



WEST COAST RV FORMATION TRAINING GUIDE

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This guideline is written as a reference document for those pilots wishing to train in the art of RV Formation flying. Whether you are an FFI Flight Lead or an experienced FFI Wingman stepping up to help train new formation pilots, this document is intended to offer a training guideline for bringing a new formation pilot along from "Rookie" status to 4-ship FFI Evaluation. While an FFI Flight Lead recommendation is required for a candidate to take a Wingman checkride, both FFI Flight Leads and experienced FFI Wingmen may be asked to lead flights as a means to train follow on candidates. In this document, Flight Leader refers to any pilot that takes on the responsibility of leading flights in this training environment. While realizing there may be limitations in resources, this Guide attempts to provide the flight leader a reference to train by, whether at a formal clinic or at your home airport. These are the thoughts of Flight Leads and / or Check Pilots, all with military and/or GA backgrounds and significant formation instruction experience training pilots in the basics of formation flying. Please use this document as you see fit and as an aid to help establish your personal guidelines as you gain experience in the formation arena.

FORMATION CLINIC OBJECTIVES

- Provide a structured and disciplined approach to formation training.
- Provide the opportunity for new and advanced formation pilots to enhance their skills.
- Promote fellowship and camaraderie within the Formation Pilot community. i.e. HAVE FUN

PRIORITIES FOR THE CLINIC

- 4-ship Formation Demo sortie for those new to formation flying
- All Rookies have the opportunity to fly at least one 2-ship training flight with a safety pilot.
- 2, 3, and 4-ship training flights to enhance the skills of the Novice, Intermediate and Advanced Formation pilots.
- All-Up practice for carded and selected advanced pilots to enhance their skills in Large Formation flying.

DEFINITIONS

ROOKIE	Little to no formation experience. Requires a safety pilot.
NOVICE	Some experience in maneuvering formation. Cleared 2-ship solo. See para 2. D. under PROGRESSION below.
INTERMEDIATE	Solid 2-ship capability. Cleared for 4-ship solo. Working on 4-ship maneuvering and positioning skills. Able to hold Lazy 8 position at 45 degrees of bank and 10-15 degrees of pitch.
ADVANCED	Displays a high degree of discipline, becoming solid at 4-ship station keeping/maneuvering. Close to FFI recommendation.
WINGMAN	FFI carded wingman
FLT LEAD	FFI carded Flight Lead
CHECK PILOT	FFI carded Check Pilot

BASICS

We have many levels of experience in the formation community, from the pilot with no formation experience to the military or FAST pilot with an extensive background, but perhaps new to the RV formation world. It is the flight leader's task to determine each individual's background, experience and capability level to determine the best training program. An individual may require all or partial use of the training guidelines and profiles listed below. It is also the responsibility of the flight leader to assess the "stick and rudder" skills of the trainee. An airman that does not demonstrate excellent command of their aircraft should be excused from training until such point that their piloting skills meet the standard.

EDUCATION

All participants should have a basic or higher understanding of formation flying. In all cases each pilot must be thoroughly familiar with the RV FORMATION GUIDELINES AND STANDARD PROCEDURES, which is the primary FFI standardization document. The "RV Formation Guideline" can be supplemented with the T-34 Formation Manual 4th Edition, the Darton Formation Videos, and the FAST Formation Manual. The Training Guideline presented here is meant to supplement these documents. If any discrepancy exists, then the RV Formation Guideline and Standard Procedures will take precedence.

PROGRESSION

For the pilot new to formation flying the basic progression should proceed as follows:

- A. 4-Ship Demonstration Flight**—The purpose of the Flight is to have the trainee fly with an experienced formation pilot in order to "Demo" the perfect flight, to show the trainee how it is supposed to look when he/she gets to an advanced level of training. This also gives the trainee the opportunity to determine if this is a disciplined skill he/she is willing to pursue. The goal is a 4-ship Demo flight, but depending on resources this can be accomplished in a 2 or 3 ship.
- B. 2-ship Training Flight with a dedicated Flight Lead and a safety observer** riding with the trainee. These 2-ship flights should continue on a regular basis until the Flight Lead and safety observer determine that the trainee is ready for 2-ship solo. Training always starts with level turns of approximately 10-20 degrees of bank and then progresses as the trainee gains confidence and experience
- C. 2-ship training with the trainee flying solo** and increasing proficiency in all maneuvers. Simplified 3 ship training may also be included in this phase. To progress from Novice to Intermediate the trainee should be stable in bank angles of 30-45 degrees of bank and up to 15 degrees of pitch during Lazy 8 maneuvering in Fingertip and Close Trail
- D. 4-ship training.** The trainee should fly 2-ship formations until the Flight Lead is comfortable in his abilities to progress to 4-ship training. If resources are available, it is preferred to have the Novice pilot fly with a safety observer on the first 4-ship sortie, and thereafter until the Flight Lead assesses that the trainee is safe for 4-ship solo, i.e. achieves Intermediate status. However, this is not a hard requirement. Based on the Flight Lead's assessment of an individual's ability, the Novice may be placed in a 3 or 4 ship-training sortie solo after careful consideration of the experience makeup of the rest of the flight, the position to be flown (i.e. 2, 3 or 4), and environmental factors affecting the flight. 4-ship training should continue increasing complexity of pitch and angles in the maneuvers as the trainee progresses.
- E. 4-ship FFI Evaluation.** If the pilot wishes to display his/her formation skills within waived airspace at air shows or special events, an FFI card is required. The evaluation by an FFI Check Pilot will determine if the candidate's formation skills are of "air show quality" before issuing an FFI Wingman Card. A recommendation by an FFI Flight Lead or Check Pilot is required prior to an evaluation.

FLIGHT PROFILES

2-SHIP PRE SOLO

- Single Ship Takeoff - minimum first sortie. Formation takeoffs should be introduced when the trainee shows stability in fingertip formation. Desired to have a safety pilot on the first formation takeoff.
- Join up to fingertip (parade) formation---coach or demo by safety pilot
- Fingertip (Parade) Formation, Left and Right wings. Straight and level and left and right turns
- Route including S-turns
- Out and In on the line Exercise
- Crossunders
- Pitch-outs and Rejoins. Minimum of one to the left and one to the right
- Echelon turns
- Close trail
- Route
- RTB (Return to base)
- Initial for the overhead pattern
- Single ship landings

The priority on the first formation flight is to get the trainee comfortable and stable in fingertip position and able to rejoin safely from a Pitchout and Rejoin. Typically, route, fingertip, crossunders and rejoins will be the extent of an individual's concentration during the first few Rookie flights. Prior to clearing for solo, the Rookie should be stable in fingertip, crossunders and pitchouts and rejoins. A close trail clearance should be required prior to performing solo.

It is always a very subjective decision whether to clear an individual to go solo. The most important factor: is the Flight Lead willing to fly with that individual on his wing without in-plane supervision? If the answer is yes—go fly. If there is a doubt—then there is no doubt, give him another flight.

In the safe-for-solo decision, Flight Leads need to determine if the individual is safe and predictable in formation. The metric is, not so much that he holds or maintains perfect position but that he is stable in his position. The new wingman needs to be able to see mistakes and make positive corrections. One shouldn't expect those corrections to be fine-tuned at this point.

GUIDELINES ON BASIC PROFILE

FINGERTIP FORMATION

Pilot must be stable in his positioning and understand the correct position. He should be able to recognize position errors, see mistakes and work to make timely, positive corrections in a controlled manner. Depending on student performance, Lead should perform left and right turns with the trainee on the left and right wing. Pilot should be able to follow along smoothly, though small mistakes and excursions from desired position are normal and acceptable.

CROSSUNDERS

Pilot should be able to safely perform a crossunder in a controlled manner. Should be slow and deliberate. Flight Leads should brief crossunders thoroughly and discourage any large aileron or power changes, or any tendency to rush or swoop across. The Flight Lead cannot totally monitor a wingman performing a crossunder. For this reason, the pilot should fly this maneuver consistently to the satisfaction of the Safety Pilot prior to solo.

OUT AND IN ON THE LINE EXERCISE

This is a good maneuver to get the pilot comfortable with closing up the bearing line, as in the final stage of a rejoin. While in fingertip formation, a good exercise is to have the pilot reduce power so as to fly "Out" the bearing line to about 100-200 feet. Stabilize and then add power to fly back up the line into fingertip (parade) formation. This helps establish the motor skills required with pitch, power, and bank to move in and out of position. This building block approach is used to introduce rejoins. Initially start in straight and level flight and progress to doing the exercise while in a turn.

PITCHOUT AND REJOINS

Since a formation flight will typically be going back to the Initial for landing, this needs to be accomplished and practiced in the area. Pilot should be able to make a level 60-degree bank turn, maintain sight of the lead aircraft and establish a trail position. Once again, this is another maneuver the Flight Lead cannot monitor and requires a safety pilot for instructional tips.

The pilot should be able to identify "the bearing line", determine if sucked or acute, correct to the bearing line and rejoin in a controlled manner. NEVER go belly-up to lead. The pilot needs a clear understanding of when and how to under-run if required. Since the Flight Lead can monitor the complete rejoin, look for safe habits by the pilot in order to solo.

CLOSE TRAIL

This is one of the maneuvers where a Flight Lead has limited control since he/she cannot monitor the wingman. The trainee pilot should see this position and be cleared by the Safety Pilot prior to performing solo. Typically, an individual's self preservation will keep him far enough away, but it's important for him to understand closure and how to cope with it. A pilot can certainly be cleared for solo without a Close Trail event, but should not be allowed to fly it in profiles until cleared by a safety pilot.

ROUTE

Typically, the new formation pilot has no problem being in route formation. But, they must understand it is a position they need to maintain and they need to understand how to crosscheck lead as they scan the cockpit and scan for other traffic. Perform S-turns so the trainee learns how to adjust position appropriately in route turns

ECHELON TURNS

Echelon can be introduced at anytime pre or post solo. It is desired to have a Safety Observer on board to help the trainee see the correct sight picture and coach through the first few echelon turns. If introduced solo, then the flight lead in a RV-6, 7 or 9 should have the wingman on the pilot's side in order to monitor and coach the trainee through the maneuver.

FORMATION TAKEOFF

This maneuver can be introduced either pre or post solo. However, it is desired that a Safety Pilot be utilized for the first formation takeoff, even if the pilot has previously soloed in a 2-ship. Flight Leads must always include a complete briefing on positioning, techniques and what-ifs, i.e. aborts, getting ahead / behind during takeoff roll, etc. It is important to make sure to have at least 10-15 foot wingtip spacing to allow for possible directional control issues. The pilot must have demonstrated good stability in Fingertip formation prior to attempting a formation takeoff solo.

2 SHIP POST SOLO PROFILE

- Formation Takeoff
- Route Formation with S-turns
- Fingertip Formation on Left and Right Wings
- Crossunders
- Echelon Turns
- Pitchouts and Rejoins
- Close Trail
- Extended Trail
- Initial for Pitchout and Landing
- Wing Formation Landings (as experience is gained)

GUIDELINES FOR 2 SHIP SOLO MANEUVERS

FINGERTIP FORMATION

Introduce increased pitch and bank angles as proficiency is developed. It's important to challenge the novice as he starts to settle in, but Flight Leads should always be wary of spatial disorientation at higher angles of bank. Can introduce crossunders while in a turn or climb/descent. Lead must always monitor the wingman during fingertip formation. Whenever starting a turn into the wingman, always make sure he is looking and responding appropriately especially as he gets a little more confident in his abilities. As the pilot increases in skill and stability, Leads should introduce greater bank and pitch angles during maneuvering, slowly working towards the 60 degree bank angle and 30 degree pitch angle limits.

ECHELON TURNS

As the pilot increases in skill and stability, Leads should introduce greater bank angles during maneuvering, slowly working towards the trainee maintaining position at bank angles of up to 60 degrees in a level turn. Emphasis should be on smoothness and maintaining proper position with the anticipation of power and "G" as the turn progresses.

PITCHOUT AND REJOINS

Vary the spacing from 2 sec to 8 sec to show the difference of longer range rejoins. Introduce rejoins to the outside of the turn, as flown from #3 or #4. Lead should also set-up overshoot situations where the pilot will be forced to properly under-run the rejoin. Always ensure the wingman goes behind and below the Lead aircraft and dissipates his energy to the outside level with lead (i.e. does not climb) and then reestablishes an inside line to complete rejoin. Be especially alert for the common early tendency, after an overshoot, for the pilot to over-correct in bank, and pull back into Lead from the outside. A technique the leader can use to "help along" an under-run event is to very gradually increase airspeed as the rejoin progresses. Then as the wingman approaches within approximately 100' smoothly reduce power to about the idle throttle position. As the under-run occurs reestablish stable power and airspeed.

CLOSE TRAIL

Increase pitch and angles as proficiency allows. It is very helpful to have an experienced pilot fly as a chase or in trail of #2, who can provide feedback of spacing and alignment. As the pilot increases in skill and stability, Leads should introduce greater bank and pitch angles during maneuvering, slowly working towards the 60 degree bank angle and 30 degree pitch angle limits.

EXTENDED TRAIL

Extended Trail can be introduced once a student is in the Novice phase and is starting to look for some additional challenges. Start with mild Lazy 8 maneuvers until the pilot understands how to maneuver to "Lead" for closure and "Lag" for separation. As experience is gained increase the challenge with larger angles, and increased G. A flight lead should always be able to see or be situationally aware where his wingman is during the entire maneuver. The goal is for the trainee to maintain the 500-1000' position using "lead" and "lag" as appropriate with a constant stabilized power setting.

INITIAL and PITCHOUT / LANDING

Continue to emphasize proper spacing in the pattern to include downwind, base and final.

WING FORMATION LANDINGS

The pilot should typically have advanced to at least INTERMEDIATE status prior to introducing Wing Landings. There is no hurry; this is a higher risk maneuver. There are very few times this is required in our daily flying. The military would only do these to get more aircraft down in a reduced timeframe during instrument conditions. Formation landings can be practiced while solo, however, the first formation landing should be with a safety observer unless a high proficiency level is demonstrated.

Emphasis items during formation landing training:

- Stack Level no later than about 100-200' on final
- Should see same picture as Formation Takeoff, i.e. top of wing, no further aft than wing's leading edge aligned with lead's trailing edge.
- Pilots new to wing landings often ask "where to look and when". A good technique is to start by watching Lead 90% of time and scanning the runway 10% of time, at 1 mile. At ½ mile, scan should be about 80% and 20%. Nearing the flare, start a transition to scanning the runway more, and watching Lead less, at touchdown the scan is about 10% Lead and 90% runway. The wingman's head is always toward Lead and flying off him.
- Scan the runway just by shifting eyes quickly to ensure alignment. Once into the flare, the wingman should slowly transition his head to looking more forward but also scanning the lead for relative position. The goal is a simultaneous touchdown, lead and wing aircraft, each on their appropriate sides of the runway, in proper formation. After touchdown, ensure positive directional control and start the slowdown process. Once under control, wingman should advise Lead that "2 is Cold" if required.
- It is always good practice to brief a contingency should the wingman, for any reason. move ahead of the lead aircraft upon landing. Emphasis should be on not over-braking to get behind lead. The wingman's total focus at this point is to ensure a safe landing on the proper side of the runway, then start the slowing process while maintaining directional control. The flight lead will be directive as to whether the wingman should exit the runway before the leader or wait for the leader to pass.

4 SHIP POST SOLO TRAINING

The 2-ship element / section is the basis for all formation flights. The basic flying formation for most everything we do is the 4 ship. It is the building block unit for establishing larger formations. Our training will work up to 4-ship proficiency and our evaluations will be in 4 ship formations.

Each flight leader should train a new formation pilot with the same building block approach. Introducing 4 ship formations as both #2 and #4, while increasing angles and complexity of maneuvers as proficiency is attained. A good baseline for an FFI recommendation is when a pilot can complete 2 or 3 consecutive "checkride profile" sorties meeting or exceeding the FFI Evaluation standards as stated in the FFI Manual. I.E. a "Good" or better evaluation in all maneuvers.

MISSION ELEMENTS

MANEUVERING FORMATIONS

Fingertip, Diamond, Close Trail and Extended Trail should have a goal of wingman achieving stable positions in Lazy 8 maneuvering with up to 60 degrees bank and up to 30 degrees of pitch in the #2 and #4 positions. Certainly, the hardest position is #4 as he is on the outside of the whip and will be most power critical. If practicing as a 3-ship then can utilize a "Phantom 2" formation to allow practice at the "#4" position.

REJOINS

One of the greatest differences in 4-ship formation is the rejoin. #3 and #4 will now join to the outside of the turn. Monitor closely and watch for Bearing Line discipline. Emphasis should be placed on timing the turn to the rejoin line for #2, #3, #4. A good technique is for #2 to move expeditiously to the rejoin line, while #3 and #4 delay slightly prior to starting their turn and establishing the line. All should join in sequence and monitor that #3 and #4 crossunder to the outside as they pass close in trail to #2 and then #1 with energy so as not to stagnate on the outside of the turn.

ECHELON

Echelon formation should be practiced to allow time for the formation to settle and allow each wingman to get set and comfortable in the position. Many times we rush this formation in our attempt to get to the Echelon Turn. This is a corner stone skill for future large formation positions. Emphasis placed on looking through the wingmen to and flying off of #1. Once this formation is stabilized then execute an echelon turn. For a 4-ship echelon turn, the goal is proper positioning for a 180 degree level turn at 45 degrees of bank.

EXTENDED TRAIL MANEUVERING

Introducing Extended Trail maneuvering in a 4-ship environment has some unique challenges. The trainee must keep track of multiple aircraft in a dynamic maneuvering environment. Whether entering Extended Trail from a Close Trail formation or an Echelon formation, emphasis must be placed on the trainee identifying the aircraft in front of him at maneuver entry and subsequently maintaining visual on all aircraft in front of him during the entire exercise. As a leader, look for proper spacing between aircraft and coach as appropriate in the use of "Lead" or "Lag". Also, as a leader, always identify the position of #4 (or last aircraft in trail) prior to turning into the formation. Lazy 8 maneuvering should be tailored to the experience level of the flight. Start with lower angles and pitch, increasing as experience is attained. Evaluation standards are to maintain proper spacing with the use of "Lead" and "Lag" at pitch angles up to 30 degrees and 60 degrees of bank.

GROUND OPERATIONS AND RADIO DISCIPLINE

Disciplined ground operations should be briefed, demonstrated, taught and debriefed from the very beginning of formation training. At this stage, the trainee should be able to start on time (or on the leader's signal), be ready for check-in on the proper frequency at the proper time, with sharp radio responses and in the proper sequence, maintain briefed taxi spacing, proper line-up in run-up area and on runway for takeoff, and understand and respond correctly to all ground and inflight signals. A good rule of thumb is, "A quiet flight is a good flight"

4 SHIP CHECKRIDE PROFILE

The 4 ship checkride profile must include the following mission elements:

Brief	Lazy 8's in:	Echelon turns
Start		Pitchout and rejoins
Formation taxi	• Fingertip	Initial and 360° overhead
Formation takeoff	• Diamond	Wing formation landing
Climbout	• Close trail	Taxi-in
Route	• Extended trail	Shutdown
Crossunders		Debrief

Each Wing candidate should fly Lazy 8's (a turn in each direction with climbs and descents) as both #2 and #4 in fingertip, diamond, close trail, and extended trail. Candidates should also demonstrate echelon formation with turns, and pitchouts and rejoins in both left and right turns as #2 and as #4. Return to base will be via an initial for the 360° overhead pattern to a low approach, missed approach and 2 element / section wing formation landings. The profile is completed with a formation taxi-in and shutdown.

NOTE: The candidate / applicant can be qualified without a wing landing if conditions or facilities dictate.

There is no single mandatory "checkride" profile. It is up to each Lead to accomplish all of the required maneuvers during a check flight.

There are several different commonly used profiles that minimize time and redundancy while including all required maneuvers. The following is only one example that includes all mission elements for a Check Pilot assessing Wingman Candidates as #2 and #4. (See Attachment #1 for a Shorthand notation of the Checkride routine).

TYPICAL FORMATION FLIGHT EVALUATION SCENARIO

- START - start at required time or with signal
- CHECK IN - Check in on correct radio frequency as directed by Lead
- TAXI - staggered (if practical)
- FORMATION TAKEOFF - 2 elements in formation takeoffs
- JOIN UP - Join to 4 ship fingertip formation
- ROUTE - Route formation exiting the Traffic Pattern and initial climb, frequency change, Ops check, turns in each direction.
- FINGERTIP - 4 ship Lazy 8 maneuvering. Minimum of one turn in each direction, one climb, one descent. Turns of up to 30° pitch and approximately 60° bank
- CROSSUNDER TO ECHELON - left or right, #2 or element
- ECHELON TURNS - 180 degrees of turn
- PITCHOUT AND REJOIN - Direction of rejoin turn to put #2 on opposite side
- FINGERTIP - Lazy 8's again, opposite sides
- DIAMOND - Move #4 to the slot. Lazy 8's
- CLOSE TRAIL - Brief this specifically. Careful that #4 does not go too far back when allowing #2 and #3 into position. Lazy 8's

- EXTENDED TRAIL - Specifically brief this transition. Lead calls for the flight to go Extended Trail and gets an acknowledgement. Lead conducts a level, low energy turn away eventually achieving a maximum of 45° angle of bank, mostly level turn until #4 calls in, then begins in large Lazy 8 maneuvers using as much as 30° of pitch and 60° of bank.
- REJOIN to FINGERTIP - In opposite direction as first rejoin
- ROUTE FORMATION
- LEAD CHANGE - Each wingman being evaluated must fly at both #2 and #4 positions. A Lead change prior to executing the second set of maneuvers is an efficient way to accomplish this, especially if two wingman candidates are being evaluated.

When only one wingman candidate is in a flight, or if there is only one Lead-capable pilot in the flight, moving the wingmen from #2 to #4 may also be accomplished via radio calls to reposition the flight, without executing a Lead change.

If a Lead Change is used:

- The old #3 becomes #1 (Lead)
 - New lead will check in flight with new position numbers
 - Ops check
 - Repeat profile (extended trail needs to only have been executed once during the flight)
 - After close trail, wingrock to reform flight into fingertip.
 - Flight Lead choice to RTB in current positions or Lead Change back to original flight positions
- ROUTE - return to base, descent in route with turns, and frequency change
 - CROSSUNDER TO ECHELON - for pattern entry
 - OVERHEAD PATTERN - PITCHOUT 2 second interval
 - LOW APPROACH - Each aircraft maintains spacing through complete pattern and goes around just before touchdown
 - REJOIN - in 2 elements on the turn to downwind
 - FORMATION LANDINGS
 - TAXI BACK and SHUTDOWN - staggered taxi if practical, shutdown as a formation

DEBRIEF

Lead will restate the objectives and review how the flight performed in all phases from engine start to shut down, with emphasis on what occurred, why it occurred, and how to improve in the future. Each member of the flight will be given an opportunity to critique the flight, the self-critique being an important component of each debrief.

Wingmen, DO NOT be the last one into the briefing room!

CONCLUSION

Our hope is these "Training Guidelines" will provide the new flight leader with a template, and some guidance as how to approach the checkout of a new FFI Wingman. Obviously, not all situations can be described here. It is incumbent on flight leaders to know the comfort level and capabilities of their wingmen on each and every flight and to tailor their profiles accordingly. However, with thorough briefings, disciplined flying, detailed debriefings and the judicious use of good judgment and common sense, a safe training environment and a clear path to qualification as a Wingman will be ensured.

HAVE FUN!

ATTACHMENT #1

Shorthand Notation

2 + 2 takeoff

Join in Fingertip (strong right if left traffic)

Route turns on way out

∞ Lazy 8 in fingertip

Cross under # 2

Echelon turn (left) / pitchout

Rejoin RIGHT

◇ ∞ (Diamond lazy 8)

Trail

∞ Lazy 8 in trail

GO Extended Trail. or return to Echelon and pitchout to Extended Trail.

Rejoin to the LEFT

LEAD CHANGE

#3 now leading / radio check with new numbers

∞ Lazy 8 in fingertip

Cross under # 2

Echelon turn (right) / pitchout

Rejoin LEFT

◇ ∞ (Diamond lazy 8)

Trail

∞ Lazy 8 in trail (if extended trail not done above, insert here)

In a right turn, rock back in to fingertip strong left

LEAD CHANGE

#1 now leading in fingertip strong right

Check flight in.

Kick out to route

Ops-check

RTB

Reconfigure to echelon

Overhead approach / pitchout

#1 and #2 go around and rejoin

#3 and #4 go around and rejoin

#3 sets spacing from #1. (make radio calls as 3 and 4)

Reconfigure wingman to outside

Wind check

On final, cross wingman. Wingman should be upwind if > 5 kts crosswind