

NAVAL AIR TRAINING COMMAND



NAS CORPUS CHRISTI, TEXAS

CNATRA P-1271 (Rev. 01-09)

LECTURE GUIDE



OPERATIONAL NAVIGATION T-45TS, TAILHOOK, AND IUT

2009



DEPARTMENT OF THE NAVY

CHIEF OF NAVAL AIR TRAINING
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Subj: LECTURE GUIDE, OPERATIONAL NAVIGATION, T-45

1. CNATRA P-1271 (Rev. 01-09) PAT, "Lecture Guide: 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 CNATRA P-1271 (05-98) PAT is hereby cancelled and superseded.

A handwritten signature in cursive script, appearing to read "James A. Crabbe", is written over a vertical line that extends from the signature down to the distribution list.

JAMES A. CRABBE
Chief of Staff

Distribution:
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COMTRAWING ONE (200)
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LECTURE GUIDE
FOR
OPERATIONAL NAVIGATION
P-1271



LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:

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LETTER	0		
iii – viii	0		
1-1 – 1-20	0		
2-1 – 2-27	0		
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3-1 – 3-4	0		
4-1 – 4-9	0		
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5-1 – 5-3	0		
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INTERIM CHANGE SUMMARY

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CHANGE NUMBER	REMARKS/PURPOSE

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INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

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**CHAPTER ONE
LECTURE GUIDE #01**

100. INTRODUCTION – N/A

COURSE/STAGE:

- T-45TS, TAILHOOK & IUT/Operational Navigation

LESSON TITLE:

- Operational Navigation Planning and Symbology

LESSON IDENTIFIER:

- T-45C TS, ADV & IUT ONAV-01

LEARNING ENVIRONMENT:

- Classroom

ALLOTTED LESSON TIME:

- 1.5 hr

TRAINING AIDS:

1. Publication References
 - a. Flight Information Publication AP/1B
 - b. Chart Update Manual
 - c. Chart Update Manual Supplement
2. Charts
 - a. TPC H-24B, G-20C
 - b. ONC H-24, G-20
3. Tools
 - a. Combat Plotter
 - b. Wheems Plotter
 - c. Dividers

4. Figures
 - a. Fig 1: North American ONC Coverage
 - b. Fig 2: Operational Navigation Chart (ONC)
 - c. Fig 3: Tactical Pilotage Chart (TPC)
 - d. Fig 4: Low-Level Jet Flight Log
 - e. Fig 5: Strip Chart Templates

STUDY RESOURCES:

1. ONAV FTI
2. Flight Information Publication General Planning
3. DMA Aeronautical Chart Updating Manual
4. Operational Navigation Chart (ONC) H-23
5. Tactical Pilotage Chart (TPC) H-23B

LESSON PREPARATION:

- Read:
 - a. ONAV FTI
 - b. Page 1-2 and page 2-1, Flight Information Publication Area Planning Military Training Routes North and South America AP/1B
 - c. Paragraphs 4-1 to 4-3, 5-17, and 5-41, Flight Information Publication General Planning
 - d. Cover page through General Information Section, DMA Aeronautical Chart Updating Manual (CHUM)

REINFORCEMENT: N/A**EXAMINATION:**

The objectives in this lesson will be tested in Operational Navigation 08X.

101. LESSON OBJECTIVES

1. Recall tools and materials required for ONAV planning.
2. List types of charts for ONAV planning.
3. Interpret charts for visual navigation.

102. MOTIVATION

The conduct of modern warfare necessitates maintaining the element of surprise, avoiding enemy defenses, and employing coordinated attacks with other friendly forces. Penetrating enemy territory at very low altitude and from several directions complicates the enemy's problem to defend a particular objective.

Old attack pilots get that way by knowing how to plan and use tactics that get them safely to the target and back. To succeed in this type of mission, precise planning, exact timing, low-level visual navigation, and dead reckoning skills are essential. To be able to plan a mission successfully, you must know and understand how to use the planning resources available to you.

In order to visually navigate undetected to a target without the use of radio navigational aids, destroy it in coordination with allied forces, and return in one piece, you must be able to construct a complete and accurate navigation chart that can be used in the cockpit.

103. OVERVIEW

This is the first of three classroom lectures in ONAV where you are introduced to the tools, symbology, procedures and conventions used to plan a low-level mission. You are then given the opportunity to practice these techniques in workbook lessons 3 and 4, where you will apply what you have learned to create your workchart and low-level jet flight log. Lesson 5 will introduce the procedures and conventions necessary to create your "strip chart" and "emergency divert chart". In workbook lesson 6, you will apply what you have learned to prepare a divert chart and a functional strip chart of a local ONAV flight. This first lesson will introduce you to the tools and symbology used in ONAV planning and chart development.

1. ONAV mission planning tools and materials
2. Chart interpretation and symbology

104. REFRESHER

Recall from your primary flight training:

1. You constructed a route of flight and used dividers and plotter to measure the course and distance of that route. You then used your CR-2/APN-91 computer to determine the time required to fly between points. Similarly, you will be plotting routes, measuring data, and making computations to determine flight information for low-level routes during this stage.
2. You used a Sectional Chart with a scale of 1:500,000 to find your position. This is the same scale as the Tactical Pilotage Chart (TPC) on which you will create workcharts and from those, strip charts from which you will navigate through the low-level routes during your T-45C ONAV training.

WARNINGS

1. Failure to follow the procedures outlined in the FTI increase the likelihood of having a mid-air with other aircraft on ONAV Routes.
2. Failure to follow the procedures outlined in the FTI increase the likelihood of having a bird strike on ONAV Routes. Aircrew must be aware of the hazards that might develop in the event of a bird strike and develop a plan for such events.

105. PRESENTATION**ONAV mission planning tools and materials**

1. Publications
 - a. AP/1B
 - i. Overview of the AP/1B publication
 - (a). Part of DOD Flight Information Publications (FLIP)
 - (b). Provides textual descriptions and operating instructions for all military training VR & IR ONAV routes and refueling tracks
 - (c). Revision cycle every 56 days

NOTE

Use current publications only!

- ii. Textual descriptions of IR and VR routes
 - (a). Identifies
 - (1). Originating activity
 - (2). Scheduling activity
 - (3). Hours of operation
 - (b). Provides
 - (1). Route description
 - i) Altitude data
 - ii) Checkpoint designator
 - iii) Checkpoint location by TACAN radial and DME
 - iv) Checkpoint location by latitude and longitude coordinates
 - v) Route width
 - (2). Terrain following operations
 - (3). Special operations procedures
 - (4). Flight Service Stations within 100 nm radius
- iii. AP/1B chart – graphic description
 - (a). Visual Routes (VR) – low level
 - (1). Blue routes
 - (2). Weather must be 3000 and 5 or greater
 - (b). Instrument Routes (IR) – low level
 - (1). Red routes
 - (2). May be flown in IMC
 - (c). Slow Routes (SR) – low level

- (d). Refueling tracts
 - (e). TPC index
 - (f). Route hours of operation
 - (g). Legend
- b. Chart Update Manual (CHUM)
- i. Revised each 6 months (March and September)
 - ii. Lists changes in TPC's and ONC's plus several other charts
 - iii. Identifies latest edition charts that must be used for low-level route planning
 - iv. Lists obstructions 200 ft or higher reported since the edition date of the chart

NOTE

Cannot "chum" outdated/obsolete chart

- c. Chum Supplement
- i. Published monthly (except March and September)
 - ii. Includes and replaces prior CHUM Supplement information
 - iii. Addendum to latest CHUM
2. Charts
- a. Operational Navigation Chart (ONC)
- i. Coverage
 - (a). Lettering begins at north pole and increases in 1 letter increments for each 8 degrees of latitude, making "F" the top row in the United States and "G" the row covering the longitude at Meridian.
 - (b). Numbering begins with zero degrees longitude in England and increases in an easterly direction. East-west coverage will vary with latitude.
 - ii. Purpose
 - (a). Used as part of low-level route work chart when departure and destinations are greater than 100 nm from low-level route entry or exit checkpoints

- (b). Used as the emergency divert chart
 - (c). Used when flying 5000 ft AGL or above (divert chart)
 - iii. Scale – One unit on the chart equals 1,000,000 units of measurement on the ground (1:1,000,000) or 1" = 16 miles
 - b. Tactical Pilotage Chart (TPC)
 - i. Coverage
 - (a). Cataloged in relation to ONC coverage
 - (b). Four TPCs cover about the same area as one ONC
 - ii. Purpose
 - (a). Supports low-altitude high-speed navigation
 - (b). Displays high geographic detail including precise location of geophysical and cultural features enabling precise positioning
 - (c). Used to plan and navigate all ONAV training routes
 - iii. Scale – One unit on the chart equals 500,000 units on the ground or 1" = 8 miles
 - c. Other useful charts
 - i. World aeronautical chart (WAC) 1:1,000,000
 - ii. Joint operational graphic (JOG) 1:250,000
 - (a). Ground (artillery) – uses universal military grid system
 - (b). Air (air to ground) – uses Lat. Long. Grid system
 - (1). Used for precisely locating a specific feature
 - (2). Used for accurate close air support and to measure loft bombing pull-up point
 - (3). Used for detailed analysis of target area
3. Low-Level Jet Flight Log

NOTE

The Low Level Jet Flight Log has been developed specifically for use when conducting an operational navigation low level flight and differs from the standard jet log you have been preparing until now. You will be taught, in Lesson 2, how to prepare this log.

4. Tools
 - a. Dividers
 - i. Plot coordinates
 - ii. Measure mileage
 - iii. Assist in reading NATOPS performance charts
 - b. Wheems Plotter
 - c. Scissors
 - d. Marking/Writing tools
 - i. Pencils
 - (a). Black
 - (b). Blue
 - (c). Red
 - (d). Green
 - ii. Felt tip pens (fine point)
 - (a). Black
 - (b). Blue
 - (c). Red
 - (d). Green
 - iii. Yellow highlighter
 - e. Hard board

NOTE

The hard board will be used in the creation of the strip chart development and should be no thicker than poster paper. Manila folders are suitable and are commonly used.

- f. Transparent tape
- g. APN-91 computer
- h. Combat plotter
 - i. Protractor
 - ii. Mileage scale
 - iii. Ground speed scale (tick mark)
 - iv. Ground speed turn radius scales (tick mark)
 - v. Plotting symbol templates
 - (a). Circles
 - (b). Initial Point (IP) - square
 - (c). Target - triangle
 - (d). Dog house
 - (e). 10 nm rectangle - Scan for obstacles within 5 nm either side of ONAV route centerline
- a. Stripping template
 - i. Used to determine and outline best page alignment for construction of the strip chart
 - ii. Dimensions – 6 inches by 16 inches (heavy paper – clear plastic)

Chart interpretation and symbology (TPC)

- 1. Maximum elevation figure (MEF)
 - a. One in each 30 minute grid square
 - b. Used to calculate emergency safe altitude
 - c. Considers elevations of both natural and cultural obstacles within the square
 - d. Large number signifies 1000's ft
 - e. Small number signifies 100's ft

LESSON NOTE

The MEF is extremely important information when planning or flying a low level mission. It provides at a glance, the MSL altitude of the highest obstacle within a given grid square.

2. Elevations

- a. Contour interval -- TPC
 - i. Basic interval – 500 ft
 - ii. Intermediate contours shown for 250 ft
 - iii. Dashed contour lines indicate approximate relief
- b. Color - TPC
 - i. Color tints indicate different elevations
 - ii. Green generally indicates lower elevation but not always (read the chart elevation)
 - iii. Brown darkens as elevation increases
- c. Spot elevations
 - i. A number near a black dot gives the elevation of that point accurate within 100 ft
 - ii. Critical elevation in bolder print

PROGRESS CHECK**Question 1 – What is the significance of color in describing terrain on the TPC?**

Answer – Color represents elevation—not steepness as on the ONC—but color may not be consistent between charts.

3. Obstructions

- a. Natural (terrain)
- b. Cultural (man made) obstructions

LESSON NOTE

Elevations of prominent cultural features greater than 200 ft are listed on the TPC legend under “Vertical Obstructions.” Remember, when depicted on a TPC they may be any man made structure, not necessarily a tower.

- i. Towers
 - (a). Upper figure is height of top above mean sea level (MSL)
 - (b). Lower figure in parenthesis is height of top above ground level (AGL)
 - (c). Numbers in larger print indicate the highest structure within that grid square
- ii. Obstructions less than 200 ft AGL are not shown

CAUTION

There is no assurance that all vertical obstructions greater than 200 ft have been reported.

NOTE

Vertical obstructions made known after the chart information date will need to be added by you as found in the Chart Updating Manual (CHUM) and its supplement.

- iii. Obstructions shown are the highest within a 1-minute by 1-minute matrix

CAUTION

There is no assurance that all transmission lines (power/telephone) lines are shown or that their locations are correct.

PROGRESS CHECK

Question 2 – Is every vertical obstruction plotted on the TPC chart or listed in the CHUM?

Answer – No—only those above 200 ft AGL and only the highest of those within a one minute by minute matrix. (apprx. 1 nm)

4. Symbols

- a. Cultural features
 - i. Towers
 - ii. Road intersections
 - iii. Mines
 - iv. Oil tanks (solid circle)
 - v. Oil wells
 - vi. Dams
 - vii. Transmission lines
 - viii. Railroad tracks / Highways
- b. Geophysical features
 - i. Mountain peaks
 - ii. Valley
 - iii. Escarpment (short closely spaced brown line)
 - iv. Dry lake bed (blue dashed stipple)
 - v. Perennial streams (solid blue line)
 - vi. Seasonal streams (dashed blue line)
- c. Aerodromes
 - i. Major
 - (a). Symbol -- solid blue circle (circle represents 8000 ft)
 - (b). Hard surface runway of 3000 ft or greater
 - (c). Airport elevation

NOTE

Most solid aerodrome circles will depict runway alignment.

- ii. Minor
 - (a). Symbol -- hollow blue circle
 - (b). Paved runway of less than 3000 ft or unpaved runways of any length
 - (c). Airport elevation

NOTE

Runway length to the nearest 100 ft, when known, may follow the name of all minor airdromes. Runway length may be indicated to the nearest 100 ft major airdromes when runway pattern is not depicted.

- 5. NAVAIDS - All NAVAIDS are depicted on TPC's.

NOTE

The chart only provides TACAN channels.

- 6. Special use airspace

PROGRESS CHECK

Question 3 – Is the upper figure next to a tower AGL or MSL?

Answer: MSL

Question 4 – What runway attributes are necessary for an aerodrome to be considered major?

Answer: Hard surface runway of 3000 ft or more.

Question 5 – What annotation identifies a major aerodrome on a TPC?

Answer: Solid blue circle

NOTE

The preceding section of the outline is not a complete discussion of all the symbols used on the TPC. Refer to the TPC legend. A complete reference of TPC chart symbology can be found in the Defense Mapping Appendix I - Symbolization for Tactical Pilotage Charts (PS/1AA/100).

106. SUMMARY

1. You should now be able to recall and identify the ONAV panning materials and tools necessary to plan an ONAV mission.
2. You now know the basic procedures and symbology which are used in the various publications and charts needed to plan an ONAV mission.
3. You should now understand how to use the procedures and apply the data presented in those publications and on the charts.

107. CONCLUSION

With what you have learned so far, you should be familiar with the resources and tools required to begin planning the low-level portion of a tactical training mission. These resources and tools will remain the same throughout your flying career no matter how complex or demanding the mission, so get to know them very well.

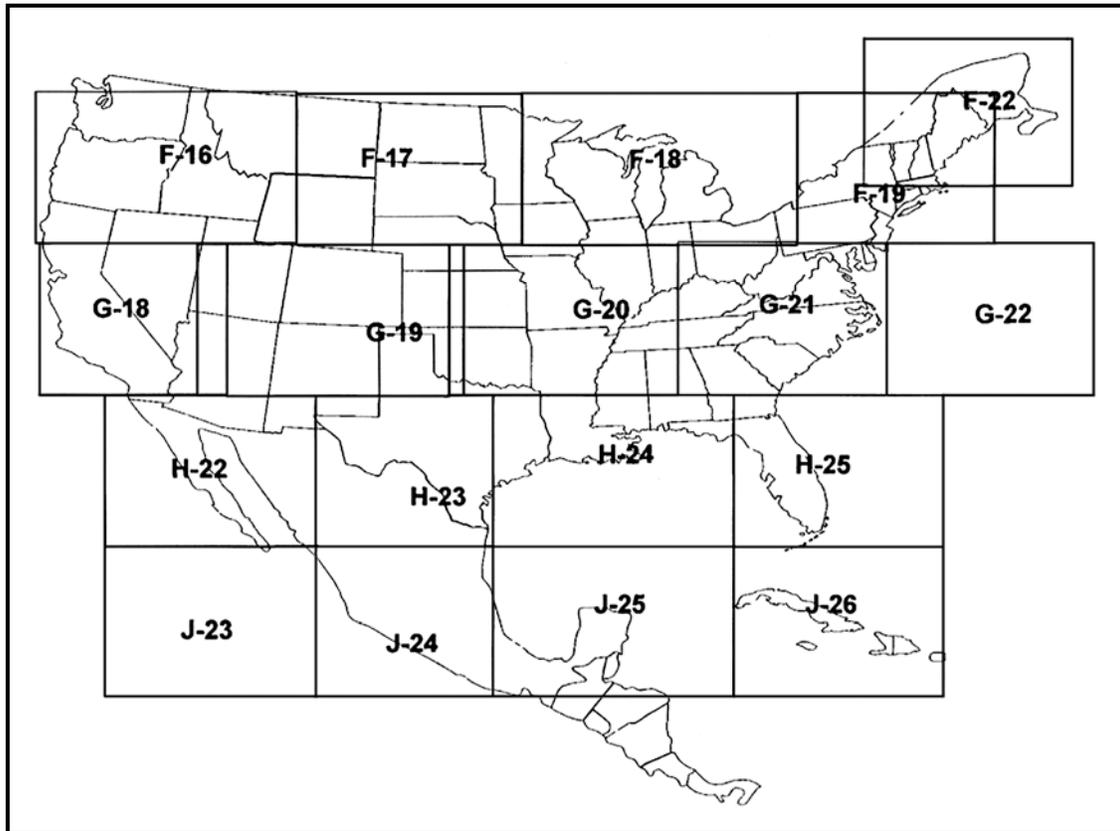


Figure 1-1 North American ONC Coverage

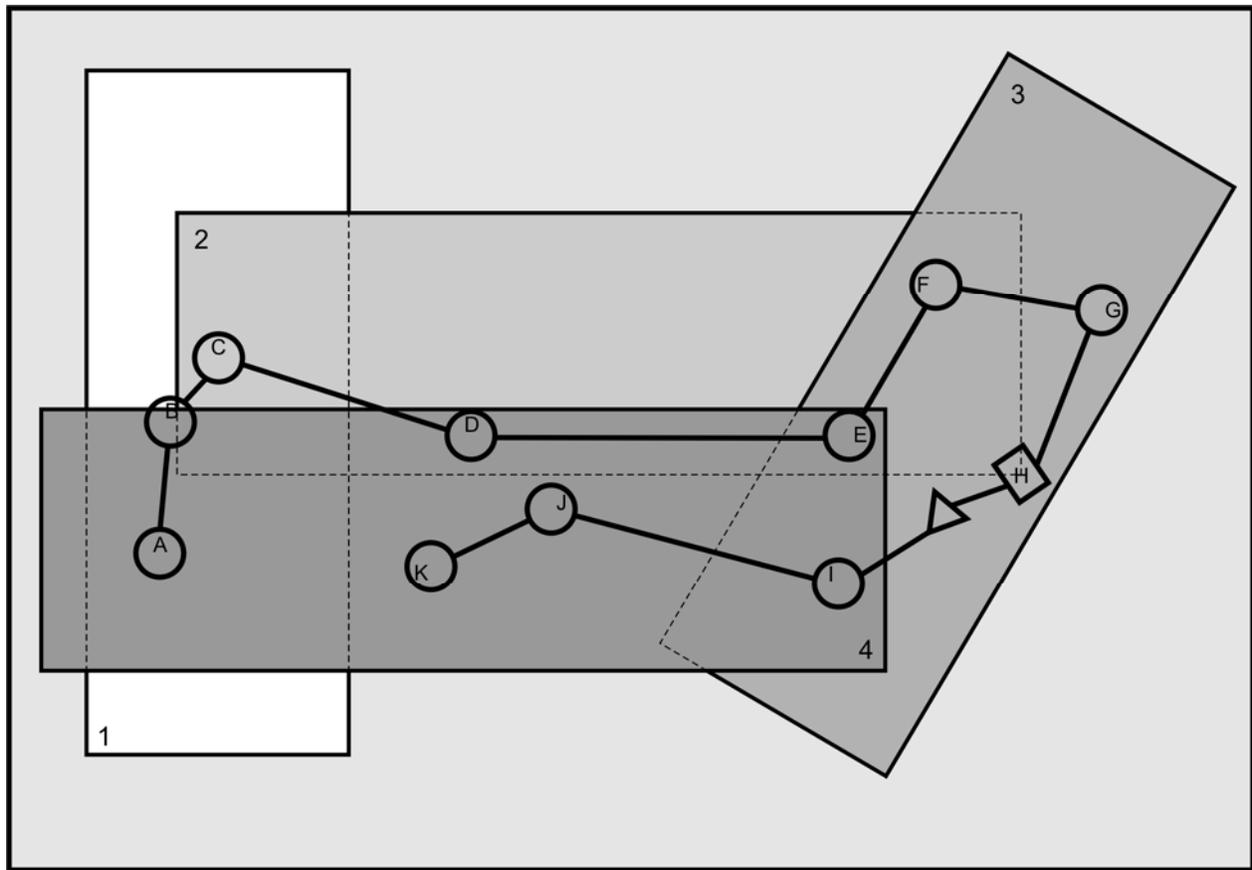


Figure 1-5 Strip Chart Templates

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CHAPTER TWO
LECTURE GUIDE #02

200. INTRODUCTION – N/A

COURSE/STAGE:

T-45TS, TAILHOOK, & IUT/Operational Navigation

LESSON TITLE:

Chart and Low-Level Jet Log Development Procedures

LESSON IDENTIFIER:

T-45TS, TAILHOOK, & IUT ONAV-02

LEARNING ENVIRONMENT:

Classroom

ALLOTTED LESSON TIME:

1.5 hr

TRAINING AIDS:

1. Figures
 - a. Fig 1: Combat Plotter
 - b. Fig 2: ONAV Low-level Route Symbology
 - c. Fig 3: ONAV Low-level Route Workchart
 - d. Fig 4: Turn Radius Plot
 - e. Fig 5: DR & Radial Intercept Departure Plots
 - f. Fig 6: Spoke Method Coast-in Procedure Plot
 - g. Fig 7: Low-level Jet Flight Log (Blank)
 - h. Fig 8: Magnetic Course from Lines of Longitude
 - i. Fig 9: Magnetic Course from Lines of Latitude

STUDY RESOURCES:

1. T-45C NATOPS Flight Manual, A1-T45AC-NFM-000
2. TRAWING TWO IN-FLIGHT GUIDE, CNAT P-295

201. LESSON OBJECTIVES

1. Recall proper ONAV chart symbology
2. Recall procedures for planning ONAV low-level route
3. Recall procedures for computing course
4. Recall procedures for preparing low-level jet flight log

202. MOTIVATION

In order to visually navigate undetected to a target without the use of radio navigational aids, destroy it in coordination with allied forces, and return in one piece, you must be able to construct a complete and accurate navigation chart. The process includes the construction of a workchart from which the "strip chart" (the chart carried in the cockpit) is developed.

203. OVERVIEW

This lesson will introduce you to the procedures and conventions used to plan and construct a low level ONAV workchart and to prepare a low-level jet flight log. You will then be given the opportunity to practice these procedures in lessons 3, 4.

This lesson presents the topics listed below. Topic 2, route planning and construction, is ordered as nearly as possible in the sequence used when creating the low-level route workchart from published navigation charts.

1. Workchart low-level route symbology
2. Route planning and construction
3. The low-level jet log

204. PRESENTATION**ONAV Low-Level Route Workchart Symbology**

1. Workchart symbology (TPC)

- Purpose: To provide clearly recognizable navigation points and chart features relative to the route, enabling the pilot to quickly focus on important information needed to navigate low level to his target and return safely
 - i. Circle
 - (a). Departure / destination field
 - (1). Template - 360 kt 30 degree circle
 - (2). Color - Black
 - (b). Low-level route checkpoint
 - (1). Template - 420 kt, 45 degree circle
 - (2). Color - Green
 - (c). Divert field
 - (1). Template - 480 kt, 45 degree circle
 - (2). Color - Blue
 - (d). Obstruction
 - (1). Template - 360 kt, 55 degree circle
 - (2). Color - Red
 - ii. Square
 - (a). Template ID - Initial - (last fix prior to the target)
 - (b). Color – Green
 - iii. Triangle
 - (a). Template ID - Target (Last fix on the route)
 - (b). Color - Green
 - iv. Doghouse - Route checkpoint info symbol
 - (a). Structure

- (1). Top section: - MAG course to next checkpoint
 - (2). 1st section: - ETA at current checkpoint
 - (3). 2nd section: MFR (minimum fuel required)
 - (4). Bottom section: Checkpoint description
 - (5). Checkpoint designation pointer
- (b). Color
- (1). Outline - Black
 - (2). Highlight - Yellow
 - (3). Information - Black pen

NOTE

Highlight doghouse before you ink in the information or outline the doghouse. The highlighter smears the areas marked with a felt pen.

- v. Arrows
- (a). Bingo
 - (1). Dimensions - 1 inch
 - (2). Color – Black
 - (b). Divert
 - (1). Dimensions - 1 inch
 - (2). Color – Blue
 - (c). Intermediate checkpoint
 - (1). Dimensions - 1 inch
 - (2). Color - Green
- vi. Tick marks - One minute time marks drawn on the right side of the course line, perpendicular to course

- (a). Major
 - (1). Dimensions - 4 nm
 - (2). Color - Green
 - (3). Frequency - every 3rd minute of timing
- (b). Minor
 - (1). Dimensions - 2 nm
 - (2). Color - Green
 - (3). Frequency - one minute intervals between major tick marks

NOTE

Tick marks are omitted when they occur within a checkpoint symbol.

Workchart Development

1. Purpose:
 - a. Used as a graphic planning document to identify and plot IR or VR route, nav points, checkpoints, obstacles, emergency divert fields, etc., to be transferred to the emergency divert chart and strip chart panels
 - b. To identify the number of TPC charts that are necessary to create the completed strip chart
2. Procedure & sequence
 - a. Receive route assignment from operations or your instructor.
 - b. Study the route description and limitations in the AP/1B. Note the latitude/longitude of the NAV points for inclusion on the jet log.
 - c. Plot departure and destination fields by drawing a 360/30 black circle around departure and destination fields.
 - d. Plot ONAV route nav points identified in the AP/1B using latitude/longitude coordinates from AP/1B **verbal description** section on the TPC workchart.

- i. Connect points using pencil (route centerline).
- ii. Identify lateral limits of the nav route from the route description section of the AP/1B.
- iii. Plot and pencil in the nav route boundaries by connecting the points on each side of the route centerline.

NOTE

The AP/1B may indicate a variance in the nav route width relative to the plotted nav route centerline. Annotate the chart and plot the variance.

- e. Checkpoints: select easily identifiable landmarks close to each nav point along the low level route.

NOTE

The checkpoints should be within 5 nm of the navigation point identified in the AP/1B but may be further from that point as long as they keep the aircraft within the nav route width when turn radius is considered.

- i. Draw low-level route checkpoint symbols centered on the landmarks using a thin "green" pen or marker.

NOTE

All checkpoint route symbols on the ONAV **low level** route are drawn in "green" on the chart which makes them easily identifiable.

- (a). Enroute - 420 kt, 45 degree circle
 - (b). Initial Point (IP) - square
 - (c). Target – triangle
- f. Pencil in **courseline** on ONAV route (CP to CP or Turn Radius to CP).
 - i. Turns less than 30 degrees, the courseline is drawn CP to CP.

NOTE

Do not make permanent marks inside route symbols.

- ii. Turns greater than 30 degrees, the course line is drawn Turn Radius to CP.
 - (a). Procedure:
 - (1). Place turn radius circle on chart so that the inbound course at the checkpoint is tangent to the circle on the side opposite the direction of turn to the next point.

NOTE

Use appropriate ground speed combat plotter turn radius circle for the speed and angle of bank being flown. (360 KTS/45 AOB or 300 KTS / 30 AOB - [420 KT / 45 AOB circle]).

- (2). Draw a line from the check point center point fix, around the turn radius circle using the template, slightly further than an imaginary direct line to the next checkpoint fix.
 - (3). Using a straight edge draw a line from the next checkpoint back to the turn radius, tangent to the turn radius arc.
 - (b). Do not extend courseline into checkpoint symbols even though they originate at the center.

NOTE

The first simulator event and the first flight are flown at 300 knots and 30 AOB turns unless flown in mountainous terrain. The remaining flights will be flown at 360 knots and 45 AOB.

- g. Plot departure to low level nav route.

NOTES

1. There are two types of departure plot procedures used when planning for an ONAV flight. Either of which could go directly to the route entry point or to a fix enroute to the entry point. One is a radial intercept plot and the other is a DR plot.
2. With entry point less than 100 nm from departure field or target less than 100 nm from the destination field, plot enroute portion of flight using a TPC. With entry point 100 nm or greater from departure field, or target 100 nm or greater from destination, plot the enroute portion of the flight using an ONC or high altitude enroute chart. Do not use turn radii on ONC or high altitude charts.

- i. Plot DR departure
 - (a). Identify and plot the departure field and route entry point or departure fix.
 - (b). Draw an extended runway centerline from each runway to the 360/30 circle.
 - (c). Draw a 250/30 turn radius at the junction of each extended runway centerline and the 360/30 circle for each runway that will require greater than a 30 degree turn to the departure course.
 - (d). Plot the departure course for each runway from the center of the departure fix to a point tangent to the outside edge of the arc for runways which require turns and to the extended runway center line for those that do not.
 - (e). Extend the course of the first leg through the checkpoint to establish a five mile lead-in point.
 - (f). Determine if a turn of greater than 30 degrees is required to become established on course at the entry point of the low-level route.

NOTE

If more than a 30 degree turn is required to become established on course of the first leg of the low level route, a 250/30 degree turn radius must be plotted.

- (g). Draw a course line from the fix to the five mile lead-in point and connect all the points with course lines, point-to-point, point-to-arc, arc-to-point, or arc-to-arc as required.
- (h). Mark FSS contact point & descent point.

NOTE

The descent point is planned so to allow the pilot sufficient time to descend to the ONAV route altitude, establish route speed, and align his aircraft with a five mile lead-in on the same magnetic course to the entry checkpoint as its outbound leg.

- ii. Plot radial intercept departure to route.
 - (a). Identify and plot departure field and route entry point plus a 5 mile lead-in leg.

NOTE

If the course of the first fix of the low-level route is greater than 30 degrees from the course leading into the fix, a 250/ 30 degree turn radius must be plotted.

- (b). Draw a course line from the center point of the departure field circle to the first fix or the beginning of the 5 mile lead-in leg.
 - (c). Mark FSS contact point & descent point.
- h. Off-target plot

NOTE

There are two plot procedures used when departing the target to a nav point. One procedure is when the point is greater than 100 nm and the other is when the point is 100 nm or less from the target. The nav point can be defined as the destination, a NAVAID or any fix.

- i. Off target procedure 100 nm or greater
 - (a). Select and plot a nav point after the target that establishes the aircraft at a fix where it can proceed to the destination direct or on the planned clearance return route.
 - (b). Determine the MAG course and distance to the selected nav point.
 - (c). Draw a short course line direct from the target symbol toward the nav point fix (no turn radius consideration).
 - (d). A doghouse will be constructed next to the target.
- ii. Off target procedure less than 100 nm
 - (a). If nav point fix within 30 degrees of final run-in to target - plot PT-to-PT to fix.
 - (b). If more than 30 degrees
 - (1). Draw a 250 KTS, 30 degree AOB turn radius toward the nav point fix from the target checkpoint.
 - (2). Draw a short course line in black from the fix tangent to the outside edge of the 250 KTS, 30 degree AOB turn radius arc.

- i. Add tick marks to courseline (green)
 - i. Normally drawn on the right side of the course line
 - ii. Every 1 min of flight
 - iii. 2 nm length

NOTE

Every 3rd tick mark is extended to a 4 nm length and elapsed time is included.

- j. Construct Dog House - highlight - outline
 - i. One at each ONAV route checkpoint
 - ii. Align parallel to outbound course
 - iii. Outside of route boundaries
 - iv. Four levels & fix pointer

NOTE

Highlight with yellow first. Once dry, outline. Do not fill in route information at this time.

- k. Add BINGO Arrows to checkpoints (BLACK)
 - i. Approximately 1 inch
 - ii. Pointed at the destination field

NOTE

The bingo field is always the "destination" field.

- (a). Annotate
- (b). Mag course
- (c). Fuel required rounded off to the nearest 10 lbs at optimum BINGO profile with 300 lbs reserve

NOTE

You may transfer the calculations to the bingo column of the low level jet log as they are determined.

1. Identify and plot emergency divert fields closest to the checkpoints, using a blue 480 at 45 AOB circle, that has
 - i. Hard surface
 - ii. 5000+ ft

NOTE

When selecting the emergency divert field a minimum runway length of 5000 ft is required. This length is calculated minus any displaced threshold that may exist for a given runway.

- iii. Listed in IFR or VFR supplements
- m. Plot emergency divert field arrow (BLUE).
 - i. Annotate
 - (a). Mag course
 - (b). Distance
 - ii. Annotate emergency divert field information on chart.
 - (a). NAVAID ID and channel and frequency
 - (b). Comm. Freq
 - (c). R/W numbers
 - (d). R/W length
 - (e). Field elevation

NOTE

Data for emergency divert fields are calculated individually and annotated on the workchart and later transferred to the Divert Chart.

- n. Identify and plot route obstructions.

- i. Procedure:
 - (a). Identify all obstructions above 300 ft AGL that fall within the lateral limits of the route.
 - (b). Plot and mark selected obstructions with red 360 KTS, 55 degree circle.

CAUTION

Obstruction symbols on TPC & ONC charts may represent more than one vertical obstruction over 200 ft AGL. On TPC's there may only be **ONE** obstruction symbol for multiple obstructions within 1 min by 1 min matrix (approx. 1 nm).

- o. Complete the low-level jet flight log.

NOTE

The procedures used in filling out the low-level jet flight log is discussed in detail in the next section of this lesson.

- p. Fill in doghouse info.
 - i. TOP - Mag course
 - ii. UPPER MIDDLE - ETA at checkpoint
 - iii. LOWER MIDDLE - MFR
 - iv. BOTTOM - Checkpoint description
 - v. LEFT BOTTOM - Checkpoint ID flag
- q. Identify and draw intermediate checkpoint arrows as needed.
 - i. At least one checkpoint for every leg greater than 15 miles identifying a prominent landmark near the route
 - ii. Mark arrow with time anticipate passing

NOTE

Try to pick a feature that has some vertical development, such as a tower, bridge, or dam. If unable, select something like a major road junction.

- r. Coast-in Procedure

NOTE

There will be times when it will be necessary to transit large bodies of water. In those instances, a funneling procedure known as "coast-in spoke method" is used when planning and preparing your chart. The funneling in procedure considers possible error due to wind drift and small deviations in heading control relative to distance over water from the last positive fix.

- Procedure
 - (a). Plot courseline to proposed landfall checkpoint.
 - (b). Plot a corridor equal to 20% of the distance flown over water with 10% on either side of the proposed landfall point.
 - (c). Plot course lines from the next inland checkpoint back to the coastline in 10° increments until the corridor is covered.
 - (d). Label each supplemental course line with the magnetic course to the inland checkpoint.

- s. Chum workchart

Low-Level Jet Flight Log Preparation Procedures

1. Sections
 - a. Route identifier
 - b. Route
 - c. Start fuel
 - d. Ground speed
 - e. Turn radius
 - f. Check point
 - g. Altitude
 - h. Course
 - i. Distances

- j. ETE
 - k. ETA
 - l. EFR
 - m. EFL
 - n. MFR
 - o. BINGO
2. Low-level jet flight log computation
- a. Fill in known portions of the top section.
 - i. Route being planned
 - ii. Entry and exit points planned

NOTE

Add the entry and exit times prior to departure.

- iii. Start Fuel (2930 lbs for T-45C).
 - iv. Planned ground speed for route (300 or 360) KTS.
 - v. Turn radius on the route – 30 AOB/300 KTS, 45 AOB/360 KTS.
- b. Complete departure to route portion low-level jet flight log.
- i. Start, taxi, takeoff (use 200 lbs)
 - ii. Climb
 - (a). To route entry point or fix enroute to entry point, enroute altitude above 5,000 ft
 - (1). Enter planned cruising altitude.
 - (2). Plot and enter course.
 - (3). Measure and enter distance.

- (4). Using the climb, cruise and descent schedules on the T-45 Planning Data Sheet, compute and enter the ETE.
 - (5). Using the climb, cruise and descent schedules, compute and enter the EFR.
 - (6). If there is more than one enroute fix, use as many lines as necessary.
- (b). To route entry point or fix enroute to entry point, enroute altitude below 5,000 ft
 - (1). Do not use climb and descent schedules.
 - (2). Compute ETE and EFR using enroute cruise at 5,000 ft. figures on T-45 Planning Data Sheet.
 - (c). List checkpoint "A", "B", "C", etc.
 - (d). Use the same procedures for those legs between the target and the destination airport as paragraph "(b)" above.
3. Complete the low-level ONAV route portion.
- a. Enter latitude/longitude for each NAV point on the route beneath the point in the first column.
 - b. Determine altitude (ALT) for each leg.
 - Above ground level (AGL): 500 ft unless route restrictions are higher
 - c. Determine and enter magnetic course (CUS) to nearest whole degree for each leg in the log.
 - i. Procedure
 - (a). Entry point - The MAG course between departure and entry fix is only entered on the log if "direct" procedure is used.
 - (b). Departing target - course to the next fix after the target will reflect the turn radius (250/30° AOB) when one is required.

NOTE

No turn radius is required when distance to destination is greater than 100 NM.

- ii. Method of determining course
 - (a). Using longitude line
 - (b). Using latitude line
- iii. Apply variation.
 - Memory aid: "East is least and west is best."
 - (1). East: $TC - \text{east variation} = MC$
 - (2). West: $TC + \text{west variation} = MC$
- d. Compute and enter distance (DIST) for each leg to the nearest .5 nm.
 - i. "ST-TX-T/O" and approach lines are left blank
 - ii. Measuring straight line distances
 - (a). Divider method
 - (1). Span distance with dividers
 - (2). Use **only** longitude line as distance measurement reference

NOTE

The scale on latitude lines is not constant and should not be used as a distance reference.

- (b). Plotter scale method - Use combat plotter for nautical mileage scale.
- iii. Measuring turn distance
 - (a). Must be added to straight line distance for turns greater than 30 degrees
 - (b). Use any accepted method such as
 - (1). Combat plotter ground speed marks on a 360 kt turn radius circle
 - (2). Spaghetti method - Paper strip cut from the chart containing uncluttered longitude line
 - (3). String method - measure the length of the string around the turn and check distance on combat plotter
- e. Compute time (ETE) for each leg.

NOTE

ETE entries are indicated in minutes and seconds required to fly the leg at a specific ground speed. Make an entry on each line except for the "ST-TX-T/O and Approach" lines.

- i. "ST-TX-T/O" line leave blank
 - ii. Compute ETE's for route legs from either tick marks or from the measured distance using the ground speed at which the route is flown or use the combat plotter time scale.
- f. ETA column (USED FOR ROUTE ONLY) starting at entry point and ending at target
- i. Enter "0+00" in ETA column for entry point (indicates start of route).
 - ii. Add each leg ETE to previous leg ETA to determine leg ETA.
 - iii. Target ETA reflects route ETA.
- g. Compute fuel consumed for each leg to determine estimated fuel required (EFR) box.
- i. Calculate and enter EFR, rounding up to the next 10 pound increment (indicate in whole numbers "2750").
 - ii. For planning purposes
 - (a). For legs enroute to the route entry point and from the target to the destination, use the T-45 Planning Data Sheet
 - (b). Use 5 pounds of fuel per mile at 300 KTS on the low level route.
 - (c). Use 6.6 pounds of fuel per mile at 360 KTS on the low level route.

NOTE

Current CNATRA fuel reserve for the T-45C is 300 pounds.

- h. Compute estimated fuel left (EFL) from the running total from start/taxi/takeoff.

NOTE

Calculate and enter EFL, rounding up to the next 10 pound increment.

- i. Compute minimum fuel required (MFR) to complete the route as planned from each leg.

NOTE

This column cannot be completed until the EFR's for all legs of the route have been computed. Start on the approach (APP) line and work upward to the ST-TX-T/O line.

- i. Enter 300 (CNATRA required minimum pounds of fuel on board at touchdown).
 - ii. Add 200 pounds (penetration and approach) fuel to the 300 pounds in the MFR column. Place the results in the MFR column above.
 - iii. Repeat the process line by line to the "ST-TX-T/O" column.
- j. Bingo column - add figures from workchart bingo arrows if not already done.

NOTE

Once the log is complete, line or X out any unused boxes in the route section.

205. SUMMARY

1. You should now be familiar with the symbology used in the development of the low-level route work chart.
2. You should also be familiar with the proper methods of the planning and construction of a low-level ONAV route over the ground to an assigned target.
3. You have also learned how to correctly complete an ONAV low-level jet log.

206. CONCLUSION

You have learned the procedures and calculations required to plan and prepare the low-level mission workchart and low-level jet flight log. In the next two class periods you will plan a low level tactical training mission and prepare and construct an actual workchart and low-level jet flight log.

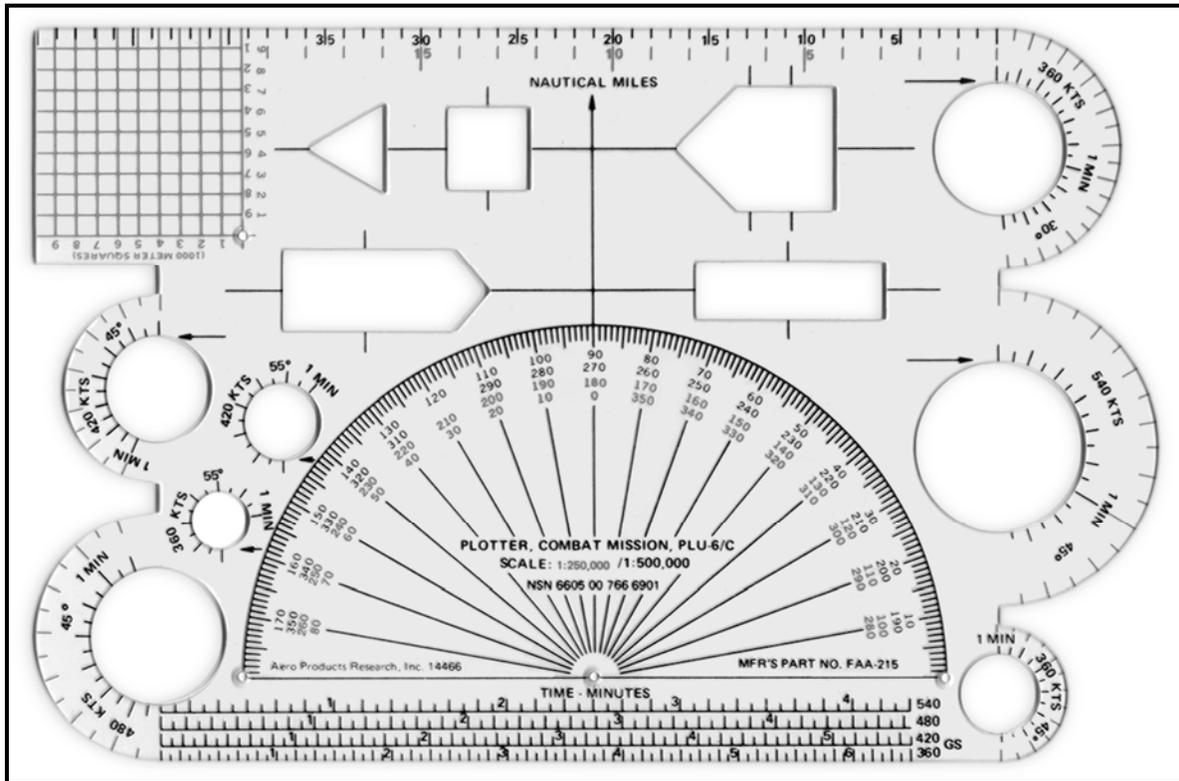


Figure 2-1 Combat Plotter

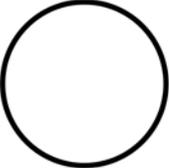
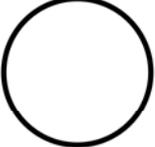
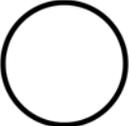
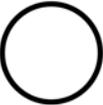
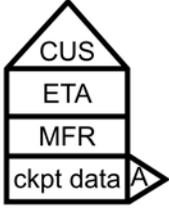
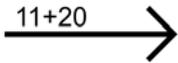
	480 kt 45 degrees	Blue. Emergency Divert TPC
	360 kt 30 degrees	Black. Departure/landing field on TPC/ONC
	420 kt 45 degrees	Green. Checkpoints on TPC Blue. Divert Fields on ONC.
	420 kt 55 degrees	Green. Checkpoints on ONC
	360 kt 55 degrees	Red. Obstructions on TPC
		Green. Initial point
		Green. Target
		Black with yellow highlighting Roof: magnetic course to next chekpoint Third floor: ETA at checkpoint Second floor: minimum fuel required to complete mission First floor: checkpoint description; CP (A,B,C, etc.) designator in point
	16/250°	Bingo Arrow (Black). Fuel/Course
	180°/27	Emergency Divert Arrow (Blue). Course/Distance
	11+20	Intermediate Checkpoint Arrow (Green) Min. + Sec.

Figure 2-2 ONAV Low-Level Route Symboly

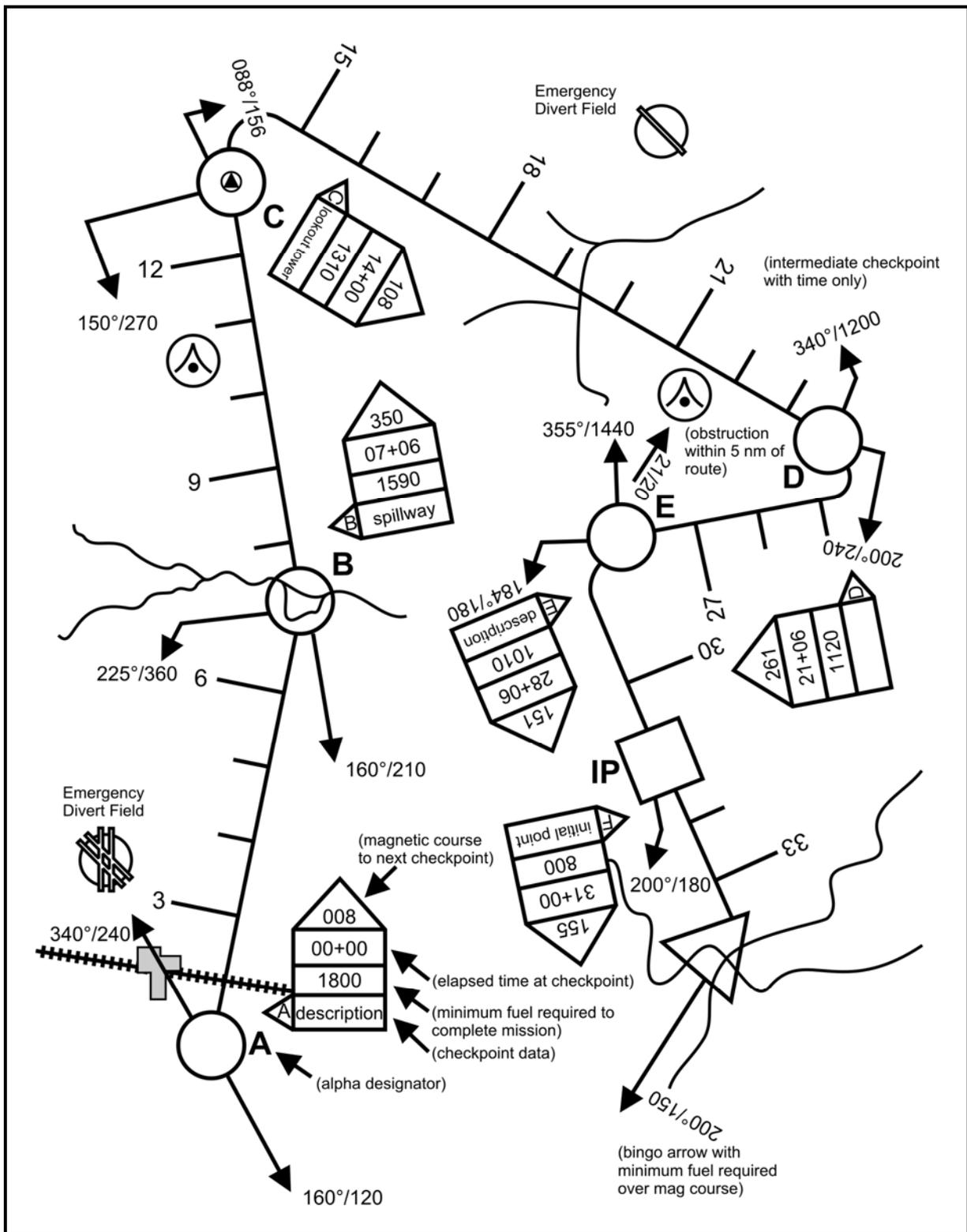


Figure 2-3 ONAV Low-Level Route Workchart

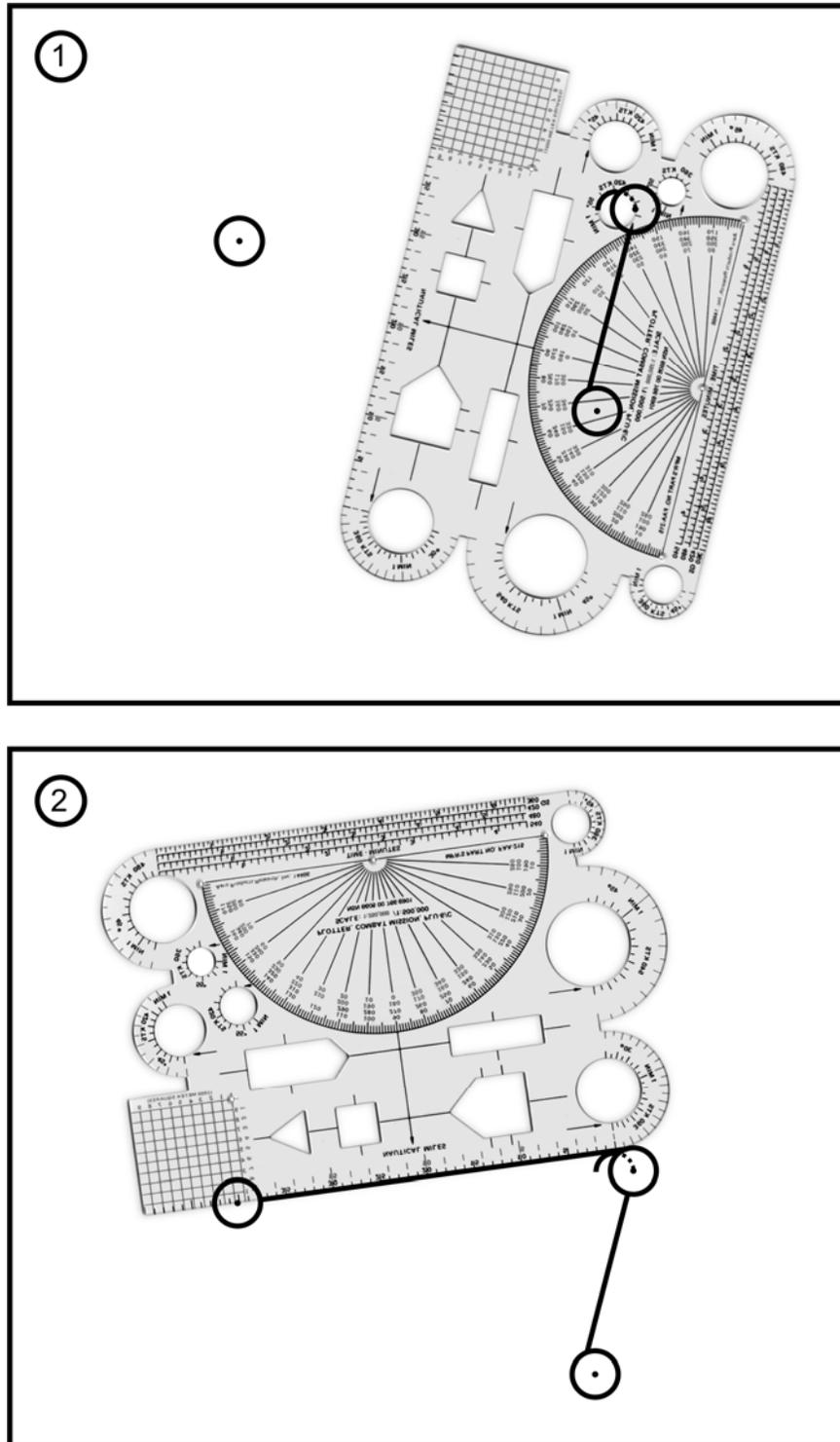


Figure 2-4 Turn Radius Plot

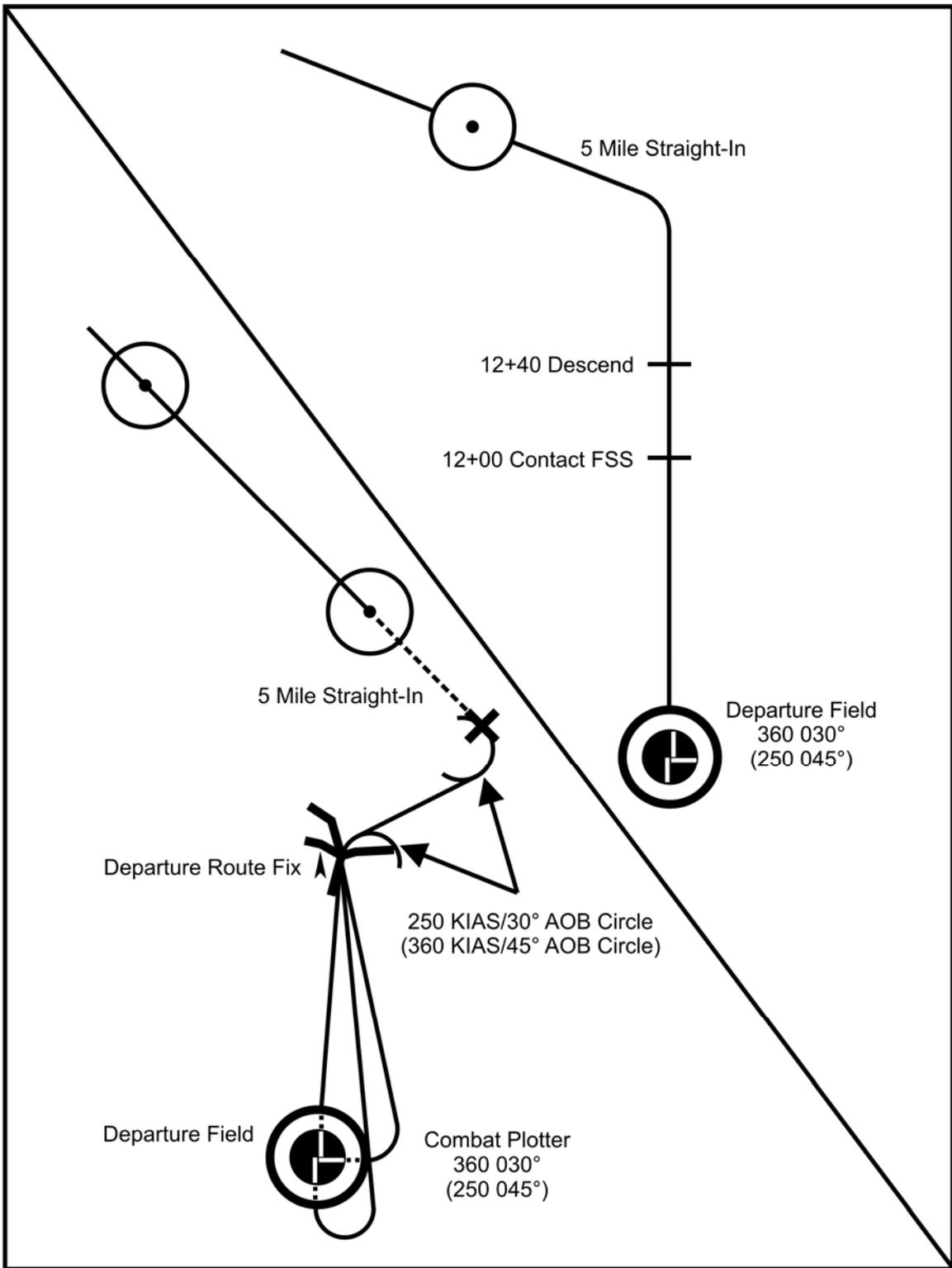


Figure 2-5 DR & Radial Intercept Departure Plots

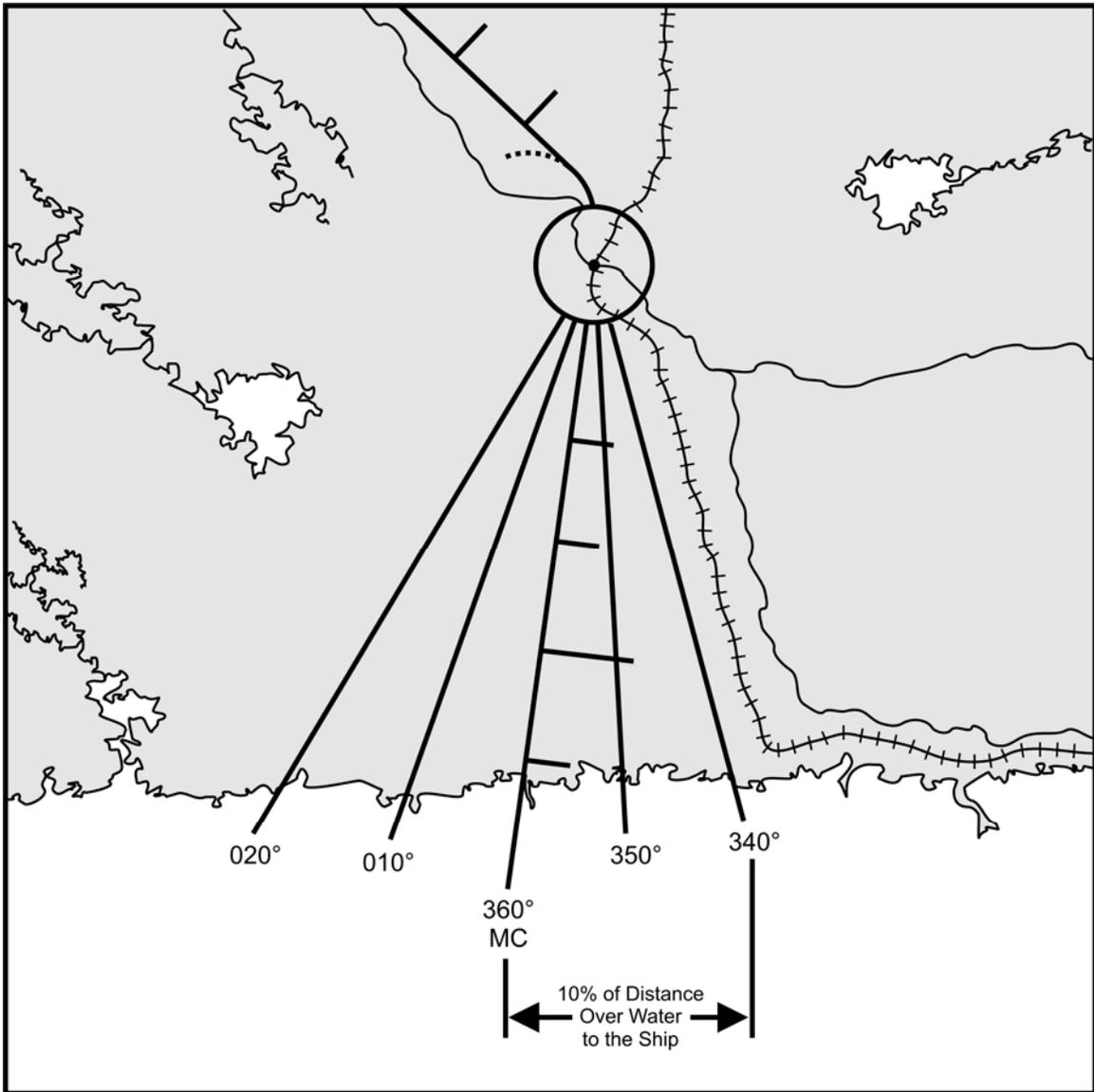


Figure 2-6 Spoke Method Coast-in Procedure Plot

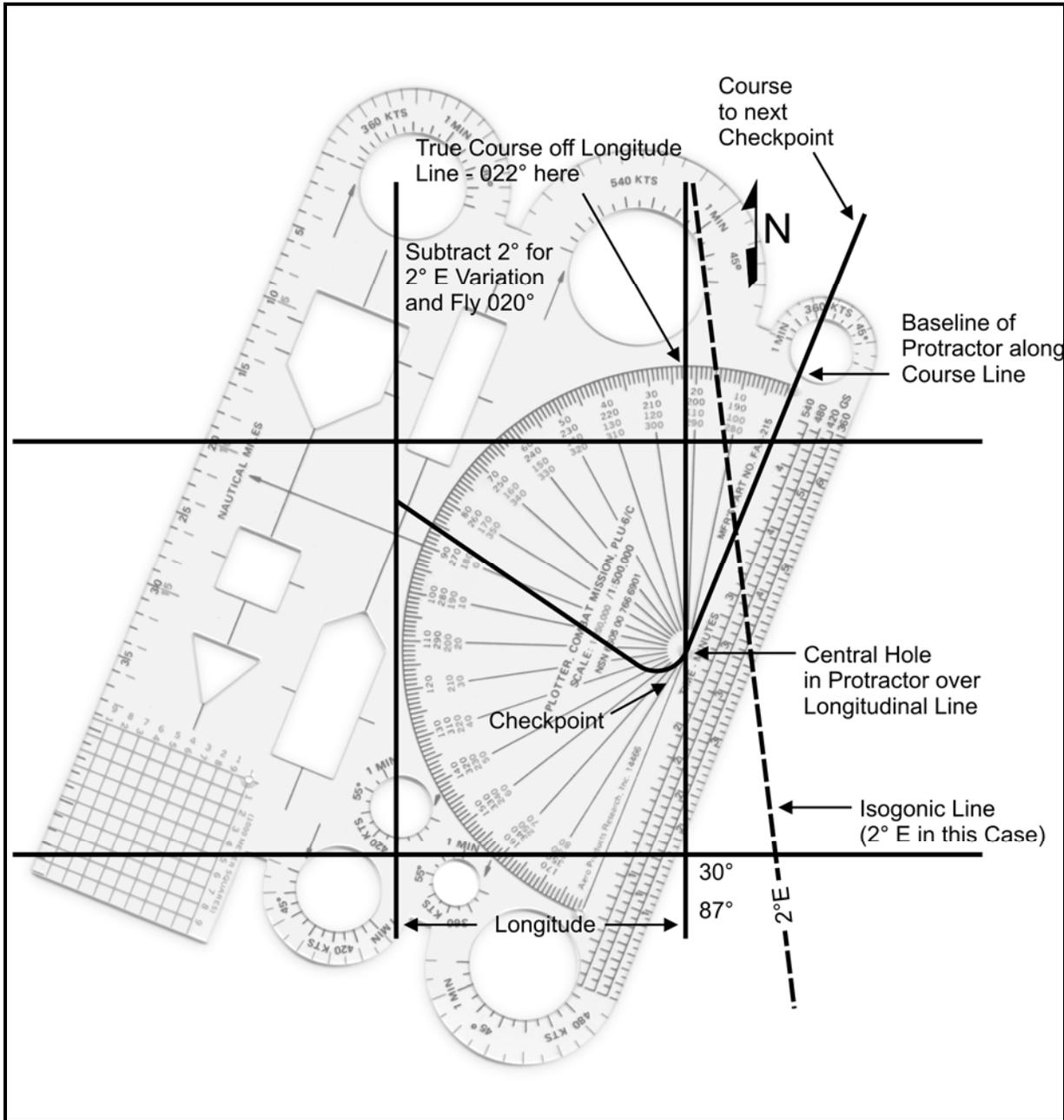


Figure 2-8 Magnetic Course from Lines of Longitude

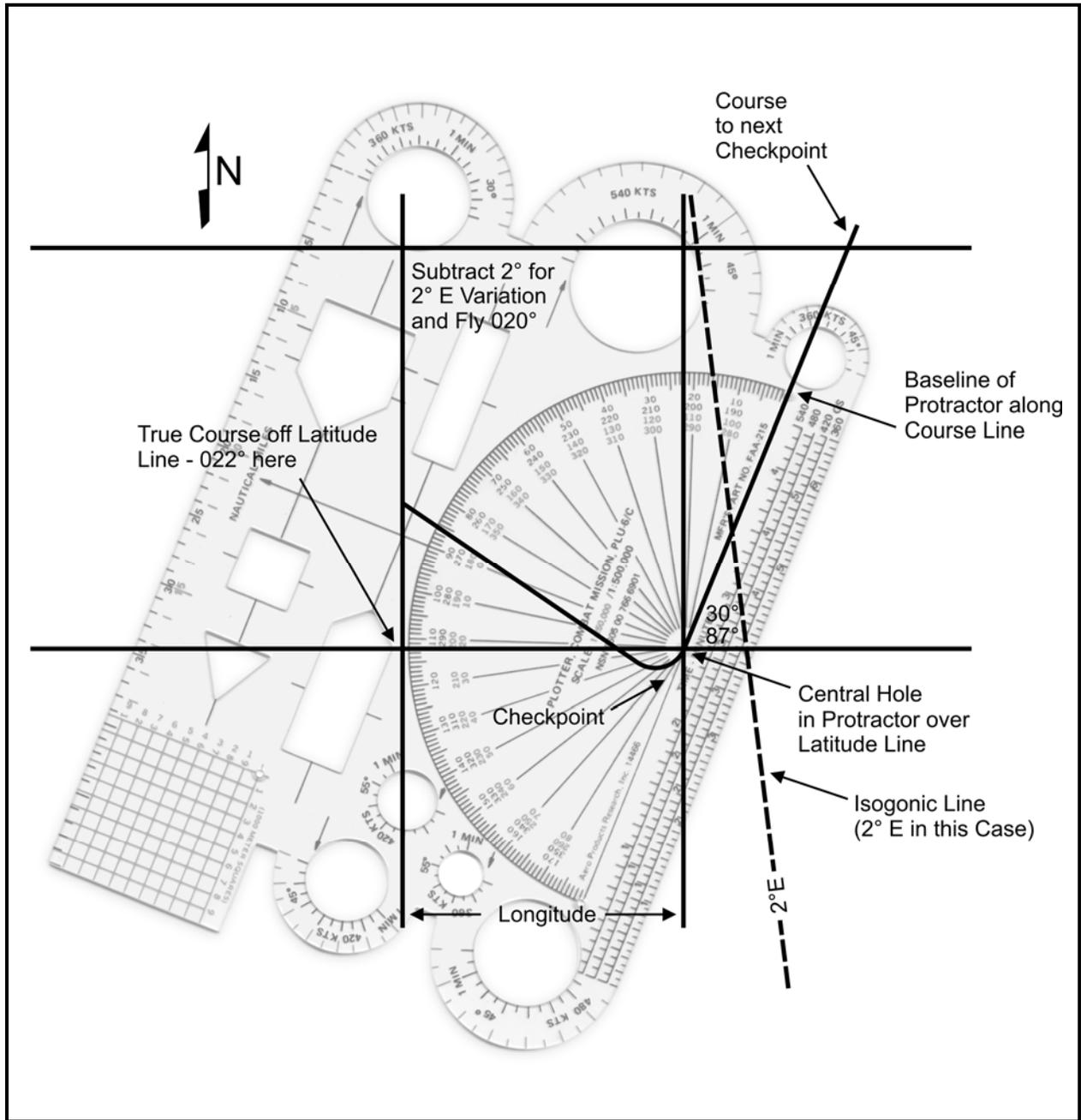


Figure 2-9 Magnetic Course from Lines of Latitude

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**CHAPTER THREE
PRACTICAL PROBLEM #01**

300. INTRODUCTION – N/A

COURSE/STAGE:

T-45TS, TAILHOOK & IUT / Operational Navigation

LESSON TITLE:

Practical Problems and Checkpoints

LESSON IDENTIFIER:

T-45TS, TAILHOOK & IUT ONAV-03, 04

STUDY RESOURCES:

1. FLIP AP/1B
2. FLIP General Planning
3. Chart Update Manual (CHUM)
4. Chart Update Manual Supplement

LESSON PREPARATION:

- Read:
 1. FLIP AP/1B, pp. 1-1, 1-2 and 2-1
 2. FLIP General Planning, paragraphs 4-1 to 4-3, 5-17, and 5-41
 3. Chart Update Manual (CHUM), cover through general information section
 4. ONAV 01 Lecture Guide
 5. ONAV 02 Lecture Guide

REINFORCEMENT: N/A

EXAMINATION:

The objectives in this lesson will be tested in Operational Navigation 08X.

HOW TO USE A WORKBOOK

This workbook is designed as a class room lab exercise to develop a workchart and low-level jet flight log without the direct supervision of an instructor, though an instructor will be available to answer questions.

This workbook contains a list of pre-planning tasks and a problem description.

If you have problems with this problem exercise, go back and research the subject matter in your Lecture Guides 1 and 2. If you are still having difficulty after studying the material, ask your instructor for help.

301. LESSON OBJECTIVES

1. **ONAV-03**
 - a. Recall tools and materials required for ONAV planning
 - b. List types of charts for ONAV planning
 - c. Prepare ONAV low-level route work chart
 - d. Prepare low-level jet flight log
2. **ONAV-04**
 - a. Prepare ONAV low-level route work chart
 - b. Prepare low-level jet flight log

302. MOTIVATION

This workbook exercise problem will give you practice at planning a low-level route work chart and jet flight log. When the time comes that you have to actually go out and fight, you should be able to plan and execute your mission using the training you have received.

303. PRE-PLANNING TASKS

1. Study route description in AP/1B
2. Call scheduling activity
3. Determine route availability
4. Obtain route briefing

3-2 PRACTICAL PROBLEM #01

5. Obtain required charts. Verify currency.
6. Insure availability of complete ONAV kit, including current publications.

EXERCISE PROBLEM**- Problem**

Plan IR1031, "A" to "K", departing from and landing at NAS Meridian.

- Materials Required

1. ONAV kit
2. TPC H-24C, G-20C
3. Low-level Jet Flight Log

- Route

NMM, IR1031 "A" IR1031 "K" NMM

- Altitudes

1. 500' AGL on IR1031 2000' to "A"
2. 3000' to NMM

- Start Fuel

2930 Pounds

CHAPTER FOUR
LECTURE GUIDE #03

400. INTRODUCTION – N/A

COURSE/STAGE:

T-45TS, TAILHOOK & IUT / Operational Navigation

LESSON TITLE:

Divert Chart & Strip Chart Development Procedures

LESSON IDENTIFIER:

T-45TS, TAILHOOK & IUT ONAV-05

LEARNING ENVIRONMENT:

Classroom

ALLOTTED LESSON TIME:

7 hr

TRAINING AIDS:

1. Publication References
 - a. Flight Information Publication AP/1B
 - b. Chart Update Manual
 - c. Chart Update Manual Supplement
2. Charts
 - a. TPC H-24B, G-20C
 - b. ONC H-24, G-20

3. Figures
 - a. Fig 1: Strip Chart Templates
 - b. Fig 2: Strip Chart Assembly Procedure
 - c. Fig 3: North American ONC Coverage

401. LESSON OBJECTIVES

1. Recall tools and materials required for ONAV planning
2. List types of charts for ONAV planning
3. Recall procedures for developing ONAV strip charts
4. Recall procedures for developing emergency divert charts

402. MOTIVATION

In an operational mission, your ability to navigate low-level accurately to a target, on time, may be the difference between the success or failure of the mission. Your accuracy in mission timing and delivery also directly impacts the survivability of your aircraft as well as others. The first step in ensuring your ability to successfully complete an ONAV mission is the accurate and correct preparation of charts and logs that you will use in the cockpit. The workchart you have already prepared would be useless in the confines of your cockpit. You will learn the procedures used to develop a small flip booklet containing the sections of your route, L-L jet flight log, and the emergency divert chart that is suitable for use in the cockpit. This booklet is known as a "strip chart."

403. OVERVIEW

The ONAV academic class was developed so that you could consistently and accurately plan and prepare for an ONAV mission. This class will teach you the procedures used to develop the charts you will use in the cockpit to navigate along your route. The workchart and low-level jet log you developed in the preceding lessons will now be used to develop a strip chart and emergency divert chart. In ONAV 05 you will learn the procedures necessary to successfully create these operational charts.

1. Identification of chart development materials & tools
2. ONAV low-level route strip chart preparation
3. Emergency divert chart preparation

404. PRESENTATION**Strip Chart****LESSON NOTE**

Have an example of a completed strip chart available. Show it to the class and demonstrate its features and function. Also have available examples of stripping templates.

1. Tools and materials
 - a. Fine point felt tip pens
 - b. Scissors
 - c. Hard board of some kind - (Manila folder)
 - d. Glue or rubber cement
 - e. Combat plotter
 - f. Pencils, colored marker pens, yellow high-lighter
 - g. TPC charts
 - h. Stripping template
2. Chart selection and stripping procedure
 - a. Using the template, determine from workchart, number of panels needed for strip chart
 - i. Procedure
 - (a). Overlap required (10 nm beyond checkpoint)
 - (b). 6 inches wide with ONAV course no closer than 10 nm from the edge of marked panel
 - (c). Plan for repeating plot of last checkpoint on next panel
 - b. Obtain as many TPC's as necessary to construct the strip chart
 - c. Using stripping template, and pencil, mark strip chart panels on the TPC's

- d. Cut out strip chart panels
3. Strip chart preparation procedure
- a. Transfer workchart information to the strip chart panels

NOTES

- 1. Plot last checkpoint from previous panel on next panel.
 - 2. Whenever possible emergency field data may be included on the ONAV TPC route as long as it does not interfere with chart interpretation.
- b. Strip chart assembly procedure
- i. Glue the bottom half of Panel #1 to the bottom half of the folder. Leave the top half freestanding
 - ii. Glue the bottom half of Panel #2 to the top half of panel #1
 - iii. Repeat the process, keeping the panels in sequence until the last panel is used
 - iv. Glue the top half of the last panel to the top half of the folder
 - v. Clean off the surplus glue; and trim the edges of the panels
- c. Glue the low-level jet log prepared for this route to the outside of the cover on the target side, with the fold at the top
- d. Glue a copy of the route text description from the AP/1B to the front outside of the cover on the departure side with the fold at the bottom
- e. Include the following on the cover page
- i. Date prepared
 - ii. Name of the individual who prepared the strip chart
 - iii. Chart and edition used
 - iv. AP/1B date
 - v. Date chummed

ONAV Emergency Divert Chart

1. Purpose:
 - a. To provide the pilot with expanded emergency field data in situations requiring a landing at the nearest emergency airfield along an ONAV route on one condensed chart
 - b. To provide for any VFR off route navigation
2. Emergency Divert Chart preparation procedure

NOTE

All symbols on the emergency divert chart use the same colors as on the work and strip charts. Only the size of the symbol presentation is reduced to match the higher scale of the ONC.

- a. Select appropriate ONC chart.
- b. Plot green checkpoints from workchart to divert chart - use 420 kt 55 degree circle.
- c. Plot destination airfield - use 360 KT 30 degree AOB circle, then plot divert airfields. Use same colors as on the TPC.
- d. Connect checkpoints point-to-point - **no turn radius.**
- e. Plot emergency divert and bingo arrows.
 - i. Black - destination arrow
 - ii. Blue - divert arrow
- f. Do not include:
 - i. Departure airfield - unless it is an emergency field or the destination airfield
 - ii. Tick marks
 - iii. Dog houses
 - iv. Obstructions
 - v. Intermediate checkpoints

- g. Enter data so that it can be read while oriented in a normal north-south direction.
- h. Ensure that the information is transferred from the workchart to the emergency divert chart and that it includes the following for both the selected emergency fields and destination:
 - i. NAVAID frequencies and channels
 - ii. Communications frequencies
 - iii. RWY length(s)
 - iv. Field elevation

NOTE

This information is commonly included on the emergency divert chart by gluing photocopied sections of the airport depiction on the bottom right corner of the FLIP High Altitude Approach plates to the divert chart. Pencil in frequencies when you make the divert chart as they are subject to change. Reconfirm frequencies the day the route is to be flown to ensure accuracy of the information. Additional information may be added per pilots discretion such as hours of operation or arresting gear.

- i. If more than one ONAV route is to be depicted on the emergency divert chart use a different color for each.

405. SUMMARY

1. You should now be able to identify the materials and tools necessary to prepare both the strip chart and the emergency divert chart.
2. You have also learned procedures used to prepare a tactical operational navigation strip chart.
3. You should be familiar with the procedures for plotting and preparing an emergency divert chart for an ONAV mission.

406. CONCLUSION

By completing this class, you have learned the basic procedures and calculations required to plan and prepare the low-level mission. The tools, publications, charts, and procedures you have used in this class you will use throughout your career as a tactical pilot. In the future, you will learn other procedures and techniques. What you have learned here will serve as the foundation. Remember, your ability to plan a mission and to be able to navigate to the target accurately is the difference between mission success and failure.

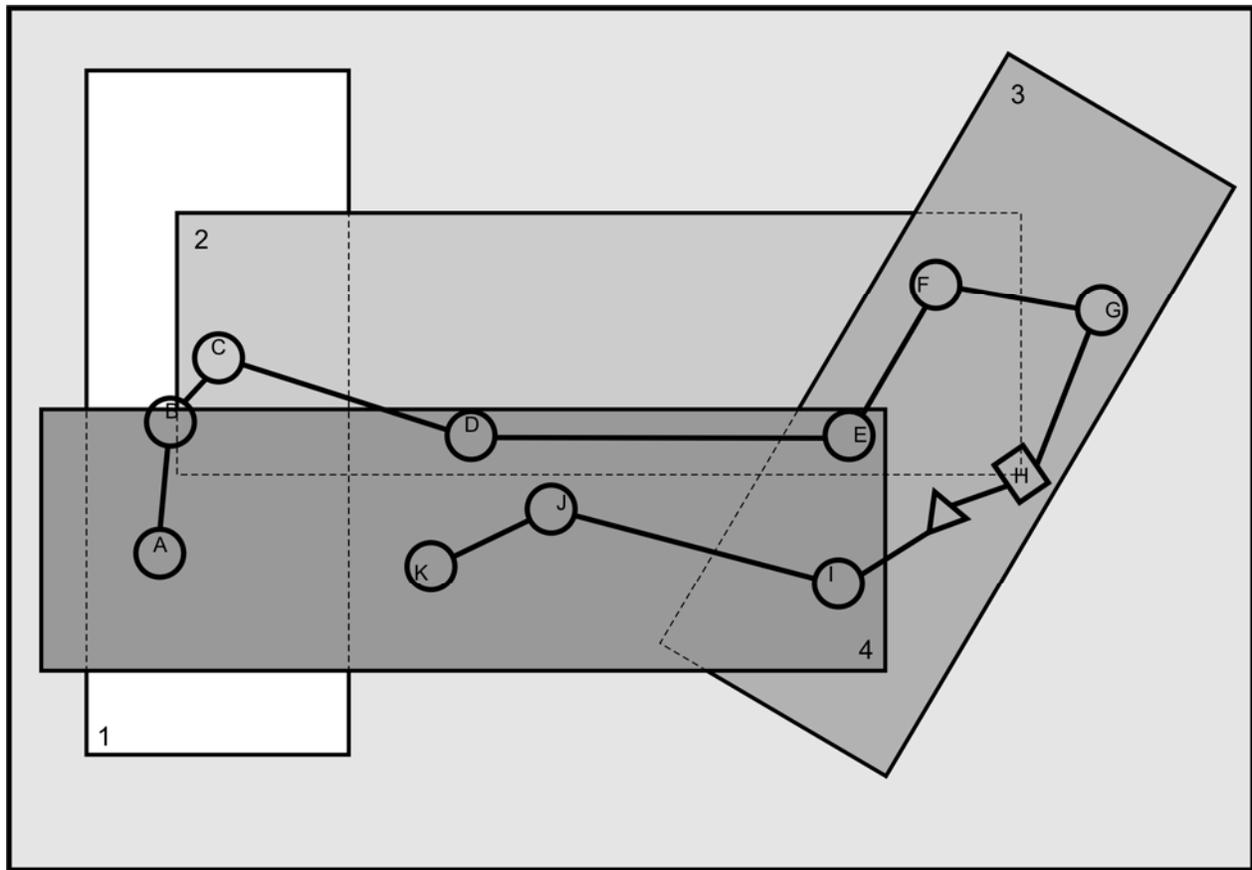


Figure 4-1 Strip Chart Templates

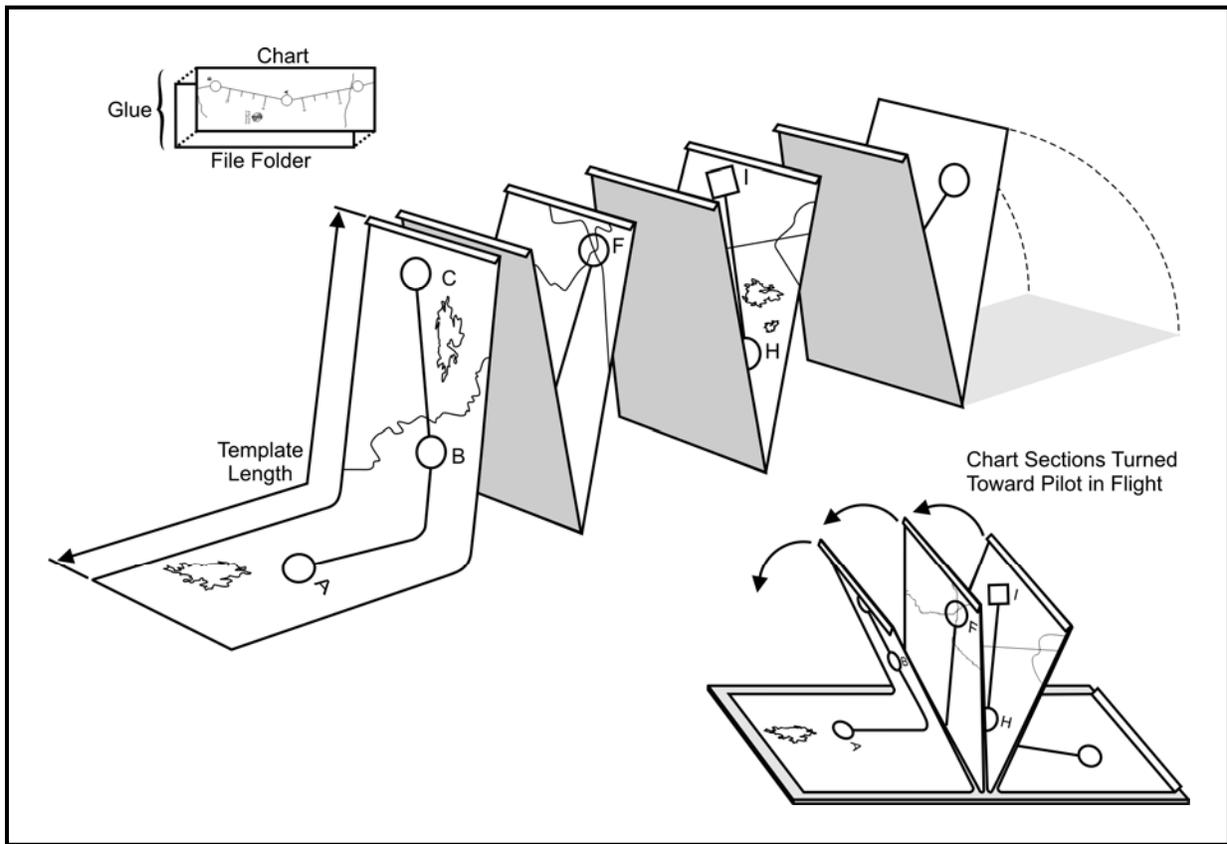


Figure 4-2 Strip Chart Assembly Procedure

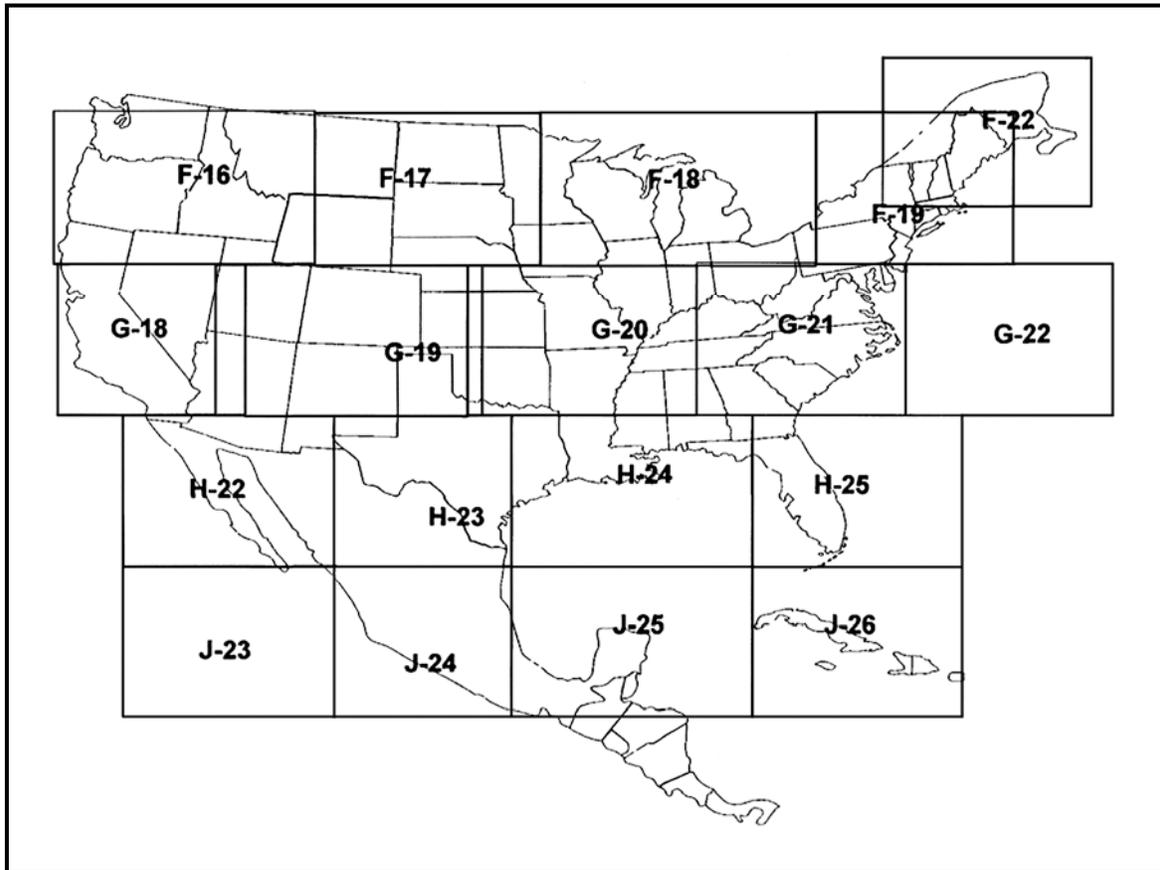


Figure 4-3 North American ONC Coverage

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**CHAPTER FIVE
PRACTICAL PROBLEM #02**

500. INTRODUCTION – N/A

COURSE/STAGE:

T-45TS, TAILHOOK & IUT / Operational Navigation

LESSON TITLE:

Practical Problems

LESSON IDENTIFIER:

T-45TS, TAILHOOK & IUT ONAV-06

STUDY RESOURCES:

1. FLIP AP/1B
2. FLIP General Planning
3. Chart Update Manual (CHUM)
4. Chart Update Manual Supplement

LESSON PREPARATION:

- Read
1. FLIP AP/1B, pp. 1-1, 1-2 and 2-1
 2. FLIP General Planning, paragraphs 4-1 to 4-3, 5-17, and 5-41
 3. Chart Update Manual (CHUM), cover through general information section
 4. ONAV 01 Lecture Guide
 5. ONAV 02 Lecture Guide
 6. ONAV 05 Lecture Guide

REINFORCEMENT: N/A

EXAMINATION:

The objectives in this lesson will be tested in Operational Navigation 08X.

HOW TO USE A WORKBOOK

This workbook is designed as a class room lab exercise to develop a strip chart and a divert chart without the direct supervision of an instructor, though an instructor will be available to answer questions.

This workbook contains a list of pre-planning tasks and a problem description.

If you have problems with this problem exercise, go back and research the subject matter in your Lecture Guides 1, 2 and 5. If you are still having difficulty after studying the material, ask your instructor for help.

501. LESSON OBJECTIVES**ONAV-06**

1. Recall tools and materials required for ONAV planning
2. List types of charts for ONAV planning
3. Prepare low-level route strip chart
4. Prepare emergency divert chart

502. MOTIVATION

This workbook exercise problem will give you practice at planning a low-level route strip chart and an emergency divert chart. When the time comes that you have to actually go out and fight, you should be able to plan and execute your mission using the training you have received.

503. PRE-PLANNING TASKS

1. Study route prepared on low-level workchart
2. Obtain required charts. Verify currency.
3. Insure availability of complete ONAV kit, including current publications.

EXERCISE PROBLEM**Problem**

- Construct strip chart and divert chart

Materials Required

1. ONAV kit
2. TPC H-24B, G-20C
3. ONC H-24, G-20
4. Completed route low-level workchart
5. Completed Low-level Jet Flight Log of route

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**APPENDIX A
GLOSSARY**

A100. INTRODUCTION – N/A

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