If, on the other hand, fuel economy is more important than getting up there just as fast as possible, then it is recommended to throttle back to a manifold-pressure/rpm combination that produces 75 percent or less. Then leaning the mixture to the maximum degree recommended by the engine manufacturer (usually 25 degrees on the rich side of peak) is sound practice. This indication is read on the EGT (exhaust gas temperature) instrument.

As with normally aspirated engines, correct leaning is much easier if an EGT is installed in the airplane. If none is available, the old guesswork method of leaning until the engine starts to run rough (or rpm starts to drop) and then enriching slightly, is all the pilot can do.

Several considerations must be remembered in planning a flight at these altitudes. The first is oxygen. At altitudes above 12,500 feet it is neither legal nor sensible to operate without supplemental oxygen.

If the aircraft, in question, is one with a factory-installed turbocharger, then it is also equipped with oxygen and the only precaution we have to take is to make sure that the tanks are full prior to takeoff. If the turbocharger was installed as a subsequent modification, then we may have to carry portable oxygen bottles with the appropriate number of masks.

Sucking on oxygen for hours at a time can be annoying. Not only do the plastic masks tend to be uncomfortable, causing perspiration to develop wherever they touch the skin, but smokers must refrain from smoking and passengers who like to talk all the time, can't (which may be a blessing for the pilot).

Still, I remember a coast-to-coast west-to-east flight in a Turbo-Centurion at FL220 in which I chalked up a ground speed of over 450 mph which made the discomfort eminently worthwhile (and made up for a lot of past headwinds).

Aside from the oxygen we must remember that all airspace above 18,000 feet is designated as positive control airspace, meaning that we must be instrument rated, must file IFR and must have an aircraft adequately equipped, including a transponder and encoding altimeter.

With the prevailing winds being virtually always out of the west or northwest it would seem that taking advantage of the altitude capabilities of the turbocharger is self-defeating on east-west flights. This is not necessarily so. Quite frequently the headwinds at 12,000 or 15,000 feet don't exceed 25 knots or so while the added TAS at 15,000, for instance, amounts to approximately 30 percent of the IAS which, in most high-performance aircraft is considerably more than 25 knots.

(An aircraft developing 150 mph IAS at sea level will, when turbocharged, develop that same 150-mph IAS at 15,000 feet, producing a TAS of 194.9 at that altitude, an increase of 44.9 mph or 39 knots, resulting, when deducting the headwind, in an increase of 14 knots or 16 mph in the groundspeed.)

Taking further into consideration that at these higher altitudes the air is usually smooth and that we are far above all minor weather systems, the advantages become even more important.

Weather looks different from up there. We find ourselves casually looking down from our three-or-four-mile-high perch at weather systems that would have caused us serious concern at a lower altitude and even some of the smaller thunderstorms appear benign when looked at from above.

What does happen with considerable frequency is that distant cloud decks obscure the actual horizon and, since their tops may be slanting, care must be taken that we don't accidentally start to slightly drop one wing in an apparent effort to fly straight and level.

In other words, using the ground or other outside references as a means to maintain the desired attitude of the aircraft turns out to be less reliable the higher we climb, and even though the visibility may be unlimited, we'd do better to fly by instruments rather than by eyeball.

Pilots new to turbocharged aircraft tend habitually to overshoot their destination, meaning that they find themselves arriving at much too high an altitude, then wasting much of the time gained en route in a lengthy descent to the destination airport. That, of course, defeats the purpose.

The sensible thing to do is to plan the descent way ahead, to figure out how long it will take to come down from our cruising altitude to the level of the pattern at the destination airport, and how many miles we'll be covering in that time.

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	non-turbo	turbo
Piper Seneca and Seneca II	3,650	13,400
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Piper Aztec E & Turbo Aztec	5,000	15,300
Cessna 310 & Turbo 310	6,680	17,550
Smith Aerostar 600 & 601	6,000	10,500

For instance, assuming that we're flying at 17,500 (eastbound) and want to land at Wichita Municipal Airport. The pattern altitude at Wichita is 2,345 feet msl, meaning that we'll have to descend 15,155 feet which, at 500 fpm, takes 30 minutes.

Assuming a ground speed of 180 mph, this means that we'll have to start our descent some 90 miles from our destination. If, on the other hand, we are concerned with fuel economy which, at today's fuel prices, is not a bad idea, we'd do a lot better to throttle back to a 200-fpm descent at no increase in speed.

Under these conditions the time to reach pattern altitude is one hour and 16 minutes. This, at 180 mph, involves a distance of 228 miles, meaning that we'd start coming down some 25 miles west of Liberal, Kan.

Another aspect of such lengthy descents is again weather related. While the weather at Wichita may be CAVU, there could be all kinds of clouds west of it and, unless we want to file IFR, we'd better plan our descent accordingly.

Certain aircraft offer an additional turbocharging advantage that is not related to cruising altitude. These aircraft are equipped with engines which permit a degree of overboosting during takeoff. This means that they permit us to safely operate with manifold pressures of 33 or more inches.

This, in turn, increases takeoff power, conversely reducing the necessary ground run. While this is of no consequence to those of us normally operating into and out of sizeable airports, it does become important if much flying is done, using very short fields.

Nothing comes for free, and that goes double for turbocharging. Not only are turbocharged aircraft more expensive to buy than normally aspirated ones (the difference is approximately $5,000), they also have somewhat lower TBOs (time between overhaul), and mechanics charge more for major overhauls.

In addition, the ability to develop a high percent of power at altitude is available only if we are willing to pour enough fuel through the engine to take advantage of it.

Granted, turbocharged aircraft can be operated with the same degree of fuel economy as can normally aspirated ones but, at all but extremely high altitudes, this defeats the purpose of the turbocharger.

For those aircraft owners who are considering installing a turbocharger on a retrofit basis, Rajay Industries, Inc. (a subsidiary of Texstar Corporation, P.O. Box 207, Long Beach, Calif. 90801 or 2602 East Wardlow Road, Long Beach Airport; Phone (213) 426-0346 is the only company producing turbocharging kits.

According to Jack Linard of Rajay, most single-engine kits cost approximately $4,000 to $5,000. Twin-engine kits run from $5,000 to $10,000 in total.

These figures do not include the cost of an oxygen system (portable or other) that becomes an added necessity. All STCs (supplementary type certificates) costs are included in the factory prices.

In trying to decide whether or not to opt for the additional cost the following considerations should become the determining factors:

Average stage length. If the average lengths of your trips exceed 300 miles and if a sufficient number of such trips is flown each year, then a turbocharger may be worth its cost.

Mountain flying. If much of your travel is in the Rocky Mountain area, then a turbocharger is worth its cost even if the average trip is less than 300 miles long.

Short fields. If much of your flying involves takeoffs from short fields (landings are less of a problem since aircraft are usually lighter when landing than at takeoff) a turbocharged aircraft that permits a degree of overboosting is a distinct advantage.

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USE CAUTION IN FORMATION FLYING

By DON DWIGGINS

NOT LONG AGO I scheduled a photographic flight to shoot some closeup air-to-air pictures of a sharp Piper PA-18 Super Cub. The day was clear, weather calm, sun at a lovely low angle, everything in order. Almost.

"Have you flown formation before?" I asked the pilot, a routine question. I want to know how much experience an airman has had in this tricky business, before such a mission.

"Yeah, lots of times," he replied with a jaunty shrug, that should have told me something. Whenever I see a pilot making like Spencer Tracy or Clark Gable, I get the feeling he's maybe putting me on.

This time, daylight was running out, and I needed the photos the next day, so off we went into the wild blue yonder, radios tuned to 123.4 megs.

I already had briefed the Super Cub pilot on what I wanted — I would be shooting from the left window of my Cessna 170, backwards at about 45 degrees, and also forward at the same angle, to miss the wing struts.

"Just get on my left wing and hang in there, about two wingspans out and back far enough, so that you can see the camera," I told him. "Then I'll lead you through some one-needle width turns to the left, to get different sun angles with the ground for background."

Simple enough. Until we reached 3,000 feet, our mission altitude, and leveled out. "Okay, let's turn," I called, gently dropping my left wing.

The Super Cub suddenly banked over too steeply, and went shooting off, as I

Pilot Joe Geiger slides his Mooney Executive up tight to author Don Dwiggins' Cessna 170 for a photo session.

tried to follow him. Then, just as suddenly, he banked right, and came zapping toward me. I pulled up to avoid a midair, just as he shot past.

I knew instantly this was no formation pilot; he'd broken one of the basic rules of formation flight — *always hold the same bank as your leader.* This way, the wing ship remains in the same turn radius as the lead ship, because rate of turn is proportional to degree of bank.

I finished off the flight by telling him to hold a straight and level course into the sun, and I would maneuver the camera ship where I wanted it. I was able to slide ahead and shoot back, with the sun full on the nose cowling, turning the propeller into a beautiful disc and lighting up the pilot, until he began to overrun. I broke off in disgust and returned to the field.

The Super Cub pilot had broken another fundamental rule of formation flying — *make quick power changes as necessary to hold position.* There's a lot of lead and lag in holding position, due to the inertia of the aircraft. To close in, use a burst of extra power, until inertia is overcome and the gap starts to narrow, then reduce power sharply to avoid overrun. When things look right, settle down.

Preflight discussion of exactly what you intend to accomplish is essential to a good formation flight, with complete understanding by all parties involved as to what voice or hand signals will be used, and what maneuvers will be flown.

Military training is very precise in this regard, and a lesson can be learned by referring to USAF Regulation 60-15 (Standard Formation Signals for Daytime Communication): *Use visual signals for daytime communication wherever possible.* Pilots in formation will relay visual signals; the leader must allow enough time for the relay of each signal after it is given. Typical USAF signals are:

- START ENGINE: Extend arm overhead and make a circular motion with the hand.
- RUNUP ENGINE FOR TAKEOFF: Make a circular motion with vertically extended index finger.
- READY FOR TAKEOFF: After runup, leader looks at wingman. Wingman nods yes or no as appropriate.
- START TAKEOFF ROLL: Leader places head back toward head rest. Leader nods for brake release.
- GEAR UP: Make an upward motion with closed fist, thumb extended upward. Wingman nods head.
- GEAR DOWN: Make a downward motion with a closed fist, thumb extended downward. Wingman nods head.
- LEVEL OFF: Make a horizontal motion with the open hand, palm down.
- FLAPS UP OR DOWN: Hand flat fingers forward, downward motion of hand from wrist to lower flaps — reverse motion to raise flaps.

Preparation for any formation flight also covers hand signals to be used when assuming different formation positions, and these may vary from service to service. In general, extending the left arm outward, fist clenched, raising and lowering arm at elbow is a signal either for a left turn, or for assuming a left echelon formation, with the right arm used similarly for right turns or echelons.

I have found that simple hand movements work better than radio calls in requesting a wingman to move in or out (similar to a lineboy's hand parking signals), but any special position or attitude changes should be ordered by voice as well as by visual signals.

"Dwig" won't let just anybody fly formation with him. He will formate with experienced pilots like Giff Hamilton who is flying this Tiger.

Thus, by prearrangement, I frequently instruct a pilot on a photo mission to "rock your wings" while holding position, either in straight-and-level flight or in a gentle turn, in order to expose both top and bottom wings to the camera. The result gives the photographer more opportunity to shoot simulated "peeloffs" and "intercepts."

A more difficult formation maneuver is sometimes used to achieve a head-on shot of the wingman's ship — by prearrangement, call for him to "SKID LEFT!" if he is flying the left echelon position. Position him at least two wingspans out for safety

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took to get to your airport. It's smart to make use of every resource when preparing for a flight, including pilots' reports and civilian weather reports. But don't neglect your prime resource, the flight service station.

Recent proposals by the FAA call for the elimination of most flight plans. Under the new proposal flight plans would be filed only for flights over mountains, lakes, swamps, and for air taxi and flights outside the U.S. The flight plan has never been mandatory. It has always been just an extra bit of insurance that the private flier could count on. If he didn't reach his destination on time, someone would start looking for him. And they would have some idea of where to start looking.

The private pilot today often counts on his required Emergency Locator Transmitter, or ELT, to take over much of the function of the flight plan. He may not realize that the ELT system, too, has shortcomings. It takes only about an extra minute to file a flight plan. It makes sense to use it as extra insurance whenever possible. As long as you can file a plan, continue to do so. Should the plans be eliminated for most flights, continue to file your flight plan for those flights on which you can file.

Have your flight plan ready *before* you make your initial call to the FSS. If, after hearing the weather reports, you decide that you can make your flight safely, you can go right on with your flight plan. Flight service stations prefer to take flight plans in person or over the phone, leaving more radio frequencies available to the airborne pilot who needs FSS information. You can file flight plans in flight by radio when necessary. However, your accompanying weather briefing can be more complete if given while the pilot is still on the ground.

It's better for the pilot to file on the ground, too, because the first moments of any flight are pretty well occupied with takeoff, watching for traffic or following air traffic control instructions, and getting the navigation started. Instead, file your flight plan on the ground and make one brief call to FSS after takeoff to activate that plan. If you're not sure how to activate it in the air, ask the FSS how you should reach them at the time you file over the phone. Sectional charts give this information above the heavy line FSS box. Frequencies 122.2, 243.0 and 255.4 are normally available at all FSSs and any additional frequencies are given above the box.

If you are out of range of the available FSS frequencies, the blue VOR and VOR-TAC boxes also give frequencies you can use to contact the FSS through the nearer omni facility. For example, departing from

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FORMATION FLYING (from page 49)

sake, and when he kicks hard right rudder, his aircraft will skid away to the left, as the nose yaws right, toward the camera. Left aileron must be used simultaneously by the wingman, to prevent the sudden yaw from inducing a right bank and the danger of collision (due to different banks of the two aircraft).

I had the extreme pleasure of formation flying with an exceptionally skilled pilot, Joe Geiger, president of Performance Aircraft, Inc., to get head-on shots of a 1975 Mooney Executive. The result was startling, looking right into the Mooney's spinner from a few feet away, in complete safety.

It was similarly satisfying to fly formation with a former Navy pilot, Giff Hamilton, an FBO at Van Nuys Airport in California, who positioned a Grumman American Tiger so precisely on my left wing we could have slapped wingtips. Later, Giff made a few quarter-stern intercept passes (by prearrangement on radio) to amuse his passengers, and I felt no qualms at all when he shot past my nose on recovery pullups.

The need for precision in formation flying is quite obvious, witness the tragedy last summer when four Spanish Air Force Saeta jets collied during a practice session over San Javier Air Force Academy, killing five officers. In 1963 a similar tragedy took five lives when three French twin-engine bombers collided at 7,000 feet over Bordeaux during a formation flight, and the year before that four West German Air Force pilots died when their fighter craft collided while formating.

The FAA is tough on pilots who like to play games, chasing other airplanes around the sky without preflight formation safeguards being mutually discussed. Under FAR 91.65 we read:

(a) No person may operate an aircraft so close to another aircraft as to create a collision hazard.

(b) No person may operate an aircraft in formation flight except by arrangement with the pilot in command of each aircraft in the formation.

(c) No person may operate an aircraft, carrying passengers for hire, in formation flight.

In the good old days of the barnstormers, no air show was complete without at least one formation flight, usually with a couple of wing riders perched atop a Jenny's wing, waiting for the second ship to swoop down and pick them off.

But barnstormers were a hardy breed of skilled daredevils, who carefully rehearsed their acts over and over, so many times they could do them with their eyes shut, and sometimes did. They lived a hard and fast life, with one basic philosophy — you make a mistake only once.

So whenever you get the urge to make a formation flight out to Deer Park or someplace with your old buddy, think twice before you try it. Get some dual from an experienced CFI first, and then go enjoy a new sensation in flying! •

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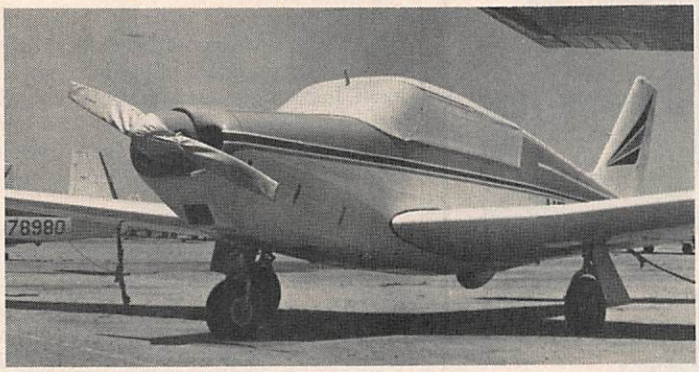

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