BY ORDER OF THE SECRETARY OF THE AIR FORCE	***AIR FORCE MANUAL 13-215, VOLUME 2***
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	AIRFIELD OPERATIONS CHARTS AND INSTRUMENT PROCEDURES SUPPORT

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This manual implements Air Force Policy Directive (AFPD) 13-2, *Air Traffic*, *Airfield*, *Airspace and Range Management*. It applies to all Regular Air Force, Air National Guard and Air Force Reserve (AFR) organizations. At joint, shared-use and overseas airfields, this manual applies to the facilities that are controlled and used exclusively by the Department of the Air Force, as outlined in real estate documents or letters of agreement. It defines procedures and responsibilities for constructing Air Traffic Control (ATC) Charts, Minimum Vectoring Altitude Charts (MVAC), Minimum Instrument Flight Rules Altitude Charts (MIFRAC), Low Altitude Alert Systems (LAAS), Diverse Vector Areas (DVA), Non- Radio Detection and Ranging (RADAR) boards for ATC RADARs, and manual Terminal Instrument Procedures (TERPS) calculations.

This manual may be supplemented at any level, however Major Command (MAJCOM) supplements to include interim changes to previously approved supplements must be routed to Headquarters (HQ) Air Force Flight Standards Agency, Director of Airfield Operations (HQ AFFSA/XA) for coordination prior to certification and approval. Unit (wing or base) level supplements to this manual must be routed to the responsible MAJCOM Office of Primary Responsibility for Airfield Operations for coordination prior to certification and approval. The authorities to waive wing/unit level requirements in this publication are identified with a Tier ("**T-0, T-1, T-2, T-3**") number following the compliance statement. See AFI 33-360, *Publications and Forms Management*, for a description of the authorities associated with the Tier numbers.

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SUMMARY OF CHANGES

This document has been substantially revised and needs to be completely reviewed. Major changes include: eliminates as many acronyms as possible; eliminates instrument procedure jargon; eliminates guidance duplicated in other governing directives or no longer required; moves attachments from AFMAN 11-230 (*formerly AFI*), *Instrument Procedures,* into the body of the AFMAN 13-215 V2, as appropriate, for better continuity; re-defines terms and processes and adds new terms for standardization and to increase clarity; adds guidance where necessary to keep up with rapidly changing instrument procedure criteria updates; aligns guidance format with governing Federal Aviation Administration (FAA) 8260-series orders wherever possible; defines waiver authority approval level for non-tiered compliance items; re-organizes guidance for better flow and increased standardization; updates tables, figures, and checklists to better define policy requirements; deletes references to outdated forms and updates data processing and automation tool guidance. A margin bar (|) indicates newly revised material.

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Chapter 1

OVERVIEW

1.1. Scope and Purpose of this Manual. This manual provides instructions, processes, and procedures to assist USAF Instrument Procedure Specialist (unit or MAJCOM) to carry out responsibilities IAW AFMAN (*formerly AFI*) 11-230.

1.2. Roles and Responsibilities.

1.2.1. Chief Controller /Air Traffic manager.

1.2.1.1. Manages the ATC facility and associated RADAR systems.

1.2.1.2. Validates facility MVAC, MIFRAC, LAAS, DVA and non-RADAR suitability/requirements.

1.2.2. Instrument Procedure Specialist.

1.2.2.1. Accomplish responsibilities IAW AFMAN (*formerly AFI*) 11-230 paragraph 1.2.5. in conjunction with this manual.

1.2.2.2. Support Flight Inspection IAW FAA Order 8200.1D, *United States Standard Flight Inspection Manual.*

1.3. Waivers. For tiered and non-tiered compliance item, process waivers IAW AFMAN (*formerly AFI*) 11-230, Chapter 2.

Chapter 2

MINIMUM VECTORING ALTITUDE CHARTS (MVAC) AND MINIMUM INSTRUMENT FLIGHT RULES ALTITUDE CHART (MIFRAC)

2.1. General. MVACs and MIFRACs are developed and maintained by TERPS authorities as directed by ATC facility management using the Chart Designer module of Global Procedure Designer (GPD) software. MVACs and MIFRACs do not require flight inspection. For more technical information on GPD software, see T.O. 31S5-4-6210-1, *USAF Global Procedure Designer (USAFGPD) Operations Manual*.

2.1.1. Minimum Vectoring Altitude Chart. Establish Minimum Vectoring Altitude Chart (MVAC)s IAW this chapter and FAA Order 7210.3AA, *Facility Operation and Administration*, Chapter 3, Section 8, *Other Displays* as appropriate. The MVAC is used in a RADAR environment to determine the lowest useable Instrument Flight Rules (IFR) altitude at which an aircraft may be vectored and maintain clearance from obstructions, terrain and uncontrolled airspace.

2.1.1.1. AF TERPS are not required to develop MVACs at AF locations where host nation or the FAA provide terminal RADAR service e.g., a USAF Visual Flight Rules (VFR) control tower. However, they are required to obtain a copy of the FAA, host nation MVAC or suitable alternative documentation for reference when developing instrument procedures. **(T-3).**

2.1.1.2. TERPS functions required to develop MVACs shall consider the adjacent ATC facilities MVAC when developing the USAF chart to prevent excessive altitude changes between the two facilities' adjoining MVAC sectors. **(T-3).**

2.1.1.3. When developing MVACs for Digital Airport Surveillance RADAR (DASR)/Standard Terminal Automation Replacement System (STARS), enter the DASR magnetic variation (MV) of record for the DASR, not STARS equipment.

2.1.2. Definitions and chart types.

2.1.2.1. Terminal MVAC.

2.1.2.1.1. This chart supports those systems where RADAR data is provided by a feed from a single short range (terminal) Airport Surveillance RADAR (ASR) or DASR antenna. Instrument Procedure Specialist will develop terminal MVACs for legacy analog RADARs (GPN-27) and mobile ASRs (MPN-14, MPN-25 and TPN-19), and DASR (GPN-30). **(T-2).** Terminal MVAC rules may also be used for multi-sensor mosaic systems where RADAR data from a single terminal RADAR is selected or adapted.

2.1.2.1.2. Develop terminal MVACs for a single-sensor terminal RADAR mode and for designated terminal areas where the area is adapted to utilize a single terminal RADAR. **(T-2).** Three nautical miles lateral separation will be provided from terrain and obstructions (sector buffer) within 40 nautical miles of the ASR/DASR and five nautical miles lateral separation will be provided 40 nautical miles and greater from the chart center. **(T-1).** A terminal MVAC is centered on the terminal ASR/DASR antenna in order for GPD to determine where to apply the increase in lateral separation to five nautical miles.

2.1.2.1.3. For a terminal area where ATC has the ability to switch from single-sensor to multi-sensor mode, an en route MVAC must be developed. **(T-1).** When operationally advantageous, both a terminal and en route MVAC may be developed.

2.1.2.2. En Route MVAC. This chart supports those systems where RADAR data is provided by a feed from one or more long range (en route) Air Route Surveillance RADAR antennas, or a feed from more than one terminal RADAR. Develop en route MVACs for multi-sensor mosaic systems such as Microprocessor En Route Automated RADAR or STARS, except for the adapted terminal area specified in paragraph 2.1.2.1.**(T-2).** When a terminal MVAC is developed for the terminal area or the single-sensor mode of a multi-sensor system, develop and maintain both terminal and en route MVACs. Five nautical miles lateral separation is provided from terrain and obstructions (sector buffer) regardless of the distance from the chart center or aerodrome.

2.1.2.3. FUSION-based MVAC. This chart supports multi-sensor (multiple radar feeds and ASDB when facility enhanced) systems enabling more precise aircraft targeting. FUSION allows for a continuous 3 nautical mile or 5 nautical mile MVAC buffers throughout the entire radar presentation, regardless of antenna distances. It is recomended to develop FUSION MVACs with 3 nautical mile or 5 nautical mile buffers in GPD under the Terminal MVAC module by selecting a desired airspace range to the extent of the work area and then selecting 3 nautical mile or 5 nautical mile buffers as appropriate. This will prevent auto-triggering of the 5 nautical mile buffers at 40 nautical mile. For the appropriate FUSION buffer selection and requirements see, FAA Order 7210.3AA, Facility Operation and Administration, Chapter 3, Section 8, Other Displays as appropriate.

2.1.3. Standard sector. A sector bounded by two bearings and two ranges (arcs) relative to chart center.

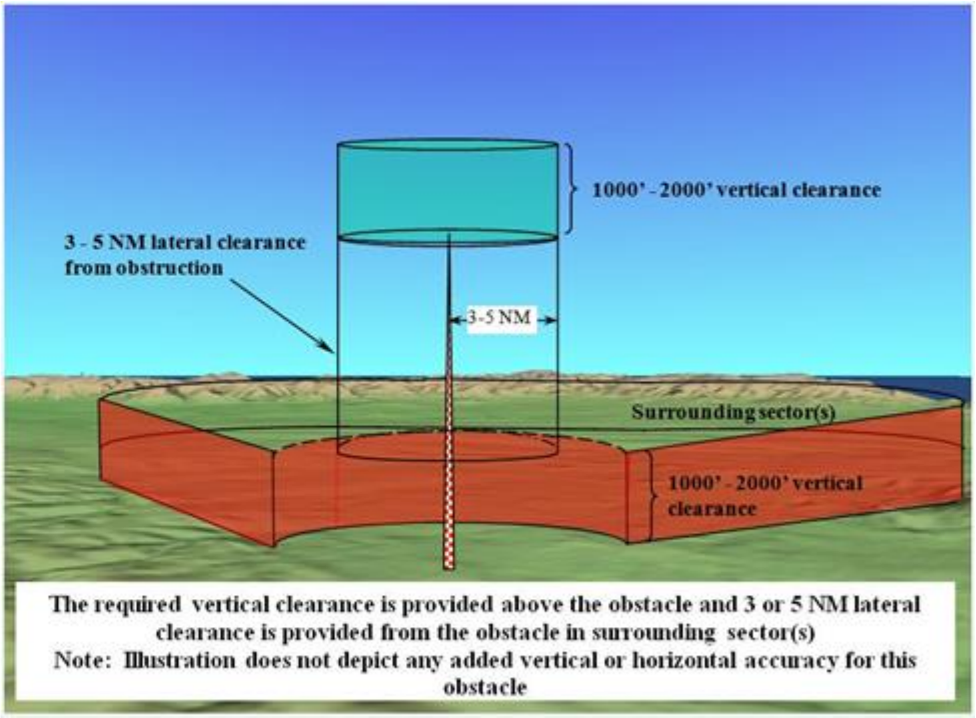
2.1.4. Irregular sector. A more complex sector bounded by more than two bearings and two ranges relative to chart center.

2.1.5. Polygonal sector. A sector defined by the World Geodetic System-84 coordinates of each corner (vertex). There is no limit to the number of sides to this type sector.

2.1.6. Prominent obstacle sector. This is a "buffer" sector intended to provide the required vertical and lateral clearance from a single, isolated, man-made obstacle. When a single, isolated, man-made obstacle causes the entire sector altitude to be higher than desired, a prominent obstacle sector may be established. A prominent obstacle sector may be contained within a single larger sector, or overlap several adjacent sectors and can be based on an obstacle that is outside the MVAC radius but within the buffer area of the sector.

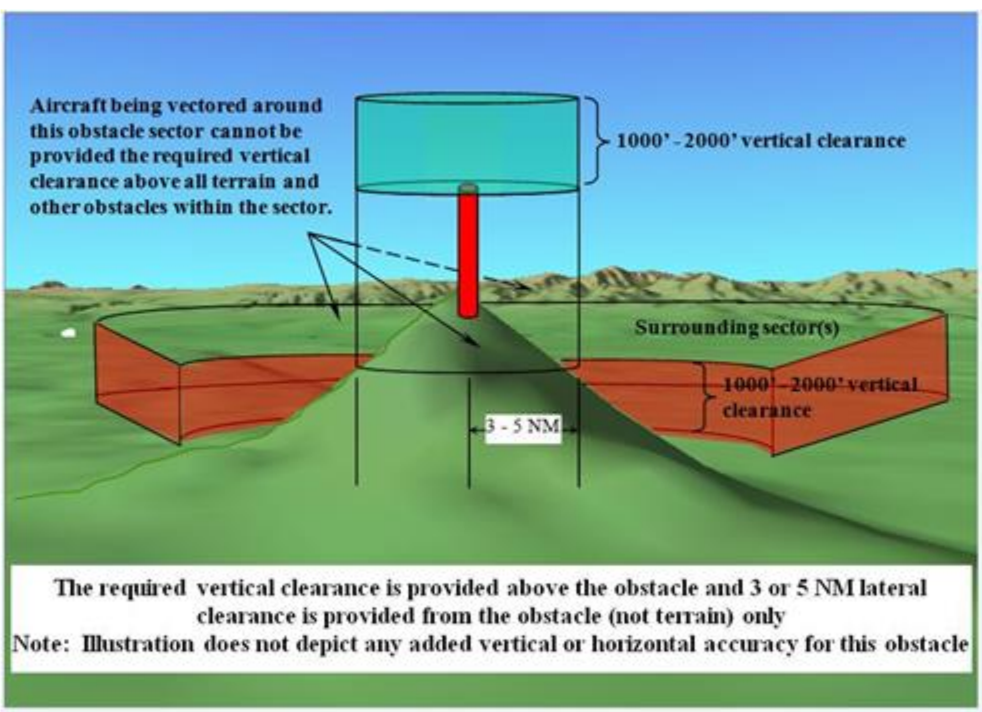
2.1.6.1. This sector type is only authorized to provide separation from an isolated, man-made obstacle that is higher than surrounding terrain or obstructions (Figure 2.1). **Note:** All obstacles inside the prominent obstacle sector, except those obstacles that fall within the horizontal accuracy of the obstacle upon which the prominent obstacle sector is based, are evaluated when determining the minimum altitude of the sector(s) surrounding or adjoining the prominent obstacle sector.

Figure 2.1. Application of Prominent Obstacle Sector without High Surrounding Terrain



2.1.6.2. Prominent obstacle sectors cannot be used to provide separation from terrain features such as mountain peaks that may or may not have towers or antennas near the peak (Figure 2.2).

Figure 2.2. Misapplication of Prominent Obstacle Sector with High Surrounding Terrain



2.1.7. **Chart design.**

2.1.7.1. Determine which type chart (Terminal, En Route, or both) is applicable based on paragraph 2.1.2. Instrument Procedure Specialist will establish MVACs irrespective of the flight-checked RADAR coverage in the sector concerned; they are based on obstruction clearance criteria and controlled airspace only. **(T-2).** It is the responsibility of ATC to determine that a target return is adequate for RADAR control purposes. It is not relevant to MVAC development whether RADAR service in a specific area is provided using primary or secondary RADAR.

2.1.7.1.1. For a Terminal MVAC, Instrument Procedure Specialist will ensure the area considered for obstacle clearance (chart radius) encompasses the maximum range of the ASR primary RADAR and be extended to include all delegated airspace. **(T-3)**. This includes adjacent areas where control responsibility is assumed because of early handoff or track initiation. **Exception:** When developing a Terminal MVAC to support the designated terminal area of a multi-sensor system (paragraph 2.1.2), the area only needs be large enough to include the entire terminal area to include the appropriate buffer area based on the distance from the ASR/DASR.

2.1.7.1.2. For an En Route MVAC, Instrument Procedure Specialist will ensure the area considered for obstacle clearance (chart radius) shall be large enough to include 20 nautical miles beyond delegated airspace boundaries to include adjacent areas where control responsibility is assumed because of early handoff or track initiation. **(T-2)**. When developing an En Route MVAC, ensure that “Multi-sensor” is selected in the chart properties of GPD to ensure the proper buffer size is constructed.

2.1.7.2. To aid in determining the appropriate chart radius, delegated ATC airspace may be entered into GPD Data Manager as a new, unclassified airspace. (See T.O. 31S5-4-6210-1, *USAF Global Procedure Designer (USAFGPD) Operations Manual*.)

2.1.7.3. Define the chart properties. Specify whether the default terrain type for the chart is designated mountainous or non-mountainous IAW Title 14, Code of Federal Regulations (CFR) Part 95, *Designated Mountainous Areas* in the Continental United States (CONUS). Outside the CONUS, review the appropriate host nation Aeronautical Information Publication (AIP) or other applicable directives and comply with mountainous terrain designations. When the host nation has not explicitly defined terrain type designations, evaluate the topography of the area to determine if it is a mountainous area as defined by International Civil Aviation Organization (ICAO) (3000 feet of terrain elevation change within a distance of 10 nautical miles). Additionally, check host nation en route charts (host and National Geospatial-Intelligence Agency) to ascertain that the required obstacle clearance (ROC) is applied on air traffic service routes and to off-route altitudes such as minimum off-route altitude and off-route obstruction clearance altitude. Make a determination which terrain type is appropriate and document the rationale in the chart’s user defined notes.

2.1.7.3.1. Apply mountainous terrain obstacle clearance per FAA Order 8260.3D, *United States Standard for Terminal Instrument Procedures (TERPS)*, Chapter 2, Level OCS, Chapter 11, *MVAC Obstacle Clearance and Altitude Selection*. When non-mountainous terrain is specified, 1000 feet of ROC is applied as the system default. When mountainous terrain is specified, 2000 feet of ROC is applied as the system default.

2.1.7.3.2. Where lower altitudes are necessary in designated mountainous areas to achieve compatibility with terminal routes or to permit vectoring to an instrument approach, the default ROC may be reduced to 1000 feet for a Terminal MVAC, and 1500 feet or 1700 feet for an En Route MVAC as specified in FAA Order 8260.3D section 15-2. Instrument Procedure Specialist will annotate each sector with the statement “ROC reduced to less than 2000 feet” in the appropriate sector defined notes. **(T-2)**.

2.1.7.4. Instrument Procedure Specialist will specify the appropriate allowance for trees and this allowance will be applied uniformly to the entire terrain model. **(T-2)**. Where vegetation is sparse, or has variable heights, or when using Shuttle RADAR Topography Mission, it may be preferable to add assumptions for vegetation to the sector altitude rather than entering a tree allowance to the entire area. This choice should be document in the designer notes to posterity. For additional guidance about vegetation (tree) allowance, see: AFMAN (*formerly AFI*) 11-230, chapter 2.

2.1.7.5. Specify standard, irregular, or polygonal sectors or any combination thereof based on the terrain, obstacle and airspace environment or other operational requirements (RADAR patterns, noise abatement areas, Special Use Airspace [SUA], etc.). Ensure sector coverage over the entire chart with no gaps between sectors. With the exception of a prominent obstacle sector, each sector’s boundary must adjoin, but not overlap, the boundary of each adjacent sector. **(T-2)**. In some cases it may be desirable to combine adjacent smaller areas having different altitudes into a single large area with one altitude. See Figure 2.3 and Figure 2.4.

2.1.7.5.1. Instrument Procedure Specialist will make each obstacle sector, except for prominent obstacle sectors, large enough to permit the efficient and safe vectoring of aircraft. Consideration should be given to aircraft performance and phase of flight. **(T-2)**.

2.1.7.5.2. There is no limitation to what sector types may be developed for either a terminal or en route MVAC. For example, polygonal sectors can be established for a terminal chart, and standard sectors can be defined for en route. However, when MVAC sector design impacts low altitude alert system (LAAS), consider low altitude alert development limitations. Coordinate with ATC automation personnel when applicable to determine optimum sector design.

2.1.7.6. Specify sector altitudes no less than the minimum altitude. The selected altitude shall provide at least the ROC above obstructions and terrain plus vegetation allowance in the sector, including buffer, and must be at least 300 feet above the highest floor of controlled airspace (FOCA) in the sector, not including buffer, rounded to the higher 100-foot increment. **(T-2)**.

2.1.7.6.1. FOCA in mountainous areas or sparsely populated areas may be as high as 14,500 feet Mean Sea Level (MSL). When the minimum altitude is higher than desired due to a high FOCA, and when operationally required by ATC (i.e., routinely expected to vector aircraft in Class G uncontrolled airspace), two sector altitudes may be established. Instrument Procedure Specialist will base one sector altitude on the FOCA, and the second sector altitude on obstruction clearance. **(T-2)**.

2.1.7.6.2. Instrument Procedure Specialist will not add the vegetation allowance to the terrain values used for FOCA determination. **(T-2)**.

2.1.7.7. Host nations may detail FOCA in their AIPs or other sources, however some compute this data differently than US criteria. Check with appropriate host nation personnel to ensure accurate information is applied. When a host nation does not designate the FOCA, controlled airspace is considered to begin at the surface. Document in the chart's user defined notes and, when available, include a hard copy version of the host nation's airspace description in the chart package.

Figure 2.3. Minimum Vectoring Altitude Chart with Standard, Irregular, Polygonal and Prominent Obstacle Sectors

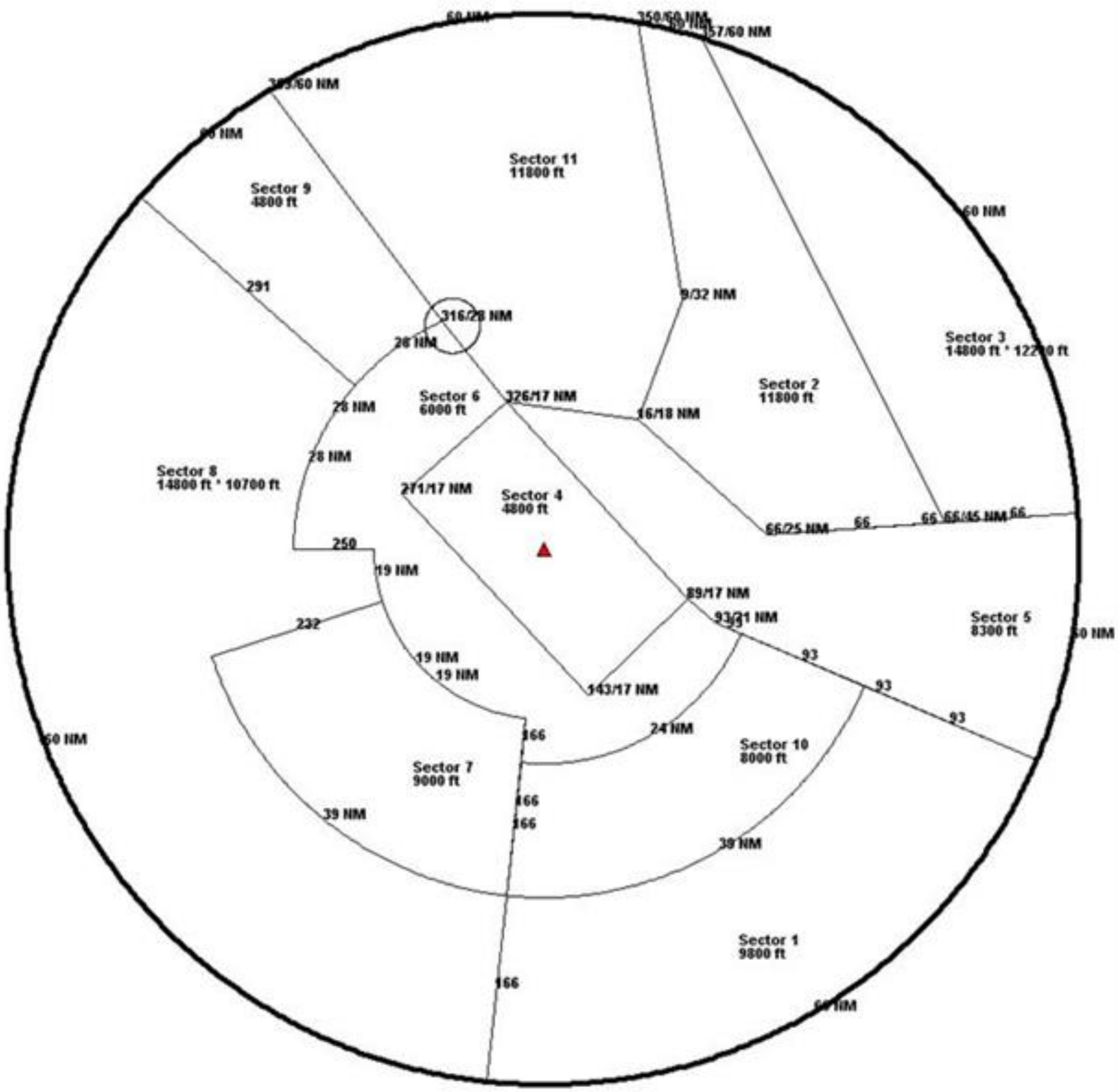
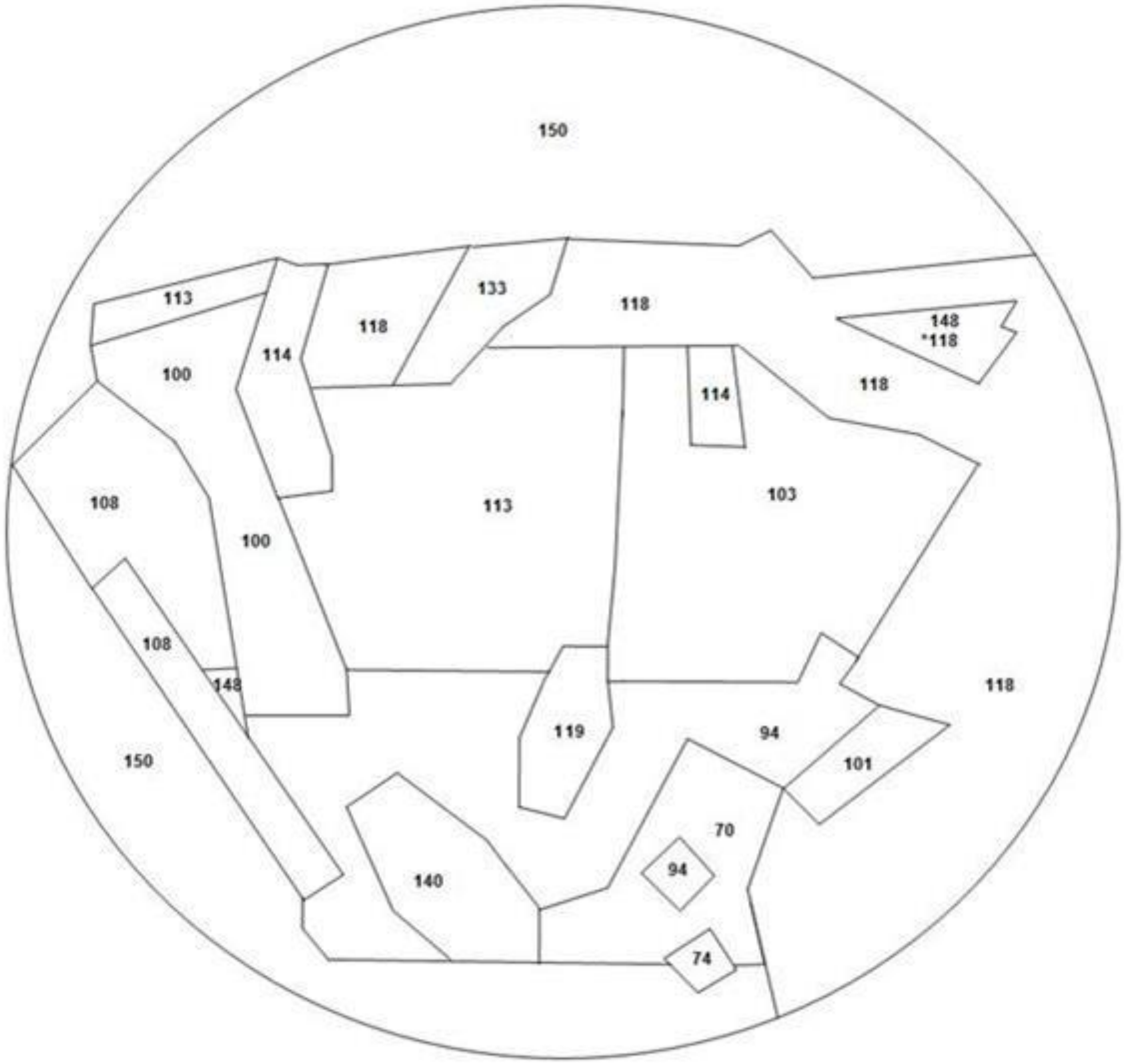


Figure 2.4. Minimum Vectoring Altitude Chart with Polygonal Sectors.



2.2. Minimum Instrument Flight Rules Altitude Chart. The MIFRAC is used to determine the lowest useable IFR altitude at which an aircraft may operate, receive the appropriate Navigation Aid (NAVAID), and maintain clearance from obstructions, terrain and uncontrolled airspace in a non-RADAR environment. **Note:** Minimum IFR altitudes are only intended for off-route and direct-route operations. The Minimum En Route Altitude or Minimum Obstruction Clearance Altitude in a particular area has no impact on MIFRAC design.

2.2.1. Chart Design. Develop a MIFRAC centered on each omni-directional NAVAID (Tactical Air Navigation (TACAN), VHF Omnidirectional Range/Tactical Air Navigation (VORTAC), VHF Omnidirectional Range (VOR) or Non-directional Radio Beacon) used for non-RADAR operations.

2.2.1.1. Do not exceed the standard service volume of the NAVAID. The existence of an expanded service volume has no bearing on MIFRAC design unless approved for an entire area or sector in which off-route operations are conducted. The area considered for obstacle clearance (chart radius) must be large enough to encompass the standard NAVAID service volume for the highest altitude where control responsibility is routinely assumed. **(T-2)**. The chart radius shall encompass all delegated airspace to include adjacent areas where control responsibility is assumed. **(T-2)**. For standard service volumes, see 8260.19H paragraph 2-4-2.

2.2.1.2. Specify the default terrain type IAW paragraph 2.1.7.3 and the vegetation allowance IAW paragraph 2.1.7.4.

2.2.1.3. When a MVAC is available, associate the MIFRAC in chart properties of GPD. This ensures the MIFRAC sector altitudes are no lower than the MVAC.

2.2.1.4. Specify standard or irregular sectors or any combination based on the terrain, obstacle, airspace environment, MVAC and other operational requirements (RADAR patterns, noise abatement areas, SUA, etc.). GPD requires sector coverage over the entire chart with no gaps between sectors and each sector's boundary adjoin, and not overlap the boundary of each adjacent sector. In some cases, it may be desirable to combine adjacent smaller areas having different altitudes into a single large area with one altitude (Figure 2.6). Note: There is no "Terminal" or "En Route" distinction for MIFRACs; 5 nautical miles lateral separation (buffer area) is provided from terrain and obstructions regardless of the distance to the facility.

2.2.1.5. Instrument Procedure Specialist will specify only one sector altitude in each sector no less than the minimum altitude. **(T-2)**. This minimum altitude shall provide at least the required ROC above obstructions and terrain plus vegetation allowance in the sector, including buffer, and must be at least 300 feet above the highest FOCA in the sector, not including buffer, rounded to the higher 100-foot increment. **(T-2)**. The selected MIFRAC sector altitude shall not be lower than the highest Minimum Vectoring Altitude (MVA) for that given area. **(T-3)**. **Note 1:** When determining MIFRAC sector altitudes, do not include MIFRAC sector buffer areas when evaluating the associated underlying MVAC sectors. **Note 2:** CAUTION: Two or more MVA altitudes may affect a single MIFRAC sector. Annotate each sector where paragraph 2.1.7.3.2 is applied with the statement "ROC reduced to less than 2000" (Figure 2.7).

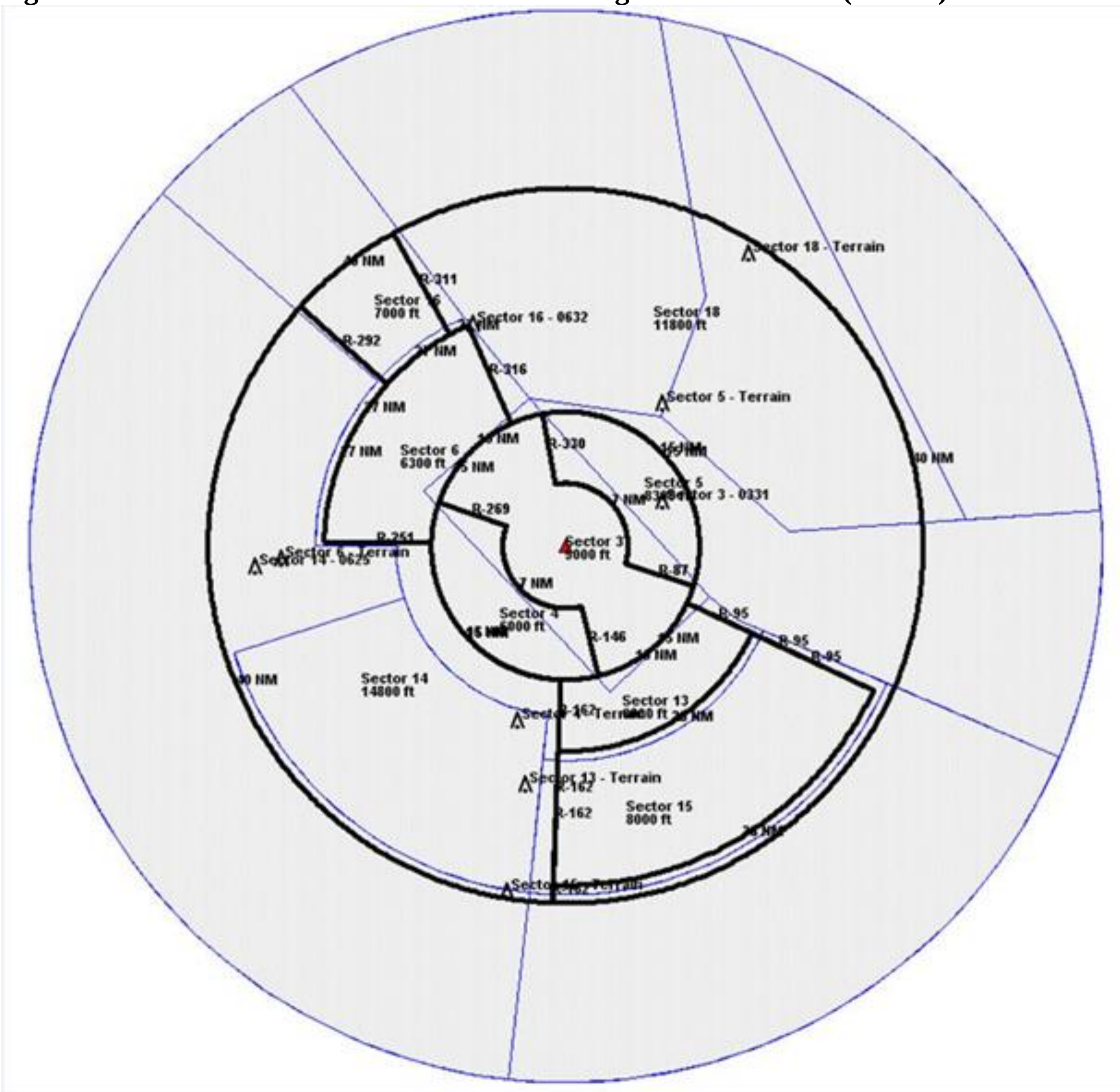
2.2.1.6. Consider restrictions noted on flight inspection reports or Aviation Standards Information System datasheet (i.e., horizontal and vertical NAVAID limitations to include unusable sectors) when determining sector design and when specifying sector altitudes (Figure 2.5). For example, for the first restriction shown in Figure 2.5, the MIFRAC sector from R-130 clockwise to R-160 beyond 29 nautical miles out to the chart radius can't be lower than 9000 feet MSL regardless of the minimum altitude specified by GPD. When flight inspection designates that no coverage exists in an area, annotate the sector as unusable.

Figure 2.5. NAVAID Restrictions

*** RESTRICTION ***								
Cmpnt	Qual	Svc Date	From	To	Byd	Below		Remark
TACAN	BOTH	08/19/93	130	160	29	9000		
TACAN	BOTH	08/19/93	235	305	19	8000		
TACAN	BOTH	02/02/96	235	305	27	12000		

Figure 2.6. MIFRAC Sectors in GPD Chart Designer with VFR Sectional

Figure 2.7. MIFRAC Sectors in GPD Chart Designer with MVAC (in blue)



2.3. ATC Chart Documentation and Coordination. Instrument Procedure Specialist will create and maintain either a hard copy (paper) or electronic copy of the ATC Chart procedure package containing documentation as follows:

2.3.1. Hard copy documentation includes the computer generated MVAC or MIFRAC Report and signed ATC Charts Signature Page from GPD. Include all hard copy source documentation relating to aeronautical or obstacle data revisions pertinent to the chart to include hard copy correspondence to MAJCOM TERPS functions. **(T-2)**.

2.3.2. Electronic documentation consists of all GPD export files and signed ATC charts signature page, as appropriate. In addition, include additional electronic documentation, to include scanned versions of hard copies, relating to aeronautical or obstacle data revisions pertinent to the chart, along with correspondence with the MAJCOM TERPS function. **(T-2)**.

2.3.3. Coordination. The Instrument Procedure Specialist will obtain all approval signatures, as appropriate. **(T-3)**. The Instrument Procedure, the appropriate ATC Facility Manager, Airfield Operations Flight Commander, and MAJCOM TERPS must provide the required signatures for ATC charts signature page. **(T-2)**. FAA or host nation signatures are only required when mandated by formal agreement. Other signatures are determined by the MAJCOM.

Chapter 3

LOW ALTITUDE ALERT SYSTEM (LAAS)

3.1. General. LAAS uses visual and aural alarms to alert the controller when a RADAR track target with mode C is below a predetermined safe altitude. Mode C is additional aircraft transponder equipage that transmits altitude data to the visual and aural alarm system. LAAS automatically processes all tracked targets with an operational mode C unless the controller exempts the target from processing. Instrument Procedure Specialist will perform a manual validation of LAAS data whenever the MVAC is re-accomplished. **(T-2)**.

3.1.1. The Federal Aviation Administration (FAA) conducts flight inspection of LAAS in accordance with Federal Aviation Administration Order (FAA Order) 8200.1D. LAAS checks are associated with the corresponding terminal RADAR system. LAAS inspections are a check of the system, not of the adequacy of specific sector altitudes (sector altitudes maybe referred to as "bin altitudes" by flight inspection).

3.1.2. The FAA Order 8200.1D refers to LAAS as "Local Area Augmentation System" which has no correlation to low altitude alert. As such, LAAS in this context may be misunderstood by flight inspection personnel. This order does refer to Minimum Safe Altitude Warning Systems (MSAW). When coordinating with flight inspection, ensure that all correspondence clearly identifies the requirement as a request for a check of the low altitude alert system/MSAW.

3.2. Low Altitude Alert System.

3.2.1. LAAS associated with Digital Bright RADAR Indicator Tower Equipment (DBRITE). Only develop LAAS for those DBRITE systems authorized to provide additional RADAR functions beyond those normally allowed for certified tower displays IAW AFMAN 13-204 (*formerly AFI*), *Airfield Operations Procedures and Programs,* Volume 3 and FAA Order JO 7110.65X, *Air Traffic Control*. Submit original and change request packages through the MAJCOM TERPS office in time for receipt by AFFSA Airfield Automation Ops Support at least 7 days prior to the effective date. Address all email correspondence concerning DBRITE LAAS to: **HQAFFSA.AFSTARSOSF.MaintTeam@us.af.mil** with "LAAS request" in the subject line.

3.2.2. Develop LAAS using appropriate charts based on processor capability, terrain, and local operating needs. After the data is processed, AFFSA Airfield Automation Ops Support forwards copies of computer-generated 15 nautical miles and 60 nautical miles charts to the requestor. These charts represent the data included as part of the operational program for the facility. The Instrument Procedure Specialist shall review the printout for accuracy, then sign and date. **(T-3)**. When changes are required, the MAJCOM shall submit corrections to AFFSA Airfield Automation Ops Support. **(T-2)**.

3.2.2.1. DBRITE LAAS packages are subject to equipment-specific radial/range restrictions (Figure 3.1. through Figure 3.6.). Figure 3.1. shows the identification of runways, Class C/D airspace, along with final, intermediate and/or initial approach areas out to the descent point. Figure 3.2. identifies general LAAS areas based on assigned airspace and MVA sectors. Figure 3.3. through Figure 3.6. illustrate the azimuth and range identification process.

3.2.2.2. DBRITE LAAS packages consist of an Approach Area Detail Map (AADM), a General Terrain Map (GTM), and a completed DBRITE LAAS Data Submission Sheet Checklist. Center all LAAS maps on the ASR antenna serving the airport for which the LAAS is being developed. All distances will be developed in nautical miles and all bearings are magnetic from the ASR antenna.

3.2.2.3. Instrument Procedure Specialist will ensure DBRITE LAAS coverage encompasses the ATC facility's assigned airspace, special use airspace where ATC controls IFR aircraft and any areas where agreements with adjacent ATC facilities allow for the control of IFR aircraft. **(T-3)**. Instrument Procedure Specialist will ensure the LAAS GTM drawings clearly depict these airspace boundaries/areas. **(T-3)**.

3.2.2.4. Develop two maps centered on the ASR antenna: an AADM and a GTM.

3.2.2.4.1. The AADM defines the LAAS circling areas and approach courses to the primary airport (normally 0 – 15 nautical miles). It is large enough to include all approaches out to the applicable descent points.

3.2.2.4.2. The GTM (normally 15 – 60 nautical miles) - defines all other LAAS areas (i.e., larger, less-detailed MVAC sectors). It covers the airspace from edge of the AADM out to the limits of the areas defined in paragraph 3.2.2.3., not to exceed 60 nautical miles from the ASR antenna.

3.2.2.5. DBRITE LAAS chart design.

3.2.2.5.1. Instrument Procedure Specialist will draw all final approach courses to airports within the facility's assigned airspace (Figure 3.1.). **(T-2)**.

3.2.2.5.2. Instrument Procedure Specialist will define the LAAS exempt areas by drawing a four nautical mile circle around the ASR antenna at the primary airport, and around each satellite airport's airport reference point. **(T-3).** The altitude within these areas are set at zero. LAAS exempt areas eliminate nuisance alarms from aircraft descending on final approach and from aircraft climbing after departure or low approach/touch and go.

3.2.2.5.3. Instrument Procedure Specialist will plot the point on each instrument approach procedure where the aircraft descends below the MVA (Figure 3.1). **(T-2)** This point is referred to as the descent point. Determine the descent point as follows:

3.2.2.5.3.1. Instrument Procedure Specialist will work outwards from the airport to find the first published fix with an altitude that is equal to or higher than the MVA. **(T-2).** If this fix is within the LAAS exempt area (4 nautical mile from the ASR antenna or the airport reference point), no further action is necessary.

3.2.2.5.3.2. When the fix falls outside of the LAAS exempt area and the altitude is equal to the MVA, the fix becomes the descent point. **(T-2).** If the altitude at this fix is above the MVA, work inwards towards the missed approach point using the maximum authorized descent gradient until reaching the MVA and that point then becomes the descent point. **(T-2).** If the descent point then falls within the LAAS exempt area, no further action is necessary.

3.2.2.5.4. When the descent point falls outside the LAAS exempt area Instrument Procedure Specialist will take the following action:

3.2.2.5.4.1. When the descent point falls between the LAAS exempt area and the FAF (Final Approach Fix)/Precise FAF (PFAF), Instrument Procedure Specialist will draw the final approach primary trapezoid from the LAAS exempt area outward to the descent point. **(T-2). Note:** Assign an altitude for LAAS processing within the primary trapezoid that is at or above the lowest published minimum decent altitude for that runway (rounded nearest 100 foot), and that is at least 200 feet above terrain and obstructions.

3.2.2.5.4.2. When the descent point falls between the FAF and the intermediate fix, Instrument Procedure Specialist will draw the final and intermediate primary trapezoids from the LAAS exempt area outward to the descent point. **(T-2)**

3.2.2.5.4.2.1. Instrument Procedure Specialist will assign an altitude for LAAS processing within the final primary trapezoid IAW paragraph 3.2.2.5.4.1. **(T-2)**

3.2.2.5.4.2.2. Instrument Procedure Specialist will assign an altitude for LAAS processing within the intermediate primary trapezoid that is no lower than 100 feet below the lowest published FAF crossing altitude for that runway, and that is at least 300 feet above terrain and obstructions. **(T-2).**

3.2.2.5.4.3. When the descent point falls between the intermediate fix and the initial approach fix, Instrument Procedure Specialist will draw the final, intermediate and initial primary trapezoids from the LAAS exempt area outward to the descent point. **(T-2).**

3.2.2.5.4.3.1. Instrument Procedure Specialist will assign an altitude for LAAS processing within the final and intermediate primary trapezoid IAW paragraph 3.2.2.5.4.1. and paragraph 3.2.2.5.4.2.2. **(T-2).**

3.2.2.5.4.3.2. Instrument Procedure Specialist will assign an altitude for LAAS processing within the initial primary trapezoid that is no lower than 200 feet below the lowest published intermediate fix crossing altitude for that runway, and that is at least 300 feet above terrain and obstructions. **(T-2).**

3.2.2.5.4.4. For all other areas, assign an altitude for LAAS processing that is no lower than 200 feet below the MVA, and is at least 700 feet above terrain and obstacles (1700 feet in designated mountainous terrain). **Note:** When two MVA altitudes are assigned to the same sector (paragraph 2.1.7.6.), the Instrument Procedure Specialist will ensure the LAAS sector altitude will be based on the highest MVA in the sector. **(T-2)**.

3.2.2.6. LAAS Sector Data Collection.

3.2.2.6.1. Instrument Procedure Specialist will define the boundaries of each LAAS sector by two ASR bearings (start and end) and by two ranges (start and end). Depict all LAAS sectors as either pie- shaped, truncated pie-shaped, or a circle around the point of origin (ASR). Using Figure 3.3 and Figure 3.5 as examples, Instrument Procedure Specialist will draw bearings to encompass all areas identified in paragraph 3.2.2.3. When able, combine bearings/ranges to reduce the number of bearings and ranges used. Instrument Procedure Specialist will ensure continuous sectors do not cross the 0 degree bearing or 360 degree bearings. Split sectors crossing either the 0 or the 360 degree bearing into two sectors; stop the first sector at the 360 degree bearing and start the second sector at the 0 degree bearing. Instrument Procedure Specialist will ensure the sector end bearings are at least 8 degrees from the start bearings and specified in whole degree increments. **(T-2).**

3.2.2.6.2. Using Figure 3.4 and Figure 3.6 as examples, Instrument Procedure Specialist will draw arcs (ranges) centered on the ASR antenna to encompass areas identified in paragraph 3.2.2.3. On the AADM, record arc ranges to the nearest .25 nautical miles. On the GTM, record arc ranges to the nearest whole nautical miles. Ensure the sector end range is at least 4 nautical miles from the start range and specified in no less than .25 nautical miles increments. **(T-2).**

3.2.2.6.3. Up to but no more than 128 sectors may be defined using azimuth and range start – end combinations. On complicated charts, it may be necessary to make compromises to conserve bearings and ranges from the ASR antenna. The geographic boundaries of each altitude-warning sector in the map are defined by two azimuth boundaries and range boundaries (range start and range end). The map for a given site may include up to 32 different azimuth boundaries and up to 32 different range boundaries. Each azimuth boundary value or range boundary value may be used as the start or stop azimuth limit for a number of different sectors. Instrument Procedure Specialist will take appropriate action to remain within this number, but in no case will aircraft operate below the MVA without proper LAAS processing. **(T-2)**.

3.2.3. LAAS Associated with Mobile and Selected Fixed RADAR Systems. The following information pertains only to LAAS associated with AN/GPN-27, AN/TPN-19, or AN/MPN-14 RADARs.

3.2.3.1. Function. This LAAS feature operates identically to the DBRITE LAAS except that only one code can be inhibited.

3.2.3.2. Data Submission. Packages include AADM and GTM, and a completed LAAS Data Collection Sheet Checklist for Mobile and Selected Fixed RADAR Systems (Table 3.1).

3.2.3.3. Data Collection and Package Development. Instrument Procedure Specialist will draw LAAS charts for these systems in the same manner as for DBRITE LAAS except the chart design accounts for different bearing and range restrictions based on equipment limitations. **(T-2).**

3.2.3.4. Instrument Procedure Specialist will complete LAAS Data Collection Sheet Checklist for Mobile and selected Fixed RADAR Systems (Table 3.1) as follows:

3.2.3.4.1. SITE NAME: Enter the four-letter ICAO identifier and name for the facility. **(T-2).**

3.2.3.4.2. DATE: Enter the unit-level submission date in the format dd-mmm-yyyy. **(T-2).**

3.2.3.4.3. MAGNETIC VARIATION (MV): Enter the MV of record of the RADAR antenna to the nearest 1/10th degree and indicate the antenna magnetic variation east or west. **(T-2).**

3.2.3.4.4. REVISION: Enter the revision number if known. **(T-2).**

3.2.3.4.5. SECTOR #: Enter each identified sector in order. Identify the exact order by sector number on all maps and drawings submitted with the LAAS package. Begin with 001 and proceed sequentially to the system limit of 128. **(T-2).**

3.2.3.4.5.1. RANGE START. Enter the sector range closest to the antenna to the nearest whole nautical mile. **(T-2).**

3.2.3.4.5.2. RANGE STOP. Enter the sector range farthest from the antenna to the nearest whole nautical mile. Ensure this range is at least 2 nautical miles greater than the sector start range. **(T-2).**

3.2.3.4.5.3. AZIMUTH START. Enter the sector-starting azimuth (also called the "left" azimuth) to the nearest whole degree. The start azimuth is the one the Plan Position Indicator sweep passes first as it rotates from the ASR magnetic 360 bearing in a clockwise direction. Use magnetic 360 bearing for due north. **(T-2).**

3.2.3.4.5.4. AZIMUTH STOP. Enter the sector ending azimuth (also called the "right" azimuth) to the nearest whole degree. The stop azimuth is the azimuth the Plan Position Indicator sweep passes last as it rotates from the ASR magnetic 360 bearing in a clockwise direction. Ensure this value is at least 4 degrees greater than the segment start azimuth. Use magnetic 360 bearing for due north. **(T-2).**

3.2.3.4.5.5. MINIMUM ALTITUDE: Enter the lowest MSL altitude at which an aircraft may operate without activating the LAAS. Enter this data in hundreds of feet. **(T-2).**

3.2.3.4.5.6. MODE 3/A LOCKOUT: Enter codes as code blocks (i.e., 1200- 1277), or as individual codes. **(T-2).**

3.2.3.4.5.7. TEST CELL TARGET RANGE: Enter the Range Azimuth Beacon Monitor target range in nautical miles. Note: For AN/MPN-14K, AN/TPN-19 and systems using an Indicator Data Processor (CP-1047/T), the Test Cell Target Range must be set at 12 nautical miles. For AN/MPN-14K, the test target CODE switches must be set to "6666" on the Video Signal Processor. **(T-2)**.

Table 3.1. LAAS Data Collection Sheet Checklist

SITE NAME: _______________ MAGNETIC VARIATION: ____ DATE: ___________ INPUT RANGE OF TEST 12 nautical miles REVISION # ______						
SECTOR #	RANGE		AZIMUTH		MINIMUM ALTITUDE	MODE 3/A LOCKOUT
	START	STOP	START	STOP		
001						
002						
003						
004						
005						
006						
007						
008						
009						
010						
011						
012						
013						
014						
015						
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Figure 3.1. LAAS Package Development. Identification of Runways, Exempt Areas and Instrument Approach Primary Area

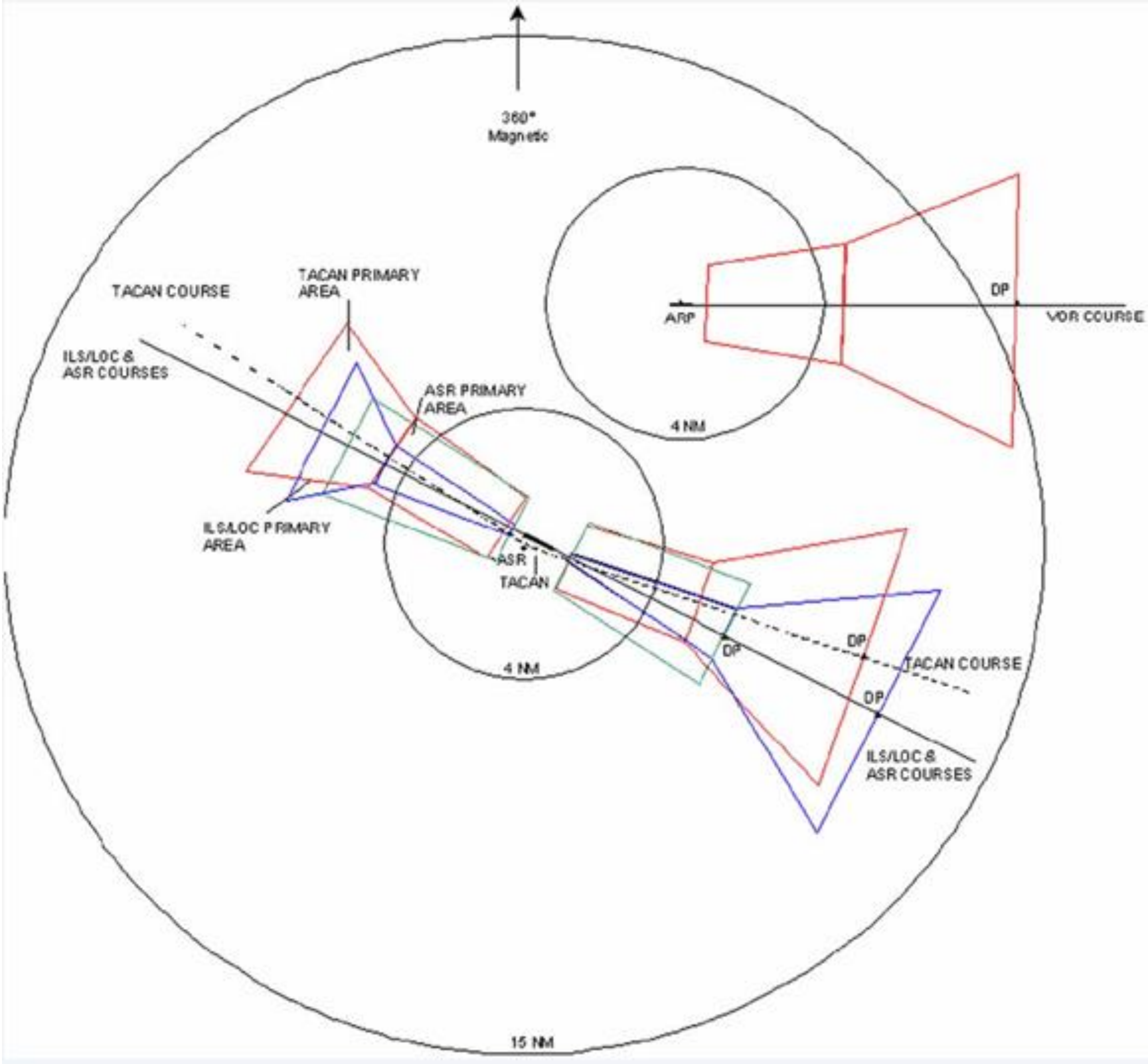


Figure 3.2. LAAS Package Development. Approach Area Detail Map - Identification of MVA sectors

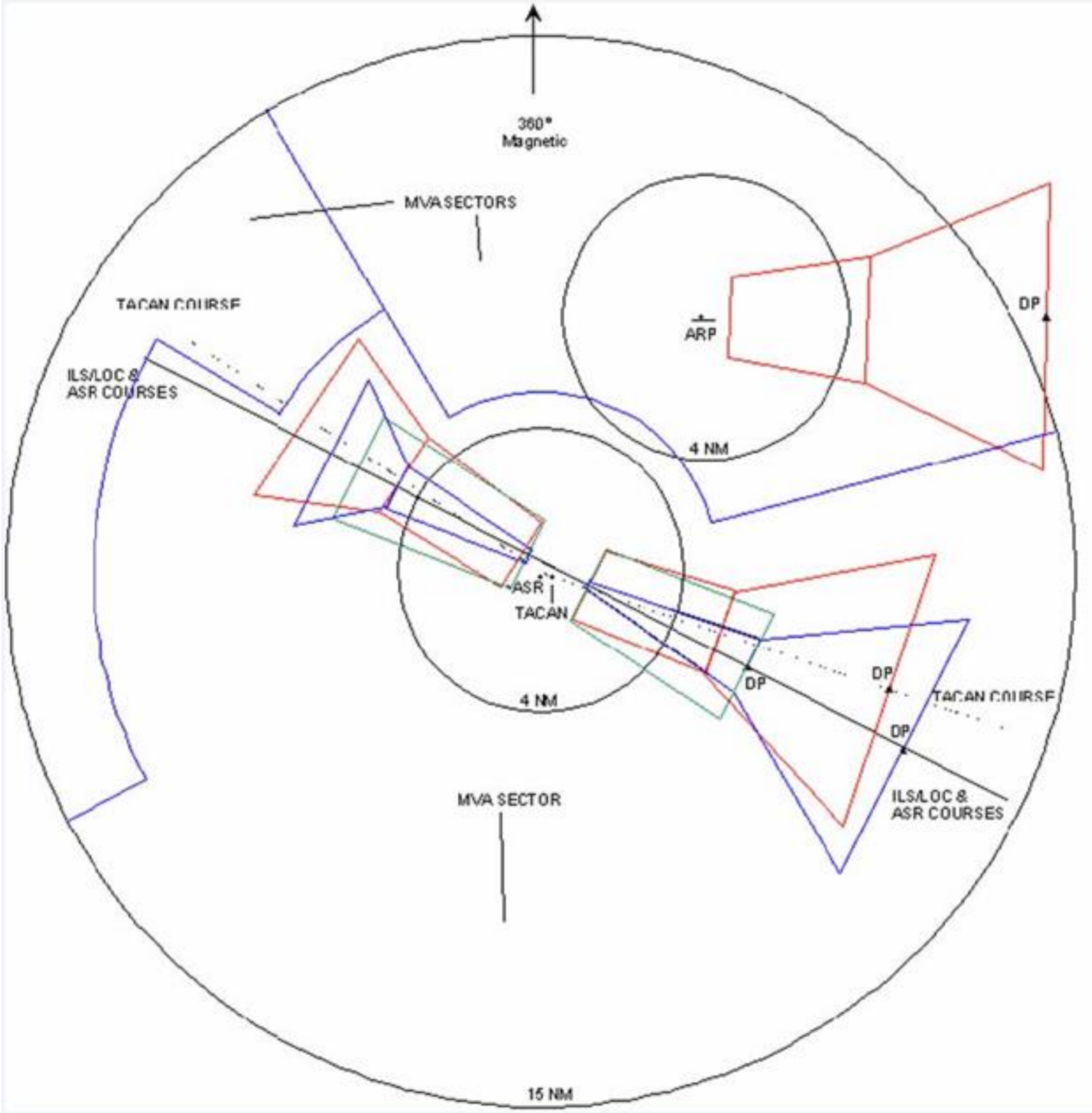


Figure 3.3. LAAS Package Development. Approach Area Detail Map - Plotting Radials

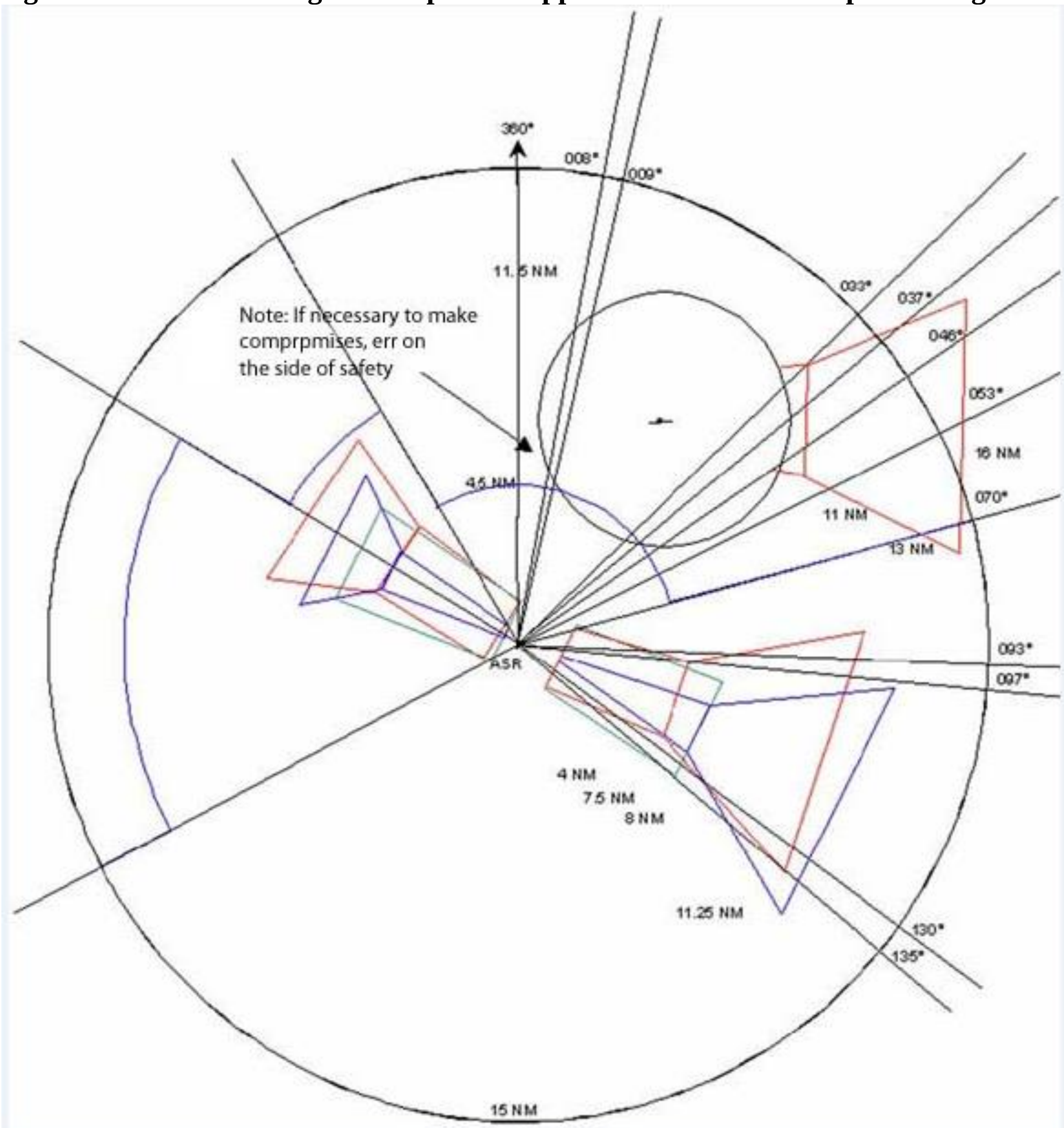


Figure 3.4. LAAS Package Development. Approach Area Detail Map - Plotting Ranges (Arcs)

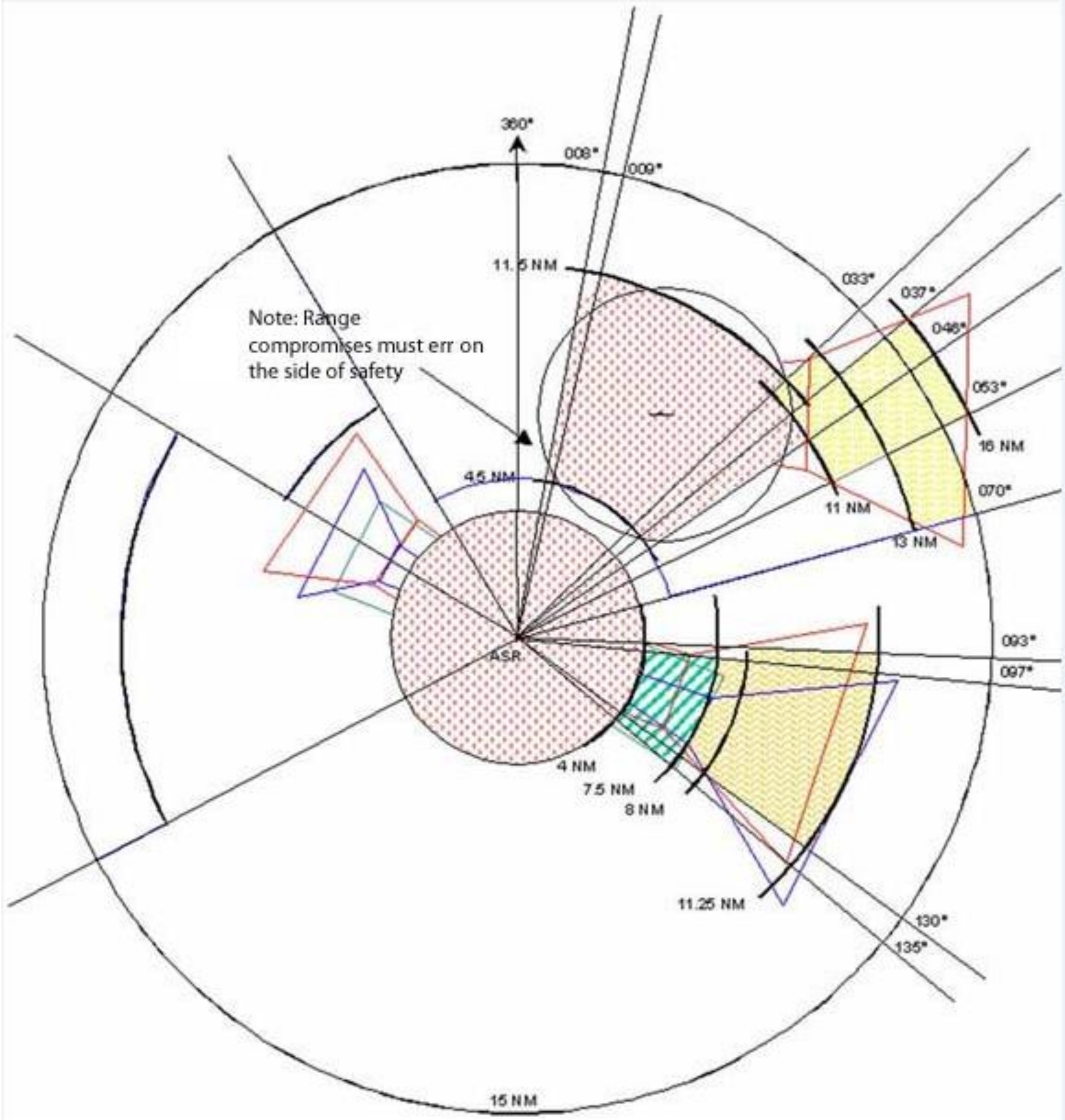


Figure 3.5. LAAS Package Development. General Terrain Map - Depicting ATC Airspace/Area under IFR Control

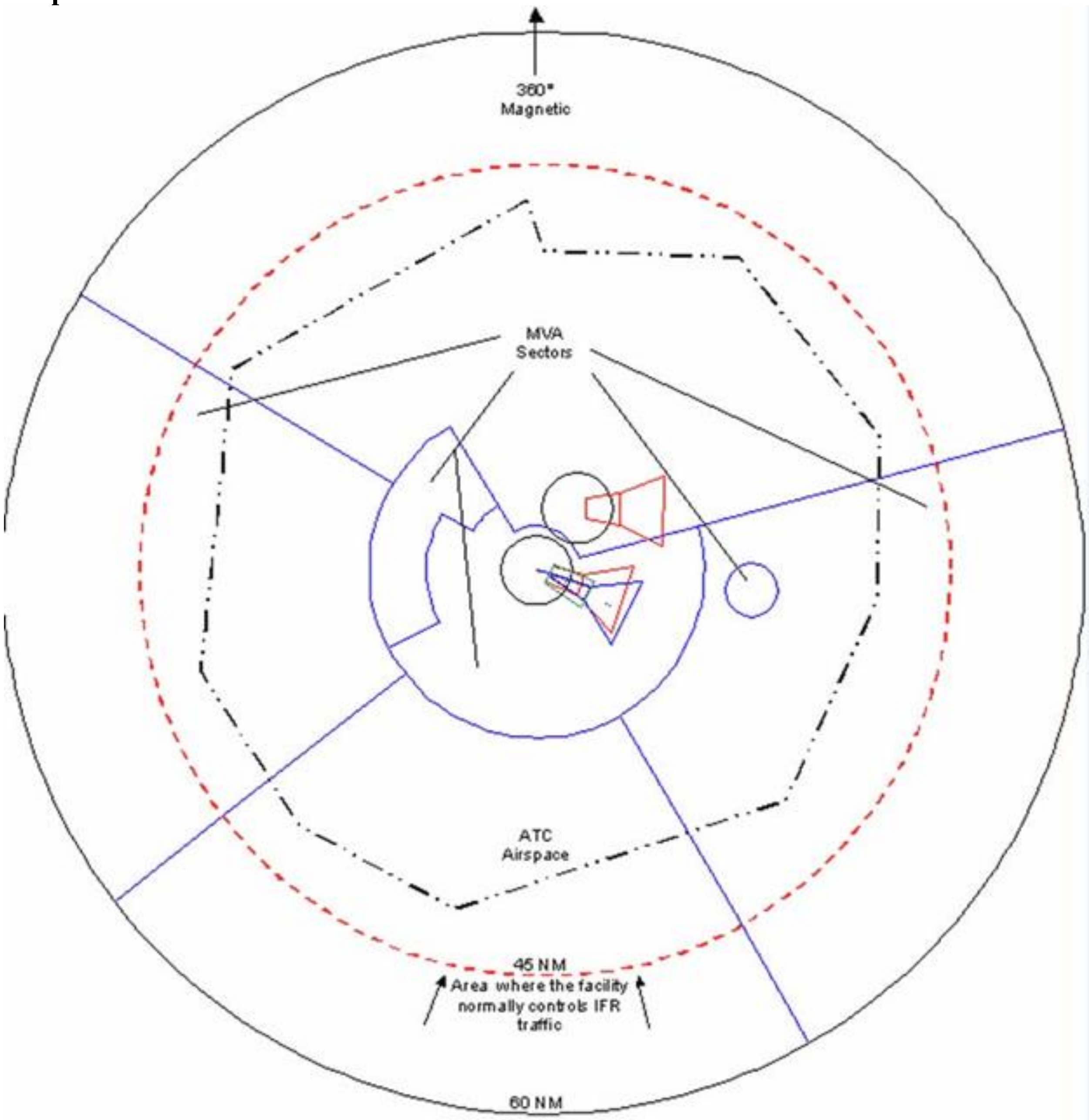
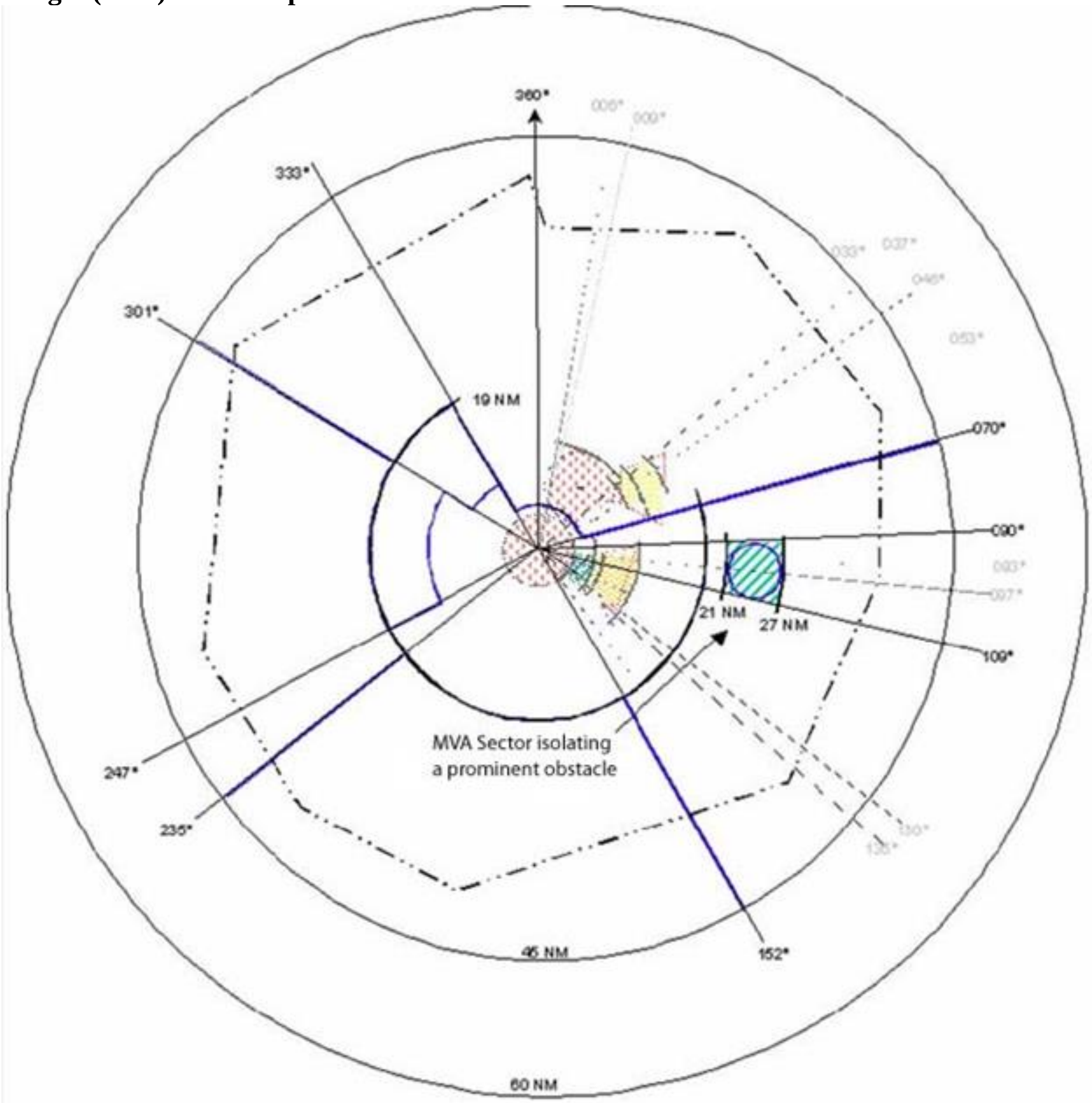


Figure 3.6. LAAS Package Development. General Terrain Map – Plotting Radials and Ranges (Arcs) to Encompass MVA Sectors



Chapter 4

DIVERSE VECTOR AREA DEVELOPMENT

4.1. Diverse Vector Area.

4.1.1. When requested by IFR facility management or host nation aviation authorities, the Instrument Procedure Specialist will use GPD, FAA Order 8260.3D, Section 14-5, FAA Order 7210.3AA, paragraph 3-8-5 and the following guidance to develop a DVA. **(T-1)**. **Exception:** When no penetrations to the 40:1 diverse departure assessment exist, Instrument Procedure Specialist will notify the requesting ATC facility management that a DVA is not required IAW FAA Order 7210.3AA, paragraph 3-8-5. **(T-1)**. When a DVA is requested and required, the Instrument Procedure Specialist will document coordination with IFR facility management and the Airfield Operation Flight Commander by obtaining their signatures on the GPD Approach/Departure Signature Page. **(T-2)**. MAJCOM TERPS review and approval is required prior to DVA implementation. **(T-2)**. DVAs do not require flight inspection. **Note 1:** When the USAF provides IFR air traffic services to an airport that the FAA has TERPS responsibilities, contact the appropriate FAA instrument procedure designer for a list of the non- Digital Terrain Elevation Data penetrations of the diverse departure assessment area for each runway. USAF Instrument Procedure Specialist will ensure these results include the location, description, and elevation of all 40:1 Obstacle Clearance Surface penetrations. **(T-3)**. The USAF Instrument Procedure Specialist will use this information when developing the DVA. **(T-3)**. **Note 2:** When the FAA provides IFR air traffic services to an airport that the USAF has TERPS responsibilities, when contacted by the appropriate FAA instrument procedure designer provide them with a list of the non-Digital Terrain Elevation Data penetrations of the diverse departure assessment area for each runway. These results will include the location, description, and elevation of all 40:1 Obstacle Clearance Surface penetrations. FAA instrument procedure designer will use this information when developing the DVA.

Chapter 5

TERPS SUPPORT OF USAF NON-RADAR PROGRAMS

5.1. General. Non-RADAR programs at USAF Air Traffic Facilities are the responsibility of the IFR Facility Manager. Non-RADAR programs are developed/maintained in concert with the supporting Instrument Procedure Specialist. This Instrument Procedure Specialist may be located locally or at the MAJCOM. **Note 1:** Most instrument procedure specialists are not certified in the IFR facilities they support and may have no practical experience working in a non-RADAR environment. However, they do have the ability to plot NAVAIDs, holding patterns, radials, Distance Measuring Equipment (DME) points, fixes, transfer of control points, airspace boundaries, arcs about NAVAIDs, and airspace to be protected, etc., as requested by facility management. **Note 2:** See Figure 5.1 for an example of a non-RADAR drawing and AFMAN (*formerly AFI*) 13-204 Volume 3 for non-RADAR board content.

5.2. IFR Facility Manager. During the non-RADAR program development, the IFR facility manager shall contact the Instrument Procedure Specialist and request support. **(T-3).**

5.3. IFR Facility Manager will supply the following as applicable:

5.3.1. Depiction of any current non-RADAR board. **(T-3)**.

5.3.2. Current non-RADAR program details. **(T-3).**

5.3.3. List of requested holding fixes, to include minimum and maximum holding altitudes. **(T-3)**.

5.3.4. List of departure routings (NAVAID radials) and or Standard Instrument Departures (SIDs) for each runway, to include altitudes and associated transfer of control points. **(T-3)**.

5.3.5. List of arrival routings (NAVAID radials) or Standard Terminal Arrival Routes for each runway, with required altitudes and any associated transfer of control points. **(T-3)**.

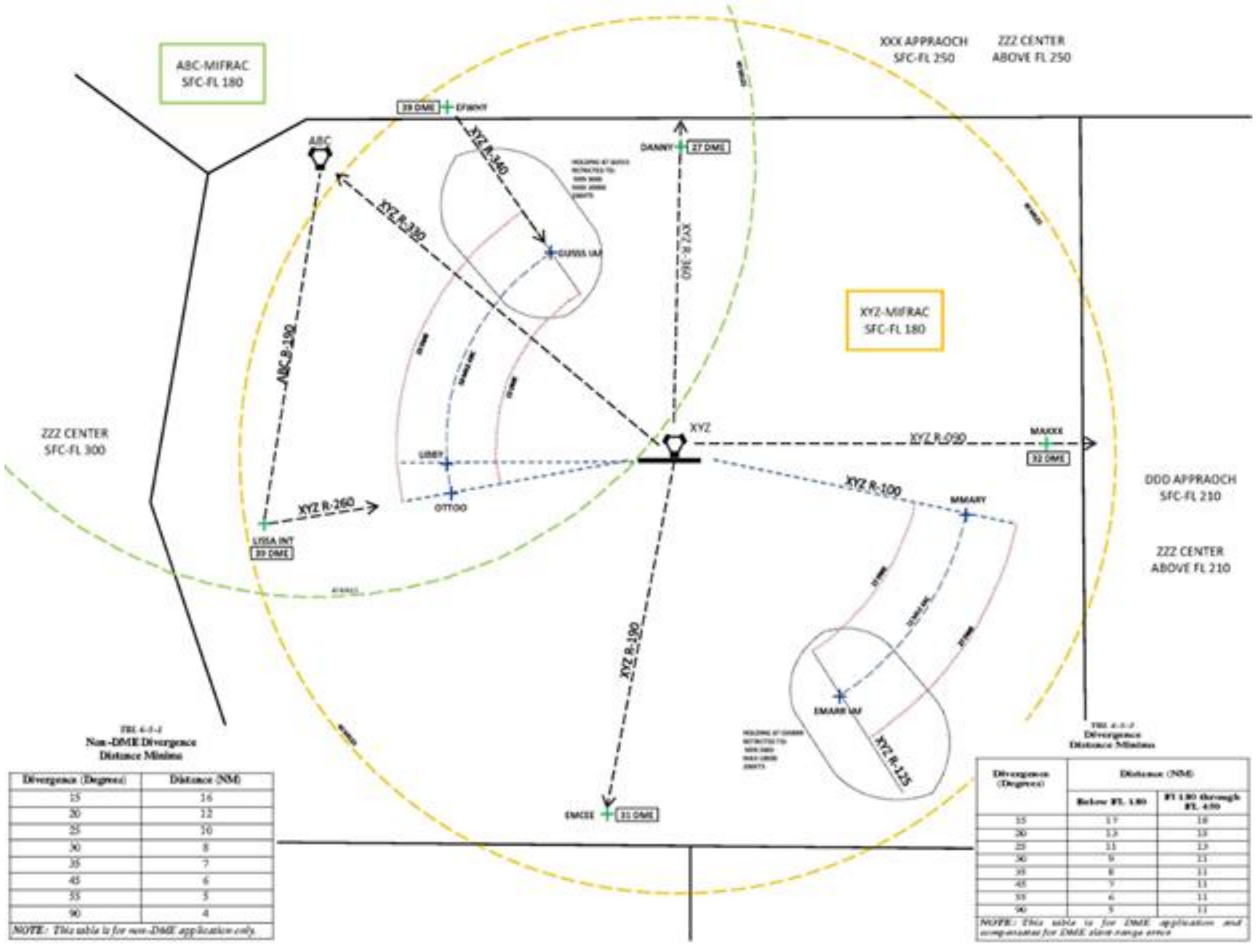
5.3.6. List of instrument procedures required to support non- RADAR operations for each airport and runway. **(T-3).**

5.3.7. List of NAVAIDs required to support the non-RADAR program. **(T-3)**.

5.3.8. Airspace description (RADAR Approach Control delegated, adjacent ATC facility and SUA). **(T-3)**.

5.3.9. Copies of Letters of Agreement with adjacent facilities that describe actions during RADAR outages. **(T-3)**.

Figure 5.1. Non-RADAR Board Example



5.4. Instrument Procedure Specialist (Unit or MAJCOM) When requested by the IFR Facility Manager will:

5.4.1. On appropriate scale aeronautical chart (electronically or manually) plot the requested non- RADAR routings (radials, arc, SIDs, approaches, missed approach segments, etc.). **(T-3)**. Note: When plotting radials, use the MV assigned to the NAVAID.

5.4.2. When drawing the airspace to be protected around a holding pattern, use GPD shape files, plastic holding templates, or manually draw the appropriate templates/patterns IAW FAA Order 8260.3D Chapter 17, *Basic Holding Criteria*, or Procedures for Air Navigation Services Operations (PANS-Ops)/NATO criteria. **(T-2)**.

5.4.3. Apply FAA Order JO 7110.65X to display airspace to be protected for arrival/departure routings, and arcs about NAVAIDs. **(T-2)**.

5.4.4. Assist ATC to determine DME points where lateral separation stops and vertical separation must exist. **(T-2)**.

5.4.5. Assist ATC to validate or develop diverging courses for non- RADAR routings as required. **(T-2).**

5.4.6. Validate routings, altitudes and holding against the MAJCOM approved MIFRAC for each NAVAID. **(T-2)**.

5.4.7. Assist ATC to de-conflict the airspace to be protected around non-RADAR routings, holding patterns, approaches, missed approaches, and SIDs as requested by facility management. **(T-2)**.

5.4.8. Clearly label all NAVAIDs, radials (magnetic), arcs about the NAVAIDs, fixes (include coordinates if requested), holding airspace with minimum and maximum authorized altitudes, and airspeed, as required. **(T-2)**.

5.4.9. Forward the completed scale drawing to the requesting IFR Facility Manager. **(T-2)**.

Chapter 6

MANUAL TERPS CALCULATIONS

6.1. ILS Application. Instrument Procedure Specialist will calculate ground point of intercept, runway point of intercept, and Threshold Crossing Height (TCH) for ILS procedures IAW FAA Order 8260.3D. See Figure 6.1, Figure 6.2, and Figure 6.3 for sample calculations. **(T-1).**

Figure 6.1. RPI/GPI/TCH Computations for Runways with Zero Slope

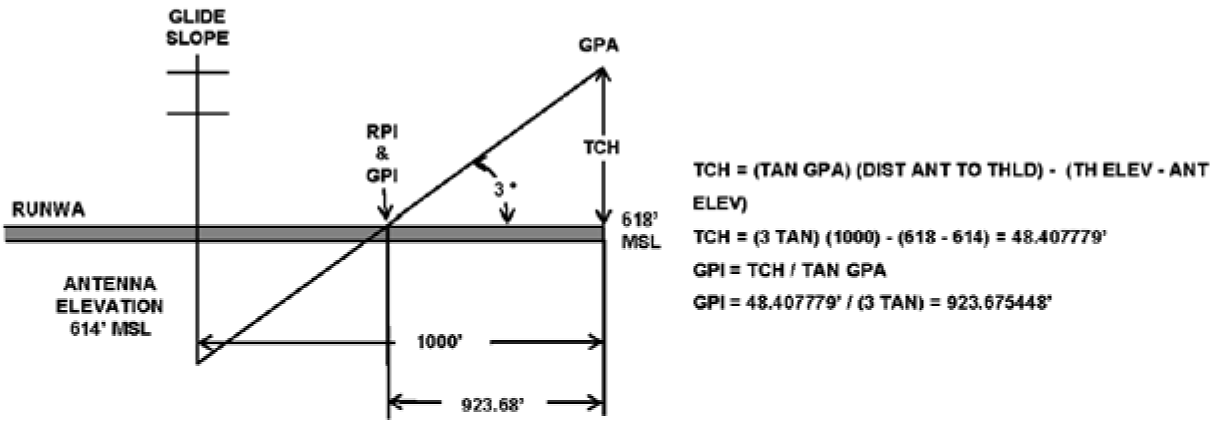


Figure 6.2. RPI/GPI/TCH Computations for Positive Sloping Runways.

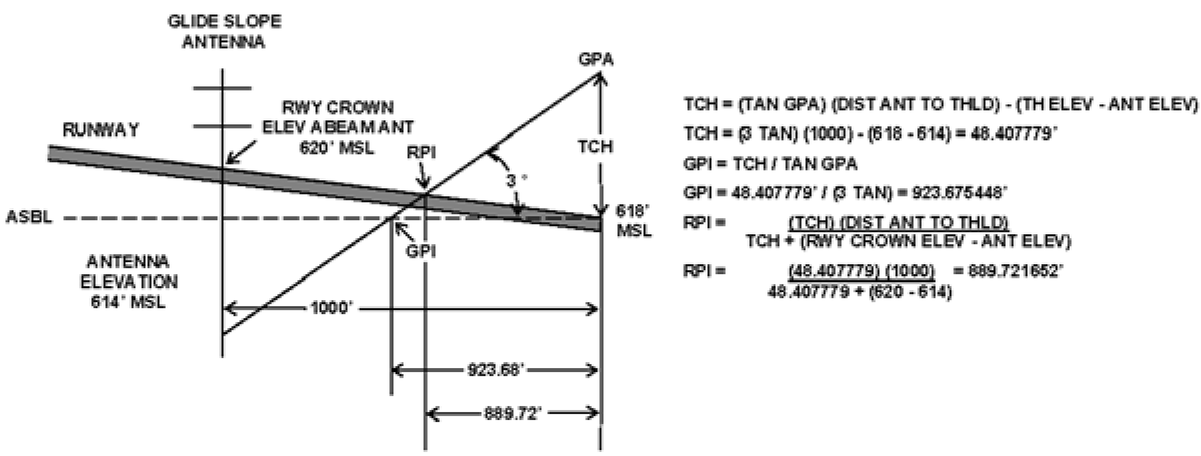
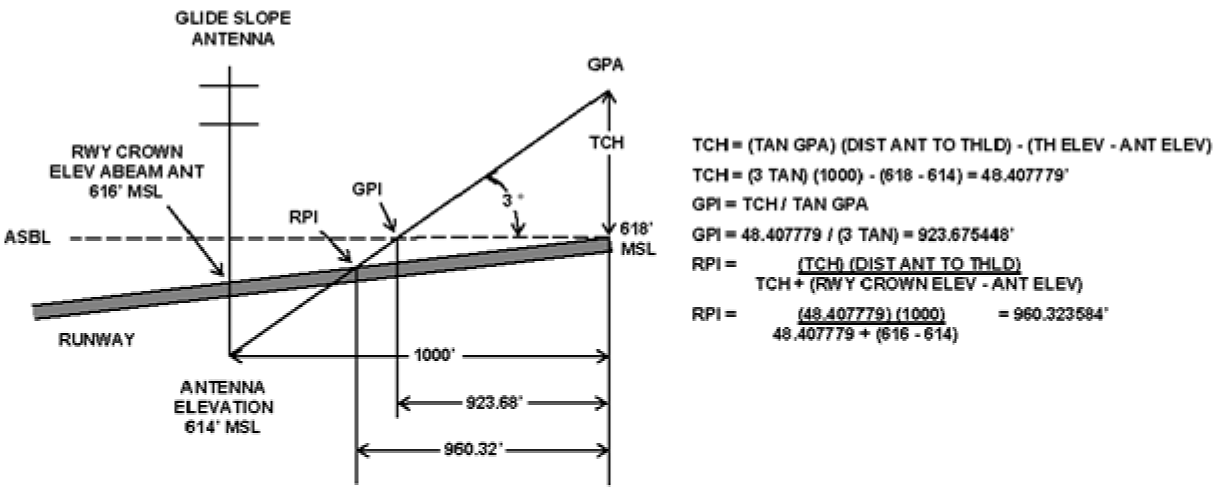


Figure 6.3. RPI/GPI/TCH Computations for Negative Sloping Runways.

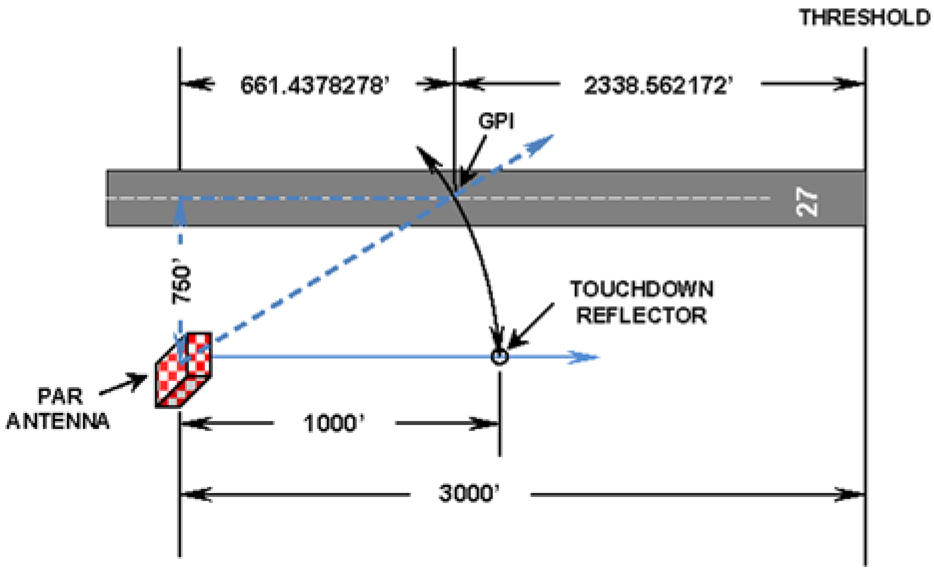


6.1.1. For a new, existing, or a relocated glide slope, enter the appropriate elevation (either site or crown elevation), as applicable, used during commissioning flight inspection of the ILS Glide Slope on the ILS properties page in GPD. Also enter this value in Block 40 of FAA Form 7900-6, *Instrument Landing System (ILS) Data*.

6.2. GPN 22/25 and TPN-19 Precision Approach RADAR (scanning RADAR) Systems. Computing the runway point of intercept is not necessary. The runway point of intercept is determined during system installation and should be coincident with the ILS runway point of intercept (where an ILS is installed). When no other precision landing aid is installed, the instrument procedure specialist determines the runway point of intercept to achieve the desired TCH consistent with mission aircraft. **(T-2)**. The "Touchdown (Kft)" value on the site parameter panel represents the distance from the runway point of intercept to the point abeam the precision approach radar (PAR) antenna, not the distance from the runway point of intercept to the threshold. In order to use the correct value for coincidence issues or FAA Form 7900-6 input, Instrument Procedure Specialist will ensure the runway point of intercept value used is from the threshold. **(T-2)**.

6.3. FPN-62 and MPN-14K Precision Approach RADAR (tracking RADAR) Systems. The ground point of intercept (touchdown) is a calculated point on the runway centerline using the requested glide slope and TCH for the procedure. The touchdown reflector is located at a point on an arc, abeam the runway centerline between the PAR antenna and the threshold where the arc centered on the PAR antenna is swung at a distance equal to the distance from the PAR antenna to the ground point of intercept (Figure 6.4). The runway point of intercept is determined during system installation and should be coincident with the ILS runway point of intercept (where an ILS is installed). When no other precision landing aid is installed, the instrument procedure specialist determines the runway point of intercept needed to achieve the desired TCH consistent with mission aircraft. **(T-2)**.

Figure 6.4. Precision Approach RADAR GPI (Touchdown) Distance from Runway Threshold.



Note: This figure is not to scale and provided only to illustrate the relationships between and among the various points involved. The distance from the PAR antenna to the touchdown reflector is equal to the distance from the PAR antenna to the ground point of intercept (touchdown).

6.4. Determining Points on Maps and Charts. Since maps do not always accurately depict the airport reference point, NAVAIDs, fixes, or the locations of some man-made obstacles, the instrument procedure specialist requires the ability to manually plot geodetic coordinates or determine the coordinates of a point depicted on a map. When using an engineer's scale to measure distances, the scale affording the greatest accuracy should be used throughout the operation.

6.4.1. Plotting Known Geographical Coordinates. Instead of Degrees/Minutes/Seconds, coordinates are sometimes recorded as Degrees/Decimal minutes. **Note:** Paragraph 6.7.3. and paragraph 6.7.4. provide example conversion calculations. **Example:** Plot the airport reference point coordinates at Myrtle Beach International Airport (N 33° 40' 47.10" W 078° 55' 42.00"):

6.4.1.1. Step 1. Locate the latitude and longitude (Lat/Lon) grid rectangle that contains the coordinates to be plotted. Figure 6.5. depicts a 1:250,000 Joint Operations Graphic (JOG). Example: The MYR airport reference point coordinates are located within the rectangle N 33° 30' 00" W 078° 45' 00" (lower right corner) to N 33° 45' 00" W 079° 00' 00" (upper left corner).

6.4.1.2. Step 2. Using an engineer's scale and a calculator, determine the number of seconds of latitude and longitude represented by each "tick" on the engineer's scale reference the map being used to plot the coordinates.

6.4.1.2.1. Latitude example.

6.4.1.2.1.1. Measure the distance between two latitudes that make the top and bottom sides of the rectangle determined in Step 1 with the 60 scale on an engineer's scale. Our example uses N 33° 30' 00" and N 33° 45' 00". This distance should measure approximately 261 "ticks" using the 60 scale between these lines of latitude.

6.4.1.2.1.2. The difference between N 33° 30' 00" and N 33° 45' 00" is 15'. Convert 15' to seconds by multiplying by 60 (15' × 60 = 900").

6.4.1.2.1.3. Divide 900" by 261 "ticks" to determine the number of seconds of latitude per "tick". 900 ÷ 261 = 3.44828 seconds of latitude per "tick".

6.4.1.2.2. Longitude example.

6.4.1.2.2.1. Measure the distance between two longitudes that make the right and left sides of the rectangle determined in Step 1 with the 60 scale on an engineer's scale. Our example uses N 78° 45' 00" and N 79° 00' 00". This should measure approximately 218 "ticks" using the 60 scale between these lines of longitude.

6.4.1.2.2.2. The difference between N 78° 45' 00" and N 79° 00' 00" is 15'. Convert 15' to seconds by multiplying by 60 (15' × 60 = 900").

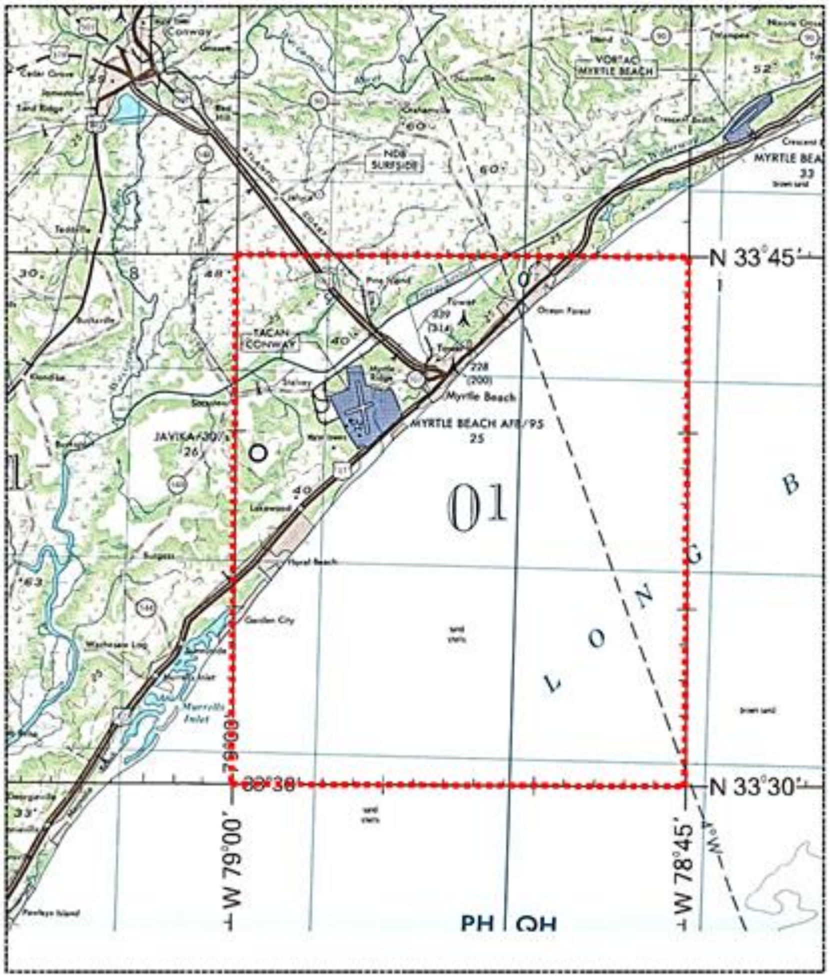
6.4.1.2.2.3. Divide 900" by 218 "ticks" to determine the number of seconds of longitude per "tick." 900 ÷ 218 = 4.12844 seconds of longitude per "tick".

6.4.1.3. Step 3. Figure 6.6. Identify a longitude on the Lat/Lon grid close to the longitude of the target coordinate. Along this same longitude line, identify the working latitude close to the latitude of the target coordinate. Add or subtract this latitude value from the target latitude as appropriate. It is generally easier to select the working latitude that is less than the target latitude, but either way is acceptable.

6.4.1.3.1. Example 1. Working latitude selected is N 33° 40' 00.00". Determine the sum of the difference between the target latitude N 33° 40' 47.10" and the working latitude to determine the number of seconds difference.

33º 40' 47.10"
-33º 40' 00.00"
47.10"

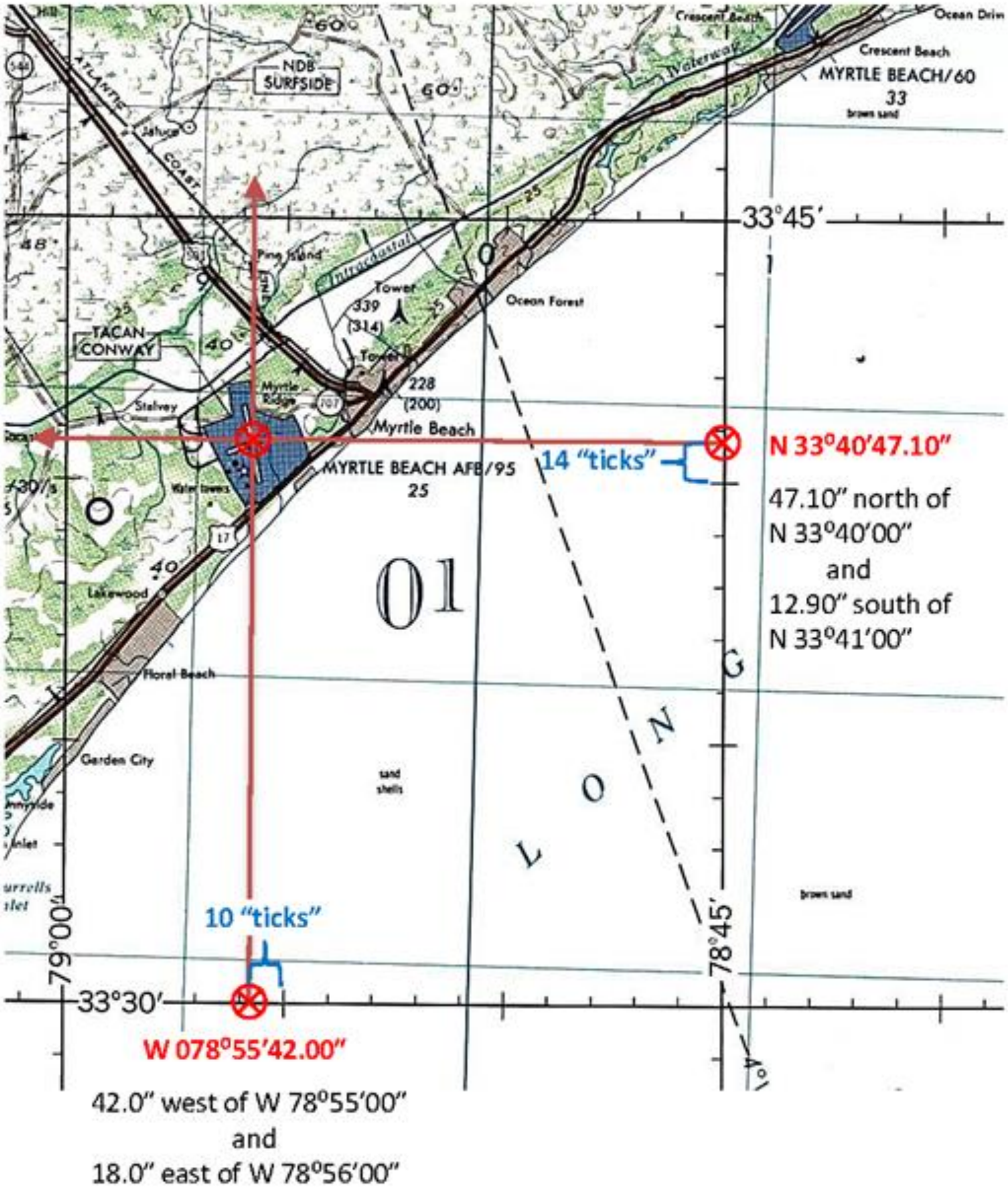
Figure 6.5. Locating the Latitude (Lat) and Longitude (Lon) Grid Rectangle Containing Target Coordinates.



6.4.1.3.2. Example 2. Working latitude selected in N 33° 41' 00.00". Determine the sum of the difference between the target latitude N 33° 40' 47.10" and the working latitude to determine the number of seconds difference.

33º 41’ 00.00”
<u>-33º 40’ 47.10”</u>
12.90”

Figure 6.6. Measuring Distance from Working Lat/Lon to Target Lat/Lon.



6.4.1.4. Step 4. Determine the number of engineer scale "ticks" for the sum determined in Step 3. Then measure this distance from the working latitude and mark with a working line perpendicular to the target longitude.

6.4.1.4.1. Example 1. 47.10" ÷ 3.44828 = 13.659 (or 14 rounded) "ticks" north of N 33° 40' 00".

6.4.1.4.2. Example 2. 12.90" ÷ 3.44828 = 3.741 (or 4 rounded) "ticks" south of N 33° 41' 00".

6.4.1.5. Step 5. Figure 6.6. Add or subtract the working longitude value from the target longitude, as appropriate, in the same manner for longitude in Step 3. It is generally easier to select a working longitude that is less than the target longitude, but either way is acceptable.

6.4.1.5.1. Example 1. Working longitude selected is W 78° 55' 00.00". Determine the sum of the difference between the target longitude W 78° 55' 42.00" and the working longitude to determine the number of seconds difference.

78º 55’ 42.00”
-78º 55’ 00.00”
42.00”

6.4.1.5.2. Example 2. Working longitude selected in W 78° 56' 00.00". Determine the sum of the difference between the target longitude W 78° 55' 42.00" and the working longitude to determine the number of seconds difference.

78º 56’ 00.00”
-78º 55’ 42.00”
18.00”

6.4.1.6. Step 6. Determine the number of engineer scale “ticks” for the sum determined in Step 5.

6.4.1.6.1. Example 1. 42.00" ÷ 4.12844 = 10.173 (or 10 rounded) “ticks” west of N 78° 55' 00".

6.4.1.6.2. Example 2. 18.00" ÷ 4.12844 = 4.360 (or 4 rounded) “ticks” east of N 78° 56' 00".

6.4.1.7. Step 7. Measure this distance from the target longitude and mark with a working line perpendicular to the latitude grid. Mark the intersection of the two working lines. This is the location of the target coordinates (airport reference point).

6.4.2. Determining Unknown Geographical Coordinates. The process for determining a set of coordinates for an object or point depicted on a map is the reverse of those steps for plotting known coordinates. Take Steps 1 and 2 as outlined in paragraph 6.4.1. Next draw two working lines through the point, first perpendicular to longitude, then perpendicular to latitude, making sure the lines are long enough to intersect the Lat/Lon grid. Determine the working latitude and longitude by finding the nearest hash mark from the points where the working lines intersect the Lat/Lon grid. Using an engineer’s scale, measure the number of “ticks” between the working lines and the working latitude or longitude. Divide the number of “ticks” by the seconds per “tick” values to determine the number of seconds the point is from the working latitude or longitude. Add or subtract as necessary the seconds from the working coordinates to determine the latitude and longitude.

6.5. Application of Magnetic Variation Conversions. Apply conversions of magnetic azimuth to true azimuth and vice versa utilizing table 6.1. and table 6.2.

Table 6.1. East Variation Conversion

WHEN CONVERTING:	APPLY THE FOLLOWING:
True to Magnetic with East Variation	**TRUE minus VARIATION equals MAGNETIC** Example: 11° East Variation 355° True minus 11° equals 344° Magnetic
Magnetic to True with East Variation	**MAGNETIC plus VARIATION equals TRUE** Example: 11° East Variation 355° Magnetic plus 011° equals 006° True (366° minus 360° equals 006°)

Note: East variation indicates that magnetic North is East of True North. To convert true azimuth to magnetic azimuth or magnetic azimuth to true azimuth with East variation, apply the applicable formula from Table 6.1. When the result is greater than 360°, subtract 360° to convert the result to a positive value between 0° and 360°.

Table 6.2. West Variation Conversion

WHEN CONVERTING:	APPLY THE FOLLOWING:
True to Magnetic with West Variation	**TRUE plus VARIATION equals MAGNETIC** Example: 11° West Variation 355° True plus 11° equals 006° Magnetic (366° minus 360° equals 006°)
Magnetic to True with West Variation	**MAGNETIC minus VARIATION equals TRUE** Example: 11° West Variation 355° Magnetic minus 011° equals 344° True

Note: West variation indicates that magnetic North is West of True North. To convert true azimuth to magnetic azimuth or magnetic azimuth to true azimuth with West variation, apply the applicable formula from Table 6.2. When the result is greater than 360°, subtract 360° to convert the result to a positive value between 0° and 360°.

6.6. True Bearing Conversions. True bearings shown on some engineering maps are depicted as values between 000 and 090, by quadrant. Convert these bearings to true azimuth (relative to true north) for TERPS application. Reference Figure 6.7, convert true bearing to true azimuth as follows:

6.6.1. Example. True Bearing N45E.

6.6.1.1. N and E identify the quadrant.

6.6.1.2. 000 plus 045 = 045° true azimuth

6.6.2. Example. True Bearing S45E

6.6.2.1. S and E identify the quadrant

6.6.2.2. 180 minus 045 = 135° true azimuth

6.6.3. Example. True Bearing S45W

6.6.3.1. S and W identify the quadrant

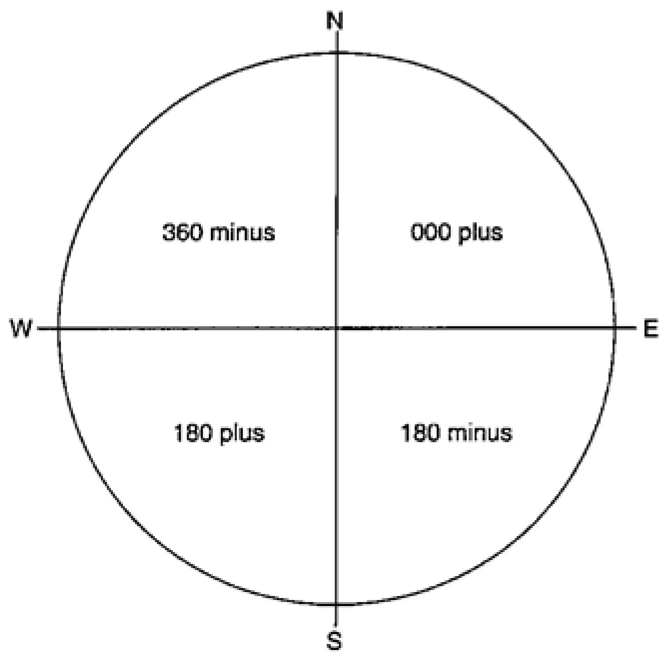
6.6.3.2. 180 plus 045 = 225° true azimuth

6.6.4. Example. True bearing N45W

6.6.4.1. N and W identify the quadrant

6.6.4.2. 360 minus 045 = 315° true azimuth

Figure 6.7. True Bearing Conversion Chart.



6.7. Miscellaneous Formulas.

6.7.1. Final approach fix to missed approach point calculation: Distance (in nautical miles) × 60 ÷ Speed in knots = Time in decimal minutes (that is, 3.5 = 3 minutes, 30 seconds)

6.7.2. Rate of Descent: feet per minute = Ground Speed in Knots × (G/S angle) × 101.2685914 ÷ 57.29577951.

6.7.3. Coordinates in Degree/Decimal minutes to Degree/Minutes/Seconds: Decimal portion of Minutes × 60 = Seconds.

Example: N 32º 25.69’
.69’ X 60 = 41.4”
N 32º 25.69’ = N32º 25’ 41.40”

6.7.4. Coordinates in Degree/Minutes/Seconds to Degree/Decimal Minutes: Seconds ÷ 60 = Minutes after the decimal; then add the minutes.

Example: N 78º 13’ 43.20”
(43.20” ÷ 60 = .72’) plus 13’ = 13.72”
N 78º 13’ 43.20” = N 78º 13.72’

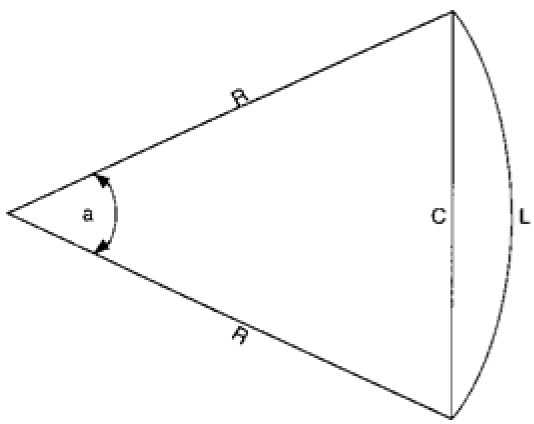
6.7.5. To find the length or angle of an arc:

Length = angle X radius ÷57.3
Angle = 57.3 X length ÷ radius

6.7.6. The following formula may be used when it becomes necessary to calculate the straight-line distance between two points on an arc (the Chord) (Figure 6.8):

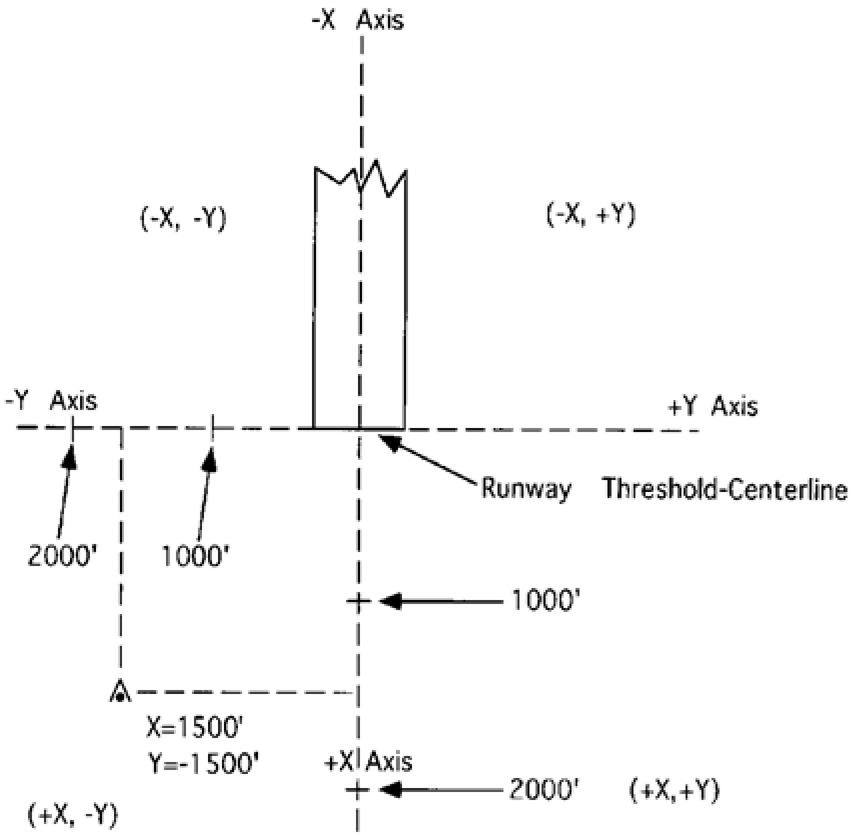
Chord (C) = 2 R sin (a) ÷ 2
Where: Angle (a) = Number of degrees between radials
Radius (R) = Distance (DME Value) of the Arc

Figure 6.8. Straight-Line Distance between Two Points of an Arc.



6.8. Cartesian Coordinates (X-Y axes). Figure 6.9. The position of an obstacle or facility can be described by referencing it to the threshold of a runway. Use an engineer’s scale and the proper measurement scale from the map to find the coordinate.

Figure 6.9. Cartesian Coordinate System.



6.9. Calculating the Length of a Teardrop Initial Segment. Use the formulas in Figure 6.10 to determine the length of the turning portion of a teardrop initial segment.

Figure 6.10. Length of Teardrop Initial Segment (turning portion only).

EXAMPLE:

Teardrop Angle: 26 degrees

Amount of Turn: 180 + 26 = 206 degrees

Turn Point Distance: 20 NM

Step 1: Find Teardrop Turn radius (*r*).

Use formula:

$$r = 2R\left(\frac{\tan a}{2}\right)$$

Where:

R = turn point distance
a = half of Teardrop Angle

2 x 20 = 40
tan 13 / 2 = 0.115434

r = 40 x 0.115434 = 4.61736 NM

Step 2: Find Length of turn (l).

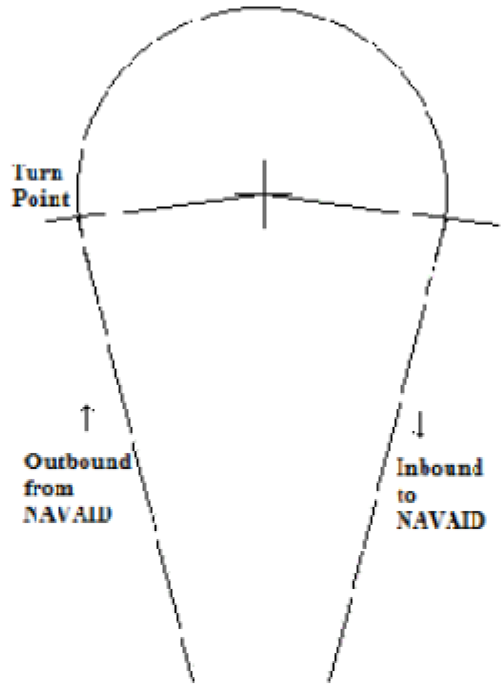
Use formula:

$$l = \frac{angle\ x\ radius}{57.29577951}$$

Where:

angle = Amount of Turn *(number of degrees required to complete the teardrop turn)*

$$l = \frac{206\ x\ 4.61736}{57.29577951} = \frac{951.17616}{57.29577951} = 16.60115\ NM$$



6.10. Convert and round host nation MSL metric values to a value expressed in feet MSL prior to publication in the DoD FLIP (Terminal). Apply conversion values from Table 6.3. Do not directly convert metric query field elevation (QFE) values to an equivalent MSL value and then round that value prior to publishing in the DoD FLIP (Terminal). When required, derive the equivalent MSL foot value of the host QFE value as follows:

6.10.1. Example **1:** The reference datum is the field elevation of 34 feet (threshold elevation 30 feet). Host publishes a QFE value of 750 meters at the stepdown fix. Do not simply divide 750 meters by 0.3047999 (750 ÷ 0.3047999 = 2460.630728) and publish 2461 in parentheses. First add the reference datum elevation to the converted value (34 + 2461 = 2495) to determine the equivalent MSL value. Next, round that result (2495) up to the next 10-foot increment (2500). Next, subtract out the reference datum elevation from the rounded value (2500 – 34 = 2466). Publish 2500 (US QNH) over 2466 (US QFE value) in parentheses at the stepdown fix on the DoD procedure.

6.10.2. **Example 2:** The reference datum is the threshold elevation of 616 feet (field elevation 625). Host publishes a QFE value of 750 meters at the final approach fix. Do not simply multiply 750 meters by 3.2808399 (750 × 3.2808399 = 2460.629925) and publish 2461 in parentheses. First add the reference datum elevation to the converted value (616 + 2461 = 3077) to determine the equivalent MSL value. Next, round that result (3077) up to the next 10-foot increment (3080) IAW paragraph 13.6.4.1.3. Next, subtract out the reference datum elevation from the rounded value (3080 – 616 = 2464). Publish 3080 (US QNH) over 2464 (US QFE value) in parentheses at the final approach fix on the DoD procedure.

Table 6.3. Distance Conversions

EQUIVALENT VALUES			
1 Nautical Mile = 6076.11548 feet		1 Nautical Mile = 1.852 Kilometers	
1 Statute Mile = 5280 feet		1 Kilometer = 3280.8399 feet	
1 Second of Latitude = 101.268594 feet (avg.)		1 Meter = 39.3700787 in./3.2808399 feet	
TO CONVERT	**TO**	**FUNCTION**	**BY VALUE**
Meters (m)	Feet (ft)	Multiply	3.2808399
		Divide	0.3047999
Feet (ft)	Meters (m)	Multiply	0.3047999
		Divide	3.2808399
Meters (m)	Yards (yd)	Multiply	1.093613298
		Divide	0.91439998
Yards (yd)	Meters (m)	Multiply	0.91439998
		Divide	1.093613298
Kilometers (km)	Statute Miles (SM)	Multiply	0.621371193
		Divide	1.609343997
Statute Miles (SM)	Kilometers (km)	Multiply	1.609343997
		Divide	0.621371193
Kilometers (km)	Nautical Miles (NM)	Multiply	0.539956804
		Divide	1.851999995
Nautical Miles (NM)	Kilometers (km)	Multiply	1.851999995
		Divide	0.539956804
Nautical Miles (NM)	Statute Miles (SM)	Multiply	1.150779447
		Divide	0.868976242
Statute Miles (SM)	Nautical Miles (NM)	Multiply	0.868976242
		Divide	1.150779447

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Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

FAA Order JO 7110.65X, *Air Traffic Control*, 12 September 2017

FAA Order JO 7210.3AA, *Facility Operation and Administration*, 12 October 2017

FAA Order 8200.1D, *United States Standard Flight Inspection Manual*, 6 November 2016

FAA Order 8260.3D, *United States Standard for Terminal Instrument Procedures (TERPS)*, 14 March 2016

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AFMAN 11-230, *Instrument Procedures,* 27 September 2013

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AFMAN 33-363, *Management of Records*, 1 March 2008

Title 14, Code of Federal Regulations (CFRs) Part 95, Subpart B, *Designated Mountainous Areas*, 29 June 1963

T.O. 31S5-4-6210-1, *USAF Global Procedure Designer (USAFGPD) Operations Manual*, 5 August 2011

Prescribed Forms

None

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*

AF Form 679, *Air Force Publication Compliance Item Waiver Request/Approval*

FAA Form 7900-6, *Instrument Landing System (ILS) Data*

Abbreviations and Acronyms

AADM—Approach Area Detail Map

AIP—Aeronautical Information Publication

ASR—Airport Surveillance RADAR

ATC—Air Traffic Control

CFR—Code of Federal Regulations

CONUS—Continental United States

DASR—Digital Airport Surveillance RADAR

DBRITE—Digital Bright RADAR Indicator Tower Equipment

DME—Distance Measuring Equipment

DVA—Diverse Vector Area

FAA—Federal Aviation Administration

FAF—Final Approach Fix

FOCA—Floor of Controlled Airspace

GPD—Global Procedure Designer

GTM—General Terrain Map

HQ AFFSA—Headquarters Air Force Flight Standards Agency

IAW—In Accordance With

ICAO—International Civil Aviation Organization

IFR—Instrument Flight Rules

LAAS—Low Altitude Alert System

MAJCOM—Major Command

MIFRAC—Minimum IFR Altitude Chart

MSAW—Minimum Safe Altitude Warning

MSL—Mean Sea Level

MV—Magnetic Variation

MVA—Minimum Vectoring Altitude

MVAC—Minimum Vectoring Altitude Chart

NAVAID—Navigational Aid

OPR—Office of Primary Responsibility

PANS—**Ops**—Procedures for Air Navigation Services Operations

PFAF—Precise Final Approach Fix

RADAR—Radio Detection and Ranging

ROC—Required Obstacle Clearance

SID—Standard Instrument Departure

STARS—Standard Terminal Automation Replacement System

SUA—Special Use Airspace

TCH—Threshold Crossing Height

TACAN—Tactical Air Navigation

TERPS—Terminal Instrument Procedures

USAF—United States Air Force

VFR—Visual Flight Rules

VORTAC—VOR and TACAN navigation facilities (collocated)

VOR—Very High Frequency Omni-Directional Range Station