROPPING ONLY 8,000 FEET. THE CONTROLLED DIVE RECOVERY AT THIS POINT REQUIRED ONLY 6,000 FEET AND THIS PILOT IS STILL FLYING.

THE SECOND PILOT DIDN'T CUT HIS THROTTLE SOON ENOUGH OR WENT INTO COMPRESSIBILITY AT A STEEP ANGLE OF DIVE AND DROPPED 13,000 FEET BEFORE COMING OUT AT 8,500 FEET. AT THIS POINT, THE CONTROLLED DIVE RECOVERY REQUIRED 9,000 FEET. HE DIDN'T HAVE IT.

ELEVATOR MODIFICATION

Latest P-51D's and K's come from the factory with metal covered elevators and with decreased angle of incidence of the horizontal stabilizer. Existing airplanes will be modified in the field so that ultimately the changeover will affect every airplane of the P-51D and K series. Be sure you know the status of your plane because this modification changes some of the flight characteristics, at high Mach numbers, from those described on the preceding pages. Porpoising has been eliminated up to Mach number of at least .80. However, the elevator stick force characteristics are not as good. When diving a modified airplane you will find that as you get close to a Mach number of .74, less and less forward pressure on the stick is required to maintain the angle of dive. As your speed exceeds .74 Mach number, you will have to start pulling on the stick to keep the nose from dropping. This pull will continue to increase with Mach number. As an example, in a dive test performed by the Flight Section of ATSC it was found that at .775 Mach number a pull of 10 pounds was required to maintain a straight forward flight path. This stick force was an increase from 0 stick force at a Mach number of 0.746. Also, a greater additional force is required to start recovery from a dive at high Mach number than from a dive at low Mach number.

The placard Mach number limit for the modified airplane is the same as for the others—.75. So long as you don't exceed it you'll be all right, but you are sticking your neck out when you do. You won't feel serious compressibility effects if you keep your diving speed below .75 Mach number, and recovery can be made without difficulty. Exceeding that Mach number will bring on vibration of the stick, vibration of the airplane, and a wallowing motion caused by low directional stability. This means that you must start a smooth recovery. Do not wait or try to ride the dive to a lower altitude because that technique is not necessary with this airplane; smooth recovery is possible at any altitude sufficiently high.

COMPRESSIBILITY RECOVERY PROCEDURE

If you ever get into compressibility in a high-speed dive, don't get excited. Keep calm, and follow this recommended recovery procedure:

1. **Cut the power immediately.** To get out of compressibility you've got to lose airspeed, so **cut your throttle back.**
2. Release a slight amount of the forward pressure you're holding on the stick.
3. Don't allow the airplane to yaw. Never **deliberately** yaw it to slow the airplane down.
4. Hold the stick as steady as you possibly can. Don't attempt to anticipate the porpoising movement by counter-movements of the stick.
5. As the airplane slowly but steadily decelerates with power off, and you get into the lower altitudes where the speed of sound is greater, the porpoising stops and you regain complete control of the airplane.
6. Pull out of the dive in a normal recovery. **Don't pull out abruptly.** Take it as easy as altitude permits.

Notice in the above procedure that you don't use the elevator trim tab. It isn't needed.

GLIDING

You can glide the P-51 safely at any speed down to 25% above stalling speed. Under average load, this is about 125 mph IAS at any level, the speed increasing with the weight of the airplane. Although the minimum safe gliding speed increases with altitude in terms of TAS, it remains approximately the same in terms of IAS.

When the landing gear and the flaps are up, the glide is fairly flat. In this condition, however, with the nose extremely high, forward visibility is poor.

Lowering either the flaps, the landing gear, or both, reduces slightly the minimum safe gliding speed, greatly steepens the gliding angle, and increases the rate of descent.

STALLS

A stall in the P-51 is comparatively mild. The airplane does not whip at the stall, but rolls rather slowly and has very little tendency to drop into a spin. When a complete stall is reached, a wing drops. After that, if you continue to pull back on the stick, the airplane falls off into a steep spiral.

When you release the stick and rudder, the nose drops sharply and the airplane recovers from the stall almost instantly.

You'll generally be warned of an approaching stall by a buffeting at the elevators. In a power-off stall the buffeting is slight, becoming noticeable at 3 or 4 mph above stalling speed. Violence of the elevator buffet increases with the speed of the stall.

The speeds at which stalling occurs vary widely, depending on the gross weight and the external loading of the airplane. Lowering the flaps and landing gear, of course, reduces stalling speed considerably.

A power stall either with wheels and flaps up or with wheels and flaps down is much more violent than a power-off stall.

Notice that while in a stalling attitude the rudder remains sensitive well after the ailerons have lost their efficiency. You can see, therefore, why a sudden application of power in making a landing will aggravate a wing-low condition.

Recovery from any stall is entirely normal. Apply opposite rudder to pick up the dropping wing and release the back pressure on the stick.

SPINS

Power-off spins in the P-51D are safe enough if you have plenty of altitude for recovery. However, you'll find them quite uncomfortable because of heavy oscillations.

When you apply controls to start a spin, the airplane snaps ½ turn in the direction of spin as the nose drops to near vertical. After one turn, the nose rises to or above the horizon and the spin slows down. The airplane then snaps again, and the process is repeated.

Spins to the left will occasionally dampen out and become stable after about three turns, but in right spins the oscillations are continuous, neither increasing nor decreasing as the spin progresses.

Power-on spins are extremely dangerous and must never be performed intentionally under any circumstances. The nose remains at from 10 to 20 degrees above the horizon, the spin tends to tighten, and there is a rapid loss of altitude. Recovery control will have no effect on the airplane until the throttle has been completely cut back.

The spin recovery procedure recommended is the standard N.A.C.A. procedure, and is the same for both left and right spins.

N.A.C.A. SPIN RECOVERY

1. Pull the stick back and use full rudder with the spin.

2. Cut the throttle.

3. Apply full opposite rudder to slow and stop the spin.

4. Move the stick quickly forward to pick up flying speed.

As soon as you apply opposite rudder the nose drops slightly and the spin speeds up rapidly for about 1¼ turns and then stops. The rudder force at first is light but then becomes heavy for about a second or so in the first half turn. The rudder force then drops to zero as the spin stops.

During the spin you feel a slight rudder buffeting. If you attempt to recover from the dive too soon after the spin stops, you also feel rather heavy buffeting in both the elevator and the rudder. The remedy for this condition is to release some of the pressure you have applied on the stick.

If you should ever get into a **power spin, cut the throttle immediately** and follow the normal recovery procedure. Be sure to hold the controls in the recovery position until you have recovered completely. It may take up to six turns to recover from a two to five turn power spin. In this situation you may lose as much as 9000 feet of altitude.

Remember these tips on spin recovery:

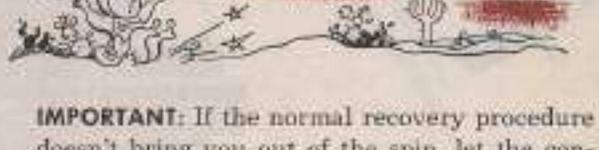
1. Don't get excited.

2. Don't be impatient. Leave the controls on long enough for them to take effect.

3. Fix in your mind the altitude at which to bail out, and bail out before it is too late.

4. Never make an intentional power-on spin.

5. In making an intentional power-off spin, start it with plenty of altitude. Be sure you can recover above 10,000 feet.



IMPORTANT: If the normal recovery procedure doesn't bring you out of the spin, let the controls go.

ACROBATICS

The P-51D has really exceptional acrobatic qualities; stick and rudder pressures are light and the aileron control is excellent at all speeds. Be sure of one thing before entering any acrobatic maneuver—have plenty of altitude.

You can do chandelles, wingovers, slow rolls, loops, Immelmans, and split-S turns with ease. However, remember that you must limit inverted flying to 10 seconds because of loss of oil pressure and failure of the scavenger pump to operate in inverted position.

In a loop you have to pull the airplane over the top, as the nose won't want to fall through by itself. If you don't fly the airplane on over the top of the loop, it has a tendency to climb on its back.

The aerodynamic characteristics of the P-51D are such that snap rolls cannot be satisfactorily performed. This has been proved by a long series of test flights. So don't try any snap rolls in an attempt to show that you're the guy who can do them. You'll invariably wind up in a power spin—and that's bad.

Caution: Acrobatics must not be attempted unless the fuselage tank contains less than 40 gallons of fuel.

EMERGENCY PROCEDURES

FORCED LANDINGS ON TAKEOFF

If your engine fails on takeoff, immediately nose the airplane down to retain airspeed. If you have sufficient runway, simply make a normal 3-point landing straight ahead. If you don't have sufficient runway, make a belly landing.

One of the most important things to remember if your engine fails on takeoff, is to land straight ahead—or only slightly to the right or left depending on obstructions. **Never attempt to turn back into the field.** There is only a slim chance that you can make it. Steep turns near the ground are hazardous even with power on; with a dead engine they are suicidal.

In making a forced landing on takeoff when the runway is behind you, nose the plane down and maintain a glide of about 110 mph. If you are carrying droppable fuel tanks or bombs, maintain a glide of about 120 mph and salvo the auxiliary load immediately.

Duck your head and jettison the canopy. Move the landing gear control to UP. The gear may not have time to retract, but once it is started it will collapse on contact with the ground.

Use full flaps, and cut the ignition, fuel, and battery switches before contact.

FORCED LANDING OVER DOUBTFUL TERRAIN

If you have to make a forced landing and the terrain is doubtful, don't hesitate to make a belly landing. Forced landings with wheels down should be made only when you're absolutely certain that such a procedure will be safe.

BELLY LANDING PROCEDURE

If you have to make a belly landing, it is best to make the landing on a hard surface. On soft or loose ground the airscoop tends to dig in, not only stopping the plane suddenly but doing more damage to your plane than if you land on a hard surface.

The belly landing procedure is as follows:

1. Keep the wheels up.

2. Jettison tanks or bombs, if you're carrying any.

3. Lower the seat, duck your head, and jettison the canopy.

4. Make sure your shoulder harness and safety belt are locked.

5. Use about 30° of flaps until just before landing. Then, when you're sure you have your landing area well in hand, use full flaps.

6. Maintain a speed of about 120-130 mph until actually landing.

7. Approach in a 3-point attitude to slow the airplane.

8. Cut the switches just before impact.

9. As soon as the airplane stops, get out and get away from it quickly.

Unless you're close to a farmhouse or town where you know you can call for help, don't wander away from your airplane. Stay near it, especially in swampy ground where you won't be able to travel far anyway. It is easier for searching parties to find your airplane than to find you alone. Also, you may want to use parts of your airplane for signaling. For example, you may want to use oil or gasoline for building a signal fire, or to use bright reflecting parts of the plane for attracting attention.

FORCED LANDING OVER AN AIRFIELD

If your engine fails directly over an established airfield, your problem is simply one of making a routine precision landing.

If you are not directly over a field but are within gliding distance of it, don't lower your gear until you are sure you can make it in, as the glide is extremely steep with wheels down.

FORCED LANDING AT NIGHT

If you ever have to make a forced landing at night, better bail out unless conditions are exceptional.

Don't attempt to bring your airplane in at night, even in a belly landing, unless you have radio contact, are right over a known airport, and feel positive that the plane is in condition to be safely landed.

If you run into serious trouble at night and are not right over an airport—bail out.

ENGINE OVERHEATING

If your engine overheats in flight, the trouble is probably caused by one of the following:

1. You've been climbing the airplane at high power and below recommended airspeed. In other words, you aren't getting a great enough blast of air through the airscoop. To remedy this difficulty, all you have to do is level out for awhile—increase airspeed but reduce power.

2. The automatic shutter controls are not functioning properly. In this case, operate the shutters manually by means of the toggle switch control, and watch the instruments to see if the condition has been remedied.

3. The oil supply is depleted. You discover this situation in checking the oil pressure. The engine continues to overheat even after the shutters are opened all the way. There isn't much you can do in this situation except keep the rpm and power settings at the minimum, and land as soon as possible.

4. The coolant supply is depleted. Here again, the engine continues to overheat even after the shutters are opened all the way. There isn't much you can do in this situation, either, except keep rpm and power settings at the minimum, and land as soon as possible. In most cases you won't have more than 10 minutes before the engine freezes.

5. You've been exceeding the operational limits of the engine. Make sure that the carburetor air control is at RAM AIR, depending upon the type of equipment. Then check the mixture control to see that it is in RUN or AUTO RICH.

RUNAWAY PROPELLERS

Failure of the propeller governor is quite rare, and the chances are that you will never encounter it. When it does happen the prop runs away, that is, the blades go to full low pitch, resulting in engine speeds as high as 3600 rpm or more. Obviously, this speed must be reduced immediately or the engine will be totally ruined, necessitating a forced landing or a bailout.

If you're ever confronted with a runaway prop, the following procedure is in order.

1. Pull the throttle back to obtain 3240 rpm, the maximum allowable diving overspeed of the engine.

2. Raise the nose of the airplane to lose speed, and if you're flying very high, return gradually to a moderate altitude. Keep your IAS at about 140 mph.

3. When you reach a landing field, lower the gear and make a normal landing.

BRAKE FAILURE

Remember that the brake system is not operated by the hydraulic system of the airplane and that each brake is operated by its own individual pressure cylinder, which is activated by using the brake pedals. It is extremely unlikely, therefore, that both brakes will fail at the same time. When one brake fails it is almost always possible to use the other in stopping the airplane.

If one brake goes out while taxiing, use the other (good) brake, and also the lockable tailwheel. Immediately chop the throttle and cut the switch. If you're going too fast to stop the airplane in this manner, lock the good brake, and groundloop until the airplane stops.

If a brake goes out while checking the magnetos, immediately cut the throttle back and hold the plane in a groundloop with the good brake.

If, in coming in for a landing, you know that your brakes are shot—or even if you suspect such a condition—approach the field and land as slow as safety permits. Use full flaps and use your best technique in making a 3-point landing. Stop your engine completely by cutting the mixture control as soon as your plane is on the ground. The dead prop creates additional braking action to help make your landing as short as possible.

If your brakes are locked, never attempt a wheel-type (tail high) landing. If you do, you will either hit the prop or nose over altogether.

HYDRAULIC SYSTEM FAILURE

If your hydraulic system ever fails, remember that you can lower the landing gear by pulling the emergency knob. The procedure is simple:

LANDING GEAR DOWN

1. Put the landing gear control handle in the DOWN position. This releases the mechanical locks which hold the gear in place.

2. Pull the red emergency knob. This releases the hydraulic pressure in the lines and allows the gear to drop of its own weight.

ROCK IT TO LOCK IT

It is possible that the gear may not fall with sufficient force to lock itself in place. Therefore, **while still pulling out on the red emergency**

knob, rock the airplane until you feel the gear catch in the locked position.

The tailwheel usually locks without any difficulty. If it doesn't, speed up the airplane to force the partially extended wheel into position by means of greater air pressure on it. Or dive the airplane a short distance and then pull out with enough acceleration to force down the tailwheel.

ELECTRICAL SYSTEM FAILURE

The airplane's electrical system circuits are protected by circuit breaker switches on the right hand panel. These switches are controlled by a single bump plate hinged across them, enabling you to re-set all the buttons at one time, and doing away with the necessity of hunting for the right switch.

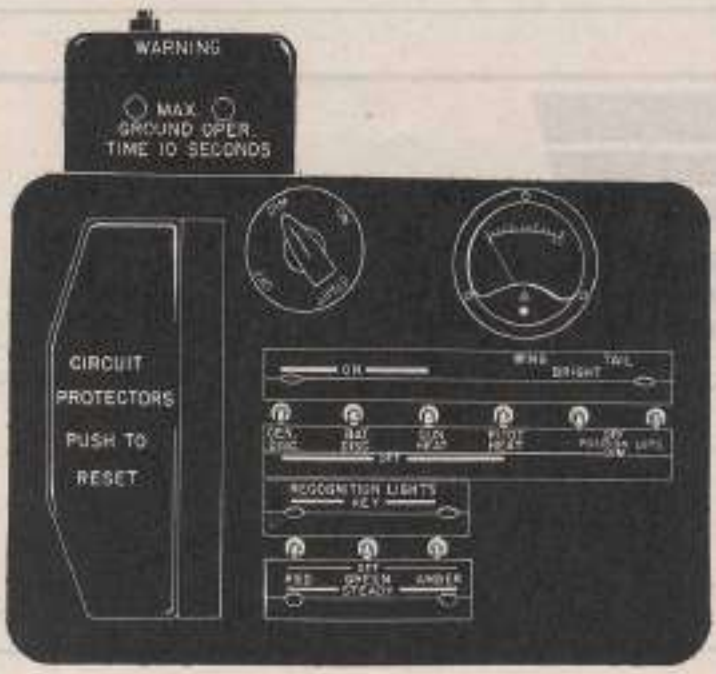
If you have an overload on any circuit, the breaker for that circuit will pop out. To re-set, wait a few seconds for the switch to cool, and then give the bump plate a firm push. If the switch pops out again immediately, allow a bit more cooling time and try again. Should repeated efforts fail to restore the switch to its original position, there's nothing more you can do. The trouble is probably a short circuit that cannot be repaired in flight.

If the ammeter shows that something has gone wrong with the electrical system and the battery is overcharging, cut the generator disconnect switch OFF. Be careful that you don't overcharge the battery.

If you ever have to shut off the generator, use your radio sparingly, as the radio quickly drains your battery.

If the ammeter shows that the battery is undercharging, check the generator disconnect switch to make sure that it hasn't been turned OFF accidentally. If it's still ON and the battery is not charging properly, use your radio only when necessary. Make the best use of whatever battery power is still available.

Remember: If the electrical system goes completely dead, the ignition system continues to operate on the magnetos. However, you won't be able to control the oil and coolant scoops, since they operate electrically.

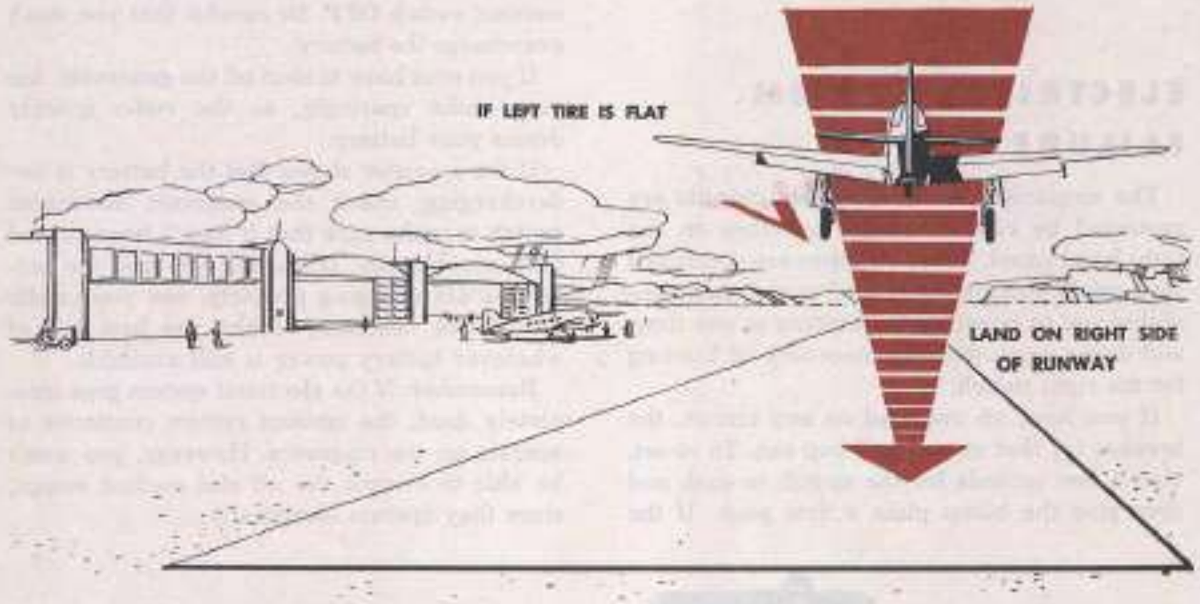


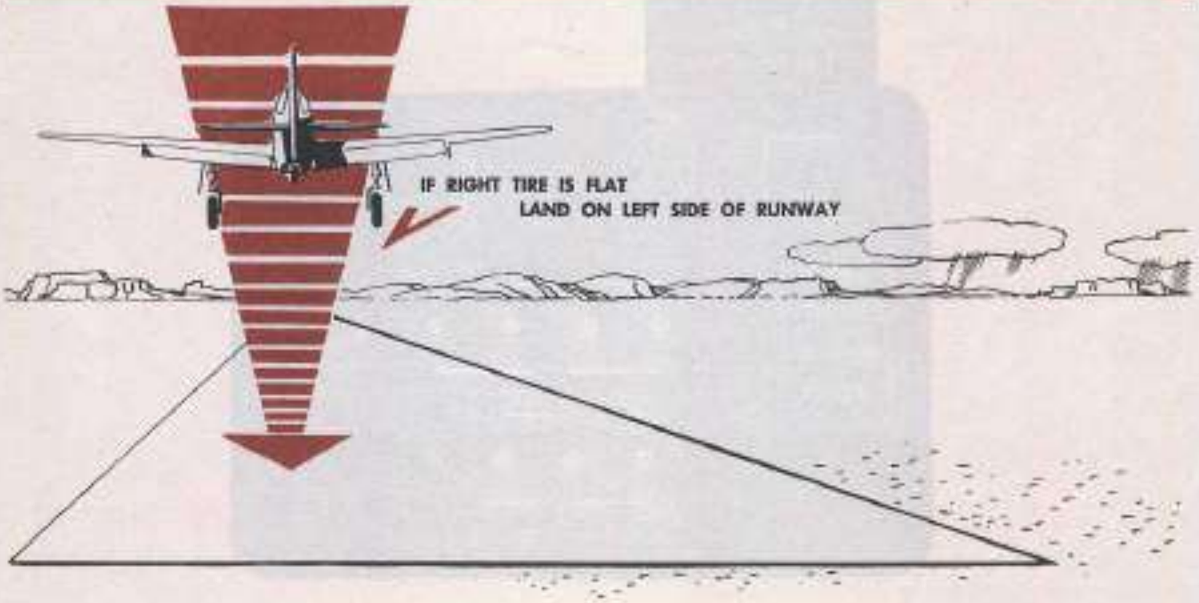
TIRE FAILURE

If, in landing, you know that a tire is low or blown out, make a 3-point landing. Don't use the brakes until necessary, then use the opposite brake—but only slightly—and enough opposite rudder to keep the airplane straight.

Land on the left side of the runway if the right tire is flat and on the right side if the left tire is flat. Then, if you swerve in the direction of the flat, you'll still be on the runway.

If a tire is completely lost, don't attempt to come in on the rim. Make a belly landing.





FIRE

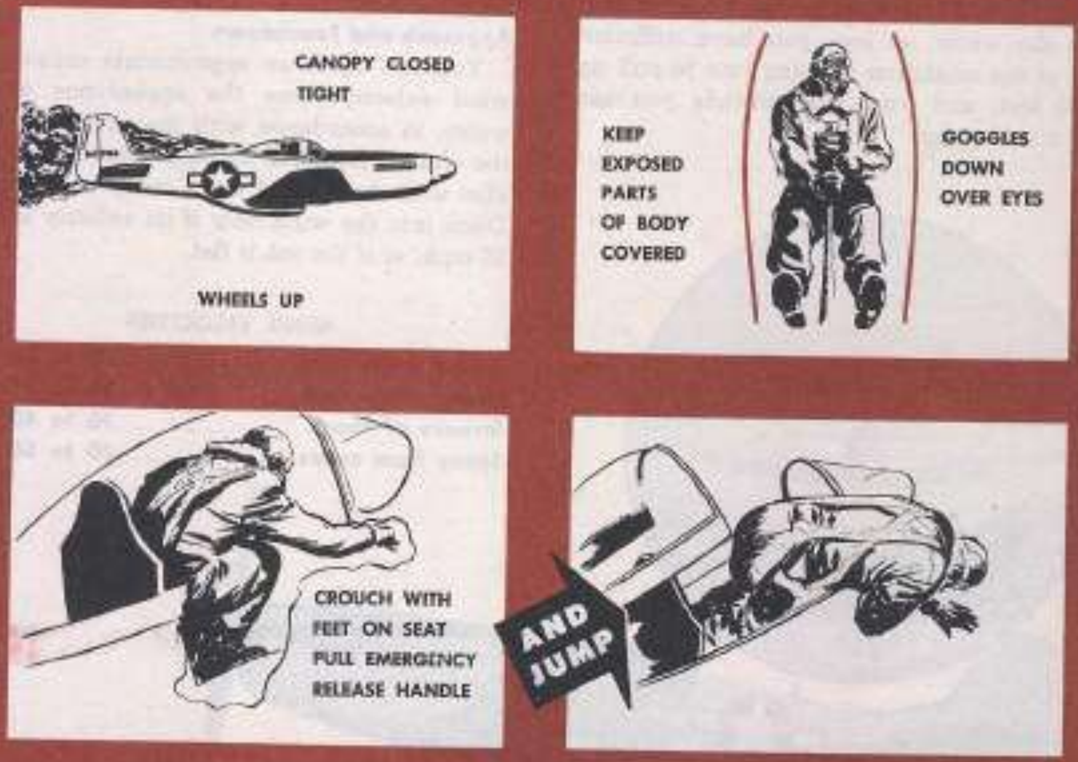
The most important thing to remember in event of a fire is to keep the canopy entirely closed as long as you stay in the cockpit. As soon as you open the canopy you make a chimney out of the cockpit and draw the fire into it, usually through the holes in the floor just ahead of the rudder controls.

For the same reason, don't lower the gear. Opening the gear wells is likely to blast the fire into the cockpit.

If fire breaks out and you don't think it's necessary to abandon the airplane—at least right away—protect yourself by covering all the exposed parts of your body. Put your goggles down over your eyes, for example, roll down your sleeves, and otherwise protect yourself from possible flash burns.

If you decide to bail out, follow the normal bailout procedure up to the point where you release the canopy. When you do release the canopy, leave the airplane at the same instant that the canopy does. **Do not release the canopy until you're all ready to go out with it.**

Don't release the canopy until after you have unlocked the safety harness, trimmed the airplane, and are crouched with your feet in the seat ready to spring out. Then pull the canopy emergency release handle and lunge upward to the right, pushing the canopy off with your head.



CAUTION: Be sure to hold your breath if you have to jump through a fire. Inhaling flame is fatal.

DITCHING

Never attempt to ditch the P-51 except as a last resort. Fighter planes are not designed to float on water, and the P-51 has an even greater tendency to dive because of the airscoop underneath. It will go down in 1½ to 2 seconds.

It is possible to ditch the P-51 successfully and it has been done on several occasions. However, it is a hazardous business.

If trouble arises during an over-water flight, and if you're sure that you can't reach land, don't hesitate to bail out. You won't be able to save the airplane by a water landing, nor will you provide yourself with any useful equipment, as would be the case with a larger airplane. So you had best abandon ship in the air.

If you're at an extremely low altitude, pull the airplane up at a steep angle, throw off the safety belt and shoulder straps and go out over the right side. Even if you're flying only 50 feet above the water, or less, you have sufficient speed at the minimum cruising rate to pull up to 500 feet, and from that altitude you can make a safe jump.

The important thing to remember is to make as steep a pull-up as possible and get out at as high an altitude as you can.

If there is a fire, or if for any other reason it is advisable to go out on the left side rather than the right side, don't hesitate to do so. The right side is recommended only because the slipstream helps you in clearing the airplane.

If it isn't possible to get up high enough to make a successful parachute drop, remember that the P-51 **can** be ditched successfully.

Radio Procedure

Theoretically, the radio procedure that you're to follow before ditching is the same as that for an over-water bailout, described on page 88. Accomplish as much of it as time and circumstances will permit. Your chances of a speedy rescue will depend heavily on whether an Air/Sea Rescue Unit can get a good fix on your position.

Approach and Touchdown

You can make an approximate estimate of wind velocity from the appearance of the water, in accordance with the table below. If the wind is less than 35 mph, touch down parallel with the lines of wave crests and troughs. Ditch into the wind only if its velocity is over 35 mph, or if the sea is flat.

WIND VELOCITIES

A few white caps	10 to 20 mph
Many white caps	20 to 30 mph
Streaks of foam	30 to 40 mph
Spray from crests	40 to 50 mph

Keep the wheels up, and use flaps in proportion to available power in order to obtain minimum forward speed with minimum rate of descent. Approach in 3-point attitude, and observe the following procedure:

1. Lower the seat, duck your head, and jettison the canopy.
2. Jettison tanks or bombs, if you're carrying any.
3. Unfasten the parachute harness.
4. Make sure that your shoulder harness and safety belt are locked and tight.
5. Maintain an airspeed of 120 mph.
6. Cut the switches just before impact.
7. Touch down in normal landing attitude. Deceleration following contact will be very violent.

Once the airplane stops you won't have more than 2 seconds, so fix in your mind the following procedure:

1. Release the safety belt.
2. Jump out and pull the life raft loose from the parachute.
3. Inflate your Mae West immediately after discarding your parachute harness.
4. Inflate the life raft and wriggle into it.

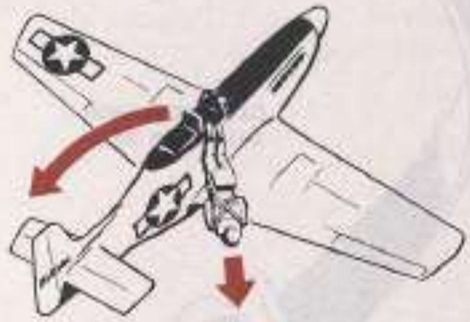
Even in shallow water don't get out of your Mae West until you are safely on shore. Also remember to salvage your parachute, if possible. It may come in handy.

BAILOUT PROCEDURE

There are several successfully tried and tested methods of bailing out of the P-51, when the airplane is under control. However, the following bailout procedure is recommended, since it remains essentially the same whether the airplane is under control, on fire, or in a spin.

1. Slow the airplane to the lowest speed that is reasonably safe—usually about 150 mph. The lower the speed at which you bail out, the less risk there is. But don't slow the airplane dangerously near the stalling point, particularly if you have no power.
2. Lower the seat, duck your head, and jettison the canopy.
3. Disconnect your headset and oxygen hose, and release the safety belt and shoulder harness. Make a special point of throwing the straps off your shoulders. This is important because, even if the straps are loose, it is more difficult to rise with the straps hanging on your shoulders.
4. Pull yourself up onto the seat so that you're in a crouching position with your feet in the seat.
5. Dive with head down toward the trailing edge of the right wing, unless a fire or some other condition makes it advisable to go out the left side. The right side is recommended because the slipstream helps you in clearing the airplane. However, don't hesitate to go out the left side, for successful jumps have been made from **both** sides of the airplane.

JUMP TOWARDS WING FROM EITHER SIDE OF PLANE



If you get in trouble at high altitude, bring the plane to a lower altitude before bailing out, when possible. But if you must jump from a high altitude, your best bet is to make a delayed free fall before opening your chute. In this way you not only escape the danger of cold, of lack of oxygen, and—if in a combat zone—the danger of gunfire, but you also eliminate the possibility of personal injury from the snap-out in the rarified air. At high altitudes the G force exerted on the pilot by the pull of the harness in the opening snap is from two to four times as great as at lower altitudes.

Before bailing out at high altitudes, open the emergency knob on the oxygen regulator and fill your lungs with oxygen. Take several good breaths and then hold your breath as long as possible. If you do this before a delayed free fall, you have a supply of oxygen to help you until you reach the lower altitudes.

Bailing Out of a Spin

If you ever have to bail out of a spin, it is recommended that you jump to the **inside,** not the outside of the spin.

If the airplane is spinning to the right, go out over the right side of the cockpit, if it's spinning to the left, go out over the left side. Following this procedure, you have a much better chance of falling clear of the airplane and escaping the centrifugal force of the spin, which tends to throw you into the tail assembly or the prop as it comes around.

Records compiled by the Office of Flying Safety show that of all the successful jumps made out of spins in all types of aircraft, by far the greatest percentage was made from **inside** the spin.

Bailing Out Over Water

If you have to bail out over water, it's extremely important that you follow a definite radio procedure, to give you the best possible chance of being picked up in a hurry. Each theater may have its own radio procedure—you'll get the full details when briefed for a mission.

If there is opportunity and time, try to gain altitude, particularly if you're below 5000 feet. Doing so increases the range of your VHF transmission and help Air/Sea Rescue Units get a good fix. How quickly you are rescued may be determined by the accuracy of this fix. Given below is a typical radio procedure for bailout over water or for ditching.

1. Notify wingmen that your airplane is in trouble.

2. If your airplane is equipped with IFF, turn the emergency switch ON.

3. Transmit "Mayday" three times, followed by the call sign of your plane three times.

4. Your first transmission will be on the assigned air-ground frequency. If you cannot establish communication on this frequency, use any other available frequency in an effort to establish contact with a ground station.

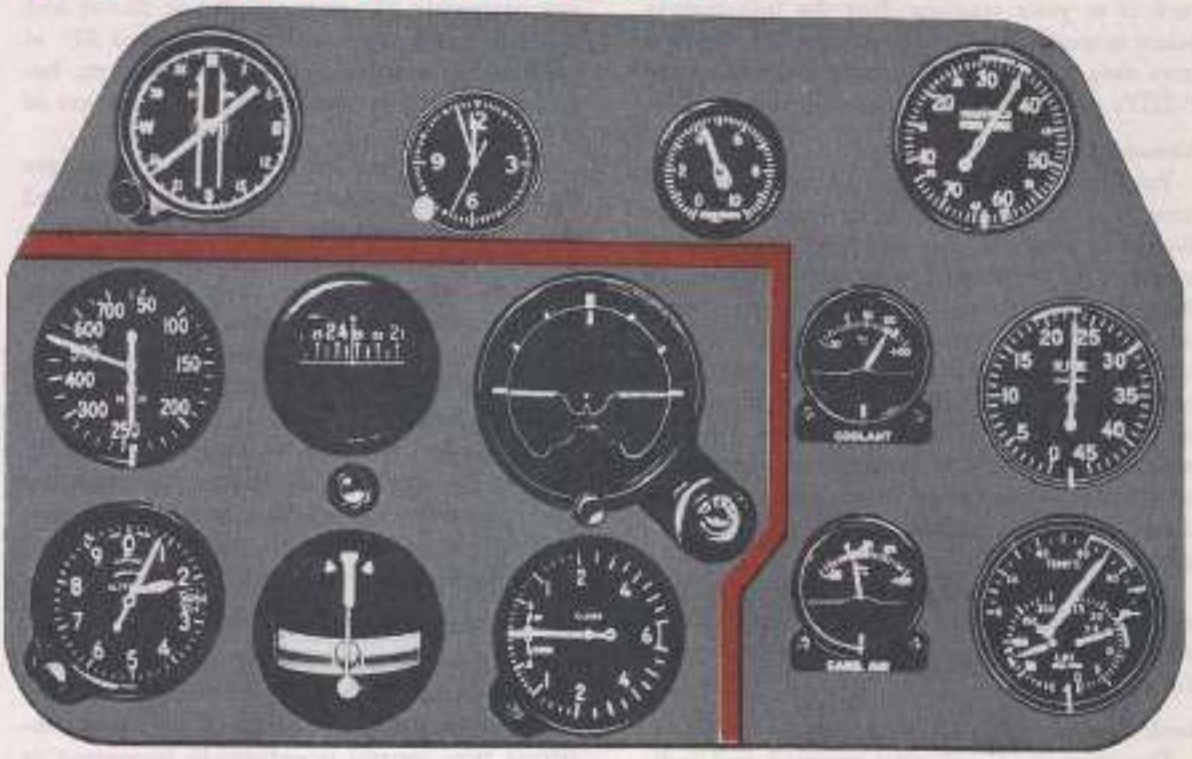
5. If time permits, give the following information:

   a. Estimated position and time
   b. Course and speed
   c. Altitude
   d. Your intention as to bailing out or ditching.
   e. Just before bailing out, break the safety wire on the VHF control switch and throw the switch to TR.
   f. In case your trouble becomes remedied and you do not have to bail out, a message cancelling the distress signal must be sent out on the same frequency.

Wingmen or flight members, on hearing your call on operations channel, should if possible orbit the spot, one plane going down low, another remaining high and continuing transmission of distress signals. This insures that a good fix is obtained.

For further information on bailout procedures, water landings, and control of parachutes, see your PIF.

INSTRUMENT FLYING



Check your vacuum gage readings for 3.75—4.25 inches and cross-check all of your instruments frequently

Instrument training in a single-place fighter plane is naturally limited. You are confined pretty much to such artificial aids as the Link and slow-speed 2-place planes. Since these facilities are of only limited value, some instrument training in fighter planes is done with the pilot flying blind and an observation plane alongside to prevent any difficulties should the pilot on instruments cross an airway or get into a swarm of PT's or other training planes.

Although instrument training in single-place fighters is rather difficult, the importance of instrument flying in these airplanes cannot be over-emphasized. If instrument flying gets you out of a tight situation just once, it is worth all the time spent in learning it. Because radio navigation aids cannot be widely used in combat zones, in some theaters a knowledge of instrument flying is absolutely necessary.

It's not within the scope of this manual to give instructions on instrument flight—that's taken care of in your training. But the information below is worth remembering, since it is derived from data of flight tests made to determine the P-51D's instrument flight characteristics.

Altitude Control

Your rate of climb or descent, at a given airspeed and power setting, is determined by the degree of pitch, or nose attitude change. This wouldn't be of much importance if you were flying a slow airplane. However, when you're cruising at 250 to 300 mph, a very slight change of nose attitude will immediately result in a high rate of climb or descent, with a rapid gain or loss of altitude. Therefore, when you are maneuvering at low altitude under instrument conditions, as during an instrument approach, the primary rule of safety is: **Keep your airspeed down.**

As a matter of fact, your precision in instrument flight maneuvers at any altitude will be greatly increased if you cut back to slow cruising speed.

Bank Control

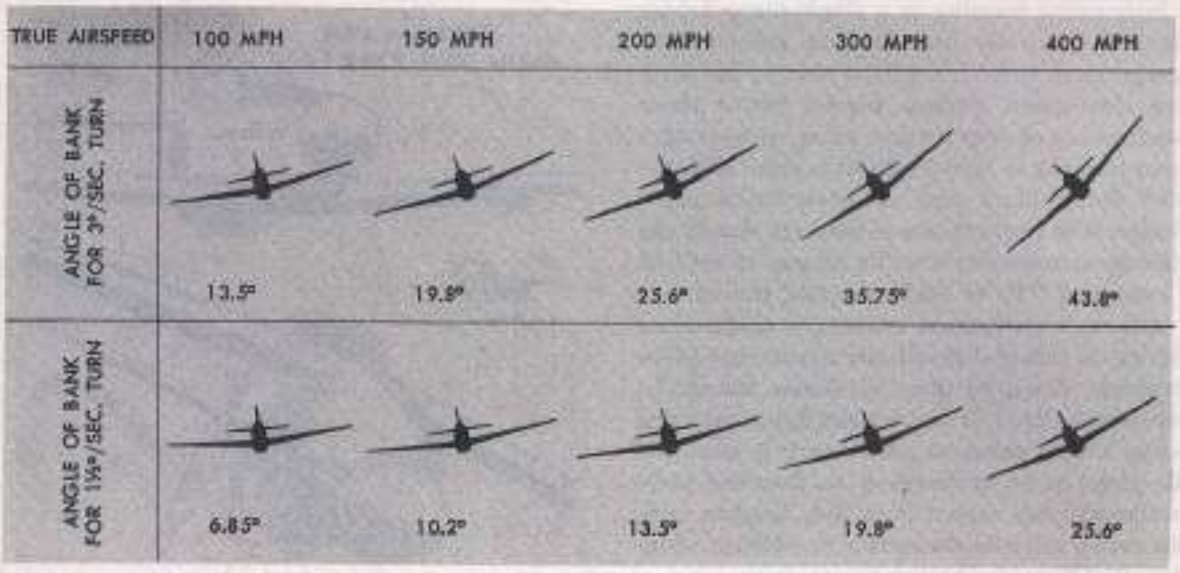
The turn needle is gyro-actuated and indicates rate of turn only, regardless of speed. Therefore, at a given rate of turn, the angle of bank in a coordinated turn depends upon true airspeed. A standard-rate turn at an altitude of 1000 feet and an IAS of 200 mph will require approximately 27° of bank. But at 25,000 feet an IAS of 200 mph will require about 37° of bank to accomplish a standard-rate turn, because the TAS at that altitude is in excess of 300 mph.

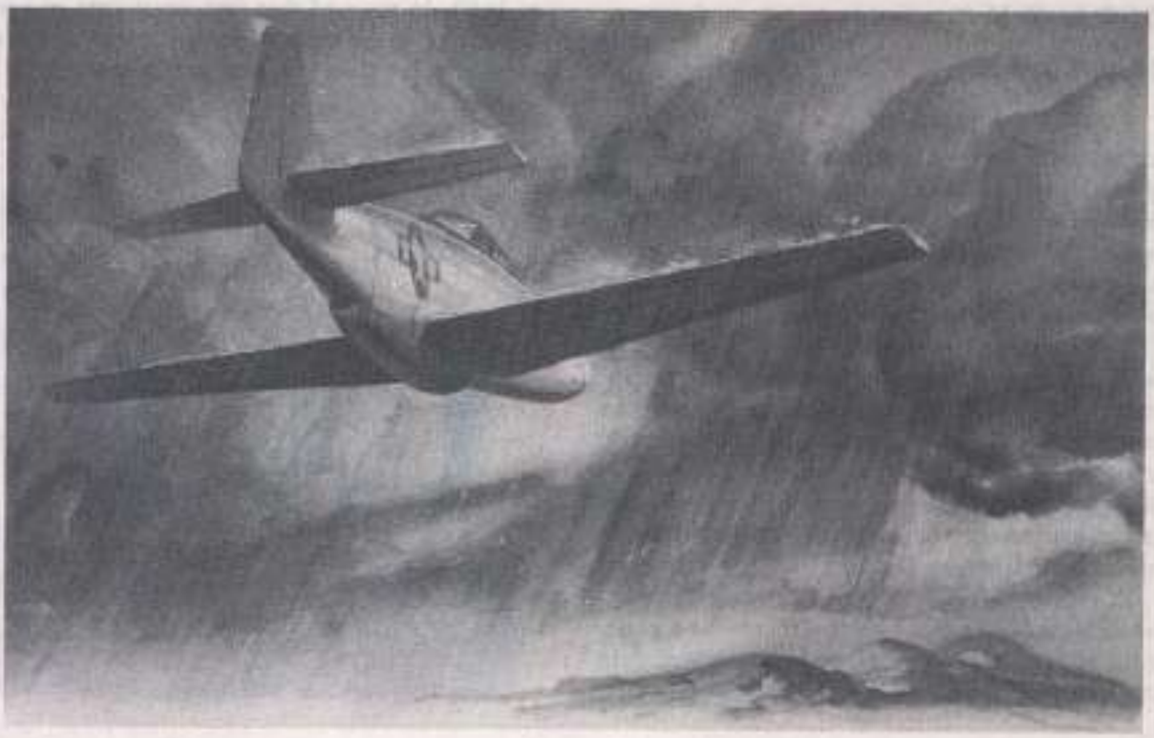
Control pressure on the elevators changes rapidly during the entry into a steeply banked turn, and it's very easy at this time to make inadvertent changes in your pitch, or nose attitude. As explained above, these slight changes in nose attitude, at high speeds, will result in large altitude variations; these can be critically dangerous if you're on instruments and close to the ground.

This hazard, too, can be largely avoided by slowing the airplane. When you cut speed, the angle of bank required for a given rate of turn is greatly lessened and the problem of control is proportionately reduced.

Control Sensitivity

Owing to the sensitivity of your P-51's controls, it is essential that you remain mentally attentive to the instruments at all times. Accurate trim control is extremely important; it will contribute greatly to your physical relaxation; and allow you to concentrate on the numerous unrelated details of instrument flight.





So, when you're on instruments, trim carefully and as often as required.

Attitude Instrument Flying

In instrument flying today, the attitude system is in general use. Attitude instrument flying is the controlling of an airplane by reference to its attitude in relation to the horizon as evidenced by instrument indications. As in contact flight, proper attitude is attained by the coordinated use of all controls.

If a pilot is thoroughly familiar with this system of instrument flying, he should have no difficulty in continuing instrument flight even though some of his instruments are lost because of mechanical failure or enemy action. This system is explained thoroughly and at length in T. O. 30-100A-2, dated 15 December 1944. Study it and practice what it preaches until you have acquired a real proficiency in attitude instrument flying. It may save your life.

Instrument Approach

Shortly before reaching the station on the initial approach, reduce your speed to 150 mph indicated, and lower flaps 10°. This low airspeed simplifies radio procedures and increases your control of the airplane.

After completion of the initial approach, execute your final approach at 130 mph indicated, with landing gear down and flaps lowered 15°.

Although final approach speed depends largely on ceiling condition, 130 mph with 15° of flaps is recommended. It's high enough so that, if you have to go around, an emergency pull-up will be quite safe. And when you have sighted the field, this speed is low enough to permit you to lower flaps and round out for touchdown without danger of floating too far down the runway.

With the airspeeds and flap settings recommended above, standard rate turns are safe and should be used whenever practicable.

Always use flaps during an instrument approach. Doing so reduces stalling speed, and the slightly increased drag necessitates more power, which in turn improves your rudder and elevator control. Also, the lowered nose attitude improves visibility when you break contact on final approach.

TIPS ON INSTRUMENT FLYING

1. If your P-51 is equipped with a K-14 gunsight, your view of the instrument panel will probably be partially obstructed. In this case, lower the seat. You'll still have enough forward vision to land the airplane, so it won't be necessary to raise the seat again during the last few seconds of final approach.

2. When you encounter severe turbulence, adjust the power settings to give you approximately 160-180 mph IAS. Don't try to maintain one definite airspeed. Set the throttle and prop control, and then let the airspeed oscillate in a 20 mph range. Doing so will give you complete control of the airplane without risk of structural damage.

3. Always remember that as the airspeed increases, the degree of bank increases for a given rate of turn. At high airspeeds a standard rate of turn may require a dangerously steep angle of bank. In view of this fact, your rate of turn should never be such as to require an angle of bank greater than you can safely control.

NIGHT FLYING

The lighting equipment for flying the P-51 at night is as follows:

Outside the Plane

1. Wing and tail position lights. Controlled by 3-position switches (BRIGHT-OFF-DIM) on the right switch panel; one for the tail light, one for the wing lights.

2. Landing light. Swings out from the left wheel well when the landing gear is extended. Controlled by an ON-OFF switch on the coolant switch panel.

3. Identification lights. Red, amber, and green lights under the right wing-tip. The lights can be used in any combination, either steadily or intermittently. Controlled by individual 3-position switches (STEADY-OFF-KEY) on the right switch panel. The key for intermittent (code) operation is on top of a small box above the right switch panel.

Inside the Cockpit

1. Cockpit lights. Two small white lights for map reading, checking fuel gages, or whenever light is needed in the cockpit. Controlled by an ON-OFF twist switch built into the housing of each light. The cockpit light switch on the front switch panel must be ON before the lights can be used.

2. Fluorescent lights. Two barrel-shaped fluorescent lights, one on each side of the cockpit, for lighting the luminous painted dials. Controlled by individual rheostat switches: the left switch on the coolant switch panel, the right one on the right switch panel. You turn the rheostat knobs to START until the lights go on, then turn them back to the desired brightness.

To make the dials glow without any glare, the opening on the front of the housing of the lights should be **closed completely.** The dials are then illuminated by invisible ultra-violet light. Open the lights only when required for checking the position of switches and levers.

When opened, a bluish light illuminates the whole cockpit, and this causes a glare that is tiring to the eyes.

3. Flashlight. Planes are not usually equipped with a flashlight, but it is wise to carry one in case any cockpit lights burn out. If the light is equipped with a red lens, or is covered with red cellophane, you can use it freely without danger of being dazzled.

Other Lights

Also inside the cockpit are other lights which operate automatically, day or night (in most cases it is possible to dim these lights for night flying):

1. Lights on VHF control box. Indicator lights, one for each of the four channels and another to show when you are transmitting. A small slide covering can be moved over these lights to dim out everything but small indicator letters (T, and A, B, C, or D).

2. Landing gear indicator lights located on the lower part of the instrument panel. Green light glows when gear is down and locked, red when it is not. These lights may be turned to dim or brighten them.

3. Supercharger light. An amber light next to the supercharger switch to show when the supercharger is in high blower.

FLIGHT OPERATION CHARTS

An important problem in planning any long flight, whether a cross-country trip or a combat mission, is calculating the amount of fuel required and planning the best use of that fuel. This is of course especially important on long over-water hops where the difference between getting back to your base or ending up in a dinghy may depend upon nothing more than how well you plan your rpm and throttle settings.

On most combat missions, fuel and flight planning problems are worked out for you by the squadron operations officer. But every pilot should be able to work these problems out for himself and know how the charts are used.

The charts used in flight planning include:

(1) Takeoff, Climb, and Landing charts, and

(2) Flight Operation charts (for constant and level flight).

Sample charts–one of each type–are given on this and the next page. These are provided so that you can follow the procedure of solving the typical problem given below. A complete set of full-size charts will be found on the pages immediately following.

By means of these charts it is possible to approximate all the details of a complete trip.

Here is an Example

You are going on a 1000-mile hop in a P-51D equipped with a V-1650-7 engine. The plane has wing racks but you will not be carrying any external fuel load. With wing and fuselage tanks full, you will be carrying 269 gallons.

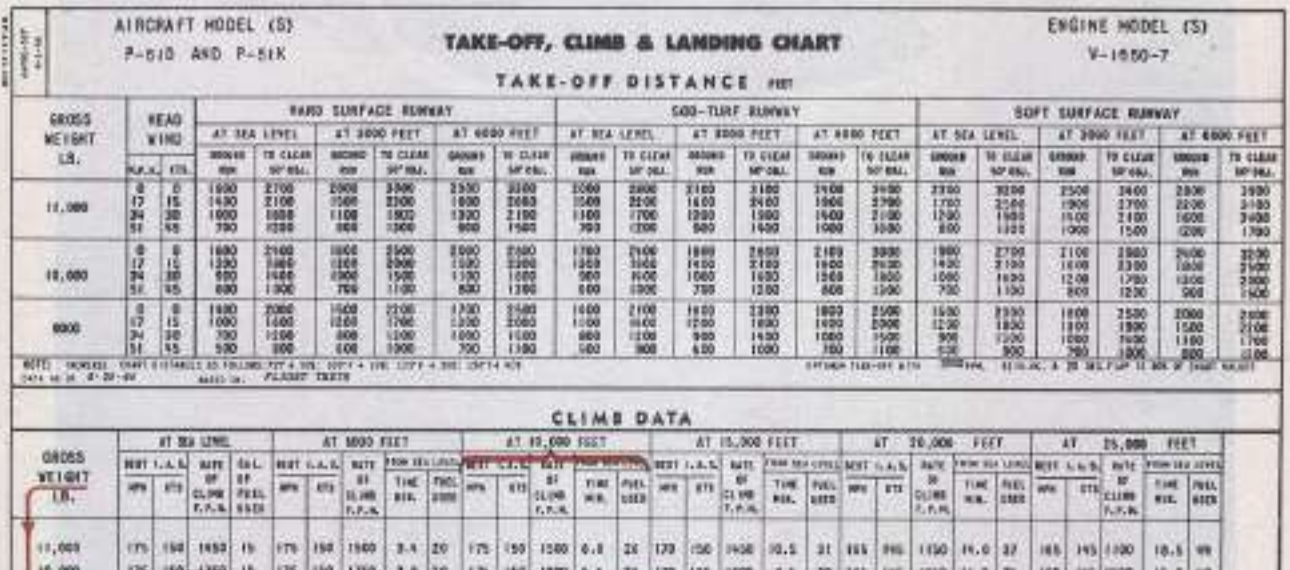
According to weather reports the most favorable winds are at 10,000 feet. You are to take off and climb to 10,000 feet above the field, then fly the 1000-mile hop.

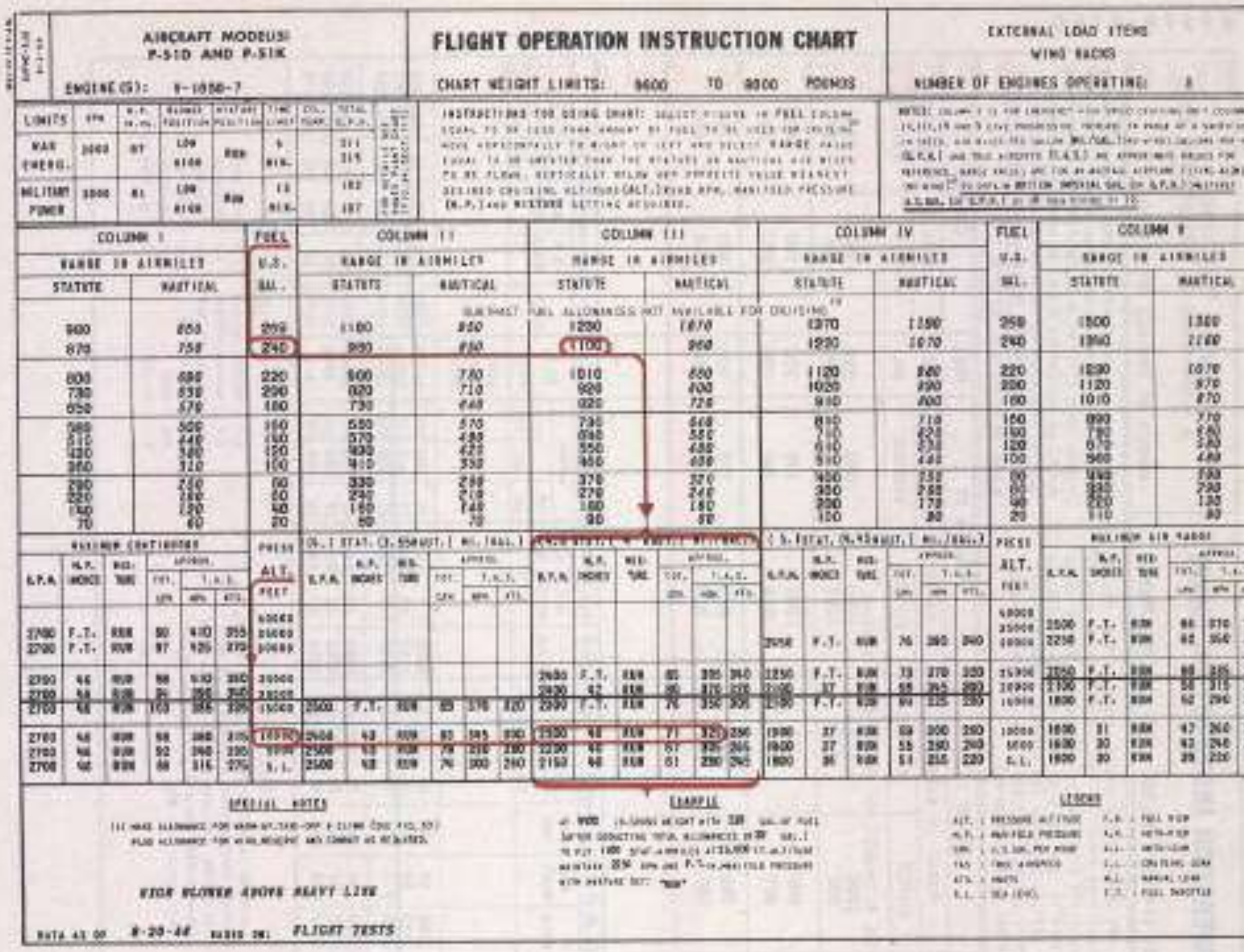
The first step in planning the flight is to select the charts suitable for the airplane's load condition.

Takeoffs and Landings

The takeoff and landing charts can be used in determining runway distances required.

For example, in working out the cross-country problem given above, you might want to know how much concrete runway is required to make a landing at a sea level airport. Note opposite the 8000 weight figure under "Hard





AIRCRAFT MODEL(S) P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 9600 TO 8000 POUNDS

EXTERNAL LOAD ITEMS WING RACKS

NUMBER OF ENGINES OPERATING: 1

SPECIAL NOTES

EXAMPLE

LEGEND

HIGH BLOWER ABOVE HEAVY LINE

DATA AS OF 8-20-44 BASED ON: FLIGHT TESTS

dry surface, at sea level" that 2100 feet is required to clear a 50 foot object.

Planning the Flight

The Flight Operation chart selected shows that a P-51D with no external tanks weighs 8000-9600 pounds (see top center of chart). Therefore on the Climb chart opposite the 9000 weight figure and under the 10,000 feet altitude figure, you find that the fuel used in the warm-up, takeoff and climb to 10,000 feet will be 23 gallons. (Notice also the underlined figures which show that the best climbing speed is 175 IAS, the rate of climb is 2150 feet per minute, and the time for the climb is 4.8 minutes.)

Deducting 23 gallons from the original supply of 269 leaves 246. Therefore on the Flight Operation chart opposite 240 (the nearest figure) find the range nearest (but not below) that of your trip. In this case it is 1100 miles.

Dropping below this 1100 figure and opposite the 10,000 feet altitude figure you find this information for the flight:

Rpm setting .... 2200 rpm
Manifold pressure .... 40 inches
Mixture setting .... RUN
Supercharger .... Low blower
Fuel consumption .... 71 gal/hour
Speed .... 325 TAS

To travel 1000 miles at 325 TAS will require 3.1 hours (1000 divided by 325). At 71 gallons per hour you will therefore use 220 gallons (71 times 3.1) in flying to your destination. Since you had 246 gallons remaining after the takeoff and climb, you will have 26 gallons (246 minus 220) left for the letdown and landing—enough for about 30 minutes of additional flying time.

Remember:

Figures are approximate. Always allow a margin of safety.

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 10,600 TO 10,000 POUNDS

EXTERNAL LOAD ITEMS
2 - 500-POUND OR SMALLER WING BOMBS

NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		211 215
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187

FOR DETAILS SEE POWER PLANT CHART (FIG.34, SECT.III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING.(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.) MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
				SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)							
910 810	*790* *700*	269 240	970 860	*840* *750*	1090 980	*950* *850*	1220 1090	*1060* *950*	269 240	1340 1190	*1160* *1040*
740 670	*640* *580*	220 200	790 720	*690* *630*	900 820	*780* *710*	1000 910	*870* *790*	220 200	1100 1000	*950* *860*
600 540	*530* *470*	180 160	640 570	*560* *500*	740 650	*640* *570*	820 730	*720* *640*	180 160	900 800	*780* *690*

MAXIMUM CONTINUOUS						PRESS	(3.0 STAT. (3.15 NAUT.) MI./GAL.)						(4.05 STAT. (3.5 NAUT.) MI./GAL.)						(4.5 STAT. (3.9 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
			APPROX.			ALT.				APPROX.						APPROX.						APPROX.			ALT.				APPROX.		
R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
						40000																			40000						
						35000																			35000						
						30000																			30000						
2700	46	RUN	98	375	325	25000							2500	42	RUN	83	365	315	2300	F.T.	RUN	75	340	295	25000	2100	F.T.	RUN	60	295	255
2700	46	RUN	99	355	310	20000							2450	43	RUN	85	340	295	2150	38	RUN	71	320	275	20000	2150	F.T.	RUN	58	285	245
2700	46	RUN	103	355	310	15000	2600	44	RUN	96	350	305	2350	F.T.	RUN	79	325	280	2150	F.T.	RUN	66	300	260	15000	1850	F.T.	RUN	54	265	220
2700	46	RUN	98	330	290	10000	2600	44	RUN	90	325	280	2250	41	RUN	75	300	260	2000	38	RUN	62	280	240	10000	1650	34	RUN	49	240	210
2700	46	RUN	92	310	270	5000	2600	44	RUN	84	300	260	2250	41	RUN	69	280	245	1950	38	RUN	57	260	225	5000	1600	34	RUN	45	220	190
2700	46	RUN	86	290	255	S.L.	2600	44	RUN	78	280	245	2250	40	RUN	64	260	225	1950	37	RUN	53	240	205	S.L.	1600	33	RUN	42	200	175

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.35.) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 10,600 LB. GROSS WEIGHT WITH 220 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 20 GAL.) TO FLY 1000 STAT. AIRMILES AT 15,000 FT. ALTITUDE MAINTAIN 2150 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: RUN

LEGEND

ALT.	PRESSURE ALTITUDE	F.R.	FULL RICH
M.P.	MANIFOLD PRESSURE	A.R.	AUTO-RICH
GPH	U.S. GAL. PER HOUR	A.L.	AUTO-LEAN
TAS	TRUE AIRSPEED	C.L.	CRUISING LEAN
KTS.	KNOTS	M.L.	MANUAL LEAN
S.L.	SEA LEVEL	F.T.	FULL THROTTLE

DATA AS OF *9-10-44* BASED ON: *FLIGHT TESTS*

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 10,000 TO 8500 POUNDS

EXTERNAL LOAD ITEMS
2 - 500-POUND OR SMALLER
WING BOMBS
NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		211 215
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187

FOR DETAILS SEE POWER PLANT CHART

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]								
620	540	184	660	580	750	650	840	730	184	920	800
540	470	160	570	500	650	570	730	640	160	800	700
470	410	140	500	440	570	490	640	560	140	700	610
400	350	120	430	380	490	420	550	480	120	600	520
340	280	100	360	310	410	350	460	400	100	500	430
270	230	80	280	250	320	280	370	320	80	400	350
200	170	60	210	190	240	210	270	240	60	300	260
130	110	40	140	120	160	140	180	160	40	200	170
60	50	20	70	60	80	70	90	80	20	100	80

MAXIMUM CONTINUOUS						PRESS	(3.6 STAT. (3.15 NAUT.) MI./GAL.)						(4.1 STAT. (3.55 NAUT.) MI./GAL.)						(4.6 STAT. (4 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
			APPROX.			ALT.				APPROX.						APPROX.						APPROX.			ALT.				APPROX.		
R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
						40000																			40000						
						35000																			35000						
						30000																			30000						
2700	46	RUN	96	375	325	25000							2500	43	RUN	89	365	315	2250	F.T.	RUN	73	335	290	25000	2050	F.T.	RUN	58	290	250
2700	46	RUN	95	355	310	20000							2450	43	RUN	82	340	295	2150	38	RUN	69	315	275	20000	2100	F.T.	RUN	56	280	245
2700	46	RUN	100	355	310	15000	2600	44	RUN	96	350	305	2350	F.T.	RUN	79	325	280	2150	F.T.	RUN	65	300	260	15000	1850	F.T.	RUN	53	265	230
2700	46	RUN	98	330	290	10000	2600	44	RUN	90	325	280	2250	41	RUN	75	300	260	2000	37	RUN	59	275	240	10000	1650	32	RUN	48	240	210
2700	46	RUN	92	310	270	5000	2600	44	RUN	84	300	260	2250	41	RUN	69	280	245	1900	37	RUN	55	255	220	5000	1600	32	RUN	44	220	190
2700	46	RUN	86	290	255	S.L.	2550	44	RUN	78	280	245	2250	40	RUN	63	260	225	1850	37	RUN	51	235	205	S.L.	1600	31	RUN	40	200	175

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. [illegible]) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 8600 LB. GROSS WEIGHT WITH 180 GAL. OF FUEL
(AFTER DEDUCTING TOTAL ALLOWANCES OF 24 GAL.)
TO FLY 600 STAT. AIRMILES AT 15,000 FT. ALTITUDE
MAINTAIN 2150 RPM AND F.T. IN. MANIFOLD PRESSURE
WITH MIXTURE SET: RUN

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF *9-10-44* BASED ON: *FLIGHT TESTS*

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 11,600 TO 10,900 POUNDS

EXTERNAL LOAD ITEMS

2 - 1000-POUND WING BOMBS
NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.	FOR DETAILS SEE POWER PLANT CHART (SEC. III)
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		211 215	
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187	

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING (1). MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I STATUTE	COLUMN I NAUTICAL	FUEL U.S. GAL.	COLUMN II STATUTE	COLUMN II NAUTICAL	COLUMN III STATUTE	COLUMN III NAUTICAL	COLUMN IV STATUTE	COLUMN IV NAUTICAL	FUEL U.S. GAL.	COLUMN V STATUTE	COLUMN V NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)								
890	770	269			1040	900	1150	1000	269	1310	1140
790	690	240			930	810	1030	900	240	1170	1020
730 660	630 570	220 200			850 780	740 680	950 880	820 750	220 200	1070 970	930 850
590 530	510 460	180 160			710 630	620 550	780 700	680 610	180 160	880 780	760 680

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(STAT. (NAUT.) MI./GAL.)						(3.75 STAT. (3.25 NAUT.) MI./GAL.)						(4.2 STAT. (3.65 NAUT.) MI./GAL.)						PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.
						40000																			40000						
						35000																			35000						
						30000																			30000						
2700	46	RUN	98	360	320	25000													2400	F.T.	RUN	79	340	295	25000						
2700	46	RUN	94	345	308	20000													2300	34	RUN	77	330	280	20000	2200	F.T.	RUN	61	280	245
2700	46	RUN	103	345	300	15000							2500	44	RUN	91	335	290	2300	F.T.	RUN	74	310	270	15000	2000	F.T.	RUN	58	270	235
2700	46	RUN	98	325	285	10000							2500	43	RUN	83	310	270	2200	40	RUN	76	290	250	10000	1750	36	RUN	54	250	215
2700	46	RUN	92	305	265	5000							2400	43	RUN	78	290	250	2150	40	RUN	55	270	236	5000	1650	35	RUN	50	230	200
2700	46	RUN	85	285	250	S.L.							2450	43	RUN	72	270	235	2050	39	RUN	66	250	215	S.L.	1600	34	RUN	46	210	180

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 51) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 11,600 LB. GROSS WEIGHT WITH 220 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 49 GAL.) TO FLY 950 STAT. AIRMILES AT 15,000 FT. ALTITUDE MAINTAIN 2300 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: RUN

LEGEND

ALT. : PRESSURE ALTITUDE	F.R. : FULL RICH
M.P. : MANIFOLD PRESSURE	A.R. : AUTO-RICH
GPH : U.S. GAL. PER HOUR	A.L. : AUTO-LEAN
TAS : TRUE AIRSPEED	C.L. : CRUISING LEAN
KTS. : KNOTS	M.L. : MANUAL LEAN
S.L. : SEA LEVEL	F.T. : FULL THROTTLE

DATA AS OF 9-30-44 BASED ON: *FLIGHT TESTS*

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 10,600 TO 9000 POUNDS

EXTERNAL LOAD ITEMS

2 - 1000-POUND WING BOMBS

NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.	FOR DETAILS SEE POWER PLANT CHART (FIG. 34,SECT.III)
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		211 215	
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187	

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING.[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S.GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]								
600	520	184	660	580	730	640	810	700	184	900	780
520 450	450 400	160 140	570 500	500 440	640 560	560 490	700 610	600 530	160 140	780 680	680 580
390 320 260	340 280 220	120 100 80	430 360 290	340 310 250	480 400 320	420 350 280	530 440 350	450 380 300	120 100 80	580 490 390	500 420 340
190 130 60	170 110 50	60 40 20	210 140 70	180 120 60	240 160 80	210 140 70	260 170 90	230 150 70	60 40 20	290 190 100	250 170 80

MAXIMUM CONTINUOUS						PRESS	(3.6 STAT. (3.15 NAUT.) MI./GAL.)						(4.0 STAT. (3.5 NAUT.) MI./GAL.)						(4.4 STAT. (3.8 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
			APPROX.			ALT.				APPROX.						APPROX.						APPROX.			ALT.				APPROX.		
R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
						40000																			40000						
						35000																			35000						
						30000																			30000						
2700	46	RUN	98	370	320	25000							2500	43	RUN	90	360	310	2300	F.T.	RUN	75	335	290	25000						
2700	46	RUN	94	345	300	20000							2500	43	RUN	86	335	285	2200	38	RUN	71	315	275	20000	2150	F.T.	RUN	58	285	250
2700	46	RUN	100	345	300	15000	2500	F.T.	RUN	91	335	290	2500	F.T.	RUN	80	320	275	2200	F.T.	RUN	68	300	260	15000	1900	F.T.	RUN	54	265	230
2700	46	RUN	98	325	280	10000	2550	44	RUN	86	315	275	2300	41	RUN	75	300	260	2000	38	RUN	63	280	240	10000	1650	34	RUN	50	245	210
2700	46	RUN	92	305	265	5000	2550	44	RUN	82	295	255	2300	41	RUN	70	280	240	2000	38	RUN	59	260	225	5000	1600	33	RUN	46	225	196
2700	46	RUN	88	285	250	S.L.	2550	43	RUN	77	275	240	2300	41	RUN	65	260	225	2000	38	RUN	55	240	205	S.L.	1600	32	RUN	43	205	180

SPECIAL NOTES

[1] MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 57) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 10,400 LB. GROSS WEIGHT WITH 100 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 24 GAL.) TO FLY 800 STAT. AIRMILES AT 15,000 FT. ALTITUDE MAINTAIN 2200 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: RUN

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S.GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF *9-10-44* BASED ON: *FLIGHT TESTS*

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 10,800 TO 9500 POUNDS

EXTERNAL LOAD ITEMS
2 - 75-GALLON COMBAT TANKS
NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. (IN.HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		211 215
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187

FOR DETAILS SEE POWER PLANT CHART (FIG. 36, SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING.(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(2) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.) MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING(1)

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
1410	1220	419	1510	1320	1710	1480	1910	1660	419	2100	1820
1350	1170	400	1440	1260	1630	1410	1820	1580	400	2010	1740
1280	1110	380	1370	1190	1550	1340	1730	1500	380	1910	1650
1210	1050	360	1290	1130	1470	1270	1640	1430	360	1810	1570
1140	990	340	1220	1070	1390	1200	1560	1350	340	1710	1480
1080	930	320	1150	1000	1310	1130	1460	1270	320	1610	1400
1010	880	300	1080	940	1220	1060	1370	1190	300	1510	1310
940	820	280	1000	880	1140	990	1280	1110	280	1420	1230
870	760	260	930	820	1050	920	1190	1040	260	1320	1140

MAXIMUM CONTINUOUS						PRESS	(3.6 STAT.-(3.15 NAUT.) MI./GAL.)						(4.05 STAT. (3.5 NAUT.) MI./GAL.)						(4.5 STAT. (3.9 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.
						40000																			40000						
2700	F.T.	RUN	80	360	310	35000																			35000						
2700	F.T.	RUN	97	385	335	30000													2500	F.T.	RUN	79	355	310	30000						
2700	46	RUN	99	375	325	25000							2500	43	RUN	89	365	315	2300	F.T.	RUN	75	340	295	25000	2100	F.T.	RUN	60	295	255
2700	46	RUN	95	355	310	20000							2450	43	RUN	86	340	295	2150	38	RUN	71	320	275	20000	2100	F.T.	RUN	58	285	245
2700	46	RUN	100	355	310	15000	2600	44	RUN	97	350	305	2350	F.T.	RUN	79	325	280	2150	F.T.	RUN	66	300	260	15000	1850	F.T.	RUN	54	265	230
2700	46	RUN	98	330	290	10000	2600	44	RUN	90	325	280	2300	41	RUN	75	305	265	1950	38	RUN	62	280	240	10000	1600	34	RUN	49	240	210
2700	46	RUN	92	310	270	5000	2600	44	RUN	85	305	265	2250	41	RUN	69	280	245	1950	38	RUN	57	260	225	5000	1600	33	RUN	45	220	190
2700	46	RUN	86	290	255	S.L.	2600	44	RUN	80	285	245	2250	40	RUN	64	260	225	1950	37	RUN	53	240	205	S.L.	1600	33	RUN	42	205	175

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 35.) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 10,500 LB. GROSS WEIGHT WITH 374 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 45 GAL.) TO FLY 1800 STAT. AIRMILES AT 25,000 FT. ALTITUDE MAINTAIN 2300 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: RUN

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF *9-10-44* BASED ON: *FLIGHT TESTS*

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 9800 TO 8000 POUNDS

EXTERNAL LOAD ITEMS
2 - 75-GALLON COMBAT TANKS
NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. IN. HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		211 216
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187

FOR DETAILS SEE POWER PLANT CHART (FIG. [illegible], SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING (1). MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S.GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)								
870	790	269	970	850	1100	950	1230	1070	269	1370	1190
810	700	240	860	750	980	850	1100	960	240	1220	1060
740	640	220	790	690	900	780	1010	880	220	1120	970
670	580	200	720	630	820	710	920	800	200	1010	880
600	520	180	640	560	730	640	820	720	180	910	790
540	470	160	570	500	650	560	730	640	160	810	700
470	410	140	500	440	570	490	640	560	140	710	620
400	350	120	430	380	490	420	550	480	120	610	530
340	290	100	360	310	410	350	460	400	100	510	440
270	230	80	290	250	320	280	360	320	80	400	350
200	170	60	210	190	240	210	270	240	60	300	260
130	110	40	140	120	160	140	180	160	40	200	170
60	50	20	70	60	80	70	90	80	20	100	80

MAXIMUM CONTINUOUS						PRESS	(3.6 STAT. (3.15 NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH	T.A.S. MPH	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH	T.A.S. MPH	T.A.S. KTS.
						40000						
2700	F.T.	RUN	90	370	320	35000						
2700	F.T.	RUN	97	380	335	30000						
2700	46	RUN	98	375	325	25000						
2700	46	RUN	94	365	310	20000						
2700	46	RUN	102	355	310	15000	2600	44	RUN	97	350	305
2700	46	RUN	96	335	290	10000	2600	44	RUN	90	325	280
2700	46	RUN	92	310	270	5000	2600	44	RUN	85	305	265
2700	46	RUN	88	290	255	S.L.	2600	44	RUN	80	285	245

PRESS	(4.1 STAT. (3.55 NAUT.) MI./GAL.)						(4.6 STAT. (4.0 NAUT.) MI./GAL.)						MAXIMUM AIR RANGE					
ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH	T.A.S. MPH	T.A.S. KTS.
40000																		
35000																		
30000							2460	F.T.	RUN	77	355	310	2200	F.T.	RUN	60	305	265
25000	2500	43	RUN	89	365	315	2300	F.T.	RUN	74	340	295	2050	29	RUN	57	290	250
20000	2450	42	RUN	82	340	295	2100	37	RUN	68	315	275	2050	F.T.	RUN	55	280	245
15000	2300	F.T.	RUN	79	325	280	2150	F.T.	RUN	65	300	260	1750	F.T.	RUN	51	260	225
10000	2250	40	RUN	74	300	260	1900	37	RUN	59	275	240	1600	32	RUN	47	240	210
5000	2250	40	RUN	68	280	245	1900	37	RUN	55	255	220	1600	31	RUN	43	220	190
S.L.	2250	40	RUN	63	260	225	1850	37	RUN	51	235	205	1600	30	RUN	39	200	175

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 39) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 9800 LB. GROSS WEIGHT WITH 220 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 20 GAL.) TO FLY 1000 STAT. AIRMILES AT 25,000 FT. ALTITUDE MAINTAIN 2300 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: RUN.

LEGEND

ALT. : PRESSURE ALTITUDE.
M.P. : MANIFOLD PRESSURE
GPH : U.S.GAL.PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF *9-10-44* BASED ON: *FLIGHT TESTS*

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 11,400 TO 10,000 POUNDS

EXTERNAL LOAD ITEMS
2 - 110-GALLON COMBAT TANKS
NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. (IN.HG.)	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		211 216
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187

FOR DETAILS SEE POWER PLANT CHART [illegible]

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING (1). MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.) MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)								
1620	1400	489			1900	1650	2130	1860	489	2360	2050
1520	1320	460			1790	1550	2010	1750	460	2220	1930
1460	1260	440			1720	1490	1920	1670	440	2120	1850
1390	1200	420			1640	1420	1840	1600	420	2030	1770
1320	1150	400			1570	1350	1750	1520	400	1940	1680
1250	1090	380			1490	1290	1660	1450	380	1840	1600
1190	1030	360			1410	1220	1580	1370	360	1750	1520
1120	970	340			1340	1160	1490	1300	340	1650	1440
1060	920	320			1260	1090	1410	1220	320	1560	1350
990	860	300			1190	1020	1320	1150	300	1460	1270
920	800	280			1110	960	1230	1070	280	1370	1190
850	740	260			1030	890	1150	1000	260	1270	1110

MAXIMUM CONTINUOUS						PRESS	(STAT.(NAUT.) MI./GAL.)						(3.8 STAT.(3.3 NAUT.) MI./GAL.)						(4.3 STAT.(3.75 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
			APPROX.			ALT.				APPROX.						APPROX.						APPROX.			ALT.				APPROX.		
R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
						40000																			40000						
2700	F.T.	RUN	95	345	300	35000																			35000						
2700	F.T.	RUN	97	380	330	30000																			30000						
2700	46	RUN	98	370	320	25000													2350	F.T.	RUN	79	340	295	25000						
2700	46	RUN	96	360	315	20000													2250	50	RUN	75	320	280	20000	2150	F.T.	RUN	59	280	245
2700	46	RUN	108	350	305	15000							2500	F.T.	RUN	88	335	290	2250	F.T.	RUN	71	305	265	15000	1950	F.T.	RUN	57	270	235
2700	46	RUN	98	330	285	10000							2450	42	RUN	81	310	270	2100	39	RUN	66	285	245	10000	1650	35	RUN	52	245	215
2700	46	RUN	92	310	270	5000							2450	42	RUN	76	290	250	2100	39	RUN	62	265	230	5000	1600	34	RUN	48	225	195
2700	46	RUN	86	290	250	S.L.							2400	42	RUN	71	270	235	2050	39	RUN	57	245	215	S.L.	1600	33	RUN	43	205	180

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 53) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 11,200 LB. GROSS WEIGHT WITH 400 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 60 GAL.) TO FLY 1800 STAT. AIRMILES AT 25,000 FT. ALTITUDE MAINTAIN 2350 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: RUN

LEGEND

ALT. : PRESSURE ALTITUDE	F.R. : FULL RICH
M.P. : MANIFOLD PRESSURE	A.R. : AUTO-RICH
GPH : U.S.GAL. PER HOUR	A.L. : AUTO-LEAN
TAS : TRUE AIRSPEED	C.L. : CRUISING LEAN
KTS. : KNOTS	M.L. : MANUAL LEAN
S.L. : SEA LEVEL	F.T. : FULL THROTTLE

DATA AS OF *9-20-44* BASED ON: *FLIGHT TESTS*

AIRCRAFT MODEL(S)
P-51D AND P-51K

ENGINE(S): V-1650-7

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 10,000 TO 8500 POUNDS

EXTERNAL LOAD ITEMS
2 - 110-GALLON COMBAT TANKS
NUMBER OF ENGINES OPERATING: 1

LIMITS	RPM	M.P. IN. HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.	3000	67	LOW HIGH	RUN	5 MIN.		213 215
MILITARY POWER	3000	61	LOW HIGH	RUN	15 MIN.		182 187

FOR DETAILS SEE POWER PLANT CHART (FIG. 36, SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING (A) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (A)

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S. GAL.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S. GAL.	RANGE IN AIRMILES	
STATUTE	NAUTICAL		STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
890	770	269	970	850	1070	930	1180	1030	269	1330	1150
790	690	240	860	750	960	830	1050	920	240	1190	1030
720	630	220	790	690	880	760	960	840	220	1090	940
660	570	200	720	630	800	690	880	770	200	990	860
590	510	180	650	560	720	620	790	690	180	890	770
530	460	160	570	500	640	550	700	620	160	790	690
460	400	140	500	440	560	480	610	540	140	690	600
390	340	120	430	380	480	410	520	460	120	590	510
330	280	100	350	310	400	340	440	380	100	490	430
260	230	80	280	250	320	270	350	310	80	390	340
200	170	60	210	190	240	200	260	230	60	290	250
130	110	40	140	120	160	130	170	150	40	200	170
60	50	20	70	60	80	70	90	70	20	100	80

MAXIMUM CONTINUOUS						PRESS ALT.	(3.6 STAT. (3.15 NAUT.) MI./GAL.)						(4 STAT. (3.45 NAUT.) MI./GAL.)						(4.4 STAT. (3.85 NAUT.) MI./GAL.)						PRESS ALT.	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.	FEET	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. GPH	APPROX. T.A.S. MPH	APPROX. T.A.S. KTS.
						40000																			40000						
2700	F.T.	RUN	80	365	315	35000																			35000						
2700	F.T.	RUN	97	385	335	30000													2500	F.T.	RUN	82	360	310	30000						
2700	46	RUN	98	370	320	25000							2500	53	RUN	90	365	315	2300	F.T.	RUN	77	340	295	25000	2060	F.T.	RUN	58	290	250
2700	46	RUN	95	350	305	20000							2500	53	RUN	85	340	295	2150	38	RUN	71	315	275	20000	2100	F.T.	RUN	56	280	240
2700	46	RUN	100	350	305	15000	2550	44	RUN	94	340	295	2400	F.T.	RUN	82	335	290	2100	F.T.	RUN	65	300	260	15000	1900	F.T.	RUN	52	260	225
2700	46	RUN	98	330	285	10000	2550	44	RUN	86	320	275	2300	41	RUN	75	300	260	2000	38	RUN	63	280	245	10000	1650	32	RUN	49	240	210
2700	46	RUN	92	310	270	5000	2550	44	RUN	81	295	255	2300	41	RUN	70	280	245	2000	38	RUN	59	260	225	5000	1600	32	RUN	45	220	190
2700	46	RUN	86	290	250	S.L.	2500	43	RUN	75	275	240	2300	41	RUN	65	260	225	2000	38	RUN	55	240	210	S.L.	1600	31	RUN	41	200	175

SPECIAL NOTES

(A) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. 35) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

HIGH BLOWER ABOVE HEAVY LINE

EXAMPLE

AT 9800 LB. GROSS WEIGHT WITH 220 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 39 GAL.) TO FLY 900 STAT. AIRMILES AT 25,000 FT. ALTITUDE MAINTAIN 2300 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: RUN

LEGEND

ALT. : PRESSURE ALTITUDE	F.R. : FULL RICH
M.P. : MANIFOLD PRESSURE	A.R. : AUTO-RICH
GPH : U.S. GAL. PER HOUR	A.L. : AUTO-LEAN
TAS : TRUE AIRSPEED	C.L. : CRUISING LEAN
KTS. : KNOTS	M.L. : MANUAL LEAN
S.L. : SEA LEVEL	F.T. : FULL THROTTLE

DATA AS OF *9-10-44* BASED ON: *FLIGHT TESTS*

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