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FLIGHT ENGINEER INITIAL QUALIFICATION

Terminal Instrument Procedures (TERPS)

Workbook

C-141 AIRCREW TRAINING SYSTEM

For Training Purposes Only

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FORWARD

This workbook is designed to provide you with information, exercises, and self tests as part of your Terminal Instrument Procedures (TERPS) training.

Each flight engineer student must monitor at least one TERPS approach in the simulator. This can be done on DAY 2. The flight engineer and pilot instructors should coordinate the time of the approach. Each flight engineer is to brief the approach that he/she will monitor. During the approach the instructor will quiz the flight engineer with questions about the approach to ensure the engineer is monitoring the approach correctly.

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CHAPTER 1: GENERAL INFORMATION

AFI 11-2C-141V1, C-141 Aircrew Training, established a new Terminal Instrument Procedures (TERPS) training requirement for C-141 flight engineers. The purpose of this training is to provide flight engineers with the knowledge and skills necessary to monitor the briefed departure and approach, and advise the pilots of any deviations that would compromise safety.

As a Flight Engineer, an essential part of your job on the flight deck is to monitor departure, enroute, and approach procedures. You are not required to be able to fly an instrument approach, however, you must be able to detect deviations from the briefed procedures. In order to accomplish that, you must understand some terminology, definitions, symbols, and procedures.

If any conflict exists between this text and the DoD Flight Information Publications (FLIP), then DoD guidance will take precedence.

You will require no additional materials to complete this workbook. You may wish to spend a few minutes with an actual approach book as you progress through this material. If you wish to use a glossary of terms, consult the front of the DoD Flight Information Publications, General Planning (GP). That document also contains a collection of abbreviations.

Training for flight engineers includes monitoring navigation equipment and pilot instruments for correct settings to ensure the departure and approach procedures are being accomplished as briefed. When you have completed this training you will be able to interpret FLIP documents to

- Locate the Plan View, Profile View, Minima Section, and Airport Sketch.
- Locate and list the frequencies for the ILS, VOR, TACAN, and NDB, and given a list of characteristics relating to navigational facilities, select those characteristics which relate to TACAN, VOR, and NDB facilities.
- Locate and list the emergency safe altitude within 100 NM of the navigation facility used for the approach and the minimum safe altitude within 25 NM of the specified NAVAID.
- Identify the symbols used to depict obstacles and their height above Mean Sea Level (MSL) on the approach plate's Plan View and Airport Sketch.
- Locate and list the UHF and VHF radio frequencies for Approach Control, Tower, Ground Control, and Automatic Terminal Information Service (ATIS.)

- Locate the distance circle and list the significance of the solid inner circle line and the dashed outer circle line.
- List the magnetic radial (course), and distance from the depicted feeder facilities to the Initial Approach Fix (IAF) or holding fix, as appropriate.
- List the altitudes from the Initial Approach Fix (IAF) to the Final Approach Fix (FAF.)
- State the ceiling and visibility requirements for the intended approach.
- Determine the approach category for a given final approach speed.
- Using a Bearing Distance Heading Indicator (BDHI) or Horizontal Situation Indicator (HSI) with Distance Measuring Equipment (DME), state the aircraft position relative to a selected NAVAID
- List the desired course to fly or track a VHF Omni-directional Range (VOR) or Tactical Air Navigation (TACAN) radial.
- State the routing, altitude, obstacles, climb gradient, and the fixed point, or location to which the aircraft is cleared on a Standard Instrument Departure (SID).
- Identify the IAF.
- List the altitude restrictions from the Initial Approach Fix (IAF) to the Final Approach Fix (FAF) from a HI altitude approach plate and from a group of statements, select the statement which describes the approach procedures, or supply the requested information.
- List the altitude restrictions from the Initial Approach Fix (IAF) to the Final Approach Fix (FAF) from a LOW altitude approach plate, and from a group of statements, select the statement which describes the approach procedures, or supply the requested information.
- List the Minimum Descent Altitude (MDA) for a nonprecision approach and the Decision Height (DH) for a precision approach.

STANDARDS

Train and evaluate Initial Qualification Flight Engineers to a **B** knowledge standard.

Train and evaluate Currently Qualified Flight Engineers to a **C** knowledge standard.

A	Facts/Nomenclature	Individual can identify basic facts and terms about the subject and, when used with a performance code, can state nomenclature, simple facts, or procedures involved in an activity.
B	Principles/Procedures	Individual can explain the relationship of basic facts and state general principles about the subject and, when used with a performance code, can determine step-by-step procedures for sets of activities.
C	Analysis/Operating Principles	Individual can analyze facts and principles and draw conclusions about the subject and, when used with a performance code, can describe why and when each activity must be done and tell others how to accomplish activities.
D	Evaluation/Complete Theory	Individual can evaluate conditions and create new rules or concepts about the subject and, when used with a performance code, can inspect, weigh, and design solutions related to the theory involved with activities.

STANDARD DOD PUBLICATIONS

This chapter describes DoD instrument approach and departure publications. The types of booklets containing approach and departure information are classified as DoD Flight Information Publications or FLIPs. The two types of publications regularly used are "Enroute" and "Terminal" FLIPs. All DoD publications are designated by color for a specific world region (e.g., United States, White; Europe, North Africa, and Middle East, Green; Pacific, Yellow; etc).

Enroute FLIPs provide basic airfield information and flight procedures for US military air operations only. Typical information found in enroute FLIPs are an alphabetical listing of airfields, International Civil Aviation Organization (ICAO) identifiers, runway information, types of ground support, specific restrictions/cautions, available navigation aids, and a complete list of radio frequencies.

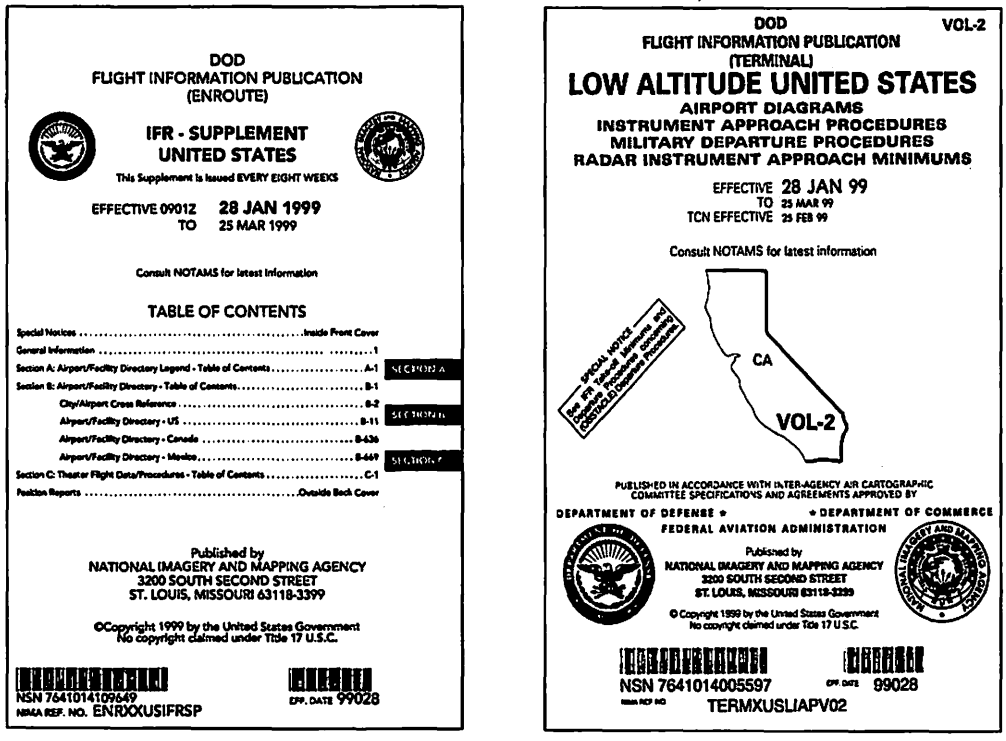

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Figure 1: DoD FLIPs, Enroute and Terminal

Terminal FLIPs describe essential departure and arrival procedures, and depict airport diagrams, instrument approach procedures, standard instrument departures (military or civilian), radar instrument approach minimums, and standard terminal arrivals. The approach and departure FLIPs are used for transition between the terminal area and world wide regions.

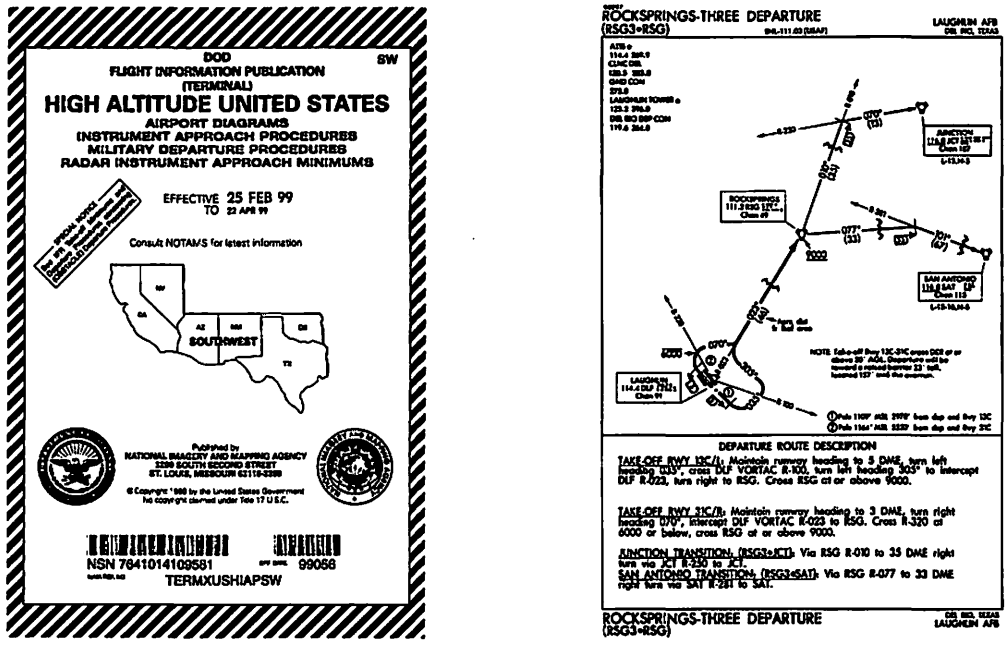

Figure 2: FLIP (TERMINAL) Departure Plate

Regional terminal FLIPs are broken down further by volumes. As examples, the "Low Altitude Terminal US" FLIPs come in 12 volumes covering the 48 contiguous United States, while the "High and Low Altitude Pacific and Australia" terminal FLIPs come in three regional volumes. Changes and updates are issued on a published schedule, and are known as TCNs or Terminal Change Notices.

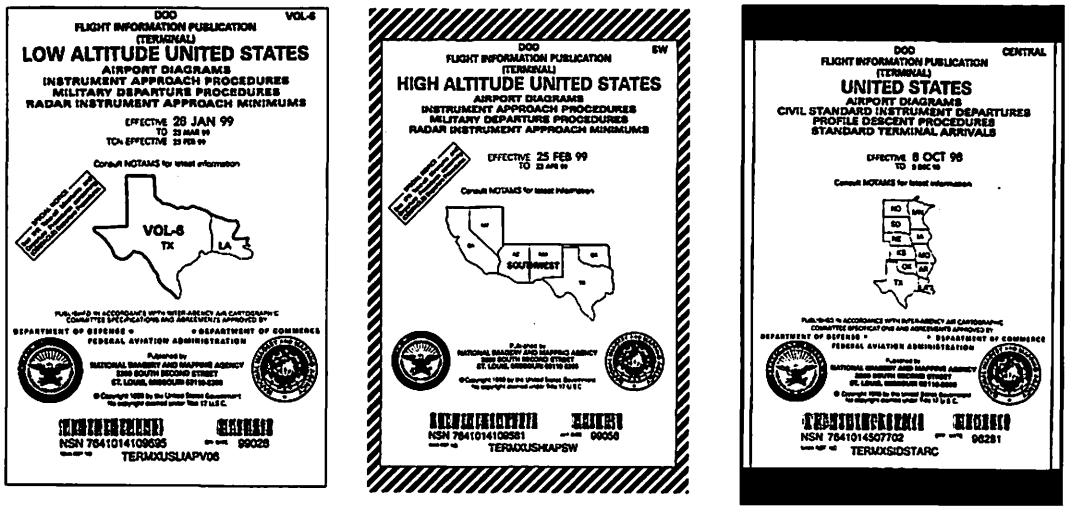

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Figure 3: Regional Terminal FLIPs

AIRCRAFT NAVIGATION EQUIPMENT

The navigation equipment installed in the C-141 aircraft consists of the VHF navigation (VOR), ILS localizer/glidepath, TACAN, ADF, marker beacon, INS, FSAS, radar, CARA, and in some instances FMS/GPS. The following systems information is provided for training purposes only. Consult T.O. 1C-141B-1 Flight Manual for specific system descriptions and operational procedures.

VHF Navigation System

These systems are capable of receiving signals for VOR and Instrument Landing System (ILS) approaches. The VOR radio stations will give bearing (direction) information and display it on the Horizontal Situation Indicator (HSI) and Bearing Distance Heading Indicator (BDHI). Additionally, steering information will be presented on the Attitude Direction Indicator (ADI) and HSI informing the pilots if they are left or right of course. The HSI also incorporates a pointer displaying flight direction either to or from the radio navigation station.

Glideslope Systems

The glideslope is an integral part of the VHF navigational systems whenever an ILS frequency is selected on the VHF navigation radio. The glideslope system displays glideslope pitch steering commands on the ADI only during an ILS approach.

TACAN Systems

Two Tactical Air Navigation or TACAN navigation systems are used to determine the relative bearing and distance to a selected station. The TACAN is the only navigational receiver capable of determining Distance Measuring Equipment (DME) from the radio station. Otherwise, TACANs and VORs are similar in that they both give steering information to the navigation instruments. Some TACAN stations provide DME only, no bearing.

ADF Systems

Two separate Automatic Direction Finder (ADF) systems are capable of receiving bearing information for display on the BDHI. A bearing pointer shows the direction to the transmitter.

Marker Beacon Receiver

The marker beacon receiver is an integral part of the VHF navigational system and is automatically tuned whenever an ILS frequency is selected on the VHF navigation radio. The marker beacons illuminate whenever the aircraft flies over the marker beacon transmitters during an ILS approach. The marker beacons will illuminate as an O (outer), M (middle), and I (inner) on the sky portion of the ADI on the C Model. (Marker Beacon Light (O, M and I) illuminate on the C141B Model).

Inertial Navigation System

The INS continuously computes horizontal navigation data and senses aircraft attitude in pitch, roll, and yaw axes, sending aircraft position and airspeed information to the appropriate avionics components. Other functions of the INS calculate wind speed, direction, and the amount of drift off course. The INS incorporates a 10-position data selector switch. Several of the functions may be used during the approach and are described as follows:

TK/GS - Present track and ground speed. Track is defined as the ground path (in degrees) the aircraft is traveling, not the direction the nose is pointing. Ground speed is defined as true airspeed corrected for wind.

HDG/DA - Heading and drift angle. Heading is defined as the direction (in degrees) the nose of the aircraft is pointed. Drift angle is displayed in degrees as left, right, or zero, and is a function of wind velocity and direction.

WIND – True wind direction and speed are indicated in the data displays when aircraft speed is 100 knots or greater (inflight).

Fuel Savings Advisory System

The Fuel Savings Advisory System (FSAS) interfaces with and controls either INS 1 or INS 2 (as selected). It provides flight operations advisories, radar indicator displays, windshear warning, altitude alert, and coupling to autopilot/autothrottle systems for altitude and airspeed control. Major components of the FSAS are the Display Interface Control Unit (DICU), Windshear and Altitude Alert Lights, FSAS/INS CDU, and the FMS/GPS on the C-141C.

DICU (C-141B) - The DICU controls radar displays, annunciates FSAS modes, and allows selection of altitude alert targets. It also allows for the selection of various SKE modes on the radar screen.

DICU (C-141C) - The DICU controls radar displays and annunciates FSAS modes. It also allows for the selection of various SKE modes on the radar screen.

Windshear Alert Lights (C-141B) - Two red colored WINDSHEAR lights illuminate when a windshear condition is encountered during an approach. There is an audible windshear warning when actual ground speed is 15 knots less than reference ground speed.

Windshear and Altitude Alert Lights (C-141C) - The Ground Collision Avoidance System (GCAS) mode 7 provides aural and visual warnings when a windshear condition is detected during low altitude phases of flight. When a windshear is detected, the Ground Collision Avoidance Panel (GCAP) displays a red backlit WINDSHEAR annunciator and the aural warning "WINDSHEAR, WINDSHEAR, WINDSHEAR" is announced over the GCAS speaker.

FSAS/INS CDU - The Control/Display Unit serves as the main interface for entering and displaying all FSAS and INS navigation data.

WEATHER RADAR SYSTEM

The primary purpose of the weather radar system is to provide weather avoidance information. During an approach, the radar receives input from the FSAS and displays the airfield location on the screen. Aircraft ground speed and reference ground speed are displayed on the lower right hand corner of the screen when approach/landing mode is selected in the FSAS.

COMBINED ALTITUDE RADAR ALTIMETER SYSTEM

The Combined Altitude Radar Altimeter (CARA) system provides accurate indications of aircraft altitude from 0 to 50,000 feet Above Ground Level (AGL). Altitude is indicated by a dial type pointer and a five digit LED display. Signals generated by the transceiver are transmitted and received by two flush mounted antennas located on the bottom aft portion of the left main gear pod.

FLIGHT MANAGEMENT SYSTEM/GLOBAL POSITIONING SYSTEM

The Flight Management System (FMS)/Global Positioning System (GPS) is the latest modification to the aircraft. It works like the INS System but uses global satellite signals to keep the INS computers constantly updated as to their position. This makes the INS more accurate as a navigational tool.

INSTRUMENT TYPE APPROACHES

When discussing instrument approaches it is important to distinguish between precision and non precision approaches. Precision approaches provide both course and glideslope information. Non precision approaches provide course information only. These approaches are guided by either ground based radar equipment via voice instructions or from the aircraft avionics equipment. This chapter provides a brief definition of the different types of approaches.

PRECISION APPROACHES - (PAR/ILS)

Precision Approach Radar - Precision Approach Radar (PAR) approaches provide the pilot with precise course, glideslope, and range information. This type of approach is provided solely by voice instructions from the approach or radar controller. The controller issues course and glide path guidance, frequently informing the pilot of any deviations. The precision radar is accurate normally from 8 miles to touchdown.

Instrument Landing System - Instrument Landing System (ILS) approaches are designed to provide exact runway alignment and descent glide path indications. Both the ADI and HSI are used to determine proper direction and glide path to the runway. At some locations, DME is associated with ILS equipment to provide distance information to the navigational aid. (This DME cannot be received on the C-141).

Distance Measuring Equipment - Distance Measuring Equipment (DME) is the straight line distance from the aircraft to a selected ground station. DME is expressed in nautical miles and displayed on the HSI or BDHI when TACAN is selected.

NON PRECISION APPROACHES (ASR, VOR, VOR/DME, TACAN, NDB, Localizer)

Airport Surveillance Radar - The Airport Surveillance Radar (ASR) approach is very similar to the PAR with the exception that no glideslope information is given. Instead of flying a glideslope, pilots descend to a minimum descent altitude (MDA) until the runway can be visually acquired.

VHF Omni-Directional Range - The VHF Omni-Directional Range (VOR) is used to provide course or bearing information to align the aircraft with the runway centerline.

Tactical Air Navigation - Tactical Air Navigation (TACAN) is used to provide course or bearing and runway alignment information similar to a VOR, but operates on a UHF frequency. Unlike the VOR, a TACAN is capable of receiving DME information for display on the HSI or BDHI when TACAN is selected.

VOR/DME - VOR/DME provides VHF bearing signals for runway alignment and UHF DME information from co-located VOR/DME equipment. It is basically a VOR and TACAN station located together, also known as a VORTAC.

Non-Directional Beacon - Non-Directional Beacon (NDB) is a low to high frequency radio beacon which transmits nondirectional signals. Aircraft use NDB signals to determine and display bearing information to any radio station.

Localizer - The Localizer approach is an ILS without the glideslope information. Localizer directional aids may not always be aligned as a straight in approach.

NOTES

INSTRUMENT APPROACH PLATE COMPONENTS

In this section, we will address the components and particulars of standard DoD approach plates.

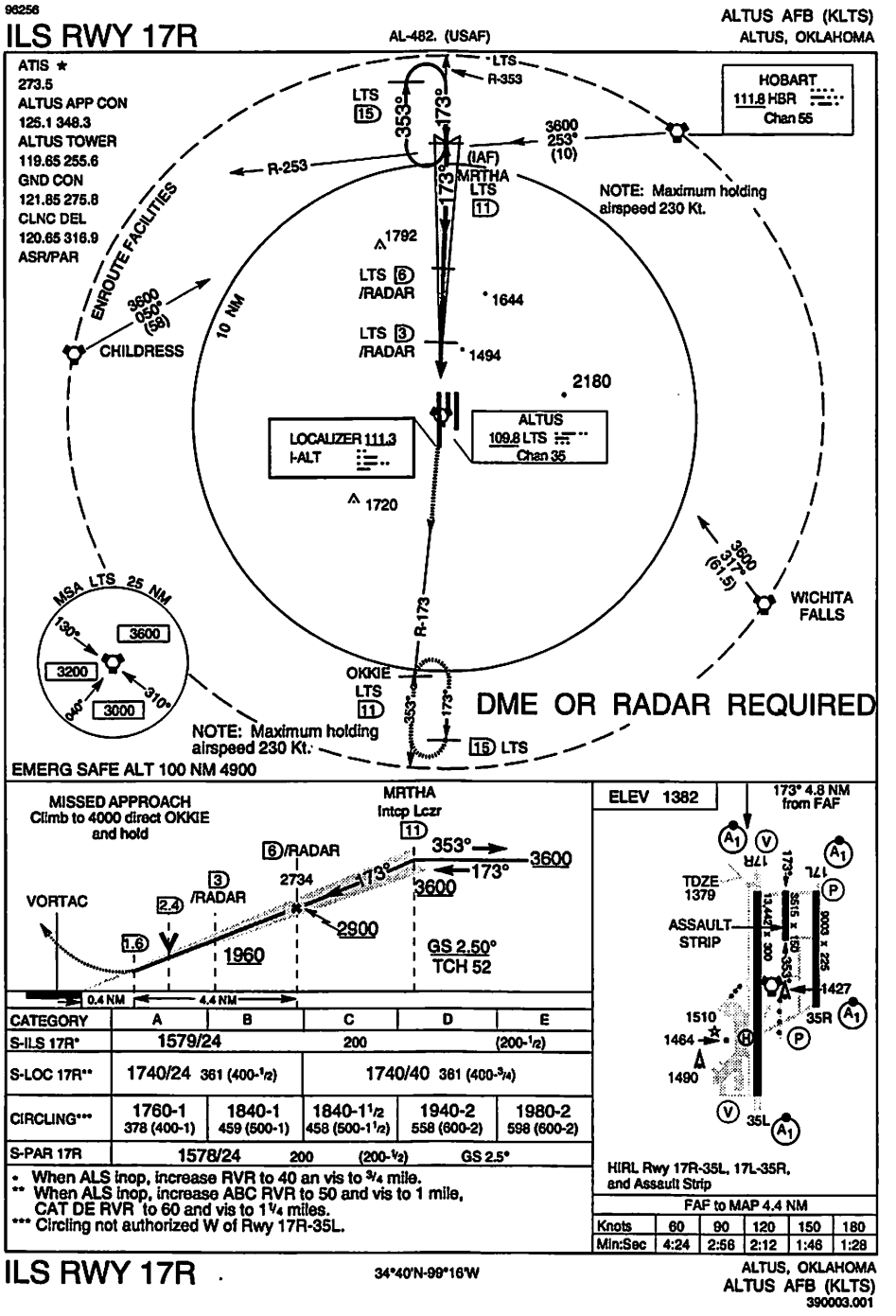


Figure 4: DoD Approach Plate

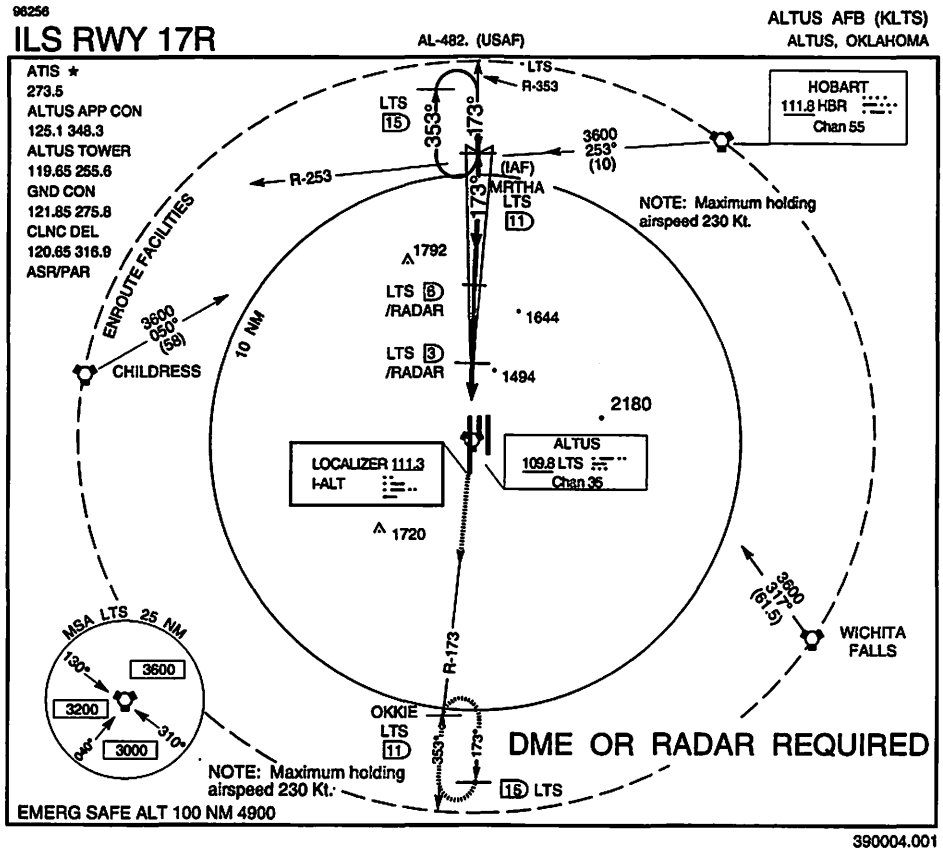


Figure 5: Plan View

PLAN VIEW

The Plan View (Fig. 5) is the largest block on the approach plate and represents the track of the approach as it would be seen by someone looking down from directly overhead. The top of the Plan View is always oriented towards north. This block contains a variety of information and symbols. The legend for these and other approach plate symbols is found at the front of the approach booklet.

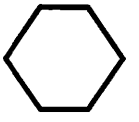
Above the Plan View, in the upper left hand corner of the approach plate, is the approach name. The name identifies the type of navigational aid or aids which provide final approach guidance and the runway to which the final approach course is aligned. When the name of the approach is followed by a letter such as A, B, C, etc, the approach is designed for circling minimums only (VOR A, TAC B, NDB C, etc).

Although the list of items is not all inclusive, the Approach Plate Plan View contains these important items.

Tactical Air Navigation (TACAN)

TACAN stations provide signals which allow airborne equipment to display a magnetic radial from the station and selected courses to or from the station. A TACAN station also includes Distance Measuring Equipment (DME) which shows the distance in nautical miles from the aircraft present position to the station. TACAN stations transmit in the Ultra High Frequency (UHF) range of radio frequencies. TACANs are usually associated with military installations.

Very High Frequency Omnirange (VOR)

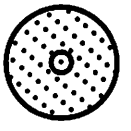


As you probably have guessed by its name, a VOR station transmits in the VHF range of radio frequencies. VOR operation is essentially the same as a TACAN, except the VOR alone does not have DME.

VORTAC

Many VOR and TACAN stations are co-located. These are known as VORTAC stations. VORTACs have DME.

Non Directional Beacon (NDB)



*symbols

A low or medium frequency radio beacon transmits nondirectional signals whereby the pilot of an aircraft properly equipped can determine bearings and "home" on the station. These facilities normally operate in the frequency band of 190 to 535 kHz and transmit a continuous carrier with either 400 or 1020 Hz modulation. All radio beacons except the compass locators transmit a continuous three-letter identification in code except during voice transmissions.

Navigational Aid Name, Radio Frequency, and Morse Code Identifier

The Plan View provides a convenient setting to display navigational aid information such as name, radio frequency, identifier, Morse code identifier, and channel.

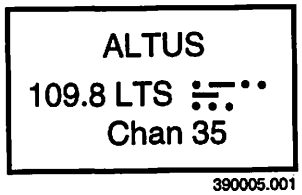


Figure 6: NAVAID Identifier

Minimum Safe Altitude (MSA)

This altitude provides at least 1,000 feet of obstacle clearance for emergency use within 25 nautical miles of the facility.

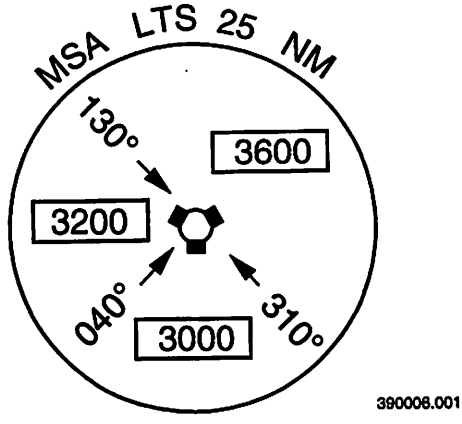


Figure 7: MSA Circle

Emergency Safe Altitude (ESA)

This altitude provides 1,000 feet of obstacle clearance (2,000 feet in designated mountainous areas) within 100 nautical miles of the facility.

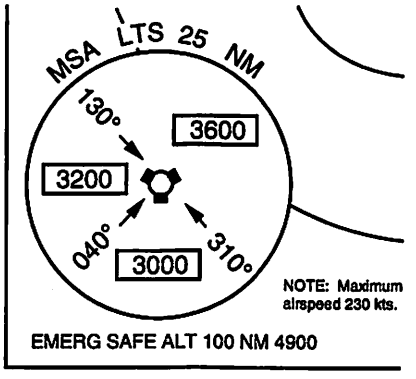


Figure 8: ESA

Obstacles

Obstacles and terrain are depicted on the approach plates by various symbols (Fig. 9).

• Spot Elevation • Highest Spot Elevation

Obstacle Group of Obstacles Highest Obstacle

± Doubtful Accuracy

Footnote ①, ②, etc., defines obstruction controlling Minimum Climb Rate

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Figure 9: Obstacles

Obstacles are measured in feet above Mean Sea Level (MSL). All distances given are from the departure end of the runway. Flying an approach exactly as depicted will assure obstacle clearance for the applicable category aircraft.

Obstacles become a factor if they are located outside the guaranteed clearance area and the aircraft is flying off track or VFR.

Radio Frequencies

The upper left corner of the plan view has the appropriate controlling agency's VHF and UHF communication frequencies. Also included is the ATIS frequency where applicable.

Automatic Terminal Information Service (ATIS) - The continuous broadcast of recorded, non-control information in selected high activity (density) areas. Its purpose is to improve controller effectiveness, and to relieve frequency congestion by automating the repetitive transmission of essential but routine information.

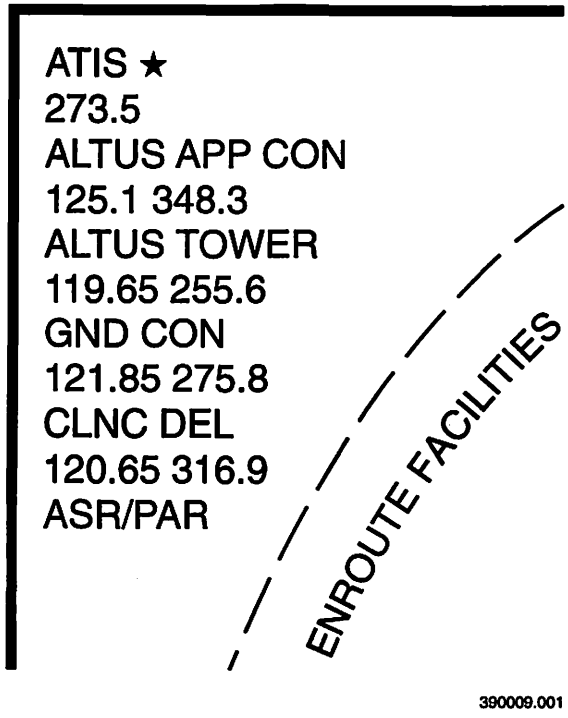
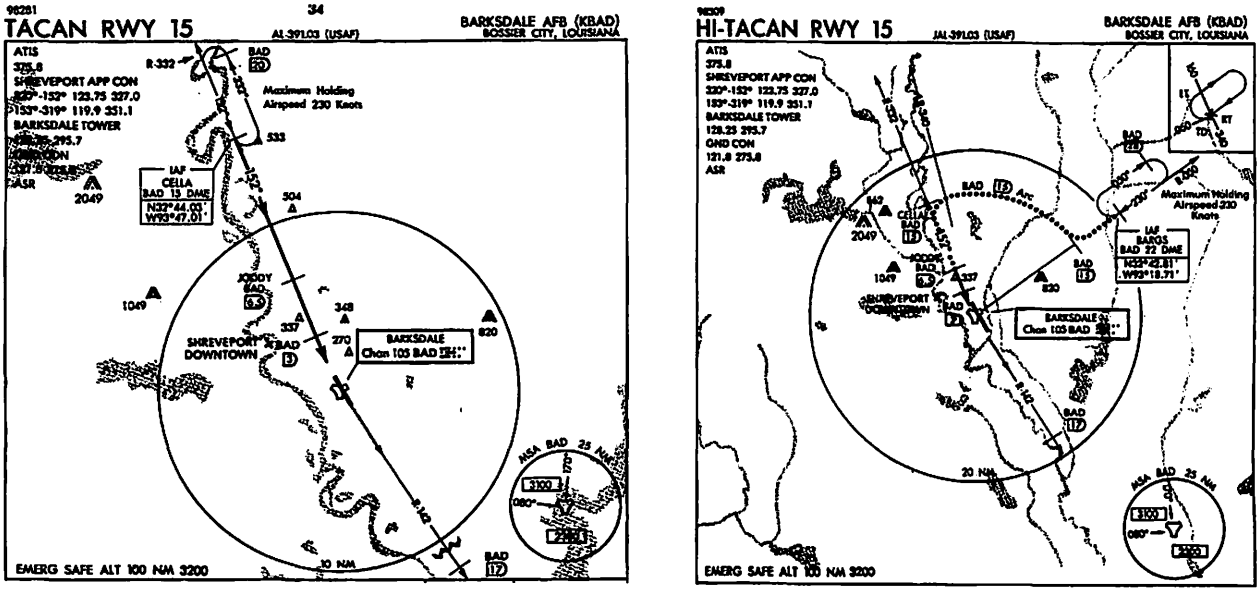


Figure 10: Communications

Distance Circle

On the Plan View of the Approach Chart there is a solid lined "Inner Circle." It is usually 10 NM or 20 NM in radius, but could be as small as 5 NM for helicopters. The distances inside the INNER circle are normally to scale. If not, a note NOT TO SCALE will be on the DISTANCE circle.



390010.001

Figure 11: Distance Circles

Normally, the 20 NM circle is for HIGH Altitude Approaches; the 10 NM circle is for LOW Altitude Approaches.

Enroute Navigational Facilities

On the Plan View of the approach plate there can be an outer dashed circle labeled "Enroute Facilities" (Fig. 12). On the Enroute Facilities circle are symbols for enroute navigational aids. From each navigational aid there is an arrow depicting the terminal routing to the Initial Approach Fix (IAF). Each routing will be annotated with minimum enroute altitude, the course, and distance to the IAF. The distances indicated within the terminal approach routing are NOT TO SCALE.

NOTE: All courses and directions on the approach plate will be MAGNETIC unless otherwise noted.

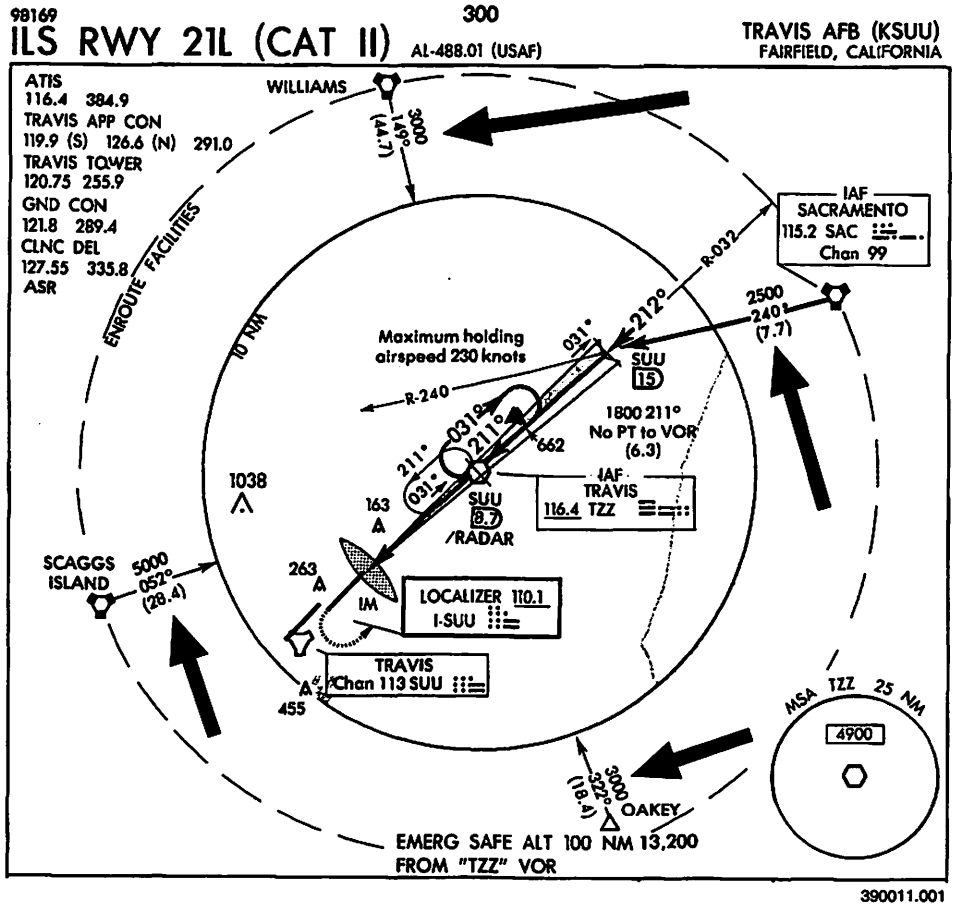


Figure 12: Enroute Navigational Facilities

For additional symbols in the Plan View section of the approach plate, consult the legend in the front of any approach book.

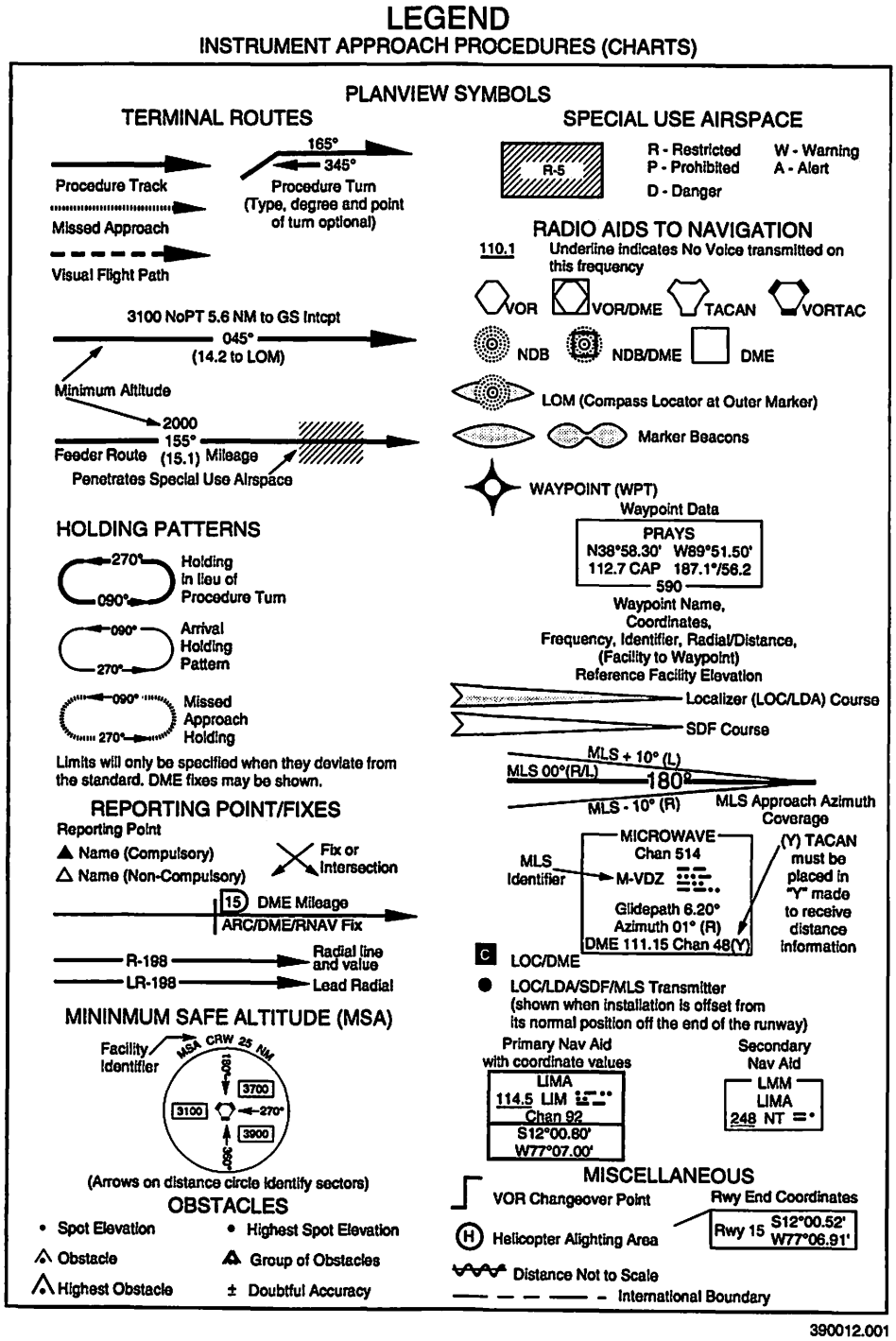


Figure 13: Legend

PROFILE VIEW

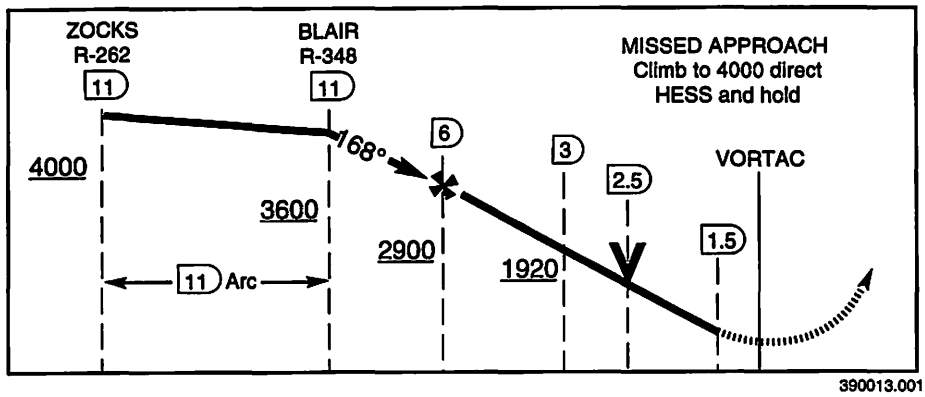


Figure 14: Profile View

The Profile View (Fig. 14) is located below the Plan View, and just to the left of the Airport Sketch. An observer standing to one side of the airport would see the movement of the aircraft as represented in the Profile View. This allows us to consider the approach in a three dimensional way by showing the effect of altitude changes. If you mentally follow the aircraft on both the Plan View and the Profile View **simultaneously,** you will be situationally aware of the aircraft position at all times. The Profile View contains the following:

Altitudes –
There are four types of altitudes: Mandatory, Minimum, Maximum, and Recommended. The legend for these altitudes is in the front of the Approach Booklet. Note that altitudes in the Profile View of the approach will be marked as indicated in the approach legend below.

Altitude

5,500 Mandatory Altitude

2,500 Minimum Altitude

4,300 Maximum Altitude

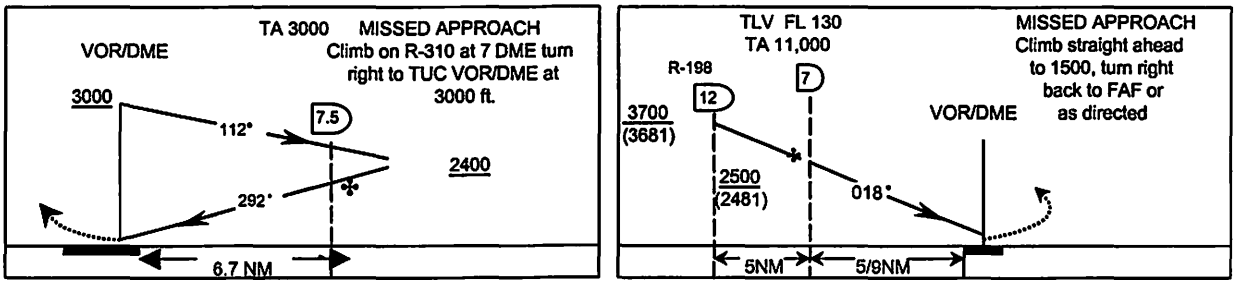
3,000 Recommended Altitude

(1,755) QFE Height (An absolute altitude, or height above the ground)

Figure 15: Altitudes

Transition Level/Transition Altitude –

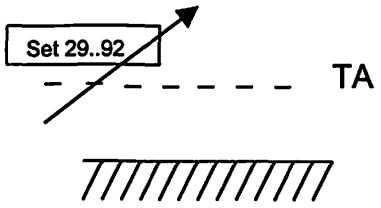
At most overseas locations, the transition altitude (TA), and in some cases, the Transition Level (TLV), appear in the Profile View.



NOTE: In the CONUS, TA = 18,000 feet, TLV = FL180

The correct altimeter setting is critical for maintaining clearance from other aircraft, and the ground! The C-141 Dash One, Section 2, contains altimeter setting procedures specific to each crew position. QNE (29.92) is set at higher altitudes to define flight levels; QNH (local) is set at the lower altitudes to assure a known altitude above mean sea level (MSL).

- The changeover point during the climbout is always the designated Transition Altitude (TA). Set 29.92 (QNE) as an altimeter setting when passing the transition altitude.



- The changeover point during the descent is the transition level (TLV). Set the local altimeter (QNH) when operating below the transition level.

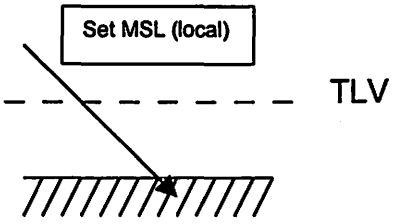


Figure 16: Transition Level

If the TLV is not printed in the profile view, it is because it varies with atmospheric conditions. It can be obtained from the ATIS or approach control.

MINIMA SECTION

This section is found below the profile view to the left of the airport sketch. It usually has several lines of information corresponding to the various types of approaches which may be flown using each plate.

CATEGORY	A	B	C	D	E
S-ILS 17R*	1579/24		200		(200-1/2)
S-LOC 17R**	1740/24 361 (400-1/2)		1740/40 361 (400-3/4)		
CIRCLING***	1760-1 378 (400-1)	1840-1 459 (500-1)	1840-1 1/2 458 (500-1 1/2)	1940-2 558 (600-2)	1980-2 598 (600-2)
S-PAR 17R	1578/24	200	(200-1/2)	GS 2.5°	

* When ALS inop, increase RVR to 40 an vis to 3/4 mile.
** When ALS inop, increase ABC RVR to 50 and vis to 1 mile, CAT DE RVR to 60 and vis to 1 1/4 miles.
*** Circling not authorized W of Rwy 17R-35L.

390017.001

Figure 17: Minima

Crewmembers should cross-check briefed approach minimums for accuracy. Crew members also are responsible to ensure altimeter and radar altimeter bugs are set correctly to the approach minimums for the approach being flown.

Aircraft Approach Category

The category line determines the minimums used based on the aircraft speed during the final portion of the instrument approach. An aircraft may use minimums for a higher category but cannot use minimums for a lower category (i.e. D may use E minimums but D can never use C minimums). The C-141 is normally a category D aircraft.

A	B	C	D	E

Figure 18: Approach Categories

Approach Categories

Aircraft performance differences have a direct effect on the airspace and visibility needed to perform certain maneuvers, such as circle to land, turning missed approaches, final alignment correction to land, and descent. Approach categories are explained below.

Category A: speed less the 91 knots

Category B: speed 91 knots or more but less than 121 knots

Category C: speed 121 knots or more but less than 141 knots

Category D: speed 141 knots or more but less than 166 knots

Category E: speed 166 knots or more

Approach Type

Landing minima are provided for three types of approaches: PRECISION, NON-PRECISION, and CIRCLING.

The PRECISION APPROACH provides a vertical flight path using an approved procedure where the navigation facility is precisely aligned with the runway centerline. Glideslope and azimuth information are provided. For example, Precision Approach Radar (PAR) and Instrument Landing System (ILS) approaches are PRECISION approaches.

A NON-PRECISION APPROACH has course and range information or course information only; a glideslope is not used (LOC, TAC, VOR, ASR, NDB).

The CIRCLING APPROACH is a combination of an instrument and a visual flight maneuver. An instrument approach is used to acquire the runway environment, and the aircraft is flown visually to the landing runway. The landing runway may be a different runway than the one to which the instrument approach was made.

A radar approach can be either a precision or non precision approach. It relies upon a radar controller vectoring the aircraft to the approach runway (ASR, PAR).

CATEGORY
S-ILS 27
S-LOC 27
CIRCLING
S-PAR 27

Figure 19: Approach Type

Visibility Minimums

RUNWAY VISUAL RANGE (RVR) is an instrumentally derived value representing the distance a pilot should see down the runway from the approach end. RVR is horizontal and NOT slant visual range. It is measured in hundreds of feet or meters as determined by country. RVR is used to determine the field conditions for straight-in approaches to that runway.

PREVAILING VISIBILITY (PV) is the greatest horizontal visibility equaled or exceeded throughout at least half of the horizon circle. PV is measured in statute miles, fractions of miles or meters, and MUST be used for circling approaches.

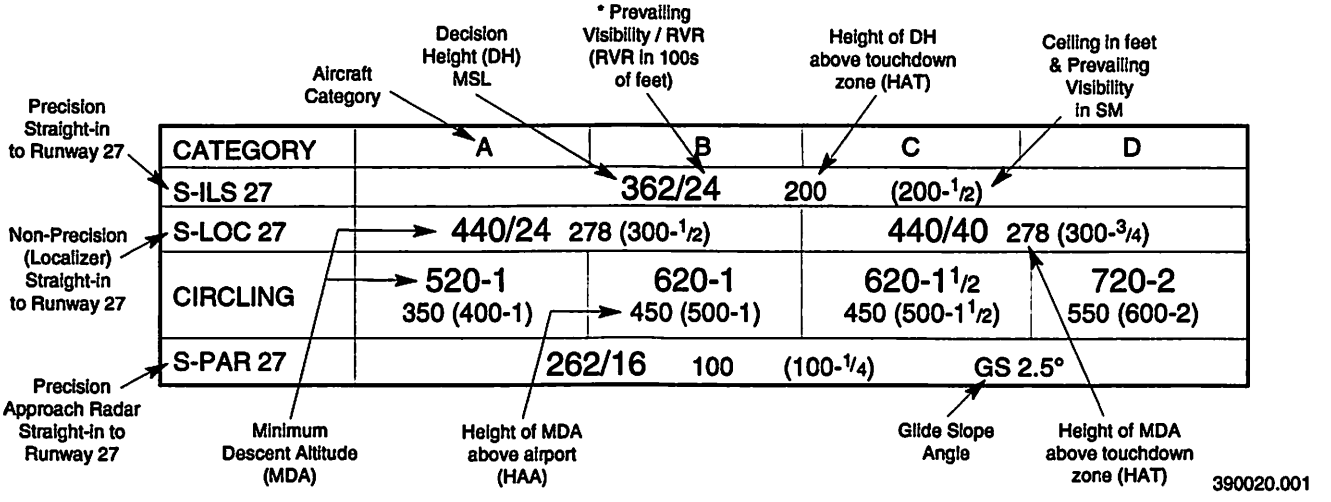


Figure 20: Visibility Requirements

Visibility requirements for the approach will be stated on the Approach Plate in terms of RVR (feet or meters), or Prevailing Visibility (statute miles or meters). The visibility required for the approach will be listed after the Decision Height (DH) for a Precision Approach, or after the Minimum Descent altitude (MDA) for a Non-Precision approach. If the visibility figure is separated from the DH or MDA by a slash (/), the visibility represents an RVR. If the separation between the visibility and the DH or MDA is a dash (-), the visibility represents a Prevailing Visibility. In Figure 20 above.

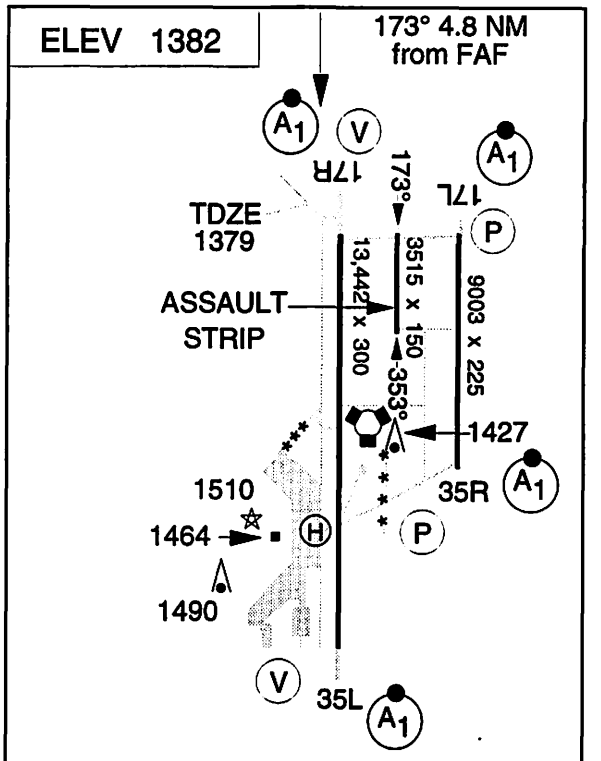
S-ILS 27	362/24	Indicates a DH of 362 feet, RVR of 2,400 feet
CIRCLING	520-1	Indicates an MDA of 520 feet, Prevailing Visibility of 1 mile

NOTE: A small case "m" will follow the visibility figure if the RVR or Prevailing Visibility are measured in meters

2,150/730m = 730 meters RVR

3,000-4,800m = 4,800 meters Prevailing Visibility

AIRPORT SKETCH



FAF to MAP 4.4 NM					
Knots	60	90	120	150	180
Min:Sec	4:24	2:56	2:12	1:46	1:28

390021.001

Figure 21: Airport Sketch

The Airport Sketch is located in the lower right hand portion of the plate. Information here applies to airfield layout, runway dimensions, obstacles, elevations, and approach lighting systems. If the plate has information for an approach which uses timing to establish the Missed Approach Point (MAP), the timing is normally found below the airport sketch. The timing chart may be found at the bottom of the profile view if the airport sketch contains large amounts of information. The timing chart is based on ground speed.

AIRPORT LIGHTING

As previously mentioned, airport lighting can also be found in the Airport Sketch.

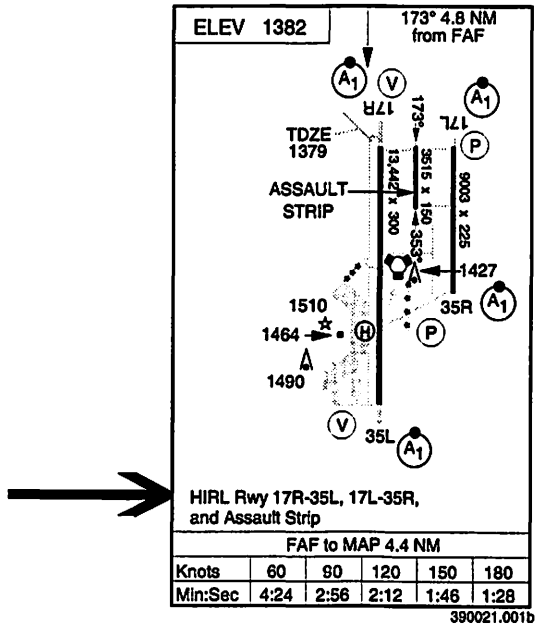


Figure 22: Airport Sketch

Runway End Identifier Lights (REIL) –
Two synchronized flashing lights, one of which is located laterally on each side of the runway threshold facing the approach area.

Touchdown Zone Lighting (TDZ) –
Consists of two rows of high intensity light bars arranged on either side of the runway centerline. The two rows of light bars are 3,000 feet long and extend from the threshold of the runway inward.

Centerline Lighting (CL) –
A straight line of lights located along the runway centerline. For landing rollout information, the last 3,000 to 1,000 foot sections display alternate red and white lights, while the last 1,000 feet display all red lights.

High Intensity Runway lighting (HIRL) –
Elevated, bi-directional white lights which extend the length of the runway.

An expanded view of the various Approach Lighting Systems can be found in the Flight Information Handbook (FIH). (See Fig. 23.)

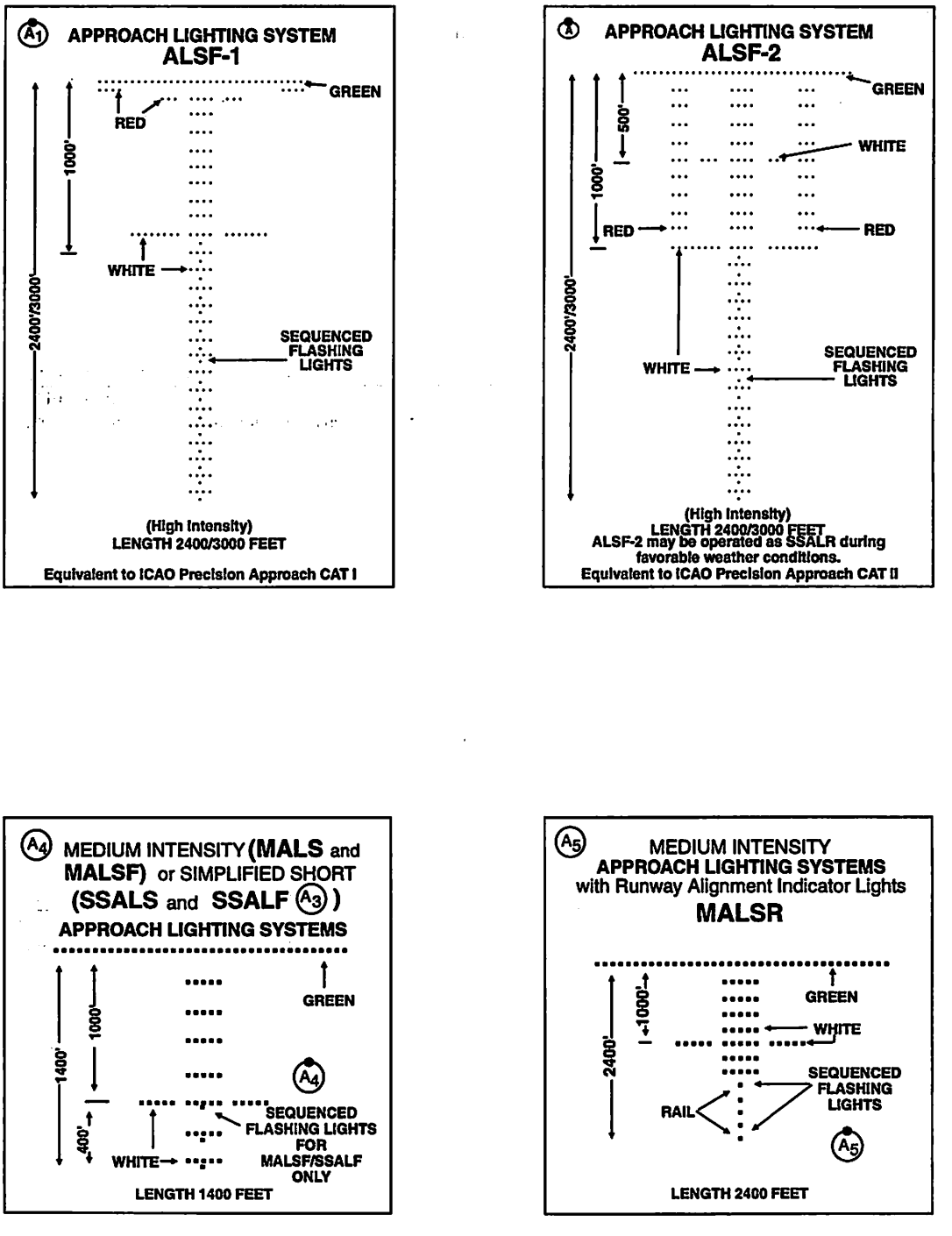


Figure 23: Approach Lighting

Exercise 1

Using Fig. 24, answer the following questions pertaining to the three sections of a standard DoD approach plate.

1. Which section of the approach plate contains the Minimum Sector Altitude for the area surrounding the airport facility?

   A. Plan View
   B. Profile View
   C. Airport Sketch
   D. Plan View and Profile View

2. Which section usually contains the Transition Level/Altitude on overseas DoD approach plates?

   A. Plan View
   B. Profile View
   C. Airport Sketch
   D. Plan View and Profile View

3. The type of runway approach lighting system for the approach may be found in the

   A. Plan View
   B. Profile View
   C. Airport Sketch
   D. Plan View and Profile View

4. What is the Minimum Safe Altitude within 25 NM of the Seymour Johnson TACAN?

   A. 6,000 feet
   B. 4,000 feet
   C. 3,100 feet
   D. 1,300 feet

5. What is the Emergency Safe Altitude within 100 NM of the Seymour Johnson TACAN?

   A. 6,000 feet
   B. 4,000 feet
   C. 3,300 feet
   D. 1,300 feet

6. The identifier signal for the Seymour Johnson TACAN is coded

   A. ISO
   B. IDDX
   C. GSB
   D. SMJ

7. Unless otherwise stated, all courses and headings listed on the approach plate are based on

   A. Magnetic North
   B. True North (INS Course)
   C. airfield orientation
   D. radials from the Final Approach Fix (FAF)

8. Locate the EEGEL IAF on the approach plate. The altitude associated with this point is a

   A. recommended altitude
   B. minimum altitude
   C. maximum altitude
   D. mandatory altitude

9. For the C-141, what is the Minimum Descent Altitude (MDA) and Runway Visual Range (RVR) for the straight in Localizer Approach to Runway 26?

   A. 309'/24
   B. 660'/40
   C. 660'/50
   D. 660'/60

10. Under normal operating configurations and weights, the C-141 is a Category

A. D
B. C
C. B
D. E

11. The approach listed as S-ILS 26 is a

A. precision approach
B. non precision approach
C. visual approach
D. radar approach

12. The other Precision Approach listed on this plate is the

A. S-LOC 26
B. Circling
C. S-PAR 26
D. Localizer

13. Where is the missed approach timing block located?

A. Plan View
B. Profile View
C. Airport Sketch
D. Minima Section

14. What type of approach lighting is depicted on the approach end of runway 26?

A. ALSF 1
B. ALSF 2
C. None
D. Sequenced Flashers only

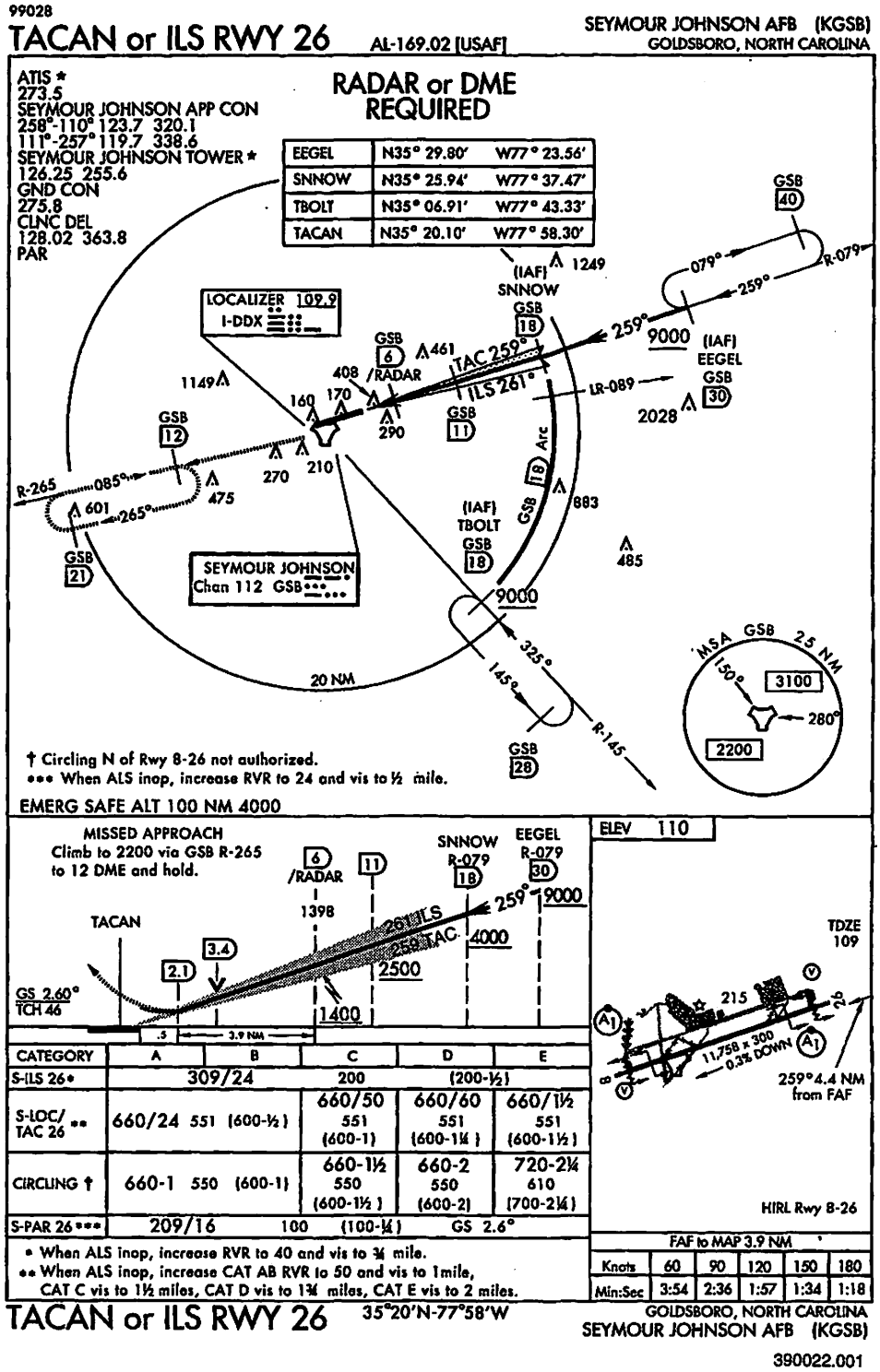


Figure 24: Approach Plate

Exercise 1 Answer Key

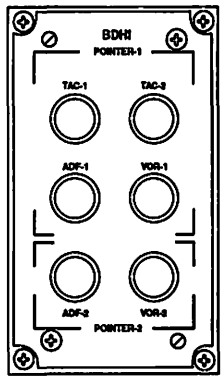
1. A. Plan View
2. B. Profile View
3. C. Airport Sketch
4. C. 3,100 feet
5. B. 4,000 feet
6. C. GSB
7. A. Magnetic North
8. B. Minimum Altitude
9. D. 660'/60
10. A. D
11. A. Precision Approach
12. C. S-PAR 26
13. C. Airport Sketch
14. A. ALSF 1

CHAPTER 2: BEARING DISTANCE HEADING INDICATOR AND HORIZONTAL SITUATION INDICATOR NAVIGATION

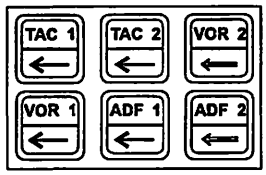
As a Flight Engineer, you must be familiar with the process of analyzing the flight instruments in conjunction with an approach plate to determine your position. The Bearing Distance Heading Indicator (BDHI) and the Horizontal Situation Indicator (HSI) will give the engineer the best picture of the aircraft position in relation to a NAVAID, and in turn, an approach procedure.

Bearing Distance Heading Indicator (BDHI)

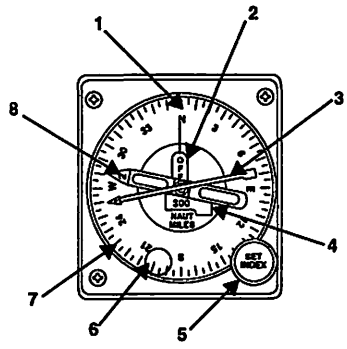
The BDHI is made up of two components, the select panel and the BDHI compass card and bearing pointers.



C-141B Select Panel



C-141C Select Panel



1. TOP INDEX
2. BDHI POWER OFF WARNING FLAG
3. NO. 1 BEARING POINTER
4. DISTANCE INDICATOR
5. HEADING SET KNOB
6. HEADING MARKER
7. COMPASS CARD
8. NO. 2 BEARING POINTER

BDHI

99C-009.CDR

Figure 25: BDHI Components

The select panel determines which Navigational aid will be represented by pointer 1 or pointer 2. Pointer 1 can display TAC 1, TAC 2, VOR 1, and ADF 1. Pointer 2 can display ADF 2 or VOR 2. To get DME on the compass card TACAN 1 or 2 must be selected. Only one NAVAID at a time can be displayed on each pointer by depressing the desired button.

The BDHI has a compass card, 2 pointers, and DME readout for TACAN.

Lubber Line

Now, imagine a vertical line through the center of the BDHI, from the index at the 12 o'clock position to the index at the 6 o'clock.

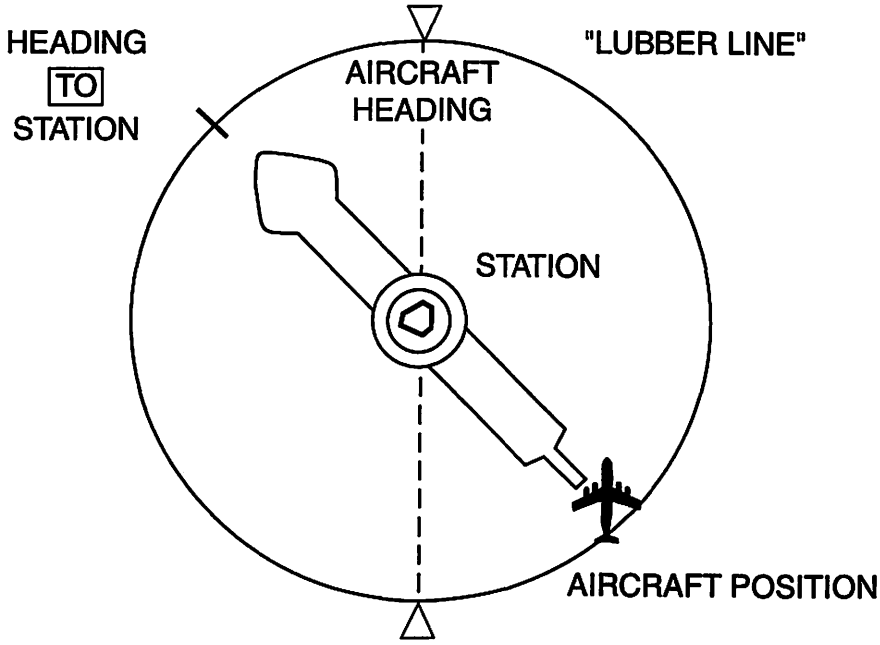


Figure 26: Lubber Line

This imaginary line is referred to as the LUBBER LINE. The upper half of the line is the UPPER LUBBER LINE, and the bottom half is the LOWER LUBBER LINE. The aircraft heading is always read from the index at the top of the upper lubber line. The selected NAVAID will always be represented by the pivot of the bearing pointer. The aircraft position is always the tail of the pointer. The head of the pointer represents the direction TO the selected station.

BDHI Position Orientation

For simplification some depictions only show a single pointer. The aircraft relative position from the station is always represented by the tail of the pointer, but the direction the aircraft is heading, is always parallel to the lubber line.

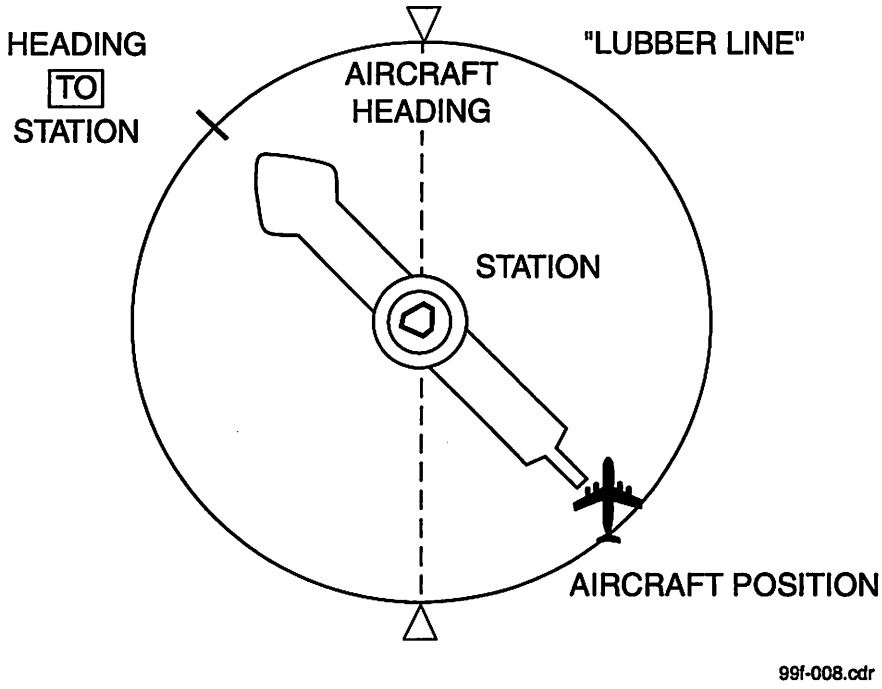


Figure 27: BDHI Position Orientation

Said a slightly different way, the position of the head of the pointer, relative to the lubber line, (left or right) tells the pilot which way to turn to fly directly to the station. If the head of the pointer was already under the lubber line, (or pointing straight up), no turn would be necessary, since the station would be directly in front of the aircraft.

Notice that no mention has been made about compass heading. It is possible for a pilot to fly directly to a NAVAID using only the bearing pointer, turning as necessary to keep the head of the pointer under the lubber line.

We can now add the component which turns our simple bearing pointer into a BDHI; the magnetic compass card. With the addition of magnetic heading information, it will be possible to determine our general position on an approach plate, relative to a selected NAVAID. The best way to explain this process is to practice it. Assume that we are flying a radar vector of 360°, (that's "0" on the compass card). Looking at the BDHI you see the following indications on the flight instruments.

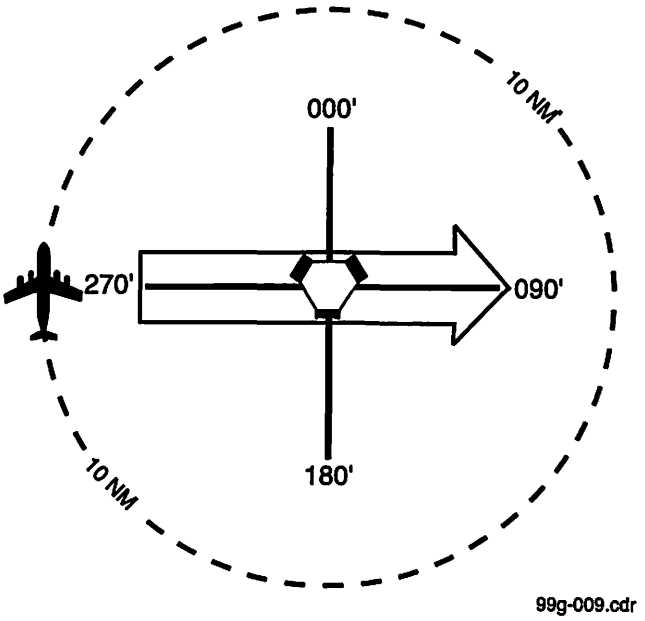


Figure 28: BDHI/DME

Remember that the pivot of the bearing pointer represents the station (TACAN), the tail is the aircraft, and the head is the direction you would have to fly to go TO the station.

The Tail of the TACAN bearing pointer is on 270. Therefore, your position is on the 270 radial, due west of the TACAN Adding DME to the picture, we find that the aircraft is 10 miles away from the station on the 270 radial.

Looking at the BDHI Compass Card, we see that the aircraft is on a heading of 360 (due north). With that in mind, look at your approach plate plan view and visualize the aircraft heading north (360), to the top of the page (Fig. 29).

If we mentally superimpose the BDHI over the plan view of the approach plate, it would look something like this:

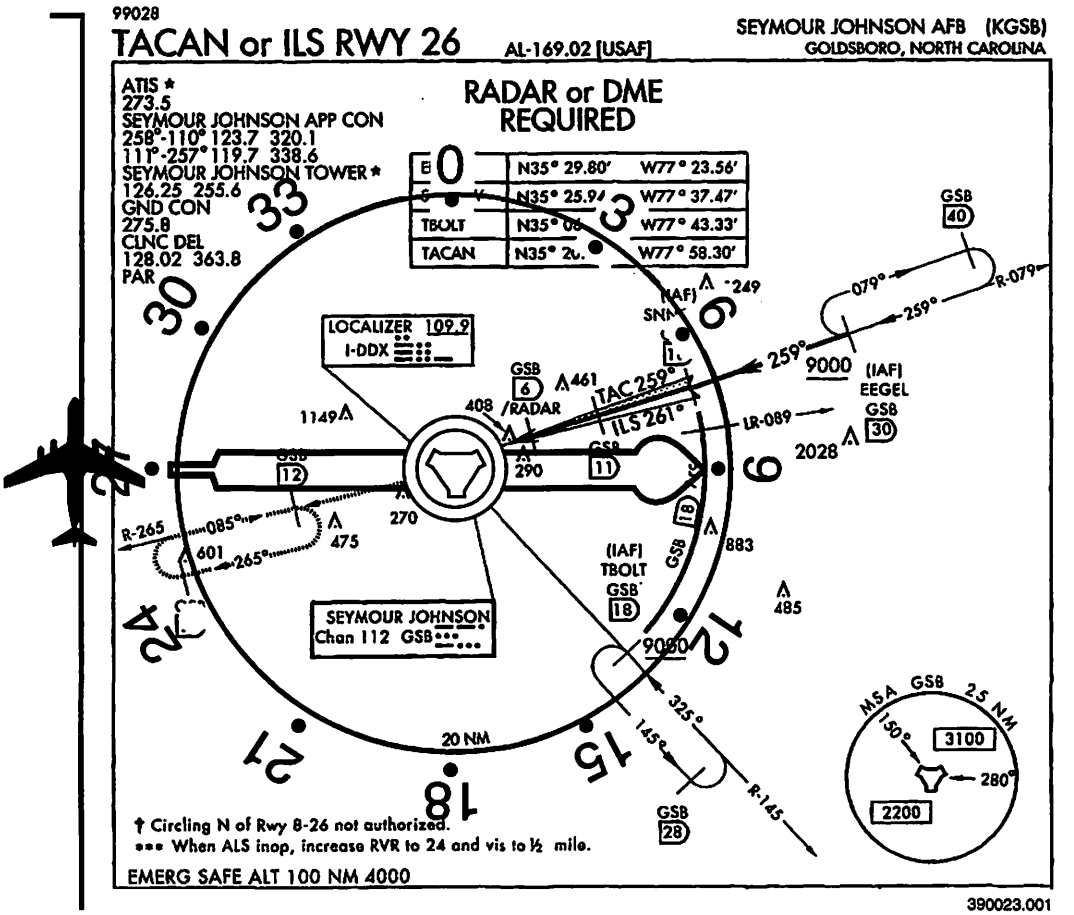


Figure 29: BDHI/Plan View

As the aircraft moves on its northbound heading, the tail of the bearing pointer will follow its movement and the bearing pointer itself will pivot accordingly (i.e., the aircraft "drags" the tail of the bearing pointer as it flies).

Radial vs. Course

A radial is a magnetic bearing extending out from a VOR/VORTAC/TACAN navigation facility. Previously we used the BDHI bearing pointer pivot as the station, or navigation facility, when determining a general position relative to a selected NAVAID. The compass card portion of the BDHI then, is a representation of these radials, or magnetic bearing, from the NAVAID. Since we used the tail of the BDHI bearing pointer to determine our position in relation to the NAVAID, we can say that the tail of the bearing pointer tells us which radial the aircraft is on (Fig. 30).

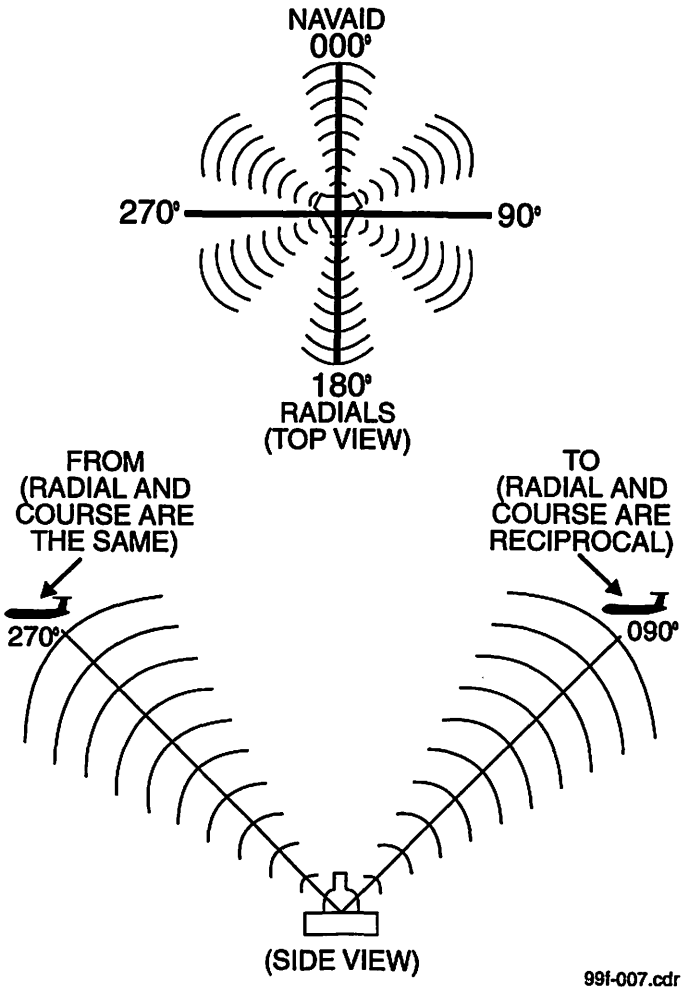


Figure 30: Radial

When selecting a desired course to be flown, the pilot must first determine if the course will take the aircraft TO or FROM the selected NAVAID (Fig. 30).

If the direction of flight (heading) is to be away FROM the station, the NAVAID radial will be the same value as the NAVAID course. In the example in Figure 31, the aircraft is heading 360° (due north). The tail of the bearing pointer is also on 360°, the aircraft heading. The head of the bearing pointer is on 180° on the BDHI compass card.

Therefore, the aircraft is flying away from the station on the 360° radial.

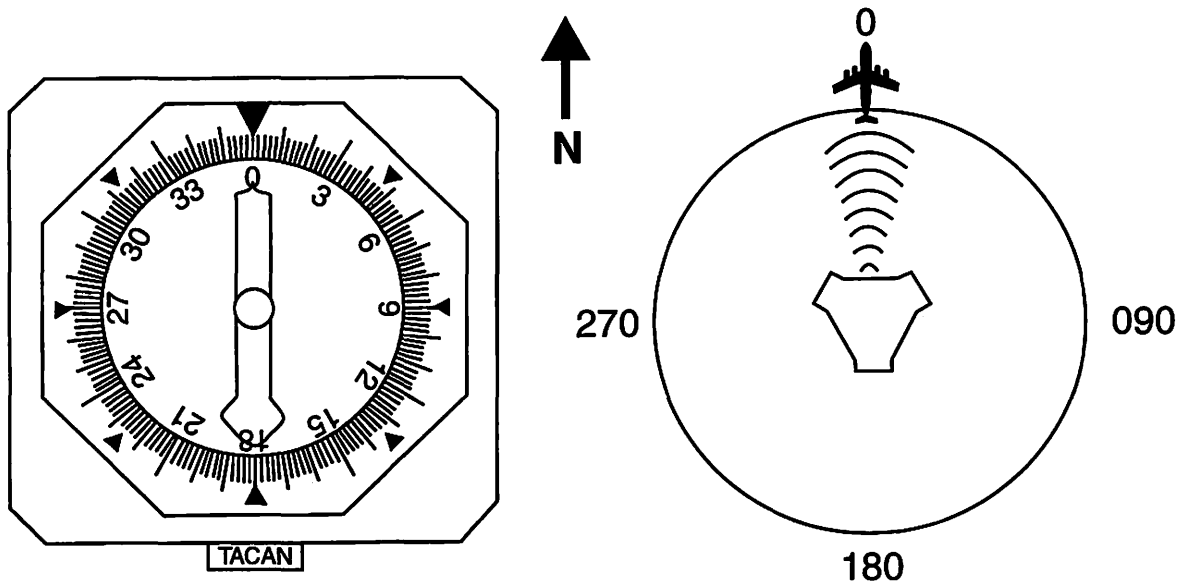


Figure 31: BDHI Course

Since the tail of the bearing pointer and the magnetic heading are on the identical mark, the aircraft course is the same as the radial (360°). (No wind conditions.)

In this second example (Fig. 32) the aircraft is heading 360°, due north. Now the head of the bearing pointer is also on 360° on the BDHI compass card. The tail of the bearing pointer is on 180°.

Therefore, the aircraft is flying to the station on the 180° radial.

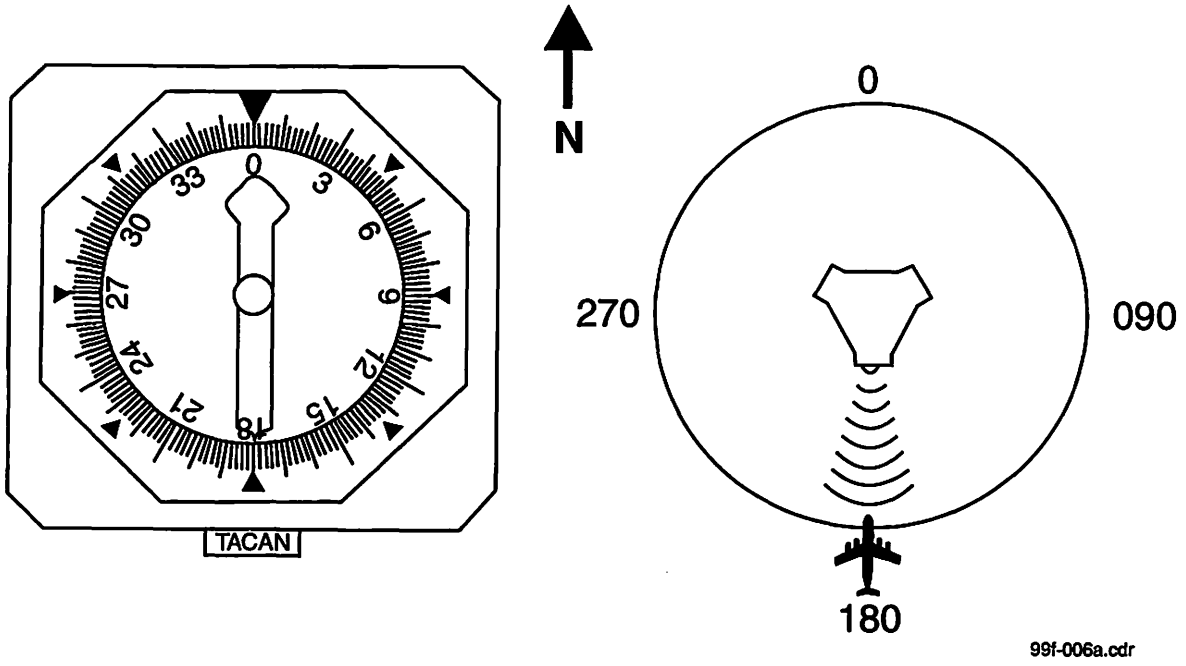


Figure 32: BDHI Course

When an aircraft is heading to the station, its inbound course is said to be the reciprocal of the radial its on. In our example, although we are on the 180° radial, the inbound course to the station is 360° (reciprocal of the 180° radial).

Adding or subtracting 180° from the radial that the aircraft is inbound on will result in the aircraft's course (i. e., 090° radial = 270° course, 330° radial = 150° course). Through the proper interpretation of radials, and inbound and outbound courses, you can keep yourself situationally aware in relation to an approach procedure.

HORIZONTAL SITUATION INDICATOR (HSI)

The Horizontal Situation Indicator (HSI) Fig. 33, in most respects, is a combination of a heading indicator, radio magnetic indicator, course indicator, and range indicator. The combination of these indications are used for basic navigation and for determining the aircraft position in relation to a ground based radio navigation aid.

The HSI displays heading, desired course, course deviation, bearing, range, and direction of flight TO or FROM a navigation aid.

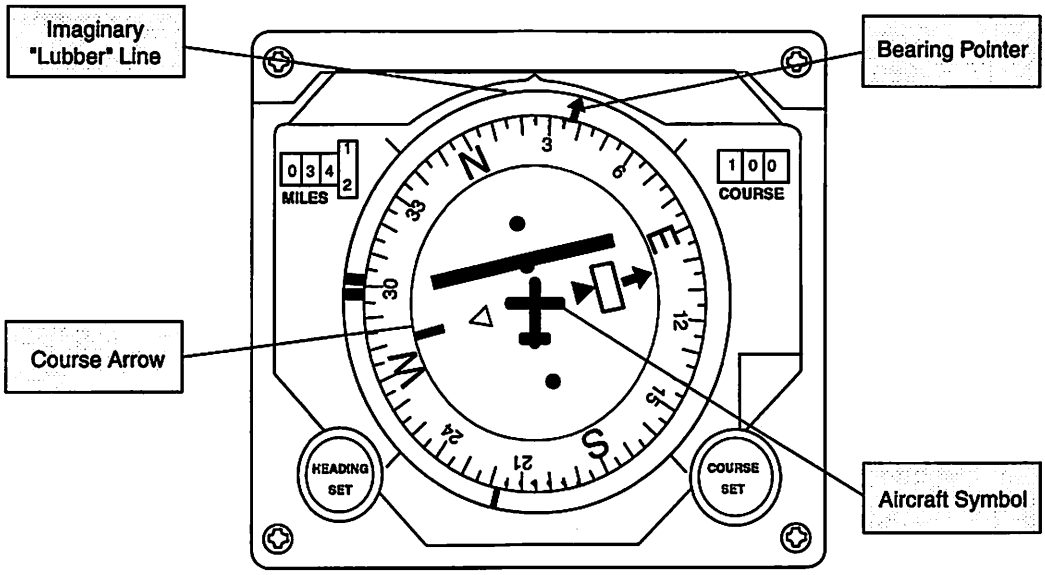


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Figure 33: HSI

Aircraft Heading –
Can be determined by viewing the top center portion of the HSI. The HSI compass card is oriented to either magnetic or true north. The HSI in Fig. 33 shows the aircraft is on a heading of 025°.

Bearing Pointer –
Shows the direction to a selected NAVAID based on aircraft heading. The pointer in Fig. 33 is about 038°, or 13° to the right of aircraft heading.

Course Arrow –
The course arrow will point to the direction dialed up by the Course Set knob. The course will also be displayed in the Course Selector Window. Fig. 33 shows a desired course of 100°.

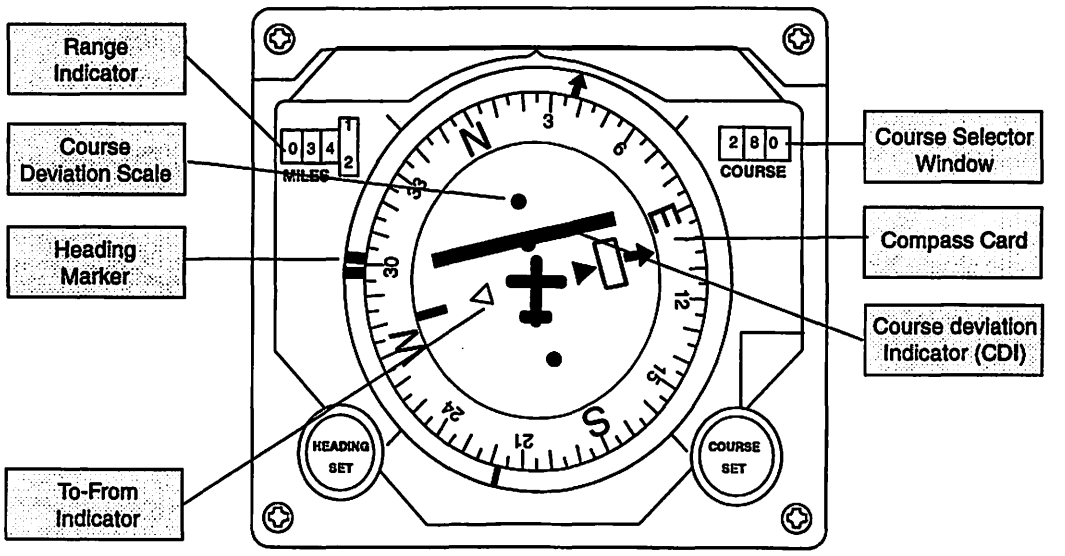

Figure 34: HSI

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Course Deviation Indicator (CDI) –
The CDI is similar to a steering bar and displays deviation from a selected course. The CDI will center up with the course arrow when the aircraft is on the selected course. If the steering bar is to the right of the course arrow the aircraft is left of course, and should steer right to the desired course. If the CDI is left of the course arrow, the aircraft is right of course and must steer left.

Course Deviation Scale –
A series of dots perpendicular to the course arrow which show deviation left or right of the selected course. Each dot represents a specific number of degrees off course, depending on the type of approach flown.

Heading Marker –
The heading marker is a movable index controlled by the Heading Set knob, and is used to visually aid the pilots in aligning the aircraft to a selected heading. As the aircraft turns, the HSI compass card will rotate with the heading marker. The pilot stops turning when the heading marker is at the 12 o'clock position.

Range Indicator –
Will display distance to or from a TACAN station when TACAN is selected.

TO-FROM Indicator –
A triangle shaped indicator that shows if the course selected, when intercepted, will take you to or away from a NAVAID (VOR, TACAN, VORTAC). If the indicator is pointing to the head of the course arrow, the selected course will take you to the NAVAID. If the indicator is pointing to the tail of the course arrow, the selected course will take you away from the NAVAID. NOTE: The TO-FROM indicator is inoperative when flying an ILS or Localizer course.

Exercise 2

Using the approach plate in Fig. 35 and the instrument indications in Fig. 36, answer the following questions pertaining to the aircraft position in relation to the navigational facility.

1. The aircraft is currently on a magnetic heading of_____.

   A. 140°
   B. 315°
   C. 135°
   D. 340°

2. The aircraft current position is indicated by which airplane symbol?

   A. A
   B. B
   C. C
   D. D

3. Assuming the aircraft maintains its current magnetic heading, it will be flying _____ the station.

   A. TO
   B. FROM
   C. Parallel
   D. Perpendicular

4. The aircraft is flying on the _____radial off the March Channel 77 (RIV).

   A. 135
   B. 315
   C. 160
   D. 340

5. In this situation, the aircraft is positioned on the _____course.

   A. 315/inbound
   B. 135/outbound
   C. 315/outbound
   D. 135/inbound

6. Where is/are the approximate location of the selected navigational aid?

   A. 9 nautical miles away.
   B. About 13° to the right of aircraft heading.
   C. On a course of 315°.
   D. Both A and B are correct.

7. Assuming the aircraft maintains its current heading, the black TO-FROM indicator shows that it will be flying _____the station.

   A. TO
   B. FROM

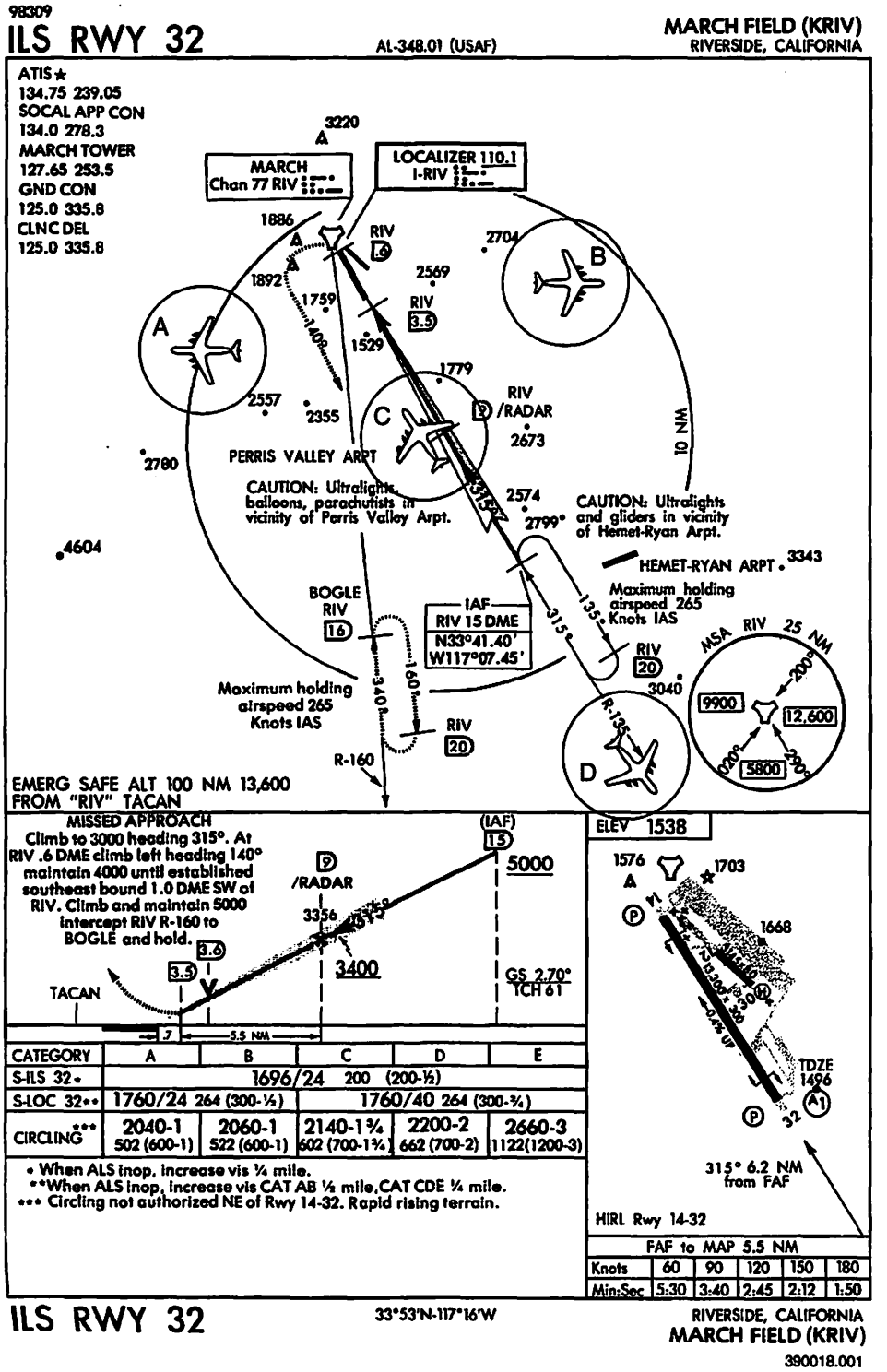
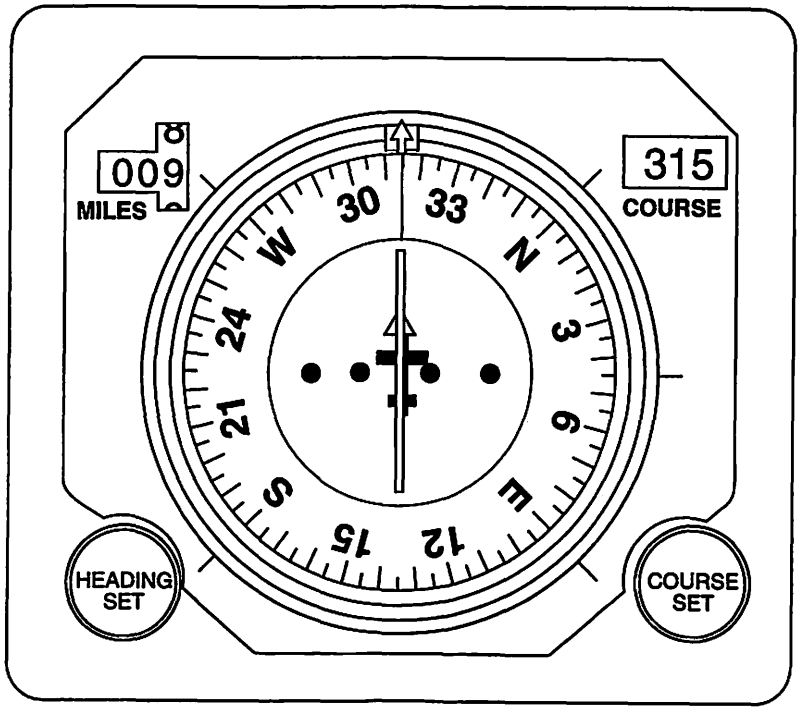


Figure 35: Approach Plate



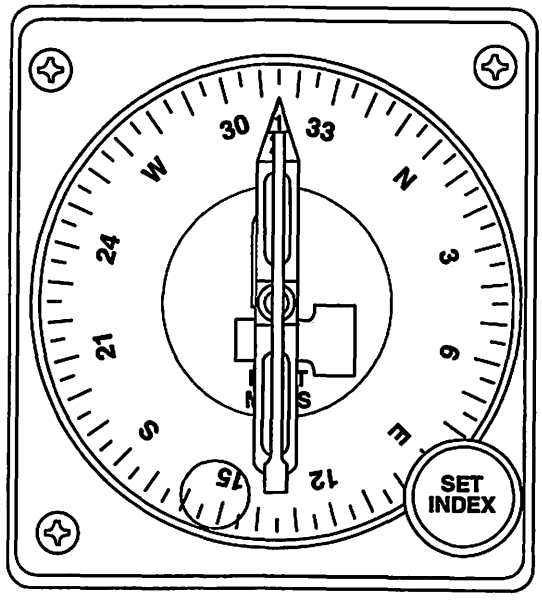


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Figure 36: Instrument Indications

Exercise 2 Answer Key

1. B. 315°
2. C. C
3. A. TO
4. A. 135
5. A. 315/Inbound
6. A 9 nautical miles away
7. A. TO

NOTES

CHAPTER 3: DEPARTURE AND TERMINAL ARRIVAL

DEPARTURE

Standard Instrument Departure

If the climbout procedure to be used is a Standard Instrument Departure (SID), the routing will be depicted on a plate very similar to an Instrument Approach plan view. A text of the Departure Route Description is also published on the plate. Refer to the departure plate, Fig. 37.

Assuming a takeoff from runway 32, the routing involves an initial left turn to track 155°, which puts the aircraft on an intercept heading to the 130° radial (130° course FROM the Paradise VORTAC). At 41 DME from the Paradise VORTAC, on the 130° radial, the aircraft will be at the SKYES intersection. Usually, clearance for a SID will also include TRANSITION routing. The depicted departure has three published TRANSITIONS: THERMAL, OCEANSIDE, and JULIAN. If, for instance, the pilot was cleared for the depicted departure, THERMAL TRANSITION, the departure routing would include a left turn off the 130° course from Paradise to intercept the 057° course, (R-237) to Thermal VORTAC.

Once you have found your SID, compare it with the approach chart and departure procedures for your airfield. There may be obstructions on the approach plate which may not be so apparent on the SID and vice-versa.

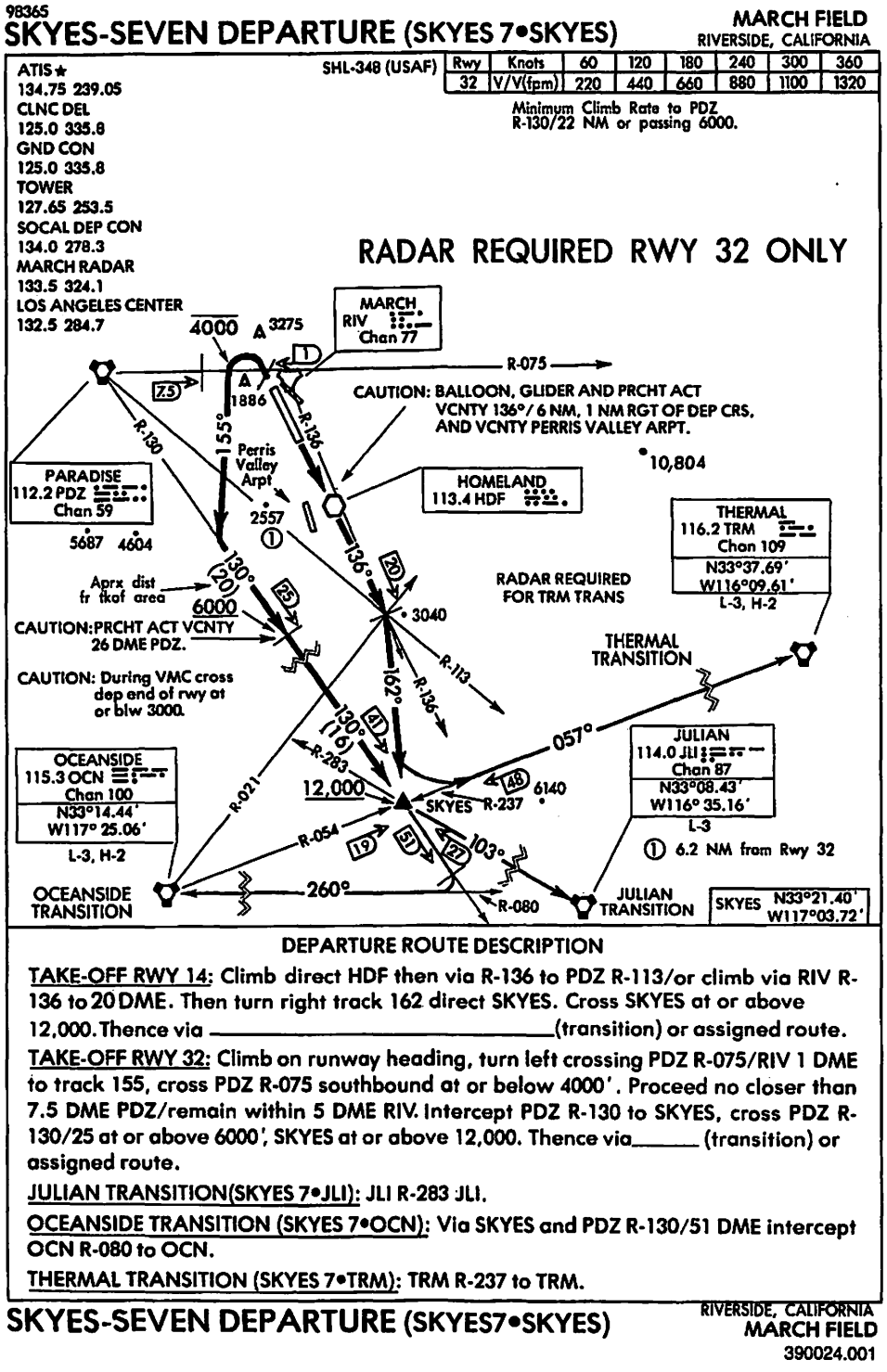


Figure 37: SID

Departure Planning

When departing from any airfield, pilots, navigators, and flight engineers must ensure they have exhausted all possible sources of information regarding obstacles that may exist in the departure area.

Told data computations are often started by the engineers well before the pilots show at the aircraft. The following sources will provide departure planning and obstacle information:

HQ AMC Airlift Suitability and Restrictions Report (ASRR)
Flight Information Publications (FLIP) Enroute supplement
Flight Information Publications (FLIP) Terminal (High or Low Altitude)
Base Operations
Other sources of information

HQ AMC Airfield Suitability and Restrictions Report (ASRR) –
A quarterly publication identifying potential airfield problems, airfield operating procedures, and restrictions to help promote a safe operating environment.

Typically, TOLD information concerning obstacles may be found under paragraph (d.) titled "Additional Information", sub-paragraph labeled "Obstacle Data". Obstacle heights and distance information are presented in chart form for airfields having obstacle data.

FLIP Enroute Supplement –
A DoD publication that contains general airfield information, flight data and procedures, and related aeronautical information for a specified location. Each listed airport contains runway information, communications, remarks, NAVAIDS, and ILS/Radar.

FLIP Terminal (High or Low Altitude) –
A world-wide regional set of DoD publications that depict airfield diagrams, instrument approaches, and departure procedures. Other specific information included are obstacle height and distance, minimum climb rates, ATC climb rates, and ATC altitude restrictions.

Base Operations –
Provides aircrews with the necessary information for safely planning all arrivals and departures. The following services should be used to assist pilots, navigators, and engineers with departures and obstacle data.

Notices To Airmen (NOTAMS) or Air Advisories (AIRADs) provide a computerized and regularly updated information service concerning specific airfield hazards or procedures not listed elsewhere.

Terrain charts for verifying obstacle and minimum climb rate computations. Chart Updating Manual (CHUM) is used to post changes to the terrain charts.

Other Sources –

Additional airfield information can be obtained from still a few other sources.

FAA Flight Service Station. Can be reached in the CONUS by dialing 1-800-WX-BRIEF. NOTAMS and a wide variety of weather forecasts are available.

The last source is the crewmembers visual inspection of the planned departure area. Obstacles such as ships in a harbor, or a newly erected structure off the end of the runway may not be depicted in other sources.

TERMINAL ARRIVAL

Feeder Facilities/Published Routings

On approach plates, routings are provided from enroute or feeder facilities from the enroute structure to the Initial Approach Fix (IAF) but may take the aircraft to a point other than the IAF if operational circumstances require. The fix or point is sometimes identified by the radial and distance from a specified NAVAID. In the case of feeder facilities, the point-to-point has been computed for the pilot so that simply proceeding along the depicted radial (Course **from** the NAVAID), for the depicted distance, the aircraft will arrive over the desired fix, or point.

From the previous block of discussion we learned to determine a position from the HSI, BDHI, and DME presentations. When the aircraft is established on a feeder course, you can use the HSI, BDHI, and DME to monitor the aircraft position as it proceeds to the desired fix. Remember that the tail of the bearing pointer is the aircraft position FROM the NAVAID. When you read the number under the tail of the bearing pointer, you are reading the present radial from the facility. When the aircraft is established on course outbound from the station, this radial should be very nearly the same as the aircraft heading.

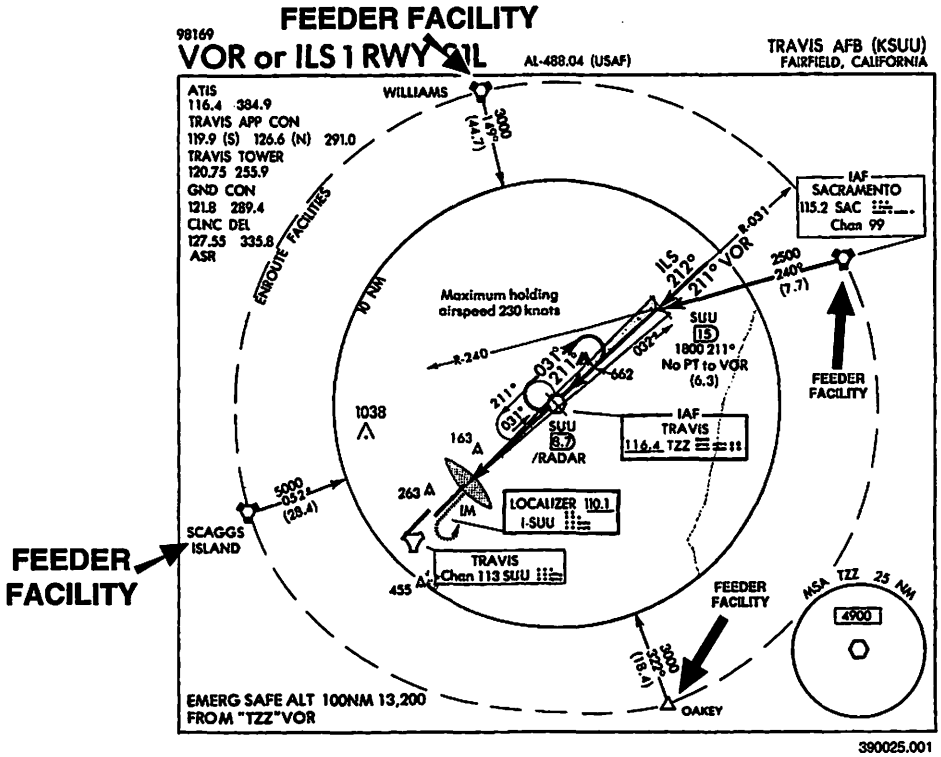


Figure 38: Feeder Facilities

Standard Terminal Arrivals (STARS)

Standard Terminal Arrivals (STARS) provide transition from the enroute structure to an outer fix, Initial Approach Fix, or arrival waypoint in the terminal area. A STAR will normally have a common reference point from which the arrival procedure originates.

Altitudes associated with STAR routing should be treated as minimum enroute altitudes. CONUS STARS are contained in a DoD FLIP document that includes departure and profile descent procedures along with STAR information.

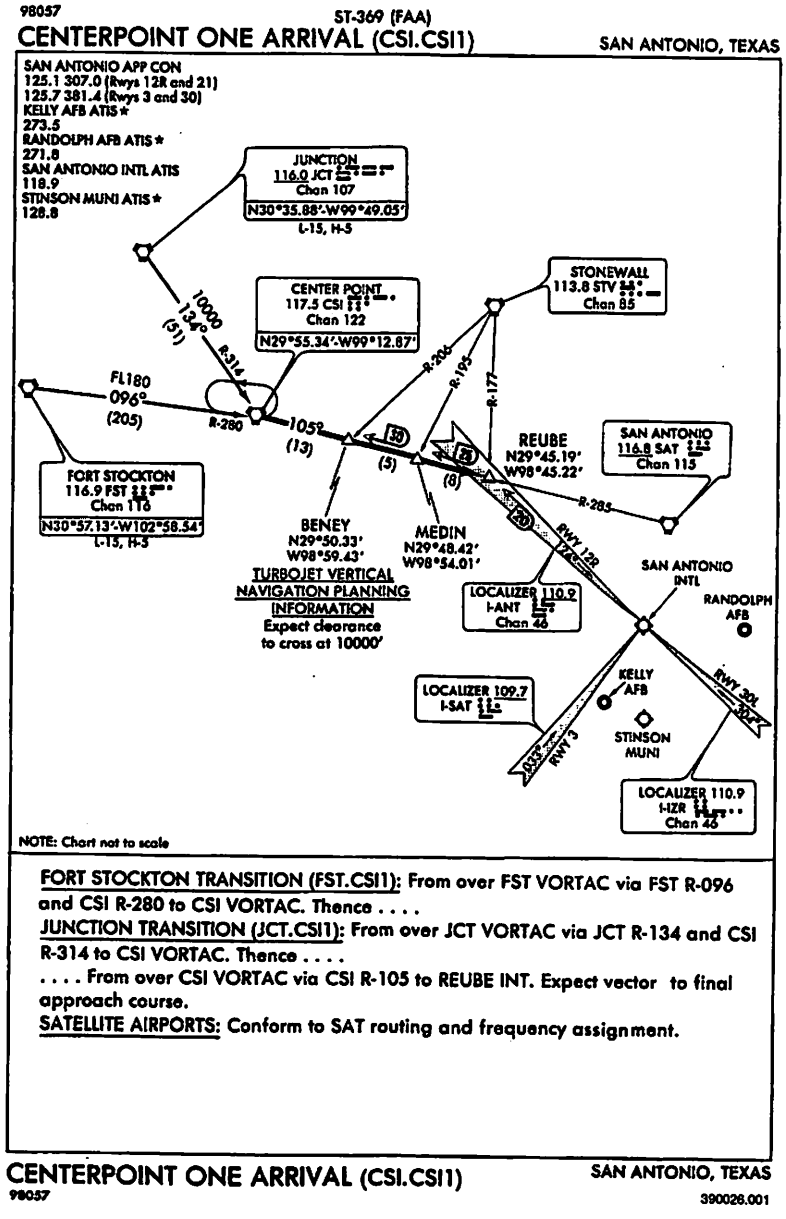


Figure 39: STAR

Exercise 3

Use the departure plate in Fig. 40 to answer the following questions pertaining to a Standard Instrument Departure.

1. The departure for runway 32 requires a left turn upon crossing the

   A. Paradise VORTAC Radial 075/RIV I DME.
   B. Paradise VORTAC Radial 133.
   C. Paradise VORTAC Radial 130/RIV 5 DME.
   D. Paradise VORTAC Radial 130/RIV 25 DME.

2. Once the left turn is completed, you must cross the same radial southbound at an altitude at or below _____ feet.

   A. 3,000 ft
   B. 4,000 ft
   C. 5,000 ft
   D. 12,000 ft

3. When crossing the Paradise Radial 130/25 you should be at or above

   A. 3,000 ft
   B. 4,000 ft
   C. 6,000 ft
   D. 12,000 ft

4. Passing the SKYES intersection, what is the mag course for the THERMAL TRANSITION?

   A. 057
   B. 130
   C. 021
   D. 075

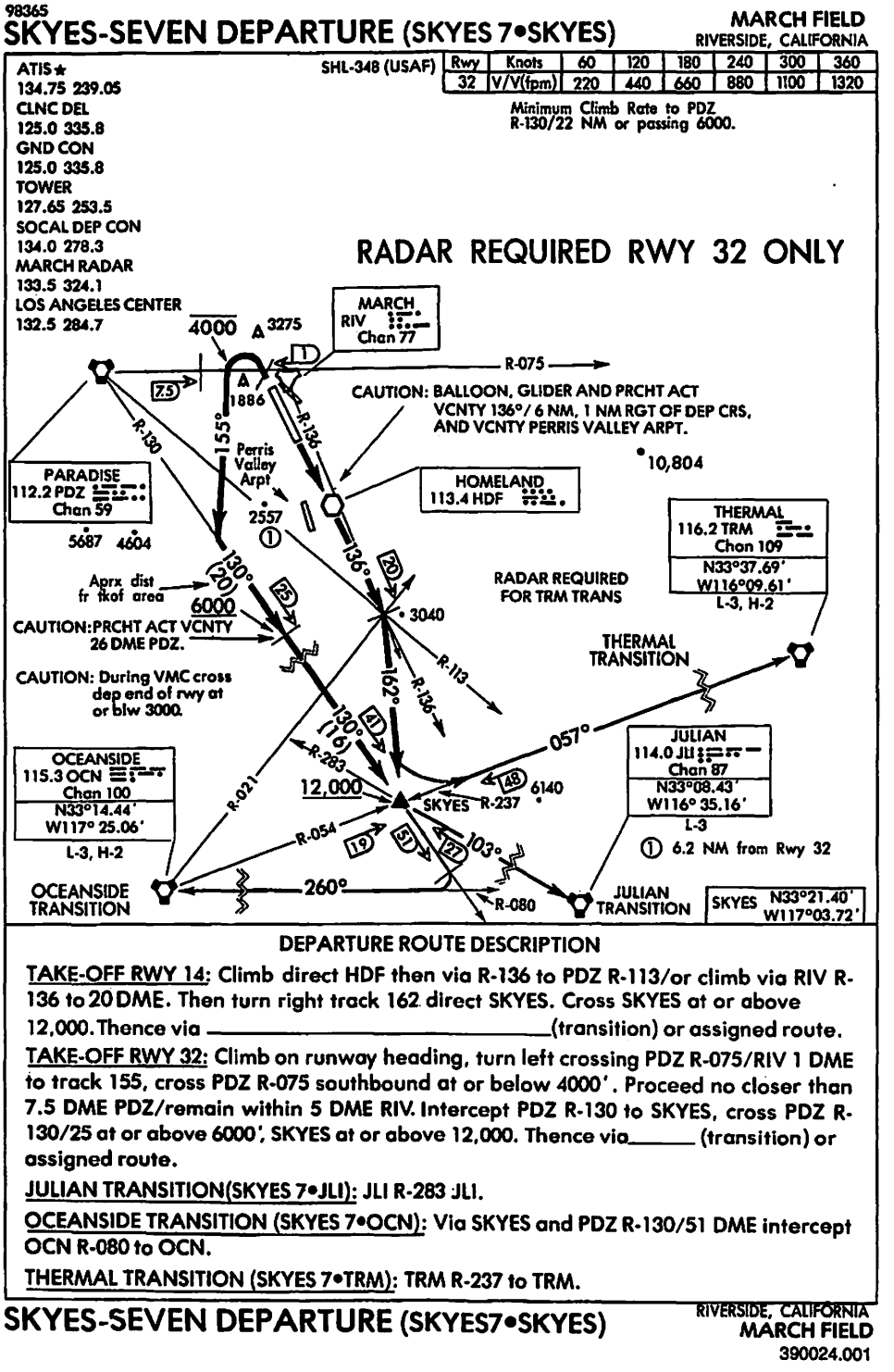


Figure 40: SID

Use Fig. 41 to answer the following questions.

5. Approaching Altus AFB from the Wichita Falls VORTAC to intercept the Altus IAF (OKKIE), what is the outbound radial from the feeder facility?

   A. R-352
   B. R-301
   C. R-173
   D. R-072

6. What is the recommended altitude outbound from the Childress VORTAC to the Altus AFB IAF (OKKIE)?

   A. 3,300 ft
   B. 3,600 ft
   C. 4,900 ft
   D. 4,000 ft

7. What is the intercept distance from the Hobart VORTAC to the Altus AFB IAF (OKKIE)?

   A. 45 NM
   B. 25 NM
   C. 51 NM
   D. 36 NM

8. What is the radial outbound from Altus AFB to the MARTHA holding fix?

   A. R-171
   B. R-173
   C. R-351
   D. R-353

9. The altitudes associated with the ILS RWY 35 are considered

   A. Minimum Altitudes
   B. Maximum Altitudes
   C. Mandatory Altitudes
   D. Recommended Altitudes

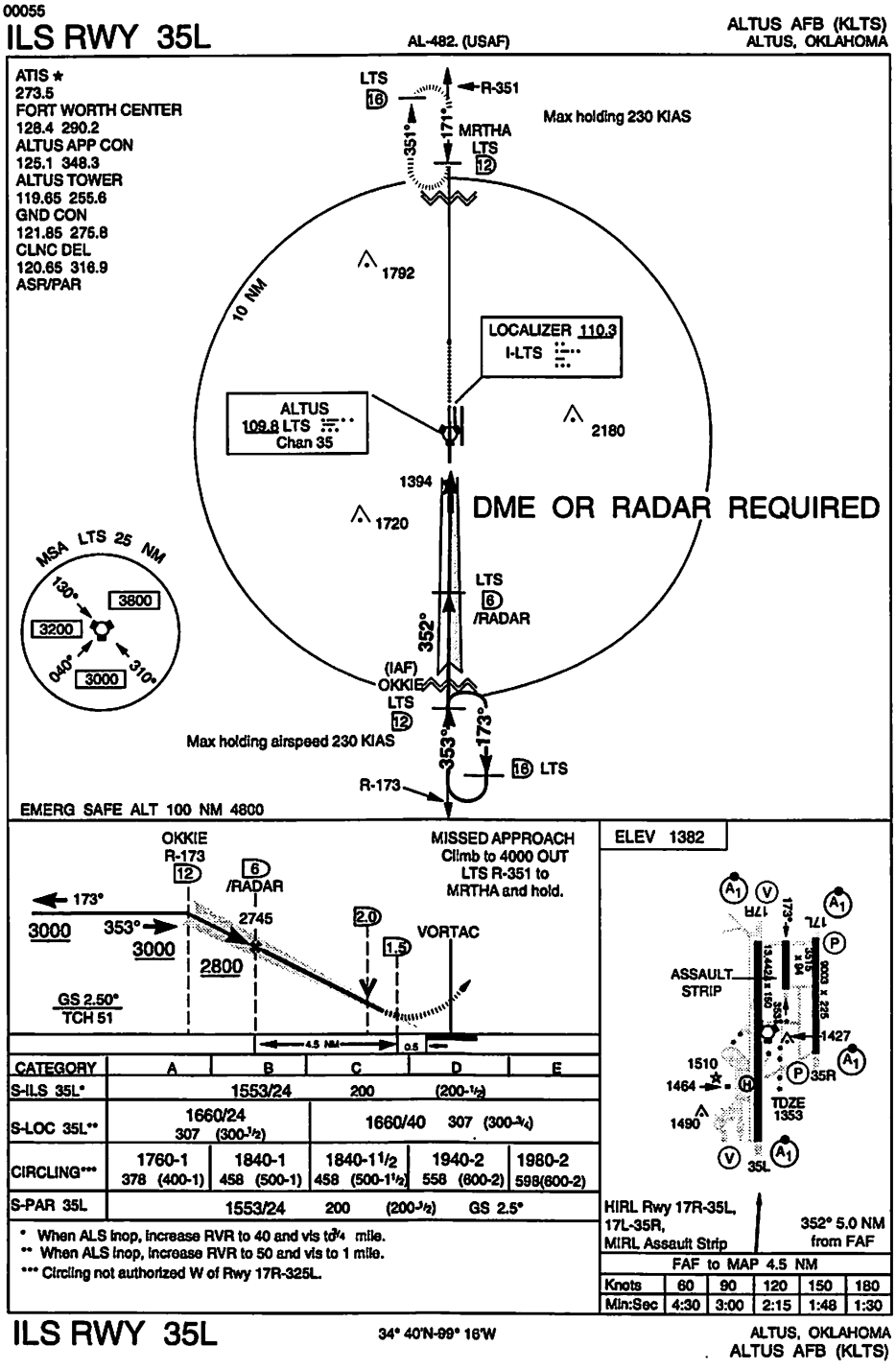


Figure 41: Approach Plate

Exercise 3 Answer Key

Part 1

1. A. Paradise VORTAC Radial 075/RIV 1 DME
2. B. 4,000 ft
3. C. 6,000 ft
4. A. 057

Part 2

5. B. R-301
6. A. 3,300 ft
7. B. 25 NM
8. D. 353°
9. A. Minimum Altitudes

NOTES

CHAPTER 4: INSTRUMENT APPROACHES

Approaching the destination, the pilot will choose an appropriate instrument procedure for the descent and landing.

A Radar Approach consists of radar monitoring and vectors to a final landing. Radar vectors to final consist of being given magnetic headings to fly to a point where vectoring is discontinued. The aircraft is then expected to continue on its own guidance and instruments to a final landing.

NOTE: The BDHI always displays magnetic heading. The HSI displays true heading when INS is selected (True or Magnetic on FMS/GPS equipped aircraft) and magnetic when TACAN or VOR are selected. Be sure you are looking at magnetic and **NOT** true headings when being radar vectored.

Without radar monitoring or vectors, the pilot can, with the appropriate navigation equipment, complete an entire approach as published in the approach plate booklet. There are some exceptions to this as when an approach procedure states RADAR REQUIRED in the plan view.

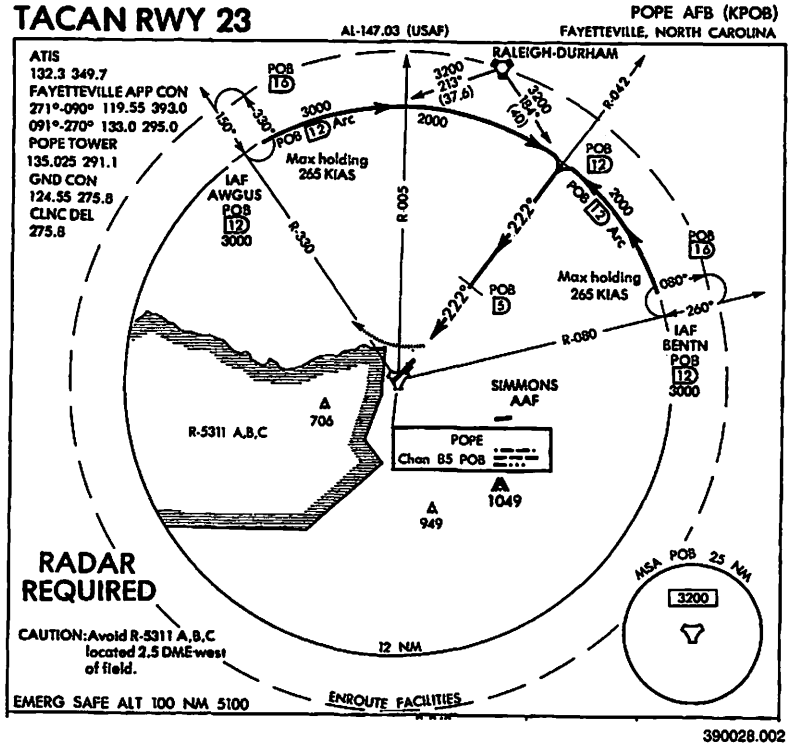


Figure 42: Instrument Approaches

Approach plates are contained in two separate booklets; High Altitude and Low Altitude.

High Altitude Books –
Distinguished by the black and white hash marks on the booklet's cover, back and spine, and cover region (i. e., Southwest, Northeast). High altitude books also contain the military SIDs for each area. This type of approach is called a penetration. They are not commonly flown, but can be used to land at a given field.

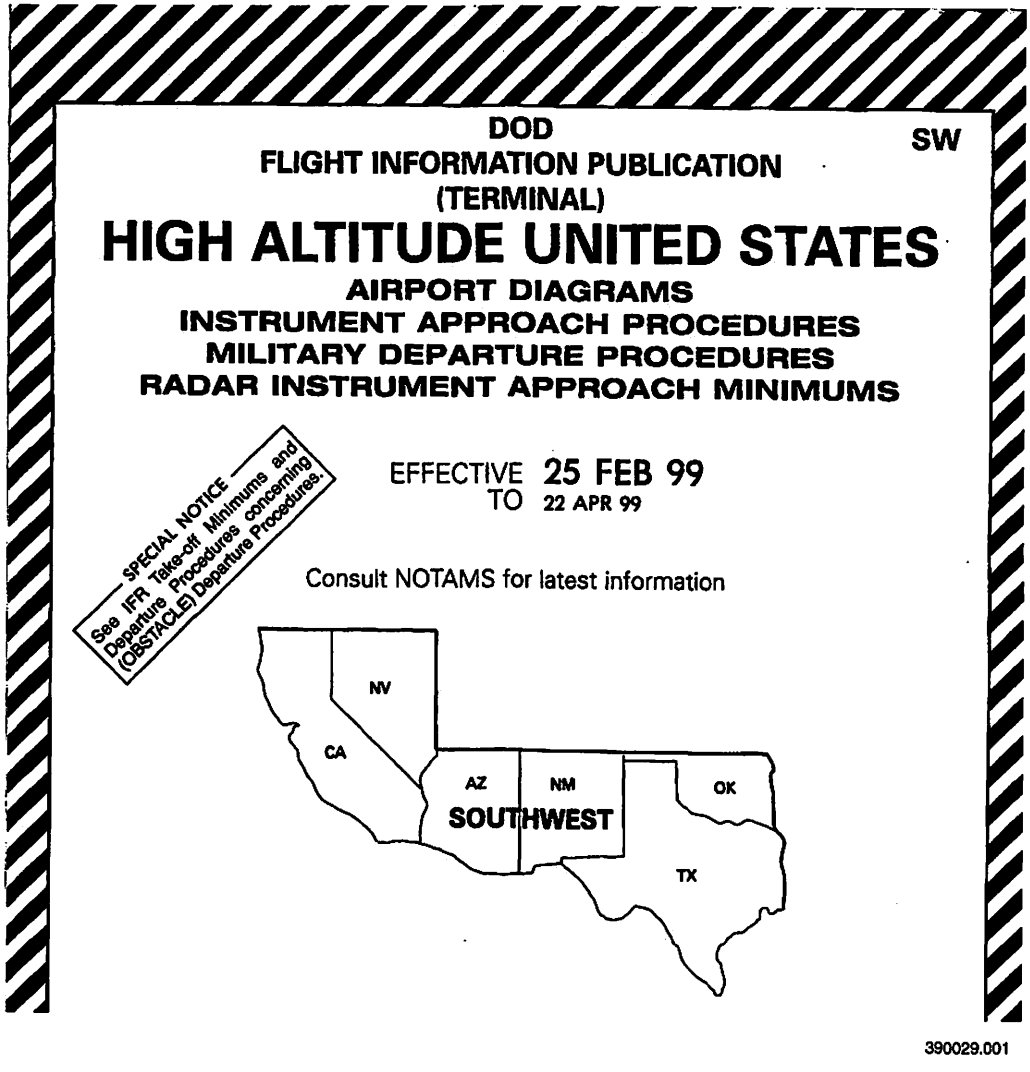


Figure 43: High Altitude FLIP

Low Altitude Books –
Cover groupings of states (CONUS); can also include airfield SIDs.

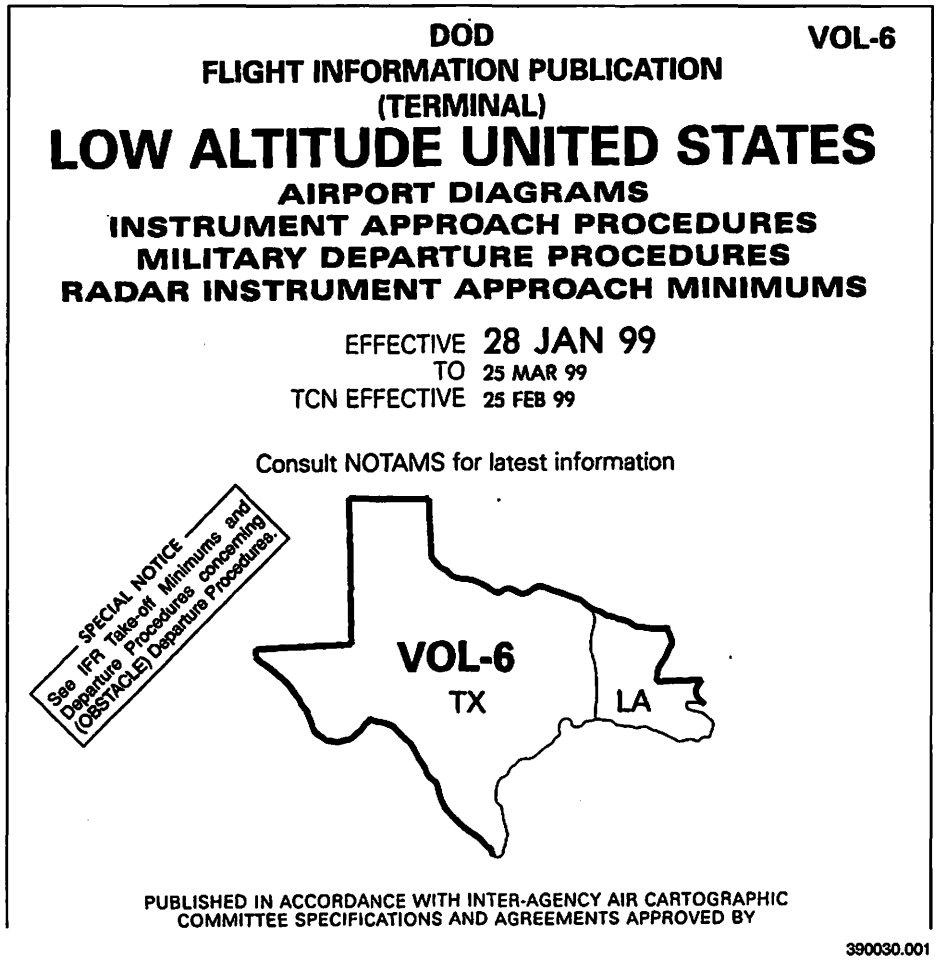


Figure 44: Low Altitude FLIP

Contained within approach booklets are the different types of procedures to get an aircraft to the landing runway. What follows are a very basic list and descriptions of the various types of instrument approaches contained in their respective booklets.

High Penetrations –

Contained within the High Altitude Book. Enables an aircraft to transition from the high altitude structure to a position on and aligned with an inbound course to the Final Approach Fix. These approaches can employ radials, arcs, courses, turns, fly-off restrictions, etc

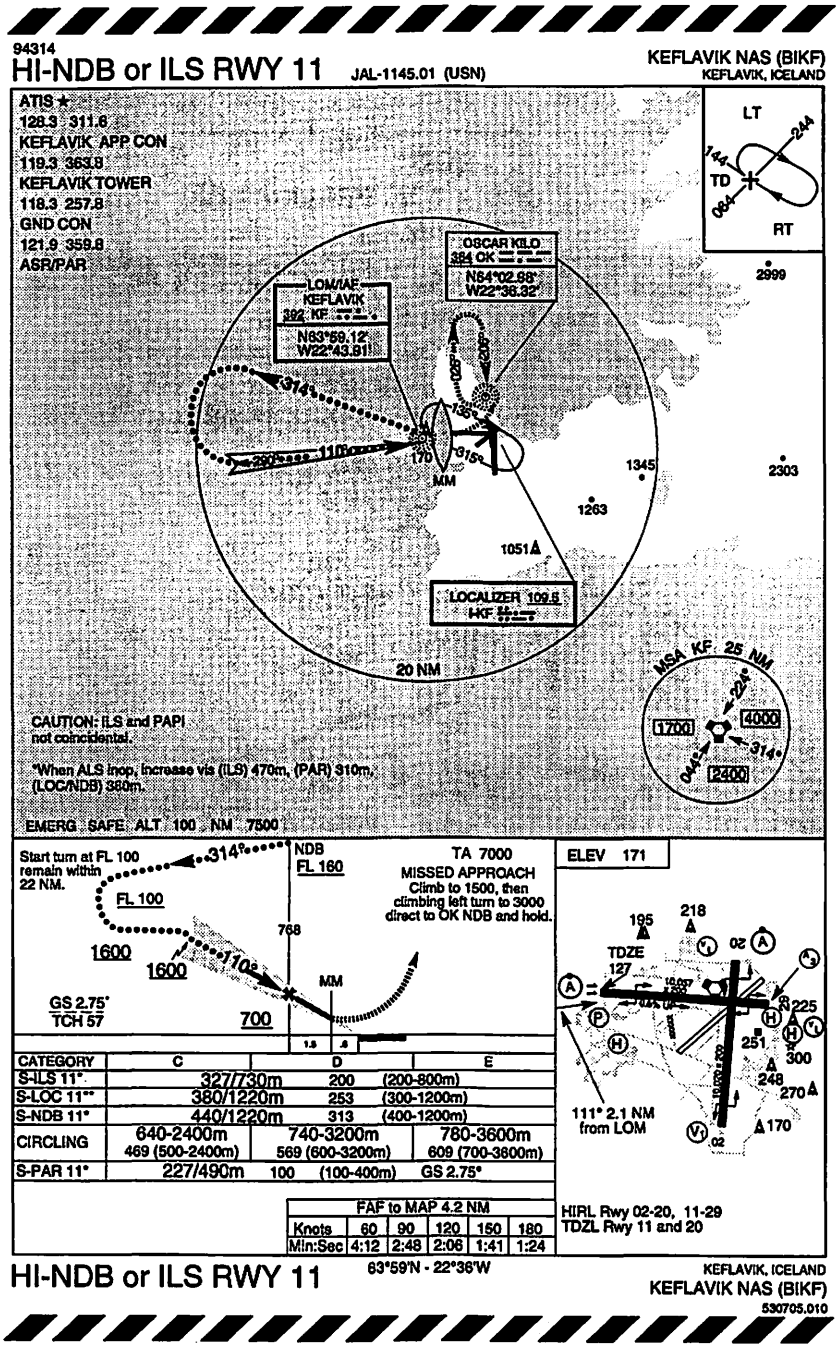


Figure 45: High Penetration

Procedure Turns –

Depicted in the plan view with a barb (↗); the barb indicates the maneuvering side of the final approach course.

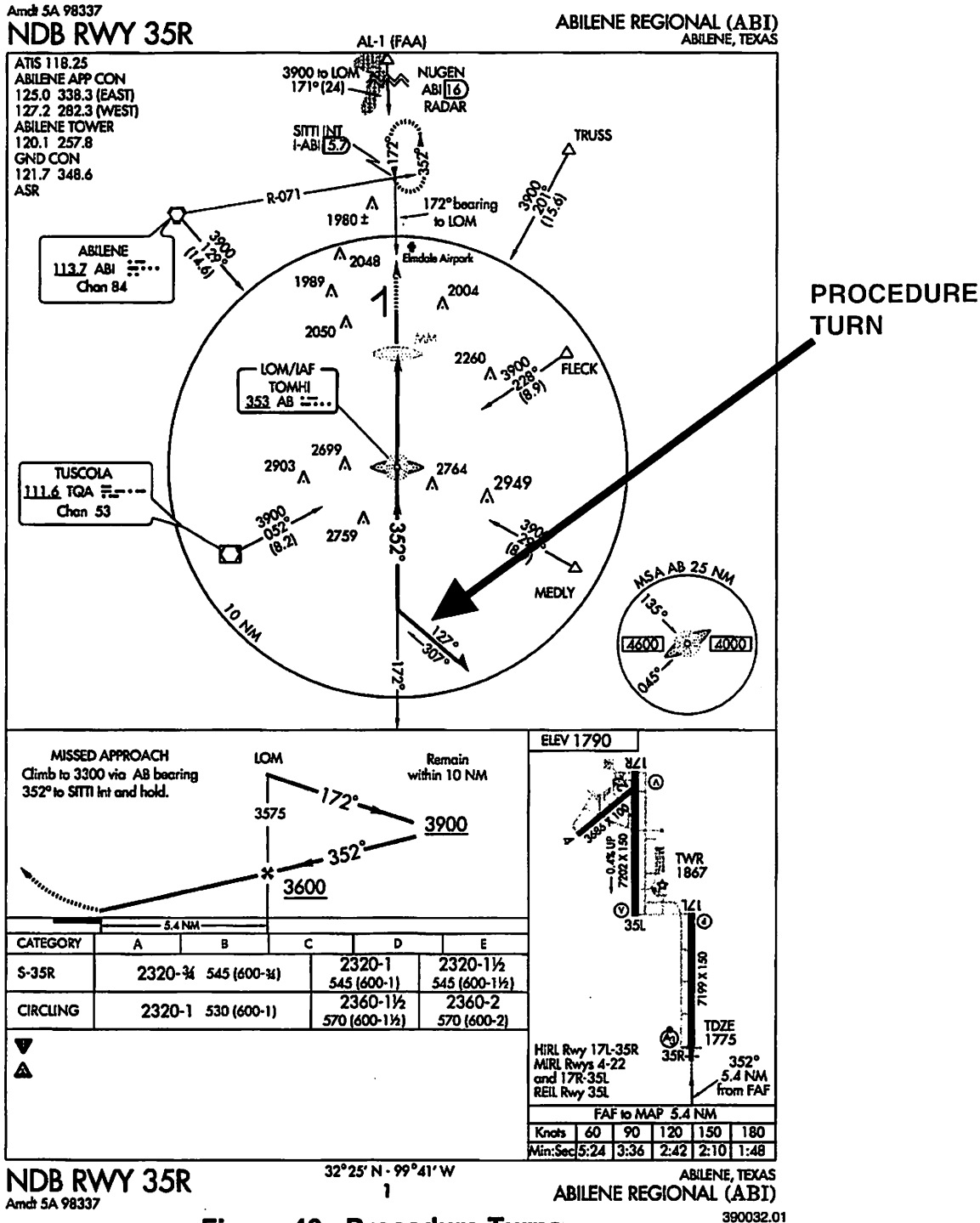


Figure 46: Procedure Turns

Holding Patterns (in Lieu of Procedure Turn) –

Depicted as a heavy line in the plan view; descent is usually accomplished in the specified holding pattern.

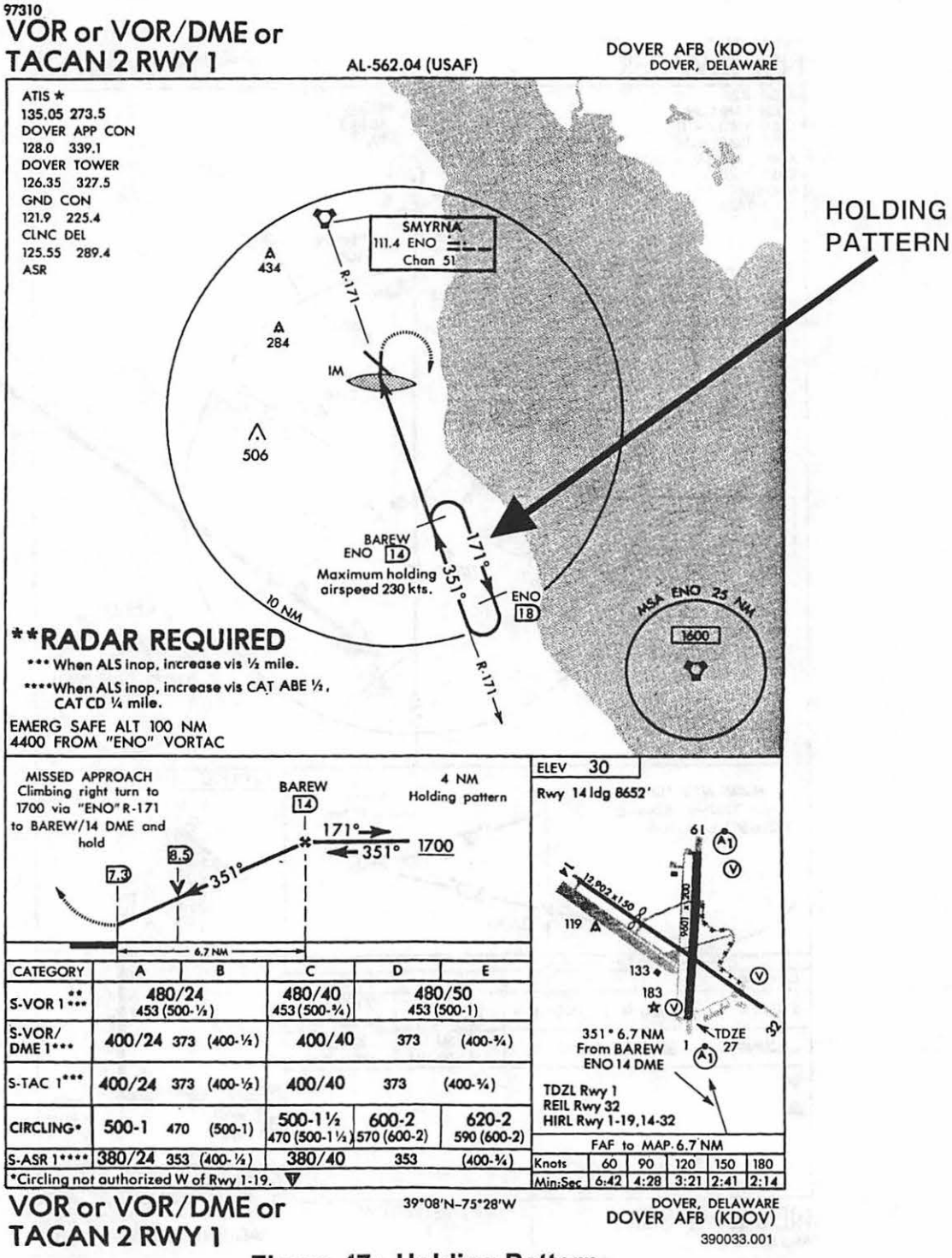


Figure 47: Holding Pattern

Procedure Tracks –

Similar to the Penetration, it may use any combination of arc, radials, etc to align the aircraft with final approach. Procedure tracks are shown as a heavy line with directional arrows.

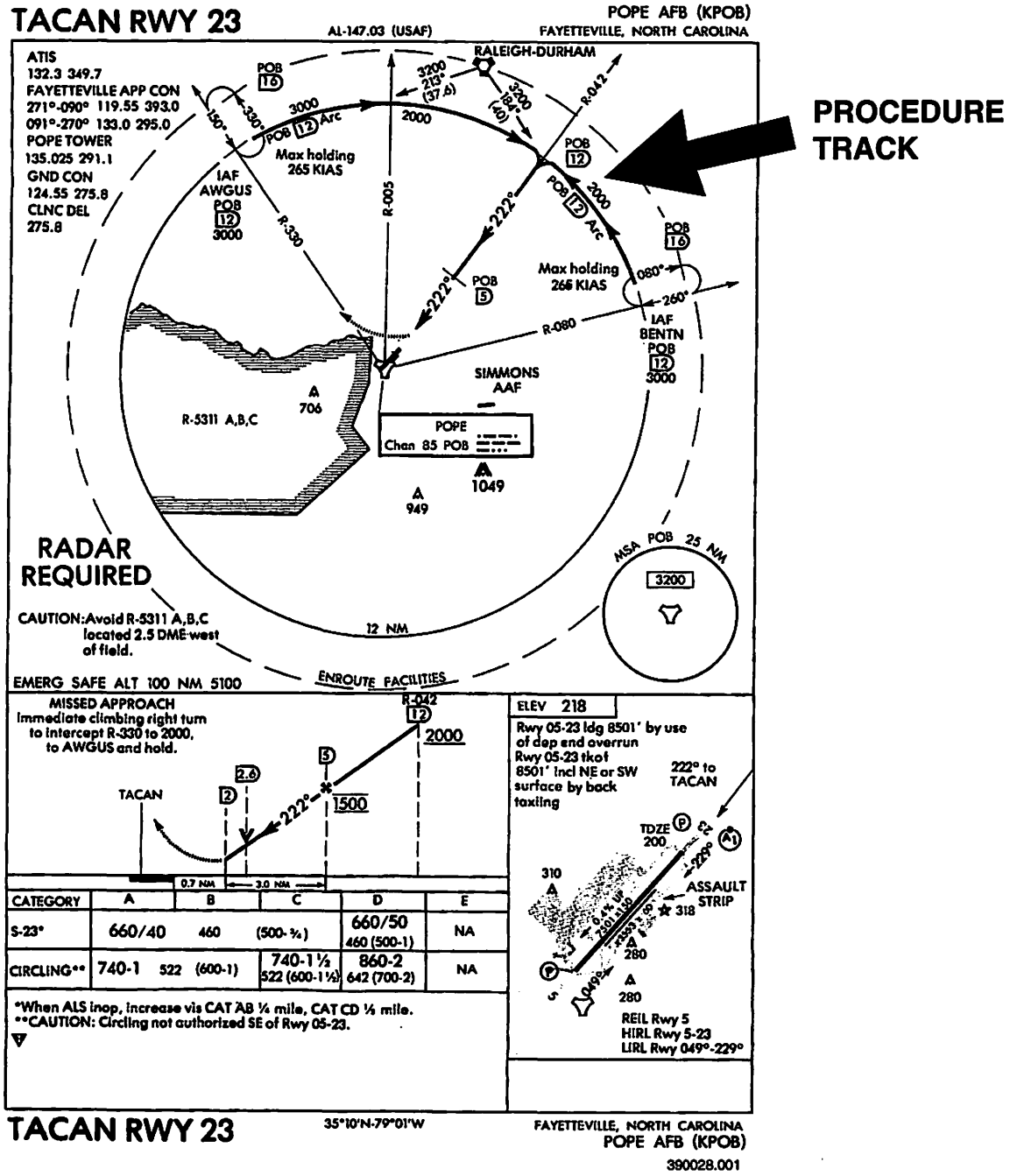


Figure 48: Procedure Tracks

Exercise 4

Match the instrument approaches in Fig. 49 and 50 with their proper category/name listed below (example A. 2.)

1. Procedure Turn

2. Holding Pattern in Lieu of Procedure Turn

3. Procedure Track

4. High Penetration

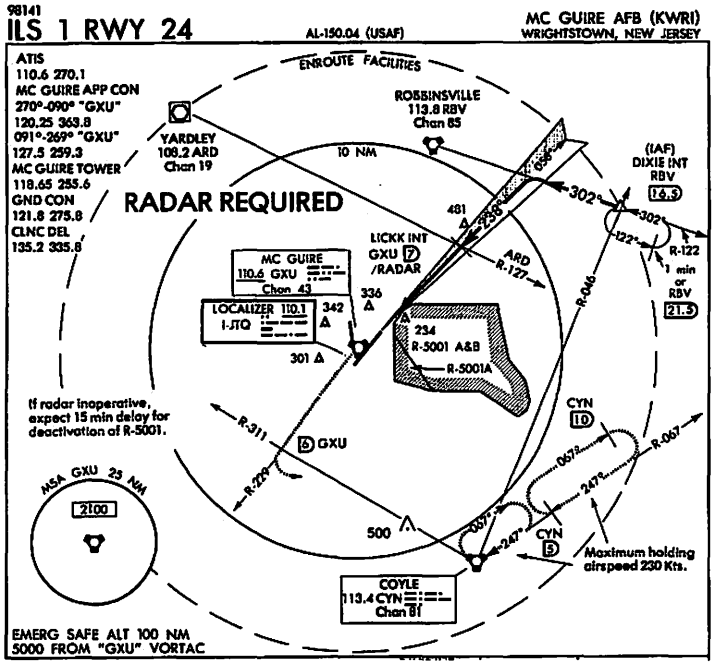
A.

B.

C.

D.

A.



B.

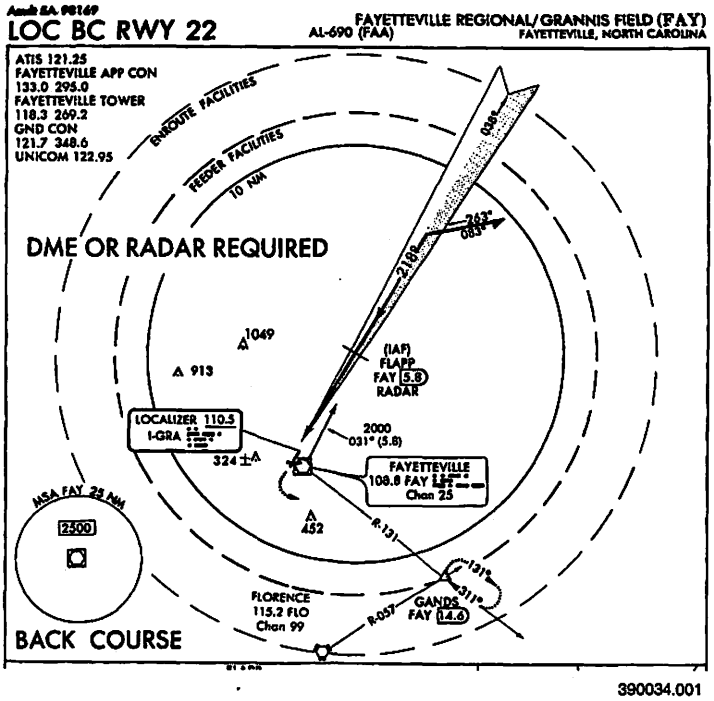


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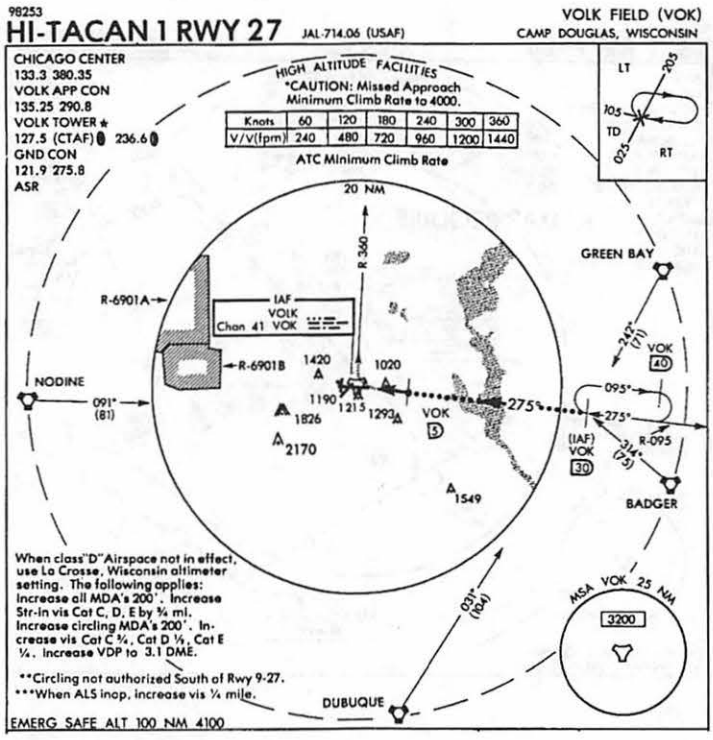
Figure 49: Instrument Approaches

C.



D.

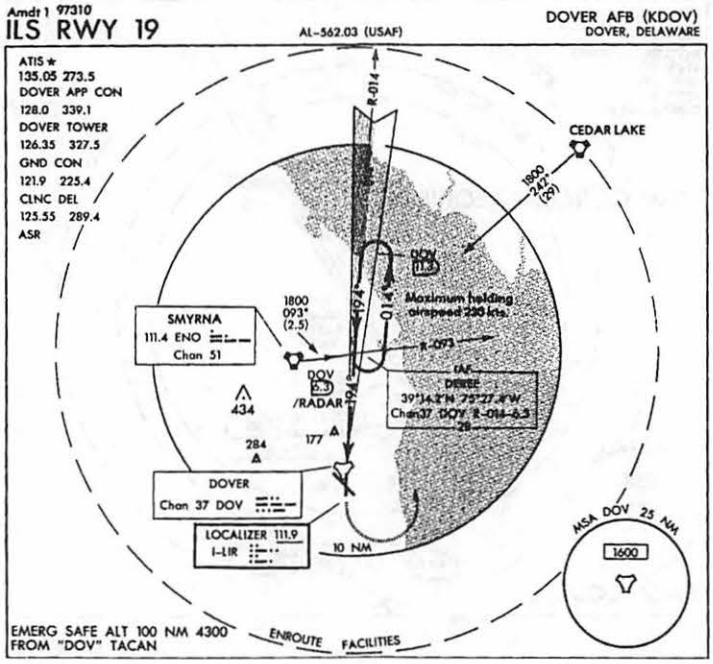


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Figure 50: Instrument Approaches

Exercise 4 Answer Key

A. 3 (Procedure Track)

B. 1 (Procedure Turn)

C. 4 (High Penetration)

D. 2 (Holding Pattern In Lieu of Procedure Turn)

NOTES

CHAPTER 5: INITIAL APPROACH FIX TO FINAL APPROACH FIX

Initial Approach Fix (IAF)

Before the pilot can safely descend below specified altitudes, the aircraft must have clearance and/or be established on a published segment of the approach. The approach must obviously begin at some point, and continue to either a successful landing or missed approach. One possible exception to this is when the pilot has been given vectors and clearance to intercept the final approach course and proceed with the approach. When the controller has issued a clearance to fly the full approach, the pilot must maneuver the aircraft to begin the letdown from a designated starting point or Initial Approach Fix (IAF) in Fig. 51. IAFs are most often a named point defined as a radial and DME. However, the IAF could be a NAVAID. There may be more than one IAF available for an approach as illustrated below.

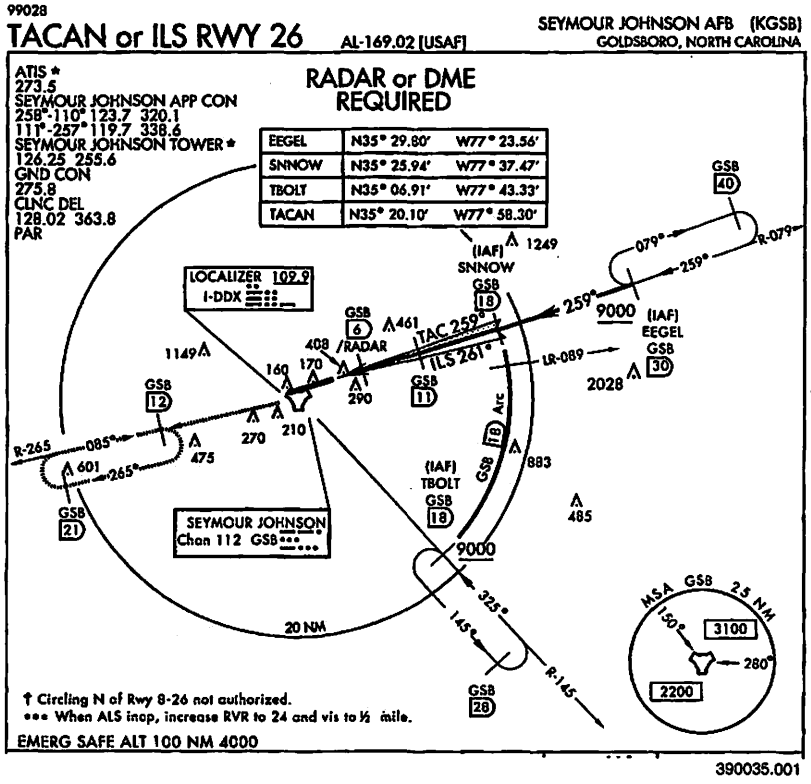

Figure 51. Initial Approach Fix

From this point on, the pilot is guaranteed adequate terrain and obstruction clearance as long as the aircraft is maneuvered on the depicted track and maintains depicted altitude restrictions.

Descent Procedures

The pilot will brief the approach, including the altitude at which the aircraft will depart the IAF and, as appropriate, restrictions to the descent as the aircraft proceeds to the FAF. The entire crew should be particularly interested in these altitude restrictions because as the aircraft descends along the approach corridor, the crew may be going below the Emergency Safe and Minimum Safe Altitudes for the area. Failure to observe and comply with altitude restrictions or deviations off course could have serious consequences.

As you look at a variety of approaches you will note four different types of altitudes depicted. Looking at the legend in the front of the booklet, we see that the definitions for these altitude depictions are as follows:

ALTITUDES

5,500	2,300	4,800	2,200
Mandatory Altitude	Minimum Altitude	Maximum Altitude	Recommended Altitude
Must be at This altitude	Do not Descend below this altitude	Do not be above this altitude	Altitude best suited for this approach

Figure 52: Altitudes

You may not recognize any of these altitude definitions from your pilot's briefing. This is because few pilots will use the terminology used in the legend. More commonly you will hear terms like "step down". "no lower than 2,300", no higher than 4,800", and "hard altitude 5,500".

The ideal situation for any instrument approach is to arrive at a position perfectly aligned with the final approach course with sufficient distance from the FAF for establishing proper configuration and stable speed. In today's radar controlled environment this apparently idyllic situation is actually the norm. Why then, do we need these intricate and confusing procedures for accomplishing an instrument letdown? The obvious reason is, for the time when radar service is not available or practical. The wide variety of letdown procedures all have points in common; they allow for safe descent from cruise altitude to approach altitude; they provide information about the airport environment to assist the pilot in transitioning from instrument to visual

conditions; they provide instructions for returning to safe flying conditions if a landing cannot be made (missed approach). This portion of the course will specifically address the phase of the approach which begins at the IAF and ends at the FAF or glide slope intercept point.

Since any instrument approach considers three dimensions, we must also be aware of any specific altitude requirements associated with the IAF. Generally, altitude at the IAF will be minimum altitudes. Occasionally, you will see an approach with a Maximum or Mandatory altitude at the IAF. In any event, the pilot bears responsibility for adhering to any altitude restrictions and determining the suitability of an altitude for the approach to be flown. Refer to Fig. 53, the TACAN approach below. Note that the CELLA IAF has an associated altitude of 3,000 ft. This of course, means that the aircraft must be at or above 3,000 MSL before proceeding past the CELLA IAF inbound on the approach.

Once overhead CELLA, the aircraft can continue its descent to the next altitude restriction; this being at 2,000 feet at JODDY/6.5 DME.

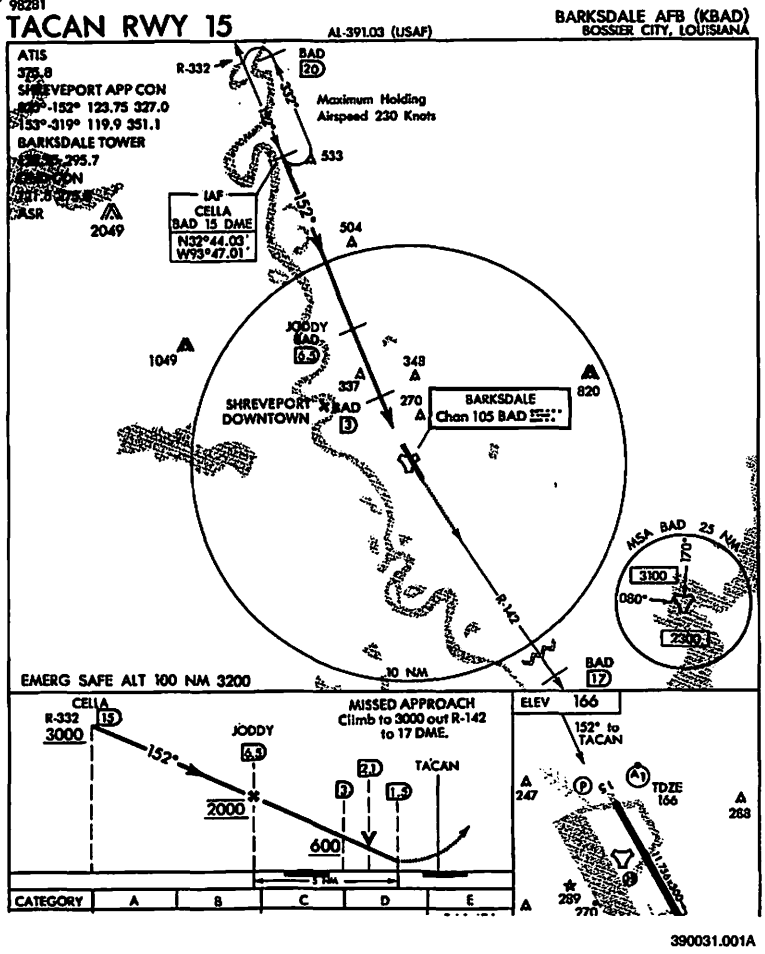

Figure 53: Altitude Depictions

Exercise 5

Use the approach plate in Fig. 54 to answer the following questions:

1. The published altitude at the IAF (CELLA) for this approach is a

   A. Maximum altitude
   B. Mandatory altitude
   C. Minimum altitude
   D. Recommended altitude

2. The published altitude at the Final Approach Fix (JODDY) is a

   A. Maximum altitude
   B. Mandatory altitude
   C. Minimum altitude
   D. Recommended altitude

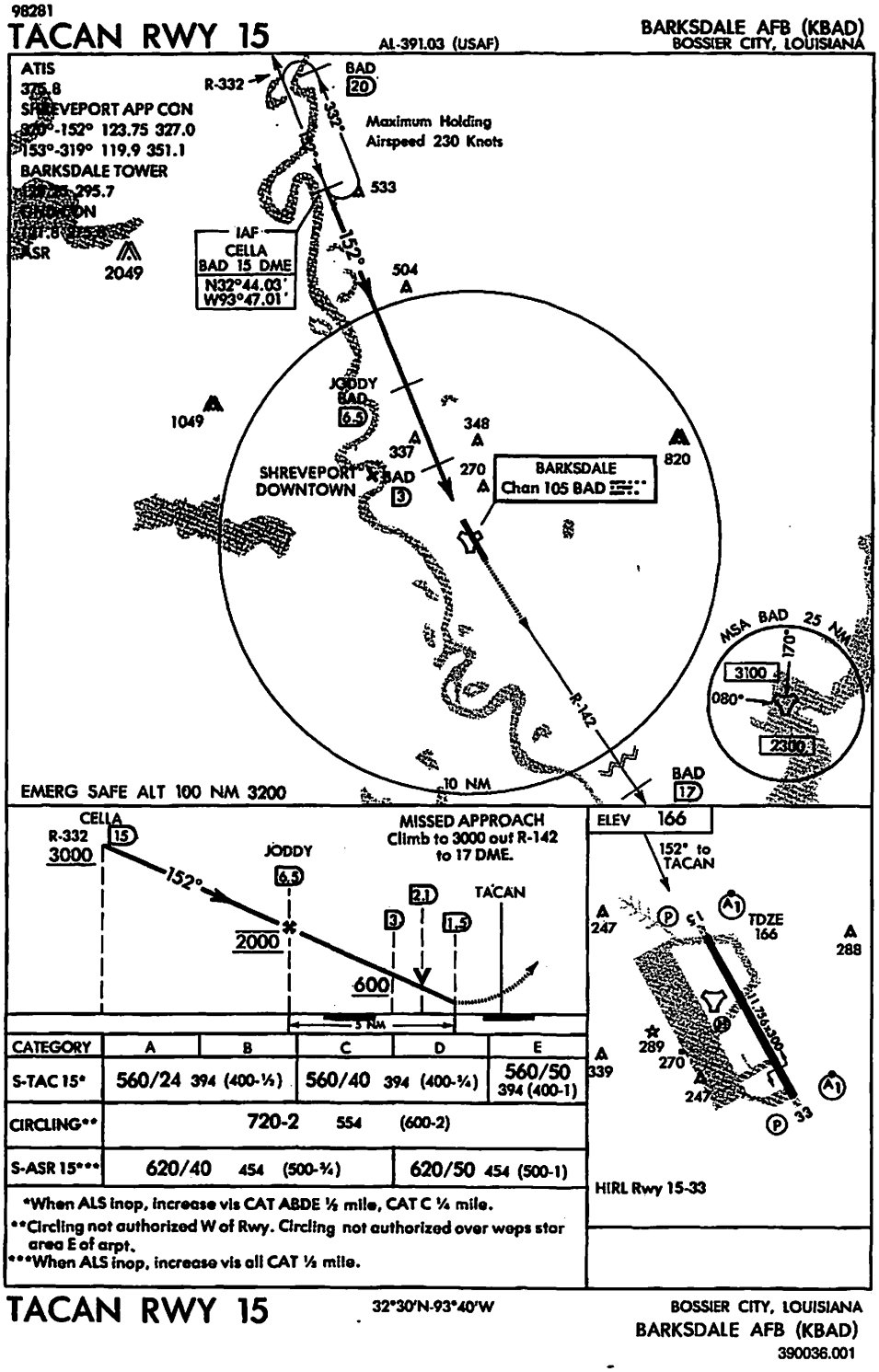

Figure 54: Approach Plate

Exercise 5 Answer Key

1. C
2. B

NOTES

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CHAPTER 6: FINAL APPROACH

Precision and Non-Precision Approaches

When discussing Instrument Procedures on final approach, it is important to distinguish between a Precision or Non-Precision Approach.

Precision Approach (ILS, PAR) –
Provides alignment with runway centerline as well as precise vertical guidance. Precision approaches are associated with Glide Slope Intercept (GSI) and Decision Height (DH).

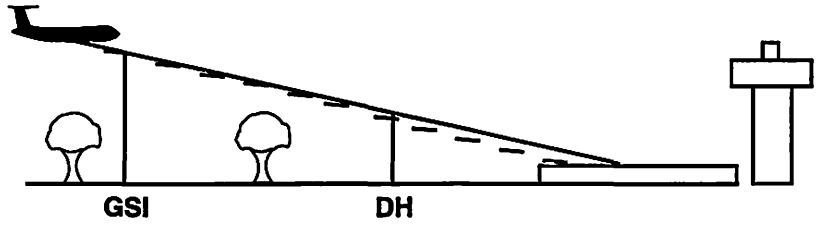

Figure 55: Precision Approach

Non-Precision Approach (LOC, TAC, ASR, etc) –
Provides alignment with runway centerline only; no vertical guidance is provided. The terms Final Approach Fix (FAF), Visual Descent Point (VDP), Minimum Descent Altitude (MDA), and Missed Approach Point (MAP), are associated with non-precision approaches.

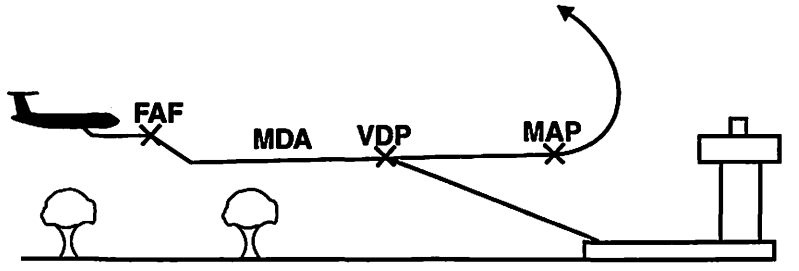

Figure 56: Non-Precision Approach

Visual Descent Point

During review of the approach plate for a non-precision approach, if it is possible for the pilots to determine the distances to the runway, and if necessary, calculate a Visual Descent Point (VDP). Though only the pilots will be able to actually establish the visual glide slope at this point, other crew members can at least "back up" the pilots. A Visual Approach Slope Indicator (VASI) lighting system is normally available at locations where VDPs are established. Where VASI is installed, the VDP and VASI glide paths are normally aligned. Not all approaches have a published VDP, even though DME may be available for determining distance to the runway. At these times the pilot may compute the VDP based on a three degree glide slope. The missed approach point will always be located past the VDP; however, the possibility of a successful approach and landing can be severely in doubt if the runway has not been acquired visually at the VDP. The VDP is depicted on the profile view as a bold **V**.

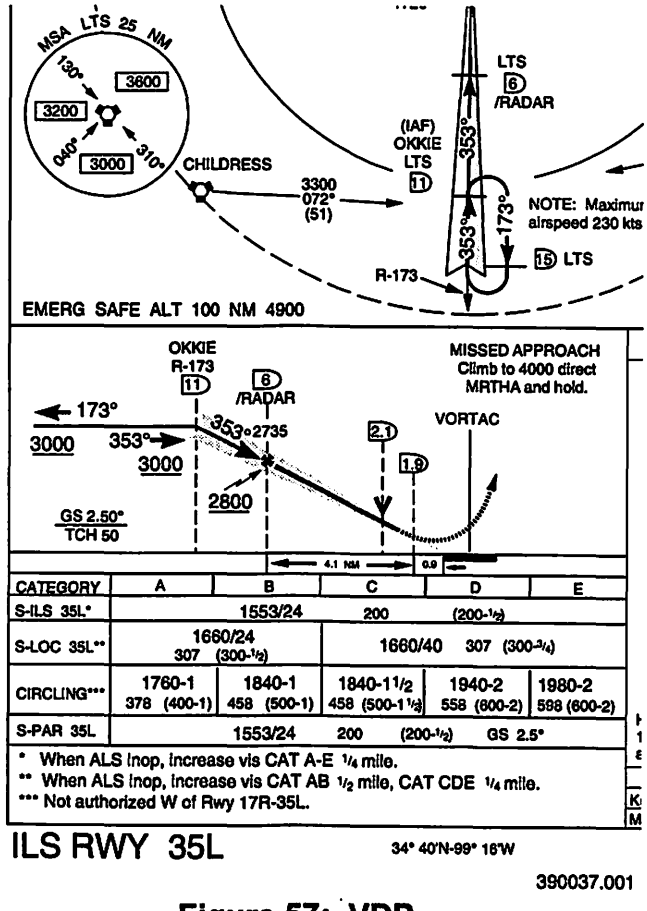

Figure 57: VDP

Circling Approaches

Sometimes the only available approach to an airfield or specific runway may be via a Circling Approach (see Fig. 58). Keep in mind that circling is a visual maneuver. An instrument approach is completed to put the aircraft in a position where the pilot can "take over" and land by visual references. Approaches identified by a suffix (i. e., A, B, etc) following the approach name, are circling only approaches.

Circling approaches may also be compatible with non-precision straight-in approaches, but require both the visibility and ceiling to be at or above the circling block minimums for the approach.

Circling approach minima are briefed and flown for a runway that the approach is flown to: it may not necessarily be on the runway intended for landing. Also, circling minimums tend to be higher than other approach minimums.

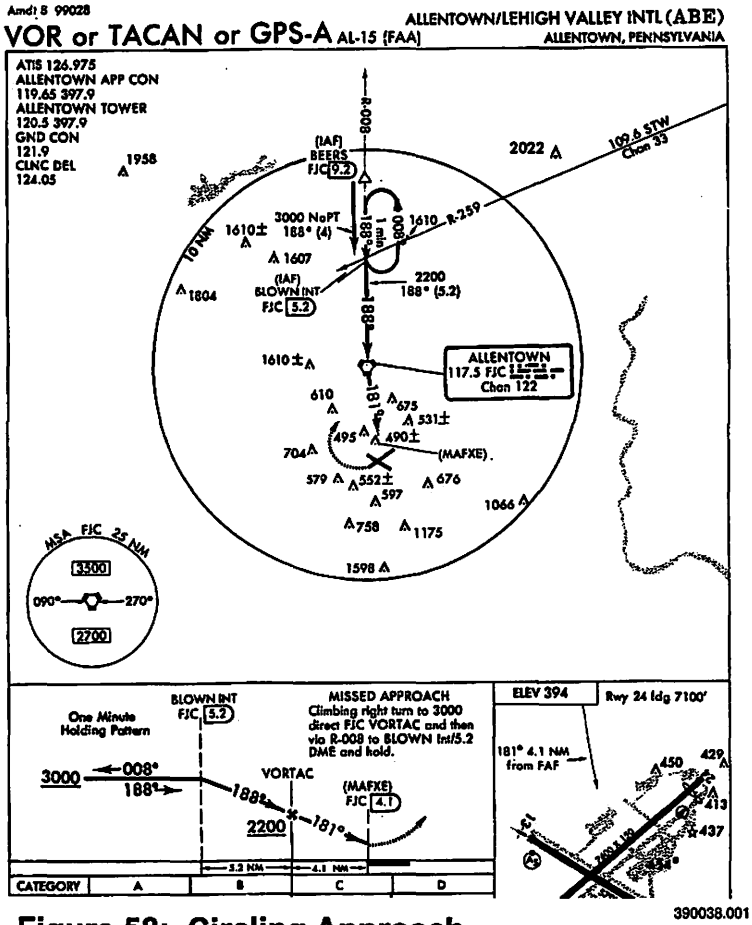

Figure 58: Circling Approach

Missed Approach

The final discussion concerns identifying the Missed Approach Point (MAP) and accomplishing the procedure.

The Missed Approach Point is the final point on an instrument procedure where the decision is made to either land or go around. It is defined as the Decision Height (DH) for a precision approach, or a published MAP for a non-precision approach.

To accurately determine the MAP for a non-precision approach, compare the distance from the FAF to the MAP adjacent to the timing block. The timing block is dependent upon the aircraft's approach ground speed from the FAF to the MAP. Although the missed approach procedure is depicted in both the profile and plan views, do not rely solely on the graphical representation. Compare the timing, DME, and distances depicted to accurately determine the MAP. Accomplish the published missed approach procedure from the MAP, **NOT BEFORE OR AFTER**. Obstacle clearance is based on beginning the maneuver directly at the missed approach point.

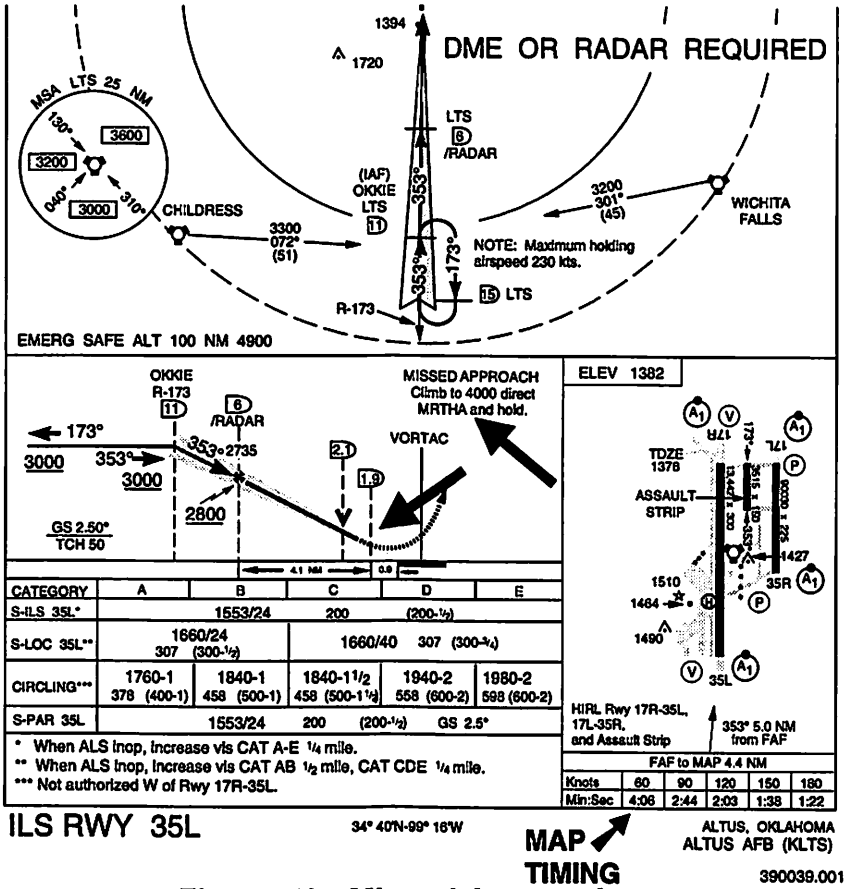

Figure 59: Missed Approach

Exercise 6

1. The major difference between a Precision and Non-Precision approach is

   A. horizontal guidance
   B. distance information
   C. vertical guidance
   D. missed approach procedures

2. Circling approaches require _____ to be at or above circling block minimums for the approach.

   A. ceiling and visibility
   B. ceiling and RVR
   C. visibility only
   D. ceiling only

3. The final point during an instrument approach where a decision must be made to land or go around is defined as _____ for a precision approach and the published _____ for a non-precision approach.

   A. DH/MAP
   B. DH/VDP
   C. MDA/DH
   D. MDA/VDP

4. The missed approach timing block is based on the aircraft _____ from the FAF to the MAP.

   A. Approach Indicated Airspeed
   B. Approach True Airspeed
   C. Approach Ground Speed
   D. Published MAP Timing

5. To assure obstacle clearance, the missed approach procedure should be accomplished

   A. before reaching the MAP
   B. after passing the MAP
   C. at the MAP
   D. at the pilot's discretion

Exercise 6 Answer Key

1. C. vertical guidance
2. A. ceiling and visibility
3. A. DH/MAP
4. C. Approach Ground Speed
5. C. at the MAP

Final Thoughts

This handout contains only a fraction of the complex subject of Terminal Instrument Procedures and operations. For a more in-depth review, there are a number of sources available. These include AFMAN 11-217V1, DoD Flight Information Publications (FLIPs), Terminal and enroute), and your squadron Stan/Eval or Instructor Pilots.

In conclusion, remember that you are flying together as a crew. Your situational awareness and general knowledge of instrument procedures will do you no good if you are hesitant to apply them when the situation dictates.

BE AWARE, SPEAK UP, and FLY SAFE.

A: GENERAL INFORMATION AND ABBREVIATIONS

GENERAL INFORMATION & ABBREVIATIONS

★ Indicates control tower or ATIS operates non-continuously, or non-standard Pilot Controlled Lighting.
x Indicates frequency is unmonitored and available on request through the controlling agency.
Distances in nautical miles (except visibility which may be statute miles or meters and Runway Visual Range which may be in hundreds of feet or meters).
Runway dimensions in feet. Elevations in feet Mean Sea Level (MSL). Ceilings in feet above airport elevation.
Radials/bearings/headings/courses are magnetic.
Coordinates are compatible with World Geodetic System (WGS)
# Indicates control tower temporarily closed UFN

ADF ..... Automatic Direction Finder
ALS ..... Approach Light System
APP CON ..... Approach Control
ARR ..... Arrival
ASLAR ..... Aircraft Surge Launch and Recovery
ASR/PAR ..... Published Radar Minimums at this Airport
ATIS ..... Automatic Terminal Information Service
BC ..... Back Course
C ..... Circling
CAT ..... Category
Chan. ..... Channel
CLINC DEL ..... clearance delivery
CTAF ..... Common Traffic Advisory Frequency
DECEL ..... Deceleration
DEP CON ..... Departure Control
DH ..... Decision Height
DME ..... Distance Measuring Equipment
DR ..... Dead Reckoning
DRAG ..... Wingman slowdown/separation point
ELEV ..... elevation
FAF ..... Final Approach Fix
FAS ..... Final Approach Speed
FL ..... Flight Level
FM ..... Fan Marker
GP ..... Glide Path
GS ..... Glide Slope
HAA ..... Height Above Airport
HAL ..... Height Above Landing
HAT ..... Height Above Touchdown
HIRL ..... High Intensity Runway Lights
IAF ..... Initial Approach Fix
ICAO ..... International Civil Aviation Organization
Intcp ..... Intercept
INT,INTXN ..... Intersection
KIAS ..... Knots Indicated Airspeed
LDA ..... Localizer Type Directional Aid
Ldg. ..... Landing
LDIN ..... Lead in Light System
LIRL ..... Low Intensity Runway Lights
LOC ..... Localizer
LR ..... Lead Radial Provides at least 2 NM (Copter 1 NM) of lead to assist in turning onto the intermediate/final course
M ..... Meters
MALS ..... Medium Intensity Approach Light System
MALSR ..... Medium Intensity Approach Light Systems with RAIL
MAP ..... Missed Approach Point
MDA ..... Minimum Descent Altitude
MIRL ..... Medium Intensity Runway Lights
MLS ..... Microwave Landing System
NA ..... Not Authorized
NDB ..... Non-directional Radio Beacon
NoPT ..... No Procedure Turn Required (Procedure Turn shall not be executed without ATC clearance)
NVG ..... Night Vision Goggles
ODALS ..... Omnidirectional Approach Light System
PAPI ..... Precision Approach Path Indicator
RA ..... Radio Altimeter setting height
Radar Required ..... Radio vectoring required for this approach
RAIL ..... Runway Alignment Indicator Lights
RBn ..... Radio Beacon
REIL ..... Runway End Indentifier Lights
RCLS ..... Runway Centerline Light System
RNAV ..... Area Navigation
RPI ..... Runway Point of Intercept(ion)
RRL ..... Runway Remaining Lights
Runway Touchdown Zone ..... First 3000' of Runway
RVR ..... Runway Visual Range
Rwy ..... Runway
S ..... Straight-in
SALS ..... Short Approach Light System
SSALR ..... Simplified Short Approach Light System with RAIL
SDF ..... Simplified Directional Facility
TA ..... Transtion Altitude
TAC ..... TACAN
TCH ..... Threshold Crossing Height (height in feet Above Ground Level)
TDZ ..... Touchdown Zone
TDZE ..... Touchdown Zone Elevation
TDZL ..... Touchdown Zone Lights
THRE ..... Threshold Elevation
TLv ..... Transition Level
VDP ..... Visual Descent Point
WPT ..... Waypoint (RNAV)

PILOT CONTROLLED AIRPORT LIGHTING SYSTEMS

Available pilot controlled lighting (PCL) systems are indicated as follows:
1. Approach lighting systems that bear a system identification are symbolized using negative symbology, e.g. (B), (V), (S),
2. Approach lighting systems that do not bear a system identification are indicated with a negative "(L)" beside the name.

A star (*) indicates non-standard PCL, consult Directory/Supplement, e.g., (B)*
To activate lights use frequency indicated in the communication section of the chart with a (L) or the appropriate lighting system indentification e.g., UNICOM 122.8 (L), (B) (V)

KEY MIKE	FUNCTION
7 times within 5 seconds	Highest intensity available
5 times within 5 seconds	Medium or lower intensity (Lower REIL or REIL-off)
3 times within 5 seconds	Lowest intensity available (Lower REIL or REIL-off)

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Appendix A