SECTION 11 - FORMATION STANDARDS
Supplement to the T-34 Formation Flying Manual

Record of Revisions

Rev	Changes	Date
A1	Revised takeoff and landing procedure, frequency to monitor, stacking	7/15/05
A2	Typos, bank angle in break to land, clarify “Route” vs “Enroute,” single-ship landing method definitions, element takeoff spacing, “Parade” definition.	4/1/06
A3	Calls on landing rollout	7/1/06

SECTION 11 - FORMATION STANDARDS

Supplement to the T-34 Formation Flying Manual

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INTRODUCTION

Section 11 is intended to supplement the T-34 Formation Flying Manual by providing a base of procedures that all participating Grumman pilots will adhere to, unless briefed otherwise. *This section does not intend to teach formation flight*.

The following procedures are considered "STANDARD" for Grumman aircraft formations, and anything briefed as "standard" will use the formation procedures listed below. Any procedure that is "non-standard" will be fully briefed by the flight lead. These standards do not supercede the T-34 Formation Flying Manual.

(Please substitute he/him/his with she/her as appropriate.)

FORMATION CONCEPTS

Formation Flight

Definition: More than one aircraft which, by prior arrangement between the pilots, operates 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.

The contract between a Flight Lead and his wingmen is fairly simple: the flight lead is responsible for making safe, sound decisions as to the operation of the flight to complete the intended mission. The wingman's primary responsibility is to stay in position, execute the flight lead's directives to the best of his ability, and advise the flight lead when he is unable.

Flight Lead

The biggest part of the flight lead’s job is to conduct the flight within the wingmen's capabilities. Any flight lead can lose his wingman; lead’s job is to keep them within the formation and safely complete the mission.

The flight lead should acknowledge wingmen's radio calls. If a wingman is directive, the flight lead should immediately execute the wingman's directives, and talk about it later on the ground. The exception would be if the flight lead has complete situational awareness and believes the directive to be in error; in this case the lead should respond to the call as such.

If a flight lead needs or wants to clear a wingman out of the flight, the call is "2, you're cleared off" (or the appropriate position number).

Wingman

The wingman should maintain flight discipline at all times. The wingman also has a responsibility to anticipate the flight lead's directives; this typically comes with experience. Generally, wingmen should fly stacked down from their flight lead (exception: fighting wing and echelon turns). The wingman should notify the flight lead of any unsafe or soon-to-be unsafe situations, like calling traffic. In a critical situation, the primary emphasis is on being *directive* (e.g. "CLIMB NOW") to avoid a possible unsafe situation.

Sometimes a wingman will be out of position. This is to be expected occasionally, and the wingman should fight to get back in position as soon as possible. Breaking out of formation, however, is a conscious choice by the wingman to leave the flight, and is to be taken very seriously. The wingman may not like what the flight lead is doing or how he is doing it, but that is *not* a reason to break out of formation. *Breaking out of formation is a last resort*. There are two times a wingman can (should) break out of formation:

1) He directed the flight lead to take some sort of evasive action ("turn hard right") and the flight lead did not, exposing both aircraft to an unsafe situation (typically a mid-air), or

2) The flight lead has exceeded the capabilities of the wingman, and the wingman can no longer maintain control and situational awareness of his aircraft.

Should a wingman ever need to break out, the call is "2's breaking out" (or appropriate position number). Once things get settled, the wingman should ask for permission from the flight lead to rejoin the flight.

While the old adage that "wingmen should be seen and not heard" is somewhat extreme, the best wingmen accomplish the mission with the minimum radio talk required.

GENERAL PROCEDURES

All formations flown are to be standard.

One pilot is designated as the flight lead, and he will designate #2, #3, and #4 as appropriate.

Formations with more than 4 aircraft will *not* be briefed as "standard".

All aircraft in the flight are on the same frequency, as designated by the flight lead.

Flight lead will check-in wingmen on all new frequencies. Wingmen should respond with their position number (e.g. "2"), in order. Wingmen should obtain appropriate information (e.g. ATIS) before checking in on the ground and before entering an airport traffic area. ***Exception:*** After landing, if appropriate, all aircraft will switch to ground frequency rolling clear of the runway without instructions from lead. Lead will not check-in wingmen in on Ground frequency.

Flight lead will make all radio calls to ATC, unicoms, etc. as appropriate.

All aircraft monitor *121.5* on radio #2, if equipped (except to obtain flight information, e.g. ATIS).

Flight lead squawks for the entire flight. Wingmen squawk stand-by. The squawk will be passed to the new lead during a lead change.

In a 4-ship formation 3 & 4 are considered a *section/element*, and make all formation position changes together.

Each individual flight member is responsible for their own in-flight checks, as appropriate (e.g. level-off, before landing).

Any aircraft experiencing an alert or emergency situation will immediately notify the flight lead (the flight lead will also notify wingmen). At that time, or anytime thereafter, the stricken aircraft can request and receive the lead of the flight, and should determine whether a chase aircraft is desired or not. Chase position will be 500-1000 feet behind and to the side of the stricken aircraft (2-ship only).

Should a wingman or a flight lead lose comm radios (NORDO), his element partner will lead him back. The NORDO pilot will give the visual signal for NORDO. If flight lead loses radios, he should pass the lead to his wingman. The (new) flight lead (with radios) will lead the NORDO back to final approach at the intended destination airport. At approximately 1 mile on final (or sooner/later as weather conditions permit), and when the NORDO aircraft is cleared to land, the flight lead will use the visual signal to pass the lead back to the NORDO aircraft, and assume the chase position. The NORDO aircraft should land normally, pull off the runway, and look for light signals from the tower (if appropriate) (the non-NORDO aircraft should inform tower of the NORDO aircraft's final destination).

GROUND OPERATIONS

After engine start, the flight lead will check-in the flight on *122.75* before taxiing.

Flight lead will taxi at an appropriate speed which allows his wingmen to maintain position.

Flight lead will taxi on one side of the taxiway, wingmen will stagger (i.e. left, right, left, right).

The flight will match lead in the run-up area. Once stopped, each aircraft will perform a thorough pre-takeoff check and run-up.

No flight member will signal ready (thumbs up) until he has received the signal from the wingman behind them.

Flight lead maintains all radio contact with ATC.

After landing, flight lead will exit the runway and allow flight to reform for taxi.

FORMATION TAKEOFFS

Element Takeoffs

The element takeoff is the standard departure method. Element takeoffs will not be done with over 15 knots of crosswind component. Only two aircraft at a time will execute an element takeoff.

Flight/element lead will position his wingman on the upwind side of runway if there is a crosswind component regardless of direction of intended turn-out after takeoff. (See Fig. 1) Wingmen will position themselves well forward of the fingertip line (without being line abreast).

For a 3- or 4-ship formation, #3 lines up on the same side of the runway as lead (offset slightly to either side, if possible). #4 lines up on the same side as #2, in position on #3.

When wingmen are in position and ready for takeoff, they will give a visual head nod to the flight/element lead.

When ready for takeoff, each flight/element lead will give a "run-up" visual signal to the wingman. The element will run up to 1800 rpm with brakes locked.

The flight lead will indicate brake release by smoothly dropping his head to his chest. Both aircraft release brakes at same time, applying full power smoothly.

If wingman falls behind at full power, he states "Lead (or 3), give me one." The element lead will reduce power slightly and continue the takeoff.

If wingman overtakes the element lead for any reason, during any part of the takeoff roll, he states "2 (or position #) has the lead on the right (or left)" and takes

the lead of the flight. Once safely airborne, and at least 500 AGL, the original element lead will direct as required to resume command of flight or element.

When in 3- or 4-ship the second element will wait 5 seconds before brake release.

Initial rejoin (See Fig. 3). and climb speed is 90-100 KIAS. Flight/element lead will cross-under wingman to the inside wing during the rejoin. #4 *automatically* performs a cross-under on #3 to the proper side as #3 moves into the fingertip position on #1.

The #3/#4 element (when applicable) always joins in fingertip to the side opposite #2. #4 is always on the outside of #3. (See Fig. 3)

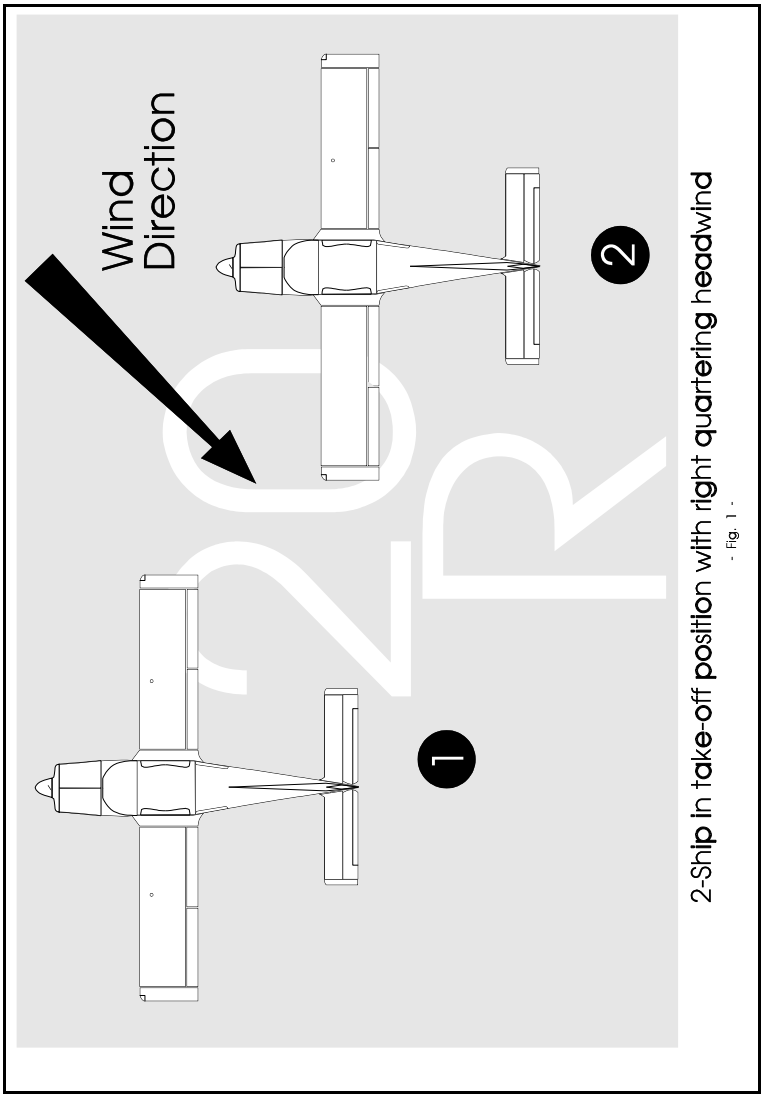
Single-Ship Takeoff

Single-ship takeoffs will be used whenever crosswind component exceeds 15 knots, the runway is less than 50' wide, or briefed by the flight lead.

Ships line up on the runway as in element takeoffs (runway width allowing) or as briefed. Flight lead takes off by himself, maintaining relative side of runway.

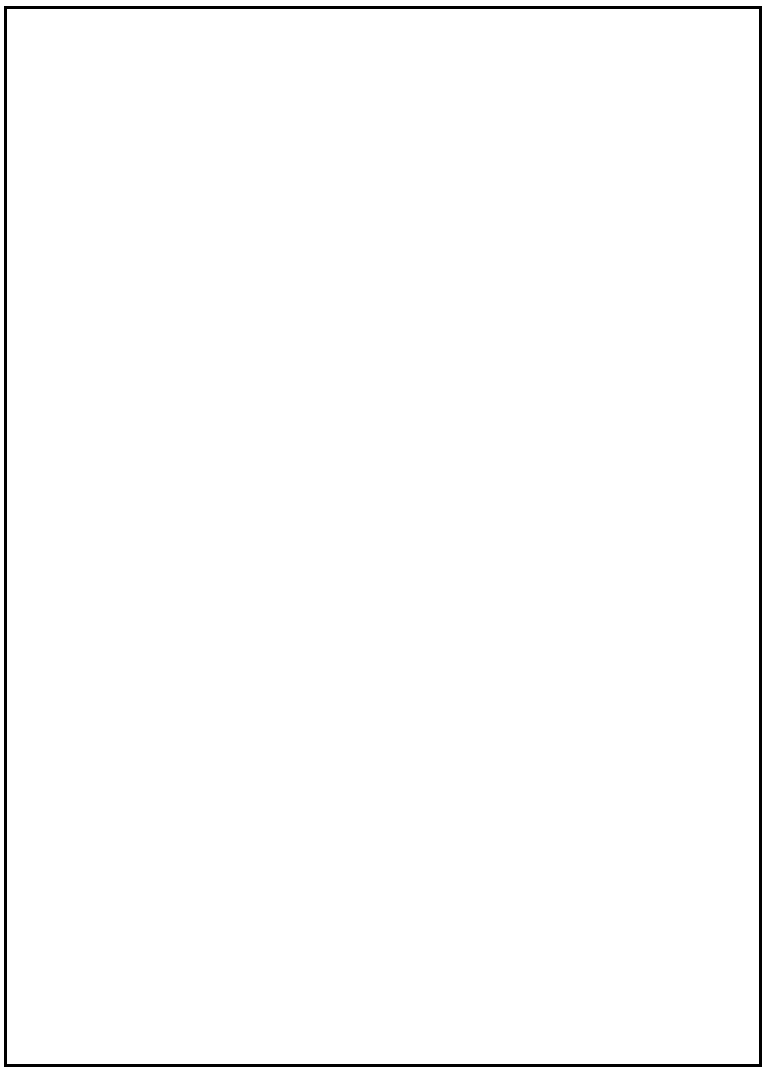
Wingmen release brakes 5 seconds after the preceding aircraft, maintaining their relative position on the runway (e.g. upwind side).

All joinups out of traffic will be to fingertip. Flight lead holds 90-100 KIAS until all wingmen are joined up. #2 *always* joins to the inside of the turn (regardless of position on runway); or if a straight ahead rejoin is executed, to the side positioned on the runway. #3 *always* joins to the outside of the turn (regardless of position on runway); or if a straight ahead rejoin is executed, to the side opposite #2. #4 *always* joins to the outside of #3 (regardless of position on runway). (See Fig. 3) Also, see “Rejoins” on page 11-11.



2-Ship in take-off position with right quartering headwind

- Fig. 1 -



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Lead's turn radius is large enough to allow other aircraft to follow a straight line "across" the circle, thereby using the angle to gain closure.
1
Aircraft 2,3,4 actually follow the same line to join up into echelon formation. Three and four then perform a cross under to move into fingertip
2
3
4
In a re-join 2 ALWAYS rejoins to the inside of the turn. 3 and 4 rejoin to the outside to become an element.

- Fig. 3 -

LANDINGS

Formation Landing

Formation landings will not be done with over 10 knots of crosswind component, or on a wet runway.

Only two aircraft at a time will execute a formation landing.

Flight lead will position his wingman on the upwind side of the runway, if there is a crosswind component.

Flight lead will maintain 75-80 KIAS on final until the threshold. Wingman will maintain a position forward of the fingertip line and stacked level, until the threshold. Over the threshold, when safe, the wingman can pull power to idle and land, or stay with lead. At touchdown, wingman will initiate braking to increase separation from the flight lead.

The flight lead and wingman maintain their own side of the runway until a safe taxi speed is reached. The wingman should call “Lead/3 cleared over” to leading aircraft, if appropriate, to let lead know it is safe to move over to taxi off the runway.

Single-Ship Landings -

Overhead Approach (FAA definition) - A series of predetermined maneuvers prescribed for VFR arrival of military aircraft (often in formation) for entry into the VFR traffic pattern and to proceed to a landing.

The overhead approach is the normal landing method for formation flight. Flight lead will enter the pattern at 100-120 KIAS and normal pattern altitude with the formation in echelon. All turns in the overhead pattern are echelon turns.

Flight lead will give the pitchout signal 5-30 seconds before breaking to downwind. Wingmen will take 3 seconds spacing before each aircraft breaks to downwind.

Break in a level, 35-40 degree bank turn, power unchanged. After 180 degrees of turn:

- Reduce to downwind power (~1500 rpm)
- Extend full flaps abeam numbers
- Adjust spacing on turn to base

Staggered Landing (standard method): Each aircraft lands ~500 feet down the runway for every wingman following. Flight lead lands on downwind side of the runway. Wingmen alternate sides of the runway. Maintain minimum of 500 feet spacing between aircraft at touchdown. Wingmen landing on the "cold" (exit) side of the runway shall call "Lead/3 cleared over" when the aircraft is under control and the brakes are checked to let the aircraft landing ahead on the "hot" side know it can safely move to the "cold" side. Aircraft landing on the "hot" side make no calls other than in an emergency.

Sturdy Landing (alternate method): Each aircraft lands on the runway centerline and when under control with brakes checked, moves to the exit (“cold”) side of the runway. Aircraft which have a problem will (if able) move to the "hot" side to avoid the preceding aircraft. No calls are made unless an aircraft has a problem, in which case the aircraft will inform the flight of the problem and what it is doing, e.g., "3, brake failure, going hot side"; "2, blown tire, stopping on the right side."

The Staggered Landing is standard but the Flight Lead may call for a Sturdy Landing in flight if more appropriate under the conditions existing at landing time. All aircraft in the formation will acknowledge the change (“Tahoe flight, Sturdy Landing” “2” “3” “4”).

IN-FLIGHT PROCEDURES

Formation Types

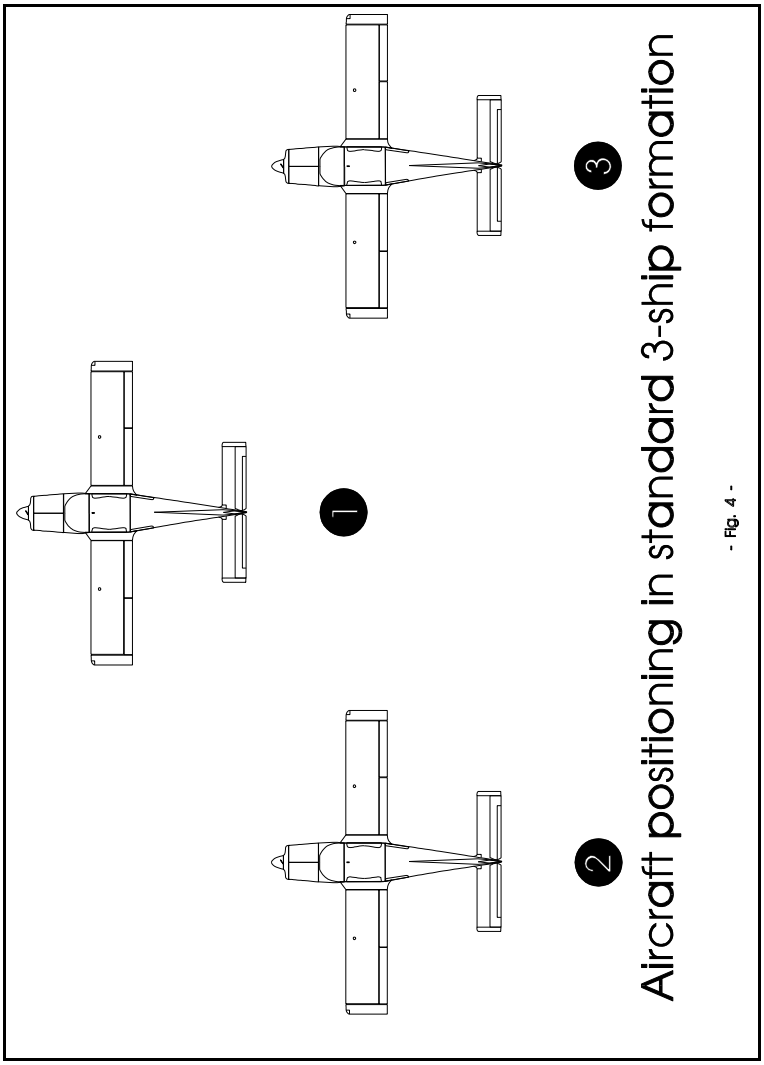
Parade - Fore/aft: rear of nose wheel pant touches the intersection of the front of the main wheel pant and the main tire. In/out: 3 feet lateral wingtip spacing. Up/down: wingman should see the trailing edge of lead's aileron but not lead's flap. Used primarily for tight formation (e.g. overhead approaches, IMC) or with more experienced wingmen.

Route (T-34 FFM "Enoute") - Relaxed fingertip, flown out to 1000 feet. Fly a forward position where the flight lead can see you. No need to be exactly on the fingertip line. Wingmen on the outside of a turn in enroute formation fly an echelon turn.

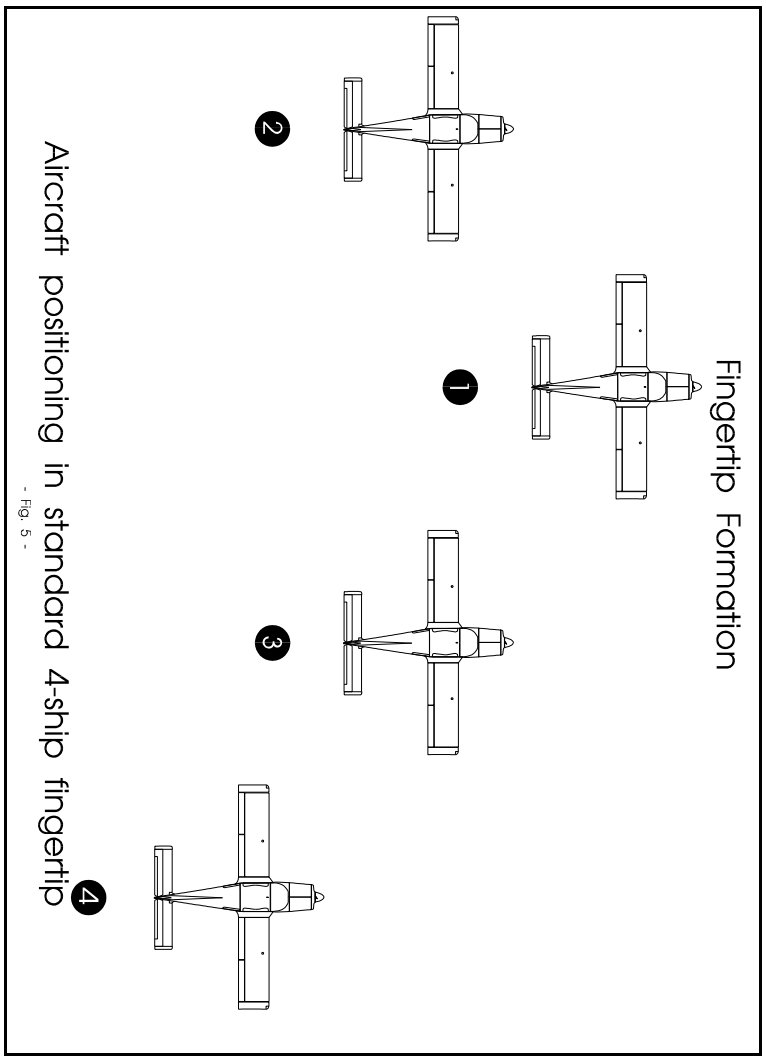
Echelon - All wingmen on the same side of the flight lead. Spacing stays the same as in fingertip or route (depending on formation being flown). All aircraft turn with the flight lead on the horizon. (See Fig. 6)

Fighting Wing - Wingman flies in a "30-45 degree cone" (off the leader's tail) 500-1500 feet out. Power is set and not adjusted by flight lead or wingman. Wingman uses angles and cutoff to maintain spacing. Wingman always attempts to fly in a position where the flight lead can see him.

Rejoin - Lead will hold cruise airspeed except on rejoins out of traffic. Wingmen will rejoin in order, all using the rejoin line off lead. When #3/4 get close to #2, they will execute a cross-under to get into position.

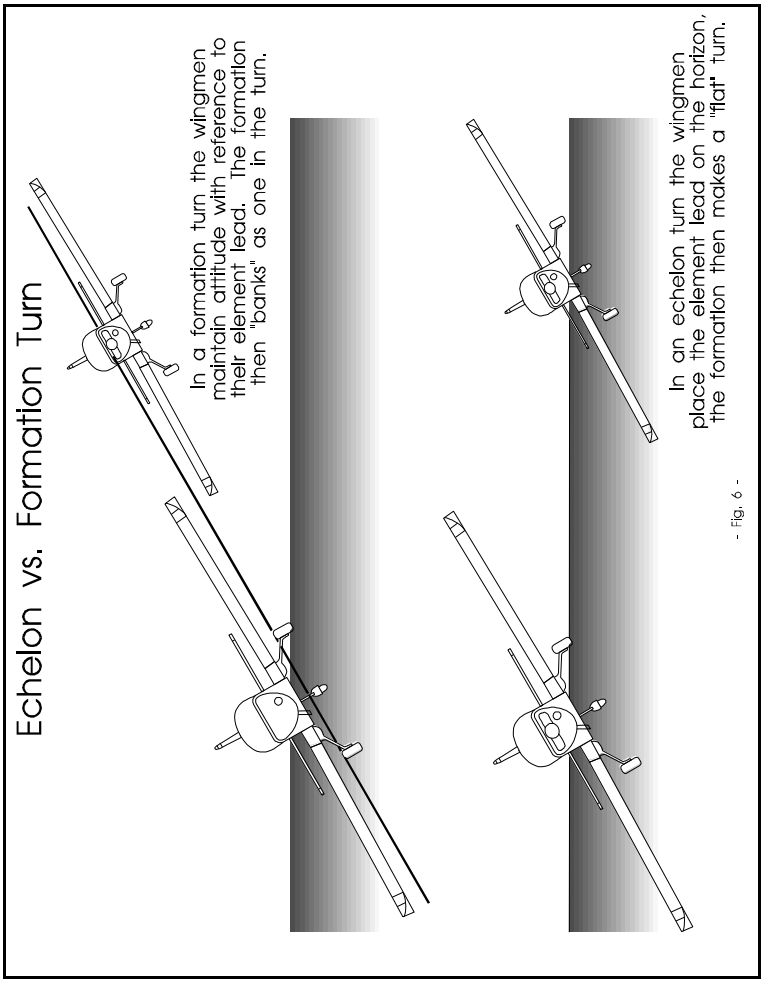


- Fig. 4 -



Aircraft positioning in standard 4-ship fingertip

- Fig. 5 -


Echelon vs. Formation Turn
In a formation turn the wingmen maintain attitude with reference to their element lead. The formation then "banks" as one in the turn.
In an echelon turn the wingmen place the element lead on the horizon, the formation then makes a "flat" turn.
- Fig. 6 -

Lost Wingman Procedures

Lost wingman procedures are only applicable in IMC or for training purposes. These maneuvers will provide adequate clearance between the flight and the lost wingman, while still remaining within protected airspace.

Whenever the wingman loses visual contact with his flight/element lead lost wingman procedures should be IMMEDIATELY executed:

(1) Execute the required maneuvers (see below)

(2) Notify the flight lead

(3) Flight lead will coordinate a separate clearance for the lost flight member. Lost wingmen always maintain the assigned altitude.

Note: #4 always stays with #3, unless #4 goes lost wingman.

While Straight and Level

#2 will alter his heading 15 degrees away from the flight for 15 seconds, then correct back to the original heading.

#3 will perform the same maneuver as #2.

#4 will alter his heading 30 degrees from the flight for 15 seconds, then correct back to the original heading.

The call is "2 (or position number) is lost wingman". Lead will acknowledge with the flight's heading and altitude.

While Turning – Wingman/men on High Wing

Lead continues his turn. #2 will immediately roll level for 15 seconds before turning to the heading that the flight rolls out on.

#3 will perform the same maneuver as #2.

#4 will roll into a standard rate turn away from the flight for 15 seconds, then turn to the heading that the flight rolls out on.

The call is "2 (or position number) is lost wingman rolled out" followed by his current heading.

Lead will respond with the flight's altitude and the target heading of the flight; e.g. "Grumman flight at eight thousand turning to 290".

While Turning – Wingman/men on Low Wing

In this situation making the radio call is the first thing that the lost wingman does. The emphasis is on being directive. The call is "Lead roll out, 2 (or position number) is lost wingman".

Lead will respond by rolling level (the remainder or the flight rolls out with lead), and acknowledges with the flights altitude and current heading.

#2 will continue the turn for an additional 15 degrees, fly that heading for 15 seconds, then turn to the same heading as the rest of the flight.

#3 will perform the same maneuver as #2.

#4 will steepen his turn away from the flight and turn for an additional 30 degrees, fly that heading for 15 seconds, then turn to the same heading as the rest of the flight.

While Inside Final Approach Fix

If any member of the flight goes lost wingman on an instrument approach inside the final approach fix the lost wingman immediately 1) climbs to FAF altitude and 2) executes the published missed approach procedure upon reaching the MAP.

Visual Signals

Visual signals will be used as much as practical, to hold down radio chatter and to develop better formation skills.

The wingman should respond to a signal by the flight lead in the same manner as the flight lead gave it to him. If the flight lead uses a visual signal, the wingman responds with a visual signal (as appropriate). If lead uses the radio, response (as appropriate) is by radio. If a wingman (or flight lead) misses or does not understand a visual signal, he shakes his head, like saying "no". This says that he did not get the signal, and requests the signal to be sent again.

The flight lead should hold the visual signal so it is prominent to the wingman. One of the best places is over the instrument panel, above the glare shield, on the same side as the wingman.

Lead Change – See T-34 FFM. The lead is changed when the wingman acknowledges the signal (or radio call). (See Fig. 7 and 8)

Rejoin/rendezvous – See T-34 FFM. Always indicates a rejoin to fingertip. Rejoins should be executed along the fingertip line.

Route/combat spread – See T-34 FFM (“Enroute”). This visual signal technically means "loosen the formation", which we define as "route" position.

Fighting Wing - With thumb outstretched from fist, move fist over shoulder several times (as in a hitchhiking motion).

Perform Checklist (in-flight, before landing, fuel, etc.) - Lead makes a "check" signal with the index finger and thumb (90 degree angle).

Cross-Under – See T-34 FFM. (Fig 9-10)

Echelon Turn - The index finger and little finger pointing up (like “landing lights on”), moving between vertical and horizontal several times. Note: not needed when in echelon formation (3 or more aircraft); all turns are echelon turns in this situation. (See Fig. 6)

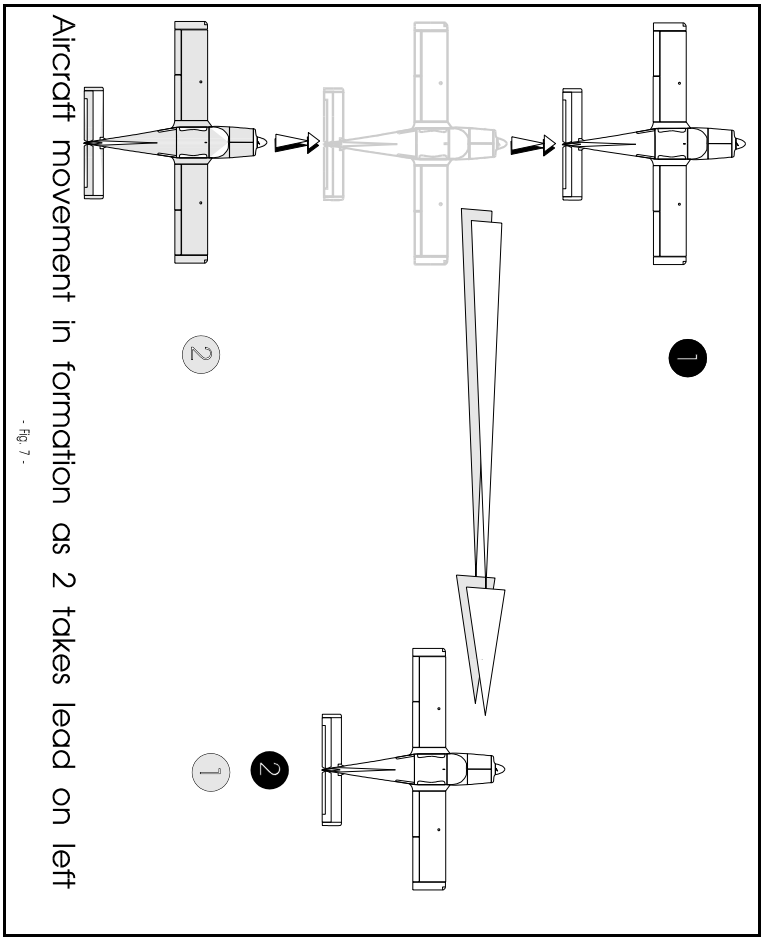
Lost Radios – See T-34 FFM.

Numbers - See T-34 FFM. All numbers are made with one hand. 1,2,3,4,5 are indicated by using the appropriate number of fingers, holding them straight up. 6,7,8,9 are indicated by holding fingers horizontal, and adding 5. 0 is indicated with a closed fist. Typically used for frequency changes when discretion is wanted.

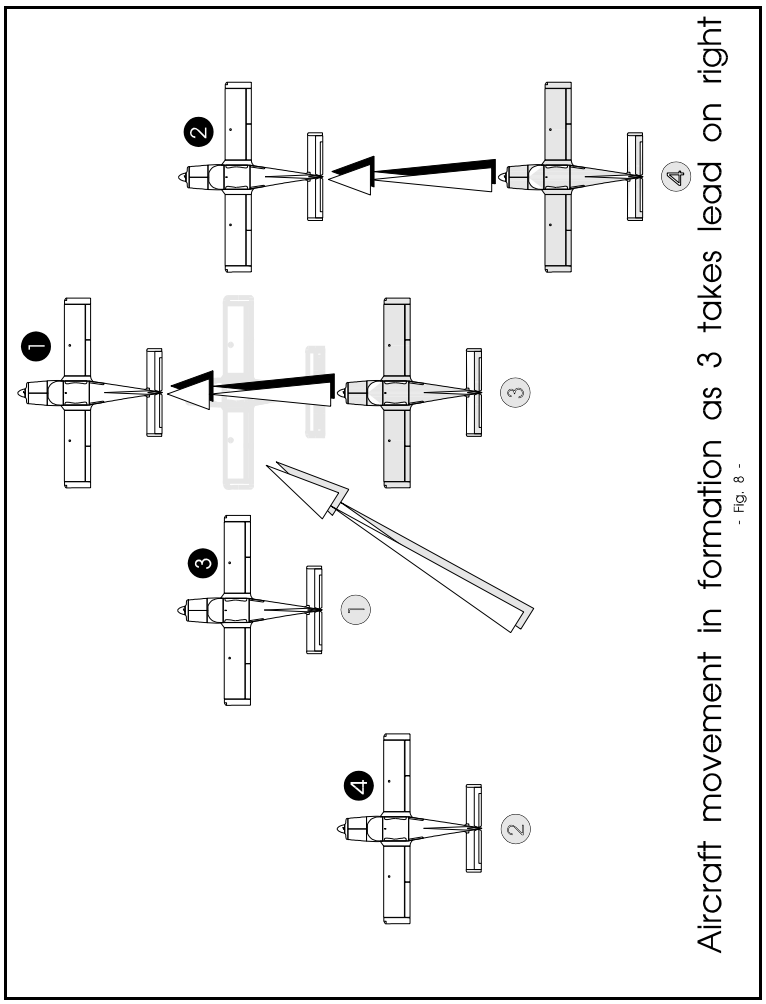
Frequency Change – See T-34 FFM.

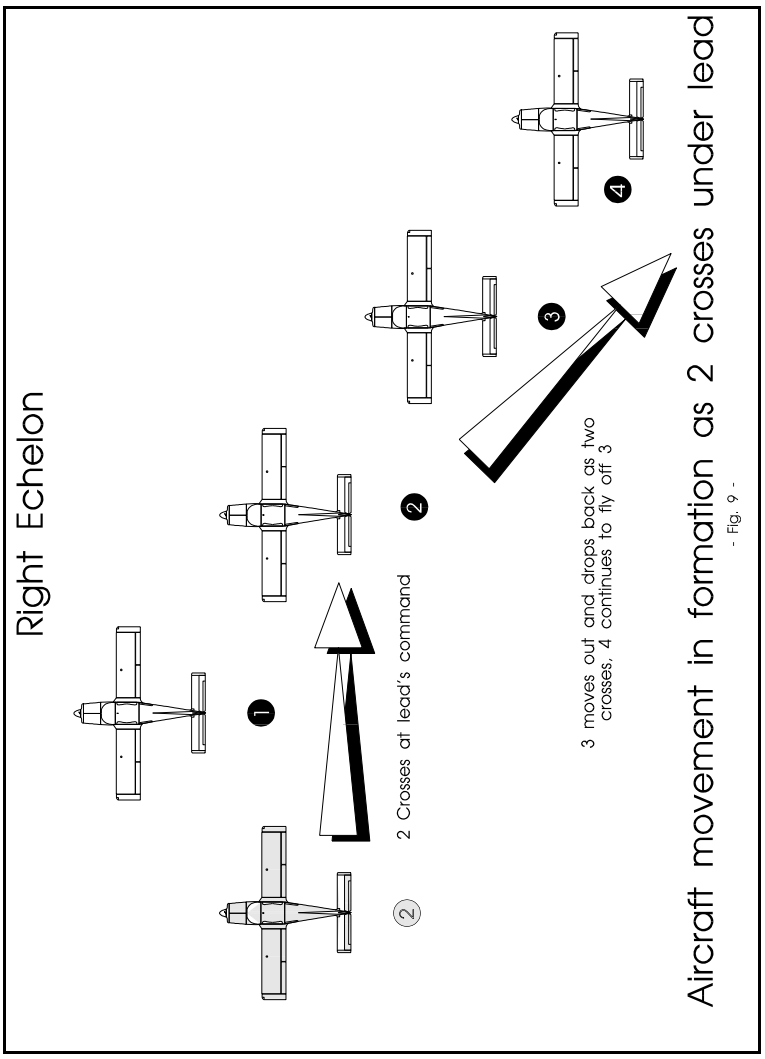
Pitchout/Run-up - See T-34 FFM. Pitchout interval is 3 seconds.

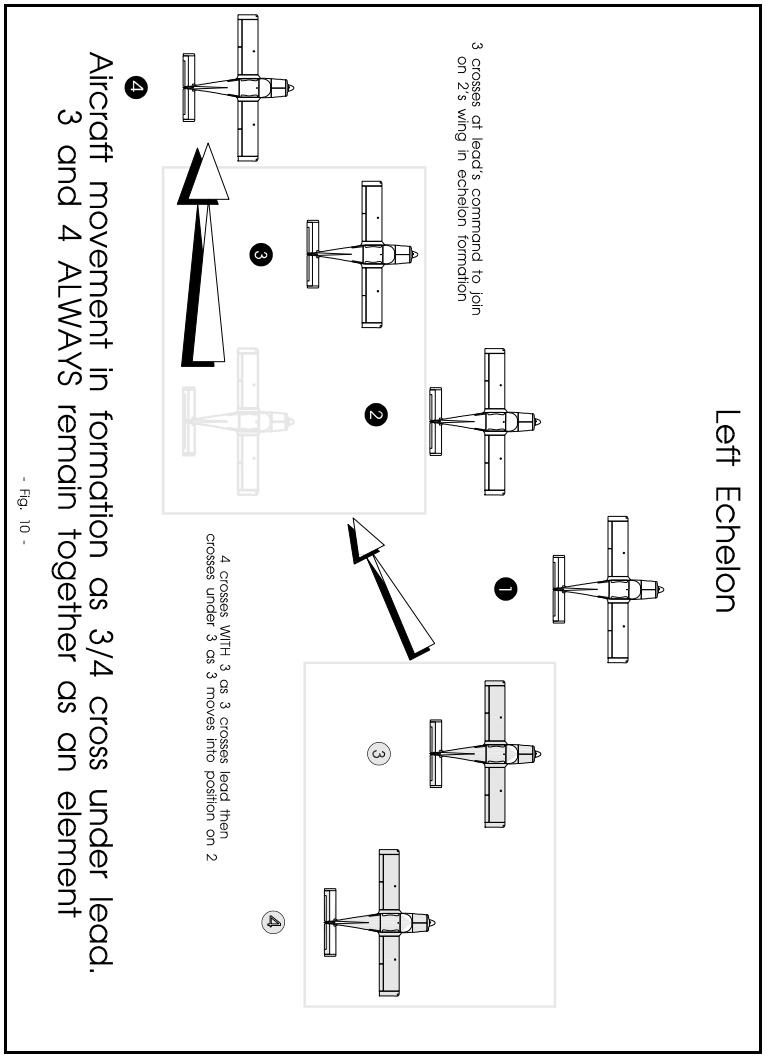
Flaps – See T-34 FFM for hand signal. Flap actuation for a formation landing is in two steps. The first time lead gives the flap signal and head nod, it is for ½ flaps (approximately 3 seconds actuation time). The second signal indicates to the wingman to go to full flaps.



- Fig. 7 -


Aircraft movement in formation as 3 takes lead on right
- Fig. 8 -


Right Echelon
2 Crosses at lead's command
3 moves out and drops back as two crosses, 4 continues to fly off 3
Aircraft movement in formation as 2 crosses under lead
- Fig. 9 -


Left Echelon
3 crosses at lead's command to join on 2's wing in echelon formation
4 crosses WITH 3 as 3 crosses lead then crosses under 3 as 3 moves into position on 2
4 Aircraft movement in formation as 3/4 cross under lead. 3 and 4 ALWAYS remain together as an element

- Fig. 10 -

Definitions/Standard Phraseology/Glossary

Beachball – the radio frequency 123.45.

Bingo - Aircraft has reached a fuel state where any delay in reaching the destination will result in a minimum fuel state.

Blind - I do not see the aircraft (in our flight).

Chase - A position well clear of a stricken aircraft, 500-1000 feet behind and to the side. The chase aircraft acts as safety observer for the stricken aircraft, and is available should he be called upon.

Check-In – the procedure where each aircraft in the flight checks in to Lead with their corresponding position number, in order.

Cross-under – a formation maneuver where a wingman/wingmen will cross under and slightly behind his lead aircraft and take position on Lead's other wing.

Directive - a radio transmission from a member of the flight to another to take action. This should be used to notify any flight member of any unsafe or soon-to-be unsafe situations, like avoiding traffic.

Element/Section - 2 aircraft operating as a unit, as in #1-2 and #3-4. #3 is considered an element lead in a 4-ship (but is not the flight lead).

No Joy - I do not see the aircraft (not in our flight).

NORDO – no radio. A condition where an aircraft has lost use of the communications radios.

Overhead Approach (FAA definition) – A series of predetermined maneuvers prescribed for VFR arrival of military or Grumman aircraft (often in formation) for entry into the VFR traffic pattern and to proceed to a landing. See also the AIM.

Staggered Landing – The standard formation landing method in which all aircraft land off the centerline, with each aircraft landing on the side opposite the preceding aircraft.

Sturdy Landing – An alternate formation landing method in which all aircraft land on centerline and move to the "cold" side of the runway when under control with brakes checked.

Tally (Tally-ho) - I see the aircraft (not in our flight).

Visual - I see the aircraft (in our flight).

Many thanks to the Lunken Cat House Gang.
In memory of Jon Maestre. May we all fly in formation together again.