PA-30

and

MULTI-ENGINE FLYING

By Alice S. Fuchs

CONTENTS

STALLS AND SPINS

By Alice S. Fuchs

To the pilot practicing stalls, the nose seems to be in an unnaturally high position before the airplane shudders to indicate the beginning of the stall. How, he wonders, could anyone ever do this accidentally? He may even decide, somewhat self-righteously, that it could never happen to him. But pilots do stall and, sometimes, spin. So let's take a look at stalls and spins - at what causes them, how to recover, and how the multi-engine situation affects the stall picture.

WHY DOES AN AIRPLANE STALL?

An airplane stalls because it stops flying. It stops flying when the air no longer produces lift by flowing smoothly over the top surface of the wing. Pilots are prone to associate a stall with a high nose position in relation to the horizon. Actually, it isn't the nose position that matters, but the angle between the chord line and the relative wind.

Let's define terms. If you drew a line from the leading edge to the trailing edge of the wing, this line would be the chord line.

Figure 1

The relative wind is the air moving past the wing. It is opposite in direction and equal in velocity to the motion of the airplane.

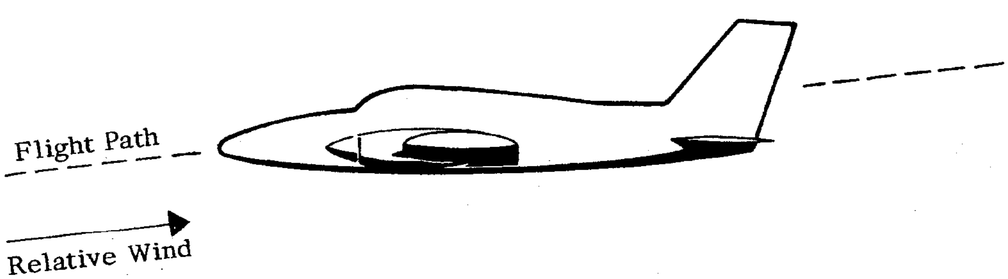


Figure 2

The angle of attack is the angle between the chord line and the relative wind.

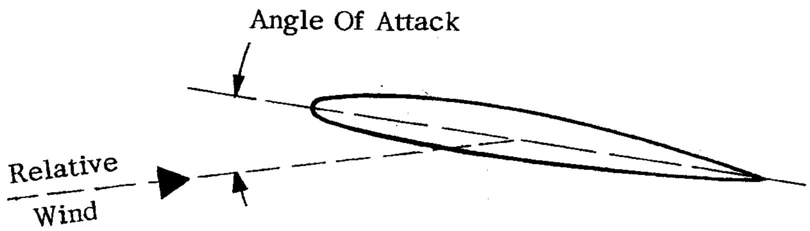


Figure 3

One cannot determine angle of attack by the attitude of the airplane. Angle of attack depends on the flight path. An airplane could have a low angle of attack in a steep climbing attitude, or a high angle of attack in what appears to be a dive.

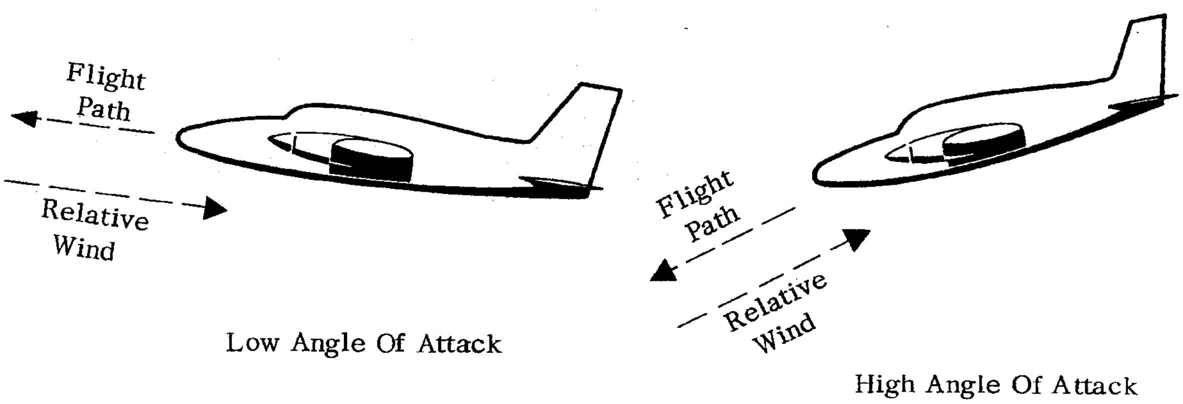


Figure 4

Whenever the angle of attack of the wing exceeds a certain angle, the air can no longer flow smoothly over the top surface of the wing. The flow near the trailing edge begins to separate and burble. Lift then decreases rapidly as the angle is increased, and the aircraft begins to lose altitude. This in turn further increases the angle of attack and lift drops even more.

Engineers use a quantity called "lift coefficient" C_L to describe the ability of the wing to produce lift under different conditions. A graph of this "ability to produce lift" with the angle of attack tells the story of the stall. As the angle of attack increases, the ability to produce lift increases to a maximum. It then drops rapidly as the wing stalls.

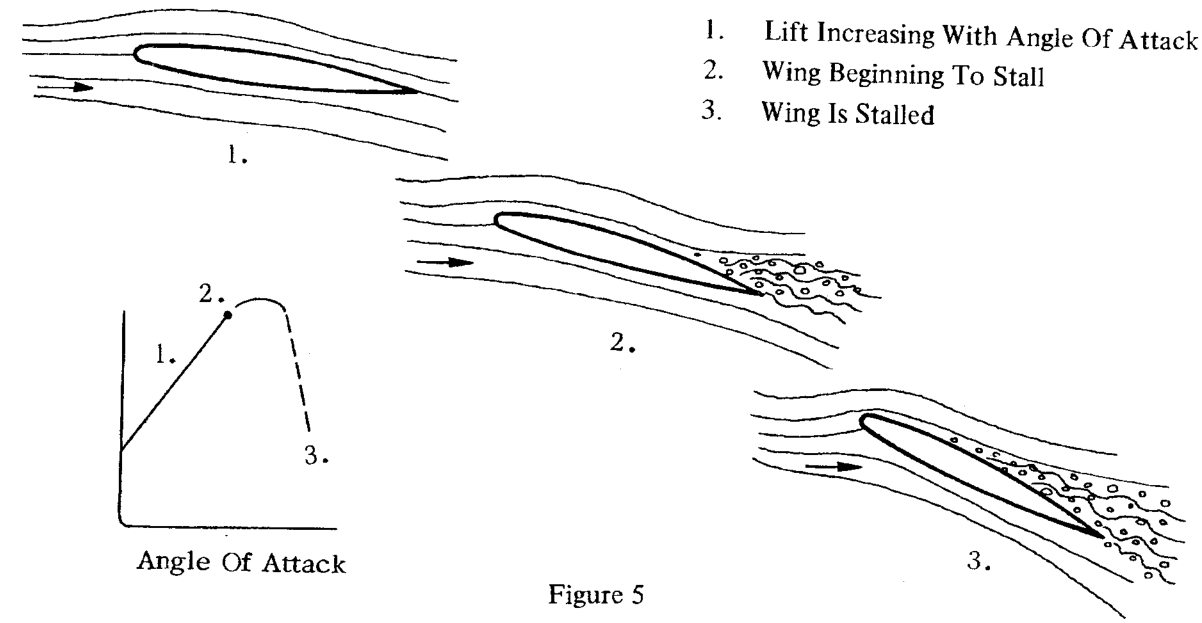


Figure 5

HOW DOES TURNING AFFECT THE STALL?

For wings-level unaccelerated flight, the lift approximately equals the weight of the airplane. However, during a turn the lift of the wing must exceed the weight of the plane in order to accomplish the turn without altitude loss, for it is lift that makes an airplane turn. The lift force has two components, one which supports the weight of the plane (and must therefore be equal to the weight) and the other which opposes centrifugal force and keeps the aircraft in the turn.

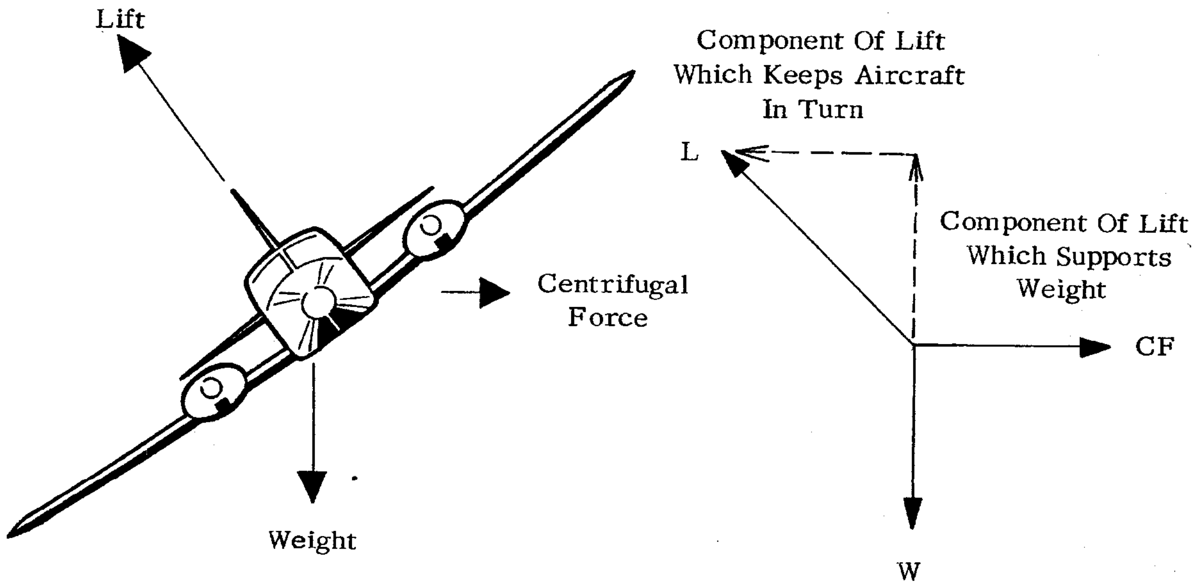


Figure 6

If we divide the wing lift by the airplane weight we get a ratio which we call the load factor.

$$\text{Load factor} = \frac{\text{Lift}}{\text{Weight}}$$

If the lift is twice the weight, we say the load factor is 2 (or 2g). For straight and level flight, lift equals weight and the load factor is 1. In a 60-degree bank at constant altitude this ratio is 2. One can tell when he is "pulling g's." He feels heavier in his seat.

Just how does the pilot get the extra lift needed for a turn? He has two ways of doing this. He can increase speed (add power) or increase the angle of attack by applying back pressure to the wheel. Normally he applies back pressure. As the angle of attack is increased, the lift coefficient (ability of the wing to produce lift) also increases. See Figure 5. The greater the angle of bank in a turn, the greater the lift required, and consequently the greater the load factor. As you can see from the Figure, this sort of thing can go only so far. If there is a high enough angle of attack, the lift coefficient reaches a maximum and any further increase in angle of attack (back pressure on the wheel) will result in a stall. The steeper the bank the higher the load factor and the closer the airplane is to a stall. Other things being equal, the airplane will stall sooner in a turn than in level flight. If the load factor is increased sufficiently, the wing will become stalled even though the airplane is flown at full power.

The load factor can be increased by banking more and more, using back pressure on the wheel to maintain altitude, or it can be increased simply by a sudden hard pull on the wheel. A stall can occur even in a power dive if the pilot pulls back hard enough to increase the angle of attack beyond that which will produce the stall.

STALL SPEEDS

Pilots frequently talk about stall speed. This is because they have airspeed indicators rather than angle of attack indicators. It is true that for a given airplane weight, configuration and angle of bank an airplane flown smoothly will stall at a given indicated airspeed. It is also true that this indicated airspeed is not affected by temperature, pressure or altitude. The stalling indicated airspeed will increase, however, with increased load factor. It will also increase with weight and can vary slightly with C.G. location.

The speed at which the airplane wing will stall in a turn is equal to the stall speed for the same configuration in level flight times a factor equal to the square root of the load factor. Thus, for a level coordinated turn of 60 degrees bank, where the load factor is 2, the stalling speed in the turn will be the square root of 2, or approximately 1.41, times the level flight stalling speed.

TWIN COMANCHE STALL SPEEDS (MPH)

Angle of Bank	Gear & Flaps Up	Gear & Flaps Down
0°	76	69
20°	79	71
40°	87	79
60°	108	98

(Airplane at gross weight of 3600 pounds)

The lowering of flaps produces more lift and decreases the stall speed. Gear position usually has little effect on stall speed.

Aircraft weight also affects stall speed. The following chart shows the decrease in stall speed with decrease in weight of the airplane.

TWIN COMANCHE STALL SPEEDS (MPH)

Aircraft Weight	Stall Speed (no bank) Gear & Flaps Up
3600 lbs.	76
3000 lbs.	70
2600 lbs.	65

THE EFFECT OF UPDRAFTS

Sometimes the angle of attack can be inadvertently increased, causing the wing to stall. For example, the unusual situation of a takeoff over a cliff into a strong wind can be hazardous.

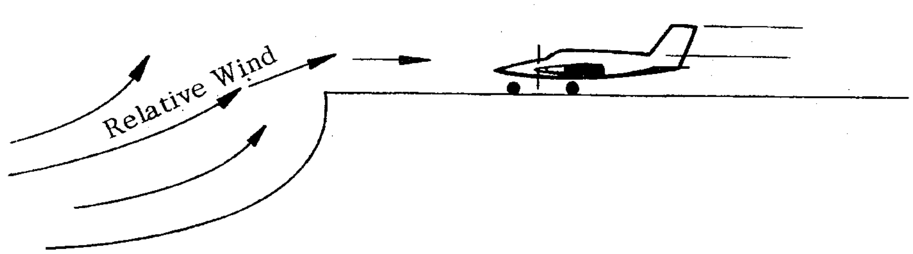


Figure 7

Unless the pilot puts the plane into a rather sharp dive as he encounters the strong updraft, the stalling angle of attack may be exceeded. In this case the airplane would stall.

In level flight the stall angle might be exceeded with unpleasant results if a pilot slowed down (thus increasing the angle of attack to get sufficient lift to hold altitude) to penetrate rough air. If he suddenly encountered a sustained strong updraft, he could find himself with an angle of attack which might produce a stall. Low (and slow) flight in mountain areas should be avoided, especially under high wind conditions.

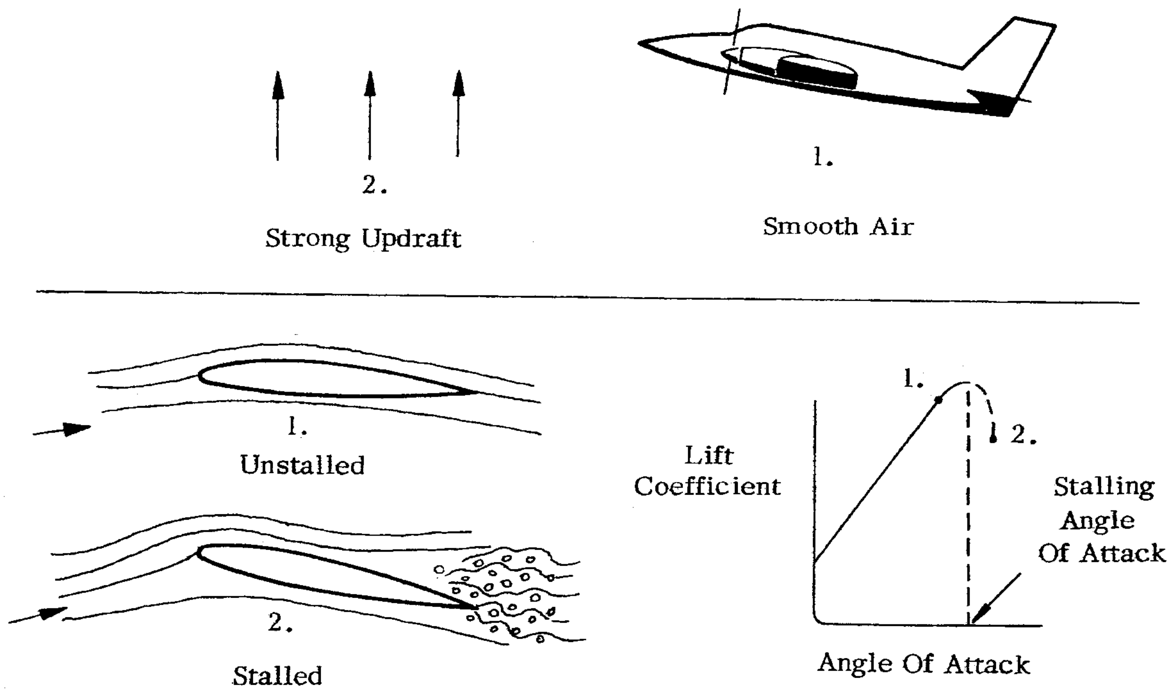


Figure 8

EFFECT OF ROUGH HANDLING

When flight is being carried out at an angle of attack approaching stalling angle, rough handling of pitch control can cause a stall. Therefore, as the pilot elects to fly nearer the stall angle of attack, as during an approach for a landing or while demonstrating slow flight, he should make a concerted effort to fly as smoothly as he can.

WHAT ARE THE INDICATIONS OF A STALL?

We have seen that the airspeed alone is not a reliable stall indication. However, the pilot can safely conclude that at low airspeeds he is usually closer to a stall than at high airspeeds.

As the wing nears the stalling angle of attack, an area of turbulence develops over the top of the wing near the trailing edge. As the angle of attack is increased further, this area of turbulence increases. The turbulence passing over the horizontal tail surface usually causes a buffeting or vibration of that surface, which can be felt by the pilot through the airframe and elevator control. Pilots should condition themselves to be alert for this buffet which precedes a stall. There is a danger, in rough air, that the pilot will confuse the buffet with gusty conditions and may not realize what is happening.

During the approach to a low-speed stall, because the air is moving past the controls at slower velocity they become much less effective and have less "feel." This is a good warning of an impending stall. Modern airplanes are designed so that the inboard part of the wing stalls before the outboard part, and hence the ailerons retain their effectiveness until the very last part of the stall. However, the presence of engine nacelles on the wings of multi-engine aircraft may affect this design goal.

A stall warning horn and light, such as those on the Twin Comanche, are of great value in alerting the pilot to a possible stall.

HOW TO RECOVER FROM A STALL

There is only one way to recover from a stall: decrease the angle of attack. This is done, of course, by forward pressure on the wheel. The simultaneous application of power will aid recovery and reduce altitude loss in the stall. The sooner recovery action is initiated, the more effective it will be and the less altitude will be lost. Any tendency to roll to either side should be promptly neutralized by strong opposite rudder and aileron. In most twins, including the Twin Comanche, the wheel should be brought well forward and, as in any airplane, care should be taken not to come back too soon or too abruptly after stall recovery. Either mistake could lead to a secondary stall, which could be more abrupt than the first.

When landing gear or flaps are extended, stall recovery should be made with a lower nose position than when in a "clean" configuration.

Most airplanes will not stall unless considerable back pressure or nose-high trim is applied. Therefore if, because of low airspeed, buffet, stall warning indicator or poor control response, you suspect you are approaching a stalled condition, you can avoid a stall by simply refusing to pull back on the wheel. You may lose some altitude, but without back pressure or back trim you are not likely to stall.

HOW ABOUT STALLS IN A MULTI-ENGINE AIRCRAFT?

The presence of an engine nacelle on each wing affects the stall characteristics of an airplane. If the engine nacelles are flat and thin, they may produce considerable lift, behaving like blunt-nosed airfoil sections which may not stall even at very high angles of attack. This is especially true at high power settings. If the center portion of the wing does not stall before the outboard portion, the airplane may have a tendency to roll or yaw before the nose pitches down. Aileron and rudder control must be used to counteract these tendencies.

In a stall in a multi-engine aircraft, if a roll begins, first the nose must promptly be pushed well down to unstall the wing and regain aileron and rudder control. The nose down attitude, especially if flaps are down, must be very steep, an attitude which may be hard to adopt if you are close to the ground.

The most dangerous stall in a twin is one which is entered during single-engine flight, with the operating engine producing high power. The asymmetric power causes the nose to yaw away from the good engine as the speed is reduced. This is true, below V_{mc}, even though the pilot is applying full rudder. The yawing and the fact that prop blast over the wing on the side of the operating engine makes that wing produce more lift causes a rolling tendency. If the down-going wing stalls because of the increased angle of attack which results from the downward movement, the aircraft is likely to go into a spin.

If a stall should develop, or be imminent, during single-engine operation, the nose of the airplane should be lowered sharply and power should be reduced immediately on the operating engine. Because of the special dangers of a stall under single-engine conditions, it is essential to stay well above stall speed and Vmc when flying on one engine.

A WORD ABOUT STALL PRACTICE

Symmetrical stall practice in a multi-engine aircraft should be conducted at an altitude of at least 5000 feet above the ground. Start recovery at the first physical indication of a stall – buffet, dropping of the nose, reduction of control effectiveness, yaw or roll to one side. In the Twin Comanche the first indication is usually a recognizable buffet. However, under certain conditions and configurations the buffet is less pronounced than in others.

It is recommended that no more than 65% power be used for power-on stalls. In airplanes with an extension on the propeller shaft, stalls should not be practiced at high RPM setting. A maximum of 2100 RPM should be used for stall practice in the Twin Comanche.

Single-engine or simulated single-engine stalls should not be practiced in any multi-engine aircraft.

For safety reasons, stalls are practiced at high altitude, but the dangerous stalls occur at low altitude, where it is completely against a pilot's instinct to push the nose down. The pilot must be conditioned to act automatically so that when a stall is approached he will push the elevator control regardless of altitude.

SPINS

Years ago all pilots were required to demonstrate spin recovery. Today only flight instructors are required to have a knowledge of spins. If you have not been taught how to recover from a spin, you may wish to engage a competent instructor and get this instruction in a Cherokee 140 or similar airplane.

Let's discuss what happens in a spin. Before a spin can occur, at least one wing must stall. If, just as the stall is taking place, something, such as pushing a rudder, causes the airplane to yaw or one wing to drop, a spin may result. The down-going wing suddenly is at an even steeper angle of attack and is deeply stalled. On the other hand, the up-going wing has a reduced angle of attack and is producing good lift. This situation causes the airplane to rotate. The rotation keeps the angle of attack of the down-going wing well above the stall angle so that it is not producing much lift. The up-going wing, although at a reduced angle of attack, still produces lift. This difference in lift continues to auto-rotate the wing until steps are taken to recover.

In the Twin Comanche, as in many high-performance airplanes, the nose of the airplane alternately drops almost straight down, then comes up to a less steep angle and then steepens again. It continues to do this until corrective action is taken.

Different airplanes spin in different ways and recovery is not always accomplished in the same manner. Nevertheless, most general aviation airplanes will recover if the following procedure is applied:

1. Retard throttle(s).
2. Push full rudder opposite to the direction of turn.
3. Push the control wheel forward.
4. When the spin stops and the airplane is diving, recover by applying steady back pressure on the wheel.

In the Twin Comanche, the control wheel should be pushed full forward and held until the spin stops, and the use of ailerons against the spin direction will expedite recovery.

Once the stall has been broken and the turning ceases, the airplane is in a steep dive. If too much back pressure is pulled, the angle of attack may be increased again beyond the stall and another spin could occur. On the other hand, if insufficient back pressure is used, the speed will become excessive and more altitude than necessary will be lost.

Spinning descent produces a natural but completely incorrect desire to pull back on the control wheel so as to avoid losing any more altitude. This is the worst thing to do because as long as the control is held back the spin will continue.

Because any stall can result in an accidental spin which requires considerable altitude for recovery, stalls should never be practiced at low altitude.

A WORD ABOUT TRAPS

How does anyone ever get into that unhappy position which results in a stall or spin? Every licensed pilot in the United States has had instruction and practice in stall recovery. What happens? Does all knowledge and training go suddenly out the window?

We can only conclude that stalls and spins are caused by situations which lead the pilot to handle the airplane unwisely even though he knows better. The problem then is psychological. If the pilot can train himself to recognize a circumstance which may lure him to approach a stall, he may be mentally conditioned to resist the trap. Let's take a look at some of these situations.

TRAP #1 - THE TURN ONTO FINAL APPROACH

The key to this trap is the wind. Many of the stall/spin accidents which occur during the turn onto final happen when the pilot has a crosswind component which gives him some tailwind on his base leg.

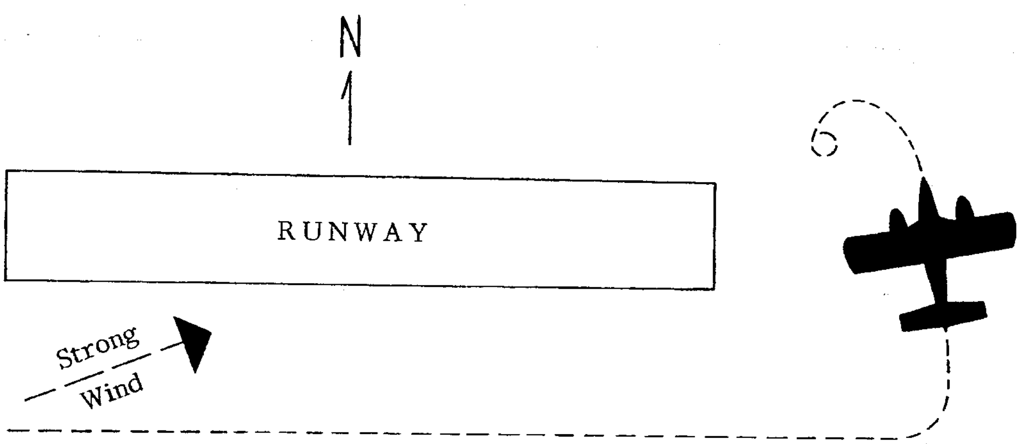


Figure 9

Picture a pilot landing toward the west with a strong southwest wind and a left-hand pattern. During the base leg his ground speed is boosted by the southerly component of the wind. If he neglects to start the turn onto final approach soon enough, he will swing beyond the final approach course during the turn. In his anxiety to get lined up with the runway, the pilot banks sharply and comes back on the wheel to tighten his turn. Looking at the ground, he thinks he is going faster than he is. And so the trap is sprung: low airspeed and a tightened turn at low altitude. The pilot knew better, but the situation caused him to forget his training.

How to avoid this trap? It's simple. If you have a tailwind component on base leg, start the turn onto final sooner than usual so that you can make a shallow turn, and remember to keep up your airspeed in spite of the false sense of security you get from seeing the landscape zip by more rapidly than usual. Remember the Bank/Stall Chart.

TRAP #2 - CLIMB-OUT AFTER TAKE-OFF

How could anyone get his nose so ridiculously high that he stalls during climb-out? He gets his nose too high for only one reason: He's afraid he's going to hit something if he doesn't. Wires, a tree, a house - something is there in front of him. He knows he may stall if he raises the nose, but he also knows that he will probably hit the obstruction if he doesn't raise the nose. He gambles on possible danger rather than what he fears is certain disaster. And again a trap is sprung.

How can one avoid the situation? By preflight planning and good climb-out procedure. The Twin Comanche Owner's Handbook contains charts showing take-off ground run distance and take-off distance over a 50-foot obstacle under different conditions of altitude, temperature, weight and headwind. There are also charts showing how fast the airplane will climb at different weights and altitudes, either multi- or single-engine. If there is the remotest doubt about the matter, it is worth taking the time before take-off to calculate whether or not you can make it. Use the charts. An obstruction does not loom up suddenly into a pilot's climb-out path. It was there all the time, before he ever started. Preflight planning could have kept him from getting so close.

TRAP #3 - ICING

Anything which changes the shape of the wing and tail can affect the stall characteristics of the airplane. If ice has accumulated on the wing, the airplane is not only heavier but, more important, it has a different airfoil as well. Roughness, especially on the leading edge and top of the forward part of the wing can be most detrimental to lift. Ice can cause the airplane to stall sooner (at a lower angle of attack and higher airspeed) and the stall to be sharper. If a landing must be made with ice on the wings, a higher airspeed should be maintained, and the pilot should be constantly mindful of the change in stall characteristics. Take-off should never be made with ice on the wings, and boots should not be operated during take-off or landing.

TRAP #4 - ENGINE LOSS DURING CLIMB-OUT

If a pilot loses an engine during climb-out after take-off, he must act promptly to raise gear and flaps, assume the best climb speed (105 mph in the Twin Comanche) and keep everything under control. If he is overloaded or heavily loaded and if it is a hot day, or if he is operating from a high-altitude field, the situation becomes increasingly difficult. Unless the bad engine is feathered promptly, he will not be able to climb. All of the chores connected with handling the situation make the pilot a busy fellow indeed. The field behind him looks very welcome and there is bound to be an anxiety to get back to it. If he tries to turn back toward the field in too steep a turn, thus increasing the stall speed by imposing a high load factor, he must raise the nose to maintain his rate of climb, or possibly even level flight, and a stall may occur. If the turn is made toward the dead engine, the situation can become even more dangerous and may result in a spin.

The cure for this trap, of course, is to make shallow turns when operating with one engine, especially if turning toward the dead engine. If an engine is lost after take-off, it is best to climb straight ahead to circling altitude before attempting a turn back to the field. The airplane will climb better in straight flight than in a turn.

If you lose an engine on climb-out, have patience and resist the urge to scramble for altitude immediately. You may have to be satisfied with maintaining present altitude until you get the situation squared away so that you can achieve a gradual, safe climb. It is important to know and use the best single-engine rate of climb speed.

AIRCRAFT LOADING

By Alice S. Fuchs

Every certificated airplane can be overloaded or the load improperly distributed. With either circumstance, under some conditions the airplane may seem to fly satisfactorily. This capability of doing more than the manufacturer says, sometimes leads to optimism about how much can be put into the airplane and where it can be located. While optimism is an admirable trait, when applied to loading an airplane, it can lead to disaster. It is the responsibility of the owner and pilot to determine that the gross weight of the airplane is not exceeded and to determine that the airplane remains within the allowable weight vs. center of gravity envelope while in flight.

GROSS WEIGHT

The manufacturer's gross weight figure is not something he pulled out of a hat. It is carefully calculated to give the pilot the greatest possible payload consistent with a margin of safety. If the airplane were going to be flown only in smooth air, with every landing greased onto a long runway, and if there were no possibility of an emergency requiring optimum performance the gross weight could be much higher. However, airplanes encounter rough air, abrupt maneuvers, rough landings, and circumstances which require good performance, climb and maneuverability to get out of a tough spot. Since a pilot needs to have an airplane which can take the inevitable extraordinary stresses which occur from time to time, he must stay within the gross weight for which the airplane has been designed.

The allowable gross weight for the Twin Comanche is 3600 pounds, or 3725 pounds if tip tanks are installed and the weight in excess of 3600 pounds is in the form of symmetrically loaded fuel in the tip tanks. The wings, fuselage, seats, instrument panel, and all the other components have been physically tested with bags of lead shot, hydraulic jacks, and other means of applying load, during the normal certification process which is required of every airplane getting an FAA type certificate. It has been determined through calculation and physical testing that the airplane can be safely flown at the gross weight and will then have sufficient margin of safety to endure most abnormal stresses which may be encountered.

The optimistic pilot who overloads the standard Twin Comanche beyond its gross weight of 3600 pounds (or 3725 if there are tip tanks) finds that his airplane will indeed take off and perhaps seem to perform satisfactorily with the higher load; but in so doing he is eating into the cushion of safety which has been built into his airplane. If he overloads he may, as in any airplane, exceed the aircraft capabilities.

Looking at the gloomy side of the picture, let's see what may happen if this, or any other airplane, is loaded at more than gross weight. The first and most obvious consequence is that all the performance figures go out the window. The performance charts for take-off distance, rates of climb, single-engine performance, speeds, range, and landing distance are no longer applicable. The charts and data for the Twin Comanche are figured on a maximum of 3600 pounds (3725 with tip tanks). Beyond that weight, the pilot is flying in an untested area. He is using up his margin of safety and he has no performance figures to go by.

The following are among the consequences that prevail when an airplane is loaded in excess of gross weight:

1. Single-engine performances decreases in all areas.
2. The structural strength of certain portions of the aircraft may be exceeded.
3. Take-off distance increases.
4. Rate of climb decreases.

5. Airspeed and range decrease.
6. Airplane service ceiling is lower.
7. Landing distance increases.
8. The best rate of climb and best angle of climb speeds are higher.
9. Stall speed increases.
10. Flight characteristics differ.

In any maneuver or condition that imposes a load factor higher than the normal factor of 1, the extra weight counts against the pilot in increased proportion. If the aircraft is overloaded by 150 pounds for instance, in a 60-degree bank, where the load factor is 2, the structure of the aircraft is subject to the equivalent of an extra 300 pounds above normal.

The effect of overloading on climb performance would be especially dangerous in the case of engine loss during climb-out after take-off or in an icing situation when flying in clouds. The lowering of single-engine service and absolute ceilings could be hazardous over high terrain. One of the reasons why a pilot buys a twin-engine airplane is that he wants to be able to keep going in the event of engine loss. If he overloads his airplane, he runs the risk that he can no longer maintain flight on one engine and thus he has lost the multi-engine safety for which the airplane was designed.

The higher stall speed of an overloaded airplane can be especially dangerous during a low-level steep turn, and for this reason such a turn should be avoided in the traffic pattern.

One of the hazards of aircraft loading is over-optimism on the part of the pilot. He often finds it convenient to estimate rather than to weigh what goes into the airplane, and estimates are apt to be on the light side when he wants to put as much as possible aboard. A scale of some kind should be used when loading becomes critical. A bathroom scale will do, or a fish scale with a net might be a handy (and light weight) item to carry.

HOW TO COMPUTE GROSS WEIGHT

In computing the amount you can put into the Twin Comanche, the important item for calculation is, of course, the basic weight of the airplane. Basic weight is defined as the empty weight of the airplane plus the oil and the unusable fuel (six gallons in the inboard tanks of the PA-30). The basic weight differs for each airplane in accordance with the amount of electronic gear and other equipment in the airplane. This weight will be found in the aircraft weight and balance paperwork for the airplane or in the aircraft log book. Each time equipment is added or changed in the airplane, the licensed mechanic should enter the new basic weight and new C.G. in the aircraft log book. To this weight, the weight of the passengers, baggage, and the usable fuel (six pounds per gallon) should be added to get the aircraft weight.

The Twin Comanche is designed to be both economical and versatile. Within the price range of the airplane, it is intended to give the pilot as much payload as possible, and also as much range as possible. The pilot is given a choice. He can carry a large payload for a reasonable distance, or a smaller payload for a longer distance. This freedom of choice makes it especially important for the pilot to pay close attention to aircraft weight. With full gas tanks, you cannot load up the cabin with four 170-pound persons and the maximum allowable weight in the rear area. However, if you take less fuel you can carry more of the allowable gross weight in the cabin. If you wish to get maximum range by filling all fuel tanks, it may be necessary to restrict the load in the cabin unless you have a very light basic weight.

The rear cabin sections of Twin Comanches with serial numbers 30-1 through 30-901 have no seats and can carry 200 pounds of baggage. The rear cabin sections of Twin Comanches with serial numbers 30-902 and up are placarded for a maximum of 250 pounds. However, if the rear section contains two family seats (7.5 pounds each) the weight allowance is then 235 pounds of passengers and/or baggage.

With tip tanks installed you can not carry full fuel in all tanks and four 170-pound persons. If it is necessary to restrict fuel in order to carry more weight in the cabin when tip tanks are installed, the best way to do so is to carry full inboard tanks and full tip tanks, restricting fuel in the outboard tanks. In this way it is possible to take advantage of the extra 125 pounds allowable with the tip tanks. Since it is not convenient to drain fuel from the tanks, it is wise not to fill them after landing until you are sure what load you will want to carry on the next flight. If you leave tanks partially empty overnight, be careful to drain fuel from them during preflight prior to the next flight to get rid of any condensation moisture.

CENTER OF GRAVITY

The center of gravity (C.G.) of an aircraft is the point at which one can consider all the weight to be located. Obviously, if you move the location of people, baggage or fuel in an airplane you will affect the location of the center of gravity. If the C.G. is far forward, we say that the airplane is nose heavy. If it is far rearward, the airplane is tail heavy. The manufacturer has calculated safe forward and aft limits for the C.G. at various aircraft weights, and it is essential that the loading be kept within these limits.

The optimist may again be mislead by the fact that the airplane will appear to fly in a fairly satisfactory manner when loaded with the C.G. slightly outside the limits. Having seen it do so, he may erroneously attach little importance to the matter of C.G. location. Let's see what happens when the C.G. is misplaced.

Possibly the most serious consequence of misloading is the effect on stability. The C.G. position influences longitudinal stability and therefore safety. An aircraft is longitudinally stable if, when trimmed for a particular speed, it takes continually increasing back pressure on the wheel to fly at lesser speeds and continually increasing forward pressure to fly at higher speeds. As the C.G. is moved farther aft, the aircraft has less longitudinal stability. If the C.G. is far enough back, the aircraft becomes unstable and the airspeed can drop with little or no more back pressure. If the C.G. is far enough aft and the airspeed is reduced to near stall, the airplane may go into a stall without additional back pressure on the part of the pilot. Thus it is easier to get into a stall situation when loaded too far aft, and it is also harder to recover from a stall or accidental spin. If the airplane is stalled, the nose may try to bob up too abruptly during recovery so that a secondary stall occurs. On take-off, with the C.G. too far aft, the airplane may have a tendency to climb in a dangerously nose-high attitude.

You may sometimes have noticed a slight movement of the nose upward after take-off in the PA-30 while the gear is going through its retraction. This causes you to put slight forward pressure on the wheel. If an overloaded Twin Comanche is operated with a C.G. behind the approved limits, the take-off and initial trim may seem to be satisfactory. However, as the gear is retracted the temporary loss of some nose-down trim becomes critical. If you have allowed overload and rearward C.G. variance from the approved limits, the situation may become unsafe. The airplane should be flown with a C.G. no farther rearward than approved in the manual; then you will have a safe margin.

If the C.G. is too far forward, it may be difficult to get the nose up on take-off. During landing, it may again be difficult to get the nose up for the flare, and the aircraft may fly into the ground.

USE OF WEIGHT AND BALANCE PLOTTER

A handy plotter is available for determining weight and balance for the Twin Comanche. Since the plotter makes an easy task of the business of seeing that the airplane remains within the allowable weight and C.G. position, its use should make the pilot more conscientious about his aircraft loading. It is strongly recommended that every PA-30 pilot have and use this plotter. If your plotter has become lost, warped by direct sunlight, broken, or otherwise destroyed, or if you never had one, you can order a plotter from a Piper dealer for under $10.00.

In order to use the plotter it is necessary to know the Basic Weight and Basic C.G. location for the airplane. If you have the plotter which accompanied your airplane, the Basic Weight and C.G.

location are noted on the upper right-hand corner of the plotter. You should change the figures on the plotter to correspond to the new values whenever there is a change in the equipment in your aircraft.

If you secure a new plotter, it will be necessary to get the Basic Weight and C.G. location from the Weight and Balance Report or the log book for your airplane.

The term "Basic Weight," as used for the plotter, means the empty weight of the aircraft plus the weight of the unusable fuel and the oil. Weight and Balance Reports for the early PA-30s do not have the Basic Weight or Basic C.G. location; they give empty weight. If you do not have the Basic figures, they can be easily computed by the following method:

	Weight (lbs.)	Moment (in.-lbs.)
Empty airplane (figures from Wt. & Bal. Report)	--	--
Unusable fuel (6 gal.)	36	3240
Oil (16 qts.)	30	1530
Basic Weight		

Add weights to get Basic Weight. Add moments and divide the total moment by Basic Weight to get C.G. location (inches from datum line). This information can then be noted on the upper right-hand corner of the plotter and a dot marked on the grid for reference.

Directions for use are marked on the face of the plotter.

> Every PA-30 owner should have and use a Weight and Balance Plotter.

COMPUTATION OF WEIGHT AND BALANCE

If a computer is not available, the weight and balance can be determined by using the attached computation form. The pilot is reminded that the weight times the distance from the datum line (arm) equals the moment.

Weight x Arm = Moment

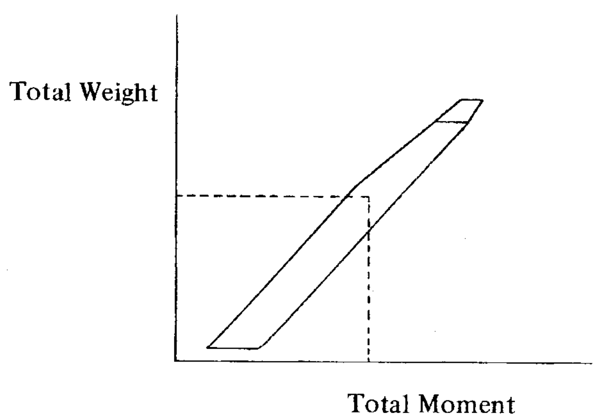
The sum of the weights of the airplane and load is the total weight. This can be plotted against the sum of the moments on the accompanying chart. If the point lies within the safe-loading envelope, the loading is satisfactory. If not, an adjustment must be made by restricting or redistributing the load.

It is recommended that the following Computation Sheet and Safe-Loading Envelope be placed with your aircraft Weight and Balance Report.

> Even if you are in a hurry, it is worth taking the time to compute weight and balance if it appears that loading could be critical.

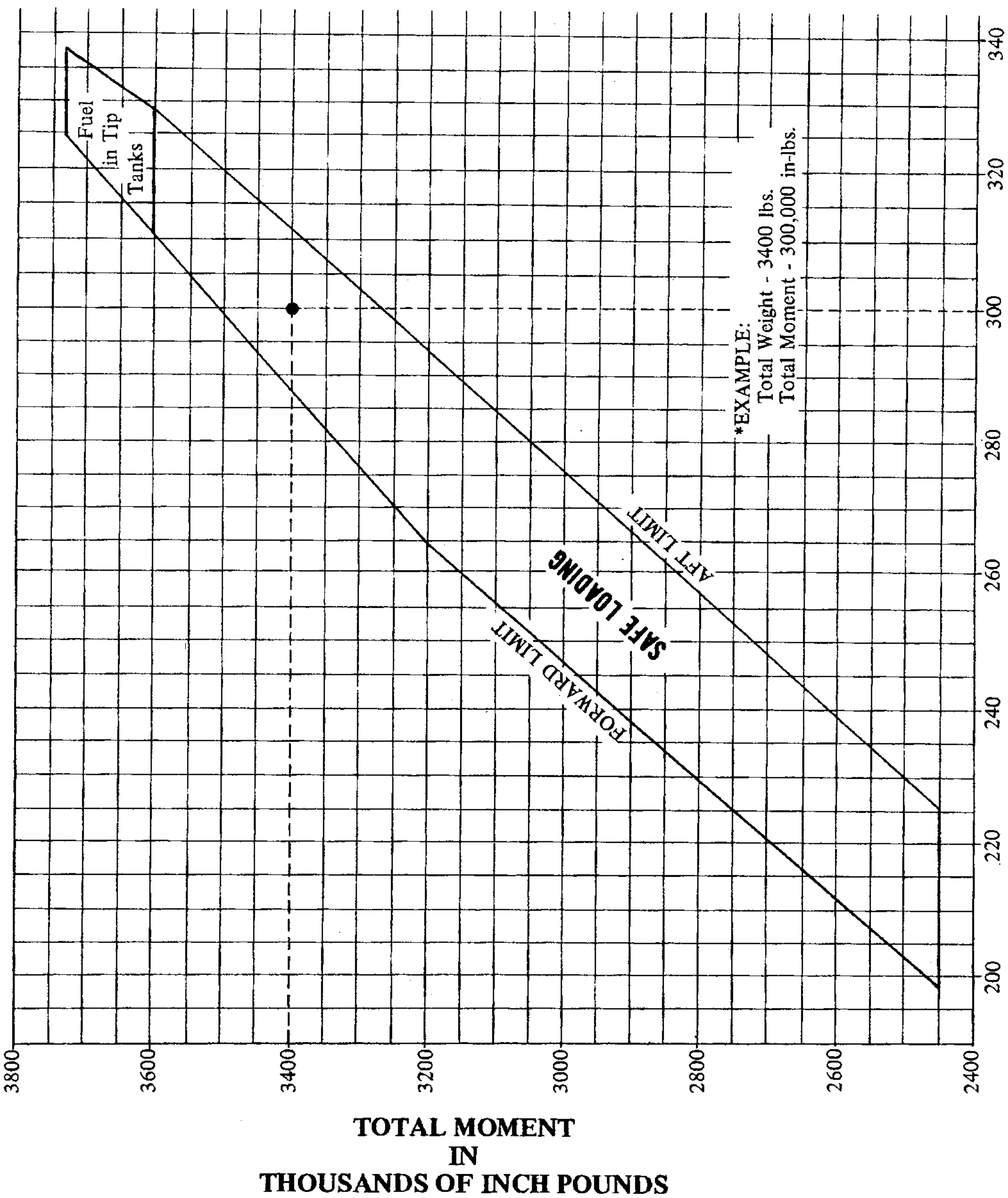
WEIGHT AND BALANCE COMPUTATION

		Weight (lbs.)	x	Arm (in.)	=	Moment (in.-lbs.)
A.	Empty aircraft	_____	x	_____	=	_____
B.	Unusable fuel (6 gals.)	36	x	90	=	3240
C.	Oil (4 gal.)	30	x	51	=	1530
1.	Basic Weight and Moment (A+B+C) (May be given in Wt. & Bal. Report)	_____				_____
2.	Inboard fuel (54 gal., 324 lbs. max.)	_____	x	90	=	_____
3.	Outboard fuel (30 gal., 180 lbs. max.)	_____	x	95	=	_____
4.	Tip tank fuel (30 gal., 180 lbs. max.)	_____	x	90.5	=	_____
5.	Seats 1 & 2	_____	x	84.8	=	_____
6.	Seats 3 & 4 (S/N 30-1 thru 30-589)	_____	x	118.5	=	_____
	Seats 3 & 4 (S/N 30-590 and up)	_____	x	120.5	=	_____
7.	Seats 5 & 6 (235 lbs. max. if seats installed)	_____	x	148	=	_____
8.	Baggage (250 lbs. max. S/N 30-902 and up if seats removed)				=	
	(200 lbs. max. S/N 30-1 thru 30-901)	_____	x	142	=	_____
	Total Weight	_____		Total Moment		_____



1. Locate coordinates of Total Weight and Total Moment.
2. If point lies within envelope loading is satisfactory.

PA-30 LOADING ENVELOPE



AIRSPEEDS – PART I

By Alice S. Fuchs

Years ago pilots flew by listening to the wind in the wires and by the attitude and feel of the airplane. For the first three decades of powered flight, many of the airplanes in use did not have airspeed indicators. With the development of more sophisticated aircraft with closed cockpits, better instrumentation became necessary. Pilots began to appreciate the value of the airspeed indicator. They learned just how much a knowledge of appropriate speeds for different flight situations enabled the pilot to operate with efficiency and safety. The PA-30, like all other aircraft, has appropriate speeds for various flight conditions.

AIRSPEED CONTROL

The ability to hold an airspeed is one of the techniques which distinguish a good pilot from a sloppy pilot. Experienced airmen have learned that for good airspeed control they must pay more attention to the pitch attitude of the airplane than to the airspeed indicator. The pilot should not chase the needle by keeping his eyes glued on the instrument. It should be read with occasional glances. If it is too high, the aircraft nose can be raised slightly; if too low, the nose can be lowered slightly, until the desired airspeed is reached. Then that pitch attitude should be held. The pilot who can control the airspeed well in this manner usually does a good job of flying the airplane.

THE AIRSPEED SYSTEM

Obviously, there's little use trying to practice speed control in an airplane unless you have an accurate airspeed system. FAA regulations require that the static system be checked and the altimeter calibrated at least every two years if the airplane is going to be used for instrument flying. Since the airspeed indicator is an equally important instrument, it is a good idea to have it checked and calibrated at the same time, or at any other time that you suspect it is inaccurate or otherwise misbehaving.

The pitot-static systems can become obstructed with dirt, water, ice or insects. A pitot cover can prevent many of these problems when the aircraft is parked outside. Of course it's important to make sure the cover is removed before flight. The static-sensing holes on either side of the rear of the PA-30 fuselage may become restricted with wax or polish. These ports are located in a position which enables them to sense nearly true static pressure over a wide range of attitudes without being clogged by external ice, but if water is accumulated in the tubing and it is not drained occasionally, ice can block the system. The draining can be done by an instrument mechanic.

Pitot heat should be used whenever flying in visible moisture. This includes clouds as well as rain, snow and sleet. However, to avoid burning out the system and wasting current, pitot heat should not be used on the ground, except immediately before taking off for an instrument departure. While pitot heat is more necessary when flying in visible moisture at freezing temperatures, it should also be turned on in visible moisture at warmer temperatures since the purpose of heat is to guard against the collection of moisture as well as ice in the system.

The airspeeds given in the performance figures and charts for the Twin Comanche are calibrated airspeeds, that is, the indicated airspeed (as read on the airspeed indicator) corrected for instrument, installation and position error. Instrument error is any error in the calibration of the individual instrument. When the airspeed indicator is new, this error is usually very low in a modern sensitive instrument. Installation error is caused by any leaks in the lines leading to the instrument. Again, in a new system this error is usually negligible. Position error is due to the different angles at which the airstream strikes the pitot head and static ports because of the different attitudes of the aircraft under different airspeed and power conditions.

The following chart shows the difference between indicated and calibrated airspeed (correcting for position error) for the PA-30, using different static sources and aircraft configurations.

	Standard Static System	Alternate Static System	Gear and Flaps
IAS mph	CAS mph	CAS mph	
80	82	81	Retracted
88	90	91	
120	121	113	
160	160	148	
200	197	185	
220	216	204	
80	80	81	Extended
91	90	91	
100	98	97	
120	117	113	

Since the static source supplies a reference for the airspeed indicator, altimeter and vertical speed indicator, all three instruments will become unreliable if the static source is blocked. If this happens in flight and the airplane is equipped with an optional alternate static source, this source should be selected, thus venting the static system to cabin pressure. The use of the alternate static source may result in a higher than normal reading of the airspeed indicator, as shown on the preceding chart, and may also result in a higher altimeter reading, while the vertical speed indicator may momentarily show a climb.

If the normal static source becomes obstructed in an aircraft not equipped with an alternate static source, in an emergency the glass on one of the three instruments (vertical speed indicator, altimeter or airspeed indicator) can be broken to supply an alternate static source for the other two instruments. Normally the vertical speed indicator would be the best choice of instrument to break.

The calibration chart given above is for a new aircraft. However, an airspeed system which was accurate when the aircraft was delivered from the factory can get somewhat out of calibration after a period of use.

AIRSPEED CALIBRATION

It is possible to calibrate your own airspeed system. The process is rather interesting, takes some time and patience, and is probably worthwhile if you suspect there is a significant inaccuracy in the system.

Pick two parallel lines with a measured distance between them - a mile or two will do. On a smooth-air day, fly across these lines on a perpendicular heading without crabbing for wind correction, at an altitude of about 500 feet above the ground. In order to have a standard reference point for viewing the surface lines, mark a spot on the side windshield (a small piece of tape would be convenient) in such a position that it can be lined up with the leading edge of the wing when the head of the viewer is in normal position. Maintaining a constant indicated airspeed, measure the flying time between the two ground lines, first in one direction and then the other. Figure the two groundspeeds separately; then average them. The result is the true airspeed for the indicated airspeed used. By feeding the pressure altitude and outside air temperature into a pilot's computer, the true airspeed can be converted to calibrated airspeed. This flight procedure can be used with a variety of airspeeds at 10 to 20 mph increments and a chart or graph can be drawn to show calibrated airspeed versus indicated airspeed. Obviously there are some airspeeds that are inadvisable to use during calibration flights - notably speeds near or at stall speeds. If a graph is drawn, the line or curve can be extended to show approximate calibrated airspeeds in this range. One of the hardest things about calibrating an airspeed system in some parts of the country is finding two parallel lines a measured distance apart. A measured and marked stretch of straight highway can be used instead if it is in a direction with little crosswind.

AIRSPEED CHECK

On every take-off, as you are rolling down the runway, glance at the airspeed indicator to make sure it is working. If it isn't, close the throttles and abort the take-off.

Having assured yourself of an accurately calibrated airspeed system, and checked that the system is working, let's now take a look at some of the airspeeds which are significant for the PA-30.

LIFT-OFF SPEED

On take-off, it is possible that the Twin Comanche may want to leave the ground prior to reaching the minimum single engine control speed of 90 mph. If this occurs, permit (but don't encourage) the airplane to fly off at a lower speed, keeping it very close to the ground for the few seconds it takes to get up to 90 mph. (We will deal further with V_{mc} in Part II of this section.) The use of flaps should be avoided during take-off when lightly loaded unless it is necessary to make a short-field take-off.

The airplane should not be held on the runway when it is ready for lift-off, as forcing the nosewheel on the runway will result in a "wheelbarrowing" tendency. You are better off a foot or so in the air flying parallel with the runway until speed builds up, than trying to hold it on the runway in the awkward condition of having only a steerable nosewheel on the ground.

MULTI-ENGINE CLIMB SPEEDS

The recommended climb speed for an airplane depends on what you want to get out of it. Usually the pilot is interested in one of three things: the best rate of climb speed, the best angle of climb speed, or some higher climb airspeed (en route climb speed) that will give a good climb coupled with good engine cooling and good visibility over the nose.

The best rate of climb speed, V_y, that which gives the maximum feet per minute, for the Twin Comanche operating on two engines is 112 mph C.A.S. This is for an airplane loaded to gross weight, flying near sea level in standard atmosphere. The best rate of climb speed varies with density altitude and aircraft weight. As density altitude increases, the best rate of climb speed decreases. Thus if you are flying at a high altitude, or at any altitude on a hot day, the best rate of climb speed will be less than 112 mph. You can check your best rate of climb speeds and determine the corresponding indicated airspeeds on a smooth day by trying out various climb speeds at various altitudes. It is important to fly smoothly. You will note a decrease in the speed that gives the best rate of climb as you go to higher altitudes. Rate of climb can most accurately be determined by establishing a climb and noting the elapsed time it takes to climb through a 1,000-foot or 2,000-foot change of altitude, rather than by using the vertical speed indicator.

The best rate of climb speed will also decrease with a decrease in aircraft weight. A PA-30 which is loaded to less than gross weight will have a lower V_y than 112 mph. However, it should be noted that with a decrease in weight there is an increase in performance. Normally, when weight is decreased, while the best rate of climb speed is less than the published figure for gross weight, you can climb at the published figure and have better rate of climb than an aircraft at gross weight. Therefore it is usually not necessary to reduce climb speed when light.

The best angle of climb speed, V_x, for the PA-30 operating at gross weight on two engines near sea level in standard atmosphere is 90 mph. This is the speed that gives the greatest height for a given distance of forward travel. However, since this speed places you at a disadvantage in the event of engine failure, it should be used only when necessary and for the shortest time possible. (If you get mixed up between V_x and V_y, remember that the letter X has more angles in it than the letter Y, and hence V_x is the best angle of climb speed.)

The best angle of climb speed, like the best rate of climb speed, is affected by density altitude and aircraft weight. As aircraft weight decreases, the best angle of climb speed also decreases. Hence at any given altitude a lightly loaded aircraft will have a lower best angle of climb speed than a heavily loaded aircraft, and the light aircraft will climb faster. If both aircraft climbed at the best angle of climb speed for the gross weight aircraft, the light airplane, although not climbing at its best angle of climb speed, would still outperform the heavy aircraft. The decrease in weight would more than make up for the fact that the airplane was not operating at the best angle of climb speed for its weight. Hence it is unnecessary (and usually inadvisable) to climb at less than 90 mph, the best angle of climb speed listed in the aircraft specifications.

Increase in altitude affects the best angle of climb speed in a manner opposite to its effect on the best rate of climb speed. As density altitude increases, the best angle of climb speed also increases very slightly. Hence as you fly at a higher altitude or on a hot day, you should count on using a little greater than 90 mph for a best angle of climb speed.

A graphical comparison of the best angle and best rate of climb speeds as the aircraft climbs to altitude shows an interesting fact. The lower of the two values, the best angle of climb speed, increases slightly with altitude. The higher of the two, the best rate of climb speed, decreases. If you climb high enough, the two values come together at the absolute ceiling of the aircraft.

MULTI-ENGINE CLIMB SPEEDS

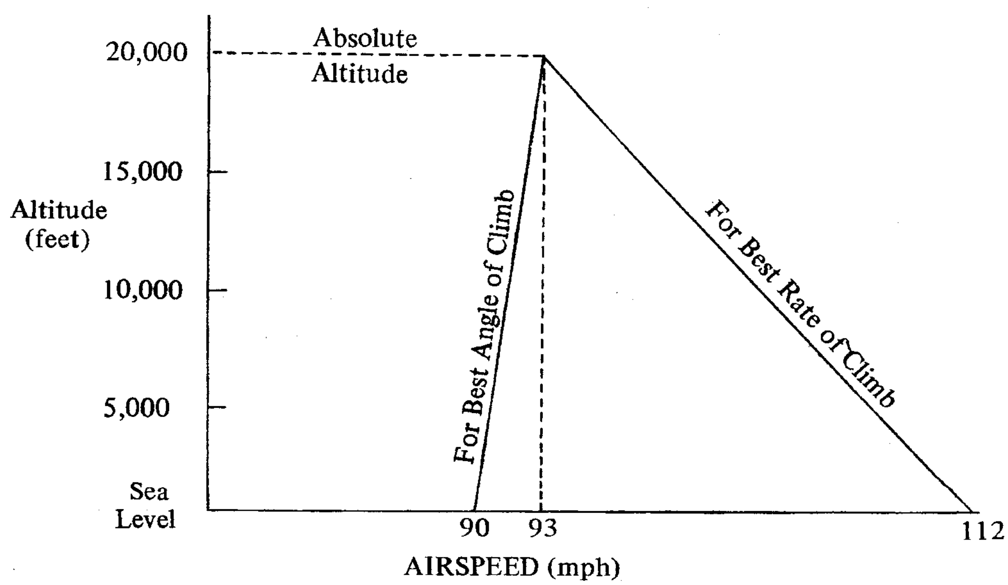


Figure 1

SINGLE-ENGINE CLIMB SPEEDS

If the aircraft is operating on one engine, there is a different set of values for best climb speeds. The best single-engine rate of climb speed, V_{yse}, is 105 mph for a PA-30 flying at gross weight in standard atmosphere near sea level. In the event of engine failure during climb-out after take-off, it is important to go immediately to this speed. If the airplane is lighter than gross weight, the best rate of climb speed will be slightly less than 105 mph at sea level; and if you are operating at a density altitude that is higher than sea level, the best single-engine rate of climb speed will also be less. In no case, however, should climb during single-engine operation be conducted at a speed lower than the recommended minimum single-engine speed of 97 mph. These climb speeds are critical. Plus or minus 5 mph can make a great deal of difference.

The best single-engine angle of climb speed, V_{xse}, is 94 mph at sea level at gross weight. However, it is recommended by the manufacturer that the airplane not be flown at speeds lower than 97 mph with one engine out. Therefore, the best single-engine angle of climb speed is academic and should not be used at low altitude. At higher altitudes, V_{xse} increases to something more than 97 mph. V_{xse} (increasing with altitude) and V_{yse} (decreasing with altitude) come together at 7,100 feet, the single-engine absolute ceiling for the airplane.

Accept what you get at the recommended speeds; dont't experiment on actual single engine to look for 50 to 100 fpm more.

SINGLE-ENGINE CLIMB SPEEDS

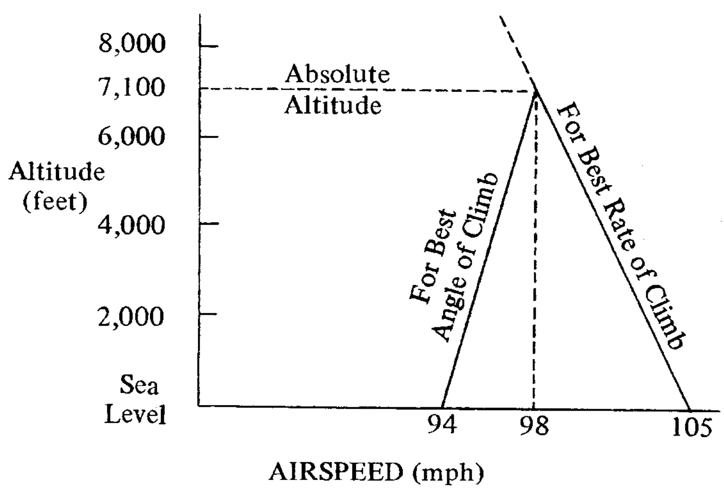


Figure 2

In the event of engine loss above single-engine ceiling, the airplane will, of course, be unable to maintain altitude. The dotted extension of the Best Rate of Climb line in Figure 2 represents the descent speed for best glide angle on one engine above single-engine absolute altitude. This speed will give the maximum distance covered for the loss of altitude until level flight can be maintained on one engine.

The en route climb speed is used where you are not striving for either maximum rate or angle of climb. It is a more conservative speed which will give better visibility than the speeds which strive for maximum performance, and it will also cover ground faster. Once you have climbed more than 500 feet above ground elevation on take-off or above surrounding obstructions, a climb speed of around 130 mph may prove to be a more practical speed than best angle or best rate of climb speed. Be prepared to transition to the single engine speeds at any time, so be sure to keep them in mind.

STALL SPEEDS

The two speeds to remember in regard to stalls are 76 mph, the stall speed with gear and flaps retracted, and 69 mph, the stall speed with gear and flaps extended. These are for an airplane flown smoothly at gross weight, power off, with no bank. Various factors (ice, turbulence, increased load factor) will increase these speeds, but about the only thing that will decrease either the "clean" or "flaps down" power-off stall speed is a decrease in weight. Given the same configuration and flight conditions, an airplane lightly loaded will have a lower stall speed than an airplane heavily loaded. For a review of the effect on stall speeds of different aircraft weights and angles of bank, the reader is referred to the two PA-30 stall speed charts on pages 1-4 and 1-5 of the "Stalls and Spins" chapter of this series.

> If you have any reason to question the reliability of your airspeed system you should have it checked by an instrument shop. Make sure your airspeed indicator operates correctly and indicates values near calibrated values. By knowing and using correct airspeeds you can achieve maximum safety and utility from the aircraft.

In "Airspeeds – Part II" we will deal with the matter of V_{mc}, design maneuvering speed and other speeds important for safe and efficient operation of your PA-30.

AIRSPEEDS – PART II

By Alice S. Fuchs

In our last chapter we discussed the airspeed system and certain climb speeds for the PA-30. Let's now consider some of the other airspeeds that are important to the PA-30 pilot.

SINGLE-ENGINE MINIMUM CONTROL SPEED – V_{mc}

If an engine fails in flight, a twin-engine aircraft is subject to asymmetric thrust, with an engine operating on one wing and no engine operating on the other wing. Unless the pilot does something about the situation, the immediate effect will be a yaw and roll toward the side of the inoperative engine. The pilot must counteract the yaw and roll with rudder and aileron. The more air that passes over the control surfaces (the greater the airspeed), the more effective the rudder and ailerons. It can therefore be seen that if an engine fails it is most important to have enough airspeed for the controls to be able to overcome the effect of asymmetric thrust.

V_{mc} (single-engine minimum control speed) is the calibrated airspeed below which a twin-engine aircraft cannot be controlled in flight if the critical engine suddenly becomes inoperative with the other engine developing standard sea-level take-off power, and with the flaps in take-off position, the landing gear retracted, and the aircraft fully loaded to most rearward C.G.

Since calibrated airspeed differs from indicated airspeed, and since density altitude and pilot flight techniques vary, it is best, especially when heavily loaded or on a cold day, to fly the aircraft as though V_{mc} were slightly higher than the published figure.

Let's talk about the term "critical engine," since V_{mc} is determined with the critical engine inoperative. The downgoing blade of any propeller takes a bigger bite of air than the upgoing blade, and hence delivers more thrust, when the aircraft has a high angle of attack as during lift-off or climb. The effect of this uneven thrust is to move the effective thrust of the propeller to one side of the crankshaft. The propellers on the PA-30 rotate in a clockwise direction when viewed from the cockpit. The effective thrust of each propeller is therefore offset to the right during climb.

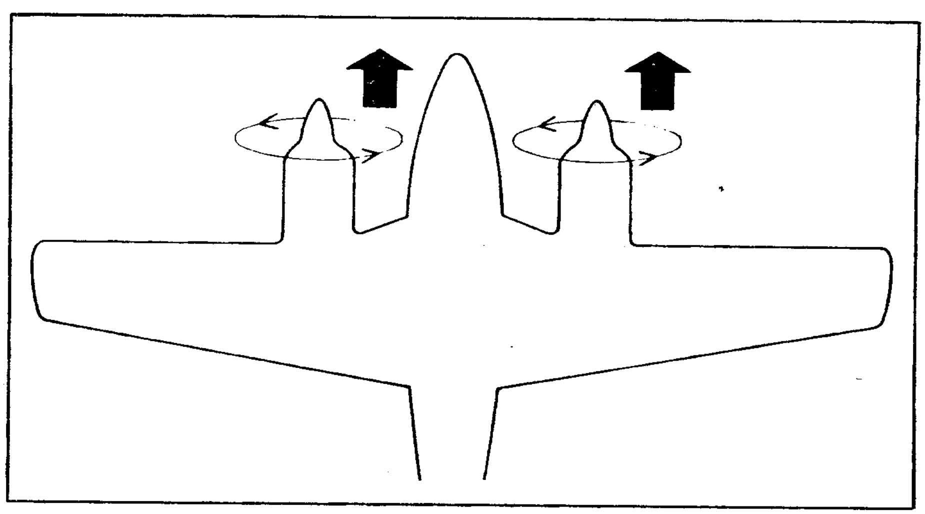


Figure 1

If equal forces are applied to each wing of an aircraft but at different distances from the fuselage, a turning moment is created which will tend to yaw the aircraft away from the side on which the force is the greater distance from the centerline of the fuselage. From Figure 1 you can see that the downgoing blade of the right engine is farther from the aircraft centerline than the downgoing blade of the left engine. When cruising in level flight you would notice no difference, but when the aircraft is at a high positive angle of attack, the thrust of the right engine creates slightly more yawing tendency than that of the left engine. Thus, if you were to lose the left engine during climb-out you would get more asymmetric thrust than you would get if you lost the right engine. Hence on the PA-30 the left engine is considered the critical engine.

On PA-30s which have been retrofitted with counter-rotating engine-propellers, neither engine is the critical engine since the lines of thrust of both engines are equidistant from the aircraft centerline as shown in Figure 2.

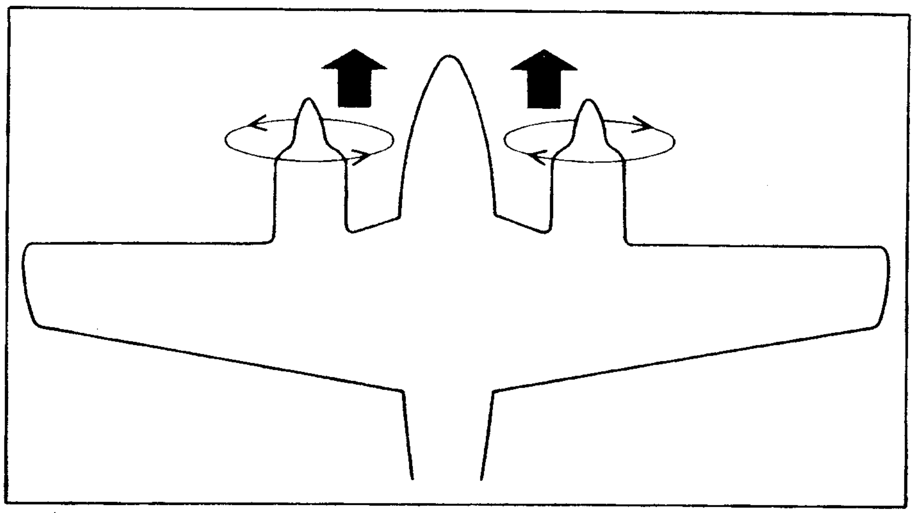


Figure 2

V_{mc} for the PA-30, as determined by the FAA, is 90 mph calibrated airspeed (CAS). With counter-rotating props it is 80 mph CAS. This means that in the PA-30 if you lost an engine on take-off or climb-out at sea level on a standard day you should be able to control the aircraft at the specified V_{mc}. At higher altitudes or on days with warmer temperature, the engine would not deliver as much power and you could control the aircraft at a lower speed; so V_{mc} would be less. Aircraft weight has little effect on asymmetric thrust and hence on V_{mc}.

A V_{mc} demonstration is required as part of the FAA multi-engine flight test. This test and the preceding practice for the test are the only occasions when a pilot should be operating at or near V_{mc} speeds with one engine throttled back. In order to demonstrate V_{mc} without exposing yourself to unnecessary danger, climb to an altitude of at least 3500 feet above the ground. The demonstration should be done in the following manner.

1. Make clearing turns. Slow the airplane to less than 125 mph and extend take-off flaps.
2. Eliminate power on the left engine by coming back all the way on the throttle.
3. Apply full power to the right engine by advancing the mixture control, prop control and throttle in that order.
4. Slowly raise the nose of the aircraft to steadily reduce airspeed, maintaining directional control with rudder and aileron, until you can no longer maintain directional control. Use 5° of bank, keeping the throttled engine high.

5. Note the speed at which you can no longer maintain control. This is the single-engine minimum control speed, in indicated airspeed, for the aircraft at that altitude and under the current conditions of flight. The published V_{mc} is calibrated airspeed.
6. Recover by lowering the nose and reducing power on the right engine.

You may notice that the V_{mc} speed you get in such a demonstration frequently does not coincide with the published V_{mc} figure. This difference is caused by several factors. In the first place, the technique you have used does not completely simulate sudden engine loss on take-off. In the second place, you are operating at an altitude higher than sea level. If your engines are normally aspirated, the available engine power is lower than at sea level, there is less asymmetric thrust, and you can thus control the aircraft at a lower speed. Hence your V_{mc} decreases with altitude. However, for safety reasons, it is best never to assume a lower V_{mc} than the published figure. In a turbocharged PA-30, the V_{mc} will be slightly higher at altitude when the turbochargers are in operation, becuase while the engines will deliver rated power up to the critical altitude, the thinner air at altitude makes the control motion slightly less effective.

Of course the most realistic V_{mc} demonstration would be one conducted at the lowest possible altitude and with a sudden loss of power. However, since you are approaching an uncontrolled flight situation with one engine throttled completely and the other delivering maximum power, the manufacturer recommends that the V_{mc} demonstration should be practiced at the highest practicable altitude and never lower than 3500 feet.

A problem arises, however, if the demonstration is conducted at too high an altitude. Since V_{mc} decreases with altitude in a PA-30 without turbochargers, at certain altitudes the aircraft will approach a stall (see Stalls and Spins chapter) before it reaches V_{mc}. In this case the demonstration should be terminated. Over areas of high terrain, a proper V_{mc} demonstration is impossible and should not be attempted. In any aircraft special care should be taken not to conduct a V_{mc} demonstration at an altitude where V_{mc} and stall speed coincide, as loss of directional control at the moment of stall could lead to a spin.

The V_{mc} demonstration described on the previous page is a static situation, where the loss of control is arrived at gradually as the speed of the aircraft is slowly reduced. In a case of actual complete engine failure soon after take-off, there would be a sudden loss of engine power and the pilot would need to react quickly. He would find this situation quite different from the gradual approach of the V_{mc} demonstration and might also find a slightly different value of V_{mc} (though not higher than the published V_{mc}). Warning: a dynamic demonstration, where the engine is cut suddenly, while more realistic, is not as safe and such practice is not recommended.

RECOMMENDED MINIMUM SINGLE-ENGINE SPEED

The difference in the V_{mc} experienced in an actual situation where an engine is lost suddenly and the V_{mc} experienced during a static demonstration is one of the reasons why the manufacturer has published a recommended minimum single-engine speed of 97 mph CAS for the PA-30. It is recommended that at no time during single-engine flight, except during the landing flare, should the aircraft be flown at a speed less than 97 mph. This is, of course, 7 mph higher than the 90 mph single-engine minimum control speed for the aircraft, but it is unnecessary as well as inadvisable to hold the aircraft at V_{mc} with one engine inoperative. The more conservative minimum allows for unexpected flight situations and pilot induced airspeed fluctuations. It permits the use of maximum power on the good engine and provides for more positive control when flying with an asymmetric thrust condition.

FLAP AND GEAR OPERATING SPEEDS

The flaps should be extended at speeds under 125 mph and the landing gear should be lowered at speeds under 150 mph. Failure to observe the flap limit speed might result in damage to the flap extending mechanism or the flaps themselves. This offers the possibility of an asymmetric flap condition, with one flap sticking down and the other up, making one wing seem heavier than the other. Gear extension at excessive speed may cause damage to the wheelwell doors or may cause a failure of some of the actuating mechanism with the possibility that you may not be able to get the gear either safely up or down.

MAXIMUM STRUCTURAL CRUISING SPEED

The maximum structural cruising speed is at the lower end of the caution (yellow arc) range for the aircraft. Beyond this speed (194 mph CAS for the PA-30) flight should be conducted only in smooth air and with no abrupt control movements. Since the aircraft flying at this speed will usually be in a dive, it is especially important not to pull out of the dive too suddenly. It is better to stay in the caution range a little longer and pull out gradually than to try to get into the normal operating range (green arc) too suddenly by using an abrupt elevator movement. If you should find yourself in a diving spiral, it is better to level the wings and then raise the nose, rather than to attempt a rolling pull-out which would place a twisting moment on the wing.

NEVER-EXCEED SPEED – V_{ne}

The red line on the airspeed indicator marks the speed which should never be exceeded, even in smooth air (230 mph in the PA-30). This is the high side of the yellow "caution range" on the airspeed indicator, and any pilot who exceeds this speed runs the risk of structural damage to the aircraft. Should the pilot inadvertently exceed this speed and have the good fortune to have no apparent structural damage, the aircraft should have a very thorough inspection before being flown again. V_{ne} is actually nine-tenths of the dive speed to which the aircraft has been tested. However, the testing was done by a parachute-equipped test pilot, who was paid to take a risk. All pilots should take every precaution never to exceed V_{ne}.

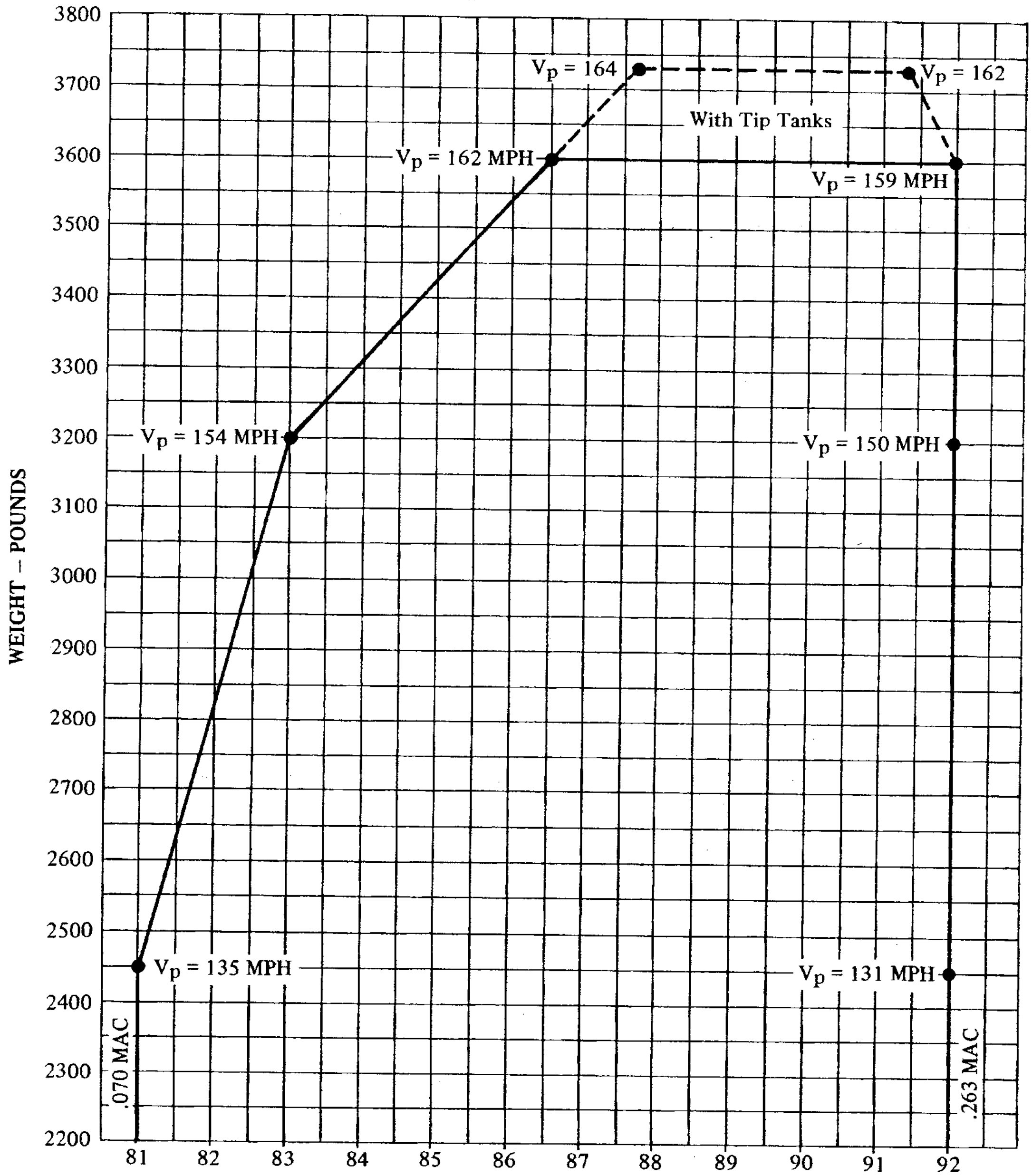
MANEUVERING SPEED

The maneuvering speed is the maximum speed, for any given weight and C.G. location, at which the controls may be fully deflected without overstressing the aircraft. Although frequently used as the rough-air speed, it is not necessarily the best rough-air speed under all conditions. A manufacturer usually gives only one or two maneuvering speeds, but it is really a varying value.

The PA-30, like most aircraft certificated under Part 23 of the Federal Aviation Regulations, is designed to withstand +3.8 g's or -1.52 g's without permanent deformation of the structure. If you are going excessively fast and pull back fully and suddenly on the elevator, you can exceed 3.8 g's on the aircraft and structural damage may result. You may remember, from our discussion of stalls, that the higher the load factor (the more g's) the higher the stall speed and that stall speed is related directly to load factor. For a load factor of 3.8 g's at a specified weight and C.G. location, there is a related stall speed. If you fly faster than this speed and pull back suddenly on the elevator, you may pull more than 3.8 g's. If you fly slower than this speed and pull back suddenly, you will never get 3.8 g's because the wing will stall first. The minimum speed at which 3.8 g's can be obtained is the maneuvering speed.

There is no one maneuvering speed that applies to all loading conditions, since this speed is dependent on the weight of the aircraft, the disposition of the weight, and the C.G. location as shown in Figure 3. For a PA-30 loaded to the most forward allowable C.G., the maneuvering speed is 135 mph for a 2450-pound airplane and 162 mph for a 3600-pound airplane.

PA-30
WEIGHT VS. C. G.
FLIGHT ENVELOPE



C. G. – INCHES AFT DATUM
V_p = Maneuvering Speed

Figure 3

The maneuvering speed is related in the following manner to the stall speed in straight, unaccelerated flight:

$$\text{Maneuvering speed} = \text{1-g stall speed} \times \sqrt{\text{Limit load factor}}$$

Since the limit load factor for this category aircraft is 3.8 g's and $\sqrt{3.8} = 1.95$,

$$\text{Maneuvering speed} = 1.95 \times \text{1-g stall speed}$$

or approximately twice the stall speed.

You will remember that the stall speed decreases with a decrease in aircraft weight. Hence the maneuvering speed for a lightly loaded aircraft is less than that for a heavily loaded aircraft.

The preceding chart shows the maneuvering speeds for the PA-30 at various weights and C.G. locations. Note that if the aircraft is loaded to the most rearward C.G. location the maneuvering speed is from two to four miles per hour lower than if it is loaded to forward C.G. This is because the stalling speed is less with rearward C.G. location.

> Rough control movements when flying faster than the appropriate maneuvering speed may result in structural damage to the aircraft.

So far we have been talking about rough maneuvering of the aircraft. Most pilots, however, do not practice violent maneuvering at high airspeed. "How about rough air?" you may ask. When the aircraft encounters a strong vertical gust, the effect on the aircraft, although not entirely the same as that encountered with rough movement of controls, imposes additional loads on the aircraft. Normal category airplanes must be able to withstand instantaneous vertical gusts of 30 feet per second at the maximum structural cruising speed (194 mph in the PA-30). Without special instrumentation, it is of course impossible in flight to tell just how strong the gusts are when the air is rough. However, a 30 fps gust is a very strong gust indeed and you would be in severe turbulence if you hit such a gust.

What then is the best speed to use in rough air? Is it the maneuvering speed? If you encounter light turbulence, it is necessary only to avoid speeds greater than maximum structural cruising speed (194 mph for the PA-30). Simply keep the airspeed in the green arc on the airspeed indicator. If you encounter moderate turbulence, it is recommended that you slow to maneuvering speed. In severe turbulence, you should immediately slow to something less than maneuvering speed. When considering this action, however, you must be aware that when you fly at less than maneuvering speed, if you hit a sudden strong gust you may stall. But to continue the flight at higher than maneuvering speed, in the same circumstance, you are risking structural damage. In weighing the alternatives - a stall versus structural damage - consider the fact that you can recover from a stall, which might be only momentary, but you may not be able to recover from the structural damage which could occur at a higher speed. (After the stall occurs, the load on the aircraft is relieved; structural damage is irreversible.)

Remember that the maneuvering speed is lower for a lighter aircraft than for a heavier one. If you are flying in rough air in a lightly loaded aircraft, you can fly at a slower speed than in a heavy aircraft without risking a stall. A sudden gust, moreover, can effect portions of the light aircraft structure more adversely than if it were heavy. Hence it is even more important to observe the maneuvering speed for the aircraft weight when you are flying lightly loaded.

The manner in which the aircraft weight is distributed laterally in the aircraft is also important. If most of the aircraft weight is contained in the fuselage, with little fuel in the wing tanks, the aircraft can be more adversely affected by the stress of rough air and rough maneuvering than an aircraft (at the same weight) with more of the weight in the form of fuel in the wings. Thus, if you fly at gross weight with a large proportion of the load in the cabin and less in the fuel tanks, you will need to be especially careful to slow the aircraft if you encounter very turbulent air.

If you use rough control handling at the same time that you are encountering rough air, the combined effect of the load factors may present a severe strain on the aircraft. It is especially important to handle the controls smoothly and gently in rough air.

PA-30 SPEEDS (CAS)

Stalling speed, gear and flaps up, power off	76 mph
Stalling speed, gear and flaps down, power off	69 mph
Best rate of climb speed	112 mph
Best angle of climb speed	90 mph
Single-engine best rate of climb speed	105 mph
Single-engine minimum control speed (V_{mc} as determined by the FAA)	90 mph
Recommended minimum single-engine speed	97 mph
Flap operating speed	125 mph
Gear operating speed	150 mph
Maximum structural cruising speed	194 mph
Never-exceed speed	230 mph
Maneuvering speed - 2450 lb. airplane	135 mph
3600 lb. airplane	162 mph

SINGLE-ENGINE PROCEDURE

By Alice S. Fuchs

As a multi-engine pilot you must often appreciate the sense of security that the second engine gives you - particularly if you fly at night, on instruments or over water or rugged terrain. Along with the advantages of multi-engine flying, however, there is a situation that presents problems which the single engine pilot never has to face – asymmetric thrust if an engine fails. If this occurs, the aircraft will yaw and roll toward the side of the inoperative engine, and the loss of power will cause reduced performance. To control aircraft heading and altitude, the pilot must of course, apply rudder and aileron against the roll and yaw and must apply some back pressure on the wheel.

If the airspeed is too low, the control effectiveness will not be enough to counteract the roll and yaw, and the speed at which these forces become uncontrollable is called the single-engine minimum control speed (V_{mc}). You are referred to the explanation of V_{mc} in the "Airspeeds - Part II" section of this series. It would be a good idea to reread this section before continuing with our current discussion.

Remember that minimum single-engine control speed is not always the same value. It is determined to a great extent by the amount of asymmetric thrust, which in turn is determined by the amount of power the operating engine is putting out. The FAA-approved V_{mc} figure (90 mph for the PA-30 unless retrofitted with counter-rotating props) is calculated for the worst possible situation: if an engine is lost suddenly at full power during take-off configuration, at sea level density altitude.

Any time you lose an engine and are flying at this speed or less, you may find yourself in trouble. In fact, unless you are at a high altitude practicing stalls (5000 feet AGL or more) or slow flight or during a very brief moment after lift-off or flaring out for landing, the aircraft should not be flown at 90 mph or less even with two engines.

The manufacturer feels so strongly on this point that a "recommended minimum single-engine speed" of 97 mph has been published for the aircraft. If you lose an engine, to keep a safe margin above V_{mc} and permit some maneuvering, the aircraft should not be operated at less than 97 mph in any configuration.

What action the pilot should take when an engine becomes inoperative depends somewhat on where he is at the time - that is on what part of his planned flight program. In any case, wherever he is, the primary concern should be to control the attitude of the aircraft while maintaining sufficient airspeed. Every other action is second in importance to aircraft control. Let's examine the appropriate action for engine failure in various situations.

ON THE GROUND BEFORE LIFT-OFF (On Take-off Run)

There will be an immediate swerve toward the side of the inoperative engine, the violence of the swerve being dependent on the speed of the aircraft at the time. Immediate application of opposite rudder should be used to regain directional control, and simultaneously both throttles should be fully retarded. With throttles retarded there will be a swerve in the opposite direction unless the original rudder action is reduced. The take-off should be aborted and the aircraft brought to a halt on the runway.

As part of the pretake-off procedure for every flight in a multi-engine aircraft, it is a good idea to run over in your mind the procedure you would follow if you lost an engine at each part of the take-off. If every take-off is made with the thought in mind that you might experience an engine failure at any time, you will be better prepared for prompt and correct action should the event ever occur. Does this seem like a gloomy approach to the flight pattern? It shouldn't, any more than you would call a thorough preflight pessimistic. One might term it "cheerful preparedness." You expect the best, but are prepared to deal with misfortune if it arises.

AFTER LIFT-OFF, WITH LANDING RUNWAY AHEAD

If an engine should stop soon after lift-off, once again your first concern must be to control the aircraft attitude. If there is sufficient runway remaining, both throttles should be closed and the aircraft landed straight ahead. The possibility of engine failure is a good reason for not retracting the landing gear after take-off until you could no longer use the runway ahead for landing. If you should land straight ahead because of engine failure or any other reason, don't forget to put down the gear if you have started to raise it. It is a good idea, when taking off from long runways, to practice judging where you could or could not land straight ahead. During normal take-offs, plan for the type of action required in case of engine loss. "Here I could land straight ahead . . . Here I might be able to with a good headwind . . . From here on I couldn't land."

DURING CLIMB-OUT

If the engine should stop when you could not make a landing on the remaining runway, or during the climb-out before the first power reduction, maintain directional control and go immediately to the best single-engine rate of climb speed of 105 mph. If you have not yet reached this speed after lift-off, it is important to fly level with the runway until attaining 105 mph. The landing gear should be retracted immediately. If you have used take-off flaps, they must be raised, but it is important, as the flaps come up, to raise the nose slightly as they retract in order to keep from sinking. With the loss of drag from the flaps, you can raise the nose slightly without getting a decrease in airspeed.

If the engine failure occurs during climb-out after the initial power reduction, come forward on the mixture controls, prop controls and throttles in that order.

Now it is necessary to decide which engine has failed. How could you miss it? Incredible as it may seem, pilots have, in the excitement of the moment, started to feather or in some cases actually feathered the wrong engine. It will take a strong foot on one of the rudder pedals to maintain directional control, and the other foot, which could just as well be resting on the floor, is on the side of the dead engine.

The failed engine should be feathered promptly, but it is important not to act so hastily that you feather the wrong engine or that you feather an engine that has not really failed entirely but had only a partial loss of power. Take a quick glance at the engine instruments. To test for engine failure, retard the throttle fully on the suspected engine. If this has no effect on the flight characteristics of the airplane, pull the prop control into the feather position. Continue climb at 105 mph, straight ahead if possible, to a circling altitude where you can return to the pattern for a landing, using shallow turns. Since the aircraft will climb better in straight than in turning flight, it is unwise to start a turn until you have reached a safe altitude for a pattern.

One of the most important factors in single-engine capability is the matter of loading. You will always do better in a single-engine situation if you are lightly loaded, and this is one of the important reasons for not overloading the Twin Comanche or any other multi-engine aircraft. Most people who get into trouble in a single-engine situation do so because they can't climb. They then raise the nose in an effort to climb, with a resulting decrease in airspeed. Then, as the aircraft approaches V_{mc} the trouble begins. While weight itself has little effect on V_{mc}, it has a very definite effect on rate of climb, and it is rate of climb (or lack of it) that can lead the pilot into the reduced airspeed trap where the asymmetric thrust becomes uncontrollable.

DURING CRUISE

If an engine fails during cruise, reaction should be just as prompt and automatic during the first part of the procedure as it needs to be during climb-out. The primary concern should still be to maintain directional control. Mixtures, prop controls and throttles should be brought forward. You now have a luxury you could not afford during an engine failure on climb-out - time to see what the matter is and perhaps to remedy the situation. Checking and remedial action can include turning on the auxiliary fuel pumps, checking fuel quantity, switching fuel tanks, selecting alternate induction air, and doing anything else that occurs to you to try to remedy the cause of failure. It is a good thing to think back on what you did just before the engine quit. If you initiated any action just before the failure, reverse the action if possible.

A word of caution on the switching of gas tanks. When a fuel injected engine quits because of fuel starvation, it takes a longer time to restart than would a carburetor engine. Be patient and give the engine a chance to restart. If you switch to another gas tank on the thought that the failure is due to fuel starvation, stay on the new tank long enough for a restart. Otherwise, in a frantic switching from tank to tank, you may not get it started at all simply because you never waited long enough on one tank.

If it becomes apparent that you cannot get the engine restarted, check for complete loss of power on that engine by fully retarding the throttle on the engine. If this makes no difference in the aircraft behavior, bring the prop control to the feather position. You can now place the mixture control for the engine in idle cut-off, shut off the fuel selector, turn off the mags and fuel pump, and close the cowl flap, making sure in each case to get the correct control for the inoperative engine. The ammeter should be checked; it may be necessary to reduce the electrical load.

If pulling back the throttle makes a difference in the way the airplane flies, you are, of course, getting some power from the engine. You may choose to use this power if you need it, or to feather the engine in order to save it.

After an engine has been shut down in cruising flight, you should pay some attention to the operating engine. If full power is necessary to clear terrain or weather, you may continue with the high power on that engine. However, if full power is not needed, as it may not be if you are below the single-engine ceiling for the aircraft weight, reduce power to a setting which will permit a reasonable cruise speed - 135 mph would be a desirable speed under many conditions. At the high power setting and lower airspeed which may be necessary to continue flight on one engine, it will probably be necessary to open the cowl flap at least partially on the operating engine. Engine instruments, especially cylinder head temperature, should be checked frequently.

Rudder trim should be used to ease control pressure during single-engine cruise. Three to five degree elevation of the wing on the side of the inoperative engine will assist in directional control. It is desirable to land at the first suitable airport.

When you lose an engine during cruise flight, you have time to evaluate the situation calmly and it's unnecessary to take hasty action. Don't be stampeded into an improper decision because you have only one engine. There are hundreds of airplanes in the sky at the moment with only one engine.

FUEL MANAGEMENT

If it is necessary to continue flight for some distance on one engine, close attention needs to be paid to the fuel situation. The operating engine, since it is at a higher power setting, will have a higher rate of fuel consumption than during normal multi-engine flight. Since the aircraft should be landed with the fuel selector on the main tank of the operating engine, it is wise to fly on other than that main tank. The outboard tank or tip tank (if installed) of the operating engine may be selected. If it is desired to use fuel from the inoperative side, crossfeed should be utilized, using the following procedure:

1. Fuel valve ON (main or auxiliary) on inoperative engine side.

2. Electric fuel pumps OFF (except in case of engine driven pump failure; electric fuel pump on operating engine side must then be used).
3. Crossfeed ON on operative engine side.

Do not attempt to put both fuel selector valves on crossfeed.

If crossfeed has been used to extend single-engine range, the fuel system should be taken off crossfeed before landing, by the following procedure:

1. Fuel valve ON main tank on operating engine side.
2. Fuel valve OFF on inoperative engine side.
3. Electric fuel pump ON on operating engine side.

If you wish to operate the heater with the right engine inoperative, leave the right fuel selector on and the right boost pump on. Make sure the mixture control is in the full-lean position for that engine and that there is no danger of fire in the right nacelle.

OPERATION ABOVE SINGLE-ENGINE CEILING

The single-engine ceilings for the PA-30 are:

	Service Ceiling	Absolute Ceiling
Normally Aspirated	5,800 feet	7,100 feet
Turbocharged	8,800 feet	12,600 feet

The ceiling figures represent density altitude, with the aircraft at gross weight. If the aircraft is lighter, the ceilings are correspondingly higher.

If an engine should fail when the aircraft is above the single-engine ceiling, the descent speed which will give the greatest forward distance for a given loss of altitude is the best rate of climb speed for that altitude. The use of the best descent speed when the aircraft cannot maintain altitude on one engine is especially important if operating over high terrain. (See page 3-5 of Airspeeds - Part I in this series.)

SINGLE-ENGINE PATTERN AND LANDING

When approaching for a single-engine landing, it is important to set things up so that you can accomplish the landing on the first try, with no possibility of a go-around. A single-engine go-around is most undesirable, and in some cases (with a heavy load or high density altitude) it may be impossible. Moreover, the sudden application of power in a single-engine situation near the ground, could present control problems due to the sudden asymmetric thrust.

On the downwind leg for a single-engine approach, careful attention should be paid to the landing check list, as under stress of a critical situation it is easy to forget an important item. It is best to wait until the base leg to extend the landing gear, in order to make sure that you will be able to make the field. Gear extension should be made soon enough that there would be time to extend it manually in case the normal system failed. The pilot coming in with one engine should be especially careful to remember the landing gear. More than one pilot has made a gear-up single-engine landing because he was concentrating so much on the single-engine emergency that he forgot the gear.

The final approach should be made with 15° of flaps and an approach speed of 105 mph. This will place the pilot in a better position for a go-around in the unhappy event that it should be necessary. The aircraft will already be at the best single-engine rate of climb speed, and the situation will be much more favorable with 15° rather than full flaps. If trim has been used to reduce rudder pressure during single-engine cruise, as power is eased off during the approach it will be necessary to apply opposite control pressure or else to ease off the trim. If the trim correction is taken off before power is reduced, the reduction of power will result in easier control pressures and a more normal flight "feel" during landing.

Should it be absolutely necessary to make a single-engine go-around (and you must do everything you can to avoid this), full power should be applied as soon as the necessity becomes apparent, with a simultaneous application of rudder and aileron to control aircraft attitude. The gear and flaps should be retracted as soon as possible. Climb (or even level flight) will usually not be possible on one engine with flaps or landing gear extended. If a go-around is initiated toward the final part of the approach, when the speed has been decreased, the nose must be held down until 105 mph is attained. Strive for speed, not altitude, until you get 105.

ENGINE LOSS IN THE TRAFFIC PATTERN

If an engine stops just as you are entering a rather wide traffic pattern, you may wish to take the same action you would at cruise flight, raising the landing gear if it has been extended. However, if the failure occurs when you are farther along in the traffic pattern and after you have started a descent, it is not necessary to apply full power on the operating engine. Power should be increased only enough to maintain the desired rate of descent and the landing gear need not be retracted. The propeller of the inoperative engine should be feathered.

A WORD ABOUT SINGLE-ENGINE PRACTICE

A careful multi-engine pilot will want to stay proficient in single-engine procedures. However, single-engine practice should be conducted with discretion. It is a good idea to go up periodically for single-engine practice with an experienced multi-engine instructor. Other passengers should not be aboard.

A feathered prop can be simulated rather accurately on the PA-30 by moving the mixture and prop controls full forward and adjusting the throttle to get slightly less than 10 inches of manifold pressure. Then make a fine adjustment of the throttle to get the following engine speeds for the airspeeds listed:

Airspeed	RPM
100 mph	1980
110 mph	2180
120 mph	2380
130 mph	2580

Actual feathering practice, if conducted, should be done only where the aircraft is within easy range of an airport, and under conditions of temperature, altitude, weight and turbulence such that you could get to the airport safely on one engine if you could not get the other restarted. If you don't feel that you can get to an airport comfortably on one engine, it is unwise to feather an engine in practice, and of course you should never feather in practice an engine that is known to be difficult to start.

The majority of your single-engine practice should be simulated, and an experienced multi-engine pilot or instructor should be beside you.

While a certain amount of single-engine practice is desirable, it should be conducted with great care. More pilots are hurt practicing single-engine work than in actual single-engine emergencies.

MULTI-ENGINE FLYING

By Alice S. Fuchs

Chapter 6 consists of the book Multi-Engine Flying, by Alice S. Fuchs, Modern Aircraft Series, Sports Car Press., Crown Publishers, 419 Park Avenue South, New York, New York 10016.

THE INSIDIOUS WAYS OF WEATHER

By Alice S. Fuchs

Near the very top of the list of the causes of aircraft accidents is WEATHER. This was true 30 years ago, and it is just as true today, in spite of the considerable increase in weather reporting and forecasting facilities and the modernization of meteorological techniques in recent years. Since technical advances and the work of many skilled and dedicated meteorologists have failed to remove the weather factor from the accident picture, we can assume that at least one of the following took place in every weather accident:

1. The pilot neglected or was unable to get a weather report and forecast before flight.
2. The pilot was too optimistic about the forecast he received or interpreted it incorrectly.
3. The pilot did not notice or failed to take precautionary action when the weather first began to be worse than expected or forecast.
4. The pilot did not properly assess the capability of his aircraft or his own flying skill to handle the weather.
5. The weather forecast was inaccurate.

You may notice that the inaccurate weather forecast comes last on the above list, and that the first four items are pilot errors.

GETTING WEATHER INFORMATION

The best way to get weather information is to talk personally with a forecaster. In this type of eyeball-to-eyeball discussion you can get a feel of how confident he is of his forecast. You can listen to his reasoning and see his data. This is much better than having someone read you a forecast prepared by computer. The local man sometimes has knowledge of local weather factors which may modify a forecast originating from a distant point.

At your home base, you of course know how to get weather information and it's hoped that you do so every time you plan to get out of sight of the airport. Admittedly at some places it is easier to get weather information than at others, but even if it takes a long distance phone call to get the information, your effort and money are well spent.

Away from the home base, it is a help to know what facilities are available. The Weather Bureau and FSS phone numbers can be obtained from Part 2 of the Airman's Information Manual (AIM), from the Airport Directory portion of the Jeppesen JAID volume, or from the AOPA Airport Directory.

At the time of this writing, 92 locations in the United States offer continuous automatic transcribed weather broadcasting service, 86 of them on a low frequency station and six on a VHF frequency.

If you want to get a ground-to-air weather briefing en route, the frequency 122.0 is appropriate for such transmissions at the 25 FSS stations around the country that utilize the frequency. This was established originally as a weather briefing frequency, but as pilots are not generally aware of the distinction you will hear non-weather chatter also on the frequency. You can find whether a station has this frequency by looking under the FSS name in the Airport/Directory section of AIM or on radio facility en route charts. Other frequencies may be used if 122.0 is not available.

In the past, weather was broadcast by Flight Service Stations at 15 and 45 minutes past the hour. This service is now scheduled only for 15 minutes past the hour, but it is frequently omitted if Flight Service personnel are busy.

In any case, wherever you get the weather, the heart of the message is the forecast. Each time you check the weather, what really matters is not so much what it is doing then, as what it will be doing when and where you are flying.

FORECAST RELIABILITY

While a forecast should be studied carefully and taken seriously, the state of the art is not such that every forecast is absolutely accurate. Many a pilot has been fooled by a weather forecast that just didn't work out. Since an element of uncertainty surrounds any prediction, it is good to adopt a cautious attitude toward forecasts. Consider what will happen if the weather gets worse than anticipated. Will you be trapped? Have you an alternate plan? In the case of an IFR flight, in addition to selecting an alternate airport you should know where the area of best weather exists so that you could file for there in case of weather deterioration at your destination and alternate, or could head for there in case of complete radio failure.

While en route cross-country, if you keep the forecast in mind you will get a feel for whether conditions are better or worse than anticipated. If things are better than forecast, you are ahead of the game. If one of the weather elements becomes worse than predicted, you should realize early that the forecast is not working out. A ceiling several hundred feet lower than the forecast, visibility a few miles less, or rain starting sooner than anticipated, can be danger signals pointing to earlier deterioration than expected. If you are en route, you may do well to land short of your destination, divert to another field, or turn back. It is dangerous to continue into deteriorating weather, hoping for things to improve. Worse-than-forecast weather rarely changes to better-than-forecast weather. The important thing is to spot the trend soon enough to do something about it.

JUDGING YOUR OWN CAPABILITY

Having obtained weather information before each flight, it is important to evaluate it in view of your own ability. Every pilot should establish his own standards of what kind of weather he is willing to fly in, and he should stick to these minimums. Unfortunately, it is easy, in the pre-journey stress that precedes a flight, to expand your weather criteria to include conditions you would not consider handling if the decision were made at home in the objectivity of your favorite arm chair.

It would be comforting if the weather accident were something that occurred only to the beginner, that the longer a man flew the better pilot he became and therefore the less likely to have a weather-related accident. Unfortunately, the facts don't bear this out. The longer a pilot flies and the more he upgrades his flying skills, the more he is inclined to upgrade the type of weather he considers himself able to handle. Thus an increase in piloting skill may not make him any safer regarding weather flying. Witness the number of accidents involving highly experienced pilots shooting instrument approaches down to low minimums. The inexperienced pilot doesn't have that kind of accident because, without an instrument rating, he doesn't try an approach in IFR conditions down to minimums. The experienced pilot who sets his goals too high is in just as much danger of a weather-related accident as is the beginner.

If a pilot decides to fly only in VFR weather, he must develop a sense of what is borderline for his ability. Three-mile visibility and a 1000-foot ceiling are legal (though marginal) for VFR flight. The trouble is that where the weather is reported as three miles, there are likely to be patches of less than three-mile visibility; and where the ceiling is reported to be 1000 feet, there may be areas lower than 1000. The struggle to stay VFR in marginal weather has produced a high number of aviation accidents. Special caution is necessary in hilly or mountainous country or at night. Low flight in bad weather requires great skill, and often a smattering of luck.

Each pilot must decide for himself just what his weather-handling capability is.

WEATHER AND THE INSTRUMENT-RATED PILOT

One of the best ways to make your airplane more useful is to get an instrument rating. Properly equipped, the PA-30 is a good instrument airplane, and often it is much safer to fly in clouds (non-icing variety) or on top than to struggle along underneath. Many a pilot has been caught in a dangerous situation by attempting VFR flight into adverse weather conditions. Occasionally an IFR-qualified pilot gets into trouble trying to stay VFR because he failed to file. He would have been much better off legally in the clouds than staying low to avoid them. Once the pilot is instrument rated, however, experience does not give immunity from weather accidents. Before he gets the rating, low clouds and restricted visibility may be the pilot's chief hazards. Afterwards, complacency and overconfidence can become his pitfalls.

An IFR-rated pilot must decide what degree of IFR weather he is capable of handling. This will depend on the amount, type, and currency of his instrument experience. Currency is not always a matter of time. A pilot who has practiced an ILS approach recently may not have tackled an ADF approach for a long time. The pilot should consider how recently he has practiced the particular type of instrument approach he anticipates for his flight. Complete honesty is important in evaluating one's ability to handle weather.

EVALUATION OF EQUIPMENT

Having evaluated the current and forecast weather, and made an honest appraisal of his ability to fly safely in such conditions, the pilot must then decide whether his equipment is good enough to fly in that type of weather.

It is assumed that as a PA-30 owner or pilot, you make sure that the airplane is in airworthy condition, properly inspected and maintained, and that all applicable bulletins have been complied with. However, over a period of use, instruments or radio equipment may become unreliable. Often it is not a case of sudden failure, but a gradual deterioration in performance, and you must decide at what point a minor discrepancy becomes large enough to require correction.

Instrument flight, in particular, requires a careful evaluation of equipment. Regulations require that the static system and altimeter of an aircraft used for instrument flight be tested within the previous two years and that the VOR receiver be checked within the last 10 days and the last 10 hours of flying time. In addition to these required checks, the pilot should make sure he has the proper equipment aboard and working to handle the weather. The reliability of transmitters, ADF, marker beacon receiver and other electronic equipment should be assured. Pitot heat should be carefully checked, by feel, not only before IFR flight but before any flight where precipitation is anticipated.

If you are flying your own PA-30, you can keep a constant check on the condition of your equipment. A pilot who flies someone else's airplane or an airplane that he has not flown for some time, does not know how well the electronic equipment or instruments are functioning. For this reason, it is unwise to do instrument flying in a strange airplane unless you have a chance to take it up first to see that everything is working properly.

Although an autopilot is a valuable piece of equipment, under no circumstances should a VFR pilot plan to use an autopilot to climb on top of or descend through an overcast.

When assessing the suitability of your PA-30 equipment for a given situation, you must face the fact that there are two types of weather which should be avoided: thunderstorms and icing. Some thunderstorms can tear any airplane apart. Unless your airplane is one of the few PA-30s with complete deicing equipment, it should not be flown into icing conditions. Even with deicing equipment, it is wise to avoid all but light icing.

WEATHER AND NIGHT FLYING

An unduly large proportion of weather accidents happen at night. The reason is simple. Since the pilot can't see the weather at night, he may barge into something that he would have avoided in the daytime. Also, certain conditions of haze and visibility, which would not hinder VFR flying in the daytime, place the pilot in a virtual IFR situation when darkness removes the horizon from view. This is especially true when flying over a sparsely settled area or over water. It is wise not to fly at all at night without considerable instrument proficiency and to attempt VFR night flight only in very good weather.

THE EFFECT OF SPEED

A pilot who moves into the Twin Comanche from a slower airplane (or who upgrades to any faster aircraft) should realize that he can get into trouble quicker in a faster aircraft and should temper his weather decisions accordingly. In the faster aircraft, he enters a weather system more quickly. His turning radius is wider and it takes longer to head out of difficulty. If he is flying low beneath an overcast, the ground – a hill or obstruction – comes up quickly and he must react faster to get out of a bad situation. In a tight spot it is sometimes safer to reduce speed. The effect of speed on weather penetration should add caution as the pilot flies a faster airplane.

THE EFFECT OF PASSENGERS

The pilot's judgment is sometimes affected by the presence of passengers in the aircraft, and a large proportion of the aircraft involved in weather accidents have others besides the pilot aboard. Ideally, the responsibility of passengers should encourage more conservative decisions. Often, however, pride makes a pilot unwilling to admit to a passenger that he does not wish to tackle a weather situation. His dilemma is compounded if the last time he had that passenger aboard he made a conservative decision which resulted in their being on the ground while the weather turned out to be better than expected. (Every pilot hopes to have his decisions vindicated. Once he has cancelled, he hopes the weather will get really bad.)

There are probably as many times when the weather is better as there are when it is worse than the forecast, and you will undoubtedly be unhappy sometimes after you decide cautiously. However, since you can't be right all the time in your go-no-go decision, it is important to make sure all your errors are on the safe side.

WEATHER TRAPS

In the title we have referred to weather as "insidious," and we have mentioned the unreliability of weather forecasts. Even a well-qualified pilot, flying well maintained, perfectly functioning equipment appropriate to the forecast weather, can find himself in a difficult meteorological situation. Let's take a look at some of the ways that weather can creep up on a pilot. Here are some of the traps that can catch the unwary:

□□□□□□

A VFR pilot flies on top of scattered clouds. At first he doesn't notice that the clouds are growing more numerous. Gradually they become broken, then solid. Caught on top, he finds a hole, attempts to spiral down steeply. The hole isn't big enough. He is soon in a tight spiral in a cloud. Seeing a high reading on the airspeed indicator, he pulls back on the wheel. The stress may be too great for the aircraft. What if there were no hole?

□□□□□□

Flying at dusk or at night, a pilot fails to notice a few spotty patches of fog creeping in below him. (It can happen at dawn also.) When he notices a haze over the ground lights, he hopes it will go away. It doesn't. Soon he is caught with widespread ground fog making a safe landing impossible. A check on the temperature-dewpoint spread and the wind would have warned him of the possibility of ground fog. A close spread combined with a light wind gives the ideal condition for fog formation. Sea fog and other localized fog conditions present a hazard in some areas.

□□□□□□

During instrument flight through stratus, a pilot encounters an unforecast thunderstorm. A check on the stability index before flight might have warned him of unstable air. Once in the storm, he should keep the wings level, the miniature airplane on the horizon of the attitude indicator, and should maintain his attitude without striving for constant altitude. He should slow to maneuvering speed in extreme turbulence. A 180° turn at this stage would be unwise. In a thunderstorm, turning up the cockpit lights will lessen the blinding effect of lightning.

□□□□□□

Sneaking through a thunderstorm area, a pilot gets boxed in, with thunderstorms forming all around him. The famed 180° turn is useless here as the weather is just as bad behind him as ahead.

□□□□□□

Another pilot plans to fly at an altitude above the clouds. He finds thunderstorms building so fast he cannot stay above the cumulus. He may not have oxygen and may be forced to go on instruments near the tops of cumulus, where it can be extremely turbulent. Towering cumulus and thunderstorms can build as high as 40,000 feet, well above the ceiling of the PA-30 and other light twins.

□□□□□□

Flying in a strong wind in mountainous terrain, a pilot experiences extreme sink and turbulence. A strong wind blowing 90° to a mountain ridge can form a mountain wave, setting up areas of violent turbulence and extreme sink on the leeward side of the ridge. In the Rockies the turbulence and downdrafts can be hazardously severe. The turbulence of a mountain wave can be as great as that of some thunderstorms. Mountain waves can be forecast by conditions of high winds and a high stability index. Avoid the Rockies when winds are very high.

□□□□□□

Passing over a runway at night, a pilot sees the runway lights through the ground fog and sets up a visual approach to the airport. Just before reaching the runway, he runs into the fog. Suddenly he is on instruments at a very low altitude. If he doesn't react quickly he may hit the ground before he knows what has happened. In some haze or fog conditions you can see down but not horizontally when close to the ground.

□□□□□□

A pilot follows a stream or road through the valley in marginal weather. Suddenly he loses visual contact at a point where the stream or road makes a bend. Unable to see the turn, the pilot flies straight – into a mountain. It is extremely hazardous to follow a winding guideline at low level in hilly terrain with marginal weather.

□□□□□□

On a flight from Harrisburg to Kansas City, a pilot plans to land at Indianapolis. Although he receives an unfavorable report en route, he presses on into deteriorating weather, spurred by the desire to complete the flight as planned, even though Indianapolis was only an en route stop. On most flights there is a strong desire to complete the mission. Sometimes a pilot stubbornly insists on going where he has planned because of a feeling of frustration if he doesn't reach his goal.

□□□□□□

Skirting a thunderstorm, and some distance out from it, a pilot suddenly finds his airplane pounded by hail. He thought he had to be in the storm to get hail. Unfortunately, hail sometimes spills out the top of a thunderstorm and comes down at a distance from the core of the storm cell. Sometimes you can see hail (often a greenish color) and sometimes not. It can ruin your PA-30, or any other airplane, in seconds. If you try to go between two closely spaced storms, you have a good chance of getting hail from one or the other.

□□□□□□

A pilot continues flight in light snow. Suddenly the snow increases, becomes heavy, and visibility is lost. Snow can cut your visibility unbelievably fast. Wet snow can clog the induction system. In this case an alternate air source is designed to open automatically in the PA-30. Alternate air can also be selected manually and when flying in heavy snow you should be prepared to open the manual controls if necessary. When you lose visibility because of snow, a change of altitude usually does not improve the situation unless you can go on instruments and climb above the clouds.

□□□□□□

Freezing rain suddenly covers a pilot's windshield. He knows that the way out of freezing rain is to climb, but a climb puts him in the clouds and he is not instrument qualified. If there are freezing temperatures down to the ground, he can't get out by descending. This is a good place for the 180° turn. Freezing rain can form very fast, and a defroster is not designed to remove ice from the outside of the windshield. If you get much ice, it may be necessary to use the side storm window to see during landing. This is a difficult task in any airplane.

□□□□□□

On a cloudless night, with a report of three-mile visibility and haze, a pilot takes off for a VFR flight. En route he becomes disorientated and loses control of the airplane. Low visibility at night is bad unless the pilot is instrument qualified and equipped.

□□□□□□

A pilot attempts a VFR flight across some Allegheny Mountain ridges in conditions of lowering ceiling and visibility. Suddenly the clouds are at the ridge tops. He must fly parallel with the ridges and try to reach an airport or suitable landing spot without crossing the next ridge.

□□□□□□

CONCLUSION

When a pilot talks about weather, he usually means bad weather. Though there are many good days, the time that sticks in his mind is the time things turned out worse than expected. How then can you outwit this weather, which is so often capricious, unpredictable and menacing, and which, as a final kick in the teeth, embarrasses you by clearing beautifully after you've made a virtuous, safe decision to stay on the ground?

We submit the following as a means of avoiding the possibility of having a weather accident:

A thorough weather check for each flight.

An honest evaluation of your own ability and the adequacy of your equipment.

Cautious and conservative weather decisions, made with a complete lack of pride or extraneous pressure.

A sense of humor when the weather occasionally proves your caution unnecessary.

THE CARE AND FEEDING OF A PA-30

By Alice S. Fuchs

A ten-year-old automobile is likely to be a pile of junk. A ten-year-old airplane can be a beautiful and reliable machine. The difference is that the aircraft gets better care than the car. How long your PA-30 lasts and how well it performs is dependent, to a large extent, on how well you treat it. Give it tender, loving care and it will give you excellent, dependable performance for many years.

When your aeronautical baby was delivered from the Piper factory, it was in the best of health. With proper care it will stay that way. Basically, a PA-30 needs just about what a human needs to stay healthy:

Proper hygiene
Correct diet
Exercise
Regular check-ups
Professional care when ailing
Good health habits.

PROPER HYGIENE

The first step toward good maintenance is to keep the airplane clean. Dirt can cause wear and abrasion on many parts of the aircraft, and excessive oil or grease on the aircraft will collect dirt. Furthermore, a layer of grime can disguise a faulty condition that needs attention. On a dirty aircraft you may not notice a fatigue crack, a loose rivet or some other fault which would be easier to spot if the aircraft were clean.

Special care should be taken when cleaning the windshield. Avoid wiping with a dry cloth or anything which might scratch it. Ice should be melted, not scraped off. Use clear, warm water. Some good aircraft plastic cleaners are available for windshields, but avoid window sprays, high ammonia content cleaners, gasoline, alcohol, benzene, carbon tetrachloride, thinner or acetone. Remove oil and grease with a cloth moistened with kerosene. A severe scratch in the plastic can be removed by rubbing with jeweler's rouge.

When cleaning ice or frost from wings and control surfaces, avoid scratching the surface. As with the windshield, warm water is the best method. Harsh abrasive or alkaline soaps or detergents used to clean plastic or painted surfaces could make scratches or cause corrosion of metal. The flap rollers and flap tracks especially should be kept clean, as a poorly maintained or dirty mechanism could cause a flap to stick down, resulting in an asymmetric flap condition in flight.

The engines also should be kept clean, by spraying with solvent. Before cleaning the engine compartment, place a strip of tape on the magneto vents to prevent any solvent from entering these units. Do not spray solvent into the generator or alternator, starter or induction air intake. Do not operate the engine until excess solvent has evaporated or otherwise been removed. After cleaning the engine, don't forget to remove the protective cover from the magneto vents.

On any airplane, one of the most important parts to keep clean is the pitot-static system. Make sure that the static vents on each side of the PA-30 fuselage are not obstructed by dirt, wax or other substance, and that the pitot tube is protected with a cover when the aircraft is not in use. Even if your airplane is hangared, it spends a good deal of time parked outdoors at other airports, and the system needs protection from moisture, dirt and insects. When you use a cover, be sure to remove it before flight.

CORRECT DIET

Your aircraft consumes various substances — fuel, oil, hydraulic fluid, air. Be sure it gets the right type and quantity.

The normally aspirated PA-30 requires at least 91/96 octane fuel and the turbocharged, 100/130 octane. This means 100 octane for both since 91 octane is no longer available at most places. Anything less than the required octane can ruin your engine. With the increased number of jet aircraft at general aviation fields, there are more trucks dispensing jet fuel. It is important to supervise the refueling of your aircraft and to note the octane printed on the fuel truck and on your fuel slip. Watch the color of your fuel. It should be pale green. Jet fuel is pale amber; 80 octane is pink. If a refueling nozzle has been dropped in the dirt, do not permit it to be used for refueling until cleaned. With a fuel injected engine, it is especially important to be sure the fuel is uncontaminated by dirt or water. If you fly into an area where the condition of fuel or fuel storage facilities are in doubt, carry a fuel-filtering funnel or a funnel with a chamois to be used during refueling.

Drain at least a half pint of fuel from each tank before the first flight of the day and be especially careful to drain before flight after the aircraft has been sitting in the rain. A pan placed under the drain beneath the aircraft will protect an asphalt surface from fuel damage and will enable you to detect fuel contamination if present.

Whether you are using detergent or non-detergent oil in the engine, make sure the weight is appropriate to the temperature, as placarded on the oil access door. Each engine holds eight quarts, with the manufacturer listing two quarts as the minimum safe quantity. When it gets below six quarts, however, you should add oil. Under ordinary circumstances, oil should be changed every 50 hours and the oil screens cleaned at the same time. If full flow (cartridge type) oil filters are installed, replace the oil filter cartridge at 50 hours, but the oil change can be extended to 100 hours. During any oil change, the oil which is drained should be felt by hand to detect the presence of metal particles which might indicate engine wear.

If you have been using a non-detergent oil and wish to change to a detergent oil, the change should be made with caution since the cleaning action of some additive oils will tend to loosen sludge deposits and cause plugged oil passages. If it is a high-time engine, the change should not be made until after an engine overhaul.

Your aircraft also needs air — 42 psi pressure in the tires — and like the tires of your car, those on the PA-30 will wear better and give better performance if kept at the right pressure. Tires can be interchanged periodically for even wear, and since all wheels and tires are balanced before original installation, you should switch the entire wheel rather than change tires on the wheel. Any installation of a new tire, tube or wheel should involve a new balance of that wheel with the tire mounted, since out-of-balance wheels can cause vibration in the landing gear.

The propeller domes should be charged preferably with dry nitrogen, but dry air may be used. The important thing is not to allow moisture to enter the air dome as this could cause the piston to freeze during cold weather operation. In the spinner cap is a placard with the dome pressure requirements for different outside air temperatures. If excessive pressure is used, there is a possibility of feathering taking place at idle speed when the engine is warm and the oil is thin; if the pressure is too low, the propeller may overspeed. A recent product improvement puts a spring in the prop hub to assist the dome pressure in decreasing the RPM. With the spring installation a lower pressure can be maintained in the prop dome, with less likelihood of leakage, and therefore the prop is less likely to overspeed.

The brake system takes MIL-H-5606 (red) hydraulic fluid. Don't use automotive brake fluid. The brake reservoir, on the left side of the forward cabin bulkhead in the nose section should be filled to the indicated level. In a well-functioning system, this will not have to be done very often. If frequent filling is necessary or brakes are spongy and need to be pumped for good action, have the system checked.

The air-oil oleo struts of the landing gear should have approximately 2-3/4 inches of piston tube exposed when the airplane is sitting on a level surface with the airplane empty plus full fuel and oil. If the strut has less tube exposed, you can determine whether it needs air or oil by rocking the airplane. If the oleo strut oscillates with short strokes (approximately one inch) and the airplane settles to the previous low position within one or two cycles after the rocking force is removed, the oleo strut requires air. If the oleo strut oscillates with long strokes (approximately three inches) and the airplane continues to oscillate after rocking force is removed, the oleo strut requires fluid. It takes high-pressure air to inflate the strut (much higher than tire pressure). If it is necessary to fly with a low strut, concentrate on making a good landing.

If the airplane is equipped with an oxygen system, only aircraft oxygen should be used. Do not use industrial oxygen. Any moistrue content may result in freezing at high altitude. The filler valve for the oxygen system is accessible through a door located on the left side of the fuselage just aft of the rear window. It is extremely important that all components of the oxygen system be kept free of oil, grease, gasoline and other readily combustible substances and that you keep hands, tools and clothing clean when coming in contact with oxygen equipment. Below 150 psi, oxygen flow from the cylinder is unreliable and the pilot should not depend on it in flight. Whenever the oxygen cylinder pressure falls below 50 psi or if any lines are left open for any length of time, the system should be purged. This should also be done if any objectional odors are present.

EXERCISE

An airplane which is used often (and well maintained) is apt to be in better condition than one which is stored for long periods without use. In an unused aircraft, "O" rings may dry out, grease may congeal, and condensation may take place in various parts of the aircraft. For this reason, it is important to inspect an aircraft carefully before flight after a period of storage. In particular, the fuel cells should be kept full during storage of the airplane to prevent accumulation of moisture and deterioration of the cells. For storage of more than ten days without fuel, the cells should be coated internally with light engine oil to prevent excessive drying.

Gasoline which becomes stale because of prolonged storage absorbs oxygen rapidly. This stale, oxidized gasoline can cause rapid deterioration of synthetic rubber parts and can also form a gummy deposit on internal metal parts of the engine. So if your airplane has been stored a long time, you would do well to drain and fill the tanks with fresh fuel.

REGULAR CHECK-UPS

In addition to the thorough preflight check which you should give the airplane before each flight, there are other maintenance inspections which you can make yourself. If something is seriously wrong, you should get it fixed by a licensed mechanic, but as an aircraft owner or pilot you can spot trouble by checking the aircraft frequently yourself.

What maintenance can you do for yourself? That depends on your ability, your knowledge and your equipment. Part 43 of the Federal Aviation Regulations says that a certificated pilot may do preventive maintenance on any aircraft owned or operated by him if it is not used in air carrier service. Appendix A to Part 43 specifies what type of work is considered preventive maintenance. You will find that the definition is rather broad.

Just as you should make an honest appraisal of your flying skills before tackling a flight situation, you should be honest about your mechanical skills before attempting to perform such permissible tasks as oil changing, air filter cleaning, battery servicing or tire change. No matter how simple the operation seems, before performing any of the permissible mechanical work on your airplane you should be sure that you have the mechanical skill, that you know how to do it on this particular airplane, that you have on hand the proper tools, and that you have available a PA-30 Service Manual to consult for exact details and procedure. You would not hire an amateur mechanic to do an annual inspection on the airplane; make sure that you don't give it amateur service on more simple matters. If you are well equipped mechanically, you can handle some routine matters yourself. Otherwise leave such things to an expert.

The battery should be checked for spilled electrolyte or corrosion at least every 30 days or every 50 flight hours, whichever comes first. The battery is located just aft of the baggage compartment in airplanes with Serial Numbers 30-2 to 30-852 and 30-854 to 30-901, and in the nose section in airplanes with Serial Numbers 30-853, 30-902 and up. Access to the battery is through a panel located at the aft side of the baggage compartment if the battery is in the rear, or by removing the nose section top if the battery is in the front. Nose section removal can be a two-man job unless you're experienced at it. The battery is enclosed in a stainless steel box with a vent system and a drain. The drain is clamped off from the bottom of the fuselage and should be opened occasionally to drain any accumulation of liquid (acid) or during cleaning of the box. The battery should be filled to the top of the baffle plates with distilled water. If the battery charge is low, a fast recharge is not recommended. Should spilled electrolyte or corrosion be found in the box, on the terminals or around the battery, the battery should be removed and both the box and battery cleaned with a baking soda-water solution. This is not a task you should perform unless you know exactly how to do it. You can ruin the alternators by installing the battery incorrectly.

The propeller blades, spinner and visible surfaces should be cleaned and inspected frequently for damage, cracks and oil leakage. Nicks in the blades should be dressed out promptly by a mechanic. Never fly with a nick as much as 1/8 inch deep or with any crack in the blade. The face of each blade can be painted when necessary with a flat paint to retard glare. To prevent corrosion, wipe surfaces with a light oil or wax.

With the engines off, cycle the flaps and listen to determine whether the motor is straining or the flaps tending to stick. As a matter of interest, it is possible to run a rough check on the flap indicator with the aileron. The full-down aileron position is 15° ± 1°, and the bottom of the white arc on the flap indicator represents the 15° position. Lower flaps to the bottom of the white arc on the indicator, turn the control wheel to get full aileron travel, and check the down aileron with the flap on that side. They should be in approximately a straight line.

The engine compartment should be checked regularly for oil and fuel leaks, chafing of lines, loose wires and tightness of all parts. The cowling may be removed by releasing the fasteners and taking off the two side access panels, then taking out the screws that secure the top cowl and removing it. You can make a fairly effective visual inspection of the engine without removing the bottom and nose cowl sections, which are somewhat more work to take off. The cowling itself should be inspected for dents, cracks, loose rivets, damaged or missing fasteners and damaged fiberglass areas.

The FAA requires an annual inspection of your aircraft by an authorized mechanic. If the plane is used commercially, an inspection is required every 100 hours. Even if your airplane is not required by law to have a 100-hour inspection, you may avoid many problems and fly safer by having it inspected at approximately this interval. The manufacturer has determined a recommended schedule of inspections at 50-hour, 100-hour, 500-hour and 1000-hour intervals, and an Inspection Report sheet accompanies this chapter. These report sheets are available to mechanics free of charge at all authorized Piper dealers and should be used by your mechanic when conducting inspections. The annual and 100-hour inspections are complete aircraft inspections and are identical.

You will note when examining the inspection schedule that many of the things recommended on the 50-hour inspection are visual inspections that you can make yourself. Some items you may prefer to have done by a mechanic.

In a turbocharged aircraft the turbocharger oil filter should be cleaned. This is an important item. Since the turbocharger of the PA-30 is lubricated with engine oil, clean oil is even more important in a turbocharged engine than a normally aspirated engine. With the turbocharger bearings turning at high speed, a small amount of dirt, which would not harm a non-turbocharged engine, can cause considerable damage to a turbocharger.

The air cleaner screen on a normally aspirated PA-30 engine should be removed and cleaned every 50 hours. This can be reached by removing the right side access panel from the engine nacelle, turning the three fasteners and removing the air filter box cover. The filter, after removal, should be tapped gently to remove dirt particles. Compressed air or cleaning solvents should not be used. If the paper element is torn or ruptured or the gasket is damaged, the filter should be replaced. The usable life of the filter is one year or 500 hours, whichever comes first. The air filter on turbocharged airplanes should be cleaned at least every 100 hours, but more often under dusty conditions. It can be reached by removing the safety wire and wing nuts from the air filter box. The filter should be cleaned thoroughly with a dry type solvent such as kerosene, and when thoroughly dried should be dipped in SAE 10 weight oil and allowed to drain for four hours. Excess oil should be wiped off prior to installation.

The fuel filter bowls and screens should be drained and cleaned every 50 hours (or 90 days if that comes sooner). These can be reached through an access opening in the center bottom of the fuselage forward of the main spar. You can have this done by a mechanic at the same time you have the oil or the oil cartridge filter changed.

The fuel injector inlet line screen should also be removed and cleaned every 50 hours and this also is a job for your mechanic, possibly at oil change or oil filter change time.

Flap tracks and flap track rollers are another 50-hour inspection and cleaning point. Flaps with nylon rollers do not require lubrication of either flap tracks or rollers. Flaps with steel rollers should have the tracks lubricated with DuPont All Purpose Slip Spray No. 6611 and the rollers cleaned with a dry type solvent before relubricating with oil.

The 100-hour inspection must be done by a certified mechanic, who should follow the Piper Inspection Report sheet. Even if you are not operating commercially and hence are not required by law to have a 100-hour inspection, you will see from the manufacturer's recommendations on the Inspection Report that there are many things which should be checked, lubricated, adjusted or replaced at 100 hours.

For information purposes, you may wish to keep the Inspection Report form on file to see what additional maintenance should be performed by a mechanic at 500 and 1000 hours.

At 500 hours, among other things, the props should be removed and sludge removed from props and crankshafts, the oil radiator should be removed and flushed, and the filters, if installed, should be replaced in the gyro horizon and directional gyro.

At 1000 hours the propellers should be overhauled. Certain major engine components should be replaced or overhauled as required, or this may be done at engine overhaul time. Recommended time between overhaul is 2000 hours for the normally aspirated engine and 1500 hours for the turbocharged engine. However, the overhaul time varies considerably with individual engines. Proper care can greatly extend engine life.

Periodic analysis of your engine oil offers an effective way to spot engine wear and other trouble before it happens. A sample of your engine oil (in a conveniently supplied mailing bottle) can be sent periodically to a company which performs laboratory tests to pinpoint abnormal metalic and other oil contaminents that might indicate engine abnormalities. The sampling procedure is simple, and when analysis is done on a regular basis, possibly every 50 hours, or more often if you suspect trouble, an increase in a given element in the oil will signal a warning that may enable you to discover an engine problem which could not be found by visual inspection. Several companies offer this service. Two of them are: Analysts, Inc., 700 Silver Spur Road, Rolling Hills Estates, California, 90274; and Wear Check, 5518 Dyer Street, Dallas, Texas, 75206.

PROFESSIONAL CARE WHEN AILING

Any mechanic who works on your aircraft should have at his disposal an up-to-date PA-30 Service Manual. This thick volume contains detailed drawings and instructions for servicing the PA-30 and is available from Piper dealers for $20. The Manual Owner Registration Card at the front of the Manual should be filled out and returned to the Piper dealer so that new and revised pages can be received and the book kept current. If the Manual owner's address changes, he should notify the same Piper dealer so that he can continue to get revisions. Another useful book is the PA-30 Parts Catalog, available from Piper dealers for $15. This lists parts numbers for ordering approved replacement parts for the aircraft, and revision service is available free to the purchaser upon registration with the dealer. The Service Manual or Parts Catalog may be reissued at some time, in which case a new volume should be purchased to stay current.

It is important that only Piper-approved parts be used for your aircraft. In some cases automotive parts or other bogus parts are available at cheaper prices. They look the same, but may not be the same as Piper parts. Frequently, in trade journals, manufacturers of imitation parts use cleverly worded ads to imply that they are offering Piper or FAA-approved parts at reduced prices. These small manufacturers try to copy; and are often successful at meeting, the appearance and dimensions. But frequently they use the wrong material, heat treatment or method of fabrication. The use of such items is illegal and they are likely to be less reliable than the approved aircraft parts. It is poor economy to save a few dollars on a part and risk an in-flight failure.

In addition to the Service Manual and Parts Catalog for the PA-30, there are other publications and notices which will help you keep the aircraft in good shape. Airworthiness Directives (AD Notes), issued by the FAA and mailed to registered aircraft owners, are mandatory and should be complied with promptly. The FAA also occasionally publishes an "Inspection Aid" about your airplane. Use it. Once you become the owner of a Piper aircraft, the manufacturer takes a continuing interest in having you get the most efficient use from it and keeping it in the best mechanical condition. Service Bulletins and Service Letters are issued by Piper for your convenience and safety. The PA-30 Service Bulletins, sent to all registered PA-30 owners, are of utmost importance and should be complied with promptly. They are frequently of a safety nature. Some of these communications offer you improvements at company expense if done within a specified time limit. Service Letters deal with product improvements. Those which are of special significance for aircraft owners are sent to registered owners of the aircraft involved. You will do well to heed the Service Letter information. The Bulletins and the Letters are a valuable service issued for your benefit and information and to help improve your aircraft. Past issues of Service Bulletins and Letters for your aircraft are available through Piper dealers and distributors. A subscription plan for all publications — Service Bulletins, Service Letters and Service Spares Letters (announcing optional equipment or parts) — is available through Piper dealers and distributors for $10 per year in the United States and $15 internationally. This covers information on all models of Piper aircraft.

As a PA-30 owner, you should keep the address of your aircraft registration current so that you can receive both FAA and Piper communications about your aircraft. In order to keep your aircraft registration current, as well as to keep your name on the list for publications relating to the PA-30, you must annually fill out AC Form 8050-73, Aircraft Registration Eligibility, Identification and Activity Report, and send it to the FAA Aircraft Registry, P. O. Box 26045, Oklahoma City, Oklahoma 73126. Forms are mailed to all registered aircraft owners and can be obtained from any FAA GADO office. Notify the Aircraft Registry any time you change your address. The Piper mailing list for material sent to PA-30 owners is obtained from the Registry.

GOOD HABITS

One of the best ways to save on aircraft maintenance is to develop good operational habits and to avoid practices which abuse the aircraft mechanism. We offer a few suggestions:

When towing the aircraft, if using power equipment be sure it will not damage or cause excessive strain to the nose gear assembly. Do not turn the nose gear more than 20° in either direction; damage may result to the nose gear and the steering mechanism. If a nose gear turn limit stop is broken or badly damaged, the part should be replaced. Otherwise during retraction, if the nose wheel is turned too far it can jam in the wheel well.

□ □ □ □ □ □

Do not operate the starter for longer than 30 seconds at one time. If an engine doesn't start within 30 seconds, allow one to two minutes for the motor to cool between periods of starter operation. This may require patience, but it can save you money and prevent inconvenience.

□ □ □ □ □ □

Do not use alternate induction air during ground operation. This supplies unfiltered air to the engine and is especially bad during dusty conditions.

□ □ □ □ □ □

When taxiing on uneven ground, avoid holes and ruts in order to save landing gear and props. Don't operate the engine at high RPM when running up or taxiing over ground containing loose stones, gravel, or any loose material that may damage the propeller blades.

□ □ □ □ □ □

When checking mags, do not exceed 10 seconds on one mag.

□ □ □ □ □ □

Use differential power rather than brakes wherever possible during turns when taxiing. Avoid excessive braking following landings. Avoid setting brakes that are overheated, or during cold weather when accumulated moisture may freeze the brakes. If brakes are set at considerable pressure during hot weather, the heat may make the pressure excessive, causing a leak or possible failure.

□ □ □ □ □ □

Before take-off, warm the engine sufficiently in cold weather; be careful not to overheat it in warm weather. When the engine will take an advanced throttle without hesitating or coughing, it is warm enough.

□ □ □ □ □ □

Move throttle and prop controls smoothly and slowly. Avoid rough, abrupt changes.

□ □ □ □ □ □

Consult the engine power chart and operate within the recommended power settings. Do not exceed the maximum permissible manifold pressure for a given RPM. When increasing power, increase RPM first, then manifold pressure. When decreasing power, decrease manifold pressure first, then RPM.

□ □ □ □ □ □

Watch cylinder head temperatures and avoid high temperatures by the use of correct mixture control, airspeed, power settings and cowl flaps. For maximum service life of the engine, maintain cylinder head temperatures below 435°F. during continuous operation.

□ □ □ □ □ □

When a circuit breaker trips, get at the root of the trouble. Don't reset the circuit breaker and brush aside the incident. This is often the first sign of a malfunction which can be serious.

□ □ □ □ □ □

Be aware of the normal operating conditions of your airplane and be alert to spot any deviation from the normal. A change in oil pressure, gear or flap operation time, alternator or generator output, a strange noise or smell, may indicate trouble.

□ □ □ □ □ □

Don't overlook small problems which may become big ones. A poor adjustment of the pilot's seat, a door which is giving trouble in closing, a defective stall warning sensing vane, a small oil leak may develop into a more serious situation when you least expect it.

□ □ □ □ □ □

Replace parts before absolutely necessary - - tires, ignition harness, spark plugs, exhaust stacks. If an item is doubtful or getting worn, replace it before it gives out entirely. This policy will save you money in the long run.

□ □ □ □ □ □

Don't treat your airplane like a car. It needs better maintenance than your car and costs more to take care of, but if properly maintained it will last years longer than your car.

PIPER AIRCRAFT CORPORATION

INSPECTION REPORT

THIS FORM MEETS REQUIREMENTS OF FAR PART 43

Make	Model	Serial No.	Registration No.
PIPER TWIN COMANCHE	PA-30 and PA-39		

Circle Type of Inspection (SEE NOTE 1, PAGE 3)
50 100 500 1000 Annual

Perform inspection or operation at each of the inspection intervals as indicated by a circle (◯).

DESCRIPTION	L	R	50	100	500	1000	Inspector
A. PROPELLER GROUP							
1. Inspect spinner and back plate	O	O	O	O	O	O	
2. Inspect blades for nicks and cracks	O	O	O	O	O	O	
3. Check for grease and oil leaks	O	O	O	O	O	O	
4. Lubricate per lubrication chart	O	O		O	O	O	
5. Check spinner mounting brackets	O	O		O	O	O	
6. Check propeller mounting bolts and safety (Check torque if safety is broken.)	O	O		O	O	O	
7 Inspect hub parts for cracks and corrosion	O	O		O	O	O	
8. Rotate blades and check for tightness on hub pilot tube	O	O		O	O	O	
9. Check propeller air pressure (Check at least once a month).	O	O		O	O	O	
10. Remove propellers, remove sludge from propeller and crankshaft	O	O			O	O	
11. Overhaul propeller	O	O				O	
B. ENGINE GROUP							
CAUTION: Ground Magneto Primary Circuit before working on engine.							
1. Remove engine cowl	O	O		O	O	O	
2. Clean and check cowling for cracks, distortion and loose or missing fasteners	O	O		O	O	O	
3. Drain oil sump (SEE NOTE 2, PAGE 3)	O	O	O	O	O	O	
4. Clean suction oil strainer at oil change (Check strainer for foreign particles.).	O	O	O	O	O	O	
5. Clean pressure oil strainer or change full flow (cartridge type) oil filter element (Check strainer or element for foreign particles.)	O	O	O	O	O	O	
6. Check oil temperature sender unit for leaks and security.	O	O		O	O	O	
7. Check oil lines and fittings for leaks, security, chafing, dents and cracks	O	O		O	O	O	
8. Clean and check oil radiator cooling fins	O	O		O	O	O	
9. Remove and flush oil radiator	O	O			O	O	
10. Fill engine with oil as per lubrication chart	O	O	O	O	O	O	
11. Clean engine	O	O		O	O	O	
12. Check condition of spark plugs (Clean and adjust gap, as required - 0.015 to 0.018 or 0.018 to 0.022 per Lycoming Service Instructions No. 1042)	O	O		O	O	O	
13. Check ignition harnesses and insulators	O	O		O	O	O	
14. Check magneto main points for clearance - Maintain clearance at 0.018 ±0.006	O	O		O	O	O	
15. Check magneto for oil seal leakage.	O	O		O	O	O	
16. Check breaker felts for proper lubrication	O	O		O	O	O	
17. Check distributor block for cracks, burned areas or corrosion and height of contact springs	O	O		O	O	O	
18. Check magnetos to engine timing	O	O		O	O	O	
19. Overhaul or replace magnetos (SEE NOTE 3, PAGE 3)	O	O				O	
20. Remove air cleaner screen and clean	O	O	O	O	O	O	
21. Remove and clean fuel injector inlet line screen (Clean injector nozzles as required.) (Clean with acetone only.)	O	O	O	O	O	O	
22 Check condition of alternate air door and box	O	O		O	O	O	
23. Check intake seals for leaks and clamps for tightness	O	O		O	O	O	
24. Inspect condition of flexible fuel lines	O	O		O	O	O	
25. Replace flexible fuel lines (SEE NOTE 3)	O	O				O	
26. Check fuel system for leaks	O	O		O	O	O	
27. Check fuel pumps for operation (engine driven and electric)	O	O		O	O	O	
28. Overhaul or replace fuel pumps (Engine driven and electric.) (SEE NOTE 3)	O	O				O	
29. Check vacuum pumps and lines	O	O		O	O	O	
30. Overhaul or replace vacuum pumps (SEE NOTE 3)	O	O				O	
31. Check throttle, alternate air, mixture and propeller governor controls for travel and operating condition	O	O		O	O	O	
32. Check exhaust stacks	O	O	O	O	O	O	
33. Check breather tube for obstructions and security	O	O		O	O	O	
34. Check crankcase for cracks, leaks and security of seam bolts	O	O		O	O	O	
35. Check engine mounts for cracks and loose mounting	O	O		O	O	O	
36. Check rubber engine mount bushings for deterioration	O	O		O	O	O	
37. Check all engine baffles	O	O		O	O	O	
38. Check firewalls for cracks	O	O		O	O	O	
39. Check firewall seals	O	O		O	O	O	
40. Check condition and tension of generator or alternator drive belt	O	O		O	O	O	
41. Check condition of generator or alternator and starter	O	O		O	O	O	
42. Replace vacuum regulator filter	O	O		O	O	O	
43. Lubricate all controls (DO NOT lubricate teflon liners of control cables)	O	O		O	O	O	
44. Overhaul or replace propeller governor (SEE NOTE 3)	O	O				O	
45. Complete overhaul of engine or replace with factory rebuilt (SEE NOTE 3)	O	O				O	

Owner:

Circle Type of Inspection (SEE NOTE 1, PAGE 3)
50 100 500 1000 Annual

C. TURBOCHARGER GROUP

DESCRIPTION	L	R	50	100	500	1000	Inspector
1. Inspect all air inlet ducting and compressor discharger ducting for worn spots, loose clamps or leaks	O	O	O	O	O	O	
2. Inspect engine air inlet assembly for cracks, loose clamps and screws	O	O	O	O	O	O	
3. Inspect waste-gate housing, exhaust ducting and exhaust stacks for signs of leaks or cracks	O	O	O	O	O	O	
4. Carefully check all Turbo support brackets, struts, etc. for breakage, sagging or wear	O	O	O	O	O	O	
5. Check all oil lines, fuel lines and fittings for wear, leakage, heat damage or fatigue	O	O	O	O	O	O	
6. Actuate waste-gate control, check spring preload and examine control for any pending sign of breakage	O	O	O	O	O	O	
7. Inspect injector system for signs of fuel dye indicating leaks. NOTE: If dye stains are present, check for loose connections and proper installation of air bleed nozzle shrouds	O	O	O	O	O	O	
8. Clean Turbocharger oil filter per Service Manual at every oil change.	O	O	O	O	O	O	
9. Remove inlet hose to compressor and visually inspect compressor wheel.	O	O		O	O	O	
10. Run up engines, check instruments for smooth, steady response	O	O	O	O	O	O	
11. Remove all Turbocharger components from the engine. Inspect and repair or replace as necessary.	O	O				O	
12. Reinstall engine cowl	O	O		O	O	O	

D. CABIN GROUP

DESCRIPTION	L	R	50	100	500	1000	Inspector
1. Inspect cabin entrance, door and windows for damage and operation				O	O	O	
2. Check upholstery for tears				O	O	O	
3. Check seats, seat belts, securing brackets and bolts				O	O	O	
4. Check trim operation				O	O	O	
5. Check rudder pedals, brake pedals and cylinders for operation and leaks				O	O	O	
6. Check parking brake				O	O	O	
7. Check control wheels, column, pulleys and cables				O	O	O	
8. Check landing, navigation, cabin and instrument lights				O	O	O	
9. Check instruments, lines and attachments				O	O	O	
10. Check instruments central air filter lines and replace filter				O	O	O	
11. Check conditon of vacuum operated instruments and operation of electric turn and bank (Overhaul or replace as required.)				O	O	O	
12. Replace filters, if installed, in gyro horizon and directional gyro					O	O	
13. Check altimeter (Calibrate altimeter system in accordance with FAR 91.170, if appropriate)				O	O	O	
14. Check operation - Crossfeed valve				O	O	O	
15. Check operation - Heater fuel valve				O	O	O	
16. Check oxygen outlets for defects and corrosion				O	O	O	
17. Check oxygen system operation and components				O	O	O	

Perform inspection or operation at each of the inspection intervals as indicated by a circle (◯).

E. FUSELAGE AND EMPENNAGE GROUP

DESCRIPTION	50	100	500	1000	Inspector
1. Remove inspection plates and panels		O	O	O	
2. Check fluid in brake reservoir (Fill as required.)		O	O	O	
3. Check battery, box and cables. (Check at least every 30 days. Flush box as required and fill battery per instructions in Service Manual	O	O	O	O	
4. Check heater for fuel or fume leaks		O	O	O	
5. Check recommended time for overhaul of heater per Piper Service Manual, Section XIII		O	O	O	
6. Check electronic installations		O	O	O	
7. Check bulkheads and stringers for damage.		O	O	O	
8. Check loop and loop mount, antenna mount and electric wiring		O	O	O	
9. Remove, drain and clean fuel filter bowl and screen (Drain and clean at least every 90 days)	O	O	O	O	
10. Check fuel lines, valves and gauges for damage and operation		O	O	O	
11. Check security of all lines		O	O	O	
12. Check stabilator, fin and rudder surfaces for damage		O	O	O	
13. Check stabilator bearings, and horns for damage and operation		O	O	O	
14. Check rudder hinges, horn and attachments for damage and operation		O	O	O	
15. Check rudder trim mechanism		O	O	O	
16. Check stabilator trim mechanism		O	O	O	
17. Check aileron, rudder, stabilator, trim cables, turnbuckles, guides and pulleys for safeties, damage and operation		O	O	O	
18. Replace rudder hinge bolts			O	O	
19. Check rotating beacon for wear, etc		O	O	O	
20. Lubricate per lubrication chart		O	O	O	
21. Check security of Auto-Pilot bridle cable clamps		O	O	O	
22. Reinstall inspection plates and panels		O	O	O	

F. WING GROUP

DESCRIPTION	50	100	500	1000	Inspector
1. Remove inspection plates and fairings		O	O	O	
2. Check wing, aileron and flap surfaces for damage and loose rivets, and condition of wing tips		O	O	O	
3. Check condition of walkway		O	O	O	
4. Check aileron attachments and hinges for damage, looseness and operation		O	O	O	
5. Check aileron cables, pulleys, bellcranks and control rods for corrosion, damage and operation		O	O	O	
6. Check flap attachments, tracks and rollers for damage, looseness and operation. Clean tracks and rollers	O	O	O	O	
7. Check flap cables, pulleys, step lock, bellcranks and control rods for corrosion, damage and operation		O	O	O	
8. Replace bolts used with aileron hinges and flap tracks				O	
9. Lubricate per lubrication chart	O	O	O	O	
10. Check wing attachment bolts and brackets		O	O	O	
11. Check engine mount attaching structure		O	O	O	
12. Check fuel tanks and lines for leaks and water		O	O	O	
13. Fuel tanks marked for capacity		O	O	O	
14. Fuel tanks marked for min. octane rating		O	O	O	
15. Check switches to indicators registering fuel tank quantity		O	O	O	
16. Check thermos type fuel cap rubber seals for brittleness and deterioration		O	O	O	
17. Check fuel cell vents		O	O	O	
18. Reinstall inspection plates and fairings		O	O	O	

Circle Type of Inspection (SEE NOTE 1, PAGE 3)

50 100 500 1000 Annual

DESCRIPTION	50	100	500	1000	Inspector
G. LANDING GEAR GROUP					
1. Check oleo struts for proper extension (Check for proper fluid level as required.)	○	○	○	○	
2. Check nose gear steering control		○	○	○	
3. Check wheels for alignment		○	○	○	
4. Put airplane on jacks		○	○	○	
5. Check tires for cuts, uneven or excessive wear and slippage		○	○	○	
6. Remove wheels, clean, check and repack bearings		○	○	○	
7. Check wheels for cracks, corrosion and broken bolts		○	○	○	
8. Check tire pressure (42 psi, all)	○	○	○	○	
9. Check brake lining and disc (1/64 min. lining)		○	○	○	
10. Check brake backing plates		○	○	○	
11. Check brake lines		○	○	○	
12. Check shimmy dampener		○	○	○	
13. Check gear forks for damage		○	○	○	
14. Check oleo struts for fluid leaks and scoring		○	○	○	
15. Check gear struts, attachments, torque links, retraction links and bolts for operation		○	○	○	
16. Check torque link bolts and bushings (Rebush as required)			○	○	
17. Check drag link bolts - (Replace as required).			○	○	
18. Check gear doors and attachments		○	○	○	
19. Check warning horn and light for operation		○	○	○	
20. Retract gear - check operation		○	○	○	
21. Retract gear - check doors for clearance and operation		○	○	○	
22. Check emergency operation of gear		○	○	○	
23. Check landing gear motor, transmission and attachments		○	○	○	
24. Check anti-retraction system		○	○	○	
25. Check position indicating switches and electrical leads for security		○	○	○	
26. Replace rubber assist cords			○	○	
27. Lubricate per lubrication chart		○	○	○	
28. Remove airplane from jacks		○	○	○	

Perform inspection or operation at each of the inspection intervals as indicated by a circle (○).

DESCRIPTION	50	100	500	1000	Inspector
H. OPERATIONAL INSPECTION					
1. Check fuel pump, fuel tank selector and cross-feed operation	○	○	○	○	
2. Check fuel quantity and pressure or flow	○	○	○	○	
3. Check oil pressure and temperature	○	○	○	○	
4. Check generator or alternator output	○	○	○	○	
5. Check manifold pressure	○	○	○	○	
6. Check brakes	○	○	○	○	
7. Check vacuum gauge	○	○	○	○	
8. Check gyros for noise and roughness	○	○	○	○	
9. Check cabin heater operation	○	○	○	○	
10. Check magneto switch operation.	○	○	○	○	
11. Check magneto RPM variation	○	○	○	○	
12. Check throttle and mixture operation	○	○	○	○	
13. Check engine idle	○	○	○	○	
14. Check propeller smoothness	○	○	○	○	
15. Check propeller governor action	○	○	○	○	
16. Check electronic equipment operation	○	○	○	○	
17. Check operation of controls	○	○	○	○	
18. Check operation of flaps	○	○	○	○	
I. GENERAL					
1. Aircraft conforms to FAA Specifications	○	○	○	○	
2. All FAA Airworthiness Directives complied with	○	○	○	○	
3. All Manufacturers Service Letters and Bulletins complied with	○	○	○	○	
4. Check for proper Flight Manual.	○	○	○	○	
5. Aircraft papers in proper order	○	○	○	○	

NOTES:

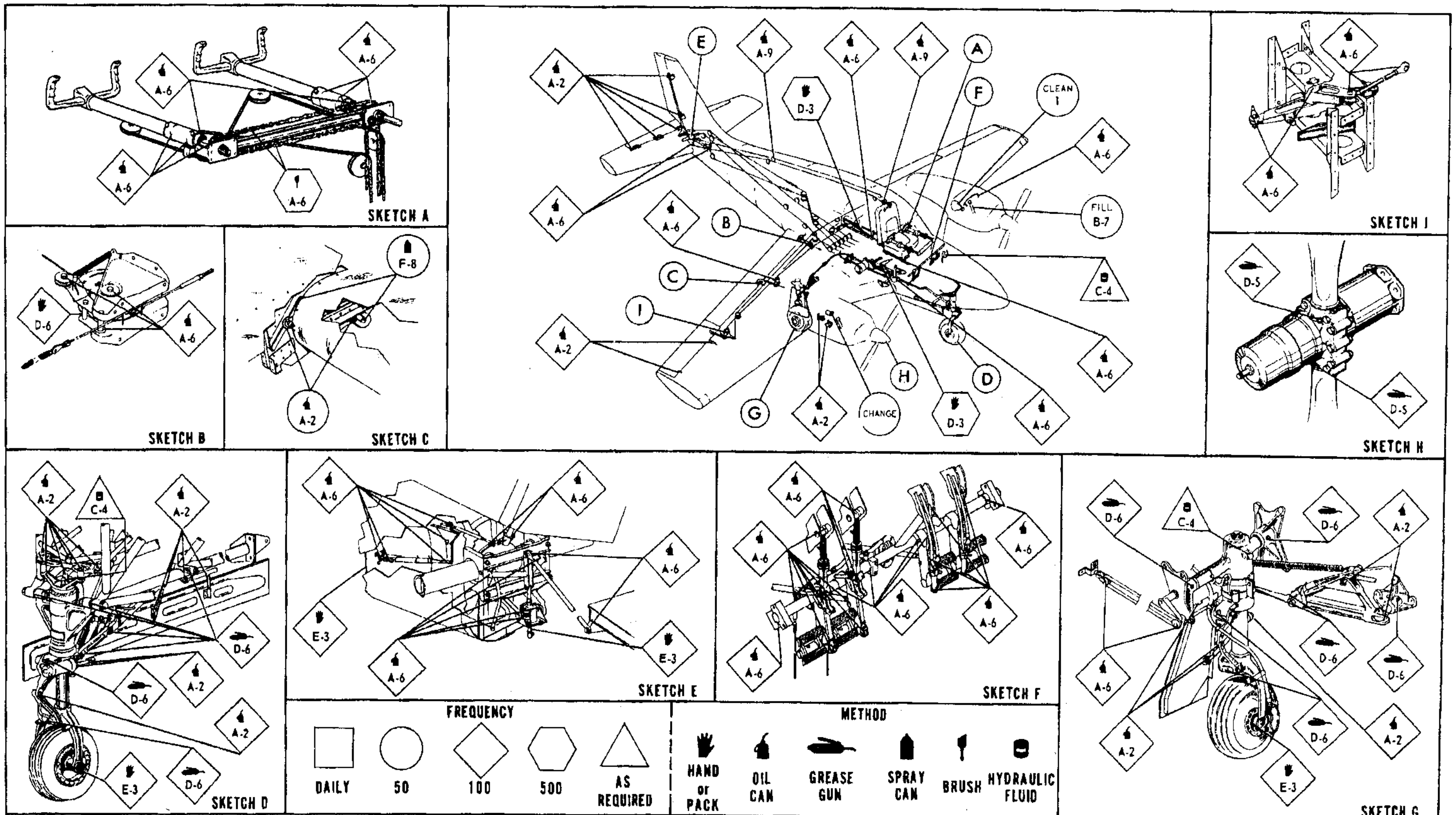
1. Both the annual and 100 hour inspections are complete inspections of the airplane - identical in scope. Inspections must be accomplished by persons authorized by FAA.

2. Intervals between oil changes can be increased as much as 100% on engines equipped with full flow (cartridge type) oil filters- provided the element is replaced each 50 hours of operation.

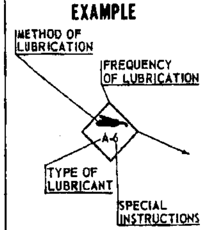
3. Replace or overhaul as required, or at engine overhaul. (For engine overhaul, refer to Lycoming Service Instructions No. 1009.)

REMARKS:

Signature of Mechanic or Inspector	Certificate No.	Date	Total Time on Airplane



EXAMPLE



LUBRICATION CHART

TYPE OF LUBRICANTS

IDENTIFICATION LETTER	SPECIFICATION	LUBRICANT
A	MIL-L-7870	LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE
B	MIL-L-6082	LUBRICATING OIL, AIRCRAFT RECIPROCATING ENGINE (PISTON) GRADE AS SPECIFIED SAE 50 ABOVE 60° F AIR TEMP. SAE 40 30° TO 90° F AIR TEMP. SAE 30 0° TO 70° F AIR TEMP. SAE 20 BELOW 10° F AIR TEMP.
C	MIL-H-5606	HYDRAULIC FLUID, PETROLEUM BASE
D	MIL-G-23827	GREASE, AIRCRAFT AND INSTRUMENT, GEAR AND ACTUATOR SCREW
E	MIL-G-3545	GREASE, AIRCRAFT, HIGH TEMPERATURE
F		ALL PURPOSE SLIP SPRAY DUPONT NO. 6611

SPECIAL INSTRUCTIONS

1. AIR FILTER – TO CLEAN FILTER, TAP GENTLY TO REMOVE DIRT PARTICLES. DO NOT BLOW OUT WITH COMPRESSED AIR OR USE SOLVENT. REPLACE FILTER IF PUNCTURED OR DAMAGED. TURBOCHARGED ENGINES – CLEAN FILTER IN SOLVENT AND ALLOW TO DRY. DIP IN SAE 10 OIL AND ALLOW TO DRAIN FOUR HOURS.
2. BEARINGS AND BUSHINGS – CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE RELUBRICATING.
3. LANDING GEAR AND FLAP TRANSMISSIONS AND SCREWS, TRIM SCREWS AND WHEEL BEARINGS – DISASSEMBLE AND CLEAN WITH A DRY TYPE SOLVENT. WHEN REASSEMBLING TRANSMISSIONS, FILL WITH LUBRICANT AND APPLY A THIN COATING TO SCREW.
4. OLEO STRUTS AND BRAKE RESERVOIR – FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO SERVICE MANUAL, SECTION II.
5. PROPELLER – REMOVE ONE OF THE TWO GREASE FITTINGS FOR EACH BLADE. APPLY GREASE THROUGH FITTING UNTIL FRESH GREASE APPEARS AT HOLE OF REMOVED FITTING.
6. LUBRICATION POINTS – WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL DIRT, ETC., BEFORE RELUBRICATING.
7. LUBRICATING OIL – INTERVALS BETWEEN OIL CHANGES CAN BE INCREASED AS MUCH AS 100% ON ENGINES EQUIPPED WITH FULL FLOW (CARTRIDGE TYPE) OIL FILTERS, PROVIDED THE ELEMENT IS REPLACED EACH 50 HOURS OF OPERATION.
8. LUBRICATE FLAP TRACK WITH DUPONT'S ALL PURPOSE SLIP SPRAY #6611. FLAPS REQUIRE CLEANING AND LUBRICATION AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER. FLAPS WITH NYLON ROLLERS WILL NOT REQUIRE LUBRICATION ON EITHER FLAP TRACKS OR ROLLERS.
9. OVERHEAD TRIM PULLEYS – LUBRICATION MAY BE EXTENDED TO 250 HOURS WHEN DUSTY CONDITIONS ARE AT A MINIMUM.

NOTES

1. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
2. SEE LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.

CAUTIONS

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER-LUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.

700105

KNOW YOUR SYSTEMS

By Alice S. Fuchs

A knowledge of the aircraft systems in your PA-30 will pay off in many ways. You can operate more efficiently; you can get better performance from the aircraft; and if an emergency arises, such knowledge may enable you to take the right action. Let's take a look at some of the important systems in the PA-30.

FUEL SYSTEM

As every PA-30 owner knows, the fuel system includes four wing tanks: two inboard tanks holding 30 gallons each, 27 gallons usable, and two outboard tanks holding 15 gallons each, all usable in level flight. Optional wing-tip tanks, when installed, increase the fuel capacity by 15 gallons each, all usable in level flight. Only the inboard tanks should be used for take-offs and landings. If you use the tip or auxiliary tanks in certain extreme attitudes when the tanks are less than full, you could uncover a tank outlet and starve an engine. You must use discretion in the selection of auxiliary or tip tanks. There is a great deal of difference between a gentle climb or descent with full tanks, and slips, skids or steep attitudes with near-empty tanks.

Fuel flow is normally maintained by engine-driven fuel pumps. Electric fuel pumps are available as a back-up in case of engine-driven fuel pump failure, and should be used as a precaution during take-offs, landings, and when switching fuel tanks.

During single-engine operation, fuel may be supplied to the operating engine from the side of the inoperative engine by crossfeed. The fuel selector for the inoperative engine should be placed on the main or auxiliary tank, and the selector on the operating side should be placed on crossfeed. Do not place both selectors on crossfeed at the same time. The electric fuel pumps may be turned off during crossfeed operation. In the case of engine-driven fuel pump failure when using crossfeed, the electric fuel pump should be turned on <u>on the side of the operating engine.</u> If crossfeed is used during single-engine cruise, switch the fuel selector for the operating engine to its inboard tank before landing. It is important, in a single-engine cruise situation, to switch to crossfeed soon enough to leave a comfortable margin in the inboard fuel tank for landing.

There are several reasons why it may be inadvisable to empty a fuel tank completely in flight. In the first place, if you wait until a tank is empty to switch to another tank, in the unlikely event that the switching mechanism breaks at that time, you will have an engine failure. In the second place, a fuel-injected engine which fails because of fuel starvation takes longer to restart than does a carburetor engine. If an engine quits because it is on an empty tank, expect a period of time before the engine restarts after you switch to the other tank. If you wish to use all the fuel in a tank, carefully monitor the fuel flow gauge. Switch tanks immediately when the gauge shows a sudden increase (which will be followed by a drop to zero). You can thus use all the fuel without engine stoppage.

A word about tip tanks: If your airplane has tip tanks you have, in addition to the "MAIN" and "AUX" positions, a "TIP/AUX" selector switch, which should be placed on "TIP" for tip tank use. When using auxiliary fuel, use the tip tank fuel first, positioning the fuel selector valve in the "AUX" position and the "TIP/AUX" fuel selector switch in "TIP" position. You then select auxiliary tank fuel by simply changing the "TIP/AUX" selector switch. The "TIP/AUX" switch should be in the "AUX" position when using main tank fuel.

Each fuel quantity gauge indicates quantity in the selected tank.

If the tip tanks have been run completely dry in flight, air may be trapped in the line when tip tanks are subsequently filled. The air pocket in the line may prevent immediate feeding of fuel from the tip tanks, with the result that the engine may quit when you switch to the tip tank in flight. To avoid this situation, purge air from the lines prior to starting the aircraft by the following method:

1. Turn fuel selector valve to "AUX" position.
2. Turn on aircraft master switch and place tip tank fuel selector switch to tip tank position. You will hear a slight click when the tip tank solenoid switch is operated.
3. Lift up the appropriate fuel drain valve and allow fuel to drain. Observe flow in clear plastic tube, followed by interrupted flow of no fuel for a few seconds, further followed by a bubbling flow, then full flow. Total drain time should not be less than 30 seconds.

The procedure should be performed for each tip tank separately. During ground run-up before flight, run each engine on the tip tank on that side long enough that you are sure of a steady fuel flow from the tip tank.

A fuel solenoid valve failure will automatically switch fuel flow from the tip to the auxiliary tank. This may show up on the fuel quantity gauges as a difference in tip tank quantity change. In case of tip tank fuel system malfunction, place the "TIP/AUX" switch in the "AUX" position. Then the fuel gauge will read quantity in the tank being used.

ELECTRICAL SYSTEM

The electrical system of the PA-30 operates the lights, landing gear, flaps, avionics equipment, starter, and some of the instruments. Power for these important functions is supplied by a 12-volt, direct current system. A 35 ampere-hour battery furnishes power for starting and as a reserve power source in case of generator (or alternator) failure. An external power receptacle is installed as optional equipment on some aircraft to permit the use of an external power source for cold weather starting. One of the important advantages of a twin-engine aircraft is the availability of two sources of electrical power. Your PA-30 has two 50-ampere generators if it is an A or B model, and two 70-ampere alternators if it is a C model.

A well-charged battery in good condition is good insurance for the electrical system, and you are referred to the suggestions for battery care and inspection on pages 8-3 and 8-4 of the previous chapter in this series. The battery should be serviced and inspected regularly, and replaced when it shows signs of becoming undependable.

The electrical system is protected by circuit breakers, which will pop out if the current flow gets too high. The circuit may be reinstated by pushing in the circuit breaker, though it may be necessary to allow two minutes cooling time before resetting. A popped circuit breaker may mean a momentary surge, which is not serious, or it may represent a serious malfunction. Continual popping of a circuit breaker indicates a problem in the system, and flight should be continued without using the related equipment if possible.

Generators

If your airplane is generator-equipped, each generator system has a regulator assembly composed of a voltage regulator and a current regulator, to prevent overloading of the battery and electrical circuits. Also with the regulator is a reverse-current cutout to prevent the generator from being motorized by the battery when the generator output drops below the battery voltage. A paralleling relay is used to connect the two generators in such a way as to make them share the load equally. If one generator should fail, the contacts of the paralleling relay unit of that charging system would open, breaking the circuit. If the other generator and regulator were not defective, they would operate as a normal single-generator charging system.

The generator system has an ammeter which shows current going to or from the battery. If the indication is negative, you are using more current than the generators are putting out; the battery is making up the difference. If only one generator is operating, the ammeter indication should be positive (if the load is less than the output of the good generator) but may be negative (if you are using more current than the good generator is putting out).

The generator switches should remain on during all phases of operation except for failure in the system.

The best assurance of obtaining maximum service from generators is to follow a regular inspection and maintenance procedure. The frequency with which this should be done will be determined by the type of service in which the aircraft is used. High speed operation, excessive dust or dirt, high temperatures and high electrical demands, which cause the generators to operate at or near full output most of the time, are all factors which increase wear of generator parts. Generally speaking, the condition of the generators and the condition and tension of the generator drive belts should be inspected every 100 hours.

Alternators

The alternator system offers full electrical power output even at low engine RPM, a condition which results in improved radio and electrical equipment operation and easier cold weather starting.

The ammeter has two test buttons which, when pressed in, allow the instrument to show the output of the left and right alternators respectively. This output should be tested before take-off, and the two indications should be approximately equal. The normal position of the ammeter shows the battery charge or discharge current. With all electrical equipment off (except the master switch) and the alternators operating, the ammeter will indicate the amount of charge current being supplied to the battery. If the battery is low, the indication will be high. If the battery is fully charged, the indication will be near zero. As each item of electrical equipment is turned on, the ammeter will reflect the increased current demand by decreasing the charge current indication (since the current, which was previously being used to charge the battery, is now being used to supply the additional electrical equipment). Before shutting down the engines, turn off all electrical equipment, run the engines at 1000 RPM and observe the ammeter. If it shows more than 25 amps, you will not have enough charge in the battery for a restart. In that case, run the engines until the ammeter reads 20 to 25 amps in order to charge the battery.

The alternator system incorporates a main voltage regulator and overvoltage relay, with an auxiliary voltage regulator and overvoltage relay as a back-up. A 90-amp circuit breaker switch protects each alternator circuit. These circuit breaker switches are immediately to the left of the circuit breaker panel on the lower right portion of the instrument panel.

The overvoltage relays should be checked by a mechanic in accordance with Service Manual instructions once a year or every 500 hours (whichever comes sooner).

LANDING GEAR AND BRAKE SYSTEM

The landing gear system is of special importance to the pilot since it is much more fun to land gear down than gear up. The PA-30 landing gear system is electrically operated, with the nose gear retracting aft into the nose section and the main gears retracting inboard into the wings. Gear doors operate by gear movement, completely covering the nose gear and partially covering the main gear when retracted.

The aircraft can be towed using the nose gear tow bar, normally stowed against the forward side of the main spar or in the baggage compartment of earlier model aircraft. The nose gear can be turned in a 40° arc, 20° either side of the centerline. During normal gear retraction a centering device straightens the nose gear so that it fits into the wheel well. When towing the aircraft with power equipment, if the nose gear is turned more than 20° in either direction the nose gear stops will be damaged and this can result in the nose wheel's jamming in the well if the wheel, because of this damage, is not centered when retracted.

Limit switches cut off the gear motor when the gear is fully extended or retracted. The gear up-limit switch stops the motor and turns on the amber gear-up indicator light on the instrument panel. When the gear is fully extended, the gear-down switches stop the motor and illuminate the green gear-down-and-locked indicator light on the instrument panel. A white light indicates that the gear is in transit. When the instrument lights are on, the gear indicating lights are dimmed, so that it is very difficult to see them on a bright day. You may save considerable embarrassment if you think the gear is not down, by first checking the instrument lights to see that the instrument light switch is not on, thus dimming the gear lights.

The landing gear system has many safety features built into it. The amber gear-up indicator light will flash if the power of one engine is reduced below 12 inches of manifold pressure while the gear is up and locked. The gear-up warning horn will sound when power is reduced below approximately 12 inches on both engines and the gear is not down and locked. If the light or horn does not operate at this manifold pressure, you should have it adjusted. It is important to note the difference between the sound of the gear warning horn and the stall warning horn so that there will be no confusion about what is happening when a horn blows.

The gear horn will also blow if the gear selector is moved to the "UP" position when the weight of the airplane is on the landing gear and the master switch is on. An anti-retract switch on the left main gear prevents retraction of the gear on the ground by preventing the completion of the electric circuit to the landing gear motor until the gear strut is within 3/4 inch of full extension.

Even the shape of the landing gear selector switch is a safety feature. It is shaped like a wheel to distinguish it from the flap selector, which is shaped like an airfoil.

Several precautions should be taken when operating the landing gear system. On take-off, do not retract the gear too soon. Premature gear retraction with subsequent sinking of the aircraft so as to strike the partially-retracted gear, may jam the gear structure so that the wheels cannot be extended or retracted. In flight, if you have the alternators or generators turned off (having forgotten to check them before take-off) with a consequent depletion of the battery, or if the master switch is turned off, the warning horn will not operate and you may land gear up because there is no current to operate the gear motor even though the gear selector is in the down position.

If you select gear down and do not get a green light, a manual gear extension system is available, but first perform a few simple checks. See that the master switch and alternators or generators are on, that the gear motor and the gear solenoid circuit breakers are in, and that the instrument lights are off if it is daytime. Do you have a burned out light bulb? Gear light bulbs can be unscrewed and interchanged for testing. A mirror on the left engine nacelle can tell you the position of the nose gear. Remove the cover plate for the manual gear extension controls. It is a good idea, when the gear system is operating normally, to look in this area and see what the mechanism looks like in both the gear retracted and the gear extended position. If you know what it should look like, then if you suspect gear malfunction you can lift the manual gear extension cover plate and get an indication of the gear position.

If it appears that the gear must be extended manually, slow the airplane to 100 mph or less and place the gear selector in the "DOWN" position. Disengage the gear motor by raising the motor release arm and pushing forward through the full travel. Next remove the gear extension handle from its bracket. You must eventually put the handle in the left socket; if possible, do so at the start. However, in most cases the left socket is not in such a position that the handle can be inserted. It is then necessary to put the handle in the right socket and rotate it forward until the left socket is in a clear position. Then the handle can be removed and placed in the left socket. The handle should then be rotated full forward to extend and lock the landing gear.

Late model aircraft have a locking feature for manual gear extension. If you pull aft on the handle, it will not come back if the gear is down and locked. Also, the green light will come on. Leave the gear selector switch in the "DOWN" position. If you moved to the "UP" position at this point, however, the gear would not retract but the white "IN TRANSIT" light would come on.

Once you have extended the gear manually, it cannot be retracted manually by normal procedure. A mechanic can reset the system after placing the aircraft on jacks.

The toe brakes are hydraulically actuated by individual master cylinders mounted to the fuselage bulkhead and actuated by toe brake pedals mounted on the rudder pedals. Left brakes are standard and right brakes are optional. A reservoir located on the front side of the forward cabin bulkhead supplies hydraulic fluid to each master cylinder. In the event of brake failure, try pumping the brakes to build up pressure in the system, and then have the fluid level and the brake system inspected before further flight. The parking brake may be actuated by applying the brakes and pulling out the parking brake handle, and may be released by depressing the brake pedals and pushing in on the parking brake handle.

It is a good idea to test the brakes before taxiing and to press with the toes to feel pressure before landing.

FLAPS

The flaps of the PA-30 are operated by an electric motor. Full flaps extension is approximately 27°, and the take-off range, marked by the white arc on the flaps indicator, is 15°. If you wish to be conservative in the matter of flap operation, lower and raise the flaps by degrees, in separate increments, to minimize an asymmetric flap situation in the event of flap malfunction.

Flap extension is not possible in the event of an electrical failure. A no-flap landing presents no special problems, but since the stall speed is higher without flaps, it is important to keep airspeed about five miles per hour above normal during a no-flap approach.

As you step onto the wing to enter the aircraft, you of course are stepping on the flap. The system is protected by two locks. The first holds the flap in the up position to permit it to be used as a step. The second lock prevents the flap from going full down in case a step load is applied and the up lock is not fully engaged.

HEATING AND VENTILATING SYSTEM

Your PA-30 is heated by either a South Wind (serial numbers 30-1 to 30-401 inclusive) or a Janitrol (serial numbers 30-402 and up) heater installed in the right side of the nose section and accessible by removing the nose access cowl.

The heater normally uses gasoline from the fuel injector on the right engine, which normally is supplied from the right fuel cells. This means that any time the right fuel selector is off, the heater is inoperative. In case of right engine failure, the heater can be operated by leaving the fuel selector on and operating the right electric fuel pump. The mixture control must be in the idle cut-off position. However, the heater should not be operated in this manner if you have reason to believe there is a fuel leak between the tank and the engine or if there has been evidence of fire.

Operation of the South Wind heater is controlled by an OFF-PRIME-LOW-HIGH switch. The ventilating fan motor operates and provides airflow through the heater system whenever the heater switch is in the low or high heat position. In flight, additional air is supplied by ram air pressure. To turn the heater on, first see that the heater fuel valve is turned full on; then move the heater switch to "HIGH" or "LOW" heat. If the heater does not start promptly, return the heater switch to "PRIME" position for 15 seconds to prime the heater; then move the switch to "HIGH," allowing one to one and a half minutes of warm-up in this position. Then go to "LOW." Use of the high heat position on the ground may result in excessive exhaust smoke from the heater. Therefore use high heat only in flight.

After the heater switch is turned to the "OFF" position, combustion in the heater stops, but the combustion fan and circulating air fan continue to operate for about two minutes while the heater cools slowly and purges itself. The heater switch should be turned off about two minutes before stopping the engines and shutting off the master switch.

Operation of the Janitrol heater is controlled by a three-position switch, labeled, "OFF," "FAN" and "HEAT." The "FAN" position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired. For heat, the heater fuel valve must be on and the three-position switch turned to "HEAT." There is no need for priming.

Controls on the bottom right of the instrument panel give a wide choice of temperature and air circulation settings. Many pilots find that a low airflow-high heat combination is comfortable and gives less feeling of drafts. In case of severe windshield fogging or icing, maximum action from the defrosters can be obtained by selecting maximum temperature and restricting the heated cabin air, thus driving more air through the defrosters. However, since the defroster is not designed to handle windshield icing, don't expect it to do so.

If the heater is operated on the ground, it should be turned to the "FAN" position for several minutes to cool before it is turned to the "OFF" position or the master switch is turned off.

The South Wind and the Janitrol heater each has an overheat switch, which acts as a safety device in the event of excessively high temperatures. This switch can trip either because of heater malfunction or improper shut-down procedure. In order to reach the reset button in the right side of the nose section, it is necessary to remove the nose access cowl. The inaccessibility of the reset button is a safety feature to prevent resetting of a malfunctioning system in flight. Care in observing proper shut-down procedure will usually prevent the inconvenience of having to reset the limit switch.

Ventilating air for the cabin comes from an inlet in the nose section and a scoop mounted on the left side of the dorsal fin. An exhaust vent in the aft section of the cabin improves the air circulation.

PROPELLERS

The propellers are oil-nitrogen operated. You may use compressed air instead of nitrogen, but it should be dry air, especially if you will be flying in temperatures below freezing. The nitrogen pressure drives the propeller toward the low RPM or feather position; oil pressure from the governor, plus the twisting moment of the blades, drives the propeller toward the high RPM or unfeather position. An insufficient charge of nitrogen may lead to propeller overspeeding, slow feathering or inability to feather.

New or modified propellers have springs which prevent overspeed with low air or nitrogen pressure. Since the pressure requirement is different for the two propeller installations, it is important to insure that the correct pressure table is used when charging with air or nitrogen.

The propeller has an anti-feathering lock, which is disengaged by centrifugal force when the propeller is rotating above 1000 RPM. At very low RPM, the lock is engaged so that the propeller cannot be feathered. This is what keeps it from feathering every time the engine is stopped. The propeller cannot be feathered when its speed is less than 1000 RPM.

One of the advantages of being able to feather an engine, in addition to reducing its drag in the event of engine failure, is that feathering enables the pilot to stop the engine quickly in case of fire, loss of oil pressure or other malfunction which might otherwise destroy the engine.

POWER PLANT

Your PA-30 is powered by two Lycoming 160-horsepower, fuel injected engines, either normally aspirated or turbocharged. It is not necessary for you, as a pilot, to know all of the construction or internal workings of the engine, but it is very important to the life of the engine that you operate it conservatively and within the recommended power settings. The PA-30 Owner's Handbook gives you a power setting table. For best engine operation, use this data and operate within its limitations. It is especially important to avoid operation with low RPM and high manifold pressure (above the chart recommendation), as this can lead to pre-ignition or detonation. When increasing power, increase RPM first and then manifold pressure. When decreasing power, decrease manifold pressure first and then RPM. Within each cruise power range listed on the table, you will find different manifold pressure-RPM combinations. This permits a choice of the setting which gives smoothest operation for your engine. When increasing power for climb, always enrich the mixture first. During descent move the mixture control toward the rich position so that when cruise power is resumed the mixture will be about right for the power setting and altitude.

If the induction air source for an engine should become obstructed, as would occur if the air filter became clogged or iced over, an alternate air source is designed to open automatically. A manual alternate air control is also available for each engine and is located in the cabin for operation by the pilot if needed. When air is supplied to the engine from the alternate source it is unfiltered air. For this reason, alternate air should never be used during ground operation.

Proper leaning technique is essential for good engine care, and the installation of an Exhaust Gas Temperature (EGT) gauge will assist in precise leaning. Without an EGT gauge, good leaning is more difficult. The fuel flow indicators on some aircraft show ranges of fuel flow for various percentages of power, and this may be used as an approximate indication of the proper leaning for a given power setting. However, this instrument can give the wrong impression if one or more of the nozzles is partially blocked; the indicator will then read high. Without power percentage figures on the fuel flow indicator, the Fuel Consumption Chart in the Owner's Handbook can be used to give approximate fuel flow for various power settings.

Power setting tables for the later model PA-30s list Normal Cruise, Intermediate Cruise, Economy Cruise and Long Range Cruise rather than percent power. For normally aspirated engines, Economy Cruise represents approximately 65% power at sea level, and more at higher altitudes. Intermediate Cruise represents 75% power at 3000 feet, more at higher altitudes and less at lower altitudes. Do not lean above 75% power without an EGT gauge.

If an EGT gauge is available, set up a desired power setting according to the power setting table, and watch the EGT gauge while leaning. The temperature will increase until it reaches a peak, at which point further leaning or enriching the mixture will result in a cooler temperature. You may fly with the temperature 25° on the lean side of peak with a saving in fuel but also with less power output. Most pilots prefer to fly on the rich side of peak. Maximum power for a given RPM-manifold pressure setting will be obtained by leaning to a peak on the EGT gauge, and enriching the mixture to 100° to 150° cooler than peak EGT. This, however, will result in a fairly high fuel consumption. If you operate at 50° on the rich side of peak, you will be fairly close to the highest power range, and the fuel consumption will be considerably less.

Do not lean to peak at more than 75% power. If you wish to operate at higher than 75% power, you may lean at the higher power setting if you use the following method:

1. Adopt a 65% power setting.
2. Lean to a peak temperature on the EGT gauge and note where this peak is located on the gauge.
3. Enrich the mixture and set up the higher power setting.
4. Lean to a temperature that is cooler than the peak which you obtained at the 65% power setting. How much cooler depends on whether you wish to obtain the maximum power for that setting (100° to 150° cooler) or a lesser power with greater fuel saving (possibly 50° cooler).

Cowl flaps should be open for ground operation except in the very coldest temperatures, and should be used as necessary to keep the cylinder head temperatures within limits. The maximum cylinder head temperature for full throttle operation is 500° and for 75% power cruise it is 435°. However, for continuous cruise operation, the temperature should be kept between 150° and 435°, and below 400° at economy power settings.

Smoothness is the key to good engine care. Avoid abrupt operation of throttles, prop controls and mixture controls, and use power settings and mixtures where the engine sounds smooth.

TURBOCHARGERS

If your PA-30 is turbocharged, you can maintain low-altitude power and engine efficiency at higher altitudes. The turbocharger is operated by exhaust gas and the amount of turbocharging is regulated by the position of a butterfly valve, the waste gate, which controls the flow of exhaust gas to the turbine. A vernier-equipped manual control under the throttle quadrant in the cabin controls the waste gate position and hence the amount of turbocharging for the engine.

The turbochargers should be used only with a full throttle setting. Try first to get the desired manifold pressure with throttles, and when full throttles will not get it for you, activate the turbochargers. When applying power, apply throttles first, then turbochargers. When reducing power, reduce turbochargers first, then throttles.

In the event of turbocharger failure, the engine will revert to normally-aspirated power. If this should happen, pull out the turbocharger control to reduce back pressure on the exhaust and adjust the mixture.

The turbochargers are lubricated with engine oil. If a turbocharger warning light comes on, deactivate the turbocharger immediately.

A turbocharged engine in the PA-30 may be operated with no time limitation on full throttle and 2700 RPM power setting when the turbocharger is not activated. With the turbocharger in operation, a take-off power of 29.5 inches of manifold pressure and 2700 RPM has a five-minute limitation. At 28 inches and 2600 RPM, there is no time limitation. For single-engine operation turbocharged, maintain a minimum airspeed of 110 mph.

At a field 2000 feet or higher above sea level, the turbocharger may be preset to give sea-level power on take-off. With mixture rich, prop set to high RPM and throttle full open, advance turbocharger control until manifold pressure is stable at 28.5 inches. Retard throttle and repeat for the other engine. On take-off, ram pressure will bring the manifold pressure to 29.5 inches.

Prior to landing at a high-altitude field, the turbochargers may be preset to deliver sea-level power in the event of a go-around. In level flight about 1000 feet above airport elevation, with prop controls and throttles full forward, advance the turbocharger controls to give 28.5 inches of manifold pressure. Leave the turbocharger controls in that position, and adjust throttle and prop controls as in any normal landing.

With a turbocharged engine, as with a normally aspirated engine, smooth operation is the secret of good operating technique and long life for your engine.

A knowledge of the aircraft systems will give you confidence in the aircraft and in your ability to handle it under all conditions.

PA-30 PROCEDURES

By Alice S. Fuchs

Pilots, like most people, are creatures of habit. Since it is just as easy (well, almost) to form a good habit as a bad one, this tendency to perform acts in a customary manner can be used to good advantage, ensuring that routine matters are handled in good form, while the mind is freed for other matters which may not be so routine. Standard procedure, preferably with the aid of a check list, is the way to good flying habits.

The PA-30, like all other airplanes, has procedures which are recommended for its operation. Some of these are good procedures for any airplane, and some are items which apply particularly to the PA-30.

Sometime in the near future we will be sending you the final portion of the PA-30 Eductional Series - a fresh new check list, which we hope you'll put in your aircraft and use every time you fly. This current chapter of the series will give you some of the background for the PA-30 check list.

PREPARATION

Is your flight legal? Is it safe? The answer to these questions should be part of your preflight preparation. This is the time to make sure that the proper aircraft papers are aboard and that required inspections have been performed. Asking a woman her weight can be as touchy as asking her age, but a pilot can develop skill at guessing passenger weight for preflight planning, and baggage can be weighed or estimated. A pilot sometimes neglects a weight and balance computation before a flight because he's afraid the answer will come out wrong and the plotter will tell him not to go. This head-in-the-sand attitude can lead to trouble if a critical flight situation arises when the aircraft is overloaded or the center of gravity outside limits. Too often, accident investigators find that the accident cause was improper flight planning – aircraft over gross weight or the C.G. outside the envelope.

Unless a wide safety margin exists, performance should be calculated from the aircraft charts to see whether the runway is long enough for take-off, whether climb performance will permit obstruction clearance, and whether the fuel offers sufficient range for the flight. Charts and navigation equipment should be checked on board, and don't forget a flashlight for night flight. Baggage should be tied down.

PREFLIGHT INSPECTION

The proper place to start a preflight inspection is inside the cabin. After checking that the gear switch is down and the radios off, the master switch can be turned on to check the gear lights. A check of the fuel gauges will permit a comparison later with what you see in the fuel tanks during the external preflight check. A check of wing flap operation at this point (while the engine is not running) will permit you to hear any binding or noise which might indicate improper operation. Leave the flaps up. The master switch may then be turned off. A very thorough draining of each fuel tank is important. (Most pilots do not drain enough fuel at this point to get rid of moisture if it is present.) Special procedure for draining from tip tanks if they have been emptied and later refilled, is given on page 9-2 of the previous chapter in this series.

If you plan to fly at altitude, a check should be made to see that the oxygen quantity is sufficient, that masks are available, and of course that the valve functions and is then turned off. A final check before leaving the cabin should ensure that the cowl flaps are open, the ignition switches off, the mixtures at idle cut-off, the trim in neutral and any control locks off.

Now you are ready to step outside the aircraft. An inspection of the fuselage condition and the antennas is important, the latter especially if you are going to fly instruments. Looking underneath the aircraft you can see whether the fuel flow from draining has stopped and that there is no fuel drip. A thorough walk-around inspection should include the condition of every significant item which can be seen outside the aircraft. Watch for evidence of fuel or oil leaks. Remember to check fuel color when checking fuel quantity, and be sure the fuel caps and covers are secure. Oil quantity should be at least six quarts in each engine; the landing gear struts should be properly inflated and the baggage door secure. The propeller inspection is of special importance, as an untreated propeller nick can cause an inflight prop failure which could result in very hazardous vibration and imbalance. Check the ailerons and stabilator for freedom of motion. If you plan to use lights or pitot heat, you will welcome the assistance of someone in the cabin to turn them on while you check them externally, or you can hop in and out yourself. The only sure way to check the pitot heat is by feel (cautiously). This is a good time to check the stall warning indicator also. A final check that the aircraft is untied and chocks removed before entering the aircraft for flight may avoid subsequent embarrassment.

BEFORE STARTING ENGINES

Most pilots, upon entering the aircraft, adjust the seat so that they can comfortably reach the rudder pedals, but it is also important to make sure the seat is properly latched in place and will not slide back unexpectedly. The pilot has a few chores to perform before starting the engines. The parking brake should be set and a check made that the circuit breakers are in, the alternators or generators on, and that the main voltage regulator is selected if the aircraft is alternator equipped. If the aircraft is turbocharged, turbochargers should be off.

STARTING ENGINES

For a normal engine start, the mixtures should be at idle cut-off, the throttles advanced one-half inch and the prop controls forward. Then with the master switch and electric fuel pumps on, the engines can be primed by moving the mixture controls to full rich until a fuel flow is indicated, then back to idle cut-off. With ignition switches on and the prop cleared, the starter may be engaged and the mixture advanced as an engine starts. After a check of the oil pressure on the engine that is started, the other engine may be started in a similar manner. Electric fuel pumps should be turned off after engine start, so that the engine driven pumps can be checked during taxiing.

When an engine is hot, first try starting it without priming. If the engine does not start without priming, move the mixture to idle cut-off and use normal starting procedure.

A flooded start calls for an open throttle and mixture at idle cut-off. With the electric fuel pump off and mag switches on, engage the starter. When the engine fires, retard the throttle and advance the mixture slowly.

PRE-TAXI AND TAXI

Before taxiing, lights should be turned on if the flight is at night, the autopilot should be off, and of course the parking brake must be off. This is a good time to set the directional gyro and the communications and navigation radios. A check of brake operation is wise as you start taxiing. Move forward a few feet, reduce power and apply brakes to make sure you will have them when needed. This is especially important if your initial taxiing is done near other aircraft. As much as possible, differential power and nose wheel steering should be used rather than brakes when taxiing. Taxiing offers a good chance to check the directional gyro and turn indicator for proper motion, and you should glance at the attitude indicator to make sure it does not bank as the aircraft turns.

If the day is cold, the heater and defroster should be checked. The fuel feed from each tank can be checked by changing the fuel selectors, and the crossfeed should be checked. Be sure to turn both selectors back to "MAIN."

PRETAKE-OFF CHECK

This is your last chance to make sure everything is in order and working satisfactorily before take-off. The check list should always be used so that no item is omitted. It is important, especially in cold weather if the taxi time has been short, to be sure that the engine is warm enough before running it up for a magneto and propeller check. If it does not hesitate when the throttle is advanced, it is probably warm enough. During engine run-up the propeller feathering should be checked at 1500 RPM and the propeller governor and magnetos at 2200 RPM. When exercising the propellers, after the RPM has been reduced slightly by propeller control, advance the throttle a few inches of manifold pressure and note whether the RPM remains the same, indicating that the governor is governing. Then move the propeller controls full forward. In the magneto check, the normal drop is 100 RPM. There should be no more than a 175 RPM drop and no greater than 50 RPM difference between operation with the left and right magnetos on an engine. Engine idling should be checked and the throttles then set to 800 to 1000 RPM. Leave the propeller controls in high RPM.

It is important that every item on the check list be checked conscientiously. Familiarity often breeds carelessness or a perfunctory glancing down the list so that occasionally an item is read but not actually checked. When checking the controls, the wheel should be moved to full position in each direction and you should look outside the aircraft at the ailerons and stabilator to ensure motion in the proper direction. The aileron should come up on the side to which the wheel is turned. The trailing edge of the stabilator should come up when the wheel is pulled back and the antiservo trim tab should move further in that direction.

Immediately before take-off, the pitot heat may be turned on if it will be required, and the electric fuel pumps should be turned on.

TAKE-OFF AND CLIMB

As the throttles are moved during take-off, watch the engine instruments to see that the engines are functioning properly (manifold pressure, RPM, fuel flow and oil pressure). Make sure the airspeed indicator is functioning. Do not move the controls for rotation before the V_{mc} of 90 MPH. If the aircraft takes off before that speed, keep it close to the ground until reaching 97 MPH, the recommended minimum single-engine control speed. The landing gear should be retracted when a landing could no longer be made on the runway ahead, and flaps (if used) should be retracted at about 50 feet or when any obstacle has been cleared.

Climb-out should normally be made with full power at the best rate of climb speed (112 MPH at sea level) to approximately 400 feet or until obstacles have been cleared, and then a lower climb power setting may be used with a higher airspeed for better cooling and visibility. Cowl flaps should be used as necessary during climb to maintain cylinder head temperatures below maximum.

As altitude increases, the throttles should be advanced to maintain manifold pressure. In a turbocharged aircraft, turbochargers should not be activated until full throttle is applied.

If it is desirable to get the aircraft off the ground in the shortest possible distance, either because the runway is short or because the surface is soft, set the brakes and run up the engines to maximum power before starting the take-off roll. Climb-out should be made at the best rate of climb speed if there is no obstacle, or may be made at the best angle of climb speed (90 MPH at sea level) if an obstacle must be cleared. When using a 90 MPH climb-out, remember that you are at V_{mc}. Be prepared to lower the nose immediately and to reduce power on the good engine in the event of engine failure in this situation. Get to at least 97 MPH as soon as you can because handling an engine failure at 90 MPH takes more skill than at 97 MPH.

NORMAL CRUISE

There are several actions to be taken when you level off at cruise altitude. The manifold pressure and RPM should be adjusted as desired, following the recommendations of the power setting table. The mixtures should be leaned and the cowl flaps closed or adjusted to maintain allowable cylinder head temperatures. Fuel selectors may be placed on any tank. Electric fuel pumps should be off unless you are flying above 15,000 feet, in which case they will be needed to maintain fuel pressure.

DESCENT

If turbochargers are used, they should be shut off before retarding the throttles. The manifold pressure should be reduced by moving the turbocharger control toward the "OFF" position. Then to further reduce power, retard throttle. Mixtures should be enriched in accordance with altitude change so that the mixture will not be too lean when power is reapplied. The oxygen may be turned off below 10,000 feet. When letting down from cold, upper atmosphere to warm, humid air, defrosters should be turned on during descent.

APPROACH AND LANDING

Sometime during the approach (during let-down is a good time) retard the throttles and check that the gear warning horn is working. The brakes can also be checked by pressing to feel pressure. The landing check list should be consulted and performed on every landing. Do not trust your memory. Once the gear handle is down (not above 150 MPH), check for a green light and look in the nacelle mirror for the nose gear position. Set propellers at 2400 RPM to be ready for a climb if necessary. The heater may be turned off at this point if it is not too cold outside. If heat is desired during the approach and landing, the heater may be left on if appropriate action is taken after landing.

Maintain a speed of at least 115 MPH on the downwind leg and 110 MPH on base leg and during the turn onto final. Avoid a steep turn from base leg to final. A final approach speed of 95 MPH can be gradually reduced over the fence with a gradual flare-out for landing. Unless you wish a short landing, you may find that half flaps give an easier flare-out and touch-down, though landing flap position is a matter of personal preference. Full flaps are not desirable in high winds or crosswinds unless the runway is very short. If flaps are not used, the approach should be made at slightly higher than normal speed since the stall speed is higher without flaps.

Keep off the brakes during the landing, but early in the landing roll slight pressure on (and then off) the toe brake pedals will tell you whether brakes are operating. If maximum braking action is needed on the landing roll, the flaps may be retracted at that time and the wheel held back. However, in normal circumstances, it is best not to raise the flaps or perform any of the post landing chores until the airplane has been turned off the active runway. This will avoid any possibility of reaching for the gear handle by mistake.

POST LANDING

After the aircraft has turned off the active runway, the flaps may be retracted, the electric fuel pumps turned off and the prop controls placed full forward. If the heater is on, this is a good time to place it in "FAN" position if it is a Janitrol heater, or to "OFF" if it is a Southwind heater. Either of these heater actions should be taken two to three minutes before shutdown in order to permit cooling of the heater system.

SHUTDOWN

Prior to shutdown, all radio and electrical equipment should be turned off, and thought should be given to the heater, if used, to ensure the proper amount of time on "FAN" position (Janitrol) or "OFF" (Southwind). The throttles may then be retarded and the mixture controls moved to idle cut-off. Pushing the red knob on the left of the throttle quadrant operates a spring-loaded device on the throttles that will permit the pilot to retard throttles further and will help prevent a rough stop. This procedure will save vibration wear and tear on engine mounts and exhaust systems. Magnetos and master switch should be turned off. Generators, or alternators and main voltage regulator, should be left on.

EMERGENCY PROCEDURES

FEATHERING PROCEDURE

Chapter 5 of this series deals with single-engine procedure in detail. This information should be frequently reviewed, and on every take-off the pilot should keep in mind the procedure to be followed if an engine fails at any point in the take-off or climb-out.

In case of engine failure, the necessary actions can be divided into four headings:

1. Maintain airspeed and directional control.
2. Add power.
   a. Mixture controls - forward
   b. Prop controls - forward
   c. Throttles - forward
   d. Electric fuel pumps - on
3. Reduce drag.
   a. Gear up
   b. Flaps up
   c. Feather bad engine.
      (1) Identify
      (2) Verify (by throttling back on the suspected engine)
      (3) Feather (prop control back)
4. Complete the check list.
   a. Cowl flap closed on bad engine, as required on operating engine
   b. Mixture idle cut-off on bad engine
   c. Electric fuel pumps off
   d. Magnetos off on bad engine
   e. Alternator or generator off on bad engine
   f. Check alternator or generator, and vacuum pump operation, for good engine.
   g. Reduce electrical load if necessary.
   h. Trim
   i. Plan fuel management for single-engine flight. Crossfeed if necessary.

Procedures 1, 2 and 3 should be memorized and carried out quickly. Procedure 4 may be done more leisurely, using the emergency check list to guard against missing anything.

CROSSFEED

If you use crossfeed to extend single-engine range by supplying the operating engine with fuel from the side of the inoperative engine, it is essential to be sure the fuel selector of the inoperative engine is on a tank containing fuel before you place the selector of the operating engine on crossfeed. The procedure is:

1. Fuel selector of inoperative engine on any tank as long as it has a reasonable amount of fuel.
2. Fuel selector of operating engine on "Crossfeed."

The electric fuel pumps do not need to be on during crossfeed operation. However, if the engine-driven pump of the operating engine fails, the electric fuel pump for that engine should be turned on.

Do not put both selectors on "Crossfeed" at the same time.

UNFEATHERING PROCEDURE

If a propeller is feathered in an actual emergency usually it should not be unfeathered in flight. However, when feathering is done for practice or as a precautionary measure to save an engine which might be needed during the final portion of a flight, unfeathering may be achieved by the following procedure:

With the fuel valve on and the electric fuel pump off, crack the throttle, align the propeller control with that of the operating engine and place the mixture control forward. The magneto switches should be on. Engage the starter until the propeller windmills; then release it. After the engine starts, the propeller should be set to cruise RPM and the throttle reduced until the engine is warm. The alternator or generator should be turned on. If the engine was feathered because of fire, it should not be restarted in flight.

Once the propeller starts to windmill during unfeathering procedure, release the starter. If the engine fails to start even though the propeller is windmilling, use the check list to see if you have forgotten something. (The magneto switches? Fuel? Mixture?)

MANUAL GEAR EXTENSION

Before beginning manual gear extension, check the circuit breakers, the master switch and the generators or alternators. Make sure the instrument panel post lights are off if it is daytime. Open the emergency gear extension cover on the floor and read the instructions. The aircraft should be slowed to 100 MPH and the gear selector placed in the down position before following the instructions for gear extension. Once the gear has been extended manually, it must be left down. A mechanic should readjust the system with the airplane on jacks.

ENGINE FIRE ON GROUND

If an engine should catch fire on the ground, shut off fuel to the engine (fuel pump off, fuel selector off) but do not shut down the engine. If the engine is running, advance power to use up the fuel in the engine. If a fire breaks out when you are trying to start the engine, continue to attempt to start the engine and draw the flame into the engine induction system. The radio can be used to call for fire fighting assistance. If there is a gasoline fire on the ground, you should taxi away from it if possible. In any ground fire situation it is important to determine when the fire cannot be controlled and it is best to evacuate the aircraft.

ENGINE FIRE IN FLIGHT

If an engine fire occurs in flight, immediately shut off the fuel selector and follow feathering procedure to shut down the engine. After the fire is extinguished, land at the nearest suitable airfield. Do not restart the engine.

CABIN FIRE

A cabin fire calls for closing all vents to reduce the oxygen supply and using a hand fire extinguisher. If your aircraft has no extinguisher, this might be a good investment. Consider using breathing oxygen if the smoke is bad. When the fire is out, open the storm window and vents to evacuate the smoke.

ELECTRICAL FIRE

An electrical fire can often be detected by the characteristic smell. If you haven't experienced it, sometime when you're not in the airplane put a match to a small piece of insulated electrical wire and smell it. If an electrical fire is suspected, the important thing to do is to cut voltage to the faulty unit. Turn off the master switch and then all electrical switches, and pull all circuit breakers. Sometimes a tripped circuit breaker will give an indication of the faulty equipment. With everything off, the master switch may then be turned on and the circuit breaker and switch for each unit may be turned on, one unit at a time. When the unit which caused the fire is turned on, the smoke should begin again. The faulty equipment should then be turned off. Other items may be turned on one at a time.

ELECTRICAL MALFUNCTION (Alternator-equipped Aircraft)

An electrical problem can usually be detected by a discharge showing on the ammeter, by a zero output showing when one of the alternator test buttons is pushed, or by dimming of lights or loss of radios. Before attempting any electrical trouble-shooting, reduce the electrical load to a minimum by turning off all unnecessary electrical equipment. (If IFR you should turn off all but one navigation-communications unit and advise ATC of the problem.) The voltage regulator may then be switched from "MAIN" to "AUXILIARY" and any tripped circuit breakers reset, except the main voltage regulator circuit breaker, which should be left off if it is tripped. The electrical equipment may then be brought on again, and if the ammeter no longer shows a discharge, flight may be continued using the auxiliary voltage regulator.

If the malfunction continues, the trouble may be a tripped overvoltage relay, a faulty alternator, or both. A tripped overvoltage relay may be reset by reducing the electrical load, turning off the master switch for about six seconds and then turning it on again.

A good procedure to check for a bad alternator and at the same time to reset a tripped overvoltage relay is to reduce the electrical load and then turn off the master switch and the alternator switches. The master switch should then be turned on (after a few seconds) and one of the alternators turned on. Turn on the electrical equipment. If the system functions satisfactorily, continue flight with the electrical requirements reduced to the point that the operating alternator can handle it without a discharge showing on the ammeter. If the system continues faulty operation, repeat the above procedure, this time turning on the other alternator.

ELECTRICAL MALFUNCTION (Generator-equipped Aircraft)

In a generator system, an electrical malfunction can be recognized by a discharge showing on the ammeter, by dimming lights or loss of radio. In this event, the electrical load should be reduced until the ammeter shows zero or positive charge. The generator switches should then be turned off, one at a time, to determine which generator is inoperative. Once the faulty unit has been detected, it should be turned off and the flight continued using only enough electrical equipment to stay within the capabilities of the operating generator.

COMPLETE ELECTRICAL FAILURE

If both generators or alternators fail, the amount of current you have available from the battery for the rest of your flight depends on three things: how soon you recognized the malfunction, how promptly you shut down electrical equipment, and how well charged the battery was before the problem occurred. It is a good idea during night or instrument flight, or any time that electric current is especially important to you, to glance often at the ammeter.

If the trouble-shooting procedures given previously fail to fix a malfunctioning system, both alternators or generators should be turned off. Turn off as much equipment as possible with switches. Pull the circuit breakers for unneeded equipment having no switches. Various economies can be practiced. Turn off the instrument lights at night and use a flashlight. You may elect to land without flaps. If you do use them, make a single flap extension, going immediately to the setting you wish for landing. Use manual gear extension. Land at the nearest suitable airport.

Without power producing units, you can't expect battery power for more than a few minutes unless proper steps are taken. Even then, don't count on current for more than 15 to 20 minutes.

EMERGENCY DESCENT FROM ALTITUDE

If the oxygen supply becomes depleted at altitude, it may be necessary to make a rapid descent. (You may not have been checking the oxygen supply as you should have.) If you are in controlled airspace, notify ATC as soon as possible. Bring the throttles full back and move the propeller controls full forward. The descent will be more comfortable for passengers if the wings are rolled approximately 30 degrees to establish a shallow diving spiral rather than pushing forward on the wheel in a straight direction and giving that "stomach in the air" feeling. With cowl flaps closed, descend at 194 MPH to an altitude where you don't need oxygen.

DOOR OPEN IN FLIGHT

If a door comes open in flight the important thing, especially during take-off or climb-out, is not to let it panic you into doing anything foolish. Continue flight, keeping proper airspeed and control. You will feel heavy buffeting, and there will be much noise. By following the proper procedure one can sometimes close a door in flight. A little muscle helps, and it is easier to close the door from the left seat than the right. Slow the aircraft to less than 125 MPH, extend flaps and slow to 100 MPH. Open the storm window. Skidding may relieve pressure around the door. Push the door out slightly and slam shut. Once the door is latched, push the handle down to lock it. If you can't get the door closed you will have to land to close it. Hold about five MPH additional airspeed on final.

RUNAWAY PROPELLER

A runaway propeller is a serious matter and any tendency to overspeed should be dealt with promptly. First try to control the speed by pulling the propeller control aft. If this does not help, retard the throttle for the affected engine. Reduce aircraft speed to minimum, say 95 MPH. If you are flying at a high altitude, descend to a low altitude, where the air is more dense and will put a greater load on the propeller. If the propeller speed cannot be controlled, feather the propeller.

ASYMMETRIC FLAPS

If you are flying with flaps down and you notice a rolling tendency when you start to retract them, stop the flaps for a moment and then start them back down to where they were originally. Keep the flaps symmetrical if possible. Supplement aileron with rudder on the side of the high wing. Keep adequate airspeed.

> Constant adherence to approved flight procedures will contribute safety, good performance and peace of mind to your flying.