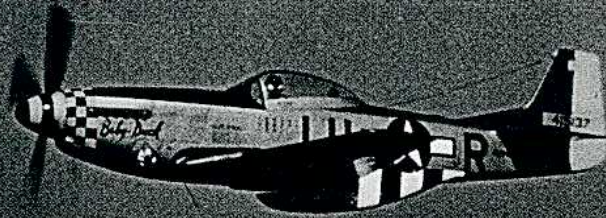
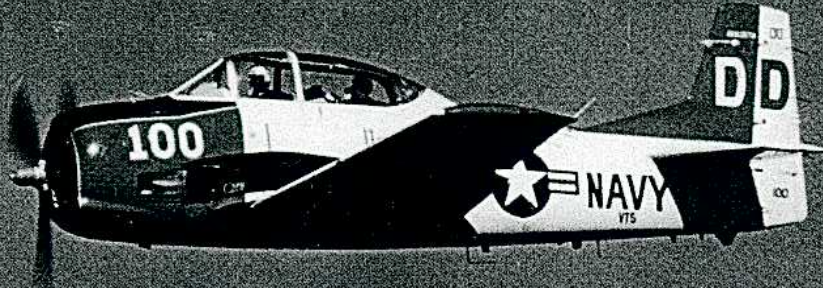
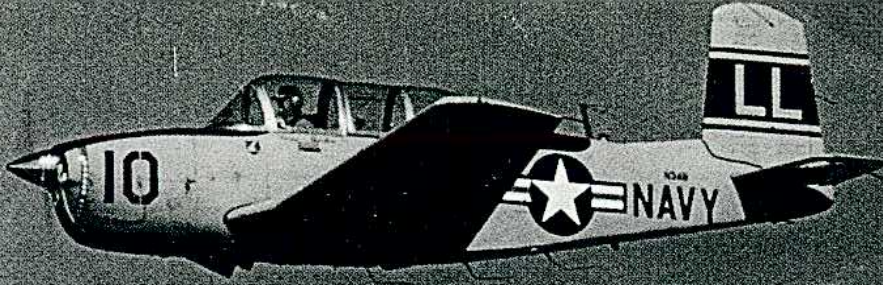




**NEW 4th EDITION**  
now includes T-6, T-28 & P-51



# **FORMATION FLIGHT MANUAL**

*4th edition*



## CREDITS AND ACKNOWLEDGMENTS

The T-34 Association, Inc. acknowledges and greatly appreciates the combined efforts of Bob Farrell, Lou Drendel, Ken Williamson, John Harrison, Bill Cherwin, John Ellis, and Jim Nogle in the writing and production of this manual.

Excerpts from:

*Every Man a Tiger*

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*Formation Flying for Light Plane Pilots*

by M. J. Doyle

1st Composite Pursuit Squadron

Illustrations and Introduction by Lou Drendel.

Layout and production by Jim Nogle.

**Front Cover:** *Formation Flight* has been adopted as the standard reference by the T-34 Association, Inc., E.A.A. Warbirds of America, North American Trainer Association, and the Valiant Air Command. The diversity of types operated in formation flights is evident in this photo of an echelon led by Gene Martin's Mentor, with Dick Dieter's Trojan, Jeff Ethell's Mustang and, Marion Gregory's Texan. (Photo by Rick Gretz)

**Rear Cover:** The Lima Lima flight, from Naperville, Illinois has developed a precision formation routine which they perform at airshows throughout the midwest. This formation was led by Lou Drendel, with Frank Fastner, Ted Adams, George Kubal, Bob Morse, and Gene Martin on the wing. (Photo by Rick Gretz from photo plane piloted by Jim Nogle over Lake Winnebago at Oshkosh '88.)

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## NOTICE

This manual is published by the T-34 Association, Inc. in order to promote safety through standardization in formation flying. The use of the procedures and signals described in this manual is entirely at the option and discretion of the formation's pilots and any such use should be fully briefed before each flight. The T-34 Association, Inc. and the members who helped write and publish this manual do not assume any liability for the use or failure to use any or all of the same.

*The following organizations have adopted Formation Flight as their official formation manual:*

*T-34 Association  
Warbirds of America  
Valiant Air Command  
North American Trainer Association, Inc.  
Confederate Air Force  
Formation And Safety Training  
Canadian Warplane Heritage*

# FORMATION FLIGHT MANUAL

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4th edition - (now includes T-6, T-28, & P-51)  
illustrated by Lou Drendel  
published by the T-34 Association, Inc.

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## INTRODUCTION

This is the 4th Edition of FORMATION FLIGHT, originally published in 1984. Our intention then was to provide a level of standardization which would ensure safety and make the job of putting up big formations at Oshkosh possible in the short time allocated. The fact that this manual is being updated for the fourth time is evidence that we succeeded. In fact, formation flying has become the most popular warbird flying activity.

FORMATION FLIGHT has been adopted as the standard reference for civilian formation flying nationally, and for the first time, FORMATION FLIGHT contains information about formation flying techniques specific to other warbird types. The diversity of these types demonstrates that the basic principles contained herein are applicable to all formation flying. These basic principles remove the mystery of formation flying, and provide the foundation for **safe** formation.

Make no mistake about it, formation flying can be dangerous if you don't have a good understanding of the basic principles. Operating in close proximity to another airplane is not like driving next to another car on the turnpike! FORMATION FLIGHT will give you the foundation to build upon, but if you are a formation neophyte, make sure you spend some time with a competent and qualified formation instructor before you try it solo.

## GLOSSARY OF TERMS

The language of formation flying is unique and possibly even arcane. Without a working knowledge of the terms, you will not be able to function in the flight, and will be forced to admit to your ignorance in pre- and post-flight briefings. On the other hand, diligent study of the following terms will allow you to understand what is being said.

**FORMATION:** A disciplined flight of two or more aircraft under the command of a flight leader, using a standardized set of signals and commands to direct the wingmen. Not to be confused with a **GAGGLE** of aircraft.

**GAGGLE:** An undisciplined group of aircraft, milling about in roughly the same piece of sky, sometimes attempting to impersonate a **FORMATION**. (Also see the FAA definition of a formation in the section dealing with basic formation training.)

**SECTION OR ELEMENT:** A flight of two aircraft. The section is the basic fighting element and is self-supporting, covering each other's six o'clock in combat (real or otherwise), and providing back-up on routine flights with radio or equipment malfunctions in addition to moral support and good company.

**DIVISION OR FLIGHT:** Four aircraft, consisting of two sections or elements, each with its own leader, but under the command of the lead element's leader, who is designated "flight lead". The flight is usually led by the most experienced pilot, with the second element leader as his deputy flight lead.

**SUCKED:** To fall behind the lead, or be too far out on the position bearing to be able to join up with available engine power.

**ACUTE:** The opposite of "sucked". To be in a position too far

forward in the formation or on a bearing (angle) that would place the aircraft too far forward during rendezvous, creating an uncomfortable closure rate and angle for the joining aircraft; vis., an "acute" rendezvous bearing as compared to a "sucked" rendezvous bearing.

**NOSE TO TAIL OVERLAP:** As viewed from above, the nose of the #2 aircraft is farther forward than the tail of the #1. Naturally, as long as there is lateral separation between aircraft, no danger exists.

**WINGTIP OVERLAP:** No lateral separation exists. A time to be smooth and concentrate if you also have nose to tail overlap.

**STEP DOWN:** The #2 aircraft is a couple of feet or more lower than the lead. This allows room to maneuver in case of turns into the wingman.

**STEP UP:** What the thinking wingman does when the leader is making low passes down the runway!

**BEARING:** The horizontal angle off the lead as flown by the #2 aircraft. (If the wingman were to overrun his leader and fly too far forward of a proper position, he would be on an "acute" bearing. If he is too far aft of his proper position, he is on a "sucked" bearing. Not to be confused with gentlemanly conduct, or officer-like "bearing".)

**RENDEZVOUS:** To join the flight onto the leader, as after takeoff. Also a gathering of pilots after a mission, wherein there may be a lot of rowdiness, drinking, and ungentlemanly bearing.

**THE BREAK:** The breakup of the formation over the runway when a flight does a 360 overhead entry into the traffic pattern. Also called "pitchout". A Fighter maneuver indicating an abrupt



bank and yank to accomplish a change of direction and/or altitude. It looks Sierra Hotel!

**SIERRA HOTEL:** Phonetic equivalent of "shit hot", used to designate anything which is outstanding, and deserving of the praise of fighter pilots.

**KISSOFF:** Signal passed by lead to the rest of the flight just before he slams the stick over to break, symbolically "kissing them off" as the flight breaks into individual aircraft for landing.

**"GIMME ONE" "GIMME SOME":** What the wingman calls to the lead when he has insufficient power to keep up, asking for lead to reduce power by one inch or more of manifold pressure.

**CALL SIGN:** The code word or words that designate a flight, usually selected by the flight leader for that particular mission. The flight then would be designated (In the case of a call sign of "Red Flight") as; "Red Lead", "Red Two", "Red Three", and "Red Four". In the case of large formations divided into flights, the flights might be divided as follows; Red, Blue, Yellow, etc. Or, Alpha, Bravo, etc. Any combination of names can be used, depending upon the imagination and audacity of the flight leader.

**BINGO FUEL:** The fuel state at which the flight must return to base. A predetermined fuel figure remaining in gallons, pounds, or minutes which will allow safe return to base plus sufficient overhead reserve. When the wingman signals bingo fuel, the leader acknowledges and heads for base.

**PARADE:** Formation configuration to be used when under observation by the public, as in an airshow appearance. Parade formation is demanding, since the aircraft are in close physical proximity to each other. It requires absolute concentration on the part of the wingmen, and smooth leadership by the flight lead.

**ENROUTE:** A much looser version of the above, applied to any formation during cross-country flight. It allows the leader to control the flight, and reduces fatigue on the wingmen. Wingmen maintain the same relative bearing on the leader, but move out to allow nose to tail and wingtip separation.

**SMASH:** Airspeed or Energy. Normally used to denote energy available to accomplish a snappy fighter-type maneuver, such as a pitchup to landing.

**INITIAL:** As in initial approach. Refers to the approach on runway heading used when doing a 360 overhead break. The leader will call his position on initial, as; "300 Sierra Hotel, flight of four T-34s on a two mile initial for a 360 overhead on runway 18."

**GIB:** Guy In Back, meaning your backseater.

**TALLY HO:** Used to indicate that you have visually acquired whatever it is you were looking for.

**NO JOY:** Used to indicate that you have not visually acquired whatever it is you are looking for.

**HUMMER:** Any neat gadget you can't remember the name for, or which you think has been saddled with too mundane a name to use.

**SLUGGER:** The other general aviation airplanes, which do not participate in formation or other fun fighter pilot-type activities. Also known as "Spam Cans".

# FORMATION BASIC TRAINING

## FORMATION DISCIPLINE

Discipline as it is related to formation flying arises by necessity out of the very nature of the activity. Webster defines discipline as: "1. Training that is expected to produce a specified character or pattern of behavior, especially that which is expected to produce moral or mental improvement. 2. Controlled behavior resulting from such training. 3. A state of order based upon submission to rules and authority."

The concept of discipline in the conduct of formation flying requires a significant attitudinal adjustment. You have to buy into the program 100% if you expect to succeed, and that can be the toughest part of learning to fly formation. Our fundamental perspectives as pilots must shift from the self-reliant individualistic orientation of single aircraft operation to a realization and acceptance of our roles in a collective effort. Each member of the flight must fly his position properly, and if he does this, confidence will suffuse the entire formation. That extends from the leader to the wingmen.....all of them. It covers the entire flight, from start-up, radio check-in, taxi, takeoff, maneuvering, arrival, and shut-down. A formation that performs in concert is a thrill to participate in, but a formation that lacks discipline will degenerate into an uncoordinated, haphazard, and dangerous gaggle of aircraft which may or may not be going the same way, on the same day.

The following basic formation training procedures and techniques will start you on the road to the Wingman Patch. As an aspiring wingman, you must first accept the authority of your leader, promptly responding to his hand signals and maintaining the proper position within the formation. Acceptance of this most basic of formation tenets is the first step towards the Wingman Patch.

## BASIC CONCEPTS

We define a formation as two or more aircraft flying in close proximity with all movements coordinated. The smallest formation unit is a section or element (we consider the two terms synonymous.) of two aircraft, comprised of leader and wingman. The next basic formation unit is a division, which is made up of two elements or sections. These are basic military tactical units, created for the sole purpose of providing mutual protection in air-to-air combat. Our manual is based upon these units, but not because we expect to have to shoot down marauding Cessnas. We stick to the basic military formation because the rules provide the greatest flexibility when increasing the size of a formation. As you read further in the manual, you will note that the largest formation shown is the four-ship division. However, the resounding success of our large Oshkosh formations (up to 34 T-34s) is testimony to the validity of our basic procedures.

As a point of interest, the FAA defines formation flight as follows: "FORMATION FLIGHT-More than one aircraft which, by prior arrangement between the pilots, operate as a single aircraft with regard to navigation and position reporting. Separation between aircraft within the formation is the responsibility of the flight leader and the pilots of the other aircraft in the flight. This includes transition periods when aircraft within the formation are maneuvering to attain separation from each other to effect individual control and during join-up and breakaway.

1. A standard formation is one in which a proximity of no more than 1 mile laterally or longitudinally and within 100 feet vertically from the flight leader is maintained by each wingman.
2. Nonstandard formations are those operating under any of the following conditions:



- a. When the flight leader has requested and ATC has approved other than standard formation dimensions.
- b. When operating within an authorized altitude reservation (ALTRV) or under the provisions of a Letter of Agreement.
- c. When the operations are conducted in airspace specifically designed for a special activity. (See Altitude Reservation) (Refer to FAR Part 91)

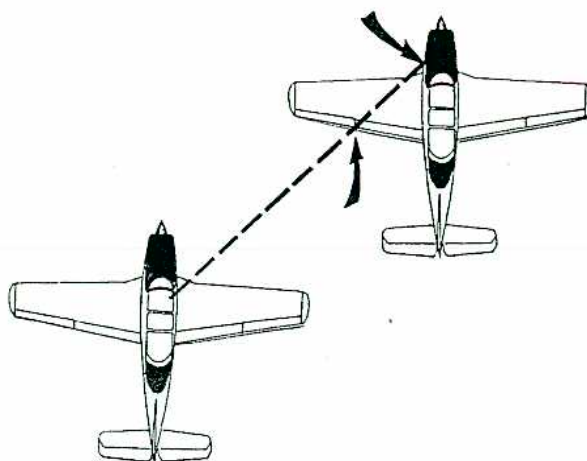
## GENERAL RECOMMENDATIONS

Notwithstanding the T-34 Association disclaimer contained elsewhere in this manual, there are some general rules that should be followed prior to starting your training.

1. You should have at least a Private Pilot License.
2. You should have a qualified instructor. (The T-34 Association and the North American Trainer Association designate check pilots who may be available for instructional purposes.)
3. You should always wear a parachute and be thoroughly briefed on it's use.
4. You should be psychologically prepared to use the parachute if it becomes necessary.
5. You should wear appropriate flight gear, to include helmet, flight suit, and gloves.
6. All formation flights must be briefed prior to takeoff.

## STATION KEEPING

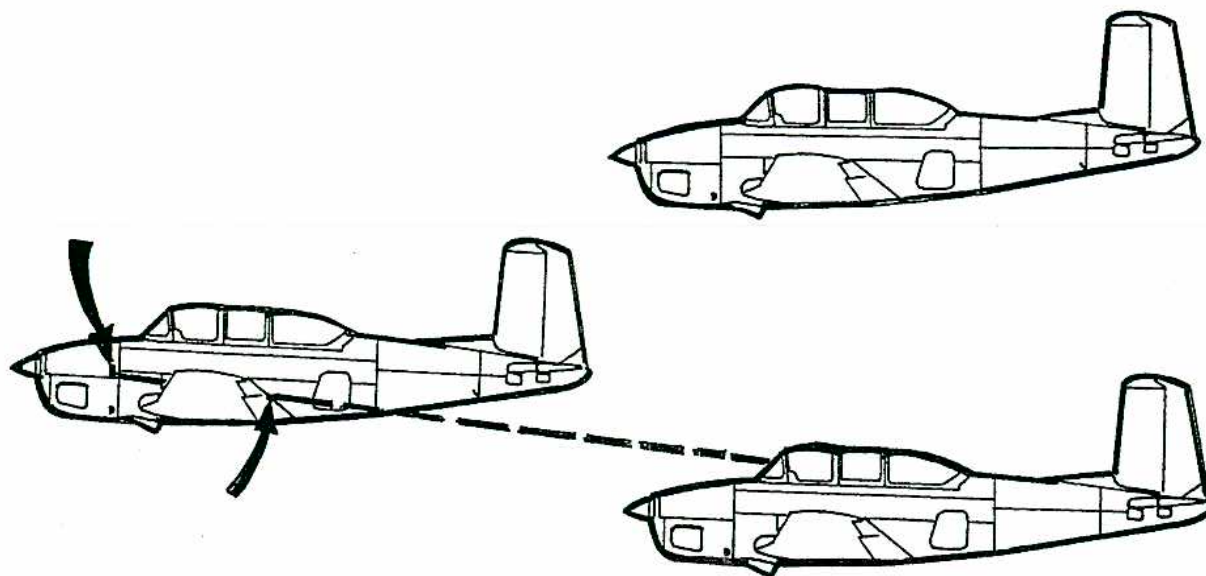
When you began flying, there was a heavy emphasis on the physical skills required to control the aircraft. You were now dealing with another dimension, which required a new awareness on your part. Landings were particularly difficult, since they required you to fine-tune your sense of depth perception. Once you had mastered this phase of your flight training, the emphasis



*Sight line of wingman passes through aileron-flap junction at trailing edge of wing to last cowl latch on the T-34.*

shifted to "head work", and the more you advanced, the more emphasis was placed on numbers. FAR's, aircraft performance figures, navigation, weather, and defining personal limits became the most important elements of flying. The actual control of the airplane was relegated to the status of riding a bicycle.....once you know how, you never forget.

Formation flying is going to take you back to basics. Your sense of depth perception is more important than ever because *in formation flying, relative motion is everything*. Station keeping....maintaining position on the leader.....is control of the relative motion between your airplanes. To maintain your position, the motion must be stopped. To maneuver safely in relation to another aircraft, the direction and rate of the motion is controlled. The leader is considered to be fixed, and any movement between aircraft is movement of the wingman. Relative motion will involve movement around any one (or more) of three axes, up, down, or sideways. Fore and aft motion is controlled by



*Nose to tail separation should be maintained. Normal step-down and step-up positions are shown.*

use of the throttle, while vertical displacement is controlled by the elevator. Horizontal motion is controlled by coordinated use of aileron and rudder (mostly rudder). Movement of any of these controls will affect station keeping, and a new awareness of aerodynamic principles is bound to result once you become attuned to station keeping.

Smoothness is a most desirable characteristic in both leaders and wingmen. This is usually developed with time and experience. Eventually, practice will enable you to sense and stop the slightest relative motion between your airplane and that of the leader. Your control movements will be so minimal that a passenger in your airplane may not even realize how you are maintaining such perfect position! But in order to get to that plateau, you will have to master the finer points of formation

flying, beginning with:

1. Relax. Tension causes over-controlling, which will result in an oscillation that is increasingly difficult to stop.
2. Strive to make small, timely corrections. Slight relative motions are hard to recognize, but easy to manage. The greater the relative motion, the more difficult it is to stabilize. Relative motion can be recognized if you are concentrating on two points on the lead aircraft. When flying on a T-34, we suggest you line up the flap-aileron junction with the last cowl latch. If these two points begin to diverge, do something to stop their motion. (If the cowl latch disappears, you are going low. If it moves forward, you are getting sucked. If it moves back, you are acute.) Other types will have different refer-



ence points, but it is imperative that you establish two reference points on the target aircraft so that you can sense and correct relative motion quickly.

3. Trim the airplane. There are two schools of thought on this, and either one may work for you. Try them both, then make your own decision.

A. In rough air, it is sometimes better to trim the airplane a little nose-down, so that you are holding some tension against the stick. In theory, this will damp out unnecessary control inputs. (It is worth noting that the Blue Angels have adopted this practice, and they use A LOT of nose-down trim.)

B. In smooth air, trim the airplane for one G flight, rest your arm on your leg, and relax. Your control movements will smooth out, and formation flying will become easier.

(Note that either of the above can be tried in smooth or rough air. What works for some may not work for others. The important thing is to strive to damp out excessive control inputs which lead to uncontrollable oscillations.)

4. Adjust your throttle quadrant friction knob so that you can move the throttle easily, but with enough resistance to allow you to sense movement. Keep your hand low on the throttle lever, heel of hand on the quadrant.

## FORMATION EXERCISES

The 45 degree off position, as defined above, is the standard wingman position in the T-34 Association. This position, with the appropriate visual references, should be demonstrated to the student formation pilot by his instructor. Other variations on this position which can be demonstrated include:

1. Stack up on the lead airplane.

2. Level with lead

(Note that neither one of these positions is ever assumed by the slot man in the diamond formation, and the level position should only be demonstrated as visual reference, but never flown as a standard position.)

Once the student has established himself in position, he should practice moving out and in on the imaginary 45 degree line that runs from his airplane to that of the leader. This exercise will demonstrate the importance of coordinated use of all controls. If this maneuver is properly executed, the relative positions of the two aircraft do not change, only the distance between them varies. This exercise should be practiced until the student is able to recognize separation and closure rates between the aircraft and stabilize them. Common errors to guard against include excessive throttle movement, which causes exaggerated fore and aft movements and target fixation, which blinds the student to closure or separation rates. Large pitch changes should also be avoided, though they tend to be much more dramatic and are easily and quickly recognized. If at all possible, the instructor should demonstrate these errors to the student, along with the appropriate corrective measures.

Radius of turn is a fundamental concept in formation flying which must be thoroughly understood in order to achieve basic proficiency. In any fixed-wing aircraft, the radius of turn (the amount of airspace required to complete a turn) is a function of its angle of bank and airspeed. For example, at a constant 20 degree angle of bank (AOB) and indicated airspeed of 120 knots, a specific radius of turn will result. If the airspeed is increased to 150 knots and the AOB remains at 20 degrees, a larger radius of turn will result. If the airspeed is decreased to 100 knots, a smaller radius will result. If the AOB is increased, the radius of turn will decrease. A combination of increased AOB and de-

creased airspeed will result in an even smaller radius of turn. (Until the airplane stalls.) In Summary:

A. With a constant bank angle (AOB):

1. Increasing IAS will increase radius of turn.
2. Decreasing IAS will decrease radius of turn.

B. With Constant Indicated Airspeed (IAS):

1. Increasing AOB will decrease radius of turn.
2. Decreasing AOB will increase radius of turn.

This is a basic flight training concept which should be reviewed and thoroughly understood by a formation student. It's importance will become immediately evident in preflight discussions concerning join-ups.

Understanding the effect of angular relationships between aircraft is essential for proper control of relative motion between aircraft in formation. Generally speaking, any change from a parallel relationship between the axes of leader and wingman will result in a change in relative motion and a consequent displacement of the relative flight paths of these aircraft. Depending upon the direction of displacement, aircraft separation will decrease or increase. This becomes graphically clear when flying in relatively close formation, when a small displacement creates an immediate position change. What is less obvious, but no less critical, is the change that takes place when the flight is separated, and attempting to rejoin.

In order to demonstrate this, put yourself a few hundred yards in trail behind the lead aircraft. Ask the leader to begin a constant rate turn. When he turns, match his turn immediately, placing his aircraft at 45 degrees angle off your nose. If you turn at the same

time, and stop his relative motion in your field of view, you will join up on the lead aircraft, quickly or gradually, depending upon the angle of bank chosen. If you wish to remain in trail, you must wait until you reach that spot in the sky at which the leader began his turn. Note that, if you turn when he does, your view of his airplane changes from the 12 o'clock position to a few degrees either side of dead ahead, and you will begin to join up on him. Now, if you are far enough back, and his angle of bank is shallow enough, you may not notice this action taking place right away, but it is happening!

A quick join-up is effected by assuming the normal wingman position on the lead aircraft. That is, by positioning the lead aircraft at the 2 o'clock or 10 o'clock position from your airplane. Line up those two points of reference on his airplane that we talked about earlier as soon as you are close enough to distinguish them. If he remains in the turn, you will cut him off and join up, simply because your turn radius is smaller than his. Simple geometry will show you that it is much easier to achieve a snappy joinup if you maintain a position that guarantees you will cut off the lead airplane. That means turning inside of him. Keep that in mind, and your joinups will happen more or less quickly. Remember that if you exceed the "ideal" 45 degrees angle-off joinup position (becoming acute), you will be faced with a possible overshoot. The key to a smooth joinup is achieving the ideal 45 degree angle off, then holding the lead airplane stationary in your field of view. Any movement of the lead will result in an overshoot or undershoot.

The overshoot usually comes as a complete surprise to the student, whose eye is not trained to recognize the increasingly rapid rate at which the target airplane is growing. Just make damn sure you overshoot *under* the target, stabilize to the outside of the turn, then turn inside again to complete the joinup. If it looks as though you might stop the overshoot by increasing your angle of bank dramatically.....DON'T! This usually leads to a situation where the target disappears under that lifted wing,



which prevents you from seeing if you actually did stop the overshoot. This can be hazardous to the health of everyone involved. NEVER go belly-up or lose sight of the leader! Having given this admonishment, it is also necessary to caution against being too low on the joinup. Many a perfect joinup has been blown by the wingman coming in 50 or 100 feet too low, then rolling out on the same heading as the leader and, as he pulls up into position on the leader's wing, he falls back because he has expended his reserve energy on the pull-up.

Having less than the desired angle-off will result in your falling behind (getting sucked). You can tell when you are getting sucked if the joinup does not happen. You just keep going around and around in a turn, never seeming to close on the target airplane. (A good rule of thumb is that experienced wingmen should join up within 180 degrees of turn, while a novice should be able to join up within 360 degrees of turn.

## POWER MANAGEMENT

.....is one of the most important aspects of formation flying. When flying in parade formation, you will probably be making continuous throttle adjustments in order to maintain position. This is where alignment of those two points on the target airplane becomes so important. Concentrating on those points allows you to make *minute* throttle adjustments. If you try to concentrate on the whole airplane, you will find yourself making large adjustments in order to control relative motion which is erratic and dramatic.

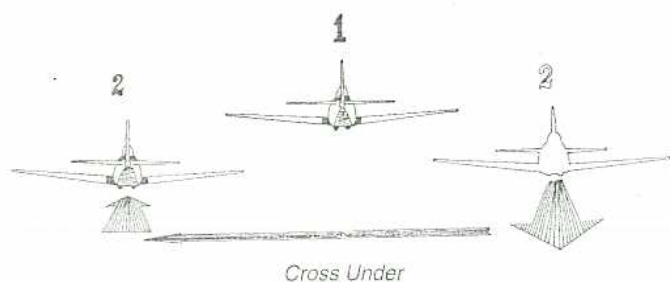
In a perfectly executed joinup, you should not have to make any throttle adjustments .....theoretically. (Since you will be matching the leaders turn rate and radius when you joinup, you should only have to also match his power setting in order to achieve perfect harmony.) However, we all know it is not a perfect world, and leaders have been known to A.) turn into wingmen at the critical moment of joinup, in order to induce an overshoot. or B.)

Increase power, rate of climb, or angle of bank during joinup. Any of these will require power adjustment. Don't be afraid to use whatever power setting is required in order to maintain or achieve position! Formation flying requires the coordinated use of all controls, including the throttle.

In the case of the T-34 and the T-28, it is possible to get radical power mismatches within the same formation. T-34s are currently flying with 225HP, 285HP, 300HP, 400HP, 420HP, and 550HP engines. (The latter three are turbines.) The T-28s face similar mismatches between A, B, C, and Fennec models. When a formation is assembled with aircraft of diverse power, it is necessary to know the capabilities of all aircraft, and the power settings which will allow enough margin for the slowest aircraft to keep up.

## CROSS-UNDERS

The proper cross-under is done in several steps. The practiced and proficient wingman will do it in one smooth, continuous motion. The fundamental, by-the-numbers method is: The wingman, when given the signal to cross under, will acknowledge the signal with a head nod, then reduce power very slightly so as to slide to the rear and down to a position which gives nose-to-tail separation and stepped down far enough (probably at least 10 feet) to avoid propwash as he crosses under. Power is added to stabilize the rearward movement. The cross under is accomplished with coordinated use of the controls, with the wingman completing the maneuver in the same relative position on the other side of the lead airplane. Note that as you cross under, you will have to add power to keep from getting sucked, and to move back up into position. When a second section is moving across under the first section, the wingman in the second section (#4) will also, simultaneously and automatically, without being signaled to do so, move further across his section leader so as to

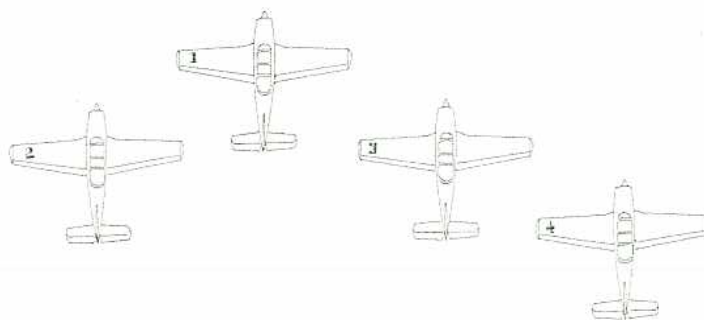


Cross Under

assume his position as tail-end Charlie, the last aircraft in the flight, on the new side in the same relative position that he occupied in the previous formation. (This occurs when the formation goes from fingertip strong right (or left) to fingertip strong left (or right), or when the formation goes from fingertip to echelon on the side opposite the second section.)

### 360 OVERHEAD APPROACH/BREAK

The overhead break entry to an airdrome traffic pattern is the fastest, most efficient method of handling a large volume of air traffic. It is also the safest way to keep aircraft from becoming entangled with one another over the airport. With this type of pattern entry all aircraft approaching the field for landing cross an initial point at a specified distance out on the extended centerline of the landing runway. When they cross this point they are at a specified altitude and headed straight in towards the runway. Usually this altitude is higher than traffic pattern altitude. This allows the flight leader to set his power at cruise so that the other members of the flight have plenty of power reserve with which to maintain good formation and still carry sufficiently high airspeed to the field. A respectably high airspeed in the break makes for a good-looking flight breakup overhead just in case anyone is watching. (They will be!) At the designated position, the lead makes his break 180 degrees to downwind. (The preferred



Fingertip Four Strong Right

method is a brisk roll to the break bank angle, followed by an equally brisk pull. This will result in noticeable G, which bleeds off airspeed to gear-down speed.) Other members of the flight follow suit at the briefed interval. In addition to the level break described above, a pitch up to pattern altitude may be used, in which case the leader should have plenty of "smash" coming down initial to allow for a snappy pull up.

Still another method of breaking is the fan break. The "Fan Break" signal is the same as any other break, but with zero time (e.g. closed fist) indicated for the break interval. It is executed from either left or right echelon, with all aircraft rolling into the break simultaneously. Lead must roll smoothly into a steep bank. All aircraft roll simultaneously with Lead, but each allows the preceding airplane to gain separation, while flying in the same plane. All aircraft roll level on the downwind leg in a giant stretched out echelon. Number Two establishes the geometry of the echelon by lining up behind the Lead with only enough lateral offset to clear his wake. Longitudinal spacing may be close at this time, but additional spacing for landing can be generated during the turn from downwind to final.



## LINE ASTERN PATTERN ENTRY

Is used in the rare instance of a flight leader wishing to enter the pattern just like all the other grandmothers and bomber pilots. He configures his flight in the tail chase formation, spaced for landing. He then enters the pattern in the normal 45 degree to downwind leg method.

## THE DOWNWIND BREAKUP

May be used when the 45 degree entry to downwind leg is necessary. The lead configures the flight in echelon away from the runway. Lead will kiss off the flight as he enters base leg, with other members of the flight taking their interval as they turn base. Very cumbersome and not recommended for more than three aircraft. Gear and flaps should be lowered on downwind leg.

## FORMATION TAKEOFF

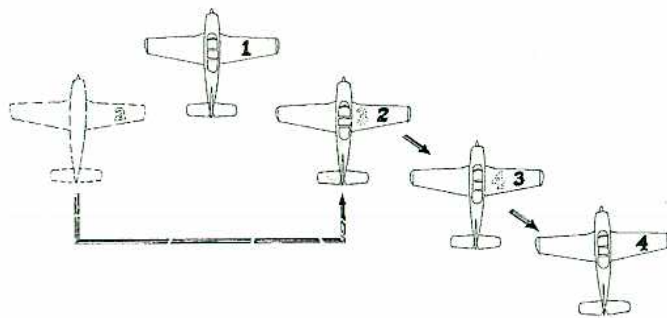
The formation takeoff eliminates the need for join-up after takeoff. Normal operational procedure will be to launch by section or element, assuming adequate runway width. In the case of an airshow appearance, three or four ship formation takeoffs may be made, if adequate runway width permits. Adequate runway width required assumes wingtip clearance. Normal formation takeoff procedure is for the lead to line up on the downwind side of the runway, ensuring that his propwash does not affect the wingman. This has the added beneficial effect of pointing the wingman's aircraft away the leader if he "weathervanes" into the wind. The wingman will line up well forward of the normal 45 degree angle-off position. (This assures that the wingman will quickly clear the leader if the leader aborts or has a tire failure which would cause him to veer to one side.) When all aircraft are in position, lead will give the signal to run up engines. He will give a head nod to signal brake release. All aircraft then roll in unison. Additional power is added smoothly,



*The ideal sight picture for a wingman has the aileron-flap junction on the trailing edge of the wing lined up with the last cowl latch, indicating a 45° angle-off from the lead aircraft. Both top and bottom of the wing are visible, indicating proper step-down. (Lou Drendel)*



*A nearly perfect echelon, with uniform step-down and angle off. (Lou Drendel)*

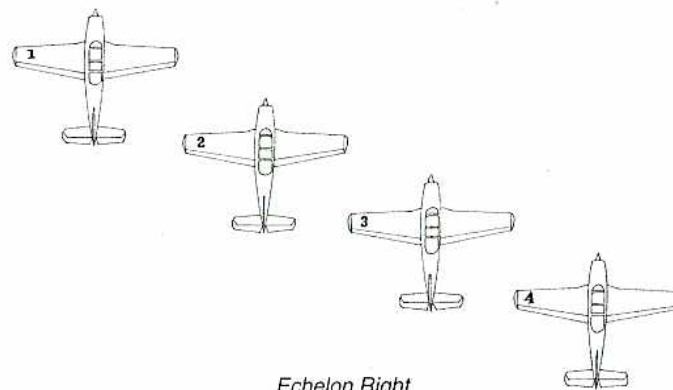
*Fingertip to Echelon*

with lead using less than METO power in order to provide margin for the wingmen. Lead will hold his aircraft on the ground slightly above takeoff speed. The wingman concentrates solely on the lead. If he stays in position on the leader, he will stay on the runway. Wingtip separation and the acute wing position should be maintained during takeoff, in the event that lead is forced to abort. If it becomes necessary for lead to abort, he will pass the lead to his wingman, and broadcast "aborting" on the radio. If he deems it necessary for the entire flight to abort, he will signal so by broadcasting "flight abort", while applying brakes smoothly. Once off the ground, the lead will establish positive rate of climb, then signal gear up to his wingmen. (Thumbs up, with head nod for execution. This may also be shortened to a head nod only, if pre-briefed.) In the case of multiple element takeoffs, the leader(s) of following element(s) will wait until the element in front of them has lifted off before beginning their takeoff roll. The same rule applies to single ship takeoffs. This margin allows for safe abort if the airplane(s) in front of you have to abort on the runway. Any advantage gained in starting your takeoff roll sooner is not worth the risk of overrunning the aborting aircraft in front of you!

## FORMATION LANDING

The leader will signal gear down and flaps down on downwind leg. In the case of a two ship landing, the leader will move the wingman to the outside of all turns in the landing pattern, and will allow enough room for the wingman to cross under on final (if necessary) to get on the upwind side of the formation. All turns in the landing pattern will be made smoothly and with the minimum bank angle. The wingman should assume the same acute position as he did for the formation takeoff, for the same reasons. On short final, the wingman will have to divide his attention between the leader and the runway lineup, always assuring adequate wingtip clearance with the lead aircraft. The wingman should stack level with the leader for the landing so that he lands at the same time as the lead. This will enable him to maintain his acute position during roll-out until lead has slowed enough to allow for safe in-trail taxi operation.

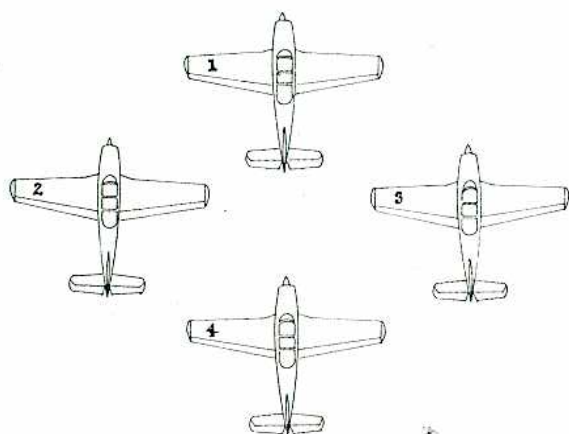
The formation takeoff and landing procedures have been written for nose-wheel type aircraft. Tailwheel airplanes present a whole new set of problems and challenges which must be addressed by flight leaders within those formations.

*Echelon Right*





*Gear Down (To be executed on head nod.)*



*Diamond*

## STANDARD 4-SHIP FORMATION RULES

The basic 4-ship configuration for maneuvering and the formation from which all other 4-ship formations will originate is the "fingertip four", so named because in plan view it resembles the position of your fingertips when your hand is extended. Positions in the fingertip are as follows: #1 = Lead, #2 = Lead's wingman, #3 = Section or element lead, #4 = Section leaders wingman. Number two is always the leader's wingman, and is always on the weak side of the fingertip formation. The fingertip formation will be designated "strong right" or "strong left", depending upon which side the element (# 3 & #4) are flying.

For the purposes of standardization and communication by hand or aircraft signals only, the 4-ship flight will always return to the basic fingertip configuration (strong right or left, as designated by flight lead) prior to reforming from any non-fingertip formation to any other non-fingertip formation. For example, if the lead wishes to configure from echelon right to diamond, he would signal number two to cross under to his left wing (single arm pump). Number's three and four close the gap to make the formation fingertip strong right. Lead then signals number four to move to the slot position. **Remember:** Any 4-ship formation change from any non-standard formation to another non-standard formation will always entail two moves. First to fingertip, then to the new formation. The following formation configuration change signals assume a standard strong right fingertip formation. They are applicable to a strong left configuration, with a change of hands.

1. **Fingertip right to echelon right:** Lead's left arm bent ninety degrees, fist clenched. In order to accomplish this, # 3 moves his element out and back to allow #2 room to cross over to lead's right wing.



*Cross Under (Motionless for wingman, double pump for element.)*



*#4 to Slot*

2. **Fingertip right to echelon left:** Lead's right arm bent ninety degrees, fist clenched, two arm pumps. #3 and #4 move as an element to #2's left wing. #4 crosses under #3 as the element is crossing under #2.
3. **Echelon right to fingertip right:** Lead's right arm bent ninety degrees, fist clenched. #2 passes this signal to #3, who moves his element out to allow #2 room to maneuver over to lead's left wing. #3 moves his element back into position on lead's right wing.
4. **Echelon left to fingertip right:** Lead's left arm bent ninety degrees, fist clenched, two arm pumps. #3 and #4 move, as an element, to lead's right wing, with #4 moving to #3's right wing.
5. **Fingertip right to diamond:** Lead's arm bent ninety degrees, fist clenched, four fingers extended, then closed with thumb pointing rearward, motions aft. #3 relays this to #4, who moves into the slot position. When #4 is in position, #3 signals "thumbs up" to lead.
6. **Diamond to fingertip:** Lead will gently rock his wings several times. #4 will move to his element lead's (#3) wing.
7. **Fingertip to trail:** Lead gently porpoises his airplane several times. #2 slides back and behind lead. #3 moves behind #2, #4 moves behind #3. As each wingman slides into position he will call "Two's in", "Three's in", etc. on the flight discreet radio frequency.
8. **Trail to fingertip:** Lead rocks his wings several times, then starts a shallow turn. #2 moves forward, joining on lead's inside wing. #3 and #4 form as an element, then join on lead's outside wing. Note that #2 always joins on lead's inside wing.

In addition to moving the formation to different configurations, hand and arm signals are also used for basic aircraft to aircraft communications. They should always be used during airshows to keep the radio clear for more necessary communications. It is a good idea to practice them at all times, just so you aren't left with your face hanging out when they **have** to be used.





*Flap Actuation*



*Fuel State Inquiry*



*"Seven"*



*Climb*



*"Two"*



*Inflight Problem (To be followed  
by HEFOE code.)*



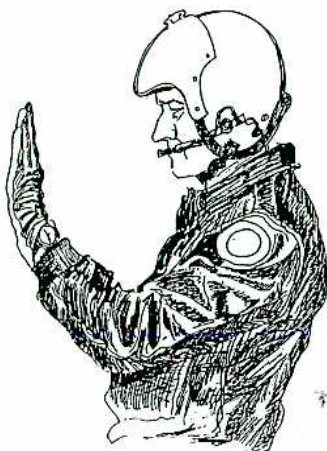
*Pitot Heat*



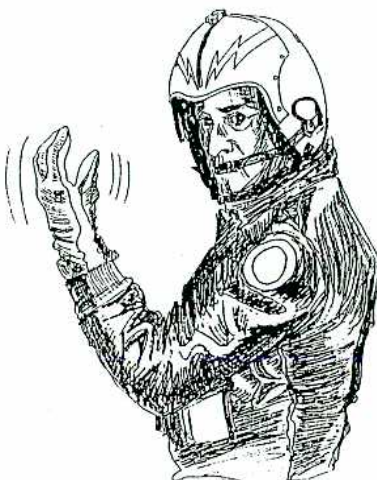
*Landing Lights On*



*Landing Lights Off*



*Speed Brakes*



*Rotating Beacon*



*"Choke the Parrot" -- Stop Squawk*



## ADDITIONAL HAND SIGNALS

**GO TO PRE-BRIEFED RADIO FREQUENCY:** Tap ear with index finger, extend index finger. (Variations on this have been used, for example, the common signal for the T-34 frequency is an extended middle finger. It is advisable to pre-brief this signal to avoid unpleasant post-flight confrontations.)

**CAN'T HEAR:** Move open palm of hand past ear, back and forth.

**CAN'T TRANSMIT:** Move open palm of hand past mouth, back and forth.

**EXTEND LANDING GEAR:** Clenched fist, thumb down, downward motion, head back against headrest (viz), nod forward to execute.

**RAISE LANDING GEAR:** Clenched fist, thumb up, upward motion, head back against headrest, nod forward to execute.

**FLAP ACTUATION:** Thumb and fingers together, opening and closing.

**REDUCE POWER:** Palm open, facing rearward, motion to rear.

**ADD POWER:** Clenched fist, arm in forward motion.

**FUEL STATE INQUIRY:** Clenched fist, thumb extended to mouth.

**INFLIGHT EMERGENCY:** Clenched fist up to forehead, land as soon as possible. If radio does not work, the following number (by raised finger(s)) indicate the nature of the emergency:

1. Hydraulic
2. Electrical
3. Fuel
4. Oxygen
5. Engine

These signals are often referred to with the acronym; "HEFOE"

**O.K. OR READY TO GO, IF ON GROUND:** Thumbs up

**LEVEL OFF:** Palm flat, moved back and forth in horizontal.

**WINGMAN TO CROSS UNDER:** Arm bent ninety degrees, fist clenched.

**ELEMENT TO CROSS UNDER:** Arm bent ninety degrees, fist clenched, two arm pumps.

**ENGINE RUNUP:** Clenched fist, index finger extended and rotated.

**BREAKUP SIGNAL:** Clenched fist, with index finger rotated. Break interval signaled with number of fingers extended after rotation.

**FLIGHT TO GO TO ENROUTE OR COMBAT SPREAD:** Lead yaws his aircraft.

**FLIGHT TO CLOSE UP TO PARADE FORMATION:** Lead rocks wings smartly.

**STACK DOWN IN FORMATION:** Lead extends palm of hand downward, with downward motion.

**STACK UP IN FORMATION:** Lead extends palm of hand upward, with upward motion.

**LEAD CHANGE:** Lead points to aircraft he wants to assume lead, then points to front. Pilot so designated should acknowledge this signal by patting the top of his head and pointing forward.

In all cases, the wingman should acknowledge receipt and understanding of any signal by nodding his head.

**SPEED BRAKES:** (T-28s) Hand up, palm forward, with head nod for execution.

**"IN-TRAIL" FORMATIONS**

by Bill Cherwin

"IN-TRAIL" is used for ground maneuvering, and interval depends on taxi speed. Pre-briefing, or team familiarity with techniques can reduce the interval to perhaps 10 feet nose-to-tail. Some very impressive "FLANK" maneuvers (simultaneous turns) can be executed while taxiing "IN-TRAIL."

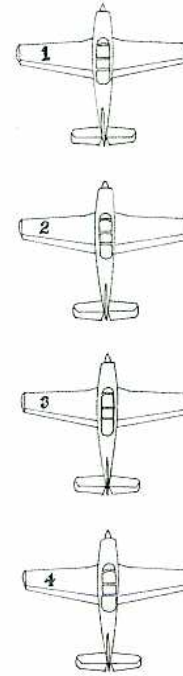
In flight, the "IN-TRAIL" formation might be used to maneuver several airplanes through some tight conditions where a large spread formation would be unable to execute faster roll rates.

"IN-TRAIL" interval can vary from one to several plane lengths, with only enough "stack-down" to avoid wake turbulence. An important point to remember is that the aircraft you are following is at twelve o'clock only when flying straight and level. When in a turn, the plane you are following should be offset in your windscreen proportionate to the amount of turn. "Tail-end-Charlie" should feel like he is in the caboose of a train rounding a curve, and should view everyone as if they were the cars and the engine. If you keep the aircraft ahead of you at twelve o'clock while in a turn, you are cutting him off and closing the gap. Conversely, the interval can be readily increased by "widening-out" your turn, allowing the aircraft ahead to increase the gap. Adjusting interval while flying straight is tricky, and can induce an accordion affect if done with anything but small power changes.

"SECTION-TRAIL" is a practical way to build or disassemble larger formations. The sections can be two, three, or four airplanes in "vics," diamonds, or echelon. For example, to "break-up" a twelve ship formation in a diamond of four "vics," the lead would first call for "SECTION-TRAIL." Bravo, Charlie, and Delta Leads would then maneuver their sections in-trail with enough longitudinal separation to allow the preceding section enough room to reconfigure. If runway width is adequate, the flight can break and land in sections. If not, the lead will call "SECTION-TRAIL, ECHELON RIGHT (or left)," and each aircraft can break and land individually.

**TAXI AND SHUT-DOWN PROCEDURES**

Where parking space allows, the leader will try to park his flight on the same line. He will taxi at a rate that allows his wingmen to maintain the same interval, and if possible will allow for a 90 or 45 degree "flank turn" into parking position. After all aircraft are aligned, the leader will call for, "1000 RPM, hand on mixture", (brief pause), "cut.....now!". Precision conduct on the ground during taxi, parking, and shut-down, demonstrates discipline, and will build confidence and pride in the formation and engender respect from onlookers.



Trail Formation



## RADIO PROCEDURES

The most important thing that can be said about formation radio procedures is; the less said, the better. The primary reason for using hand and arm signals is to avoid the confusion of several people talking on the radio simultaneously. Sage advice from leaders to their wingmen: The only thing I want to hear from you is; "Two" or "Lead, you're on fire!"

During the formation briefing, the leader will brief the radio frequencies to be used, assigning a "channel" number to each. (viz: 122.9 = Channel One, 123.45 = Channel Two, etc.) He will call for check-in on the startup frequency by transmitting; "Red flight, radio check....one." Flight members should answer with their number **only**. There is nothing more impressive than a quick check-in that goes; "...one.", "two", "three", "four".

Frequency changes will be signaled using prearranged hand signals for the frequency. A check-in on the new frequency will be called after a suitable interval. The thinking wingman will have his radios set up with the known frequencies before takeoff to make switching quick and easy, enabling him to hold his position in the formation.

When the leader has to transmit special procedures on the radio, the wingmen will acknowledge receipt and understanding of those instructions by transmitting their number **only** after the leaders transmission is complete. (Note that it is most important for the #2 man to be aware of this and transmit quickly. Failure to do so may result in the #3 or #4 man transmitting first, in which case the #2 man may be liable to buy drinks for the rest of the flight.)

## DISSIMILAR AIRCRAFT FORMATION

by John Ellis

Flying aircraft of different types in the same formation presents special concern relating to procedures, technique, and safety of flight. When this concern is addressed, dissimilar formation can be accomplished safely and present unique opportunities for air show activities, photography, etc.

Dissimilar aircraft formation is not recommended in the takeoff or the approach and landing phase of flight. Acceleration and deceleration rates, plus aerodynamic differences (particularly during configuration changes) add unnecessarily to pilot workload during these critical phases of flight operations. Dissimilar flight formations should plan a three to five second interval for brake release of individual aircraft on takeoff, and utilize the 360 degree break procedure for individual landings.

### BRIEFING AND PLANNING THE FORMATION

Aircraft performance and aerodynamics are both major concerns when placing dissimilar aircraft in the same formation. For example, a modern, swept wing jet fighter can safely fly formation on its World War II propeller driven ancestor by placing the jet fighter in the formation on the outside of the leaders turns. Accordingly, power-limited aircraft should be placed on the inside of planned turns. These formations are usually flown for Airshow activities or for photographic purposes, and the flight path is normally planned prior to takeoff.

### LEADER CONCERNS FOR DISSIMILAR AIRCRAFT

In order to safely lead a formation flight of dissimilar aircraft, it is imperative that the flight leader have a thorough understanding and knowledge of the performance characteristics, aerodynamic envelope, and operating limitations of each aircraft in the formation. The flight leader will use this knowledge to establish airspeeds for climb, cruise and descent, rates of climb and descent, turn radius and turn rates, as well as mission planning,

operating limitations, cross-wind limits, and setting fuel "bingo" level.

### ESTABLISHING THE WING POSITION

The field of view may vary substantially from one aircraft to another, because of aircraft configuration, cockpit location on the aircraft, aircraft size and obstructions to vision such as engine nacelles. For example, a Skyraider pilot with the same sight picture of a leader's aircraft, would be in an entirely different position from a Corsair pilot with the same sight picture, because of cockpit location on the aircraft. Establishing the proper position for a "parade" formation is the responsibility of the flight leader, and he should move the wingmen into a proper line of bearing, where the wingmen will pickup visual cues on the leader's aircraft to maintain the established position. It is imperative that the leader be able to maintain visual contact with wingmen, and wingmen must always remember that if the leader's head is not visible, then the leader cannot see the wingman. Under some circumstances, this may require wingmen to fly with more or less stepdown than a similar position flown with two similar aircraft. For example, if a mid-wing, twin engine F7F Tigercat is the lead aircraft, a low-wing aircraft in the same formation will need a position slightly higher than normal, with less stepdown, in order to see the Tigercat's pilot's head over the wing and engine nacelle.

### PRACTICE BEFORE PERFORMANCE

Many airshow organizers will attempt to encourage pilots to fly dissimilar formation in the airshow environment who have never flown together. The low altitude airshow environment, combined with flight lines, spectators, and other geographical limitations, is the least desirable place to make a "first flight" in dissimilar formation. Dissimilar formation flights should be carefully briefed and practiced at altitude with wingmen becoming comfortable in their positions before the dissimilar formation is flown in the airshow environment. The same good judgement and discipline required to perform as a flight leader or a wingman must be

exercised in the choice of pilots, aircraft, and when and where to fly. As in any phase of flight, it must be remembered that "the superior pilot is the one who uses superior judgement to avoid the use of superior skill."

*John Ellis is a former Naval Aviator and test pilot. He is the President of KAL-AERO, a large general aviation services company and experienced warbird restoration center. John is the leader of the famed "Cat Flight", the most prominent example of a dissimilar formation.*



*The Kalamazoo "Air Zoo" Museum flies the "Cat Flight" at many airshows. It consists of, from left to right: F-6F Hellcat, F-14A Tomcat, F-7F Tigercat, F-9F Pather, F-8F Bearcat, and F-4F Wildcat. (Lou Drendel)*



**TYPE SPECIFIC: T-28BCD/FENNEC**

by Dave Clinton

**SPEED-BRAKE SIGNAL:** Hand up, palm forward. Deploy or retract on head nod.

**NORMAL DRESS:** 30° angle off with 10' step-down. Leading edge of wing even with trailing edge of rudder.

**TAXI OUT:** Canopy open, speed brake retracted, 1/2 flaps, cowl flaps full open. In all cases wingmen configure like leader.

**TAXI IN:** Canopy open, speed brake retracted, flaps full down, cowl flaps full open. Again, configure like leader.

**TAKEOFF:** Canopy closed, 1/2 flaps, cowl flaps trail. Lead should use 44" and 2700 RPM, and wingmen can use up to 52" with 2700 RPM (which is NATOPS MAX).

When in position, lead will signal "spool-up" (25"), he will check wingman readiness, exaggerated head nod for brake release, while advancing his power to 44". Rotation will commence at 60 to 70 KTS, with liftoff at 80 to 90 KTS. Lead will accelerate to 120 KTS and assure positive rate of climb. When lead verifies that wingman is safely airborne and flight is in a stable climb, he will signal for gear retraction with thumb up and head nod. Lead will signal for flap retraction, and accelerate to 140 KTS and continue climb to 1000' A.G.L. Lead will then signal for power reduction to climb power.

**CLIMB:** Lead will climb at 140 KTS with 32" and 2400 RPM, while wingmen can use up to 36" and 2400 RPM. This power should yield about 1000 ft/min climb rate. Lead may have to adjust his power setting, so as to give his wingmen power margin, and so that they will not exceed any engine limitations.

**LEVEL OFF:** Wingmen should close his cowl flaps just prior to level off, provided engine temperature limits are not exceeded,

and accelerate with the leader. Failure to reduce drag in this manner, or reducing to cruise power prematurely, will cause wingmen to become "sucked".

**CRUISE:** Clean configuration with cowl flaps closed and mixture normal. Lead will set power to give a cruise speed of 170 to 180 KTS below 12,000' M.S.L. Recommended power is 26" to 28" with 1850 to 1950 RPM. Lead will assure that all power settings provide a necessary power advantage to all flight members. Power settings may be pre-briefed to be suitable for the mission.



**TYPE SPECIFIC: P-51 MUSTANG**

by Vlado Lenoch

**TAKE OFF:** Section takeoffs require a 100 ft. wide runway. The leader will always position his aircraft in the middle of the left side of the runway, while the wingman positions his in the center of the right side. The wingman will taxi up so as to put his wing even with the lead's tail. Lead will give the "run-up" signal, and both aircraft will advance their power to 30" MAP, while holding their brakes. When the leader gives the head nod, both pilots will release their brakes, and the leader will advance his power to 50" MAP. The wingman should have adequate power margin to hold station throughout the takeoff. If the lead has to abort, he should announce it if possible, and the wingman should continue the takeoff using normal takeoff power.

**CLIMB:** After the gear is up and the takeoff phase is over, the lead will set a climb power of: 35" MAP and 2300 RPM.

**CRUISE:** Normal cruise power is 31" MAP and 2300 RPM. Nominal sight picture is to line up the wing tip light with the tip of the prop spinner, and far enough out so that your eyes are even with the lead's rudder hinge. This alignment will also produce some "stack-down." In an echelon, #3 and #4 can line up helmets and check the rudder hinge line.

**SIGNALS:** All signals are the same, with the addition of another commonly used sign: The "wing-dip" (left or right). A wing -dip signal is used to cross a wingman under to the other side, or to signal a finger-tip formation to go to echelon. Be sure to clarify this signal with your leader in the preflight briefing! If the lead had configured his flight to echelon right, for a left break, and had to reconfigure for a right break, he would first give a wing rock signal (return to fingertip). After the fingertip was reestablished, he would then dip his left wing to signal for left echelon.

**DESCENT:** The leader will normally set 27" MAP and 2300RPM for descent.

**PITCH AND LANDING:** The leader will configure the flight as appropriate for the break. Runway width will dictate the break interval. On runways that are 100 ft wide, the spacing can be as close as 1600 ft, as aircraft will be landing on alternate sides of center. In no case should any airplane land closer than 3000 ft directly behind another. The leader will bring the flight over at the appropriate speed, so that after the break, all aircraft will be able to end up abeam the point of intended landing at 1000 ft and at 170 MPH (147 KTS), where the gear is extended and the turn to final "played" to fine tune any spacing.

Section landings are not done in P-51s due to control and visibility limitations.





**TYPE SPECIFIC: AT-6 / SNJ**

by Carl Schmieder

The North American AT-6 is a very straight forward aircraft for formation flight, and poses no unusual difficulties. The one area that needs to be remembered, is the aircraft has a lot of drag, and thus will slow down quickly when power is significantly reduced. Energy management is very important, and care must be taken to keep in position, especially in turns away.

Two other areas that require special attention is the takeoff and landing phases of flight. In these areas the pilot has the least visibility, and must remain particularly attentive.

**TAKEOFFS:** Section takeoffs are normal. The aircraft will track straight, and as soon as the tail is up you have adequate visibility to continue the takeoff roll. Many pilots have found the minimum time to roll the next section, is when the tail wheel of the preceding section is off the ground. Alternatively, roll the next section when the previous section is airborne. In order to reduce the power changes, the lead should advance the throttle to 2000 RPM while holding the brakes. Then, with a head nod, lead releases his brakes, and smoothly advances his throttle to a max of 32" MAP. The wingman will also be "spooled-up" to 2000 RPM when the brake release signal is given, and will have adequate power margin during takeoff to remain in position.

**SIGHT PICTURE:** The sight picture of the T-6 is the tail wheel splitting the aft trailing edge of the opposite wing tip. This will generate a 45 degree angle off. The near wing tip should just touch the canopy bow. This alignment will provide both wing tip and nose to tail clearance with plenty of stack-down.

**LANDINGS:** Due to control and visibility limitations, section landings are generally not performed. The recovery should occur from an overhead break, with the landings being made on alternate sides of the runway (width permitting). All aircraft should be configured alike (full flaps or specified partial flap

setting), and should maintain 100 MPH (85 KTS) on the approach. Due to visibility limitations, a wheel landing is preferred over the three point technique. When each aircraft is rolling steadily in a three point attitude, each pilot should continue quickly to the end of the runway, taxi clear, and wait the rest of the flight.



*Sight picture of the T-6: Tail wheel splitting the aft trailing edge of the opposite wing tip.  
Photo by Matt Gunsch.*





# QUALIFICATION PROGRAMS

The "Wingman" patch which has been awarded by the T-34 Association to qualified members since 1982, is evidence that the wearer has passed a check ride by an Association approved check pilot. The Association will not allow any pilot who has not been awarded the patch to fly in Association-sanctioned air shows or other events. Many other war bird organizations have adopted this manual and use very similar wingman qualification checks. The following procedure is used during the T-34 Association Wingman patch qualification check, and is illustrative.

**T-34 Association Wingman Qualification:** During the briefing phase, the qualification check pilot will conduct a normal formation briefing. During the briefing, he will ask the candidate questions to ensure that the candidate has a basic understanding of what will be covered in the check ride.

During the flight phase the check pilot will ride in the rear seat of the candidate's aircraft. This position provides the check pilot with the optimum view and control during the check flight. It will be up to the candidate to arrange for the lead aircraft in the flight. The candidate's aircraft must be equipped with parachutes for both seats and operable VHF radio and Intercom.

No formation flight or exercise is ever conducted or executed at 100% by either wingmen or the leader. The debriefing offers an opportunity to discuss the flight, and to rectify any misunderstandings. It is important to adopt a positive attitude about debriefing a formation exercise. One should be prepared to both offer and receive constructive criticism. Any aviator not willing to accept such criticism should not be engaged in the very exact and demanding art of formation flight. Constantly striving for better performance, both in flying technique and discipline can make the difference between success or failure.....or even tragedy.

The final evaluation of the candidate requires that he/she meets minimum standards, which include demonstration of understanding of all signals and performance of all of the above

Name: _____		T-34 Association, Inc. Wingman Qualification Report		Date: _____	
Aircraft No.: _____				Location: _____	
				Flight Duration: _____	

Oral Phase (Briefing)	S	U	Flight Phase	S	U
Standard Hand Signals: Run-up, frequency changes, number signals, head nod, wingman cross, element cross, break-up and rejoin, gear and flap cycling, power addition & reduction, level off, climb, descent, fuel state inquiry, inflight emergency, can't hear, can't transmit, lead change, stack up, stack down, #4 to slot			Start time, start, taxi, response to signals		
Standard formation configurations: trail, echelon, fingertip, enroute, diamond			Radio discipline: check-in, frequency changes		
Cross unders, rejoins, aircraft configuration changes			Run-up: check list and standard procedures		
Break-up and rejoin, radius of turn, cut-off, overshoot energy management			Section take-off: position and power management		
Turns in fingertip, echelon, trail, enroute, terminal maneuvering			Climbing turns 90° and 180° level off and power reduction		
Lead change, emergency signals, HEFOE system			Cross unders: power management smoothness -- proper nose/tail clearance		
360° overhead approach, breaks, intervals, section landings			Break-up and rejoin: signal recognition, proper interval, radio call, cut-off angle, 45° line, overshoot energy management		
Taxi-in, shut down procedures			Landing gear and flap cycling, turns in "dirty" configuration, power and position management, signal recognition		
Radio discipline: check-in, frequency changes, traffic calls			Aircraft recognition signals: yaw, porpoise, wing rock		
Comments:			Lazy eights left and right and 45° bank plus or minus 20° pitch		
			Terminal maneuvers: overhead approach, break and landing or section landing at check pilot's discretion		
			Runway clearing, taxi-in, shutdown, and debriefing		
			<b>Flight Evaluation:</b> Patch Issued (Date): _____ Check Pilot: _____ Recommended Further Training and Recheck: _____ Check Pilot Signature: _____		
Pilot Signature: _____					

maneuvers to a level acceptable to the check pilot.

We don't believe that formation flying is any more dangerous than IFR flying.....if you are properly trained and follow the correct procedures. In fact, the parallels between the two are striking. When the FAA issues you an instrument rating, it is after you have passed a written test and a check ride. They are certifying that you are instrument-rated and qualified to use that rating at that time. It is your responsibility to remain current. If you



don't, you are not legally able to use your rating. Worse still, you may be endangering yourself and others.

When we issue you a wingman patch, it will be because you have passed an oral exam and a check ride, demonstrating that you are familiar with the procedures and are capable of station keeping in a formation at the time of the check ride. If you do not utilize your newly acquired skills for months at a time, you will likely lose them. IFR flying demands more head work than pure physical skill, and is therefore subject to rapid deterioration of competence. Formation flying procedures are the equivalent of IFR "head work". The physical aspect of both may return quickly with a little practice, but the mental aspects must be practiced regularly to remain sharp. One thing we all agree on.....most accidents are caused by lapses in judgment. The FAA assumes no liability for lapses in judgment after issuing you a rating, and the T-34 Association assumes no liability for lapses in judgment after issuing you a wingman patch. Individual responsibility applies in both cases. The T-34 Association, North American Trainer Association, and other organizations require a "formation annual" flight check. This may be accomplished by flying in an EAA show, in formation (Oshkosh or Sun & Fun), or by sign-off by a qualified flight lead or check pilot.

**F.A.S.T. (Formation And Safety Training):** In response to airshow sponsors and FAA plans to regulate formation flying in waived airspace during air shows, the warbird groups have formed three self-regulating organizations. The L-Bird organization will deal with liaison and cabin configured aircraft, a multi-engine transport/bomber organization will handle formation qualifications for these types, and the F.A.S.T. organization will deal with our type of aircraft -- low wing, single engine, glass canopied, tandem, fighter trainer type. At some point, the FAA will require that anyone performing formation maneuvers carry credentials from the appropriate organization. F.A.S.T. is currently working out the details of qualification, currency, and record keeping. At the same time, it is attempting to determine what degree of regulations are necessary to satisfy the FAA, while still being tolerable and without being overly restrictive and bureaucratic. Note that F.A.S.T., and these other organizations, deal only with air show waived airspace.

## T-34 ASSOCIATION FLIGHT LEADER QUALIFICATION

1. Must be a fully qualified and experienced T-34 Wingman.
2. Must demonstrate the following to a lead check pilot:
  - A. Organize and brief a flight or mission of at least four aircraft.
  - B. Demonstrate competence in smooth and deliberate manipulation of flight controls, including constant roll rates into and out of turns.
  - C. Proper management of power so that wingmen always have an energy advantage.
  - D. Avoidance of unbriefed maneuvers.
  - E. Ability to position wingmen in all standard formations through the use of hand and aircraft signals.
  - F. Demonstrate flight entry into an airport traffic control zone, including changing flight to the proper frequencies, frequency check-in power reductions and additions, maneuvering the flight for; a.) 360 overhead break b.) formation landings.
  - G. Demonstrate situational awareness at all times, including spotting and calling any possible conflicting traffic, and in maintaining up-to-date position information.
  - H. Demonstrate forceful and positive leadership in use of the radio. Since most civilian controllers will be unfamiliar with controlling formations of aircraft, it is most important for the leader to be in control of his formation, and to convey that sense of control to any air traffic controllers the formation works with.

## FORMATION DOS AND DON'TS

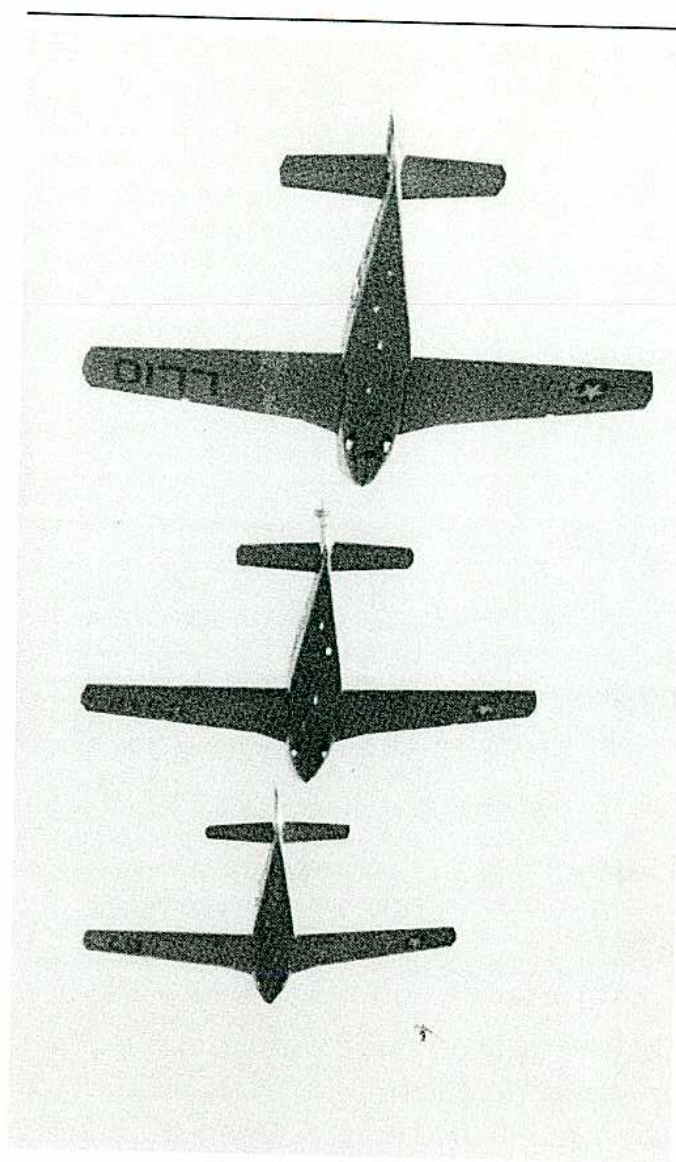
### DO:

- \* Know your mission, your airplane, and yourself.
- \* Brief every mission thoroughly
- \* Wear parachutes on all formation missions.
- \* Use an instructor or safety pilot on all training missions.
- \* Learn and practice the maneuvers that are easiest first, then proceed to the more difficult maneuvers.
- \* Know your aircraft emergency procedures thoroughly.
- \* Plan well ahead if you are leading a formation.
- \* Be extra smooth on the controls if you are leading a flight.
- \* Know the hand and aircraft signals used in formation.
- \* Keep alert for and acknowledge and relay all signals in formation.
- \* Work constantly to achieve and maintain the ideal formation position.
- \* Insure adequate clearance before starting cross-overs.
- \* Know switch locations and proper directions to move switches by feel alone.
- \* Keep the windscreen and canopy clean at all times.
- \* Use the clock code when calling traffic.
- \* Know the egress procedures for your aircraft and practice them occasionally on the ground.
- \* Stay loose and flexible!

### DON'T:

- # Go below the minimum altitude established for the mission.
- # Fly a mission if there are restrictions to visibility in the working area.
- # Continue the mission below bingo fuel.
- # Talk unnecessarily on the radio.
- # Fly with known or suspected malfunctions.
- # Leave the briefing with questions unanswered.
- # Attempt any maneuvers that were not briefed for that mission.
- # Forget to plan ahead when leading a flight.
- # Check in on radio frequency out of turn.
- # Attempt to join up with excessive overtake or rate of closure.
- # Take your eyes off the airplane you are flying formation on, except for the **briefest** of instants to make necessary cockpit checks.
- # Try to impress everyone by flying too close.
- # Change sides in the formation without permission of the leader.
- # Anticipate a leader's moves and react prematurely.
- # Turn into an echelon
- # Bunch up in the traffic pattern, especially on final.
- # Give a frequency change to the formation in a turn.





An example of dissimilar formation, a T-34B with an F-18 Hornet.  
Photo by Lou Drendel.



Formation Sight Picture of a T-6, photo courtesy of Carl Schmieder.

Left: Three T-34s In Trail Formation. Photo by Lou Drendel.

## POWER SETTINGS

One of the most important aspects of smooth formation flight is the relative power settings used by lead and his wingmen. Since there are several different versions of many of the types likely to use this manual as a reference, we will not attempt to put numbers in the blanks. Suffice to say, it is important to develop a standard through trial and error, and to stick to that during formation operations. The leader always wants to allow his wingman/men adequate margin to maintain position, so it is the lead airplane power settings that we are concerned with here. These will change according to circumstance. (Big engine T-28 leading small engine or vice-versa would result in radical differences in power settings) so we have provided several blanks under each category.

### TAKEOFF

RPM \_\_\_\_\_  
RPM \_\_\_\_\_  
RPM \_\_\_\_\_

MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_

### CLIMB

RPM \_\_\_\_\_  
RPM \_\_\_\_\_  
RPM \_\_\_\_\_

MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_

### CRUISE

RPM \_\_\_\_\_  
RPM \_\_\_\_\_  
RPM \_\_\_\_\_

MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_

### DESCENT

RPM \_\_\_\_\_  
RPM \_\_\_\_\_  
RPM \_\_\_\_\_

MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_  
MANIFOLD PRESSURE \_\_\_\_\_



## FORMATION BRIEFING GUIDE

1. PURPOSE OF MISSION
  2. WEATHER (location current and forecast, destination or working area)
  3. FLIGHT CALL SIGN
  4. FLIGHT LINE-UP BY POSITION AND PILOT
  5. ALTERNATE LEAD
  6. TIME HACK (Everyone synchronizes their watch with that of the leader. Especially important in the case of large formations which must start engines at the same time in order to keep an orderly flow of events.)
  7. RADIO FREQUENCIES (to include ATIS, ground, tower, departure, enroute, and working. May include prearranged hand signals for these frequencies.) Radio check-in procedures should stress the need for a minimum of dialogue.
  8. TAXI (if possible, taxi as a flight in sequence. Taxi on leader's signal. At run-up area, if space permits, line up in echelon. If unable, attempt to position yourself so that all flight members can see each other.)
  9. RUN UP (On lead's signal, accomplish run up and finish pre-takeoff check list: Signal ready to wingman or lead. When ready, thumbs up signal should be passed from 4 to 3 to 2 to lead. Thumbs up by 2 indicates 3 and 4 are ready.)
  10. LINE UP FOR TAKEOFF (Check wind direction, No. 1 on downwind side of runway, proper spacing between aircraft and elements, lineup in center of your half of runway, last man call in position, use appropriate hand signals, review rejected takeoff procedures, wing tip clearance, etc., and time intervals between elements.)
  11. TAKEOFF (Formation takeoff if crosswind is less than 10 knots, power settings, hand signals for run-up, brake release, gear/flaps up, power reductions.)
  12. JOIN-UP (Airspeed, join-up configuration at lead's discretion, overshoots remain clear of flight until speed has stabilized, ease into position when airspeed is under control, never go belly-up to lead or lose sight of the lead, cross under flight and keep them in view, brief frequency changes if join-up is protracted.)
  13. ENROUTE (Formation to be used, check points, frequency changes, hand and aircraft signals, level off altitude and airspeed.)
  14. WORKING AREA (Frequency change, boundaries of area, prominent check points and obstructions, sequence of maneuvers to be performed, rendezvous point for lost wingman or late arrivals with orbit altitude and airspeed, review of formation details and techniques, set bingo fuel.)
  15. RETURN TO BASE OR DESTINATION ARRIVAL (Descent checklist, lead calls for spread formation and flight members perform descent checklist to include fuel selectors, radio frequency selection, transponder off (only lead squawks), mixture position, altimeter setting, check-in of flight when check-list is complete.)
  16. APPROACH AND LANDING (Approach frequencies, formation to be used, pitchout interval, hand and aircraft signals, pattern, airspeeds, spacing – No.2 determines interval, pattern altitude.)
  17. LANDING (Alternate side of runway, with lead taking downwind side and landing long, stay in center of your half of the runway, be prepared for turbulence and prop wash, passing on runway, call when aircraft in front of you is clear to turn off runway, taxi to parking area as a flight, monitor appropriate frequency.)
  18. DEBRIEFING (problem areas, timing, communication, lead signals, basic flying.)
-

## FORMATION BRIEFING

FLIGHT CALL SIGN: \_\_\_\_\_

WEATHER: Wind \_\_\_\_\_ Alt. Setting \_\_\_\_\_

POSITIONS: Lead \_\_\_\_\_ #2 \_\_\_\_\_

#3 \_\_\_\_\_ #4 \_\_\_\_\_

Alternate Lead \_\_\_\_\_

FREQUENCIES: Atis \_\_\_\_\_ Ground \_\_\_\_\_ Tower \_\_\_\_\_

Departure \_\_\_\_\_ Enroute \_\_\_\_\_

Airshow Control \_\_\_\_\_

Atis \_\_\_\_\_ Approach \_\_\_\_\_

Tower \_\_\_\_\_ Ground \_\_\_\_\_

TIME HACK: Start \_\_\_\_\_ Takeoff \_\_\_\_\_

Rendezvous \_\_\_\_\_

Overhead (Parade Display) \_\_\_\_\_

Other: \_\_\_\_\_

ENROUTE: Altitude \_\_\_\_\_ Airspeed \_\_\_\_\_

RENDEZVOUS: Point \_\_\_\_\_ Orbit Alt/Speed \_\_\_\_\_

PLANNED MANEUVER SEQUENCE: \_\_\_\_\_

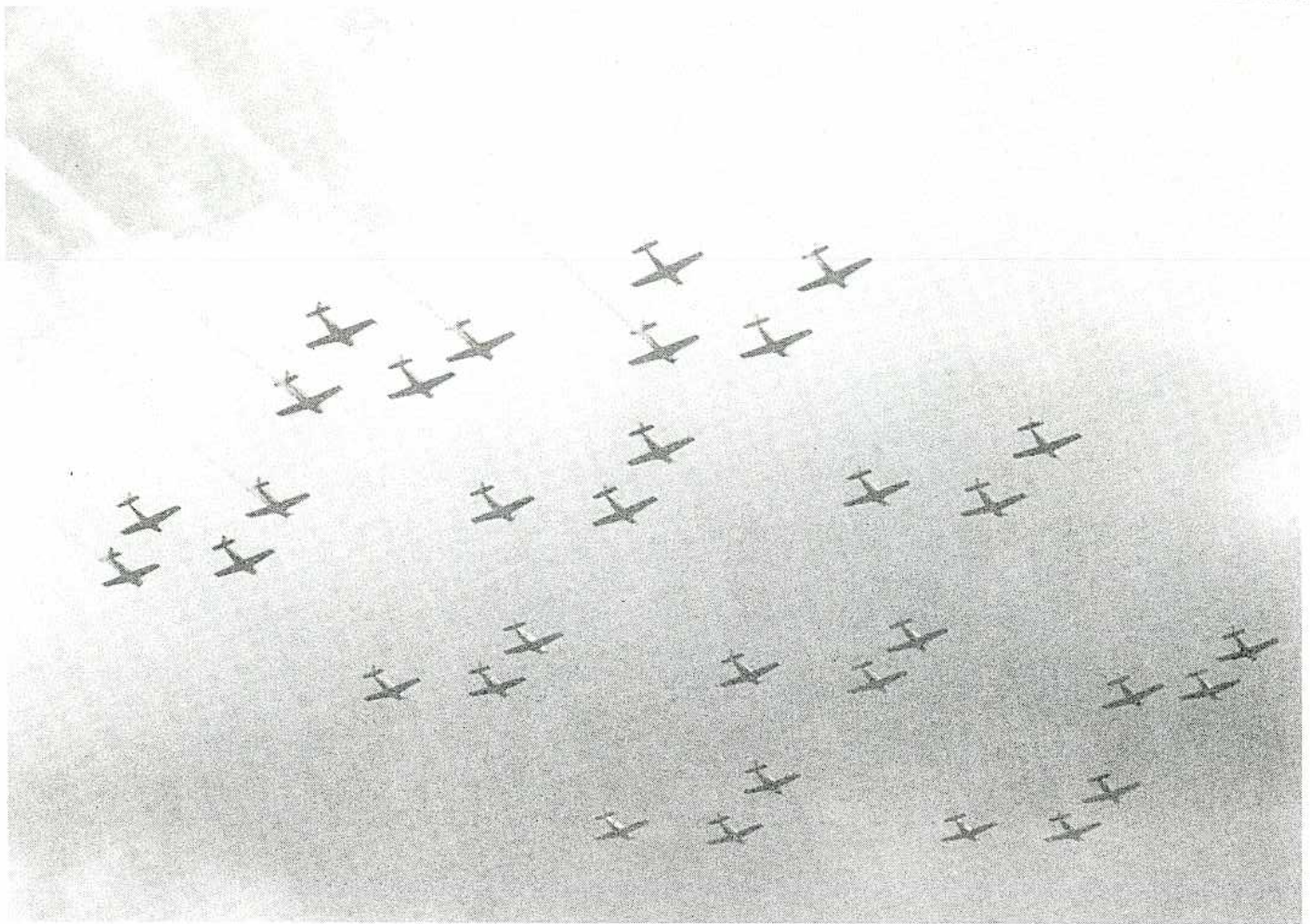
LANDING: Pattern \_\_\_\_\_ Alt. \_\_\_\_\_

Formation \_\_\_\_\_ Pitchout Interval \_\_\_\_\_

Airspeeds \_\_\_\_\_

BINGO FUEL: \_\_\_\_\_ NOTES: \_\_\_\_\_





The grand-daddy of all T-34 formations was this monumental effort put up at Oshkosh '87.  
It included 34 T-34s (Top Cover is not visible in this picture.)



