NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS **CNATRA P-1208 (Rev. 12-08)**

FLIGHT TRAINING INSTRUCTION

OPERATIONAL NAVIGATION

T-45 STRIKE

2008

DEPARTMENT OF THE NAVY
CHIEF OF NAVAL AIR TRAINING
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Subj: FLIGHT TRAINING INSTRUCTION, OPERATIONAL NAVIGATION, T-45

1. CNATRA P-1208 (Rev. 12-08) PAT, "Flight Training Instruction, Operational Navigation" is issued for information, standardization of instruction, and guidance for all flight instructors and student aviators within the Naval Air Training Command.

2. This publication shall be used as an explanatory aid to support the T-45 Advanced Strike Flight Training Curriculum. It will be the authority for the execution of all flight procedures and maneuvers herein contained.

3. Recommendations for changes shall be submitted via CNATRA TCR form 1550/19 in accordance with CNATRAINST 1550.6E.

4. CNATRA P-1208 (04-03) PAT is hereby cancelled and superseded.

JAMES A. CRABBE
Chief of Staff

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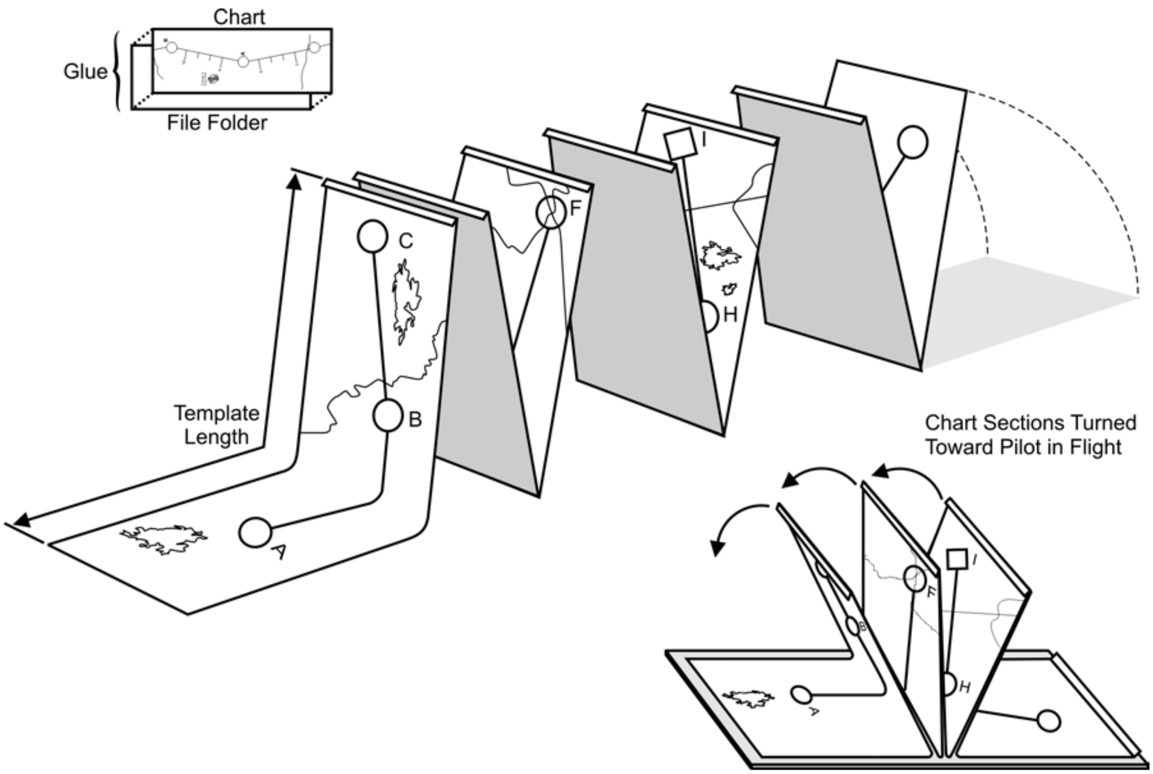
FLIGHT TRAINING INSTRUCTION

FOR

OPERATIONAL NAVIGATION

P-1208



LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:
Original...0...30 Apr 03 (his will be the date issued)
Revision 1…0…24 Feb 09
Change Transmittal 1…0…10 Nov 10

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 70 **CONSISTING OF THE FOLLOWING:**

Page No.	**Change No.**	**Page No.**	**Change No.**
COVER	1	5-7	0
LETTER	0	5-8	1
iii – xi	0	5-9	0
xii (blank)	0	5-10 (blank)	0
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5-2	1	11-1	0
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5-4	0	A-1 – A-4	0
5-5	1	B-1	0
5-6	1	B-2	1

INTERIM CHANGE SUMMARY

The following Changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE
1	Changes made per transmittal letter (10-Nov-10)

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

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

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HOW TO USE THIS FTI

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

Use your FTI to prepare for lessons and flights, and afterward to review. Your Student Guides specify FTI reading assignments prior to flight procedure lessons. 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-45C. 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-45C NATOPS Flight Manual.

INTRODUCTION

The Master Curriculum Guide and flight instructor will determine exactly which advanced T-45C navigation features you'll use on specific training missions. As you know, the T-45C is equipped with a superb navigation suite that includes cockpit readouts for true airspeed, groundspeed, true heading, drift angle, ground track, and wind direction/velocity. Additionally, waypoint coordinates can be entered, and steering information is then provided to the pilot. All of these features can be employed to greatly simplify the task of navigation.

Advanced aircraft navigation systems are now installed in most frontline military aircraft. However, instruction in this phase of your Naval pilot training concerns itself with fundamental pilotage and navigation**—fundamentals** that you must comprehend and master. You **must** be able to navigate competently, even when advanced navigation systems malfunction or are not installed in your assigned aircraft. Mastery of basic navigation and pilotage skills will enhance your professional judgment, making you a more confident, safer, and better military pilot.

As a student Naval pilot, you are training for a wide variety of tactical and strategic missions. Specific tactics have been developed for each type of mission and are frequently updated and improved to keep pace with new technology and enemy defenses. With all the differing technology, however, some of the goals and requirements of flying these missions remain the same. You must be able to navigate to a target, successfully perform your assigned task, and egress to friendly territory. In order to perform the mission and return safely, you must avoid detection, potentially hazardous location, and enemy defenses.

Enemy defenses improve with technology and vary in intensity and employment. Despite intelligence reports, pilots face an unknown element over enemy territory, and tactics must be flexible. You must be able to plan your mission around the best intelligence available, taking advantage of terrain, weather, tactics, and weakness in enemy defenses.

Sophisticated navigation equipment has extended operational capabilities beyond the restrictions of night or adverse weather. However, no enemy nation will provide you with a convenient TACAN/ DME fix or a VOR to help you get to your target. In addition, battle damage may deny you the use of your inertial and GPS navigation system. You must, therefore, be prepared to carry out your mission using dead reckoning techniques (time, distance, and heading) to update position with reference to geographic checkpoints.

The Operational Navigation Flight Procedures are an important segment of training for strike pilots. The purpose of this training stage is twofold: (1) to introduce mission planning and chart interpretation for correct pilotage methods, and (2) to introduce basic multiplane reconnaissance techniques.

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CHAPTER ONE
NAVAL AVIATION MISSION REQUIREMENTS

100. INTRODUCTION

Mission planning varies in complexity. At the lower end is the single-plane cross-country navigation that you will do in the training command. At a higher level, there may be a coordinated strike of more than fifty planes with different combat roles launched from multiple bases and/or carriers. Staffs, operations officers, and air intelligence personnel contribute to defining and assigning missions and weapons, but it is generally left to the squadron or air wing to supply the tactics. Following are some missions similar to ones you may be required to plan and fly:

101. SPECIAL WEAPONS

A single aircraft launches from a carrier, navigates over water, accomplishes coastal orientation, penetrates enemy defenses, navigates over land to target, executes the attack, and egresses to friendly territory. Alert time is minimum. Timing and attack positioning must be precise.

102. COORDINATED STRIKE

Many aircraft coordinate in various types of missions. Aircraft may include attack, fighter, electronic countermeasures, tanker and reconnaissance. Elements may launch from more than one point, and aircraft of different types fly at different speeds, so timing and coordination must be precise. Tactics must be disciplined. Such tactics are constantly evolving to keep up with such scenarios as war-at-sea, and may vary between air wings. As a fleet pilot, you must be prepared to plan and fly such coordinated missions.

103. DIVISION STRIKE

Four aircraft attack a planned target. Fighter cover may be employed, tanker aircraft may be needed at one end or the other of the flight, photo reconnaissance may precede or follow the attackers, or both.

104. RECONNAISSANCE

Two aircraft reconnoiter assigned area (land or water) for targets of opportunity or some specific reported target. Tactics are determined by enemy defenses, difficulties anticipated in locating targets, and ordnance load.

105. CLOSE AIR SUPPORT

Multiple aircraft attack targets assigned by forward air control (FAC). Accuracy is paramount due to proximity of friendly forces, and precise timing is mandatory.

106. PHOTOGRAPHIC RECONNAISSANCE

A single aircraft flies over a targeted area and collects radar and/or photographic imagery.

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CHAPTER TWO
FLIGHT PLANNING

200. INTRODUCTION

Preflight planning is the most important factor in the performance of a successful mission, especially for the pilot of a fast tactical aircraft. As a Naval aviator, you will need to spend much time planning and studying your low-level missions. An experienced attack pilot will spend twice as much time in planning and study as in the actual mission. You will spend more than that in the training command, but probably not as much as the fifty hours of planning nominally required for one nuclear mission. Route selection for attack routes and route selection in the training command cover the same items, but the requirements are different.

201. WEATHER

Weather does not affect attack missions to the extent it once did. All-weather aircraft may launch day or night and in all weather. Their navigation and radar systems will get them through inclement weather to a target. On the other hand, weather may well be a factor to single-piloted aircraft or to support planes. Weather minima for training command low-level missions will be discussed later in this FTI.

202. BASH

Prior to any flight on a low level route, the aircrew will conduct a BASH evaluation via the USAF Safety Center website at: HTTP://AFSAFETY.AF.MIL/AFSC/BASH/HOME.HTML

Procedures for the outcome of this evaluation can be found in the CTW-1/CTW-2 joint SOP.

203. AIRSPEED

When planning airspeed you must take many factors into account. Among these are flight composition (the slowest airplane will control planned airspeed to a great extent); fuel (a higher airspeed burns more fuel at low altitude); exposure to enemy defenses; maneuverability and ordnance on board (G restriction); reconnaissance requirements (you have to go slower if you spend time looking for targets); target time versus time en route; and type of attack.

204. ALTITUDE

Altitude selection is more important for getting to the beginning of the low-level than with the route itself. If there is any threat from electronic detection, attack altitudes should be as low as possible, varying to accommodate terrain. Altitudes will be selected according to fuel required (cruising at high altitude takes less fuel than at low altitude) and weather (an all-weather attack aircraft can go above a ceiling and penetrate it, but another might have to stay below). You will also want to consider radar avoidance plus type and intensity of enemy defenses (high altitudes to avoid small- arms fire and AAA; low to avoid SAMs). Finally, consider aircraft capabilities if more than one type of aircraft is involved (an aircraft with terrain avoidance radar can fly lower than one without); reconnaissance requirements (if you or sensors have to look farther, you have to fly higher); and type of attack (a steep dive angle requires a higher altitude and consequently more time in a climb from low altitude).

205. AREAS OF AVOIDANCE

Avoid enemy defenses whenever you can. Intelligence personnel can tell you locations of radar installations, surface-to-air missile sites and other known threats, so you can plan to avoid them. It is also helpful to avoid towns and lines of communication (roads, railroads, rivers) in enemy territory. You attempt to get to a target undetected.

206. TYPES OF ATTACK

Laydown

Weapons are dropped from aircraft in level flight. Release point is usually determined by weapons systems. Weapons use high drag devices to allow the attacker to avoid the fragmentation pattern.

Loft

Weapons are released by computer with aircraft in a nose-up attitude so that the weapon is actually thrown at the target in a ballistic trajectory. Loft maneuvers allow increased distance between weapon detonation and target area defenses.

Pop-Up

The attacker makes a low-level run at the target, pulling up rapidly at a preplanned point to make a dive delivery. A pop-up may be a roll-ahead or an angle-off. In the roll-ahead, the aircraft remains on the same heading throughout the attack. In the angle-off, a heading change of 30-60 degrees at the preplanned point, combined with a hard climb, places the attackers at a roll-in position similar to what is attained during a practice weapons delivery pattern. This vertical and lateral displacement further complicates a defender’s firing solution.

CHAPTER THREE
ROUTES IN THE TRAINING COMMAND

300. INTRODUCTION

All pertinent regulations, i.e., FAR 91 and OPNAVINST 3710 apply to all routes flown within the conterminous U.S. The only waiver applicable to flying a military training route within the U.S. is the 250 knots airspeed restriction below 10,000 feet MSL. This low-level waiver exists while operating within the route's lateral and vertical limits.

301. WEATHER

Training Command Operational Navigation missions will not be flown unless weather is above minima and forecast to remain so. Weather minima for IR and VR routes are 3,000 foot ceiling and 5 sm visibility on the low-level portion of the route. Two-plane road reconnaissance requires 8,000 feet and 5 sm visibility.

302. PLANNED AIRSPEED

All T-45C ONAV flights will be planned for 360 knots and 45 degrees AOB. Check your curriculum outline and course rules for each individual flight.

303. ALTITUDE

The minimum altitude for CNATRA aircraft is 500 feet AGL. **Never** violate published route minimum altitudes. For field departure and recovery, use altitudes published for the route, or choose the best altitude for fuel efficiency.

304. AREAS OF AVOIDANCE

1. Do not overfly airports or violate associated control zones. Avoid uncontrolled airstrips by 3 miles if you are below 1,500 feet AGL. (FLIP AP/1B).

2. Do not overfly any congested area, city, town, or settlement, or over an open-air assembly of persons. You must remain 1,000 feet above or 2,000 feet horizontally from the highest obstacle. (FAR 91).

3. Do not overfly noise sensitive-areas (e.g., breeding and poultry farms, resorts, beaches, national parks). Avoid by 1 mile if you are lower than 3,000 AGL. If it is necessary to overfly wild fowl habitations, maintain at least 3,000 feet AGL. (FAR Part 91).

4. Do not fly into restricted areas without clearance from the controlling agency. (FLIP AP/1B).

5. Do not make simulated attacks on installations important to national defense. You may not simulate attacks on refineries, chemical plants and other potentially dangerous targets.

On single-plane ONAV flights, attacks may be simulated by fleet experienced IPs. Roll-aheads are forbidden. Depending on local SOP, an angle-off pop-up may be demonstrated at the instructor's discretion.

6. Do Not begin a route greater than five minutes from the scheduled brief time without re-coordination with the scheduling agency. Flight leads are responsible for briefing crossing route conflicts on the divert charts, and each page of the low level chart.

3-2 ROUTES IN THE TRAINING COMMAND

CHAPTER FOUR
FLYING THE ROUTE

400. INTRODUCTION

Knowing your chart is of obvious importance. Study the chart, and use your imagination about what to expect. Experience is helpful in this matter. As you progress through the ONAV syllabus, following landmarks will become easier. Notice the symbols for roads, railroad, and rivers. Check where the roads go; a road between large towns is likely to be heavily traveled and wider than one connecting small country towns. Is the road labeled as a U.S. highway or a state highway? The U.S. highway may not be any wider, but you can expect to see more traffic on it. At crossroads, try to project what may be there beside the roads. What vertical definition might you see? Railroads have more stringent requirements for construction than highways and you see them easily. Even an abandoned roadbed may be easy to see and use as a landmark. Rivers and streams may not be very good, especially during floods, droughts and at times of year when leaves are off the trees. If you can tell which way rivers are flowing, you may be able to funnel to a larger stream or a recognizable bridge. Forget trying to count the streams you cross; all are not always shown on the charts. All checkpoints and landmarks should be studied not as singular points, but in terms of overall environment associated with the "checkpoint." Consider the checkpoints in the categories identified below. Refer to Figures 4-1 and 4-2 for examples of these various types of landmarks.

401. POSITIVE LANDMARKS

Positive landmarks can be positively identified and plotted as a point on a chart. Mountains and large natural bodies of water are very good positive landmarks. You need not pass directly over a positive landmark for it to be useful to you. Be cautious when using man-made landmarks, as they may have changed, moved, or no longer exist.

402. LINEAR LANDMARKS

Linear landmarks are features which can be positively identified but not specifically plotted because they extend for some distance. Features such as roads, railroads, coastlines, power lines, and rivers may make good timing checkpoints if they are perpendicular to the course line **and** have other specific environmental particulars that identify your position. A power line should be large and not easily confused with other lines near. Rivers must be identified positively. It helps if they are either isolated or very large, and you should have some confirming landmark to ensure that you have the right one.

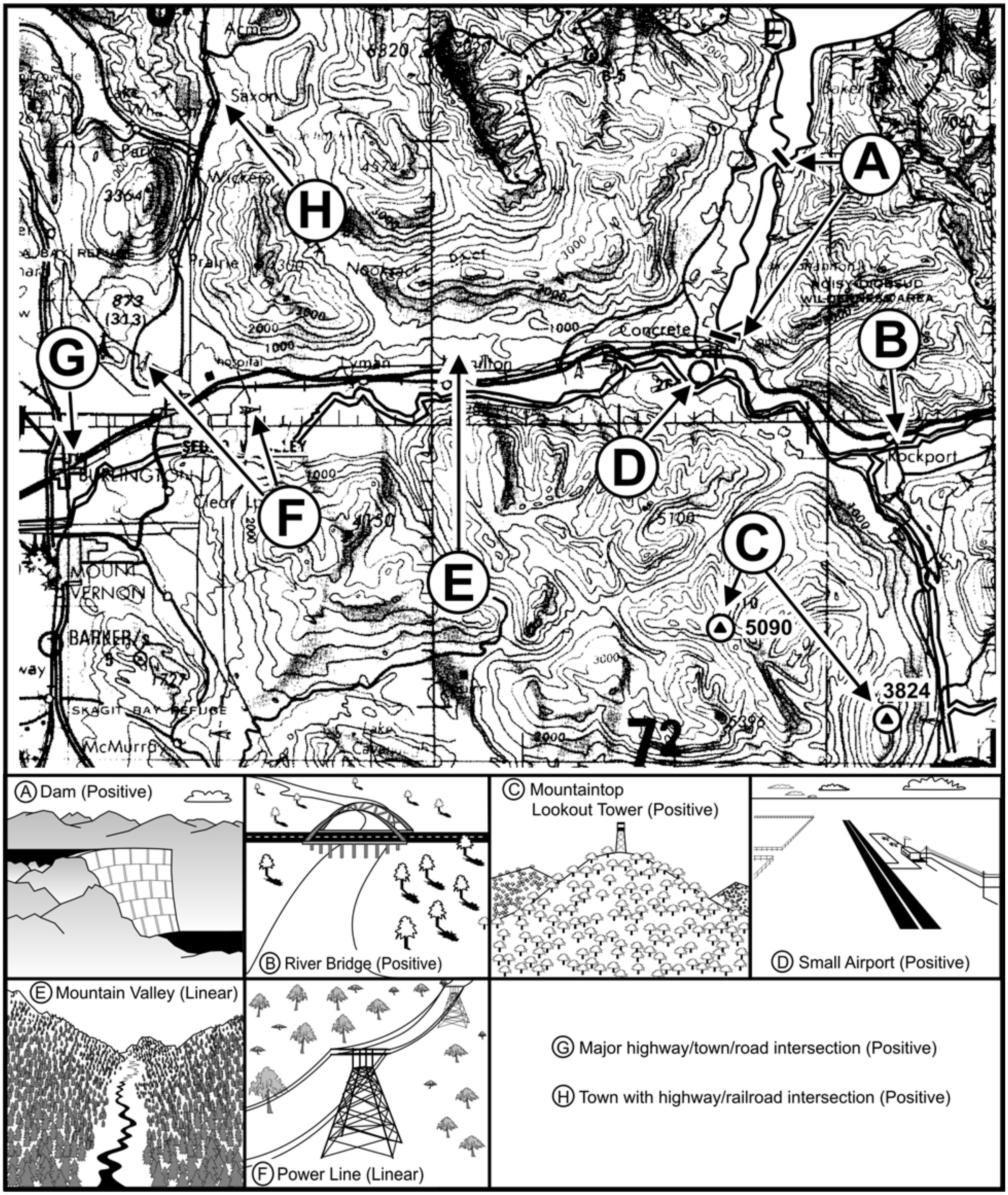
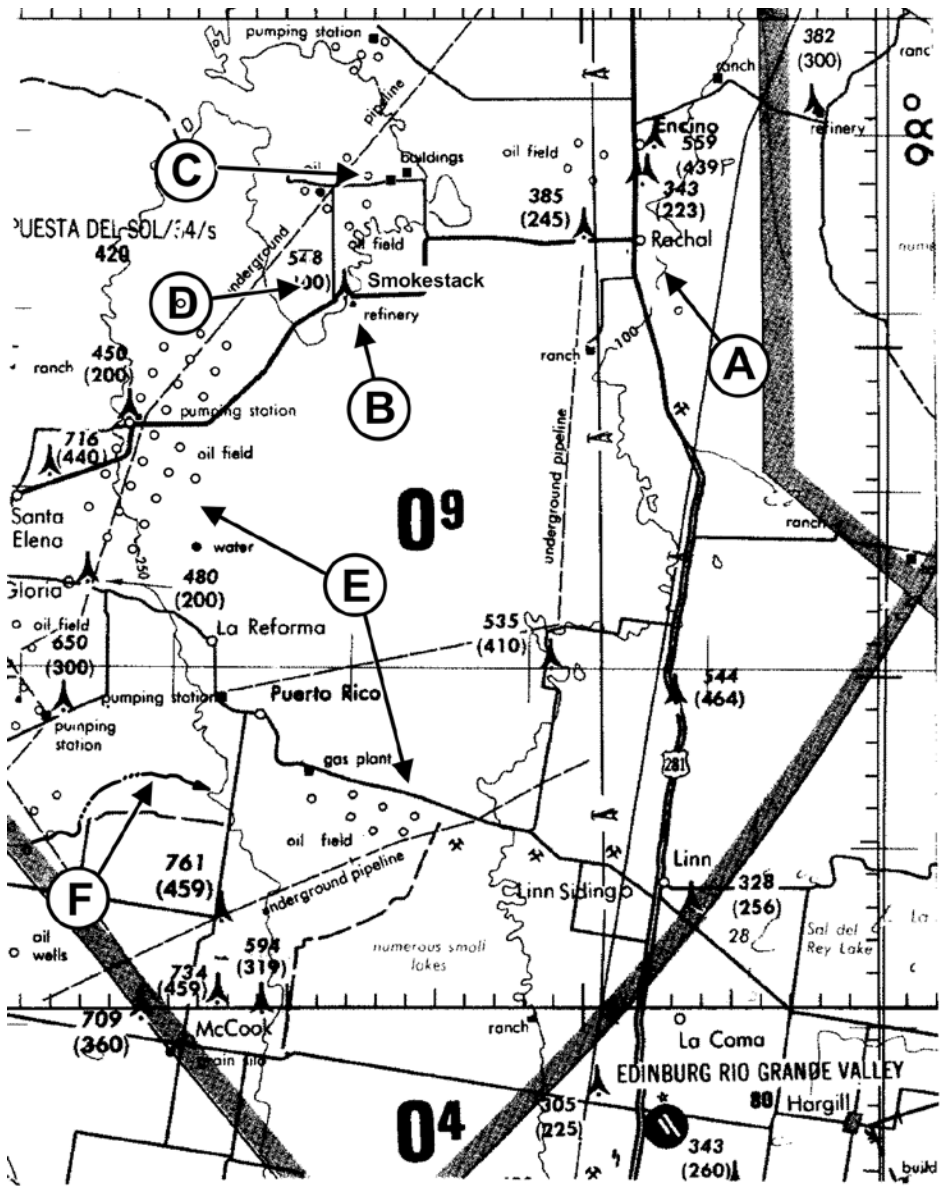


Figure 4-1 Positive/Linear Landmarks



Ⓐ Road "T" intersection with town (Positive)

Ⓑ Refinery (Positive)

Ⓒ Buildings (Uncertain)

Ⓓ Smokestack (Positive)

Ⓔ Oil field (Uncertain)

Ⓕ Dry creek bed with intermittent water (Linear and Uncertain)

Figure 4-2 Positive/Linear/Uncertain Landmarks

403. UNCERTAIN LANDMARKS

Uncertain landmarks are features that the pilot suspects he can correlate with the chart, but they may not be fully reliable. Generally, navigate from the chart to the landmarks; not the other way around. All landmarks are not always shown and charts are not always current. Always check a chart's edition revision date. Uncertain landmarks such as oil wells and windmills may be repetitious. You cannot navigate from oil well to oil well in the Permian Basin of west Texas, nor, from oil field to oil field. Uncertain landmarks may be objects that look much alike; if you see the oval symbol for a racetrack on your chart and you see a racetrack on the ground, is it a horse track, a dog track or a high school athletic track?

Check the surroundings. A high school athletic track will certainly have a high school nearby, and will probably be in town, while a horse or dog track is usually more removed. An automobile race track will have identifiable mechanical facilities and a horse track will have stables.

404. DATE ON THE CHART

How much time has there been for structures to be built; and how much likelihood is there that something new was erected? If you have a 1980 chart of an oil producing area, you may expect radical changes owing to the boom of the 1980s.

On the other hand, if your chart is dated within the last year or two, minimal change probably has occurred. In any case, get the latest edition of the chart! Don't use old charts!

405. CHART UPDATE MANUAL (CHUM)

Use the latest CHUM or supplement to identify the current edition of the chart you need. It will list additions or deletions concerning obstructions on the current edition of the chart. Here, too, use a little imagination. What will additions look like? What change will be observable after a tower was removed or added?

406. PILOT POINT OF VIEW

Altitude, airspeed, light conditions, and obstructions must be considered when selecting visual navigation features. At high altitude, visibility may be as great as 100 miles with ample checkpoints, but 100 miles ahead, only a large city might serve as a landmark. From 500 feet AGL, you have limited radius of vision. Compare that with the extended field of view you have at 6,000 feet AGL. Look for large features and consider the possibility of an undercast; in conjunction with time and course, check directly under you as well as ahead. At low altitude, you must consider the oblique perspective you will have from your cockpit (Figure 4-3). Experience is a great teacher in this respect.

As airspeed increases, you have less time to interpret, analyze and locate landmarks, intermediate checkpoints and checkpoints.

Early or late in the day, consider the effect of shadows on checkpoints. A long shadow may make an object more visible, or it may hide another, leading to dangerous situations when flying in mountainous terrain. Shadows in northern latitudes will cause snow to remain in some places much longer than in others; the presence of a large patch of white can make a landmark much easier to see due to the contrast while also making it harder to identify because of glare.

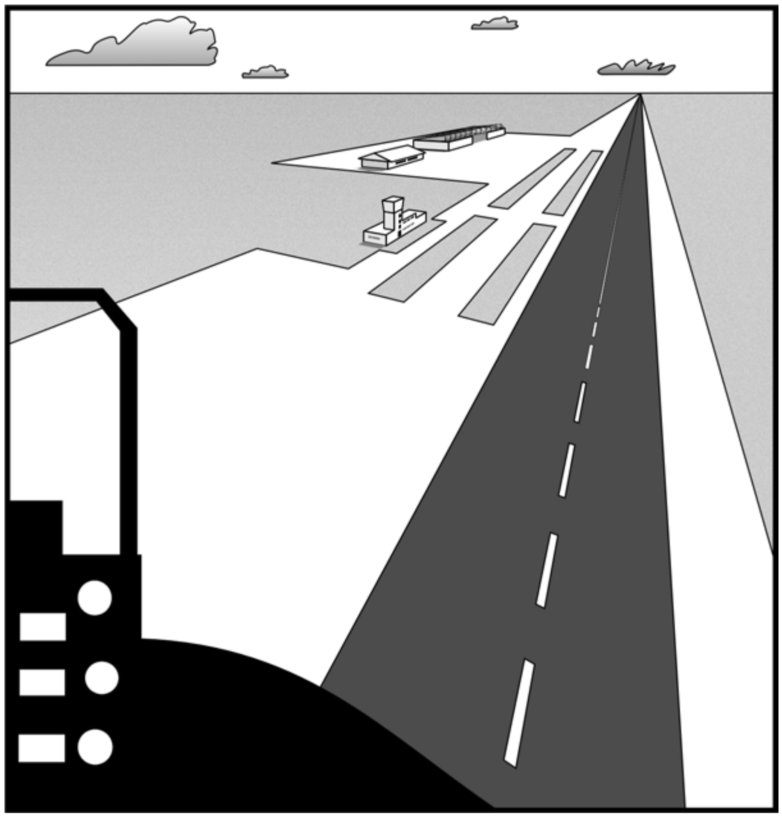


Figure 4-3 View from 500 feet AGL and ½ Mile

Finally, consider vegetation and terrain. Which way does the ground slope? Is it higher than your landmark? Might a ground slope lead you to your landmark? From any knowledge of the country you have, what effect will vegetation have on your checkpoints? It will have less effect around El Centro, California, where there is **little vegetation**. Mississippi, on the other hand, is full of tall trees. In northern locations the effect of vegetation can be dramatic. If the predominant vegetation is evergreen trees, there will be little seasonal difference, as is the case with the ocotillo cactus in southern California and the live oak trees of south Texas. But grass turns brown and disappears in some places, and leaves fall off trees, changing the overall appearance of the surface. Imagine what it will look like.

407. ROUTE FAMILIARITY

Mentally flying a route almost to the point of memorization will significantly reduce the visual navigation in-flight workload. You must spend time flying the route while studying the chart. The more pre-mission study the smoother your visual navigation flight will be.

408. DEAD RECKONING NAVIGATION AND PILOTAGE

Dead Reckoning Navigation is the sole use of time, distance and heading to get from one fix to another fix. Pilotage is the use of charts and landmarks for navigation. To successfully fly a low-level route, the combination of dead reckoning and pilotage must be used. Obviously, basic air-work is of prime importance in low-level navigation. Precise control of heading and airspeed is mandatory in order to stay on course and on time. Go from clock to chart to ground, in that order, to check your location against the terrain features. Maintain proper airspeed and heading control using a disciplined instrument scan throughout the route. **Use** your elapsed-time clock. If timing corrections are needed, use intermediate checkpoints along the route.

1. The elapsed-time clock consists of a regular clock with a stopwatch feature. Use the stopwatch feature in conjunction with the tick marks on your chart for monitoring total elapsed time. Set it to zero prior to the first checkpoint. Start it when you cross the first checkpoint and do not reset it.

2. The regular clock in the aircraft may be used as a backup for the stopwatch. In the event of an inoperative stopwatch, set the minute hand at 12:00 when passing the first checkpoint. It’s a good idea to have a digital wristwatch with a stopwatch function as a backup.

3. You measured and plotted exact heading on your chart so fly those exact headings. Any course deviations then, will likely be the result of wind; be alert for surface winds where you will be flying. Crosscheck the heading on your HUD against your magnetic compass. When you make a correction at a checkpoint, apply that correction after you turn. Use such things as smoke, waving grass or trees, or the waves on water to help estimate winds and correct your heading accordingly.

4. Perform all actions required over/immediately after checkpoint: turn, check time, check estimated fuel left, minimum fuel required and bingo fuel against actual fuel left at each checkpoint. Initiate corrections.

409. TECHNIQUES FOR FLYING

You have planned a route from checkpoint to checkpoint. Now, here are some hints and clues that will help you as you fly your planned route.

Clock-to-Chart-to-Ground

"Clock-to-chart-to-ground" is a scan that you must develop. You do not have time to locate a landmark and then search your chart for something that looks like it. If you have controlled your airspeed and heading properly, your clock will correspond to the time ticks on your chart. If you know that you should cross a railroad track at an elapsed time of 12 + 36, then look for a railroad track beginning early—you must look ahead for terrain features. If you do not locate your checkpoint, **turn on time**. If you disregard your timing and continue straight ahead, you will become disoriented and perhaps even lost.

Flying to Landmarks

Funneling. Funneling is simply following some linear landmark (valley, river) until it intercepts the planned landmark along or on your route of flight, or purposely selecting a heading which will lead to a positive landmark. If you intercept such a linear landmark and **know** where it leads, use it to guide you to your next checkpoint.

Roads. It is quite possible that your route will parallel a road or railroad for a leg or considerable portion of a leg. In this case, it is important to keep the road in sight while maintaining your correct position and distance from it. For instance, if your course line stays to the left side of the road and never crosses it, then you should always remain left of the road and never cross it.

Coast-in (Spoke Method)

The spoke method (Figure 4-4) is used to get onto the proper course after flying for a considerable distance over water; (as a Naval aviator, you will fly over water a great deal). This involves drawing several spokes to either side of your planned track to the first inland checkpoint or to a good intermediate checkpoint 10-20 miles inland from the coast-in point. As a rule of thumb, draw lines every 10 degrees of heading on each side of your coast-in checkpoint. Draw them to the sides for a distance of 10% of distance flown over water or between the planned coast-in point and positive landmarks on each side. This is called the "spoke method" because the course lines converge on the first inland checkpoint. You should choose checkpoints on the coast to draw the spokes from if you have good, positive features. Otherwise you will have to search for a prominent feature further inland and then adjust your course in accordance with the nearest spoke.

Measure heading for each spoke as you would for any course line. Use your judgment when actually flying such a route; it may be better to parallel the planned course rather than make a correction if you are not exactly sure where you are.

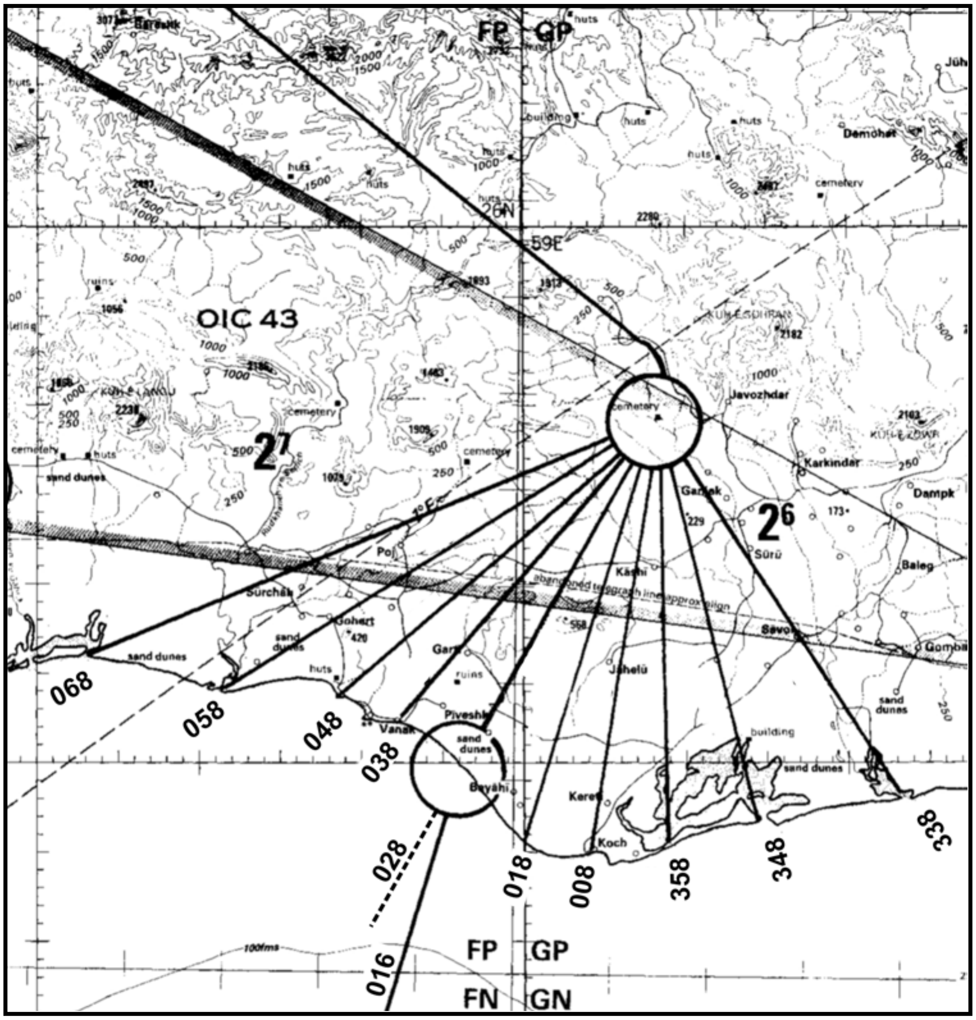


Figure 4-4 Spoke Method of Coast-In

Course/Time Corrections at Checkpoints

If you see a checkpoint ahead and slightly off course and you know you are supposed to pass directly over it, maneuver to fly over it. If it is too close or you see it late, maneuver to put it on your tail as you turn to the outbound heading. Try to reach it on the planned inbound heading, if you can pass over it, you can turn directly to the correct outbound heading. Check your time and adjust power and airspeed as necessary to correct for being early or late at the turnpoint.

410. CORRECTIONS

Time

Some operational missions require a precise time over target (TOT). Obviously, when a TOT is scheduled, the pilot must closely monitor his elapsed mission time. Speed and/or course adjustments may be necessary to assure arrival at the TOT. Coordinated air/land attacks often demand this precision. Missing a TOT may endanger friendly forces.

At other times an exact TOT is not required. Then, timing is most important for accurate navigation. Experience shows that on lengthy routes it's often advisable to use a number of "hack points" — points where the hack watch is reset to zero. Ideal hack points cross your course at nearly right angles. Select prominent speed-line references, like a perpendicular river, coast line, or large highway. Do not choose obscure references that may contribute to missing your "hack," particularly, if you get somewhat off course. Multiple hack points help pilots avoid predictable confusion that can occur following unexpected mission deviations: e.g., targeting revisions, circumvention of bad weather, and avoidance of unanticipated enemy activity.

Timing is very important in operational navigation, both in locating yourself along your course line and in correcting your position. You should consistently check your time and make an adjustment any time you find your timing off by more than five seconds. You may be fast or slow, so be sure to correct in the right direction. If you are supposed to be at a bridge at 10+00 but you fly over it a 9+50 then you are fast, ahead of your clock. Adjust speed to slow down and let your clock catch up.

Add or subtract 1 knot airspeed for each second slow or fast; hold the corrected airspeed 6 minutes at 360 knots. For example, if you are 20 seconds late on a 300-knot low-level, add 20 knots for 6 minutes.

If distance to your next point is short, use a larger correction and hold it for less time. Increase or decrease airspeed by 30 knots for 2 minutes to correct for 10 seconds off time on a 360-knot route. If timing is significantly off, a 60-knot correction may be made for one minute to adjust for 12 seconds off. The 60-knot correction should only be made if there is insufficient time or distance to make a smaller correction. Small speed changes provide smoother, more controlled and predictable corrections.

Once you are back on time, return to your planned airspeed, incorporating any required adjustment. Analyze the recent correction. Why were you off time? Consider wind, course corrections, your own airspeed control, and take them into account. If you are flying into a headwind, you will need to account for it with your indicated airspeed. How strong is it? Which direction? Which way will it blow you on your next leg? If you corrected your course, you probably used up some time. Are you flying the correct IAS for the temperature? You should be flying or 360 knots **true** airspeed in a no-wind, standard-day condition. The key to accurate timing is **precise** heading and airspeed control!

NOTE

Ground speed (GS) corrections are discussed in the Systems section of this FTI.

Course

Course corrections may be rapid or gradual, depending on the situation. If you see your checkpoint straight off to one side when it should be directly underneath, you have to maneuver to get on course after the checkpoint. If you see your turnpoint ahead and a bit to one side, just fly to it and turn "on top" to pick up your outbound heading. If you have enough room prior to the checkpoint, you can make an S-turn to cross the point on planned inbound heading. You can also apply a calculated correction: 10 degrees for one minute for each mile off course (360 knots). You have to estimate accurately how far off course you are, but you can do that by reference to such items as section lines, known landmarks, and experience.

Be careful of large changes; like timing corrections, smaller corrections are usually better. A large heading change of 30 degrees for one minute will move the track three miles, but changes the view that you planned to have. Do you know what to look for? You can become disoriented easier. Use 10 degrees for three minutes instead, provided you have sufficient leg time. As always, turn on time. Course corrections take time because they decrease your forward travel. Any course correction will make you lose time, though perhaps not enough to matter if small. Check time as soon as possible after a course correction, especially a large one, and apply any necessary time correction.

Cruise Control

Adjust power to planned settings that will maintain the corrected cruise Mach number, TAS or GS. If speed deviations occur, make the correction the same magnitude as the error. For example, if airspeed is 20 knots slow, add power appropriately. When the desired is attained, reduce power to a setting higher than before. Do not jockey the throttle while flying straight and level—make precise adjustment to preplanned settings. Power must be adjusted to maintain a constant airspeed while negotiating altitude changes to maneuver over or around terrain features. Fly precise airspeed by referencing fuel flow and/or RPM. Make small corrections around a "base" setting.

411. DISORIENTATION

A cool head is a pilot's best asset should he become temporarily disoriented. Follow these procedures:

1. Determine what is wrong. "Anxiety" disorientation can occur even with the pilot exactly on course if he fails to identify an anticipated landmark and misconstrues it as proof of being lost. Be sure that you are off course. Do not immediately break down your scan and go "ground to chart." Review your progress from your last known position and determine the cause and extent of any error. Possible causes include errors in heading, airspeed control, timing or planning;

malfunction of instruments or navigation aids; and wind. Deviations around weather can place you in unfamiliar territory; in combat situations, deviations around enemy defenses can have the same effect.

2. Check the clock immediately. Timing will be a factor in determining the extent of disorientation and the correction required. Where **should** you be at the present elapsed time? If you have been slow and behind, you must look back on the course line. Look ahead of the present time from the present time to see the terrain you are now over if you have been fast/ahead on the courseline.

3. Check your fuel state. Compare your available fuel with the MFR (minimum fuel required to complete the route) and bingo fuel. The disorientation may have caused more problems than just navigation. If lost, remember the Five C's: confess, climb, conserve, communicate, and comply. Take **action** before your fuel state becomes a significant factor.

4. Do not complicate matters. Immediately upon realizing that a problem exists, decide on a plan. Avoid wandering aimlessly while planning what to do next. Stick with what you know - time, distance, and heading. Normally, continue flying preplanned headings and times while climbing to a higher altitude to increase visibility. Be aware of the top of the route structure. If you must go higher, be sure to slow to 250 KIAS.

5. Reorient. You must find landmarks and identify them on the chart. Take care to avoid following a hunch or making a decision based on uncertain information. Comply with FAA speed restrictions (250 KIAS) if you suspect that you have exceeded the applicable route widths described in FLIP AP/1B.

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CHAPTER FIVE
SYSTEMS NAVIGATION

500. INTRODUCTION

Waypoint Navigation and Symbology

The Global positioning system Inertial Navigation Assembly (GINA) is a navigation-grade strapdown inertial system with an embedded GPS receiver. The GINA ring laser gyro and inertial-grade accelerometers determine aircraft movement to provide attitude, velocity, and heading. Inertial Navigation System (INS) position data is refined by the GPS. Waypoint data can be entered on the DATA displays, and navigation information is displayed on the HSI and the HUD.

501. COURSE DEVIATION SITUATION STEERING ARROW

The course deviation situation steering arrow (Figure 5-1a) is displayed on the HUD when the selected steering is TACAN, waypoint (WYPT) or waypoint offset (WO/S) and course (CRS) is selected. The HSI display mode, CDI or PLAN doesn't affect the HUD steering arrow display format. The orientation of the situation arrow indicates the difference between the aircraft ground track and the course line setting. The two dots represent the same deflection scale as the HSI CDI display. The reference dots are removed when the deviation from the selected course is within one degree with TACAN selected, 0.4 nautical miles with waypoint or waypoint offset selected and the landing gear up, or 0.003 nautical miles with waypoint or waypoint offset selected and the landing gear down.

502. GROUND TRACK MARKER

The ground track marker (Figure 5-1a) displays the actual aircraft magnetic track over the ground. A technique for using the ground track marker to maintain a selected course is to fly a heading that places the ground track marker directly over the courseline.

503. SEQUENTIAL STEERING

The sequential steering string (Figure 5-1a) is displayed as dashed lines on the HSI when two or more waypoints have been entered and SEQ is selected. The dashed lines are displayed to the edge of the active MFD display area, including the area outside the compass rose, as determined by the selected HSI scale.

504. WAYPOINT SYMBOL

The waypoint symbol is a circle with a dot in the middle (Figure 5-1a). Waypoint 0 has a unique symbol shaped like a baseball home plate. The waypoint number is displayed just to the right of the waypoint symbol. Only the "selected" waypoint symbol is displayed, and then only if the distance to the waypoint is less than the selected HSI compass rose scale.

505. WAYPOINT OFFSET SYMBOL

If the selected waypoint has a valid offset entered, the waypoint offset symbol, a plus sign (Figure 5-1a), and WO/S legend are displayed. An offset symbol is not displayed if the compass rose scale is less than the distance to the waypoint offset. When offset steering is selected and a new waypoint is selected, manually or automatically, offset steering is automatically deselected and waypoint steering is selected.

506. WAYPOINT DATA

The waypoint data block (Figure 5-1a & 5-1b) displays bearing, distance, time-to-go waypoint identifier and fuel remaining at waypoint overfly (after ASC-010). The time-to-go is calculated using the current ground speed and actual distance to the selected waypoint or waypoint offset. A change in heading will change ground speed; therefore, time-to-go is only accurate to waypoints on the nose of the aircraft. When CRS is selected on the HSI, the bearing to the selected waypoint or waypoint offset is shown on the HUD by the course deviation situation steering arrow. The distance, time-to-go and selected steering mode are shown on the right side of the HUD below the barometric altitude block.

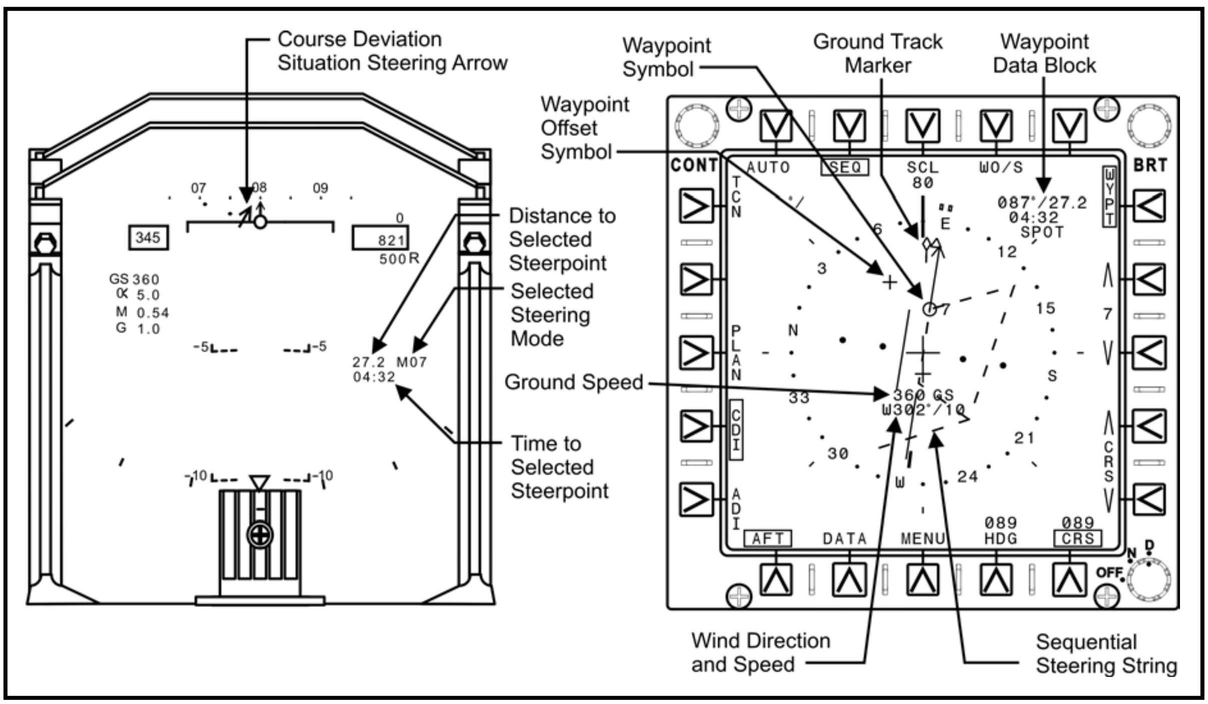

Figure 5-1a Waypoint Steering (Before ASC – 010)

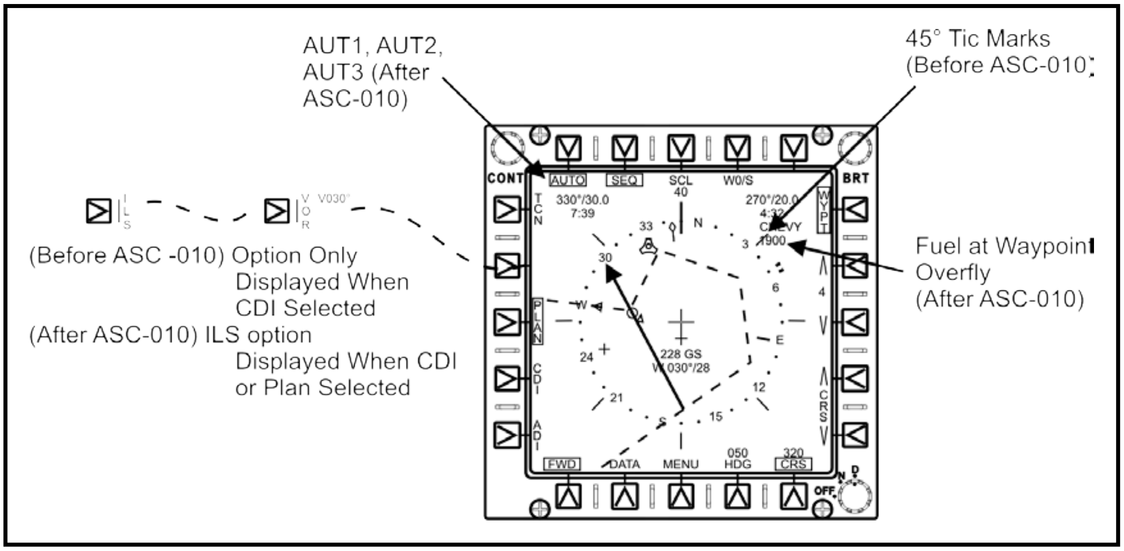

Figure 5-1b Waypoint Steering (After ASC – 010)

Waypoints

On start, the ten active tactical waypoints from the last flight are retained in the display system. There are a maximum of ten active waypoints plus waypoint zero. Waypoint zero is distinguished from other waypoints because it is used for the GPS/INS alignment and is not normally used for a navigation point except for returning to home field. Changing waypoint zero prior to a full alignment will delay the alignment as the system resolves any difference between the location of the pilot entered waypoint zero and the actual location of the aircraft. Waypoint data in the system can be changed in two ways:

1. transferring waypoint data from one of 200 waypoints in the mission data loader (GPS option) or

2. manually changing the latitude, longitude, elevation and/or magnetic variation of a tactical waypoint (WYPT option).

Waypoint data entry—transferring data from the mission data loader

Select DATA from the HSI, ADI, or MENU display. On initial selection of DATA, the system defaults to the waypoint selection. On subsequent selections of DATA, the display returns to the last selected sublevel format, WYPT, ACFT or GPS. Select GPS to bring up the Global Positioning System Display (Figure 5-2).

The first fifteen waypoints in the mission data loader are displayed at the top of the screen in the GPS waypoint identifiers block. The waypoints are in alphabetical order by column. The desired page of the GPS waypoint identifiers is selected with the increment/decrement arrows in the upper right of the display. Individual GPS waypoint information is selected by locating the selector box around the desired GPS waypoint with the selector box control arrows in the upper left corner of the display. The selected GPS waypoint data is shown in the selected GPS waypoint data block. Using the increment/decrement arrows on the right side of the display, select the tactical waypoint you want to overwrite; the tactical waypoint data is shown in the tactical waypoint data block. Press the push button next to XFER to copy the waypoint data from the GPS mission data block into the tactical waypoint data block. Verification of a successful transfer of waypoint information is accomplished by comparing the two waypoint data blocks.

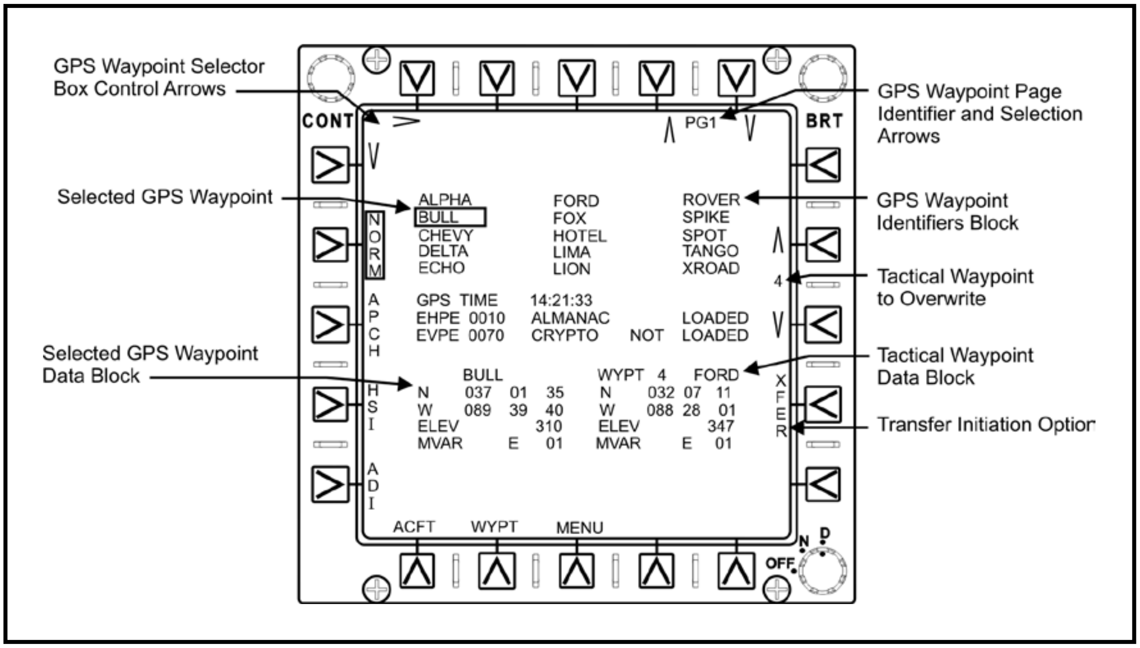

Figure 5-2 Global Positioning System Data Display

Waypoint Data Entry—Manually Changing Waypoints

From the HSI, ADI, or MENU display, select DATA. Then select WYPT if required. (Figure 5-3).

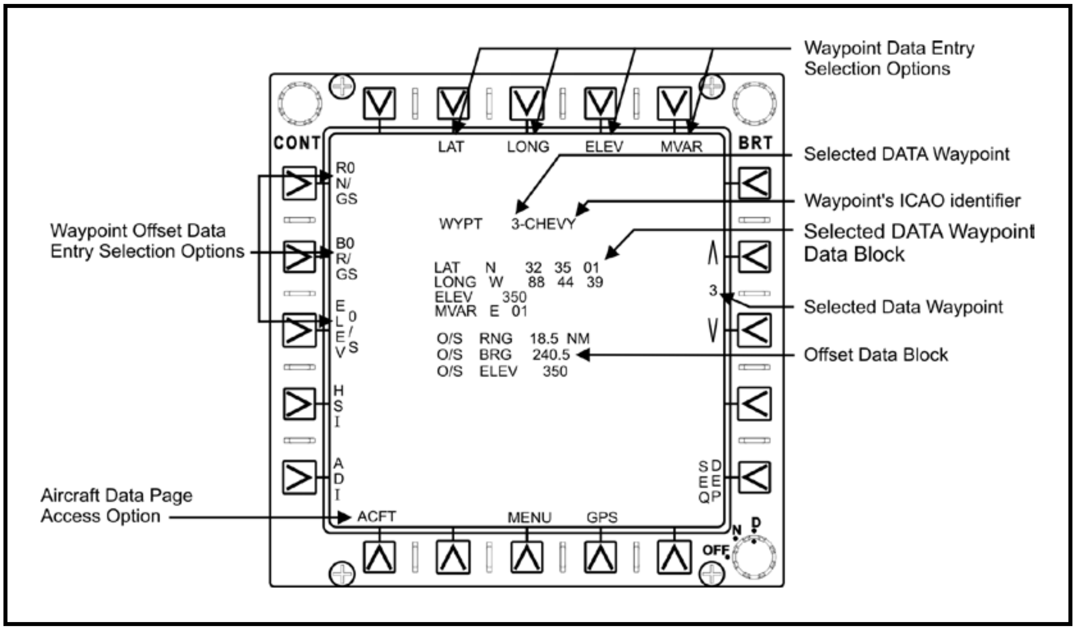

Figure 5-3a Waypoint Display Page (Before ASC – 010)

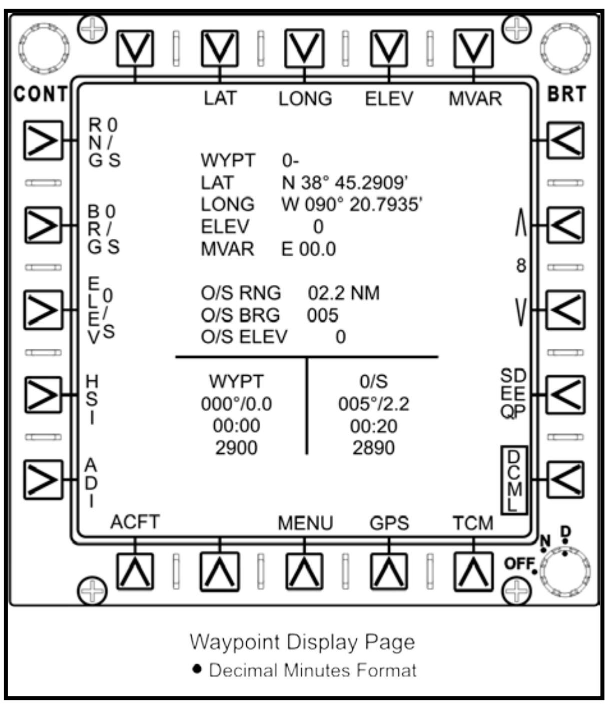

Figure 5-3b Waypoint Display Page (After ASC – 010)

Manual waypoint data entry starts by selecting the desired waypoint number with the increment/ decrement arrows on the right of the display. When the desired waypoint is displayed, all parameters for that waypoint may then be changed by selecting data options at the top of the display: LAT (latitude), LONG (longitude), ELEV (elevation), or MVAR (magnetic variation).

Selecting a data option enables the scratchpad on the MFD and HUD; other data options are blanked (Figure 5-4). New data is entered with the push buttons on the data entry panel (DEP). When the ENT push button on the DEP is pressed, the scratchpad is removed, waypoint data is updated with the new value, the option is unboxed, and the other blanked options are redisplayed.

NOTE

Waypoint elevation is only used for CCIP bombing computations when using barometric altitude ranging vice radar altitude ranging; not for waypoint steering or time-to-go.

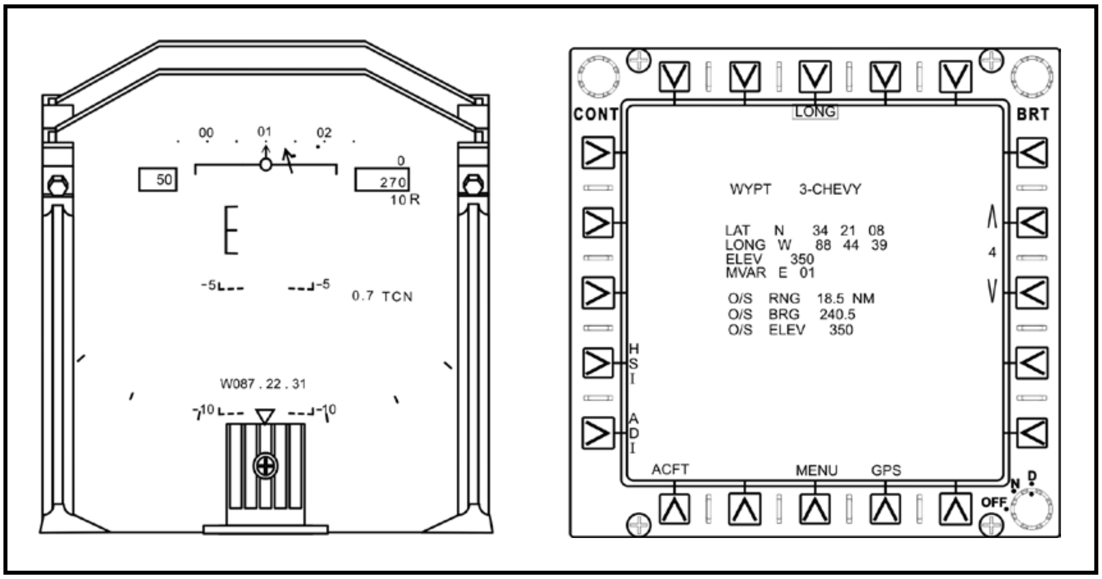

Figure 5-4 Waypoint Data Entry

507. WAYPOINT OFFSET

Each waypoint can have a defined offset (O/S), or none. The options and headers for offset data entry are displayed on the waypoint display (Figure 5-3a). Offset entry options are located on the left bezel of the MFD: range (RNG O/S), magnetic bearing (BRG O/S) and elevation (ELEV O/S). Offset data entry, using the DEP and scratchpad, is enabled when one of the O/S options is selected. No offset data is displayed if range is set at 0.0 nm. Range is limited to 0.0 to 99.9 nm in tenth of a mile increments. Bearing is 000 to 359.9 degrees in tenths of a degree increments (360 may be entered for 000). The decimal is not displayed on the scratch pad, but is automatically entered before the last digit, once the data is entered into the system. The decimal is displayed in the offset data block. Elevation initializes to the associated waypoint elevation and is limited from -999 to 9999 feet in one foot increments. Changing the position of the waypoint after entering offset data automatically sets offset data for that waypoint to zero and all offset data is blanked (Figure 5-4).

508. WAYPOINT SEQUENCING

Waypoint sequential navigation allows the pilot to select the sequence of waypoints when sequential (SEQ) is selected on the HSI display (Figure 5-5). On power-up, waypoint data initializes with the last entered waypoint sequence string displayed across the bottom of the waypoint display (Figure 5-6).

Selecting (boxing) SEQ DEP blanks the old waypoint sequence string and enables the DEP and scratchpad for entry of a new string. Selecting a waypoint number on the DEP and depressing ENT inserts the waypoint into the string. As each waypoint is entered, the waypoint number is displayed in the order in which it is entered, from left to right. Up to ten waypoints can be entered into the string, and multiple entry of the same waypoint is allowed. An invalid waypoint entry (a number greater than 10) will flash until cleared by depressing CLR on the DEP. Selecting SEQ DEP option on the waypoint display or entering the tenth waypoint will save the waypoint string, and deselect (unbox) the SEQ DEP option. When a waypoint string of two or more is entered in the waypoint string, the SEQ and AUTO option on the HSI display are enabled. When SEQ is selected, the sequence steering string is displayed on the HSI as dashed lines (Figure 5-5). Steering to any waypoint, not just those in the sequence string, is selected with the waypoint increment/decrement arrows.

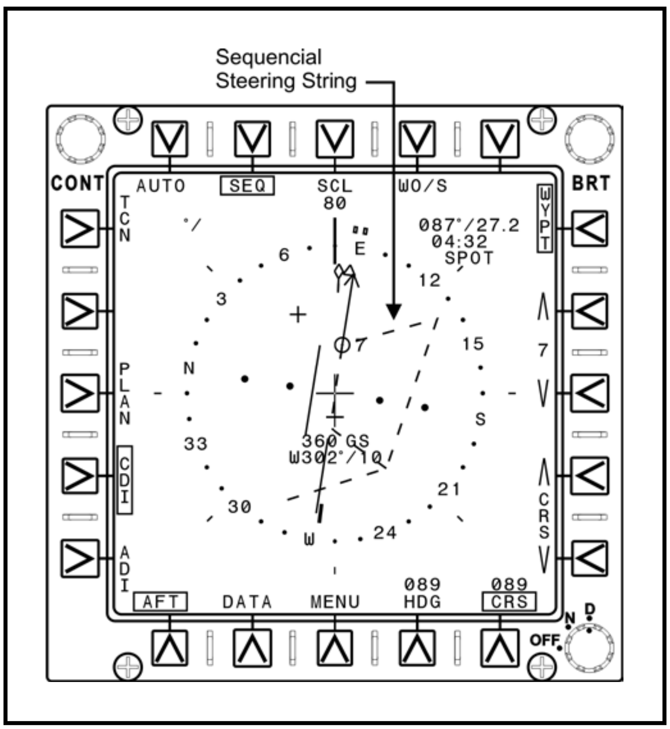

Figure 5-5 Waypoint Sequential Navigation – CDI

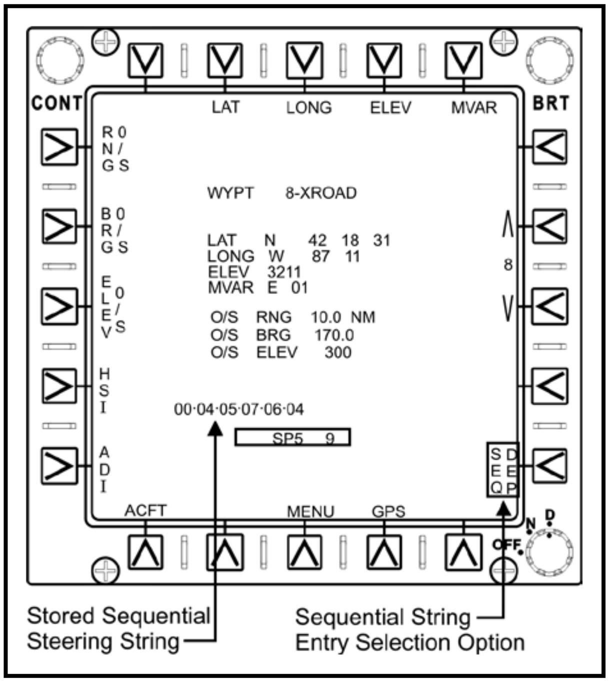

Figure 5-6a Waypoint Sequence Entry (Before ASC-010)

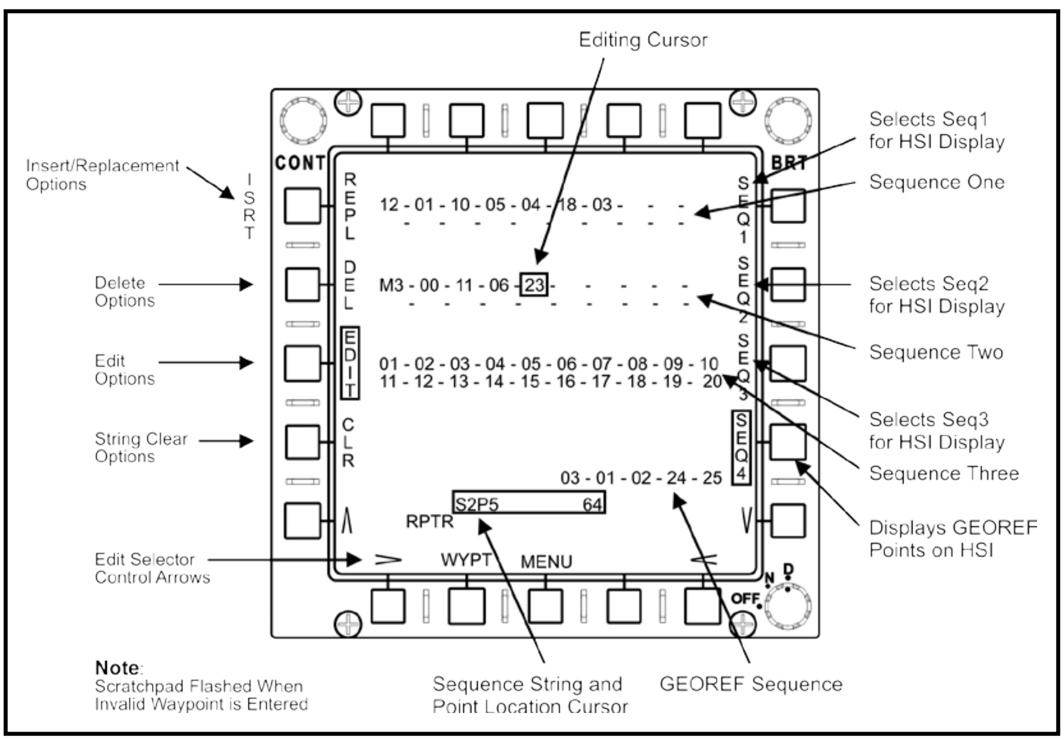

Figure 5-6b Waypoint Sequence Entry (After ASC-010)

509. WAYPOINT AUTO SEQUENCE NAVIGATION

When the AUTO option is selected on the HSI display, any previously selected steering mode (TCN, VOR/ILS, or WO/S) is deselected. WYPT is boxed, steering to the first waypoint in the stored sequence is provided, and the course setting is set to the waypoint bearing. With AUTO sequence selected, the waypoint increment/decrement selection arrows allow manual selection of the waypoints contained in the sequence string in the order of the sequence string that was entered. Selection of the last waypoint wraps to the first, and vice versa. As the aircraft proceeds along the route entered in the string, the steering automatically increments to the next waypoint in the string and the course setting is updated to the new leg bearing. This automatic waypoint change occurs when the range to the selected steer-to waypoint is less than five nautical miles and the difference between the waypoint bearing and aircraft ground track transitions from less than to greater than ninety degrees. Upon reaching the last waypoint in the sequence string, AUTO is unboxed and steering to the last waypoint in the string is retained.

NOTE

When a closed loop sequence is entered [*the first and last waypoint in the string are the same and the pilot has sequenced through the waypoint string manually*], the pilot must ensure that the active waypoint displayed is the first one in the string, not the last one.

510. WAYPOINT NAVIGATION HSI DISPLAYS

CDI Mode

The CDI mode (Figure 5-5) for waypoint or waypoint offset steering is similar to the TACAN mode, except that the CDI deviation reference scale dots represent deviation in nautical miles, and the scaling varies based on landing gear position. With the landing gear UP, full scale deflection (two dots) of the inner CDI bar represents ±4.0 nautical miles of cross track deviation. With the landing gear down, full scale deflection represents ±0.3 nautical miles of cross track deviation.

PLAN Mode

The PLAN mode (Figure 5-7) for waypoint or waypoint offset steering is identical to TACAN. The course line is drawn through the waypoint or waypoint offset symbol that is displayed inside the compass rose parallel to the selected course. If the waypoint or waypoint offset is not displayed, distance greater than the compass rose scale, the course line is drawn on the edge of the compass rose parallel to the selected course. The course deviation and intercept angle are shown by the relationship of the aircraft symbol to the planimetric course line.

In Figure 5-7 the aircraft just overflew the previous waypoint in the string and is turning to waypoint number 6. Waypoint steering and course were automatically changed to waypoint number 6 when the previous waypoint was overflown.

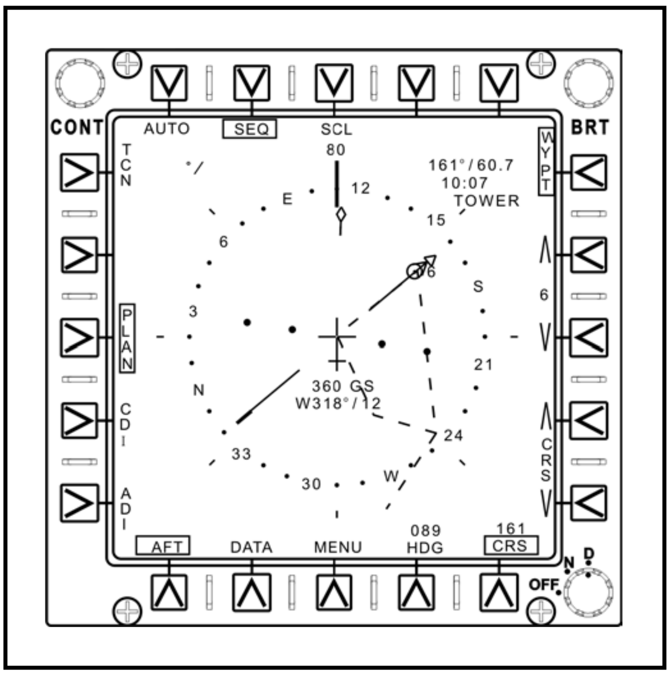

Figure 5-7 Waypoint Auto-Sequence Navigation Plan

CHAPTER SIX
COMMUNICATIONS ON TRAINING ROUTES

600. INTRODUCTION

Refer to Instrument routes (IR ROUTES) and Visual routes (VR ROUTES).

601. INSTRUMENT ROUTES (IR ROUTES)

Comply with FLIP AP/1B, local letters of agreement, and in-flight clearances.

602. VISUAL ROUTES (VR ROUTES)

Same as IR routes. Normally, you will contact the controlling ARTCC to cancel the IFR portion of your flight plan and receive clearance to descend for route entry. Contact the nearest FSS (255.4 MHz) and provide your call sign, route number, entry point, times in Zulu for entry and exit, number of aircraft, type of aircraft, true airspeed, and altitude for route of flight. Check sectional and FLIP publications for the correct FSS for route entry and exit (if different). If no response is received from the FSS, transmit in the blind. This will alert other potential route users in the area. Monitor 255.4 en route, and fly the route as filed. At exit, check off the route with FSS and contact Center (ARTCC) to resume your IFR flight plan.

Sample Comm:

ARTCC

"Houston Center, [call sign] 201"

"[call sign] 201, Houston Center, go ahead"

"[call sign] 201, cancel IFR, would like to proceed VFR to point Alpha on Victor Romeo 196"

"[call sign] 201, Houston, cancellation received, frequency change approved, squawk appropriate codes"

"[call sign] 201, roger"

FSS

“San Angelo radio, [call sign] 201”

“[call sign] 201, San Angelo radio, go ahead”

“[call sign] 201, single T-45, entering point Alpha on the Victor Romeo 196 at 1730 Zulu, exiting point Golf at 1802 Zulu; 500 feet, 360 knots”

“[call sign] 201, San Angelo radio, roger”

CHAPTER SEVEN
TWO-PLANE ROAD RECONNAISSANCE

700. INTRODUCTION

The two-plane missions flown in the Training Command are reconnaissance missions, flown to search for targets (hence the term **reconnaissance** or **recce**), rather than flying point-to-point in section to destroy a known target. The latter mission would be flown like the single-plane missions except with two aircraft, a lead and a wingman.

701. PURPOSES

The purpose of two-plane road reconnaissance as flown in the Training Command is to familiarize you with the basic skills of the mission. You will apply what you learned in Tactical Formation, Weapons Delivery, and Operational Navigation to the more fluid aspects of flying the recce formation, describing and attacking targets, and maintaining mutual support. Road recce as flown in the Training Command employs tactics for a low-threat environment, with little or no anti-aircraft artillery (AAA) or surface-to-air missiles (SAMs). Although high-threat tactics are not used here, many of the skills learned at this medium altitude can be adapted to the low-altitude regime. Recce missions are flown over road or railroad segments, river segments, etc., and do not extend to large population or industrial centers. Road recce is a tactical mission aimed at enemy support and material production.

702. PLANNING

Planning is similar to planning for a single-plane point-to-point mission, but rather than straight courses between points, your route will simply follow a road, railroad, or river. (In the training command, you will use roads.) You still stay within the route structure as defined by AP/1B. For fuel planning purposes, multiply the EFR for each road reconnaissance leg by 1.2 to allow for attacks and jinking. Plan to fly the route at 300 knots with no particular radius of turn. You do not plan for time at the checkpoints, but your doghouses should show headings from one checkpoint to the next.

703. FORMATIONS

The formation must meet several criteria. It must allow ample opportunity for all pilots to view the area being searched, because even from a relatively short distance, many ground targets are extremely difficult to see. The formation must be one from which an attack can be quickly mounted when a target is located and one in which airspeeds and/or altitudes can be kept high enough so that even an ordnance-laden aircraft can rapidly climb to a roll-in position. It must enable both leader and wingman to keep sight of one another, but not require constant attention by either pilot. The wingman should not fly so close to the lead that he degrades the lead's ability to maneuver, nor so far away that he is hard to see. The formation must present minimum exposure to various types of enemy defenses, and allow maximum opportunity for mutual support against ground and air threats. A low dive angle minimizes exposure time to ground threat while a high dive angle maximizes accuracy of attack and effectiveness of weapons.

NOTE

Performed only on road recce flight events, **not permitted by students at low altitude**.

704. COMBAT SPREAD

With the tactical lead (TACLEAD) in level flight 300 knots, the wingman flies a position either side of the lead, 4,000 feet abeam and stepped up 1,000 feet (Figure 7-1). Lead's altitude is between 3,000 and 5,000 AGL. 1,000-8,000 AGL block altitude during the recce exercise, according to airspace limitations of the local SOP and route structure apply; do not fly outside of the route as published in FLIP AP/1B. Procedures and techniques learned in Tactical Formation apply; only the distances and altitudes vary. Note that the abeam distance is roughly 2/3 that used in the TACF/ACM stage.

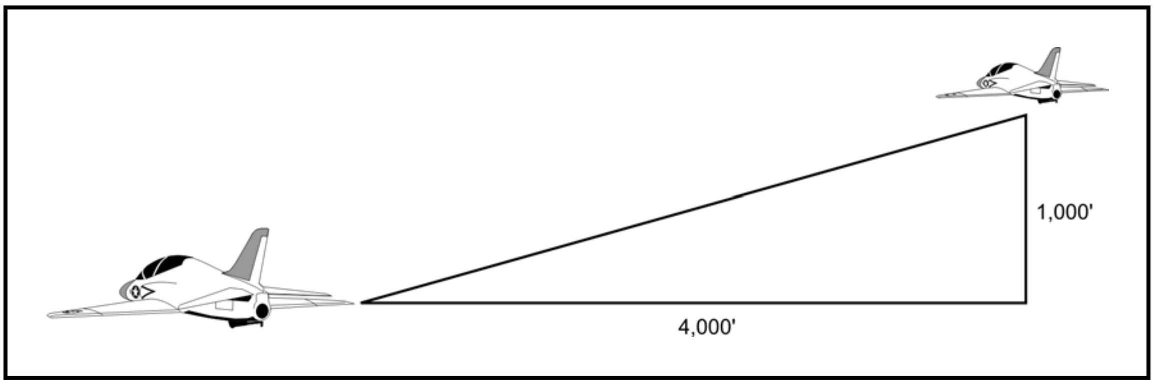

Figure 7-1 Combat Spread

705. RESPONSIBILITIES

When flown in the fleet, road recce involves a continual shift of responsibilities as the tactical situation develops. Lead may locate and call the attack or the wingman may acquire the target first and assume TACLEAD. The objective is destruction of enemy forces. However, in the Training Command you will practice both roles. Flight lead is the TACLEAD for the first half of the route (the lead change is determined by local SOP and will be briefed) and the wingman becomes TACLEAD for the rest of the mission.

TACTICAL LEAD

Your responsibilities include:

1. Navigation. Keep the flight within the route structure and maintain situational awareness at all times. Timing between checkpoints is not critical.

2. Locating targets. Select targets.

3. Communications. Talk the wingman onto the target.

4. Formation maneuvering. Maneuver the flight through the route to maintain mutual support.

WINGMAN

Your responsibilities include:

1. Lookout. Maintain a vigilant scan. You have to keep lead in sight as well as look out for bogeys and keep proper position. Formation. Maintain good combat spread and maneuver to keep up your lookout and maintain mutual support.

2. Navigation. Be ready to assume tactical lead. Know where you are along the route at all times.

3. Attack. Acquire the target, maintain sight of the lead, and execute the lead's plan.

706. MANEUVERING

The TACLEAD maneuvers the flight, while the wingman is ultimately responsible for maintaining flight separation. The TACLEAD must both navigate the flight into a position to attack the target and maneuver the flight off target for maximum mutual support. Use maneuvers learned in Tactical Formation. As in TACF, the TACLEAD initiates the communications for all maneuvers. The wingman acknowledges the lead's call with his own call sign. He also makes the "six clear" call at the appropriate times.

CAUTION

Road recce missions are flown at low-to-medium altitudes. Be aware of altitude when performing these maneuvers.

Check Turn

Use the check turn for heading changes of less than 30 degrees. The lead initiates the turn by calling, "[lead's call sign], check left/right, twenty degrees." Both members turn immediately to the new heading and the wingman corrects to maintain combat spread.

TAC Turn

For heading changes between 60 and 120 degrees, use the tac turn. The lead initiates the turn by calling, "[lead's call sign], tac left/right." The flight maneuvers as in TACF, and the wingman adjusts his turn to maintain the recce spread.

Shackle

This is the same shackle used in Tactical Formation. Use the shackle in road recce to correct for a sucked or acute wingman or to move the wingman to the other side of the section. It maintains the section heading, allows a check behind the section, and is expeditious. The lead initiates the maneuver by calling, "[lead's call sign], shackle." The acute aircraft, whether lead or wingman, executes a turn greater than 45 degrees across the section. The sucked aircraft maneuvers as in the weave.

Weave

Use the weave in road recce to check the six of the section and move wingman from one side of the formation to the other. Again the lead initiates the maneuver. Calling, "[lead's call sign], weave." Both aircraft turn 45 degrees towards each other with the wingman crossing 1,000 feet above TACLEAD. Upon returning to original heading there should be 4,000 feet lateral separation between aircraft.

707. WEAPONS PREFLIGHT SET-UP

Though ordnance is not carried on the road reconnaissance missions in the training command, you still must set up your weapons system for air-to-ground weapons delivery.

After completing the post-start checks and entering waypoint data, select the air-to-ground stores display by selecting MENU, then STRS and then A/G. The air-to-ground display initializes to GUN and manual delivery (Figure 7-2). Select the appropriate station and weapon according to your simulated weapons load. If RKT (rockets) (Figure 7-3) is selected, ensure that rockets single is selected (RPPL not boxed), and the rocket quantity reflects the simulated weapons load.

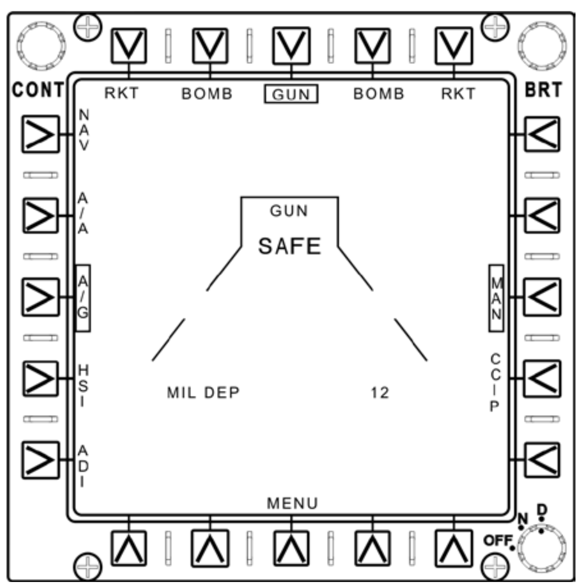

Figure 7-2 Air-to-Ground Stores Display – Manual Gun

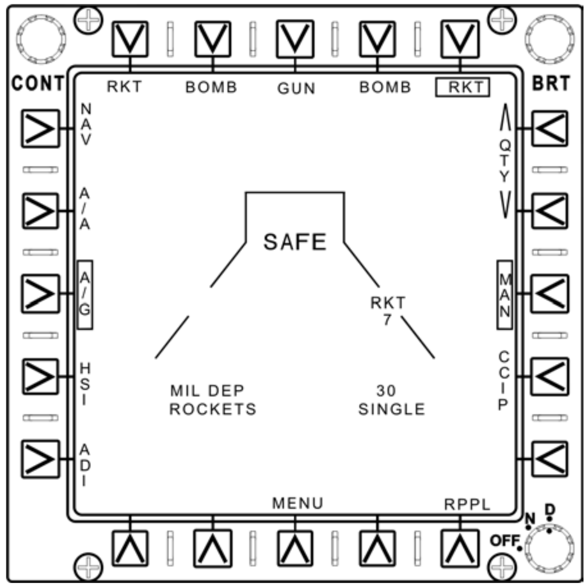

Figure 7-3 Air-to-Ground Stores Display – Manual Rocket

If BOMB (Figure 7-4) is selected, ensure that the bomb quantity reflects the simulated weapons load. If a manual delivery is planned, the mil setting may need to be changed for the planned dive angle and release altitude. On start, the system default mil setting is 12 for guns, 30 for rockets and 140 for bombs. The mil setting is changed by pressing the SET DEP + to increase or SET DEP - to decrease the mil setting on the DEP (Figure 7-5) for the selected weapon.

If CCIP is the planned delivery mode, select CCIP on the stores display. The target height does not need to be set (Figure 7-6). The entered target height is only retained as long as the waypoint doesn't change. As soon as a new waypoint is selected, manually or automatically, the target height reverts to the waypoint elevation. In addition, the system uses the radar altimeter for AGL altitude for CCIP computations. Target height is only used if the radar altimeter is off or inoperative.

When the desired weapon, mil setting, and delivery mode are entered, return to the ADI and HSI display on the MFDs and the navigation mode on the HUD. Because it is difficult to achieve a consistent dive angle and determine a correct release altitude during a pop-up attack on targets of opportunity, the CCIP delivery mode is more accurate.

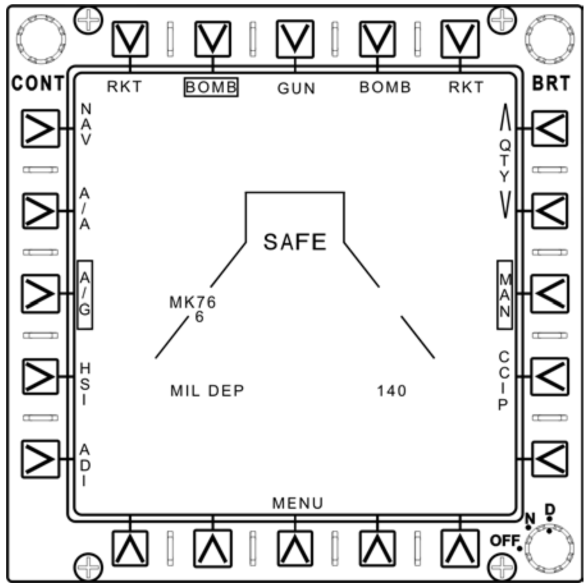

Figure 7-4 Air-to-Ground Stores Manual Bomb

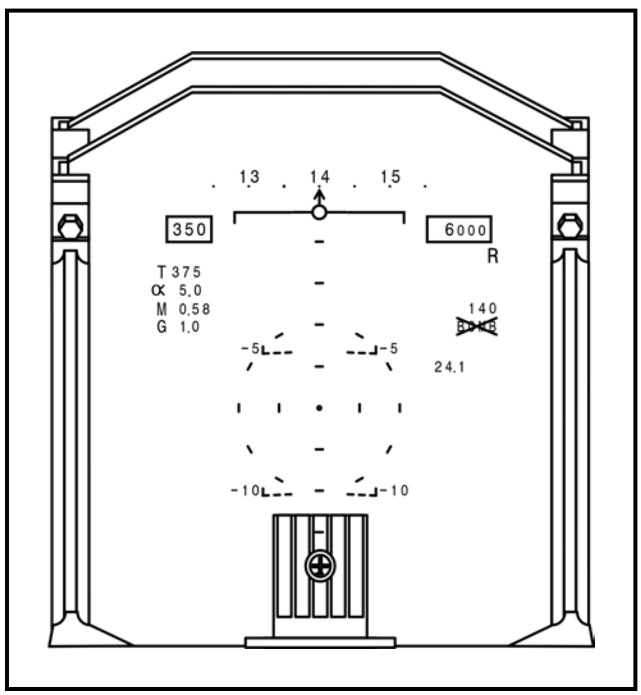

Figure 7-5 HUD Air-to-Ground – Manual Bomb

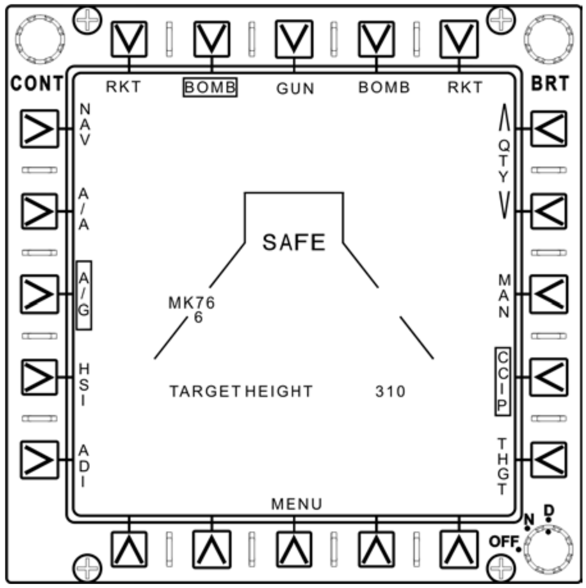

Figure 7-6 Air-to-Ground Stores – CCIP Bomb

708. ATTACK PROCEDURES

A successful search for targets of opportunity results in an attack. These attacks use procedures you learned in the weapons delivery course, with the exception that you must climb to altitude, roll in, and deliver your simulated weapon without going around a wagon wheel pattern. Use 10-, 20-, and 30-degree dives, depending on distance to the target, simulated threat environment, and route structure (refer to Figure 7-7). (You are not allowed outside, above or below the training route boundaries.)

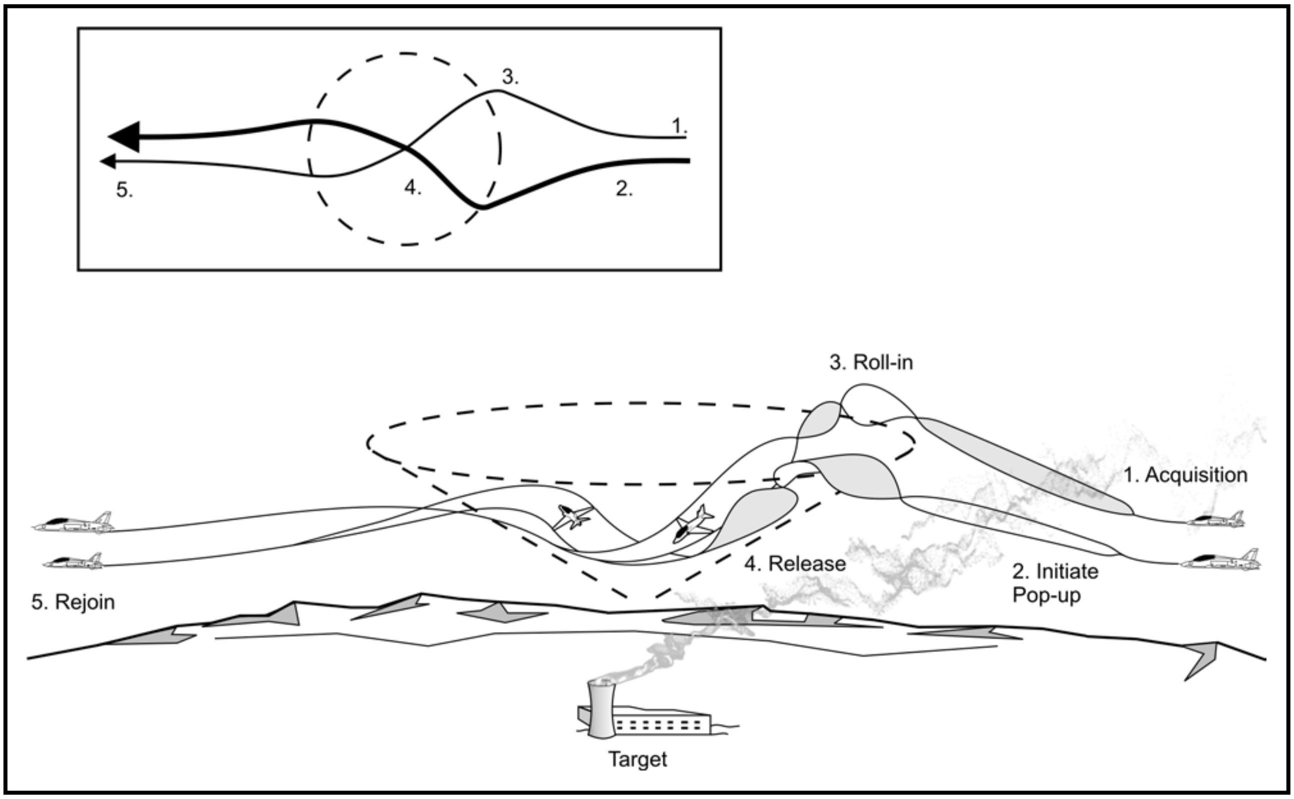

Figure 7-7 Typical Pop-up on Road Reconnaissance

Target Acquisition

The tactical lead locates the target. Depending on environmental factors along the route (dust, haze, vegetation), it may be anywhere from 3-1/2 to 7 miles ahead. He must then talk his wingman on to it. Often, target description comes during the pop-up when time is very short. Clear and concise radio transmissions are essential. In the initial call to the wingman, the TACLEAD should start by calling the target left or right of a landmark (usually a road) to effectively eliminate half of the area the wingman must search. Visual funneling, similar to the techniques used in single-plane ONAV missions, further narrows the wingman's focus.

Pop-Up Maneuver

This maneuver gets the aircraft from the recce altitudes (3,000-5,000 feet AGL plus 1,000 feet for the wingman) to a roll-in position for a dive of 10 to 30 degrees. When the lead calls for the "pop", commence a climbing turn at MRT away from the section for roughly 30 degrees of turn. During the climb select the air-to-ground delivery mode by depressing the MODE button on the DEP twice. Climb to the correct altitude for the intended dive angle and begin an aggressive roll-in to wings-level tracking (limit pulls to 4 G's). Although several techniques may be used to perform the pop-up, all require both aircraft to maintain sight of the target and each other. Maintain aircraft separation. Because the wingman is stepped up 1,000 feet, he will normally be above the lead when crossing the target. You can also maintain separation by delaying roll-in (as wingman) or by altitude differential at release. Stay above the bottom of the route structure, i.e., minimum recovery altitude for a 10-degree attack during a road recce is 1,000 feet AGL. Minimum recovery for a 30-degree attack during a road recce is 3,000 feet AGL. If, for some reason, either aircraft is not in a position to roll in safely (e.g., dive angle greater than 30 degrees or probable collision course), the pilot should transmit, "[call sign], high cover," abort his roll-in, and fly to maintain mutual support near his roll-in altitude. If you decide to change the selected weapon or delivery mode in flight, you make the change on the air-to-ground stores display. When in manual delivery mode and A/G HUD display, the mil setting can be changed without having to display the air-to-ground stores display on the MFD.

Jinking

This maneuver is the sudden, rapid displacement of the aircraft's flight path in three axes. This is used to confuse the enemy and prevent him from getting a good tracking solution, to avoid ground fire, or to avoid fragmentation patterns and ricochets.

Track Target

As wings level tracking is accomplished, establish initial pipper placement, check dive angle, altitude, power setting, and begin to track target. At release altitude with attack solution, "pickle," commence recovery.

Off Target

Initiate a normal 4-G recovery, call off safe and return to combat spread formation. Note this recovery differs from the recovery used in the weapons delivery pattern because you do not have to climb as high. In fact, you may not have to climb at all. Check six when crossing the other aircraft's flight path and regain mutual support. If a turn is required to put the flight on a new heading, the lead will make that call off target. When the attack is completed, return to the navigation mode by depressing the MODE button once.

Communications

The art of making an effective road recce attack involves making and understanding clear and concise communications while aggressively maneuvering the aircraft. You must maneuver your aircraft to an attack position, execute a dive delivery, and maneuver off target. You must also communicate your actions and intentions clearly and concisely. The following represents a typical road recce attack sequence. Nerf is the TACLEAD and Nemo is his wingman.

TACLEAD: "Nerf's got a target, left side of the road, four miles, water tanks."

TACLEAD: (If less than three miles from target): "Nemo, get your nose up, I have a target left side of the road, water tanks."

WINGMAN: "No joy."

TACLEAD: “Look one mile prior to green field.”

WINGMAN: “Tally, visual!”

TACLEAD: “Nerf’s poppin’.”

WINGMAN: “Nemo’s poppin’.”

TACLEAD: “Nerf’s in.”

WINGMAN: “Nemo’s in.”

TACLEAD: “Nerf’s off, heading one eight zero, six clear.”

WINGMAN: “Nemo’s off, one eight zero, six clear.”

CHAPTER EIGHT
TWO-PLANE LOW-LEVELS

800. INTRODUCTION

Up to this point, the ONAV syllabus in the training command has developed your skills in navigating within the confines of a VR route as a single ship to arrive on target, on time. Road reconnaissance flights developed your skills in navigating the more permissive altitude restrictions of an IR route while performing the responsibilities of tac-lead or tac-wing to identify and attack planned targets and targets of opportunity while familiarizing you with mutual support doctrine. In the two-plane low-level flights, you will combine and refine the skills and procedures you have developed in previous ONAV stages. You will now fly point to point in section along a VR route while providing mutual support for the purpose of arriving on time at a preplanned target for multi-ship weapons delivery. These flights simulate a low-level section ingress to a target attack in a high threat environment, and will provide the foundation for further training in the FRS and eventually, the fleet. Someday soon, the towers you are avoiding now may be replaced by ZSU-23's and SA-6's in operational missions. Remember that all the formation, low-level flying, and weapons delivery skills are TOOLS to put steel on-target, on time.

801. FLIGHT PLANNING ROUTES AND CHARTS

The route used for ONAV 13/14x will be a VR route, preferably one that has been flown previously. The same strip chart used for single-plane ONAV will be utilized for these flights, although additional notation and chart preparation will be required for the two-plane mission. Specifically, notations for types of turns used at checkpoints, offsets to the course line for obstacle avoidance, and action areas should be noted. The same fuel planning numbers and 360 knot ground speed should be used.

802. MULTI-PLANE NAVIGATION

Pre-plan specific courses of action during the low-level. This preplanning will be critical to mission success, and will allow decision-making efforts to be focused elsewhere in this dynamic environment. Some items of consideration:

1. Offsetting section to one side of the course line for avoidance of obstacles.

2. Determining which side wing will fly off lead during appropriate phases of the route.

3. Determining what types of turns will be executed at checkpoints and other action points.

4. Any additional considerations, which will allow you to more fully focus your attention on the route, and to provide mutual support.

803. FLIGHT PROCEDURES

These will be full systems flights. Having the section arrive on-target, on time will be emphasized and graded. Use the system to your best advantage to achieve this goal, but don't neglect intermediate checkpoint identification as a tool to build SA.

804. RESPONSIBILITIES

Lead

1. Navigation: Keep the flight within the route structure and maintain SA at all times. Keep the flight on time.

2. Locating the target: Locate the target and talk the wingman's eyes on.

3. Communications: Give verbal commands for turns, obstacle avoidance, and target description.

4. Formation Maneuvering: Maneuver the flight throughout the route to maintain mutual support.

Wing

1. Lookout: Primarily responsible for collision avoidance between the two aircraft. Keep lead in sight, maintain proper position, and clear your flight path. Lead is driving the flight, but you are responsible for your own aircraft's obstacle clearance and avoidance of birds, etc.

2. Navigation: Know where you are on the route at all times and be ready to assume the lead if necessary.

3. Attack: Be ready to attack the target on Lead's commands.

805. ROUTE ENTRY

Lead will have the section aimed at the first point and in line with the first route leg as soon as practical, but no later than 5 miles prior to route entry. All other entry procedures, such as cancellation, FSS notification, squawk, and setting 360 knots will be as for single plane ONAV.

Once the previous items are completed, Lead will affect combat spread. Wing will maintain +/- 100 feet of lead's altitude until within the route structure.

806. FLYING THE ROUTE

Altitudes

Lead will fly in a 500-800 feet AGL block (LAW set at 450 feet) and Wing will fly in an 1100-1500 feet AGL block (LAW set at 1000 feet). The wingman's knowledge of the route must be impeccable, since he will need to devote most of his scan to the front (to clear his flight path), and to the side (to stay in position abeam Lead). Only minimal scan time is allowed for reference to the chart and time.

TACFORM

When performing TacForm, the wingman will be responsible for aircraft deconfliction and will deconflict high unless otherwise declared over the radios. A wingman's deconfliction will always be greater than or equal to 500 feet. If aircraft cross directly above and below each other, the wingman will need at least 500 feet of altitude clearance. Otherwise, he must pull lag or lead as necessary to obtain minimum clearance. The wingman must always be vigilant of the top of the route structure. If Wing does not have Lead in sight, Wing must respond to Lead's call to maneuver by saying "Negative, (call sign) is blind."

Turns

For turns of 0-20 degrees, Lead should call for a check turn. For turns of 21-50 degrees, Lead should call for an off-heading shackle. For turns of 51-140 degrees, Lead should call a tac turn. All turns greater than 140 degrees should be accomplished through In-place turns. Again, SNA's should preplan the type of turns used at specific points on the route.

Corrections

Since the wingman does not have sufficient altitude to change his energy package, Shackles will be the primary method to return an out-of-position wingman to the abeam position. If the wingman is sucked, he will need to float his turn to the point of aircraft crossing during the shackle. Conversely, if acute, the wingman will need to pull **more** than 14 units AOA in an effort to pull back to Lead by the point of aircraft crossing while ensuring deconfliction. If the wingman is sucked **at the shackle cross point**, he will need to reverse to the new heading early and then allow for a slightly increasing separation (get pointed downrange, then worry about getting wide). If the wingman is acute **at the cross point**, he will need to float his next run as much as possible until seeing approximately .6 or .7 DME, then perform a hard pull to the new heading (get wide first, then get pointed downrange).

Communications

Besides calling turns, Lead will announce any relevant obstructions by describing the obstruction (tower, airport, etc.), a clock code in relation to the wingman, and a distance estimate. This is especially critical if the section will bracket an obstruction. Wing will notify his IP if a checkpoint is reached with more than a 10 second deviation from planned timing.

807. ATTACKS

SNA's should plan to make an attack on one planned target near the end of the route, and arrival time at this target will be graded. One additional mid-route target may be selected for attack if briefed, but making more than two target attacks is discouraged since the prescribed attack method will take approximately 15 seconds longer than straight and level flight. Additional fuel will also be expended both in the attack, and in the subsequent increase in airspeed for timing correction.

Fence In

When reaching the IP for the planned target, or 10 miles, whichever comes first, Lead will initiate a "fenced-in" call. Fence procedures will include A/G mode (Bombs and CCIP selected), Master Arm--Arm, and a G's and Fuel check. VCR's should be recording the entire flight, and this item need not be reported, but check VCR--On also at this time.

Attack Procedures

Attack procedures, as depicted in Figure 8-1, will be standard approaching the target. Approaching the target, Lead will describe the target, give distance to target, and say the egress heading. Lead should maneuver the section so that the target will be off his own nose. Lead will line up his own aircraft on the run-in line, give the command "Action" at 4 miles from the target, and proceed in his altitude block performing a simulated level lay-down delivery by dragging the CCIP cross over the target. Wing, upon hearing the "Action" command will roll into a level 14 unit, 90-degree turn towards Lead **while maintaining 360 knots**. After rolling wings level, Wing will time for 7-8 seconds **while maintaining 360 knots**. After 7-8 seconds, which should make Wing cross Lead's flight path, Wing will reverse towards the target and perform a simulated level lay-down delivery of his own. Wing will remain in his altitude block for the entire attack and egress.

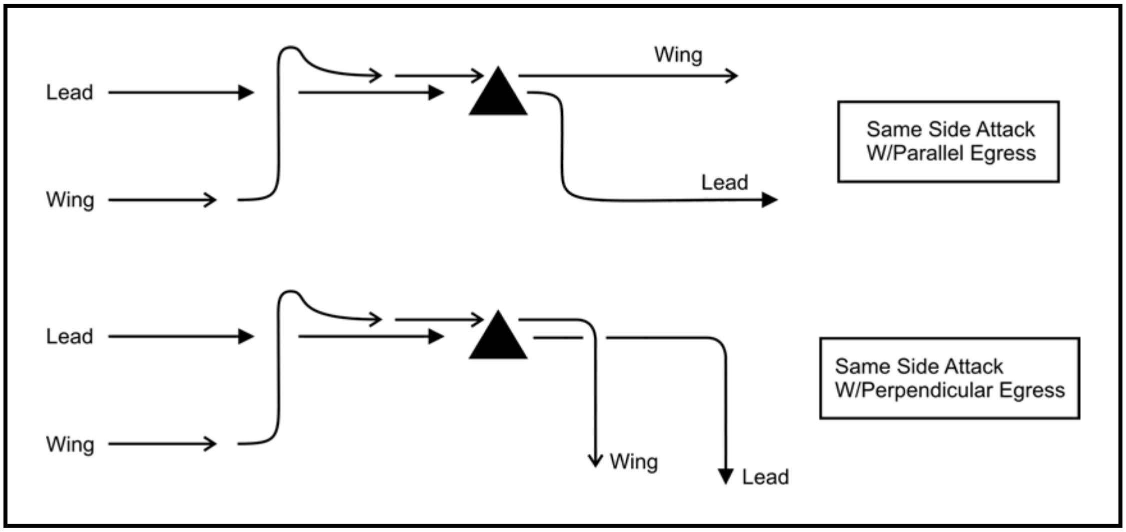

Figure 8-1 Level Attacks on Low-Levels

Egress

If egress is in the same direction as the initial attack heading (see Figure 8-1), Lead will, immediately after the simulated delivery, perform a level 14 unit AOA, 90-degree turn to the side Wing was on prior to the "Action" call. He will then roll wings level, time 7-8 seconds, and reverse back to the egress heading. Wing will simply turn to parallel the egress heading after weapons delivery. Wing should keep sight of lead during Lead's of target maneuver. After rollout on the egress heading, Lead must then reacquire sight of Wing and call a shackle if section integrity dictates.

If egress heading is perpendicular to the initial attack heading (see figure 8-1), Lead will proceed past the target maintaining his attack heading for 7-8 seconds. At the completion of timing, Lead will perform a level 14 unit AOA 90 degree turn (maintaining 360 knots) towards the egress heading. Wing will perform the same turn immediately after the simulated delivery. Once both aircraft have reacquired sight of each other, Lead will dress the section as in the straight ahead egress. Once the flight is back in spread, Lead will fence the flight out. Master Arm--Safe, Nav Mode, G's and Fuel.

808. REJOIN

After the last target or last point on the route, Lead will call a knock-it-off with heading, and Wing will respond, "2 knock it off (heading)." Lead will then clear Wing to join with a visual and begin a decelerating climb to his predetermined RTB VFR altitude, as appropriate for the route being flown.

Lead

"Lead is climbing to X.5, decelerating to 250, with visual, you are cleared to join."

Wing

"Visual." Lead will then clear the flight off the route will FSS, squawk VFR, and coordinate with appropriate control agencies for RTB. Wing will execute a running rendezvous with lead, and join in parade. Lead will dash 2 into cruise for a normal section RTB.

CHAPTER NINE
BINGO PROCEDURES

900. INTRODUCTION

You may be faced with an unplanned, low-fuel divert. This is an emergency situation and requires quick and well-advised actions on your part. Bingo information should be calculated for each of the route checkpoints to include: fuel, magnetic course and distance and recorded on the jet log for later transfer to the charts.

901. BINGO

1. Climb to conserve fuel and increase visibility. Know the optimum altitudes for various fuel states and distances (refer to the NATOPS Pocket Checklist). Do not go above an overcast if that may lead to disorientation on top or delays at the destination. If fuel is low enough that you must climb above an overcast, do so; that is better than running out of fuel.

2. Proceed at maximum range airspeed on the BINGO profile, squawk emergency.

3. Use all available navigation aids, IFF, radio communications facilities, radar, etc., to verify accurate navigation. Check the standby compass.

4. Proceed to the destination airport and set up for an emergency approach (straight, downwind entry, etc.).

5. Make a maximum range idle descent in accordance with the BINGO chart.

6. This is a standard bingo profile, just like the ones you plan from points along the route. The difference is that you have to plan it as you fly. You have to be right on with your navigation; you do not have fuel to waste.

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CHAPTER TEN
EMERGENCIES

1000. INTRODUCTION

You cannot plan for every event that may cause you to be in an unsafe situation, nor can we discuss all alternatives and proper actions. However, from an evaluation of aircraft accident reports, emergencies, aircraft malfunctions and severe weather experiences, we can make general contingency plans that will be appropriate in a majority of unplanned situations and emergencies. In all cases, handle emergencies in accordance with prescribed NATOPS procedures.

This is the first training you will do that puts you close to the ground for an extended period of time. This environment affects the most likely threats to you and your aircraft and the action you must take to avoid them. The first step is to climb to a safe altitude. This allows you to assess the situation without having to concentrate on ground avoidance as you would at 500 feet AGL.

You should have an emergency safe altitude calculated and entered on the jet log for each leg of the low-level route. Flying at this altitude will ensure safe clearance from all obstructions so that you can devote your attention to the immediate problem of weather, aircraft malfunction, or navigation error.

Two of the biggest hazards to low-level flight are birds and the ground. A disciplined low-level scan will help you to avoid both of these hazards. You can give yourself added protection from birds by keeping your helmet visor down. If you are blinded by a bird strike through your canopy, you must first try to maneuver away from the ground and slow down. Communications will be extremely difficult, if possible at all, and forward visibility may be nonexistent. It is advisable to fly with a zero trim setting or slightly nose up for this reason.

If the emergency requires ejection, consider that the best airspeed for ejection is below 250 knots. If possible, slow the aircraft before ejection to reduce the windblast. Ejection seat trajectory is improved if you zoom climb to trade airspeed for altitude. Additional altitude increases time for seat/man separation and parachute deployment. Do not delay ejection if the aircraft is nose down, out-of-control at low altitude.

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CHAPTER ELEVEN
SUITABLE DIVERT AIRFIELDS

1100. INTRODUCTION

To be usable as a divert field, an airstrip must have at least 4,000 feet of hard-surfaced runway and be listed in either the FLIP, IFR or VFR en route supplement. Consideration must be made as to the seriousness of the emergency situation requiring a divert. An ideal divert field would be military, with arresting gear, servicing equipment and personnel, security, etc.

Primary, secondary and tertiary divert fields can be identified and used in priority order depending on how critical the emergency is. A "land as soon as possible" emergency, for instance, may require you to land at a small civilian field with a short runway and few services. Divert fields will be identified by a blue circle. A blue arrow with divert information will point from each turnpoint to the nearest divert field.

Reasons that may require you to divert: aircraft system trouble, bird strike or midair collision. If aircraft system trouble is detected, comply with NATOPS procedures first. Then decide whether a divert is required. If you have a bird strike (or any midair collision), determine if the aircraft is controllable. If controllable, establish a shallow climb of 5-10 degrees and slow down, following NATOPS procedures for damaged aircraft. If the aircraft is uncontrollable, EJECT.

Always fly with the latitude/longitude of possible low-level diverts. If the low-level route does not require all ten active waypoints, enter divert field coordinates prior to takeoff. This will provide an expeditious initial steer in the event of a divert scenario.

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APPENDIX A
GLOSSARY

A

AAA: Anti-Aircraft Artillery

ALT: Altitude. Top block of Low-Level Jet Flight Log has altitude AGL for leg; bottom block has emergency safe altitude (MSL) for leg.

AP/1B: Flight information publication with information on training routes in North and South America; published by the Department of Defense.

ATA: Actual time of arrival at a checkpoint.

B

BASH: Bird Aircraft Strike Hazard.

Bingo: Aircraft is considered to be in an emergency/fuel critical situation.

Blind: No sight (or lost sight) of wingman.

C

Checkpoint: A landmark used as a time and/or course reference.

CHUM: DMA Aeronautical Chart Updating Manual; contains changes to individual DoD charts; published by the Department of Defense.

Coast-in: A point on a coastline where the aircraft crosses over to become "feet-dry" after a flight over water.

Combat Plotter: A planning tool with course protractor, turn radius templates, and time and distance scales; distances in nautical miles. See also Navigation plotter.

CUS: Magnetic course line on the low-level jet flight log.

D

Dead Reckoning: Use of time, distance and heading for purposes of navigation.

DIST: Distance in nautical mile on the low-level jet flight log.

E

EFL: Estimated fuel left at a checkpoint, on the low-level jet flight log.

EFR: Estimated fuel required for one leg of a flight, on the low-level jet flight log.

ETA: Estimated time of arrival on the low-level jet flight log; not Zulu or local time, but cumulative time from first checkpoint.

ETE: Estimated time en route; the time on one leg of the mission on the low-level jet flight log.

F

Funneling: Following a linear feature such as a road, river, etc., to locate a predetermined checkpoint.

H

HI-LO-HI: A flight profile that makes use of fuel-efficient high altitudes going to and from a low-level training route.

I

Intermediate Checkpoint: A pilot-chosen checkpoint between the AP/1B checkpoints of a Low- Level High-Speed Training Route.

J

Jet Navigation Chart (JNC): A Department of Defense navigation chart for use at very high altitudes; scales 1:2,000,000.

Jink: A defensive maneuver in three dimensions.

Joint Operations Graphic (JOG): A Department of Defense chart for precision work such as locating a target or computing loft bombing pull-up point; scales 1:250,000.

L

Landmark: Terrain feature used to visually navigate.

Low-Altitude, High-Speed Training Route: FAA authorized corridors where the 250 KIAS speed limit does not apply; floors, ceilings and lateral boundaries are defined in FLIP AP/1B.

M

MEF: Maximum elevation figure; the tallest object in a grid of a chart used in low-level navigation.

MFR: Minimum fuel required; minimum fuel to complete an entire route from a checkpoint; on the low-level jet flight log.

N

Navigation Plotter: Also known as Weems plotter; used for headings and distances; may have statute miles rather than nautical miles. See also combat plotter.

No Joy: No sight (or lost sight) of target.

O

Operational Navigation Chart (ONC): A Department of Defense navigation chart for use above 5,000 AGL; scaled 1:1,000,000.

R

Recce: Pilot's terminology for reconnaissance.

Road Recce: Reconnaissance along a road, river, or railroad.

S

SAM: Surface-to-air missile.

Sectional Chart: A civilian chart scaled 1:5,000,000. Published by the National Oceanic and Atmospheric Administration.

Shackle: A road recce maneuver used to correct the formation and check six; not the same as the shackle in Tactical Formation. See also Weave.

Strip Chart: The chart of a particular mission cut and pasted to kneeboard size.

Supply Convoy: One or more trucks observed during a road recce.

T

TACLEAD: The tactical lead of a multiplane mission; as opposed to the flight lead. Can be either pilot of a two-plane mission.

Tactical Pilotage Chart (TPC): A Department of Defense navigation chart for use below 5,000 AGL; scaled 1:500,000

Tally: Target in sight.

Turnpoint: A checkpoint that requires a heading change.

V

Visual: Wingman in sight.

W

WAC Chart: World Aeronautical Chart. A civilian chart scaled 1:1,000,000.

Weave: A road recce maneuver used to check the six o'clock and to move the wingman from one side of the formation to the other. See also shackle.

APPENDIX B
INDEX

S

T

V

W