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By Phillip Bostwick

FORMATION

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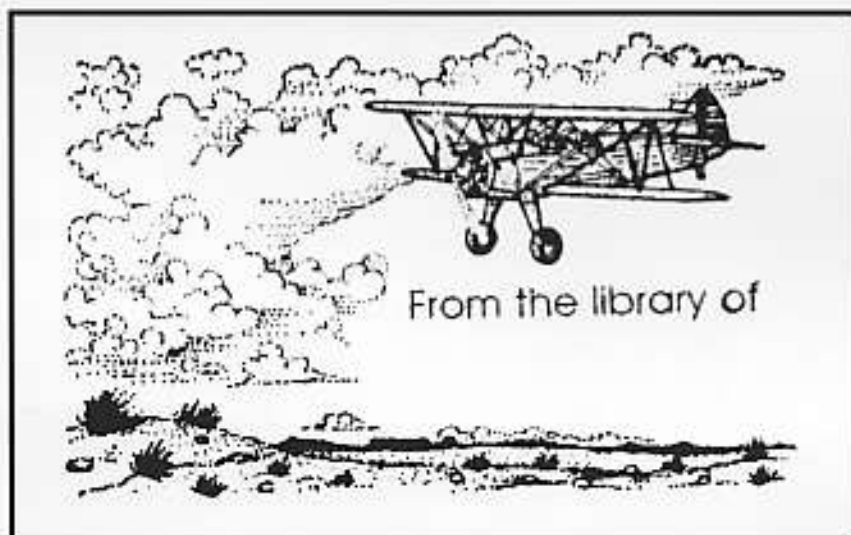
All material and drawings in this document were prepared by Phillip D. Bostwick, SRA Member 3501, and are based on his experience in attending the JLFC Formation clinic held at Keokuk, Iowa in July 2000. It has been printed by the Stearman Restorers Association as an accommodation to those members considering properly certified instruction in Stearman formation flying.

The material was reviewed and edited by a group of Certified JLFC Formation Instructors and the Formation Standardization Committee of the JLFC. All recommendations, corrections and additions were included in this final document.

This publication is a collection of "Stearman Specific" information, that only supplements the general information in the other documents, that are, required readings for anyone attending a JLFC Formation Clinic.

This document IS NOT a stand alone Formation Flying Manual. There is critically important information in other documents that must be carefully studied and understood by anyone contemplating signing up for a Clinic, or arranging for formation flying instruction from a certified instructor.

Pilots are strongly advised not to attempt any of the formation flying or maneuvers outlined herein, without prior study and completion of a JLFC ground school, and without an on-board instructor properly certified by the JLFC to conduct such instruction.



STEARMAN FORMATION NOTES

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Stearman Formation Flying Notes

By Phillip D. Bostwick

INTRODUCTION

This document is a compilation of my notes taken during the ground school and instruction flights I received from the instructors at the formation clinic given by the Joint Liaison Formation Committee (JLFC) at Keokuk, Iowa in July, 2000. JLFC requires all attendees to have read and viewed the following manuals and videotapes:

1. JLFC Operations Manual;
2. T-34 Association's Formation Manual
3. Canadian Bushhawks Liaison Squadron's Formation Flight Syllabus Manual
4. Darton International's video tapes, "Formation Flying, The Art" (2 volumes).

These manuals and tapes contain no Stearman Specific" information or sight pictures for the Stearman pilot who wishes to fly formation. The T-34 manual and the videotapes are concerned with low wing aircraft and the Bushhawks manual, while concerned with high wing, fixed gear Liaison-type aircraft, is also devoid of any information pertaining specifically to Stearman aircraft. Such information must be obtained from the JLFC instructors at one of their formation clinics. This manual is an attempt to supplement the information in the above manuals and tapes with text and sight pictures specific to Stearmans as taught by JLFC. All of the above manuals and tapes should be read or viewed before reading this manual, which does not repeat the general information found there.

GENERAL

Formation flying in Stearmans involves several factors not encountered in heavier, more powerful low wing aircraft. The light wing loading of a Stearman results in the aircraft being affected by turbulence to a greater degree than heavier aircraft, making it more difficult to maintain station during hot weather at lower altitudes. The fact that stock Stearmans are underpowered means that wingmen do not have large power reserves to utilize when they are sucked or attempting to rendezvous. Finally, the top wing of the Stearman is a hindrance to a wingman's vision and can interfere with his ability to abide by the most important rule of formation flying:

***NEVER* LOSE SIGHT OF THE LEADER, EVEN FOR AN INSTANT.**

This manual contains JLFC procedures that help overcome these factors.

Formation flying requires the following equipment:

1. A good VHF radio (not a hand held radio)

2. An intercom system;
3. A kneepad for briefings and radio information; and
4. A parachute is highly desirable. The Formation and Safety Team (FAST) requires that a parachute be worn when flying formation in waived airspace (air shows).

Every formation flight must include a thorough briefing before the flight and a thorough debriefing after landing. See Brief and Debrief, p. 26. Each pilot flying formation should familiarize himself with everything in the cockpit, including radios, transponders, etc., and be able to pass a blindfold test of the cockpit.

This manual uses terminology that was in use in the Naval Air Training Command during the 1950's. That is, a two plane element is always a "section" and a four plane element is always a "division." The number 1 plane in a section is the Section Leader and the number 2 plane is the Wingman. If two sections fly together to form a division the number 1 plane is the Division Leader, the number 2 plane is his Wingman, the number 3 plane is the Second Section Leader and the number 4 plane is his Wingman.

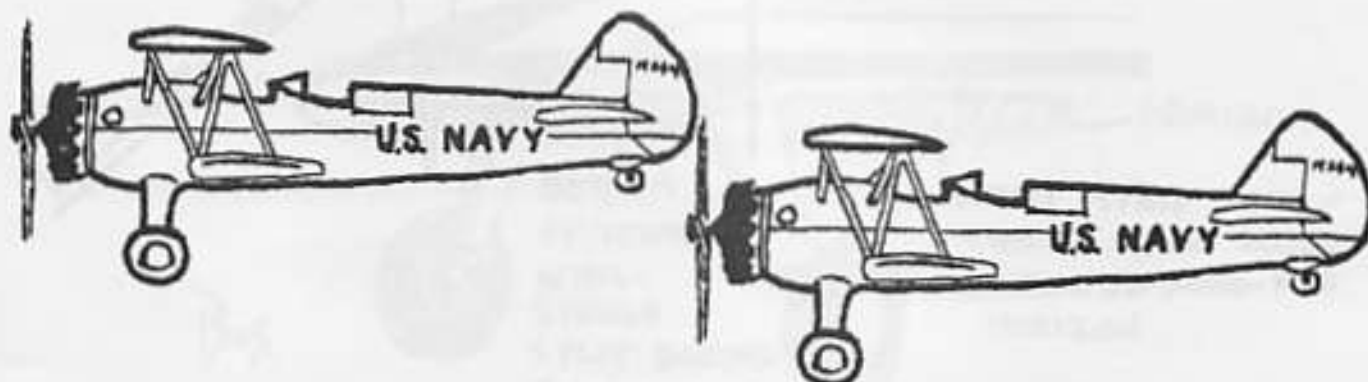
Hand signals and radio procedures used by Stearman pilots flying formation appear in Attachments A and B attached hereto.

A. SECTION TACTICS

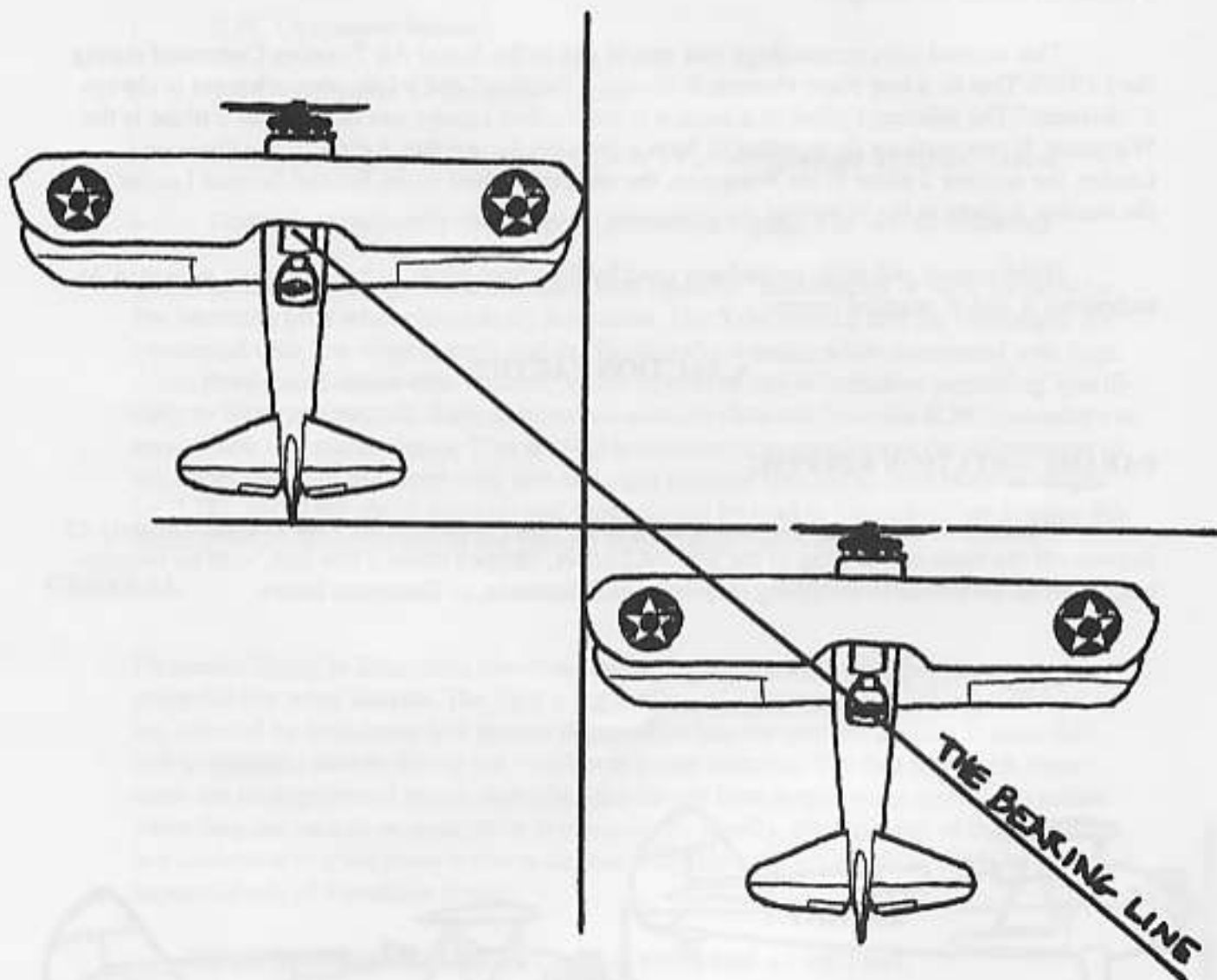
PARADE ---STATION KEEPING

In parade the Wingman flies on "the Bearing Line." The Bearing Line is approximately 45 degrees off the right or left wing of the Section Leader, stepped down a few feet, with no overlapping of wingtips and no overlapping of nose to tail clearance, as illustrated below.

Proper Step-down



The Bearing Line For Echelon Right (Approximately 45 Degrees Off Section Leader's Right Wing).



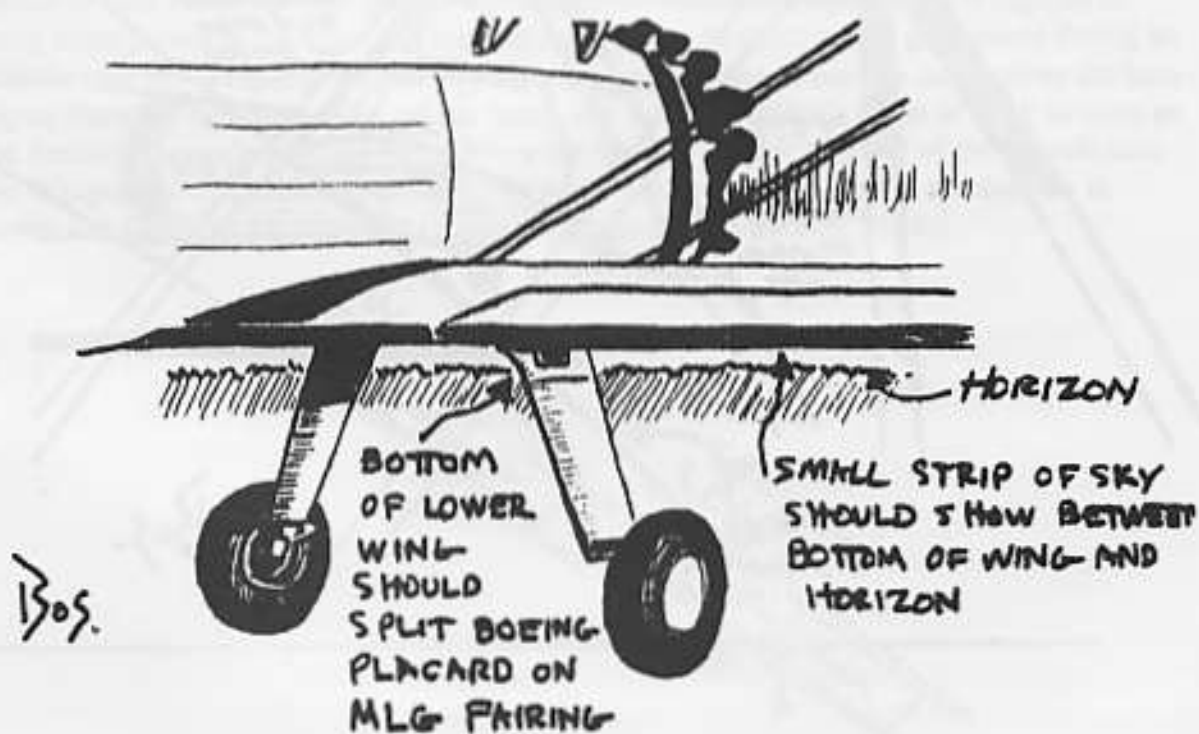
Sight Picture When On The Bearing Line.

When the Wingman is on The Bearing Line off the Section Leader's right wing the anti-drag wire between the cabane struts of the Section Leader's aircraft will be lined up with the rear of the windscreen of the leader's front cockpit, as illustrated below:



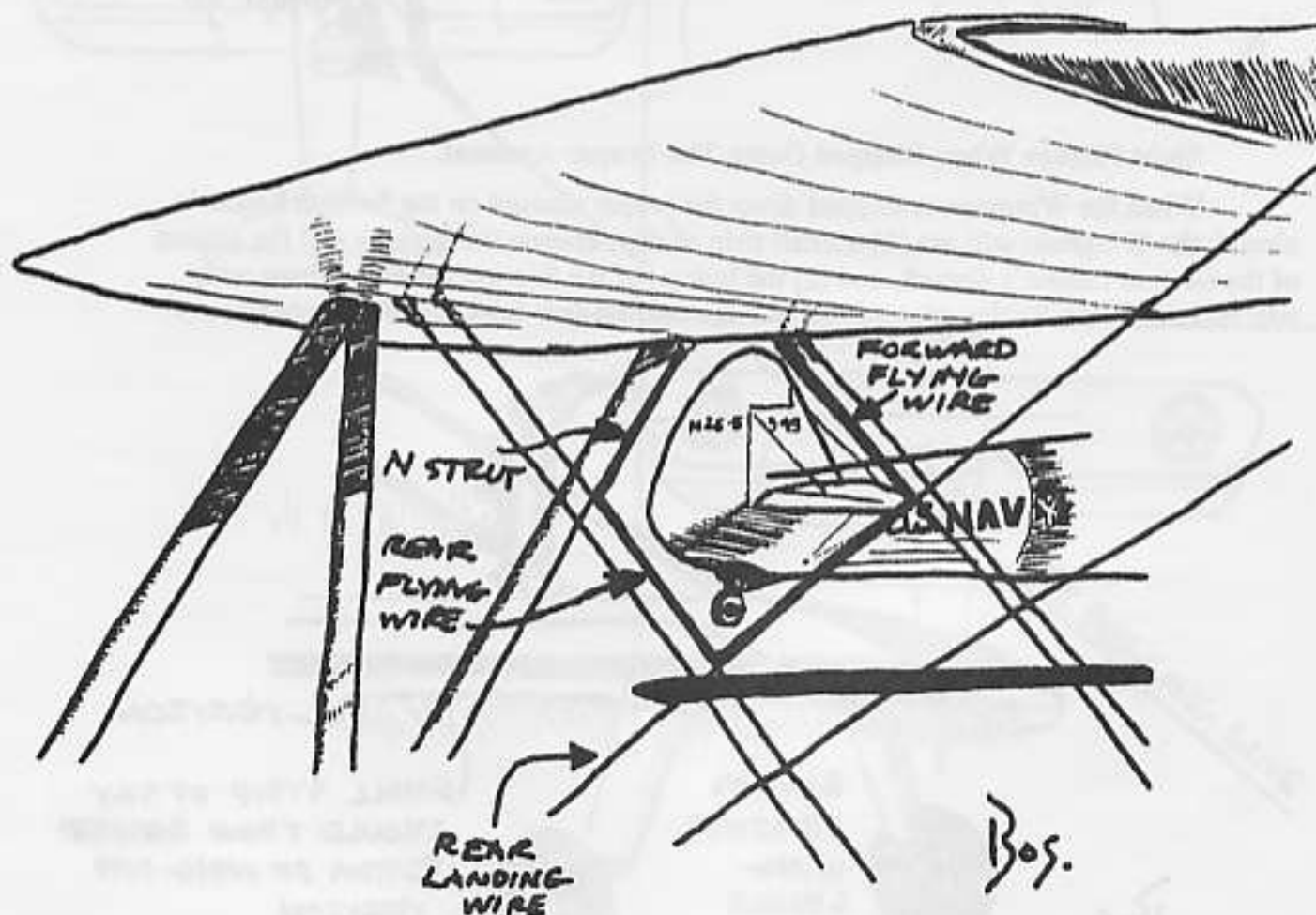
Sight Picture When Stepped Down The Proper Amount.

When the Wingman is stepped down the proper amount on the Section Leader's aircraft the Wingman will see (1) a small strip of sky between the horizon and the bottom of the Section Leader's aircraft, and (2) the bottom of the Section Leader's lower wing will split the black Boeing placard on the main landing gear fairing, as illustrated below:



Sight Picture When Flying The Correct Distance Out On The Bearing Line.

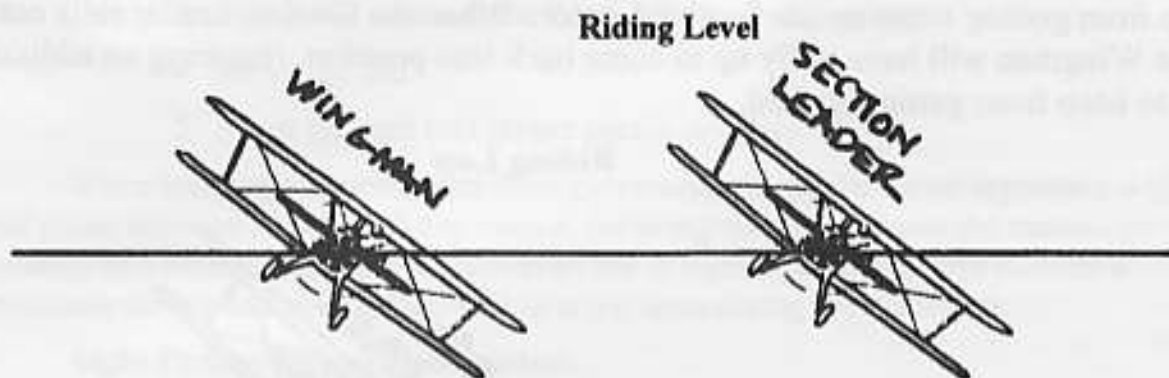
When the Wingman is the correct distance out from the Section Leader while on The Bearing Line and is flying coordinated (ball centered), the Section Leader's rudder and vertical fin will nearly fill a diamond formed by the following four things on the Wingman's left wing: (1) the forward edge of the N strut; (2) the forward flying wire; (3) the rear landing wire; and (4) the rear flying wire, as illustrated below:



PARADE TURNS

Riding Level in Parade Turns is Not Recommended in Stearmans.

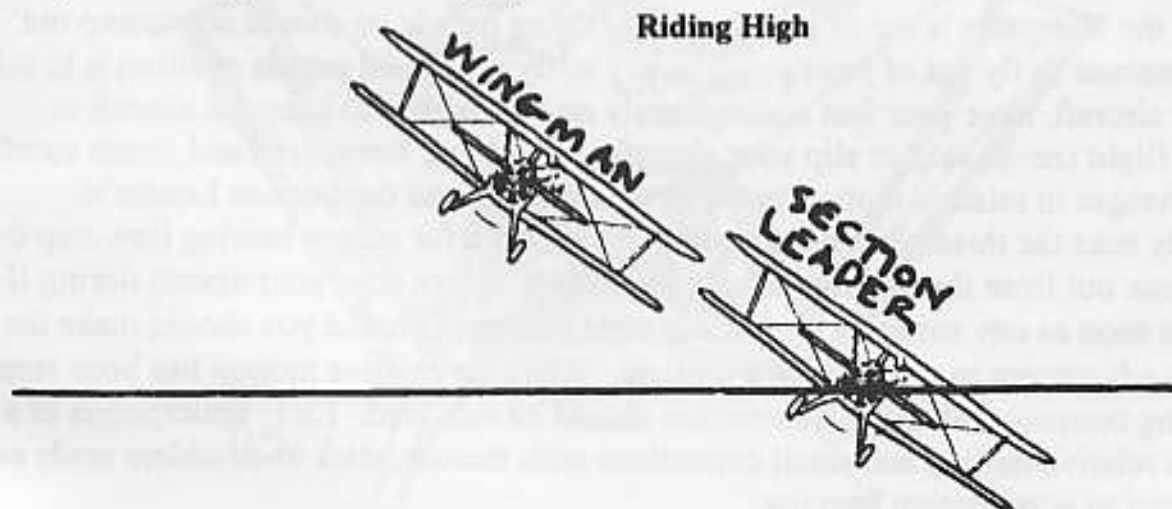
Although it is possible in low wing aircraft for the Wingman to "Ride Level" when the Section Leader turns away from him by rotating on his own axis rather than on the Section Leader's axis, as illustrated below, this type of parade turn is **not** recommended in Stearmans because the Wingman will lose sight of the Section Leader in the Wingman's top wing if the Wingman becomes sucked.



On Outside Turns Wingman Rides High.

In Stearmans when the Section Leader turns away from the Wingman in parade the Wingman rides high on the outside of the turn by rotating on the Section Leader's longitudinal axis, not his own, as illustrated below. Thus, the Wingman's sight picture of the Section Leader's aircraft will remain the same, regardless of the attitude of the Section Leader's aircraft. Only the Wingman's view of the horizon in relation to the Section Leader's aircraft will change.

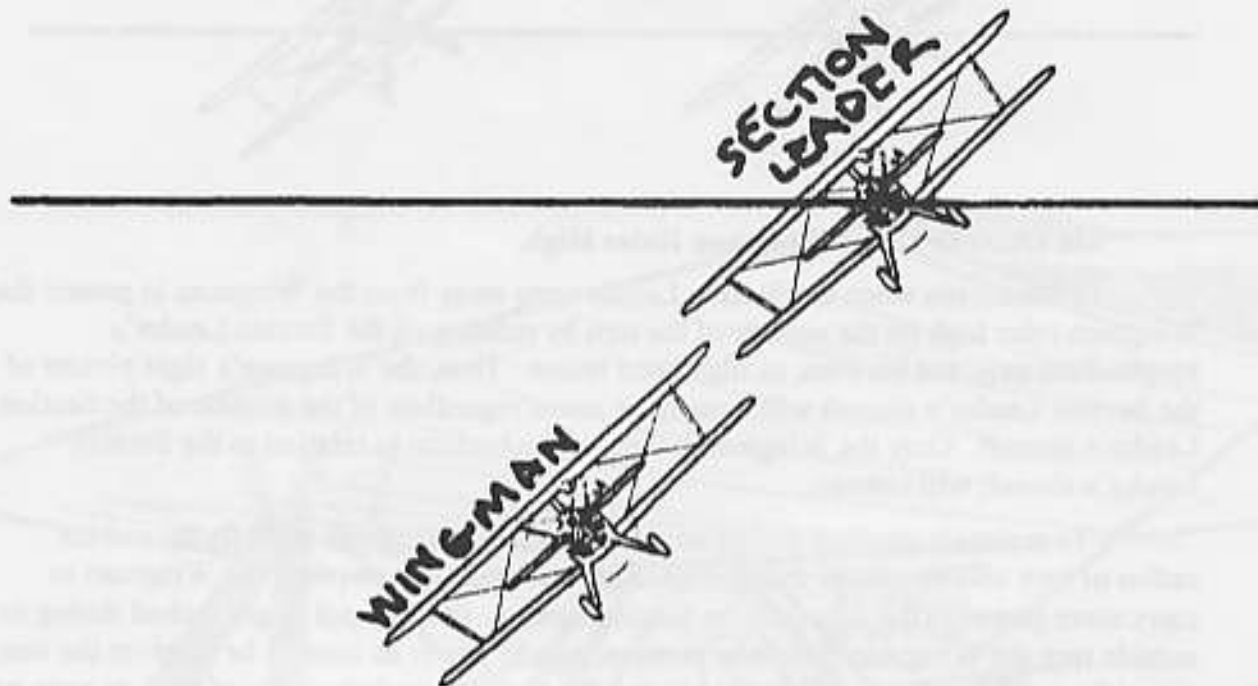
To maintain position during an outside turn the Wingman must fly up and his radius of turn will be greater than the Section Leader's. This requires the Wingman to carry more power in the turn than the Section Leader. In order not to get sucked during an outside turn the Wingman should be prepared to add power as soon as he receives the turn signal from the Section Leader and to match the Section Leader's angle of bank as soon as the Section Leader begins his turn. When the Section Leader rolls out of the outside turn the Wingman will have to fly down to get back into position, requiring a reduction in power to keep from overrunning (becoming acute on) the Section Leader.



On Inside Turns Wingman Rides Low.

When the Section Leader turns into the Wingman in parade the Wingman rides low on the inside of the turn by rotating on the Section Leader's longitudinal axis rather than his own, as illustrated below. Again, the Wingman's sight picture of the Section Leader's aircraft—except for the horizon—will remain the same. To maintain position during an inside turn the Wingman must fly down and his radius of turn will be less than the Section Leader's. This requires the Wingman to reduce power as the Section Leader starts his turn to keep from getting acute on the Section Leader. When the Section Leader rolls out of the turn the Wingman will have to fly up to come back into position, requiring an addition of power to keep from getting sucked.

Riding Low



When Out of Position, Do Not "Camp Out."

If the Wingman is out of position while flying parade he should not "camp out"—that is, continue to fly out of position. The key to flying a good parade position is to relax, trim your aircraft, have your feet resting lightly on the rudders to keep the aircraft in balanced flight (never skid or slip your aircraft while flying formation) and watch carefully for any changes in relative motion between your aircraft and the Section Leader's. Constantly scan the three sight pictures illustrated above for proper bearing line, step down and distance out from the Section Leader, much as you scan your instruments during IFR flight. As soon as *any* variation from these sight pictures is noted you should make the necessary adjustment to power and/or attitude. When the relative motion has been stopped after taking corrective action the correction should be removed. Early anticipation of a change in relative motion and small corrections with throttle, stick and rudders made early are essential to good station keeping.

CROSSUNDERS

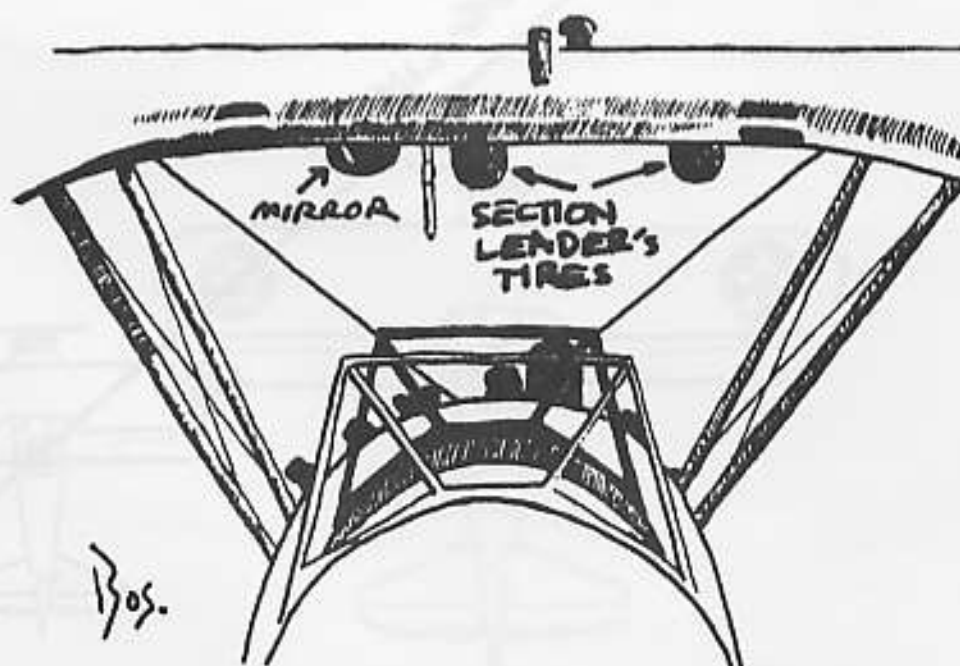
To go from echelon right to echelon left the Wingman must execute a crossunder. After receiving and acknowledging the Section Leader's hand signal for a crossunder the Wingman executes five moves. These are:

1. Move back a few feet;
2. Move down slightly;
3. Fly *slowly* across to the Section Leader's left wing;
4. Move up; and
5. Move forward into proper parade position.

When learning the crossunder these movements should be flown separately with a brief pause between each. With experience, the Wingman will execute the maneuver smoothly and without any pauses. However, the Wingman should always execute a crossunder slowly and be prepared to stop at any time during the maneuver.

Sight Picture During Crossunders.

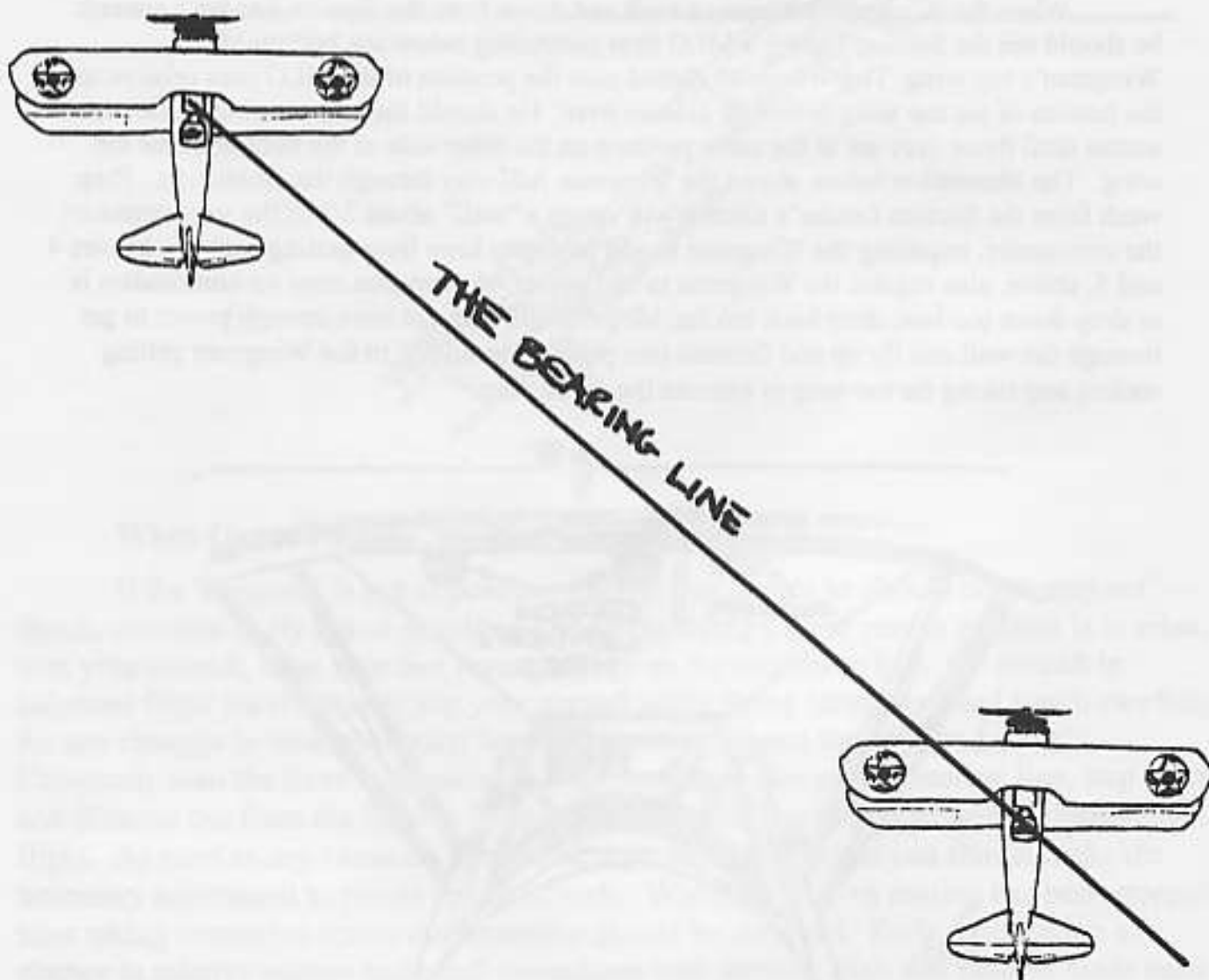
When the Wingman has moved back and down from the Section Leader's aircraft he should see the Section Leader's MLG tires protruding below the bottom of the Wingman's top wing. The Wingman should note the position of the MLG tires relative to the bottom of his top wing before he crosses over. He should then fly his aircraft slowly across until those tires are in the same position on the other side of the bottom of his top wing. The illustration below shows the Wingman half-way through the crossunder. Prop wash from the Section Leader's aircraft will create a "wall" about 2/3 of the way across on the crossunder, requiring the Wingman to add power to keep from getting sucked. Moves 4 and 5, above, also require the Wingman to add power. A common error on crossunders is to drop down too low, drop back too far, hit the "wall" and not have enough power to get through the wall and fly up and forward into position, resulting in the Wingman getting sucked and taking far too long to execute the crossunder.



ENROUTE POSITION

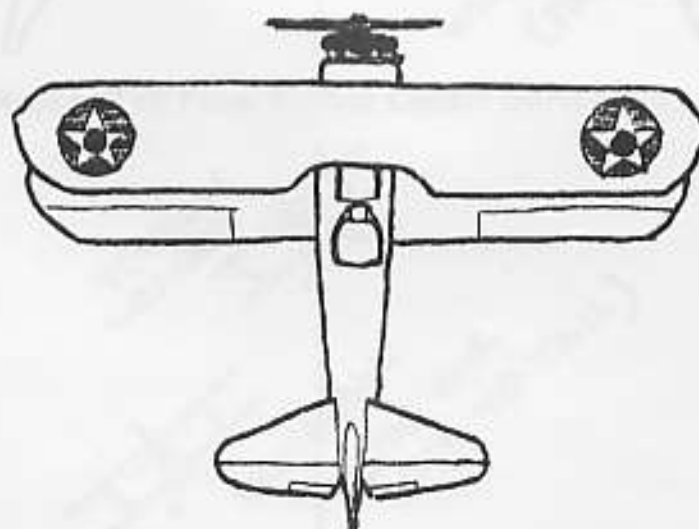
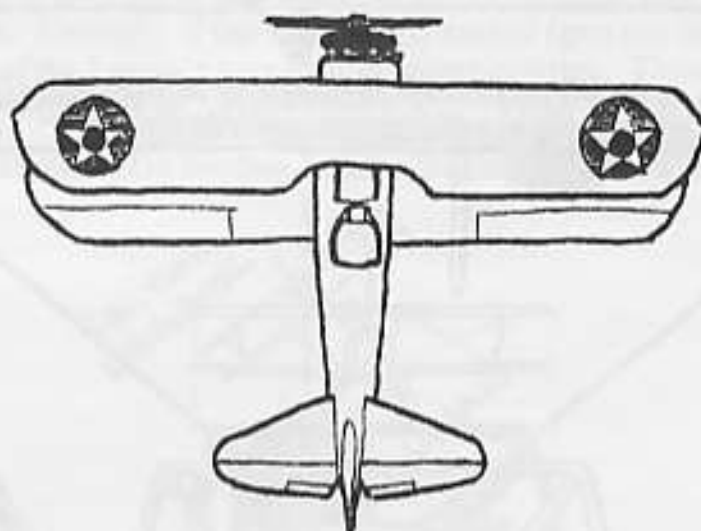
During cross-country flying the Wingman may move into the enroute position by flying two to three plane positions out on The Bearing Line, as illustrated below. In this position the Wingman uses less fuel than in the parade position, is able to conduct his own navigation and can change radio frequencies without risking a midair collision with the Section Leader. When moving from parade to the enroute position the Wingman must turn his aircraft slightly away from the Section Leader's. Because the Section Leader's thrust line is straight ahead the Wingman must add power to stay on the Bearing Line and not get sucked.

If the Wingman is given a radio frequency change by the Section Leader while flying in parade, the Wingman should move out slightly on The Bearing Line before dialing in the new frequency. **The Wingman should *never* stick his head in the cockpit to change frequencies while flying in parade.** If his VHF radio contains a button that allows the pilot to set two frequencies on the radio and switch from one to the other by pressing the button, the Wingman should reach for that button while looking at the Section Leader if the Section Leader gives him the signal to "Go to button two."



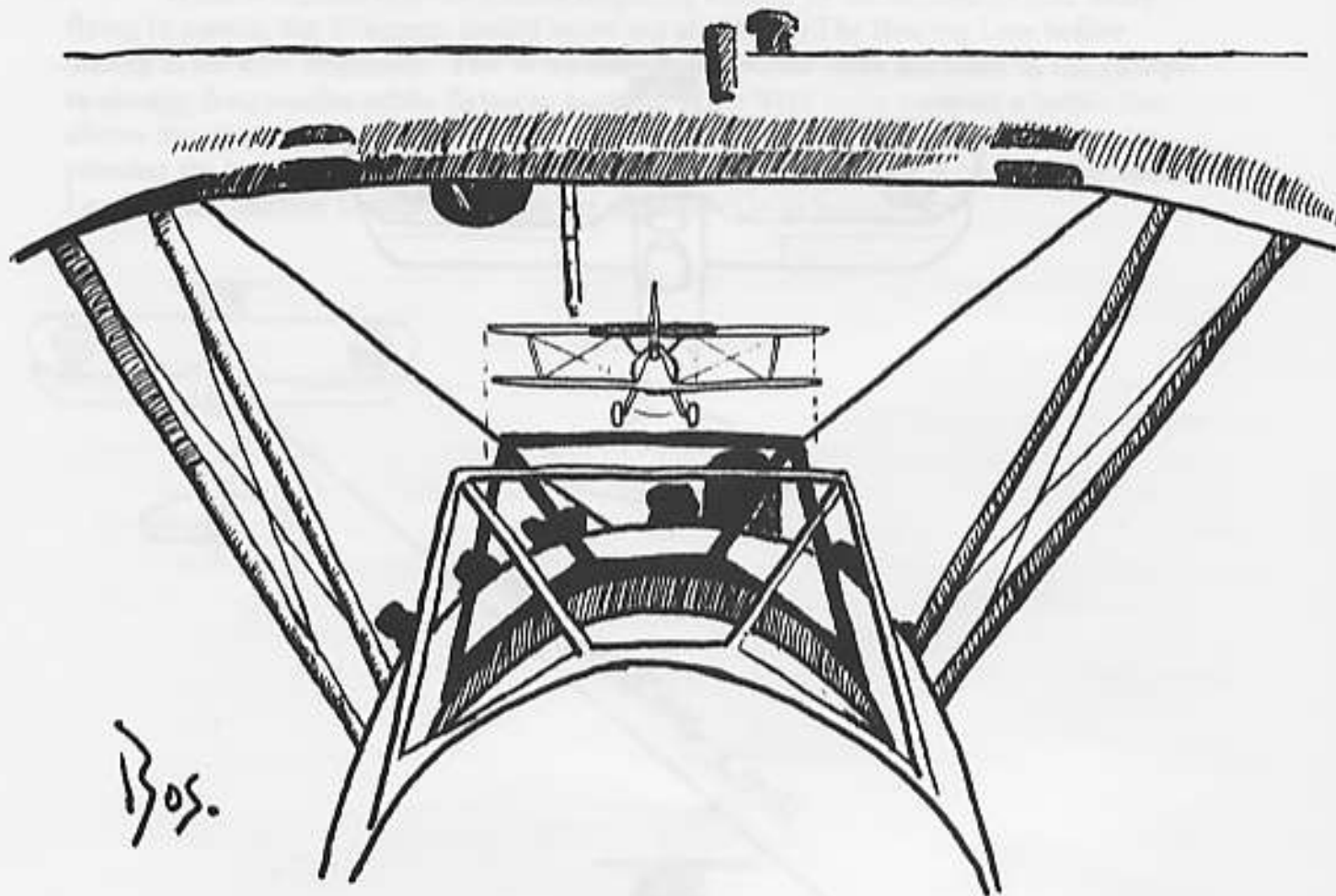
TRAIL POSITION (LINE ASTERN)

To go from parade position to the trail position the Wingman must move back and down, centering his aircraft below and behind the Section Leader's aircraft, as illustrated below:



Sight Picture When In Trail.

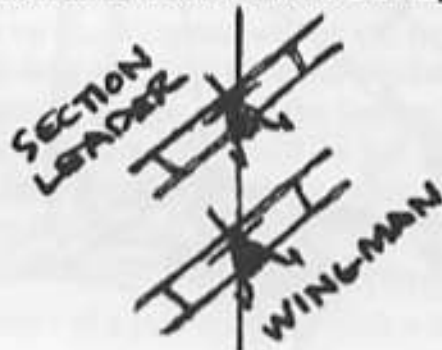
When the Wingman is in the proper trail position the Section Leader's aircraft will appear to be framed above the windscreen on the Wingman's front cockpit, with the Section Leader's wingtips just spanning the top windscreen frame and with the Section Leader's horizontal stabilizer appearing to be superimposed on his top wing, as illustrated below. A common error is for the Wingman to position himself too far behind the Section Leader's aircraft.



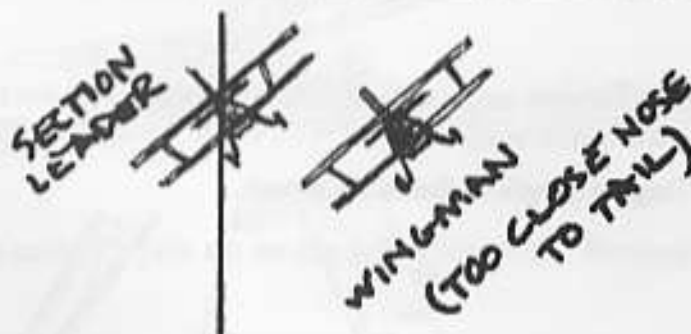
MANEUVERING IN TRAIL

While in trail the Section Leader will perform a series of Lazy Eights, entering into shallow climbs and dives and 30 to 45 degree banked turns. Unlike parade, where the Wingman maintains his position through the use of the throttle, in the trail position the Wingman sets his throttle when in the proper position and calls, "Two's in" to the Section Leader. Thereafter, the Wingman maintains his nose to tail separation on the Section Leader by varying the radius of his turn in relation to the Section Leader's radius of turn. While the Section Leader is climbing or descending wings level the Wingman's sight picture of him will remain the same. However, when the Section Leader banks the Wingman will be on the same radius of turn as the Section Leader only if the Wingman is neither acute nor sucked. If the Wingman begins to overrun the Section Leader (gets too close nose to tail), the Wingman must fly to the **outside** of the Leader's turn until in proper position, then return to match the Leader's radius of turn. Similarly, if the Wingman is sucked (gets too far nose to tail) he must fly to the **inside** of the Leader's turn until in proper position. These three situations are illustrated below:

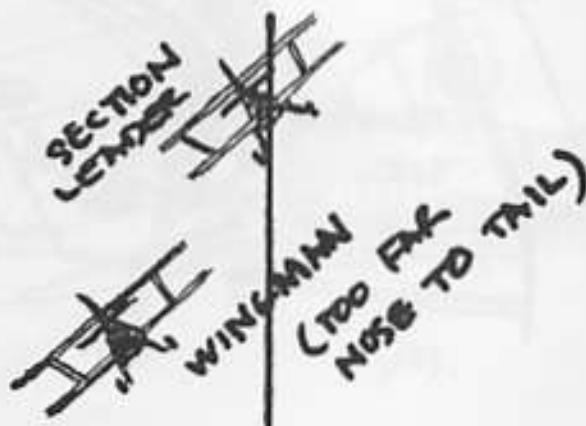
Wingman in Proper Position On Section Leader During Turn While in Trail.



Wingman Too Close Nose to Tail on Section Leader During Turn While in Trail.



Wingman Too Far Nose to Tail From Section Leader During Turn While in Trail.



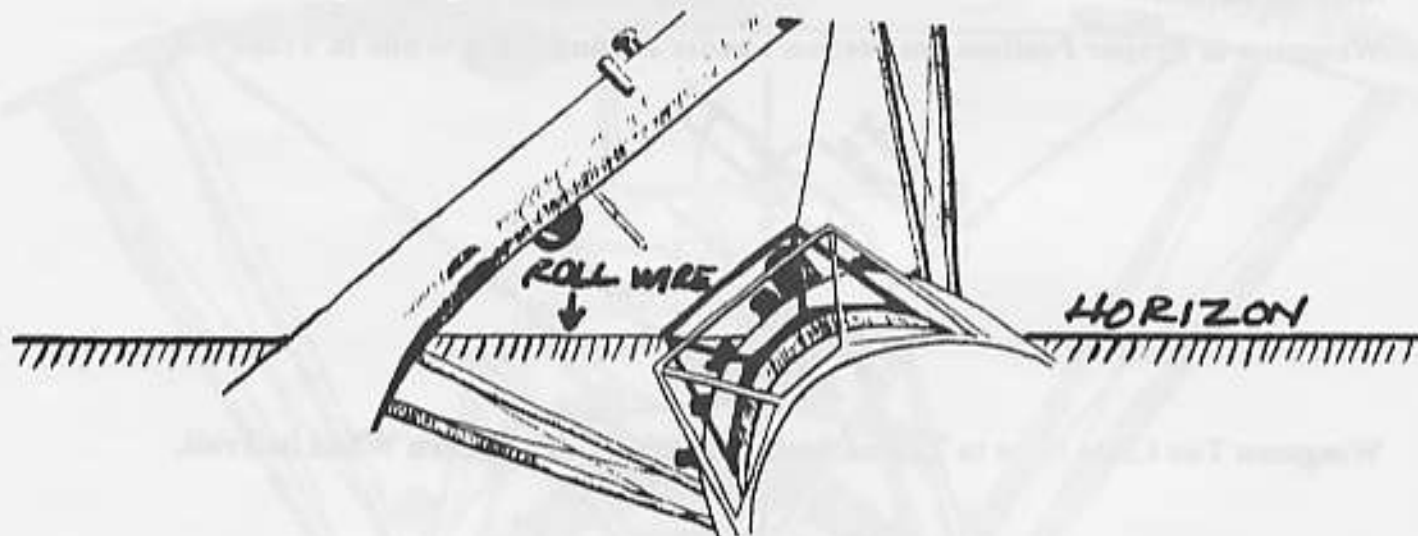
RETURNING TO PARADE FROM TRAIL.

When the Section Leader is ready to put the Wingman back in the parade position from trail he will rock his wings, then start a turn right or left using 10-15 degrees of bank (the intersection of the Section Leader's N Strut and his top wing will be on the horizon when his bank is 10-15 degrees). The Wingman will then join up on the **inside** of the Section Leader's turn.

BREAKUP AND RENDEZVOUS (JOIN UP).

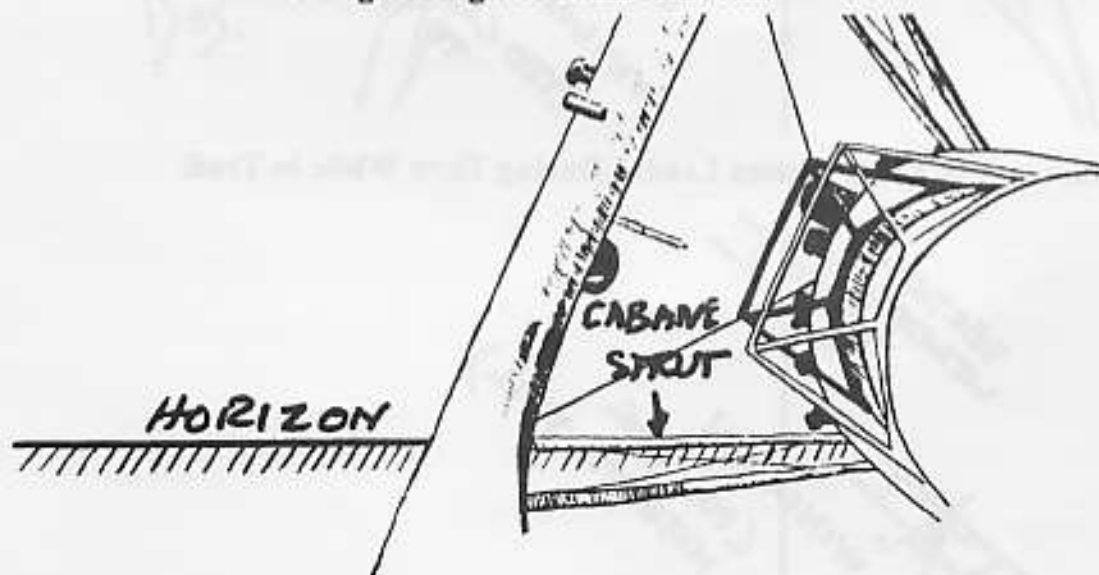
The Section Leader puts the Wingman in echelon right and gives him the breakup signal and number of seconds for the break (assume 5 seconds). The Section Leader then "kisses off" to the Wingman and breaks left sharply with a 45 degree or 60 degree angle of bank, depending on how the flight was briefed. For a 45 degree angle of bank roll the aircraft until the roll wires are on the horizon, as illustrated below.

45 Degree Angle of Bank on Break.



For a 60 degree angle of bank roll the aircraft until the cabane struts are on the horizon, as illustrated below.

60 Degree Angle of Bank on Break.



After breaking, the Section Leader turns 180 degrees while maintaining the same altitude and rolls out on a heading reciprocal to his heading at the time of the break. When the Wingman sees the Section Leader break he counts, "one thousand one, one thousand two, one thousand three, one thousand four, BREAK," banking left sharply to the pre-briefed bank angle on the word "break." The Wingman maintains the altitude he was flying at the time of the break, even if the Section Leader loses altitude in his turn, rolling out after 180 degrees of turn to line up directly behind the Section Leader. When the Wingman is in position in extended trail he calls, "Two's in" on the radio.

When the Wingman is in position the Section Leader turns right or left using a 10-15 degree angle of bank and holding his altitude constant. As soon as the Section Leader begins his turn the Wingman turns in the same direction in order to join up on the **inside** of the Section Leader's turn.

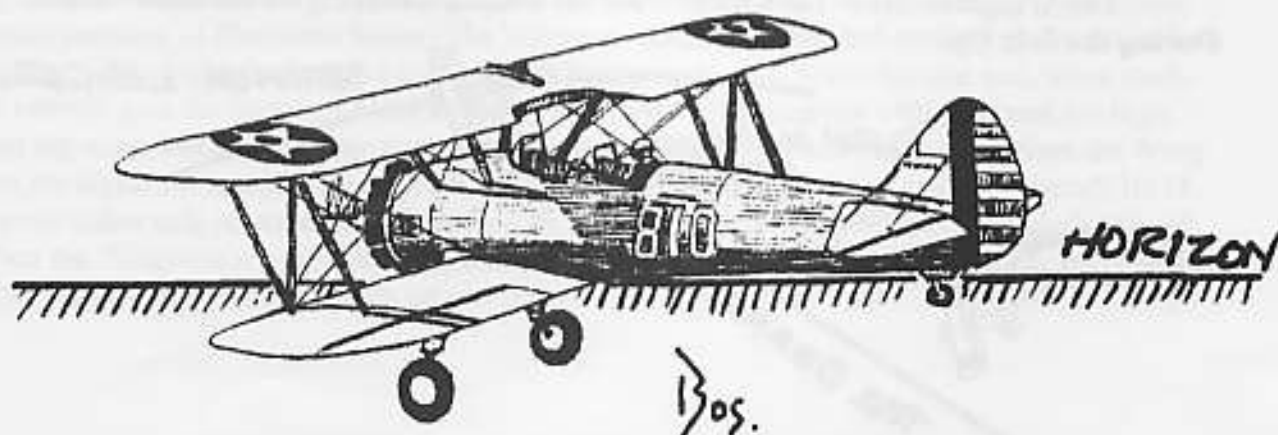
THE WINGMAN SHOULD KEEP THE SECTION LEADER'S AIRCRAFT ON THE HORIZON DURING THE JOIN UP UNTIL HE IS NEARLY IN PARADE POSITION. GET ALTITUDE FIRST, THEN GET ON THE BEARING LINE. DO NOT JOIN UP FROM "IN THE HOLE" (BELOW THE LEADER'S ALTITUDE).

At the start of the join up the Wingman will be too far away from the Section Leader to line up the Leader's drag wire with his front windscreen. If the Wingman is on The Bearing Line from the Section Leader, and if the Section Leader's aircraft is on the horizon, the top of the Section Leader's rudder will be just below the level of the tip of the Leader's top wing, with very little space between the rudder and wingtip, as illustrated below. As the Wingman nears the Section Leader's aircraft he can line up the Leader's drag wire with his front windscreen, also illustrated below.

Sight picture at the start of a join up on the left wing of the Section Leader:



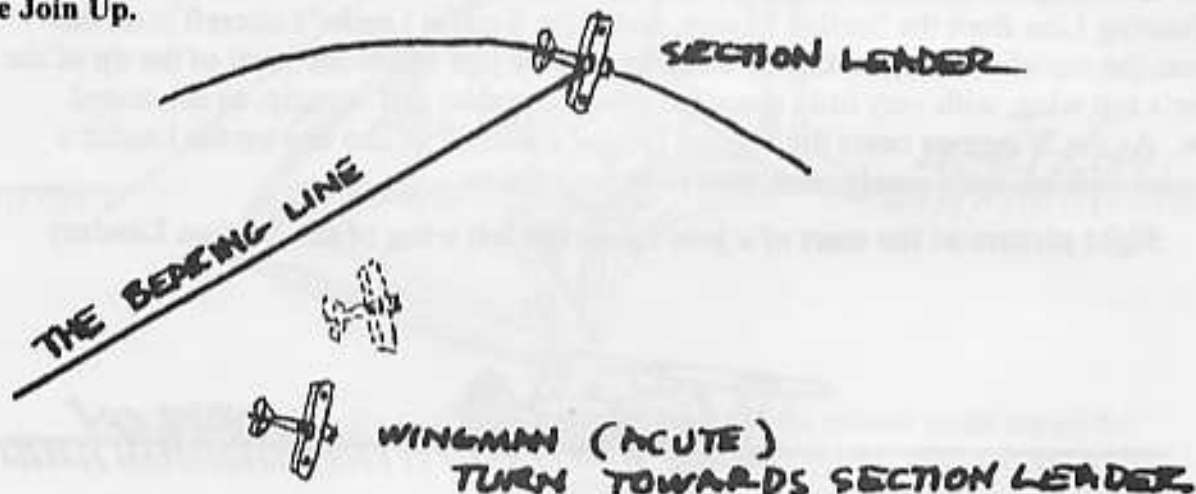
Sight Picture near the end of a join up on the left wing of the Section Leader:



As the Wingman's aircraft approaches the Section leader's aircraft on The Bearing Line the Wingman can pick up the sight picture of the drag wire on the Leader's front cockpit. When he is 4-5 ship widths from the Section Leader the Wingman can begin to ease his aircraft down to the proper step down position. The Wingman stops his advance on the bearing line when the Section Leader's rudder fills the diamond on the Wingman's wing. A join up should be relatively slow and controlled, but the Wingman should be joined on the Section Leader within 180 degrees of the Section Leader's initial turn. If the Wingman does not keep the Section Leader's aircraft on the horizon he will be joining from "in the hole," which will take an excessive amount of time and power. If the join up is done correctly the Wingman should not have to touch his throttle until he gets close to the Section Leader, when the rate of closure will appear to increase. At that time the Wingman can use throttle adjustments to effect a join up into the proper parade position.

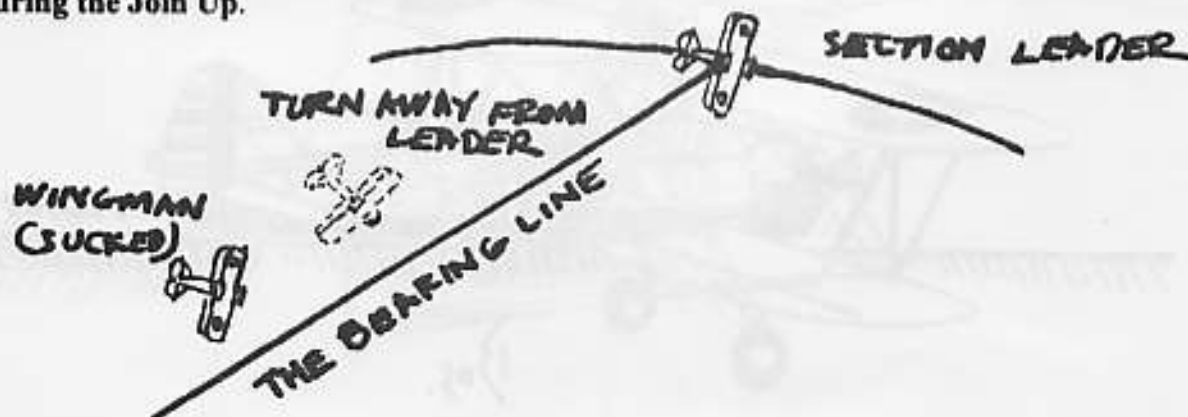
If the Wingman gets acute on the Section Leader during the join up he must turn **TOWARDS** the Section Leader to get back on the Bearing Line, as illustrated below. This causes the rate of closure to increase and a reduction in power may be required. The closer the Wingman gets to the Section Leader during the join up the more unnatural this may feel, but it is the **ONLY** way to turn if the Wingman is acute. Turning **away** from the Section Leader could result in the Wingman losing sight of the leader, a cardinal sin.

The Wingman Must Turn Towards the Section Leader if he Gets Acute During the Join Up.



If the Wingman becomes sucked during the join up he must turn **AWAY** from the Section Leader so that he will make a smaller radius turn than the Section Leader and get back on The Bearing Line, as illustrated below.

The Wingman Must Turn Away from the Section Leader if he Becomes Sucked During the Join Up.



BROKEN REJOIN

As with station keeping, early recognition of whether you are too low, off The Bearing Line, acute or sucked, followed by immediate corrective action, is the key to a smooth and safe join up. Once the technique is learned, join ups are a matter of the Wingman smoothly and safely sliding his aircraft up The Bearing Line into the parade position. However, a join up that does not stay controlled will result in a broken join up. The most common cause of a broken join up is for the Wingman to get acute on the Section Leader late in the join up and when the Wingman turns towards the Section Leader the rate of closure is too fast to effect the join up. When this happens there is another cardinal rule in formation flying that must never be violated. That is:

NEVER GO BELLY UP ON (LOSE SIGHT OF) THE LEADER WHEN JOINING UP

If the Wingman must execute a broken join up he must fly well below and behind the Section Leader to the outside of the Section Leader's turn, keeping the Section Leader's aircraft in view at all times. The Wingman calls, "Two's underrunning" to the Section Leader and stays on the outside of the turn until the Section Leader clears the Wingman to rejoin the formation.

LEAD CHANGE

Before turning the lead over to his Wingman the Section Leader should put the section in parade, straight and level flight, and advise the Wingman by radio of the flight's position from the field, its heading and altitude and of any traffic in the area. The Section Leader then gives the lead change signal to his Wingman. Upon acknowledging the signal the old Wingman, now the Section Leader, must fly straight and level with no airspeed change and divide his attention between looking ahead and watching the old Section Leader, now the Wingman, maneuver back into parade position off his left wing. The old Section Leader, now the Wingman, must not take his eyes off the new Section Leader. This is difficult to do because the new Wingman is looking back over his shoulder at the new Section Leader. To maneuver into position the new Wingman moves out one aircraft width, reduces power and moves back slowly to the Bearing Line. When on the Bearing Line he moves into the parade position stepped down on the new Section Leader's left wing.

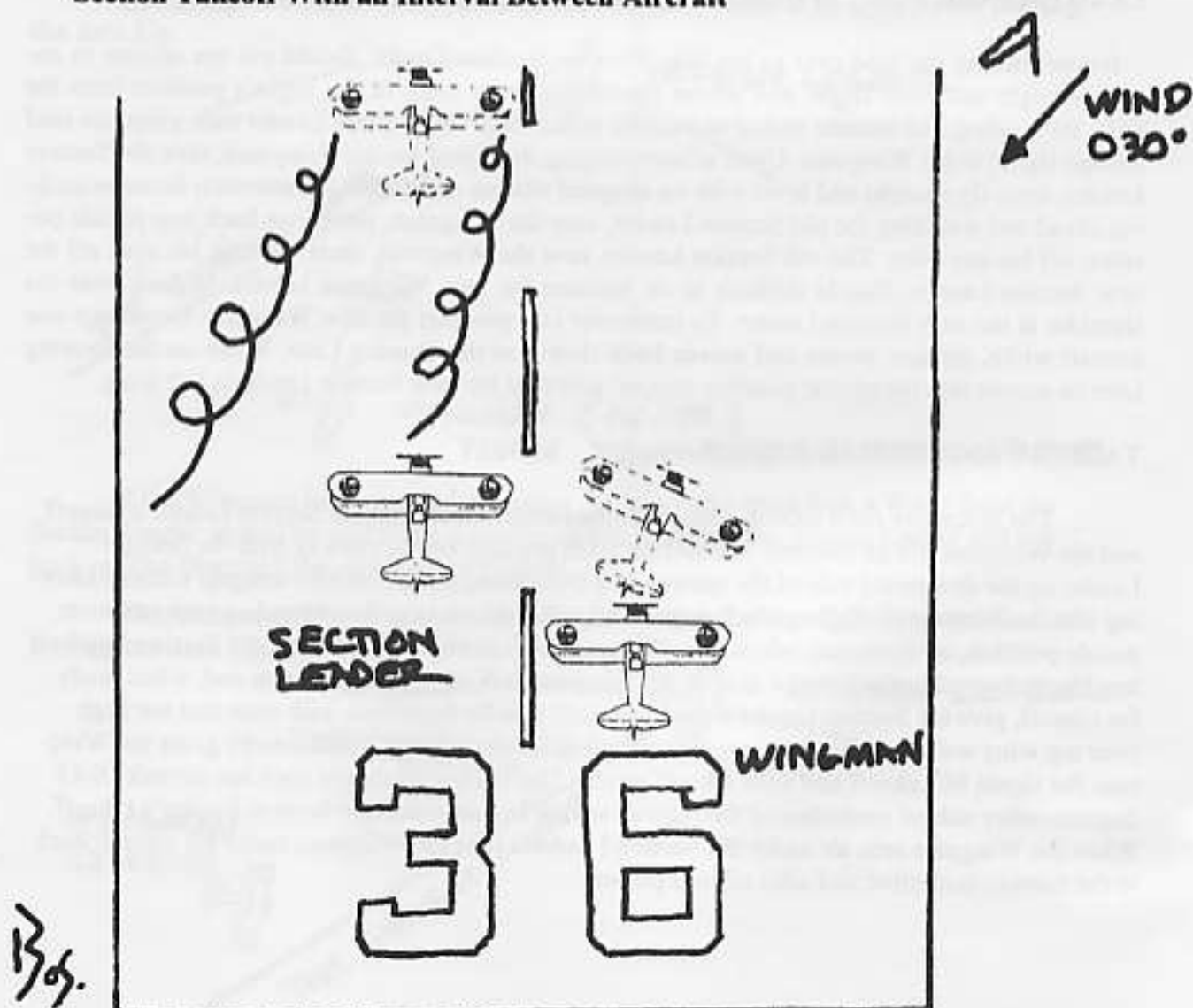
TAKEOFF AND INITIAL JOIN UP

The procedure for a section takeoff with an interval between the Section Leader's takeoff and the Wingman's is as follows: The section takes position on the runway with the Section Leader on the downwind side of the runway in a cross-wind (to prevent his wingtip vortices blowing into the Wingman's flight path during the takeoff roll), and the Wingman in an approximate parade position, as illustrated below. The Wingman should pull forward until the Section Leader's head is positioned in the forward area of the Wingman's N strut, lower his seat and, when ready for takeoff, give the Section Leader a thumbs up. (If you fly formation with your seat too high your top wing will impede your view of the Section Leader.) The Section Leader gives the Wingman the signal for takeoff and adds takeoff power. The Wingman should cock his aircraft 10-15 degrees either side of centerline of the runway so that he can watch the Section Leader's takeoff. When the Wingman sees air under the Section Leader's tires the Wingman cocks his aircraft back to the runway centerline and adds takeoff power.

After lifting off the Wingman calls the Section Leader on the radio advising, "Two's off." The Section Leader should climb out at a shallow angle of climb. The Wingman should leave climb power on and climb at the best rate of climb to put the Section Leader's aircraft on the horizon as soon as possible. When the Section Leader turns right or left, using a 10-15 degree angle of bank, the Wingman should start his turn, matching the Section Leader's angle of bank, to join up on the **inside** of the Section Leader's turn. The Wingman should leave climb power on and continue to climb until he has the Section Leader's aircraft on the horizon. At that point the Wingman can reduce his power to cruise power and effect the rendezvous. It cannot be said too often: ***Put the Section Leader's aircraft on the horizon and keep it there in order to avoid joining up from "in the hole."***

If the Section Leader has an emergency on takeoff and has to abort he calls the Wingman on the radio saying, "Lead's Aborting!" If the Section Leader has directional control he brings his aircraft to a stop on the "cold" side of the runway (the side that will permit him to turn off) and advises the Wingman, "Lead's cold left (or right)." The Section Leader may lose directional control on takeoff during an abort. In either situation the Wingman should hold up or abort his take off, if possible, and **avoid striking the Section Leader's aircraft at all costs.**

Section Takeoff With an Interval Between Aircraft



ENTRY INTO PATTERN FOR 360 DEGREE OVERHEAD BREAK

If the traffic permits at a non-controlled airport, or if the tower will approve it at a controlled airport, the best way for a formation to enter the pattern and land is to use the 360 degree overhead break. The following are the procedures to use for entry into the pattern for such a break (assuming the active runway is runway 36 and that a left break is the normal pattern for that runway).

More than ten miles out from the field the Section Leader advises the Wingman that he is going to the local weather frequency briefly to get the weather and the surface winds at the field. After listening to the local weather the Section Leader returns to the tactical frequency and advises the Wingman of the active runway, the surface winds, any weather and traffic at the field.

At ten miles out the Section Leader gives the Wingman the signal to go to Unicorn or tower frequency and calls Unicorn or tower that a flight of two Stearmans is ten miles South requesting a 360 degree overhead left break for runway 36, advising that the flight will "call one mile initial." The Section Leader gives the Wingman the signal to descend and starts a power on descent to reach the initial point one mile from the approach end of the runway at traffic pattern altitude, or the altitude given by the tower, on the runway heading.

Between ten miles out and the initial point the Section Leader puts the Wingman in echelon right and gives him a signal for the number of seconds for the break (assume 5 seconds). One mile from the approach end of the runway (the initial point) the Section Leader calls Unicorn or the tower, "-Leader's call sign]. Flight of two Stearmans one mile initial for 360 degree overhead left break for runway 36." and gives the Wingman the signal to descend. The Section Leader should make a power on descent to arrive at the approach end of the runway at traffic pattern altitude, on the center line of the runway at cruising airspeed or above. The Wingman should not get sucked during the descent, concentrating on maintaining position to arrive at the break in perfect echelon right.

360 DEGREE OVERHEAD BREAK AND LANDING

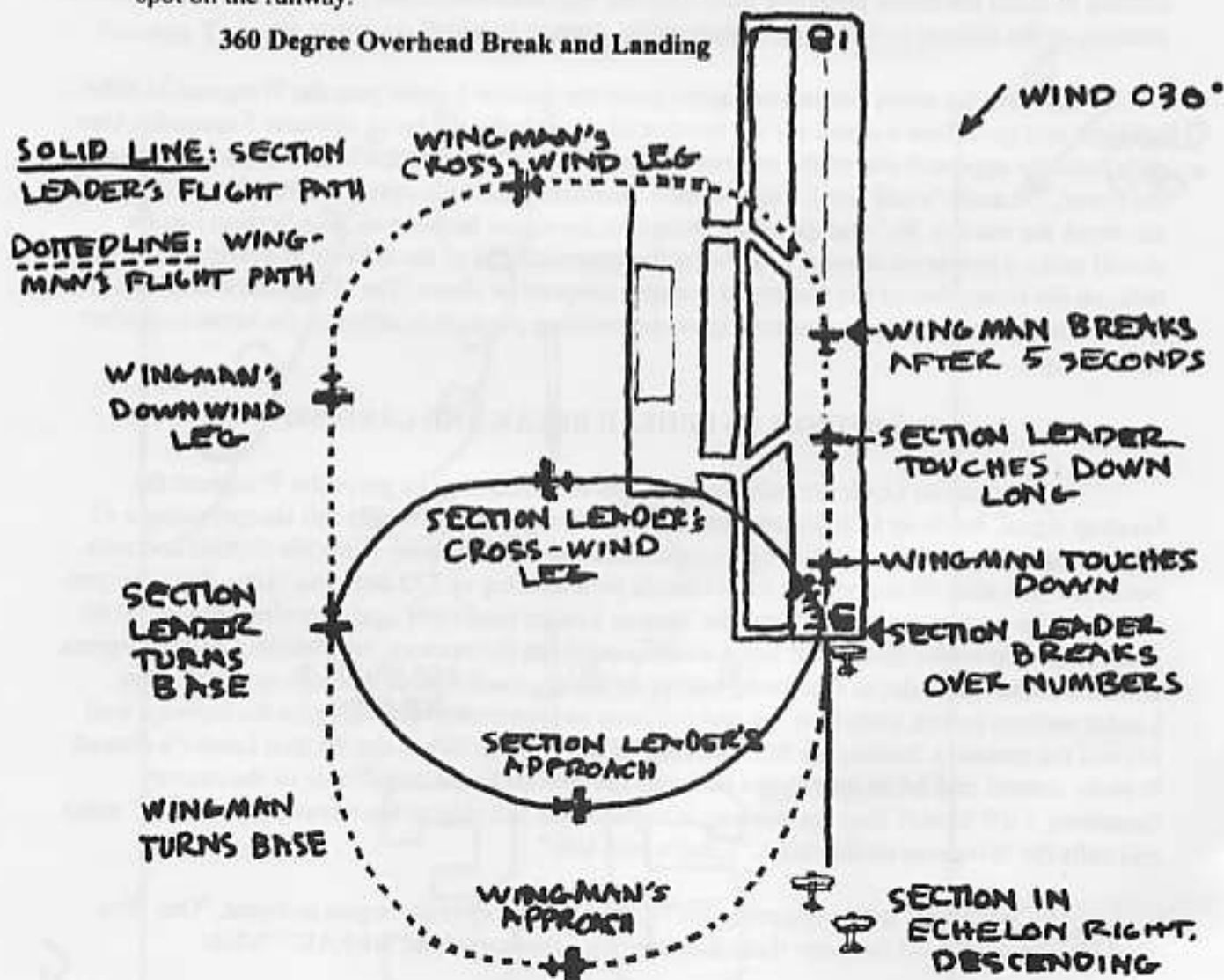
As the Section Leader crosses the numbers of the runway he gives the Wingman the breakup signal, holds up five fingers, kisses off the Wingman and breaks left sharply using a 45 degree angle of bank. The Section Leader does not reduce his power, holds his altitude and rolls out of his turn after 90 degrees (in this example on a heading of 270 degrees). After flying perpendicular to the runway a short distance the Section Leader banks left again, turning another 90 degrees to line up on the downwind leg, a wingtip out from the runway, on a heading of 180 degrees at traffic pattern altitude, as illustrated below. At the approach end of the runway the Section Leader reduces power, calls base leg and executes an approach to land long on the runway, well beyond the numbers, landing on the centerline of the runway. When the Section Leader's aircraft is under control and the rollout ended he taxis his aircraft to the "cold" side of the runway (assuming a left turnoff from the runway is required the left side of the runway is the "cold" side), and calls the Wingman on the radio, "Lead's cold left."

The Wingman, when observing the Section Leader's break, begins to count, "One thousand one, one thousand two, one thousand three, one thousand four, BREAK." While

doing this the Wingman looks to his left for a landmark off his left wingtip. At the word "BREAK" the Wingman banks sharply to his left using a 45 degree angle of bank.

Leaving his power untouched and maintaining traffic pattern altitude, the Wingman rolls out of his turn after 90 degrees, putting the nose of his aircraft on the landmark that had been off his left wingtip. He looks at the Section Leader and, when the Section Leader is approximately 45 degrees in front of the Wingman's left wing, the Wingman begins his second 90 degree turn to line up on the downwind leg directly behind the Section Leader and at traffic pattern altitude. When the Wingman arrives at the downwind end of the runway he extends his downwind as required to take up a proper interval on the Section Leader's aircraft, reduces power, calls base leg and executes an approach to land **just beyond the numbers** on the centerline of the runway. If the Wingman has used the correct interval on the Section Leader he will probably receive the Section Leader's "cold left" call before the Wingman touches down, but this is **not** a requirement for landing. However, safety is paramount and, if the Wingman is in **any** doubt about the position of, or the condition of the Section Leader's aircraft, **he should not hesitate to GO AROUND**. Stearman pilots flying formation should be proficient at precision landings and should be able to land at any desired spot on the runway.

360 Degree Overhead Break and Landing



DOWNWIND ENTRY INTO PATTERN FOR LANDING

If the tower at a controlled airport, or congested traffic at an uncontrolled airport, will not permit a 360 degree overhead break to a landing, the Section Leader can put his Wingman in echelon right and enter the pattern in the standard manner for a downwind entry, approaching the downwind leg at a 45 degree angle and turning right when a wingtip's distance from the runway. The Section Leader gives the Wingman the signal for break up and kiss off when abeam the approach end of the runway, turns base and flies an approach to land long on the runway's centerline, well beyond the numbers. The Wingman continues flying downwind to take up a proper interval on the Section Leader so that he can turn base and fly an approach that will permit him to land just beyond the numbers on the runway centerline about the time the Section Leader radios. "Lead's cold left"

NOTE: The above procedure can be used for section tactics only, because the Section Leader can turn into his Wingman at any time, which permits the Section Leader to turn right when a wingtip's distance from the runway. A Division Leader cannot turn into his echelon, so he must enter the pattern as explained below.

B. DIVISION TACTICS

GENERAL

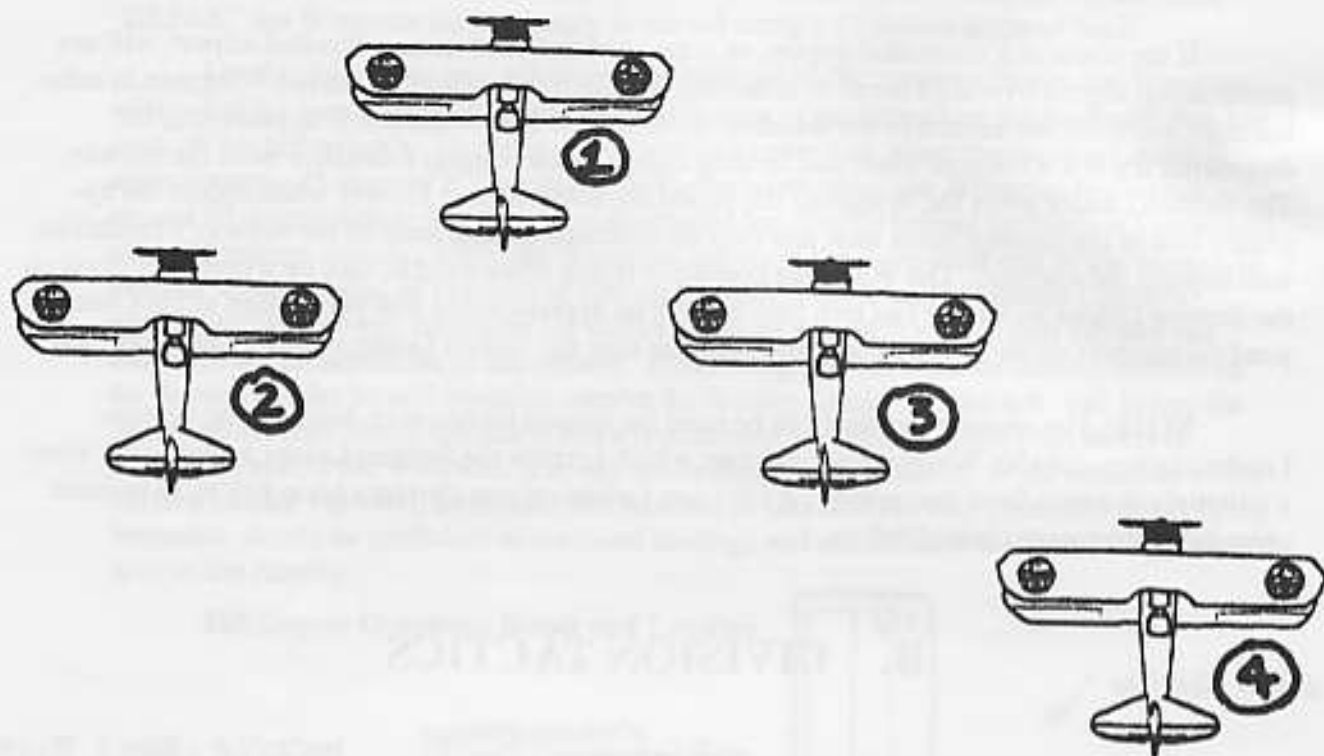
As noted above, when two sections fly together, or if a third plane joins a section to form a "Vee", the resulting formation is a division and the number 1 plane is the Division Leader. The number 2 plane is the Division Leader's Wingman, the number 3 plane is the Second Section Leader and the number 4 plane is the Second Section Leader's Wingman. There are five principal formation arrangements for a division: (1) Fingertip Four Strong Right (or left); (2) Echelon Right (or left); (3) Trail (Line Astern); (4) Diamond; and (5) Enroute. Each of these is discussed and illustrated below.

FINGERTIP FOUR STRONG RIGHT

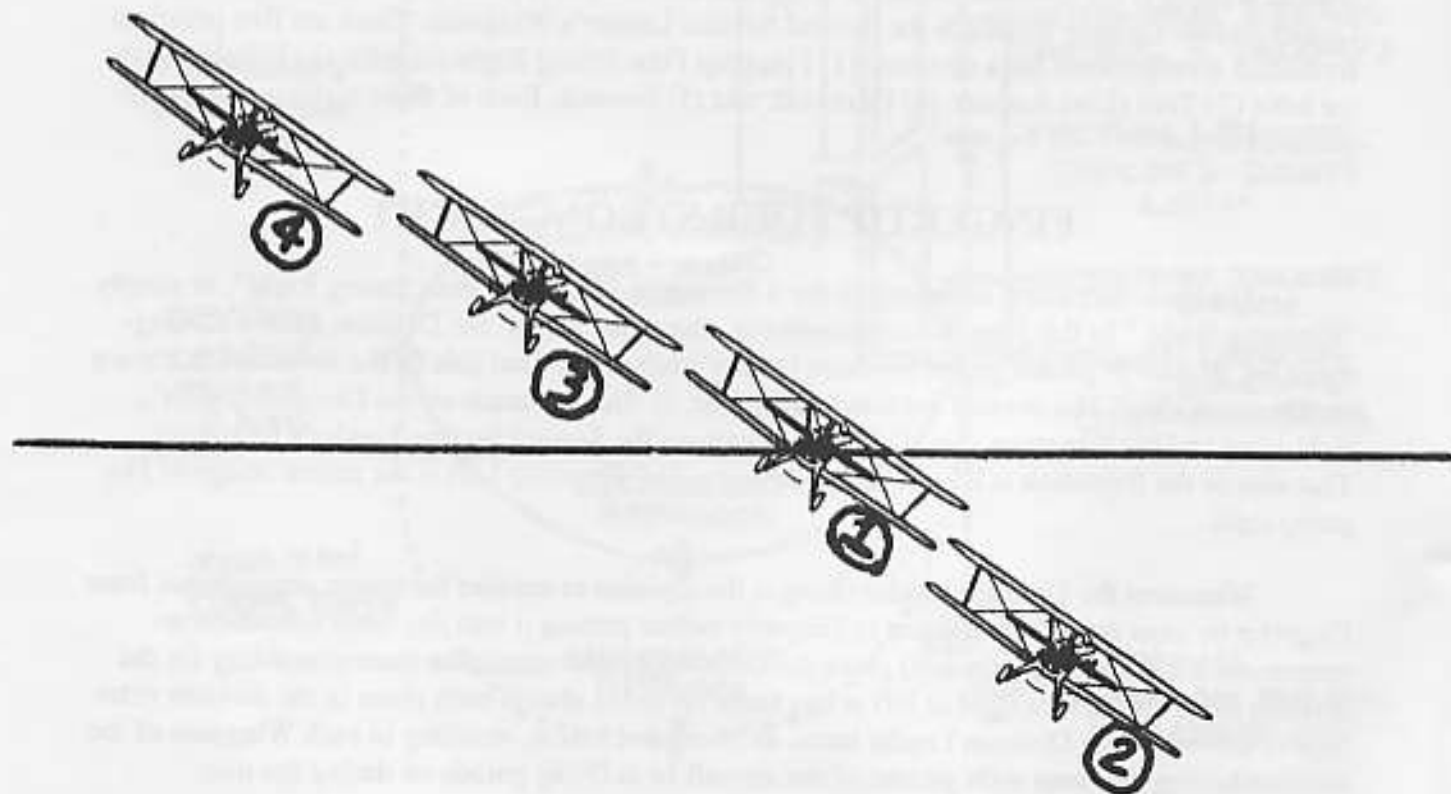
The basic formation arrangement for a division is "Fingertip Four Strong Right", or simply, "Fingertip Right." In this formation arrangement, illustrated below, the Division Leader's Wingman (No. 2) flies in parade on the Division Leader's left wing. That side of the formation is known as "the weak side." The Second Section Leader (No. 3) flies in parade on the Division Leader's right wing and his Wingman (No. 4) flies in parade on the Second Section Leader's right wing. That side of the formation is known as "the strong side." Fingertip Left is the mirror image of Fingertip right.

Whenever the Division Leader changes the division to another formation arrangement from Fingertip he must return the division to Fingertip before putting it into any other formation arrangement. Fingertip Right (or left) gives the Division Leader maximum maneuverability for the division since he can turn right or left at any time. As noted above, each plane in the division rides high or low when the Division Leader turns, as illustrated below, resulting in each Wingman of the division having the same sight picture of the aircraft he is flying parade on during the turn.

Fingertip Four Strong Right



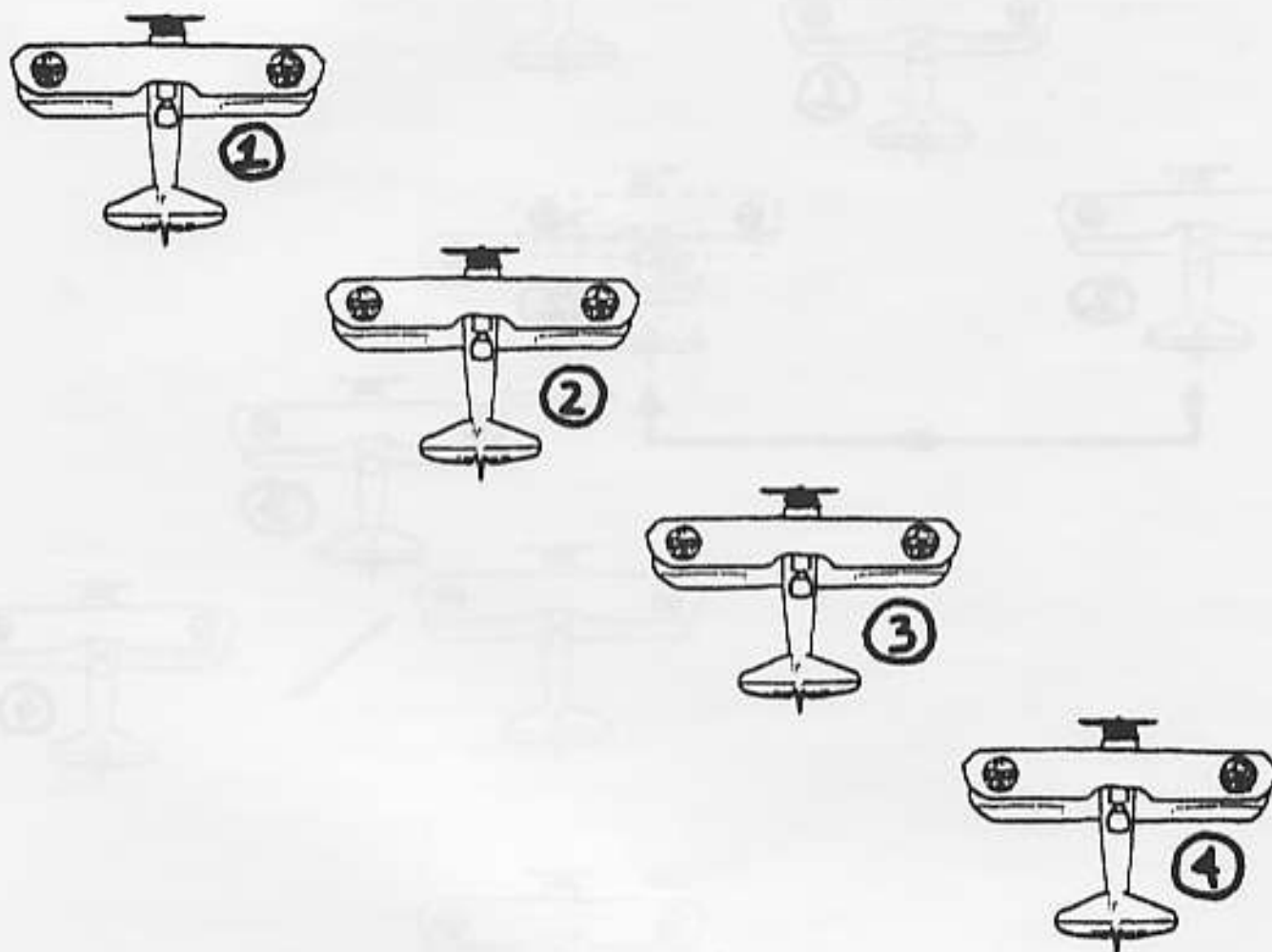
Fingertip Right in Turn Riding High



ECHELON RIGHT

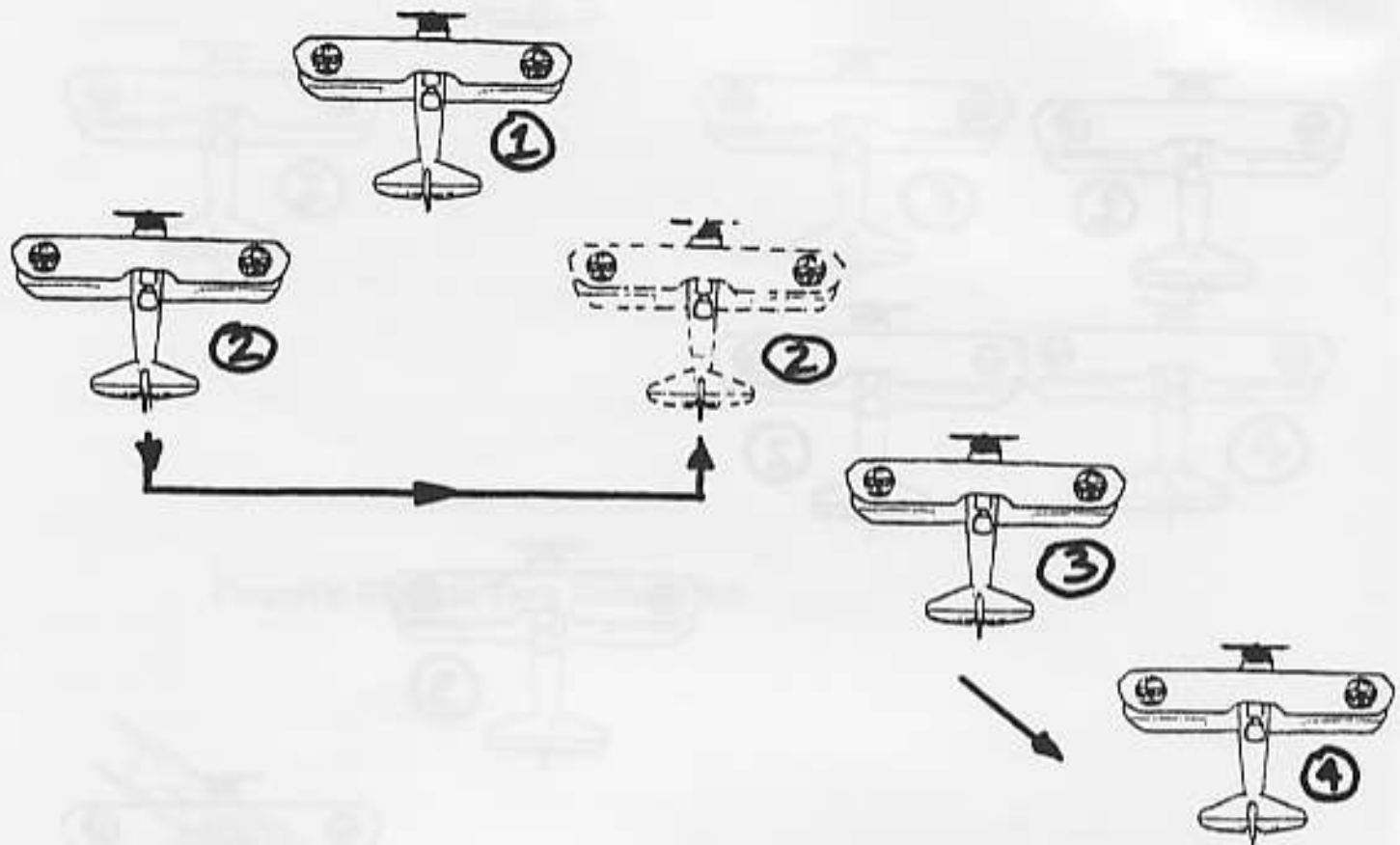
In Echelon Right Nos. 2, 3, and 4 fly in parade off the Division Leader's right wing, as illustrated below.

Echelon Right



To have the division go from Fingertip Right to Echelon Right the Division Leader gives the signal for a crossunder to No. 3 first, then to No. 2. No. 3 passes the signal to No. 4 while looking at the Division Leader. No. 3 then moves his section out and down The Bearing Line to give No. 2 room to execute a crossunder beneath No. 1. After No. 2 is in position on No. 1, No. 3 moves his section back up The Bearing Line and into position on No. 2. This change is illustrated below.

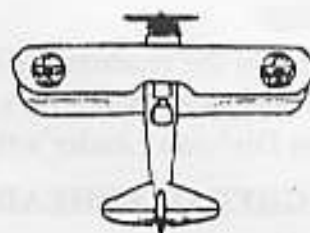
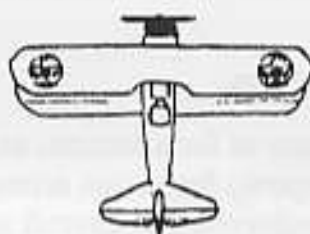
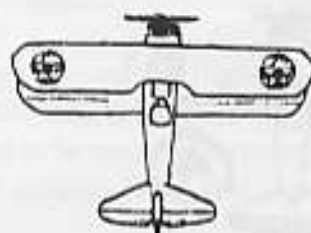
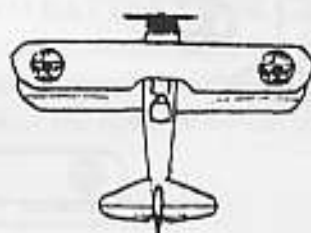
Going From Fingertip Right to Echelon Right



TRAIL POSITION (LINE ASTERN)

In the trail position Nos. 2, 3, and 4 take up position directly behind and stepped down on the Division Leader, as illustrated below. To have the division go from Fingertip Right to Trail the Division Leader gently porpoises his aircraft. No. 2 moves down and behind the Division Leader. No. 3 moves down and back behind No. 2 and No. 4 moves down and back behind No. 3. When all aircraft are in the Trail position No. 4 calls, "Four's in."

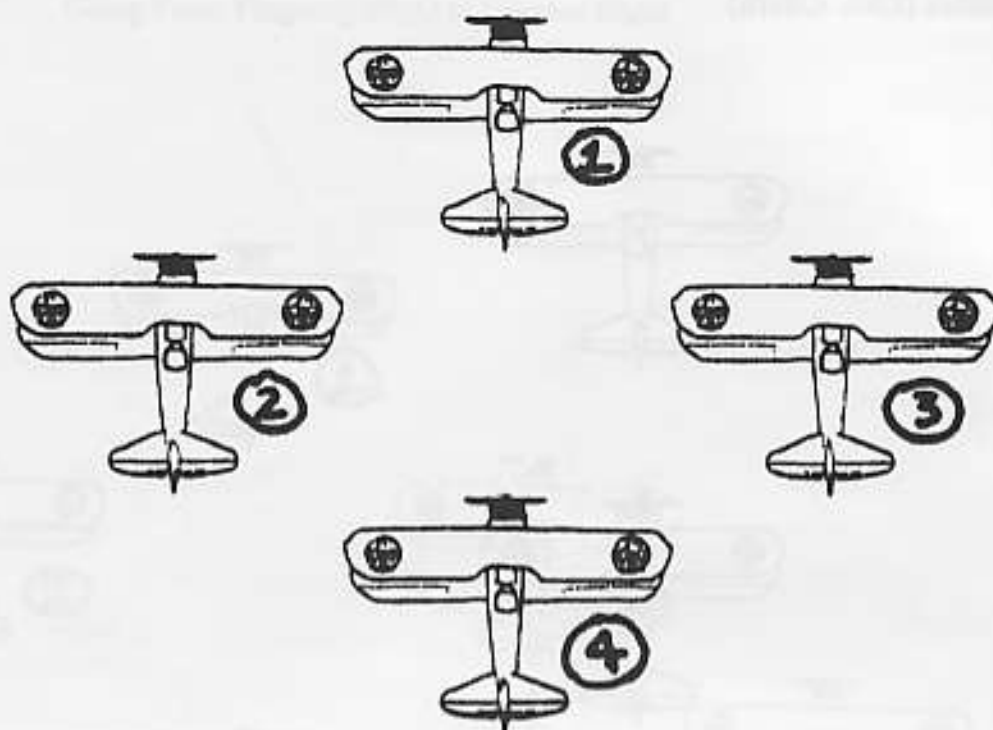
Trail Position (Line Astern)



DIAMOND

In the diamond position No. 4 takes up position in the "slot" directly behind and stepped down on the Division Leader, and stepped down on Nos. 2 and 3, all in the parade position, as illustrated below. To have the division go from Fingertip Right to Diamond the Division Leader gives the signal to No. 3, who relays it to No. 4. When No. 4 is in the slot position No. 3 gives a thumbs up to No. 1.

Diamond Position



BREAKUP AND RENDEZVOUS (JOIN UP)

The breakup for a division is the same as for a section, as described above. When a division joins up it always takes up the Fingertip formation arrangement. Thus, if the Division Leader turns **right** to begin the rendezvous all aircraft turn right to join up on him. No. 2 joins on the Division Leader's right wing in parade position on the **inside** of the turn and stays there. Nos. 3 and 4 join up on the **outside** of the turn in parade position on the Division Leader's left wing.

If the Division Leader turns **left** to begin the rendezvous No. 2 joins on the Division Leader's left wing on the **inside** of the turn and stays there. Nos. 3 and 4 join up on the **outside** of the turn in parade position on the Division Leader's right wing.

ENTRY INTO PATTERN FOR 360 DEGREE OVERHEAD BREAK

A division uses the same procedure for entry into the pattern for a 360 degree overhead break to landing as described above for a section except that the Division Leader, after placing his division into echelon right **cannot turn right** because of another cardinal rule of formation flying:

WHEN FLYING AS DIVISION LEADER *NEVER* TURN INTO YOUR ECHELON

Thus, the Division Leader should leave his division in Fingertip Right until he has lined his flight up with the runway heading on the way to the initial point. When lined up with the runway the Division Leader should put his flight in Echelon Right in time for his

wingmen to go from Fingertip Right to Echelon Right and dress the echelon before reaching the field. All Wingmen should concentrate on arriving at the field in perfect Echelon Right.

DOWNWIND ENTRY INTO PATTERN FOR LANDING

Again, the Division Leader should leave his division in Fingertip Right until he has lined the flight up on the downwind leg parallel to the runway. He must put his flight in Echelon Right in time for the wingmen to dress the echelon by the time the division reaches the downwind leg.

BRIEF AND DEBRIEF

The Federal Aviation Regulations require pilots who intend to fly formation to brief together before taking off for the flight. The JLFC lays heavy emphasis on a mandatory briefing before a formation flight and a mandatory debriefing after the flight.

A JLFC briefing before a formation flight covers: the purpose of the mission, the weather, the flight call sign, the alternate lead, a time hack (everyone synchronizes their watch with that of the Leader), radio frequencies to be used, taxi, run up, line up for takeoff, takeoff, join up, hand signals, the working area and altitude, bingo fuel, descent, approach, interval on the break and landing.

A JLFC debriefing involves a critique of problem areas, and covers timing, communication, lead signals, basic flying and questions by the Wingman or Wingmen.



ATTACHMENT A

STANDARD FORMATION HAND SIGNALS USED BY STEARMAN FORMATION PILOTS

A. GENERAL

The Leader should look at the Wingmen when giving the hand signal. **The Wingmen should acknowledge that they have received and understood the signal by giving head nods to the Leader.** If a Wingman is unsure of the signal he should not move his head or acknowledge the signal in any way. If the Leader does not receive a head nod from his Wingman he should repeat the signal until he receives a head nod. All signals by the Leader should be given with the throttle hand and arm while flying the aircraft with the stick hand. When flying in a division all signals are passed down the line while looking at the Division Leader. Some signals, such as turn left or right, climb or descend, are courtesy signals and will sometimes not be given by the Leader if the Wingmen are experienced. During early formation training the Leader should give the Wingmen such signals. A thumbs up means ready to go or action completed. A thumbs down or a negative head shake means all is not well or cannot comply.

B. STANDARD HAND SIGNALS

1. CROSSUNDER-SECTION

For the Wingman in a Section to cross under, the Section Leader's arm is held up towards the Wingman, bent 90 degrees with fist clenched, no arm movement, as illustrated below:



2. CROSSUNDER-DIVISION

For the second Section in a Division (Nos. 3 and 4) to cross under, the Division Leader's arm is held as illustrated above towards the Section Leader of the second section (No. 3) with multiple up-and-down arm pumps.

3. GO TO TRAIL (LINE ASTERN)—SECTION

Section Leader's arm is held up towards Wingman, bent 90 degrees, with fist clinched and thumb pointing rearward, motioning aft.

4. GO TO TRAIL—DIVISION

Division Leader gently porpoises his aircraft several times.

5. RETURN TO ECHELON OR FINGERTIP RIGHT FROM TRAIL—SECTION OR DIVISION

Leader rocks his wings gently, then begins a turn of 10-15 degrees angle of bank right or left. The first dip of the Leader's wings may signify the direction in which the Leader will turn, however, this is not always the case and the Wingmen should be prepared for the Leader to turn either way.

6. BEGINNING A TURN IN PARADE

Leader nods head in the direction of the turn.

7. ROLLING OUT OF A TURN IN PARADE

Leader's hand extended with fingers forward, palm flat and vertical, moving as if to slice a cake, pointing at 12 o'clock.

8. BEGINNING A CLIMB

Leader's hand extended with fingers forward and palm down, with forward and upward hand motion.

9. BEGINNING A DESCENT

Leader's hand extended with fingers forward and palm down, with forward and downward motion.

10. LEVELLING OFF

Leader's hand extended with fingers forward and palm down, moving back and forth in the horizontal.

11. ADD POWER

Leader's fist clinched, arm in forward motion (alternatively, Leader nods head forward towards instrument panel).

12. REDUCE POWER

Leader's hand extended with palm open, facing rearward, motioning to rear (alternatively, Leader nods head backwards towards rear of aircraft).

13. GO TO ENROUTE POSITION—SECTION OR DIVISION

Leader yaws his aircraft with rudder.

14. RETURN TO PARADE FROM ENROUTE POSITION—SECTION OR DIVISION

Leader rocks his wings gently.

15. GO FROM FINGERTIP RIGHT TO ECHELON RIGHT—DIVISION

Division Leader gives section cross-under signal first to No. 3, then to No. 2. No. 3 passes the signal to No. 4. No. 3 moves his section out and back down The Bearing Line to give No. 2 room to execute a cross-under. When No. 2 is in position Nos. 3 and 4 move back up The Bearing Line into position.

16. GO FROM FINGERTIP RIGHT TO DIAMOND—DIVISION

Division Leader's arm is held up towards No. 3, bent 90 degrees with four fingers extended, then Leader closes his fist with thumb pointing rearward, motioning aft. No. 3 relays the signal to No. 4, who moves into the slot position. When No. 4 is in position No. 3 gives the Division Leader a thumbs up signal.

17. GO FROM DIAMOND TO FINGERTIP RIGHT

Division Leader gently rocks his wings, then starts a turn into No. 3, the Second Section Leader. No. 4 moves to No. 3's right wing in parade position.

18. LEAD CHANGE

Leader looks at Wingman, pats top of head and points index finger at Wingman who is to take the lead. The Wingman who is to take the lead acknowledges the Leader's signal by patting the top of his head and pointing forward.

19. BREAKUP AND RENDEZVOUS (JOIN UP)

Leader puts Wingman (and second Section if a Division) in Echelon Right, holds up arm with fist clinched and index finger pointing upward. Leader moves index finger in circling motion, followed by a display of fingers showing the number of seconds for the break. When the Wingman (No. 2) acknowledges the breakup signal Leader kisses off the Wingman and breaks left. When all Wingmen are in trail and have called, "Two's in" or "Four's in," Leader begins a turn to the right or left (10-15 degrees angle of bank) for Wingmen to rendezvous.

20. BREAKUP FOR LANDING.

As above but without the rendezvous.

21. FUEL STATE INQUIRY

Leader holds up arm, fist clinched and thumb extended towards his open mouth.

22. WINGMAN'S RESPONSE TO FUEL STATE INQUIRY

Wingman holds up four fingers to signal he has a full tank of fuel; three fingers to signal 3/4 of a tank; two fingers to signal half a tank; and one finger to signal 1/4 tank.

23. CAN'T HEAR RADIO TRANSMISSIONS

Pilot with radio trouble moves open palm back and forth past his ear.

24. CAN'T TRANSMIT

Pilot moves open palm back and forth across his mouth.

25. IN-FLIGHT EMERGENCY

Pilot with problem holds a clenched fist against his forehead. This is followed by holding up one or more fingers to signal the HEFOE Code. One finger signals a Hydraulic problem (not applicable to Stearmans); two fingers for Electrical; three fingers for Fuel; four fingers for Oxygen (not applicable to Stearmans); and five fingers for Engine.

26. GO BUTTON TWO

Leader Taps ear and holds up two fingers. If Wingmen have the second frequency tuned in and need only touch the change frequency button on the radio, they reach for the button while looking at the leader.

27. FREQUENCY CHANGE

If the leader signals or radios a frequency changed to an unbriefed frequency, or if the Wingmen must tune their radios to a new frequency, all wingmen must move out on The Bearing Line before changing frequencies. Mid air collisions can occur during frequency changes if this rule is not followed.

28. NUMBERS

For numbers one through five leader holds up index finger vertically for number one, first two fingers for number two, three fingers for number three, four fingers for number four and four fingers and thumb for number five. For numbers six through nine leader holds index finger horizontally for number six, first two fingers horizontally for number seven, etc. For zero the leader makes a clinched fist.

ATTACHMENT B

RADIO PROCEDURES USED BY STEARMAN FORMATION PILOTS

GENERAL

In formation flying radio transmissions are kept to a minimum through the use of hand signals between the leader and the wingmen. However, some standard radio calls are part of formation flying. The most common of these, and their meanings, are stated below.

"Two's off." The wingman in a section has completed his takeoff.

"Four's off." Only the No. 4 aircraft calls when all aircraft in a division have completed their takeoffs.

"Two's in." The wingman in a section is in position in trail.

"Four's in." Only the No. 4 aircraft calls when all aircraft in a division are in position in trail.

"Charlie Flight check in." Leader calls for all wingman to call in on the assigned frequency.

"Two, Three, Four." Wingmen in a division each check in on the assigned frequency.

"Lead's cold left (or right)." The leader has landed, his aircraft is under control and he has taxied to the "cold side" of the runway (the side which will put him in position to turn off the runway).

"Two's cold left" or right (section) or "Four's cold left" or right (division). All wingmen have landed, their aircraft are under control and they are taxiing to the "cold" side of the runway, preparing to taxi to the ramp in formation behind the Leader.

"Lead's aborting!" The leader has aborted his takeoff.

"Two's underrunning." The wingman in a section has a broken join up and is going well below and behind the Section Leader.

"Go drag" The leader wants his wingmen to go into an extended trail

Notes from Formation Clinic



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Additional copies are available to SRA members

Contact the SRA Secretary