

NAVAL AIR TRAINING COMMAND



NAS CORPUS CHRISTI, TEXAS

CNATRA P-1242 (Rev. 03-09)

FLIGHT SUPPORT LECTURE GUIDE



FORMATION FLIGHT PROCEDURES T-45TS, TAILHOOK, AND IUT

2009



DEPARTMENT OF THE NAVY

CHIEF OF NAVAL AIR TRAINING
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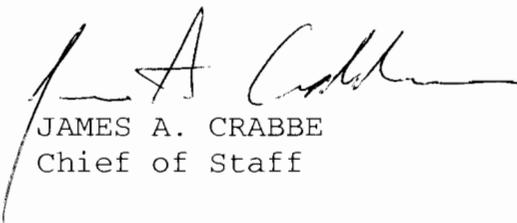
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15 MAY 2009

CNATRA P-1242 (REV. 03-09)

Subj: FLIGHT SUPPORT LECTURE GUIDE BOOK 1 & 2, FORMATION
FLIGHT PROCEDURES, T-45TS, TAILHOOK, AND IUT

1. CNATRA P-1242 (Rev. 03-09) PAT, "Flight Support Lecture Guide Book 1 & 2, T-45TS, TAILHOOK, and IUT" is issued for information, standardization of instruction, and guidance for all flight instructors and student aviators within the Naval Air Training Command.
2. This publication shall be used as an explanatory aid to support the T-45C Advanced Strike Flight Training Curriculum. It will be the authority for the execution of all flight procedures and maneuvers herein contained.
3. Recommendations for changes shall be submitted via CNATRA TCR form 1550/19 in accordance with CNATRAINST 1550.6E.
4. CNATRA P-1242 (10-95) PAT is hereby cancelled and superseded.


JAMES A. CRABBE
Chief of Staff

Distribution:
CNATRA N7 (5) Plus Original
COMTRAWING ONE (200)
COMTRAWING TWO (200)

FLIGHT SUPPORT LECTURE GUIDE
FOR
FORMATION FLIGHT PROCEDURES
P-1242



INTERIM CHANGE SUMMARY

The following Changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE

The following interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

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CHAPTER ONE
FORMATION MARSHAL, TAKEOFF,
RENDEZVOUS, DEPARTURE/CLIMBOUT

100. INTRODUCTION – N/A

COURSE/STAGE:

- Formation

LESSON TITLE:

- Formation Marshal, Takeoff, Rendezvous, Departure/Climbout

LESSON IDENTIFIER:

- FFP-01

LEARNING ENVIRONMENT:

- Classroom

ALLOTTED LESSON TIME:

- 1.5 hr

TRAINING AIDS:

- Formation CD-ROM

STUDY RESOURCES:

1. T-45 NATOPS Flight Manual, A1-T45AB-NFM-000 or A1 -T45AC-NFM-000
2. Formation Flight Training Instruction (FTI)

LESSON PREPARATION:

1. Read:
 - “Section Daytime Flight Procedures,” in the Formation FTI
2. Review:
 - Parts III, IV, V, and VII in the T-45 NATOPS Flight Manual, A1-T45AB-NFM-000

REINFORCEMENT:

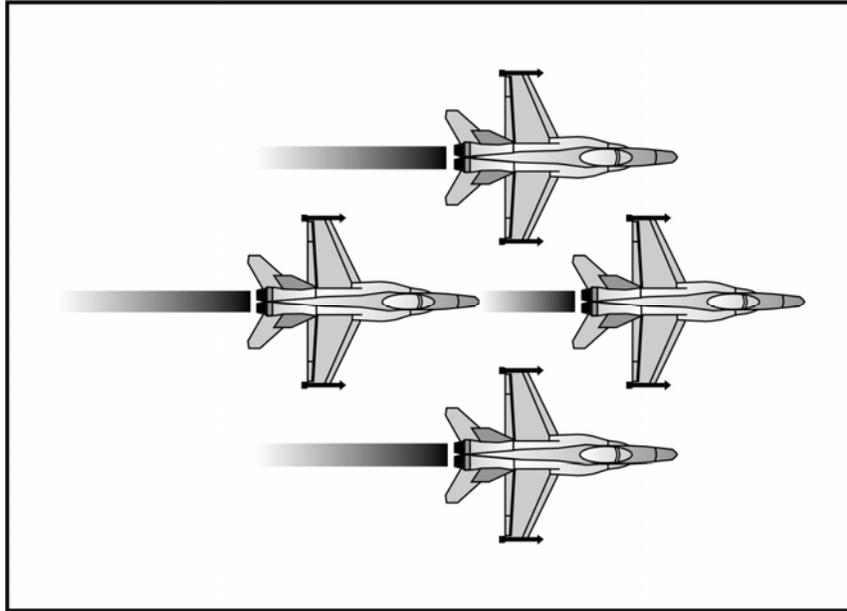
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EXAMINATION:

The objectives in this lesson will be tested in FFP-06X.

101. LESSON OBJECTIVES

1. Recall formation visual communications
2. Recall aircraft marshal procedures
3. Recall formation taxi/hold short procedures
4. Recall procedures for positioning aircraft for interval takeoff
5. Recall procedures for interval takeoff as lead
6. Recall procedures for interval takeoff as wingman
7. Recall procedures for abort during interval takeoff
8. Recall procedures for initial rendezvous/departure/climbout
9. Recall procedures for CV rendezvous
10. Recall procedures for running rendezvous
11. Recall procedures for TACAN rendezvous
12. Recall tasks and responsibilities of a formation lead



102. MOTIVATION

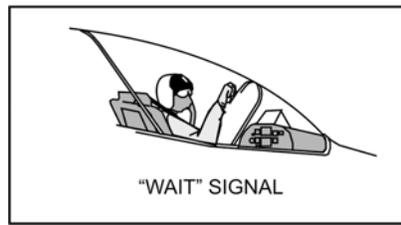
Most missions in the fleet are flown in formations of two or more aircraft. Before you can fly formation safely and confidently, you must learn the radio and visual communication procedures between the lead and his wingmen. You must also know ground, takeoff, and flight procedures for section and division formations. You will find these procedures in this and the other lessons in the formation block.

103. OVERVIEW

This lesson will introduce you to section formation flight in the T-45. You will be familiar with formation flight from marshaling through the initial rendezvous. You will also know the visual signals used between pilots in formation flight as well as the tasks and responsibilities of the formation lead.

In this lesson the following topics will be covered:

1. Visual signals
2. Marshaling and takeoff
3. Initial rendezvous/departure/climbout
4. Responsibilities of flight/formation lead

104. PRESENTATION**Visual signals****Figure 1-1 Visual Signals – General**

1. General
 - a. Affirmative (thumbs-up)
 - b. Negative, do not understand (thumbs-down)
 - c. Wait (on deck)



Figure 1-2 Visual Signals – Takeoff

2. Takeoff
 - a. Perform normal engine runup
 - b. Preparatory: takeoff path clear/I am commencing section takeoff



Figure 1-3 Visual Signals – General Airborne 1

3. General airborne
 - a. Wingman crossunder to right/left
 - b. Section crossunder to right/left echelon



Figure 1-4 Visual Signals – General Airborne 2

- c. Turn lights on/off or check lighting configuration



Figure 1-5 Visual Signals – General Airborne 3

- d. Leveling off
- e. Add power

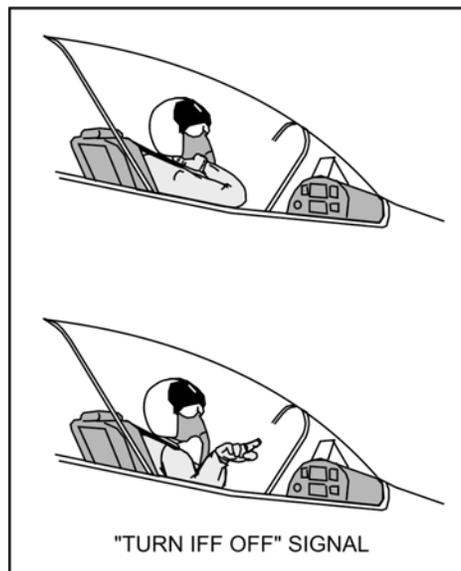


Figure 1-6 Visual Signals – General Airborne 4

- f. Turn IFF off



Figure 1-7 Visual Signals – General Airborne 5

- g. I am turning right/left
- h. Roll out of turn

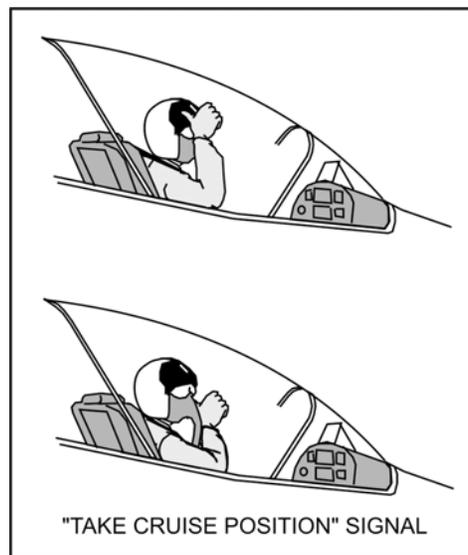


Figure 1-8 Visual Signals – General Airborne 6

- i. Take cruise position



Figure 1-9 Visual Signals – General Airborne 7

- j. Join on me
- k. Breakup (breakup and rendezvous exercise)



Figure 1-10 Visual Signals – General Airborne 8

- l. Kiss off or I am leaving formation

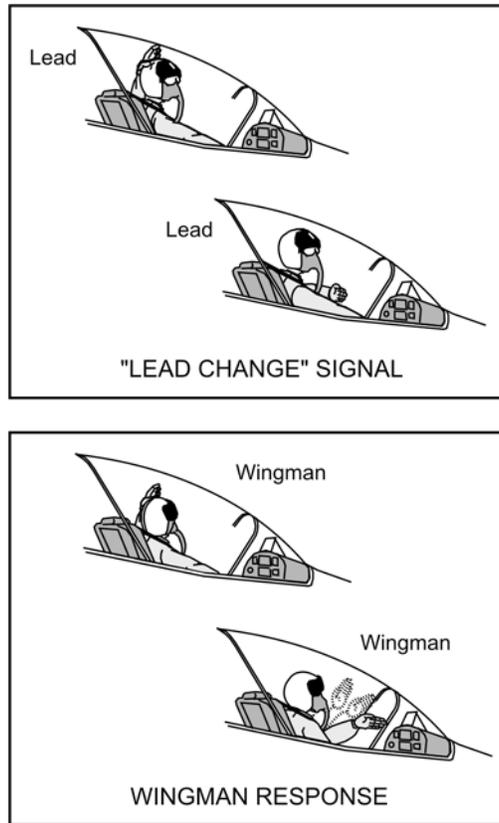


Figure 1-11 Visual Signals – General Airborne 9

- m. Lead change (signal/acceptance)



Figure 1-12 Visual Signals – General Airborne 10

- n. Tail-chase exercise



Figure 1-13 Visual Signals – General Airborne 11

- o. I am going to descend/climb

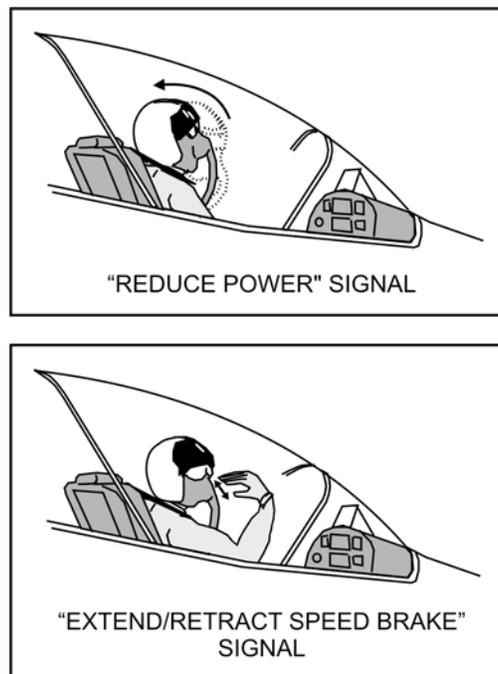


Figure 1-14 Visual Signals – General Airborne 12

- p. Reduce power
- q. Extend/retract speed brakes

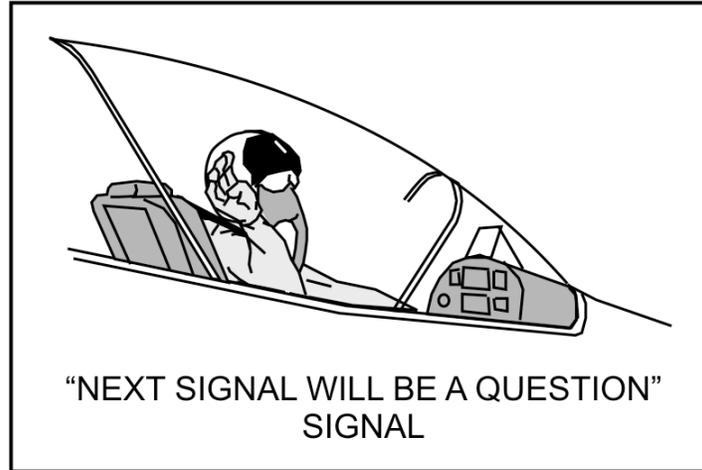


Figure 1-15 Visual Signals – General Airborne 13

- r. Next signal will be a question

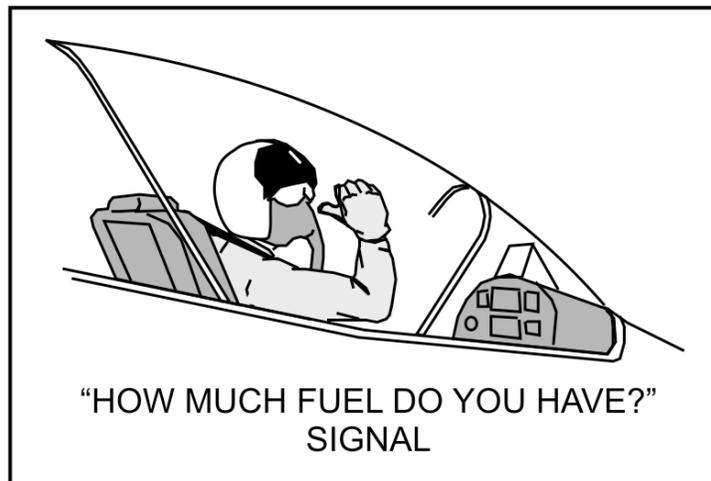


Figure 1-16 Visual Signals – Fuel Check 1

- s. Fuel check



Figure 1-17 Visual Signals – Fuel Check 2

- i. Thousands of pounds series

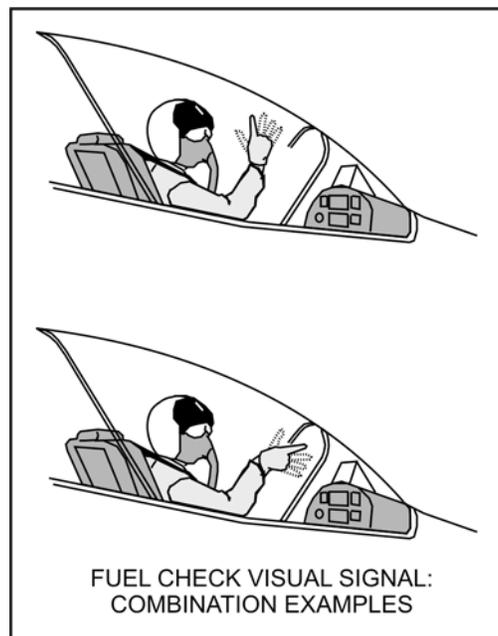


Figure 1-18 Visual Signals – Fuel Check 3

- ii. Combination examples

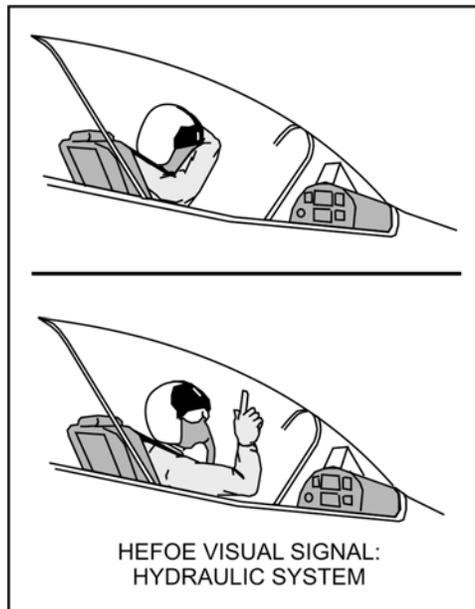


Figure 1-19 Visual Signals – HEFOE 1

- t. HEFOE (I am in trouble)
 - i. Hydraulic system

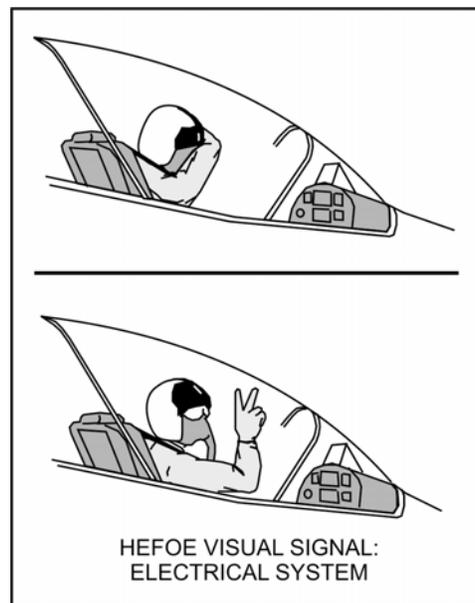


Figure 1-20 Visual Signals – HEFOE 2

- ii. Electrical system



Figure 1-21 Visual Signals – HEFOE 3

iii. Fuel system

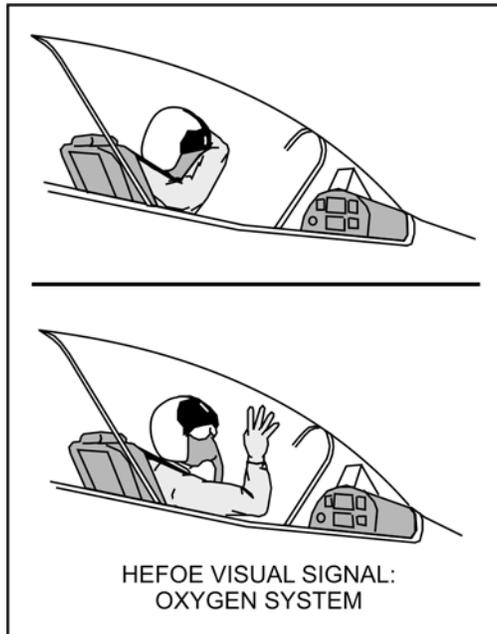


Figure 1-22 Visual Signals – HEFOE 4

iv. Oxygen system



Figure 1-23 Visual Signals – HEFOE 5

- v. Engine

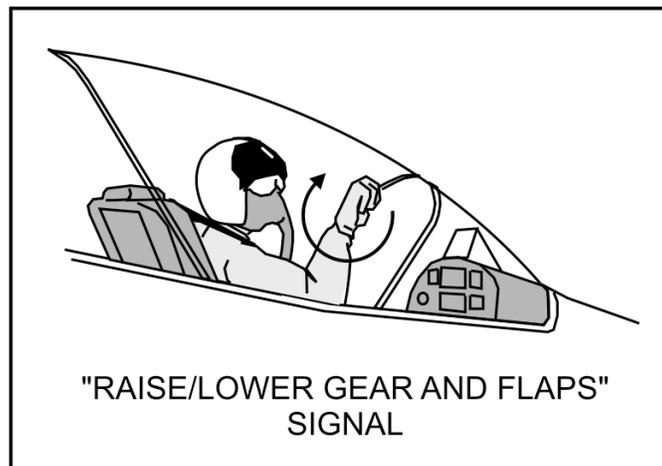


Figure 1-24 Visual Signals – Approach 1

- 4. Approach
 - a. Raise/lower gear and flaps

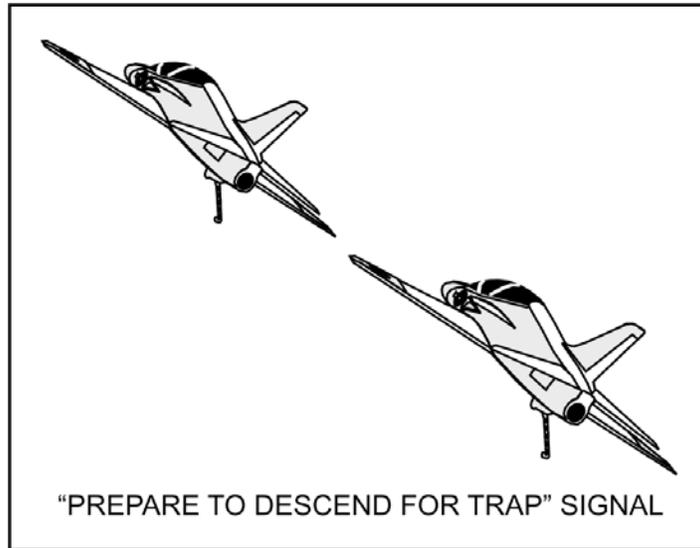


Figure 1-25 Visual Signals – Approach 2

- b. Prepare to descend for trap

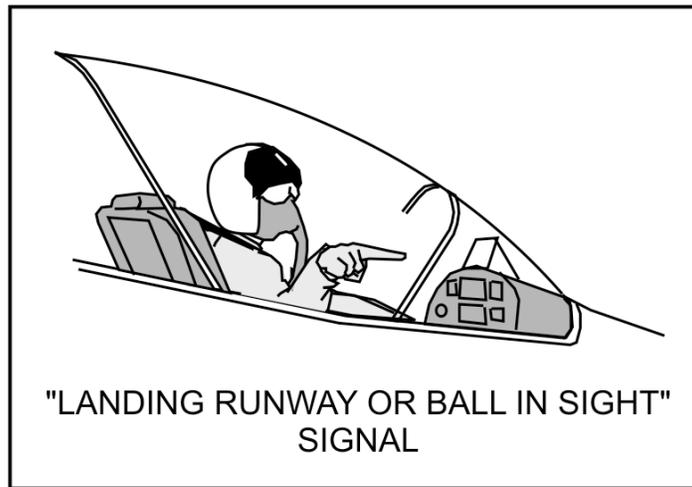


Figure 1-26 Visual Signals – Approach 3

- c. Landing runway or ball in sight

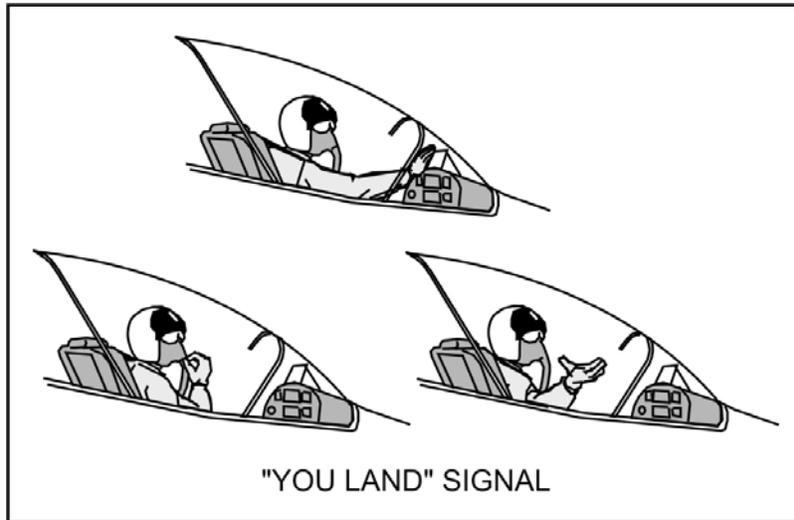


Figure 1-27 Visual Signals – Approach 4

- d. You land

Marshaling and Takeoff

1. Marshaling and taxiing

- a. Marshaling procedures
 - i. Lead and wingman
 - (a). Man aircraft and start engines at same time
 - (b). Complete checklists (identical to those used in Familiarization Stage)
 - (c). While in marshaling area, lead checks flight in on marshaling frequency, passes ATIS and clearance information (refer to local course rules for aircraft positioning and parking)
 - ii. Lead: if marshaling completed on frequency other than ground control, radio wingman to switch to appropriate frequency for taxi
 - iii. Wingman
 - (a). Acknowledge with flight number (e.g., “Two”)
 - (b). Switch to new frequency
 - iv. Lead

- (a). Switch to new frequency
- (b). Initiate check-in IAW local course rules
- v. Wingman: check in
- vi. Lead and wingman: taxi to duty runway in order

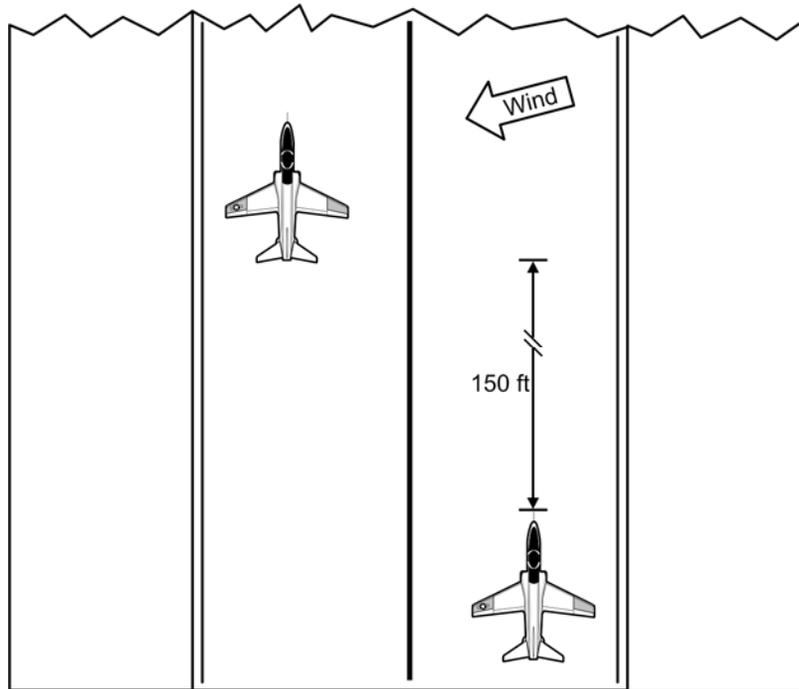


Figure 1-28 Section Taxiing

- b. Taxiing procedures: after marshaling, flight will taxi to duty runway in order
 - i. Lead
 - (a). Request taxi for flight and make all transmissions to ground control
 - (b). Take downwind side of taxiway (tailpipe courtesy)
 - (c). Taxi to hold short area
 - ii. Lead and wingman
 - (a). Follow local course rules
 - (b). Ensure enough clearance between wingtips while moving out of marshaling area

- iii. Wingman: in case of brake failure and to minimize possibility of FOD, allow minimum nose-to-tail of
 - (a). 150 ft during day, using alternate sides of taxiway
 - (b). 300 ft if conditions dictate, and use taxiway centerline

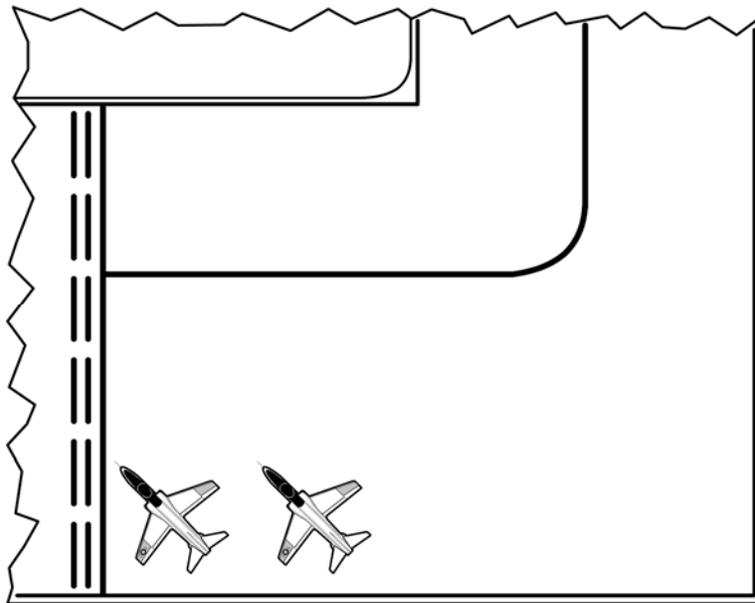


Figure 1-29 Section hold short

- c. Hold short procedure at hold short line
 - i. Lead and wingman
 - (a). Switch radio to tower frequency when lead approaches hold short
 - (b). Complete takeoff checklist while stopped in hold short area
 - ii. Wingman: passes thumbs-up
 - (a). To signal completed takeoff checklist
 - (b). To signal visual inspection complete
 - iii. Lead: calls for takeoff
 - iv. Wingman: passes thumbs-up to signal check-in on tower frequency

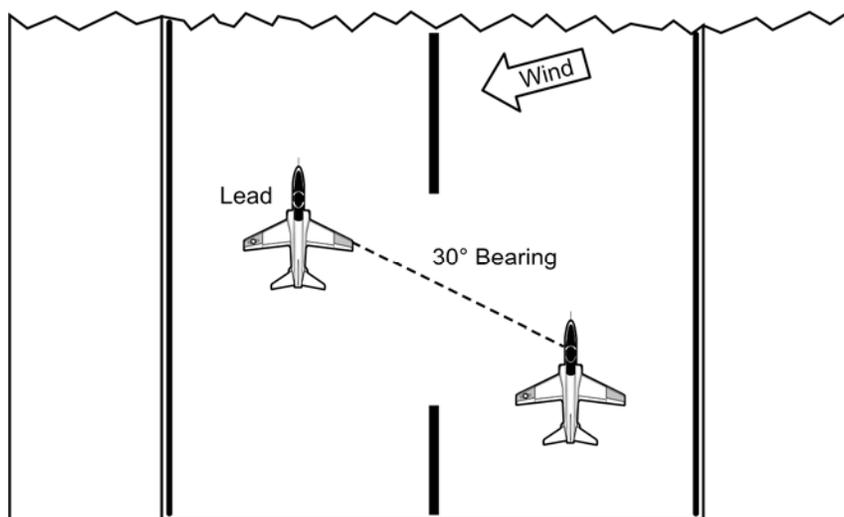


Figure 1-30 Section Interval Takeoff Position

2. Interval takeoff
 - a. Procedures for interval takeoff with 2 aircraft positioned on runway
 - i. When cleared by tower, flight will taxi onto runway in proper order
 - ii. Lead
 - (a). Move to left or downwind side and line up nose in middle of that half of runway
 - (b). Taxi up runway sufficiently to allow wingman to line up on bearing line
 - (c). Pass runway signal when flight in position
 - iii. Wingman
 - (a). Move onto bearing line on opposite side of runway from lead
 - (b). Acknowledge runway signal
 - (c). Perform engine runup check
 - iv. Lead: perform engine runup check
 - v. Wingman
 - Check lead's aircraft visually

- (a). No fluid pooling beneath aircraft
 - (b). Tires properly inflated
 - (c). Nose wheel straight
 - (d). Launch bar up
 - (e). Safety pins out
 - (f). Flaps/slats set properly
 - (g). Doors and panels secure
 - (h). Stabilator set
 - (i). Canopy down
- vi. Lead: check wingman's aircraft visually (same as wingman procedures)
- vii. Wingman: pass thumbs-up if both lead's aircraft and own aircraft check out

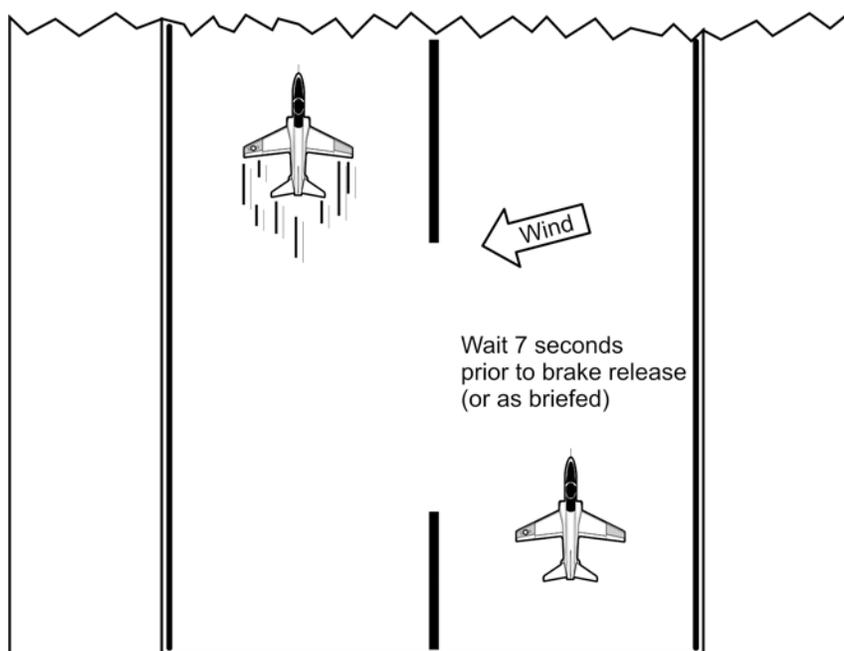


Figure 1-31 Section Interval Takeoff Procedure

- viii. Lead
 - (a). Take off normally per Fam stage procedures and local course rules
 - (b). Reduce power to 92-94 percent when airborne with gear and flaps/slats retracted and intercepts the briefed rendezvous airspeed
- ix. Wingman
 - (a). Roll no less than 7 seconds (or as briefed) after lead rolls
 - (b). Take off normally per Fam stage procedures and local course rules
 - (c). When airborne, stay at MRT until attaining desired closure rate (maximum closure = 50 KIAS)
- b. Takeoff abort procedures
 - i. Aircraft that is aborting, follow abort procedures IAW NATOPS

NOTE

Transmit intentions using tactical call sign to ensure safety of any following aircraft or to notify the lead.

LESSON NOTES

Emphasize the need for transmitting intentions.

- ii. Aircraft behind aborting aircraft (wingman)
 - (a). If airspeed is 50 KIAS or less
 - (1). Retard power to idle
 - (2). Extend speed brakes
 - (3). Brake as required
 - (4). Clear lead to centerline, if stop is possible prior to the arresting gear

NOTE

With the minimum 7-second interval, the wingman will usually be slow enough to allow for a safe abort behind the lead.

- (b). If airspeed above 50 KIAS, continue with takeoff

Initial rendezvous/departure/climbout: the rendezvous immediately after takeoff can be CV rendezvous, running rendezvous, combination of running/CV rendezvous, or TACAN rendezvous, as briefed

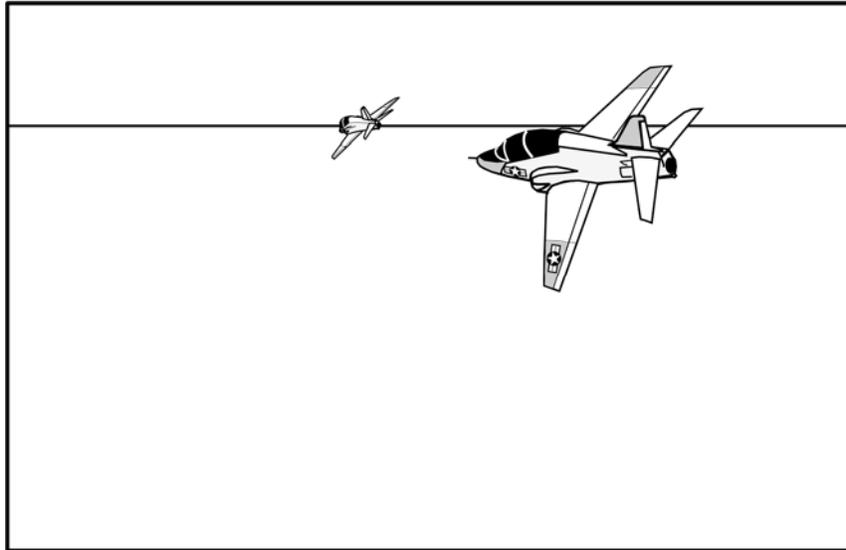


Figure 1-32 CV Rendezvous Turn

1. CV rendezvous

WARNING

Failure to follow the procedures outlined in the FTI increase the likelihood of having a Mid-air collision during both day and night CV rendezvous.

- a. Description: join flight together in a turn
- b. Procedure
 - i. Lead: after takeoff, begin a 30-degree AOB climbing turn at briefed airspeed
 - ii. Wingman
 - (a). Turn as necessary to intercept a 30-degree bearing on lead
 - (b). Put lead on horizon

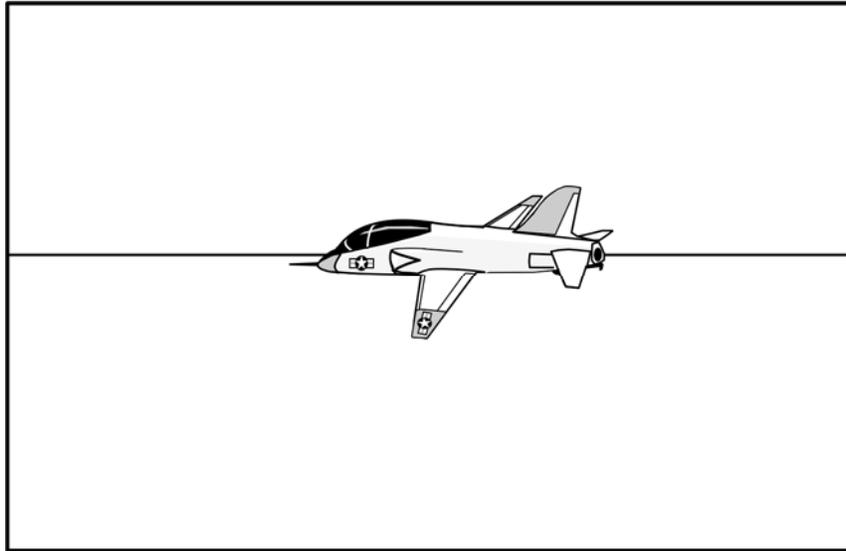


Figure 1-33 Maintain Bearing

- (c). Maintain position on rendezvous bearing and close on lead
 - (1). Approaching bearing line, reduce AOB to prevent going acute

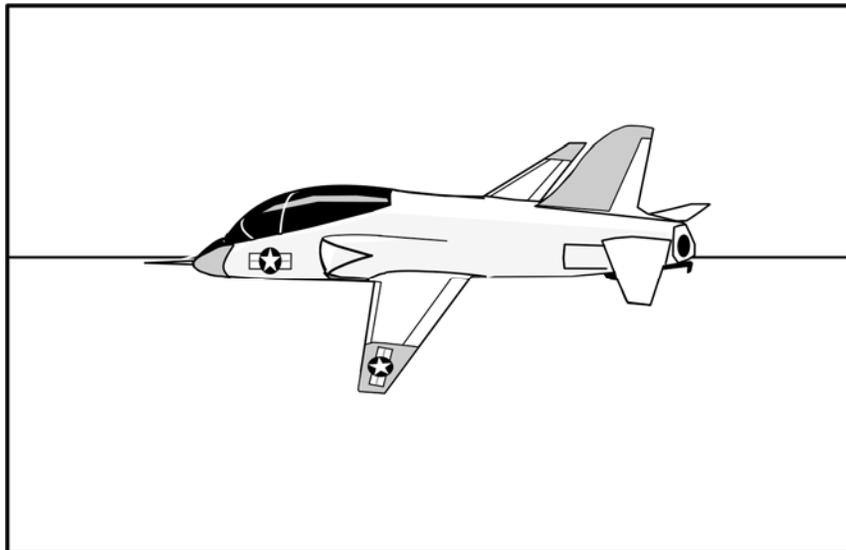


Figure 1-34 Keep Lead on Horizon

- (2). Keep lead on horizon to stabilize vertical separation
- (3). Fly maximum of 10-KIAS closure when within 1,000 ft

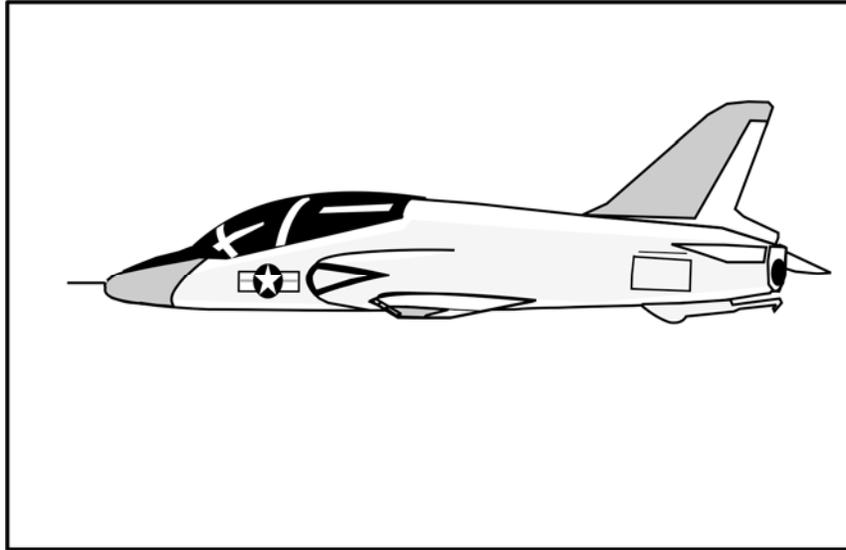


Figure 1-35 Begin Join-Up

- (d). On bearing line approximately 3 wingspans away, begin join-up by increasing stepdown to 15 ft, and flying to 10-foot nose-to-tail

LESSON NOTES

Closure on lead aircraft should continue as stepdown is increased. The wingman should not leave the bearing line until reaching 10 ft nose-to-tail.

- (e). Pause momentarily on lead's radius of turn, maintaining 10 ft of nose-to-tail and 15-ft stepdown

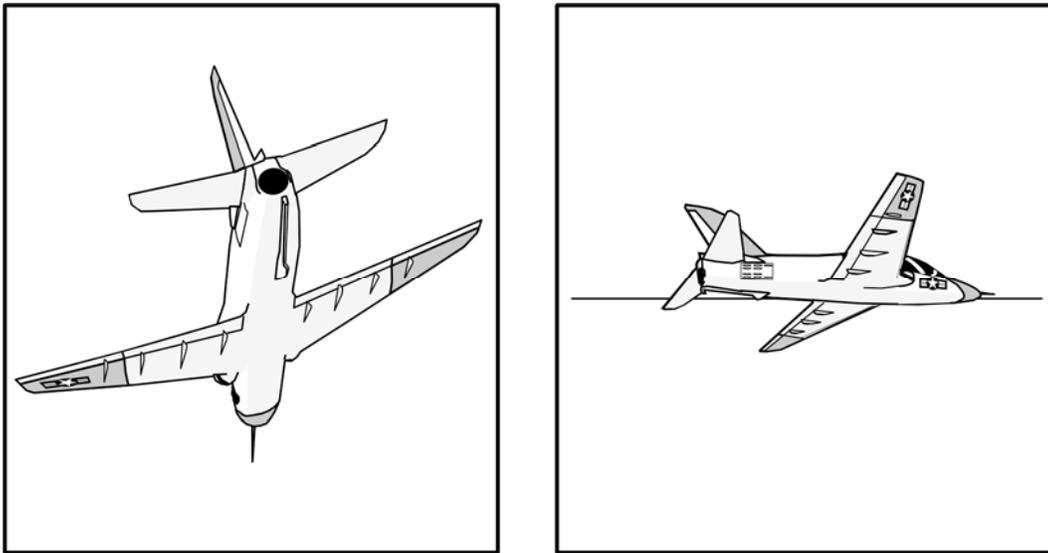


Figure 1-36 Move Up into Parade Turn-Away

- (f). Move up into parade turn-away position
- c. Level rendezvous: if weather or local course rules dictate, perform level instead of climbing rendezvous, in which case the following would apply
 - i. Lead: level off and maintain constant airspeed, altitude, and AOB as briefed
 - ii. Wing: keep lead on horizon, maintain bearing line, and monitor airspeed using a maximum of 10 KIAS of closure when within 1,000 ft to avoid excessive closure

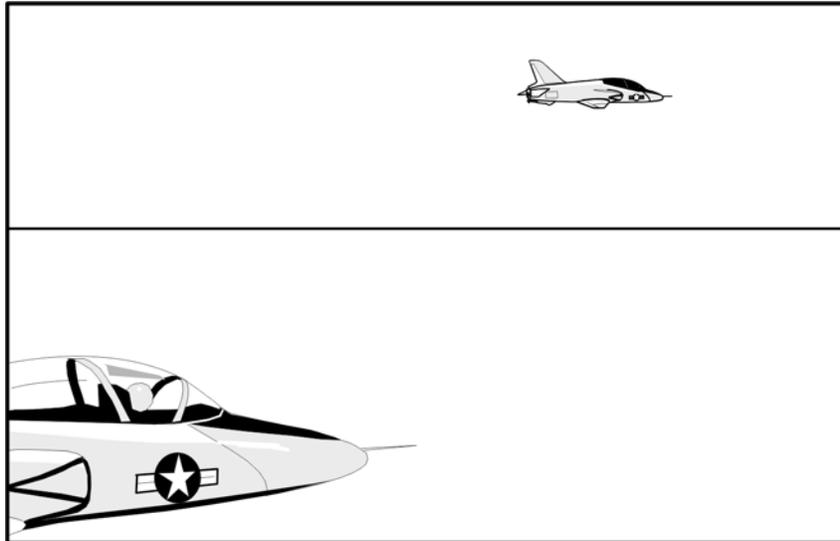


Figure 1-37 CV Rendezvous Error: Not Keeping Lead on Horizon

- d. Common errors by wingman
 - i. **Problem:** erratic airspeed control and closure due to not keeping lead aircraft on horizon during rendezvous

Correction: keep lead on horizon and be aware that airspeed is more sensitive to power changes during climb

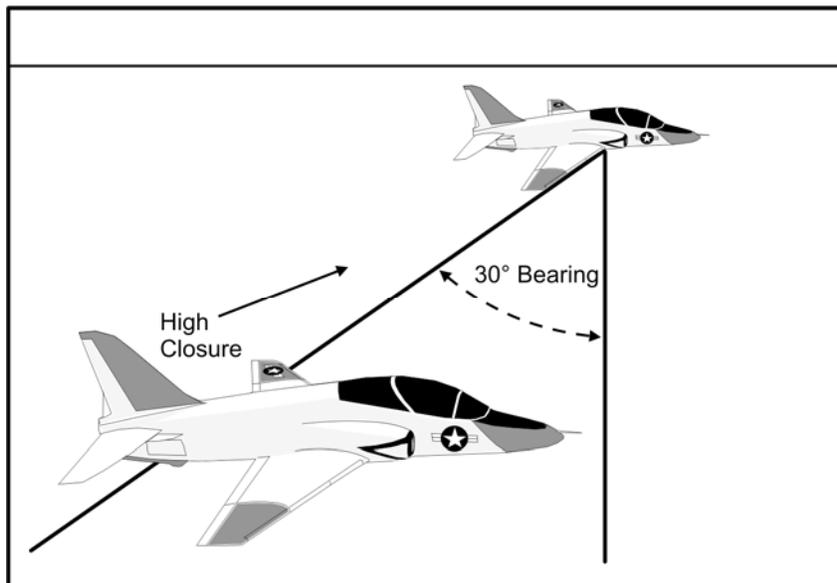


Figure 1-38 CV Rendezvous Errors: Acute with High Closure

- ii. **Problem:** wingman acute at high closure rate due to failure to anticipate the proper bearing line as he approaches it, and failure to adjust power to maintain proper speed differential

Correction: shallow AOB to drop back to bearing line, adjust power for proper speed differential, anticipate a larger correction to catch the proper bearing line

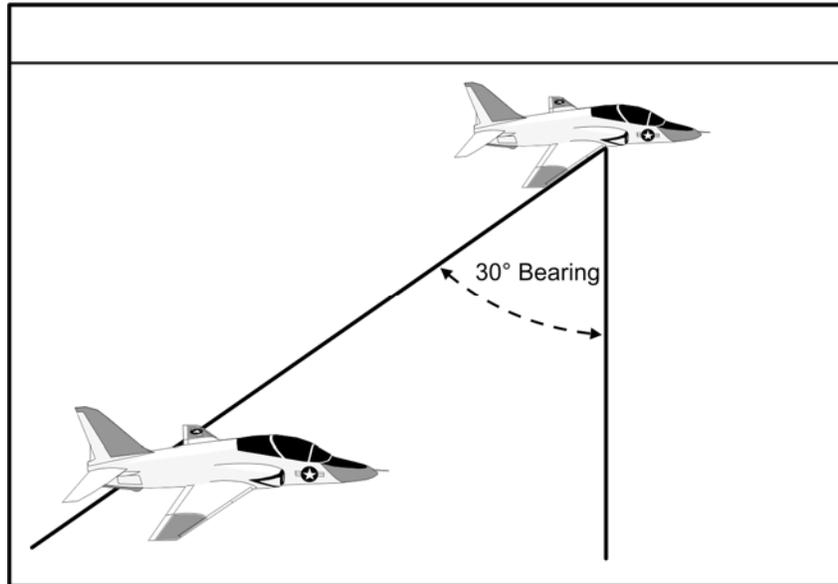


Figure 1-39 CV Rendezvous Errors: Acute at Normal Closure

- iii. **Problem:** wingman acute but at normal closure rate due to failure to anticipate the proper bearing line, as he approaches it, and being underpowered

Correction: reduce AOB to slide aft to bearing, then readjust (add) power to maintain proper closure

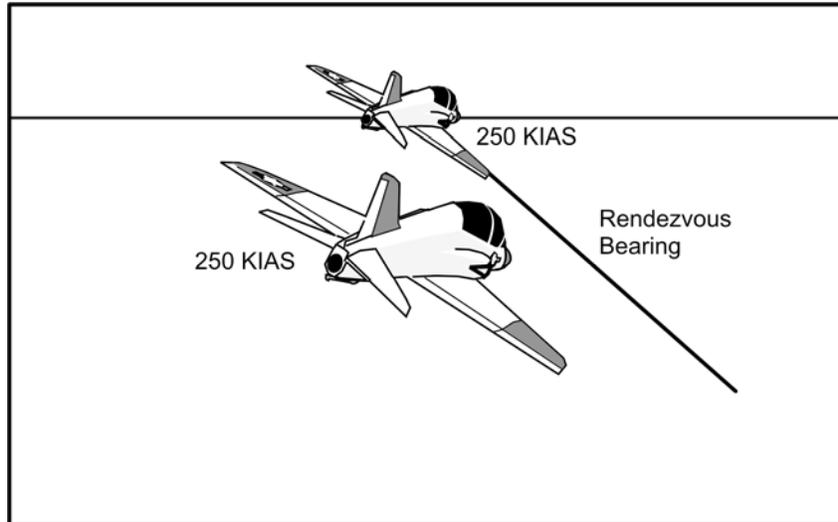


Figure 1-40 CV Rendezvous Error: Sucked at Normal Closure

- iv. **Problem:** wingman sucked at normal closure due to failure to anticipate the proper bearing line, as he approaches it, and being overpowered

Correction: increase AOB for proper bearing, then readjust power to maintain proper closure

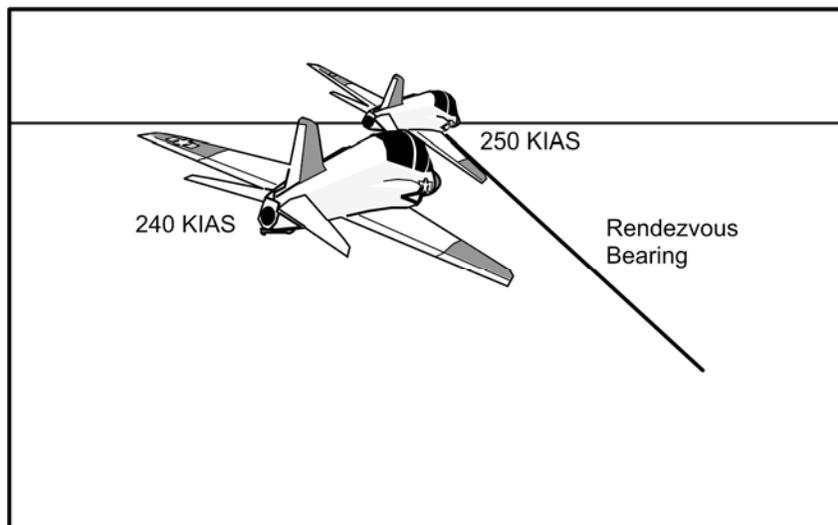


Figure 1-41 CV Rendezvous Error: Sucked with Slow Closure

- v. **Problem:** wingman sucked at slow closure due to failure to anticipate the proper bearing line, as he approaches it, and being underpowered

Correction: increase AOB for proper bearing, readjust (add) power to establish proper closure

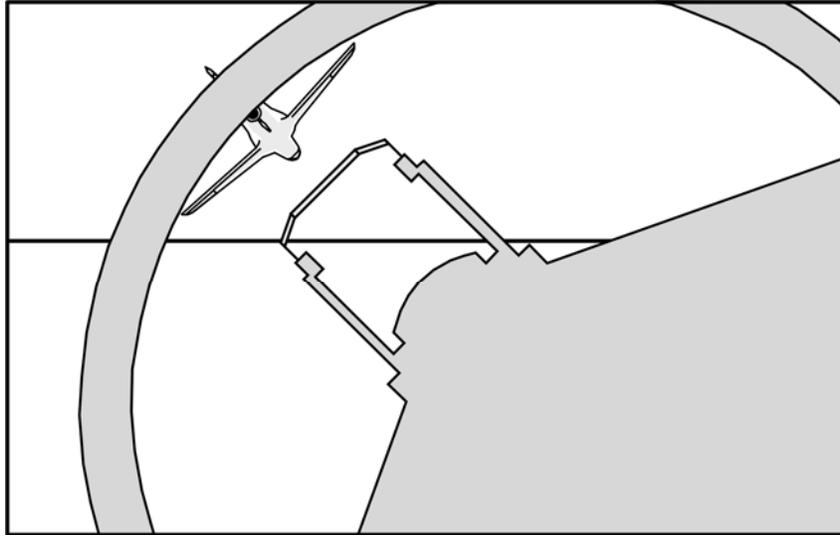


Figure 1-42 CV Rendezvous Error: Leaving Bearing Too Soon

- vi. **Problem:** wingman crossing behind lead at greater than 10 ft nose-to-tail due to leaving bearing line too soon

Correction: increase AOB to return to bearing line and maintain closure until proper nose-to-tail crossunder position is reached

- vii. **Problem:** wingman stagnates on bearing line due to not enough closure

Correction: increase power and monitor airspeed

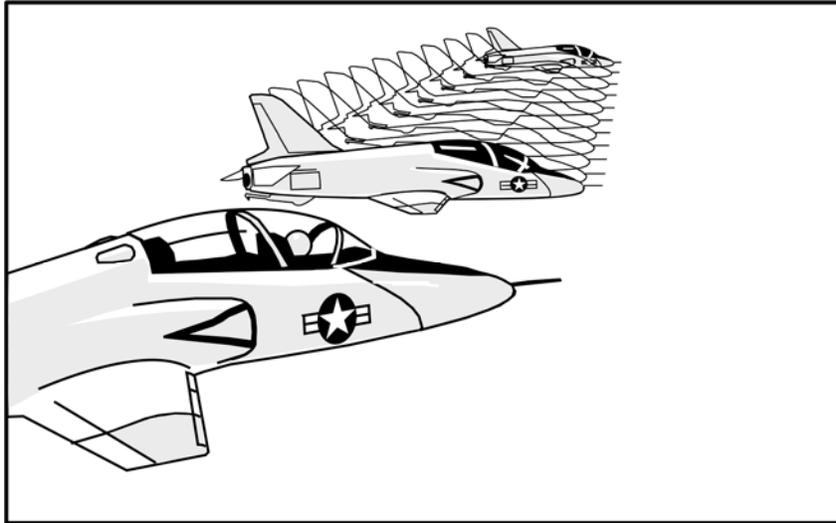


Figure 1-43 CV Rendezvous Error: High Uncontrollable Closure

- viii. **Problem:** wingman has high and uncontrollable closure rate due to excess power

Correction: slow aircraft to controllable speed differential with lead, or underrun

- ix. **Problem:** wingman does not recognize join-up window

Correction: learn to recognize appropriate visual cues

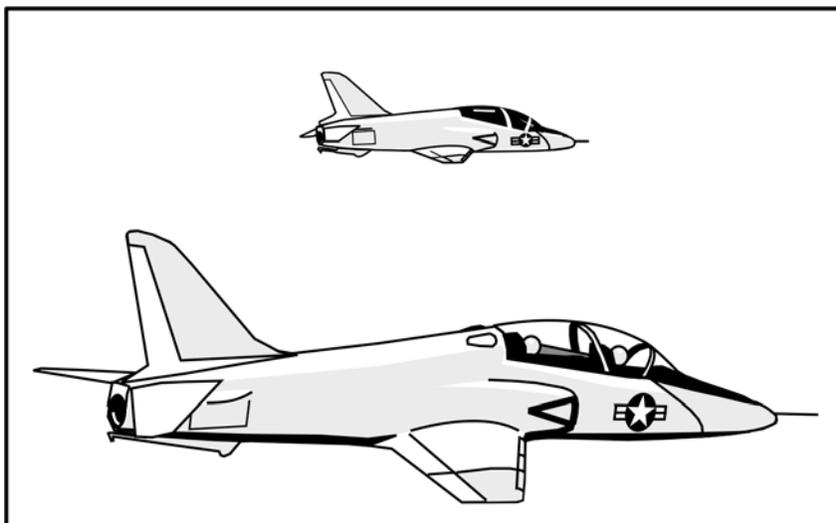


Figure 1-44 CV Rendezvous Error: Rapid Stepdown in Joining

- x. **Problem:** during join-up, wingman lowers nose too much during crossunder, increasing stepdown and airspeed, resulting in acute position

Correction: slightly reduce power to control nose-to-tail, adjust nose up to fly proper stepdown, readjust power

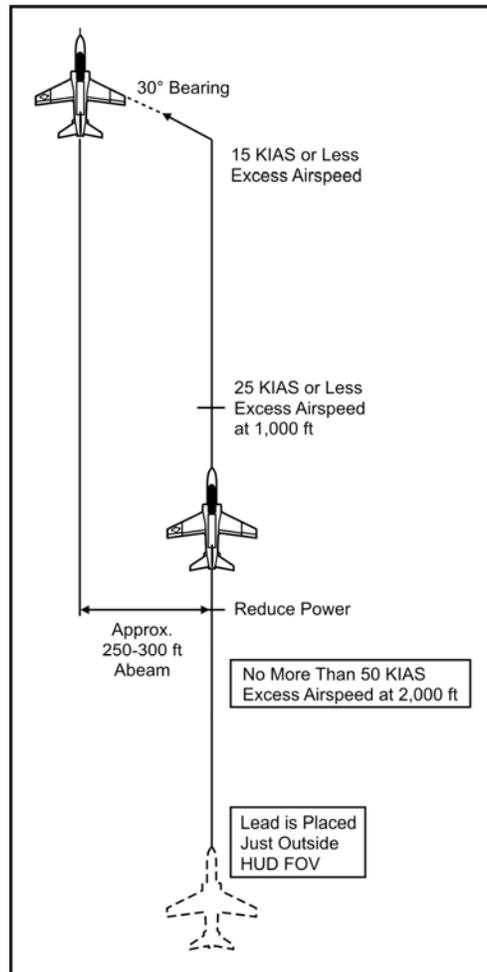


Figure 1-45 Running Rendezvous: Approaching the Bearing

2. Running rendezvous
 - a. Description: join-up while proceeding on course; may utilize after an interval takeoff and may be accomplished in a climb, level, or descent
 - b. Procedure
 - i. Lead: climb on briefed course and airspeed at 92-94 percent power
 - ii. Wingman

- (a). Climb
 - (1). Keep lead slightly above horizon
 - (2). Stay out of jetwash
- (b). Close on lead in trail, slowing to arrive at 2,000 ft of lead with no more than 50 KIAS excess airspeed

NOTE

If level rendezvous, wingman needs to make larger power reduction.

- (c). If short duration turn necessary, fly inside lead's radius of turn (but never acute of bearing)
- (d). At 2,000 ft from lead, be 250 to 300 ft abeam and on a course parallel to the leads. This distance places the lead just outside the HUD field of view. Reduce power..."
- (e). Maintain 250 to 300 ft abeam on a parallel course to rendezvous with the bearing line
- (f). Slow, so as not to exceed 15 KIAS of closure
- (g). Maneuver on the bearing line into parade position, maintaining bearing line

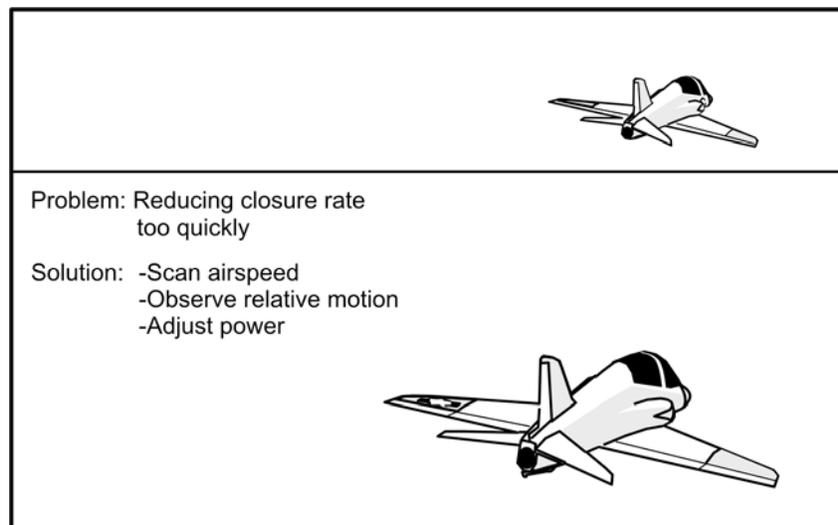


Figure 1-46 Running Rendezvous Error: Reducing Closure Too Early

- c. Common errors by wingman
- i. **Problem:** reducing closure rate too early due to power and nose attitude changes which reduce airspeed below acceptable speed differential with lead

Correction:

- (a). Scan airspeed indicator in order to compare current speed with briefed airspeed
- (b). Observe relative motion between aircraft
- (c). Use power to maintain closure

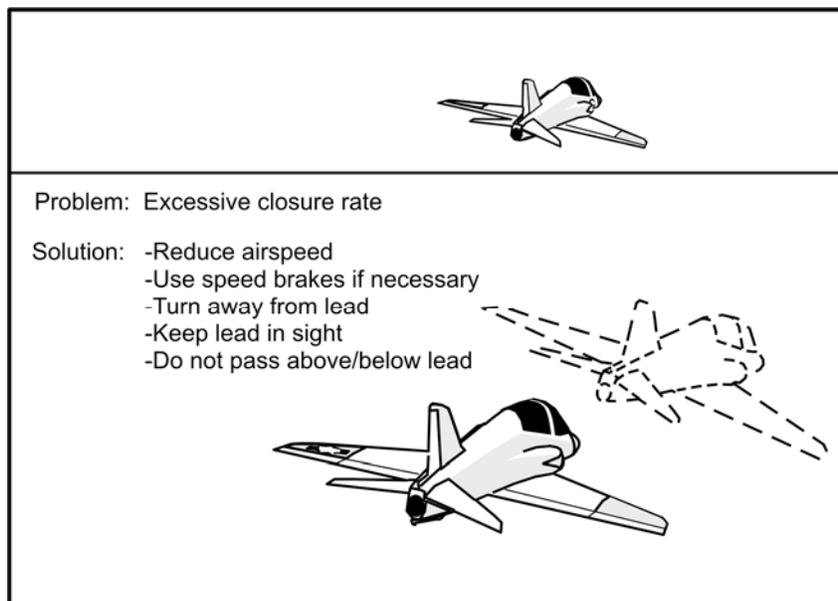


Figure 1-47 Running Rendezvous Error: Excessive Closure Rate

- ii. **Problem:** high closure rate due to excessive power/airspeed

Correction:

- (a). Reduce power
- (b). If necessary, use speed brakes
- (c). Turn away from lead to ensure adequate lateral separation
- (d). Keep lead in sight at all times
- (e). Do not pass directly above or below lead

- iii. **Problem:** too much lateral separation in join-up phase due to excessive heading differential from trail position to the bearing line

Correction: use minimal AOB adjustments to establish and control heading differential

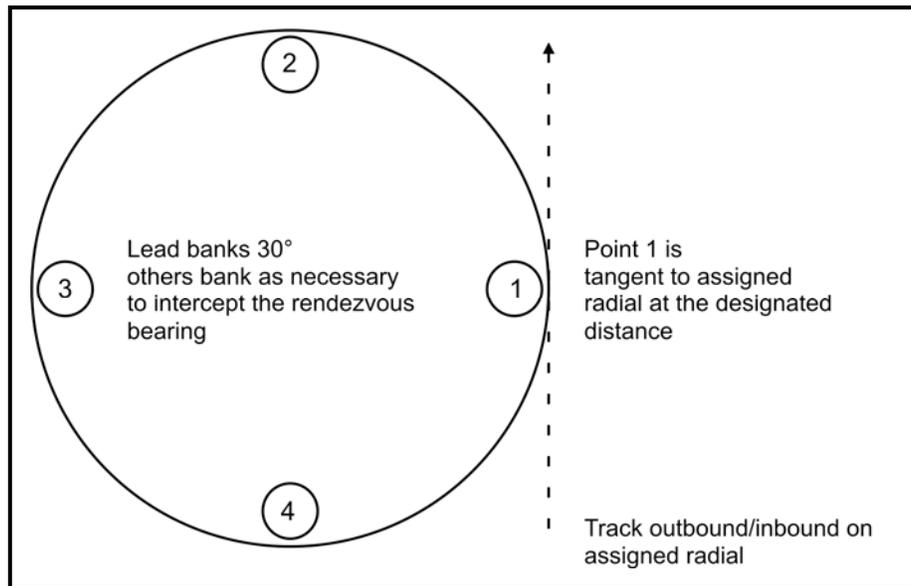


Figure 1-48 TACAN Rendezvous

3. TACAN rendezvous
- a. Description
 - i. Visual rendezvous in circle
 - ii. Normally at left tangent to briefed TACAN inbound/outbound radial and DME
 - iii. At specified airspeed, altitude, and direction from briefed TACAN fix
 - iv. Utilized
 - (a). In departure with marginal weather
 - (b). To establish visual contact in nonvisual contact situations
 - b. Procedures for TACAN rendezvous
 - i. Lead: start rendezvous turn

- (a). At briefed TACAN fix (point 1: point tangential to radial at designated distance)
 - (b). At briefed altitude
 - (c). Briefed direction with 30-degree AOB turn
 - (d). At briefed airspeed
 - (e). Simultaneously making radio call “[call sign], point one”
 - ii. Wingman
 - (a). Fly to point 1 with 500 ft of stepdown and remain 500 ft below lead until lead in sight.
 - (b). At night, wingman must remain 500 ft below the lead until established on bearing with fuselage alignment
 - iii. Wingman and lead: call four points of circle as they are passed
 - iv. Wingman: upon seeing lead
 - (a). Call “Visual”
 - (b). Fly to rendezvous bearing line
 - (c). Climb to lead’s altitude
 - (d). Proceed as in standard CV rendezvous
 - v. Angle of bank during the day may vary as necessary and is limited to 45 degrees at night
4. Departure Climbout
- a. Lead: pass fuel check signal and comply with clearance/local course rules
 - b. Wingman: pass fuel quantity rounded to closest 100 pounds

Responsibilities of flight/formation lead:

1. Maintain safe and orderly conduct of mission
2. Stay clear of traffic and weather
3. Stay within briefed operations area
4. Execute checklists
5. Execute proper visual and radio communication
6. Make smooth/consistent changes in power, heading, and altitude

105. SUMMARY

This lesson covered:

1. Visual signals
2. Marshaling and takeoff
3. Initial rendezvous/departure/climbout
4. Responsibilities of flight/formation lead

106. CONCLUSION

As you can appreciate by now, the wingman flying parade position takes all cues for flight from his lead. Where the lead goes, so goes the wingman. Thus the wingman should focus attention on where the lead is at the moment and, by paying attention to signals, where the lead is going. An inattentive wingman can jeopardize both his own safety and the lead's.

CHAPTER TWO
SECTION PARADE FORMATION

200. INTRODUCTION – N/A

COURSE/STAGE:

- Formation

LESSON TITLE:

- Section Parade Formation

LESSON IDENTIFIER:

- FFP-02

LEARNING ENVIRONMENT:

- Classroom

ALLOTTED LESSON TIME:

- 1.3 hr

TRAINING AIDS:

- Formation CD-ROM

STUDY RESOURCES:

1. T-45 NATOPS Flight Manual, A1-T45AB-NFM-000 or A1 -T45AC-NFM-000
2. Formation Flight Training Instruction (FTI)

LESSON PREPARATION:

1. Read:
 - “Section Daytime Flight Procedures,” in the Formation FTI
2. Review:
 - Parts III, IV, V, and VII in the T-45 NATOPS Flight Manual, A1-T45AB-NFM-000

REINFORCEMENT:

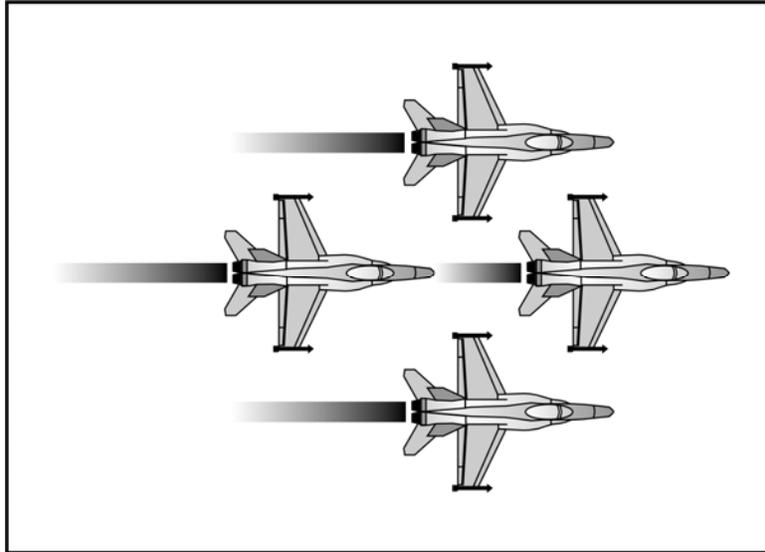
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EXAMINATION:

- The objectives in this lesson will be tested in FFP-06X.

201. LESSON OBJECTIVES

1. Recall position for section VFR/IFR parade position
2. Recall procedures for intercepting and flying bearing line
3. Recall procedures for turn into wingman
4. Recall procedures for turn away from wingman
5. Recall procedures for crossunder
6. Recall procedures for breakup and rendezvous as lead
7. Recall procedures for breakup and rendezvous as wingman
8. Recall procedures for underrun maneuver
9. Recall procedures for lead change



202. MOTIVATION

The vast majority of the flights that are launched from a carrier or from shore bases in the tactical air community involve formation flight. Since many takeoffs from land involve an interval takeoff and it is impossible to do a section takeoff from an aircraft carrier, there must be a way of assembling the formation prior to heading towards the mission area. Similarly, upon leaving the mission area or during separation due to bad weather, the section or division must be able to reassemble. Therefore, this lesson emphasizes the rendezvous and its constituent parts that you will practice on formation flights.

203. OVERVIEW

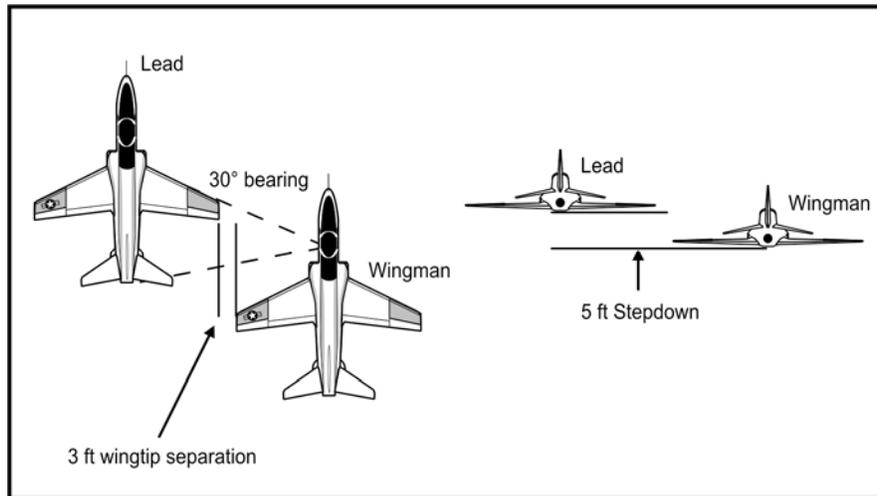
This lesson will introduce you to procedures for in-flight section parade formation. By the completion of this lesson, you will be familiar with techniques for maintaining parade position and the procedures for turns into and away from the wingman, the breakup and rendezvous exercise, the underrun, and the lead change.

This lesson covers in-flight procedures for the following:

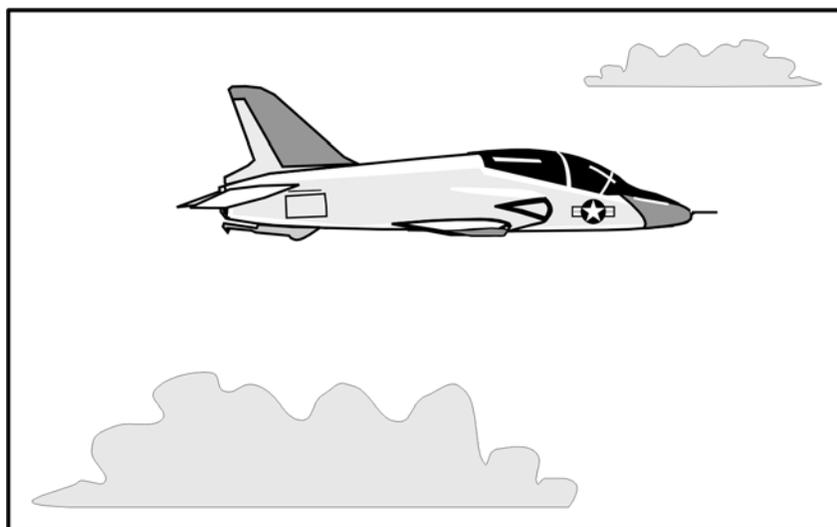
1. Section parade
2. Formation turns into and away from wingman
3. Crossunder
4. Breakup and rendezvous maneuvers
5. Underrun
6. Lead change

204. PRESENTATION

Section Parade Position

**Figure 2-1 Parade Position**

1. Description
 - a. T-45 VFR
 - i. Stepdown 5 ft
 - ii. Lateral wingtip separation of 3 ft
 - iii. Bearing of 30 degrees

**Figure 2-2 Standard Parade Gouge**

- iv. Standard parade gouge:
 - (a). Sight down leading edge of lead's wingline
 - (b). Estimate stepdown by seeing equal portions of top and bottom of wing
 - (c). Maintain wingtip separation by aligning leading corner of stabilator tip cap with exposed portion of exhaust nozzle

LESSON NOTES

Remember, do not fixate on any one particular gouge, and keep the aircraft trimmed.

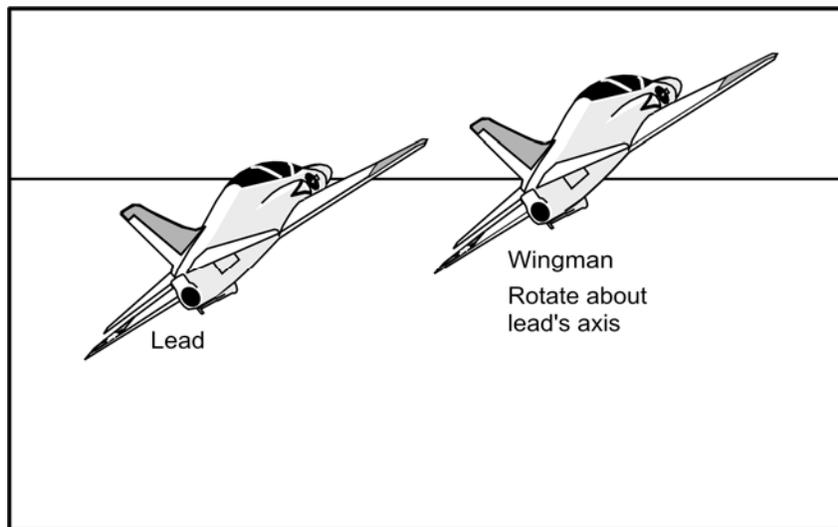


Figure 2-3 Parade Position – IFR Turn Away

- b. T-45 IFR: position same as VFR position except in turn away from wingman, wingman rotates about lead's longitudinal axis as with VFR parade turn into wingman, providing wingman with point of reference to avoid possible disorientation (welded-wing concept)

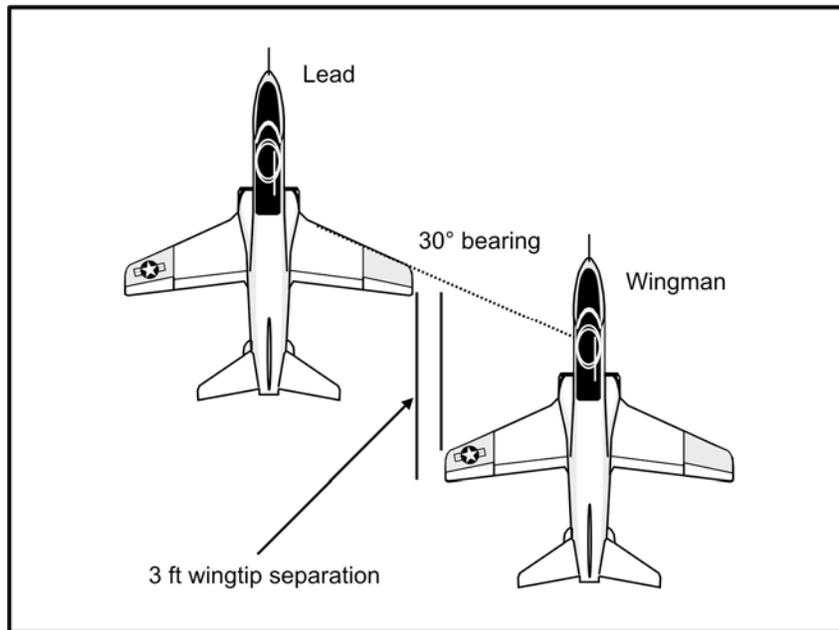


Figure 2-4 Flying the Bearing Line 1

2. Procedure

- a. Bearing line controlled through coordinated use of

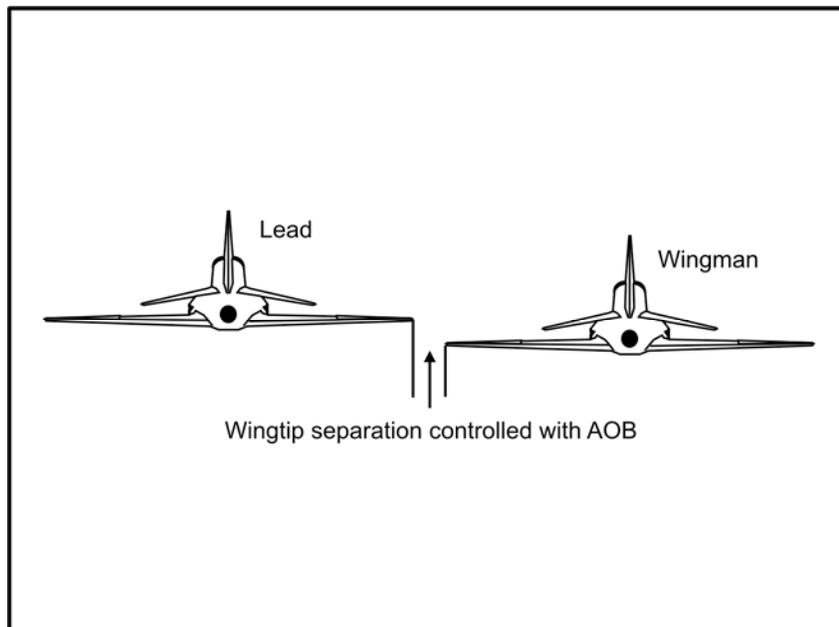


Figure 2-5 Flying the Bearing Line 2

- i. AOB for wingtip separation

2-6 SECTION PARADE FORMATION

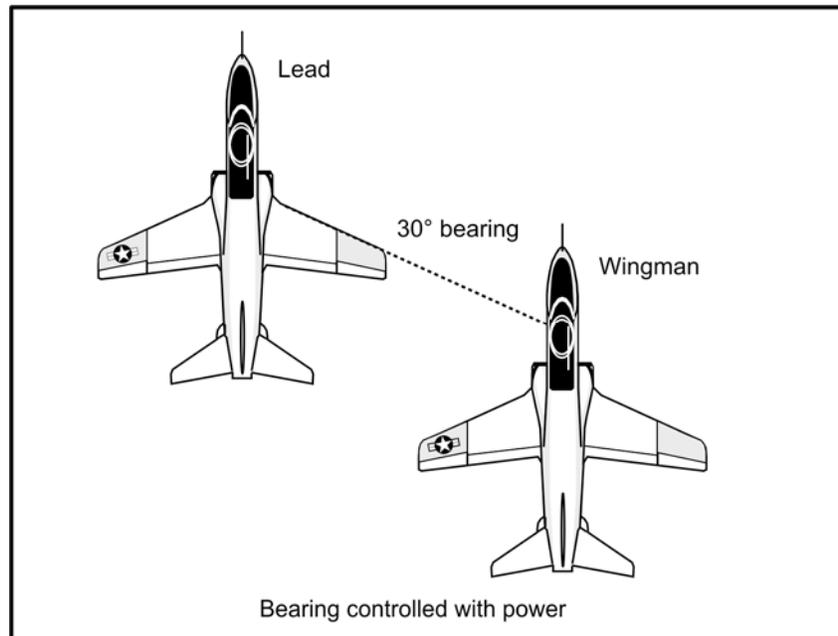


Figure 2-6 Flying the Bearing Line 3

- ii. Power for nose-to-tail
- b. Pitch is used to control stepdown

LESSON NOTES

Stress the early recognition and correction of relative motion.

- 3. Common error by wingman
 - **Problem:** wingman rough on controls
 - Correction:** trim aircraft and relax controls

Section Parade Turns

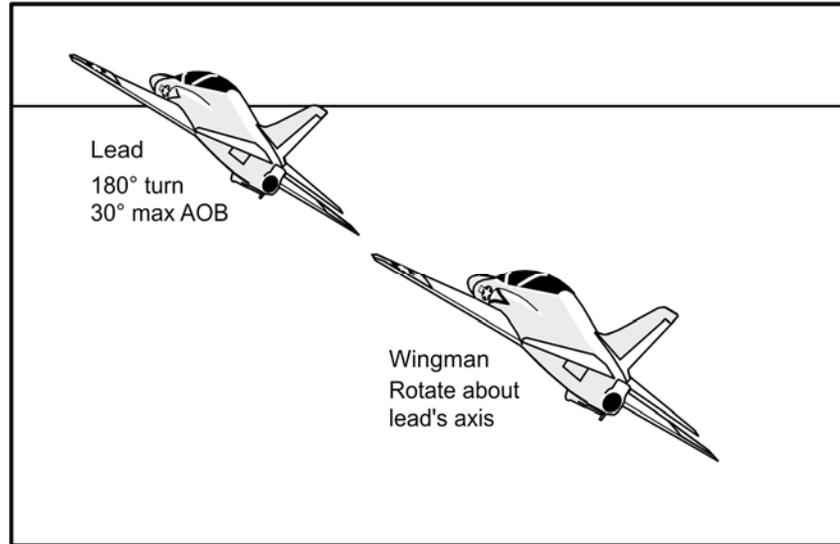


Figure 2-7 VFR/IFR Parade Turn into Wingman

1. Turns into wingman
 - a. Description: Normally 30-degree AOB
 - b. Procedure for rolling into turn
 - i. Lead
 - (a). Pass signal for turn (optional)
 - (b). Turn into wingman, rolling to 30-degree AOB with parade rate of roll

NOTE

A constant rate of roll is important as well as making all rolls uniform.

- ii. Wingman
 - (a). Match lead's rate of roll while rotating about lead's longitudinal axis so wingman sees lead from same perspective as in straight and level flight (i.e., same wingtip distance, bearing, nose-to-tail, and stepdown) [VFR & IFR]
 - (b). Simultaneously reduce power slightly to stay on bearing because
 - (1). Wingman on inside of lead's radius of turn

(2). Nose was lowered when entering turn to maintain parade position

iii. Common error by wingman

Problem: Wingman is close and acute because he fails to match lead's rate of roll and fails to anticipate power change. In trying to correct, wingman overbanks trying to gain wingtip separation. Instead, he cuts off lead's radius of turn and goes more acute

Correction:

(a). Reduce power and match lead's rate of roll and AOB

(b). Maintain proper wingtip and nose-to-tail overlap with

(1). Minor AOB adjustments and

(2). Minor power adjustments

c. Procedure for rolling out of turn

i. Lead

- Roll out using parade rate of roll

ii. Wingman

(a). Match lead's rate of roll while rotating about lead's longitudinal axis

(b). Increase power to maintain parade bearing

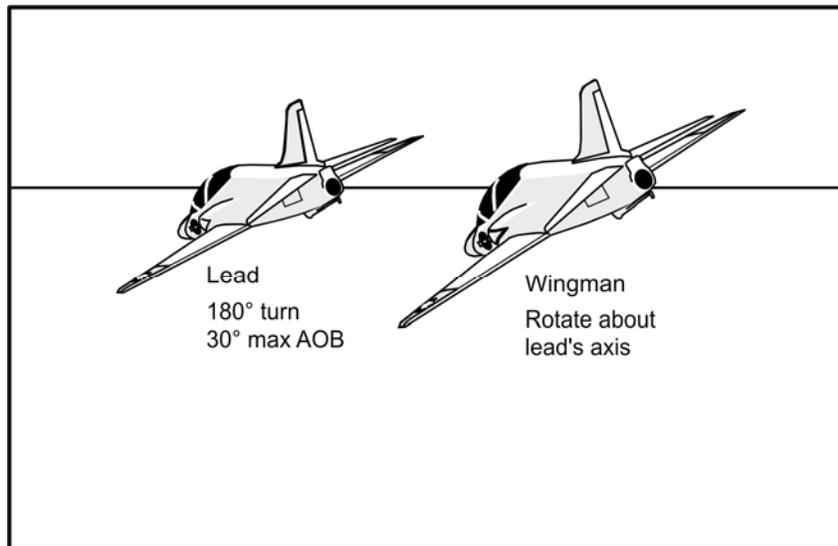


Figure 2-8 VFR Parade Turn Away from Wingman

2. Turns away from wingman
 - a. Description: Normally 30-degree AOB
 - b. Procedure for rolling into turn
 - i. Lead
 - Turn away from wingman, rolling to 30-degree AOB with parade rate of roll
 - ii. Wingman
 - (a). When VFR, match lead's rate of roll while rotating about own longitudinal axis; keep lead's fuselage on the horizon

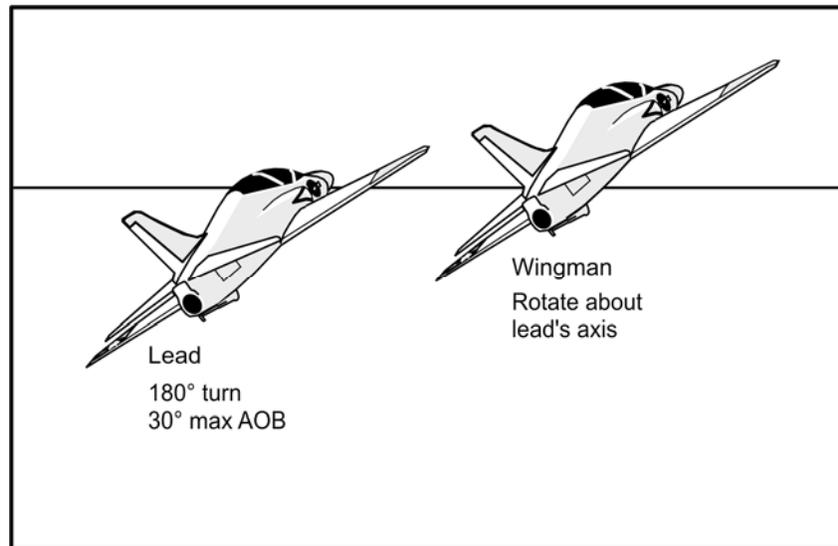


Figure 2-9 IFR Parade Turn Away from Wingman

- (b). When IFR, match lead's rate of roll while rotating about lead's longitudinal axis
- (c). Add power slightly because on outside of turn with larger turn radius

NOTE

More power is required for IFR turn away than for VFR turn away.

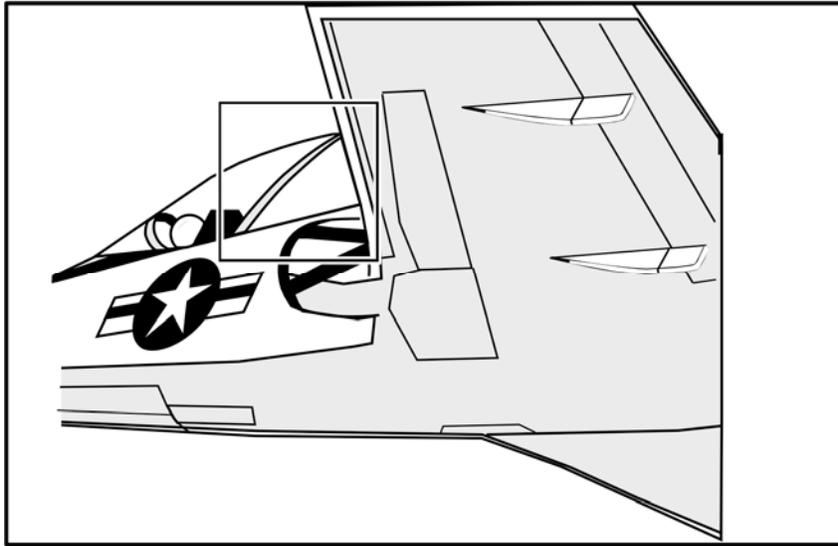


Figure 2-10 Turn-Away Reference

- (d). Maintain bearing by creating a triangle with the lead's center canopy bow, canopy rail, and the leading edge of the wing

iii. Common error by wingman

Problem: Wingman becomes sucked with too little wingtip separation in turn away because of failure to match lead's rate of roll, anticipate power changes and shift position gouges; wingman attempts to correct by banking deeper into turn, but instead of moving closer to bearing, he becomes more sucked and loses more wingtip separation as he cuts across lead's radius of turn

Correction:

- (a). Add power and match lead's rate of roll and AOB
- (b). Maintain correct wingtip and nose-to-tail separation during turn
- (1). Minor AOB adjustments
- (2). Minor power adjustments
- (c). Keep lead's fuselage on horizon
- c. Procedure for rolling out of turn
- i. Lead
- Roll using parade rate of roll

- ii. Wingman
 - (a). Match lead's rate of roll
 - (b). Reduce power as needed to maintain bearing line

Crossunder

1. Description: wingman moves in box or "V" pattern from parade position on one side of lead, below and behind lead, to parade position on opposite side. The box crossunder is used in day formation (until the first cruise formation flight) and in night formation. After the first cruise formation flight (parade form), the "V" crossunder will be used exclusively for day formation flights.

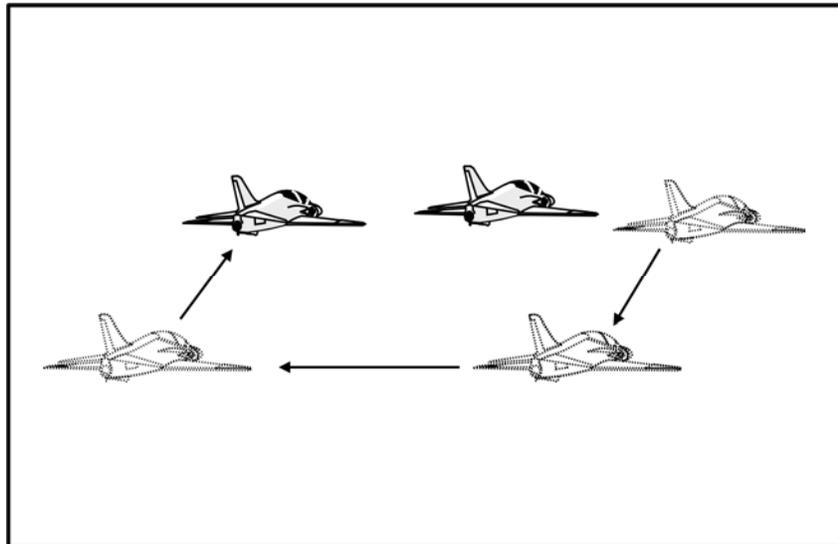


Figure 2-11 Box Crossunder

- 2. Procedure for box crossunder
 - a. Lead: give crossunder signal
 - b. Wingman
 - i. Acknowledge crossunder signal

- ii. Simultaneously make power and attitude corrections to move straight back and down until achieving 10 ft nose-to-tail and 15 ft of vertical separation on lead
- iii. Begin a slight wingdip to start moving aircraft to other side of lead
 - Maintain the front portion of the MDC cord on the underside of lead's intakes
- iv. Stop aircraft on other side of lead with 10 ft of nose-to-tail and 15 ft of stepdown
- v. Add power and noseup pitch to simultaneously drive up and forward into parade position

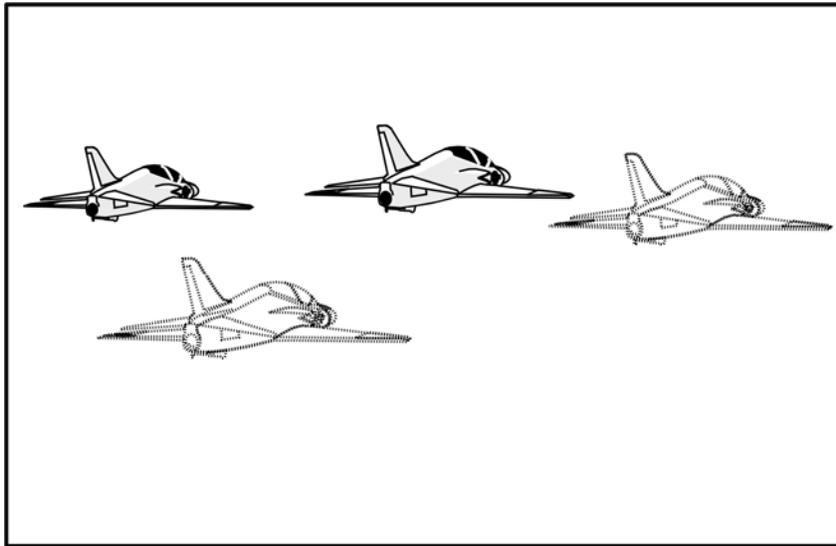


Figure 2-12 "V" Crossunder

3. Procedure for "V" crossunder
 - a. Lead: give crossunder signal
 - b. Wingman
 - i. Acknowledge crossunder signal
 - ii. Fly aircraft on the down, aft, and into vector to arrive at the column position
 - (a). 15 ft of stepdown
 - (b). 10 ft of nose-to-tail

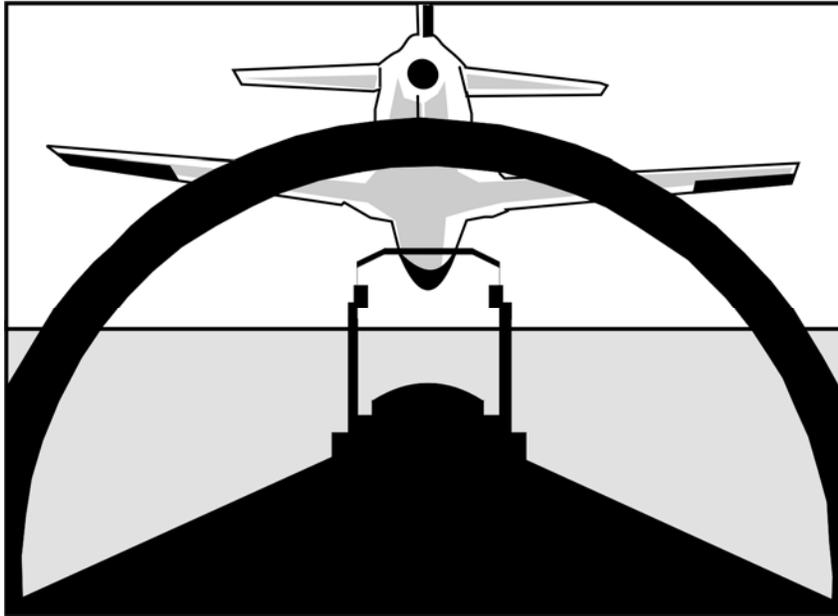


Figure 2-13 Begin Climb

- iii. Begin climbing to reach parade position on the other side of the lead
4. Common errors by wingman
 - a. **Problem:** excessive nose-to-tail separation due to reducing power too much or failure to anticipate changing power requirements while crossing
Correction: adjust power to reacquire proper nose-to-tail; coordinate power and nose attitude to maintain position
 - b. **Problem:** crossing rate steadily increases due to failure to take out AOB
Correction: level wings after desired crossing rate is established
 - c. **Problem:** acute and close due to overcorrections during movement to new parade position
Correction: use small AOB and power corrections when finishing crossunder

Breakup and Rendezvous

1. Description: involves separating formation and joining them into formation again; aircraft put into trail from which rendezvous and join-up is practiced

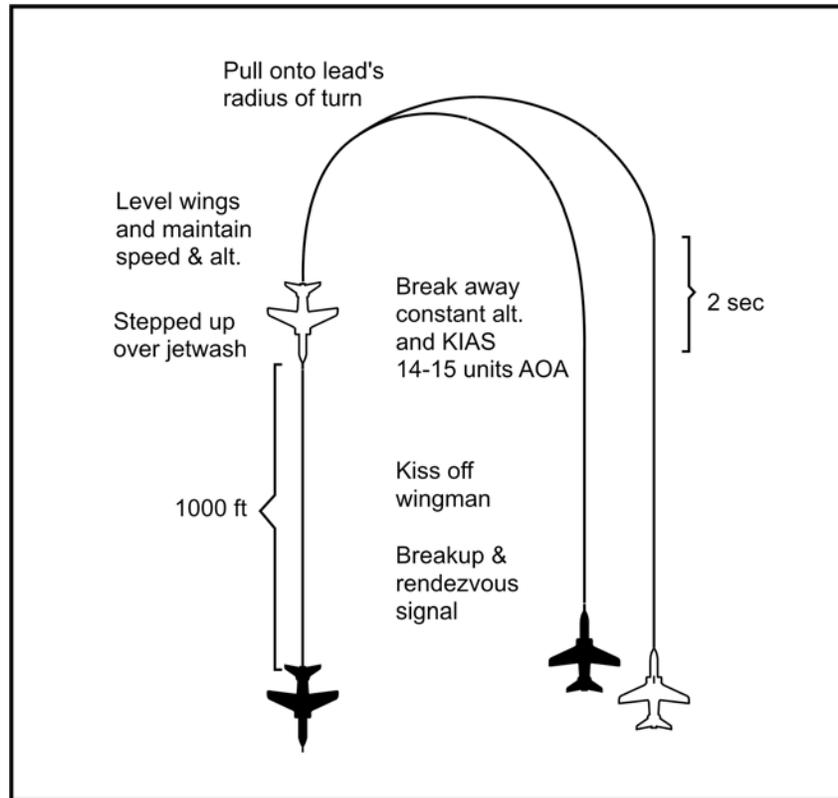


Figure 2-14 Breakup and Rendezvous – Breakup Portion 1

2. Procedure for breakup
 - a. Lead
 - i. Ensure area is clear
 - ii. Signal wingman with signal for breakup and rendezvous exercise
 - b. Wingman: acknowledge signal
 - c. Lead
 - i. Give wingman kiss-off

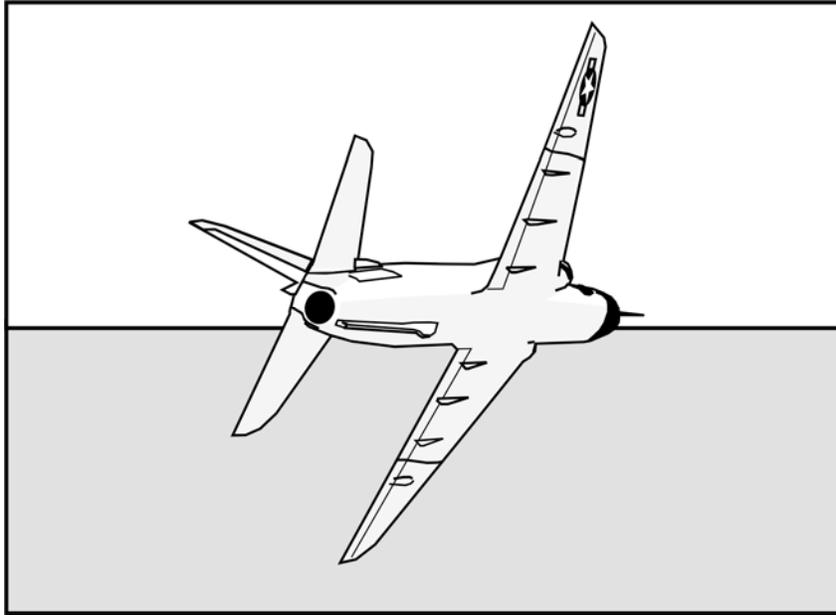


Figure 2-15 Breakup and Rendezvous – Breakup Portion 2

- ii. Break away
 - (a). Normally for 180 degrees of turn
 - (b). Break up, maintaining 14-15 units AOA and constant altitude and airspeed

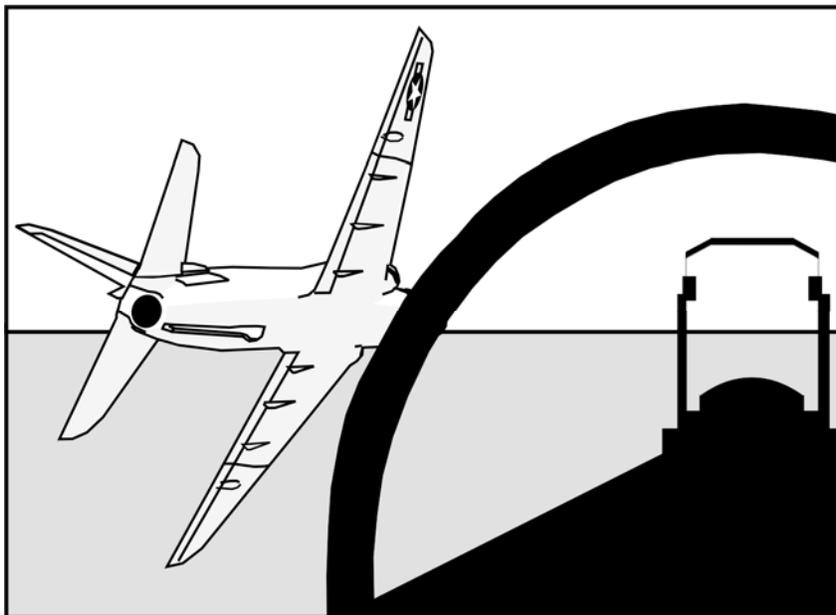


Figure 2-16 Breakup and Rendezvous – Breakup Portion 3

- d. Wingman
 - i. Upon lead's breakaway, maintain altitude and heading for two seconds
 - ii. Break, maintaining airspeed and 14-15 units AOA

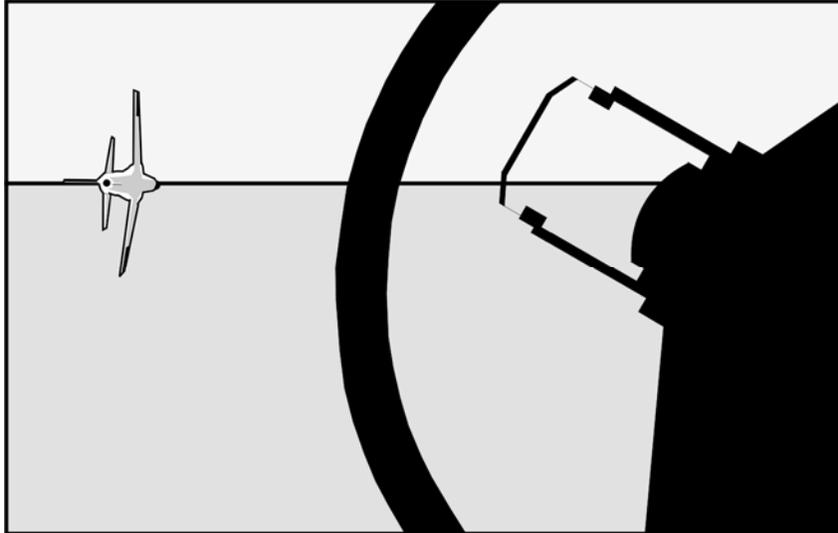


Figure 2-17 Breakup and Rendezvous – Breakup Portion 4

- iii. Keep lead on horizon by varying AOB slightly as needed throughout turn

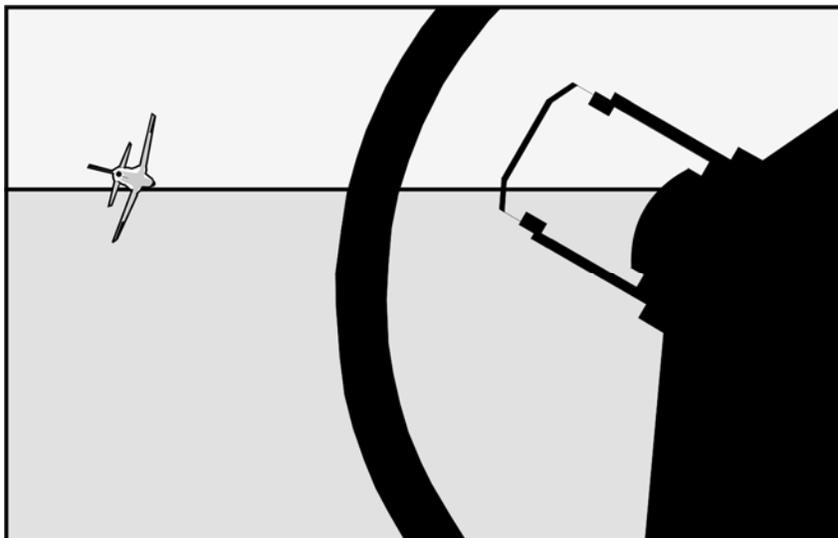


Figure 2-18 Breakup and Rendezvous – Breakup Portion 5

- iv. Vary g to obtain 1,000 ft of nose-to-tail separation during first half of turn

LESSON NOTES

Point out that the **farther** the wingman's nose is pointed behind the lead, the **more rapidly** his nose-to-tail distance will increase. The **longer** his nose is pointed behind the lead, the more nose-to-tail is **increased**.

- v. Pull onto lead's radius of turn until roll-out
- e. Lead
 - i. Complete breakup turn
 - ii. Level wings
 - iii. Maintain rendezvous airspeed

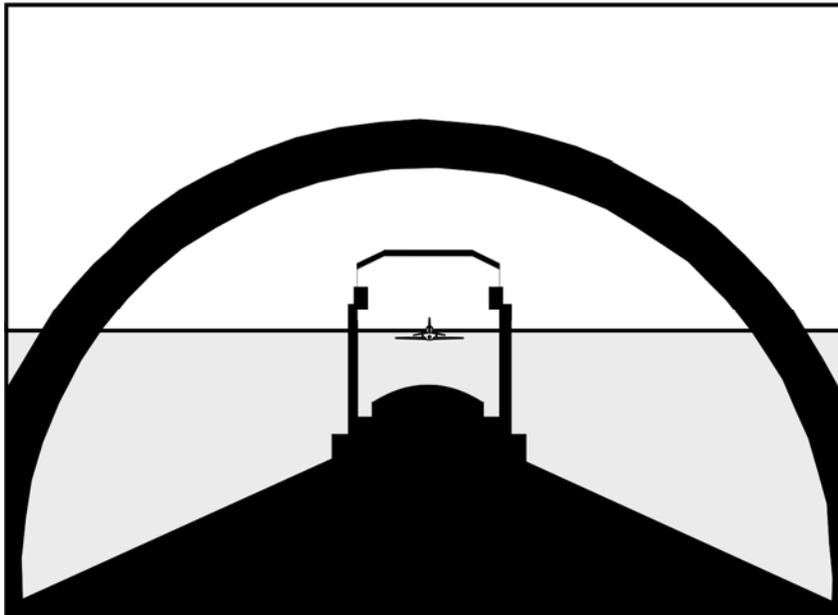


Figure 2-19 Breakup and Rendezvous – Breakup Portion 6

- f. Wingman
 - i. Regain rendezvous airspeed and altitude
 - ii. Roll out of turn
 - (a). In trail behind lead with 1,000 ft of nose-to-tail clearance

- (b). At rendezvous airspeed and altitude, step up slightly to avoid lead's jetwash

NOTE

Wingman should not adjust power to compensate for nose-to-tail error in trail.

LESSON NOTES

The reason for not adjusting power in trail is to prepare the student for division flight. Adjusting power causes other aircraft in trail to make larger power corrections and leads to overcontrolled nose-to-tail.

3. Common errors (breakup portion of breakup and rendezvous exercise) by wingman
- Problem:** wingman excessive distance in trail due to not enough g in the turn
Correction: establish proper g to pull onto lead's radius of turn to establish 1,000 ft in trail
 - Problem:** not keeping lead on horizon, causing excessive stepdown or stepup
Correction: during break, vary AOB while holding g constant to keep lead on horizon

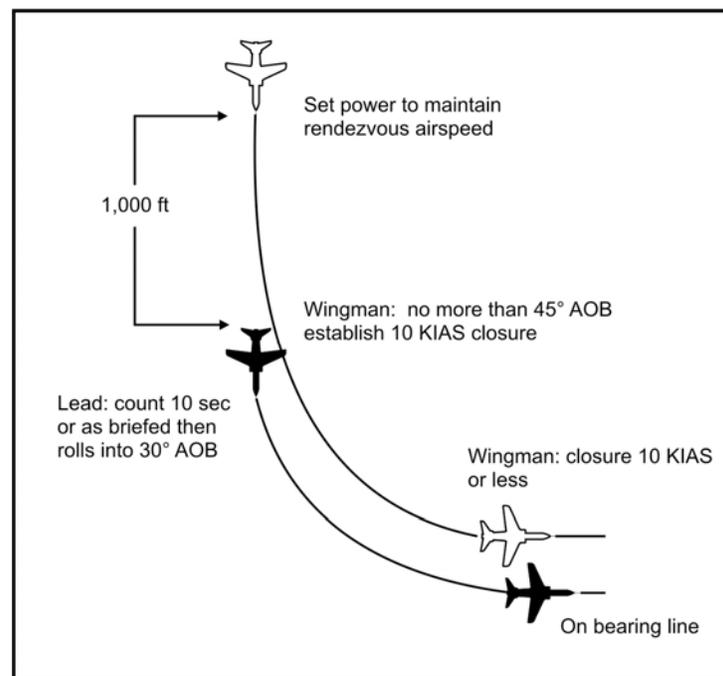


Figure 2-20 Breakup and Rendezvous – Rendezvous Portion 1

4. Procedure for rendezvous
 - a. Lead
 - i. Set power to maintain rendezvous airspeed and altitude in level flight

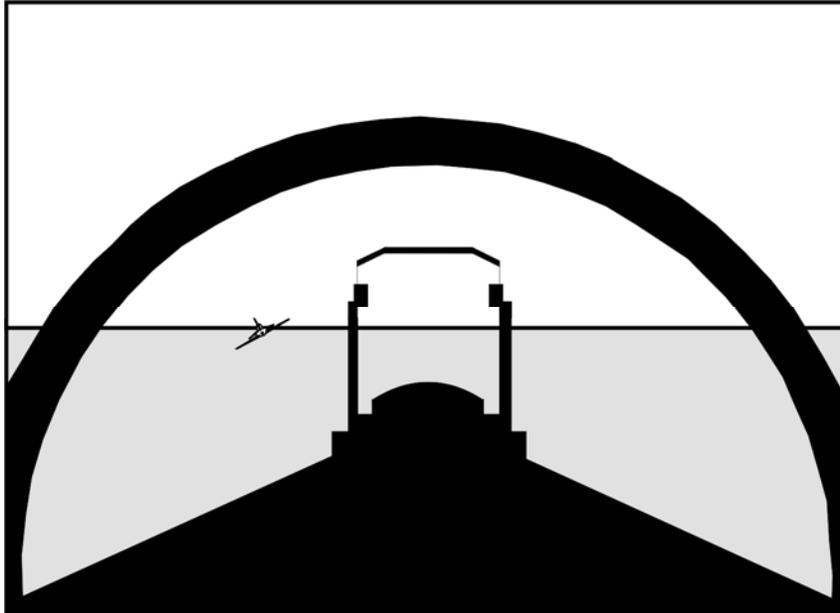


Figure 2-21 Breakup and Rendezvous – Rendezvous Portion 2

- ii. Wait 10 seconds as briefed
 - iii. Roll either direction
 - (a). Maintain rendezvous airspeed
 - (b). Maintain 30-degree AOB rendezvous turn
 - (c). Roll out when wingman is in parade turn-away position
 - b. Wingman: intercept and fly parade bearing

LESSON NOTES

Emphasize how the bearing line develops as the lead aircraft turns, and that the wingman must be patient or he will go acute.

- i. At lead's rendezvous turn
 - (a). Allow lead to move approximately 10-20 degrees left or right of nose

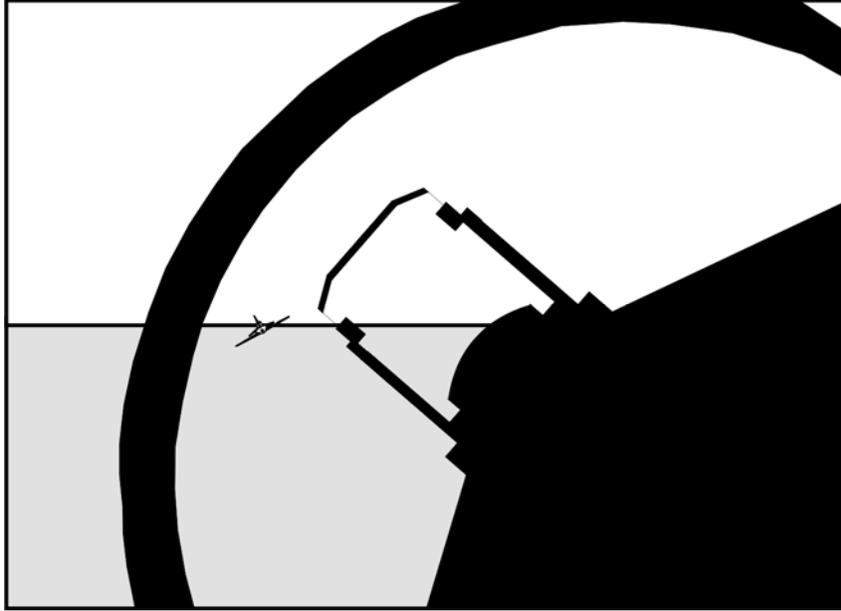


Figure 2-22 Breakup and Rendezvous – Rendezvous Portion 3

- (b). Commence no more than a 45-degree AOB turn
- (c). Add power, if required, in order to establish 10-KIAS closure

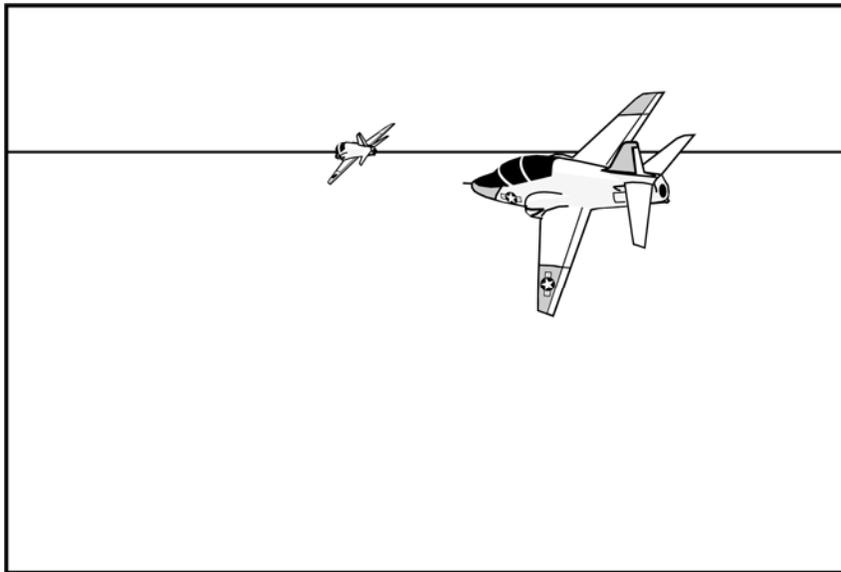


Figure 2-23 CV Rendezvous Turn

- (d). Move out to the rendezvous bearing line
- ii. Maintain altitude and position lead aircraft on horizon

- iii. Anticipate intercepting bearing line by shallowing AOB and avoid overshooting rendezvous bearing

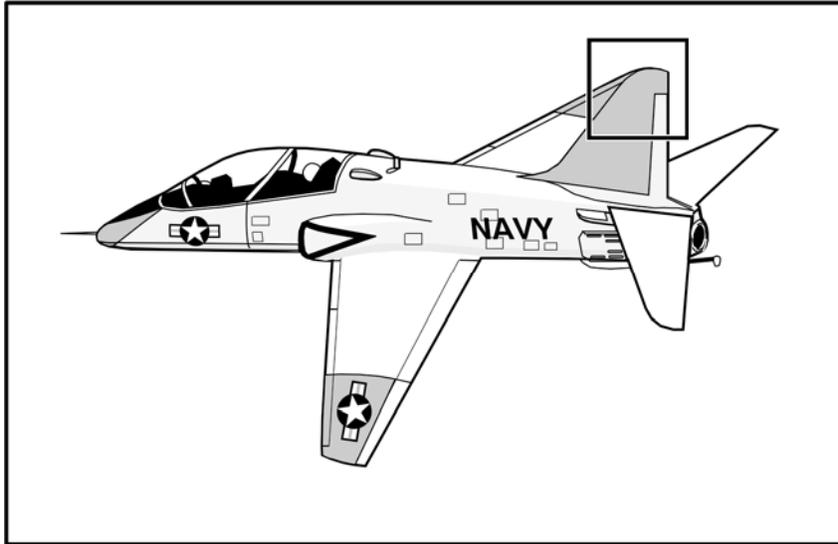


Figure 2-24 Rendezvous Bearing Line 1

- iv. When on bearing line, begin to align fuselage with lead's and keep lead on horizon while moving up bearing line
 - (a). On bearing line, see lead's vertical stabilizer intersect with lead's outboard wingtip

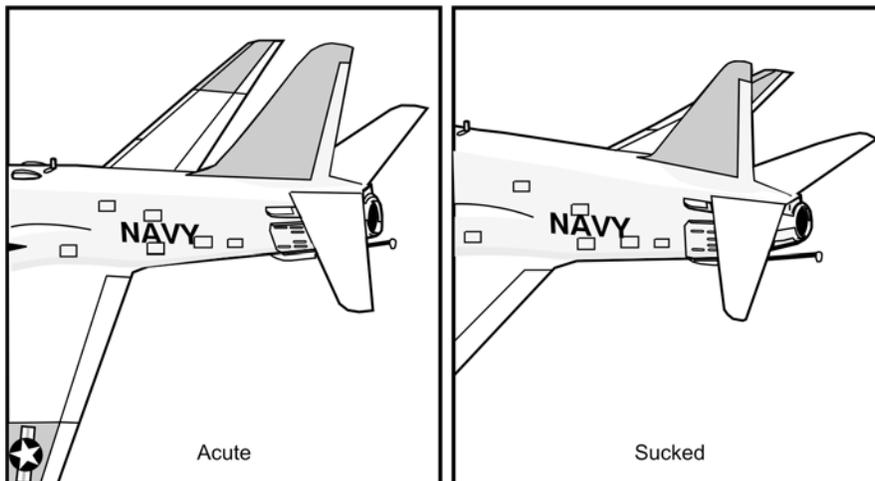


Figure 2-25 Rendezvous Bearing Line 2

- (b). If acute, lead's outboard wingtip will appear forward of vertical stabilizer
- (c). If sucked, lead's wingtip will appear behind vertical stabilizer

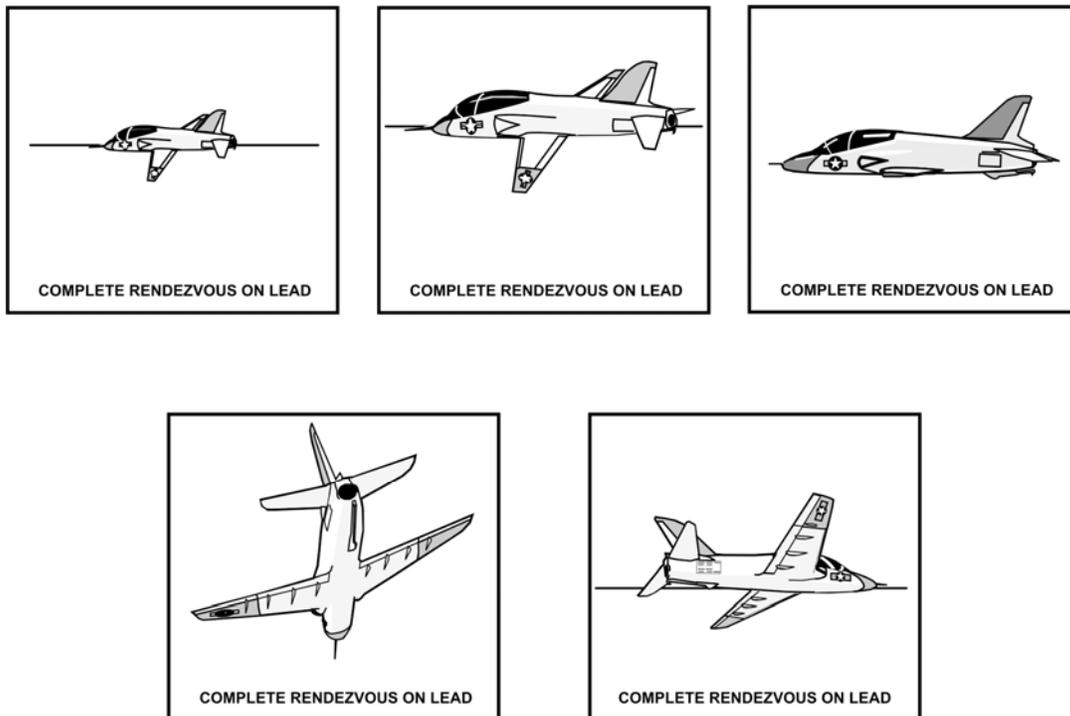


Figure 2-26 Rendezvous on Lead

- v. Hold lead stable on bearing and altitude
- vi. Monitor airspeed, and do not let closure rate exceed rendezvous airspeed by more than 10 KIAS

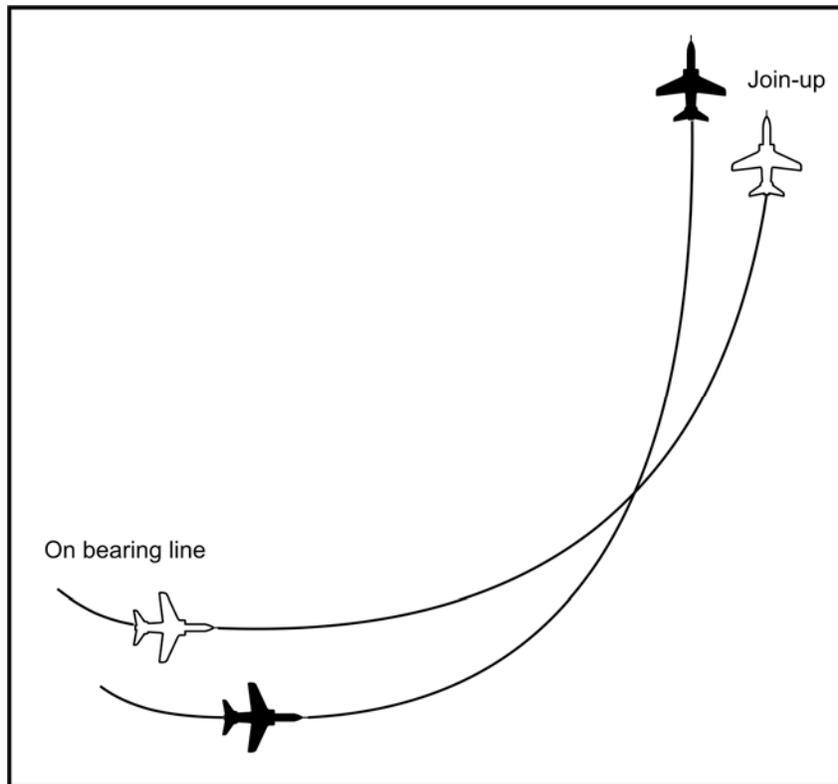


Figure 2-27 Breakup and Rendezvous – Join-Up Portion

- vii. To join on lead, use same join-up procedures as CV rendezvous procedure
- c. Lead
 - i. Commence slow, continuous, roll-out to level flight when wingman is aboard
 - ii. Need to plan smooth roll-out (rapid one can cause adverse relative motion)

NOTE

Common errors for rendezvous are noted during the initial rendezvous discussion in this lesson and do not need to be reiterated here.

Parameters and Procedures for Underrun

LESSON NOTES

Emphasize the safety aspects of an underrun.

- 1. Description

- a. Safe and orderly method for passing below and behind lead when excessive closure or acuteness precludes normal join-up
- b. Parameters which cause need for underrun
 - i. Wingman has uncontrolled closure rate near or in join-up phase of rendezvous
 - ii. Wingman is extremely acute, preventing safe return to proper bearing before join-up

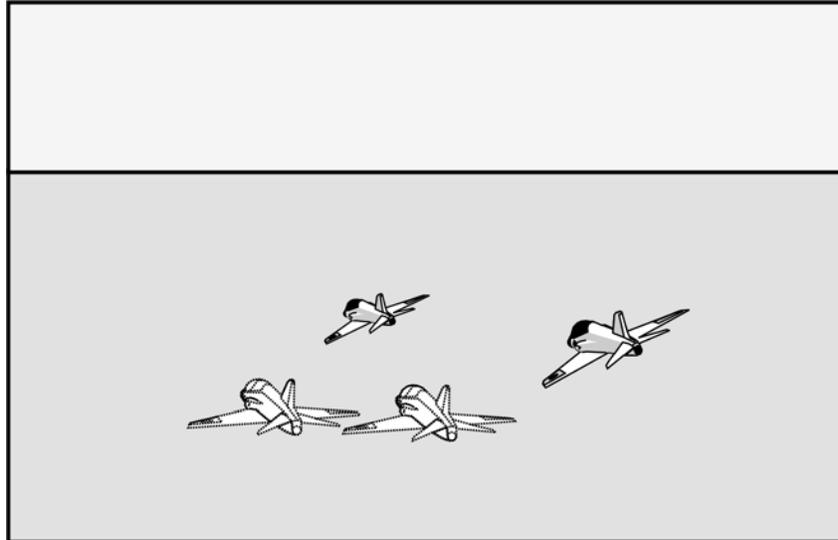


Figure 2-28 Underrun

2. Procedures
 - a. Wingman
 - i. To begin underrun, simultaneously
 - (a). Level wings
 - (b). Lower nose to ensure vertical separation
 - (c). Reduce power to idle
 - (d). Extend speed brakes
 - ii. Notify lead of underrun, for example “[Call sign], two’s underrunning” (if ordered to underrun, acknowledge command and underrun)
 - iii. Pass below and behind lead

- iv. Stabilize outside of lead's radius of turn in a slightly acute parade turn-away at approximately 200 ft and slightly stepped up
 - v. Retract speed brakes
 - vi. Reset power as necessary
 - vii. Regain airspeed to approximately rendezvous airspeed
 - viii. When told to rejoin flight by flight lead (e.g., "Cleared inside when stable")
 - (a). Go below and behind lead to return to 30-degree rendezvous bearing on inside of turn
 - (b). Execute join-up
 - ix. Monitor airspeed until close enough to discern relative motion by sight only
- b. Lead: in case of underrun, remain in rendezvous turn until flight is properly joined
3. Common errors by wingman
- a. **Problem:** wingman fails to underrun due to lack of recognition of underrun parameters (excessive closure, extremely acute)
Correction/prevention:
 - i. Monitor both airspeed differential in the cockpit and closure/ bearing on the lead outside the cockpit to recognize excessive closure and acute position
 - ii. Initiate underrun
 - b. **Problem:** wingman is too wide after underrun due to failure to anticipate stabilizing just outside lead's radius of turn
Correction: use AOB and g to dissipate energy, preventing excessive separation
 - c. **Problem:** once outside radius of turn, nose-to-tail increasing instead of stabilizing
Correction: apply power to maintain proper nose-to-tail and stabilize outside radius of turn
 - d. **Problem:** when returning to bearing line for another attempt, wingman goes acute again due to failure to anticipate proper bearing line

Correction: reduce AOB to drop back to the bearing line, anticipating AOB requirements to maintain bearing line visually projected from lead's aircraft

Procedures for Lead Change

1. Description: lead passes lead to wingman, then increases wingtip separation, steps down, moves aft, and then up into position while keeping eyes on new lead

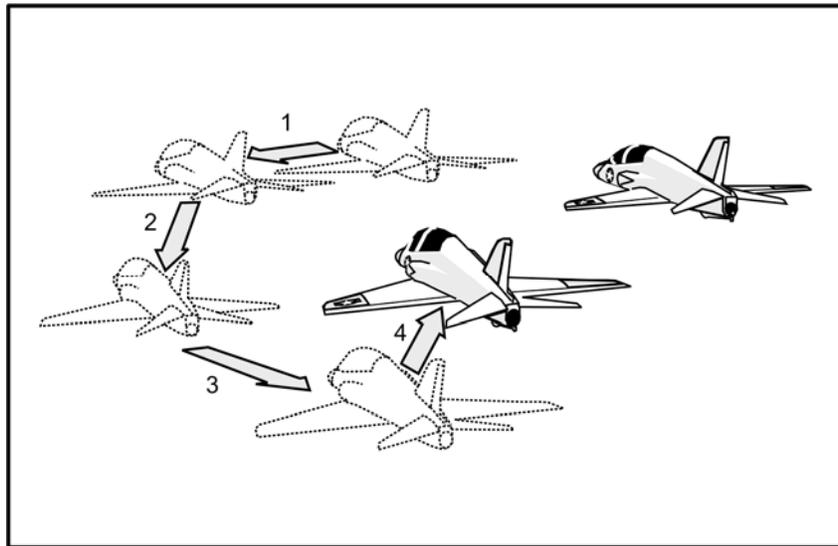


Figure 2-29 Lead Change

2. Procedure
 - a. Lead
 - i. Clear area
 - ii. Pass lead change signal to wingman
 - b. New Lead—accepting
 - i. Pass acceptance signal
 - ii. Assume responsibility for flight
 - iii. Maintain airspeed, altitude, and present heading until completion of lead change
 - c. New Wingman
 - i. Do not take eyes off of new lead

- ii. Move out laterally to establish 10 ft of wingtip clearance and then stabilize
 - iii. Step down without sacrificing bearing by easing nose down and adjusting power to keep from moving farther ahead of new lead
 - iv. As stepdown of 5 ft is reached, level off
 - (a). Adjust power as necessary to move aft slowly
 - (b). Maintain 10 ft of wingtip clearance
 - (c). 5 ft of stepdown
 - (d). Control this slow deliberate rate of relative motion aft with power
 - v. Slow aft movement by addition of power to stop on the 30- degree bearing line
 - vi. Stabilize momentarily and then complete lead change by moving up into parade position
- d. New lead: pass fuel-check signal
 - e. New wingman: reply with fuel quantity
 - f. Wingman's refusal of lead
 - i. Wingman: shake head "no"
 - ii. Lead: clear area
 - iii. Wingman: stabilize in position
 - iv. Lead: pass signal for lead change again
3. Common errors by new wingman
- a. **Problem:** takes eyes off of new lead
Correction: keep lead in sight
 - b. **Problem:** moves back and out at same time
Correction: execute individual procedures in sequence
 - c. **Problem:** on heading change, overbanks and then overcorrects, resulting in wing rocking

Correction: use minimal AOB adjustments/heading differential to establish proper wingtip clearance

- d. **Problem:** angles toward new lead when trying to reestablish parallel heading due to natural tendency to move stick in direction of view

Correction: use minimal AOB adjustments to maintain proper wingtip clearance

- e. **Problem:** moves out in front or slides too far back due to poor power control

Correction: anticipate power requirements with required nose attitude changes to establish proper stepdown

205. SUMMARY

This lesson covered:

1. Section parade
2. Formation turns into and away from wingman
3. Crossunder
4. Breakup and rendezvous maneuvers
5. Underrun
6. Lead change

206. CONCLUSION

The rendezvous is important for getting a formation together after takeoffs, mission activities, and in-flight separations. Because of the complexity of the exercises, it is important that you be thoroughly familiar with the procedures before flights.

CHAPTER THREE
SECTION FORMATION RECOVERY,
APPROACHES, LANDING CONFIGURATION

300. INTRODUCTION – N/A

COURSE/STAGE:

- Formation

LESSON TITLE:

- Section Formation Recovery, Approaches, Landing Configuration

LESSON IDENTIFIER:

- FFP-03

LEARNING ENVIRONMENT:

- Classroom

ALLOTTED LESSON TIME:

- .8 hr

TRAINING AIDS:

- None

STUDY RESOURCES:

1. T-45 NATOPS Flight Manual, A1-T45AB-NFM-000 or A1 -T45AC-NFM-000
2. Formation Flight Training Instruction (FTI)

LESSON PREPARATION:

Read:

1. “Section Daytime Flight Procedures,” in the Formation FTI Review:
2. Parts III, IV, V, and VII in the T-45 NATOPS Flight Manual, A1-T45AB-NFM-000 or A1 -T45AC-N FM-000

REINFORCEMENT:

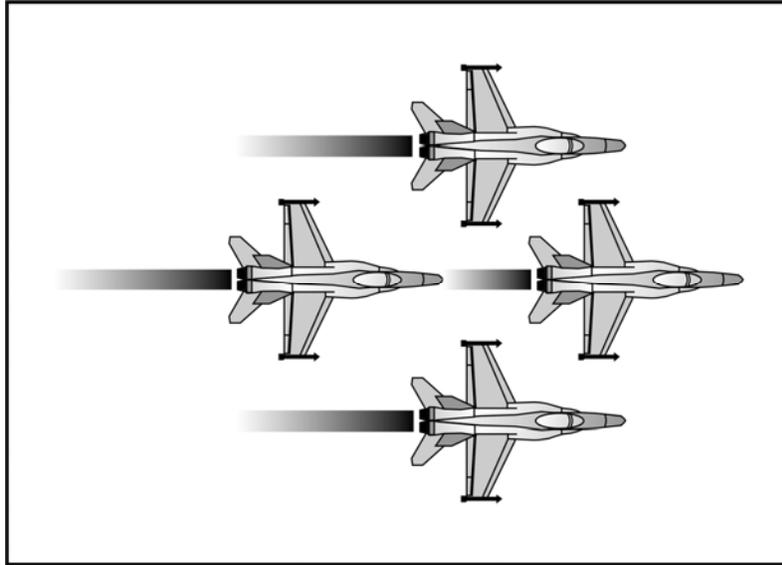
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EXAMINATION:

- The objectives in this lesson will be tested in FFP 06X.

301. LESSON OBJECTIVES

1. Recall procedures for section VFR overhead entry (break)
2. Recall procedures for section approach
3. Recall procedures for section circling approach
4. Recall procedures for section missed approach



302. MOTIVATION

One place where your skills as a pilot are observed by both instructors and peers alike is during recoveries and landings. It is not uncommon for Naval aviators to comment on the approach of a section of aircraft entering the break and to “grade” the way the section performed. But more important than looking smart is the safety factor. For example, flying good wing during an approach to the ship in bad weather on a dark night may make the difference in getting aboard.

303. OVERVIEW

This lesson will introduce you to procedures for several types of section recoveries. After this lesson, you should be familiar with the procedures to be followed in the section VFR overhead break as well as section, circling, and missed section approaches.

In this lesson you will be studying:

1. Section VFR overhead entry (break)
2. Section approach
3. Section circling approach
4. Section missed approach

304. PRESENTATION**Section VFR Overhead Entry (Break)**

1. Description: brings section of aircraft from operating area to initial entry point and into break

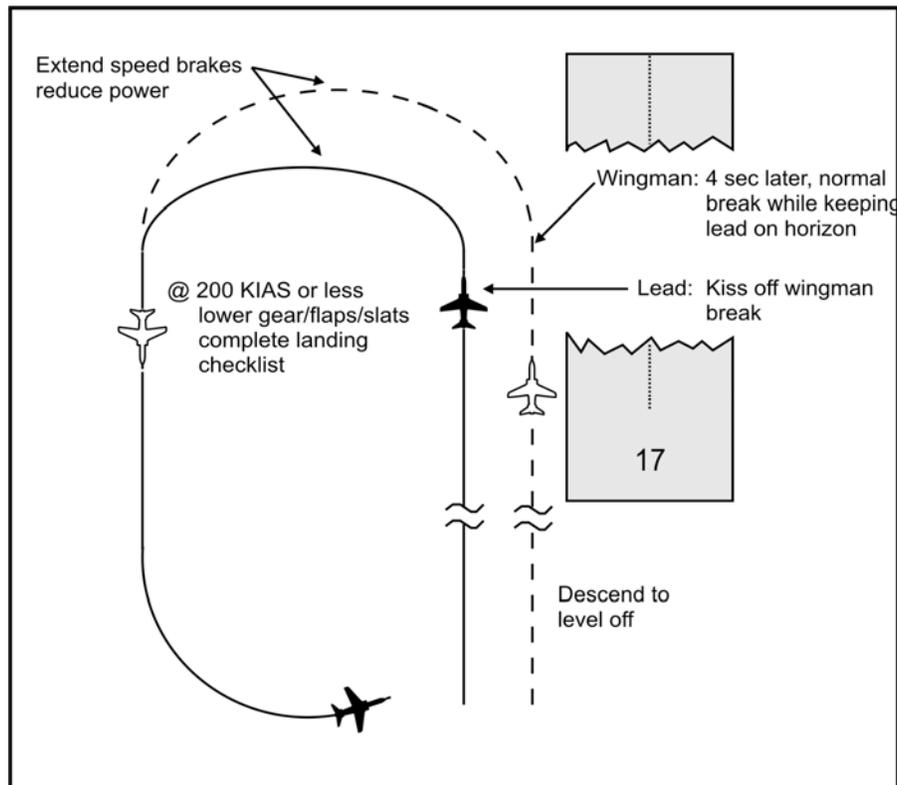


Figure 3-1 Section VFR Overhead Entry: The Break

2. Descent procedures

a. Lead

- i. Return-to-base (RTB) procedures IAW local course rules
- ii. Reduce power to no less than 80 percent
- iii. Make decision on rate of descent; pass signal to extend speed brakes as appropriate
- iv. Approximately 1,000 ft above assigned altitude
 - (a). Smoothly change to level flight
 - (b). Pass signal to retract speed brakes, if extended

- b. Wingman
 - i. Acknowledge signal
 - ii. Fly parade/cruise position (as briefed); extend/retract speed brakes as appropriate
- 3. Common errors by wingman during descent
 - a. **Problem:** wingman is late extending speed brakes and goes acute due to lead not giving wingman enough time before executing
Correction: lead should give proper attention to timing between speed-brake signal and execution
 - b. **Problem:** wingman overcontrols stick when extending speed brakes
Correction: anticipate attitude and power adjustments required to maintain position when extending the speed brakes
- 4. Field entry procedures
 - a. Lead
 - i. Prior to arriving over the runway, arrange flight as necessary for break
 - ii. When cleared to break, and with proper interval on other aircraft in landing pattern, kiss off and break
 - iii. At 200 KIAS, while on downwind leg
 - (a). Lower landing gear and flaps/slats
 - (b). Complete landing checklist IAW SOP
 - b. Wingman
 - i. Break at briefed (generally 4 seconds) interval
 - ii. Make turn that is identical with lead's and stay at same altitude to get into trail (i.e., keep lead on horizon)
 - iii. At 200 KIAS, while on downwind leg
 - (a). Lower landing gear and flaps/slats

- (b). Complete landing checklist IAW SOP
5. Common errors by wingman during field entry (break), similar to common errors in breakup and rendezvous
- a. **Problem:** not enough interval due to wingman applying more g than lead
Correction: similar to breakup maneuver, during break turn, program AOB and g to match lead's break
 - b. **Problem:** altitude difference due to not keeping lead on horizon
Prevention: similar to breakup maneuver, during break turn, vary AOB while holding constant g to keep lead on horizon

Section Approach

LESSON NOTES

Emphasize that planning ahead during instrument flight is even more important than in VMC. The wingman must set up his navigation equipment for the approach, and have an approach plate available in case he has to assume the lead and complete the instrument approach.

- 1. Description
 - a. Efficiently brings section through IFR conditions for an expeditious recovery
 - b. Similar to individual instrument approach except
 - i. Flight penetrates and executes instrument approach in IFR parade position
 - ii. Wingman is detached and lands as briefed
 - c. Consideration should be given to having appropriate external lights on prior to entering IMC
 - d. Types
 - i. Clean penetrations
 - ii. Dirty penetrations (dirtying up before entering IMC): reasons include
 - (a). Control problems that would compound transition difficulties in IMC

- (b). Emergencies such as complete electrical failures
- (c). IMC conditions at normal dirty-up attitude

2. Procedures

CAUTIONS

If wingman loses sight of lead during approach:

- 1. Shift to instrument scan**
- 2. Turn away from lead**
 - a. Transmit "[call sign] lost sight" and execute lost sight procedures**
 - b. Turn 30 degrees away from last heading for 1 minute (10 degrees on final)**
 - c. If in descent or climb, level off**
 - d. After 1 minute, if not in radio contact with ATC, turn back to last assigned heading and altitude and comply with IMC Lost Comm Procedures.**
- 3. Conform to instructions from approach (when possible)**
 - a. Penetrations
 - i. Clean penetrations carried out same as clean penetrations for single aircraft IFR approaches

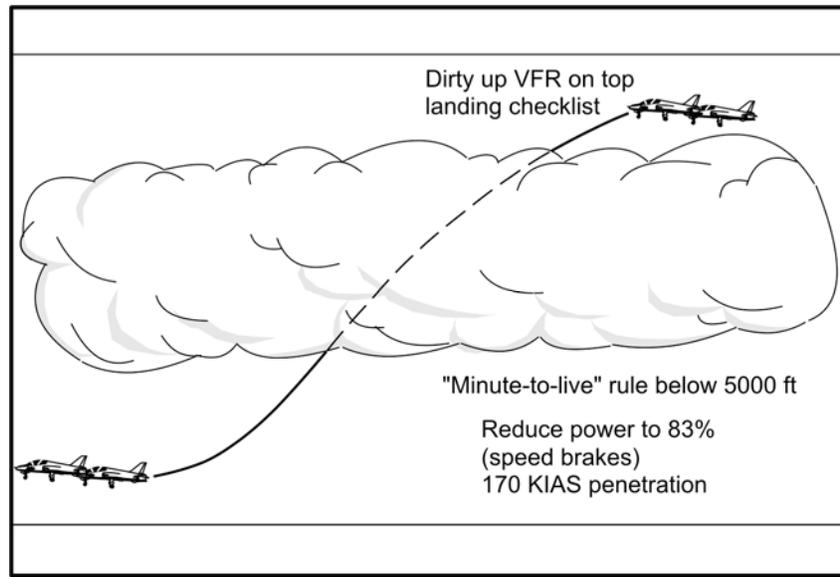


Figure 3-2 Section Approach: Dirty Penetration

- ii. Dirty penetrations (dirtying up before entering IMC)
 - (a). Lead
 - (1). Use standard instrument approach profile
 - (2). Notify approach of deviation from standard descent airspeed
 - (3). AT 200 KIAS, give visual signal for lowering gear and flaps

NOTE

1/2 flaps/slats can be used for section approaches as briefed.

- (4). At head nod, lower gear and flaps/slats
 - (5). Complete landing checklist while VFR on top, if possible
 - (6). Reduce power to about 83 percent
 - (7). Extend speed brakes as required
 - (8). Penetrate at 170 KIAS
 - (9). Use minute-to-live rule below 5,000 ft
- (b). Wingman: execute signals and maintain IFR parade position

NOTE

Configuration changes in IMC conditions will be passed via radio.

- b. Final approach
 - i. Lead
 - (a). Fly slightly fast (140 to 150 KIAS) in order to facilitate the wingmen's staying in position.
 - (b). On final and at descent point, slow to fly wingman on- speed

NOTE

When executing a GCA approach, normally extend speed brakes upon receiving “up and on glideslope” call

- ii. Wingman: execute approach in position

NOTE

If consistently slow, call “[lead’s call sign], give me a little” to tell lead to increase power slightly.

LESSON NOTES

Stress two considerations when in a lost-sight situation: 1) don’t hit another aircraft, and 2) don’t hit the ground.

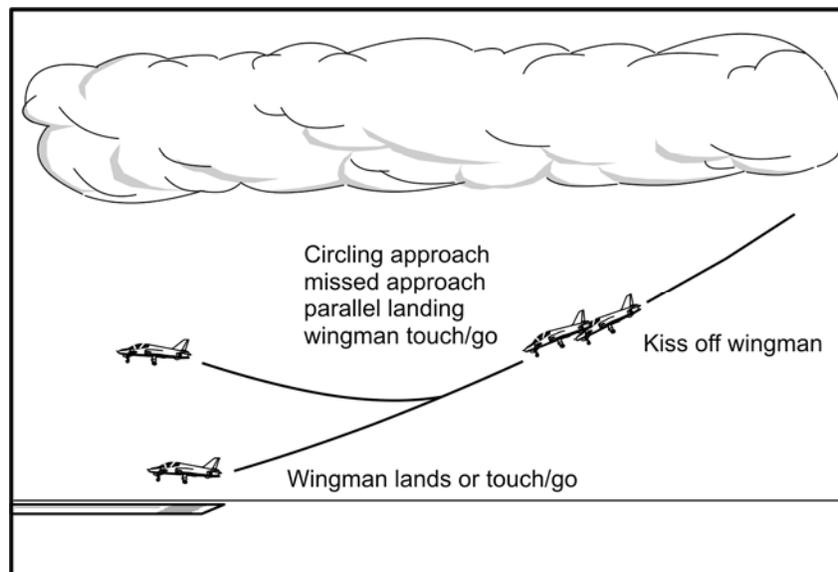


Figure 3-3 Section Approach: Wingman Leads or Touch/Go

c. Landing/Touch and Go

NOTE

When the runway environment is in sight and section is to full stop, flight will land on separate parallel runways or take separation to land on the same runway.

i. Landing on separate parallel runways

(a). Lead: pass landing signal to wingman and then “kiss off” the wingman

(b). Wingman:

(1). Pay attention to all clearances given over radio to determine type of landing and which runway to use

(2). Land upon receiving signal

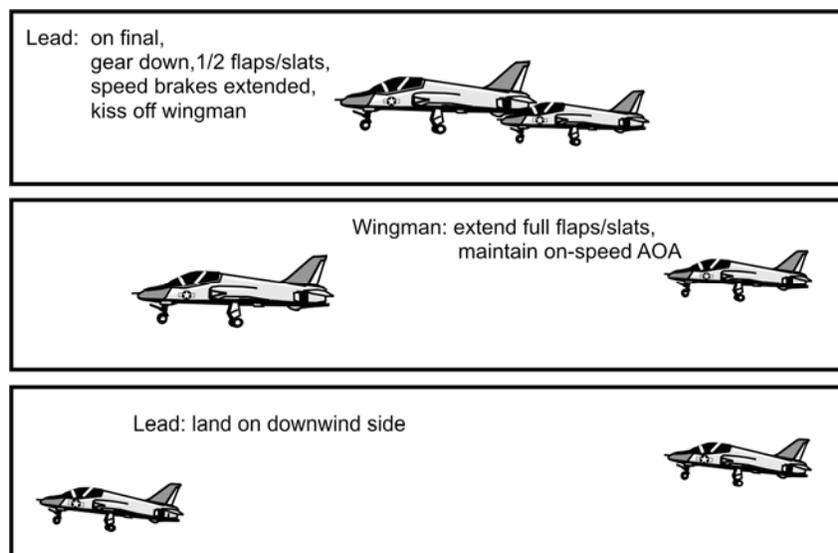


Figure 3-4 Section Approach: Landing on Same Runway

ii. Taking separation to land on same runway

(a). Lead:

(1). Kiss off wingman

(2). Maintain 1/2 flaps/slats to obtain separation

(b). Wingman:

- (1). Upon receiving kiss off, go to full flaps/slats and slow to on-speed
 - (2). Keep sight of lead; land
- iii. Touch and go

NOTE

Circumstances may dictate that the lead stay airborne and the wingman full stop. In this case, the lead needs to be in a position where the wingman can rejoin if a landing cannot be completed.

- (a). Lead:
 - (1). Pass the landing signal to the wingman
 - (2). Kiss off wingman
- (b). Wingman: acquire runway and execute normal touch and go approach
- (c). Lead: level off and maintain position slightly in front of wingman
- (d). Wingman:
 - (1). Execute touch and go
 - (2). Match lead's configuration if changed from point of separation
 - (3). Rendezvous on lead

3. Common errors

- By wingman

- a. **Problem:** wingman overcontrols aircraft during transitions in dirty approach

Correction: wingman should anticipate aircraft pitch changes with proper trim and maintain position with small adjustments in AOB and power

- b. **Problem:** wingman does not maintain IFR parade in turns, getting too much stepdown or too much stepup

Correction: wingman should maintain IFR parade in turns; rotate around axis of lead's aircraft

- c. **Problem:** wingman gets too wide with risk of losing sight of lead

Correction: wingman should be particularly concerned with maintaining good IFR parade due to criticality of situation

Section Circling Approach

1. Description: brings aircraft through IMC as one formation for circling approach under following condition

- Straight-in approach to landing runway is not available

2. Procedure

LESSON NOTES

Point out that the most dangerous portion of this approach is after separation when circling to land.

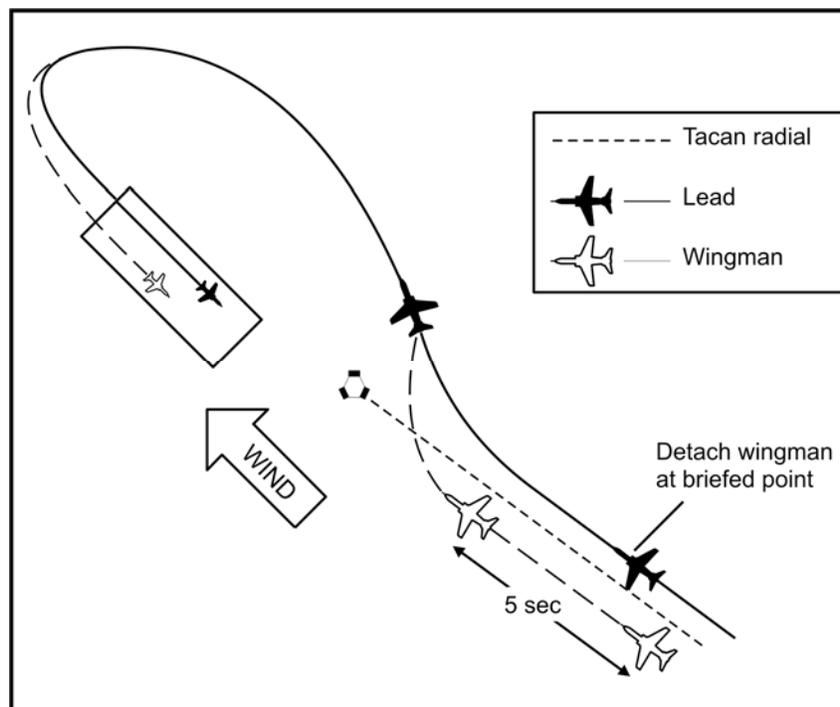


Figure 3-5 Section Circling Approach

- Lead
 - With runway in sight, detach wingman
 - Turn for appropriate runway
- Wingman
 - Slow to approach speed at kiss off

- ii. Turn to follow lead, avoiding lead's jetwash
 - c. Lead: at abeam position, make normal FAM approach and land
 - d. Wingman: make normal FAM approach and land
3. Common errors by wingman
- 1. **Problem:** wingman does not follow lead at execution of circling maneuver, which could cause wingman to reenter IMC or overshoot landing runway
Correction: while keeping lead in sight, follow his flight path over ground
 - 2. **Problem:** wingman does not get proper interval by failing to slow to approach speed when given kiss off by lead
Correction: when given kiss off by lead, expeditiously reduce to approach speed and, if necessary, use slight turn differential to gain adequate landing interval

Section Missed Approach

- 1. Description:
 - a. Runway environment not sighted by minimums
 - b. Section out of good position for safe landing
 - c. Both aircraft fly either VFR or IFR pattern as directed by
 - i. Tower
 - ii. Approach
 - iii. Course rules
- 2. Procedure
 - a. Lead and wingman: smoothly advance power, retract speed brakes, and rotate to appropriate pitch angle (10 degrees noseup)
 - b. Lead: with positive rate of climb and 140 KIAS, signal to raise gear and flaps/slats, if in VMC. Otherwise, lead will transmit gear and flaps/slats call over radio.
 - c. Wingman: execute
 - d. Lead and wingman: follow departure clearance

- i. IAW local course rules
- ii. As defined by controlling authority (approach control or tower)
- iii. As defined on IFR approach plate

305. SUMMARY

This lesson has focused on the following material:

1. Section VFR overhead entry (break)
2. Section approach
3. Section circling approach
4. Section missed approach

306. CONCLUSION

In formation flight, the wingman needs to be aware of not only what he's supposed to do, but he must also be aware of what the lead's procedures are so he can anticipate what the flight should do next. If you learn these procedures well, you will have the confidence you need on some cold, dark night when you go NORDO approaching bingo fuel, and you have to hook up with someone for help making your approach.

CHAPTER FOUR FORMATION EMERGENCIES

400. INTRODUCTION – N/A

COURSE/STAGE:

- Formation

LESSON TITLE:

- Formation Emergencies

LESSON IDENTIFIER:

- FFP-04

LEARNING ENVIRONMENT:

- Classroom

ALLOTTED LESSON TIME:

- 1.5 hr

TRAINING AIDS:

- Formation CD-ROM

STUDY RESOURCES:

- “Emergency Procedures” in the Pilot’s Pocket Checklist, A1-T45AB-NFM-500 or A1 - T45AC-N FM-000

LESSON PREPARATION:

Read:

1. Part 1, Chapter 4, “Operating Limitations,” Part 5, Chapter 14, “Takeoff Emergencies,” Part 5, Chapter 15, “In-Flight Emergencies,” and Part 5, Chapter 17, “Ejection,” in the T-45 NATOPS Flight Manual, A1-T45AB-NFM-000 or A1-T45AC-NFM-000
2. “Emergency Procedures” in the Pilot’s Pocket Checklist, A1-T45AB-NFM-500

REINFORCEMENT:

- N/A

EXAMINATION:

- N/A

401. LESSON OBJECTIVES

1. Recall crosswind limitations
2. Recall procedures for abort during interval takeoff
3. Recall procedures for abort during section takeoff
4. Recall procedure for formation lost sight
5. Recall lost sight/NORDO procedures
6. Recall midair collision procedures
7. Recall procedures for performing as SAR on-scene commander
8. Recall procedures for section approach-- wingman NORDO

402. MOTIVATION

Formation emergencies simply require that you add the dimension of another aircraft and close professional coordination with another skilled aviator.

403. OVERVIEW

In this lesson, you will learn about formation emergencies. Although you may never encounter these problems, preparing for the unexpected is a necessity in all aircraft operations.

The goal of this lesson is to increase your ability to make proper decisions should you face an in-flight formation emergency. The knowledge you gain from this and other emergency flight procedure lessons will enable you to make educated decisions that could ensure the safe completion of a flight.

In addition to crosswind limitations, this lesson presents procedures for the following formation emergencies:

1. Formation abort situations
 2. Formation lost sight
- NORDO

4-2 FORMATION EMERGENCIES

3. Midair collision
4. SAR on-scene commander duties
5. Section approach (wingman NORDO)

404. REFRESHER

Recall the location and function of T-45 cockpit engine indicators, WCP lights, FIRE warning light, and MSTR ALERT light.

405. PRESENTATION

Crosswind Takeoff Limitations

CROSSWIND LIMITATIONS	
AIRCRAFT	90-Degree Crosswind Greater than 10 KTS
SECTION	As Listed in NATOPS
DUAL/SOLO	or SOP

1. Aircraft: 90-degree crosswind greater than 10 knots
2. Section dual and solo: as listed in NATOPS or SOP

Takeoff Abort Procedures

1. Interval takeoff

NOTE

There are many circumstances that may require aborting a takeoff. Some of these circumstances are unacceptable engine acceleration characteristics, less than normal takeoff EGT/rpm, illumination of the FIRE warning light, trim failures, loss of oil pressure, fuel transfer failures, smoke in the cockpit, abnormally slow aircraft acceleration to takeoff speed, blown tire, uncommanded swerving, and loss of canopy. Early detection of an aircraft malfunction during takeoff roll is of primary importance. The decision to abort or continue takeoff must be based on the nature of the malfunction, aircraft speed, runway remaining, braking conditions, and whether or not the aircraft can become airborne prior to leaving the runway.

- a. *If decision to abort is made*
 - i. *Throttle-- IDLE*
 - ii. *Speed brakes-- EXTEND*
 - iii. *Brakes-- AS REQUIRED*
 - iv. *Hook-- DOWN 1000 FT PRIOR TO ARRESTING GEAR, IF REQUIRED*

NOTE

If off center just prior to engaging the arresting gear, do not attempt to go for the center of the runway. Continue straight ahead parallel to the runway centerline.

LESSON NOTES

Emphasize the need for transmitting intentions.

- v. *Transmit your intentions*

NOTE

With the 7-second interval, the wingman will usually be slow enough to allow for a safe abort behind the lead. If lead aborts, stay on your side of centerline until cleared to centerline or passed by trailing aircraft.

2. Section takeoff
 - a. Single-aircraft abort during takeoff roll
 - i. Transmit intentions using tactical call sign
 - ii. Move to centerline after separation or cleared by trailing aircraft and continue abort IAW NATOPS procedures
 - iii. Aircraft not aborting: go to MRT and continue takeoff roll on its side of runway
 - b. Dual-aircraft abort immediately after brake release
 - i. Aborting aircraft, transmit intentions using tactical call sign
 - ii. Both aircraft execute abort procedures IAW NATOPS procedures

- iii. Both aircraft remain on appropriate side of runway
- iv. First aircraft to reach long-field arresting gear must bypass it unless cleared to engage by trailing aircraft

Formation Lost Sight

1. Indications: N/A

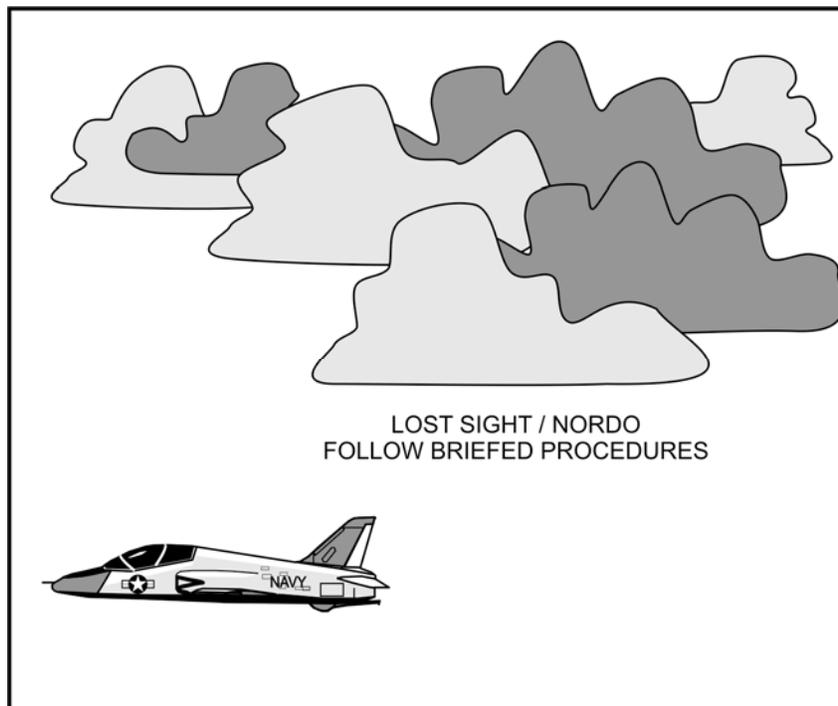


Figure 4-1 Lost Sight/NORDO

2. Procedures

NOTE

If NORDO, follow briefed lost comm/lost sight procedures

- a. Wingman
 - i. If sight lost en route
 - (a). Turn away from lead (30-degree cut for 1 minute)
 - (b). Transmit “[Call sign], lost sight”
 - (c). Follow lead’s instructions

- ii. If sight lost during approach
 - (a). Simultaneously shift to an instrument scan and turn away from lead
 - (b). Inform lead of lost sight by transmitting “[Call sign], lost sight”
 - (c). Conform to instructions from approach

NOTE

Turn away for 30 degrees in pattern (10 degrees on final) from flight’s last heading, hold for one minute, and, if in a descent, level off. After one minute, without further instructions from approach control, turn back to original heading.

- b. Lead
 - i. If sight lost during approach, continue approach
 - ii. If sight lost en route
 - (a). Call a visual and direct join-up or confirm mutual lost sight
 - (b). If mutual lost sight exists, direct a TACAN rendezvous

Midair Collision



Figure 4-2 Midair Collision

- 1. Indications:

- a. Observe collision
- b. Wingman reports collision
- c. Vibrations, structural popping/groaning, control problems

NOTES

1. If the aircraft is uncontrollable, EJECT, following NATOPS ejection criteria.
 2. If the aircraft is controllable after a midair collision, bird strike, or any other situation where you suspect structural damage, slow flight the damaged aircraft at altitude following NATOPS procedures (controllability check).
2. Procedures (Controllability Check)

NOTE

Considerations for conducting a controllability check are: severity of damage/malfunction, fuel remaining, flight conditions (VFR vs IFR), field landing facilities, other existing emergencies, and pilot experience.

- a. *Climb as required, maintaining flying airspeed and proceed toward point of intended landing*
- b. *When possible, obtain a visual inspection by another aircraft to assist in evaluating the damage.*
- c. *Slow the aircraft to 200 KIAS in 10-KIAS increments*
- d. *Landing gear - DOWN*
- e. *Slow the aircraft in 5-KIAS increments; slow to an airspeed at which flight controllability starts to become marginal (no slower than optimum AOA). Increase airspeed 10 KIAS and use as a minimum airspeed for the duration of the flight.*
- f. *If no damage is evident in the flap and slat area, extend the flaps to 1/2 then FULL and check controllability. If damage to slat area but no damage to the flap area consider a no-flap arrested landing. However, if minimum airspeed is too high for landing, extend flaps with EMERG FLAPS switch. Flap extension is at pilot discretion.*
- g. *Field arrested landing recommended. Shipboard landing not recommended.*

NOTE

1. Aircraft involved in midair should not rejoin flight. The pilots of the damaged aircraft must decide if they can land safely.
2. Depending on the situation, return to home field or proceed to the nearest suitable field for landing.

SAR On-Scene Commander Duties**NOTE**

SNPs performing SAR should maintain a minimum of 2,500 ft AGL and 250 KIAS.

1. In the event an aircraft mishap occurs beyond the control boundaries of an airport, the responsibility for initial coordination of the search and rescue (SAR) effort is left with one of the following
 - a. Senior aviator in the flight
 - b. Senior student in the flight
 - c. Any aviator airborne identifying himself/herself as senior
2. The on-scene commander shall
 - a. Assure responsibility for the remainder of the flight
 - b. Make the necessary voice reports
 - c. Keep the downed aircraft/pilots in sight
3. Flight management by the on-scene commander falls into two categories
 - a. Remainder of flight remains intact
 - b. Flight members not needed for SAR efforts are ordered to return to base (RTB)
4. The particulars for either situation listed above should be covered in the flight brief and fully understood by all members in the flight
5. The on-scene commander should utilize the following checklist commensurate with the situation

- a. Identification
 - i. Number of survivors
 - ii. Establish order of communication
 - iii. Determine injuries
 - iv. Check all assets' time on station and equipment on board which may help pinpoint survivor location, etc.
- b. Location
 - i. Request general terrain description
 - ii. Determine signaling devices
 - iii. Request beeper for homing
 - iv. Request survivor(s) give vectors to position
 - v. Record the following data applicable to each survivor and each crash site location, depending upon availability
 - (a). TACAN bearing/DME using most applicable station
 - (b). Bearing/range from home base (use Homeplate waypoint)
 - (c). Actual LAT/LONG from the MFD DATA/Aircraft Display page
- c. Recovery
 - i. Brief helo and remainder of SAR team
 - (a). Number and physical condition of survivor(s)
 - (b). Distance to survivor(s) from a known geographic checkpoint
 - (c). Terrain description
 - (d). Location of each survivor and crash site
 - (1). TA CAN bearing/DME using most applicable station
 - (2). Bearing/range from home base (use Homeplate waypoint)

- (3). Actual LAT/LONG from the MFD DATA/Aircraft Display page
- (e). Altitude of recovery area
- (f). Wind speed and direction
- (g). Describe survivor(s) signal devices
- (h). Describe ingress/egress routes
- (i). Emergency safe landing areas
- ii. Direct survivor(s) to
 - (a). Prepare and ignite smokes
 - (b). Vector helo if necessary
 - (c). Retain helmet for recovery

NOTE

Although aiding downed pilots is important, the safe conduct of remaining flight members is equally important. An instructor may designate a high and a low orbit, but the low orbit must be an instructor.

Section Approach (Wingman NORDO)

NOTE

NORDO procedures are mandatory during every brief.

1. Indications: unable to transmit, receive, or both
2. Procedures
 - a. Wingman
 - i. Maintain IFR parade position
 - ii. Acknowledge all hand/light signals from lead
 - iii. Make full-stop landing on signal from lead

NOTE

Look for green light from tower.

- iv. If unable to land, match lead's configuration, if changed from when separated, and rendezvous on lead
- b. Lead

NOTE

Lead needs to be in a position where wingman can rejoin if a landing cannot be completed.

- i. Make all maneuvers as smoothly as possible
- ii. Notify approach control of the situation
- iii. Use standard approach profile

NOTE

Consider dirty penetration if fuel permits.

- iv. Utilize appropriate hand/light signals
- v. Fly standard section approach
- vi. With runway in sight and in position for wingman to make safe landing, detach wingman
- vii. While wingman is landing
 - (a). Level off and maintain a position slightly in front of wingman
 - (b). Expect wingman to rejoin in event of waveoff
 - (c). After wingman has landed, execute missed approach or land as cleared

406. SUMMARY

In addition to crosswind limitations, this lesson has presented procedures for these formation emergencies:

- 1. Formation abort situations

2. Formation lost sight
 - NORDO
3. Midair collision
4. SAR on-scene commander duties
5. Section approach (wingman NORDO)

407. CONCLUSION

This is the fourth lesson in the FFP block. You will continue to practice the emergency procedures in the simulator and discuss “emergencies of the day,” planning for emergencies that might very well never occur. But denying that something can go wrong is asking for disaster. Preparing yourself to deal with emergencies and showing good headwork is what Naval aviation is all about: maturity and grace under pressure.

CHAPTER FIVE
FORMATION SECTION CRUISE/COLUMN

500. INTRODUCTION – N/A

COURSE/STAGE:

- Formation

LESSON TITLE:

- Formation Section Cruise/Column

LESSON IDENTIFIER:

- FFP-05

LEARNING ENVIRONMENT:

- Classroom

ALLOTTED LESSON TIME:

- .8 hr

TRAINING AIDS:

- Formation CD-ROM

STUDY RESOURCES:

1. T-45 NATOPS Flight Manual, A1-T45AB-NFM-000 or A1 -T45AC-NFM-000
2. T-45 Formation FTI

LESSON PREPARATION:

Read:

- “Section Daytime Flight Procedures,” in the T-45 Formation FTI

Review:

- Parts III, IV, V, and VII in the T-45 NATOPS Flight Manual, A1-T45AB-NFM-000

REINFORCEMENT:

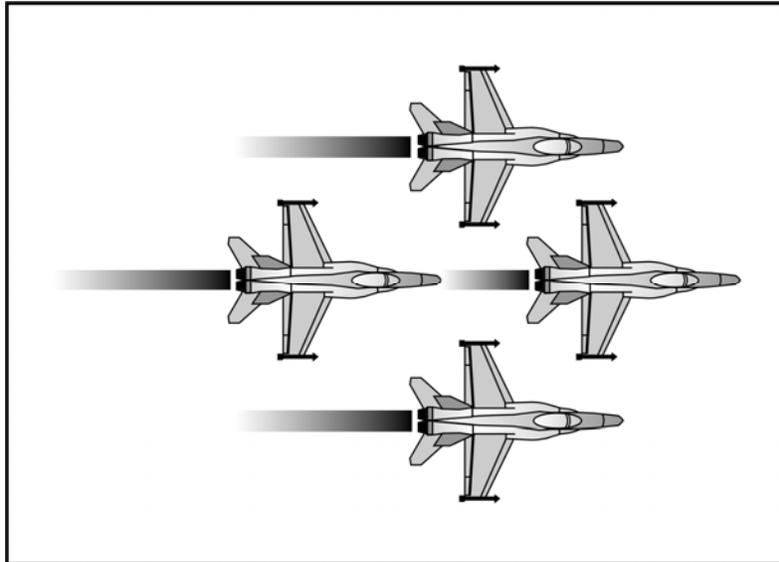
- N/A

EXAMINATION:

- The objectives in this lesson will be tested in FFP 06X.

501. LESSON OBJECTIVES

1. Recall procedures for section takeoff as lead
2. Recall procedures for section takeoff as wingman
3. Recall procedures for abort during section takeoff
4. Recall position for section cruise formation
5. Recall procedure for section cruise turns
6. Recall procedures for cruise aerobatics
7. Recall procedures for section column formation aerobatics



502. MOTIVATION

The tactical Naval pilot rarely goes on a mission in which he is not teamed with another aircraft. The concept of section flying goes back to World War I when German fighters discovered that two aircraft working as a team could defeat the enemy more efficiently. The basics of this type of flying start here in the classroom.

503. OVERVIEW

After completing FFP-05, you will be familiar with procedures for performing section interval takeoff and abort and cruise/column formation. You will also be able to demonstrate this knowledge initially on the exam for this lesson and later in the cockpit.

During this lesson you will cover procedures for:

1. Section takeoff
2. Section cruise formation
3. Section cruise maneuvering
4. Section column formation
5. Section column maneuvering

504. REFRESHER

Review what has been covered in the curriculum so far on barrel rolls, aileron rolls, and wingovers (previous Familiarization FP lectures, Fam-07S, Fam-13).

505. PRESENTATION**Section Takeoff**

1. Description: two aircraft taking off at same time in formation

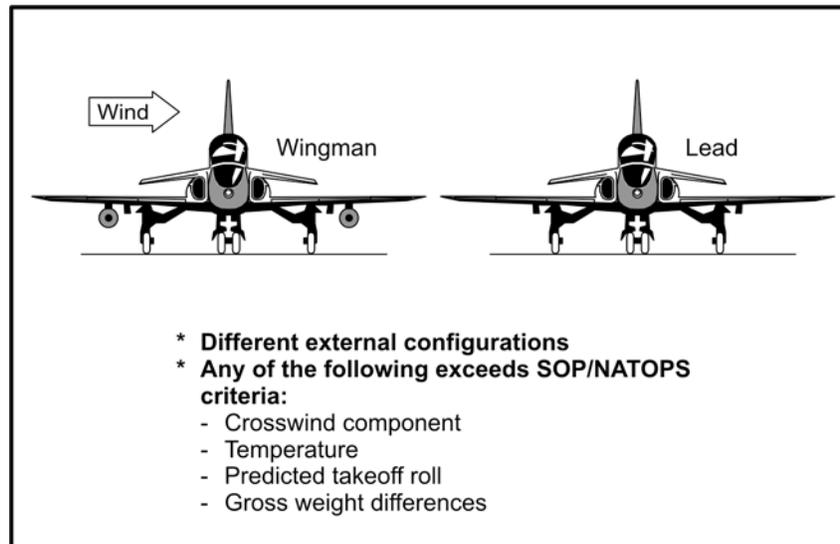


Figure 5-1 Section Takeoff Restrictions

2. Procedure

CAUTION

Section takeoffs are not performed when the aircraft have different external configurations (e.g., one with ordnance and one without) or when one of the following exceeds SOP/NATOPS criteria for respective dual or solo flights:

1. Maximum crosswind component
2. Temperature
3. Takeoff roll
4. Difference in gross weight

NOTE

Section takeoff is allowed, however, if the different external configuration consists of one aircraft with unloaded pylons and the other without pylons.

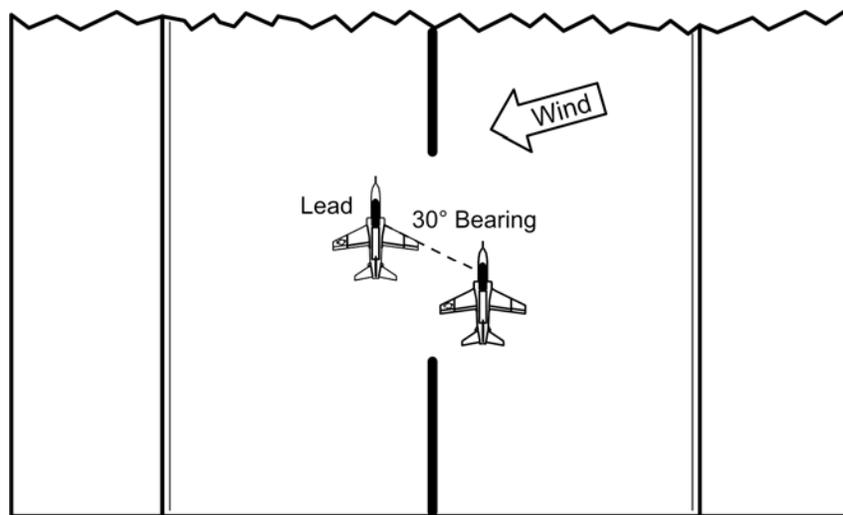


Figure 5-2 Section Takeoff

- a. Adhere to squadron SOP
 - i. Crosswind factors
 - ii. Takeoff roll limits
 - iii. Weight/configuration differentials
- b. Position aircraft on runway and on bearing
- c. Complete same runup and check procedures as in interval takeoff
 - i. Lead
 - (a). Reduce power 2 percent from MRT to give wingman excess power available
 - (b). Receive thumbs-up when wingman is ready to go
 - (c). Raise forearm vertically (on wingman side), hesitate a moment, and drop arm smartly
 - ii. Wingman: give lead a thumbs-up when your aircraft and lead's aircraft check OK
- d. Takeoff roll
 - i. Lead and wingman: simultaneously release brakes as lead's arm drops below canopy rail

- ii. Wingman
 - (a). Maintain parade bearing
 - (1). If going acute, immediately after beginning roll, lightly tap brakes
 - (2). After gaining some speed during takeoff roll, manipulate power slightly to stay on bearing line
 - (b). Maintain directional control of aircraft down runway, using the rudder
- iii. Lead
 - (a). As lift-off speed is approached, signal lift-off with climb signal (per NATOPS)
 - (b). Smoothly rotate
- iv. Wingman
 - Match lead's rotation rate and attitude

LESSON NOTES

Point out that the lead's rotation rate may be matched by monitoring his nose-strut extension.

- v. Lead: when safely airborne and at 140 KIAS
 - (a). Nod head
 - (b). Raise gear and flaps/slats

NOTE

No turn into the wingman will be made below 500 ft AGL.

- vi. Wingman
 - (a). Raise gear and flaps/slats on lead's head nod
 - (b). After safely airborne, move into parade position

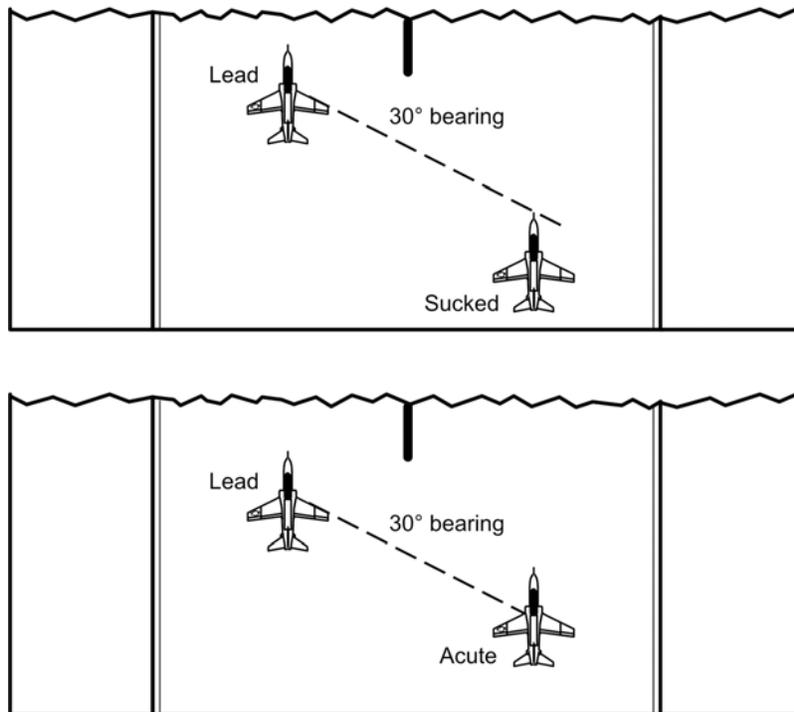


Figure 5-3 Section Takeoff Roll Errors

- e. Common errors by wingman
- i. Takeoff roll
 - (a). **Problem:** goes acute during roll due to power differential with lead
Correction: anticipate power adjustments to maintain bearing line
 - (b). **Problem:** goes sucked during roll due to failure to anticipate power readjustments to maintain bearing line
Correction: add power and anticipate readjustment-- position might not be regained until after rotation
 - ii. Rotation and lift-off
 - (a). **Problem:** wingman stepped up over lead and sucked after lift-off due to wingman's early rotation
Correction:

NOTE

Do not initiate a rate of descent

- (1). Maneuver aircraft so as not to lose sight of lead
- (2). Maintain horizontal separation
- (3). Allow lead to climb slightly above your relative position
- (4). Join immediately in parade position

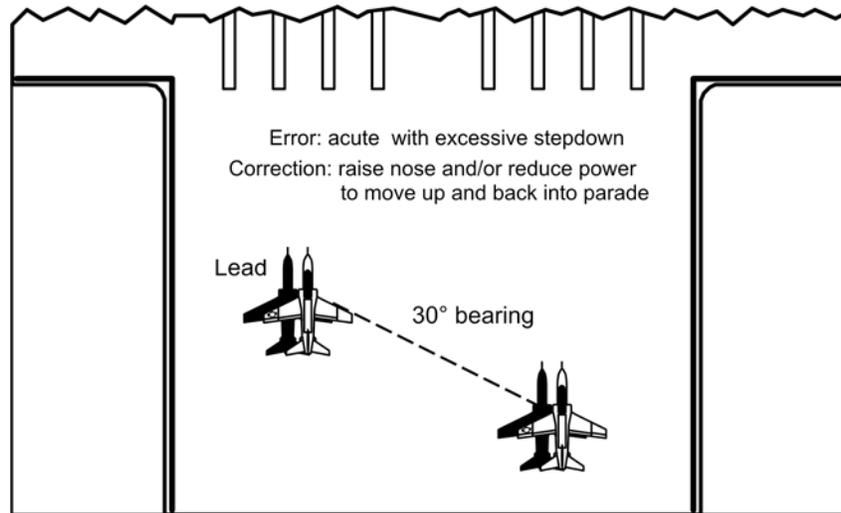


Figure 5-4 Section Takeoff Rotation Errors

- (b). **Problem:** wingman acute and too much stepdown on lead due to wingman's late rotation

Correction: raise nose and/or slightly reduce power as required to fly up and back into parade position

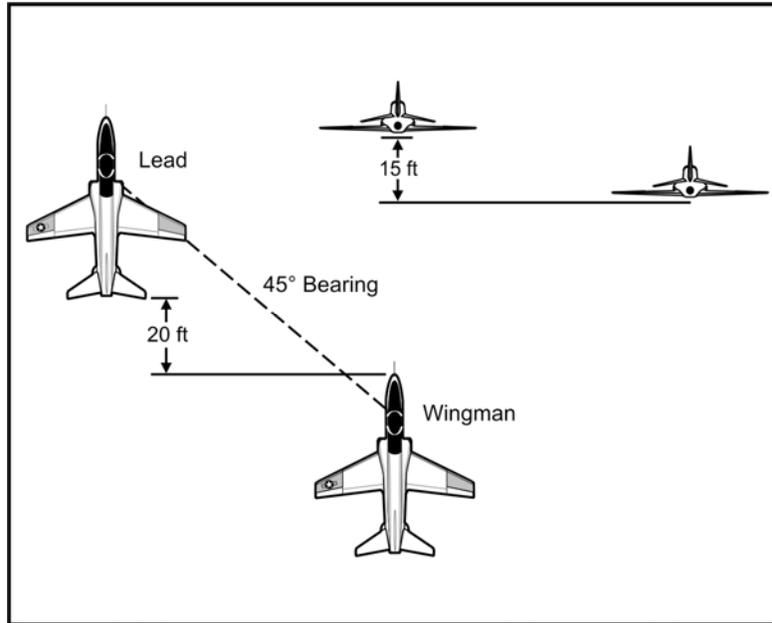
- f. Abort procedures
- i. If lead or wingman aborts immediately after brake release, both aircraft abort
 - ii. If both aircraft abort, they maintain their portions of runway and execute abort procedures per
 - iii. If wingman aborts above 50 KIAS, lead takes off and wingman executes abort procedures per NATOPS
 - iv. If lead aborts above 50 KIAS, wingman takes off

LESSON NOTES

Emphasize that if one pilot of a section aborts and the other takes off, the airborne pilot must ensure that he or she is at MRT.

Section Cruise Formation

1. Description
 - a. Safer, requires less attention to maintaining position, provides better lookout capabilities, and is more fuel efficient for the wingman than parade
 - b. Leaves more flexibility for maneuvering than parade position

**Figure 5-5 Cruise Position**

- c. Bearing behind lead of 45 degrees
- d. Stepdown of 15 ft
- e. Nose-to-tail separation of 20 ft

LESSON NOTES

Point out that when in cruise formation, the wingman assumes a greater responsibility for maintaining lookout doctrine. The wingman should scan the area from the nose to past the wing in the direction of the lead. The lead should adjust his lookout doctrine by placing more emphasis in the direction of the wingman.

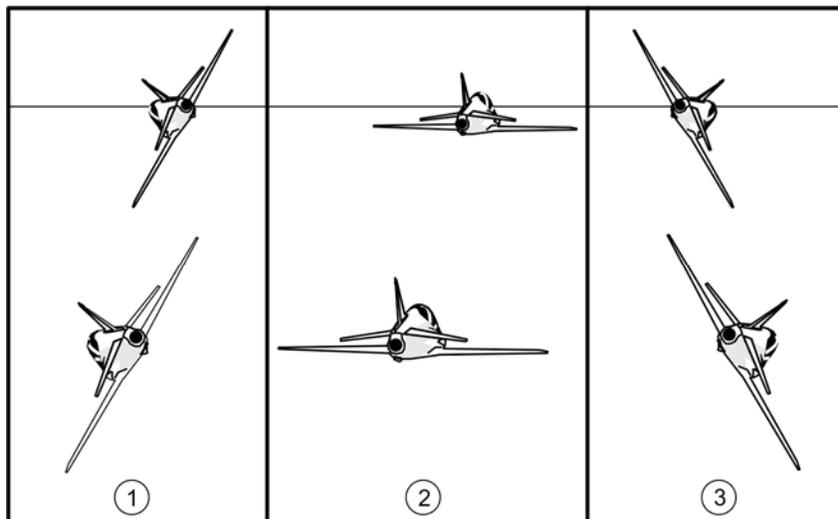


Figure 5-6 Cruise Position-Gouge

- f. Cruise position gouge
 - i. Split star on lead's fuselage with lead's inboard wingtip or align outboard aileron hinge (canoe) with danger arrow on intake
 - ii. Estimate proper nose-to-tail separation
 - g. All flight members maintain position by sliding to inside of lead's turn radius to minimize throttle movements
 - h. Wingman may change position to either side of lead to maintain cruise position on the inside of lead's turn
2. Procedure for achieving cruise position from wings level
- a. Lead: give cruise signal
 - b. Wingman
 - i. Drop nose slightly and adjust power to increase stepdown
 - ii. Adjust nose-to-tail (down and aft) to proper cruise position
 - iii. Primarily utilize radius of turn to maintain nose-to-tail

Section Cruise Maneuvering

1. Description: lead maneuvers through turns, gradually increasing AOB and pitch while working into wingovers and modified barrel rolls, followed by wingman in cruise position
2. Procedure for cruise turns away
 - a. Lead: turn away from wingman
 - b. Wingman:
 - i. Roll with lead and smoothly maneuver to inside of lead's turn by slowly increasing rate of roll
 - ii. Add power as needed to maintain nose-to-tail while maneuvering to inside

**Figure 5-7 Section Cruise: Turn Reversal**

- iii. When inside lead's turn, reduce power slightly and decrease angle of bank to maintain proper position

NOTE

Wingman may need to reduce stepdown on lead as lead increases angle of bank. Wingman must avoid being stepped up on lead.

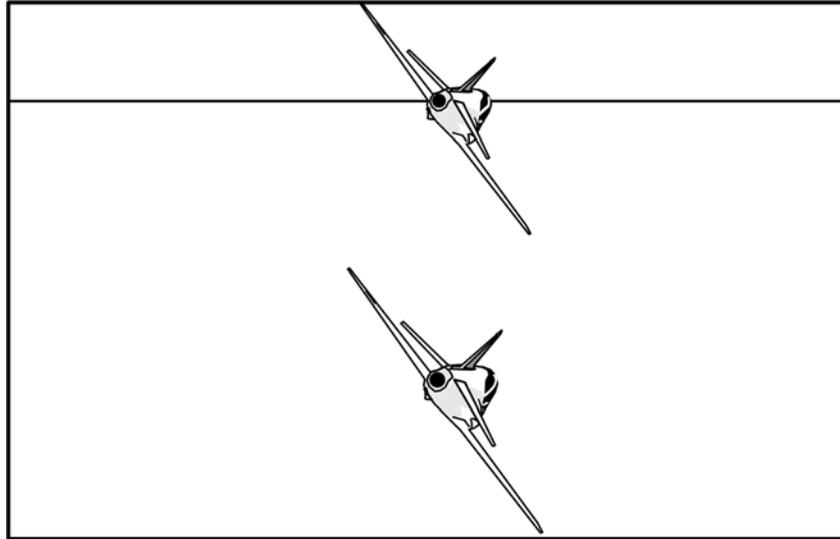


Figure 5-8 Section Cruise: Turn Into Wingman

3. Procedures for cruise turns into
 - a. Lead: turns into wingman
 - b. Wingman: simultaneously and smoothly reduces power and may slightly lag lead's rate of roll in order to slide toward lead's turn radius
4. Procedure for wingovers/modified barrel rolls

NOTE

This maneuver is a "High Risk" maneuver and there is an increased potential for a mid-air collision if the procedures in the FTI are not strictly followed.

- a. Lead
 - i. Maintain power at approximately 92 percent rpm
 - ii. At approximately 350 KIAS, start by increasing g to establish a climb
 - iii. Perform wingovers and modified barrel rolls
 - iv. Maintain airspeed at minimum of 150 KIAS
 - v. Maintain at least 1 positive g during barrel roll

LESSON NOTES

Point out that because the lead is using a lower power setting than in Fam aerobatics, he should pay closer attention to airspeed during wingovers and barrel rolls.

- b. Wingman
 - i. Match lead's pull to maintain position
 - ii. When possible, fly inside lead's radius of turn; add power as necessary when passing through inverted position
 - iii. If executing maneuver outside lead's radius of turn, smoothly reduce power as necessary when passing through inverted position
- 5. Return to parade position
 - a. Lead: reduce power and then pass join-up signal (porpoise the aircraft or pat either shoulder)
 - b. Wingman: move into parade position, adjusting power as necessary
- 6. Common errors by wingman
 - a. **Problem:** excessive nose-to-tail due to falling outside lead's radius of turn
Correction: as soon as nose-to-tail opening is observed, expeditiously move to proper position inside lead's radius of turn
 - b. **Problem:** erratic g due to overcontrolling of stick
Correction: hold constant g until correction takes effect
 - c. **Problem:** excessive stepdown due to improper coordination of AOB and g
Correction: use AOB to control stepdown
 - d. **Problem:** wingman overbanks to correct for position and fails to use g to reestablish radius of turn
Correction: coordinate g with radius of turn and AOB with stepdown

Section Column Formation

- 1. Description:

- a. Instills confidence in section maneuvering and allows practice of smooth application of g

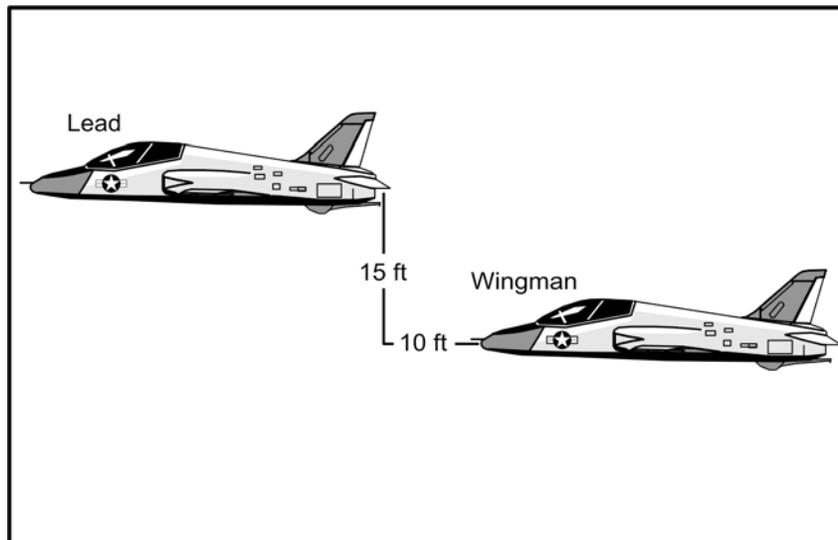


Figure 5-9 Section Column Position

- b. Stepdown of 15 feet
 - c. Nose-to-tail separation of 10 feet
 - d. Position gouge
 - i. Place top of canopy bow on lead's wingline
 - ii. Maintain position directly behind lead with AOB
 - iii. Maintain nose-to-tail separation with power and control stepdown with g
2. Procedure
- a. Lead

NOTE

Do not use speed brakes while in column formation.

- i. Maintain at least 1, and not more than 3, positive g while being very smooth with stick
- ii. Maintain power about 92 percent

- iii. Maintain airspeed minimum of 150 KIAS
- b. Wingman
 - i. Fly position with reference to lead's aircraft (no reference to horizon)
 - ii. Smoothly reduce or add power as necessary
 - iii. Control stepdown with g

Section Column Maneuvering

1. Description: lead performs wingovers and modified barrel rolls as in cruise, as well as aileron rolls; wingman follows in column position
2. Procedure

LESSON NOTES

Remember that as the lead's nose starts down, the lead will accelerate first and have a tendency to open on the wingman. The wingman will need to add minimal power to compensate, readjusting power as both aircraft approach the same speed. The opposite is true as the lead's nose starts up.

- a. Lead:
 - i. Maintain positive g, power, and minimum airspeed of 150
 - ii. Perform wingovers, modified barrel rolls, and aileron rolls
 - b. Wingman: follow lead through maneuvers
3. Common errors by wingman
 - a. **Problem:** wingman fails to match lead's g changes, affecting stepdown and nose-to-tail separation
Correction: anticipate g application and match lead's pull
 - b. **Problem:** wingman does not maintain position during maneuver
Prevention: scan all of lead's aircraft; match wing position while maintaining stepdown with g application

506. SUMMARY

During this lesson we discussed procedures for:

1. Section takeoff
2. Section cruise formation
3. Section cruise maneuvering
4. Section column formation
5. Section column maneuvering

507. CONCLUSION

The procedures for flying cruise formation are the building blocks for more advanced tactical maneuvering, providing more flexibility in the employment of the flight and the advantages of the flight's being joined from takeoff.

CHAPTER SIX
DIVISION PARADE FORMATION

600. INTRODUCTION – N/A

COURSE/STAGE:

- Formation

LESSON TITLE:

- Division Parade Formation

LESSON IDENTIFIER:

- FFP-07

LEARNING ENVIRONMENT:

- Classroom

ALLOTTED LESSON TIME:

- 1.5 hr

TRAINING AIDS:

1. Formation CD-ROM
2. T-45 Scale Models

STUDY RESOURCES:

1. T-45 NATOPS Flight Manual, A1-T45AB-NFM-000 or A1 -T45AC-NFM-000
2. Formation Flight Training Instruction (FTI)

LESSON PREPARATION:

Read:

- “Division Daytime Flight Procedures,” in the Formation FTI

Review:

- Parts III, IV, V, and VII in the T-45 NATOPS Flight Manual, A1-T45AB-NFM-000

REINFORCEMENT:

- N/A

EXAMINATION:

- The objectives in this lesson will be tested in FFP 08X.

601. LESSON OBJECTIVES

1. Recall aircraft marshal procedures
2. Recall formation taxi/hold short procedures
3. Recall procedures for positioning aircraft for interval takeoff
4. Recall procedures for interval takeoff
5. Recall considerations for abort during division takeoff
6. Recall procedures for division takeoff by section
7. Recall procedures for division rendezvous/join-up after takeoff
8. Recall procedures for division underrun
9. Recall procedures for balancing formation from echelon parade
10. Recall procedures for turns away when in balanced parade (fingertip) formation
11. Recall procedures for turns into section when in balanced parade (fingertip) formation
12. Recall procedures for moving balanced parade (fingertip) into echelon parade
13. Recall procedures for turns away when in echelon parade formation
14. Recall procedure for division breakup and rendezvous exercise
15. Recall procedures for division cruise maneuvering
16. Recall procedure for shuffle division
17. Recall tail-chase procedures
18. Recall procedures for division overhead entry
19. Recall procedures for formation recovery to division VFR straight-in

6-2 DIVISION PARADE FORMATION

602. MOTIVATION

Division flying facilitates command and control of multiple aircraft. A division may be a part of a weapons strike or fighter cover, or just a cross-country flight; regardless, it is easier to have an orderly coordination of aircraft when flown as a unit rather than randomly. As a member of a division, your responsibilities increase, and any errors you make affect the entire unit. This lesson will give you the basics for division formation.

603. OVERVIEW

After completion of FFP-07, the student will be familiar with division formation and the increased complexity of flying four aircraft in close proximity. The student will be able to demonstrate the knowledge initially on the exam for this lesson and later in the cockpit.

During this lesson you will cover the following aspects of division flight:

1. Marshal procedure
2. Taxi and hold short procedures
3. Interval takeoff positioning and procedure
4. Division takeoff procedure and abort considerations
5. Division rendezvous/join-up after takeoff procedure
6. Balancing formation from echelon parade procedure
7. Turns away and into section when in balanced parade (fingertip) procedure
8. Moving balanced parade (fingertip) into echelon parade procedure
9. Echelon parade formation turns away procedure
10. Division breakup and rendezvous exercise procedures
11. Division underrun procedure
12. Division cruise maneuvering procedure
13. Shuffle division procedure
14. Tail-chase exercise
15. Division overhead entry procedure
16. Formation recovery to division VFR straight-in procedure

604. REFRESHER

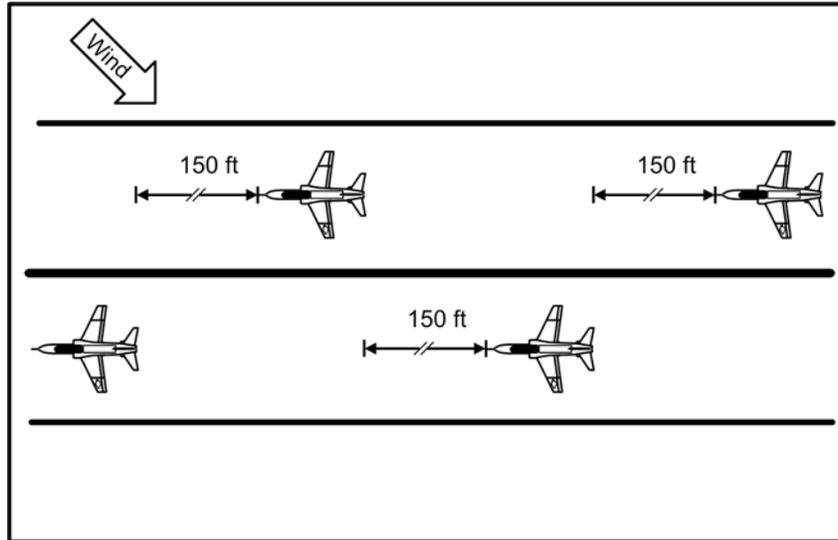
1. Division marshaling and taxiing, as well as interval takeoff and abort procedures, are essentially the same as section procedures. See FFP-01 for a review of those topics.
2. Formation visual communications (signals) are an essential part of division formation flying. See FFP-01 for a review of those signals.

605. PRESENTATION**NOTE**

Throughout division formation, all signals will be passed down the line and appropriate responses passed back up the line.

Division Marshaling

1. Description: similar to section, except there are four aircraft instead of two
2. Procedure
 - a. All aircraft
 - i. Man aircraft and start engines at same time
 - ii. Complete checklists (identical to those used in Familiarization Stage)
 - iii. While in marshaling area, lead checks flight in on marshaling frequency, passes ATIS and clearance information (refer to local course rules for aircraft positioning and parking)
 - b. Lead: if marshaling completed on frequency other than ground control, radio wingmen to switch to appropriate frequency for taxi
 - c. Wingmen
 - When directed, check in in order (e.g., “Two,” “Three,” “Four”)
 - d. Flight
 - i. Continue procedures as in 2 plane
 - ii. Taxi to duty runway in order by flight position

Division Taxiing/Hold Short**Figure 6-1 Division Taxiing**

1. Description: similar to section taxiing and hold short except there are four aircraft instead of two – alternate aircraft on opposite side of taxiway from aircraft ahead
2. Procedure: identical to section taxiing and hold short procedure except there are four aircraft instead of two

NOTE

All aircraft automatically switch to tower frequency when lead turns into hold short area.

Division Takeoff

1. Interval takeoff
 - a. Description: standard takeoff procedure on runways 200 ft or wider

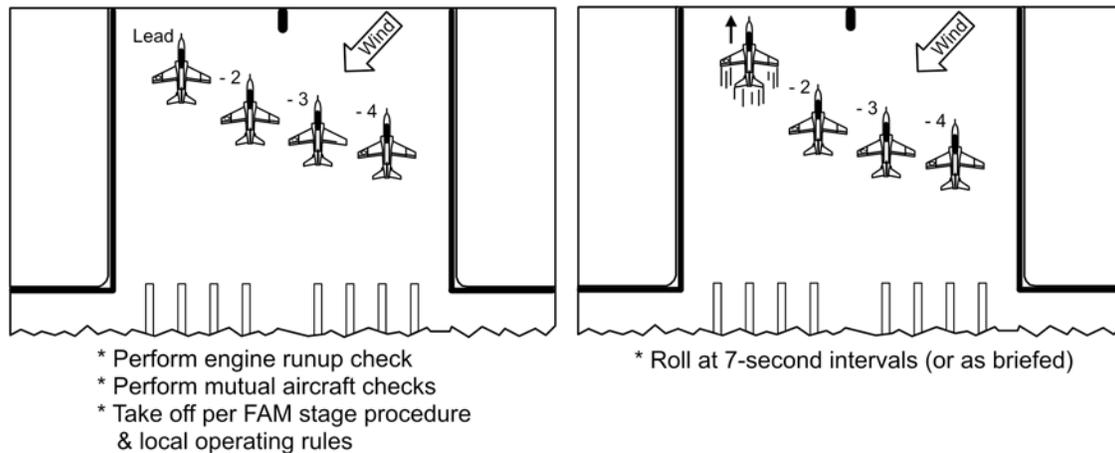


Figure 6-2 Division Interval Takeoff Positions and Takeoff

- b. Procedure: same as section interval takeoff except there are four aircraft lined up in “banana” echelon with Dash-2 on the parade bearing line and Dash-3 and Dash-4 aligned so they can see the lead’s cockpit
- c. Abort
 - i. Description

NOTE

When following aircraft are involved, a potentially dangerous situation exists, especially if arresting gear is required.

- (a). Same as procedure for section abort, with added complexity of four aircraft
- (b). Dash-2, Dash-3 or Dash-4: there may be aircraft ahead still on takeoff roll which may abort

NOTE

Remain alert to the possibility of aircraft ahead aborting while doing your normal checks/scans on your aircraft.

- ii. Procedure: identical to abort procedure for section interval takeoff with added complexity of four aircraft

- (a). With flight members behind you, call “[Call sign], aborting,” and remain on your side of runway until all other aircraft are airborne and pass you or you are cleared to centerline by remaining aircraft
- (b). As last aircraft in flight, call “[Call sign], aborting,” and ease to centerline to take long field arresting gear

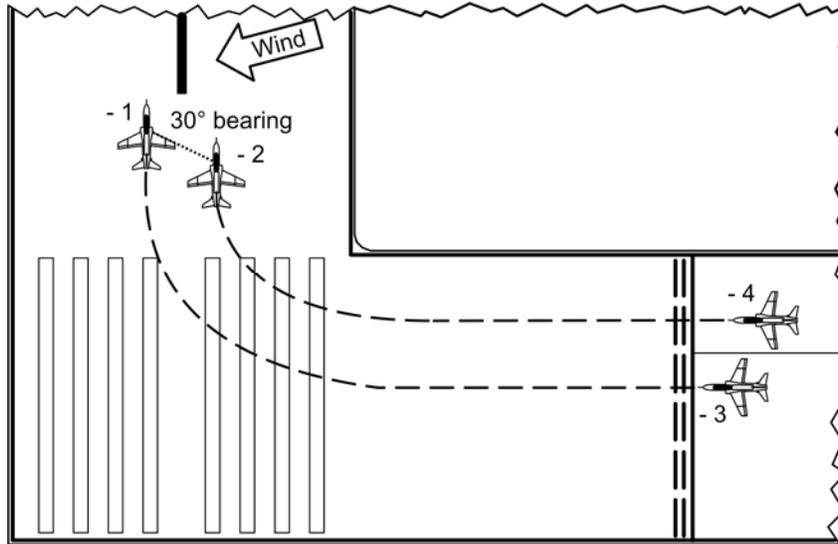


Figure 6-3 Division Takeoff by Sections

2. Division takeoff by section
 - a. Description
 - i. Used in IMC or marginal VMC
 - ii. Two separate section takeoffs with only one section on runway at any one time
 - b. Procedure
 - i. Lead
 - (a). Advise tower of your flight of four
 - (b). Request minimum separation interval between sections
 - ii. First section
 - (a). With clearance for takeoff, taxi onto runway
 - (b). Position aircraft on runway as in interval takeoff
 - (c). Perform section takeoff

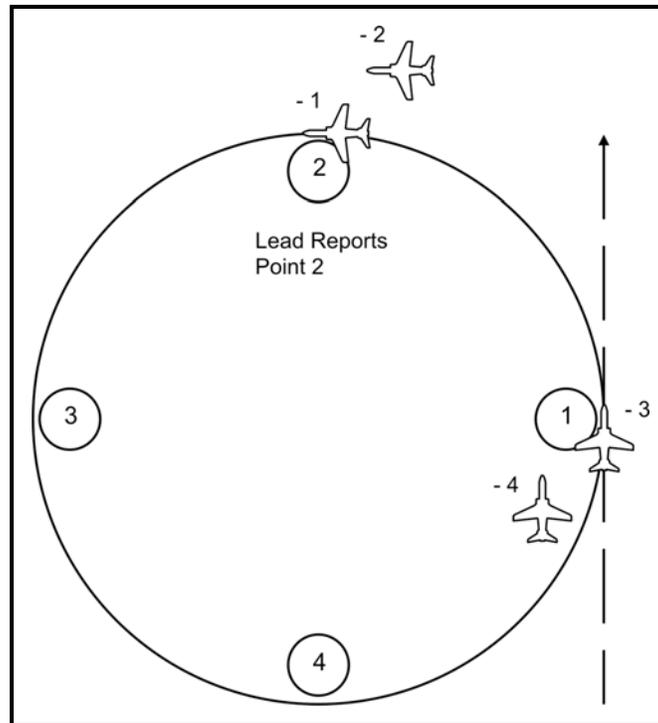


Figure 6-4 Division TACAN/Rendezvous

iii. Second section: same as first section

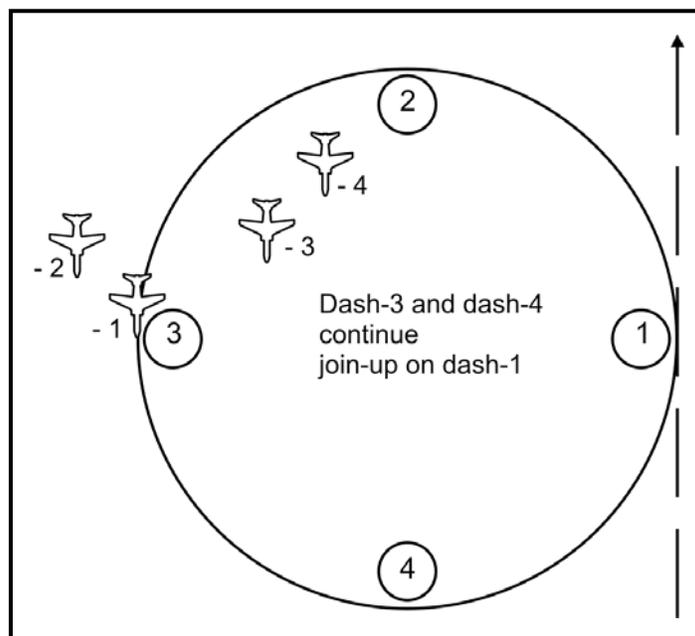


Figure 6-5 Division TACAN Rendezvous by Section

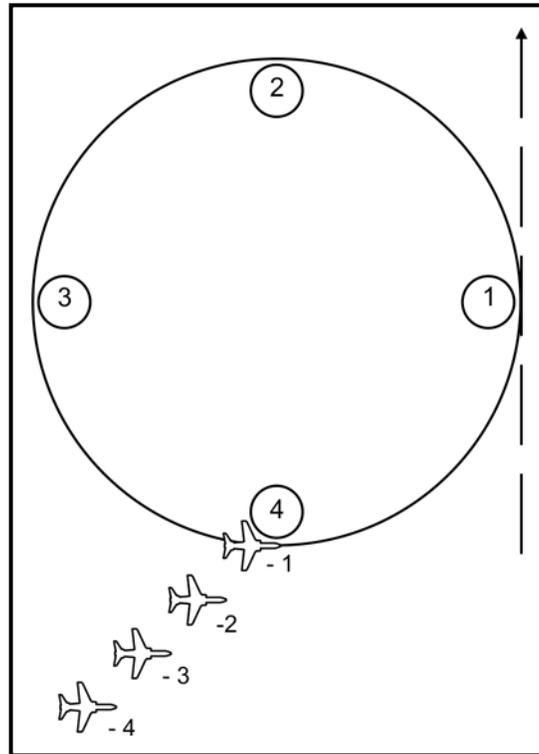


Figure 6-6 Division TACAN Rendezvous: Section Crosses Under Into Echelon

- iv. First and second sections: fly to briefed TACAN rendezvous point

LESSON NOTES

Point out that as soon as the flight is VMQ the second section leader should put his wingman in cruise to improve the flight's lookout and allow the section lead more maneuvering latitude to complete the rendezvous.

- c. Abort: use section formation abort procedure
3. Common errors: same as for section formation

Division Rendezvous

1. Division rendezvous/join-up after interval takeoff
 - a. Description: expeditious joining of all four aircraft, after interval takeoff, while keeping all aircraft ahead in sight at all times

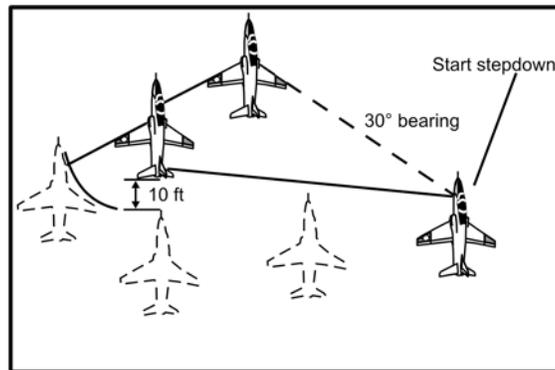


Figure 6-7 Division CV Rendezvous/Join-Up as Made by Dash-3

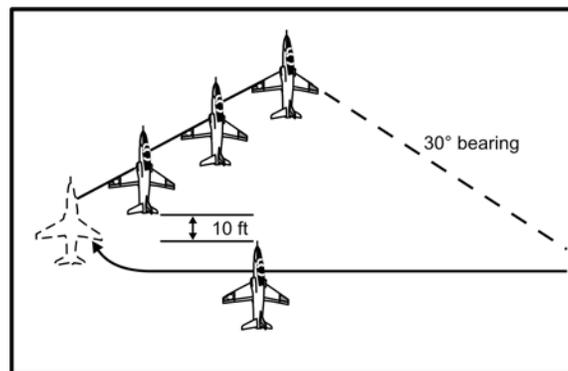


Figure 6-8 Division CV Rendezvous/Join-Up as Made by Dash-4

- b. CV rendezvous procedure
 - i. Dash-2, Dash-3, and Dash-4 perform CV rendezvous and join-up IAW section procedures, with the following exceptions

LESSON NOTES

Remind the SNP there may be aircraft behind him/her—use caution when maneuvering on the bearing line.

- (a). Dash-3 and Dash-4 may need to use larger power additions than Dash-2 to join-up
- (b). Dash-3 and Dash-4 must keep all aircraft ahead in sight; stagnation on bearing line may be required to keep preceding aircraft in sight

- ii. Lead: roll out on desired heading and balance formation
- iii. Wingmen
 - (a). Dash-2 crosses under to balance formation when signaled by lead
 - (b). Dash-3 and Dash-4 move up into fingertip position

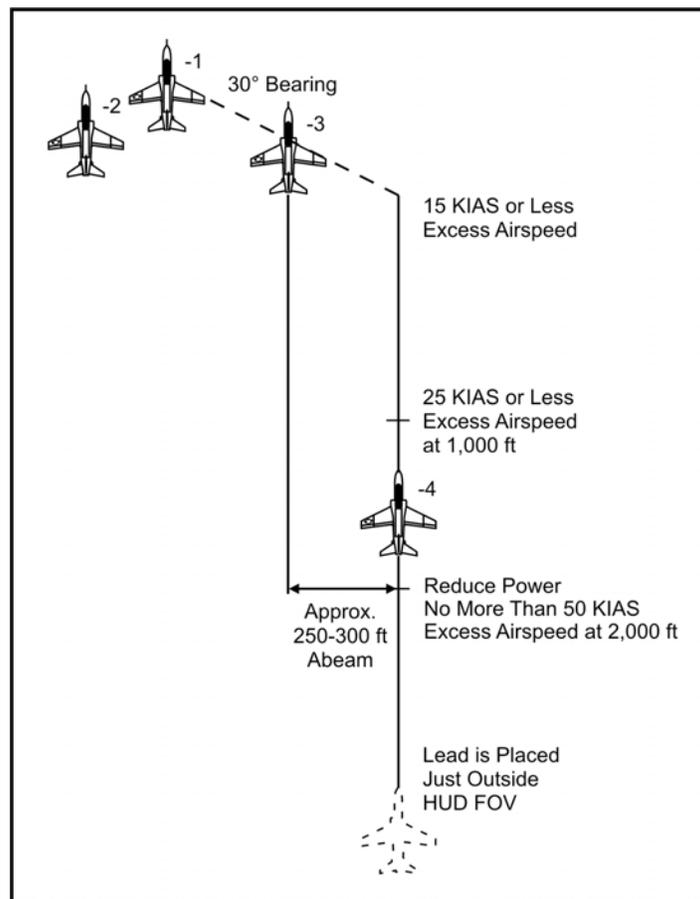


Figure 6-9 Division Running Rendezvous: Approach the Bearing

- c. Running rendezvous (balanced formation) procedure
 - i. Lead: climb at constant airspeed and power setting as briefed and dictated by local operating rules
 - ii. Wingmen: normally join in balanced parade (fingertip) formation
- d. Common errors by Dash-2, Dash-3 or Dash-4 for division join-up
 - i. **Problem:** closing too rapidly on aircraft ahead

Correction: use any one of the following as appropriate

- (a). Adjust closure rate to maintain safe distance
- (b). Underrun

NOTE

Division underrun procedures follow.

- ii. **Problem:** preceding aircraft slow to rendezvous, hindering subsequent aircraft

Prevention: stagnate on and maintain bearing line until you can proceed with your join-up

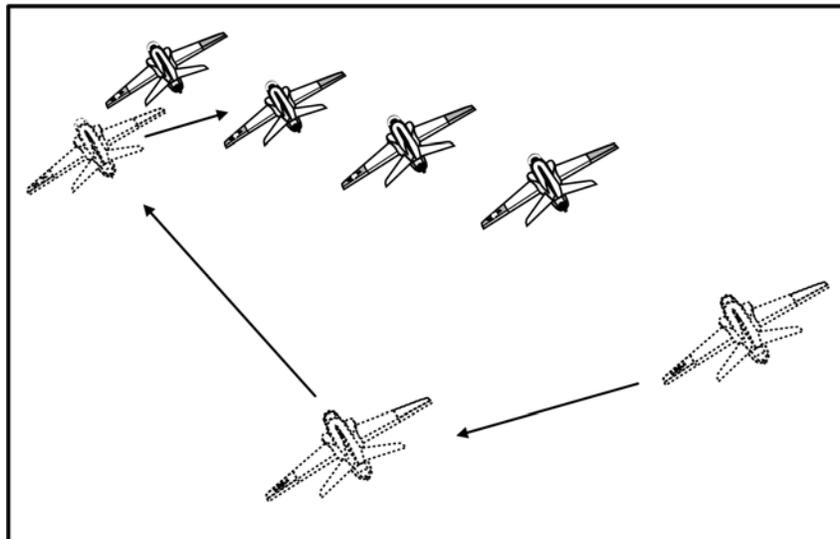


Figure 6-10 Division Underrun

2. Division underrun

a. Description

- i. Resembles underrun in section rendezvous
- ii. Used to avoid unsafe situation
 - (a). Aircraft acute on bearing and unable to return to proper bearing prior to join-up
 - (b). Aircraft has uncontrolled closure rate in-close

- b. Procedure
 - i. Underrunner: perform normal underrun crossing underneath and behind all aircraft
 - (a). Stabilize outside lead's radius of turn at a parade turn- away position, approximately 200 ft and slightly stepped up on lead
 - (b). When cleared by lead, move below and behind flight to return to rendezvous bearing on inside of turn
 - (c). Join-up, moving into open slot
 - ii. Any aircraft behind underrunner: complete rendezvous and leave room for underrunner to join in his respective position when cleared by lead
 - iii. Lead: if necessary, continue turn past 180 degrees until underrunner has joined up
- c. Common error by Dash-2, Dash-3, or Dash-4 during division underrun
 - i. **Problem:** potential midair due to failure to recognize parameters for underrun
Correction: scan airspeed and relative motion to all preceding aircraft
 - ii. **Problem:** potential midair due to not stabilizing in underrun position and not waiting for lead's direction to cross back over for join-up
Correction: stabilize in underrun position and await lead's direction to cross back over for join-up

Balanced Parade (Fingertip)

LESSON NOTES

Emphasize throughout division formation maneuvers that each pilot should attempt to fly off the lead while allowing lateral separation from aircraft.

- 1. Description
 - a. Division formation allowing for aircraft maneuverability and ease of flying
 - b. Formed with Dash-2 on one side of lead's wing, balanced by Dash- 3 and Dash-4 on lead's other wing

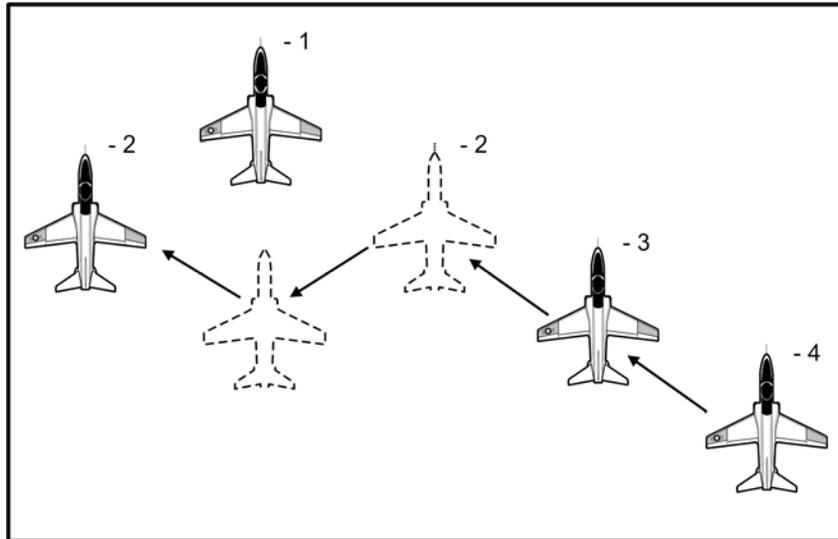


Figure 6-11 Wingman Crossunder

2. Procedure

a. Balancing formation from echelon parade

i. With wingman crossunder

- (a). Lead: signal to Dash-2 for wingman crossunder
- (b). Dash-2, Dash-3: pass signal down line
- (c). Dash-2: execute “V” crossunder on lead
- (d). Dash-3, Dash-4: move up into parade position on lead and Dash-3, respectively, after Dash-2 performs crossunder (for fingertip)

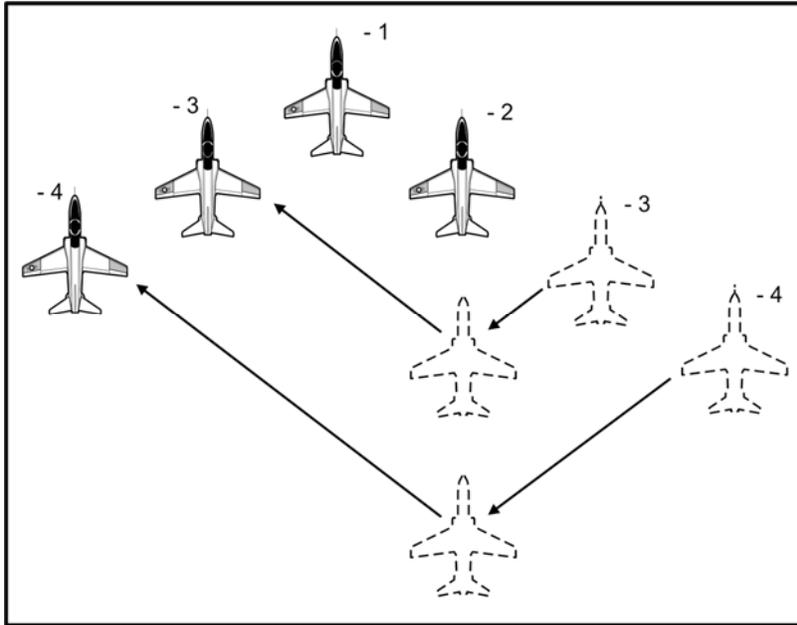


Figure 6-12 Section Crossunder

- ii. With section crossunder
 - (a). Lead: signal for section crossunder
 - (b). Dash-2, Dash-3: pass signal down line
 - (c). Dash-3: execute “V” crossunder on Dash-2, maintaining nose-to-tail separation and continuing to parade position on Dash-2, who is on lead’s opposite wing
 - (d). Dash-4: execute “V” crossunder on Dash-3 as Dash-3 executes crossunder, keeping Dash-3 between self and lead and ending maneuver when Dash-3 ends crossunder

LESSON NOTES

Emphasize that Dash-3 needs to maintain a steady normal crossunder rate to make it easier for Dash-4 to follow.

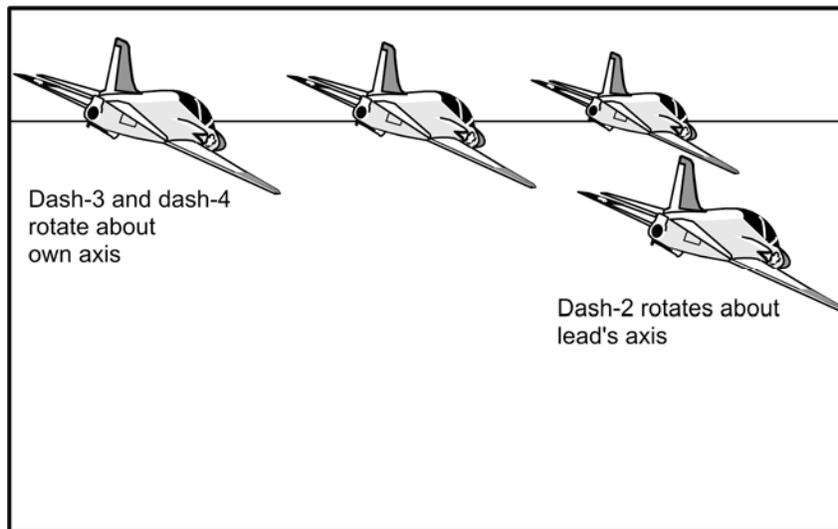


Figure 6-13 Balanced Formation (Fingertip) Turn Away from Section

- b. Balanced parade (fingertip) turns

NOTE

Dash-4 needs to apply larger power adjustments to maintain position.

- i. Turns away from section [VFR]
- (a). Dash-2: rotate about lead's axis
 - (b). Dash-3: rotate about own axis
 - (c). Dash-4: rotate about own axis

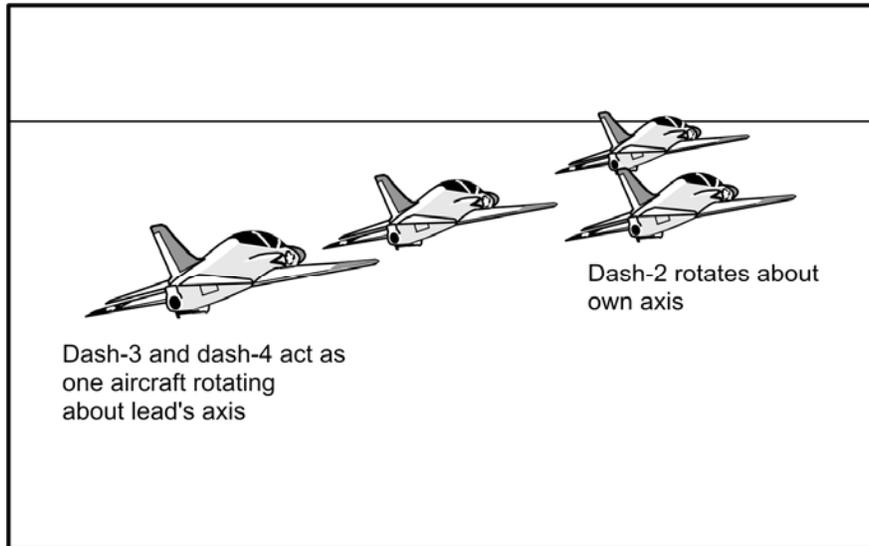


Figure 6-14 Balanced Formation (Fingertip) Turn Away into Section

- ii. Turns into section [VFR]
 - (a). Second section: act as one aircraft, rotating about lead's axis (same as turn into wingman)
 - (b). Dash-2: rotate about own axis
3. Common errors by Dash-3 during balanced parade
 - a. During balancing formation (section crossunder)
 - **Problem:** Dash-4 lags behind because Dash-3 executes crossunder too rapidly
 - Correction:** Dash-3 must be slow/judicious so Dash-4 can arrive in correct parade position
 - b. During balanced parade turns: errors are similar to section except that they are magnified due to Dash-4 flying on Dash-3 instead of on lead

Echelon Parade

1. Description: formed when all formation aircraft are on same side of lead, along common 30-degree bearing line, each in parade wing position on preceding aircraft

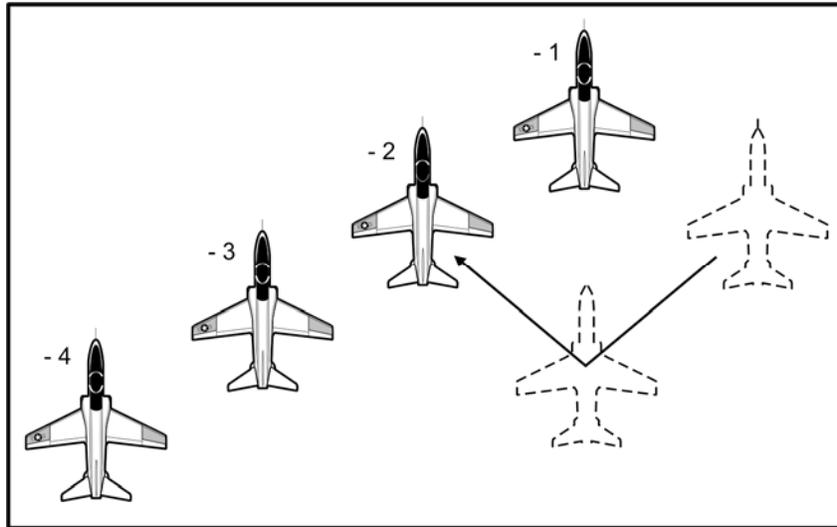


Figure 6-15 Parade (Fingertip) Formation To Echelon with Wingman Crossunder

2. Procedure: Dash-2 will fly slightly stepped down parade position to allow other aircraft to maintain sight of lead
 - a. Moving from balanced parade (fingertip) into echelon parade
 - i. Wingman crossunder
 - (a). Lead: pass signal to Dash-3 for wingman crossunder
 - (b). Dash-3: move diagonally out on bearing from balanced parade (fingertip) position to leave slot for Dash-2 while observing Dash-2 and keeping adequate separation
 - (c). Dash-4: maintain position on Dash-3 while Dash-3 moves out
 - (d). Lead: signal Dash-2 to cross under, when Dash-3 begins moving out
 - (e). Dash-2: perform "V" crossunder on lead into empty slot between lead and Dash-3

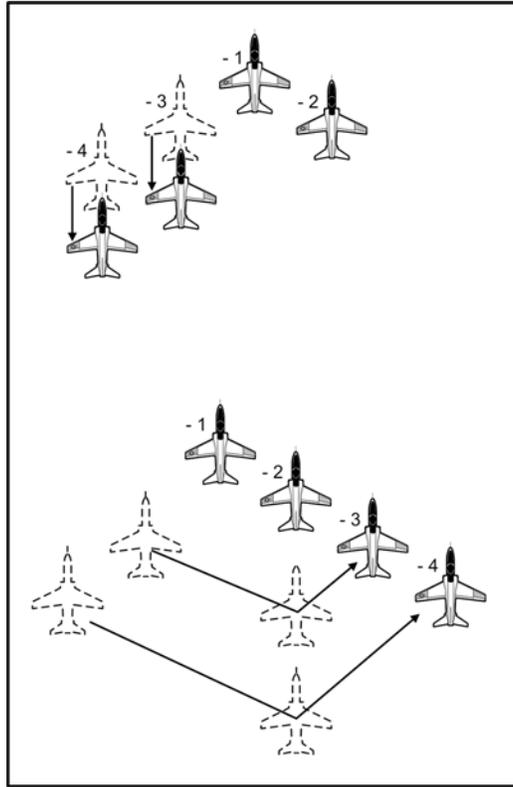


Figure 6-16 Parade (Fingertip) Formation To Echelon With Section Crossunder

- ii. Section crossunder
 - (a). Lead
 - (1). Signal Dash-2 to advise of section crossunder
 - (2). Signal Dash-3 to execute section crossunder
 - (b). Dash-3
 - (1). Signal Dash-4 for section crossunder
 - (2). Move aft to obtain adequate ft nose-to-tail separation on Dash-2
 - (3). Perform “V” crossunder on Dash-2, maintaining nose-to-tail separation
 - (c). Dash-4: as Dash-3 executes crossunder, execute “V” crossunder on Dash-3, keeping Dash-3 between himself and lead, and ending maneuver when Dash-3 ends his crossunder

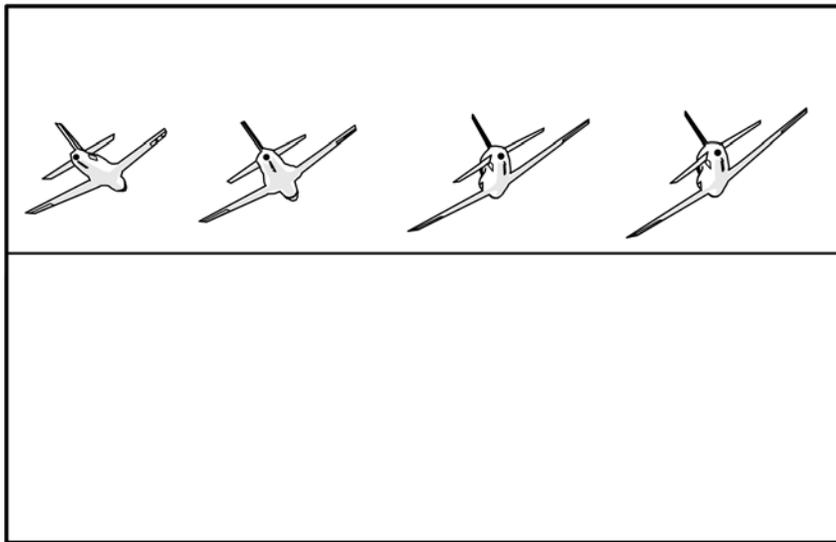


Figure 6-17 Echelon Parade Turn Away From Echelon

- b. Turns away from echelon
 - i. Lead
 - (a). Give turn-away signal
 - (b). Execute 30-degree AOB turn away from echelon
 - ii. Dash-2, Dash-3, Dash-4
 - (a). Keep lead on horizon during turn; rotate about your own longitudinal axis
 - (b). Make power adjustments as required to maintain position (larger at increasing distances away from lead due to greater radius of turn)
 - c. Turns into echelon
 - i. Not normally executed
 - ii. Any turns into echelon must be shallow (no more than 10 degrees AOB)
3. Common errors by Dash-2, Dash-3, or Dash-4
 - a. **Problem:** too much nose-to-tail for Dash-3 and Dash-4 due to failure to anticipate power requirements
Correction:

- i. Anticipate power requirements
 - ii. Average out movements of aircraft between you and lead
- b. **Problem:** erratic formation due to each aircraft flying formation on preceding aircraft instead of on lead

Correction: all aircraft must reference lead for stepdown and preceding aircraft for lateral separation

Division Breakup and Rendezvous Exercise

1. Description: maneuver similar to section breakup and rendezvous exercise

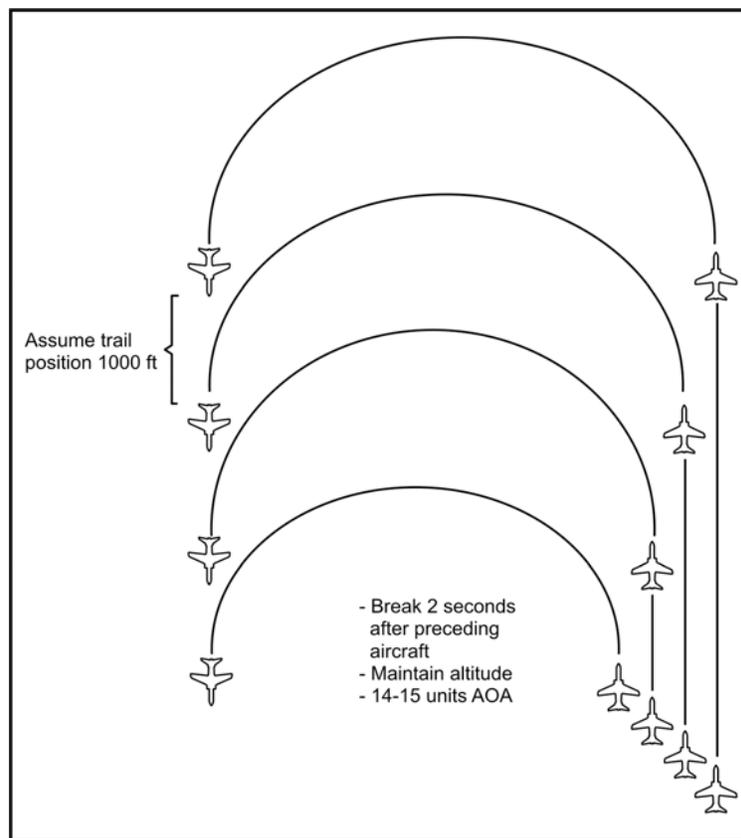


Figure 6-18 Division Breakup & Rendezvous Exercise: Breakup

2. Procedure: perform breakup and rendezvous exercise IAW section procedures except
 - a. Breakup
 - i. Lead
 - (a). Establish rendezvous airspeed while in balanced formation

- (b). Put flight into left or right echelon
- (c). Pass breakup signal
- ii. Dash-2, Dash-3: pass signal down line
- iii. Lead: perform breakup as in section formation
- iv. Dash-2, Dash-3, Dash-4
 - (a). Establish 1000-ft interval by breaking two seconds later than preceding aircraft and utilizing lead/lag
 - (b). Keep lead on horizon while maintaining airspeed
 - (c). Roll out of breakup turn into trail with 1000-ft interval

NOTE

Wingmen should not adjust airspeed to compensate for nose-to-tail error in trail.

- v. All aircraft: maintain rendezvous airspeed and altitude
- vi. Lead: roll level
- vii. Dash-2, Dash-3, Dash-4: fly slightly stepped up on the aircraft ahead
 - Nose-to-tail distance of 1000 ft
- viii. Lead: after 15 seconds, begin rendezvous turn of 30 degrees AOB
- ix. Dash-2, Dash-3, Dash-4: turn to intercept bearing as soon as aircraft ahead is 10-20 degrees off centerline (out of the HUD glass)

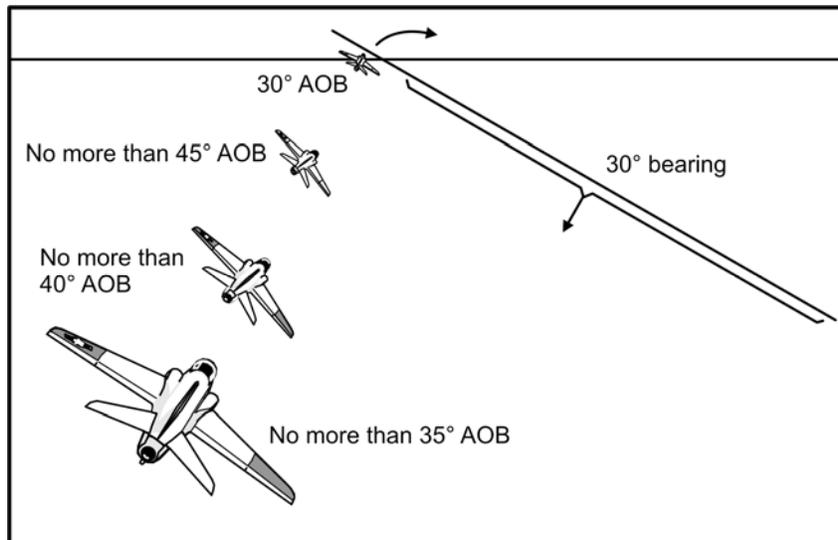


Figure 6-19 Division Breakup and Rendezvous Exercise: Rendezvous Turn

b. Rendezvous

- Perform rendezvous IAW section procedures except
 - i. Dash-2: no more than 45-degree AOB turn out of trail
 - ii. Dash-3: no more than 40-degree AOB turn out of trail
 - iii. Dash-4: no more than 35-degree AOB turn out of trail

NOTES

1. Anticipate intercepting bearing line by shallowing AOB.
 2. Stagnation on bearing line by Dash-3 and Dash-4 may be required to keep all preceding aircraft in sight.
- c. Join-up: conducted like join-up for section with special considerations for Dash-3 and Dash-4
- i. Begin join-up while on lead's bearing when approaching the projected leading edge of the preceding aircraft's stabilator
 - ii. Make larger power additions during crossunder to maintain 10 ft nose-to-tail

3. Common error by Dash-3 or Dash-4

- **Problem:** Dash-3 or Dash-4 do not fly lead's bearing line to join-up window resulting in a sucked join-up on aircraft ahead

Prevention: fly lead's bearing until reaching join-up window on aircraft ahead

NOTE

Additional common errors for division breakup and rendezvous exercise are included in the common error discussion of division rendezvous join-up after interval takeoff and of section breakup and rendezvous exercise.

WARNING

Failure to follow the procedures outlined in the FTI increase the likelihood of having a Mid-air collision during the division rendezvous.

Division Cruise Maneuvering

1. Description
 - a. Division formation with aircraft farther apart than in division parade
 - b. Pilots maneuver through allotted airspace to hold position in turns, returning to balanced formation in level flight
 - c. When returning to level flight, second section lead chooses side of lead on which to fly and division lead's wingman balances formation

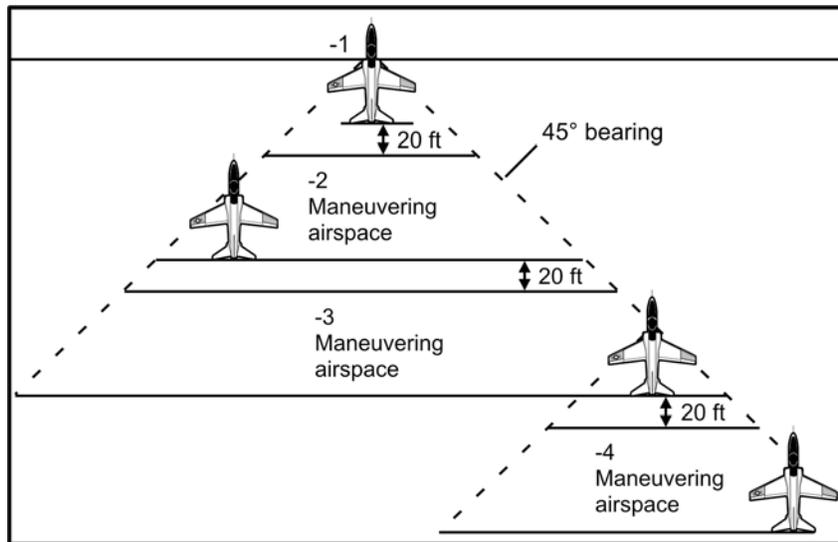


Figure 6-20 Division Cruise Maneuvering

2. Procedure

a. Dash-2

- i. Fly cruise on lead as in section, always balancing formation
- ii. Stay in allotted space to give Dash-3 freedom of action to maintain division formation integrity

b. Dash-3 (second section lead)

- i. Fly on 45-degree bearing from division lead
- ii. Maintain 20-ft nose-to-tail and 15-ft stepdown off Dash-2
- iii. Dash-4: fly cruise on Dash-3 as in section

Shuffle Division

1. Description

- a. Reorders division to provide practice in all positions
- b. Dash-2 takes Dash-4 position by performing “V” crossunder on entire division

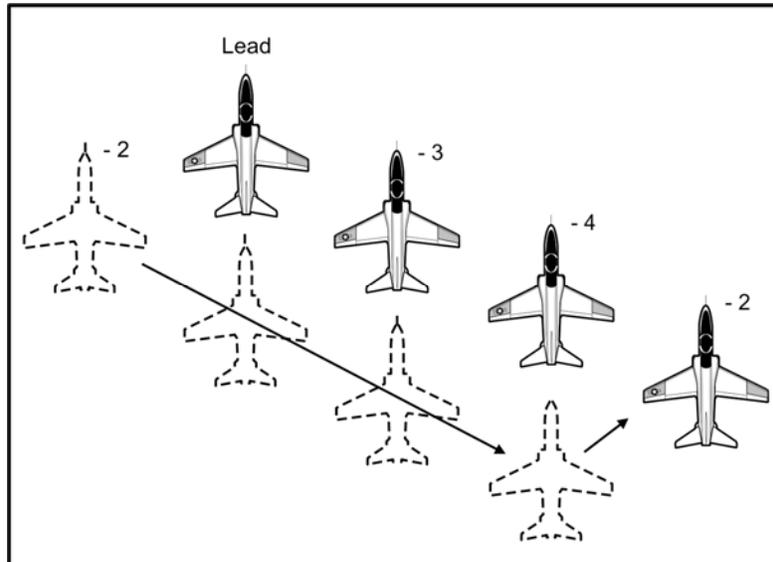


Figure 6-21 Shuffle Division

2. Procedure

a. Lead

- i. Clear area
- ii. Transmit over radio, "Dash-2, you are now 4."

b. Dash-2

- i. Respond "Roger"
- ii. Keep eyes on lead, then on new Dash-2 and Dash-3, while moving aft
- iii. Move down laterally and perform first half of "V" crossunder on lead
- iv. Continue moving in straight diagonal line across the formation (line should pass through column position of each aircraft)
- v. Execute second half of "V" crossunder on new Dash-3 and join up in parade position as Dash-4

c. Lead

- After shuffle is complete, balance formation

Tail-Chase Exercise

1. Description: exercise used to demonstrate effects of lead and lag pursuit on nose-to-tail distance
2. Procedure
 - a. Lead
 - i. Give arming signal with the formation in echelon parade
 - ii. Set power at approximately 92% or as briefed
 - iii. Kiss off the echelon
 - iv. Maneuver away from flight and begin maneuvering as in cruise formation
 - b. Wingmen
 - i. Break at approximately 2-second intervals to establish 1000-ft nose-to-tail off preceding aircraft
 - ii. Maintain distance while flying through same “gates” as your interval prescribes
 - iii. If nose-to-tail becomes greater than 1000 feet, maneuver to inside of interval’s turns (lead pursuit) to reduce nose-to-tail
 - iv. If nose-to-tail decreases, maneuver to outside of interval’s turns (lag pursuit) until 1000 feet is obtained
 - v. Continue to follow interval’s flight path (pure pursuit)
 - c. Lead: call over radio for rendezvous to complete exercise
 - d. Wingmen: execute called rendezvous

Division Field Entry Procedures

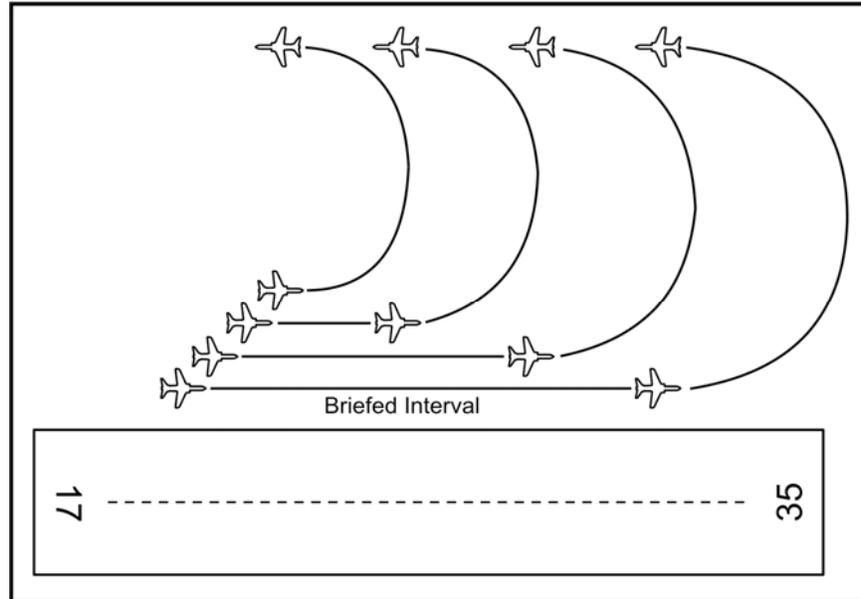


Figure 6-22 Division Overhead Entry

1. Division overhead entry
 - a. Description: four-plane formation back into field for breakup and landing
 - b. Procedure
 - i. Lead
 - Have division in parade echelon prior to the break
 - (a). Left echelon if breaking right
 - (b). Right echelon if breaking left
 - ii. Dash-2, Dash-3, Dash-4
 - (a). Break at briefed intervals, normally 4 seconds, with Dash-2 setting interval
 - (b). Keep lead and preceding aircraft on horizon
 - (c). Land on alternating sides of runway

2. Formation recovery to division VFR straight-in
 - a. Description: VFR straight-in approach required in circumstances such as weather, fuel state, hung ordnance, emergencies

NOTE

If an emergency requires an arrested landing, consider landing all good aircraft first--situation and fuel dictating.

- b. Procedure
 - i. Lead
 - (a). Request vectors for straight-in approach from approach control
 - (b). When appropriate, initiate flight breakup at approximately 8 miles to establish wingmen in trail, with 1000-ft separation when lead is 3 miles from airport
 - (1). Radio to detach each wingman at 20-second intervals, beginning with last wingman in flight
 - (2). Detach wingmen in level flight
 - (3). Dirty up 20 seconds after detaching Dash-2
 - (4). Intercept glideslope and land on downwind half of runway
 - ii. Wingmen
 - (a). When detached, smoothly reduce power to idle, dirty up at 200 KIAS, and slow to approach speed
 - (b). Follow lead
 - (c). Intercept glideslope for a straight-in landing

NOTE

To ensure safe ground clearance, no division member will descend below 300 feet AGL without acquiring the ball.

- (d). Contact tower for landing clearance
- (e). Land on alternating sides of runway

606. SUMMARY

During this lesson we discussed the following aspects of division flight:

1. Marshal procedure
2. Taxi and hold short procedures
3. Interval takeoff positioning and procedure
4. Division takeoff procedure and abort considerations
5. Division rendezvous/join-up after takeoff procedure
6. Balancing formation from echelon parade procedure
7. Turns away and into section when in balanced parade (fingertip) procedure
8. Moving balanced parade (fingertip) into echelon parade procedure
9. Echelon parade formation turns away procedure
10. Division breakup and rendezvous exercise procedures
11. Division underrun procedure
12. Division cruise maneuvering procedure
13. Shuffle division procedure
14. Tail-chase exercise
15. Division overhead entry procedure
16. Formation recovery to division VFR straight-in procedure

607. CONCLUSION

The adage of “The whole is more than the sum of its parts” holds true in division flying. However, before the extra potential provided by division flying can be realized, those four separate aircraft must be unified as a division. Each pilot must learn not only his individual pilot responsibilities but also his added responsibilities as a division member.

**APPENDIX A
GLOSSARY**

A100. INTRODUCTION – N/A

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