FLIGHT TRAINING INSTRUCTION

FORMATION T-45TS, TAILHOOK, and IUT

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Subj: FLIGHT TRAINING INSTRUCTION, FORMATION T-45TS, TAILHOOK, and IUT

1. CNATRA P-1213 (Rev. 04-08) PAT, "Flight Training Instruction, Formation 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 the T-45TS, TAILHOOK, and IUT Curricula. 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 1555/19 in accordance with CNATRAINST 1550.6E.

4. CNATRA P-1213 (01-07 DRAFT) PAT is hereby cancelled and superseded.

M. MCLAUGHLIN
By direction

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COMTRAWING ONE (200)
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FLIGHT TRAINING INSTRUCTION

FOR

FORMATION T-45TS, TAILHOOK, and IUT

P-1213

HOW TO USE THE FTI

This Flight Training Instruction (FTI) is your textbook for the Formation stage and is the source document for all procedures related to Formation. In addition, it includes suggested techniques for performing each maneuver and making corrections.

Use your FTI to prepare for and afterward to review lessons and flights. This information will help you effectively prepare for lessons. Know all the procedures in the assigned section(s), review the glossary, and be prepared to ask your instructor about anything that remains unclear. Then you can devote your attention to flying the T-45. After a flight, review the FTI materials to reinforce your understanding and to clarify any difficult maneuvers or procedures.

Note that this FTI also contains information on emergencies related to this stage. This section of the FTI amplifies but does not supplant the emergency procedures information contained in the T-45 NATOPS manual.

Reading requirements for flight procedures lessons (lectures) are listed in Appendix A, "Lesson Preparation," along with the course learning objectives. The end of stage exams will be based on these objectives. Complete the required reading prior to each lesson (lecture).

INTRODUCTION

From the early days of Naval Aviation, formation flying has been instrumental in the tactical movement of aircraft. Whether you are a wingman on a cross-country flight or lead on a multi-plane combat strike against a terrorist stronghold, flying good formation is critical to the success of the mission. Because flying formation is a team effort, the success of the flight depends upon individual efforts coordinated with other flight members.

The fundamentals of section and division formation that you will learn will apply throughout your Naval career. These building blocks are the base for many future operational skills. Your professional reputation will reflect how well you fly formation.

This flight training instruction (FTI) provides information and procedures on:

1. Maneuvering as a member of a section or division during the day

2. Maneuvering as a member of a section at night

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1-1 – 1-37	0		
1-38	1		
1-39 – 1-43	0		
1-44 (blank)	0		
2-1 – 2-17	0		
2-18 (blank)	0		
3-1 – 3-10	0		
4-1	0		
4-2	1		
4-3 – 4-4	0		
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B-6 (blank)	0		
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INTERIM CHANGE SUMMARY

The following Changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE
1	Changes made per Transmittal Letter (01-28-09)

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

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

TABLE OF CONTENTS

HOW TO USE THE FTI ..... **iv**
INTRODUCTION ..... **v**
LIST OF EFFECTIVE PAGES ..... **vi**
INTERIM CHANGE SUMMARY ..... **vii**
TABLE OF CONTENTS ..... **viii**
TABLE OF FIGURES ..... **x**
TABLE OF TABLES ..... **xii**

CHAPTER ONE – SECTION DAYTIME FLIGHT PROCEDURES **1-1**
100. INTRODUCTION 1-1
101. GROUND PROCEDURES 1-14
102. FLIGHT PROCEDURES 1-15
103. APPROACHES 1-40
104. FLIGHT SEQUENCE – SECTION 1-42

CHAPTER TWO – DIVISION DAYTIME FLIGHT PROCEDURES **2-1**
200. INTRODUCTION 2-1
201. GROUND PROCEDURES 2-1
202. FLIGHT PROCEDURES 2-1
203. APPROACHES 2-13
204. FLIGHT SEQUENCE 2-16

CHAPTER THREE – NIGHT FORMATION FLIGHT PROCEDURES **3-1**
300. INTRODUCTION 3-1
301. GROUND PROCEDURES 3-1
302. FLIGHT PROCEDURES 3-2
303. APPROACHES 3-7
304. NIGHT FORMATION SIGNALS 3-9

CHAPTER FOUR – SAFETY/EMERGENCY PROCEDURES **4-1**
400. INTRODUCTION 4-1
401. ABORTS 4-1
402. INADVERTENT IFR 4-1
403. LOST SIGHT 4-1
404. MIDAIR COLLISION 4-1
405. AIRCRAFT MALFUNCTIONS IN FLIGHT 4-2
406. DOWN AIRCRAFT PROCEDURES 4-2

CHAPTER FIVE– SELF-TEST **5-1**
500. SECTION DAYTIME FLIGHT PROCEDURES: BACKGROUND 5-1
501. SECTION DAYTIME FLIGHT PROCEDURES: GROUND PROCEDURES 5-1
502. SECTION DAYTIME FLIGHT PROCEDURES: FLIGHT PROCEDURES 5-1
503. SECTION DAYTIME FLIGHT PROCEDURES: APPROACHES 5-3
504. DIVISION DAYTIME FLIGHT PROCEDURES: FLIGHT PROCEDURES 5-4

505. DIVISION DAYTIME FLIGHT PROCEDURES: APPROACHES 5-5
506. NIGHT FORMATION FLIGHT PROCEDURES: BACKGROUND 5-5
507. NIGHT FORMATION FLIGHT PROCEDURES: GROUND PROCEDURES 5-5
508. NIGHT FORMATION FLIGHT PROCEDURES: FLIGHT PROCEDURES 5-6
509. NIGHT FORMATION FLIGHT PROCEDURES: APPROACHES 5-7
510. SAFETY/EMERGECY PROCEDURES: MIDAIR COLLISION 5-7

APPENDIX A – GLOSSARY A-1
A100. GLOSSARY A-1

APPENDIX B – (FORMFP) B-1
B100. STUDY RESOURCES FOR FORMFP B-1
B200. STUDY RESOURCES FOR NFORMFP B-3

APPENDIX C – INDEX C-1

TABLE OF FIGURES

Figure 1-1 General Signals 1-4
Figure 1-2 Takeoff Signals 1-5
Figure 1-3 General Airborne Signals (1 of 7) 1-6
Figure 1-4 General Airborne Signals (2 of 7) 1-7
Figure 1-5 General Airborne Signals (3 of 7) 1-8
Figure 1-6 General Airborne Signals (4 of 7) 1-9
Figure 1-7 General Airborne Signals (5 of 7) 1-10
Figure 1-8 General Airborne Signals (6 of 7) 1-11
Figure 1-9 General Airborne Signals (7 of 7) 1-12
Figure 1-10 Approach Signals (1 of 2) 1-13
Figure 1-11 Approach Signals (2 of 2) 1-14
Figure 1-12 Section Hold Short 1-15
Figure 1-13 Section Positioned on Runway 1-16
Figure 1-14 Interval Takeoff 1-17
Figure 1-15 Plum Line 1-20
Figure 1-16 Running Rendezvous 1-22
Figure 1-17 TACAN Rendezvous 1-23
Figure 1-18 Maintaining Parade Position 1-25
Figure 1-19 Parade Turns Into/Away 1-26
Figure 1-20 Turn-Away Reference 1-27
Figure 1-21 Box Crossunder 1-28
Figure 1-22 "V" Crossunder 1-29
Figure 1-23 Breakup (Section) 1-30
Figure 1-24 Rendezvous (Section) 1-31
Figure 1-25 Rendezvous Bearing Line 1-32
Figure 1-26 Join-up (Section) 1-33
Figure 1-27 Lead Change 1-34
Figure 1-28 Cruise Position 1-36
Figure 1-29 Column Position 1-38

Figure 2-1 Division Runway Lineup/Interval Takeoff 2-2
Figure 2-2 CV Rendezvous 2-3
Figure 2-3 Division Running Rendezvous 2-4
Figure 2-4 Fingertip Formation 2-5
Figure 2-5 Crossunder to Establish Fingertip 2-6
Figure 2-6 Echelon Parade 2-7
Figure 2-7 Crossunder to Establish Echelon Parade 2-8
Figure 2-8 Division Breakup 2-9
Figure 2-9 Division Rendezvous 2-10
Figure 2-10 Division Cruise 2-12
Figure 2-11 Shuffle Division 2-13
Figure 2-12 Division Overhead Entry 2-14

Figure 3-1 Night Light Triangle Reference 3-3
Figure 3-2 Parade Position-IFR Turn Away 3-4
Figure 3-3 Parade Position-VFR/IFR Turn Into Wingman 3-4
Figure 3-4 Running Rendezvous 3-6
Figure 3-5 Gear/Flaps Up/Down Night Visual Signal 3-8
Figure 3-6 Night Visual Signals-Yes/No 3-9
Figure 3-7 Night Visual Signals-HEFOE 3-9

TABLE OF TABLES

Table 1-1 Visual Checklist 1-16
Table 3-1 Night Landing Configuration 3-1

CHAPTER ONE
SECTION DAYTIME FLIGHT PROCEDURES

100. INTRODUCTION

1. Section Roles and Responsibilities

The section, consisting of two aircraft, is the basic flying unit used in formation. The section has a lead and wingman, each with specific roles and responsibilities in the formation.

The lead's responsibilities cover two areas: flight lead and formation lead. The flight lead is an instructor ultimately responsible to conduct a safe and orderly flight. The flight lead may fly either position (lead or wingman) in formation. The formation lead flies the lead position and is responsible for immediate conduct of the flight. In the Training Command, these responsibilities include staying clear of traffic, weather and remaining within the briefed operations area, executing checklists, utilizing proper visual and radio communications, and performing smooth/consistent changes in power and heading. In addition, the formation lead must be considerate of the wingman both by providing a smooth and consistent platform for the wingman and by planning the flight such that signals and maneuver execution are not rushed.

The wingman's primary responsibility is to maintain position off the lead. Wingmen must know the procedures to carry out the flight's mission, maintain situational awareness, and be prepared to assume the lead at any time. By maintaining position as a wingman, you enhance the formation's effectiveness and ability to accomplish the mission.

2. Keys to Successful Formation Flying

a. Relax, using a light touch on the aircraft controls – easy to say, but hard to do. By relaxing, you will be amazed at the ease of flying formation.

b. Keep the aircraft trimmed.

c. Scan the lead's entire aircraft, and don't fixate on any one gouge or aspect of the lead aircraft.

d. For every correction, apply a corresponding re-correction. For example, if you are sucked and add power, you will reduce power approaching the position, and then slightly increase power to stabilize.

e. Have fun. If you're not, you're not doing it right.

Safe formation flight requires control of direction and rate of relative motion between aircraft. Because the lead is considered to be fixed, he is the primary reference for attitude control. Any movement between aircraft involves the wingman as he moves around the three axes of the lead's aircraft. You can control relative motion through anyone axis or a combination of all three axes.

Power controls nose-to-tail distance, pitch controls stepdown, and AOB controls wingtip separation. Good formation flight results from anticipating and controlling relative motion, with small, timely corrections about all three axes. By keeping the aircraft trimmed and in coordinated flight, you reduce fatigue and enhance your ability to fly a smooth wing position.

Another key to good formation flight is to clearly understand radius of turn and how it relates to controlling position during formation. Because the lead aircraft acts as the source of all position information, you need to anticipate position corrections in relation to the lead's radius of turn. As a wingman in parade position, if the lead turns into your position, you will require less power to complete the turn because you fly a smaller radius of turn. When the lead turns away from your position, you will require more power because you will fly a larger turn radius. Radius of turn is especially important when executing parade turns, during the breakup and rendezvous exercise, and especially during the tail-chase exercise.

3. **Communications**

Your visual or radio communications within the section must be clear and timely to avoid confusion. The wingman should have time to acknowledge the signal before the lead executes the maneuver.

Immediately following aircraft start-up, the student should select the flight tactical frequency on radio #2 and follow the lead through clearance delivery on radio #1. ATIS can be monitored on radio #1 either before or after the flight clearance has been obtained but no later than check-in at marshal prior to taxi.

Radio. Your communications must be brief and concise. Use the radio under IMC conditions and/or at night when visual signals would be very difficult to interpret. The lead conducts all communications with controlling agencies. The lead initiates all formation flight frequency changes, and the wingman acknowledges (except when checking on or off of ground and tower frequency, or as briefed). When on the new frequency, the lead initiates flight check-in, and the wingman acknowledges.

Example:

Lead: "Hawk button 8."

Wingman: "Two."

Both pilots then switch to the new frequency

Lead: "Hawk."

Wingman: "Two."

1-2 SECTION DAYTIME FLIGHT PROCEDURES

NOTE

The above example shows both a positive check-out and check-in. Since the T-45 has two radios and radio #2 is normally a dedicated flight tactical frequency, it is not a requirement to perform positive check-outs on the controlling frequency. For the sake of comm. brevity in high volume traffic areas, the TAC frequency can be used to "get-well" if the wingman misses a frequency change.

The lead then contacts the controlling agency. When transmitting on ground or tower frequency, the wingman acknowledges with a thumbs-up, instead of over the radio, to avoid congesting these frequencies. In case the wingman must assume the lead position, he must know with whom the leader is communicating.

Visual Signals. Because it is difficult to see a signal given with green flight gloves in front of a green mask, execute your visual signals high in the canopy, away from the face, in clear view of the wingman. Some signals may have to be exaggerated for clearer interpretation. Reference the next several pages (Figures 1-1 through 1-11) to review these signals.

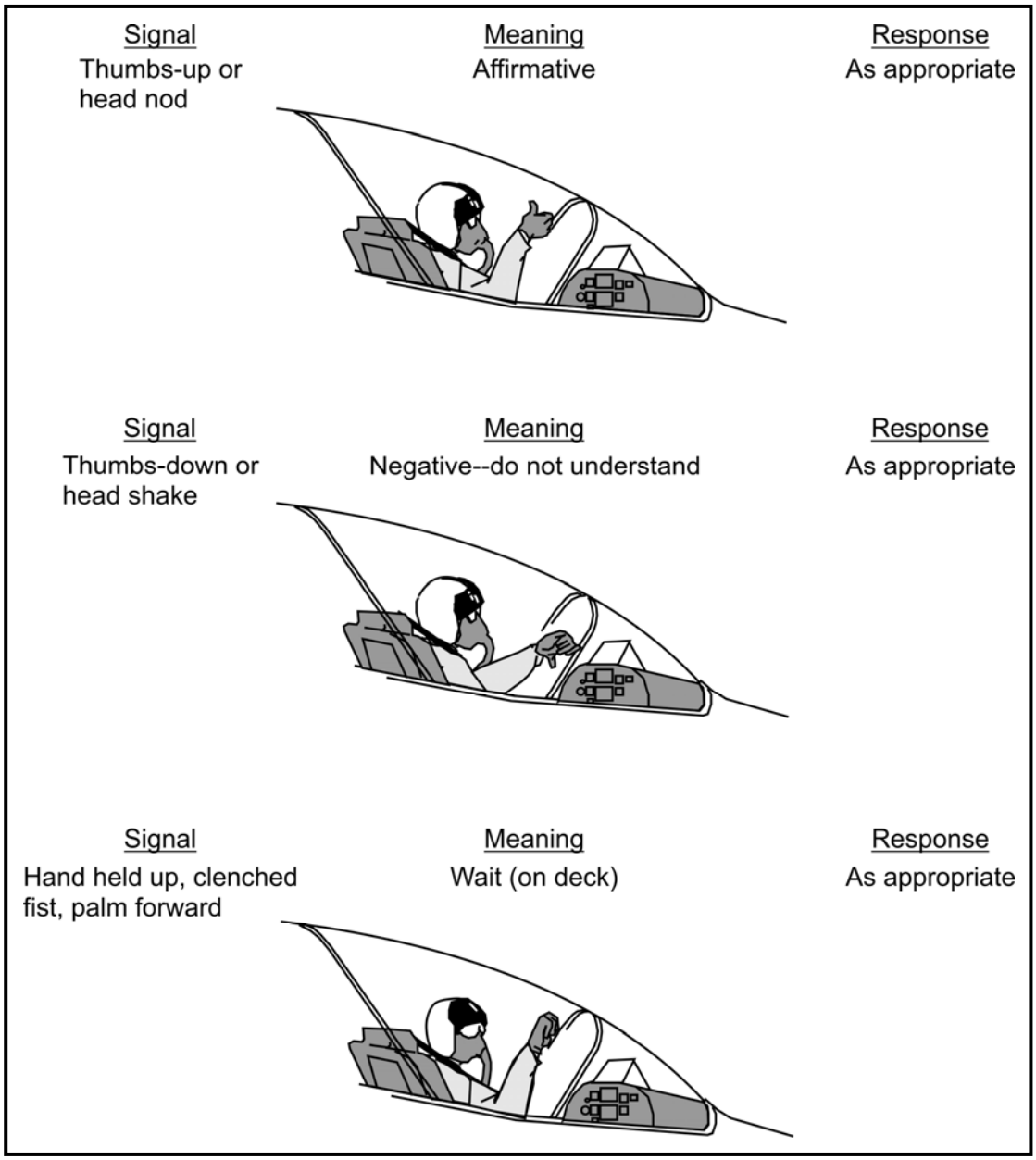


Figure 1-1 General Signals

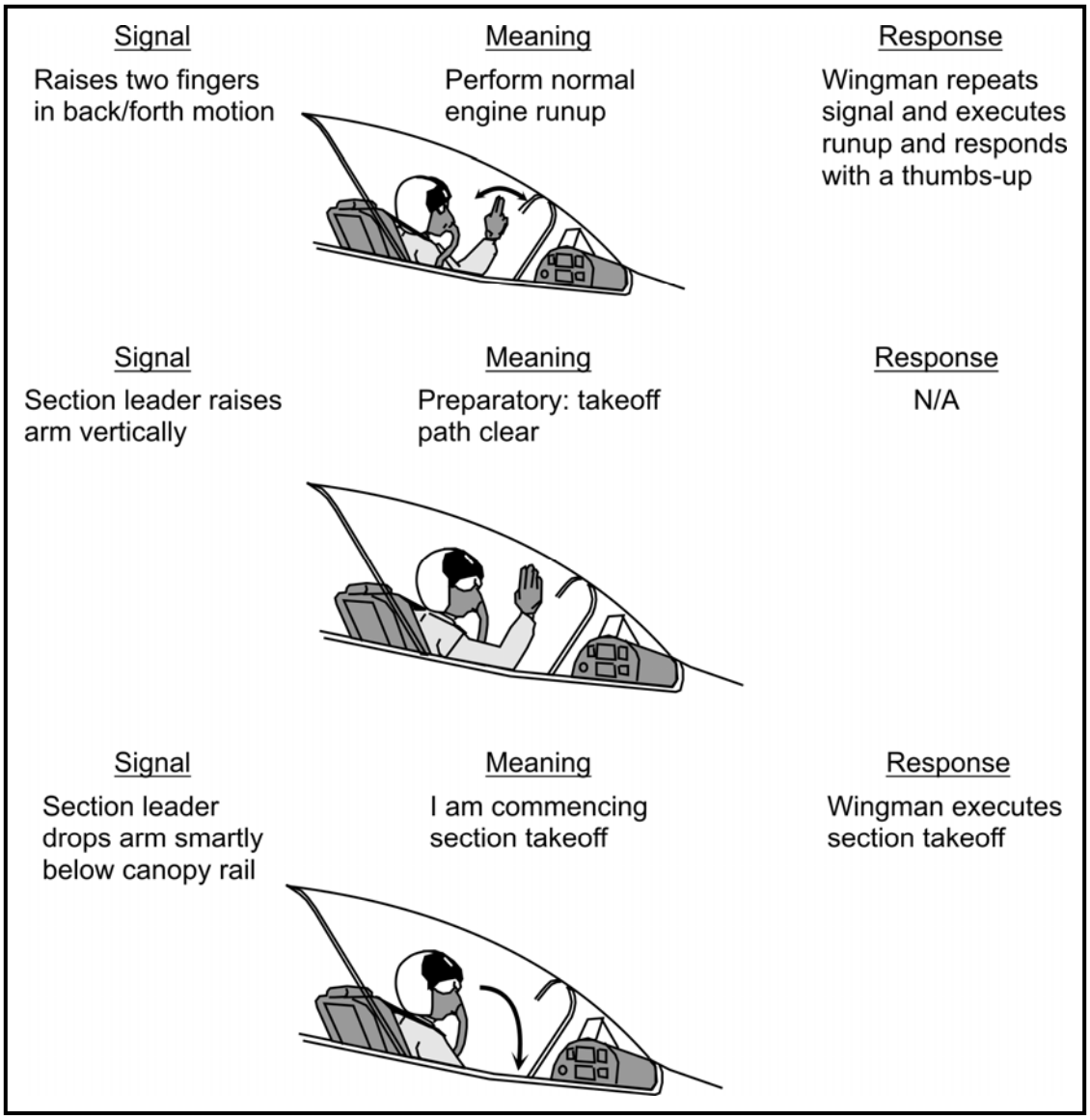


Figure 1-2 Takeoff Signals

Signal	Meaning	Response
Lead holds up right/left forearm vertically with clenched fist	Wingman crossunder to right/left	Execute

Signal	Meaning	Response
Leader holds up right/left forearm vertically with clenched fist and double pump	Section crossunder to right/left echelon	Dash-3 relays to Dash-4, then execute

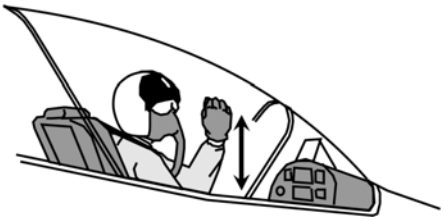


Figure 1-3 General Airborne Signals (1 of 7)

Signal	Meaning	Response
Two-fingers pointed toward eyes followed by "cut" signal for "off"	Turn lights on/off	Perform action

Signal	Meaning	Response
Hand moved horizontally above glare shield, palm down	Leveling off	Prepare to execute

Signal	Meaning	Response
Head moved forward	Add power	Execute

Figure 1-4 General Airborne Signals (2 of 7)

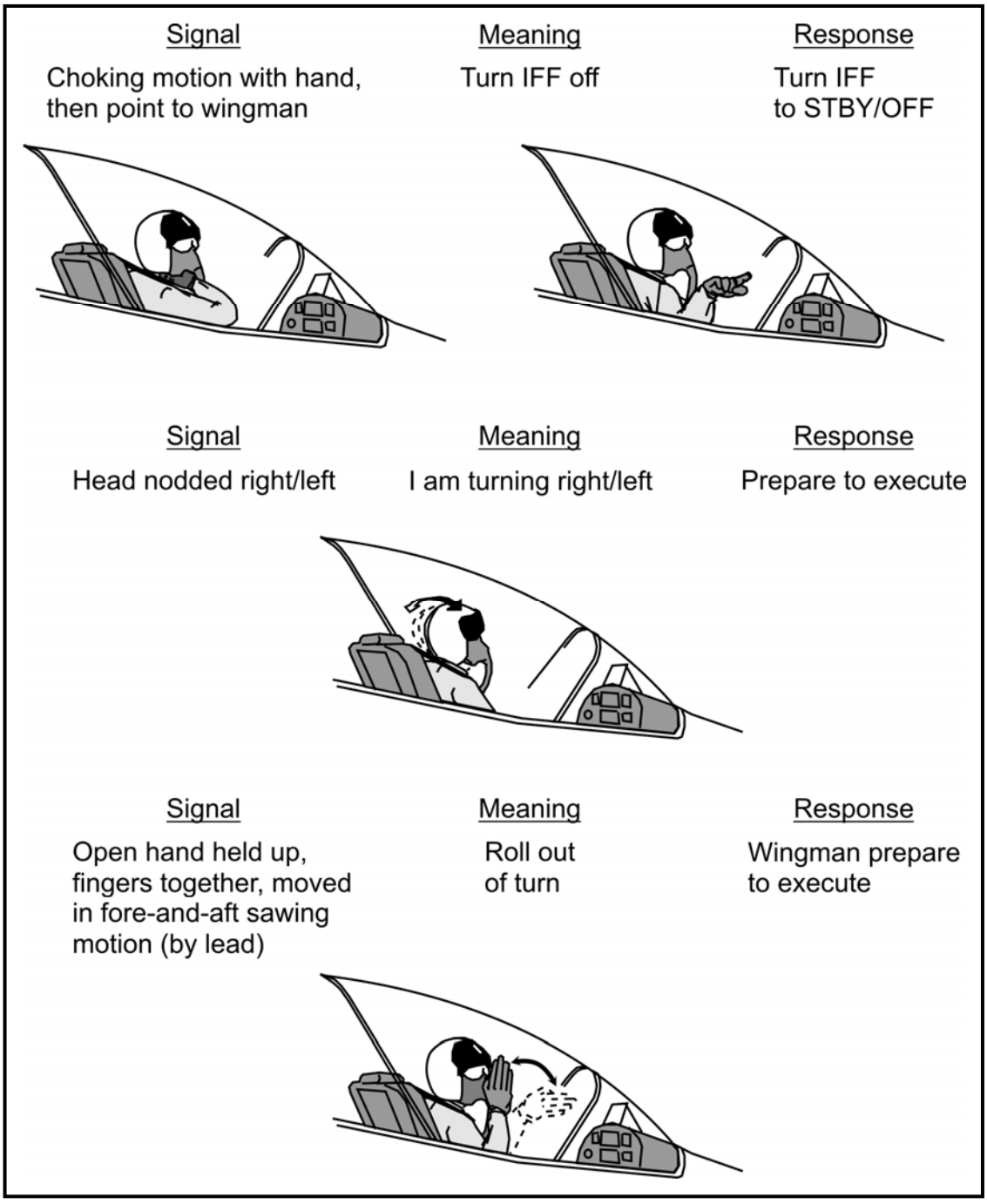


Figure 1-5 General Airborne Signals (3 of 7)

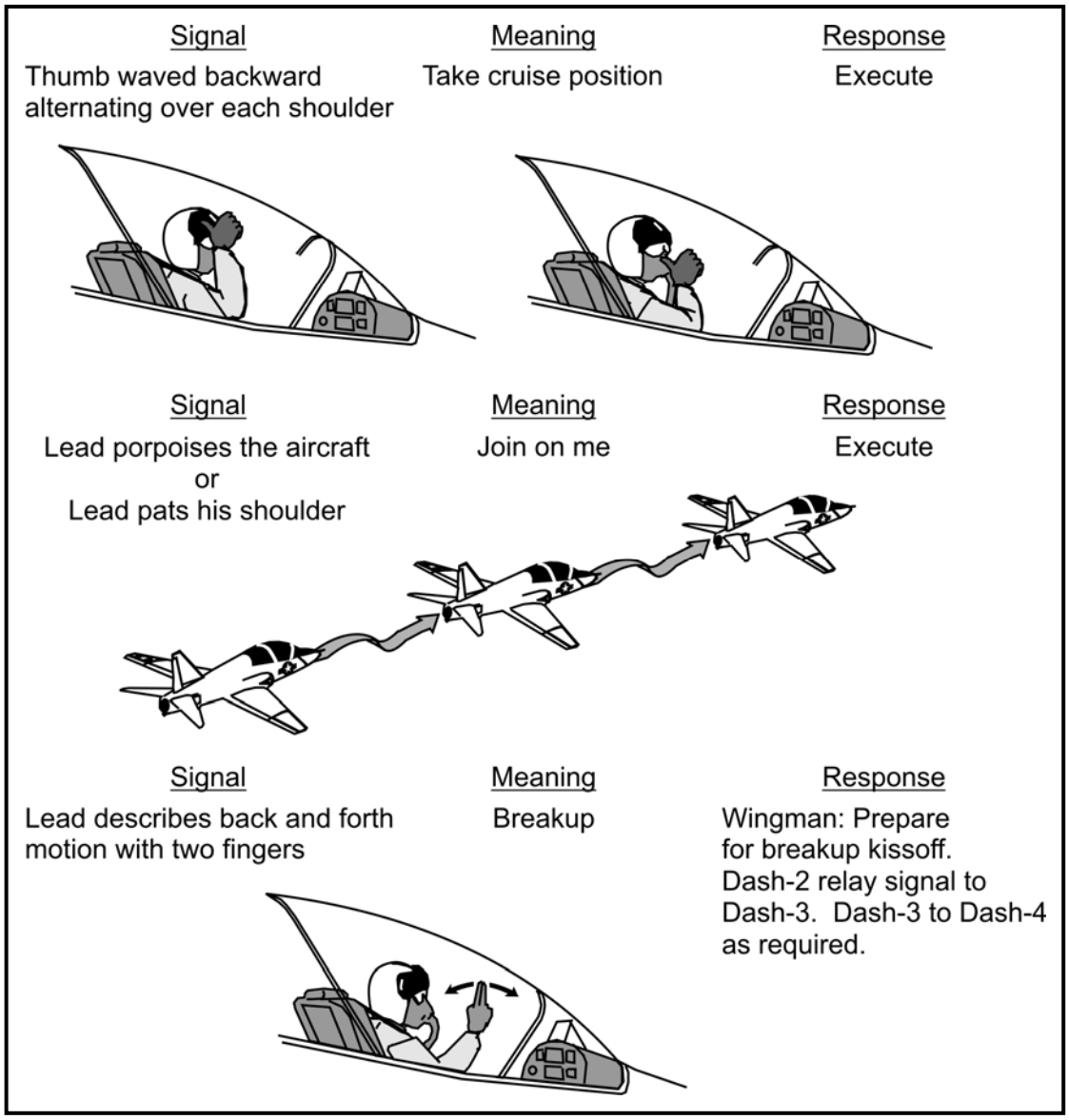


Figure 1-6 General Airborne Signals (4 of 7)

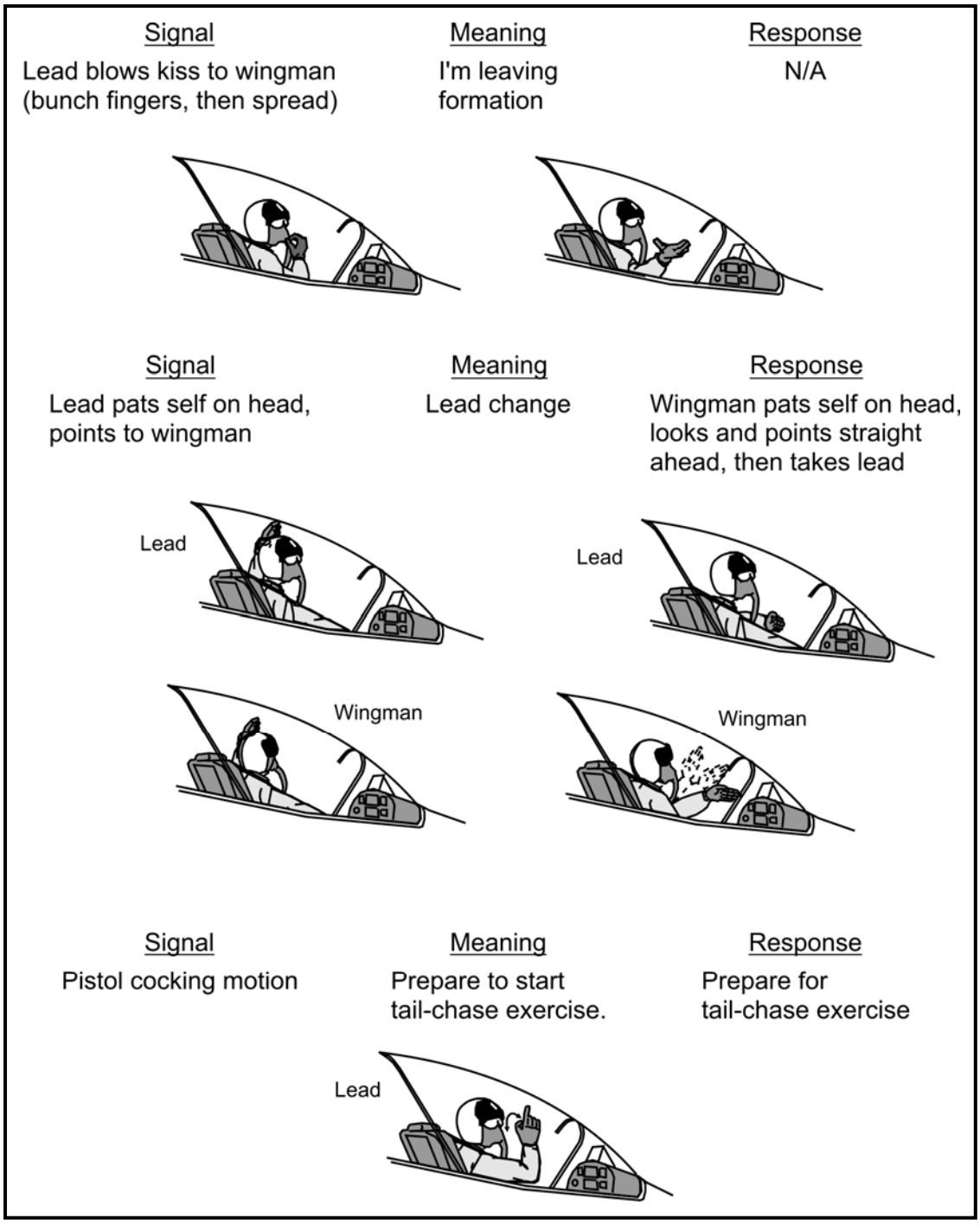
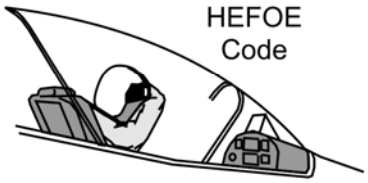


Figure 1-7 General Airborne Signals (5 of 7)

Signal	Meaning	Response
Raised fist with thumb extended in drinking position	How much fuel do you have?	Indicate remaining fuel in hundreds of lbs by finger numbering

Signal	Meaning	Response
Weeping signal and then finger(s) held vertically to signify following meanings	I'm in trouble	Nod or thumbs-up. Pass lead to disabled aircraft or assume lead, as required



HEFOE Code

Hydraulic system	1 finger	
Electrical system	2 fingers	
Fuel system	3 fingers	
Oxygen system	4 fingers	
Engine	5 fingers	

Figure 1-8 General Airborne Signals (6 of 7)

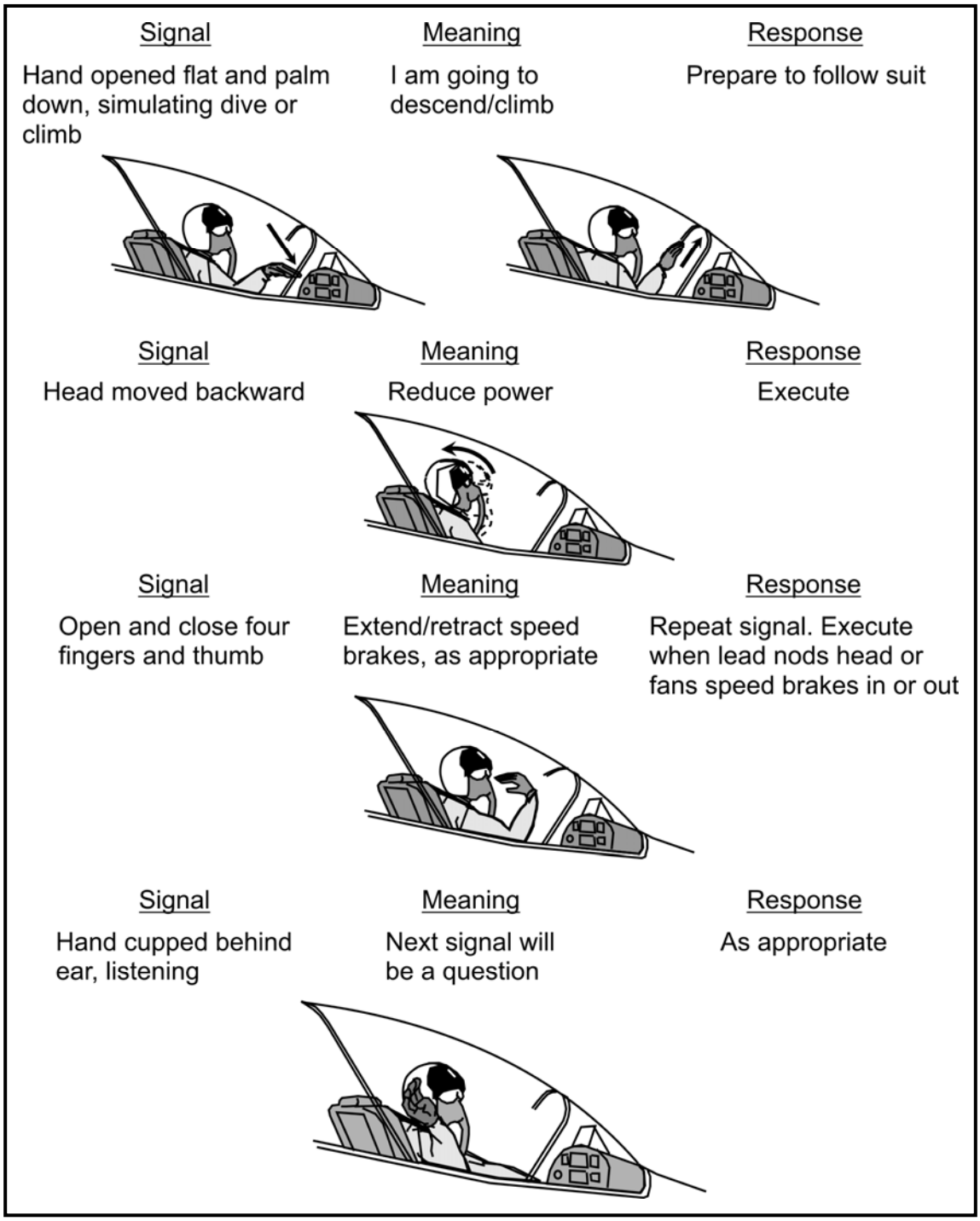


Figure 1-9 General Airborne Signals (7 of 7)

Signal	Meaning	Response
Rotary movement of clenched fist as if cranking wheels, followed by nod	Raise/lower gear and flaps/slats	Execute at nod

Signal	Meaning	Response
Lead or wingman lowers hook	Lead: Prepare to descend for trap. Wingman: I need to land/trap	Execute. If hook appears, lead will give thumbs-up

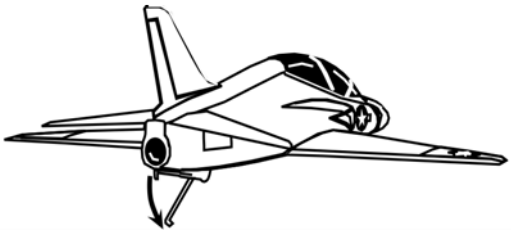


Figure 1-10 Approach Signals (1 of 2)

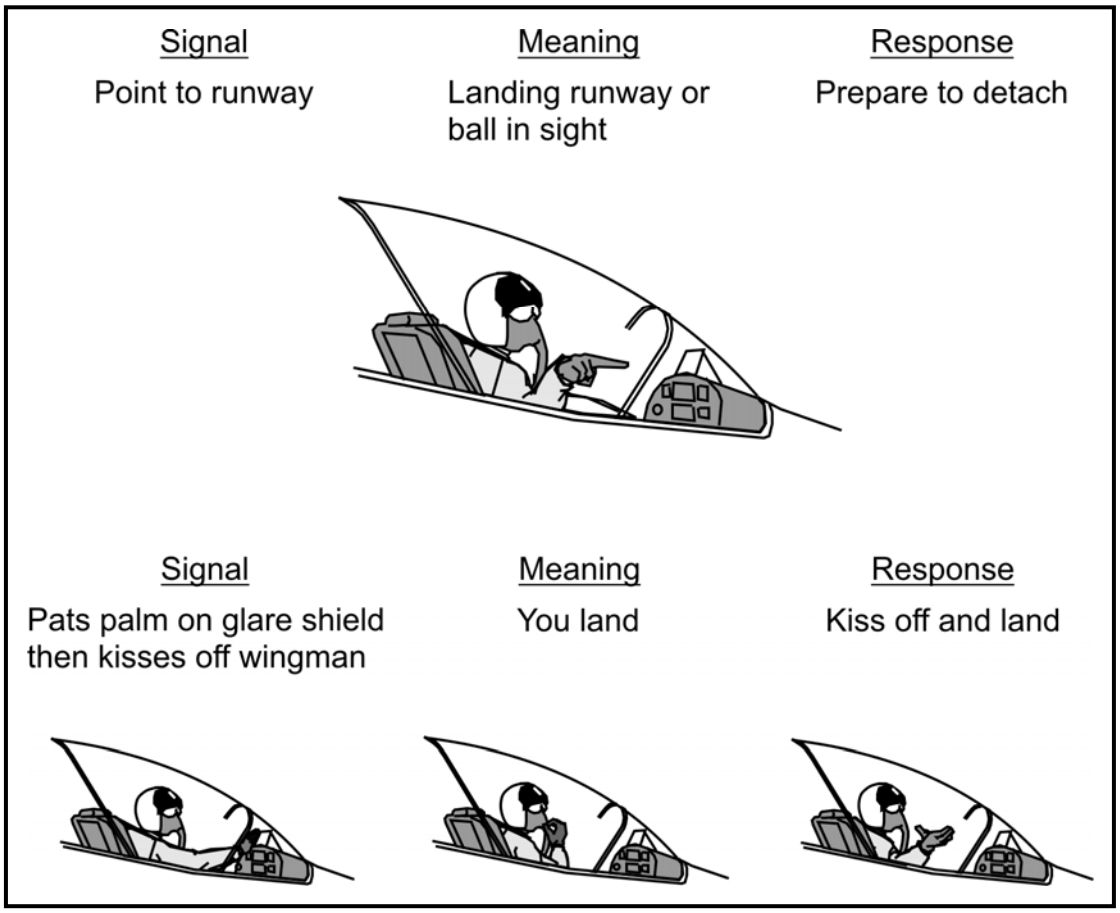


Figure 1-11 Approach Signals (2 of 2)

101. GROUND PROCEDURES

Marshaling and Taxi. The flight should perform preflight and man-up such that both aircraft start engines and arrive in marshal together with the same fuel quantity. After start, complete the checklists (identical to the Familiarization Stage). The formation lead obtains ATC clearance for the flight. In the marshal area, pilots switch to marshaling frequency as briefed. When all flight members are in the marshaling area, the formation lead passes ATIS, ATC clearance, and any other last minute instructions. The wingman dials in the ATC IFF code and leaves IFF in standby throughout the flight, unless otherwise directed.

Lead should call "out of chocks" on base frequency for the entire flight, as required.

After the lead switches the flight to ground control, he requests taxi for the flight. After receiving clearance from ground control, you both taxi out of the marshaling area. Ensure proper wingtip clearance and go to idle power prior to turning, to reduce FOD (tailpipe courtesy). The lead takes the downwind side of the taxiway. The wingman follows on the opposite side maintaining 150 ft nose-to-tail separation, allowing for FOD or possible brake failure.

If the taxiway is in poor condition or there is a high potential for FOD, the formation should taxi on the centerline with 300 ft of nose-to-tail separation. Section taxi is authorized if briefed.

As the lead approaches the hold short area, the flight switches to tower frequency. As the flight reaches the hold short area each aircraft lines up abreast, as pictured in Figure 1-12, angled toward the runway, IAW course rules. This decreases congestion and allows other aircraft to take the runway while the section completes their takeoff checklist. The wingman passes thumbs-up to the lead, indicating he is on tower frequency and has completed the takeoff checklist.

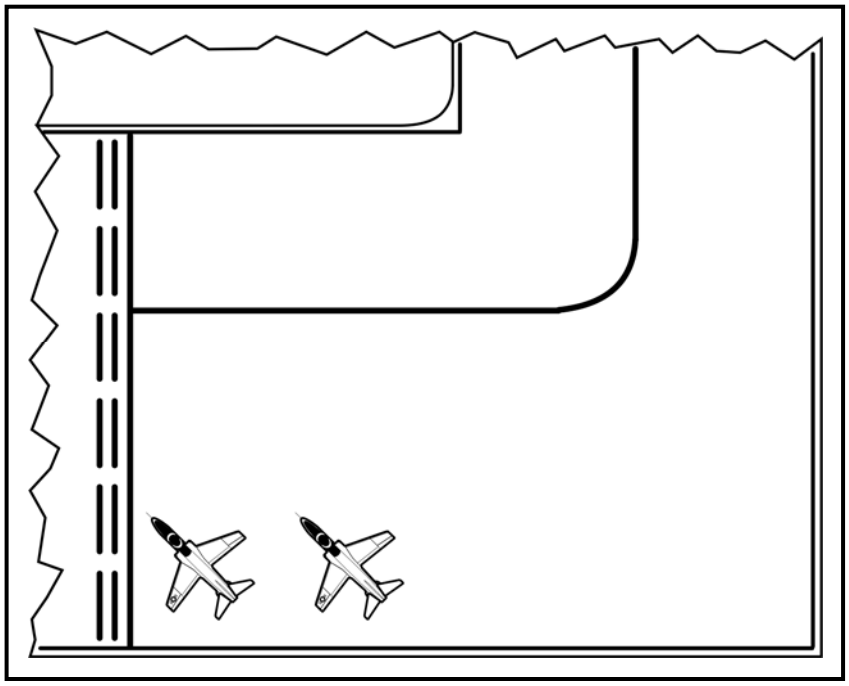


Figure 1-12 Section Hold Short

102. FLIGHT PROCEDURES

1. Takeoff/Departure

The lead requests takeoff for the section. When cleared by the tower, the lead taxis onto the runway taking the left or downwind side for section or interval takeoff, allowing sufficient distance for the wingman to line up in the middle of the opposite side of the runway and on the bearing line, as in Figure 1-13.

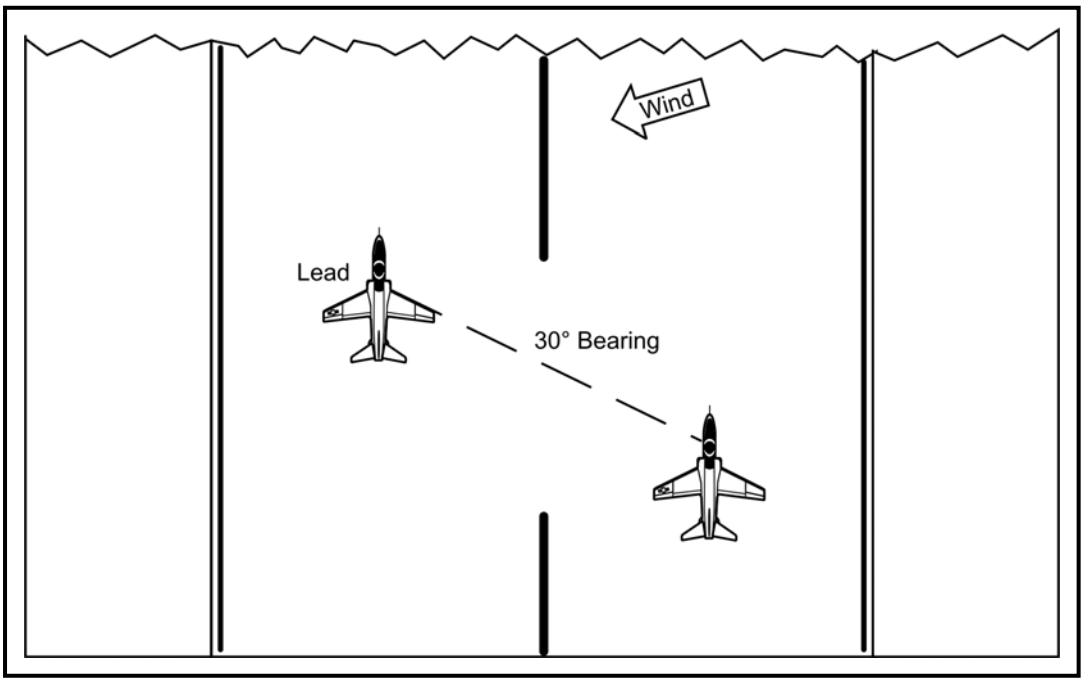


Figure 1-13 Section Positioned on Runway

When cleared for takeoff, the lead passes the runup signal and the wingman acknowledges. Both perform full power engine checks. After the runup check, each pilot visually inspects the other aircraft, using the following checklist, Table 1-1.

When both aircraft check out, the wingman passes the thumbs-up signal to the lead.

FROM GROUND UP	
Fluid Pooling Beneath Aircraft?	No
Tires Properly Inflated?	Yes
Nosewheel Straight?	Yes
Launch Bar Up?	Yes
Safety Pins Out?	Yes
Flaps/Slats Set Properly?	Yes
Doors and Panels Secure?	Yes
Stabilator?	Yes
Canopy Down?	Yes

Table 1-1 Visual Checklist

Interval Takeoff. The interval takeoff allows aircraft separation during the roll. The lead takes off IAW Familiarization (Fam) stage procedures and local course rules. The wingman rolls no less than 7 seconds (or as briefed) after lead IAW Fam stage procedures (Figure 1-14). Once airborne with gear and flaps/slats retracted, the lead reduces power to 92-94 percent and intercepts the briefed rendezvous airspeed, allowing the wingman excess power to establish proper closure.

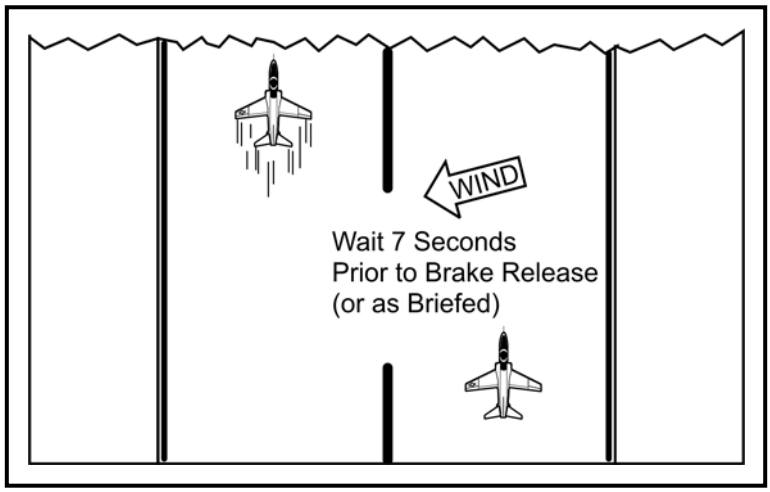


Figure 1-14 Interval Takeoff

Aborting. Good judgment should prevail in any abort situation. When an abort is necessary, simultaneously initiate abort procedures IAW NATOPS and transmit intentions using tactical call sign – for example, "Hawk two aborting." If you abort as a wingman, follow normal procedures and drift toward centerline. If you abort as the lead, remain on your side of the runway until the wingman clears you to centerline or passes you. If the lead aborts, the wingman should continue to takeoff if the airspeed is greater than 50 KIAS or as briefed. The wingman clears the lead to centerline if he can stop prior to the arresting gear. The minimum 7-second interval (or as briefed) allows a safe abort behind the lead, prior to the long field gear. The aborting aircraft brakes as necessary and, if "clear," attempts to take the arresting gear perpendicular to the cable and on centerline. As discussed during FAM, taking the arresting gear at 90 degrees is more critical than being on centerline. To reduce the probability of a hook skip, lower the hook a minimum of 1500 ft prior to the arresting gear.

Section Takeoff. Two aircraft simultaneously taking off in formation present many practical advantages in tactical aviation. If a flight must be established on course quickly or if poor weather conditions prevail, a section takeoff eliminates the necessity for a rendezvous. If a hostile encounter is expected, a section takeoff can immediately establish mutual support.

Section takeoffs are not performed when:

1. The maximum crosswind component, temperature, takeoff roll, or difference in gross weight exceeds SOP/NATOPS criteria for respective dual or solo flights or

2. The aircraft have different external configurations, such as one aircraft with ordnance and one without. Section takeoff is allowed, however, if the different external configuration consists of one aircraft with unloaded pylons and the other without pylons.

Section takeoff procedures start with both aircraft on the runway and on bearing. After runup checks, the lead reduces power 2 percent from MRT to allow the wingman excess power, receives thumbs-up when the wingman is ready, raises his forearm vertically on the wingman's side, hesitates a moment, and drops his arm smartly. As the lead's arm drops below the canopy rail, the flight simultaneously releases the brakes.

Early detection and correction for changes in relative motion are the keys to performing a section takeoff. The wingman maintains position down the runway by adjusting power to control bearing and rudder to maintain wingtip separation. If he goes acute immediately after beginning the takeoff roll, he may lightly tap the brakes. To maintain directional control, the wingman applies rudder.

As rotation speed is approached, the lead smoothly rotates. The wingman then matches the lead's rotation rate and attitude. After both aircraft are safely airborne, the wingman moves into parade position.

When the lead is safely airborne and at 140 KIAS, he gives the gear/flap/slat signal by distinctly nodding his head forward and then sharply back. When the lead's head reaches the headrest, both pilots raise the gear and flaps/slats. The flight lead will ensure both aircraft gear are up and locked and the flaps/slats are up before exceeding 200 KIAS.

CAUTION

The gear uplock mechanism can be overridden with 20-50 lbs of force applied to the gear handle.

Early lift-off by the wingman creates a less than ideal situation due to:

1. Low altitude

2. Step up on the lead

3. Difficulty in keeping sight. Avoid abrupt corrections. You should stabilize bearing, maintain separation, and relax back stick pressure to reduce the rate of climb. Allow the lead to climb above you, at which time you join in parade position. Do not create a rate of descent.

Aborting. If an abort occurs immediately after brake release, both aircraft may abort. If an abort occurs during takeoff roll, the non-aborting aircraft will go to MRT and continue takeoff on its side of the runway. The aborting aircraft moves to centerline after separation and continues the abort IAW NATOPS procedures. We do not want to execute a sympathetic abort that could result in a dual high-speed abort.

1-18 SECTION DAYTIME FLIGHT PROCEDURES

2. Initial Rendezvous/Departure/Climbout

A rendezvous joins a flight together after takeoff. The briefed departure rendezvous can be a CV rendezvous, a running rendezvous, or a TACAN rendezvous.

CV Rendezvous. The CV rendezvous joins a flight in a turn.

Climbing. This procedure combines a climb with a basic CV circling rendezvous. After takeoff, the lead begins a 30-degree angle of bank (AOB) climbing turn at a briefed airspeed. When safely airborne and cleaned up, the wingman executes a climbing turn inside the lead's radius of turn to intercept the lead's 30-degree bearing. Climbing, he places the lead on the horizon. He maintains the rendezvous bearing, closing on the lead using a maximum 10 KIAS of closure when within 1000 ft. The wingman monitors airspeed until close enough to visually discern relative motion. Your throttle adjustments at high power settings affect closure more significantly than at low power settings. While in a climb, any throttle decrease has a large effect on closure; conversely, any throttle increase has a smaller effect on closure.

Approaching the bearing line, the wingman reduces AOB to avoid going acute and keeps the lead on the horizon to stabilize vertical separation. When the wingman is on the bearing line, 100 ft away (three wingspans), he begins the join-up by increasing stepdown to 15 ft and flying to 10 ft nose-to-tail.

He then pauses momentarily on the lead's radius of turn and then moves up into the parade turn away position. The lead's radius of turn is defined as his "plum line" (Figure 1-15). Techniques for executing a CV rendezvous are discussed under breakup and rendezvous procedures.

On cruise and division formation flight, the wingman will not pause on the lead's radius of turn during CV rendezvous, but will make a smooth continuous transition from the rendezvous bearing line through the crossunder to the parade position.

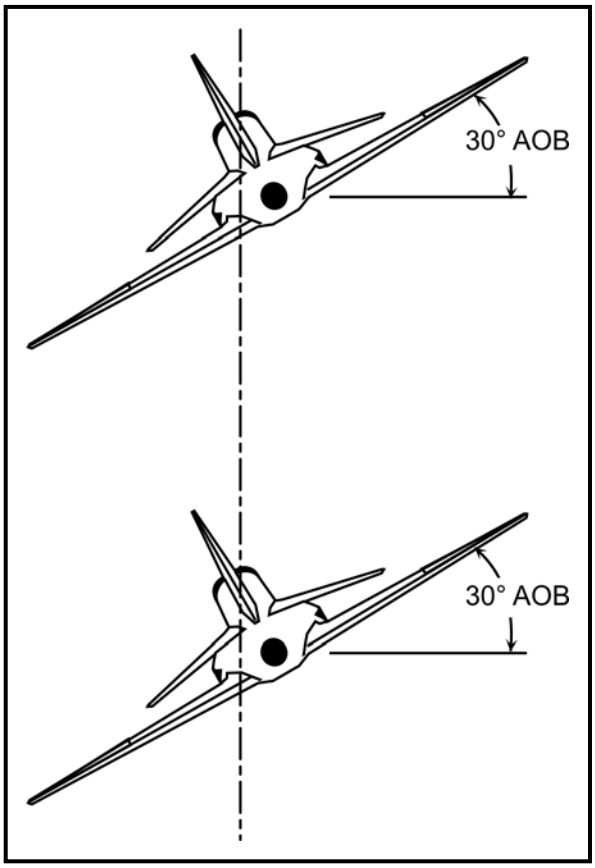


Figure 1-15 Plum Line

Level. If weather or local course rules dictate, the flight may perform a level rendezvous instead of a climbing rendezvous. In that case, the lead levels off at the briefed altitude and maintains constant airspeed, altitude, and AOB. The wingman performs a circular rendezvous by keeping the lead on the horizon, maintaining the bearing line, and monitoring his airspeed using a maximum of 10 KIAS of closure when within 1000 ft to avoid excessive closure. In contrast to the climbing CV rendezvous in which power additions have a smaller effect on closure than power reductions, level rendezvous power additions and reductions have the same effect on closure.

Running Rendezvous. The running rendezvous is used to join a flight while proceeding on course. The running rendezvous is normally the initial procedure following an interval takeoff. The lead will be climbing at a reduced power setting (92-94%) in order to allow the wingman to close sufficiently. Wingman should begin the maneuver by initially placing the lead slightly above the horizon while allowing their aircraft to accelerate. Once sufficient airspeed has been achieved (approximately 250 kts), the wingman should continue to climb to place the lead on the horizon, as in a CV rendezvous. The wingman should exploit any turns made by the lead by cutting inside lead's radius and converting to a CV rendezvous as required. As in the climbing CV rendezvous, any throttle decrease will have a greater effect on reducing airspeed when

compared to a level rendezvous. Conversely, any throttle increase will have a smaller effect on closure when compared to a level rendezvous.

The most important aspect in a running rendezvous for the wingman will be setting the distance abeam the lead. This distance is critical because visual closure cueing is derived from the lead's aircraft tracking aft on the wingman's canopy. If too wide a distance is chosen, the wingman will arrive on the bearing line with a large distance to traverse in order to join. If too narrow a distance is chosen, the wingman may not recognize closure early enough when approaching the bearing line. Also, closure on any airplane day or night is most difficult to perceive when approaching from directly behind and constitutes a flight hazard as excess closure may easily develop. Therefore, the appropriate distance abeam should be set as soon as possible in the maneuver, which will normally be just outside the HUD field of view and corresponds to 250-300 ft abeam the lead. (This is 8-10 wingspans.) Once this distance is chosen, the wingman should look forward through the HUD (referencing velocity vector as required) and concentrate on flying the aircraft on a straight line that projects forward to a point abeam the lead (Figure 1-16). Airspeed should be monitored so that no more than 50 kts excess is maintained. Approaching 2000 ft of nose to tail distance, the lead should displace from the 11/1 o'clock position and begin to drift aft on the canopy. At this time, power should be reduced so that at 1000 ft of nose to tail distance no more than 25 kts of closure exists. Inside 1000 ft, the lead will appear to track aft with increasing rate along the canopy as the wingman approaches the bearing line. Wingman should avoid the tendency to reduce this tracking rate by prematurely banking toward the lead, thus reducing the distance abeam. Instead, wingman should continue to track on a parallel course to the targeted position abeam the lead and arrive on the bearing line with no more than 15 kts closure. Once stabilized on the bearing line with closure under control, the wingman will effect the join by traversing toward the lead to the parade position.

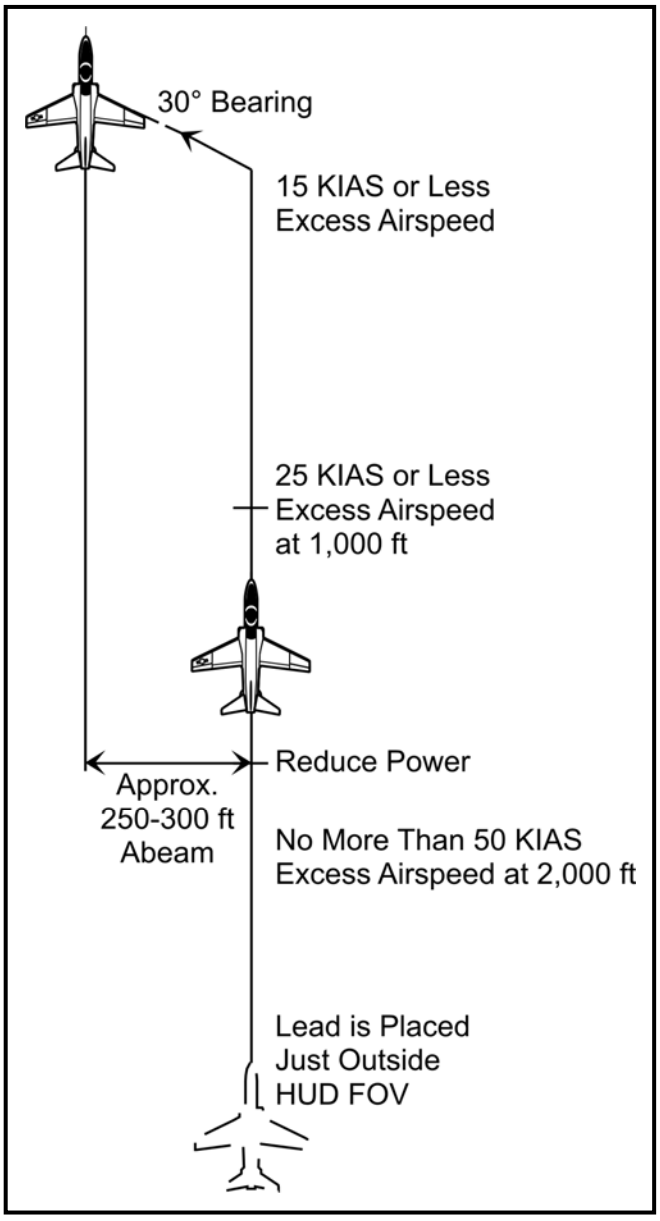


Figure 1-16 Running Rendezvous

TACAN Rendezvous. A TACAN rendezvous is a visual circular rendezvous employed to rendezvous a flight above the weather after takeoff or during the mission if the flight is separated. The TACAN rendezvous is normally executed in a left-hand turn tangent to the briefed TACAN fix (radial/DME) at a specified airspeed, altitude, and direction (inbound or outbound). As shown in Figure 1-17, points around the rendezvous circle are numbered from one to four, with point one located at the TACAN fix and sequential positions located at 90-degree intervals around the circle.

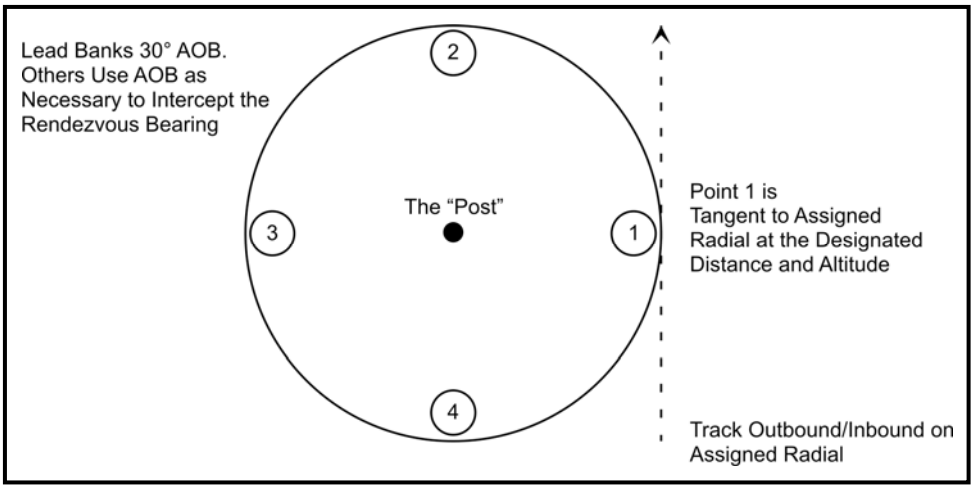


Figure 1-17 TACAN Rendezvous

Upon reaching the TACAN fix, the lead simultaneously calls his "[call sign], point one" and commences a 30-degree AOB turn in the briefed direction. Passing each 90-degree position, the lead transmits his position number until the wingman acquires a visual. The lead must adjust the rendezvous turn to compensate for wind, ensuring that point one is always at the briefed TACAN fix. The wingman will fly toward the point one fix at 500 ft below the briefed rendezvous altitude and remain 500 ft below the briefed rendezvous altitude until established on lead's bearing line with relative fuselage alignment. Relative fuselage alignment is defined as the lead's aircraft just above the side canopy rail and just aft of the canopy bow, sometimes referred to as the "crutch" of the canopy. At night, the procedures remain the same. Upon arrival at a known point on the circle, typically point one, the wingman will initiate a turn in the briefed direction of the rendezvous using AOB as required. The lead should continue to call his arrival at the points along the circle to help the wingman establish an idea of the lead's relative position from him. From these cues, the wingman should be able to narrow his search for lead. Once the wingman sees the lead, the wingman will call "visual" and continue to maneuver his aircraft toward lead's bearing line and align the fuselages. Once those parameters have been met, the wingman will climb to lead's altitude by placing the lead aircraft upon the horizon and proceed with a standard CV join-up. Initially, if the lead's aircraft is behind the wingman's wing line when a visual sighting is achieved or when lead's position call has provided the necessary situational awareness, the wingman should proceed to the center of the circle. The center of the circle is known as the "post" and serves as a control zone from which the wingman should be able to expeditiously maneuver his aircraft to visually acquire the lead and begin the lead/lag procedure for rendezvous. The lead/lag procedure is best conceptualized as maneuvering to place the lead at the wingman's "10 and 2" position. For example: in a normal left hand rendezvous, the wingman should use AOB as required to place the lead aircraft at the 2 o'clock position relative to the wing aircraft's nose. The wingman is now using a lead pursuit maneuver inside lead's radius of turn. The wingman is closing the distance to lead but must still resolve fuselage alignment. The wingman should immediately reduce his AOB and allow the lead aircraft to drift left across his windscreen towards the 10 o'clock position. The wingman is now using the lag maneuver.

The wingman should then increase AOB as required to place the lead back at the 2 o'clock position and evaluate. By repeating this process, the wingman is closing the distance to lead while working off "angles" to align the fuselages. Once the wingman has achieved bearing line and fuselage alignment, he should step-up and proceed with the CV join. The goal of this procedure is to teach the student to use lead/lag principles for rendezvous while maintaining a constant airspeed. If the lead obtains visual contact first, he may call "visual" and describe his relative position from the wingman over the radio to help the wingman gain sight of the lead. The wingman may use angle of bank as required during the day but is limited to no more than 45 degrees at night.

Fuel Check. Fuel-check signals should be passed during two occasions: when the lead is exchanged and prior to returning to the field. To determine the flight's fuel state, the lead passes the fuel-check signal, and the wingman passes his fuel quantity rounded to the closest 100 lbs. The lead uses the lowest fuel state for planning purposes and for communicating the fuel state of the flight to other aircraft or a controlling agency.

3. **Parade Position**

Parade position is used for flight in congested areas, instrument approaches, and, in general, at any time when the formation is likely to be critically observed.

Parade formation presents two advantages:

1. It provides good visual communication between aircraft making it easier for the lead to maintain positive control

2. It presents a professional military appearance

The disadvantages are:

1. The formation is less maneuverable than a single aircraft or a tactical formation

2. The wingman constantly adjusts power which results in fatigue and higher fuel consumption

3. It restricts the wingman's lookout doctrine

As a wingman flying parade position, maintain approximately a 30-degree bearing by sighting down the leading edge of the lead's wingline with 5 ft of stepdown and a lateral separation of 3 ft, as in Figure 1-18.

You can tell when you are in position by:

1. Sighting down the leading edge of lead's wing

2. Estimating stepdown by seeing equal portions of the top and bottom of the wing

3. Maintaining wingtip separation by aligning leading corner of stabilator tip cap with exposed portion of exhaust nozzle

Also as wingman, maintain parade position by coordinating AOB, pitch, and power. Use AOB to maintain wingtip separation, pitch to control stepdown, and power to control the 30-degree bearing. Maintain position by coordinating AOB and power.

To maintain parade position, you must remain relaxed and scan the lead's entire aircraft. By keeping the aircraft trimmed, you need apply only slight stick pressures to maintain position. Anticipate all error corrections, and correct immediately to minimize the error. The perfect parade position is transitory, and every correction has a corresponding re-correction. Because the T-45 has more inertia and different power response than the T-34, power corrections require a longer time to take effect. Also because the cruise airspeed of the T-45 is greater than the T-34, you need smaller pitch or AOB adjustments to correct for similar errors.

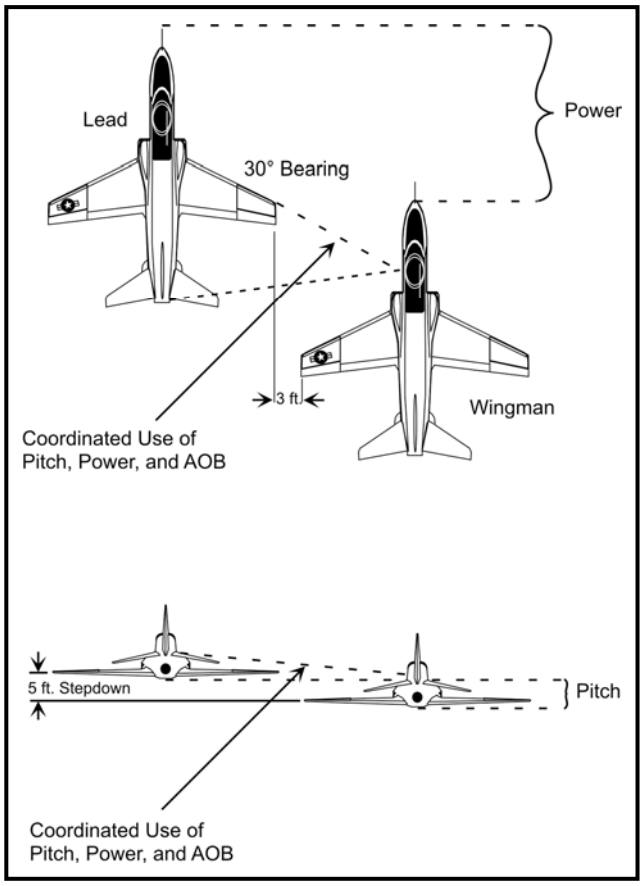


Figure 1-18 Maintaining Parade Position

NOTE

With proper step-down, only the first 3-5 vortex generator on top of lead's wing should be visible to the wingman.

4. Parade Turns

As shown in Figure 1-19, two types of section parade turns exist – into and away from the wingman using 30 degrees AOB. During early formation flights, parade turn exercises should consist of two 180-degree turns – one turn into and one turn away.

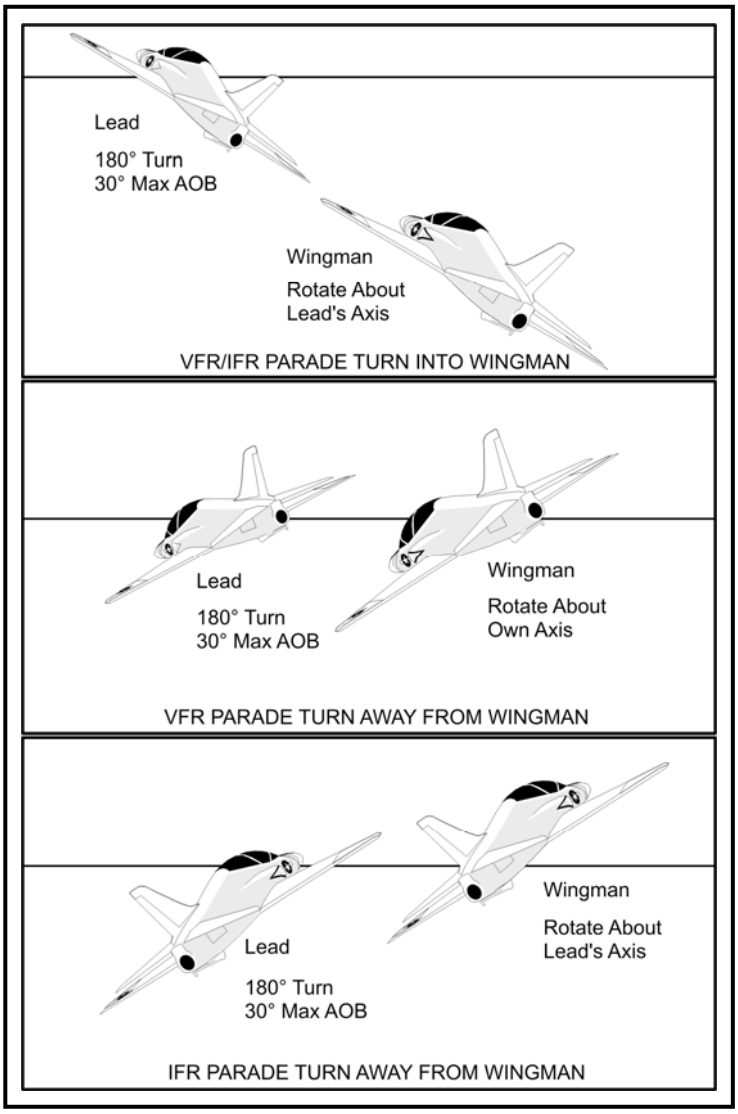


Figure 1-19 Parade Turns Into/Away

Into Wingman. The lead turns into the wingman by rolling into 30 degrees AOB at the parade rate of roll (approximately 10 degrees per second). The turn signal is optional for the lead.

The lead must execute all rolls consistently, employing a constant rate of roll. The wingman rotates about the lead's longitudinal axis, remaining in parade position while matching the lead's rate of roll.

The wingman maintains bearing by reducing power slightly to compensate for dropping the nose and being inside the lead's radius of turn. If power is not reduced when entering the turn, the wingman will go acute.

In order to roll out of the turn, the lead rolls out using parade rate of roll. The wingman matches the lead's rate of roll while rotating about lead's longitudinal axis, increasing power to maintain the parade bearing.

Away from Wingman. The lead turns away from the wingman by rolling into 30 degrees AOB at the parade rate of roll. The lead must make all rolls consistent while using a constant rate of roll. When flying VFR parade position, the wingman rotates about his own longitudinal axis while matching the lead's rate of roll. He maintains a constant bearing on the lead by adding a little power to compensate for being outside the lead's radius of turn. If power is not added when entering the turn, the wingman will go sucked.

When established in the turn, the wingman maintains a bearing that will position him in parade when the lead rolls out of the turn. While in the turn, maintain bearing by creating a triangle with the lead's center canopy bow, canopy rail, and the leading edge of the wing (Figure 1-20). Remember, power controls nose-to-tail relationship, and AOB controls lateral separation. The wingman will see the lead's fuselage on the horizon with the horizon line passing through the lower engine intake.

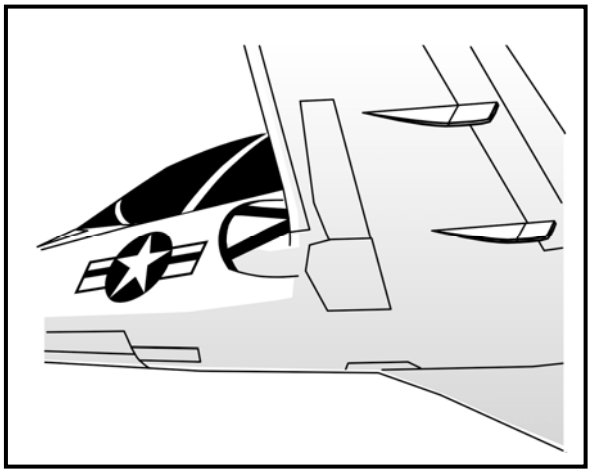


Figure 1-20 Turn-Away Reference

In order to roll out of the turn, the lead rolls using parade rate of roll. The wingman matches the lead's rate of roll while rotating about his own longitudinal axis and reduces power to maintain the parade bearing. If power is not reduced when rolling out, the wingman will go acute.
IFR parade may be used when the section is penetrating clouds and during instrument approaches. In contrast to the VFR turn away, the wingman rotates about the lead's longitudinal axis while matching the lead's rate of roll and maintaining parade position. The wingman's position on the lead remains the same as in straight and level flight. Known as the "welded wing" concept, this provides the wingman a point of reference to avoid possible disorientation.

The IFR turn away initially requires more power than the VFR turn away because the wingman's relative position is above the lead in addition to being outside of the lead's radius of turn. If power is not added when entering the turn, the wingman will go sucked. Conversely, when the wingman rolls out of the IFR parade turn away, he will initially require a larger power reduction than the roll-out from the VFR turn away.

5. **Crossunder**

For the formation to meet operational maneuverability requirements, the wingman must be able to change positions within the formation. The "Box" type crossunder (Figure 1-21) will be utilized in the early Formation stages until your first cruise formation flight (parade form). Then the "V" type crossunder (Figure 1-22) will be used exclusively.

Box Crossunder. This crossunder will give the wingman practice in maneuvering his aircraft around the lead's and will demonstrate the importance of recognizing relative motion and smooth control of the aircraft. After receiving the crossunder signal from the lead, make power and attitude corrections to simultaneously move straight back and down until 10 ft of nose-to-tail and 15 ft of vertical separation is achieved. Visually, the wingman should slide back until looking approximately down the leading edge of the horizontal stabilator for proper nose-to-tail reference. Then initiate a slight wing dip to start moving the aircraft to the other side of the lead. Maintain the front portion of the MDC cord on the underside of the lead's intakes. Stop the aircraft on the other side of the lead with 10 ft of nose-to-tail and 15 ft of stepdown. Add power and noseup pitch to simultaneously drive up and forward into parade position.

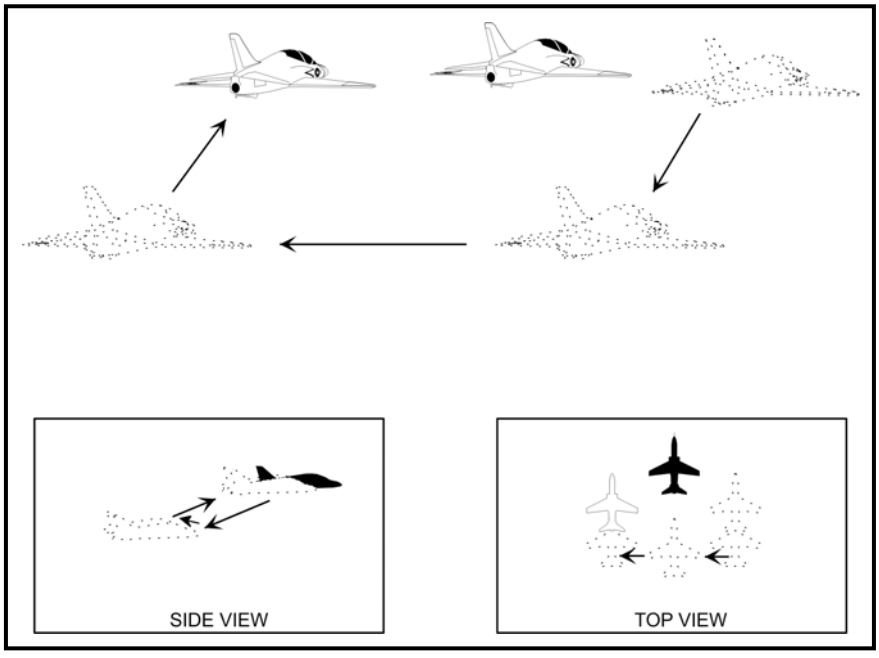


Figure 1-21 Box Crossunder

V-Crossunder. The "V" crossunder consists of two straight lines from the parade position on one side of the leader, below and behind into column position, then into parade position on the other side. The student must control relative motion in three directions at the same time (Figure 1-22). This maneuver involves controlling the stepdown with nose attitude, controlling the crossing rate with heading differential, and controlling nose-to-tail separation with power.

The crossunder begins when the lead gives the crossunder signal and the wingman acknowledges. Fly the aircraft on the down, aft, and into vector to arrive at the column position. Upon passing the lead's centerline with 15 ft of stepdown and 10 ft of nose-to-tail, the wingman starts climbing to reach parade position on the other side of the lead.

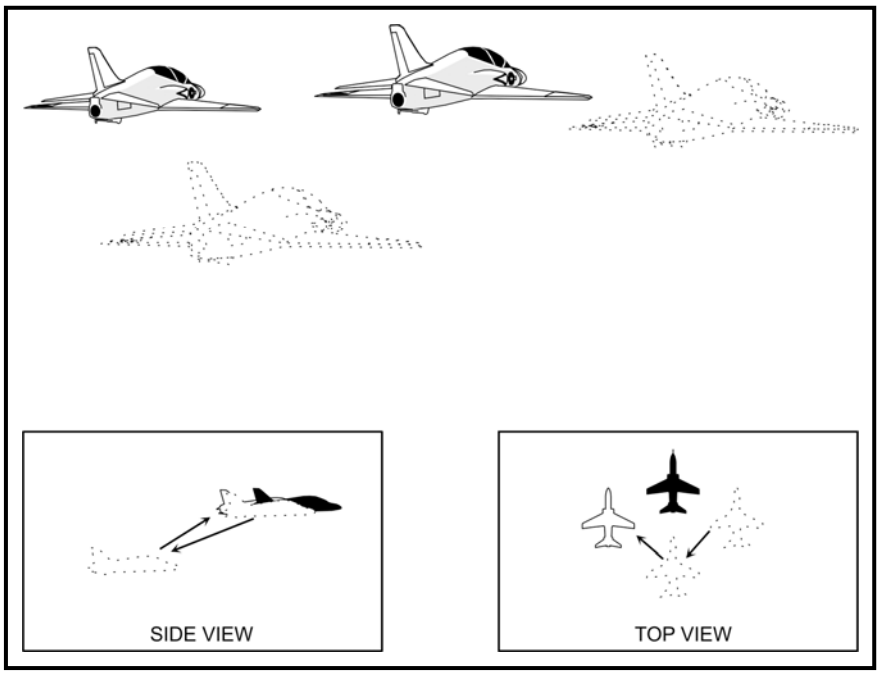


Figure 1-22 "V" Crossunder

6. **Breakup and Rendezvous Exercise**

The breakup and rendezvous separates the formation so that you can practice CV rendezvous procedures. The lead always initiates this exercise. Prior to the first breakup and rendezvous, the lead establishes himself in straight and level unaccelerated flight at the briefed altitude and airspeed; breakup and rendezvous will be performed at 250 and 300 KIAS. Throughout the exercise, the lead can continue the break beyond 180 degrees or vary the rendezvous turn as necessary to avoid clouds or to keep the formation in the assigned area.

Breakup. The lead passes the breakup and rendezvous signal to the wingman while ensuring that the area is clear of traffic. When the lead looks back for the acknowledgment from the wingman, he kisses off the wingman. In Figure 1-23, the lead breaks away for 180 degrees of turn while maintaining airspeed, altitude, and 14-15 units AOA. Upon the lead's break, the wingman maintains altitude and heading for 2 seconds, and then breaks while maintaining airspeed and lead on the horizon to arrive 1000 ft in trail. The wingman must keep the lead on the horizon by varying AOB slightly as needed throughout the turn.

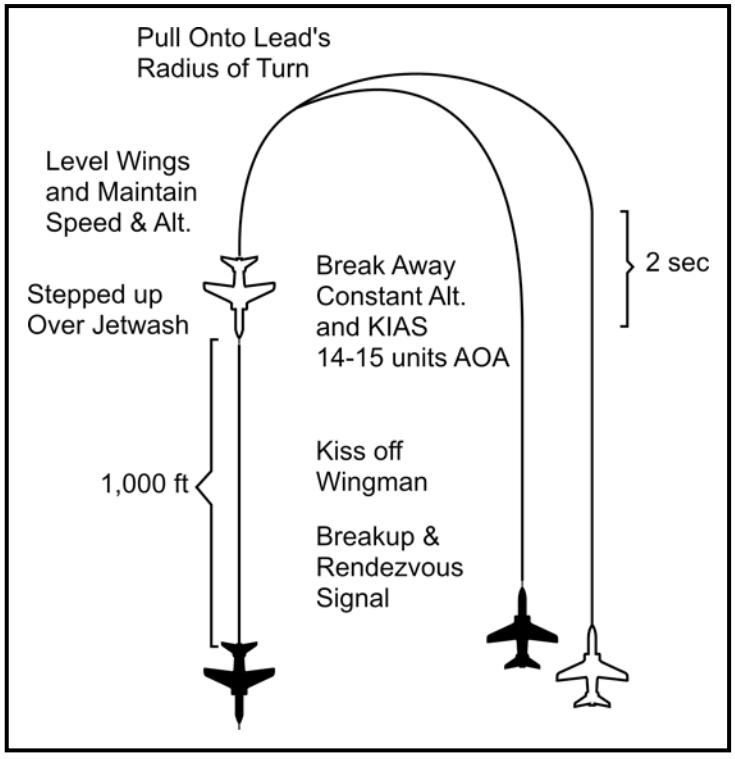


Figure 1-23 Breakup (Section)

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.

The wingman varies g to obtain 1000 ft of nose-to-tail separation during the first half of the turn and then pulls onto the lead's radius of turn until the roll-out. The lead completes the breakup turn, levels his wings, and maintains rendezvous airspeed.

The wingman rolls out of the turn in trail behind the lead with 1000 ft of nose-to-tail at rendezvous airspeed. To avoid the lead's jetwash, the wingman should fly slightly stepped up. The wingman must not adjust power to compensate for nose-to-tail error in trail; rather he should maintain rendezvous airspeed and correct for being long or short in trail during the rendezvous portion of the exercise. This is an opportune time to perform a "15 minute" report as in the FAM stage. Report this to the IP over the ICS as required.

Rendezvous. To rendezvous (Figure 1-24), the lead waits ten seconds or as briefed, and rolls into a 30-degree AOB turn in either direction. After the lead initiates his turn and is approximately 10-20 degrees left or right of the nose, the wingman rolls into no more than a 45-degree AOB turn, adding power, if required, to establish 10 KIAS of closure while moving out to the bearing line.

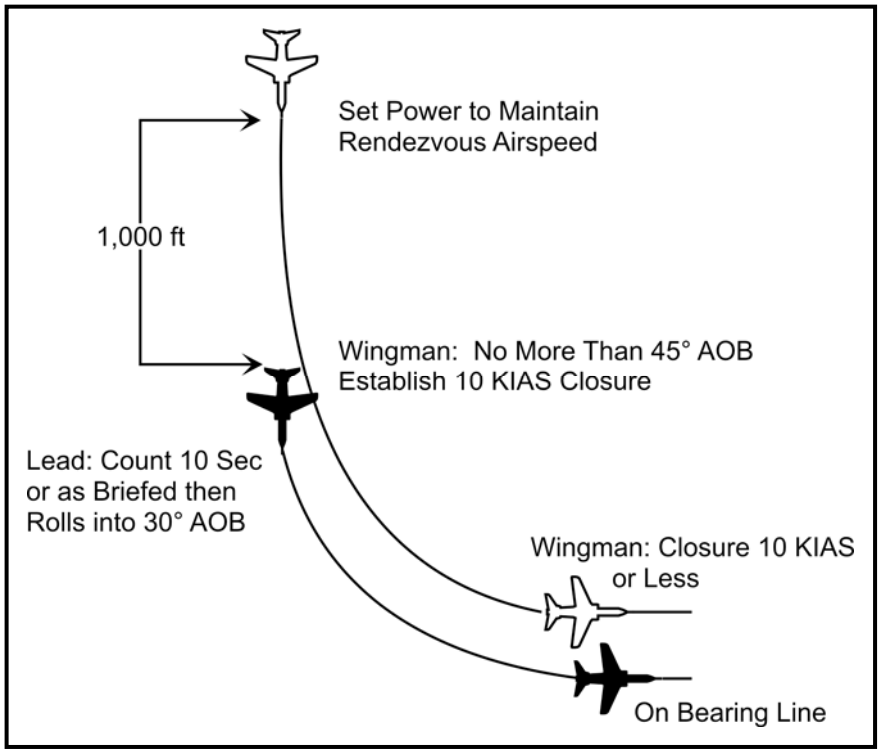


Figure 1-24 Rendezvous (Section)

The wingman maintains altitude by positioning lead's aircraft on the horizon. The bearing line is achieved when the front tip of the vertical stabilizer meets and covers the lead's outside wingtip (Figure 1-25). The wingman anticipates intercepting the bearing line by shallowing his AOB. He must reduce his AOB prior to reaching the rendezvous bearing to avoid going acute.

When the wingman arrives on the bearing line, he should begin to align his fuselage with the lead's. The wingman keeps the lead on the horizon as he moves up the bearing line. When the wingman is on the bearing line, he will see the lead's vertical stabilizer intersect with the lead's outboard wingtip. If he becomes acute, the lead's outboard wingtip will appear forward of the vertical stabilizer. Conversely, if he is sucked, the lead's wingtip will appear behind the vertical stabilizer (Figure 1-25). When the wingman can discern the lead's wingline, transition to and fly up the wingline (30-degree bearing line).

Once on the bearing line, the wingman can discern whether he is going to go acute or sucked by the relative motion of lead on his canopy. If the lead aircraft is sliding aft in the canopy then the wingman is going acute and needs to decrease angle of bank and reduce power. If the lead aircraft is moving forward in the canopy, the wingman is going sucked and needs to increase angle of bank and add power.

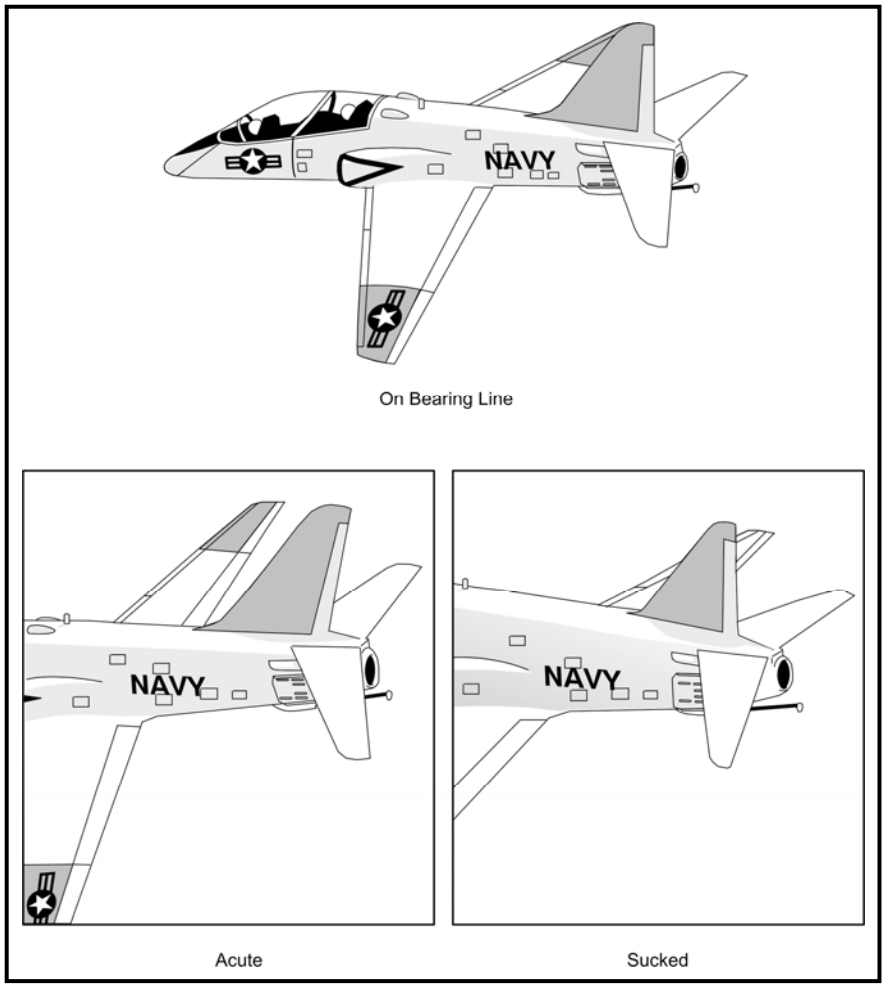


Figure 1-25 Rendezvous Bearing Line

The wingman then holds the lead stable on bearing and altitude and monitors airspeed, not allowing his closure rate to exceed rendezvous airspeed by more than 10 KIAS. If the wingman does not hold the lead on the horizon, his airspeed control will be more difficult. The wingman monitors his airspeed until close enough to visually discern relative motion. As in Figure 1-26, when the wingman is on the bearing line, 100 ft away (three wingspans), he begins the join-up by increasing stepdown to 15 ft. At this point, closure rate should be controlled to the point that any small throttle movement will produce an immediate effect on closure rate. He must stay on the bearing line as he increases stepdown. Otherwise, leaving the bearing line too soon creates excess nose-to-tail. The wingman pauses momentarily on the lead's radius of turn while

maintaining both 10 ft of nose-to-tail and 15 ft of stepdown. At this point the wingman's power should be set to maintain rendezvous airspeed. He continues crossing below and behind the lead, after which he moves up into the parade turn away position, adding power as he moves outside the lead's radius of turn. On cruise and division formation flights, the wingman will not pause on the lead's radius of turn.

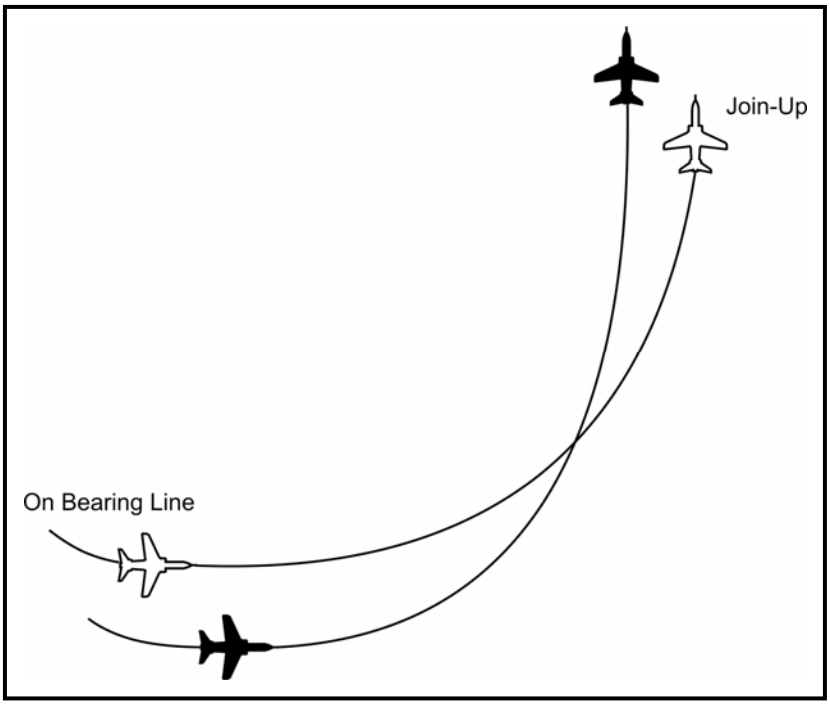


Figure 1-26 Join-up (Section)

7. **Underrun**

An underrun provides a safe and orderly method for the wingman to pass below and behind the lead when excessive closure precludes a normal join-up.

Two situations dictate an underrun:

1. Uncontrolled closure near or in the join-up phase of the rendezvous, or

2. When the wingman is extremely acute and unable to return safely to proper bearing prior to join-up.

If the wingman fails to recognize the dangerous situation, the lead can order the wingman to underrun. In that case, the wingman should acknowledge the command and underrun.

Whether the wingman recognizes the need to underrun or he is ordered to underrun by the lead, the maneuver is performed the same way. The wingman simultaneously lowers the nose to ensure vertical separation, levels the wings, reduces power to idle, and extends speed brakes. He then notifies the lead of the underrun by calling "[call sign], [position number], underrunning".

The wingman passes below and behind the lead and then stabilizes outside the lead's radius of turn in a slightly acute parade turn away position at approximately 200 ft and slightly stepped up. To stabilize, the wingman retracts the speed brakes, resets the power as necessary, and maintains approximately rendezvous airspeed.

When stable and cleared to rejoin the flight, the wingman moves below and behind the lead to return to the 30-degree rendezvous bearing on the inside of the turn and executes the join-up. During an underrun, the lead remains in the rendezvous turn until the flight is properly joined.

8. **Lead Change**

A lead change normally occurs when the lead aircraft has radio or navigation equipment problems that hamper his ability to lead the flight in a safe and orderly manner. In the Training Command, the lead change is normally performed for practice. To ensure a safe and orderly transfer of the flight lead, the lead change procedures are highly structured and much more involved than in the T-34.

Prior to passing the lead change signal to the wingman, the lead will ensure that the flight is clear of other aircraft and weather, and that he will remain in the operating area during the lead change. The lead passes the lead change signal to the wingman. If the wingman accepts the lead, he passes the acceptance signal and assumes responsibility for the flight while maintaining rendezvous airspeed, altitude, and the present heading until after the lead change. The new wingman must keep his eyes on the new lead. Figure 1-27 shows that the new wingman moves out laterally to establish 10 ft of wingtip clearance and then stabilizes. Flying wing from this position becomes uncomfortable because you are looking over your shoulder, but do not let your head movement affect stick movement.

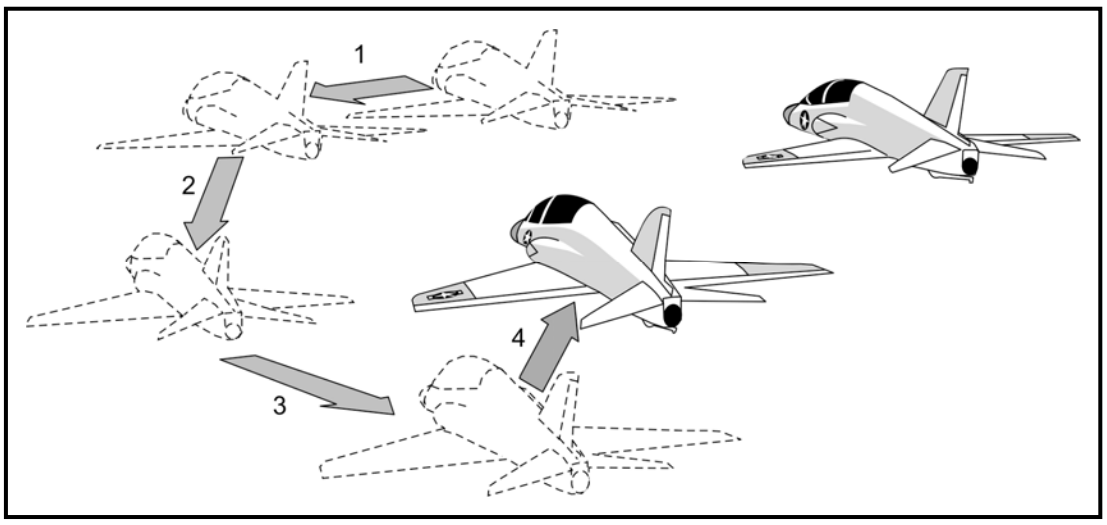


Figure 1-27 Lead Change

The new wingman continues the lead change, stepping down without sacrificing bearing by easing the nose down and adjusting power to keep from moving farther ahead of the new lead. As the stepdown of 5 ft is reached, the new wingman levels off and stabilizes position by adjusting power, as necessary. The new wingman then reduces power to move aft slowly, maintaining 10 ft of wingtip clearance and 5 ft of stepdown. He then slows aft movement by adding power to stop on the 30-degree bearing line and stabilizes momentarily.

Once again because you are looking over your shoulder as you are moving aft, you will have a common tendency to drift toward the lead. Ensure your head movement does not affect stick movement. Once the aircraft is stabilized, the wingman adds power to move up the bearing line on the lead and establishes the parade position.

The wingman then completes the lead change maneuver by moving into parade position. At this point the new lead passes the fuel check signal, and the new wingman replies with his fuel quantity. The wingman can refuse the lead with a negative head shake. In that case, the lead will clear the area again as the wingman stabilizes in parade position; then, the lead will pass another lead change signal to the wingman.

The new wingman must maintain sight of the new lead throughout this maneuver to avoid a possible midair.

9. **Cruise Position**

Cruise formation is used as an enroute formation. Cruise formation is safer, requiring less attention to maintaining position, provides better lookout capabilities, and is more fuel efficient for the wingman. The cruise position allows a section greater maneuverability than the parade formation because the lead is not restricted to 30-degree AOB turns.

Figure 1-28 shows that in the cruise position the wingman maintains a bearing of approximately 45-degrees, a stepdown of 15 ft and a nose-to-tail separation of 20 ft. The cruise position is defined by splitting the star on the lead's fuselage with the lead's inboard wingtip, or aligning the outboard aileron hinge with the danger arrow on the intake, and by sighting along the leading edge of the horizontal stabilizer.

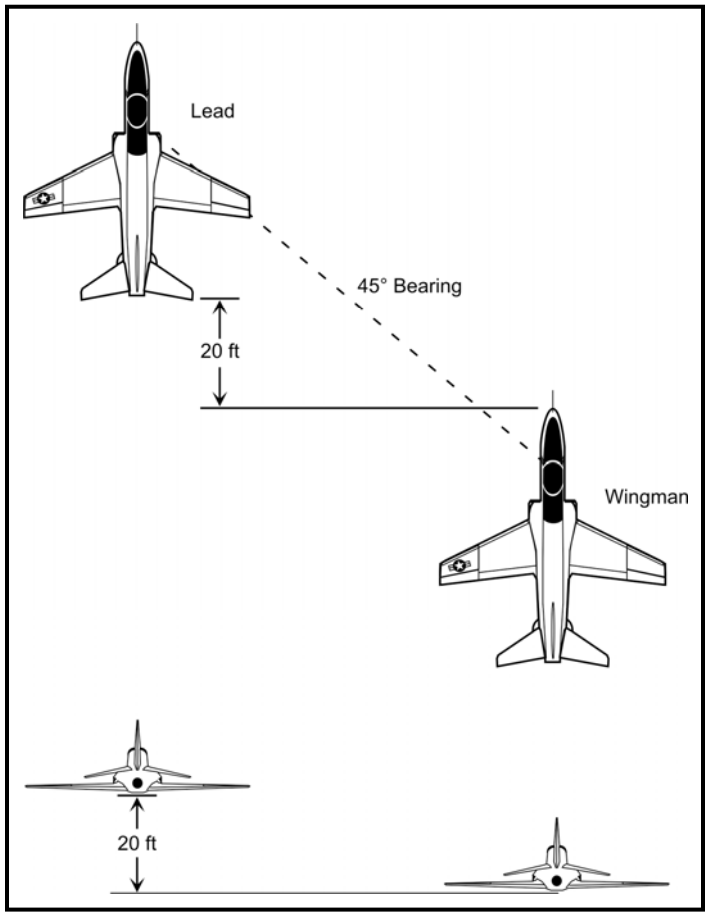


Figure 1-28 Cruise Position

Another reference is placing the lead's hook point on his outer wingtip.

The basic principal of cruise is that all flight members will maintain position by sliding to the inside of the lead's radius of turn in order to minimize throttle movements. When maneuvering, wingmen may change their position to either side of the lead to maintain cruise position on the inside of the lead's turn. Nose-to-tail is primarily maintained by utilizing radius of turn. Flying a shorter radius of turn (increased g) with respect to the lead will decrease nose-to-tail, while flying outside the lead's radius will increase nose-to-tail. Mild turns may be the exception where maneuvering to the inside is not required or desired, such as maneuvering from the initial to the break.

Cruise Sequence. Cruise is flown at approximately 92%. The lead should set power at 92% and then pass the cruise signal. The lead will maneuver through turns, gradually increasing the AOB and pitch while working into wingovers and modified barrel rolls. The minimum airspeed during cruise is 150 KIAS and the lead should maintain at least 1 positive g during the barrel rolls. The wingman should fly a cruise position so as not to lose sight of the lead, i.e., lead's helmet. Maintaining nose-to-tail is of primary importance during cruise; wingmen should maintain nose-to-tail distance while holding their position inside the lead's turn radius.

During straight and level flight, the wingman may fly on either side of the lead unless otherwise directed.

Cruise Turns Away. When the leader turns away from the wingman, the wingman should roll with the lead and slowly increase his rate of roll so as to smoothly maneuver to the inside of the lead's turn. A small amount of power may be needed to maintain nose-to-tail while maneuvering to the inside. Once inside the lead's turn, a slight power reduction and decrease in angle of bank will be necessary to maintain proper position. As the lead increases the angle of bank and the wingman maintains position on the inside of the turn, the wingman will find that he may need to reduce his stepdown on the lead. At no time should the wingman allow himself to be stepped up on the lead.

Cruise Turns Into. When the lead turns into the wingman, the wingman should simultaneously and smoothly reduce power and may slightly lag the lead's rate of roll so as to slide toward the lead's turn radius. Depending on the rate of roll, this may be a gentle maneuver requiring almost no sliding, or one which requires the wingman to expeditiously slide to the lead's turn radius. One common error for the wingman, particularly if the lead rolls and pulls rapidly, is to lag too much behind the lead's rate of roll and get "spit out" of the turn. Another error is to roll faster than the lead, and lose nose-to-tail by being inside the lead's radius of turn.

Wingovers/Modified Barrel Rolls. "Over-the-top" maneuvers may be signaled to the wingman via the radio or by hand/arm signal. Wingovers are performed as in the FAM stage; barrel rolls will be modified to be inverted after 45 degrees of heading change. When performing these maneuvers, the lead will start by increasing g into the wingman in order to establish a climb. The wingman should match the lead's pull in order to maintain position.

If the wingman is slow in applying g, two problems arise simultaneously:

1. Lead will gain altitude faster than the wingman.

2. Lead will have more induced drag (less airspeed) than the wingman. The end result is a wingman who is below and acute on the lead.

This uncomfortable position may be resolved by smoothly increasing g (and induced drag) to get back into position, making small power adjustments as necessary. A common error is for wingman to reduce power in order to regain proper position (due to the acute sight picture). This will decrease airspeed and g available, and still leave the wingman out of position (low and likely going sucked) and now needing more power to reestablish proper position.

When performing the modified barrel rolls, the wingman needs to understand how radius of turn affects the maneuver. If the lead performs the maneuver to the left and the wingman is established on the left, the wingman will be on the inside of the lead's radius of turn. However, when passing through the inverted position, the wingman is now on the outside of the lead's turn radius, even though he is still on the lead's left wing. Therefore, when passing through the inverted position, the wingman must add power to remain in position.

If the wingman is established on the right wing of the lead and stays there throughout a left barrel roll, the wingman will begin the maneuver on the outside of the lead's turn radius, therefore requiring a power reduction going through the inverted position. The lead will maintain positive g during any rolling maneuver.

NOTE

This maneuver is a "High Risk" maneuver and shall be briefed as such during the ORM portion of the flight brief. Leads will discuss the potential hazards that exist while performing this maneuver.

Return to Parade Position. After all maneuvering, the lead reduces the power and then passes the join-up signal (porpoise the aircraft or pat either shoulder). As the lead passes the join-up signal, the wingman moves into the parade position, adjusting power as necessary.

10. **Column Position**

Column formation is used to instill confidence in section maneuvering and to practice smooth application of g. The lead will always maintain at least one positive g and will not normally exceed three g's during maneuvering. The lead may perform wingovers and modified barrel rolls as in cruise, and also may perform aileron rolls. The lead's power will be set at approximately 92%. At no time will the speed brakes be used while in column formation.

Column position is directly behind the lead with 15 ft of stepdown and 10 ft of nose-to-tail separation (Figure 1-29). To maintain this position, place the top of the canopy bow on the lead's wingline. In column, maintain position directly behind the lead with AOB. Maintain nose-to-tail separation with power, and control stepdown with g. Your smooth application of g is crucial to maintain stepdown in section column maneuvers.

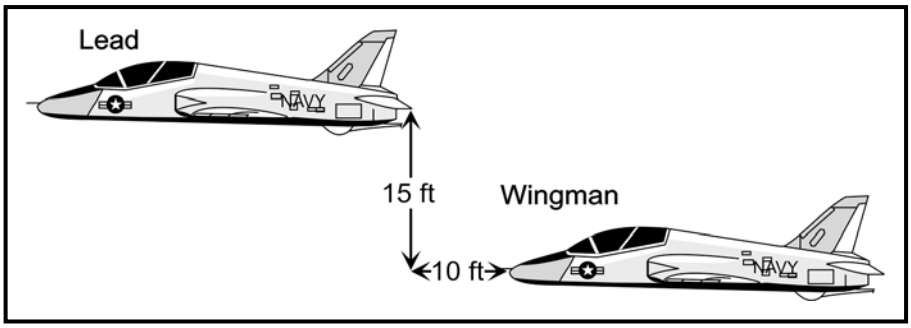


Figure 1-29 Column Position

Column Maneuvering. Maintaining stepdown is of primary importance during column formation. If the wingman ever has any doubt of safe aircraft clearance during maneuvering, he merely needs to relax his back pressure on the stick and separation between the two aircraft will occur almost immediately. Corrections for nose-to-tail errors are similar to those of cruise

maneuvering. For example, if the wingman is slow to match the pull of the lead and becomes acute and low, smoothly increase g to return to the proper position, making small power corrections as necessary.

It is important for the wingman to 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 have to add a small amount of power to compensate, then readjust the power as both aircraft approach the same speed. The opposite is true as the lead's nose starts up. Use small, almost imperceptible, control inputs to make corrections, especially in pitch during maneuvering.

11. **Section Tail-Chase Exercise**

This exercise is to demonstrate the effects of lead and lag pursuit on nose-to-tail distance.

The lead will give the arming signal to signal the tail-chase exercise. The lead will then give the "kiss-off" signal and smartly break away. Wing will pause 2 seconds and break to follow lead at 1000 ft nose-to-tail. Wing should use lead and lag pursuit and power adjustments as required to maintain nose-to-tail interval as lead maneuvers.

Lead can do maneuvers such as loops, barrel rolls, and wingovers. The wing should make sure he does not get any closer than 500 ft to the lead during these maneuvers. If nose-to-tail becomes greater than 1000 ft, maneuver to the inside of your interval's turns (lead pursuit) in order to reduce the nose-to-tail. Conversely, if nose-to-tail decreases, maneuver to the outside of your interval's turns (lag pursuit) until 1000 ft is obtained, then continue to follow your interval's flight path (pure pursuit).

This exercise will be completed with a rendezvous, normally a level, 30-degree AOB, circling rendezvous. The lead will call over the radio for the rendezvous, normally stating the type and speed; wingman will execute the called rendezvous.

12. **Overhead Entry (Break)**

The section VFR overhead entry (break) brings a section from the operating area to the initial entry point and into the break.

Descent. The lead follows the return to base (RTB) procedures IAW local course rules. The wingman flies parade or cruise as directed. The lead's minimum power setting will be no less than 80 percent.

If a higher than normal rate of descent is required, the lead passes the speed brake signal. The wingman acknowledges, and upon the lead's head nod, the flight extends their speed brakes.

Approximately 1000 ft above the assigned altitude, the lead smoothly levels off. If speed brakes are extended, the lead will pass the signal to retract them.

Field Entry. The initial point of entry is either about 5 nautical miles from the field on an extended centerline of the duty runway or IAW local course rules. Both the lead and wingman

must remember that flight maneuverability is reduced, and both should increase their lookout when operating inside the initial and in the vicinity of the airport.

Prior to arriving over the runway, the lead must establish the flight in parade position with the wingman on the side opposite the break direction. When cleared to break and with the proper interval, the lead kisses off and breaks.

The wingman then breaks at the briefed interval (generally 4 seconds) and makes a turn identical to the lead's, keeping the lead on the horizon and establishing a trail position on downwind. At 200 KIAS, each aircraft lowers his landing gear and flaps/slats and completes the landing checklist.

103. APPROACHES

1. Section Approach

A section approach efficiently recovers multiple aircraft in IFR conditions. Approach control handles a section the same as a single aircraft during an approach. OPNAV requires the weather to be at or above circling minimums for a section instrument approach to commence with the intent to land (if no circling mins are published then 1000/3 is required).

The wingman of course flies the IFR parade position. The lead will set his position lights to bright and steady and use the radio to communicate if in actual IMC conditions. If in VMC conditions, hand signals will be used as described in an earlier section of this FTI. When speed brakes are required, the lead will transmit "[call sign], speed brakes [pause] now" at which time both flight members will fully extend their speed brakes. For the landing configuration, lead will transmit "[call sign], gear and half flaps [pause] now" at which time the gear and flaps are positioned to down and half and the speed brakes are automatically retracted if previously extended. The speed brakes will be extended again for landing when the controller calls "up and on glide path," or when directed by the lead.

A clean penetration is the normal procedure unless the situation dictates that the section dirty up early on the approach. For example, if heavy IMC conditions are anticipated at normal dirty up altitude or if aircraft troubles would make a late dirty up impractical. For a dirty penetration, the lead will configure the flight in VMC and commence the approach at 170 kts, notifying ATC of penetration speed as required.

A potentially dangerous situation exists if the wingman loses sight of the lead while IMC during the approach. If this occurs, the wingman must turn expeditiously away from the lead while simultaneously transitioning to an instrument scan and calling "[call sign], lost sight." A 30 degree (10 on final) heading differential should be achieved and held for 1 minute unless positive deconfliction is achieved via the radio. If in a descent or climb, the wingman will level off. If after one minute, positive communication with ATC is not established, the wingman will resume the last assigned heading and altitude, squawk 7600 and comply with normal IMC lost comm procedures.

2. Final Approach

The lead will fly the final portion of the approach slightly fast (approximately 140-150 kts) in order to facilitate the wingman staying in position. If the wingman is experiencing difficulty maintaining position, he should transmit "[lead call sign], give me a little." Which indicates the lead should accelerate slightly. Leads will normally slow to a near on speed condition once VMC and landing is imminent.

3. Separating to Land

With the runway environment in sight, the lead will detach the wingman by "kissing him off" or transmitting "2 detach" and sharply breaking away from the wingman while retracting his speed brakes. The wingman will select full flaps and prepare to land. Flights may either gain separation on final to land on the same runway (preferably choosing different sides of the runway), or splitting to land on parallel runways (if available). Flights may also separate to execute individual circling approaches.

4. Touch and Go Rejoin

The lead may also elect to detach the wingman to land, while maintaining a parallel track at the wingman's 10 or 2 o'clock position. Once the wingman has safely landed, the lead may then circle to land or execute a missed approach. If required, the wingman may rejoin at any time on the lead (normally after landing if done for practice). In doing so, the wingman shall maintain half-flaps throughout the approach and landing, observing the NATOPS limit of a maximum of 600 fpm rate of descent upon touch-down. On the go, climb to lead’s altitude first, and then execute a normal running rendezvous using no more than 20 kts of closure. (Lead will normally maintain 150 kts, half flaps, and speed brakes in.) Once rejoined, the lead may either clean up the flight and execute a missed approach (as described below) or detach the wingman by turning tower downwind with the wingman following with proper interval.

5. Section Missed Approach

Anytime a missed approach is required, the lead will slowly advance power while rotating nose up and retract speed brakes (wingman will mimic automatically). With a positive rate of climb the lead will transmit "[call sign], gear and flaps up [pause] now." If in VMC conditions, the lead may elect to use hand signals as described in an earlier section of this FTI.

When executing a practice approach in VMC conditions, the lead shall initiate the missed approach NLT 500 ft AGL in order to provide a safety margin for terrain and obstacle clearance in the event of student error.

104. FLIGHT SEQUENCE – SECTION

1. Parade Form

Marshal/taxi
Running rendezvous
Parade position
Parade turns
Crossunder (box type)
Breakup and rendezvous (250)
Underrun
Lead change
Flight lead (if applicable)
Formation recovery
Full flap/slat landings

2. Cruise Form

Section takeoff
Parade position
Parade turns with reversals (IFR)
Crossunder ("V" type)
Breakup and rendezvous (250 and 300 KIAS)
Cruise
Column
Tail-chase
Lead change
Section approach
Section T&G rejoin/missed approach
Formation break
Landings

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CHAPTER TWO
DIVISION DAYTIME FLIGHT PROCEDURES

200. INTRODUCTION

Throughout the division formation procedures, all signals will be passed down the line and appropriate responses passed back up the line. The wingman will acknowledge all frequency changes in sequence, as well as checking in on new frequencies. The exceptions to this are ground and tower; the wingman will give only a visual thumbs-up to acknowledge receiving this frequency.

201. GROUND PROCEDURES

1. Division Marshaling

Division marshaling is very similar to section marshaling except there are four aircraft. All pilots man their aircraft and start their engines at the same time, complete checklists (identical to the FAM stage), final checkers, and move to the marshaling area. The formation lead obtains ATC clearance for the flight. In the marshaling area, pilots switch to marshaling frequency as briefed and check-in in sequence when the lead calls "[flight call sign]." The formation lead passes ATIS, ATC clearance, squawk, and any other last-minute instructions. Each wingman dials in the appropriate IFF code and leaves the IFF in standby throughout the flight unless otherwise directed. The lead directs the wingmen to switch to the appropriate frequency for taxi. The wingmen acknowledge in order with the position number – for example, "Two," "Three," "Four" – and then switch to the new frequency. The lead switches to the new frequency and calls ground control for taxi - for example, "Ground, [call sign], taxi flight of four, with alpha." Wingmen acknowledge they are up ground control frequency by passing a thumbs-up up the line to the lead. The flight then taxis to the duty runway in order.

2. Division Taxiing/Hold Short

The division taxis in the same way that a section does, using alternate sides of the taxiway and maintaining 150 ft of nose-to-tail. All aircraft in the formation should automatically switch to tower frequency when the lead turns into the hold short area.

202. FLIGHT PROCEDURES

1. Takeoff/Departure

Interval Takeoff. The interval takeoff is standard for division formation. On runways of 200 ft or wider, the procedures mirror section interval takeoffs, except with four aircraft. The lead will taxi down the runway a short distance to allow sufficient space for the remaining flight members to line up in "banana" echelon off the lead (Figure 2-1). Dash-2 will line up on the parade bearing line, Dash-3 and 4 should line up so that they can see the lead aircraft's cockpit, avoiding wing overlap. When cleared for takeoff, the lead passes the runup signal; each wingman acknowledges and passes the signal down the line, and the flight performs their engine runups.

Dash-3 and Dash-4 may retard their throttles to approximately 75 rpm percent after completing their engine checks. When the visual inspection of the aircraft on either side of you is completed, look for the thumbs-up from the aircraft behind you, then pass the thumbs-up to the aircraft ahead of you. After the lead receives a thumbs-up from Dash-2, he begins the takeoff roll. The wingmen begin their takeoff roll at a minimum of 7-second intervals (or as briefed). When the lead rolls, Dash-2 maintains MRT; when Dash-2 rolls, Dash-3 goes to MRT; when Dash-3 rolls, Dash-4 goes to MRT. Other procedures for positioning aircraft on the runway may be briefed.

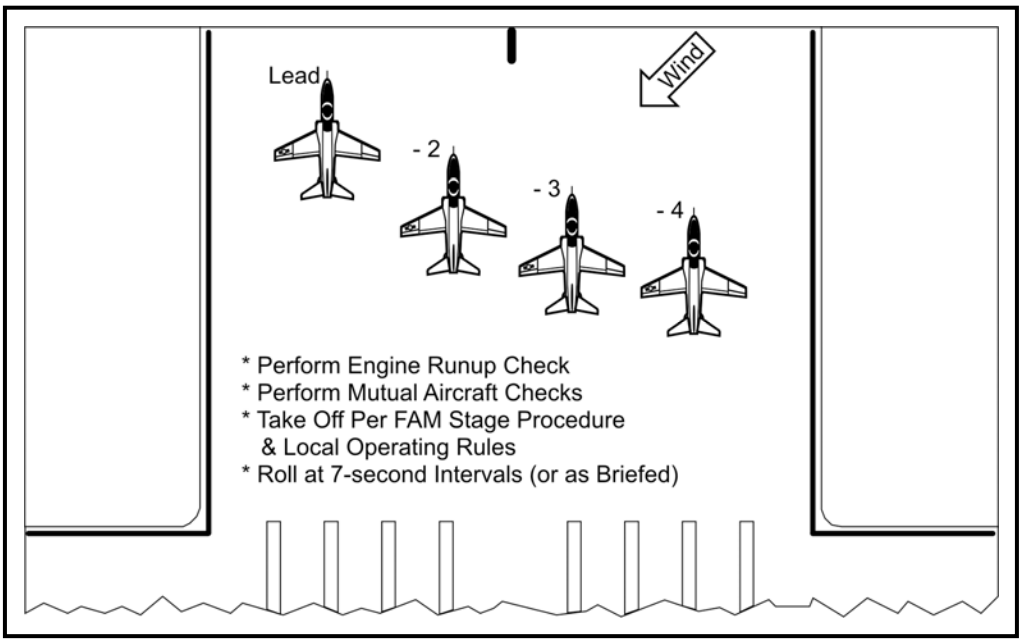

Figure 2-1 Division Runway Lineup/Interval Takeoff

Aborting. During an abort, a dangerous situation exists when aircraft are following, especially if arresting gear is required. Even though the abort procedure is the same as in section, the complexity increases with four aircraft. Nevertheless, the wingmen still completing the normal checks/scans must remain alert to the possibility of aircraft ahead aborting.

If you need to abort with flight members behind you, call "[call sign], aborting," and remain on your side of the runway until either all other aircraft are airborne and pass you, or you are cleared to centerline by the remaining aircraft. If you are aborting as the last aircraft in the flight, call "[call sign], aborting" and ease the aircraft to the centerline in preparation for taking the long field arresting gear.

Division Takeoff by Section. The division takeoff by section is used in IMC or marginal VMC. Two separate section takeoffs occur with only one section on the runway at a time. Section takeoff spacing is controlled by the release time ATC passes to the tower.

2-2 DIVISION DAYTIME FLIGHT PROCEDURES

The lead advises the tower that flight of four is requesting minimum separation between sections. After the first section receives takeoff clearance and begins their section takeoff, the tower will clear the second section to position and hold. When cleared for takeoff, the second section also performs a section takeoff. Both sections fly to the briefed TACAN rendezvous point. If aborting, use the section formation abort procedures.

2. **Initial Rendezvous/Departure/Climbout**

The division rendezvous join-up, after an interval takeoff, joins all four aircraft expeditiously while keeping the aircraft ahead in sight at all times. Procedurally, the rendezvous mirrors the section rendezvous. However, complexity increases with four aircraft.

CV Rendezvous. Level or Climbing. Refer to Figure 2-2. A CV rendezvous is basically the same as the section CV rendezvous. All aircraft must keep the lead on the horizon. If Dash-2 or Dash-3 fail to keep the lead on the horizon, rendezvousing becomes more difficult for the following aircraft forcing them to go low to keep everyone in sight. Stagnation on the bearing line by Dash-3 and Dash-4 may often be required to keep the preceding aircraft in sight. If the wingman ahead of you is slow to get aboard, stagnate on and maintain the bearing line until you can proceed with your join-up. Dash-3 and Dash-4 also need a little more power than Dash-2 after crossing the lead's radius of turn on the join-up. After join-up, the lead balances the formation by crossing Dash-2 under and Dash-3 and Dash-4 move up into balanced parade (fingertip) position. (Refer to Figure 2-4, to get an idea of that formation.)

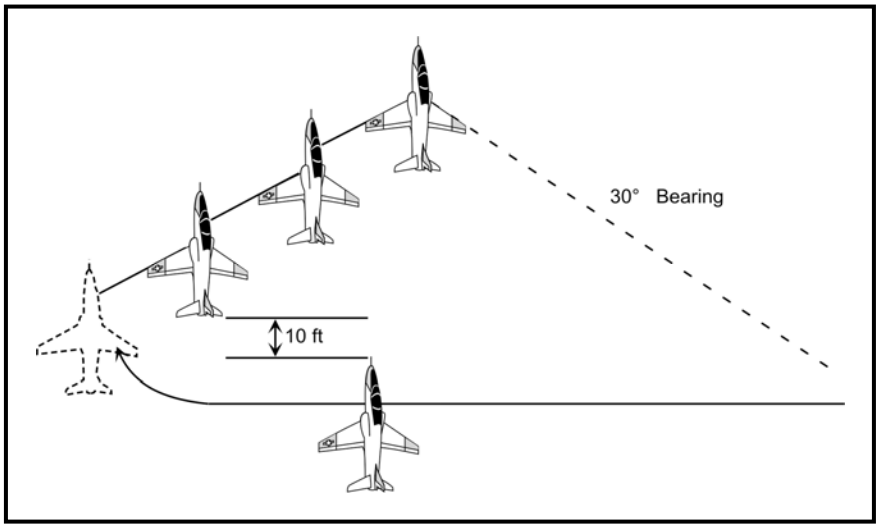

Figure 2-2 CV Rendezvous

Running Rendezvous. The lead climbs at a constant airspeed and power setting, as briefed. The wingmen normally join in balanced parade (fingertip) formation. The wingmen should take advantage of any turn the lead may make by cutting inside the lead's radius of turn while keeping all aircraft in sight (Figure 2-3).

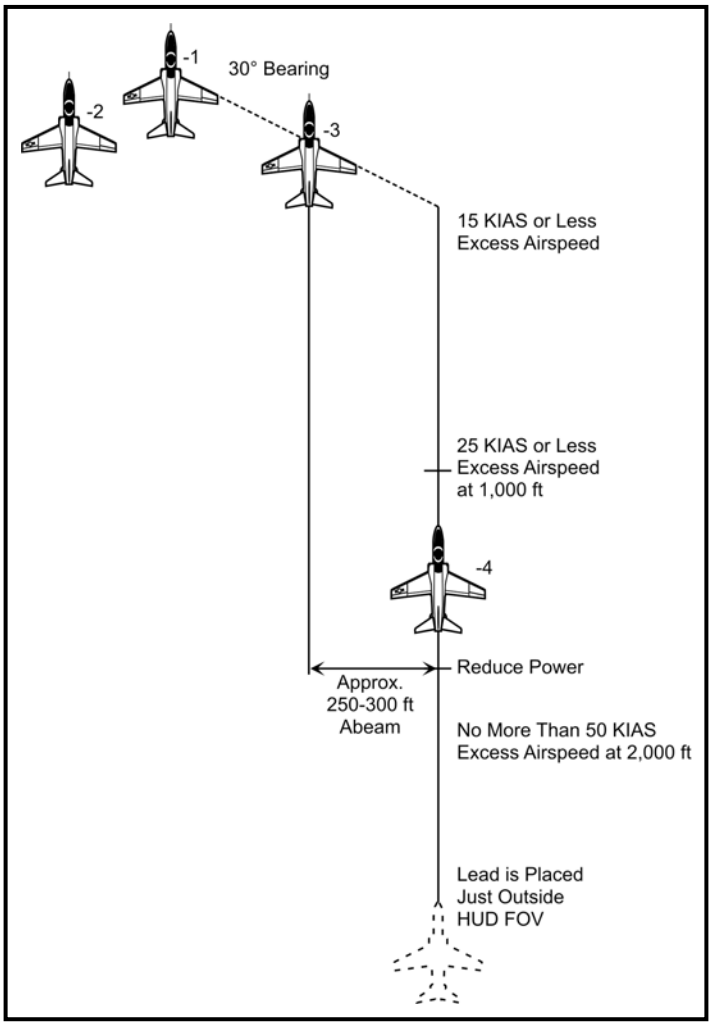

Figure 2-3 Division Running Rendezvous

Division Fuel Check. As in section formation, a fuel check is passed in balanced parade position after the initial join-up and after any lead change. The lead passes the fuel check to his wingman and the second section. The second section lead (Dash-3) then passes the fuel-check signal to his wingman (Dash-4). The second section lead passes the lowest fuel state for his section to the division lead, who then uses the lowest fuel state of the four aircraft for planning purposes.

3. Balanced Parade or Fingertip

The balanced parade position (commonly referred to as the fingertip formation) is a division formation which allows for more maneuverability and ease of flying. As in Figure 2-4, it is formed with Dash-2 on one side of the lead and Dash-3 and Dash-4 on the other side.

2-4 DIVISION DAYTIME FLIGHT PROCEDURES

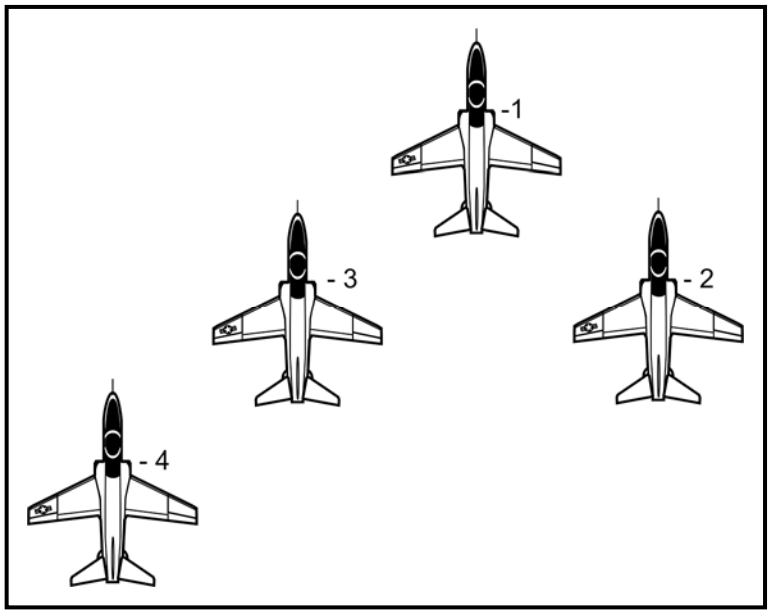

Figure 2-4 Fingertip Formation

The key to minimizing relative motion while flying division, especially as Dash-3 and Dash-4, is to maintain bearing and stepdown off the lead, while maintaining wingtip separation on the aircraft ahead.

The fingertip formation is established from echelon (see Figure 2-6, Echelon Parade) in two ways as in Figure 2-5:

1. Having Dash-2 crossunder, or

2. Having the section crossunder.

In the first case, the lead signals for a crossunder. Dash-2 passes the signal to Dash-3. Dash-3 does not pass the signal to Dash-4 due to section integrity. Dash-2 executes a "V" crossunder. When Dash-2 is clear, Dash-3 moves up to parade position on the lead's wing, and Dash-4 maintains parade position on Dash-3.

In the second case, the lead signals for a section crossunder. Dash-2 and Dash-3 pass the signal down the line, and the section (Dash-3 and Dash-4) executes a section crossunder. For a section crossunder, Dash-3 executes a "V" crossunder, maintaining nose-to-tail separation on Dash-2, and continues to a parade position on Dash-2, who is on the lead's opposite wing. As Dash-3 executes the crossunder, Dash-4 executes a "V" crossunder on Dash-3, controlling relative motion so that Dash-3 is always between Dash-4 and the lead. The second section lead (Dash-3) should not rush this maneuver because his wingman must travel a greater distance, causing the wingman to possibly lose proper position or to be spit out.

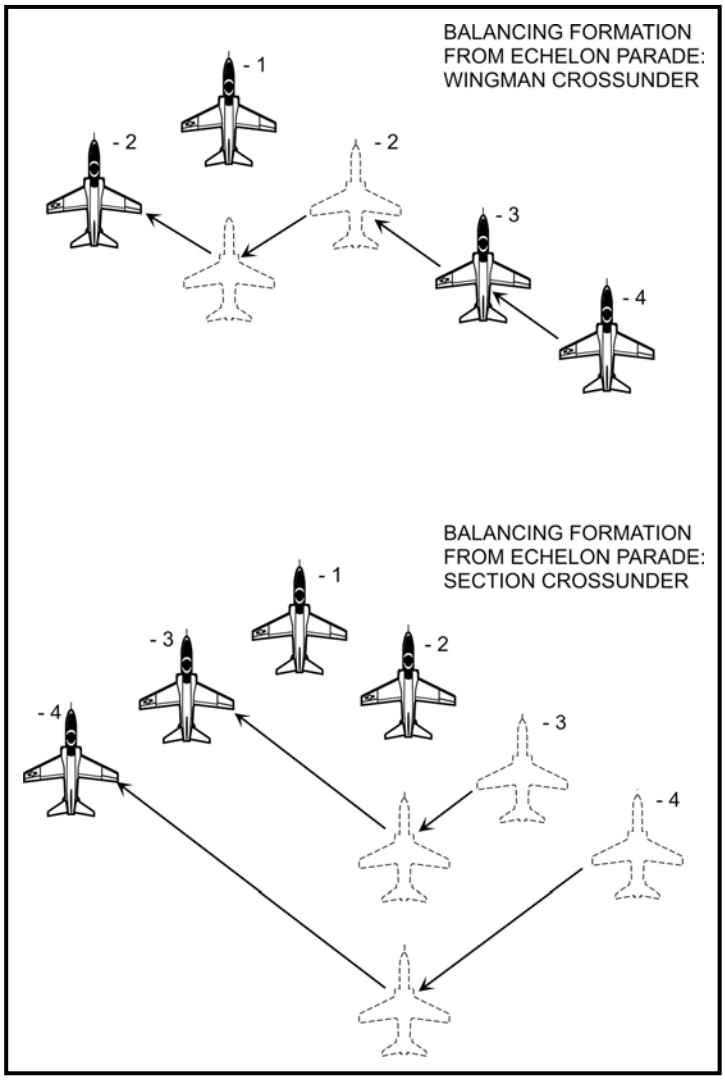

Figure 2-5 Crossunder to Establish Fingertip

4. **Parade Turns**

As a wingman in a division, your position relative to the lead during turns is the same as in section parade turns, except that Dash-4 maintains position off of Dash-3. When the lead turns away from your position, you rotate about your longitudinal axis. When the lead turns into your position, rotate about the lead's axis. Because Dash-4 is farther from the lead's radius of turn, Dash-4 must apply larger power adjustments to maintain position.

2-6 DIVISION DAYTIME FLIGHT PROCEDURES

5. **Echelon Parade**

Echelon parade (Figure 2-6) is formed when all aircraft are on the same side of the lead along a common 30-degree bearing line and each aircraft is in parade position on the preceding aircraft. Dash-2 will fly a slightly stepped down parade position to allow the other aircraft to maintain sight of the lead.

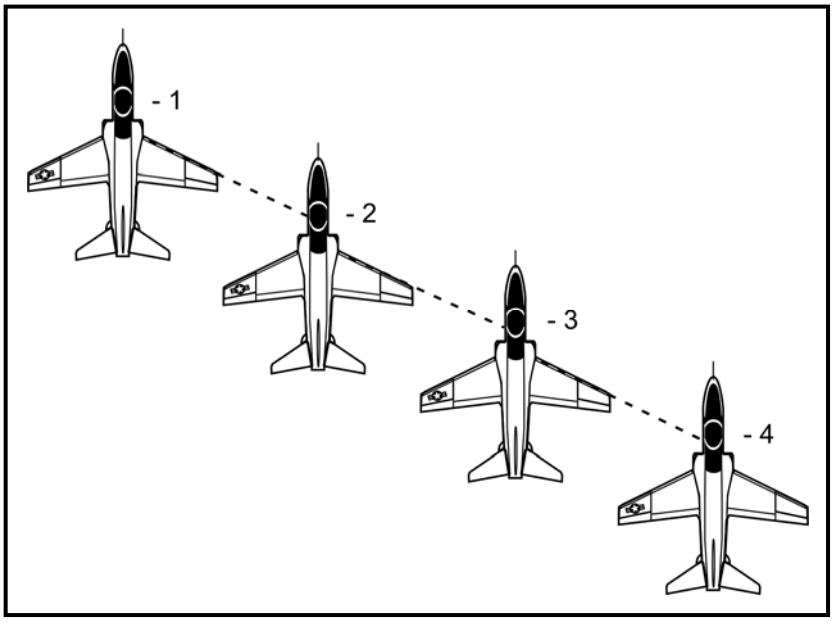

Figure 2-6 Echelon Parade

As in balanced parade, two alternatives exist to establish echelon parade from balanced parade:

1. The second section crosses under the first section, or

2. Dash-2 crosses under.

In the first case, after receiving the section crossunder signal and passing it to Dash-4, Dash-3 moves aft to obtain proper nose-to-tail separation on Dash-2. The section then performs a "V" crossunder referencing Dash-2 and the lead (see Figure 2-7). As described in balanced parade, Dash-4 executes the "V" crossunder on Dash-3, keeping Dash-3 between himself and the lead.

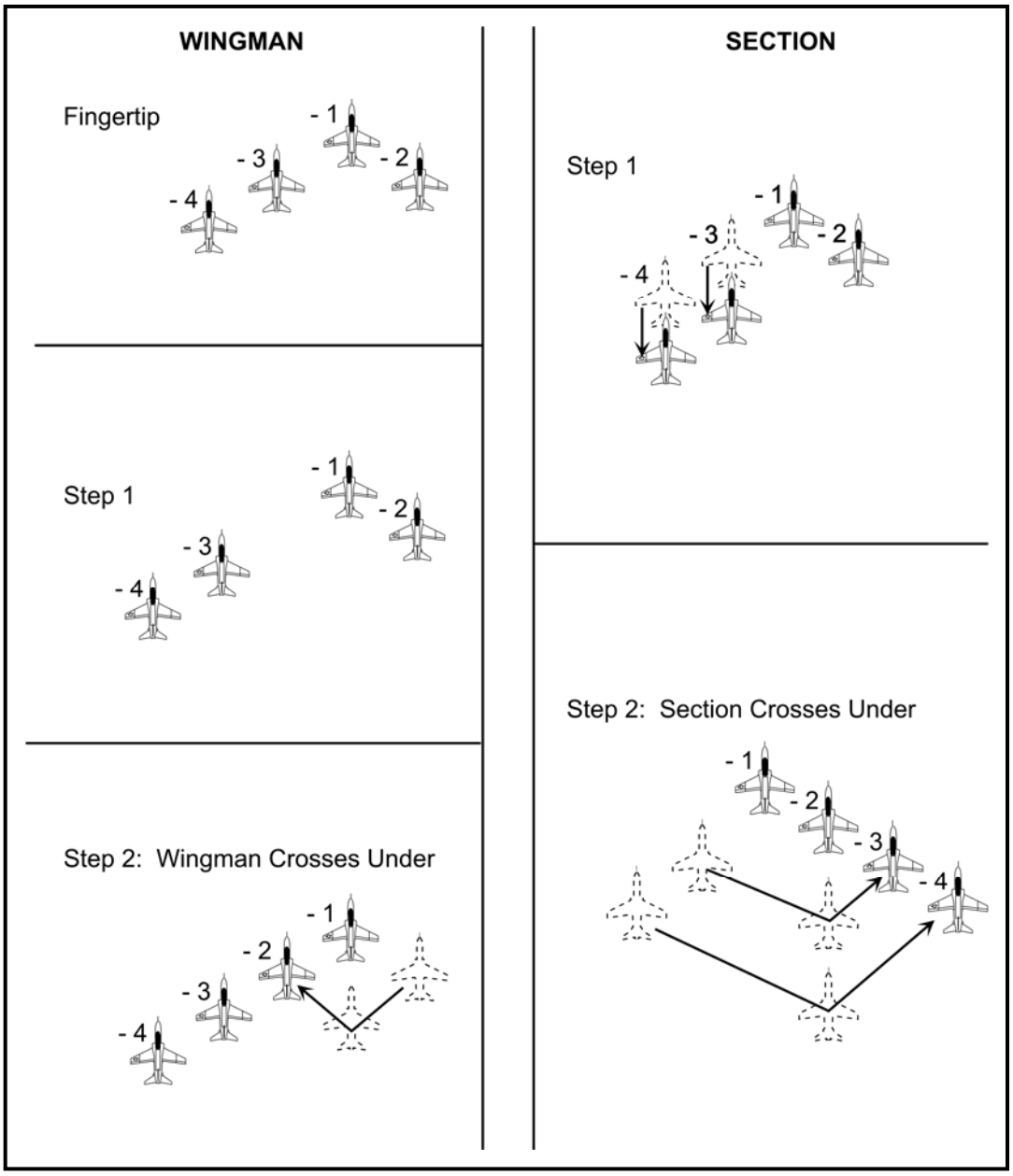

Figure 2-7 Crossunder to Establish Echelon Parade

In the second case, the lead passes the crossunder signal to Dash-3. Then, Dash-3 and Dash-4 move diagonally out the bearing line to leave a slot open for Dash-2. When the lead observes Dash-3 moving aft, he signals Dash-2 to cross under. Dash-2 performs a "W" crossunder on the lead and moves into the open slot between the lead and Dash-3.

As a wingman, your position relative to the lead during turns in echelon parade is the same as in section parade turns. When the lead turns into your position, rotate about the lead's axis. When the lead turns away from your position, rotate about your own longitudinal axis. Because Dash-3 and Dash-4 are farther from the lead's radius of turn, larger power changes will be required to stay in position.

For training purposes, turns away from echelon are executed at 30 degrees AOB for a minimum of 180 degrees. Turns into the echelon are not normally executed, but, if required, they should be very shallow – no more than 10 degrees AOB.

6. **Breakup and Rendezvous Exercise**

Similar to the section breakup and rendezvous exercise, this maneuver is performed IAW the section procedures with exceptions noted below (refer to Figures 2-8 and 2-9).

Breakup. The lead puts the flight into echelon (Figure 2-8). As he continues to clear the area, the lead passes the breakup signal. Dash-2 and Dash-3 pass the signal down the line. The lead performs the breakup as in section formation. Dash-2 sets the break interval by breaking 2 seconds after the lead and matching his turn. Dash-3 and Dash-4 will break using the same interval set by Dash-2, making the break interval symmetric. The wingmen keep the lead on the horizon throughout the break while maintaining airspeed.

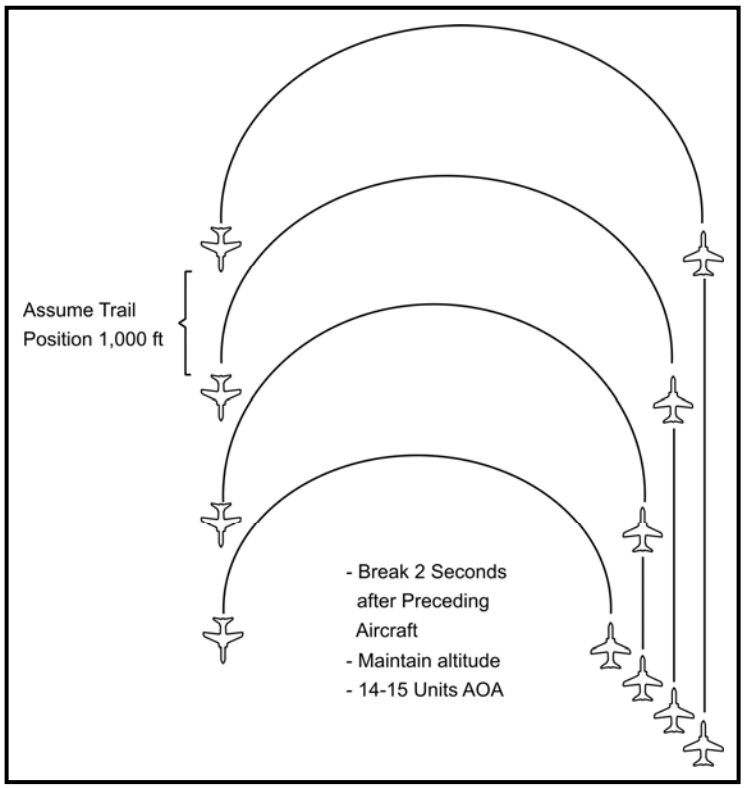

Figure 2-8 Division Breakup

The wingmen then roll out of the turn in trail behind the lead with 1000 ft of nose-to-tail at rendezvous airspeed. To avoid the jetwash, the wingmen should fly slightly stepped up. The wingmen should not adjust airspeed to compensate for nose-to-tail error in trail. Fifteen seconds after rolling wings level, the lead begins the rendezvous turn using 30 degrees AOB in either direction. Each wingman turns to intercept the bearing as soon as the preceding aircraft is 10-20 degrees off his centerline (out of the HUD glass).

Rendezvous. The rendezvous is performed in the same manner as the section rendezvous, except that the wingmen should adjust their AOB when turning out of trail position: Dash-2 at no more than 45 degrees AOB, Dash-3 at no more than 40 degrees AOB, and Dash-4 at no more than 35 degrees AOB. These bank angles help to preclude wingmen from going acute as the lead's bearing line sweeps aft. The wingmen anticipate intercepting the bearing line by shallowing their AOB.

When the wingmen arrive on the bearing line, they should begin aligning their fuselages with the lead's, as in Figure 2-9. The wingmen keep the lead on the horizon as they move up the bearing line, and then hold the lead stable on bearing and altitude as they monitor airspeed, not allowing their closure rate to exceed rendezvous airspeed by more than 10 KIAS. Stagnation on the bearing line by Dash-3 and Dash-4 may be required to keep all preceding aircraft in sight. The wingmen monitor their airspeed until close enough to visually discern relative motion. While on the bearing line they will see the lead's vertical stabilizer intersect with the lead's wingtip. If they become acute, the lead's wingtip will appear forward of the vertical stabilizer. Conversely, if sucked, the lead's wingtip will appear behind the vertical stabilizer. Dash-3 and Dash-4 remain on the lead's bearing line and altitude until they begin their join-up.

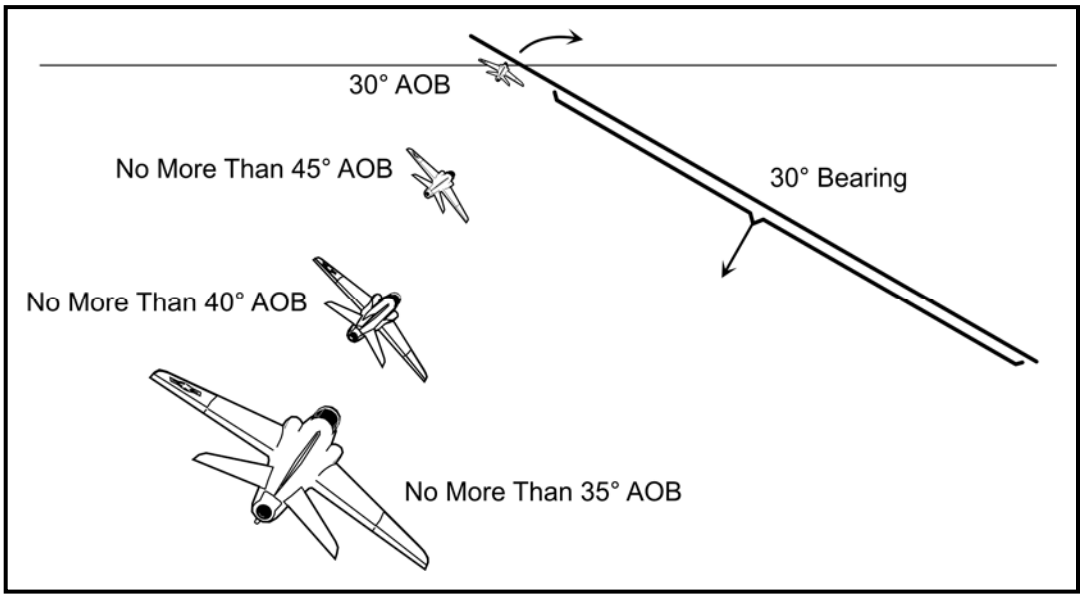

Figure 2-9 Division Rendezvous

Join-up. Assuming that the preceding aircraft is in position, Dash-3 and Dash-4 will transition to the crossunder as they approach the projected leading edge of the stabilator of the aircraft ahead. Without pausing on the lead's radius of turn, they continue crossing below and behind the preceding aircraft with 10 ft nose-to-tail and 15 ft of stepdown into the parade turn away position. The wingman requires more power as he moves outside the lead's radius of turn.

7. **Underrun**

The underrun in division is similar to the underrun in section. Situations which dictate an underrun are uncontrolled closure in-close, or when the wingman is extremely acute and unable to return to proper bearing prior to join-up.

Whether a wingman recognizes the need to underrun or he is ordered to underrun by the lead, it is performed the same way. The wingman simultaneously lowers the nose to ensure vertical separation, levels the wings, reduces power to idle, and extends speed brakes. He then notifies the lead of the underrun by calling, "[call sign], position number, underrunning." The wingman passes below and behind all preceding aircraft and stabilizes outside the flight lead's radius of turn at a parade turn-away position at approximately 200 ft and slightly stepped up on the lead so as to be visible to other aircraft still rendezvousing. Any aircraft that is behind the underrunning aircraft should complete the rendezvous and join in parade echelon.

When cleared to rejoin the flight by the lead, the wingman moves below and behind the flight to return to the rendezvous bearing on the inside of the turn. When directed by lead, the appropriate aircraft will move back, leaving a space for the joining aircraft. The underrunning aircraft then executes the join-up moving into the open slot. The lead continues to turn until the underrunner has joined up.

In the event that multiple aircraft need to underrun during a division rendezvous, great care must be taken to remain clear of all aircraft during the procedure. The first aircraft to execute an underrun will pass below and behind all preceding aircraft and establish the "perch" position described above. Any subsequent underruning aircraft will also pass below and behind all preceding aircraft and establish the perch position outside of the previous uderrunner. In general, the last aircraft to underrun will be the first aircraft cleared to re-join using the procedures described above. Exercise caution during this process as aircraft may not be in their original position after a multiple aircraft underrun. A good rule of thumb is that only one aircraft should be moving at any given time, and only when the lead directs.

8. Cruise Maneuvering

Division cruise positions for Dash-2 and Dash-4 are similar to the section cruise position with Dash-2 maintaining position off the lead and Dash-4 maintaining position off of Dash-3 as in Figure 2-10. Dash-3's cruise position is on the 45-degree bearing line from the lead with 20 ft of nose-to-tail and 15 ft stepdown from Dash-2. Each wingman is free to maneuver within his allotted airspace to maintain position during turns. When lead gives the cruise signal, Dash-2 will automatically balance the flight. During division cruise maneuvering, Dash-2 flies cruise on the lead as in section cruise maneuvering. Dash-3, the second section leader, flies on the 45-degree bearing from the division lead (Dash-1) and maintains nose-to-tail and stepdown off of Dash-2. Dash-4 flies cruise on Dash-3 as in section cruise maneuvering. When the lead rolls wings level, the flight returns to balanced formation. The second section lead (Dash-3) chooses the side of the lead on which to fly and the division lead's wingman (Dash-2) balances the formation by moving to the opposite side of the lead from Dash-3.

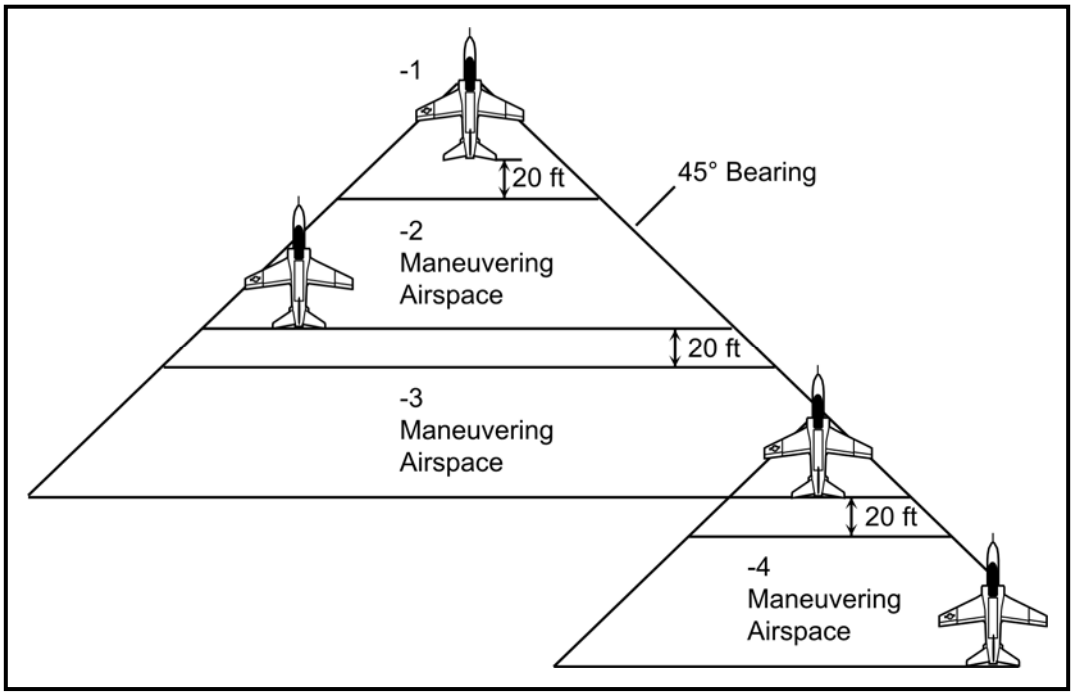

Figure 2-10 Division Cruise

Shuffle Division. Since all division formation flights will have a dedicated lead, there is no "lead" change. In order to reorder the division so students get practice in all positions, a "shuffle" will be accomplished from a balanced parade formation. The lead will transmit over the radio, "Dash-2, you are now 4." Upon hearing this, Dash-2 responds, "Roger," and moves aft and down laterally, performing the first half of a "V" crossunder on the lead. Continue the motion to move in a straight diagonal line across the formation. The line should pass through the column position of each aircraft (see Figure 2-11). Complete the maneuver by executing the second half of a "V" crossunder on the new Dash-3.

When the former Dash-2 passes behind the last aircraft and completes the crossunder to join up in parade position as Dash-4, the lead will commence the entire division formation sequence again beginning with crossunders.

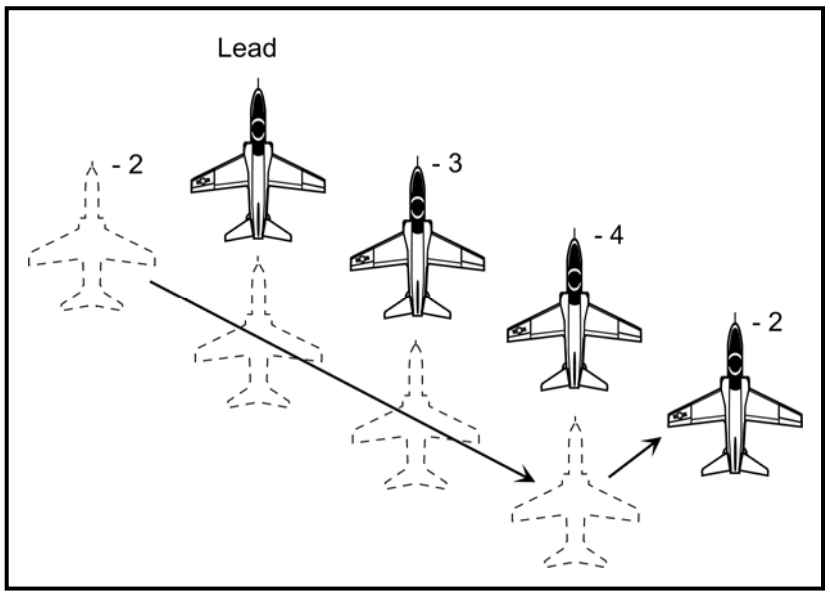

Figure 2-11 Shuffle Division

203. APPROACHES

Field Entry Procedures

1. **Division Overhead Entry**

The division overhead entry and break interval are the same as the section overhead entry as shown in Figure 2-12. The lead must plan the overhead entry to give the wingmen time to establish parade echelon prior to arriving at the airfield but not so soon that extended or steep turns into the echelon formation are required to line-up with the runway. As in the breakup and rendezvous exercise, Dash-2 sets the break interval (normally 4 seconds), and all aircraft keep the lead on the horizon.

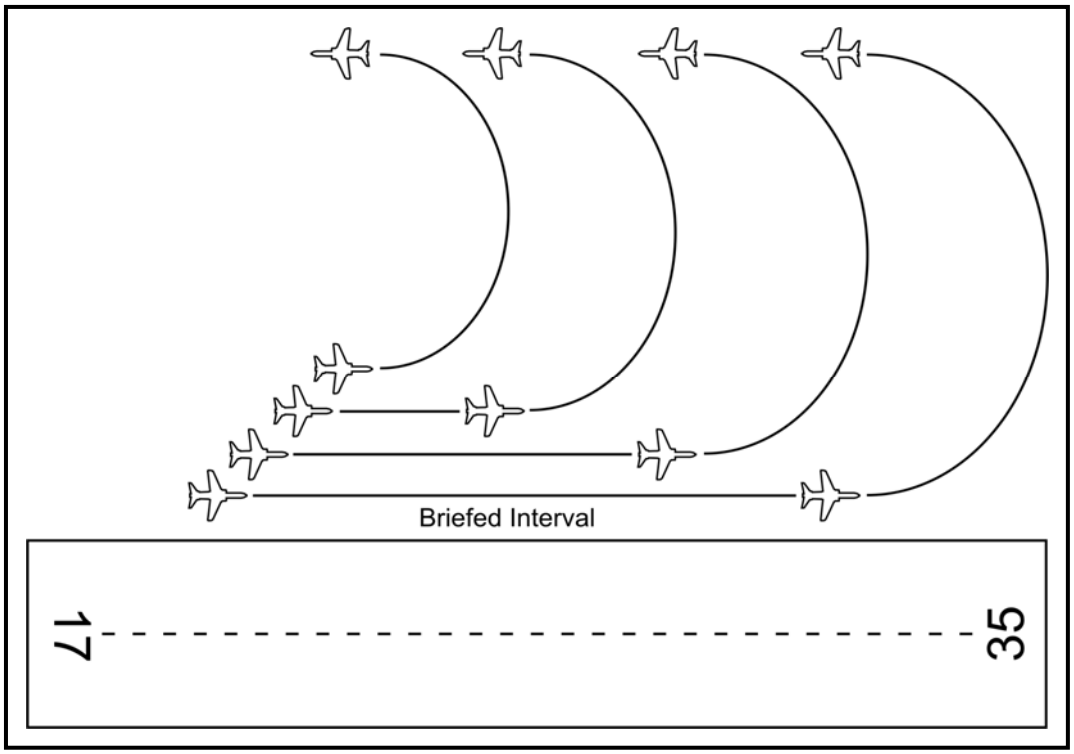

Figure 2-12 Division Overhead Entry

2. **Formation Recovery to Division VFR Straight-in**

The division VFR straight-in approach facilitates a landing when a situation like fuel state, hung ordnance, or emergencies make it necessary to do so. The aircraft do not enter the overhead break pattern but land off a straight-in approach.

The flight lead requests a straight-in approach for a flight of four. The lead should initiate flight breakup at approximately 8 miles, so that, when the lead is at 3 miles from the airport, all flight members are established in trail with 1000 ft separation. To establish trail position, the lead radios to detach each wingman at 20-second intervals, beginning with the last wingman in the flight. The lead should detach the wingmen in level flight. After detaching, the wingmen should immediately orient themselves as to their altitude, airspeed, rate of descent and position in relation to the runway.

When detached, each wingman reduces power smoothly to idle, dirties up at 200 KIAS, and slows to approach speed. Twenty seconds after detaching Dash-2, the lead dirties up in the same manner as the wingmen. If the lead makes any turns, the wingmen must follow his track over the ground to maintain 1000 ft of interval on the aircraft ahead. When lined up on the extended runway centerline and intercepting the visual glide path, a normal rate of descent is established.

The proper glide path is maintained with reference to the runway, using the ball when possible, remembering that glide path information from the ball is less precise at greater distances from the lens. To ensure safe ground clearance, no division member will descend below 300 ft AGL without acquiring the ball. The lead lands on the downwind half of the runway, and each subsequent wingman will land on alternating sides of the runway.

3. **Section Recovery**

If weather would dictate taking the division through IMC on the recovery, the flight lead will normally separate the flight into two sections provided there is another section lead in the flight. The sections will then recover on a section approach or to the over head weather permitting. Without another section lead, the remaining two aircraft will recover individually.

4. **Three Plane Contingency**

In the event a division sortie is conducted as a three plane, the lead should brief and execute the flight sequence as follows in order to expose the wingmen to the maneuvers and sight pictures they will see in a four plane:

After the initial rendezvous, the lead should conduct parade turns in echelon to simulate dash-3 and 4 in fingertip. Next, lead should pass the section crossunder signal via dash-2 to dash-3 who then executes a standard section crossunder to parade position with an imaginary dash-4. Next, dash-3 is given the standard crossunder signal by lead. This is the signal for dash-3 to back away from lead and create a space. The lead should then crossunder dash-2, via standard crossunder signal, who then crosses into the space left by dash-3. In order to simulate a normal section crossunder, the lead should now signal, via "push away" hand signal or over the radio, for dash-2 and 3 to back away from the lead and assume the positions of dash-3 and 4. The lead will then pass the section crossunder signal to the "section" who will then execute a section crossunder, arriving in parade echelon. The formation should now be in position for breakup and rendezvous. Fuel permitting, 3 B&Rs should be conducted during each iteration of the sequence. In order to simulate the sight picture normally seen from the dash-3 and 4 positions, dash-2 should delay 4 seconds before breaking with dash-3 following 2 seconds later on at least one B&R in each sequence. The cruise sequence should be performed with a notional dash-4. Dash-2 shall always balance the formation.

204. FLIGHT SEQUENCE

1. Division (4-Plane)

Marshal/taxi/takeoff
Four-plane 250-knot initial rendezvous in echelon
Section crossunder
Balance parade turns, finger-tip formation
Crossunder, dash-2 into the section
Breakup and rendezvous (X 2)
Cruise maneuvering
Shuffle division
Formation
Recovery
Landings

NOTE

After the shuffle, repeat the crossunders, turns, B&Rs, and cruise maneuvering so that wingmen get practice from each position in the flight. Following the last shuffle, the flight members are in their original positions.

2. Division (3-Plane)

Marshal/taxi/takeoff
Three-plane 250-knot initial rendezvous in echelon
Parade turns in echelon
Section crossunder (dash-3 only)
Crossunder dash-2 into the section
Section crossunder (dash-2 and 3 simulating dash-3 and 4)
Breakup and rendezvous (X 3 fuel permitting)
Cruise maneuvering
Shuffle division
Formation
Recovery
Landings

NOTE

After the shuffle, repeat the crossunder, B&Rs, and cruise maneuvering so that wingmen get practice from each position in the flight. Following the last shuffle, the flight members are in their original positions.

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CHAPTER THREE
NIGHT FORMATION FLIGHT PROCEDURES

300. INTRODUCTION

Because at night relative motion is harder to discern and the wingman is more susceptible to vertigo due to limited visual cues, most maneuvers are performed slower at night using different techniques than daytime to identify positional errors. The techniques and gouges for night formation are referenced in the appropriate procedure.

301. GROUND PROCEDURES

The pilots perform preflight, start, and taxi to marshal exactly as they would in the Night Fam stage.

1. Lightning Configuration

The wingman's lighting configuration (Table 3-1) is similar to the Night Fam stage, except that strobe lights are not used during night formation. In general, the lead flies with his external lights on dim and steady and with his anti-collision and strobe lights off, or as briefed. The interior lighting should be adjusted as dim as possible to prevent glare on the canopy but still enable scanning of the instruments.

LIGHT	LEAD	WINGMAN
Wing	Dim	Bright
Tail	Dim	Bright
Formation	Dim	Bright
Navigation	Steady	Steady
Landing	Off	On
Anti-collision	Off	Rotating
Strobe	Off	As Briefed

Table 3-1 Night Landing Configuration

2. Aircraft Marshal

These procedures are the same as daytime marshaling.

3. Taxi/Hold Short

Night taxi/hold short procedures are similar to the day procedures with a few exceptions:

a. Taxi speed is slower (twice the caution, half the speed)

b. The flight taxis on the centerline with the wingman maintaining 300 ft separation

c. As the lead arrives at the hold short area, the flight switches to tower

d. Individual takeoff procedures apply

The lead calls for takeoff, and then the wingman calls for takeoff.

Due to the difficulty in seeing relative motion at night, the wingman must draw on all available visual cues - for example, using the number of taxi lights between the lead and the wingman to maintain proper taxi interval. Use the taxi light, if it is desired, whenever it will not blind other pilots or ground crew personnel.

302. FLIGHT PROCEDURES

1. Takeoff/Departure

Night takeoffs are performed on instruments from rotation until the aircraft is safely airborne.

Individual Takeoff. Normally individual takeoffs followed by TACAN rendezvous are performed at night. The lead positions on the runway the same as in day formation with lights on bright and anti-collision on. The wingman holds short of the runway. When cleared for takeoff, the lead performs his runup, completes his checks, and performs an individual takeoff. When cleared by the tower, the wingman taxis into takeoff position and completes his checks. With checks complete and lead safely airborne, Dash-2 begins his takeoff roll. The lead and the wingman perform the night takeoff as in the Night Fam Stage.

Aborting. Night abort procedures are the same as during the day. However, since the visual cues are limited, neither the lead nor the wingman should hesitate to radio in order to clarify intentions. Voice communications are critical during night formation.

2. TACAN Rendezvous

Even though the procedures for a night TACAN rendezvous are the same as for day, some techniques are different. The lead makes sure his strobe light is on. The wingman maintains stepdown of 500 ft below the briefed rendezvous altitude.

When the wingman sees the aircraft he believes to be the lead, he confirms sight of the lead by transmitting "[flight call sign], strobes." When the lead hears this transmission, he turns off his strobe lights. When the lead's strobe lights go off, the wingman calls "Visual." If the lead aircraft is still not in sight, the wingman flies to Point 1 at 500 ft below rendezvous altitude and commences 30-degree AOB turn at 250 KIAS. After the wingman is established in the working area and after confirming visual with lead, the wingman should "strangle parrot" (IFF to standby) and secure his own strobe light.

When the wingman is visual and established on bearing with relative fuselage alignment, he then moves up to co-altitude and conducts a night rendezvous. The wingman flies a maximum of 45 degrees AOB to intercept the bearing line, using the lead/lag method to align fuselages.

When the wingman is close aboard and has transmitted "Lights," the lead turns his anti-collision light off and his external lights to dim and steady, or as briefed.

3. Carrier Rendezvous

Differences exist between day and night rendezvous, both in procedure and technique. You conduct a nighttime carrier rendezvous at co-airspeed using turn radius instead of airspeed to achieve closure. During the initial part of the rendezvous, the wingman needs to maintain an inside/outside scan, monitoring airspeed and altitude on instruments while maintaining rendezvous position on the lead by looking outside.

You will find it difficult to get bearing line information using day visual cues on the lead's aircraft. As a wingman intercepting the bearing line, turn across the lead's tail toward the rendezvous bearing line. With fuselages approximately aligned, place the lead's lights in the windscreen just in front of the canopy bow. Use instruments to control closure and altitude until you can discern relative motion and altitude off the lead. Maintain the lead in this position until you can distinguish individual position lights on the lead. If the lead's anti-collision light appears above and midway between the tail light and wingtip light, forming a light triangle, you are on the correct bearing (see Figure 3-1). All night rendezvous reference this same light triangle.

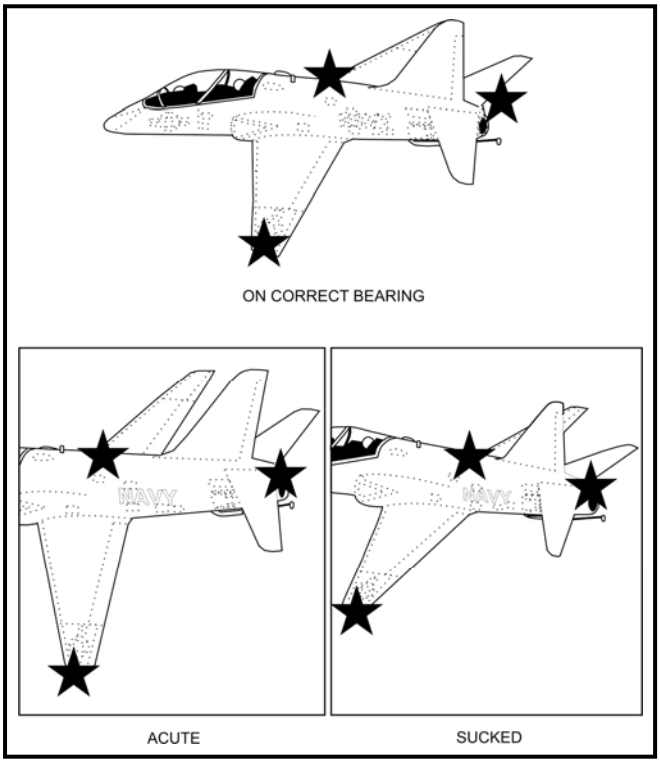

Figure 3-1 Night Light Triangle Reference

While this position is more sucked than the daytime bearing, it is easier to monitor and allows more margin for error. If the anti-collision light is close to the wingtip light, you are acute. If you are sucked, the anti-collision light will appear closer to the tail light than the wingtip light.

When the wingman is close aboard and has broadcast "Lights," the lead turns his anti-collision light off and his external lights to dim and steady, or as briefed. The wingman executes a normal join-up and crosses under into the IFR parade turn-away position. When within 100 ft of the lead's aircraft, the wingman will see closure rate better up close because his external lights will partially illuminate the lead.

4. **Parade Turns**

The procedures for nighttime IFR parade turns are the same as the daytime IFR procedures (Figures 3-2 and 3-3).

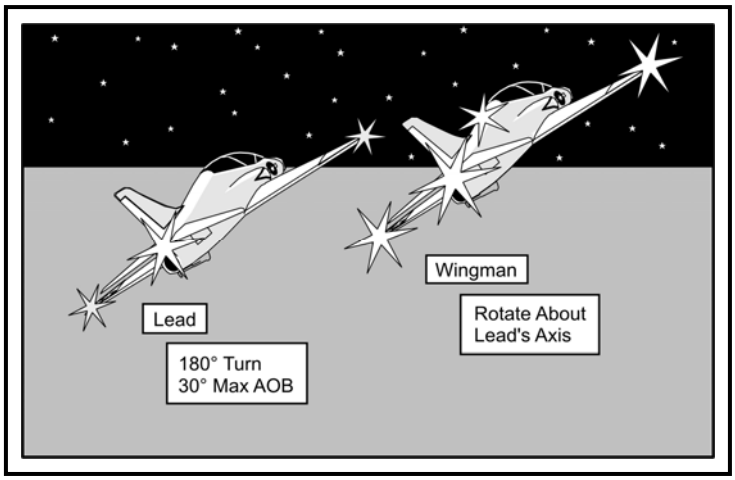

Figure 3-2 Parade Position-IFR Turn Away

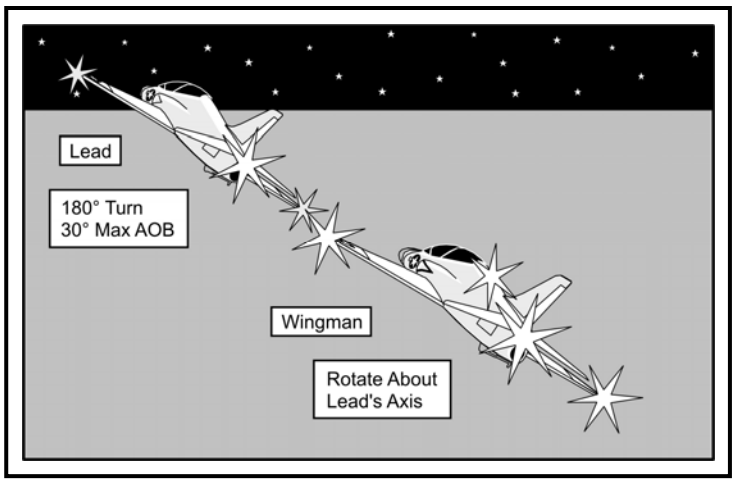

Figure 3-3 Parade Position-VFR/IFR Turn Into Wingman

3-4 NIGHT FORMATION FLIGHT PROCEDURES

5. **Crossunder**

The box crossunder will be used at night. The procedures for the nighttime crossunder are the same as for daytime. The command will be given over the radio.

6. **Breakup and Rendezvous Exercise**

The procedure is similar to daytime with the following exceptions:

a. To kiss off the wingman, the lead switches his external lights to bright and steady and turns on his anti-collision light

b. Breakup is performed with a 2-second interval at 14-15 units AOA, 250 KIAS, and 180 degrees

c. The lead rolls wings level and waits about 10 seconds for the wingman to get established in trail

d. The lead then rolls into a 30-degree AOB turn in either direction maintaining rendezvous airspeed and altitude. When the lead begins the turn, the wingman waits until the lead is 10-20 degrees left or right of the nose, then initiates an AOB turn (not to exceed 45 degrees) to begin the rendezvous. Ensure an inside/outside scan while maintaining rendezvous position. The wingman maintains rendezvous airspeed and performs a co-airspeed rendezvous.

The rendezvous and breakup techniques are discussed in the Carrier Rendezvous section.

7. **Underrun**

The procedures for the nighttime underrun are the same as for daytime, except that after the underrun, maintain altitude outside lead's radius of turn and establish 500 ft stepdown and 250 KIAS.

NOTE

Do not maneuver to day "stepped-up" position.

8. **Running Rendezvous**

Night running rendezvous procedures are similar to day procedures. However, night closure cueing is difficult to discern, especially when closing from the rear quadrant. This is mainly because there is very little surface area of the lead's aircraft that is visible from the six o'clock position. Additionally, the AFT navigation light of the lead will tend to create a halo around the aircraft, essentially shrouding the aircraft as invisible other than a white glow. For this reason, the extreme aft cone of the lead aircraft (20 degrees to either side of the lead's tail) should always

be avoided. So, just as in the day procedure, the lead should initially be placed just outside the HUD field of view when the wingman attains the trail position.

Airspeed will be closely monitored so that the wingman arrives at 2000 ft with no more than 25 kts of closure. Just as in the day procedure, it is imperative that a proper distance abeam is set and maintained. Wingman must be vigilant in preventing their aircraft from banking into and "mothing" toward the lead. Instead, the wingman's aircraft should track forward on a course parallel to the lead's, toward the extended bearing line. Power should be reduced so that at 1000 ft, no more than 15 kts of closure exists. Inside 1000 ft, as the lead tracks aft on the canopy, additional aircraft lighting should become visible. The tracking rate on the canopy (provided the wingman is maintaining a straight flight path and not banking toward the lead) is of course the primary visual closure cue (constantly cross-checked with airspeed). By flying slightly stepped down (approximately 10 ft), the bottom anticollision light should be visible. The bearing line is achieved by aligning the bottom anticollision light with the wingtip light. Closure to the parade position should not begin prior to achieving the bearing line. Once the bearing line is acquired the wingman will then move inboard to the parade position using no more than 5 kts of closure, calling for "lights" if required. (Figure 3-4)

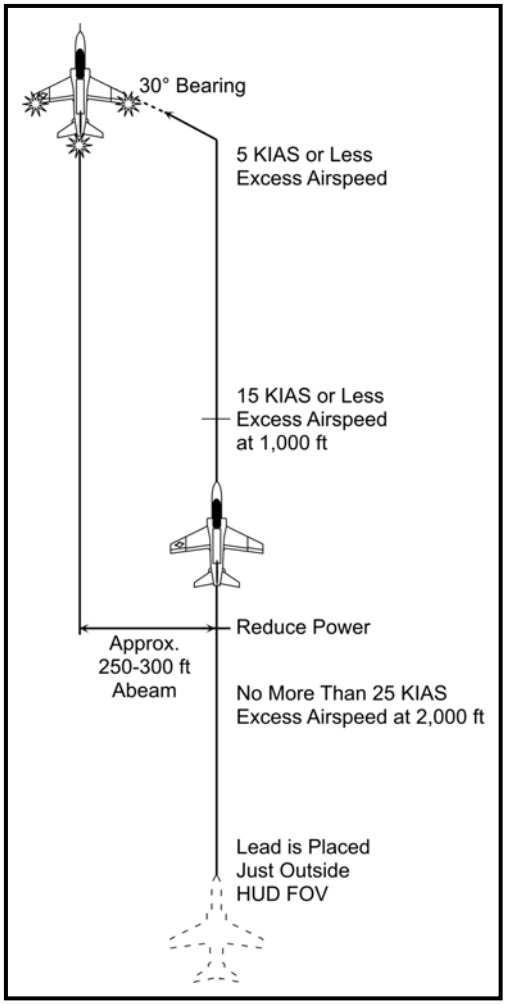

Figure 3-4 Running Rendezvous

3-6 NIGHT FORMATION FLIGHT PROCEDURES

9. Lead Change

Lead change procedures are the same as day except that external lights and the radio will be used to confirm the lead change. This procedure is known as "lights, lips, lips, lights." To initiate the lead change, the lead should switch his external lights to bright and steady, turn on his anti-collision light, and transmit "[flight call sign] two, you have the lead." Dash-2 says "[flight call sign] two has the lead." The new lead will cut off his anti-collision light and set lights on dim. The new lead should expeditiously turn off his anti-collision light and begin an inside/outside scan to maintain flight profile. The new wingman should execute the lead change slowly and deliberately, keeping relative motion under control. The new wingman must avoid fixating on any single light to prevent angling into or away from the new lead. As soon as possible, the new wingman should turn on his anti-collision light.

If the lead is NORDO, the lead has two procedures to signal a lead change. First, the lead switches his external lights to bright and flashing to indicate that he is NORDO. He then switches his anti-collision light on to indicate the lead change.

Second, in the case that the lead's external lights are inoperative, he would shine the flashlight at his own helmet and then shine it toward the wingman. In either case if the wingman accepts the lead, he secures his anti-collision light and switches external lights to dim and steady. If the wingman were to decline the lead, he continues flying wing, does not change his lights, and signals "No" with the flashlight.

10. Lost Sight

The aircraft who has lost sight transmits "[call sign], lost sight." The other aircraft either calls a visual and directs the join-up or confirms mutual lost sight. If mutual lost sight exists, the lead directs a TACAN rendezvous. If NORDO, the flight performs the briefed lost comm/lost sight procedures.

303. APPROACHES

1. Night Section Penetration with Instrument Approach

The procedures for a night section approach are very similar to the day procedures. The lead will extinguish his landing light while the wingman's remains on. (Consideration may be given to extinguishing both landing lights when in IMC conditions as the landing light tends to cause disorientation.) Additionally, all configuration changes are transmitted over the radio as described in the day procedures section.

A night section approach may conclude in any manner that a day approach would. (Section missed, split for landing or touch and go rejoin.) Procedures are similar, however, configuration changes will of course be given over the radio. Lead may signal the wingman to detach for landing by switching his lights to bright and steady with anti-collision on, while turning smartly away from the wingman.

2. **Section Overhead Entry (Break)**

The nighttime procedures for the section overhead entry break are very similar to daytime procedures. However, the airspeed for the break should be a 300 KIAS level pull. Signal the break by turning exterior lights to bright and steady and the anti-collision lights on. The flight then breaks ensuring a level break to arrive at the proper abeam position.

3. **Section Instrument Approach with Wingman NORDO**

To signal the lead that he is NORDO, the wingman switches his external lights to bright and flashing. In VMC conditions at night, the lead aircraft will most likely bring the NORDO wingman into the overhead. The lead will be responsible for coordinating the NORDO wingman's permission to land with tower via the radio. At military airfields, the NORDO wingman should expect cut-lights or ALDIS lamp signals as in the day. If a section approach is required, the lead aircraft will signal section dirty-up for the approach by using his flashlight. The signal will be a circular "cranking the gear" movement. He should repeat the circling motion three times, pausing on the final rotation at the top of the circle and then dropping the light smartly below the canopy rail. This signals the wingman to lower landing gear and select the standard half flaps setting for approaches.

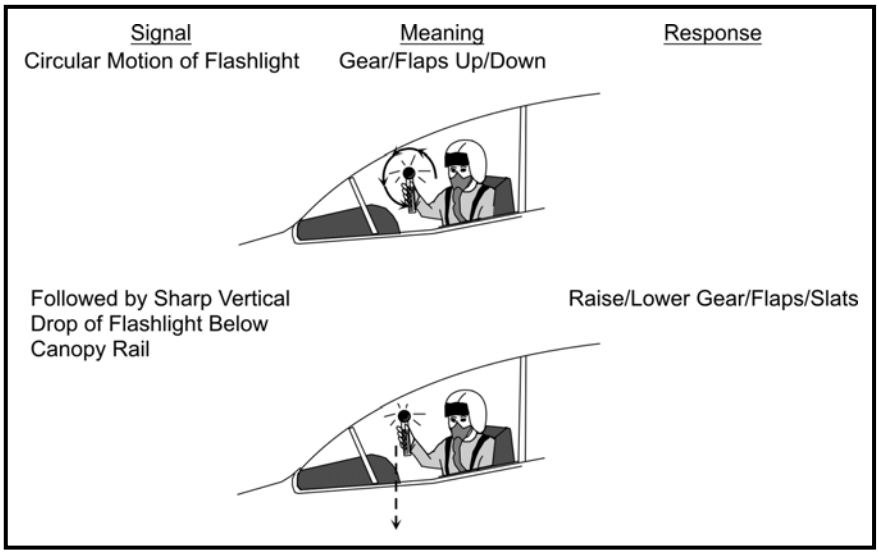

Figure 3-5 Gear/Flaps Up/Down Night Visual Signal

4. **Full-Stop Landings**

All student full-stop landings will be on centerline.

304. NIGHT FORMATION SIGNALS

Because hand signals are hard to see at night, radio calls are the primary means for signaling. Other circumstances, such as NORDO, require using a flashlight or exterior lights to pass signals. Use the following flashlight signals (Figure 3-6) under NORDO conditions:

Yes: repeatedly move the flashlight in a circular motion
No: repeatedly move the flashlight horizontally back and forth

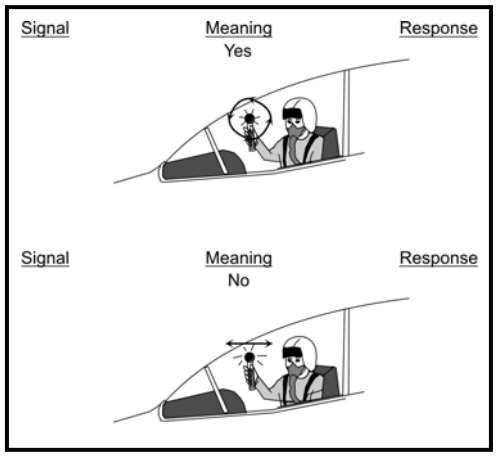

Figure 3-6 Night Visual Signals-Yes/No

HEFOE: Hold the flashlight close to the top of the canopy (Figure 3-7); then point toward the other aircraft and present "dashes" to indicate the system affected:

One dash	=	Hydraulic system
Two dashes	=	Electrical system
Three dashes	=	Fuel system
Four dashes	=	Oxygen system
Five dashes	=	Engine

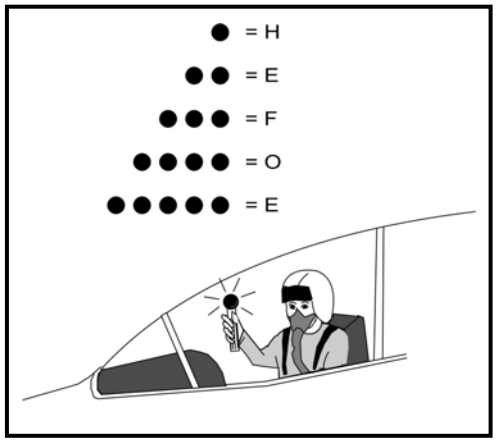

Figure 3-7 Night Visual Signals-HEFOE

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CHAPTER FOUR
SAFETY/EMERGENCY PROCEDURES

400. INTRODUCTION

As you fly in close proximity to one another, you need to be cognizant of more than just individual procedures. As lead, you must remember that you have at least one wingman and any action you take affects him. As wingman, you must have situational awareness at all times. If either of you forgets, the potential for a midair exists.

Within this FTI, procedures for specific emergency situations have been explained where they are most likely to occur. In this section, we will provide some focus on those procedures, as well as additional procedures for other potentially dangerous situations.

401. ABORTS

Specific formation abort procedures are referenced under "Section Daytime Interval Takeoff," "Division Daytime Interval Takeoff Procedures," and "Night Formation Interval Takeoff Procedures." The lead should be prepared, decisive, and ready to follow NATOPS abort procedures. The wingman must remember that if the lead aborts, he must provide clearance for the lead to move to the centerline. Sympathetic aborts above 50 KIAS should not occur.

402. INADVERTENT IFR

If a formation flight inadvertently enters a cloud and it is obvious that IFR conditions will prevail more than a moment, the flight lead transitions to instrument flight. The wingman will maintain a good IFR parade position on the aircraft ahead. The lead should determine the best way to exit the cloud and, if necessary, reverse his heading in a shallow, gentle turn to exit the cloud. In division, the lead should turn away from the section allowing Dash-4 to stay up on the power, or detach the section prior to the possibility of a lost sight within the division.

403. LOST SIGHT

Specific lost sight procedures are referenced under "Section Daytime Flight Procedures" and "Night Formation Flight Procedures." Emphasis remains on:

1. Transmitting lost sight to your lead or wingman

2. Following the briefed procedure

404. MIDAIR COLLISION

The first consideration after a midair collision is either to regain control if the aircraft can still be flown or to eject if control is impossible. If your aircraft is out of control, follow NATOPS ejection criteria. If possible, slow flight the damaged aircraft at altitude following NATOPS procedures. Make shallow turns in both directions to determine landing characteristics.

The pilots of the damaged aircraft must decide if they can land safely. Depending on the situation, return to home field or proceed to the nearest suitable field for landing. Transmit the situation to the controlling agency, using Guard frequency, if necessary.

NOTE

The ORM flight brief shall address the increased potential for a midair collision during day and night CV rendezvous. Additionally, the possible causes of a CV rendezvous mid-air along with the controls that are going to be used to prevent a mid-air will be discussed.

405. AIRCRAFT MALFUNCTIONS IN FLIGHT

When any member of a flight develops an emergency requiring him to land, the instructional flight will be terminated. The aircraft with the emergency will proceed directly to its point of intended landing, escorted by another aircraft – a dual flight, if possible. Escorts should remain well clear of emergency aircraft, unless a visual inspection is required, so as not to interfere if ejection becomes an immediate concern.

406. DOWN AIRCRAFT PROCEDURES

If one aircraft in a flight of two or more develops difficulties such that the pilot or pilots must eject, the responsibility of coordinating search and rescue (SAR) falls in order to the following aviator:

1. Senior instructor in the flight

2. Any instructor in the area with both the crash scene and remaining members of the flight in sight

3. The senior student in the flight

4. Any airborne, winged aviator identifying himself as senior

The aviator who has assumed responsibility for the remainder of the flight as listed above will make the necessary voice report, keep the downed pilot/pilots and aircraft in sight, and control the remainder of the flight.

In the case where a student has assumed the responsibility as on-scene commander, he will direct the other wingman to detach and return to base as single-ship flights. The on-scene commander will report the emergency on Guard frequency including the following:

1. "Mayday, Mayday, Mayday" followed by "[call sign]"

2. Position (TACAN and geographical)

3. Explain the emergency and request assistance

The on-scene commander will execute the remainder of his procedures IAW NATOPS. When the on-scene commander or any member for the SAR effort reaches bingo fuel, he will return to base.

Although aiding the downed pilots is important, the safe conduct of the remaining members of flight is equally important. An instructor may designate a high and a low orbit, but the low orbit must be an instructor. The low orbit will check the condition of the pilots and the crash scene. He will advise the high orbit, who will then relay the information.

This page reserved for Notes

CHAPTER FIVE
SELF-TEST

500. SECTION DAYTIME FLIGHT PROCEDURES: BACKGROUND

1. What are the formation lead's responsibilities?

2. What is the signal for "Next signal will be a question"?

3. The wingman sees the lead raise his arm vertically and then drop it smartly below the canopy rail. What should the wingman do?

4. You see the lead make the weeping signal and then hold up three fingers vertically. What is he saying?

501. SECTION DAYTIME FLIGHT PROCEDURES: GROUND PROCEDURES

5. Why does the lead take the downwind side of the runway?

6. Why should pilots man their aircraft and start engines at the same time?

7. Describe the wingman's actions while taxiing for takeoff during day, section formation.

8. What is the crosswind limitation for a section dual?

502. SECTION DAYTIME FLIGHT PROCEDURES: FLIGHT PROCEDURES

9. What is the crosswind limitation of the T-45?

10. During an interval takeoff, after the flight arrives in position on the runway, what does the lead do?

11. During an interval takeoff, what does each pilot look for when inspecting the other aircraft?

12. During an interval takeoff, when does the wingman initiate the thumbs-up signal?

13. Why does the wingman wait no less than 7 seconds or as briefed before initiating the takeoff roll during an interval takeoff?

14. During an interval takeoff, if an abort is necessary, what is the best way to engage the arresting gear?

15. In an aborting situation during an interval takeoff, why must the pilot immediately transmit his intentions?

16. During a section takeoff, the _____receives a thumbs-up signal from the _____ when ready to roll.

17. During a section takeoff, if the lead aborts above 50 KIAS, the wingman _____.

18. During a section takeoff, while rolling down the runway how do you maintain directional control?

19. During a section takeoff, the wingman maintains _____while rolling down the runway.

20. After takeoff on a CV rendezvous, the lead begins a _____-degree AOB climbing turn at briefed airspeed.

21. During a CV rendezvous, the wingman may use a maximum of _____-KIAS closure to join-up on the lead.

22. After takeoff on a CV rendezvous, as the wingman approaches the bearing line, what action should he take to prevent going acute?

23. After the join-up on a CV rendezvous, the wingman moves into the _____.

24. During a running rendezvous, the wingman realizes his closure rate is too high as he nears the join-up point. How does he correct his closure rate?

25. Why do you move out to a position approximately 400 ft abeam during a running rendezvous?

26. In the running rendezvous, how much excess airspeed can the wingman initially use for closing on the lead?

27. During a TACAN rendezvous the lead initiates a _____-degree AOB turn, at the TACAN fix, in the briefed direction and altitude.

28. During a TACAN rendezvous when the wingman sees the lead, he transmits

29. During a TACAN rendezvous, why does the wingman fly with 500 ft of stepdown until he is established on lead's bearing line with relative fuselage alignment?

30. In section parade formation, the wingman is on bearing when _____with a wingtip distance of ___ ft.

31. Describe the VFR section parade position.

32. The IFR section parade position is the same as VFR except

5-2 SELF-TEST

33. Why must the wingman reduce power to stay on the bearing during a turn into the wingman?

34. During an IFR turn away from the wingman, the wingman rotates about the _____ longitudinal axis.

35. Describe the box crossunder.

36. During the breakup and rendezvous exercise, after completing a 180-degree turn, the lead levels his wings and _____.

37. You are the wingman in the breakup and rendezvous exercise. When the lead goes into the rendezvous turn, commence with no more than a ____ degree AOB turn toward _____.

38. During the rendezvous portion of the breakup and rendezvous exercise, the lead maintains a ____ degree AOB turn.

39. As the wingman during the breakup portion of the breakup and rendezvous exercise, how do you obtain 1000 ft nose-to-tail separation during the first half of the breakup turn?

40. What is the primary indication that an underrun is necessary?

41. The wingman begins an underrun by simultaneously leveling wings, lowering the nose, reducing power, and _____.

42. If the lead signals a lead change, what should the wingman do if he cannot accept it?

43. After acceptance of the lead change, what action does the new lead take?

44. Describe the section cruise position for a wingman in straight and level flight.

45. When moving from outside to inside the lead's turn during a cruise turn away, how does the wingman maintain proper position?

46. During a cruise turn into, what does the wingman have to do in order to slide toward the lead's turn radius?

47. When performing section cruise aerobatics, the lead will start by increasing _____ to establish a climb and maintain a minimum airspeed of _____ and a minimum of _____ percent power.

48. What is the normal break interval for the wingman during a VFR overhead entry?

503. SECTION DAYTIME FLIGHT PROCEDURES: APPROACHES

49. How is the section approach different from the individual instrument approach?

50. What is the procedure for a section missed approach?

51. When is a section circling approach flown?

504. DIVISION DAYTIME FLIGHT PROCEDURES: FLIGHT PROCEDURES

52. What are the significant differences between section positioning and interval takeoff, and division positioning and interval takeoff?

53. What are the significant differences between section abort and division abort procedures?

54. During a division takeoff by section, how does the second section rendezvous with the first section?

55. What formation does a division join in during a running rendezvous?

56. In a running rendezvous after initial takeoff, the lead climbs at constant airspeed and power setting as briefed; wingmen normally join in _____.

57. After the signal for section crossunder is passed down the line while in echelon parade, _____ executes a "V" crossunder on Dash-2 to the parade position on Dash-2, who is on lead's opposite wing; _____ simultaneously executes "V" crossunder on Dash-3.

58. When a division moves from fingertip into echelon parade using section crossunder, Dash-4 executes a crossunder on

59. When balancing formation from echelon parade, after Dash-2 performs a "V" crossunder on the lead, Dash-3 _____and Dash-4 _____.

60. When balancing formation from echelon parade, the section crosses under; Dash-3 and Dash-4 join in_____.

61. During balanced parade turns away from the section, which aircraft rotates about the lead's axis?

62. During balanced parade turns into the section, which aircraft rotate about the lead's axis?

63. When a division moves from balanced parade into echelon parade by using a wingman crossunder, Dash-3 moves diagonally out on the bearing from balanced parade position to leave a slot for?

64. When a division moves from balanced parade into echelon parade using a section crossunder, what action does Dash-4 perform?

65. When a division in echelon parade performs a turn into the division, the lead should limit the turn using a maximum of _____degrees AOB.

66. When a division moves from fingertip into echelon parade using wingman "V" crossunder, Dash-2 crosses under

67. During a division underrun, where does the underrunning aircraft stabilize?

68. During a division underrun, any aircraft behind the underrunner will complete the rendezvous, leaving _____.

69. During cruise maneuvering, Dash-3 flies a 45-degree bearing on _____.

70. During cruise maneuvering, Dash-4 flies cruise on _____.

71. During a shuffle division, when Dash-2 has passed behind the last aircraft with proper wingtip separation, nose-to-tail, and stepdown, he completes the _____ to join up in _____ as Dash-4.

72. Maneuvering to outside of interval's turns to increase nose-to-tail is called

ANSWER: lag pursuit

505. DIVISION DAYTIME FLIGHT PROCEDURES: APPROACHES

73. In division overhead entry and prior to the initial point for the duty runway, the lead puts the division in right echelon for a _____ break.

74. In division overhead entry and prior to the initial point for the duty runway, Dash-2, Dash-3, and Dash-4 break at _____ intervals, normally _____ seconds set by _____.

75. In a division VFR straight-in entry, when will the lead breakup the division?

76. In a division VFR straight-in entry, the wingmen are detached to a trail position with_____ separation.

506. NIGHT FORMATION FLIGHT PROCEDURES: BACKGROUND

77. The primary means of signaling at night is the _____.

78. The lead's anti-collision light remains in the "on" position during the entire flight. (True or False)

507. NIGHT FORMATION FLIGHT PROCEDURES: GROUND PROCEDURES

79. What are the differences between night and day taxi/hold short procedures?

80. Taxi interval at night is _____ ft _____.

508. NIGHT FORMATION FLIGHT PROCEDURES: FLIGHT PROCEDURES

81. What type of rendezvous is normally conducted for the initial rendezvous?

82. What factor of an abort becomes more critical at night than during the day?

83. During a running rendezvous, the wingman maintains a six o'clock approach until 2000 ft from lead, at which time he moves out 400 ft abeam to a _____ position from the lead and establishes _____ course.

84. During a running rendezvous, when the wingman is close-aboard and calls _____, the lead should turn the anti-collision light off and turn his external lights to _____.

85. During a nighttime TACAN rendezvous, if the lead is not sighted, the wingman flies to point 1 and commences a _____ degree turn.

86. During a nighttime TACAN rendezvous, once the lead has been sighted, the wingman flies to intercept the bearing line using a maximum of _____ degrees AOB.

87. During a night TACAN rendezvous, the wingman maintains a _____ ft step down until a "visual" is made with the lead aircraft and the wingman is on bearing with fuselage alignment.

88. A CV rendezvous at night is conducted co-airspeed, using _____instead of _____ to achieve closure.

89. During a CV rendezvous, if the lead's anti-collision light is closer to the wingtip light than the tail light, the aircraft is _____.

90. During a CV rendezvous, if the lead's anti-collision light is closer to the taillight than the wingtip light, the aircraft is _____.

91. Procedures for nighttime IFR parade turns are _____ as daytime IFR procedures.

92. All crossunders are _____ crossunders at night time.

93. What are the procedures for the night breakup and rendezvous exercise?

94. Underruns at night have different procedures than day. (True or False)

95. During lead changes at night, primary communications are conducted by _____ instead of hand signals.

509. NIGHT FORMATION FLIGHT PROCEDURES: APPROACHES

96. During a section instrument approach at night, the lead initiates all configuration changes by _____.

97. Section approaches are completed at _____ flaps.

98. During a section instrument approach at night, what is the normal altitude for detaching the wingman?

99. What are the significant differences between day and night section missed approach procedures?

100. What is different between day and night section VFR overhead entry procedures?

101. Switching external lights to bright and flashing during a section instrument approach indicates _____.

510. SAFETY/EMERGECY PROCEDURES: MIDAIR COLLISION

102. What action should you initiate following a midair collision if the aircraft is uncontrollable?

ANSWER SHEET

1. a. Maintain safe and orderly conduct of mission
   b. Stay clear of traffic and weather
   c. Stay within the briefed operations area
   d. Execute checklists
   e. Execute proper visual and radio communications
   f. Make smooth/consistent changes in power, heading, and altitude

2. Hand cupped behind ear, listening

3. Perform section takeoff, i.e., release brakes.

4. I'm in trouble because of a fuel malfunction.

5. FOD hazard, jetwash, and wingtip vortices

6. To arrive in marshal at approximately the same time with the same amount of fuel

7. a. Positions himself on opposite side of taxiway from the lead
   b. Taxis to the hold short area while ensuring a minimum of 150 ft nose-to-tail separation on the lead
   c. Switches to tower frequency as the lead approaches the hold short area

8. As listed in NATOPS or SOP

9. As listed in NATOPS or SOP

10. Passes the runup signal

11. 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

12. Immediately after checking the lead's aircraft

13. To provide a safety margin in case the lead aborts

14. Perpendicular on centerline

15. Safety of any following aircraft or to notify the lead

16. lead; wingman

17. takes off

18. Use the rudder

19. parade bearing

20. 30

21. 10

22. The wingman should reduce AOB.

23. parade turn-away position

24. a. Reduces power
    b. Uses speed brakes as necessary
    c. Turns away from the lead to ensure adequate lateral separation
    d. Keeps the lead in sight at all times
    e. Does not pass directly above or below the lead

25. To see closure and safely join on the bearing line

26. No more than 50 KIAS

27. 30

28. "Visual"

29. To avoid a possible midair and to control closure.

30. sighting down the leading edge of lead's wing; 3

31. The wingman maintains 5 ft stepdown and 3 ft of lateral wingtip separation while flying a 30-degree bearing off the lead.

32. during a turn away from the wingman

33. The wingman is on the inside of the lead's turn, and his nose was lowered when starting the turn to maintain parade position.

34. lead's

35. The wingman moves in a box pattern from parade position on one side of the lead, below and behind the lead, to parade position on the opposite side.

36. maintains rendezvous airspeed

37. 45; bearing line

38. 30

39. Vary g to obtain 1000 ft of nose-to-tail separation.

40. Uncontrolled closure rate or extreme acuteness nearing join-up

41. extending speed brakes

42. Shake head no

43. Maintains airspeed, altitude and heading until the new wingman moves into parade position; then the new lead passes the fuel-check signal.

44. The wingman's aircraft is 45 degrees off the lead's aircraft with a stepdown of 15 ft and nose-to-tail separation of 20 ft.

45. The wingman reduces power slightly and decreases angle of bank.

46. Simultaneously and smoothly reduce power and may slightly lag lead's rate of roll.

47. g; 150 KIAS; 92

48. 4 seconds

49. Flight penetrates and executes instrument approach in IFR parade position

50. a. Advance power, retract speed brakes, and rotate 10 degrees noseup.
    b. After achieving a positive rate of climb and 140 KIAS, the lead signals the wingman to raise gear and flaps/slats.
    c. Both lead and wingman follow departure clearance.

51. If a straight-in approach is not available

52. The procedures are the same as section 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.

53. The procedures are identical; however, there is an increased complexity with four aircraft.

54. The second section meets the first section at a prebriefed rendezvous point.

55. Wingmen normally join in balanced parade (fingertip) position

56. balanced parade (fingertip) formation

57. Dash-3; Dash-4

58. Dash-3 as Dash-3 executes a crossunder on Dash-2

59. a. moves up into parade position on the lead
    b. moves up into parade position on Dash-3

60. parade position on the lead

61. Dash-2

62. Dash-3 and Dash-4

63. Dash-2

64. Dash-4 executes a "V" crossunder on Dash-3, as Dash-3 executes a "V" crossunder.

65. 10

66. after Dash-3 and Dash-4 have moved out from fingertip position to allow room for Dash-2

67. The underrunning aircraft stabilizes at a parade turn-away position at approximately 200 ft, slightly stepped up.

68. room for the underrunner to join in his respective position when cleared by the lead

69. lead

70. Dash-3

71. crossunder; parade position

72. lag pursuit

505. DIVISION DAYTIME FLIGHT PROCEDURES: APPROACHES

73. left

74. briefed; 4; Dash-2

75. Approximately 8 miles from airport

76. 1000 ft

506. NIGHT FORMATION FLIGHT PROCEDURES: BACKGROUND

77. radio

78. False. In general, the lead flies with his anti-collision light off.

507. NIGHT FORMATION FLIGHT PROCEDURES: GROUND PROCEDURES

79. a. Pilots need to know taxi routes and taxi signals by line personnel.
    b. Move slower– "twice the caution, half the speed."
    c. Use taxi lights for all taxi movements.
    d. Maintain 300 ft taxi interval.

80. 300, on centerline

508. NIGHT FORMATION FLIGHT PROCEDURES: FLIGHT PROCEDURES

81. TACAN rendezvous

82. Voice communication

83. 5 or 7 o'clock; parallel

84. "Lights"; dim and steady

85. 30

86. 45

87. 500

88. turn radius; airspeed

89. acute

90. sucked

91. the same

92. box

93. a. In order to kiss off the wingman, the lead turns his external lights to bright and steady and then turns on his anti-collision light.
    b. The breakup is performed with 2-second intervals at 14-15 units AOA, 250 KIAS, and 180 degrees
    c. The wingman performs a co-airspeed rendezvous.

94. True. Nighttime underrun procedures do not require you to fly to a stepped up, slightly acute position on lead following underrun.

95. radio

509. NIGHT FORMATION FLIGHT PROCEDURES: APPROACHES

96. radio

97. half

98. 500 ft AGL

99. Lead uses the radio for gear up signal or if the wingman is NORDO, he uses a flashlight.

100. a. Airspeed for break is 250 KIAS.
    b. To signal the break, the lead turns external lights to bright and steady and the anti-collision light on.
    c. Break ensuring a level break to arrive at the proper abeam position.

101. NORDO

510. SAFETY/EMERGENCY PROCEDURES: MIDAIR COLLISION

102. Eject

This page reserved for Notes

APPENDIX A
GLOSSARY

A100. GLOSSARY

Acute: A situation where a wingman is ahead of the bearing line.

Balanced Formation: A division formation where Dash-3 and Dash-4 are in parade position on the lead and Dash-2 is in parade position opposite Dash-3 from the lead.

Bearing: An angle off the nose of the lead's aircraft used for position reference.

Bearing Line: A bearing off the nose of the lead's aircraft used for position reference.

Break: The portion of the landing pattern where an aircraft executes a decelerating turn to downwind.

Breakup and Rendezvous Exercise: The exercise that separates (breaks up) the flight in order to practice rendezvous.

Climbing CV Rendezvous: The procedure which combines a climb with a basic CV circling rendezvous.

Closure: The rate at which an aircraft reduces range on another aircraft.

Column Position: The position behind the lead aircraft with 15 ft of stepdown and 10 ft of nose-to-tail.

Crossunder: A maneuver that moves a wingman laterally from parade position on one side of the formation to parade position on the other. Two types of crossunder, the box and the "V," are flown. The box crossunder is utilized at night and in the early formation flights. The "V" crossunder is used exclusively for day flights after the first cruise formation flight.

Cruise Formation: A formation which allows the wingman more flexibility, providing better lookout capabilities and additional fuel efficiency for the wingmen. (See also "Cruise position.")

Cruise Position: The position where the wingman maintains a bearing of approximately 45 degrees, a stepdown of 15 ft and a nose-to-tail separation of 20 ft. (See also "Cruise formation.")CV Rendezvous: A rendezvous that joins a flight together in a circular pattern. (See also "Climbing CV rendezvous.")

Division: The formation consisting of four aircraft (two sections). If the division separates into two sections, Dash-3 is the lead for the second section.

Echelon: A division parade formation where all aircraft are on the same side of the lead along a common 30-degree bearing line and each aircraft is in parade position on the preceding aircraft.

Fingertip: Common term for the division balanced parade formation where the Dash-2 aircraft is on one side of the lead and Dash-3 and Dash-4 on the other side. (See also "Balanced formation.")

HEFOE: A method of signaling system failure when NORDO, using hand signals during the day or a flashlight at night.

IFR Parade: A formation used when a section is penetrating clouds, or during an instrument approach.

Initial Rendezvous: A rendezvous used to join a flight together after takeoff that can be a CV rendezvous, a running rendezvous, a combination of running and CV rendezvous, or a TACAN rendezvous.

Interval Takeoff: A takeoff where the wingman rolls 7 seconds after the lead allowing aircraft separation in the event of an abort.

Kiss Off: The signal a pilot gives prior to detaching from the flight.

Light Triangle: The triangle used to judge bearing line position on a CV or TACAN rendezvous at night. It is formed by the wingtip light, anti-collision light, and the tail light.

Marshal Area: A designated place on the ramp where formation flights assemble prior to taxiing to the hold short area.

Nose-to-Tail: The distance from the preceding aircraft's tail to the wingman's nose.

Parade Position: A position defined as the 30-degree bearing, with 5 ft of stepdown, and 3 ft of wingtip separation.

Relative Motion: Any movement of the wingman's aircraft in relation to the lead's.

Rendezvous: A type of maneuver used to join the flight. (See also, "CV rendezvous," "climbing CV rendezvous," "running rendezvous," and "TACAN rendezvous.")

Rendezvous Airspeed: An airspeed established by the original lead in the air to provide a constant reference for maneuvers.

Running Rendezvous: A rendezvous that joins the flight while continuing on course after takeoff.

Section: The basic flying unit used in formation consisting of two aircraft.

Section Penetration: Two aircraft executing an instrument approach in formation.

Section Takeoff: Two aircraft taking off simultaneously in formation.

Stepdown: The vertical distance from the bottom of the lead's aircraft to the bottom of the wingman's aircraft.

Sucked: A situation where a wingman is behind the bearing line.

Sissy: A pilot who is out of flight parameters.

TACAN Rendezvous: A circular rendezvous used to join a flight at a predetermined point.

Tail-chase Exercise: Demonstrates the relationship between lead and lag pursuit and its effects on nose-to-tail. Flown 1000 ft in trail.

Trail Position: Positioned directly behind your interval and slightly stepped up. Breakup and rendezvous utilize a 1000-ft trail position.

Underrunning: A maneuver providing a safe and orderly method for the wingman to pass below and behind the lead when excessive closure precludes a normal join-up.

VFR Parade: The standard formation used in VMC conditions. (See also "Parade position.")

Welded Wing: A technique used in an FIR parade, where the wingman rotates about the lead's longitudinal axis while matching the lead's rate of roll, maintaining parade position.

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APPENDIX B
(FORMFP)

B100. STUDY RESOURCES FOR FORMFP

[A] T-45A NATOPS Flight Manual, A1-T45AB-NFM-000
[B] Formation Flight Training Instruction (FTI)
[C] Pilot's Pocket Checklist, A1-T45AB-NFM-500

TS, TAILHOOK, & IUT FormFP-01: "Takeoff, Rendezvous, Departure/Climbout" 1.5 hr. Classroom

1. Lesson Preparation:
   a. [A] Review Parts III, IV, V, and VII
   b. [B] Read "Section Daytime Flight Procedures"

2. Lesson Objectives:
   a. Recall formation visual communications
   b. Recall aircraft marshal procedures
   c. Recall formation taxi/hold short procedures
   d. Recall procedures for positioning aircraft for interval takeoff
   e. Recall procedures for interval takeoff as lead
   f. Recall procedures for interval takeoff as wingman
   g. Recall procedures for abort during interval takeoff
   h. Recall procedures for initial rendezvous/departure/climbout
   i. Recall procedures for CV rendezvous
   j. Recall procedures for running rendezvous
   k. Recall procedures for TACAN rendezvous
   l. Recall tasks and responsibilities of a formation lead

TS, TAILHOOK, & IUT FormFP-02: "Section Parade Formation" 1.3 hr Classroom

1. Lesson Preparation:
   a. [A] Review Parts III, IV, V, and VII
   b. [B] Read "Section Daytime Flight Procedures"

2. Lesson Objectives:
   a. Recall position for section VFR/IFR parade position
   b. Recall procedures for intercepting and flying bearing line
   c. Recall procedures for turn into wingman
   d. Recall procedures for turn away from wingman
   e. Recall procedures for crossunder
   f. Recall procedures for breakup and rendezvous as lead
   g. Recall procedures for breakup and rendezvous as wingman
   h. Recall procedures for underrun maneuver
   i. Recall procedures for lead change

TS, TAILHOOK, & IUT FormFP-03: "Section Formation Recovery, Approaches, Landing Configuration." 0.8 hr. Classroom

1. Lesson Preparation:
   a. [A] Review Parts III, IV, V, and VII
   b. [B] Read "Section Daytime Flight Procedures"

2. Lesson Objectives:
   a. Recall procedures for section VFR overhead entry (break)
   b. Recall procedures for section approach
   c. Recall procedures for section circling approach
   d. Recall procedures for section missed approach

TS, TAILHOOK, & IUT FormFP-04: "Formation Emergencies," 1.5 hr. Classroom

1. Lesson Preparation:
   a. [A] Read 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"
   b. [C] Read "Emergency Procedures"

2. Lesson Objectives:
   a. Recall crosswind limitations
   b. Recall procedures for abort during interval takeoff
   c. Recall procedures for abort during section takeoff
   d. Recall procedure for formation lost sight
   e. Recall lost sight/NORDO procedures
   f. Recall midair collision procedures
   g. Recall procedures for performing as SAR on-scene commander
   h. Recall procedures for section approach – wingman NORDO

TS, TAILHOOK, & IUT FormFP-05: "Formation Section Cruise/Column" 0.8 hr. Classroom

1. Lesson Preparation:
   a. [A] Review Parts III, IV, V, and VII
   b. [B] Read "Section Daytime Flight Procedures"

2. Lesson Objectives:
   a. Recall procedures for section takeoff as lead
   b. Recall procedures for section takeoff as wingman
   c. Recall procedures for abort during section takeoff
   d. Recall position for section cruise formation
   e. Recall procedure for section cruise turns
   f. Recall procedures for cruise aerobatics
   g. Recall procedures for section column formation aerobatics

TS, TAILHOOK, & IUT FormFP-07: "Division Parade Formation" 1.5 hr. Classroom

1. Lesson Preparation:
   a. [A] Review Parts III, IV, V, and VII
   b. [B] Read "Division Daytime Flight Procedures"

2. Lesson Objectives:
   a. Recall aircraft marshal procedures
   b. Recall formation taxi/hold short procedures
   c. Recall procedures for positioning aircraft for interval takeoff
   d. Recall procedures for interval takeoff
   e. Recall considerations for abort during division takeoff
   f. Recall procedures for division takeoff by section
   g. Recall procedures for division rendezvous/join-up after takeoff
   h. Recall procedures for division underrun
   i. Recall procedures for balancing formation from echelon parade
   j. Recall procedures for turns away when in balanced parade (fingertip) formationFormFP-07
   k. Recall procedures for turns into section when in balanced parade (fingertip) formation
   l. Recall procedures for moving balanced parade (fingertip) into echelon parade
   m. Recall procedures for turns away when in echelon parade formation
   n. Recall procedures for division cruise maneuvering
   o. Recall procedures for shuffle division
   p. Recall tail-chase procedures
   q. Recall procedures for division overhead entry
   r. Recall procedures for formation recovery to division VFR straight-in

B200. STUDY RESOURCES FOR NFORMFP

[A] T-45A NATOPS Flight Manual, A1-T45AB-NFM-000
[B] Formation Flight Training Instruction (FTI)

TS, TAILHOOK, & IUT NFormFP-01: "Night Formation Flight Procedures" 1.2 hr. Classroom

1. Lesson Preparation:
   a. [A] Review Parts III, IV, V, and VII
   b. [B] Read "Night Formation Flight Procedures"

2. Lesson Objectives:
   a. Recall aircraft marshal procedures
   b. Recall formation taxi/hold short procedures
   c. Recall procedures for positioning aircraft for individual takeoff
   d. Recall procedures for TACAN rendezvous
   e. Recall procedures for section IFR parade/turns away/turns into wingman
   f. Recall procedures for crossunder

g. Recall procedures for breakup and rendezvous
h. Recall procedures for CV rendezvous
i. Recall procedures for underrun maneuver
j. Recall procedures for running rendezvous
k. Recall procedures for lead change
l. Recall procedures for section approach
m. Recall procedures for establishing landing configuration
n. Recall procedures for formation lost sight
o. Recall procedures for section missed approach
p. Recall procedures for formation recovery to VFR landing pattern
q. Recall procedures for section instrument approach with wingman NORDO
r. Recall procedures for section VFR overhead entry (break)
s. Recall formation visual communications

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APPENDIX C
INDEX

A

Abort….1-17, 1-18, 2-2, 2-3, 3-2, 4-1, A-2
Approaches….1-15, 1-21, 1-24, 1-27, 1-40, 1-41, 2-13, 3-7, 3-8

B

Balanced parade….2-3, 2-4, 2-7, 2-13
Barrel rolls….1-36, 1-37, 1-39
Bearing line….1-15, 1-19, 1-20, 1-21, 1-23, 1-24, 1-31, 1-32, 1-35, 2-1, 2-3, 2-7, 2-8, 2-10, 2-12, 3-2, 3-3, 3-6, A-1, A-2, A-3
Box crossunder….1-28, 3-5, A-1
Break….1-29, 1-30, 1-36, 1-39, 1-40, 2-9,2-13, 2-14, 3-8, A-1
Breakup and rendezvous….1-2, 1-19, 1-29, 1-30, 1-42, 2-9, 2-13, 2-15, 2-16, A-1, 3-5, A-1, A-3

C

Climbout….1-19, 2-3
Column maneuvering….1-38
Column position….1-29, 1-38, 2-13, A-1
Communication….1-1, 1-2, 1-24, 1-40, 3-2
Crossunder….1-19, 1-28, 1-29, 1-42, 2-5, 2-6, 2-7, 2-8, 2-11, 2-13, 2-16, 2-16, 3-5, A-1
Cruise….1-19, 1-25, 1-28, 1-33, 1-35, 1-36, 1-37, 1-38, 1-39, 1-42, 2-12, 2-15, A-1
Cruise maneuvering….1-38, 2-12, 2-16
Cruise position….1-35, 1-36, 2-12, A-1
Cruise sequence….1-36, 2-15
Cruise turns….1-37

D

Departure….1-15, 1-19, 2-1, 2-3, 3-2
Descent….1-18, 1-39, 1-40, 1-41, 2-14
Division daytime flight procedures….2-1 – 2-18
Division takeoff….2-2

E

Echelon parade….2-5, 2-7, 2-8, 2-9
Emergency procedures….4-1 – 4-4

F

Field entry….1-39, 2-13
Fingertip….2-3, 2-4, 2-5, 2-6, 2-15, A-2
Flight procedures….1-1 – 3-10, 4-1
Fuel check….1-24, 1-35, 2-4

G

Ground procedures….1-14, 2-1, 3-1

I

Inadvertent IFR….4-1
Interval takeoff….1-15, 1-17, 1-20, 2-1, 2-2, 2-3, 4-1, A-2

J

Join up….2-13

L

Lead change….1-34, 1-35, 1-42, 2-4, 3-7
Lighting….3-1, 3-6
Lost sight….1-40, 3-7, 4-1

M

Marshal….1-2, 1-14, 1-42, 2-1, 2-16, 3-1, A-2
Midair….1-35, 4-1
Missed approach….1-41, 1-42

N

Night formation flight procedures….3-1 – 3-10, 4-1
Night Overhead Entry (break)….3-8

O

Overhead entry (break)….1-39, 2-13, 3-8

P

Parade position….1-2, 1-18,1-19, 1-21, 1-24 – 29, 1-35, 1-38, 1-40, 1-42, 2-4, 2-5, 2-7, 2-13, 2-15, 3-4, 3-6, 4-1, A-1 – A-3
Parade turns….1-2, 1-26, 1-42, 2-6, 2-9, 2-15, 2-16, 3-4

R

Rendezvous….1-2, 1-17, 1-19, 1-20 – 1-24, 1-29 – 1-34, 1-39, 1-41, 1-42, 2-3, 2-4, 2-9, 2-10, 2-11, 2-13, 2-15, 2-16, 3-2, 3-3, 3-5, 3-6, 3-7, A-1 – A-3
Running rendezvous….1-2, 1-26, 1-42, 2-6, 2-9, 2-15, 2-16, 3-4

S

Safety/emergency procedures…4-1 – 4-4
Section column….1-38
Section cruise….2-12
Section daytime flight procedures….1-1 – 1-44, 4-1
Section takeoff….1-17, 1-18, 1-42, 2-2, 2-3, A-2
Shuffle division….2-13, 2-16

T

TACAN rendezvous….1-19, 1-22, 1-23, 2-3, 3-2, 3-7, A-2, A-3
Tail-chase exercise….1-2, 1-39, A-3
Takeoff/departure….1-15, 2-1, 3-2
Taxi….1-2, 1-14, 1-15, 1-42, 2-1, 2-16, 3-1, 3-2, A-2

U

Underrun….1-33, 1-34, 1-42, 2-11, 3-5, A-3

V

V crossunder….1-29, 2-5, 2-7, 2-13, A-1
Visual Signals….1-2, 1-3, 3-9

W

Wingovers….1-36, 1-37, 1-38, 1-39