CHANGE U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8260.3B CHG 18

11/12/99

ARMY .... TM 95-226
NAVY .... OPNAVINST 3722.16C
USAF .... AFMAN 11-226(1)
USCG .... CG 318

SUBJ: UNITED STATES STANDARD FOR TERMINAL INSTRUMENT PROCEDURES (TERPS)

1. PURPOSE. This change transmits revised pages to Order 8260.3B, United States Standard for Terminal Instrument Procedures (TERPS).

2. DISTRIBUTION. This change is distributed in Washington Headquarters to the branch level in the Offices of Airport Safety and Standards; and Communications, Navigation, and Surveillance Systems; to Flight Standards, Air Traffic, and Airway Facilities Services; the National Flight Procedures Office and the Regulatory Standards Division at the Mike Monroney Aeronautical Center; to the branch level in the regional Flight Standards, Airway Facilities, and Air Traffic Divisions; special mailing list ZVS-827, and to special Military and Public Addressees.

3. EFFECTIVE DATE. January 20, 2000.

4. EXPLANATION OF CHANGES. Significant areas of new direction, guidance, and policy included in this change are as follows:

a. Paragraph 122a adds wording to ensure requirements in AC-150/5340-1, Marking of Paved Areas on Airports, and AC 150/5300-13, Airport Design, are met during instrument procedure design and review. The changes in these AC's will impact instrument procedures.

b. Paragraph 161 changes the approach procedure naming convention. Instrument landing system (ILS) procedures utilizing distance measuring equipment (DME) will no longer have DME in the procedure name. If DME is required to support ILS localizer minimums, the chart will be noted to indicate DME is required for localizer (LOC) final. The naming scheme for multiple approaches of the same type to the same runway is changed to use alphabetical suffixes. The procedure title "area navigation (RNAV)" indicates wide area augmentation system (WAAS), lateral navigation (LNAV)/ vertical navigation (VNAV), Flight Management System (FMS), or global positioning system (GPS) approach systems define the final segment. The title for these procedures is RNAV RWY.XX, etc.

c. Paragraph 234b changes the procedure turn protected airspace to allow it to vary according to the entry altitude. As the altitude increases, so does true airspeed. This change ensures the obstruction area will contain the PT maneuver regardless of initiation altitude.

d. Paragraph 251 increases the visual segment obstacle clearance surface (OCS) starting width associated with straight-in approaches from a total width of 400 feet (± 200 feet) to 800 feet (± 400 feet).

Distribution: A-W(AS/ND/FS/AT/AF)-3; AVN-100(150CYS); AMA-200 (80 CYS); A-X(FS/AF/AT)-3; ZVS-827; Special Military and Public Addressees

Initiated By: AFS-420

e. Paragraph 252 publishes actual descent gradient to threshold crossing height (TCH) where straight-in minimums are prohibited because of excessive descent gradient. Publishing this value aids pilots in determining whether or not to attempt a straight-in landing and provides methodology for accommodating S/D fix altitudes above the final approach fix (FAF) to TCH descent.

f. Paragraph 253 adds requirement for the visual descent point (VDP) DME to be collocated with the facility providing final approach course guidance (U.S. Navy/U.S. Army/U.S. Air Force/U.S. Coast Guard NA). Wording is changed to clarify the requirement, but the meaning is not changed.

g. Paragraph 277b provides the "appropriate final required obstacle clearance (ROC)." Previous version required 250 feet of ROC regardless of facility type.

h. Paragraph 282c adds guidance to ensure marker beacons are used as fixes ONLY when associated with the facility providing course instructions.

i. Paragraph 334c adds the new guidance in AC 150/5300-13 that requires precision instrument runway markings for visibility minimums less than 3/4 statute mile, and requires touchdown zone lighting and runway centerline (TDZ/CL) for runway visual range (RVR) less than 2,400 feet.

j. Paragraph 1028 changes the wording to allow military operations with 100-foot category I height above touchdown (HAT) on precision approach radar (PAR) procedures.

5. INFORMATION CURRENCY.

a. Forward for consideration any deficiencies found, clarification needed, or suggested improvements regarding the contents of this order to:

DOT/FAA
Flight Procedure Standards Branch, AFS-420
P.O. Box 25082
Oklahoma City, OK 73125

b. Your assistance is welcome. FAA Form 1320-9, Directive Feedback Information, is included at the end of this change for your convenience. If an interpretation is needed immediately, you may call the originating office for guidance. However, you should use FAA Form 1320-9 as a follow-up to the verbal conversation.

c. **Use the "Other Comments" block** of this form to provide a complete explanation of why the suggested change is necessary.

6. DISPOSITION OF TRANSMITTAL. This change transmittal should be retained after changed pages are filed.

PAGE CONTROL CHART

REMOVE PAGES	DATED	INSERT PAGES	DATED
1 thru 6	2/13/98	1	2/13/98
		2 thru 5 (and 6)	11/12/99
13 and 14	2/13/98	13 thru 13-1 and 14	11/12/99
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44	5/21/92	44	5/21/92
44-1 (and 44-2)	4/1/83	44-1 (and 44-2)	4/1/83
89 (and 90)	2/13/98	89 (and 90).	11/12/99
15-11 and 12	2/13/98	15-11	11/12/99
		15-12	2/13/98

L. Nicholas Lacy
Director, Flight Standards Service

CHAPTER 1. ADMINISTRATIVE

SECTION 1. SCOPE

1. PURPOSE. This handbook contains criteria which shall be used to formulate, review, approve, and publish procedures for instrument approach and departure of aircraft to and from civil and military airports. These criteria are for application at any location over which an appropriate United States agency exercises jurisdiction.

2. DISTRIBUTION. This order is distributed to selected Federal Aviation Administration (FAA) addressees. For distribution within the Department of Defense, see pages v and vi.

3. CANCELLATION. Order 8260.34, Glide Slope Threshold Crossing Height Requirements, dated 10/26/83, is canceled. This change also incorporates criteria contained in VN Supplements 2 and 3 to Order 8260.3B; therefore, VN SUP 2, dated 10/8/92, and VN SUP 3, dated 1/11/93, are canceled.

4. EXISTING PROCEDURES. Existing procedures shall comply with these standards. Approval of nonstandard procedures as required is specified in paragraph 141.

5. TYPES OF PROCEDURES. Criteria are provided for the following types of authorized instrument procedures:

a. Precision Approach.

(1) Straight-In. A descent in an approved procedure where the navigation facility alignment is normally on the runway centerline and glide slope (GS) information is provided. For example, Precision Approach Radar (PAR), Instrument Landing System (ILS) and Microwave Landing System (MLS) procedures are precision approaches.

(2) Simultaneous. A procedure which provides for approaches to parallel runways. This procedure uses two or more ILS-equipped parallel runways. Simultaneous approaches, when authorized, shall be radar monitored. Military commanders may approve simultaneous approaches based upon dual precision radar.

b. Nonprecision Approach.

(1) Straight-In. A descent in an approved procedure in which the final approach course (FAC) alignment and descent gradient permits authorization of straight-in landing minimums.

(2) Circling. A descent to circling minimums from which a circle to land maneuver is performed, or an approach procedure which does not meet criteria for authorizing straight-in landing minimums.

c. Departure Procedures. Procedures designed to provide obstacle clearance during instrument departures.

6. WORD MEANINGS. Word meanings as used in this manual:

a. Shall means that application of the criteria is mandatory.

b. Should means that application of the criteria is recommended.

c. May means that application of the criteria is optional.

7.-119. RESERVED.

SECTION 2. ELIGIBILITY, APPROVAL, AND RETENTION

120. ELIGIBILITY.

a. Military Airports. Procedures at military airports shall be established as required by the directives of the appropriate military service.

b. Civil Airports. Instrument procedures shall be provided at civil airports open to the aviation public whenever a reasonable need is shown. No minimum number of potential instrument approaches is specified; however, the responsible FAA office must determine that a public procedure will be beneficial to more than a single user or interest. Private procedures, for the exclusive use of a single interest, may be provided on a reimbursable basis under Title 14 of the Code of Federal Regulations (14 CFR) Part 171, where applicable, if they do not unduly conflict with the public use of airspace. Reasonable need is deemed to exist when the instrument flight procedure will be used by:

(1) A certificated air carrier, air taxi, or commercial operator; or

(2) Two or more aircraft operators whose activities are directly related to the commerce of the community; or

(3) Military aircraft.

121. REQUESTS FOR PROCEDURES. Requests for military procedures are processed as described by the appropriate military service. No special form is required for requesting civil procedures. Civil requests may be made by letter to the appropriate Regional Office. Requests for civil procedures shall be accepted from any aviation source, provided the request shows that the airport owner/operator has been advised of this request. (This advice is necessary only when the request is for an original procedure to an airport not already served by an approach procedure.) Airport owners/ operators will be advised of additional requests for procedures by the FAA as soon as possible after receipt thereof.

122. APPROVAL. Where a military requirement or reasonable civil need has been established, a request for an instrument approach procedure (IAP) and/or instrument departure procedure for an airport shall be approved if the following minimum standards are met:

a. Airport. The airport landing surfaces must be adequate to accommodate the aircraft which can be reasonably expected to use the procedure. Appropriate runway markings, hold position markings, and signs, required by AC 150/5340-1, Marking of Paved Areas on Airports, shall be established and in place; and all runway design standards in AC 150/5300-13, Airport Design, must be met. Runway lighting is required for approval of night instrument operations. EXCEPTION: Do NOT deny takeoff and departure procedures at night due solely to the absence of runway edge lights. The airport must have been found acceptable for instrument flight rules (IFR) operations as a result of an airport airspace analysis conducted pursuant to Order 7400.2, Procedures for Handling Airspace Matters, and/or appropriate military directives, as applicable. Only circling minimums shall be approved to airports where the runways are not clearly defined.

b. Navigation Facility. All instrument and visual navigation facilities used must successfully pass flight inspection.

c. Obstacle Marking and Lighting. Obstacles which penetrate 14 CFR Part 77 imaginary surfaces are obstructions and, therefore, should be marked and lighted, insofar as is reasonably possible under FAA Advisory Circular AC 70/7460.1, Obstruction Marking and Lighting. Those penetrating the 14 CFR Part 77 approach and transitional surfaces should be removed or made conspicuous under that AC. Normally, objects which are shielded need not be removed or made conspicuous.

NOTE: *In military procedures, the appropriate military directives apply.*

d. Weather Information. Terminal weather observation and reporting facilities must be available for the airport to serve as an alternate airport. Destination minimums may be approved when a general area weather report is available prior to commencing the approach and approved altimeter settings are available to the pilot prior to and during the approach consistent with communications capability.

e. Communications. Air-to-ground communications must be available at the initial approach fix (IAF) minimum altitude and when the aircraft executing the missed approach reaches the missed approach altitude. At lower altitudes, communications shall be required where essential for the safe and efficient use of airspace. Air-to-ground communication normally consists of ultra high frequency (UHF) or very high frequency (VHF) radio, but high frequency (HF) communication may be approved at locations which have a special need and capability. Other suitable means of point-to-point communication, such as commercial telephone, are also required to file and close flight plans.

123. RETENTION AND CANCELLATION. Civil instrument procedures shall be canceled when a re-evaluation of the usefulness of an IAP indicates that the benefits derived are not commensurate with the costs of retaining the procedure. This determination will be based upon an individual evaluation of requirements peculiar to each specific location, and will consider airport complexity, military requirements, planned airport expansion, and the need for a backup or supplement to the primary instrument approach system. Certain special procedures exist, generally based on privately operated navigation facilities. When a procedure based on a public facility is published, special procedures for that airport shall be canceled unless retention provides an operational advantage to the user. Before an instrument procedure is canceled, coordination with civil and military users shall be effected. Care shall be taken not to cancel procedures required by the military or required by air carrier operators at provisional or alternate airports. Military procedures shall be retained or canceled as required by the appropriate military authority.

124.-129. RESERVED.

SECTION 3. RESPONSIBILITY AND JURISDICTION

130. RESPONSIBILITY.

a. Military Airports. The United States Army, Navy, Air Force, and Coast Guard, shall establish and approve instrument procedures for airports under their respective jurisdictions. The FAA will accept responsibility for the development and/or publication of military procedures when requested to do so by the appropriate military service through an interagency agreement. Military instrument procedures are official procedures. The FAA (AVN-100 Regional FPO) shall be informed when military procedures are canceled.

b. Civil Airports. The FAA shall establish and approve instrument procedures for civil airports.

c. Military Procedures at Civil Airports. Where existing FAA approach or departure procedures at civil airports do not suffice, the military shall request the FAA to develop procedures to meet military requirements. These requirements may be met by modification of an existing FAA procedure or development of a new procedure. The FAA shall formulate, coordinate with the military and industry, and publish and maintain such procedures. The military shall inform the FAA when such procedures are no longer required.

131. JURISDICTION. The United States Army, Navy, Air Force, Coast Guard, and Marine Corps Commanding Officers, or FAA Regional Directors having jurisdiction over airports are responsible for initiating action under these criteria to establish or revise TERPS when a reasonable need is identified, or where:

a. New facilities are installed.

b. Changes to existing facilities necessitate a change to an approved procedure.

c. Additional procedures are necessary.

d. New obstacles or operational uses require a revision to the existing procedure.

132.-139. RESERVED.

SECTION 4. ESTABLISHMENT

140. FORMULATION. Proposed procedures shall be prepared under the applicable portion of this publication as determined by the type and location of navigation facility and procedure to be used. To permit use by aircraft with limited navigational equipment, the complete procedure should be formulated on the basis of a single navigation facility whenever possible. However, the use of an additional facility of the same or different type in the procedure to gain an operational advantage is permitted.

141. NONSTANDARD PROCEDURES. The standards contained in this manual are based on reasonable assessment of the factors which contribute to errors in aircraft navigation and maneuvering. They are designed primarily to assure that safe flight operations for all users result from their application. The dimensions of the obstacle clearance areas are influenced by the need to provide for a smooth, simply computed progression to and from the en route system. Every effort shall be made to formulate procedures in accordance with these standards; however, peculiarities of terrain, navigation information, obstacles, or traffic congestion may require special consideration where justified by operational requirements. In such cases, nonstandard procedures which deviate from these criteria may be approved, provided they are fully documented and an equivalent level of safety exists. A nonstandard procedure is not a substandard procedure, but is one which has been approved after special study of the local problems has demonstrated that no derogation of safety is involved. The FAA, Flight Technologies and Procedures Division, AFS-400, is the approving authority for nonstandard civil procedures. Military procedures which deviate from standards because of operational necessity, and in which an equivalent level of safety is not achieved, shall include a cautionary note to identify the hazard and shall be marked "not for civil use."

142. CHANGES. Changes in instrument procedures shall be prepared and forwarded for approval in the same manner as in the case of new procedures. Changes so processed will not be made solely to include minor corrections necessitated by changes in facility frequencies, variation changes, etc., or by other minor changes not affecting the actual instrument procedure. Changes which require reprocessing are those which affect fix, course, altitude, or published minimums.

143.-149. RESERVED.

SECTION 5. COORDINATION

150. COORDINATION. It is necessary to coordinate instrument procedures to protect the rights of all users of airspace.

a. Military Airports. All instrument procedures established or revised by military activities for military airports shall be coordinated with the FAA or appropriate agency or an overseas host nation. When a procedure may conflict with other military or civil activities, the procedure shall also be coordinated with those activities.

b. Civil Airports. Prior to establishing or revising instrument procedures for civil airports, the FAA shall, as required, coordinate such procedures with the appropriate civil aviation organizations. Coordination with military activities is required when a military operating unit is based at the airport or when the proximity of a military airport may cause procedures conflicts.

c. Air Traffic Control (ATC). Prior to establishing or revising instrument procedures for a military or civil airport, the initiating office shall coordinate with the appropriate FAA Air Traffic office to ensure compatibility with air traffic flow and to assess the impact of the proposed procedure on current or future air traffic programs.

d. Airspace Actions. Where action to designate controlled airspace for a procedure is planned, the airspace action should be initiated sufficiently in advance so that effective dates of the procedure and the airspace action will coincide.

e. Notice to Airmen (NOTAM). A NOTAM to **RAISE** minimums may be issued in case of emergencies; i.e., facility outages, facility out-of tolerance conditions, new construction which penetrates critical surfaces, etc. NOTAM's may also be issued to **LOWER** minimums when a supporting facility is added and a significant change in minimums (60 feet in MDA/DH or a reduction in visibility) will result. A NOTAM may be issued to **RAISE OR LOWER** minimums as appropriate on a no-FAF procedure when a procedure turn (PT) altitude is modified as the result of construction or terrain, or when a facility restriction is removed. However, a complete new procedure may not be issued by NOTAM, except where military requirements dictate. ATC shall be advised of the required NOTAM action prior to issuance and normal coordination shall be effected as soon as practicable.

151. COORDINATION CONFLICTS. In areas under the FAA jurisdiction, coordination conflicts which cannot be resolved at the field level shall be submitted to the appropriate FAA region for additional coordination and resolution. Problems which are unresolved at the regional level shall be forwarded to the FAA, AFS-400, for action. If the problem involves a military procedure, parallel action through military channels shall be taken to expedite coordination at the appropriate level.

152.-159. RESERVED.

SECTION 6. IDENTIFICATION OF PROCEDURES

160. IDENTIFICATION OF PROCEDURES. Instrument procedures shall be identified to be meaningful to the pilot, and to permit ready identification in ATC phraseology.

161. STRAIGHT-IN PROCEDURE IDENTIFICATION. Instrument procedures which meet criteria for authorization of straight-in landing minima shall be identified by a prefix describing the navigational system providing the final approach guidance and the runway to which the final approach course is aligned:

a. Non-RNAV. ILS runway (RWY) 18R, localizer (LOC) back course (BC) RWY 7, Tactical Air Navigational Aid (TACAN) RWY 36, localizer type directional aid (LDA) RWY 4, nondirectional radio beacon (NDB) RWY 21, VHF omnidirectional radio range (VOR) RWY 15, VOR/distance measuring equipment (DME) RWY 6, ILS or TACAN RWY 9, etc. A slash (/) indicates more than one type of equipment is required to execute the final approach; e.g., VOR/DME, etc. ILS procedures do not require DME to fly the final approach, even if a DME fix has been substituted for one of the marker beacons, hence ILS procedures will not be named ILS/DME. When a LOC procedure requires DME or RADAR to fly the final approach, and is charted on an ILS approach, the procedure name will be ILS. The chart will be noted to indicate DME or RADAR is required for localizer minima, as appropriate. When procedures are combined, the word "or" shall indicate either type of equipment may be used to execute the final approach; e.g., ILS or TACAN, ILS or NDB, VOR/DME or TACAN, etc. Where more than one approach using the same final approach guidance is developed to the same runway, identify each for the runway/navigational aid combination with alphabetical suffix beginning at the end of the alphabet; e.g., ILS Z RWY 28L (first procedure), ILS Y RWY 28L (second procedure), ILS X RWY 28L (third procedure), etc.

b. RNAV. Identify WAAS, Baro VNAV, and GPS approach procedures as RNAV RWY (Number); e.g., RNAV RWY 21.

NOTE: The published minima lines will identify required RNAV sensors; e.g., GLS, LNAV/VNAV (includes degraded WAAS and Baro VNAV), or LNAV (includes GPS and WAAS without glidepath). A single RNAV approach will be *published depicting GLS. and/or LNAV/VNAV, and/or LNAV minimums where they share the same courses and altitudes*.

c. OTHER RNAV. Identify VOR/DME and LORAN based RNAV procedures as (system) RNAV RWY (number); e.g., VOR/DME RNAV RWY 13, LORAN RNAV RWY 31.

162. CIRCLING PROCEDURE IDENTIFICATION. When an approach procedure does not meet criteria for straight-in landing minimums authorization, it shall be identified by the type of navigational aid (NAVAID) which provides final approach guidance, and an alphabetical suffix starting with the beginning of the alphabet. The first procedure formulated shall bear the suffix "A" even though there may be no intention to formulate additional procedures. If additional procedures are formulated, they shall be identified alphabetically in sequence, e.g., VOR-A, VOR/DME-B, NDB-C, NDB-D, LDA-E, RNAV-A, etc. A revised procedure will bear its original identification.

163. DIFFERENTIATION. Where high altitude procedures are required, the procedure identification shall be prefixed with the letters "HI" e.g., HI-VOR RWY 5.

164.-169. RESERVED.

SECTION 7. PUBLICATION

170. SUBMISSION. Instrument procedures shall be submitted by the approving authority on forms provided by the originating agency. A record of coordination shall be maintained by the originating agency. Procedures shall be routed under current orders or directives of the originating agency.

171. ISSUANCE. The following are designated as responsible offices for the release of approved instrument procedures for each agency.

a. Army. Director, U.S. Army Aeronautical Services Agency.

b. Navy and Marine Corps. Chief of Naval Operations (CNO), Naval Flight Information Group.

c. Air Force. Headquarters, Air Force Flight Standards Agency, Instrument Standards Division.

d. Coast Guard. Commandant, U.S. Coast Guard.

e. Civil. Administrator, FAA.

172. EFFECTIVE DATE. TERPS and revisions thereto shall be processed in sufficient time to permit publication and distribution in advance of the effective date. Effective dates should normally coincide with scheduled airspace changes except when safety or operational effectiveness is jeopardized. In case of emergency, or when operational effectiveness dictates, approved procedures may be disseminated by NOTAM (see paragraph 150e). Procedures disseminated by NOTAM must also be processed promptly in the normal fashion and published in appropriate instrument procedures charts and in the Federal Register when required.

173.-199. RESERVED.

234. INITIAL APPROACH SEGMENT BASED ON A PT. A PT shall be specified when it is necessary to reverse direction to establish the aircraft on an intermediate or FAC, except as specified in paragraph 234e. A PT begins by overheading a facility or fix which meets the criteria for a holding fix (see paragraph 287b), or for a FAF (see paragraph 287c). The procedure shall specify the PT fix, the outbound and inbound course, the distance within which the PT shall be completed, and the direction of the PT. When a teardrop turn is used, the angle of divergence between the outbound courses and the reciprocal of the inbound course shall be a MINIMUM of 15° or a MAXIMUM of 30° (see paragraph 235a for high altitude teardrop penetrations). When the beginning of the intermediate or final approach segment associated with the procedure turn is not marked by a fix, the segment is deemed to begin on the inbound procedure turn course at the maximum distance specified in the procedure. Where neither segment is marked by a fix, the final segment begins at the maximum distance specified in the procedure.

a. Alignment. When the inbound course of the PT becomes the intermediate course, it must meet the intermediate course alignment criteria (see paragraph 242a). When the inbound course becomes the FAC, it must meet the FAC alignment criteria (see paragraph 250). The wider side of the PT area shall be oriented in the same direction as that prescribed for the PT.

b. Area. The PT areas are depicted in figure 5. The normal PT distance is 10 miles. See table 1A. Decrease this distance to 5 miles where only CAT A aircraft or helicopters are to be operating, and increase to 15 miles to accommodate operational requirements, or as specified in paragraph 234d. No extension of the PT is permitted without a FAF. When a PT is authorized for use by approach CAT E aircraft, use a 15-mile PT distance. The PT segment is made up of the entry and maneuvering zones. The entry zone terminates at the inner boundary which extends perpendicular to the PT inbound course at the PT fix. The remainder of the PT segment is the maneuvering zone. The entry and maneuvering zones are made up of primary and secondary areas. The PT primary area dimensions are based on the PT completion altitude or the highest feeder route altitude, whichever is greater. To allow additional maneuvering area as the true airspeed increases at higher altitudes, the dimensions of the PT primary area increase. The PT secondary area is 2 miles on the outside of the primary area.

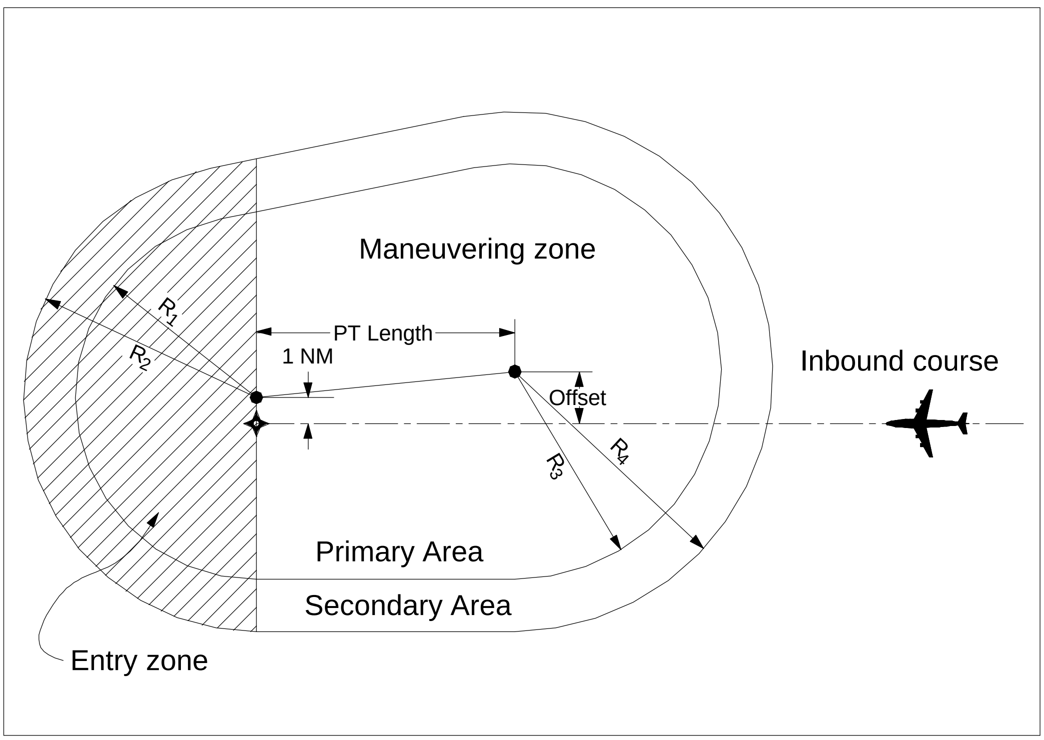


Figure 5. PROCEDURE TURN AREA, Par 234b.
(See Table 1A to determine radius values.)

Table 1A, PROCEDURE TURN VARIABLES ACCORDING TO ALTITUDE, Par 234b.

$\leq 6{,}000$

PT Length	Offset	R_1	R_2	R_3	R_4
5	2	4	6	5	7
>5-10	2	5	7	6	8
>10-15	β-4	5	7	β	β+2

$$\beta = 0.1 \times (d - 10) + 6$$

Where d = PT Length

$>6{,}000 \quad \leq 10{,}000$

PT Length	Offset	R_1	R_2	R_3	R_4
5	2	4	6	5	7
>5-10	2	6	8	7	9
>10-15	β-5	6	8	β	β+2

$$\beta = 0.1 \times (d - 10) + 7$$

Where d = PT Length

$>10{,}000$

PT Length	Offset	R_1	R_2	R_3	R_4
5	2	4	6	5	7
>5-10	2	7	9	8	10
>10-15	β-6	7	9	β	β+2

$$\beta = 0.1 \times (d - 10) + 8$$

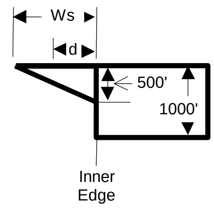
Where d = PT Length

c. Obstacle Clearance. A minimum of 1,000 feet of clearance shall be provided in the primary area. In the secondary area, 500 feet of obstacle clearance shall be provided at the inner edge, tapering uniformly to zero feet at the outer edge (see figure 6). Allowance for precipitous terrain should be considered as specified in paragraph 323a. The primary and secondary areas determine obstacle clearance in both the entry and maneuvering zones. The use of entry and maneuvering zones provides further relief from obstacles. The entry zone is established to control the obstacle clearance prior to proceeding outbound from the PT fix. The maneuvering zone is established to control obstacle clearance AFTER proceeding outbound from the PT fix (see figure 5). The altitudes selected by application of the obstacle clearance as specified in this paragraph may be rounded to the nearest 100 feet (see paragraph 231).

$$\text{Secondary ROC} = 500 \times \frac{Ws - d}{Ws}$$

Where d = distance from inner edge

Ws = Width of secondary area



d. Descent Gradient. The OPTIMUM descent gradient in the initial approach is 250 feet per mile. Where a higher descent gradient is necessary, the MAXIMUM permissible gradient is 500 feet per mile. Where a PT is established over a FAF, the PT completion altitude should be as close as possible to the FAF altitude. The difference between the PT completion altitude and the altitude over the FAF shall not be greater than those shown in table 1B. If greater differences are required for a 5- or 10-mile PT, the PT distance limits and maneuvering zone shall be increased at the rate of 1 mile for each 200 feet of required altitude.

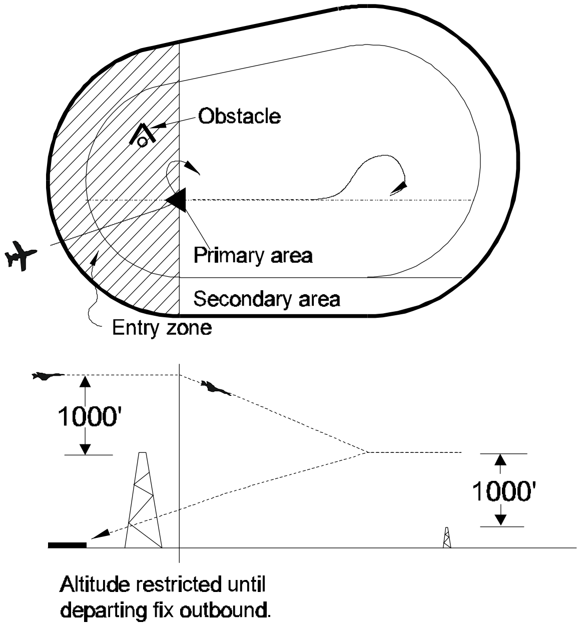


Figure 6. PT INITIAL APPROACH AREA. Par 234c.

e. Elimination of PT. A PT is NOT required when an approach can be made direct from a specified IF to the FAF. A PT NEED NOT be established when an approach can be made from a properly aligned holding pattern. See paragraph 291. In this case, the holding pattern in lieu of a PT, shall be established over a final or intermediate approach fix and the following conditions apply:

(1) If the holding pattern is established over the FAF, the minimum holding altitude (MHA) shall not be more than 300 feet above the altitude specified for crossing the FAF inbound.

(2) If the holding pattern is established over the IF, the MHA shall permit descent to the FAF altitude within the descent gradient tolerances prescribed for the intermediate segment (see paragraph 242d).

Table 1B. PT COMPLETION ALTITUDE DIFFERENCE. Par 234d.

TYPE OF PT	ALTITUDE DIFFERENCE
15 Mile PT from FAF	Within 3,000 Ft of Alt. over FAF
10 Mile PT from FAF	Within 2,000 Ft of Alt. over FAF
5 Mile PT from FAF	Within 1,000 Ft of Alt. over FAF
15 Mile PT, no FAF	Not Authorized
10 Mile PT, no FAF	Within 1,500 Ft of MDA on Final
5 Mile PT, no FAF	Within 1,000 Ft of MDA on Final

235. INITIAL APPROACH BASED ON HIGH ALTITUDE TEARDROP PENETRATION. A teardrop penetration consists of departure from an IAF on an outbound course, followed by a turn toward and intercepting the inbound course at or prior to the IF or point. Its purpose is to permit an aircraft to reverse direction and lose considerable altitude within reasonably limited airspace. Where no IF is available to mark the beginning of the intermediate segment, it shall be assumed to commence at a point 10 miles prior to the FAF. When the facility is located on the airport, and no fix is available to mark the beginning of the final approach segment, the criteria in paragraph 423 apply.

a. Alignment. The outbound penetration course shall be between 18° and 26° to the left or right of the reciprocal of the inbound course. The actual angular divergence between the courses will vary inversely with the distance from the facility at which the turn is made (see table 2).

b. Area.

(1) Size. The size of the penetration turn area must be sufficient to accommodate both the turn and the altitude loss required by the procedure. The penetration turn distance shall not be less than 20 miles from the facility. The penetration turn distance depends on the altitude to be lost in the procedure and the point at which the descent is started (see table 2). The aircraft should lose half the total altitude or 5,000 feet, whichever is greater, outbound prior to starting the turn. The penetration turn area has a width of 6 miles on both sides of the flight track up to the IF or point, and shall encompass all the areas within the turn (see figure 7).

Table 2. PENETRATION TURN DISTANCE/DIVERGENCE. Par 235a.

ALT TO BE LOST PRIOR TO COM-MENCING TURN	DISTANCE TURN COM-MENCES (NM)	COURSE DIVER-GENCE (DEGREES)	SPECIFIED PENETRATION TURN DIS-TANCE (NM)
12,000 Ft	24	18	28
11,000 Ft	23	19	27
10,000 Ft	22	20	26
9,000 Ft	21	21	25
8,000 Ft	20	22	24
7,000 Ft	19	23	23
6,000 Ft	18	24	22
5,000 Ft	17	25	21
5,000 Ft	16	26	20

(2) Penetration Turn Table. Table 2 should be used to compute the desired course divergence and penetration turn distances which apply when a specific

(3) Intermediate Segment Area.

(a) PT Over a Facility. The intermediate segment starts 15 NM from the facility at a width of 6 NM each side of the inbound course and connects to the width of the final segment at the FAF. The area considered for obstacle clearance is from the start of the PT distance to the FAF.

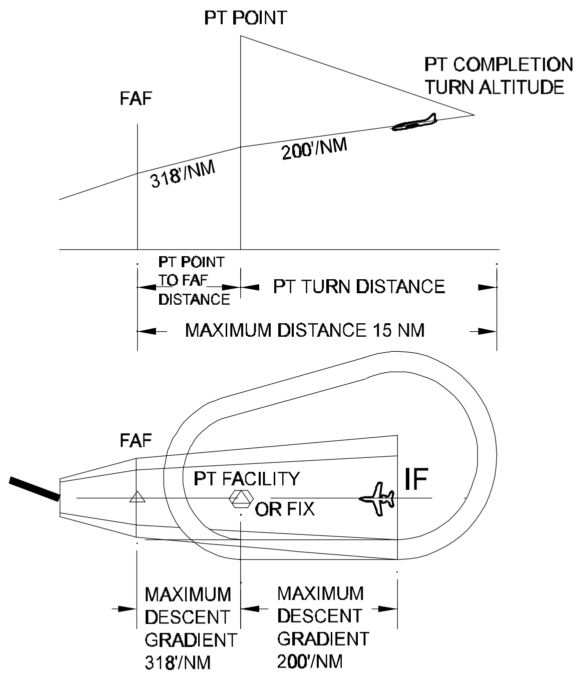


Figure 14-2. INTERMEDIATE AREA WITHIN PT AREA. PT Facility/Fix Used as a Stepdown Fix. Par 244d(4).

(b) PT Over a Fix (NOT a Facility). The intermediate segment starts at the PT distance at a width of 6 NM each side of the inbound course and connects to the width of the final segment at the FAF. The area considered for obstacle clearance is from the start of the PT distance to the FAF.

(4) The MAXIMUM descent gradient is 200 feet/NM. If the PT facility/fix is a stepdown fix, the descent gradient from the stepdown fix to the FAF may be increased to a maximum of 318 feet/NM (see figure 14-2). The PT distance may be increased in 1 NM increments up to 15 NM to meet descent limitations.

(5) When establishing a stepdown fix within an intermediate/initial segment underlying a PT area:

(a) When the PT fix is over a facility/fix prior to the FAF, the facility/fix is the stepdown fix in the intermediate/initial area, and another stepdown fix within this segment is not authorized.

(b) The MAXIMUM descent gradient from the IF point to the stepdown fix is 200 feet/NM. The MAXIMUM descent gradient from the stepdown fix to the FAF is 318 feet/NM.

e. PT Facility Fix Used as an IF. See figure 14-3.

(1) When the PT inbound course is the same as the intermediate course, either paragraph 244d may be used, or a straight initial segment may be used from the start of the PT distance to the PT fix.

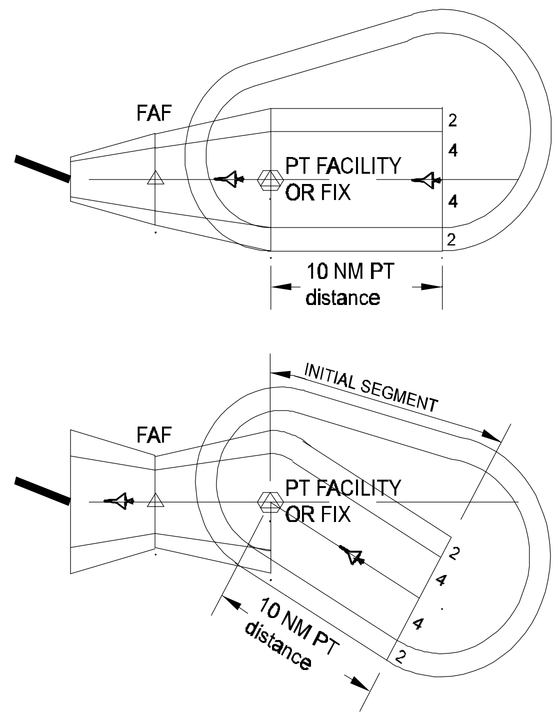


Figure 14-3. USE OF PT FIX FOR IF. Par 244e.

(2) When the PT inbound course is NOT the same as the intermediate course, an intermediate segment within the PT area is NOT authorized; ONLY a straight initial segment shall be used from the start of the PT distance to the PT fix.

(3) When a straight initial segment is used, the MAXIMUM descent gradient within the PT distance is 318 feet/NM, the PT distance may be increased in 1 NM increments up to 15 NM to meet descent limitations.

(4) When establishing a stepdown fix within an intermediate/initial segment underlying a PT area:

(a) Only one stepdown fix is authorized within the initial segment that underlies the PT maneuvering area.

(b) The distance from the PT facility/fix and a stepdown fix underlying the PT area shall not exceed 4 NM.

(c) The MAXIMUM descent gradient from the PT completion point (turn distance) to the stepdown fix, and from the stepdown fix to the IF, is 318 feet/NM.

f. When a PT from a facility is required to intercept a localizer course, the PT facility is considered on the localizer course when it is located within the commissioned localizer course width.

245.-249. RESERVED.

SECTION 5. FINAL APPROACH

250. FINAL APPROACH SEGMENT. This is the segment in which alignment and descent for landing are accomplished. The final approach segment considered for obstacle clearance begins at the FAF or points and ends at the runway or missed approach point (MAP), whichever is encountered last. A visual portion within the final approach segment may be included for straight-in nonprecision approaches (see paragraph 251). Final approach may be made to a runway for a straight-in landing or to an airport for a circling approach. Since the alignment and dimensions of the non-visual portions of the final approach segment vary with the location and type of navigation facility, applicable criteria are contained in chapters designated for specific navigation facilities.

251. VISUAL PORTION OF THE FINAL APPROACH SEGMENT. Evaluate the visual area associated with each usable runway at an airport. Apply the STANDARD visual area described in paragraph 251a(1) to runways to which an aircraft is authorized to circle. Apply the STRAIGHT-IN area described in paragraph 251a(2) to runways with approach procedures aligned with the runway centerline. Apply the OFFSET visual area described in paragraph 251a(3) to evaluate the visual portion of a straight-in approach that is not aligned with the runway centerline. These evaluations determine if night operations must be prohibited because of close-in unlighted obstacles, or if visibility minimums must be restricted.

Note: If a runway is served by an approach procedure not aligned with the runway centerline, and is authorized for landing from a circling maneuver on an approach procedure to a different runway, it will receive both standard and offset evaluations.

a. Area.

(1) Standard.

(a) Alignment. Align the visual area with the runway centerline extended.

(b) Length. The visual area begins 200 feet from the threshold (THR) at THR elevation and extends 10,000 feet out the runway centerline (see figure 14-4).

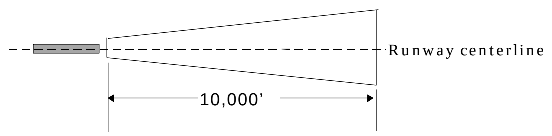


Figure 14-4. VISUAL AREA, Par. 251a(1)(b)

(c) Width. The beginning width of the visual area is 400 feet (200' either side of runway centerline) (see figure 14-5). The sides splay outward relative to runway centerline. Calculate the width of the area at any distance 'd' from its origin using the following formula:

$$\frac{1}{2}W = (0.15 \times d) + 200'$$

where ½W = Perpendicular distance from centerline to edge of area
d = Distance (ft) measured along centerline from area origin

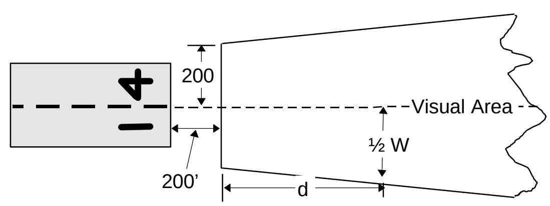


Figure 14-5. VISUAL AREA ORIGIN, Par 251a(1)(c).

(2) Straight-in. (need not meet straight-in descent criteria)

(a) Alignment. Align the visual area with the runway centerline extended.

(b) Length. The visual area begins 200 feet from the threshold (THR) at THR elevation and DH for precision procedures for the VDP location (even if one is not published) for nonprecision procedures (see paragraph 253).

NOTE: When more than one set of minimums are published, use the lowest MDA to determine VDP location.

(c) **Width**. The beginning width of the visual area is 800 feet (400 feet either side of runway centerline). The sides splay outward relative to runway centerline (see figure 14-6). Calculate the width of the area at any distance "d" from its origin using the following formula:

$$\tfrac{1}{2}W = (0.138 \times d) + 400$$

Where ½W = Perpendicualr distance in feet from centerline to edge of area

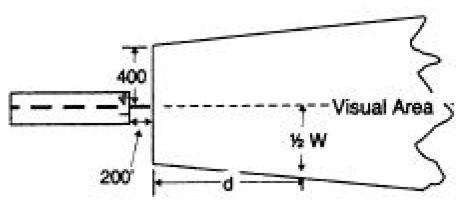


Figure 14-6 VISUAL AREA ORIGIN, Par 251a(2).

(3) **Offset**. When the final course does not coincide with the runway centerline extended (± 0.05°), modify the visual area as follows: (See figure 14-6A)

(a) **STEP 1.** Draw the area aligned with the runway centerline as described in paragraph 251a(2).

(b) **STEP 2.** Extend a line perpendicular to the final approach course (FAC) from the visual descent point (VDP) (even if one is not published) to the point it crosses the runway centerline (RCL) extended .

(c) **STEP 3.** Extend a line from this point perpendicular to the RCL to the outer edge of the visual area, noting the length (L) of this extension.

(d) **STEP 4.** Extend a line in the opposite direction than the line in Step 2 from the VDP perpendicular to the FAC for the distance (L).

(e) **STEP 5.** Connect the end of the line constructed in Step 4 to the end of the inner edge of the area origin line 200 feet from runway threshold.

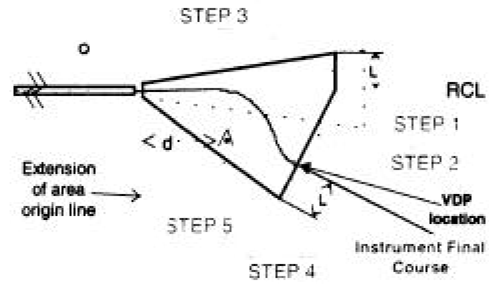


Figure 14-6A. VISUAL SEGMENT FOR OFFSET COURSE, Par 251a(3).

b. Obstacle Clearance. Two obstacle identification surfaces (OIS) overlie the visual area with slopes of 20:1 and 34:1, respectively. When evaluating a runway for circling, apply the 20:1 surface. When evaluating a runway for an approach procedure satisfying straight-in alignment criteria, apply the 20:1 and 34:1 surfaces. Calculate the surface height above threshold at any distance "d" from an extension of the area origin line using the following formulae:

$$20{:}1 \text{ Surface Height} = \frac{d}{20}$$

$$34{:}1 \text{ Surface Height} = \frac{d}{34}$$

(1) **If the 34:1 surface is penetrated**, take **ONE** of the following actions:

(a) **Adjust the obstacle height** below the surface or remove the penetrating obstacles.

(b) **Limit minimum visibility** to ¾ mile.

(2) **In addition to the 34:1 evaluation,** if the 20:1 surface is penetrated, take **ONE** of the following actions:

(a) **Adjust the obstacle height** below the surface or remove the penetrating obstacles.

(b) **Do not publish a VDP,** limit minimum visibility to 1 mile, and take action to have the penetrating obstacles marked and lighted.

(c) **Do not publish a VDP,** limit minimum visibility to 1 mile, and do not authorize night IFR operations to this runway.

252. DESCENT ANGLE / GRADIENT. The OPTIMUM nonprecision final segment descent gradient is 318 ft/NM which approximates a 3.00° angle. The MAXIMUM descent gradient is 400 ft/NM which approximates a descent angle of 3.77°. Calculate descent gradients from the plotted position of the FAF or stepdown fix to the plotted position of a stepdown fix or final endpoint (FEP) as appropriate (see figure 14-7). The FEP is formed by the intersection of the final approach course (FAC) and a line perpendicular to the FAC that extends through the runway threshold (first usable landing surface for circling only procedures). When the maximum descent gradient is exceeded, straight-in minimums are NOT authorized; however, circling only minimums may be authorized if the maximum circling descent gradient is not exceeded (see paragraph 252d). In these cases, publish the actual descent gradient to TCH rather than to CMDA.

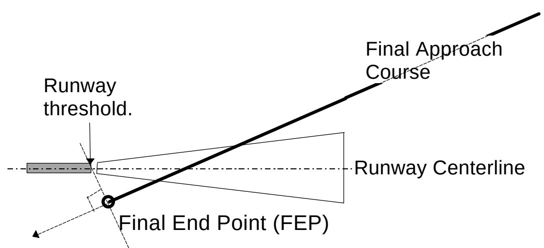


Figure 14-7. FINAL END POINT, Par 252.

a. Non-RNAV approaches. FAF and/or last step-down fix (S/D) location and altitude should be selected to provide a descent angle and TCH coincident (±0.20°, ± 3′) with the lowest published visual glide slope indicator (VGSI) glide slope angle, when feasible; or, when VGSI is not installed, the FAF and/or last S/D location and altitude should be selected so as to achieve a near optimum final segment descent gradient. To determine the FAF or S/D altitude necessary to align the descent angle with the lowest VGSI, calculate the altitude gain of a plane with the slope of the lowest published VGSI glide slope angle emanating from the lowest published VGSI threshold crossing height (TCH) to the FAF or S/D location. To determine the OPTIMUM FAF or S/D altitude, calculate the altitude gain of a 318 ft/NM gradient (3° angle) extending from the visual TCH (when there is not a VGSI, see table 18A) to the FAF or S/D location. Round this altitude up or down to the 100′ increment for the FAF or 20' increment for the S/D. Ensure that ROC requirements are not violated during the rounding process. If the gradient from TCH to S/D is greater than the gradient from TCH to FAF, continue the greater gradient to the FAF and adjust the FAF altitude accordingly. If ATC, application of hold-in-lieu of PT criteria in paragraph 234e(1), or intermediate segment obstacles prohibit this altitude, consider relocating the FAF to achieve an altitude that will satisfy these requirements and the VGSI or optimum descent gradient (see figure 14-8).

SL in NM:

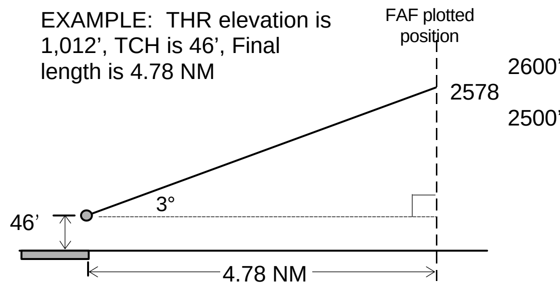
$$FAF\ \text{Altitude} = \text{THRe} + \text{TCH} + (318 \times SL)$$

SL in feet:

$$\text{FAF Altitude} = \text{THRe} + \text{TCH} + \left(\tan(\text{VGSI angle}) \times SL \times 6076.11548\right)$$

where: THRe = THR Elevation

SL = Segment Length



$$2578.04 = 1012 + 46 + (318 \times 4.78)$$

or

$$2580.12 = 1012 + 46 + \tan(3°) \times (4.78 \times 6076.11548)$$

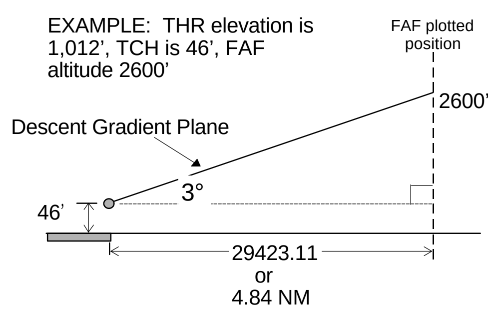
Figure 14-8. FAF ACTIVITIES GIVEN FINAL LENGTH, Par 252a.

b. RNAV Approaches. If feasible, place the FAF waypoint where the optimum descent angle, or the lowest published VGSI (if installed) glidepath angle intersects the intermediate altitude or the altitude determined by application hold-in-lieu of PT criteria in paragraph 234e(1). When an S/D is used, the S/D altitude should be at or below the published VGSI glide slope angle (lowest angle for multi-angle systems). See figure 14-9.

$$SL = \frac{\left(\text{FAF Altitude} - [\text{THRe} + \text{TCH}]\right)}{\tan(3° \text{ or VGSI angle})}$$

where: SL = Segment Length in feet

THRe = Threshold Elevation



$$29423.11 = \frac{2600 - (1012 + 46)}{\tan(3°)}$$

Figure 14-9. FINAL LENGTH GIVEN FAF ALTITUDE, Par 252b.

c. Determining Final Segment Descent Gradient and Angle.

(1) Final Without Stepdown Fixes. Calculate the final descent gradient by dividing the height loss from FAF to TCH by the segment length in NM.

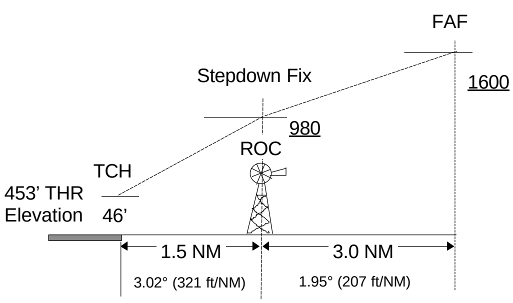
$$\text{Descent Gradient} = \frac{\text{Height Loss}}{\text{Segment Length (NM)}}$$

The descent gradient divided by 6076.11548 is the tangent of the segment descent angle(θ).

$$\text{Tan}(\theta) = \frac{\text{Descent Gradient}}{6076.11548}$$

For RNAV SIAPš, this angle is the glide slope computer setting.

(2) Final With Stepdown Fix. The maximum descent angle is calculated using the difference between the FAF/stepdown altitude and the stepdown/TCH altitude as appropriate. Descent gradient and angle computations apply to each stepdown segment. Height loss in the last segment flown is from the stepdown fix minimum altitude to the TCH (see figure 14-10).



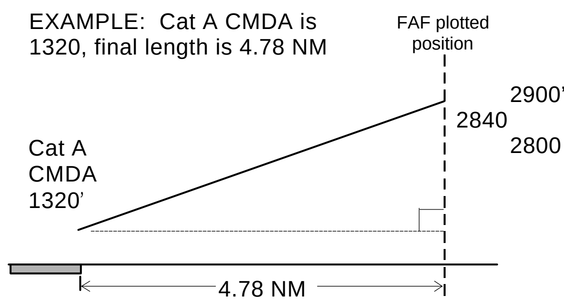
$$\text{Descent Gradient} = \frac{(1600 - 980)}{3.0}$$
$$\text{Descent Gradient} = 207 \text{ ft / NM}$$
$$\text{Tan}(\theta) = \frac{207}{6076.11548}$$
$$\theta = 1.95°$$

$$\text{Descent Gradient} = \frac{(980 - (453 + 46))}{1.5}$$
$$\text{Descent Gradient} = 321 \text{ ft / NM}$$
$$\text{Tan}(\theta) = \frac{321}{6076.11548}$$
$$\theta = 3.02°$$

Figure 14-10. DESCENT GRADIENT AND ANGLE, Par 252c(2).

d. Circling Approaches. The maximum descent angle is calculated using the difference between the FAF/stepdown altitude and stepdown/lowest circling minimum descent altitude (CMDA) as appropriate (see figure 14-11).

$$\text{FAF Altitude} = \text{CMDA} + (318 \times \text{Seg. Len. in NM})$$



To calculate FAF altitude for a given descent gradient:
$$2840.04 = 1320 + (318 \times 4.78)$$

Figure 14-11, FAF NET GIVEN SEGMENT LENGTH, Par 252d.

To calculate Descent Gradient and Angle given a FAF altitude and final length:

$$\text{Descent Gradient} = \frac{(2900 - 1320)}{4.78}$$
$$\text{Descent Gradient} = 331$$
$$\text{Tan}(\theta) = \frac{331}{6076.11548}$$
$$\theta = 3.12°$$

253. VISUAL DESCENT POINT (VDP) (applicable to straight-in procedures only). When dual minimums are published, use the lowest minimum descent altitude (MDA) to calculate the VDP distance. **PUBLISH A VDP FOR ALL STRAIGHT-IN NONPRECISION APPROACHES** except as follows:

- Do not publish a VDP associated with an MDA based on part-time or full time remote altimeter settings.
- Do not publish a VDP if the visual descent angle passes below a required altitude at a stepdown fix.
- If the VDP is between the MAP and the runway, do not publish a VDP.

a. For runways served by a VGSI, using the VGSI TCH, establish the distance from THR to a point where the lowest published VGSI glidepath angle reaches an altitude equal to the MDA. Use the following formula:

$$\text{VDP Distance} = \frac{\text{MDA} - (\text{TCH} + \text{THR Elevation})}{\text{Tan}(\text{VGSI Angle})}$$

• If the difference between the calculated descent angle (paragraph 252) and the VGSI angle is greater than ±0.20°, do not publish a VDP.

b. For runways NOT served by a VGSI, using an appropriate TCH from table 18A, establish the distance from THR to a point where the greater of a 3° or the final segment descent angle reaches the MDA. Use the following formula:

$$VDP\ \text{Distance} = \frac{\text{MDA} - (\text{TCH} + \text{THR Elevation})}{\text{Tan}(*\ \text{Angle})}$$

* final segment descent angle or 3°, whichever is higher.

c. Marking VDP Location.

(1) For Non-RNAV SIAP's, mark the VDP location with a DME fix. The DME must be collocated with the facility providing final approach course guidance (USN/USA/USAF NA). If DME is not available, do not establish a VDP. Maximum fix error is ± 0.5 NM.

(2) For RNAV SIAP's, mark the VDP location with an along track distance (ATD) fix to the MAP. Maximum fix error is ± 0.5 NM.

(3) If the final course is not aligned with the runway centerline, use the THR as a vertex, swing an arc of a radius equal to the VDP distance across the final approach course (see figure 14-12). The point of intersection is the VDP. (For RNAV procedures, the distance from the point of intersection to the MAP is the ATD for the VDP.)

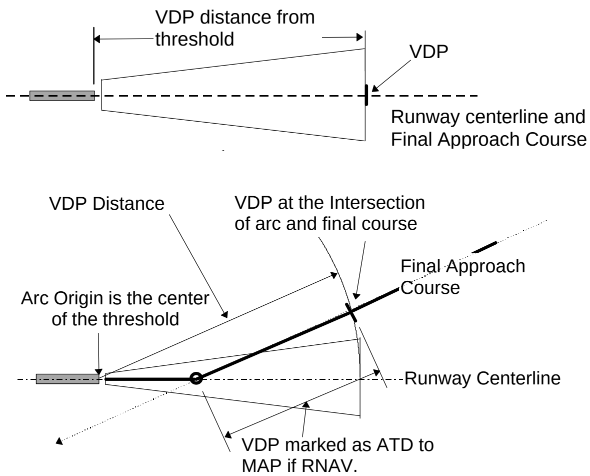


Figure 14-12. VDP LOCATION, Par 253c(3).

254.-259. RESERVED.

SECTION 6. CIRCLING APPROACH

260. CIRCLING APPROACH AREA. This is the obstacle clearance area which shall be considered for aircraft maneuvering to land on a runway which is not aligned with the FAC of the approach procedure.

a. Alignment and Area. The size of the circling area varies with the approach category of the aircraft, as shown in table 4. To define the limits of the circling area for the appropriate category, draw an arc of suitable radius from the center of the end of each usable runway. Join the extremities of the adjacent arcs with lines drawn tangent to the arcs. The area thus enclosed is the circling approach area (see figure 15).

Table 4. CIRCLING APPROACH AREA RADII. Par 260a.

Approach Category	Radius (Miles)
A	1.3
B	1.5
C	1.7
D	2.3
E	4.5

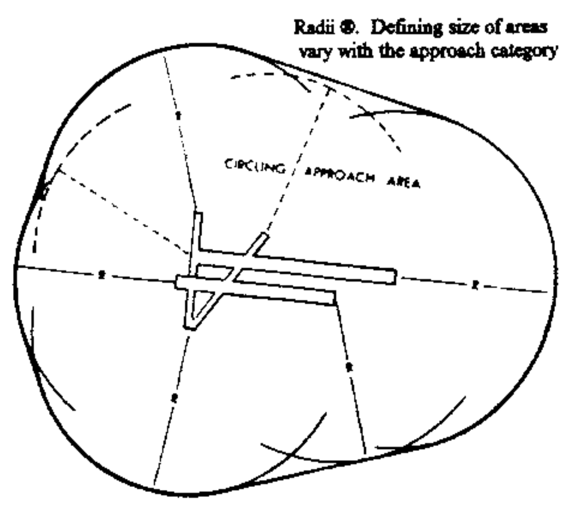


Figure 15. CONSTRUCTION OF CIRCLING APPROACH AREA. Par 260a.

b. Obstacle Clearance. A minimum of 300 feet of obstacle clearance shall be provided in the circling approach area. There is no secondary obstacle clearance area for the circling approach (see paragraph 322).

261. CIRCLING APPROACH AREA NOT CONSIDERED FOR OBSTACLE CLEARANCE. It will be permissible to eliminate from consideration a particular sector where prominent obstacles exist in the circling approach area, provided the landing can be made without maneuvering over this sector and further provided that a note to this effect is included in the procedure. Sectors within which circling is not permitted should be identified with runway centerlines, and where necessary, illumination of certain runway lights may be required. Circling restrictions shall be noted on the procedure.

262.-269. RESERVED.

SECTION 7. MISSED APPROACH.

270. MISSED APPROACH SEGMENT. (See ILS and PAR chapters for special provisions,) A missed approach procedure shall be established for each IAP. The missed approach shall be initiated at the decision height (DH) or MAP in nonprecision approaches. The missed approach procedure must be simple, specify an altitude, and a clearance limit. The missed approach altitude specified in the procedure shall be sufficient to permit holding or en route flight. Design alternate missed approach procedures using the criteria in this section. The area considered for obstacles has a width equal to that of the final approach area at the MAP and expands uniformly to the width of the initial approach section 1. Point B_1 is one mile from the end of section 1 (see figure 27).

b. Turning Portion. Section 2 is constructed as specified in paragraph 275 except that it begins at the end of section 1 instead of at the MAP. To determine the height which must be attained before commencing the missed approach turn, first identify the controlling obstacle on the side of section 1 to which the turn is to be made. Then measure the distance from this obstacle to the nearest edge of the section 1 area. Using this distance as illustrated in figure 27, determine the height of the 40:1 slope at the edge of section 1. This height, plus the appropriate final ROC, (the sum rounded up to the next higher 100-foot increment) is the height at which the turn should be started. Obstacle clearance requirements in section 2 are the same as those specified in paragraph 276 except that zone 1 is not considered and section 2 is expanded to start at point "B" if no fix exists at the end of section 1, or if no course guidance is provided in section 2 (see figure 27).

c. Evaluate the 40:1 surface from the MAP to the clearance limit (end of the missed approach segment). If obstacles penetrate the surface, take action to eliminate the penetration.

d. The preliminary charted missed approach altitude is the lowest of the minimum missed approach obstruction altitude, MHA established in accordance with paragraph 293a, or the lowest airway MEA at the clearance limit. To determine the minimum missed approach obstruction altitude for the missed approach segment, identify the highest obstacle in the primary area; or if applicable, the highest equivalent obstacle in the secondary area. Then add the appropriate ROC (plus adjustments) for holding or en route to the highest obstacle elevation. Round the total value to the nearest hundred foot value.

EXAMPLE

Given:

1. MDA 360′ MSL
2. Obstacle height: 1098′ MSL
3. Obstacle in section 2 = 3NM from near edge of section

Find:

1. Minimum altitude at which aircraft can start turn.
2. Required length of section 1.

Solution:

1. Find height MSL at near edge.
   a. A = 18,228′ (3 mi) ÷ 40 = 456′.
   b. 1098′ MSL − 456′ = 642′ MSL.
2. Add 250′ obstacle clearance.
   a. 250′ + 642′ = 892′ MSL.
3. Round up to next higher 20′.
   a. 892′ = 900′ MSL to start turn.
4. Find height to climb from MDA to 900′ MSL.
   a. 900′ − 360′ = 540′ to climb.
5. Find length of section 1.
   a. 540′ × 40 = 21,600′ − length of section 1.
6. Missed approach instructions.
   a. "Climb to 900′ before starting right turn to, etc."

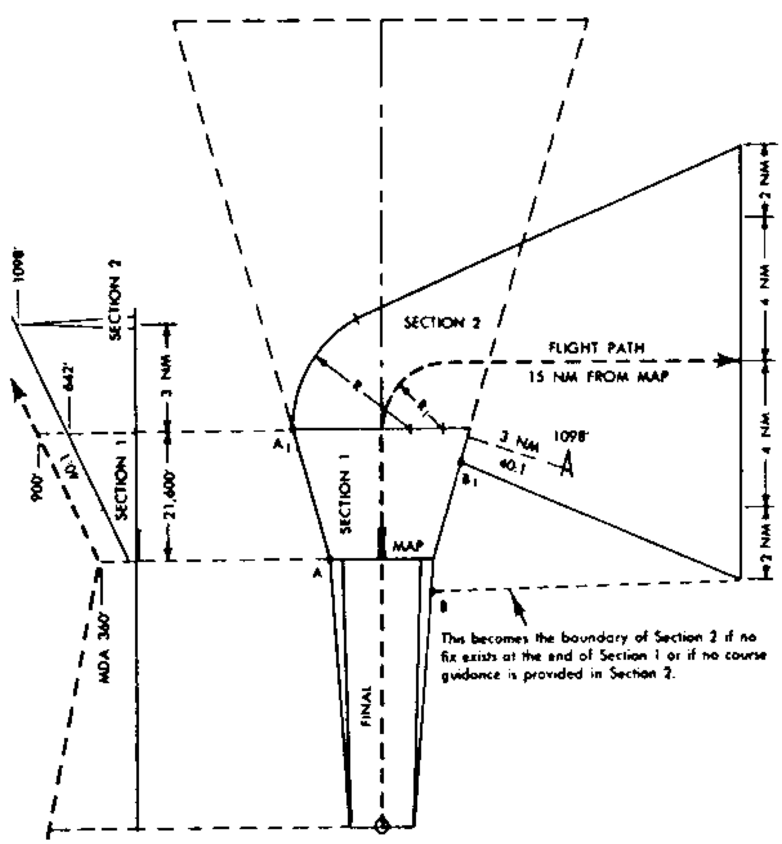


Figure 27. COMBINATION MISSED APPROACH AREA. Par 277(a).

e. Determine if a climb-in-hold evaluation is required (see paragraph 293b).

(1) Calculate the elevation of the 40:1 surface at the end of the segment (clearance limit). The 40:1 surface starts at the same elevation as it does for obstacle evaluations. First, compute the 40:1 rise from a point on the line defining the origin of the 40:1 surface at the MAP, in the shortest distance and perpendicular to the end-of-section 1 segment. If there is a remote altimeter setting source (RASS) and the missed approach instructions do not include a parenthetical climb to altitude then the elevation at the end of section 1 is adjusted by subtracting the altitude difference between the RASS adjustments when two remote altimeter sources are used; or subtracting the RASS adjustment for a part-time altimeter source. The resulting altitude at the end of section 1 shall not be lower than the 40:1 surface height at the MAP. Second, compute the 40:1 rise from a point on the nearest edge of section 1, in the shortest distance to the end-of-segment line at the clearance limit. Add the two values together and this is the 40:1 surface height at the end of the segment (clearance limit).

(2) Compute the ROC surface elevation at the clearance limit by subtracting the appropriate ROC (plus adjustments) from the preliminary charted missed approach altitude.

(3) Compare the ROC surface elevation at the clearance limit with the 40:1 surface elevation.

(a) If the computed 40:1 surface elevation is equal to or greater than the ROC surface elevation, a climb-in-hold evaluation is NOT required.

(b) If the computed 40:1 surface elevation is less than the ROC surface elevation, a climb-in-hold evaluation IS required. FAA Order 7130.3, paragraph 35, specifies higher speed groups and therefore, larger template sizes are usually necessary for the climb-in-hold evaluation. These templates may require an increase in MHA under TERPS paragraph 293a. If this evaluation requires an increase in the MHA, evaluate the new altitude using the higher speed group specified in paragraph 35. This sequence of review shall be used until the MHA does not increase, then the 40:1 surface is re-evaluated. If obstacles penetrate the 40:1 surface, take action to eliminate the penetration.

f. The charted missed approach altitude is the higher of the preliminary charted missed approach altitude or the MHA established under paragraph 274c(3)(b).

278. END OF MISSED APPROACH. Aircraft shall be assumed to be in the initial approach or en route environment upon reaching minimum obstacle clearance altitude (MOCA) or MEA. Thereafter, the initial approach or the en route clearance criteria apply.

279. RESERVED.

SECTION 8. TERMINAL AREA FIXES

280. GENERAL. Terminal area fixes include, but are not limited to the FAF, the IF, the IAF, the holding fix, and when possible, a fix to mark the MAP. Each fix is a geographical position on a defined course. Terminal area fixes should be based on similar navigation systems. For example, TACAN, omni-directional radio range tactical air navigation (VORTAC), and VOR/DME facilities provide radial/DME fixes. NDB facilities provide bearings. VOR facilities provide VOR radial. The use of integrated (VHF/NDB) fixes shall be limited to those intersection fixes where no satisfactory alternative exists.

281. FIXES FORMED BY INTERSECTION. A geographical position can be determined by the intersection of courses or radials from two stations. One station provides the course the aircraft is flying and the other provides a crossing indication which identifies a point along the course which is being flown. Because all stations have accuracy limitations, the geographical point which is identified is not precise, but may be anywhere within a quadrangle which surrounds the plotted point of intersection. Figure 28 illustrates the intersection of an arc and a radial from the same DME facility and the intersection of two radials or courses from different navigation facilities. The area encompassed by the sides of the quadrangle formed in these ways is referred to in this publication as the "fix displacement area".

282. COURSE/DISTANCE FIXES.

a. **A DME fix is formed by a DME reading** on a positive navigational course. The information should be derived from a single facility with collocated azimuth and DME antennas. Collocation parameters are defined in FAA Order 6050.32, Spectrum Management Regulations and Procedures. However, when a unique operational requirement indicates a need for DME information from other than collocated facilities, an individual IAP which specifies DME may be approved, provided the angular divergence between the signal sources at the fix does not exceed 23° (see figure 28). For limitation on use of DME with ILS, see paragraph 912.

b. ATD Fixes. An ATD fix is an along track position defined as a distance in NM, with reference to the next WP along a specified course.

c. Fixes Formed by Marker Beacons. Marker beacons are installed to support certain NAVAID's that provide course guidance. A marker beacon is suitable to establish a fix only when it marks an along course distance from the NAVAID it is associated with; e.g. localizer and outer markers.

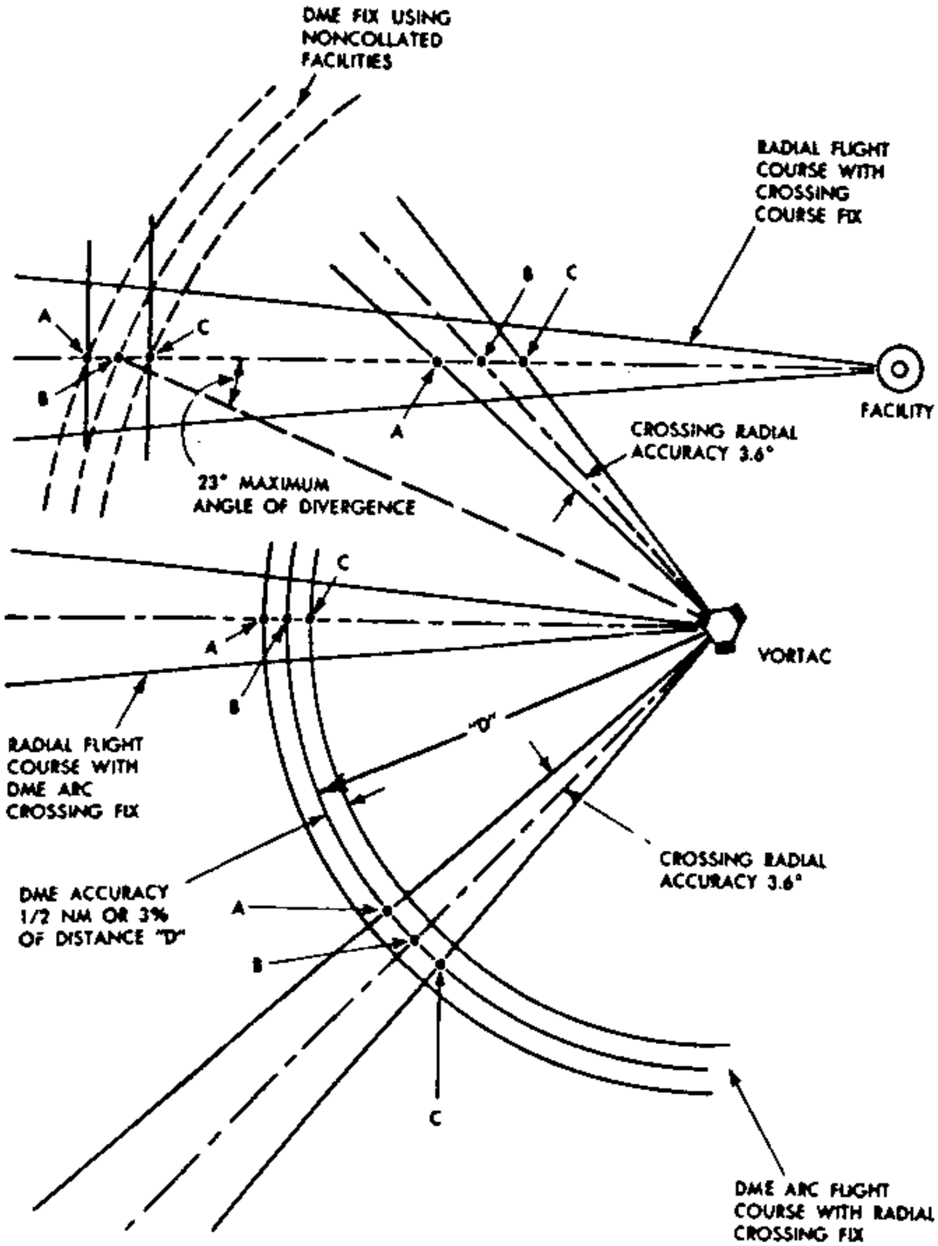


Figure 28. INTERSECTION FIX DISPLACEMENT. Par 281 and 282a.

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.

CHAPTER 3. TAKEOFF AND LANDING MINIMUMS

300. APPLICATION. The minimums specified in this chapter are the lowest which can be approved at any location for the type facility concerned.

301.-309. RESERVED.

SECTION 1. GENERAL INFORMATION

310. ESTABLISHMENT. The minimums established for a particular airport shall be the lowest permitted by the criteria contained in this order. Each procedure shall specify minimums for the various conditions stated in the procedure; i.e., straight-in, circling, alternated, and takeoff, as required. The elements of minimums are the MDA (or DH) and the weather. The weather minimums shall include the visibility required by the procedure, and may include a ceiling value which is equal to or greater than the height of the MDA or DH above airport elevation. Where ceilings are not specified, the height of the straight-in MDA or DH above the highest elevation in the touchdown zone (or the airport elevation in circling approaches) shall be shown on the procedure. Alternate minimums, when specified, shall be stated as ceiling and visibility. Takeoff minimums, when specified, shall be stated as visibility only, except where the need to see and avoid an obstacle makes it necessary to specify a ceiling value. Military services may specify alternate and takeoff minimums in separate directives.

311. PUBLICATION. Minimums should be published for each approach category which can be accommodated at the airport. Where the airport landing surface is not adequate, or other restrictions exist which prohibit certain categories of aircraft from making an instrument approach at an airport, "NA" (not authorized) shall be entered in lieu of the minimums values. Approach Category "E" minimums should be published only on high altitude procedures, except where a special requirement exists for their publication or other procedures. Minimums on military procedures shall be published as prescribed by the appropriate Service.

312.-319. RESERVED.

SECTION 2. ALTITUDES

320. MINIUM DESCENT ALTITUDE (MDA). The MDA is the lowest altitude to which descent shall be authorized in procedures not using a glide slope. Aircraft are not authorized to descend below the MDA until the runway environment (see glossary) is in sight, and the aircraft is in a position to descend for a normal landing. The MDA shall be expressed in feet above MSL and is determined by adding the required obstacle clearance to the MSL height of the controlling obstacle in the final approach segment and circling approach area for circling approaches.

321. MDA FOR STRAIGHT-IN APPROACH. The MDA for a straight-in approach shall provide at least the minimum required clearance over obstacles in the final approach segment. It shall also be established high enough to ensure that obstacles in the missed approach area do not penetrate the 40:1 missed approach surface (see paragraph 274). The MDA shall be rounded off to the next HIGHER 20-foot increment. For example, 2,104 feet becomes 2,120.

322. MDA FOR CIRCLING APPROACH. The height of the circling MDA above the airport (HAA) shall not be less than the minimum shown in paragraph 351. In addition, the MDA shall provide at least the minimum required final obstacle clearance in the final approach segment and the minimum required circling obstacle clearance in the circling approach area. It shall also meet the missed approach requirements specified in paragraph 321. Round the MDA to the next higher 20-foot increment. For example, 2,109 feet shall become 2,120. The published circling MDA shall not be above the FAF altitude or below the straight-in MDA.

323. MINIMUMS ADJUSTMENTS. Raising the MDA or DH above that required for obstacle clearance may be necessary under the following conditions:

a. Precipitous Terrain. When procedures are designed for use in areas characterized by precipitous terrain, in or outside of designated mountainous areas, consideration must be given to induced altimeter errors and pilot control problems which result when winds of 20 knots or more move over such terrain. Where these conditions are known to exist, required obstacle clearance in the final approach segment should be increased. Procedures specialists and approving authorities should be aware of the hazards involved and make appropriate addition, based on their experience and good judgment, to limit the time in which an aircraft is exposed to lee-side turbulence and other weather phenomena associated with precipitous terrain. This may be done by increasing the minimum altitude over the intermediate and final approach fixes so as to preclude prolonged flight at low altitudes. User comments should be solicited to obtain the best available local information.

b. Remote Altimeter Setting Source (RASS). When the altimeter setting is obtained from a source more than 5 NM from the airport reference point (ARP) for an airport, or the heliport reference point (HRP) for a heliport or vertiport, the ROC shall be increased by the amount of RASS adjustment for the final (except precision final), step-down, circling, and intermediate segments. For precision finals, the DH shall be increased by the amount of RASS adjustment. When two altimeter sources are used, RASS shall be applied to the missed approach climb-to-altitude. RASS adjustment does not apply to MSA's, initials, en route, feeder routes, or segment/areas based on en route criteria. A remote altimeter setting source is not authorized for a remote distance greater than 75 NM or for an elevation differential between the RASS and the landing area that is greater than 6,000 feet. To determine which adjustment shall apply, evaluate the airport/heliport/vertiport for adverse atmospheric pressure pattern effects. Comments should be solicited from the National Weather Service (NWS), the National Aviation Weather Advisory Unit (NAWAU), the Center Weather Service Unit (CWSU), and the local Flight Service Station (FSS) to obtain the best available climatological information.

(1) Where intervening terrain does not adversely influence atmospheric pressure patterns, the following formula shall be used to compute the basic adjustment in feet:

$$\text{Adjustment} = 2.30d_R + 0.14e$$

where "d_R" is the horizontal distance in nautical miles from the altimeter source to the ARP/HRP; and "e" is the elevation differential in feet between the elevation of the RASS and the elevation of the airport/heliport/vertiport (see figure 37B).

(2) Where intervening terrain adversely influences atmospheric pressure patterns, an elevation differential area (EDA) shall be evaluated. The EDA is defined as an area 5 NM each side of a line connecting the ARP/HRP and the RASS, and includes a circular area enclosed by a 5 NM radius at each end of this line (see figure 37C). The following formula shall be used to compute the basic adjustment feet.

$$\text{Adjustment} = 2.30d_R + 0.14E$$

where "d_R" is the horizontal distance in nautical miles from the altimeter source to the ARP/HRP; and "E" is the terrain elevation differential in feet between the lowest and highest terrain elevation points contained within the EDA (see figure 37C).

(3) For the intermediate segment, use 60 percent of the basic adjustment from paragraphs 323b(1) or (2), and increase the intermediate segment of ROC by the amount this value exceeds 200 feet.

(4) For a missed approach climb-to-altitude when two altimeter sources are available and the climb-to-altitude is less than the missed approach clearance limit altitude, apply RASS adjustment to the climb-to-altitude or to the section 2 and zone 2/3 40:1 surface height as follows:

(a) Decrease the starting height of the 40:1 surface for section 2 and zone 2/3 by the difference between RASS adjustments for the two remote altimeter sources. (Where one altimeter source is local, subtract the full RASS adjustment.) Do not decrease these surface starting heights to less than the height of the 40:1 surface at the MAP.

(b) If application of 323b(4)(a) results in a 40:1 surface penetration that cannot be resolved by other methods, provide a second climb-to-altitude using the least accurate altimeter source by adding the difference between the RASS adjustments to the climb-to-altitude and rounding to the next higher 20-foot increment. DO NOT lower the section 2 and zone 2/3 40:1 surfaces. This application shall not increase the climb-to-altitude above the missed approach clearance limit altitude.

For example: MISSED APPROACH
Climb to 5,900 (6,100 when using Denver/Stapleton altimeter setting) then ………….

(5) Point-in-Space Approach (PINSA). When the MAP is more than 5 NM from the PINSA altimeter setting source, RASS adjustment shall be applied. For application of the RASS formula, define "d_R as the distance from the altimeter setting source to the MAP, -- and define "e," or "E," as in paragraph 323b(1) or (2).

(6) Minimum Reception Altitude (MRA). Where a minimum altitude is dictated by the MRA, the MRA shall be increased by the amount of the RASS adjustment factor.

(7) Where the altimeter is based on a remote source, the procedure shall be annotated, or provided a second set of minima.

c. Excessive Length of Final Approach. When a final approach fix is incorporated in the procedure, and the distance from that fix to the nearest landing surface exceeds 6 miles, the required obstacle clearance in the final approach segment shall be increased at the rate of 5 feet for each one-tenth of a mile over 6 miles. Where a step-down fix is incorporated in the final approach segment, the basic obstacle clearance may be applied 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 HEIGHT (DH). The decision height applies only where an electronic glide slope provides the reference for descent, as in ILS or PAR. The decision height is the height, specified in feet above MSL, above the highest runway elevation in the touchdown zone at which a missed approach shall be initiated if the required visual reference has not been established. Decision heights shall be established with respect to the approach obstacle clearance requirements specified in the ILS and PAR chapters, and shall NOT be less than the HAT shown in the appropriate table in paragraph 350.

325.-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 the touchdown zone (TDZ) 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 runway alignment criteria have been met.

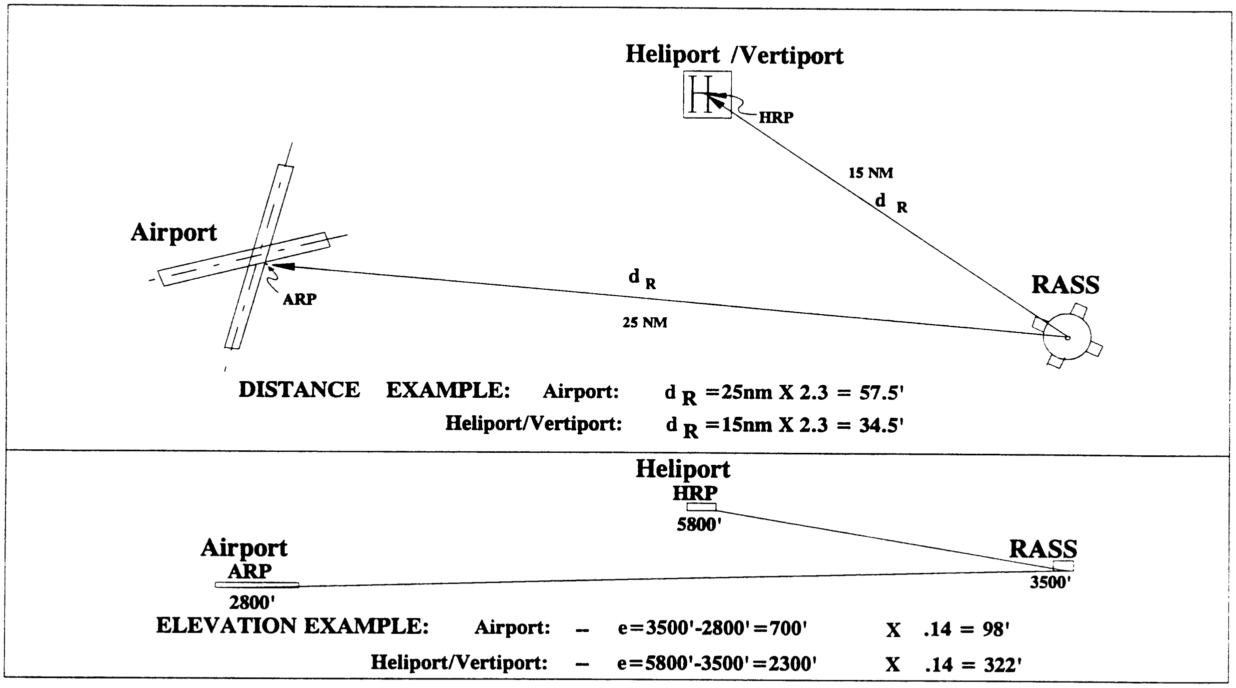
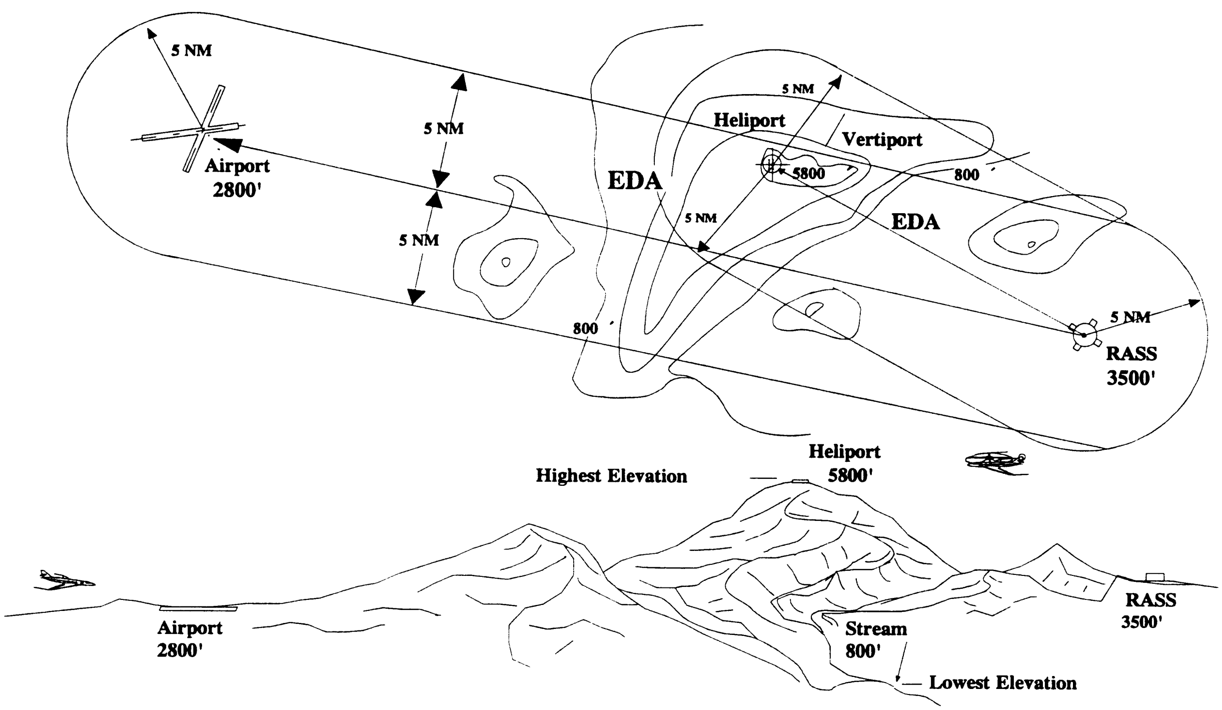


Figure 37B. DISTANCE REMOTED (d_R) AND ELEVATION. Par 323b.



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 6. EFFECT OF HAT/HAA ON VISIBILITY MINIMUMS

HAT/HAA (ft.)	250-320	321-390	391-460	461-530	531-600	601-670	671-740	741-810	811-880	881-950	951 & above
CAT A	1 mi ----------									1¼-	
CAT B	1 mi----------							1¼----------			1½

HAT/HAA	250-400	401-500	501-600	601-670	671-740	741-810	811-880	881-950	951 & above
CAT C	1 mi	1¼	1½	1¾	2	2¼	2½	2¾	3

HAT/HAA	250-341	342-426	427-511	512-600	601-670	671-740	741-810	811-880	881-950	951 & above
CAT D	1 mi	1¼	1½	1¾	2	2¼	2½	2¾	3----------	

HAT/HAA	250-320	321-390	391-460	461-530	531-600	601-670	671-740	741-810	811-880	881-950	951 & above
CAT E	1 mi	1¼	1½	1¾	2	2¼	2½	2¾	3----------		

c. The minimum visibility prior to applying credit for lights shall be the higher of the following values:

(1) The MAP to threshold distance (where the MAP is reached before the threshold).

(2) Those given in table 6 or 6a, paragraph 331.

This subparagraph does not apply to a procedure where the MAP is more than 2 statute miles from the airport and the procedure is noted, "Fly visual to airport" in which case the required visibility shall be at least 2 miles, but not less than the visibility specified in Table 6.

d. When straight-in minimums are not authorized, only circling MDA's and visibilities will be established. In establishing circling visibility minimums, paragraph 331 applies. These minimums shall be no lower than those specified in paragraph 351.

e. Circling landing minimums shall NOT be lower than straight-in landing minimums.

331. EFFECT OF HAT/HAA AND FACILITY DISTANCE ON STRAIGHT-IN AND CIRCLING VISIBILITY MINIMUMS. The minimum standard visibility required for the pilot to establish visual reference in time to descend safely from the MDA and maneuver to the runway or airport varies with the aircraft category, the HAT/HAA, and the accuracy of the navigation system. Table 6 specifies the minimum standard visibility as determined by HAT/HAA.

Table 6A specifies the minimum standard visibility as determined by distance from the facility to the runway.

NOTE: The higher of the visibilities derived from the table applies.

Table 6A. EFFECT OF FACILITY DISTANCE ON VISIBILITY MINIMUMS

NAVAID TYPE	CAT	DISTANCE FROM FACILITY TO MAP OR RWY THLD (whichever is farther)				
		0-10	>10-15	>15-20	>20-25	>25-30
ASR	A	1	1	1	N/A	N/A
	B	1	1¼	1¼		
	C	1	1½	1½		
	D-E	1	2	2		
NDB DF	A	1	1	N/A	N/A	N/A
	B	1	1¼			
	C	1	1½			
	D-E	1	2			
VOR TACAN LOC SDF LDA	A	1	1	1	1	1
	B	1	1	1	1¼	1¼
	C	1	1	1¼	1½	1½
	D-E	1	1¼	1½	1¾	2

332. EFFECT OF OBSTACLES. Visibility minimums must be at or above certain values when obstacles penetrate the visual assessment surfaces (see paragraph 251).

333. RUNWAY VISUAL RANGE (RVR). RVR is a system of measuring the visibility along the runway. It is an instrumentally derived value that represents the horizontal distance a pilot will see down the runway from the approach end. It is based on the sighting of either high intensity runway lights or the visual contrast of other targets, whichever yields the greater visual range.

334. RUNWAY REQUIREMENTS FOR APPROVAL OF RVR. RVR may be authorized for straight-in approach procedures and takeoff when the following requirements are met with respect to the runway to be used.

a. Transmissometers shall be located under standards established by the approval authority (e.g., FAA Standard 008).

b. High intensity runway lights spaced at consecutive intervals of not more than 200 feet shall be operative.

c. Instrument runway markings or touchdown zone and centerline (TDZ/CL) lighting are required for nonprecision approaches. Precision instrument (all-weather) runway markings are required for all runways served by a precision approach. Precision markings are also required for nonprecision or instrument procedure with vertical guidance (IPV) approaches with visibility minimums less than ¾ statute mile. Except for PAR, TDZ/CL lighting is required for precision approaches with RVR 1800. Where sufficient runway lengths are not available to accommodate standard all-weather markings, the approving authority will determine the runway markings to be used. Where required runway markings are not available and credit for lights is not granted, but TDZ/CL's are available, RVR equal to the visibility minimum without lights is authorized.

335. COMPARABLE VALUES OF RVR AND GROUND VISIBILITY. If RVR minimums for takeoff or landing are prescribed in an instrument approach procedure but RVR is not reported for the runway of intended operation, the RVR minimums shall be converted to ground visibility in accordance with table 7, and observed as the applicable visibility minimum for takeoff or landing on that runway.

Table 7. COMPARABLE VALUES OF RVR AND GROUND VISIBILITY

RVR	VIS (Statute Miles)	RVR	VIS (Statute Miles)
1600	¼	4500	7/8
2400	½	5000	1
3200	5/8	6000	1-1/4
4000	¾		

336.-339. RESERVED.

SECTION 4. VISIBILITY CREDIT FOR LIGHTS

340. GENERAL. Approach lighting systems extend visual cues to the approaching pilot and make the runway environment apparent with less visibility than when such lighting is not available. This section identifies lighting systems and prescribes the operational conditions which must exist in order to reduce straight-in visibility minimums. Table 9 for civil and table 10 for military in paragraph 350 specify the **LOWEST** civil and military visibility minimums which can result from application of this section.

341. STANDARD LIGHTING SYSTEMS. Listed in table 8 are the types of standard lighting systems and the required operational coverage for each type.

342. OPERATIONAL CONDITIONS. Credit to reduce straight-in landing minimums for standard or equivalent approach light systems may be given when the following conditions exist for the straight-in landing runway:

a. Markings. The runway must have nonprecision instrument or precision instrument (all-weather) markings or TDZ/CL's as specified in paragraph 334c, and in the directives of the appropriate approving authority.

b. Approach Course. The final approach course must place the aircraft within the operational coverage of the lighting system at a distance from the landing threshold equal to the standard visibility required without lights. See paragraph 330 and figure 37D for guidance.

Table 8. STANDARD LIGHTING SYSTEMS

ABBREV. IFR	LIGHTING SYSTEM	Oper. Coverage (Degrees) Lateral (±)	Vertical (abv Hor.)
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** 332, 342, 935, or 1025, as appropriate, must be met.

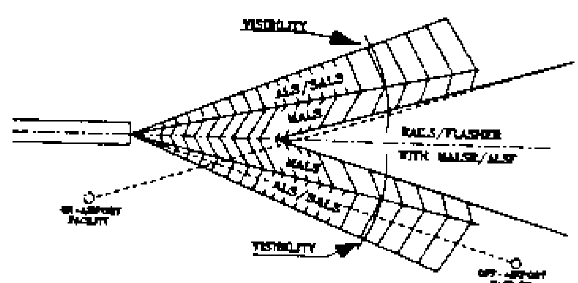


Figure 37D. APPLICATION OF LATERAL COVERAGE ANGLES OF TABLE 8, Par 342b.

NOTE: *The final approach course to an 'on-airport' facility transits all approach light operational areas within 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. Tables 9 and 10 specify the lowest civil and military minimums which may be prescribed for various combinations of electronic and visual navigation aids. Lower minimums based on special equipment or air crew 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 HAA and visibility which 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. CIVIL STANDARD STRAIGHT-IN MINIMUMS

	NONPRECISION APPROACHES					
	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	RVR	Vis	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, 3/4 miles or RVR 4000.

	PRECISION APPROACHES					
	14 CFR Part 97.29					
	APPROACH LIGHT CONFIGURATION	CAT →	A – B – C		D	
		HAT[4]	Vis	RVR	Vis	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). With Offset LOC (max 3°). HAT is 250 and RVR below 2400 is not authorized.

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 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 zone elevation (HAT).
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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Table 11. STANDARD CIRCLING MINIMUMS					
	Approach Category				
	A	B	C	D	E
Height Above Airport Elevation in feet	350	450	450	550	550
Visibility in Miles	1	1	1 ½	2	2

Table 12. STANDARD ALTERNATE MINIMUMS		
Type of Approach Facility	**Ceiling**	**Visibility**
VOR, VORTAC, LOC, LDA, ASR, NDB	800	2
ILS or Par	600	2

Table 13. STANDARD CIVIL TAKEOFF MINIMUMS	
Number of Engines	**Visibility (Statute Miles)**
1 or 2	1
3 or more	½

371.-399. RESERVED.

Tables reformatted.

$$OCS_I \text{ Height Above THR } = \left[\left(\tan(gs) - 0.02366 \right) \times D \right] - 20$$

where: gs = glide slope angle
D = distance from GPI in feet

b. Outer OCS. Calculate the height of the outer slope (OCS_O) at any distance D equal to or greater than 10,975 feet from GPI using the following formula:

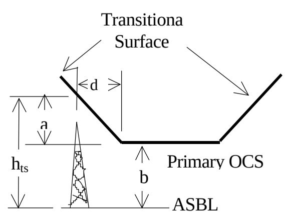
$$OCS_O \text{ Height Above THR } = \left[\left(\tan(gs) - 0.01866 \right) \times D \right] - 75$$

where: gs = glide slope angle
D = distance from GPI in feet

c. Transitional Surface. Calculate the height of the transitional surface (h_{ts}) at any distance (d) from the edge of the primary area measured perpendicular to the final approach course using the following formula.

(1) $a = \frac{d}{7}$

(2) $h_{ts} = a + b$



Where a = amount of surface adjustment
d = distance from edge of primary
b = OCS_I or OCS_O as appropriate

1025. EFFECT OF OBSTACLES INSIDE THE DH. See paragraph 251 for the assessment of the visual portion of a PAR approach.

1026. GLIDE SLOPE. In addition to the required obstacle clearance, the following shall apply to the selection of the glide slope angle and antenna location.

a. Glide Slope Angle. The optimum glide slope angle is 3°. Angles less than 2° or more than 3° shall not be established without the authorization of the approving authority. The PAR glide slope angle shall be within 0.20 of the non-radar precision instrument approach/VGSI glide slope angle and the RPI shall be within plus or minus 50 feet (30 feet for PAPI and PVGSI) of the non-radar precision approach RPI and/or VGSI runway reference point (RRP).

b. Glide Slope Threshold Crossing Height (TCH). See paragraph 980 for TCH requirements. A height as low as 32 fee for military airports may be used at locations where special consideration of the glidepath angle and antenna location are required. Where the glide slope TCH exceeds 60 feet, consider relocating the landing threshold to ensure effective placement of the approach light system. See appendix 2 for a method of computing TCH.

1027. RELOCATION OF GLIDE SLOPE. Where the OCS associated with a 3° glide slope is penetrated, and sufficient length of runway is available, the glide slope may be moved the required distance down the runway to ensure the OCS is clear. Where the glide slope threshold crossing height exceeds 60 feet, consider relocating the landing threshold to ensure effective placement of the approach light system. The minimum distance between the GPI and the runway threshold is 775 feet. (No minimum GPI distance need be applied to military locations provided the OCS is clear and TCH standards are met.)

1028. Height above Touchdown (HAT). The HAT value associated with the DA shall not be less than 200 feet for civil operations and 100 feet for military operations.

1029. RESERVED.

SECTION 3. PAR MISSED APPROACH

1030. MISSED APPROACH SEGMENT. The MAP begins at the missed approach point and ends at an appropriate point or fix where initial approach or en route obstacle clearance is provided. Missed approach procedures shall be based on positive course guidance where possible.

1031. MISSED APPROACH POINT (MAP). The MAP is a point on the final approach course where the height of the glide slope is equal to the authorized DH.

1032. STRAIGHT MISSED APPROACH. The straight missed approach area (maximum of 15° turn from FAC) starts at the MAP. The length of the area is 15 miles measured along the missed approach course. The area has a width equal to that of the final approach area at the MAP and a width equal to that of the initial approach area at a point 15 miles from the MAP. The missed approach area is divided into 2 sections.

Section 1 starts at the MAP and is longitudinally centered on the missed approach course. It has the same width at the MAP as the final approach area.

(a) VOR/DME Basic Areas. Secondary obstacle clearance areas extend laterally 2 miles on each side of the primary area and splay 4.9° in the region where the primary area splays at 3.25° (see figure 15-11 and paragraph 1512b(1)(a).

(b) Non-VOR/DME Basic Area. Non-VOR/DME secondary areas are a constant 2-mile lateral extension on each side of the primary area, except where the basic area tapers as specified in paragraph 1512b(1)(b). Over this area, the secondary area tapers linearly from 2 miles each side of the primary to 1 mile each side of the primary area.

(3) Obstacle Clearance. Paragraph 220 applies.

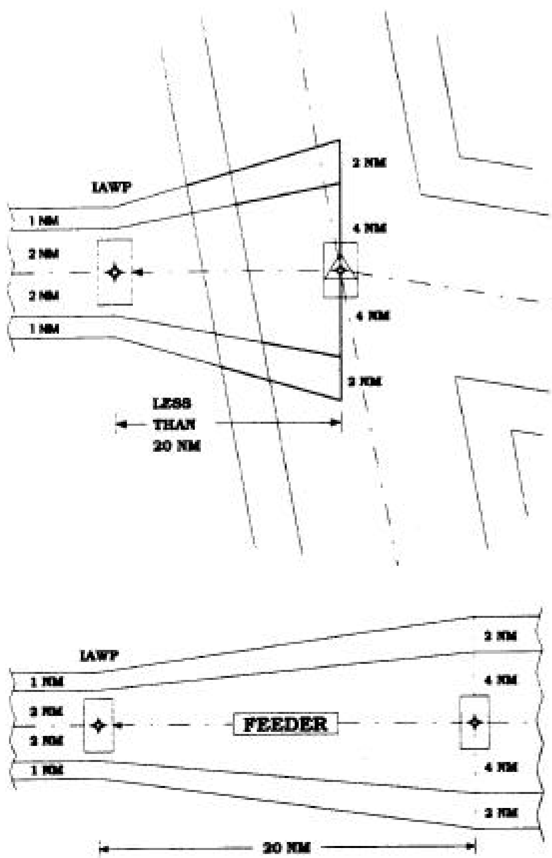


Figure 15-10. FEEDER ROUTES CONNECTING NON-VOR/DME BASIC AREAS. Par 1512b(1)(b).

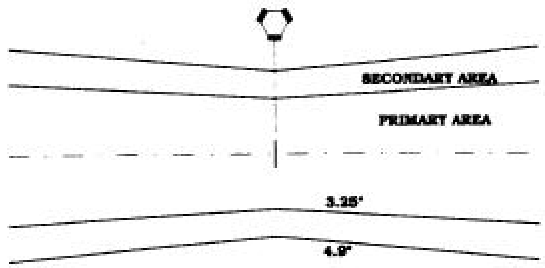


Figure 15-11. VOR/DME SECONDARY AREAS SPLAY 4.9°. Par 1512b(2)(a).

1513-1519. RESERVED.

SECTION 2. TERMINAL CRITERIA.

1520. TERMINAL TURNING AREA EXPANSION. Obstacle clearance areas shall be expanded to accommodate turn anticipation. Outside expansion is not required for terminal procedures. Inside expansion applies to all turns of more than 15° within SIAP's, except turns at the MAP. Paragraph 1534 satisfies early turn requirements for the MAP. Determine the expanded area at the inside of the turn as follows:

a. Determine the ATRK Fix Displacement Tolerance.

b. Locate a point on the edge of the primary area at a distance prior to the earliest point the WP can be received. The distance of turn anticipation (DTA) is measured parallel to the course leading to the fix and is determined by the turn anticipation formula:

$$DTA = 2 \times \tan(\text{turn angle} \div 2)$$

c. From this point, splay the primary area by an angle equal to one-half of the course change (see figure 15-12).

d. Secondary Area Boundary:

(1) When the obstacle clearance area boundaries of the preceding and following segments of the WP are parallel with the course centerline, construct the secondary area boundary, parallel with the expanded turn anticipation primary area boundary, using the width of the preceding segment secondary area.

(2) When the obstacle clearance area boundaries of the preceding and/or following segments taper, construct the secondary area boundary by connecting the secondary area at points abeam the primary expansion area where it connects to the preceding/following segments of the primary area boundaries.

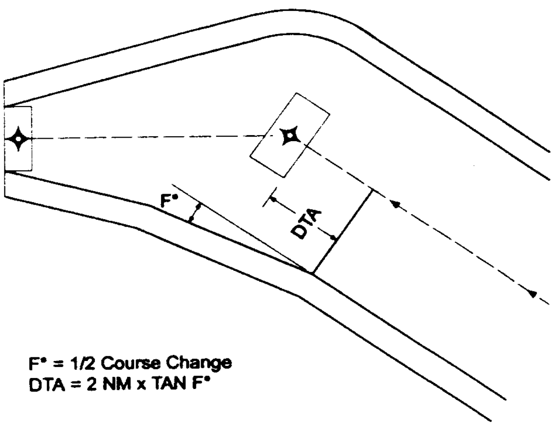


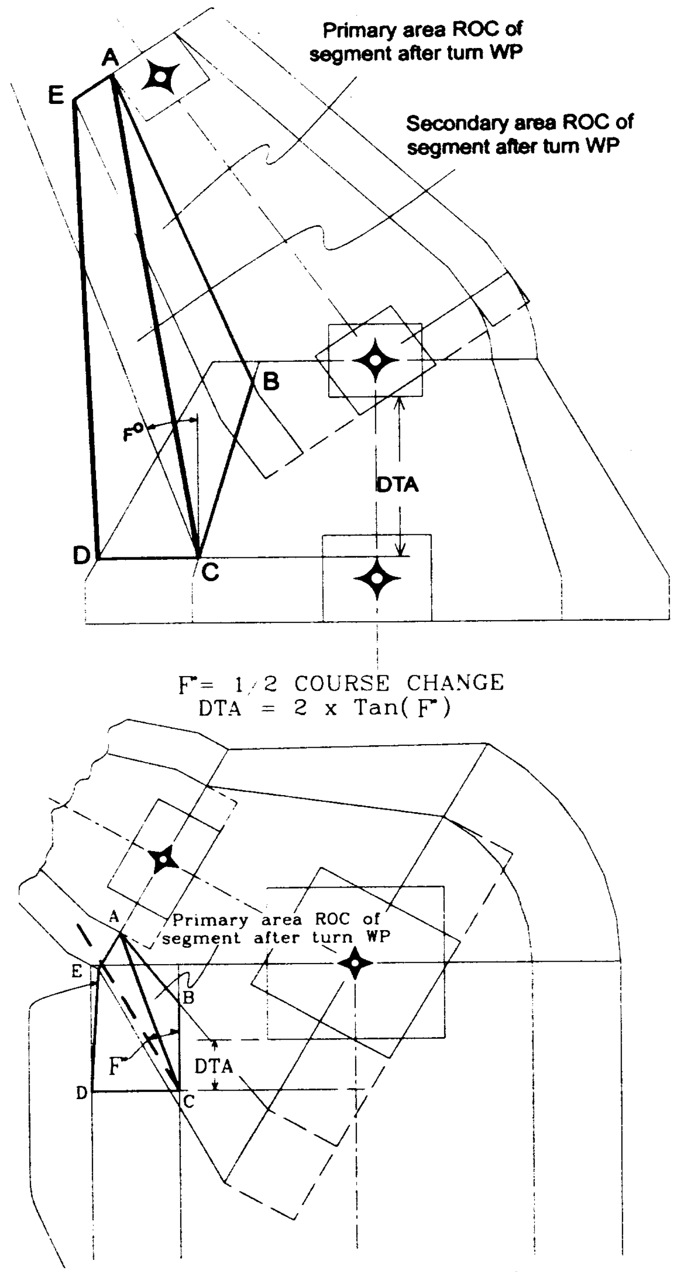
Figure 15-12. TURN ANTICIPATION SPLAY. Par 1520.

e. When the boundary of the expanding turn area will not connect with the boundary of the primary area of the following segment, join the expanded area at the boundary abeam the plotted position of the next WP or at the latest reception point of the RWY WP or APT WP, as appropriate (see figure 15-13).

f. Obstacle Evaluation of the Expanded Area. Evaluate the primary and secondary expansion areas using the ROC for the segment following the turn WP (see figures 15-13 and 15-14).

1521. INITIAL APPROACH SEGMENT. The initial approach segment begins at the IAWP and ends at the IWP. See figures 15-15, 15-16, and 15-17. For VOR/DME systems, the distance from the reference facility to the IAWP shall not exceed 53 miles, nor exceed the TPD or ATD values associated with the limits of the 8 NM zone (see figure 15-2).

a. Alignment. The angle of intercept between the initial and intermediate segment shall not exceed 120°.



NOTE: Secondary area boundary line for expanded area. Enclosed areas A, B, C are primary areas using ROC of segment following turn WP. Enclosed areas A, C, D, E are secondary areas using ROC of segment following turn WP. Obstacle slope in these areas are perpendicular to lines AC.

Figure 15-13. SHALLOW-ANGLED TURN ANTICIPATION ILLUSTRATIONS. TAPERING INTERMEDIATE AND CONSTANT WIDTH SEGMENT. ROC APPLICATIONS. Par 1520e and f.

U.S. Department
of Transportation

Federal Aviation Administration

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Please submit any written comments or recommendations for improving this directive, or suggest new items or subjects to be added to it. Also, if you find an error, please tell us about it.

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Oklahoma City, OK 73125

(Please check all appropriate line items)

An error (procedural or typographical) has been noted in paragraph _______ on page ______.

Recommend paragraph ______ on page ______ be changed as follows:
(*attach separate sheet if necessary*)

In a future change to this directive, please include coverage on the following subject:
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