

CASUAL FORMATION FLYING

IT'S A CONTRADICTION IN TERMS....

Van

Often, when we think of formation flying, we envision something on the order of the Blue Angels or Thunderbirds, or at least non-aerobatic precision formation groups such as the RV Blackjack Squadron. However, there are other, less spectacular, forms of formation flying in which the everyday RV pilot is more likely to participate. We often fly "loose formation" on short X-C flights enroute to that \$75 hamburger, or in closely spaced fly-in traffic patterns. While there is no argument that the skills needed for the precision airshow formation examples above are greater, it is very important that any pilot who participates in any level of formal or informal formation flying knows some basic formation principles and have some practiced skills.

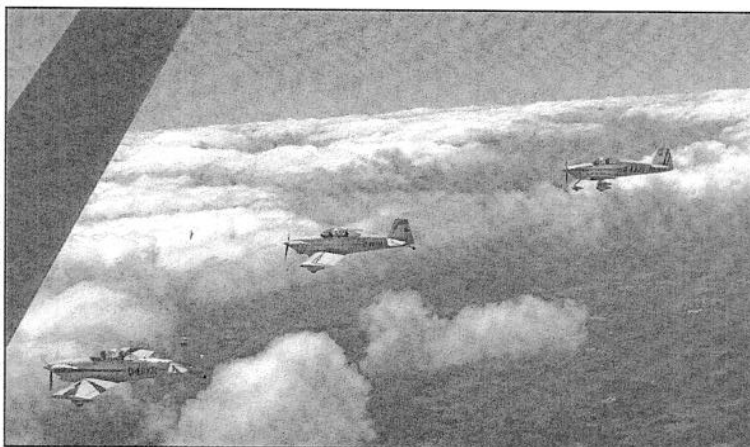
An operative word essential to formation flight is "relative". "Relative" can pertain to position as well as speed and direction. What is your position relative to other aircraft? What is your speed relative to the other aircraft? What is your flight vector (heading) relative to the other aircraft?

If you are in stable formation with another aircraft, you have no relative motion even though you may be traveling forward several miles per minute. If you are very close to the other aircraft, a slight change in relative motion can result in contact or greater separation, depending on the vector of the relative motion. If your position on the X, Y, or Z axis is changing in relation to the other aircraft, then you have relative motion which needs to be managed.

When close to another airplane, relative motion is immediately evident. When your aircraft is some distance away from another airplane, such as overtaking from behind, relative motion is difficult to perceive---usually it seems that you are not gaining very fast. However, as you draw nearer to the lead aircraft, relative motion (overtake) becomes very evident and it is very easy to overrun your target, even when at the last moment, you have completely idled your throttle. This sort of thing almost has to be experienced to be believed. While in formation flying there are some similarities with driving on a multi-lane highway (which we have all experienced), there are also many subtle differences. For instance, air is softer than pavement, and airplanes don't have brakes like automobiles do. Despite our mastery of formation driving, we need to learn a new set of skills for formation flying, and the only way to

learn is through study, training, and experience.

One of the first things we learn is that small control inputs cause large amounts of relative motion --precise flying is a pre-requisite for successful formation flying. The other surprise pilot get is that of relative speed management. It takes a lot of added or reduced power to pull ahead of or drop behind the other airplane. This is because of the mass and inertia of the airplane. On the other hand, vertical and lateral relative motion happens quickly. Movement up and down, or right or left, is produced by changing the



A well-briefed gaggle of German RVs heading out in "casual" formation.

angle of attack, of lift, of the wing. Since the airplane has more lift than thrust, movement can be quicker and of greater magnitude. Sideways movement is produced by banking and redirecting a portion of the wing's lift to the right or left, thus yielding rapid movement.

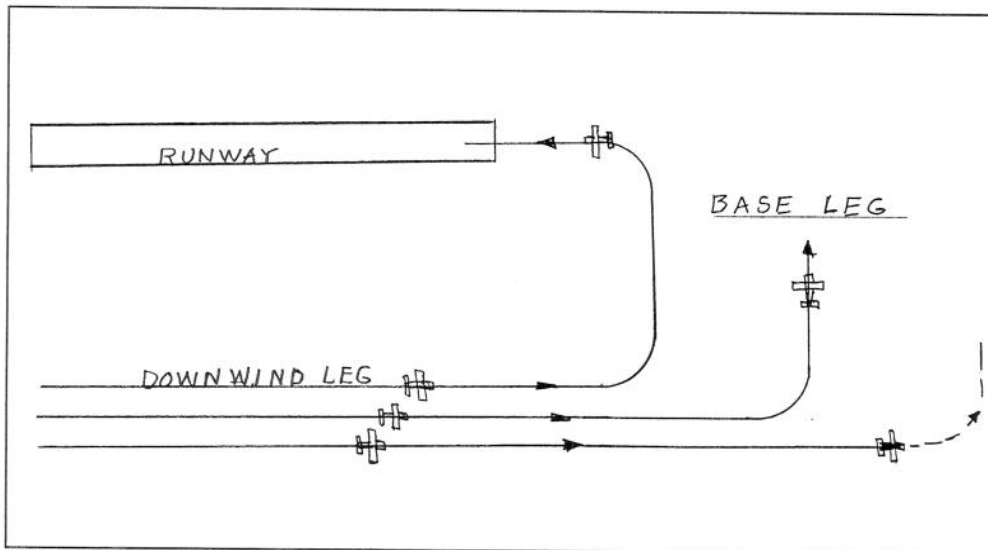
While it is not my intention that this article be a tutorial on formation flying, the following is an example of a real world "casual formation" circumstance, which if not handled properly, could increase flight risks.

Example: You are flying in loose formation with one or more other aircraft approaching the destination airport and want to establish spacing for landing. As you throttle back to lag behind the lead aircraft, you notice that it takes longer to "drop back" than anticipated, particularly if there are more than two aircraft. Each additional aircraft adds another increment of spacing or deceleration required.

In attempting to increase spacing, you slow too much and risk loss of control through a stall. If you slow too much and then try "S" turning to increase spacing, you further risk an accelerated stall. When you are concentrating on the space between you and another aircraft, you can easily overlook your speed management.

Try this suggested procedure:

Begin the process of establishing spacing several miles (yes, several miles) before entering the airport



This procedure involves flying a fingertip formation and accomplishing the separation spacing while making the downwind-to-base leg turn. By staggering the timing of this turn, separation can be safely and accurately achieved. All of the participating airplanes maintain the same speed; some simply fly a longer pattern, thus arrive later at the landing point. This is a good principle to remember when you find yourself in an unplanned "close spacing" pattern situation. Rather than trying too hard to slow too much for the airplane close ahead, simply fly a longer downwind after the "slowpoke in front" turns his base leg. Then you can maintain a safe pattern speed and provide safe spacing for landing. This is the same basic principle being applied when the control tower advises "extend your downwind" to increase spacing.

traffic pattern. If you are flying at 150 mph, it takes only a minute to fly 2 1/2 miles. If you slowed instantly to 20 mph below the lead aircraft, in the process of flying that distance and time, you will separate 1760 ft. That is about half the length of a typical 3500 ft. runway. The lead aircraft would not even have time to pull off at mid-field before #2 aircraft lands. In reality, you cannot slow instantly by 20 mph, so the separation distance would be less than this. Two and half miles is not far enough... you need to plan ahead even further to provide separation for landing.

For a worst case scenario, consider a formation of two or more aircraft entering a traffic pattern at a speed of 150 mph or more. Assume that the lead aircraft is equipped with a constant speed prop and a following aircraft is equipped with a fixed pitch prop. The lead aircraft closes his throttle abruptly, the prop flattens to flat pitch and the airplane and slows rapidly. The pilot of the following aircraft with the fixed pitch prop doesn't have big brake on the nose and cannot slow as quickly, and, even with his throttle fully closed, can over-run the leader. (If you haven't experienced the difference in relative deceleration in otherwise identical airplanes equipped with different props, be prepared for a big eye-opener....ed.) This in itself is not catastrophic, but creates a situation that can lead to confusion and can compound mistakes. Especially on landing approach, which is the most critical phase of the flight, you can't afford any unnecessary distractions.

Some things which can go wrong:

1. Passing the lead and then slowing excessively (stall?) in an attempt to let the lead get ahead again.
2. Slowing excessively to permit greater separation behind the lead.
3. Turning (downwind to base, base to final) while flying too slow and being distracted through

watching the lead aircraft.

4. Overlooking landing checklist items because of the distraction of leading and following aircraft.
5. Etc.

I think that it should by now be evident that even the most basic forms of formation flying involve more possible complications than solo flying. Thus, safe and successful formation flying requires training, skill, and planning. Planning is the operative word here. In the traffic pattern approach example above, planning would have caused the formation participants to be aware of the deceleration qualities of their respective airplanes. The lead pilot would have instructed the trailing aircraft to begin separation earlier, and lead would have then decelerated cautiously to avoid being overtaken. Or, the formation may have planned to accomplish an orderly separation spacing by using a technique as shown in the illustration above. Regardless, it should be apparent by now that some level of training is desired for even the most elementary forms of formation flight.

When entering a busy traffic pattern, a pilot may find himself in a proximity situation which can only be called "formation flight" because of the relativity of other aircraft. In this less-than-ideal situation, neither pilot had anticipated this informal formation flying. Thus, it is important that all pilots have some knowledge of "relative" flying so that they can apply safe practices without the benefit of preparation.

To repeat my introductory remark, this piece was not intended to inspire all readers to devote themselves to becoming "demonstration team" quality formation pilots. Rather, it was to illustrate that even the most elementary form of formation flying needs to be taken very seriously. I believe that it's fair to say that, in formation flying as with most other challenging ventures, the best rule is

"Either do it right, or don't do it at all!"