283. FIXES FORMED BY RADAR. Where ATC can provide the service, Airport Surveillance Radar (ASR) may be used for any terminal area fix. PAR may be used to form any fix within the radar coverage of the PAR system. Air Route Surveillance Radar (ARSR) may be used for initial approach and intermediate approach fixes.

284. FIX DISPLACEMENT AREA. The areas portrayed in figure 28 extend along the flight course from point "A" to point "C". The fix error is a plus-or-minus value, and is represented by the lengths from "A" to "B" and "B" to "C". Each of these lengths is applied differently. The fix error may cause the fix to be received early (between "A" and "B"). Because the fix may be received early, protection against obstacles must be provided from a line perpendicular to the flight course at point "A".

285. INTERSECTION FIX DISPLACEMENT FACTORS. The intersection fix displacement area is determined by the system use accuracy of the navigation fixing systems (see figure 29). The system use accuracy in VOR and TACAN type systems is determined by the combination of ground station error, airborne receiving system error, and flight technical error (FTE). En route VOR data have shown that the VOR system accuracy along radial 4.5°, 95 percent of occasions, is a realistic, conservative figure. Thus, in normal use of VOR or TACAN intersections, fix displacement factors may conservatively be assessed as follows:

a. Along-Course Accuracy.

(1) **VOR/TACAN radials,** plus-or-minus 4.5°.

(2) **Localizer course,** plus-or-minus 1°.

(3) **NDB courses or bearing,** plus-or-minus 5°.

NOTE: The plus-or-minus 4.5° (95 percent) VOR/TACAN figure is achieved when the ground station course signal error, the FTE, and the VOR airborne equipment error are controlled to certain normal tolerances. Where it can be shown that any of the three error elements is consistently different from these assumptions (for example, if flight inspection shows a consistently better VOR signal accuracy or stability than the one assumed, or if it can be shown that airborne equipment error is consistently smaller than assumed), VOR fix displacement factors smaller than those shown above may be utilized under paragraph 141.

b. Crossing Course Accuracy.

(1) **VOR/TACAN radials,** plus-or-minus 3.6°.

(2) **Localizer course,** plus-or-minus 0.5°.

(3) **NDB bearings,** plus-or-minus 5°.

NOTE: The plus-or-minus 3.6° (95 percent) VOR/TACAN figure is achieved when the ground station course signal error and the VOR airborne equipment error are controlled to certain normal tolerances. Since the crossing course is not flown, FTE is not a contributing element. Where it can be shown that either of the error elements is consistently different, VOR displacement factors smaller than those shown above may be utilized IAW paragraph 141.

286. OTHER FIX DISPLACEMENT FACTORS.

a. Radar. Plus-or-minus 500 feet or 3 percent of the distance to the antenna, whichever is greater.

b. DME. Plus-or-minus 1/2 (0.5) miles or 3 percent of the distance to the antenna, whichever is greater.

c. 75 MHz Marker Beacon.

(1) **Normal powered fan marker,** plus-or-minus 2 miles.

(2) **Bone-shaped fan marker,** plus-or-minus 1 mile.

(3) **Low powered fan marker,** plus-or-minus 1/2 mile.

(4) **"Z" marker, plus-or-minus** 1/2 mile.

NOTE: Where these 75 MHz marker values are restrictive, the actual coverage of the fan marker (2 milliamp signal level) at the specific location and altitude may be used instead.

d. Overheading a Station. The fix error involved in station passage is not considered significant in terminal applications. The fix is therefore considered to be at the plotted position of the navigation facility. The use of TACAN station passage as a fix is **NOT** acceptable for holding fixes or high altitude IAF's.

287. SATISFACTORY FIXES.

a. Intermediate, Initial, or Feeder Fix. To be satisfactory as an intermediate, initial, or feeder approach fix, the fix error must not be larger than 50 percent of the appropriate segment distance that follows the fix. Measurements are made from the plotted fix position (see figure 29).

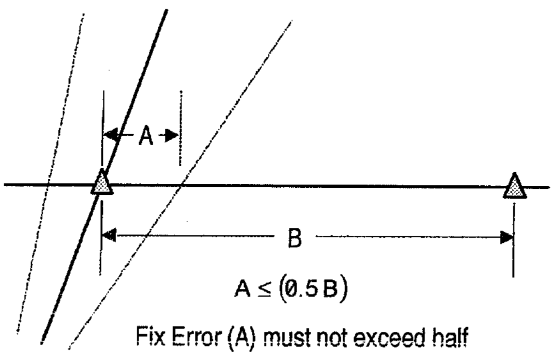


Figure 29. INTERMEDIATE, INITIAL, OR FEEDER APPROACH FIX ERRORS. Par 287.

b. Holding Fixes. Any terminal area fix except overheading a TACAN may be used for holding. The following conditions shall exist when the fix is an intersection formed by courses or radials:

(1) **The angle of divergence** of the intersecting courses or radials shall not be less than 45°.

(2) **If the facility** which provides the crossing courses is NOT an NDB, it may be as much as 45 miles from the point of intersection.

(3) **If the facility which provides** the crossing course is an NDB, it must be within 30 miles of the intersection point.

(4) **If distances stated in paragraphs 287b(2)** or (3) are exceeded, the minimum angle of divergence of the intersecting courses must be increased at the following rate:

(a) If an NDB facility is involved, 1° for each mile over 30 miles.

(b) If an NDB facility is NOT involved, 1/2° for each mile over 45 miles.

FIGURE 30 DELETED BY CHG 19.

c. FAF. For a fix to be satisfactory for use as a FAF, the fix error should not exceed plus-or-minus 1 mile (see figures 31-1 and 31-2). It may be as large as plus-or-minus 2 miles when:

(1) The MAP is marked by overheading an air navigation facility (except 75 MHz markers); OR

(2) A buffer of equal length to the excessive fix error is provided between the published MAP and the point where the missed approach surface begins (see figure 32).

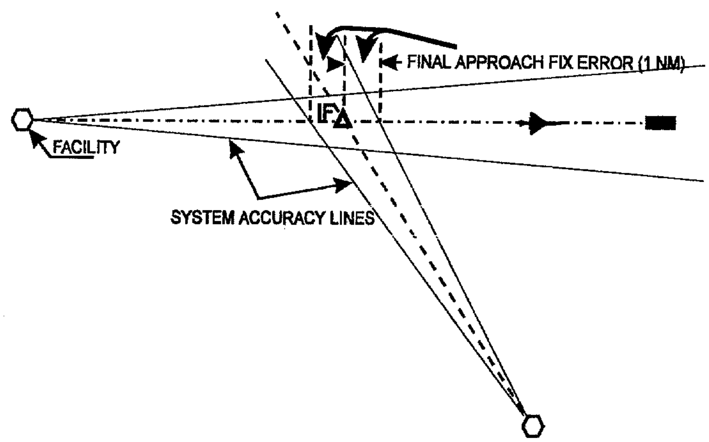


Figure 31-1. MEASUREMENT OF FAF ERROR. Par 287c.

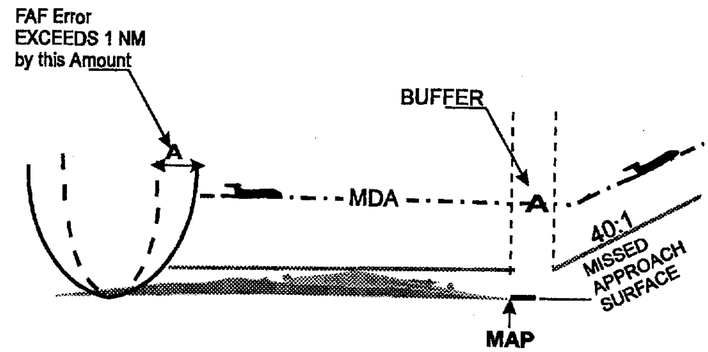
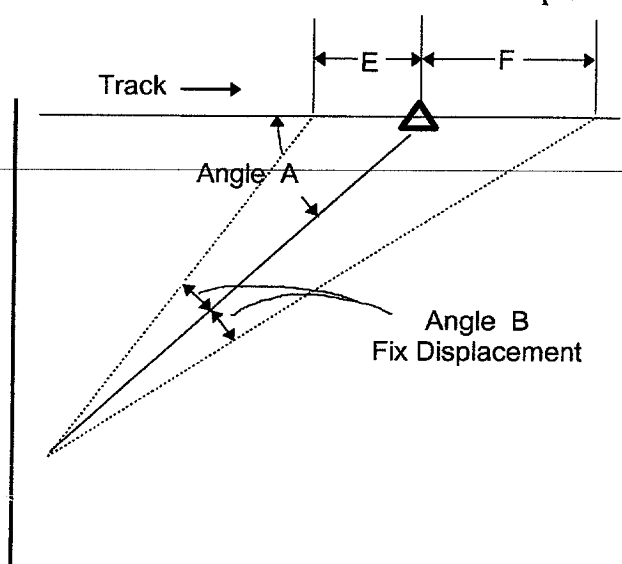


Figure 32. FAF ERROR BUFFER. Par 287c(2).

Calculate fix displacement using the following formulas:



Formula	*Example*
$E = \frac{6076.11548 \times D \times \text{Sin}\,B}{\text{Sin}\,(A+B)}$	$E = \frac{6076.11548 \times 30 \times \text{Sin}\,3.6^\circ}{\text{Sin}\,(50+3.6^\circ)}$
	$E = 14220.10$
$F = \frac{6076.11548 \times D \times \text{Sin}\,B}{\text{Sin}\,(A-B)}$	$F = \frac{6076.11548 \times 30 \times \text{Sin}\,3.6^\circ}{\text{Sin}\,(50^\circ - 3.6^\circ)}$
	$F = 15805.19$

Figure 31-2. FIX DISPLACEMENT CALCULATIONS. Par 287c.

between the step-down fix and the MAP, provided the fix is within 6 miles of the landing surface. These criteria are applicable to nonprecision approach procedures only.

324. DECISION ALTITUDE (DA). The DA applies to approach procedures where the pilot is provided with glidepath deviation information; e.g., ILS, MLS, TLS, GLS, LNAV/VNAV, Baro VNAV, or PAR. The DA is the barometric altitude, specified in feet above MSL, at which a missed approach shall be initiated if the required visual reference has not been established. DA's shall be established with respect to the approach obstacle clearance and HAT requirements specified in TERPS Volume 3.

325. DECISION HEIGHT (DH). The DH is the value of the DA expressed in feet above the highest runway elevation in the touchdown zone. This value is also referred to as **HAT**.

326.-329. RESERVED.

Section 3. Visibilities.

330. ESTABLISHMENT OF VISIBILITY MINIMUMS.

a. Straight-in minimums for NONPRECISION approaches shall be established for an approach category when:

(1) The final approach course-runway alignment criteria have been met, AND

(2) The visibility requirements of paragraph 331 are met, AND

(3) The height of the MDA above touchdown zone elevation (TDZE) and the associated visibility are within the tolerances specified in paragraph 331, AND

(4) The descent gradient from the final approach fix to the runway does not exceed the maximum specified in the applicable facility chapter of this order.

b. Straight-in minimums for PRECISION approaches shall be established for an approach category when the final approach course alignment criteria have been met.

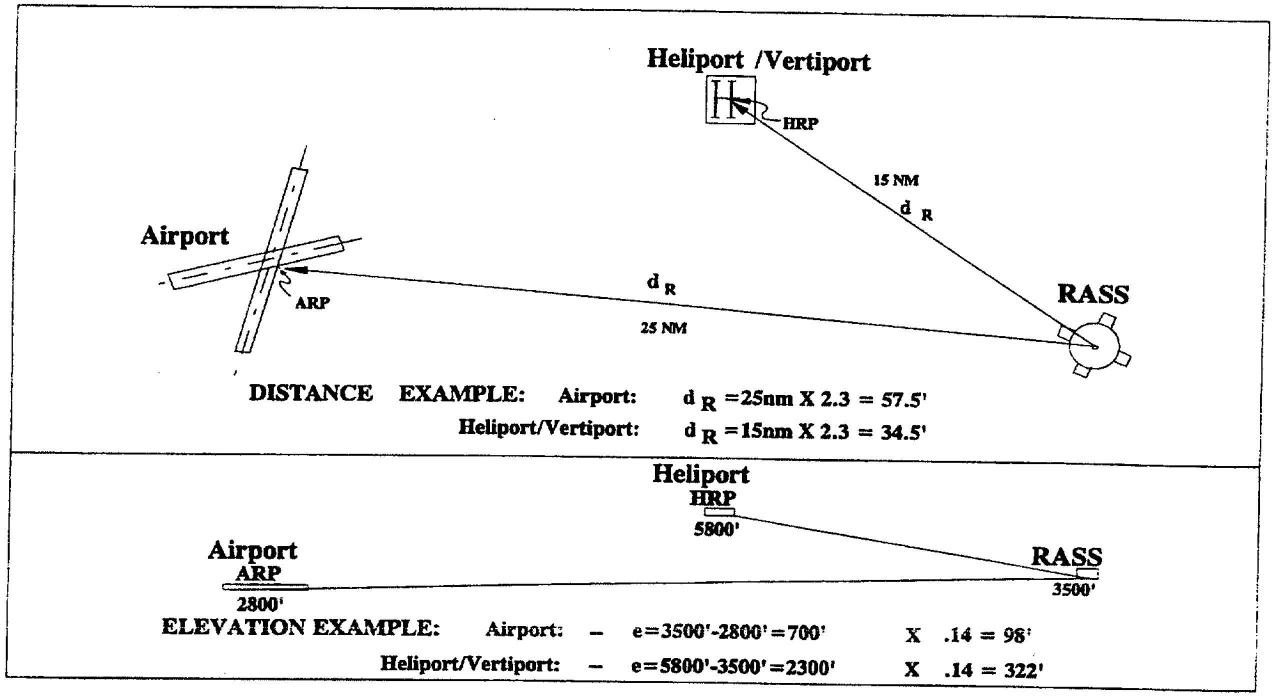
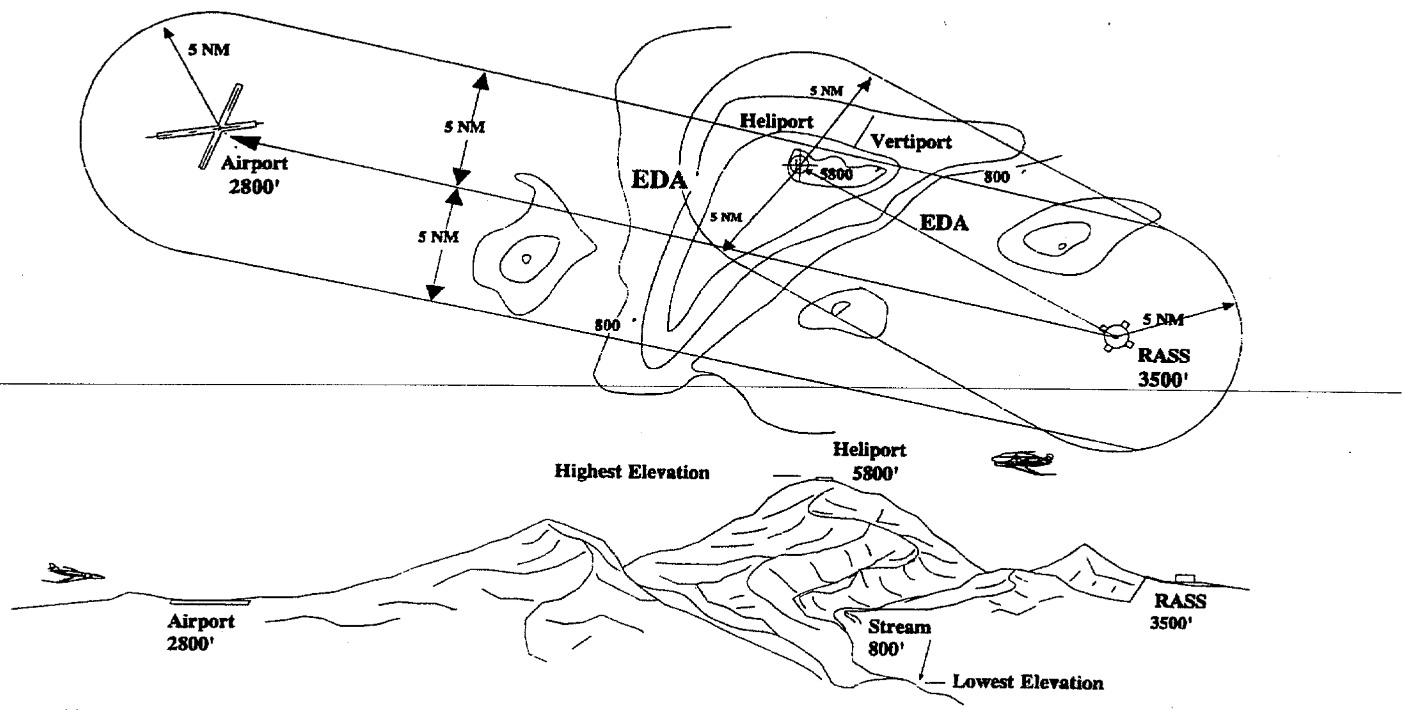


Figure 37B. DISTANCE REMOTED (d_R) AND ELEVATION. Par 323b.



EXAMPLE: ELEVATION DIFFERENTIAL: Airport: – E=5800'-800'=5000' X .14 = 700'
Heliport/Vertiport: – E=5800'-800'=5000' X .14 = 700'

Figure 37C. ELEVATION DIFFERENTIAL AREA (EDA). Par. 323b. WHERE INTERVENING TERRAIN INFLUENCES ATMOSPHERIC PRESSURE PATTERNS.

Table 8. STANDARD LIGHTING SYSTEMS

ABBREV. IFR	LIGHTING SYSTEM	Operating. Coverage (Degrees) Lateral (±)	Vertical (above Horizon.)
ALSF-I	Standard approach light system with sequenced flashers	21.0* 12.5#	12.0* 12.5#
ALSF-II	Standard approach light system with sequenced flashers & CAT II mod.	21.0* 12.5#	12.0* 12.5#
SSALS	Simplified short approach light system	21.0	12.0
SSALF	Simplified short approach light system with sequenced flashers	21.0* 12.5#	12.0* 12.5#
SSALR	Simplified short approach light system with runway alignment indicator lights	21.0* 12.5#	12.0* 12.5#
MALS	Medium intensity approach light system	10.0	10.0*
MALSF	Medium intensity approach light system with sequenced flashers	10.0* 12.5#	10.0* 12.5#
MALSR	Medium intensity approach light system with runway alignment indicator lights	10.0* 12.5#	10.0* 12.5#
ODALS	Omnidirectional approach light system	360#	+2- +10#
VFR			
REIL	Runway end identifier lights	12.5	12.5
LDIN	Lead-in lighting system (can be * or #)	12.5	12.5
VASI	Visual approach slope indicators	10.0	3.5

RUNWAY LIGHT SYSTEMS

HIRL	High intensity runway lights
MIRL	Medium intensity runway lights
LIRL	Low intensity runway lights
TDZ/CL	Touchdown zone and centerline lights

NOTE: *Descriptions of lighting systems may be found in appendix 5 and FAA Order 6850.2.*

**Steady-burning* *#Sequenced flashers*

343. VISIBILITY REDUCTION. Standard visibility requirements are computed by applying the criteria contained in paragraph 331. When the visibility without lights value does not exceed 3 statute miles, these requirements may be reduced by giving credit for standard or equivalent approach light system as follows (see paragraph 341 and appendix 5):

a. **The provisions of paragraphs** 251, 332, 342, or 1025 must be met.

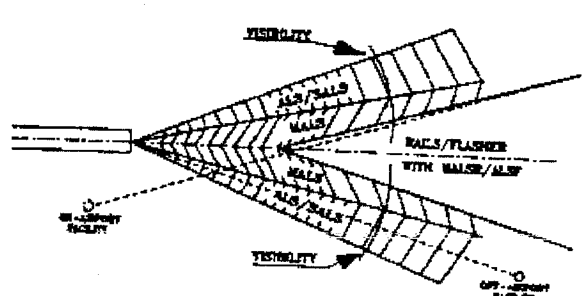


Figure 37D. APPLICATION OF LATERAL COVERAGE ANGLES OF TABLE 8, Par 42b.

NOTE: The final approach course to an 'on airport' facility transits all approach light operational areas within the limits of visibility arc, whereas the final approach course from the 'off-airport' facility may be restricted only to an ALS or SALS for visibility credit.

b. Where the visibility required without lights does not exceed one mile, visibility as low as that specified in the appropriate table in paragraph 350 with associated DH or HAT and lighting may be authorized.

c. For civil application, where the visibility required without lights exceeds 1 mile, a reduction of ½ mile may be made for SSALR, MALSR or ALSF-1/2 provided such visibility minimum is not less than that specified in paragraph 350. Reduction for CAT D aircraft in NDB approach procedures shall not exceed 1/4 mile or result in visibility minimums lower than 1 mile.

d. For military applications, where the visibility required without lights exceeds 1 mile, a reduction of 1/4 mile may be made for SSALS, SALS, MALS, or ODALS, and a reduction of 1/2 mile may be made for ALS, SSALR, or MALSR provided such visibility minimum is not less than that specified in paragraph 350.

e. Where visibility minimums are established in order to see and avoid obstacles, visibility reductions shall not be authorized.

f. Visibility reductions are NOT cumulative.

344. OTHER LIGHTING SYSTEMS. In order for variations of standard systems and other systems not included in this chapter to receive visibility reduction credit, the operational conditions specified in paragraph 342 must be met. Civil airport lighting systems which do not meet known standards or for which criteria do not exist, will be handled UNDER the provisions of paragraph 141. Military lighting systems may be equated to standard systems for reduction of visibility as illustrated in appendix 5. Where existing systems vary from the configurations illustrated there and cannot be equated to a standard system, they shall be referred to the appropriate approving authority for special consideration.

345.-349. RESERVED.

SECTION 5. STANDARD MINIMUMS

350. STANDARD STRAIGHT-IN MINIMUMS. Table 9 specifies the lowest NONPRECISION and Volume 3, table 2-2B specifies the lowest PRECISION civil minimums that may be prescribed for various combinations of electronic and visual navigation aids. Table 10 specifies the lowest DOD NONPRECISION and PRECISION minimums. Lower minimums based on special equipment or aircrew qualifications may be authorized only by approving authorities. Higher minimums shall be specified where required by application of criteria contained elsewhere in this order.

351. STANDARD CIRCLING MINIMUMS. Table 11 specifies the lowest civil and military minimums that may be prescribed for circling approaches. See also paragraph 330c. The MDA established by application of the minimums specified in this paragraph shall be rounded to the next higher 20 feet.

352.-359. RESERVED.

SECTION 6. ALTERNATE MINIMUMS

360. STANDARD ALTERNATE MINIMUMS. Minimums authorized when an airport is to be used as an alternate airport appear in table 12. The ceiling and visibility specified shall NOT be lower than the circling HAA and visibility, or as specified in military directives for military operations.

361.-369. RESERVED.

SECTION 7. DEPARTURES

370. STANDARD TAKEOFF MINIMUMS. Where applicable, civil standard takeoff minimums are specified by the number of engines on the aircraft. Takeoff minimums are stated as visibility only, except where the need to see and avoid an obstacle makes a ceiling value necessary (see table 13). In this case the published procedure shall identify the location of the controlling obstacle. Takeoff minimums for military operations shall be as stated in the appropriate service directives.

Table 9. STANDARD STRAIGHT-IN MINIMUMS

	NONPRECISION APPROACHES Procedures associated with 14 CFR Part 97.23, 25, 27, 31, 33, and 35					
	APPROACH LIGHT CONFIGURATION	CAT →	A — B — C		D	
		HAT[1]	Vis	or RVR	Vis	or RVR
1	NO LIGHTS	250	1	5000	1	5000
2	ODALS	250	3/4	4000	1	5000
3	MALS	250	3/4	4000	1	5000
4	SSALS/SALS	250	3/4	4000	1	5000
5	MALSR	250	1/2[2]	2400	1[3]	5000
6	SSALR	250	1/2[2]	2400	1[3]	5000
7	ALSF-1	250	1/2[2]	2400	1[3]	5000
8	DME Arc Any Light Configuration	500	1	5000	1	5000

[1] Add 50 ft to HAT for VOR without FAF or NDB with FAF.
Add 100 ft to HAT for NDB without FAF.
[2] For NDB approaches, 3/4 mile or RVR 4000.
[3] For LOC and LNAV/VNAV, 3/4 miles or RVR 4000.

	PRECISION APPROACHES 14 CFR Part 97.29					
	APPROACH LIGHT CONFIGURATION	CAT →	A — B — C		D	
		HAT[4]	Vis	or RVR	Vis	or RVR
9	NO LIGHTS	200	3/4	4000	3/4	4000
~~10~~	~~MALSR~~	~~200~~	~~1/2~~	~~2400~~	~~1/2~~	~~2400~~
11	SSALR	200	1/2	2400	1/2	2400
12	ALSF-1	200	1/2	2400	1/2	2400
13	ALSF-1-TDZ/CL MALSR-TDZ/CL SSALR-TDZ/CL	200	-	1800	-	1800

[4] ILS includes LOC, GS, and OM (or FAF). For an Offset LOC, the minimum HAT is 250 and minimum RVR is 2400.

NOTE: HIRL is required for RVR. Runway edge lights required for night.

Table 10. MILITARY STANDARD STRAIGHT-IN MINIMUMS

		NO LIGHTS		ALS TDZ/CL		ALS		SSALR		SALS or SSALS		MALSR		MALS		ODALS	
PRECISION																	
HAT	CAT	MILE	RVR[1]	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR
100	A–E	1/2	24	—	12	1/4	18	1/4	16	1/4	16	1/2	24	1/2	24	1/2	24
200	A–B	3/4	40	1/2	18	1/2	24	1/2 [2]	24 [2]	1/2	24	1/2	24	3/4	40	1/2	24
200	C.D.E..	3/4	40	1/2 [2]	24 [2]	1/2 [2]	24 [2]	1/2 [2]	24 [2]	3/4	40	1/2 [2]	24 [2]	3/4	40	3/4	40
250	A–B	3/4 [4]	40 [4]	1/2	24	1/2 [3]	24 [3]	1/2	24	3/4	40	1/2	24	3/4	40	3/4	40
250	C.D.E	1	50	1/2	24	1/2 [3]	24 [3]	1/2	24	3/4	40	1/2	24	3/4	40	1	50
NONPRECISION																	
AS REQUIRED	A-B	1	50	1/2	24	1/2	24	1/2	24	3/4	40	1/2	24	3/4	40	3/4	40
AS REQUIRED	C.D.E	1	50	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40
DME ARC APPROACH																	
AS REQUIRED	A–E	1	50	(REDUCTION BELOW ONE MILE NOT AUTHORIZED)													

[1]RVR shown in hundreds of feet, i.e., RVR 24=2,400 feet.
[2]Minimum length of approach lights is 2,000 feet.
[3]For non-standard ALS lengths of:
a. 2,400 to 2,900 feet, use SSALR.
b. 1,000 to 2,300 feet, use SSALS.
[4]When the MAP is located 3/4 statute mile or less from the threshold.

INSTRUCTIONS FOR ESTABLISHING MILITARY STRAIGHT-IN MINIMUMS (Use Table 10)

STEP 1.	Determine the required DH or MDA by applying criteria found in the appropriate facility chapter of this Order.
STEP 2.	Determine the height above touchdown (HAT) zone elevation.
~~STEP 3.~~	~~Determine the visibility value as follows:~~ a. Precision Approaches. (1) HAT 250 feet or less. Enter "precision" portion of table 10 at HAT value for aircraft approach category. Read across table to determine minimum visibility for the appropriate light system. If the HAT is not shown on the table, use the next higher HAT. (2) HAT greater than 250 feet. Use the instructions for the nonprecision minimums in paragraph b below. Paragraph 331 does not apply. b. Nonprecision Approaches. Determine the basic visibility by application of criteria in paragraphs 330 and 331. If the basic visibility is 1 mile, enter table 10 with aircraft approach category being considered. Read across the table to ~~determine minimum visibility for the appropriate light system.~~
STEP 4.	Establish ceiling values in 100-foot increments in accordance with paragraph 310.

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CHAPTER 8. VHF/UHF DF PROCEDURES

800. GENERAL. These criteria apply to direction finder (DF) procedures for both high and low altitude aircraft. DF criteria shall be the same as criteria provided for automatic direction finder (ADF) procedures, except as specified herein. As used in this chapter, the word "facility" means the DF antenna site. DF approach procedures are established for use in emergency situations. However, where required by a using agency, DF may be used for normal instrument approach procedures.

801.-809. RESERVED.

Section 1. VHF/UHF DF Criteria

810. EN ROUTE OPERATIONS. En route aircraft under DF control follow a course to the DF station as determined by the DF controller. A minimum safe altitude shall be established which provides at least 1,000 feet (2,000 feet in mountainous areas) of clearance over all obstacles within the operational radius of the DF facility. When this altitude proves unduly restrictive, sector altitudes may be established to provide relief from obstacles, which are clear of the area where flight is conducted. Where sector altitudes are established, they shall be limited to sectors of not less than 45 degrees in areas BEYOND a 10-mile radius around the facility. For areas WITHIN 10 miles of the facility, sectors of NOT LESS THAN 90 degrees shall be used. Because the flight course may coincide with the sector division line, the sector altitude shall provide at least 1,000 feet (2,000 feet in mountainous terrain) of clearance over obstacles in the adjacent sectors within 6 miles or 20 degrees of the sector division line, whichever is the greater. No sector altitude shall be specified which is lower than the procedure or penetration turn altitude or lower than the altitude for area sectors, which are closer to the navigation facility.

811. INITIAL APPROACH SEGMENT. The initial approach fix is overhead the facility.

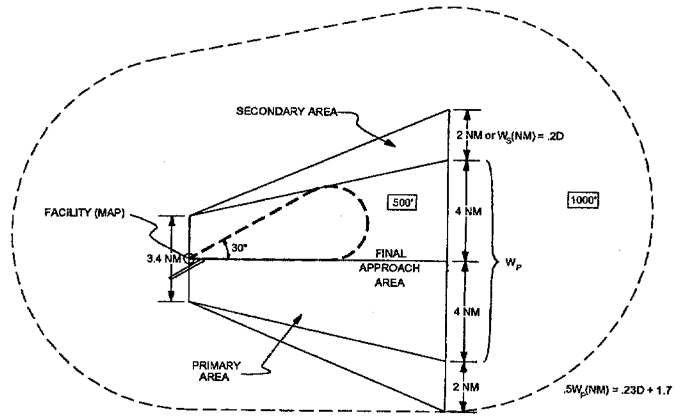


Figure 72. LOW ALTITUDE DF APPROACH AREA, Par 8ll.

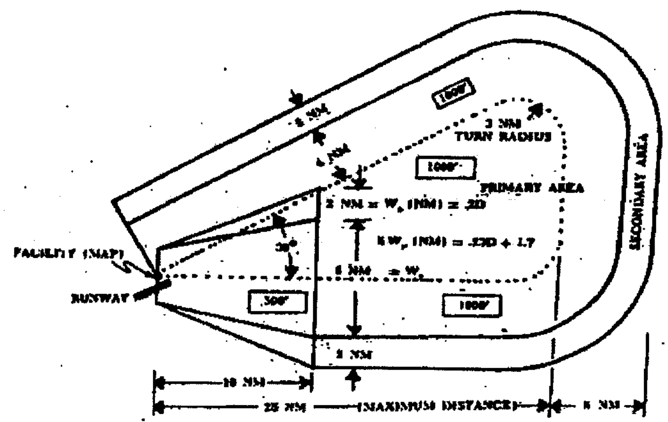


Figure 73, HIGH ALTITUDE DF APPROACH AREA, Par 811.

a. Low Altitude Procedures. The initial approach may be either a 10-mile teardrop procedure turn or the triangular procedure illustrated in figure 72. In either case, the 10-mile procedure turn criteria contained in paragraphs 234a, b, c, and d apply.

b. High Altitude Procedures. The initial approach may be either the standard teardrop penetration turn or the triangular procedure illustrated in figure 73. When the teardrop penetration turn is used, the criteria contained in paragraphs 235a, b, c, and d apply. When the triangular procedure is used, the same criteria apply except that the limiting angular divergence between the outbound course and the reciprocal of the inbound course may be as much as 45 degrees.

812. INTERMEDIATE APPROACH SEGMENT. Except as outlined in this paragraph, criteria for the intermediate segment are contained in chapter 2, section 4. An intermediate segment is used only when the DF facility is located off the airport and the final approach is made from overhead the facility to the airport. The width of the primary intermediate area is 3.4 miles at the facility, expanding uniformly on each side of the course to 8 miles wide 10 miles from the facility. A secondary area is on each side of the primary area. It is zero miles wide at the facility, expanding along the primary area to 2 miles each side at 10 miles from the facility. See figure 74.

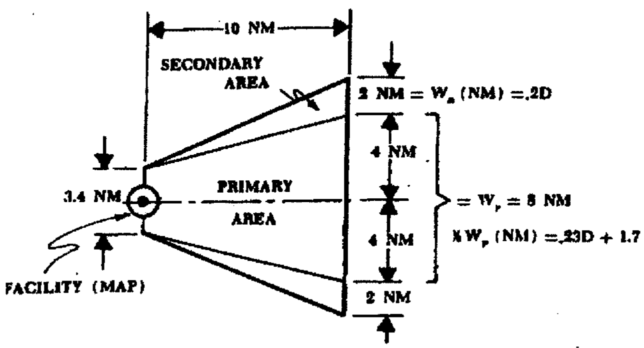


Figure 74. DF INTERMEDIATE APPROACH AREA. Par 812.

813. FINAL APPROACH SEGMENT. The final approach begins at the facility for off-airport facilities or where the procedure turn intersects the final approach course for on-airport facilities (see paragraph 400 for the definition of on-airport facilities). DF procedures shall not be developed for airports that are more than 10 miles from the DF facility. When a facility is located in excess of 6 miles from an airport, the instrument approach shall end at the facility and flight to the airport shall be conducted in accordance with visual flight rules (VFR).

a. Alignment.

(1) On - Airport Facilities. Paragraphs 613a(1) and (2) apply.

(1) Off - Airport Facilities. Paragraphs 713a(1)(a) and (b) apply.

b. Area.

(1) Low Altitude Procedures. Figure 74 illustrates the final approach primary and secondary areas. The primary area is longitudinally centered on the final approach course and is 10 miles long. The primary area is 3.4 miles wide at the facility and expands uniformly to 8 miles wide at 10 miles from the facility. A secondary area is on each side of the primary area. It is zero miles wide at the facility and expands uniformly to 2 miles on each side of the primary area at 10 miles from the facility.

(2) High Altitude Procedures. The area considered is identical to that described in paragraph 623b and figure 60 except that the primary area is 3.4 miles wide at the facility.

c. Obstacle Clearance.

(1) Straight-In. The minimum obstacle clearance in the primary area is 500 feet. In the secondary areas, 500 feet of obstacle clearance shall be provided at the inner edge, tapering to zero feet at the outer edge. The minimum required obstacle clearance at any given point in the secondary area can be computed by using the formula specified in paragraph 523b.

~~**(2) Circling Approach.** In addition to~~ the minimum requirements specified in paragraph 813c(1), obstacle clearance in the circling area shall be as prescribed in chapter 2, section 6.

d. Procedure Turn Altitude. The procedure turn completion altitude (minimum base leg altitude in triangular procedures) shall be within 1,500 feet of the MDA on final approach.

e. Penetration Turn Altitude (Descent Gradient). The penetration turn altitude (minimum base leg altitude in triangular procedures) shall be at least 1,000 feet but not more than 4,000 feet above the MDA on final approach.

f. Minimum Descent Altitude (MDA). The criteria for determining MDA are contained in chapter 3, section 2, except that in high altitude procedures, the MDA specified shall provide at least 1,000 feet of clearance over obstacles in that portion of the initial approach segment between the final approach segment and the point where the assumed penetration course intercepts the inbound course (see figure 60).

814. MISSED APPROACH SEGMENT. Criteria for the missed approach segment are contained in chapter 2, section 7. For on-airport facility locations, the missed approach point is the facility. For off-airport facility locations, the missed approach point is a point on the final approach course which is NOT farther from the facility than the first usable landing surface. The missed approach surface shall commence over the missed approach point at the required height (see paragraph 274).

815.-819. RESERVED.

Section 2. Communications.

820. TRANSMISSION INTERVAL. DF navigation is based on voice transmission of heading and altitude instructions by a ground station to the aircraft. The MAXIMUM interval between transmissions is:

a. En route Operations. 60 seconds.

b. From the Initial Approach Fix to Within an Estimated 30 Seconds of the Final Station Passage or Missed Approach Point. 15 seconds

c. **Within 30 Seconds of the Final Station Passage or Missed Approach Point.** 5 seconds. (15 seconds for doppler DF equipment).

821.-829. RESERVED.

Section 3. Minimums.

830. APPROACH MINIMUMS. The minimums established for a particular airport shall be as prescribed by the appropriate approving agency, but the MDA shall NOT be lower than that required for obstacle clearance on final approach and in the circling area specified in chapter 2, section 6.

831.-899. RESERVED.

CHAPTER 9. LOCALIZER AND LOCALIZER TYPE DIRECTIONAL AIDS (LDA)

900. FEEDER ROUTES, INTIAL APPROACH, AND INTERMEDIATE SEGMENTS. These criteria are contained in chapter 2, Section 3. When associated with a precision approach procedure, Volume 3, paragraph 2.3 applies.

901. USE OF LOCALIZER ONLY. Where no usable glidepath is available, a localizer-only (front or back course) approach may be approved, provided the approach is made on a LOC from a FAF located within 10 miles of the runway threshold. Criteria in this section are also applicable to procedures based on localizer type directional aids (LDA). Back course procedures shall not be based on courses that exceed 6° in width and shall not be approved for offset LOC.

902. ALIGNMENT. Localizers which are aligned within 3° of the runway alignment shall be identified as localizers. If the alignment exceeds 3°, they will be identified as LDA facilities. The alignment of the course for LDA facilities shall meet the final approach alignment criteria for VOR on-airport facilities. See chapter 5, paragraph 513, and figure 48.

903. AREA. The final approach dimensions are specified in figure 75. However, only that portion of the final approach area that is between the FAF and the runway need be considered as the final approach segment for obstacle clearance purposes. The optimum length of the final approach segment is 5 miles. The MINIMUM length of the final approach segment shall be sufficient to provide adequate distance for an aircraft to make the required descent. The area shall be centered on the FAC and shall commence at the runway threshold. For LDA procedures, the final approach area shall commence at the facility and extend to the FAF. The MAP for LDA procedures shall not be farther from the FAF than a point adjacent to the landing threshold perpendicular to the FAC. Calculate the width of the area using the following formulae:

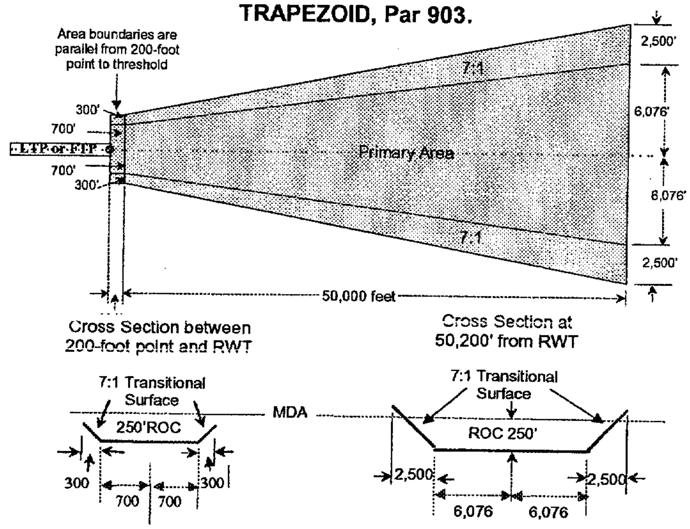
Perpendicular Width from RCL to the Edge of the Primary = $0.10752(D-200)+700$

Perpendicular Width from RCL to the Edge of the Transitional Sfc = $0.15152(D-200)+1000$

Where D = Distance (ft) from RWT measured along RCL

904. OBSTACLE CLEARANCE. The minimum ROC in the final approach area is 250 feet. In addition, the MDA established for the final approach area shall assure that no obstacles penetrate the 7:1 transitional surfaces.

Figure 75. LOCALIZER FINAL TRAPEZOID, Par 903.



905. DESCENT GRADIENT. The OPTIMUM gradient in the final approach segment is 318 feet per mile. Where a higher descent gradient is necessary, the MAXIMUM permissible gradient is 400 feet per mile. When maximum straight-in descent gradient is exceeded, then a "circling only" procedure is authorized. When a stepdown fix is incorporated, descent gradient criteria must be met from FAF to SDF and SDF to FEP. See para-graphs 251, 252, and 288a.

906. MDA. The lowest altitude on final approach is specified as an MDA. The MDA adjustments specified in paragraph 232 shall be considered.

907. MISSED APPROACH SEGMENT. The criteria for the missed approach segment are contained in chapter 2, section 7. The MAP is on the FAC not farther from the FAF than the runway threshold (first usable portion of the landing area for circling approach). The missed approach surface shall commence over the MAP at the required height (see paragraph 274).

908.-909. RESERVED

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CHAPTER 11. HELICOPTER PROCEDURES

Section 1. Administrative

1100. GENERAL. This chapter contains criteria for application to "helicopter only" procedures. These criteria are based on the premise that helicopters are classified in approach Category A and are capable of special maneuvering characteristics. The intent, therefore, is to provide relief from those portions of other TERPS chapters that are more restrictive than the criteria specified herein. However, any criteria contained elsewhere in other chapters of this document may be applied to helicopter only procedures when an operational advantage may be gained.

a. Identification of Inapplicable Criteria. Criteria contained elsewhere in this document normally apply to helicopter procedures. Where this chapter changes such criteria, the changed material is identified. Circling approach and high altitude penetration criteria do not apply to helicopter procedures.

b. Use of Existing Facilities. Helicopter only procedures based on existing facilities may be developed using criteria contained in this chapter.

1101. TERMINOLOGY. The following terms are peculiar to helicopter procedures and are defined as follows:

a. Height Above Landing (HAL) is the height above landing area elevation.

b. Height Above the Surface (HAS) is the height of the MDA above the highest terrain/surface within a 5,200-foot radius of the MAP in point in space procedures.

c. Landing Area as used in helicopter operations refers to the portion of the heliport or airport runway used, or intended to be used for the landing and takeoff of helicopters.

d. Landing Area Boundary (LAB) is the beginning of the landing area of the heliport or runway.

e. Point in Space Approach is an instrument approach procedure to a point in space, identified as a missed approach point, which is not associated with a specific landing area within 2,600 feet of the MAP.

f. Touchdown zone, as used in helicopter procedures, is identical to the landing area.

1102. DELETED.

1103. TYPE OF PROCEDURE. HELICOPTER ONLY PROCEDURES are designed to meet low altitude straight-in requirements ONLY.

1104. FACILITIES FOR WHICH CRITERIA ARE NOT PROVIDED. This chapter does not include criteria for procedures predicated on VHF/UHF DF, area navigation (RNAV), airborne radar approach (ARA), or microwave landing system (MLS). Procedures using VHF/UHF DF may be developed in accordance with the appropriate chapters of this document.

1105. PROCEDURE IDENTIFICATION. Identify helicopter-only procedures using the term "COPTER," the type of facility or system providing final approach course guidance, and:

a. For Approaches to Runways. The abbreviation RWY, and the runway number; e.g., COPTER ILS or LOC RWY 17; COPTER RNAV (GPS) RWY 31.

b. For Approaches to Heliports and a Point-in-Space. The magnetic final approach course value and degree symbol; e.g., COPTER ILS or LOC 014°; COPTER TACAN O97°, COPTER RNAV (GPS) 010°.

c. For Approaches Based on an ARC Final. The word ARC will be used, and will be followed by a sequential number; e.g., COPTER VOR/DME ARC 1.

d. For separate procedures at the same location. Use the same type of facility and same final approach course, add an alpha suffix starting in reverse alphabetical order; COPTER ILS or LOC Z RWY 28L (first procedure), COPTER ILS or LOC Y RWY 28L (second procedure), COPTER ILS or LOC X RWY 28L (third procedure), etc.

Section 2. General Criteria

1106. APPLICATION. These criteria are based on the unique maneuvering capability of the helicopter at airspeeds not exceeding 90 knots.

1107. POINT IN SPACE APPROACH. Where the center of the landing area is not within 2,600 feet of the MAP, an approach procedure to a point in space may be developed using any of the facilities for which criteria are provided in this chapter. In such procedures the point in space and the missed approach point are identical and upon arrival at this point, helicopters must proceed under visual flight rules (or special VFR in control zone as applicable) to a landing area or conduct the specified missed approach procedure. The published procedure shall be noted to this effect and also should identify available landing areas in the vicinity by noting the course and distance from the MAP to each selected landing area. Point in space approach procedures will not contain alternate minima.

1108. APPROACH CATEGORIES. When helicopters use instrument flight procedures designed for fixed wing aircraft, approach Category "A" approach minima shall apply regardless of helicopter weight.

1109. PROCEDURE CONSTRUCTION. Paragraph 214 applies except for the reference to circling approach.

1110. DESCENT GRADIENT. The descent gradient criteria specified in other chapters of this document do not apply. The optimum descent gradient in *all* segments of helicopter approach procedures is 400 feet per mile. Where a higher descent gradient is necessary, the recommended maximum is 600 feet per mile. However, where an operational requirement exists, a gradient of as much as 800 feet per mile may be authorized, provided the gradient used is depicted on approach charts. See special procedure turn criteria in paragraph 1112.

1111. INITIAL APPROACH SEGMENTS BASED ON STRAIGHT COURSES AND ARCS WITH POSITIVE COURSE GUIDANCE. Paragraph 232 is changed as follows:

a. Alignment.

(1) Courses. The 2-mile lead radial specified in paragraph 232a(1) is reduced to 1 mile. See Figure 3.

(2) Arcs. The minimum arc radius specified in paragraph 232a(2) is reduced to 4 miles. The 2-mile lead radial may be reduced to 1 mile. See Figure 10.

1112. INITIAL APPROACH BASED ON PROCEDURE TURN. Paragraph 234 applies except for all of subparagraph d and the number 300 in subparagraph e(1) which is changed to 600. Since helicopters operate at approach Category A speeds the 5-mile procedure turn will normally be used. However, the larger 10-and 15-mile areas may be used if considered necessary.

a. Descent Gradient. Because the actual length of the track will vary with environmental conditions and pilot technique, it is not practical to specify a descent gradient solely in feet per mile for the procedure turn. Instead, the descent gradient is controlled by requiring the procedure turn completion altitude to be as close as possible to the final approach fix altitude. The difference between the procedure turn completion altitude and the altitude over the final approach fix shall not be greater than those shown in Table 23.

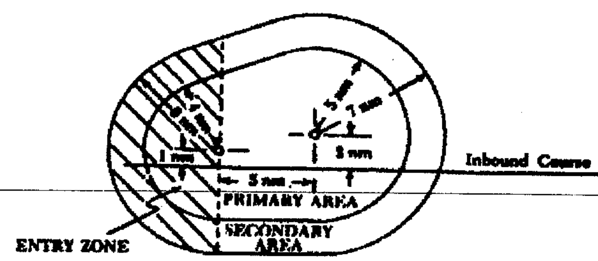

Figure 105. HELICOPTER PROCEDURE TURN AREA. Par 1112.

Table 23. PROCEDURE TURN COMPLETION ALTITUDE DIFFERENCE. Par 1112.

Type Procedure Turn	Altitude Difference
15 mile PT from FAF	Within 6000 ft of alt over FAF
10 mile PT from FAF	Within 4000 ft of alt over FAF
5 mile PT from FAF	Within 2000 ft of alt over FAF
15 mile PT, no FAF	Not Authorized
10 mile PT, no FAF	Within 4000 ft of MDA on Final
5 mile PT, no FAF	Within 2000 ft of MDA on Final

CHAPTER 14. SIMPLIFIED DIRECTIONAL FACILITIES (SDF) PROCEDURES

1400. GENERAL. This chapter applies to approach procedures based on Simplified Directional Facilities (SDF). "SDF" is a directional aid facility providing only lateral guidance (front or back course) for approach from a final approach fix.

1401.-1409. RESERVED.

1410. FEEDER ROUTES. Criteria for feeder routes are contained in paragraph 220.

1411. INITIAL APPROACH SEGMENT. Criteria for the initial approach segment are contained in chapter 2, section 3

1412. INTERMEDIATE APPROACH SEGMENT. Criteria for the intermediate approach segment are contained in chapter 2, section 4.

1413. FINAL APPROACH SEGMENT. The final approach shall be made only "TOWARD" the facility because of system characteristics. The final approach segment begins at the final approach fix and ends at the missed approach point.

a. Alignment. The alignment of the final approach course with the runway centerline determines whether a straight-in or circling-only approach may be established.

(1) Straight-in. The angle of convergence of the final approach course and the extended runway centerline shall not exceed 30°. The final approach course should be aligned to intersect the extended runway centerline 3,000 feet outward from the runway threshold. When an operational advantage can be achieved, this point of intersection may be established at any point between the threshold and a point 5,200 feet outward from the threshold. Also, where an operational advantage can be achieved, a final approach course which does not intersect the runway center, or which intersects it at a distance greater than 5,200 feet from the threshold may be established, provided that such a course lies within 500 feet laterally of the extended runway centerline at a point 3,000 feet outward from the runway threshold (see figure 48).

(2) Circling Approach. When the final approach course alignment does not meet the criteria for a straight-in landing, only a circling approach shall be authorized, and the course alignment should be made to the center of the landing area. When an operational advantage can be achieved, the final approach course may be aligned to any portion of the usable landing surface (see figure 49).

b. Area. The area considered for obstacle clearance in the final approach segment starts at the final approach fix (FAF) and ends at, or abeam, the runway threshold. It is a portion of a 10-mile long trapezoid that is centered longitudinally on the final approach course (see figure 14-1). For 6° course width facilities, it is 1,000 feet wide at, or abeam, the runway threshold and expands uniformly to 19,228 feet at 10 miles from the threshold. For 12° course width facilities, it is 2,800 feet wide at, or abeam, the runway threshold and expands uniformly to a width of 21,028 feet at 10 miles from the threshold. For course widths between 6° and 12°, the area considered for obstacle clearance may be extrapolated from the 6° and 12° figures to the next intermediate whole degree. For example, the width of the obstacle clearance area for a 9° course width would start at 1,900 feet and expand to 20,148 feet. The OPTIMUM length of the final approach segment is 5 miles. The MAXIMUM length is 10 miles. The MINIMUM length of the final approach segment shall provide adequate distance for an aircraft to make the required descent, and to regain course alignment when a turn is required over the facility. Table 14 shall be used to determine the minimum length needed to regain the course.

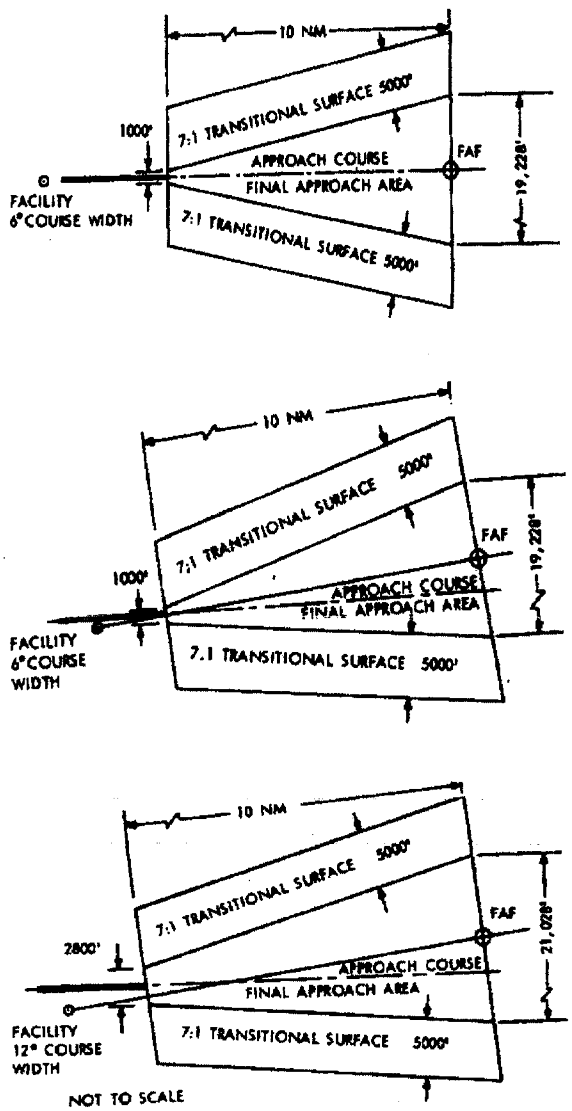

Figure 14-1. FINAL APPROACH AREAS WITH FAF.

c. Transitional Surfaces. Transitional surfaces are inclined planes with a slope of 7:1 that extend upward and outward 5,000 feet from the edge of the final approach area. The transitional surfaces begin at a height no less than 250 feet below the MDA .

d. Obstacle Clearance.

(1) Straight-in Landing. The minimum obstacle clearance in the final approach area shall be 250 feet. In addition, the MDA established for the final approach area shall assure that no obstacles penetrate the transitional surfaces.

(2) Circling Approach. In addition to the minimum requirements specified in paragraph 1413d(1), obstacle clearance in the circling area shall be as prescribed in chapter 2, section 6.

e. Descent Gradient. Criteria for descent gradient are specified in paragraph 252.

f. Use of Fixes. Criteria for the use of radio fixes are contained in chapter 2, section 8.

g. Minimum Descent Altitudes. Criteria for determining the MDA are contained in chapter 3, section 2.

1414. MISSED APPROACH SEGMENT. Criteria for the missed approach segment are contained in chapter 2, section 7. For SDF procedures the missed approach point is a point on the final approach course that is NOT farther from the final approach fix than the runway threshold (first usable portion of the landing area for circling). The missed approach surface shall commence over the missed approach point at the required height. See paragraph 274, missed approach obstacle clearance.

1415. BACK COURSE PROCEDURES. Back course SDF procedures may be developed using these criteria except that the beginning point of the final approach obstacle clearance trapezoid is at the facility.

1416.-1499. RESERVED.

b. When a change of altitudes is involved with a course change, course guidance must be provided if the change of altitude is more than 1,500 feet and/or if the course is more than 45 degrees.

EXCEPTION: Course changes of up to 90 degrees may be approved without course guidance provided that no obstacles penetrate the established MEA requirement of the previous airway/route segment within 15 NM of the boundaries of the system accuracy displacement area of the fix. See figure 17-22 and paragraph 1740b(2).

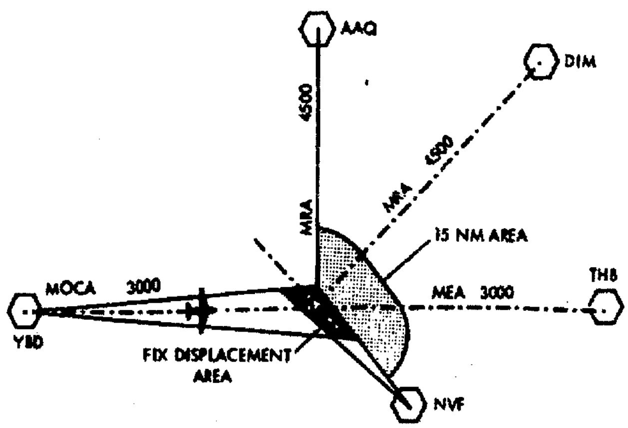

Figure 17-22. MEA WITH NAVIGATION GAP AT TURNING POINT. Par 1740b(2)

1731. EN ROUTE MINIMUM HOLDING ALTITUDES. Criteria for holding pattern airspace are contained in Order 7130.3, Holding Pattern Criteria, and provide for separation of aircraft from aircraft. The criteria contained in this document deal with the clearance of holding aircraft from obstacles.

a. Area. The primary obstacle clearance area for holding shall be based on the appropriate holding pattern airspace area specified in Order 7130.3. No reduction in the pattern sizes for "on entry" procedures is permitted. In addition, when holding at an intersection fix, the selected pattern shall also be large enough to contain at least 3 corners of the fix displacement area. See paragraphs 284, 285, and figure 37-1. A secondary area 2 miles wide surrounds the perimeter of the primary area.

b. Obstacle Clearance. The minimum obstacle clearance of the route shall be provided throughout the primary area. In the secondary area 500 feet of obstacle clearance shall be provided at the INNER edge, tapering to zero feet at the outer edge. For computation of obstacle clearance in the secondary area, the computation formula specified in paragraph 1721 shall be applied. Allowance for precipitous terrain should be considered as stated in paragraph 323a. The altitudes selected by application of the obstacle clearance specified in this paragraph may be rounded to the nearest 100 feet.

c. Communications. The communications on appropriate ATC frequencies (as determined by ATS) shall be required throughout the entire holding pattern area from the MHA up to and including the maximum holding altitude. If the communications are not satisfactory at the minimum holding obstacle clearance altitude, the MHA shall be authorized at an altitude where the communications are satisfactory. For communications to be satisfactory, they must meet the standards as set forth in Order 8200.1, United States Standard Flight Inspection Manual.

d. Holding Patterns On/Adjacent to ILS Courses. Holding patterns on or adjacent to ILS courses shall comply with Order 7130.3, paragraph 4-7.

e. High Altitude. All holding patterns in the high altitude structure shall be coordinated with the Aviation Systems Standards office prior to being approved.

1732.-1739. RESERVED.

Section 4. Navigational Gaps

1740. NAVIGATIONAL GAP CRITERIA. Where a gap in course guidance exists, an airway or route segment may be approved in accordance with the criteria set forth in paragraph 1740c, provided:

a. Restrictions.

(1) The gap may not exceed a distance which varies directly with altitude from zero NM at sea level to 65 NM at 45,000 feet MSL, and

(2) Not more than one gap may exist in the airspace structure for the airway/route segment, and

(3) A gap may not occur at any airway or route turning point, except when the provisions of paragraph 1740b(2) are applied, and

(4) A notation must be included on FAA Form 8260-16 which specifies the area within which a gap exists where the MEA has been established with a gap in navigational signal coverage. The gap area will be identified by distances from the navigation facilities.

b. Authorizations. MEA's with gaps shall be authorized only where a specific operational requirement exists. Where gaps exceed the distance in paragraph 1740a(1), or are in conflict with the limitations in paragraph 1740a(2) or (3), the MEA must be increased as follows:

(1) For straight segments:

(a) To an altitude which will meet the distance requirement of paragraph 1740a(1), or

(b) When in conflict with paragraph 1740a(1) or (2) to an altitude where there is continuous course guidance available.

(2) For turning segments. Turns to intercept radials with higher MEA's may be allowed provided:

(a) The increase in MEA does not exceed 1,500 feet, and

(b) The turn does not exceed 90 degrees, and

(c) No obstacles penetrate the MEA of the course being flown within 15 NM of the fix displacement area (see figure 17-22).

(3) When in conflict with paragraph 1740b(1) or (2) to an altitude where there is continuous course guidance available.

c. Use of Steps. Where large gaps exist which require the establishment of altitudes that obviate the effective use of airspace, consideration may be given to the establishment of MEA

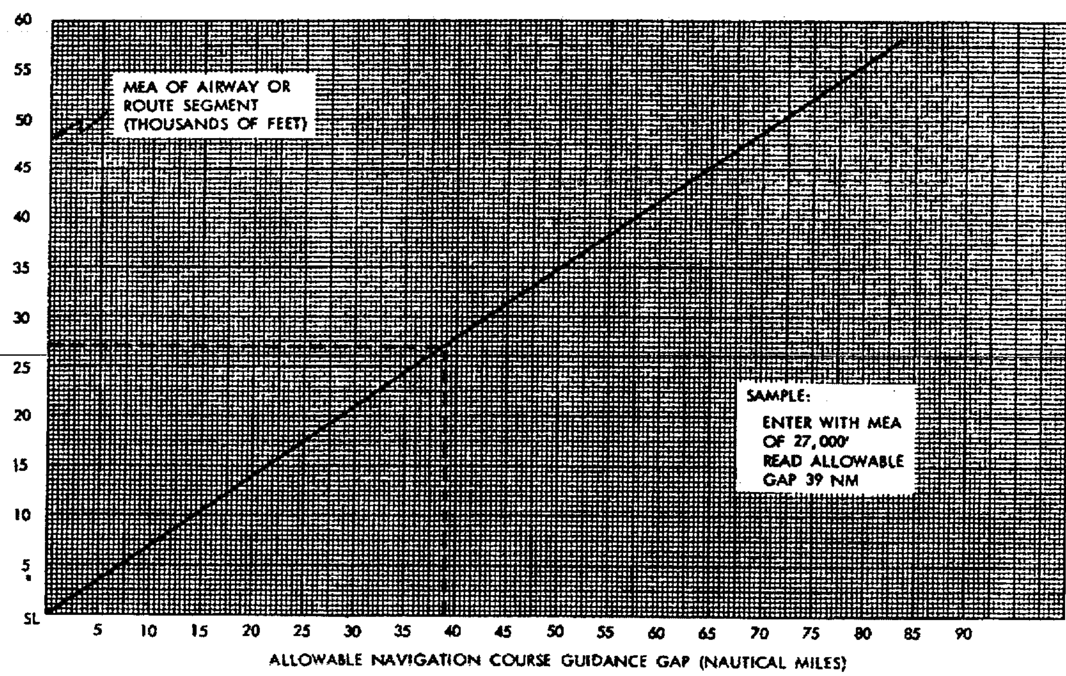

Figure 17-23. NAVIGATION COURSE GUIDANCE GAPS. Par 1740.

APPENDIX 1. APPENDIX APPLICATION, GLOSSARY, ACRONYMS, AND ABBREVIATIONS

1. APPENDIX APPLICATION. The material contained in these appendices supports criteria contained in several chapters of this order. Appendix material includes:

a. Appendix 1, paragraph 2. Glossary. A listing of special terms and abbreviations to explain their meaning and application to procedures and criteria.

b. Appendix 1, paragraph 3. Acronyms and Abbreviations. A listing of all acronyms and abbreviations used in this order.

c. Appendix 2. RESERVED

d. Appendix 3. References. This appendix contains a list of referenced publications.

e. Appendix 4. Table of Tangents. A complete list of tangents for angles from 0.0 to 9.0 degrees in hundredths of degrees for application in solving glide slope problems.

f. Appendix 5. Approach Lighting.Systems. This appendix contains descriptions of standard approach lighting systems and lists of other systems which may be given the same visibility credit in the development of military procedures.

g. Appendix 6. Alphabetical Index.

2. GLOSSARY. Definitions shown in the glossary apply to terminal instrument procedures criteria in this order.

AL Approach and Landing (Chart).

Angle of Divergence (Minimum). The smaller of the angles formed by the intersection of two courses, radials, bearings, or combinations thereof.

ASBL Approach Surface Baseline. An imaginary horizontal line at threshold elevation.

Approving Authority. Headquarters representative of the various signatory authorities shown in the Foreword, Page iv.

BC Back Course (Localizer).

Circling Approach Area. The area in which aircraft circle to land under visual conditions after completing an instrument landing approach.

Controlling Obstacle. The highest obstacle relative to a prescribed plane within a specified area.

NOTE: In precision approach procedures where obstacles penetrate the approach surface, the controlling obstacle is the one which results in the requirement for the highest decision height (DH).

Dead Reckoning. The estimating or determining of position by advancing an earlier known position by the application of direction and speed data. For example, flight based on a heading from one VORTAC azimuth and distance fix to another is dead reckoning.

Diverse Vector. An instruction issued by a radar controller to fly a specific course, which is not a part of a predetermined radar pattern. Also referred to as a "random vector."

DH Decision Height . The height, specified in mean sea level (MSL), above the highest runway elevation in the touchdown zone at which a missed approach must be initiated if the required visual reference has not been established. This term is used only in procedures where an electronic glide slope provides the reference for descent, as in an instrument landing system (ILS) or precision approach radar (PAR).

DME Distance Measuring Equipment Arc. A course, indicated as a constant DME distance, around a navigation facility which provides distance information.

DME Distance. The line of sight distance (slant range) from the source of the DME signal to the receiving antenna.

FAC Final Approach Course.

FAF Final Approach Fix.

Flight Inspection. In-flight investigation and certification of certain operational performance characteristics of electronic and visual navigation facilities by an authorized inspector in conformance with Order 8200.1, U. S. Standard Flight Inspection Manual.

Gradient. A slope expressed in feet per mile, or as a ratio of the horizontal to the vertical distance. For example, 40:1 means 40 feet horizontally to 1 foot vertically.

GPI Ground Point of Intercept. A point in the vertical plane on the runway centerline at which it is assumed that the straight line extension of the glide slope intercepts the runway approach surface baseline.

HAA Height above airport elevation.

HAT Height above touchdown zone elevation.

IAC Initial Approach Course.

IAF Initial Approach Fix.

IC Intermediate Course.

IF Intermediate Fix

JAL High Altitude Approach and Landing (Chart).

LOC Localizer. The component of an ILS which provides lateral guidance with respect to the runway centerline.

LDA Localizer type directional aid. A facility of comparable utility and accuracy to a LOC, but which is not part of a full ILS and may not be aligned with the runway.

LPV - Lateral Precision Performance with Vertical Guidance

MAP Missed Approach Point (paragraph 272).

MDA Minimum Descent Altitude (paragraph 310)

MHA Minimum Holding Altitude.

NDB (ADF) Non Directional Beacon (Airborne Automatic Direction Finder). A combined term which indicates that an NDB provides an electronic signal for use with ADF equipment.

Obstacle. An existing object, object of natural growth, or terrain at a fixed geographical location which may be expected at a fixed location within a prescribed area, with reference to which vertical clearance is or must be provided during flight operation. For example, with reference to mobile objects, a moving vehicle 17 feet high is assumed to be on an Interstate Highway, 15 feet high on other highways, and 23 feet high on a railroad track, except where limited to certain heights controlled by use or construction. The height of a ship's mast is assumed according to the types of ships known to use an anchorage.

Obstacle Clearance. The vertical distance between the lowest authorized flight altitude and a prescribed surface within a specified area.

Obstacle Clearance Boxes [500]. When used in figures which depict approach segments, these boxes indicate the obstacle clearance requirements in feet.

Operational Advantage. An improvement which benefits the users of an instrument procedure. Achievement of lower minimums or authorization for a straight-in approach with no derogation of safety is an example of an operational advantage. Many of the options in TERPS are specified for this purpose. For instance, the flexible final approach course alignment criteria may permit the ALS to be used for reduced visibility credit by selection of the proper optional course.

Optimum Most Favorable. As used in TERPS, optimum identifies the value, which should be used wherever a choice is available.

Positive Course Guidance. A continuous display of navigational data which enable an aircraft to be flown along a specific course line.

Precipitous Terrain. Terrain characterized by steep or abrupt slopes.

Precision and Nonprecision. These terms are used to differentiate between navigational facilities which provide a combined azimuth and glide slope guidance to a runway (Precision) and those that do not. The term nonprecision refers to facilities without a glide slope, and does not imply an unacceptable quality of course guidance.

Primary Area. The area within a segment in which full obstacle clearance is applied.

ROC Required Obstacle Clearance.

Runway Environment. The runway threshold or approved lighting aids or other markings identifiable with the runway.

Secondary Area. The area within a segment in which ROC is reduced as distance from the prescribed course is increased.

Segment. The basic functional division of an instrument approach procedure. The segment is oriented with respect to the course to be flown. Specific values for determining course alignment, obstacle clearance areas, descent gradients, and obstacle clearance requirements are associated with each segment according to its functional purpose.

Service Volume. That volume of airspace surrounding a VOR, TACAN, or VORTAC facility within which a signal of usable strength exists and where that signal is not operationally limited by co-channel interference. The advertised service volume is defined as a simple cylinder of airspace for ease in planning areas of operation.

TCH Threshold Crossing Height. The height of the straight line extension of the glide slope above the runway at the threshold.

TDZ Touchdown Zone. The first 3,000 feet of runway beginning at the threshold.

TDZE Touchdown Zone Elevation. The highest runway centerline elevation in the touchdown zone.

Transition Level. The flight level below which heights are expressed in feet MSL and are based on an approved station altimeter setting.

VDP Visual Descent Point. The VDP is a defined point on the final approach course of a nonprecision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided visual reference is established.

3. ACRONYMS AND ABBREVIATIONS. Many acronyms and abbreviations for old and new aviation terms are used throughout this order. Users of this order can refer to the following alphabetical listing of frequently used acronyms and abbreviations:

AAF	Airway Facilities Service
ABM	abeam
AC	Advisory Circular
ADF	automatic direction finder
AFM	Airplane Flight Manual
AFS	Flight Standards Service
AFSS	Automated Flight Service Station
AGL	above ground level
AIM	Aeronautical Information Manual
ALPA	Air Line Pilots Association
ALSF-1	approach lighting system with sequenced flashing lights (CAT I Configuration)
ALSF-2	approach lighting system with sequenced flashing lights (CAT II Configuration)
AOPA	Aircraft Owners and Pilots Association
APV	approach with vertical guidance (ICAO)
ARA	airborne radar approach
ARC	Airport Reference Code
ARDH	achieved reference datum height
ARINC	Aeronautical Radio, Inc.
ARP	airport reference point
ARSR	air route surveillance radar
ARTCC	Air Route Traffic Control Center
ASBL	approach surface baseline
ASOS	automated surface observing system
ASR	airport surveillance radar
AT	Air Traffic
ATA	Air Transport Association
ATC	Air Traffic Control
ATD	along track distance
ATRK	along track
ATS	Air Traffic Service
AVN	Aviation System Standards
AWO	all weather operations
AWOP	All Weather Operations Panel
AWO/PM	All Weather Operations/Program Manager
AWOS	automated weather observation system
AWS	Aviation Weather System
Baro VNAV	Barometric vertical navigation
BC	back course
CAT	Category
CF	course to fix
CFIT	controlled flight into terrain
CFR	Code of Federal Regulations
CG	climb gradient
CGL	circling guidance light
CHDO	Certificate Holding District Office
CIH	climb-in-hold
CMO	Certificate Management Office
CMT	Certificate Management Team
CONUS	Continental United States
COP	changeover point
CRM	collision risk model
CW	course width
CWSU	Center Weather Service Unit
CY	Calendar Year
DA	decision altitude
dB	decibel
DCG	desired climb gradient
DER	departure end of runway
DF	direct to fix

DF	direction finder
DG	descent gradient
DH	decision height
DME	distance measuring equipment
DOD	Department of Defense
DOT	Department of Transportation
DP	departure procedure
DR	dead reckoning
DRL	departure reference line
DRP	departure reference point
DTA	distance turn anticipation
DVA	diverse vector area
EARTS	en route automated radar tracking system
EDA	elevation differential area
ESA	emergency safe altitudes
ESV	expanded service volume
FAA	Federal Aviation Administration
FAATC	FAA Technical Center
FAC	final approach course
FAF	final approach fix
FAP	final approach point
FAR	Federal Aviation Regulations
FAS	final approach segment
FATO	final approach and takeoff area
FAWP	final approach waypoint
FDC	Flight Data Control
FDR	Flight Data Record
FDT	fix displacement tolerance
FEP	final end point
FIFO	Flight Inspection Field Office
FMS	flight management system
FPAP	flight path alignment point
FPCP	flight path control point
FPO	Flight Procedures Office
FR	Federal Register
FSDO	Flight Standards District Office
FSS	Flight Service Station
FTE	flight technical error
~~FTIP~~	~~Foreign terminal instrument procedure~~
FTP	fictitious threshold point
GA	general Aviation
GCA	ground controlled approach
GH	Geoid Height
GLONASS	Global Orbiting Navigation Satellite System
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
GP	glidepath
GPA	glidepath angle
GPI	ground point of intercept
GPS	Global Positioning System
GRI	group repetition interval
GS	glide slope
HAA	height above airport
HAE	height above ellipsoid
HAH	height above helipoint
HAI	Helicopter Association International
HAL	height above landing area elevation
HAS	height above surface
HAT	height above touchdown
HATh	height above threshold
HCH	heliport crossing height
HF	high frequency
HIRL	high intensity runway lights
HRP	heliport reference point
HUD	heads-up display
IAC	initial approach course
IAF	initial approach fix
IAP	instrument approach procedure
IAPA	instrument approach procedure automation
IC	intermediate course
ICA	initial climb area
ICAB	ICA baseline
ICAE	ICA end-line
ICAO	International Civil Aviation Organization
ICWP	initial course waypoint
IDF	initial departure fix
IF	intermediate fix
IF	initial fix
IF/IAF	intermediate/initial approach fix
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
INS	inertial navigation system
IPV	instrument procedure with vertical guidance
IRU	inertial reference unit
ISA	International Standard Atmosphere
kHz	kilohertz
KIAS	knots indicated airspeed
LAAS	Local Area Augmentation System
LAB	landing area boundary
LAHSO	land and hold short operations
~~LDA~~	~~localizer type directional aid~~
LDIN	lead-in lighting system
LF	low frequency
LIRL	low intensity runway lights
LNAV	lateral navigation
LPV	Lateral Precision Performance with Vertical Guidance
LOA	Letter of Agreement
LOB	lines of business
LOC	localizer
LOM	locator outer marker
LORAN	long range navigation system
LTP	landing threshold point
MALS	minimum intensity approach lighting system
MALSF	minimum intensity approach lighting system with sequenced flashing

MALSR	minimum intensity approach lighting system with runway alignment indicator lights
MAP	missed approach point
MCA	minimum crossing altitude
MDA	minimum descent altitude
MEA	minimum en route altitude
MHA	minimum holding altitude
MHz	megahertz
MIA	minimum IFR altitudes
MIRL	medium intensity runway lights
MLS	Microwave Landing System
MM	middle marker
MOA	Memorandum of Agreement
MOA	military operations area
MOC	minimum obstacle clearance
MOCA	minimum obstruction clearance altitude
MOU	Memorandum of Understanding
MRA	minimum reception altitude
MSA	minimum safe/sector altitude
MSL	mean sea level
MTA	minimum turn altitude
MVAC	minimum vectoring altitude chart
NAD	North American Datum
NAS	National Airspace System
NAVAID	navigational aid
NAWAU	National Aviation Weather Advisory Unit
NBAA	National Business Aviation Association
NDB	nondirectional radio beacon
NFDC	National Flight Data Center
NFDD	National Flight Data Digest
NFPO	National Flight Procedures Office
NM	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NOTAM	Notice to Airmen
NOZ	normal operating zone
NPA	nonprecision approach
NTSB	National Transportation Safety Board
NTZ	no transgression zone
NWS	National Weather Service
OC	obstruction chart
OCA	obstacle clearance altitude
OCH	obstacle clearance height
OCS	obstacle clearance surface
ODALS	omnidirectional approach lighting system
OEA	obstruction evaluation area
OE/AAA	Obstruction Evaluation/Airport Airspace Analysis
OFA	object free area
OIS	obstacle identification surface
OM	outer marker
ORE	obstacle rich environment
OSAP	off-shore approach procedure
PA	precision approach
PAPI	precision approach path indicator
PAR	precision approach radar
PCG	positive course guidance
PDA	preliminary decision altitude
PFAF	precision final approach fix
PGPI	pseudo ground point of intercept
PinS	point-in-space
PLS	precision landing system
POC	point of contact
PRM	precision runway monitor
PT	procedure turn
PVG	positive vertical guidance
PVGSI	pseudo visual glide slope indicator
RA	radio altimeter
RAA	Regional Airline Association
RAIL	runway alignment indicator lights
RAPCON	radar approach control
RASS	remote altimeter setting source
RCL	runway centerline
RDP	reference datum point
REIL	runway end identifier lights
RF	radio frequency
RF	radius to fix
RNAV	area navigation
RNP	required navigation performance
ROC	required obstacle clearance
RPI	runway point of intercept
RRP	runway reference point
RTCA	Radio Technical Commission for Aeronautics
RVR	runway visual range
RWP	runway threshold waypoint
RWT	runway threshold
RWTE	runway threshold evaluation
RWY	runway
SALS	short approach lighting system
SATNAV	satellite navigation
SCG	standard climb gradient
SDF	simplified directional facility
SDF	step-down fix
SER	start end of runway
SIAP	standard instrument approach procedure
SID	standard instrument departure
SM	statute mile
SSALF	short simplified approach lighting system with sequenced flashers
SSALR	short simplified approach lighting system with runway alignment indicator lights
STAR	standard terminal arrival route
STOL	short takeoff and landing
TAA	terminal arrival area
TACAN	tactical air navigational aid
TCH	threshold crossing height
TD	time difference
TDP	touchdown point
TDZ	touchdown zone

TDZE	touchdown zone elevation
TDZL	touchdown zone lights (system)
TERPS	terminal instrument procedures
TF	track to fix
TL	Transmittal Letter
TLOF	touchdown and life-off area
TLS	transponder landing system
TORA	takeoff runway available
TP	tangent point
TPD	tangent point distance
TRACON	terminal radar approach control facility
TSO	technical standard order
TWP	turn waypoint
UHF	ultra high frequency
USA	U.S. Army
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USMC	U.S. Marine Corps
USN	U.S. Navy
VA	heading to altitude
VASI	visual approach slope indicator
VCA	visual climb area
VCOA	visual climb over airport
VDA	vertical descent area
VDP	visual descent point
VFR	visual flight rules
VGA	vertically guided approach
VGSI	visual glide slope indicator
VHF	very high frequency
VLF	very low frequency
VMC	visual meteorological conditions
VNAV	vertical navigation
VOR	very high frequency omnidirectional radio range
VOR/DME	very high frequency omnidirectional radio range collocated with distance measuring equipment
VORTAC	very high frequency omnidirectional radio range collocated with tactical air navigation
VPA	vertical path angle
VSDA	visual segment descent angle
VTOL	vertical take-off and landing
WAAS	Wide Area Augmentation System
WCH	wheel crossing height
XTRK	crosstrack

FAA ORDER **8260.3B**

Army
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Air Force

TM 95-226
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CG 318
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UNITED STATES STANDARD FOR TERMINAL INSTRUMENT PROCEDURES (TERPS)

VOLUME 2

NONPRECISION APPROACH PROCEDURE (NPA) CONSTRUCTION

RESERVED

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

FAA ORDER **8260.3B**

Army
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TM 95-226
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UNITED STATES STANDARD FOR TERMINAL INSTRUMENT PROCEDURES (TERPS)

VOLUME 3

Precision Approach (PA) and Barometric Vertical Navigation (Baro VNAV) Approach Procedure Construction

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

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PRECISION APPROACH (PA) AND BAROMETRIC VERTICAL NAVIGATION (BARO VNAV) APPROACH PROCEDURE CONSTRUCTION

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CHAPTER 1. GENERAL INFORMATION

1.0 PURPOSE.

This TERPS volume contains final and initial missed approach segment construction criteria applicable to instrument approach procedures that provide positive glidepath guidance. Apply this criteria to approaches based on instrument landing system (ILS), microwave landing system (MLS), precision approach radar (PAR), transponder landing system (TLS), wide area augmentation system (WAAS), local area augmentation system (LAAS), barometric vertical navigation (Baro-VNAV), and future 3-dimensional navigational systems.

1.1 BACKGROUND.

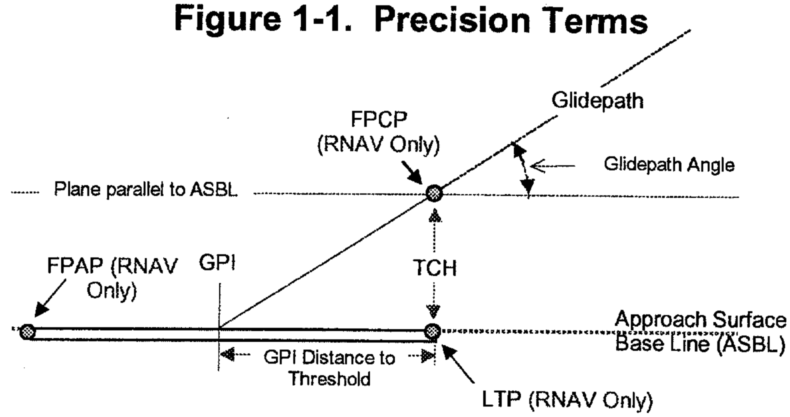
The ILS defined the navigational aid (NAVAID) performance standard for precision vertical and lateral guidance systems. Several different NAVAID's providing positive vertical guidance have evolved since the inception of ILS. NAVAID's capable of supporting Category I landing minimums are: ILS, PAR, MLS, TLS, WAAS, and LAAS. NAVAID's capable of providing Category II/III landing minimums are: ILS, MLS, and LAAS. A NAVAID capable of supporting Category I/II/III minimums does not qualify as a precision approach (PA) system without supporting ground infrastructure. Certain airport and obstruction clearance requirements are mandatory for the system to be considered a PA system and achieve the LOWEST minimums. These requirements are contained in AC 150/5300-13, Airport Design; and Order 8260.3, Volume 3, Precision Approach (PA), Barometric Vertical Navigation (Baro VNAV) Approach Procedure Construction, and appropriate military directives. When mandatory ground infrastructure requirements are not met, these NAVAID's may provide a vertically guided stabilized final approach descent, but command higher landing minimums. Additionally, some flight management system (FMS) avionics suites are equipped with Baro-VNAV systems that provide stabilized descent guidance.

1.2 DEFINITIONS.

1.2.1 Approach Surface Base Line (ASBL).

A horizontal line tangent to the surface of the earth at the runway threshold (RWT) point, aligned with the final approach course (see figure 1-1).

Figure 1-1. Precision Terms



1.2.2 Barometric Altitude).

Altitude above the orthometric Geoid surface; i.e., mean sea level (MSL), based on atmospheric pressure measured by an aneroid barometer. This is the most common method of determining aircraft altitude.

1.2.3 Barometric Vertical Navigation (Baro VNAV).

RNAV and Non-RNAV. Positive vertical guidance relative to a computed glidepath that is based on the difference between published altitudes at two specified points or fixes.

1.2.4 Decision Altitude (DA).

A specified altitude in reference to mean sea level in an approach with vertical guidance at which a missed approach must be initiated if the required visual references to continue the approach have not been established.

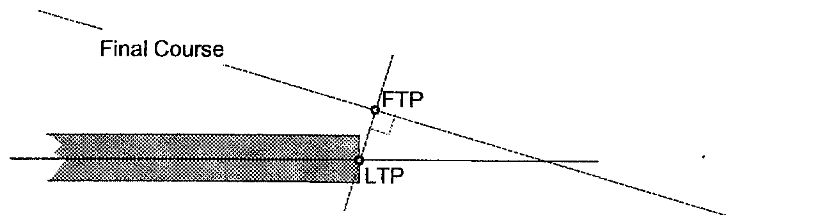
1.2.5 Departure End of Runway (DER).

The end of the runway that is opposite the landing threshold. It is sometimes referred to as the stop end of runway.

1.2.6 Fictitious Threshold Point (FTP).

The equivalent of the landing threshold point (LTP) when the final approach course is offset from runway centerline. It is the intersection of the final course and a line perpendicular to the final course that passes through the LTP. FTP elevation is the same as the LTP (see figure 1-2).

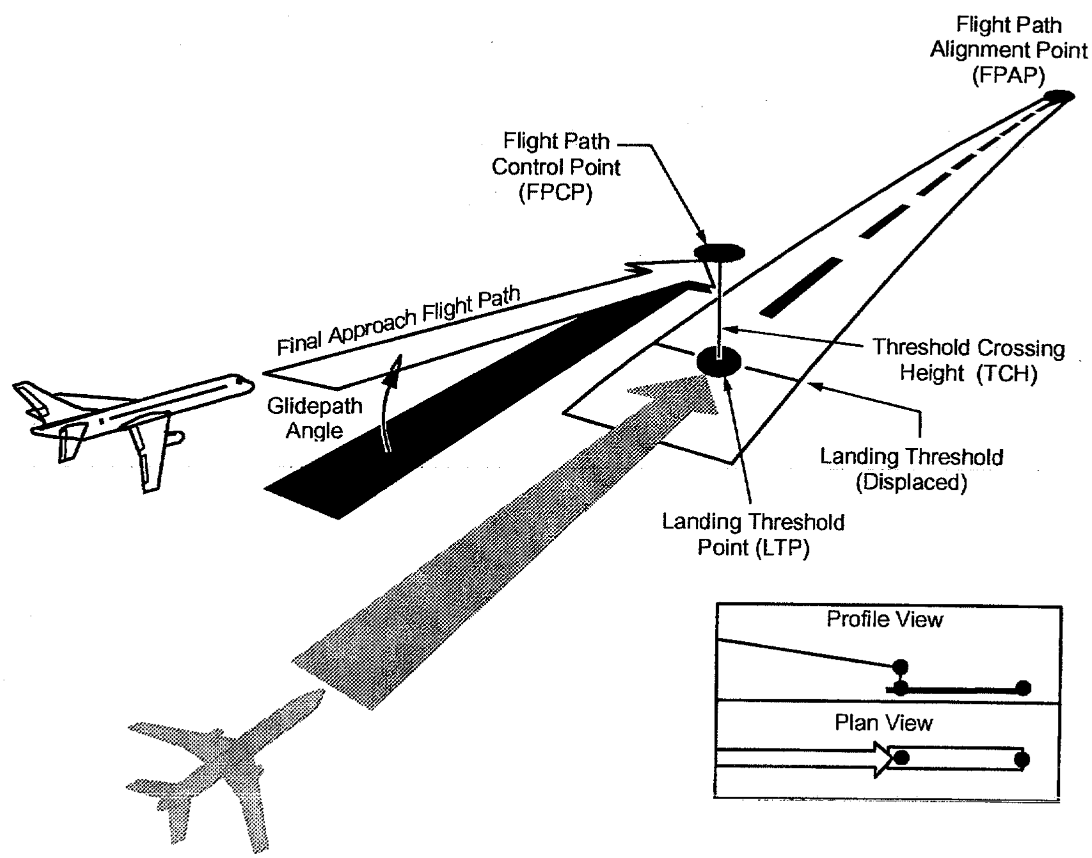
Figure 1-2. Fictitious Threshold Point



1.2.7 Flight Path Alignment Point (FPAP). [RNAV Only]

The FPAP is a 3D point defined by World Geodetic System (WGS)-84/North American Datum (NAD)-83 latitude, longitude, MSL elevation, (see figures 1-1 and 1-3). The FPAP is used in conjunction with the LTP and the geometric center of the WGS-84 ellipsoid to define the vertical plane of a PA RNAV final approach course. The approach course may be offset up to 3° by establishing the FPAP left or right of centerline along an arc centered on the LTP.

Figure 1-3. Precision Approach Path Points (Straight-In)



1.2.8 Flight Path Control Point (FPCP). [RNAV Only]

An imaginary point above the LTP from which the glidepath mathematically emanates. It is in a vertical plane containing the LTP and FPAP. The FPCP has the same geographic coordinates as the LTP. The elevation of the FPCP is the sum of LTP elevation and the TCH value (see figure 1-3).

1.2.9 Geoid Height (GH). [RNAV Only]

The height of the Geoid (reference surface for orthometric or MSL heights) relative to the WGS-84 ellipsoid. It is a positive value when the Geoid is above the WGS-84 ellipsoid and negative when it is below. The value is used to convert an MSL elevation to an ellipsoidal or geodetic height - the height above ellipsoid.

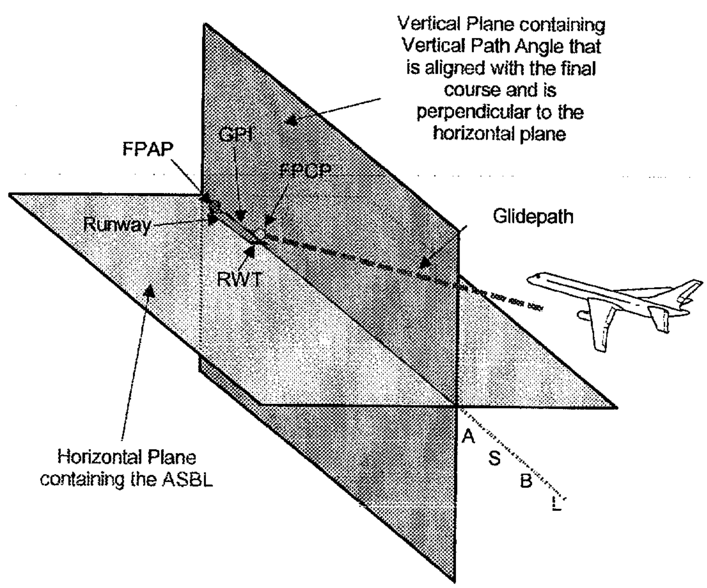
1.2.10 Glidepath Angle (GPA).

The angular displacement of the glidepath from a horizontal plane that passes through the LTP/FTP. This angle is published on approach charts (e.g., 3.00°, 3.20°, etc.).

1.2.11 Ground Point of Intercept (GPI).

A point in the vertical plane containing the glidepath where the vertical path intercepts the ASBL. GPI is expressed as a distance from RWT (see figure 1-4).

Figure 1-4. 3D Path & Course



1.2.12 **Height Above Ellipsoid (HAE). [RNAV Only]**

A height expressed in feet above the WGS-84 ellipsoid. This value differs from a height expressed in feet above the geoid (essentially MSL) because the reference surfaces (WGS-84 Ellipsoid and the Geoid) do not coincide. To convert an MSL height to an HAE height, algebraically add the geoid height value to the MSL value. HAE elevations are not used for instrument procedure construction, but are documented for inclusion in airborne receiver databases.

EXAMPLE:	Given:	KOUN RWY 35	Runway ID
		N 35 14 31.65	Latitude
		W 97 28 22.84	Longitude
		1177.00	MSL Elevation
		-87.29 feet (-26.606 m)	Geoid Height (GH)

HAE = MSL + GH

HAE = 1177 + (-87.29)

HAE = 1089.71

1.2.13 **Height Above Touchdown (HAT).**

The HAT is the height of the DA above touchdown zone elevation (TDZE).

1.2.14 **Inner-Approach Obstacle Free Zone (OFZ).**

The airspace above a surface centered on the extended runway centerline. It applies to runways with an approach lighting system.

1.2.15 **Inner-Transitional OFZ.**

The airspace above the surfaces located on the outer edges of the runway OFZ and the inner-approach OFZ. It applies to runways with approach visibility minimums less than ¾ statute mile.

1.2.16 **Landing Threshold Point (LTP).**

The LTP is a 3D point at the intersection of the runway centerline and the runway threshold. It is defined by WGS-84/NAD-83 latitude, longitude, MSL elevation, and geoid height (see figure 1-1). It is used in conjunction with the FPAP and the geometric center of the WGS-84 ellipsoid to define the vertical plane of an RNAV final approach course. LTP elevation applies to the FTP when the final approach course is offset from runway centerline.

1.2.17 **Lateral Navigation (LNAV). [RNAV Only]**

Azimuth navigation without positive vertical guidance. This type of navigation is associated with nonprecision approach procedures.

1.2.18 Microwave Landing System/Mobile Microwave Landing System (MLS/MMLS). [DOD Only)

MLS/MMLS can be configured in two ways; "Split Site" where the azimuth and elevation antennas are sited the same as an ILS, or "Collocated Site" where the azimuth and elevation antennas are located together along side the runway. "Split Site" is the normal configuration for "fixed" MLS locations to meet the capability of standard MLS avionics receiver equipment. Aircraft that will use MLS/MMLS procedures configured as a "Collocated Site" must have a special MLS avionics receiver capable of computing the offset runway centerline location. These procedures will have the following caveat: "COMPUTED APPROACH: FOR USE BY AIRCRAFT CAPABLE OF COMPUTING OFFSET RUNWAY CENTERLINE ONLY." Since the MMLS has a selectable azimuth and glide slope, procedures will be published with the caveat: "FLYING OTHER THAN PUBLISHED AZIMUTH AND/OR GS ANGLE RENDERS THE PROCEDURE UNUSABLE." MMLS equipment computing capability for "collocated" configuration requires that all system components (DME/P, AZ, and EL) must be operating, thus the following caveat must be published: "ALL SYSTEM COMPONENTS MUST BE OPERATIONAL."

1.2.19 Object Free Area (OFA).

An area on the ground centered on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.

1.2.20 Obstacle Clearance Surface (OCS).

An inclined obstacle evaluation surface associated with a glidepath. The separation between this surface and the glidepath angle at any given distance from GPI defines the MINIMUM required obstruction clearance at that point.

1.2.21 Positive Vertical/Horizontal Guidance.

Glidepath or course guidance based on instrumentation indicating magnitude and direction of deviation from the prescribed glidepath or course on which obstruction clearance is based.

1.2.22 Precision Approach (PA).

An approach based on a navigation system that provides positive course and vertical path guidance conforming to ILS or MLS system performance standards contained in ICAO Annex 10. To achieve lowest minimums, the ground infrastructure must meet requirements contained in AC 150/5300-13 and TERPS Volume 3.

1.2.23 Precision Approach Radar (PAR).

A ground radar system displaying an aircraft on final approach in plan and profile views in relation to glidepath and course centerlines. Air traffic controllers issue course line and glidepath information to the pilot. The pilot alters course and rate of descent in response to gain course and glidepath alignment. Military pilots may achieve 100′ HAT and 1/4 mile visibility minimums with PAR.

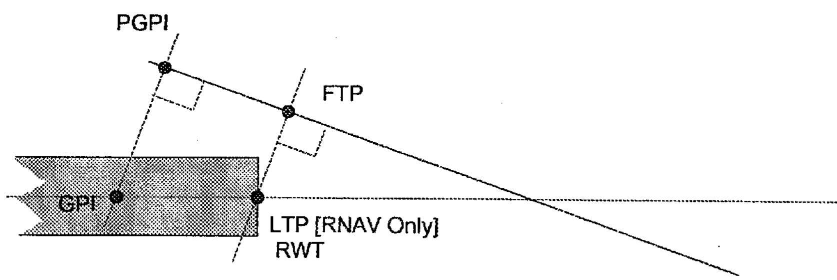
1.2.24 **Precision Final Approach Fix (PFAF).** Applicable to all PA approach procedures.

A 2D point located on the final approach course at a distance from LTP/FTP where the GPA intercepts the intermediate segment altitude (glidepath intercept altitude). The PFAF marks the outer end of the PA final segment.

1.2.25 **Pseudo Ground Point of Intercept (PGPI).**

Phantom location abeam the GPI when the approach course is offset. PGPI elevation is the same as ASBL (see figure 1-5).

Figure 1-5. PGPI and FTP Locations



1.2.26 **Radio Altimeter Height (RA).**

An indication of the vertical distance between a point on the nominal glidepath at DA and the terrain directly beneath this point.

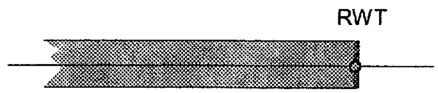
1.2.27 **Required Navigation Performance (RNP).**

A statement of the navigation performance accuracy necessary for operation within a defined airspace. Note that there are additional requirements, beyond accuracy, applied to a particular RNP type.

1.2.28 **Runway Threshold (RWT).**

The RWT marks the beginning of that part of the runway usable for landing (see figure 1-6). It extends the full width of the runway. The RWT geographic coordinates identify the point the runway centerline crosses the RWT.

Figure 1-6. Threshold



1.2.29 Three-Dimensional (3D) Point/Waypoint. [RNAV Only]

A waypoint defined by WGS-84 latitude and longitude coordinates, MSL elevation, and GH.

1.2.30 Touchdown Zone Elevation (TDZE).

The highest elevation in the first 3,000 feet of the landing surface.

1.2.31 Two-Dimensional (2D) Point/Waypoint. [RNAV Only]

A waypoint defined by WGS-84 latitude and longitude coordinates.

1.2.32 Wide Area Augmentation System (WAAS). [RNAV Only]

A method of navigation based on the GPS. Ground correction stations transmit position corrections that enhance system accuracy and add VNAV features.

CHAPTER 2. GENERAL CRITERIA

2.0 POLICY DIRECTIVES.

The final and missed approach criteria described in this order supersede the other publications listed below, except as noted. The following orders apply unless otherwise specified in this order:

2.0.1 **8260.3**, United States Standard for Terminal Instrument Procedures (TERPS), Volume 1;

2.0.2 **8260.19**, Flight Procedures and Airspace;

2.0.3 **8260.38,** Civil Utilization of Global Positioning System (GPS);

2.0.4 **8260.44,** Civil Utilization of Area Navigation (RNAV) Departure Procedures;

2.0.5 **8260.45,** Terminal Arrival Area (TAA) Design Criteria; and

2.0.6 **7130.3**, Holding Pattern Criteria.

2.1 DATA RESOLUTION.

Perform calculations using at least 0.01 unit of measure. Document latitudes and longitudes to the nearest one hundredth (0.01") arc second; elevations to the nearest hundredth (0.01') foot; courses, descent and glidepath angles to the nearest one hundredth (0.01°) degree, and distances to the nearest hundredth (0.01) unit. Where other publications require different units and/or lesser resolution, use established conversion and rounding methods.

2.2 PROCEDURE IDENTIFICATION.

2.2.1 RNAV.

Title a GPS, WAAS, or Baro-VNAV approach procedure: RNAV (sensor) RWY (number). Examples: **RNAV (GPS) RWY 13, RNAV (GPS, DME/DME) Z RWY 34R**. A typical RNAV approach chart will depict minima for LPV, LNAV/VNAV, LNAV, and circling. Title LAAS procedures: GLS RWY (Runway number). Example: GLS RWY 16.

2.2.2 Non-RNAV.

Title an ILS, MLS, TLS, or LDA/glide slope procedure: XXX RWY (Runway number). Examples: **ILS RWY 16, ILS or LOC RWY 16, ILS or LOC Z RWY 5, MLS RWY 28, TLS RWY 4, LDA RWY 31L** (chart noted glide slope required).

2.3 EN ROUTE, INITIAL, AND INTERMEDIATE SEGMENTS.

Apply criteria in TERPS, Volume 1 to non-RNAV approaches. Apply criteria in Order 8260.38, paragraphs 8-12, to construct the RNAV approaches except as noted. If a TAA is desired, apply Order 8260.45, paragraph 5.

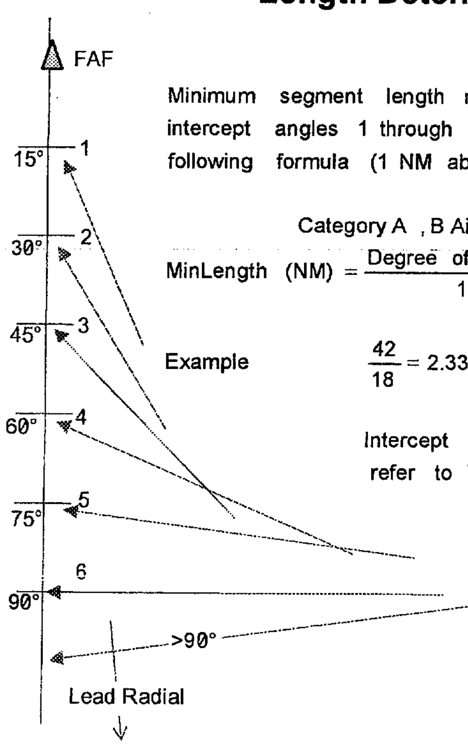
TLS NOTE: Establish an intermediate fix (IF) defined by NAVAID's not associated with the TLS. The IF shall be on the final approach course. Establish a holding pattern at the IF (based on an inbound course to the IF) for use in the event the TLS azimuth course is not acquired.

2.3.1 Minimum Intermediate Segment Length.

The intermediate segment blends the initial approach segment into the final approach segment. It begins at the IF and extends along the final approach course extended to the PFAF. Where a turn from the initial course to the final approach course extended is required, the initial course shall intercept at or before the IF.

2.3.1 a. **Length.** The MINIMUM length of the intermediate segment is 1 NM. Minimum segment length varies where a turn is required at the IF. The length is determined by the magnitude of heading change in the turn on to the final approach course extended (see figure 2-1A). The maximum angle of intersection is 90° unless a lead radial as specified in TERPS Volume 1, paragraph 232a, is provided and the length of the intermediate segment is increased as specified in TERPS Volume 1, table 3.

Figure 2-1A. Minimum Intermediate Segment Length Determined by Intercept Angle



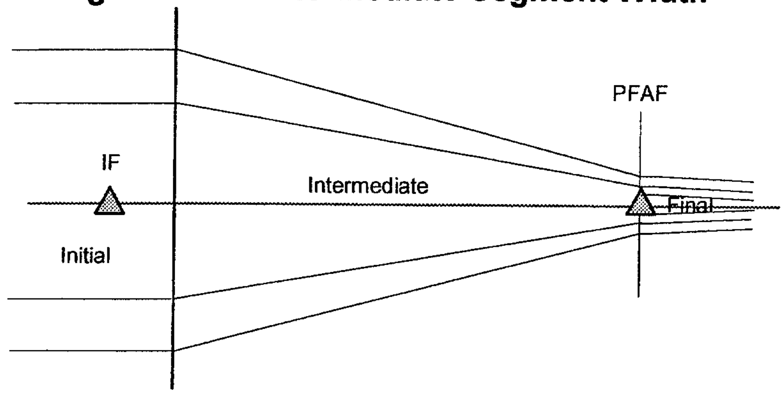
Minimum segment length may be calculated for intercept angles 1 through 90 degrees using the following formula (1 NM absolute minimum) :

Category A , B Aircraft	Category C, D, E Aircraft
$\text{MinLength (NM)} = \frac{\text{Degree of Intercept}}{18}$	$\text{Min Length (NM)} = \frac{\text{Degree of Intercept}}{15}$
Example $\frac{42}{18} = 2.33$	$\frac{42}{15} = 2.8$

Intercept angles greater than 90 degrees refer to TERPS Volume 1, Table 3

2.3.1 **b. Width.** The intermediate trapezoid begins at the width of the initial segment at the latest point the IF can be received, to the width of the final segment at the plotted position of the PFAF (see figure 2-1B).

Figure 2-1B. Intermediate Segment Width



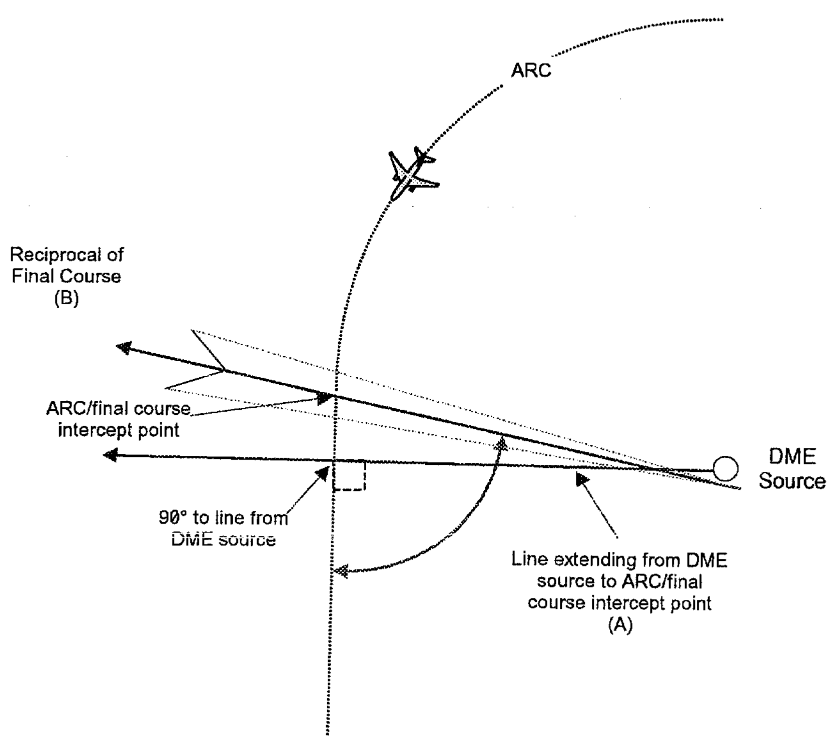
2.3.2 **Determining FAC Intercept Angle Where DME Source is not Collocated with FAC Facility.**

Determine the intercept initial/intermediate segment intercept angle on approach procedures utilizing ARC initial segments using the following formulas.

2.3.2 **a. DME source** on the same side of course as the aircraft (see figure 2-2).

$90 - |A - B| =$ Intercept Angle   Example: $90 - |270 - 285| = 75°$

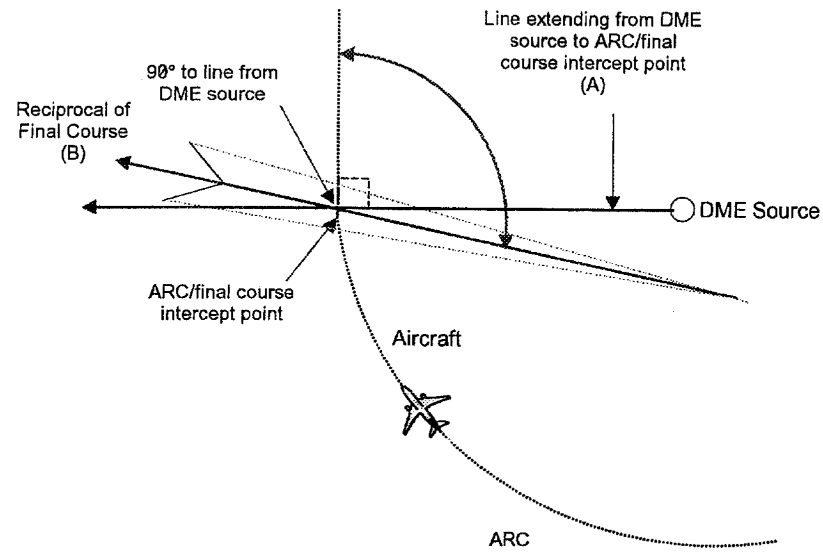
Figure 2-2. Aircraft on the Same Side of Localizer as DME Sources



2.3.2 b. **DME source** on opposite side of course as the aircraft (see figure 2-3).

$90 + |A - B| = \text{Intercept Angle}$ Example: $90 + |270 - 285| = 105°$

Figure 2-3. Aircraft on Opposite Side of Localizer as DME Sources



2.4 RNP VALUES.

Procedures designed under this order may be flown by aircraft with navigation systems certified to RNP values. Each segment of an RNAV procedure has a specific RNP value. Table 2-1 lists RNP values (95% accuracy) by segment type.

Table 2-1. Segment RNP Values

Segment	Lateral (NM) RNAV
En Route	2.0
Initial	1.0
Intermediate	0.5
Final	0.30
LNAV	0.30
Missed Approach	1.0

2.5 MAXIMUM AUTHORIZED GPA'S.

Tables 2-2A, 2-2B, and 2-2C list the MAXIMUM allowable GPA's and MINIMUM visibility by aircraft category, and MAXIMUM TCH values for allowing credit for approach lighting systems (USAF NA). Use Volume 1, Chapter 3 for computing landing minimums). Design all approach procedures to the same runway with the same glidepath angle and TCH. Angles above 3.0° require approval of FAA Flight Standards Service or the appropriate military authority.

Table 2-2A. Maximum GPA's

Category	GPA
A (80 knots or less)	6.4
A (81-90 knots)	5.7
B	4.2
C	3.6
D&E	3.1

2.5.1 RNAV Glidepath Angles.

If a non-RNAV PA system (ILS, MLS, TLS, or PAR) serves the same runway as an RNAV PA system, the RNAV glidepath angle and TCH should match the non-RNAV system.

2.5.2 VGSI Angles.

A VGSI is recommended for all runways to which an instrument approach is published. Where installed, the VGSI angle and TCH should match the glidepath angle of vertically guided approach procedures to the runway.

Table 2-2B. Standard PA Landing Minimums

GLIDEPATH ANGLE (WITH APPROACH LIGHT CONFIGURATION)		MINIMUM HAT*	AIRCRAFT CATEGORY			
			A	B	C	D & E
			MINIMUM VISIBILITY			
3.00° — 3.10°	★	200	¾ 4000			
	#	200	½ 2400			
	$	200	1800			
3.11° — 3.30°	★	200	¾ 4000		NA	
	★	250	¾ 4000		1 5000	NA
	#	200	½ 2400		NA	
	#	250	½ 2400		¾ 4000	NA
	$	200	1800		NA	
	$	250	1800		½ 2400	NA
3.31° — 3.60°	★	200	¾ 4000		NA	
	★	270	¾ 4000		1 5000	NA
	#	200	½ 2400		NA	
	#	270	½ 2400		¾ 4000	NA
	$	200	2000		NA	
	$	270	2000		½ 2600	NA
3.61° — 3.80°	★	200	¾ 4000		NA	
	#	200	½ 2400		NA	
3.81° — 4.20°	★	200	¾ 4000	NA		
	★	250	¾ 4000	1 5000	NA	
	#	200	½ 2400	NA		
	#	250	½ 2400	¾ 4000	NA	
4.21° — 5.00°	★	250	¾ 4000	NA		
	#	250	½ 2400	NA		
5.01° — 5.70°	★	300	1 5000	NA		
	#	300	¾ 4000	NA		
5.71° — 6.40° AIRSPEED NTE 80 KNOTS	★	350	1 ¼	NA		
	#	350	1 5000	NA		

* The HAT shall not be less than 200 feet for civil operations, or 100 feet for military operations.

★= No Lights $ = # Plus TDZ/CL Lights # = MALSR, SSALR, ALSF NA = Not authorized

NOTE: For a HAT higher than the minimum, the visibility (prior to applying credit for lights) shall equal the distance from DA/MAP to RWT, or

(a) ¾ mile up to 5.00°, or
(b) 1 mile 5.01° through 5.70°, or
(c) 1 ¼ miles 5.71° through 6.40°, whichever is the greater.

2.6 GLIDE SLOPE THRESHOLD CROSSING HEIGHT REQUIREMENTS.

2.6.1 Category I Threshold Crossing Height (TCH) Requirements.

2.6.1 a. **Standard.** The glide slope should be located considering final approach obstructions and achieving TCH values associated with the greatest table 2-3 wheel height group applicable to aircraft normally expected to use the runway. The TCH should provide a 30-foot wheel crossing height (WCH).

2.6.1 b. **Deviations from Standard.** The TCH shall provide a WCH of no less than 20 feet or greater than 50 feet for the appropriate wheel height group. These limits shall not be exceeded unless formally approved by a Flight Standards waiver as outlined in Order 8260.19C or by the appropriate military authority.

NOTE: 60 feet is the maximum TCH.

2.6.1 c. **Displaced Threshold Considerations.** The TCH over a displaced threshold can result in a WCH value of 10 feet if the TCH over the beginning of the full strength runway pavement suitable for landing meets table 2-3 TCH requirements.

2.6.2 Category II and III TCH Requirements.

2.6.2 a. **Standard.** The commissioned TCH shall be between 50 and 60 feet with the optimum being 55 feet.

2.6.2 b. **Deviations from the Standard.** Any deviation must be formally approved by a Flight Standards waiver as outlined in Order 8260.19 or by the appropriate military authority.

2.6.2 c. **Temporary Exemption Clause.** Paragraph 4.0 may be applied to a published PA system where the TCH is within the allowable limits in table 2-3. If the new flight inspection derived TCH is within 3 feet of the published TCH but not within the limits of table 2-3, operations may continue without waiver action for up to 365 days from the date the order is applied.

2.6.2 c. (1) **If aircraft in height group 4** have not been excluded from conducting Category II or III operations on that runway, a TCH lower than 50 feet is not permitted unless the achieved ILS reference datum height (ARDH) has averaged 50 feet or higher.

2.6.2 c. (2) **After 365 days,** a flight procedures waiver must have been approved, the situation corrected, or Category II and III operations canceled.

2.6.2 c. (3) **Flight Standards Service** or the appropriate military authority can authorize further deviation or immediately rescind this temporary exemption.

Table 2-2C. Threshold Crossing Height Upper Limits for Allowing Visibility Credit for Lights

HAT (Feet)	GLIDEPATH ANGLE (Degrees)	TCH UPPER LIMIT (Feet)	HAT (Feet)	GLIDEPATH ANGLE (Degrees)	TCH UPPER LIMIT (Feet)
200	3.00 - 3.20	75	300	3.00 - 4.90	75
	3.21 - 3.30	70		4.91 - 5.00	71
	3.31 - 3.40	66		5.01 - 5.10	66
	3.41 - 3.50	63		5.11 - 5.20	61
	3.51 - 3.60	59		5.21 - 5.30	56
	3.61 - 3.70	55		5.31 - 5.40	52
	3.71 - 3.80	50		5.41 - 5.50	48
	3.81 - 3.90	47		5.51 - 5.60	43
	3.91 - 4.00	43		5.61 - 5.70	39
	4.01 - 4.10	39	350	3.00 - 5.60	75
	4.11 - 4.20	35		5.61 - 5.70	70
250	3.00 - 4.10	75		5.71 - 5.80	65
	4.11 - 4.20	71		5.81 - 5.90	60
	4.21 - 4.30	67		5.91 - 6.00	55
	4.31 - 4.40	62		6.01 - 6.10	50
	4.41 - 4.50	58		6.11 - 6.20	45
	4.51 - 4.60	54		6.21 - 6.30	40
	4.61 - 4.70	50		6.31 - 6.40	35
	4.71 - 4.80	45			
	4.81 - 4.90	41			
	4.91 - 5.00	37			
270	3.00 - 4.40	75			
	4.41 - 4.50	73			
	4.51 - 4.60	68			
	4.61 - 4.70	64			
	4.71 - 4.80	59			
	4.81 - 4.90	55			
	4.91 - 5.00	51			

2.6.3 Required TCH Values.

Publish a note indicating VGSI not coincident with the procedure GPA when the VGSI angle is more than 0.2 ° from the GPA, or when the VGSI TCH is more than 3 feet from the procedure TCH.