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of Transportation

**Federal Aviation
Administration**

Advisory Circular

Subject: AIRPORT DESIGN

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1. PURPOSE. This Change provides expanded guidance for new approach procedures and incorporates new Flight Standards requirements. The change number and date of change is shown at the top of each page. The changed material is indicated by lines in the left-hand column margins.

2. PRINCIPAL CHANGES.

a. Runway Protection Zone (RPZ). Golf courses are no longer expressly permitted in the RPZ, but may be if a wildlife hazard assessment determines that it will not provide an environment attractive to birds.

b. Precision Object Free Area (POFA). This is a new surface that applies to new instrument approach procedures with less than ¾-mile visibility minimums.

c. Runway Safety Area (RSA) Width. The RSA no longer increases in width at higher elevations for Approach Category D aircraft.

d. Threshold Siting Criteria. Changes have been made in criteria for various approaches and night operations. In some cases, displacement of the threshold may be avoided by lighting of obstructions. These changes align airport design criteria with the requirements in TERPS.

e. New Instrument Approach Category. Appendix 16 has been expanded to include a new category of instrument approach, Approach Procedure with Vertical Guidance (APV). Criteria for other instrument approach procedures have also been changed.

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Chapter 2. AIRPORT GEOMETRY

200. INTRODUCTION. This chapter presents the airport geometric design standards and recommendations to ensure the safety, economy, efficiency, and longevity of an airport.

201. PRINCIPLES OF APPLICATION.

a. Need to Plan. The significance of the interrelationship of the various airport features cannot be overemphasized. It is important that airport owners look to both the present and potential functions of the airport.

(1) Existing and planned airspace required for safe and efficient aircraft operations should be protected by acquisition of a combination of zoning, easements, property interests, and other means. AC 150/5190-4, A Model Zoning Ordinance to Limit Height of Objects Around Airports, presents guidance for controlling the height of objects around airports.

(2) All other existing and planned airport elements, including the following, should be on airport property:

(a) Object free areas;

(b) Runway protection zones;

(c) Areas under the 14 CFR Part 77 Subpart C airport imaginary surfaces out to where the surfaces obtain a height of at least 35 feet (10 m) above the primary surface; and

(d) Areas, other then those which can be adequately controlled by zoning, easements, or other means to mitigate potential incompatible land uses.

b. Airport Functions. Coordination with the FAA and users of the airport should assist in determining the airport's immediate and long range functions which will best satisfy the needs of the community and traveling public. This involves determining the following:

(1) The operating characteristics, sizes, and weights of the airplanes expected at the airport;

(2) The airport reference code (ARC) resulting from (1);

(3) The most demanding meteorological conditions in which airplanes will operate;

(4) The volume and mix of operations;

(5) The possible constraints on navigable airspace; and

(6) The environmental and compatible land-use considerations associated with topography, residential development, schools, churches, hospitals, sites of public assembly, and the like.

c. Airport Layout Plan. When developing the airport layout plan, application of the standards and recommendations in this publication to the long range functions of the airport will establish the future airport geometry. See appendices 6 and 7 for detailed information on the development of the airport layout plan.

202. RUNWAY LOCATION AND ORIENTATION. Runway location and orientation are paramount to airport safety, efficiency, economics, and environmental impact. The weight and degree of concern given to each of the following factors depend, in part, on: the airport reference code; the meteorological conditions; the surrounding environment; topography; and the volume of air traffic expected at the airport.

a. Wind. Appendix 1 provides information on wind data analysis for airport planning and design. Such an analysis considers the wind velocity and direction as related to the existing and forecasted operations during visual and instrument meteorological conditions. It may also consider wind by time of day.

b. Airspace Availability. Existing and planned instrument approach procedures, missed approach procedures, departure procedures, control zones, special use airspace, restricted airspace, and traffic patterns influence airport layouts and locations. Contact the FAA for assistance on airspace matters.

c. Environmental Factors. In developing runways to be compatible with the airport environs, conduct environmental studies which consider the impact of existing and proposed land use and noise on nearby residents, air and water quality, wildlife, and historical/archeological features.

d. Obstructions to Air Navigation. An obstruction survey should identify those objects which may affect airplane operations. Approaches free of obstructions are desirable and encouraged, but as a minimum, locate and orient runways to ensure that the approach areas associated with the ultimate development of the airport are clear of hazards to air navigation.

e. Topography. Topography affects the amount of grading and drainage work required to construct a runway. In determining runway orientation, consider the costs of both the initial work and ultimate airport development. See chapter 5 and AC 150/5320-5 for further guidance.

f. Airport Traffic Control Tower Visibility. The location and orientation of runways and taxiways must be such that the existing (or future) airport traffic control tower (ATCT) has a clear line of sight to: all traffic patterns; the final approaches to all runways; all runway structural pavement; and, other operational surfaces controlled by ATC. A clear line of sight to taxilane centerlines is desirable. Operational surfaces not having a clear unobstructed line of sight from the ATCT are designated by ATC as uncontrolled or nonmovement areas through a local agreement with the airport owner. See chapter 6 for guidance on airport traffic control tower siting.

g. Wildlife Hazards. In orienting runways, consider the relative locations of bird sanctuaries, sanitary landfills, or other areas that may attract large numbers of birds or wildlife. Where bird hazards exist, develop and implement bird control procedures to minimize such hazards. See AC 150/5xxx-xx, *Announcement of Availability,* FAA/USDA manual *Wildlife Hazard Management at Airports.* This manual may be used to determine, on a case-by-case basis, what uses may be compatible with a particular airport environment with respect to wildlife management. Guidance is also available through local FAA Airports Offices.

203. ADDITIONAL RUNWAYS. An additional runway may be necessary to accommodate operational demands, minimize adverse wind conditions, or overcome environmental impacts.

a. Operational Demands. An additional runway, or runways, is necessary when traffic volume exceeds the existing runway's operational capability. With rare exception, capacity-justified runways are parallel to the primary runway. Refer to AC 150/5060-5 for additional discussion.

b. Wind Conditions. When a runway orientation provides less than 95 percent wind coverage for any aircraft forecasted to use the airport on a regular basis, a crosswind runway is recommended. The 95 percent wind coverage is computed on the basis of the crosswind not exceeding 10.5 knots for Airport Reference Codes A-I and B-I, 13 knots for Airport Reference Codes A-II and B-II, 16 knots for Airport Reference Codes A-III, B-III, and C-I through D-III, and 20 knots for Airport Reference Codes A-IV through D-VI. See Appendix 1 for the methodology on computing wind coverage.

c. Environmental Impact. An additional runway may be needed to divert traffic from overflying an environmentally sensitive area.

204. TAXIWAY SYSTEM. As runway traffic increases, the capacity of the taxiway system may become the limiting operational factor. Taxiways link the independent airport elements and require careful planning for optimum airport utility. The taxiway system should provide for free movement to and from the runways, terminal/cargo, and parking areas. It is desirable to maintain a smooth flow with a minimum number of points requiring a change in the airplane's taxiing speed.

a. System Composition. Through-taxiways and intersections comprise the taxiway system. It includes entrance and exit taxiways; bypass, crossover or transverse taxiways; apron taxiways and taxilanes; and parallel and dual parallel taxiways. Chapter 4 discusses taxiway design.

b. Design Principles:

(1) Provide each runway with a parallel taxiway or the capability therefore;

(2) Build taxiways as direct as possible;

(3) Provide bypass capability or multiple access to runway ends;

(4) Minimize crossing runways;

(5) Provide ample curve and fillet radii;

(6) Provide airport traffic control tower line of sight; and

(7) Avoid traffic bottlenecks.

205. AIRPORT APRONS. Chapter 5 contains gradient standards for airport aprons. The tables cited in paragraph 206 present separation criteria applicable to aprons. For other apron criteria, refer to AC 150/5360-13 and Appendix 5 herein.

206. SEPARATION STANDARDS. Tables 2-1, 2-2, and 2-3 present the separation standards depicted in figure 2-1. *The separation distances may need to be increased with airport elevation to meet the runway obstacle free zone (OFZ) standards.* The

a. Recommendations. Other objects which are desirable to clear, if practicable, are objects which do not have a substantial adverse effect on the airport but, if removed, will enhance operations. These include objects in the controlled activity area and obstructions to air navigation which are not covered in paragraph 211.a, especially those penetrating an approach surface. On a paved runway, the approach surface starts 200 feet (61 m) beyond the area usable for takeoff or landing, whichever is more demanding. On an unpaved runway, the approach surface starts at the end of the area usable for takeoff or landing.

212. RUNWAY PROTECTION ZONE (RPZ). The RPZ's function is to enhance the protection of people and property on the ground. This is achieved through airport owner control over RPZs. Such control includes clearing RPZ areas (and maintaining them clear) of incompatible objects and activities. Control is preferably exercised through the acquisition of sufficient property interest in the RPZ.

b. Standards.

(1) RPZ Configuration/Location. The RPZ is trapezoidal in shape and centered about the extended runway centerline. The controlled activity area and a portion of the Runway OFA are the two components of the RPZ (see figure 2-3). The RPZ dimension for a particular runway end is a function of the type of aircraft and approach visibility minimum associated with that runway end. Table 2-4 provides standard dimensions for RPZs. Other than with a special application of declared distances, the RPZ begins 200 feet (60 m) beyond the end of the area usable for takeoff or landing. With a special application of declared distances, see Appendix 14, separate approach and departure RPZs are required for each runway end.

(a) The Runway OFA. Paragraph 307 contains the location, dimension, and clearing standards for the Runway OFA.

(b) The Controlled Activity Area. The controlled activity area is the portion of the RPZ beyond and to the sides of the Runway OFA.

(2) Land Use. In addition to the criteria specified in paragraph 211, the following land use criteria apply within the RPZ:

(a) While it is desirable to clear all objects from the RPZ, some uses are permitted, provided they do not attract wildlife (see paragraph 202.g., *Wildlife Hazards*), are outside of the Runway OFA, and do not interfere with navigational aids. Automobile parking facilities, although discouraged, may be permitted, provided the parking facilities and any associated appurtenances, in addition to meeting all of the preceding conditions, are located outside of the object free area extension (as depicted in figure 2-3). Fuel storage facilities should not be located in the RPZ.

(b) Land uses prohibited from the RPZ are residences and places of public assembly. (Churches, schools, hospitals, office buildings, shopping centers, and other uses with similar concentrations of persons typify places of public assembly.) Fuel storage facilities should not be located in the RPZ.

c. Recommendations. Where it is determined to be impracticable for the airport owner to acquire and plan the land uses within the entire RPZ, the RPZ land use standards have recommendation status for that portion of the RPZ not controlled by the airport owner.

d. FAA Studies of Objects and Activities in the Vicinity of Airports. The FAA policy is to protect the public investment in the national airport system. To implement this policy, the FAA studies existing and proposed objects and activities, both off and on public-use airports, with respect to their effect upon the safe and efficient use of the airports and safety of persons and property on the ground. These objects need not be obstructions to air navigation, as defined in 14 CFR Part 77. As the result of a study, the FAA may issue an advisory recommendation in opposition to the presence of any off-airport object or activity in the vicinity of a public-use airport that conflicts with an airport planning or design standard or recommendation.

213. to 299. RESERVED

Table 2-1. Runway Separation Standards for aircraft approach categories A & B

ITEM	DIM 1/	AIRPLANE DESIGN GROUP				
		I 2/	I	II	III	IV
Visual runways and runways with not lower than ¾-statute mile (1 200 m) approach visibility minimums						
Runway Centerline to:						
Parallel Runway Centerline	H	- Refer to paragraphs 207 and 208 -				
Holdline		- Refer to Advisory Circular 150/5340-1 -				
Taxiway/Taxilane Centerline 3/	D	150 ft 45 m	225 ft 67.5 m	240 ft 72 m	300 ft 90 m	400 ft 120 m
Aircraft Parking Area	G	125 ft 37.5 m	200 ft 60 m	250 ft 75 m	400 ft 120 m	500 ft 150 m
Helicopter Touchdown Pad		- Refer to Advisory Circular 150/5390-2 -				
Runways with lower than ¾-statute mile (1200 m) approach visibility minumums						
Parallel Runway Centerline	H	- Refer to paragraphs 207 and 208 -				
Holdline		- Refer to Advisory Circular 150/5340-1 -				
Taxiway/Taxilane Centerline 3/	D	200 ft 60 m	250 ft 75 m	300 ft 90 m	350 ft 105 m	400 ft 120 m
Aircraft Parking Area	G	400 ft 120 m	400 ft 120 m	400 ft 120 m	400 ft 120 m	500 ft 150 m
Helicopter Touchdown Pad		- Refer to Advisory Circular 150/5390-2 -				

1/ Letters correspond to the dimensions on figure 2-1.

2/ These dimensional standards pertain to facilities for small airplanes exclusively.

3/ The taxiway/taxilane centerline separation standards are for sea level. At higher elevations, an increase to these separation distances may be required to keep taxiing and holding airplanes clear of the OFZ (refer to paragraph 206).

Table 2-2. Runway Separation Standards for aircraft approach categories C & D

ITEM	DIM 1/	AIRPLANE DESIGN GROUP					
		I	II	III	IV	V	VI
Visual runways and runways with not lower than ¾-statute mile (1 200 m) approach visibility minimums							
Runway Centerline to:							
Parallel Runway Centerline	H	- Refer to paragraphs 207 and 208 -					
Holdline		- Refer to Advisory Circular 150/5340-1 -					
Taxiway/Taxilane Centerline 2/	D	300 ft 90 m	300 ft 90 m	400 ft 120 m	400 ft 120 m	3/ 3/	600 FT 180 M
Aircraft Parking Area	G	400 ft 120 m	400 ft 120 m	500 ft 150 m	500 ft 150 m	500 ft 150 m	500 ft 150 m
Helicopter Touchdown Pad		- Refer to Advisory Circular 150/5390-2 -					
Runways with lower than ¾-statute mile (1200 m) approach visibility minumums							
Parallel Runway Centerline	H	- Refer to paragraphs 207 and 208 -					
Holdline		- Refer to Advisory Circular 150/5340-1 -					
Taxiway/Taxilane Centerline 2/	D	400 ft 120 m	400 ft 120 m	400 ft 120 m	400 ft 120 m	3/ 3/	600 FT 180 M
Aircraft Parking Area	G	500 ft 150 m	500 ft 150 m	500 ft 150 m	500 ft 150 m	500 ft 150 m	500 ft 150 m
Helicopter Touchdown Pad		- Refer to Advisory Circular 150/5390-2 -					

1/ Letters correspond to the dimensions on figure 2-1.

2/ The taxiway/taxilane centerline separation standards are for sea level. At higher elevations, an increase to these separation distances may be required to keep taxiing and holding airplanes clear of the OFZ (refer to paragraph 206).

3/ For Airplane Design Group V, the standard runway centerline to parallel taxiway centerline separation distance is 400 ft (120 m) for airports at or below an elevation of 1,345 feet (410 m); 450 feet (135 m) for airports between elevations of 1,345 feet (410 m) and 6,560 feet 2 000 m); and 500 feet (150 m) for airports above an elevation of 6,560 feet (2 000 m).

Table 2-3. Taxiway and taxilane separation standards

ITEM	DIM 1/	AIRPLANE DESIGN GROUP					
		I	II	III	IV	V	VI
Taxiway Centerline to:							
Parallel Taxiway/ Taxilane Centerline	J	69 ft 21 m	105 ft 32 m	152 ft 46.5 m	215 ft 65.5 m	267 ft 81 m	324 ft 99 m
Fixed or Movable Object 2 and 3/	K	44.5 ft 13.5 m	65.5 ft 20 m	93 ft 28.5 m	129.5 ft 39.5 m	160 ft 48.5 m	193 ft 59 m
Taxilane Centerline to:							
Parallel Taxilane Centerline		64 ft 195. m	97 ft 29.5 m	140 ft 42.5 m	198 ft 60 m	245 ft 74.5 m	298 ft 91 m
Fixed or Movable Object 2 and 3/		39.5 ft 12 m	57.5 ft 17.5 m	81 ft 24.5 m	112.5 ft 34 m	138 ft 42 m	167 ft 51 m

1/ Letters correspond to the dimensions on figure 2-1.

2/ This value also applies to the edge of service and maintenance roads.

3/ Consideration of the engine exhaust wake impacted from turning aircraft should be given to objects located near runway/taxiway/taxilane intersections.

The values obtained form the following equations may be used to show that a modification of standards will provide an acceptable level of safety. Refer to paragraph 6 for guidance on modification of standard requirements.

Taxiway centerline to parallel taxiway/taxilane centerline equals 1.2 times airplane wingspan plus 10 feet (3 m).

Taxiway centerline to fixed or movable object equals 0.7 times airplane wingspan plus 10 feet (3 m).

Taxilane centerline to parallel taxilane centerline equals 1.1 times airplane wingspan plus 10 feet (3 m).

Taxilane centerline to fixed or movable object equals 0.6 times airplane wingspan plus 10 feet (3 m).

Chapter 3. RUNWAY DESIGN

300. INTRODUCTION. This chapter presents standards for runways and runway-associated elements such as shoulders, blast pads, runway safety areas, obstacle free zones (OFZ), object free areas (OFA), clearways, and stopways. Tables 3-1, 3-2, and 3-3 present the standard widths and lengths for runway and runway associated elements. Also included are design standards and recommendations for rescue and fire fighting access roads. At new airports, the RSA and ROFA lengths and the RPZ location standards are tied to runway ends. At existing constrained airports, these criteria may, on a case-by-case basis, be applied with respect to declared distances ends. See appendix 14.

301. RUNWAY LENGTH. AC 150/5325-4 and airplane flight manuals provide guidance on runway lengths for airport design, including declared distance lengths. The computer program cited in Appendix 11 may be used to determine the recommended runway length for airport design.

302. RUNWAY WIDTH. Tables 3-1, 3-2, and 3-3 present runway width standards that consider operations conducted during reduced visibility.

303. RUNWAY SHOULDERS. Runway shoulders provide resistance to blast erosion and accommodate the passage of maintenance and emergency equipment and the occasional passage of an airplane veering from the runway. Tables 3-1, 3-2, and 3-3 present runway shoulder width standards. A natural surface, e.g., turf, normally reduces the possibility of soil erosion and engine ingestion of foreign objects. Soil with turf not suitable for this purpose requires a stabilized or low cost paved surface. Refer to chapter 8 for further discussion. Figure 3-1 depicts runway shoulders.

304. RUNWAY BLAST PAD. Runway blast pads provide blast erosion protection beyond runway ends. Tables 3-1, 3-2, and 3-3 contain the standard length and width for blast pads for takeoff operations requiring blast erosion control. Refer to chapter 8 for further discussion. Figure 3-1 depicts runway blast pads.

305. RUNWAY SAFETY AREA (RSA). The runway safety area is centered on the runway centerline. Tables 3-1, 3-2, and 3-3 present runway safety area dimensional standards. Figure 3-1 depicts the runway safety area. Appendix 8 discusses the runway safety area's evolution.

a. Design Standards. The runway safety area shall be:

(1) cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations;

(2) drained by grading or storm sewers to prevent water accumulation;

(3) capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and fire fighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft; and

(4) free of objects, except for objects that need to be located in the runway safety area because of their function. Objects higher than 3 inches (7.6 cm) above grade should be constructed on low impact resistant supports (frangible mounted structures) of the lowest practical height with the frangible point no higher than 3 inches (7.6 cm) above grade. Other objects, such as manholes, should be constructed at grade. In no case should their height exceed 3 inches (7.6 cm) above grade.

b. Construction Standards. Compaction of runway safety areas shall be to FAA specification P-152 found in AC 150/5370-10.

306. OBSTACLE FREE ZONE (OFZ). The OFZ clearing standard precludes taxiing and parked airplanes and object penetrations, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function. The runway OFZ and, when applicable, the inner-approach OFZ, and the inner-transitional OFZ comprise the obstacle free zone (OFZ). Figures 3-2, 3-3, 3-4, and 3-5 show the OFZ.

a. Runway OFZ. The runway OFZ is a defined volume of airspace centered above the runway centerline. The runway OFZ is the airspace above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline. The runway OFZ extends 200 feet (60 m) beyond each end of the runway. Its width is as follows:

(1) For runways serving small airplanes exclusively:

(a) 300 feet (90 m) for runways with lower than 3/4-statute mile (1 200 m) approach visibility minimums.

(b) 250 feet (75 m) for other runways serving small airplanes with approach speeds of 50 knots or more.

(c) 120 feet (36 m) for other runways serving small airplanes with approach speeds of less than 50 knots.

(2) For runways serving large airplanes, 400 feet (120 m).

b. Inner-approach OFZ. The inner-approach OFZ is a defined volume of airspace centered on the approach area. It applies only to runways with an approach lighting system. The inner-approach OFZ begins 200 feet (60 m) from the runway threshold at the same elevation as the runway threshold and extends 200 feet (60 m) beyond the last light unit in the approach lighting system. Its width is the same as the runway OFZ and rises at a slope of 50 (horizontal) to 1 (vertical) from its beginning.

c. Inner-transitional OFZ. The inner-transitional OFZ is a defined volume of airspace along the sides of the runway OFZ and inner-approach OFZ. It applies only to runways with lower than 3/4-statute mile (1 200 m) approach visibility minimums.

(1) For runways serving small airplanes exclusively, the inner-transitional OFZ slopes 3 (horizontal) to 1 (vertical) out from the edges of the runway OFZ and inner-approach OFZ to a height of 150 feet (45 m) above the established airport elevation.

(2) For runways serving large airplanes, separate inner-transitional OFZ criteria apply for Category (CAT) I and CAT II/III runways.

(a) For CAT I runways, the inner-transitional OFZ begins at the edges of the runway OFZ and inner-approach OFZ, then rises vertically for a height "H", and then slopes 6 (horizontal) to 1 (vertical) out to a height of 150 feet (45 m) above the established airport elevation.

1) In U.S. customary units,
$H_{feet} = 61 - 0.094(S_{feet}) - 0.003(E_{feet})$.

2) In SI units,
$H_{meters} = 18.4 - 0.094(S_{meters}) - 0.003(E_{meters})$.

3) S is equal to the most demanding wingspan of the airplanes using the runway and E is equal to the runway threshold elevation above sea level.

(b) For CAT II/III runways, the inner-transitional OFZ begins at the edges of the runway OFZ and inner-approach OFZ, then rises vertically for a height "H", then slopes 5 (horizontal) to 1 (vertical) out to a distance "Y" from runway centerline, and then slopes 6 (horizontal) to 1 (vertical) out to a height of 150 feet (45 m) above the established airport elevation.

1) In U.S. customary units,
$H_{feet} = 53 - 0.13(S_{feet}) - 0.0022(E_{feet})$ and distance
$Y_{feet} = 440 + 1.08(S_{feet}) - 0.024(E_{feet})$.

2) In SI units,
$H_{meters} = 16 - 0.13(S_{meters}) - 0.0022(E_{meters})$ and distance
$Y_{meters} = 132 + 1.08(S_{meters}) - 0.024(E_{meters})$.

3) S is equal to the most demanding wingspan of the airplanes using the runway and E is equal to the runway threshold elevation above sea level. Beyond the distance "Y" from runway centerline the inner-transitional CAT II/III OFZ surface is identical to that for the CAT I OFZ.

307. OBJECT FREE AREA. The object Free Area (OFA) is a two dimensional surface comprising both the Runway Object Free Area (ROFA) and the Precision Object Free Area (POFA). The OFA clearing standard requires clearing the OFA of above ground objects protruding above the runway safety area edge elevation. Except where precluded by other clearing standards, it is acceptable to place objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes and to taxi and hold aircraft in the OFA. Objects non-essential for air navigation or aircraft ground maneuvering purposes are not to be placed in the OFA. This includes parked airplanes and agricultural operations.

a. Runway Object Free Area. The runway object free area (ROFA) is centered on the runway centerline. Tables 3-1, 3-2, and 3-3 specify the standard dimensions of the runway ROFA. Extension of the ROFA beyond the standard length to the maximum extent feasible is encouraged. See figure 2-3.

b. Precision Object Free Area. The Precision Object Free Area (POFA) is centered on the runway centerline extended, beginning at the runway threshold, 200 feet long and 800 feet wide. This area applies to all new authorized instrument approach procedures with less than 3/4-mile visibility as described in tables 16-1. See figure 3-6.

308. CLEARWAY STANDARDS. The clearway (See figure 3-7) is a clearly defined area connected to and extending beyond the runway end available for completion of the takeoff operation of turbine-powered airplanes. A clearway increases the allowable airplane operating takeoff weight without increasing runway length.

a. Dimensions. The clearway must be at least 500 feet (150 m) wide centered on the runway centerline. The practical limit for clearway length is 1,000 feet (300 m).

b. Clearway Plane Slope. The clearway plane slopes upward with a slope not greater than 1.25 percent.

c. Clearing. Except for threshold lights no higher than 26 inches (66 cm) and located off the runway sides, no object or terrain may protrude through the clearway plane. The area over which the clearway lies need not be suitable for stopping aircraft in the event of an aborted takeoff.

d. Control. An airport owner interested in providing a clearway should be aware of the requirement that the clearway be under its control, although not necessarily by direct ownership. The purpose of such control is to ensure that no fixed or movable object penetrates the clearway plane during a takeoff operation.

e. Notification. When a clearway is provided, the clearway length and the declared distances, as specified in appendix 14, paragraph 7, shall be provided in the Airport/Facility Directory (and in the Aeronautical Information Publication (AIP), for international airports) for each operational direction.

309. STOPWAY STANDARDS. A stopway is an area beyond the takeoff runway, centered on the extended runway centerline, and designated by the airport owner for use in decelerating an airplane during an aborted takeoff. It must be at least as wide as the runway and able to support an airplane during an aborted takeoff without causing structural damage to the airplane. Their limited use and high construction cost, when compared to a full-strength runway that is usable in both directions, makes their construction less cost effective. See figure 3-8. When a stopway is provided, the stopway length and the declared distances, as specified in appendix 14, paragraph 7, shall be provided in the Airport/Facility Directory (and in the Aeronautical Information Publication (AIP), for international airports) for each operational direction.

310. RESCUE AND FIRE FIGHTING ACCESS. Rescue and fire fighting access roads are normally needed to provide unimpeded two-way access for rescue and fire fighting equipment to potential accident areas. Connecting these access roads, to the extent practical, with the operational surfaces and other roads will facilitate aircraft rescue and fire fighting operations.

a. Recommendation. It is recommended that the entire runway safety area (RSA) and runway protection zone (RPZ) be accessible to rescue and fire fighting vehicles so that no part of the RSA or RPZ is more than 330 feet (100 m) from either an all weather road or a paved operational surface. Where an airport is adjacent to a body of water, it is recommended that boat launch ramps with appropriate access roads be provided.

b. All Weather Capability. Rescue and fire fighting access roads are all weather roads designed to support rescue and fire fighting equipment traveling at normal response speeds. Establish the widths of the access roads on a case-by-case basis considering the type(s) of rescue and fire fighting equipment available and planned at the airport. The first 300 feet (90 m) adjacent to a paved operational surface should be paved. Where an access road crosses a safety area, the safety area standards for smoothness and grading control. For other design and construction features, use local highway specifications.

c. Road Usage. Rescue and fire fighting access roads are special purpose roads that supplement but do not duplicate or replace sections of a multi-purpose road system. Restricting their use to rescue and fire fighting access equipment precludes their being a hazard to air navigation.

311. to 399. RESERVED.

Table 3-1. Runway design standards for aircraft approach category A & B visual runways and runways with not lower than 3/4-statute mile (1 200 m) approach visibility minimums

(Refer also to Appendix 16 for the establishment of new approaches)

ITEM	DIM[1]	AIRPLANE DESIGN GROUP				
		I [2]	I	II	III	IV
Runway Length	A	- Refer to paragraph 301 -				
Runway Width	B	60 ft 18 m	60 ft 18 m	75 ft 23 m	100 ft 30 m	150 ft 45 m
Runway Shoulder Width		10 ft 3 m	10 ft 3 m	10 ft 3 m	20 ft 6 m	25 ft 7.5 m
Runway Blast Pad Width		80 ft 24 m	80 ft 24 m	95 ft 29 m	140 ft 42 m	200 ft 60 m
Runway Blast Pad length		60 ft 18 m	100 ft 30 m	150 ft 45 m	200 ft 60 m	200 ft 60 m
Runway Safety Area Width	C	120 ft 36 m	120 ft 36 m	150 ft 45 m	300 ft 180 m	500 ft 150 m
Runway Safety Area Length Beyond RW End[3]	P	240 ft 72 m	240 ft 72 m	300 ft 90 m	600 ft 180 m	1,000 ft 300 m
Obstacle Free Zone Width and length	- Refer to paragraph 306 -					
Runway Object Free Area Width	Q	250 ft 75 m	400 ft 120 m	500 ft 150 m	800 ft 240 m	800 ft 240
Runway Object Free Area Length Beyond RW End[3]	R	240 ft 72 m	240 ft 72 m	300 ft 90 m	600 ft 180 m	1,000 ft 300 m

1/ Letters correspond to the dimensions on figures 2-1 and 2-3.

2/ These dimensional standards pertain to facilities for small airplanes exclusively.

3/ The runway safety area and runway object free area lengths begin at each runway end when stopway is not provided. When stopway is provided, these lengths begin at the stopway end.

Table 3-2. Runway design standards for aircraft approach categories A & B runways with lower than 3/4-statute mile (1 200 m) approach visibility minimums
(Refer also to Appendix 16 for the establishment of new approaches)

ITEM	DIM[1]	AIRPLANE DESIGN GROUP				
		I [2]	I	II	III	IV
Runway Length	A	- Refer to paragraph 301 -				
Runway Width	B	75 ft 23 m	100 ft 30 m	100 ft 30 m	100 ft 30 m	150 ft 45 m
Runway Shoulder Width		10 ft 3 m	10 ft 3 m	10 ft 3 m	20 ft 6 m	25 ft 7.5 m
Runway Blast Pad Width		95 ft 29 m	120 ft 36 m	120 ft 36 m	140 ft 42 m	200 ft 60 m
Runway Blast Pad length		60 ft 18 m	100 ft 30 m	150 ft 45 m	200 ft 60 m	200 ft 60 m
Runway Safety Area Width	C	300 ft 90 m	300 ft 90 m	300 ft 90 m	400 ft 120 m	500 ft 150 m
Runway Safety Area Length Beyond RW End[3]	P	600 ft 180 m	600 ft 180 m	600 ft 180 m	800 ft 240 m	1,000 ft 300 m
Obstacle Free Zone Width and length	- Refer to paragraph 306 -					
Runway Object Free Area Width	Q	800 ft 240 m	800 ft 240 m	800 ft 240 m	800 ft 240 m	800 ft 240
Runway Object Free Area Length Beyond RW End[3]	R	600 ft 180 m	600 ft 180 m	600 ft 180 m	800 ft 240 m	1,000 ft 300 m
Precision Object Free Area	- See figure 3-6 -					

1/ Letters correspond to the dimensions on figures 2-1 and 2-3.

2/ These dimensional standards pertain to facilities for small airplanes exclusively.

3/ The runway safety area and runway object free area lengths begin at each runway end when stopway is not provided. When stopway is provided, these lengths begin at the stopway end.

Table 3-3. Runway design standards for aircraft approach categories C & D
(Refer also to Appendix 16 for the establishment of new approaches)

ITEM	DIM[1]	AIRPLANE DESIGN GROUP					
		I	II	III	IV	V	VI
Runway Length	A	- Refer to paragraph 301 -					
Runway Width	B	100 ft 30 m	100 ft 30 m	100 ft[2] 30 m[2]	150 ft 45 m	150 ft 45 m	200 ft 60 m
Runway Shoulder Width[3]		10 ft 3 m	10 ft 3 m	20 ft[2] 6 m[2]	25 ft 7.5 m	35 ft 10.5 m	40 FT 12 M
Runway Blast Pad Width		120 ft 36 m	120 ft 36 m	140 ft[2] 42 m[2]	200 ft 60 m	220 ft 66 m	280 ft 84 m
Runway Blast Pad length		100 ft 30 m	150 ft 45 m	200 ft 60 m	200 ft 60 m	400 ft 120 m	400 ft 120 m
Runway Safety Area Width[4]	C	500 ft 150 m	500 ft 150 m	500 ft 150 m	500 ft 150 m	500 ft 150 m	500 ft 150 m
Runway Safety Area Length Beyond RW End[5]	P	1,000 ft 300 m	1,000 ft 300 m	1,000 ft 300 m	1,000 ft 300 m	1,000 ft 300 m	1,000 ft 300 m
Obstacle Free Zone Width and length	- Refer to paragraph 306 -						
Runway Object Free Area Width	Q	800 ft 240 m	800 ft 240 m	800 ft 240 m	800 ft 240 m	800 ft 240	800 ft 240
Runway Object Free Area Length Beyond RW End[5]	R	1000 ft 300 m	1000 ft 300 m	1000 ft 300 m	1000 ft 300 m	1,000 ft 300 m	1000 ft 300
Precision Object Free Area	- See figure 3-6 -						

1/ Letters correspond to the dimensions on figures 2-1 and 2-3.

2/ For Airplane Design Group III serving airplanes with maximum certificated takeoff weight greater than 150,000 pounds (68 100 kg), the standard runway width is 150 feet (45 m), the shoulder width is 25 feet (7.5 m), and the runway blast pad width is 200 feet (60 m).

3/ Design Groups V and VI normally require stabilized or paved shoulder surfaces.

4/ For Airport Reference Codes C-I and C-II, a runway safety area width of 400 feet (120 m) is permissible.

5/ The runway safety area and runway object free area lengths begin at each runway end when stopway is not provided. When stopway is provided, these lengths begin at the stopway end.

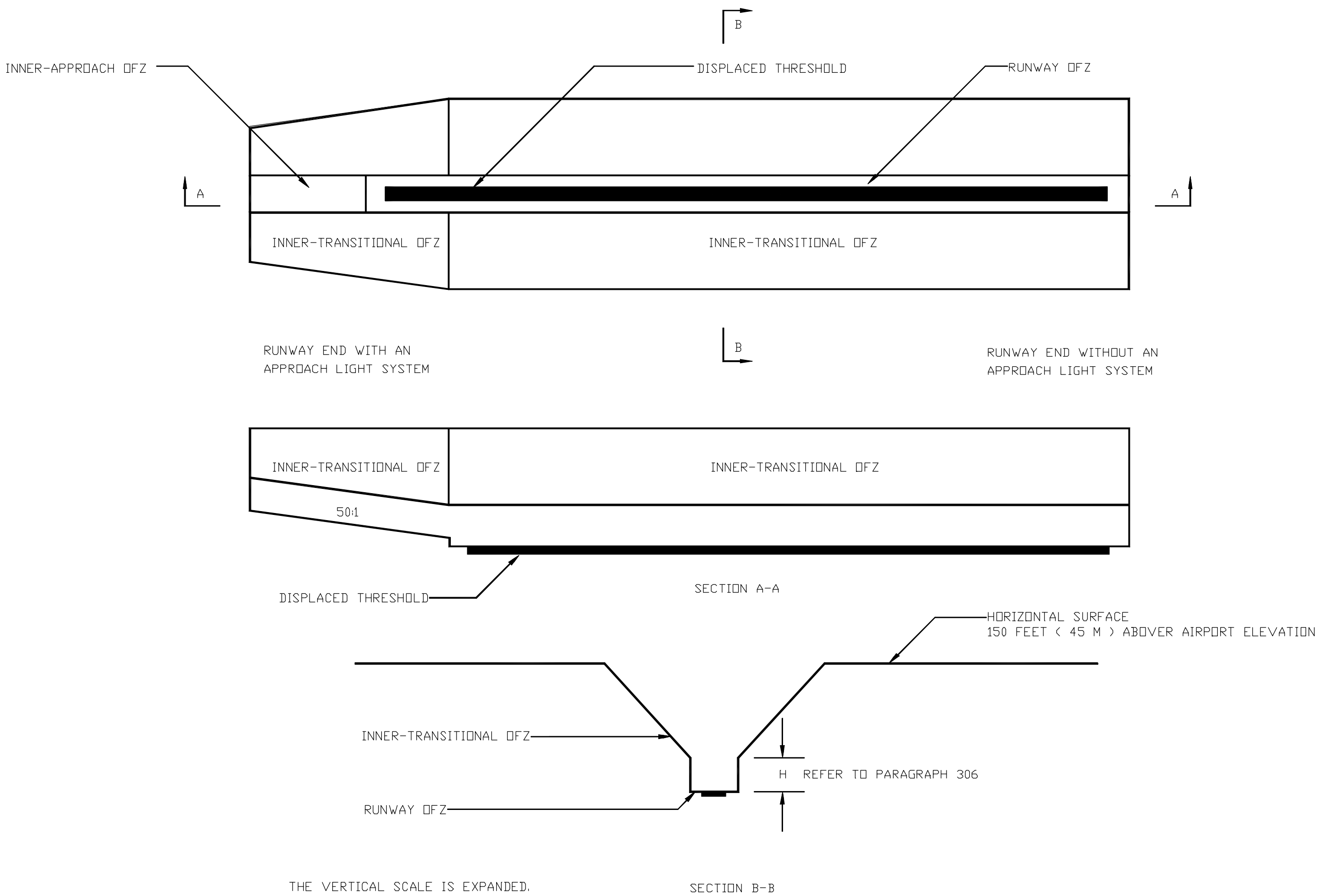

Figure 3-5. Obstacle free zone (OFZ) for runways serving large airplanes with lower than 3/4-statute mile (1 200 m) approach visibility minimums and displaced threshold

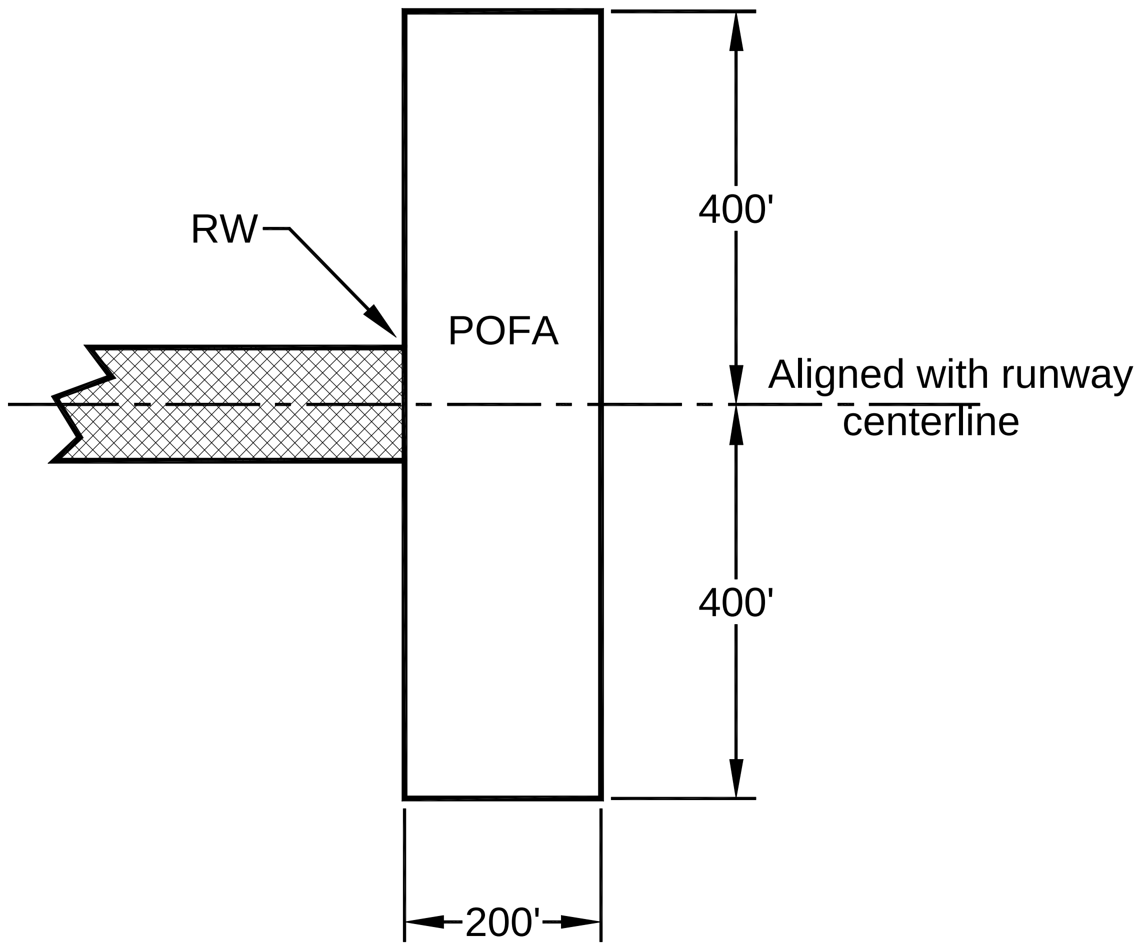

Figure 3-6. Precision Object Free Area

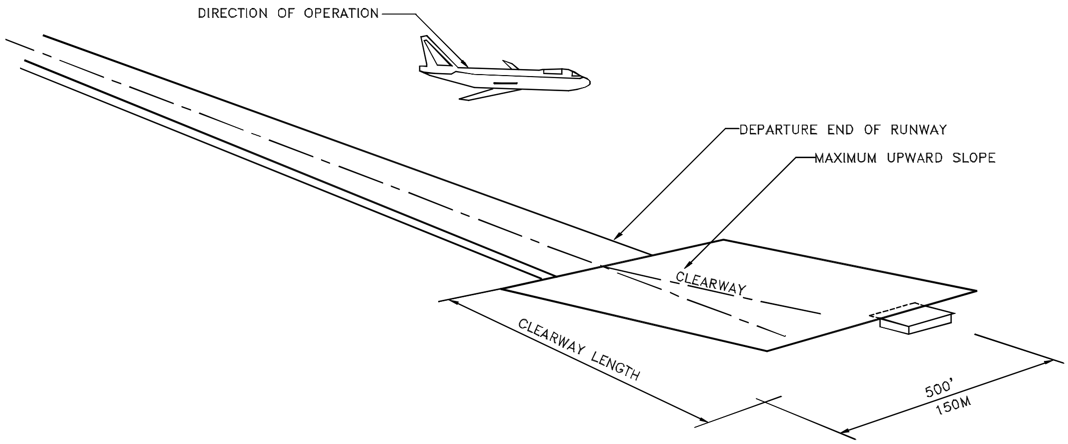

Figure 3-7. Clearway

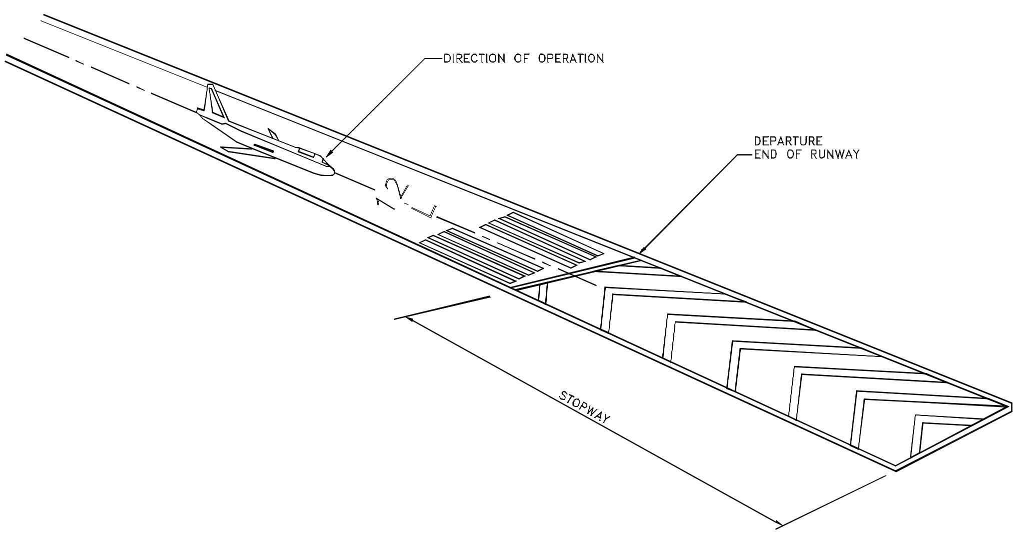

Figure 3-8. Stopway

a. Marker Beacons. Marker beacons radiate cone or fan shaped signals vertically to activate aural and visual indicators in the cockpit marking specific points in the ILS approach.

(1) Marker beacons are located on the extended runway centerline at key points in the approach as noted below. Figure 6-2 illustrates the placement of marker beacons for an ILS. Figure 6-8 illustrates typical marker beacon installation.

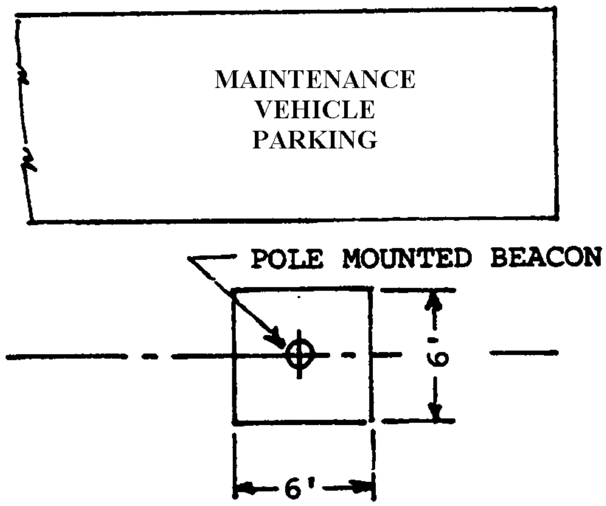

Figure 6-8. Marker beacon site

(a) The outer marker (OM) beacon is located 4 to 7 nautical miles (7.4 to 13 km) from the ILS runway threshold to mark the point at which glide slope altitude is verified or at which descent without glide slope is initiated.

(b) A middle marker (MM) beacon is located 2,000 to 6,000 feet (600 to 1 800 m) from the ILS runway threshold. It marks (approximately) the decision point of a CAT I ILS approach.

(c) An inner marker (IM) beacon may be located to mark the decision point of a CAT II or CAT III ILS approach. Inner marker beacons are not used for CAT I ILS's.

(d) A "back course" marker beacon (comparable to an outer marker beacon) may be located to the rear of a bidirectional localizer facility to permit development of a nonprecision approach.

(2) Off airport marker beacons are located in a fenced 6-foot by 6-foot (2 m by 2 m) tract situated on the extended runway centerline. Interference sources such as metal buildings, power lines, trees, etc., shall be avoided within 100 feet (30 m) of the antenna. A vehicle access and parking area is required at the site.

(3) Marker beacon sites should be smooth, level, and well drained.

603. NONDIRECTIONAL BEACON. The non-directional beacon (NDB) radiates a signal which provides directional guidance to and from the transmitting antenna. An NDB is normally mounted on a 35 foot (11 m) pole. Figure 6-9 illustrates an NDB antenna.

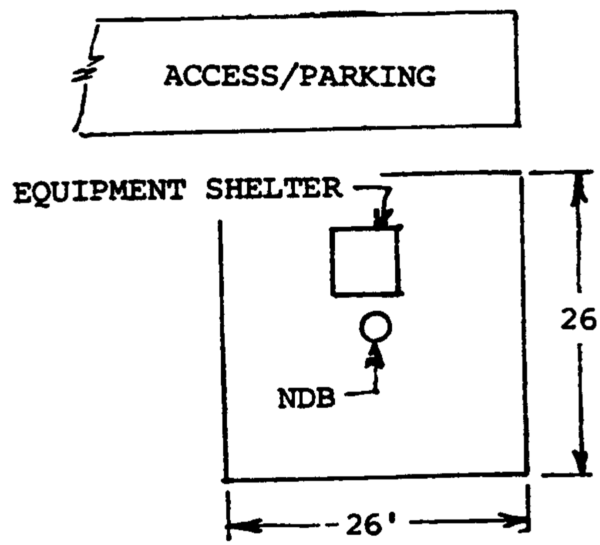

Figure 6-9. NDB site

a. Location. A NDB may be located on or adjacent to the airport. Metal buildings, power lines, or metal fences should be kept 100 feet (30 m) from a NDB antenna.

b. Grading. The NDB site should be smooth, level, and well drained.

c. Equipment Shelter. Electronic equipment is housed in a small collocated shelter.

604. VERY HIGH FREQUENCY OMNIRANGE. The standard very high frequency omnirange (VOR) located on an airport is known as a TVOR. TVORs radiate azimuth information for nonprecision instrument approach procedures. Figure 6-10 illustrates a typical TVOR installation.

a. Location. If the airport has intersecting runways, TVORs should be located adjacent to the intersection to provide approach guidance to both. TVORs should be located at least 500 feet (150 m) from the centerline of any runway and 250 feet (75 m) from the centerline of any taxiway.

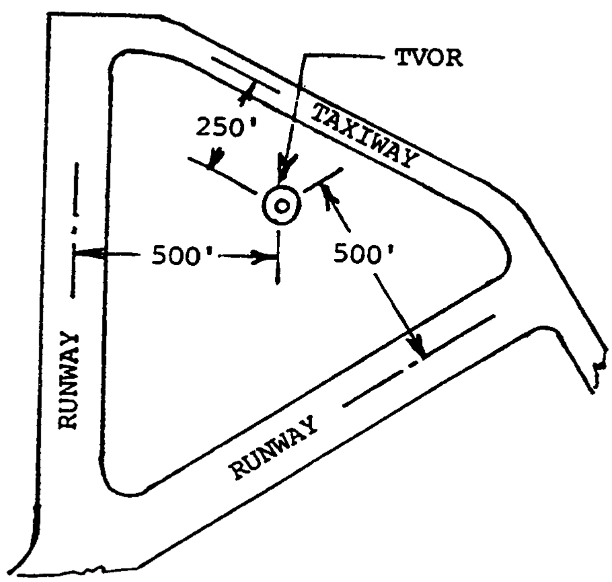

Figure 6-10. A TVOR installation

b. Clearances. TVOR signals are susceptible to distortion caused by reflections. Structures should be at least 1,000 feet (300 m) from the antenna. Metal structures beyond 1,000 feet (300 m) should not penetrate a 1.2 degree angle measured from the antenna base. Nonmetal structures beyond 1,000 feet (300 m) should not penetrate a 2.5 degree angle measured from the antenna base. Metal fences should be at least 500 feet (150 m) from the antenna and overhead power and telephone lines at least 1,200 feet (360 m) from the antenna. While trees should be at least 1,000 feet (300 m) from the antenna, a single tree may be tolerated if it is at least 500 feet (150 m) from the antenna. Beyond a 1,000 feet trees should not penetrate a 2.0 degree angle measured from the antenna.

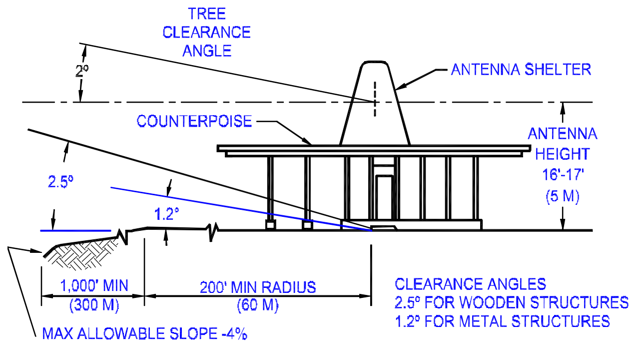

Figure 6-11, TVOR Clearances

c. Grading. TVOR sites should be level within 1000 feet (300 m) of the antenna. However, a downward slope of as much as 4 percent is permitted between 200 feet (60 m) and 1,000 feet (300 m) of the antenna. Surfaces should be cleared and smooth with no major irregularities.

d. Equipment Shelter. All necessary electronic equipment is located within the structure.

605. APPROACH LIGHTING SYSTEMS. All approach lighting systems (ALS) are configurations of lights positioned symmetrically along the extended runway centerline. They begin at the runway threshold and extend towards the approach. An ALS augments the electronic navigational aids. Guidance on ALS systems is found in AC 150/5340-14.

a. ALS Configurations. The FAA recognizes four ALS configurations to meet visual requirements for precision and nonprecision approaches.

(1) An ALSF-2 is a 2,400 foot (720 m) high intensity ALS with sequenced flashing lights. It is required for CAT II and CAT III precision approaches.

(2) A MALSR is a 2,400 foot (720 m) medium intensity ALS with runway alignment indicator lights (RAILs). It is an economy ALS system approved for CAT I precision approaches. The MALS portion of the system is 1,400 feet (420 m) in length. The RAIL portion extends outward an additional 1,000 feet (300 m).

(3) A MALS is a 1,400 foot (420 m) medium intensity ALS. It enhances nonprecision instrument and night visual approaches.

(4) A MALSF is a medium intensity ALS identical to the MALS above except that sequenced flashing lights are added to the outer three light bars. The sequenced flashing lights improve pilot recognition of the ALS when there are distracting lights in the airport vicinity.

b. Land Requirements. An ALS requires a site centered on the extended runway centerline. It is 400 feet (120 m) wide. It starts at the threshold and extends 200 feet (60 m) beyond the outermost light of the ALS.

c. Clearance Requirements. A clear line of sight is required between approaching aircraft and all lights in an ALS.

606. OMNIDIRECTIONAL APPROACH LIGHTING SYSTEMS. An omnidirectional approach lighting system (ODALS) may be installed on a runway with a nonprecision approach or on a runway that is difficult to identify due to an excessive number of lights in the area.

a. ODALS Configuration. ODALS consists of seven capacitor discharge lights. Five of the seven lights are sequence flashing omnidirectional lights. These five are located on the extended runway centerline, beginning 300 feet (90 m) from the runway threshold and spaced at 300-foot (90 m) intervals. The remaining two lights are located on either side of the runway threshold.

b. Land Requirements. ODALS require a site centered on the extended runway centerline. It is 400 feet (120 m) wide. It starts at the threshold and extends 1,700feet (510 m).

c. Clearance Requirements. A clear line of sight is required between approaching aircraft and all lights in an ODALS.

607. LEAD-IN LIGHTING SYSTEMS. Lead-in lights (LDIN) consist of at least three flashing lights installed at or near ground level to define the desired course to an ALS or to a runway threshold.

a. LDIN Configuration. Each LDIN installation is unique. An LDIN is designed to overcome problems associated with hazardous terrain, obstructions, noise sensitive areas, etc. LDIN systems may be curved, straight, or a combination thereof. The lights are placed on the desired approach path, beginning at a point within visual range of the final approach. Generally the lights are spaced at 3,000-foot (900 m) intervals.

b. Land Requirements. Sufficient land or property interest to permit installation and operation of the lights, together with the right to keep the lights visible to approaching aircraft, is required.

c. Clearance Requirements. A clear line of sight is required between approaching aircraft and the next light ahead of the aircraft.

608. AIRPORT ROTATING BEACONS. Airport rotating beacons indicate the location of an airport by projecting beams of light spaced 180 degrees apart. Alternating white/green flashes identify a lighted civil airport; white/white flashes an unlighted civil airport.

a. Location. The beacon shall be located to preclude interference with pilot or controller vision. Beacons should be within 5,000 feet (1 500 m) of a runway.

b. Land Requirements. Most beacons are located on airport property. When located off the airport, sufficient land or property interest to permit installation and operation of the beacon, together with the right to keep the beacon visible to approaching aircraft, is required.

c. Clearance Requirements. A beacon should be mounted high enough above the surface so that the beam sweep, aimed 2 degrees or more above the horizon, is not blocked by any natural or manmade object.

609. AIRPORT TRAFFIC CONTROL TOWERS. From airport traffic control towers (ATCTs), ATC personnel control flight operations within the airport's designated airspace and the operation of aircraft and vehicles on the movement area. A site should be reserved for an ATCT after consulting with the appropriate FAA regional office.

a. Land Requirements. A typical ATCT site will range from 1 to 4 acres (0.4 to 1.6 hectares). Additional land may be needed for combined flight service stations/towers.

b. Clearance Requirements. ATCT sites must meet these requirements:

(1) There must be maximum visibility of the airport's traffic patterns.

(2) There must be a clear, unobstructed, and direct line of sight to the approaches, to all runways or landing areas, and to all runway and taxiway surfaces.

(3) Most ATCTs penetrate an 14 CFR Part 77 surface. A tower penetrating an 14 CFR Part 77 surface is an obstruction to air navigation. As such, it is presumed to be a hazard to air navigation until an FAA study determines otherwise.

(4) The ATCT must not derogate the signal generated by any existing or planned electronic NAVAID or an ATC facility.

(5) The proposed site must be large enough to accommodate current and future building needs, including employee parking spaces.

610. AIRPORT SURVEILLANCE RADAR. Airport surveillance radars (ASR) are used to control air traffic. ASR antennas scan through 360 degrees to present the controller with the location of all aircraft within 60 nautical miles of the airport. The site for the ASR antenna is flexible, subject to the following guidelines:

a. Location. The ASR antenna should be located as close to the ATCT control room as practical. ASR-4, -5, -6, and -7 antennas should be within 12,000 feet (3 600 m) of the control room. ASR-8 antennas should be within 20,000 feet (6 000 m) of the control room. ASR-9 antennas may be located over 20,000 feet (6 000 m) from the control room.

b. Clearances. Antennas should be located at least 1,500 feet (450 m) from any building or object that might cause signal reflections and at least one-half mile (.8 km) from other electronic equipment. ASR antennas may be elevated to obtain line-of-sight clearance. Typical ASRs heights range from 25 to 85 feet (7.5 to 25.5 m) above ground.

611. AIRPORT SURFACE DETECTION EQUIPMENT. Airport surface detection equipment (ASDE) compensates for the loss of line of sight to surface traffic during periods of reduced visibility. ASDE should be sited to provide line-of-sight coverage of the entire aircraft movement area. While the ideal location for the ASDE antenna is on the ATCT cab roof, the antenna may be placed on a freestanding tower up to 100 feet (30 m) tall located within 6,000 feet (1 800 m) of the ATCT cab.

612. RUNWAY VISUAL RANGE FACILITIES. Runway visual range facilities provided a measurement of horizontal visibility, i.e., how far ahead the pilot of an aircraft should be able to see high intensity runway edge lights or contrasting objects. RVR installations consist of a projector and a receiver. Existing systems will be replaced by single-point systems in the 1990-1998 time frame.

a. Number. The number of RVRs required depends upon the runway approach category and physical length.

(1) CAT I runways require only a touchdown RVR.

(2) CAT II runways with authorized visibility minimums down to 1,600 RVR require only a touchdown RVR. Minimums below 1,600 RVR require touchdown and rollout RVRs. CAT II runways more than 8,000 feet (2 400 m) in length require touchdown, roll-out, and midpoint RVRs.

(3) CAT III runways with visibility minimums below 1,200 RVR require touchdown, midpoint, and rollout RVRs.

b. Longitudinal Location.

(1) Touchdown RVRs are located 750 to 1,000 feet (225 to 300 m) from the runway threshold, normally behind the MLS elevation antenna or ILS glide slope antenna.

(2) Rollout RVRs are located 750 to 1,000 feet (225 to 300 m) from the rollout end of the runway.

(3) Mid-point RVRs are located within 250 feet (75 m) of the runway's center longitudinally.

c. Lateral Location. RVR installations are located adjacent to the instrument runway.

(1) Single-point visibility sensor installations are located at least 400 feet (120 m) from the runway centerline and 150 feet (45 m) from a taxiway centerline.

(2) Transmissometer projectors are located at least 400 feet (120 m) from the runway centerline and 150 feet (45 m) from a taxiway centerline. Receivers are located between 250 feet (75 m) and 1,000 feet (300 m) from the runway centerline. The light beam between the projector and receiver should be at an angle of 5 to 14.5 degrees to the runway centerline. The light beam may be parallel to the runway centerlines when installations are between parallel runways.

613. AUTOMATIC WEATHER OBSERVATION STATIONS (AWOS). Automatic recording instruments have been developed for measuring cloud height, visibility, wind speed and direction, temperature, dewpoint, etc.. The U.S. Department of Commerce's National Oceanic and Atmospheric Administration publication "Federal Standard for Siting Meteorological Sensors at Airports" addresses siting of sensors. AC 150/5220-16, Automated Weather Observing Systems (AWOS) for Non-Federal Applications provides additional guidance.

Appendix 1. WIND ANALYSIS

1. OBJECTIVE. This appendix provides guidance on the assembly and analysis of wind data to determine runway orientation. It also provides guidance on analyzing the operational impact of winds on existing runways.

a. A factor influencing runway orientation and number of runways is wind. Ideally a runway should be aligned with the prevailing wind. Wind conditions affect all airplanes in varying degrees. Generally, the smaller the airplane, the more it is affected by wind, particularly crosswind components (see figure A1-1). Crosswinds are often a contributing factor in small airplane accidents.

b. Airport planners and designers should make an accurate analysis of wind to determine the orientation and number of runways. In some cases, construction of two runways may be necessary to give the desired wind coverage (95 percent coverage). The proper application of the results of this analysis will add substantially to the safety and usefulness of the airport.

2. CROSSWINDS. The crosswind component of wind direction and velocity is the resultant vector which acts at a right angle to the runway. It is equal to the wind velocity multiplied by the trigonometric sine of the angle between the wind direction and the runway direction. Normally, these wind vector triangles are solved graphically. An example is shown in figure A1-1. From this diagram, one can also ascertain the headwind and tailwind component for combinations of wind velocities and directions. Refer to paragraph 203 for allowable crosswind components.

3. COVERAGE AND ORIENTATION OF RUNWAYS. The most desirable runway orientation based on wind is the one which has the largest wind coverage and minimum crosswind components. Wind coverage is that percent of time crosswind components are below an acceptable velocity. The desirable wind coverage for an airport is 95 percent, based on the total numbers of weather observations. This value of 95 percent takes into account various factors influencing operations and the economics of providing the coverage. The data collection should be with an understanding of the objective; i.e., to attain 95-percent usability. At many airports, airplane operations are almost nil after dark, and it may be desirable to analyze the wind data on less than a 24-hour observation period. At airports where operations are predominantly seasonal, regard should be given to the wind data for the predominant-use period. At locations where provision of a crosswind runway is impractical due to severe terrain constraints, consideration may be given to increasing operational tolerance to crosswinds by upgrading the airport layout to the next higher airport reference code.

4. ASSEMBLING WIND DATA. The latest and best wind information should always be used to carry out a wind analysis. A record which covers the last 10 consecutive years of wind observations is preferred. Records of lesser duration may be acceptable on a case-by-case basis. In some instances, it may be highly desirable to obtain and assemble wind information for periods of particular significance; e.g., seasonal variations, instrument weather conditions, daytime versus nighttime, and regularly occurring gusts.

a. Data Source. The best source of wind information is the National Oceanic and Atmospheric Administration, National Climatic Data Center (NCDC). The NCDC is located at:

Climate Services Branch
National Climatic Data Center
151 Patton Avenue
Asheville, North Carolina 28801-5001
Tel: 828-271-4800/ Fax: 828-271-4876
Public Web Address: http://www.ncdc.noaa.gov/

The Center should be contacted directly to determine the availability of data for a particular site.

b. Data Costs. The EDS provides wind information at cost. The cost will vary, depending upon the complexity of the information desired, how the data are being stored, and whether the data have been assembled (summarized) previously. The wind summary for the airport site should be formatted with the standard 36 wind quadrants (the EDS standard for noting wind directions since January 1, 1964) and usual speed groupings (see figure A1-3). An existing wind summary of recent vintage is acceptable for analysis purposes if these standard wind direction and speed groupings are used. Figure A1-2 is an example of a typical EDS wind summary.

c. Data Not Available. In those instances when EDS data are not available for the site, it is permissible to develop composite wind data using wind information obtained from two or more nearby recording stations. Composite data are usually acceptable if the terrain between the stations and the site is level or only slightly rolling. If the terrain is hilly or mountainous, composite data may only have marginal validity. In extreme cases it may be necessary to obtain a minimum of 1 year of onsite wind observations. These meager records should be augmented with personal observations (wind-bent trees, interviews with the local populace, etc.) to ascertain if a discernible wind pattern can be established. Airport development should not proceed until adequate wind data are acquired.

5. ANALYZING WIND DATA. One wind analysis procedure uses a scaled graphical presentation of wind information known as a windrose.

a. Drawing the Windrose. The standard windrose (figure A1-3) is a series of concentric circles cut by radial lines. The perimeter of each concentric circle represents the division between successive wind speed groupings. Radial lines are drawn so that the area between each successive pair is centered on the direction of the reported wind.

b. Plotting Wind Data. Each segment of the windrose represents a wind direction and speed grouping corresponding to the wind direction and speed grouping on the EDS summary. The recorded directions and speeds of the wind summary are converted to a percentage of the total recorded observations. Computations are rounded to the nearest one-tenth of 1 percent and entered in the appropriate segment of the windrose. Figure A1-4 illustrates a completed windrose based on data from figure A1-2. Plus (+) symbols are used to indicate direction and speed combinations which occur less than one-tenth of 1 percent of the time.

c. Crosswind Template. A transparent crosswind template is a useful aid in carrying out the windrose analysis. The template is essentially a series of three parallel lines drawn to the same scale as the windrose circles. The allowable crosswind for the runway width establishes the physical distance between the outer parallel lines and the centerline. When analyzing the wind coverage for a runway orientation, the design crosswind limit lines can be drawn directly on the windrose. NOTE: EDS wind directions are recorded on the basis of true north.

d. Analysis Procedure. The purpose of the analysis is to determine the runway orientation which provides the greatest wind coverage within the allowable crosswind limits. This can be readily estimated by rotating the crosswind template about the windrose center point until the sum of the individual segment percentages appearing between the outer "crosswind limit" lines is maximized. It is accepted practice to total the percentages of the segments appearing outside the limit lines and to subtract this number from 100. For analyses purposes, winds are assumed to be uniformly distributed throughout each of the individual segments. Figures A1-5 and A1-6 illustrate the analysis procedure as it would be used in determining the wind coverage for a runway, oriented 105-285, intended to serve all types of airplanes. The wind information is from figure A1-2. Several trial orientations may be needed before the orientation which maximizes wind coverage is found.

6. CONCLUSIONS. The example wind analysis shows that the optimum wind coverage possible with a single runway and a 13-knot crosswind is 97.28 percent. If the analysis had shown that it was not possible to obtain at least 95-percent wind coverage with a single runway, then consideration should be given to provide an additional (crosswind) runway oriented to bring the combined wind coverage of the two runways to at least 95 percent.

7. ASSUMPTIONS. The analysis procedures assume that winds are uniformly distributed over the area represented by each segment of the windrose. The larger the area, the less accurate is this presumption. Therefore, calculations made using nonstandard windrose directions or speeds result in a derivation of wind coverage (and its associated justification for a crosswind runway) which is questionable.

8. COMPUTER WIND ANALYSIS. Another wind analysis procedure uses a computer program. Figures A1-7, A1-8, and A1-9 are computer printouts based on the data from figure A1-2. The computed generated coverage in this example is 96.75 percent. Figures A1-10 and A1-11 are Lotus 1-2-3 cell-equations used to generate figures A1-7, A1-8, and A1-9 on an IBM PC compatible computer. Appendix 11 gives details on availability of another wind analysis computer program.

Appendix 2. THRESHOLD SITING REQUIREMENTS

1. PURPOSE. This appendix contains guidance on locating thresholds to meet approach obstacle clearance requirements.

2. APPLICATION.

a. The threshold should be located at the beginning of the full-strength runway pavement or runway surface. However, displacement of the threshold may be required when an object that obstructs the airspace required for landing airplanes is beyond the airport owner's power to remove, relocate, or lower. Thresholds may also be displaced for environmental considerations, such as noise abatement, or to provide the standard RSA and ROFA lengths.

b. When a hazard to air navigation exists, the amount of displacement of the threshold should be based on the operational requirements of the most demanding airplanes. The standards in this appendix minimize the loss of operational use of the established runway. These standards reflect FAA policy of maximum utilization and retention of existing paved areas on airports.

c. Displacement of a threshold reduces the length of runway available for landings. Depending on the reason for displacement of the threshold, the portion of the runway behind a displaced threshold may be available for takeoffs in either direction and landings from the opposite direction. Refer to appendix 14 for additional information.

3. LIMITATIONS.

a. These standards should not be interpreted as an FAA blanket endorsement of the alternative to displace or relocate a runway threshold. Threshold displacement or relocation should be undertaken only after a full evaluation reveals that displacement or relocation is the only practical alternative.

b. The standards in this appendix are not applicable for identifying objects affecting navigable airspace (14 CFR Part 77) or zoning to limit the height of objects around airports (AC 150/5190-4).

4. EVALUATION CONSIDERATIONS.

a. When a penetration to a surface defined in paragraph 5 (threshold siting surfaces) exists, one or more of the following actions is required:

(1) The object is removed or lowered to preclude penetration of applicable threshold siting surfaces;

(2) The threshold is displaced to preclude object penetration of applicable threshold siting surfaces, with a resulting shorter landing distance; or

(3) Visibility minimums are raised.

(4) Prohibit night operations.

b. Relevant factors for evaluation include:

(1) Types of airplanes which will use the runway and their performance characteristics.

(2) Operational disadvantages associated with accepting higher landing minimums.

(3) Cost of removing, relocating, or lowering the object.

(4) Effect of the reduced available landing length when the runway is wet or icy.

(5) Cost of extending the runway if insufficient runway length would remain as a result of displacing the threshold. The environmental and public acceptance aspects of a runway extension need also be evaluated under this consideration.

(6) Cost and feasibility of relocating visual and electronic approach aids, such as threshold lights, visual approach slope indicator, runway end identification lights, localizer, glide slope (to provide a threshold crossing height of not more then 60 feet (18 m)), approach lighting system, and runway markings.

(7) Effect of the threshold change on noise abatement.

5. LOCATING, DISPLACING, OR RELOCATING THE THRESHOLD. The standard shape, dimensions, and slope of the surface used for locating a threshold is dependent upon the type of aircraft operations currently conducted or forecasted, the landing visibility minimums desired, and the types of instrumentation available or planned for that runway end.

Subparagraphs e, f, and g describe the minimum area required for instrument approach procedures aligned with the runway centerline. For nonprecision approach procedures not aligned with the runway centerline, the area is expanded on the side on which the procedure course lies. This expansion may splay up to 35° from runway. Both the length of these areas and the expansion for offset alignment are determined through instrument approach procedure development.

a. For Approach End of Runways Expected to Serve Small Airplanes with Approach Speeds Less Than 50 Knots (Visual Runways Only).

(1) No object should penetrate a surface that starts at the threshold and at the elevation of the runway centerline at the threshold and slopes upward from the threshold at a slope 15 (horizontal) to 1 (vertical).

(2) In the plan view, the centerline of this surface extends 3,000 feet (900 m) along the extended runway centerline. This surface extends laterally 60 feet (18 m) on each side of the centerline at the threshold and increases in width to 150 feet (45 m) at a point 500 feet (150 m) from the threshold; thereafter, it extends laterally 150 feet (45 m) on each side of the centerline. (See figures A2-1 and A2-2.)

b. For Approach End of Runways Expected to Serve Small Airplanes with Approach Speeds of 50 Knots or More (Visual Runways Only).

(1) No object should penetrate a surface that starts at the threshold and at the elevation of the runway centerline at the threshold and slopes upward from the threshold at a slope 20 (horizontal) to 1 (vertical).

(2) In the plan view, the centerline of this surface extends 5,000 feet (1 530 m) along the extended runway centerline. This surface extends laterally 125 feet (38 m) on each side of the centerline at the threshold and increases in width to 350 feet (110 m) at a point 2,250 feet (690 m) from the threshold; thereafter, it extends laterally 350 feet (110 m) on each side of the centerline. (See figures A2-1 and A2-2.)

c. For Approach End of Runways Expected to Serve Large Airplanes (Day and Night), or Instrument Minimums ≥ 1 Statute Mile (Day Only).

(1) No object should penetrate a surface that starts at the threshold and at the elevation of the runway centerline at the threshold and slope upward from the threshold at a slope 20 (horizontal) to 1 (vertical).

(2) In the plan view, the centerline of this surface extends 10,000 feet (3 000 m) along the extended runway centerline. This surface extends laterally 200 feet (60 m) on each side of the centerline at the threshold and increases in width to 500 feet (150 m) at a point 1,500 feet (450 m) from the threshold; thereafter, it extends laterally 500 feet (150 m) on each side of the centerline. (See figures A2-1 and A2-2.)

d. For Approach End of Runways Expected to Support Instrument Night Circling.

(1) No object should penetrate a surface that starts 200 feet (60 m) out from the threshold and at the elevation of the runway centerline at the threshold and slopes upward from the starting point at a slope of 20 (horizontal) to 1 (vertical).

(2) In the plan view, the centerline of this surface extends 10,000 feet (3 000 m) along the extended runway centerline. This surface extends laterally 200 feet (60 m) on each side of the centerline at the starting point and increases in width to 1,700 feet (520 m) at the far end of this surface. (See figures A2-1 and A2-2.)

(3) To obtain night minimum, penetrations to this surface can be lighted to avoid displacing the threshold.

e. For Approach End of Runways Expected to Support Instrument Straight-In Night Operations.

(1) No object should penetrate a surface that starts 200 feet (60 m) out from the threshold and at the elevation of the runway centerline at the threshold and slopes upward from the starting point at a slope of 20 (horizontal) to 1 (vertical).

(2) In the plan view, the centerline of this surface extends 10,000 feet (3 000 m) along the extended runway centerline. This surface extends laterally 400 feet (120 m) on each side of the centerline at the starting point and increases in width to 1900 feet (570m) at the far end of this surface. (See figures A2-1 and A2-2.)

(3) If the instrument approach procedure utilizes an offset localizer with an offset angle of

3 degrees or less, the above surface is centered upon the final approach course rather than the extended runway centerline. (See figure A2-3.)

(4) To obtain night minimum, penetrations to this surface can be lighted to avoid displacing the threshold.

f. For Approach End of Runways Expected to Accommodate Instrument Approaches Having Visibility Minimums ≥ ¾ Mile but Less Than 1 Mile (Day or Night).

(1) No object should penetrate a surface that starts 200 feet (60 m) out from the threshold and at the elevation of the runway centerline at the threshold and slopes upward from the starting point at a slope of 20 (horizontal) to 1 (vertical).

(2) In the plan view, the centerline of this surface extends 10,000 feet (3 000 m) along the extended runway centerline. This surface extends laterally 400 feet (120 m) on each side of the centerline at the starting point and increases in width to 1900 feet (570m) at the far end of this surface. (See figures A2-1 and A2-2.)

(3) If the instrument approach procedure utilizes an offset localizer with an offset angle of 3 degrees or less, the above surface is centered upon the final approach course rather than the extended runway centerline. (See figure A2-3.)

g. For Approach End of Runways Expected to Accommodate Instrument Approaches Having Visibility Minimums Less Than ¾ Mile, or a Precision Approach (Day or Night).

(1) No object should penetrate a surface that starts 200 feet (60 m) out from the threshold and at the elevation of the runway centerline at the threshold and slopes upward from the starting point at a slope of 34 (horizontal) to 1 (vertical).

(2) In the plan view, the centerline of this surface extends 10,000 feet (3 000 m) along the extended runway centerline. This surface extends laterally 400 feet (120 m) on each side of the centerline at the starting point and increases in width to 1900 feet (570m) at the far end of this surface. (See figures A2-1 and A2-2.)

(3) If the instrument approach procedure utilizes an offset localizer with an offset angle of 3 degrees or less, the above surface is centered upon the final approach course rather than the extended runway centerline. (See figure A2-3.)

h. For Approach End of Runways Expected to Accommodate Category II Approach Minimums. Criteria are set forth in TERPS Order 8260.3B.

CAT.	Runway Type	DIMENSIONAL STANDARDS* Feet (Meters)					Slope
		A	B	C	D	E	
a.	Approach end of runways expected to serve small airplanes with approach speeds less than50 knots. (Visual runways only)	0	60 (18)	150 (45)	500 (150)	2,500 (750)	15:1
b.	Approach end of runways expected to serve small airplanes with approach speeds of 50 knots or more. (Visual runways only)	0	125 (38)	350 (110	2,250 (690)	2,750 (840)	20:1
c.	Approach end of runways expected to serve large airplanes, or instrument minimums ≥ 1 statute mile, day only.	0	200 (60)	500 (150)	1,500 (450)	8,500 (2,550)	20:1
d.[1]	Approach end of runways expected to support instrument night circling.	200 (60)	200 (60)	1700 (520)	10,000 (3,000)	0	20:1
e.[1]	Approach end of runways expected to support instrument straight in night operations	200 (60)	400 (120)	1900 (550)	10,000 [2] (3,000)	0	20:1
f.	Approach end of having visibility minimums ≥3/4 but < 1 statute mile, day or night.	200 (60)	400 (120)	1900 (570)	10,000 [2] (3,000)	0	20:1
g.	Approach end of runways having visibility minimums <3/4 statute mile or a precision approach, day or night.	200 (60)	400 (120)	1900 (570)	10,000 [2] (3,000)	0	34:1
h.	Approach runway ends having Category II approach minimums or greater.	The criteria are set forth in TERPS order 8260.3B					

- The letters are keyed to those shown on figures A2-2 and A2-3.

Notes:
1. Lighting of obstacle penetrations to this surface may avoid displacing the threshold.
2. 10,000 feet is a nominal value for planning purposes. The actual length of these areas is dependent upon the visual descent point position of the instrument approach procedure.

Figure A2-1. Dimensional standards for locating thresholds

site. If a drainage pipe is required within 300 feet (90 m) of the center of the site, use a nonmetallic or aluminum culvert.

b. Each of the radials is oriented within one minute of the magnetic bearing indicated by its markings.

c. Mark the date of observation and any annual change in direction of magnetic north durably and legibly on the surface of the calibration pad near the magnetic north mark. It would be well to establish a permanent monument at some remote location on the true north radial for future reference.

d. The U.S. Geological Survey of the Department of Interior is available to conduct the necessary surveys to determine the difference between true and magnetic north and the uniformity of this difference. The cost for this service is that necessary to cover the expense to the U.S. Geological Survey. Requests for this service should be made to the following:

National Geometric Information Center
U.S. Geomagnetic Survey
Box 25046 MS 968
Denver, Colorado 80225-0046 USA
Tel: 1(303)273-8486 Fax: 1(303)273-8450
Public Web Site: http://geomag.usgs.gov

There are also many other competent registered surveyors or engineers who are capable of performing these surveys. It is recommended that a qualified engineer be employed to lay out the work in the field and to design the pavement for the critical aircraft that can reasonably be expected to use the pad.

e. After all construction work on the compass pad is completed, it is advisable to have the pad magnetically resurveyed to guard against the possibility of objectionable magnetic materials being introduced during the construction.

f. Magnetic surveys of existing compass calibration pads should be performed at regular intervals of 5 years or less. Additional surveys should be performed after major construction of utility lines, buildings, or any other structures within 600 feet (180 m) of the center of the pad.

7. VOR CHECKPOINT. At some airports, it may be advantageous to collocate a VOR checkpoint with the compass calibration pad. In such instances, the requirements presented in paragraph 201.3212 of FAA Handbook OA P 8200.1, United States Standard Flight Inspection Manual, should be followed.

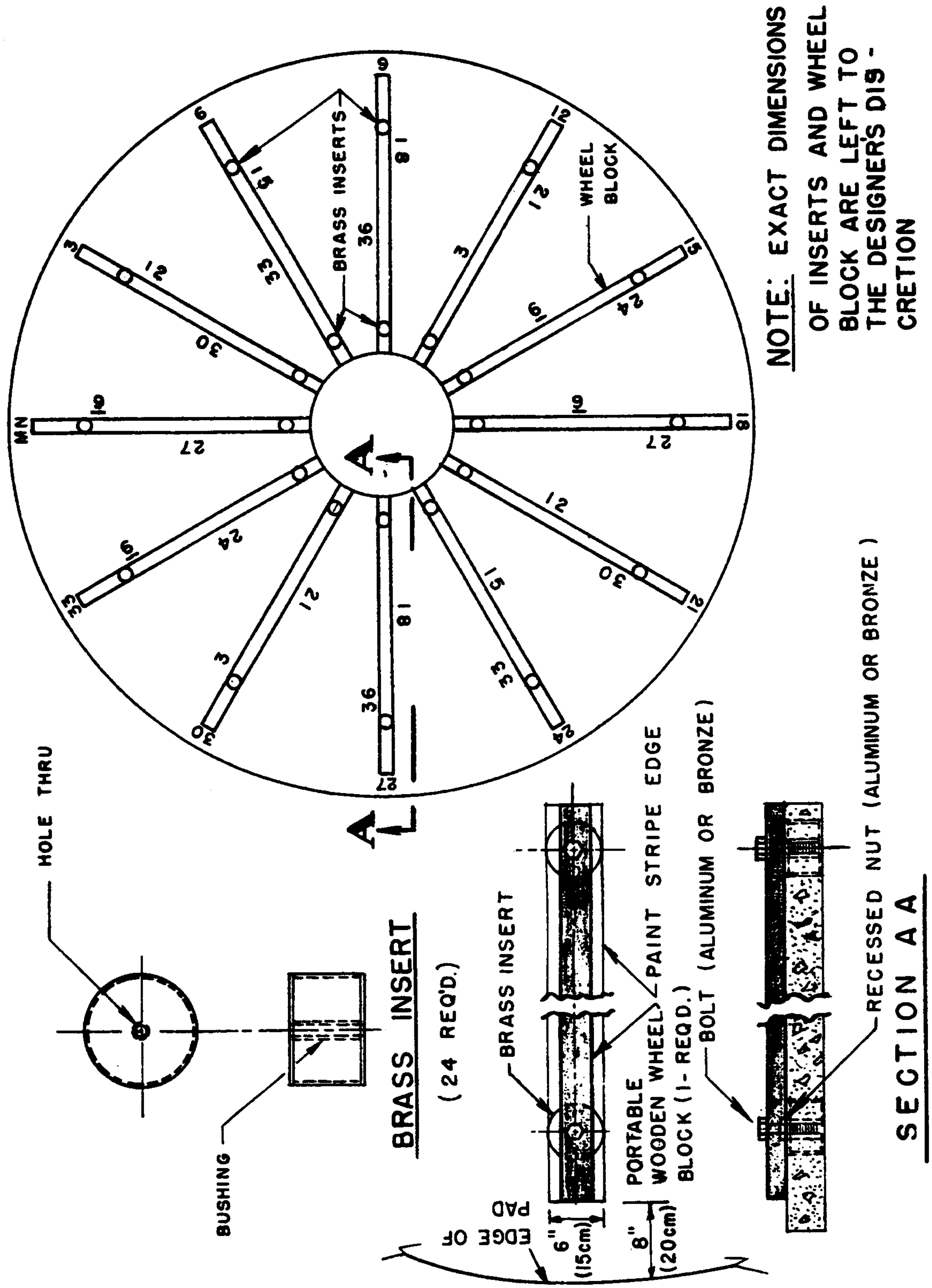

Figure A4-1. Marking layout and details of wheel block

Appendix 11. COMPUTER PROGRAM

*****Warning*** Airport Design for Microcomputers Version 4.2D does not calculate POFA. It also cannot be used in connection with IPV approaches.**

1. AIRPORT DESIGN (FOR MICROCOMPUTERS) VERSION 4.2. Airport Design (for microcomputers) version 4.2 provides:

a. Width and clearance standard dimensions for runway, taxiway, taxilane, and associated facilities;

b. Recommended runway lengths;

c. Runway wind coverage analysis;

d. Files for editing, printing, and plotting windroses with AutoCAD and Design CAD2D (formally Prodesign II);

e. Files loadable into WordPerfect, Microsoft Word, and other CAD/CAM systems;

f. Taxiway exit, intersection, and curve configurations; and

g. Airplane wingtip clearance analyses.

h. Airport capacity and delay for long range planning.

i. Declared distance lengths.

2. HOW TO OBTAIN A COPY OF AIRPORT DESIGN (FOR MICROCOMPUTERS) VERSION 4.2. Airport Design version 4.2 is available for downloading from the Office of Airports public web site at:

http://www.faa.gov/arp/software.htm

3. REQUIREMENTS. Airport Design version 4.2 runs on the IBM PC family of computers and all true IBM compatible. It requires DOS of 3.1 or higher and at least 640K of RAM.

4. SETUP ON A MICROCOMPUTER. This program is composed of seven files, namely AD.EXE, HELP.TXT, HELPE.PLT, HELPM.PLT, WINDDXF.AD, WINDPD1.AD, and WINDPLT.AD. These files must be located into a subdirectory. If you have Microsoft Windows, run this program as a Non-Windows Application to make use of the Windows graphic printing applications. Make the subdirectory where the program files are located the start-up directory. The working directories should be other than the start-up directory. Adjust the graphic colors with Shift F4, the size with Page Up and Page Down, and the location with the cursor keys of the graphic displayed on the screen as required by the windows application.

5. RUN AIRPORT DESIGN PROGRAM. The first window displayed on the screen upon executing AD.EXE is the airport design task selection window. Press the task number listed in the left margin or scroll to the task line and press Enter/Return to select a task from this list.

6. HOT KEYS. The HOT KEYS are as follows:

Enter/Return advances the program one step.

Esc retreats the program one or more steps.

Alt X exits the program.

Ctrl C (Controlled Crash) aborts the program.

Hot keys, when listed at the bottom of screen, are:

F1-Help - Press F1 and scroll for more program help instructions. When the help instructions are on the screen, press H or the task number to fast scroll to the top of the HOT KEYS or the top of the task help instructions. Press Enter/Return or Esc to end the help section.

F2-Save - Press F2 and enter output file name to create a DOS text *.TXT file. Scroll to preview the entire file. Press Enter/Return or Esc to end the preview section. These files are retrievable into WordPerfect, Microsoft Notepad, and back into the task which created the file.

F3-Retrieve or F3-Retrieve/Clear - Press F3 or F5 to retrieve a file. When files and directories are listed on the screen and hot key F3 is listed on the bottom of the screen type or scroll to the file name and press F3 to retrieve the highlighted file or press Esc to return to where the program was when F3 or F5 was pressed. When a file is displayed on the screen and hot key F3 is listed on the bottom of the screen press F3 to retrieve the file. When files and directories are listed on the screen, all of the F5-Files functions may also be executed.

F3-Retrieve/Clear - Press Shift F3 to clear the wind observation data.

F4- Dir/Color - Press F4 and enter the drive letter to change the working drive. Press Shift F4 to change the graphic screen colors (Background and Pen colors). Press Enter/Return or Esc to end the color change section.

F5-Files - Press F5 to list files and directories and to add hot keys F3, F4, F6, and F7 to the bottom of the screen. When files and directories are listed on the screen, type or scroll to the file or directory name and press Enter/Return to preview the highlighted file or change the highlighted directory or press Esc to return to where the program was when F5 was pressed. Line only HP plotter (HPGL) files are previewed in graphic format. To preview a HPGL file in the DOS text format, press Enter/Return while "Please wait" is displayed on the screen. Press Enter/Return or Esc to end the preview section.

F6-Delete **-** Type or scroll to the file name and press F6 to delete the highlighted file. Press F6 to delete a file being previewed on the screen.

F7-Print **-** When files and directories are listed on the screen and hot key F7 is listed on the bottom of the screen, type or scroll to the file name and press F7 to print the highlighted file. Press F7 to print the file being previewed on the screen.

F8-Quit **-** Press F8 to exit the program.

F9-PLT/PD1/DXF – Press F9 to create a windrose in the HP 7440A ColorPro plotter (HPGL) file format. Press Shift F9 to create a windrose in the Design CAD2D (formerly Prodesign II) file format. Press Alt F9 to create a windrose in the AutoCAD Drawing Interchange file format (DXF). Press Enter/Return or Esc to end the preview section. The HPGL files are loadable into WordPerfect, Microsoft Word, and other CAD/CAM systems. The PD1 files are loadable into Design CAD2D (formerly Prodesign II). Call (918) 825-4844 for information on Design CAD2D.

F10-Find **-** Press F10 to find a string of characters in a file.

F10-Next – Press F10 to move to the next taxiway section. Press Esc to move back to the previous taxiway section.

7. RUNWAY AND TAXIWAY WIDTH AND CLEARANCE STANDARD DIMENSIONS. Task 1 **calculates** site specific runway, taxiway, taxilane, and other airport item's standard width and clearance dimensions. To obtain these dimensions:

a. Select task 1 (Item N1), from the airport design task selection window. Update the data items listed on the airport design airplane and airport data window (see figure A11-3). A change in one item may change one or more items down the list. Select items for updating starting from the top and work down the list. Press the item letter listed in the left margin, or scroll to the item line and type in the data, or press Enter/Return to select an item. Press the data number or letter listed in the left margin or scroll to the data line and press Enter/Return to select an item on the subtables. The following explains some of the data items:

(1) Item B. Changing the airplane design group will change the airplane wingspan to the maximum wingspan for that group. This is the wingspan used for the standard design group method of airport design. A small airplane is an airplane of 12,500 lbs. (5 700 kilograms) or less maximum takeoff weight. A large airplane is an airplane of over 12,500 lbs. (5 700 kilograms) maximum takeoff weight.

(2) Item C. Changing the airplane wingspan will adjust the airplane design group automatically. For airplanes with folding wingtips, input the taxiing wingspan(s) for taxiway and taxilane width and clearance standard dimension (Item N3). Input the takeoff and landing wingspan for all other width and clearance standard dimensions (Item N2).

(3) Item D. The primary runway end is the runway end the user selected as the primary end.

(4) Item I. The undercarriage width is the distance between the airplane's outer main wheels, including the width of the wheels. When this distance is not available, use 1.15 times the airplane's main gear track.

When the data items are updated, press F2, enter the output file name, and press Enter/Return or Esc to end the preview section. Line items with two numbers represent the calculated design values for the rationale method (column one) and the airport reference code method (column two) (see figures A11-4 and A11-5).

8. RECOMMENDED RUNWAY LENGTHS. Task 2 from the airport design task selection window calculates the recommended runway length for airport design. Press F2 to save the recommended runway lengths and then print them by pressing F7. Refer to AC 150/5325-4, Runway Length Requirements for Airport Design, for details on runway length. The publication "Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree-Days" (Climatography of the United States No.81) is the official source for the mean maximum temperature for the hottest month. This temperature is presented by station under the heading "Normal Max." The higher of these values should be selected to represent the hottest month. The latest data, averaged over a period of thirty years, may be obtained from the National Climatic Data Center, Federal Building, Asheville, North Carolina 28801. Specify the state(s) when ordering. Price is $2.00 per state plus a $5.00 service and handling charge.

9. STANDARD WIND ANALYSIS. This task calculates the wind coverage for up to a six runway configuration. Figure A11-6 displays a two bi-directional runway configuration analysis printout and figure A11-8

Appendix 13. AIRPLANES ARRANGED BY AIRPLANE MANUFACTURER, AND AIRPORT REFERENCE CODE

Section 1. Alphabetical Listing (U.S. customary units)

Aircraft	Airport Reference Code	Appch Speed Knots		Wingspan Feet	Length Feet	Tail Height Feet	Maximum Takeoff Lbs
Aeritalia G-222	B-III	109		93.8	74.4	32.0	61,700
Aerocom Skyliner	A-II	88		54.0	54.3	16.5	12,500
Aerospatiale C 160 Trans.	C-IV	124		131.3	106.3	38.7	108,596
Aerospatiale NORD-262	B-II	96		71.9	63.3	20.4	23,480
Aerospatiale SE 210 Carav.	C-III	127		112.5	105.0	28.6	114,640
Aerospatiale SN 601 Corv.	B-I	118		42.2	45.4	13.9	14,550
Ahrens AR 404	B-II	98		66.0	52.7	19.0	18,500
AIDC/CAF XC-2	A-III	86		81.7	65.9	25.3	27,500
Airbus A-300-600	C-IV	135		147.1	177.5	54.7	363,763
Airbus A-300-B4	C-IV	132		147.1	175.5	55.5	330,700
Airbus A-310-300	C-IV	125		144.1	153.2	52.3	330,693
Airbus A-320-100	C-III	138		111.3	123.3	39.1	145,505
Air-Metal AM-C 111	B-II	96		63.0	55.2	21.0	18,629
AJI Hustler 400	B-I	98		28.0	34.8	9.8	6,000
Antonov AN-10	C-IV	126		124.8	121.4	32.2	121,500
Antonov AN-12	C-IV	127		124.8	109.0	34.6	121,500
Antonov AN-124	C-VI	124		232.0	223.0	66.2	800,000
Antonov AN-14	A-II	52		72.1	37.2	15.2	7,607
Antonov AN-22	C-V	140	*	211.0	167.0	41.2	500,000
Antonov AN-24	B-III	119		95.8	77.2	27.3	46,305
Antonov AN-26	C-III	121		95.8	78.1	28.1	52,920
Antonov AN-28	A-II	88		72.1	42.6	16.1	12,350
Antonov AN-30	B-III	112		96.4	80.1	27.3	51,040
Antonov AN-72	A-III	89	*	84.7	84.7	27.0	66,000
AW.650 Argosy 220	C-III	123		115.0	86.8	27.0	93,000
AW.660 Argosy C.Mk.1	B-III	113		115.0	89.1	27.0	97,000
BAC 111-200	C-III	129		88.5	93.5	24.5	79,000
BAC 111-300	C-III	128		88.5	93.5	24.5	88,500
BAC 111-400	C-III	137		88.5	93.5	24.5	87,000
BAC 111-475	C-III	135		93.5	93.5	24.5	98,500
BAC 111-500	D-III	144		93.5	107.0	24.5	104,500
BAC/Aerospatiale Concord	D-III	162		83.8	205.4	37.4	408,000
BAe 146-100	B-III	113		86.4	85.8	28.3	74,600
BAe 146-200	B-III	117		86.4	93.7	28.3	88,250
BAe 146-300	C-III	121		86.4	104.2	28.1	104,000
BAe Jetstream 31	B-II	99		52.0	47.2	17.5	14,550
Beech Airliner 1900-C	B-II	120	*	54.5	57.8	14.9	16,600
Beech Airliner C99	B-I	107		45.9	44.6	14.4	11,300
Beech Baron 58	B-I	96		37.8	29.8	9.8	5,500
Beech Baron 58P	B-I	101		37.8	29.8	9.1	6,200
Beech Baron 58TC	B-I	101		37.8	29.8	9.1	6,200
Beech Baron B55	A-I	90		37.8	28.0	9.1	5,100
Beech Baron E55	A-I	88		37.8	29.0	9.1	5,300
Beech Bonanza A36	A-I	72		33.5	27.5	8.6	3,650

Aircraft	Airport Reference Code	Appch Speed Knots		Wingspan Feet	Length Feet	Tail Height Feet	Maximum Takeoff Lbs
Beech Bonanza B36TC	A-I	75		37.8	27.5	8.6	3,850
Beech Bonanza F33A	A-I	70		33.5	26.7	8.2	3,400
Beech Bonanza V35B	A-I	70		33.5	26.4	6.6	3,400
Beech Duchess 76	A-I	76		38.0	29.0	9.5	3,900
Beech Duke B60	B-I	98		39.2	33.8	12.3	6,775
Beech E18S	A-II	87		49.7	35.2	9.5	9,300
Beech King Air B100	B-I	111		45.8	39.9	15.3	11,800
Beech King Air C90-1	B-II	100		50.2	35.5	14.2	9,650
Beech King Air F90	B-I	108		45.9	39.8	15.1	10,950
Beech Sierra 200-B24R	A-I	70		32.8	25.7	8.2	2,750
Beech Skipper 77	A-I	63		30.0	24.0	6.9	1,675
Beech Sundowner 180-C23	A-I	68		32.8	25.7	8.2	2,450
Beech Super King Air B200	B-II	103		54.5	43.8	15.0	12,500
BN-2A Mk.3 Trislander	A-II	65		53.0	45.7	14.2	10,000
Boeing 707-100	C-IV	139		130.8	145.1	41.7	257,340
Boeing 707-200	D-IV	145		130.8	145.1	41.7	257,340
Boeing 707-320	C-IV	139		142.4	152.9	42.2	312,000
Boeing 707-320B	C-IV	136		145.8	152.9	42.1	336,600
Boeing 707-420	C-IV	132		142.4	152.9	42.2	312,000
Boeing 720	C-IV	133		130.8	136.2	41.4	229,300
Boeing 720B	C-IV	137		130.8	136.8	41.2	234,300
Boeing 727-100	C-III	125		108.0	133.2	34.3	169,000
Boeing 727-200	C-III	138		108.0	153.2	34.9	209,500
Boeing 737-100	C-III	137		93.0	94.0	37.2	110,000
Boeing 737-200	C-III	137		93.0	100.2	37.3	115,500
Boeing 737-300	C-III	137		94.8	109.6	36.6	135,000
Boeing 737-400	C-III	139		94.8	119.6	36.6	150,000
Boeing 737-500	C-III	140	*	94.8	101.8	36.6	133,500
Boeing 747-100	D-V	152		195.7	231.8	64.3	600,000
Boeing 747-200	D-V	152		195.7	231.8	64.7	833,000
Boeing 747-300SR	D-V	141		195.7	231.8	64.3	600,000
Boeing 747-400	D-V	154		213.0	231.8	64.3	870,000
Boeing 747-SP	C-V	140		195.7	184.8	65.8	696,000
Boeing 757	C-IV	135		124.8	155.3	45.1	255,000
Boeing 767-200	C-IV	130		156.1	159.2	52.9	315,000
Boeing 767-300	C-IV	130		156.1	180.3	52.6	350,000
Boeing 777-200	D-V	145		199.9	209.1	61.5	632,500
Boeing 777-300	D-V	145		199.9	242.3	61.5	660,000
Boeing B-52	D-V	141	*	185.0	157.6	40.8	488,000
Boeing C97 Stratocruiser	B-IV	105		141.3	110.3	38.3	145,800
Boeing E-3	C-IV	137		145.9	153.0	42.0	325,000
Boeing E-4 (747-200)	D-V	152		195.7	231.8	64.7	833,000
Boeing YC-14	A-IV	89		129.0	131.7	48.3	216,000
Bristol Brittania 300/310	B-IV	117		142.3	124.2	37.5	185,000
Canadair CL-44	C-IV	123		142.3	136.8	38.4	210,000
Canadair CL-600	C-II	125		61.8	68.4	20.7	41,250
Casa C-207A Azor	B-III	102		91.2	68.4	25.4	36,400
Casa C-212-200 Aviocar	A-II	81		62.3	49.8	20.7	16,976
Cessna Citation I	B-I	108		47.1	43.5	14.3	11,850
Cessna Citation II	B-II	108		51.7	47.2	15.0	13,300
Cessna Citation III	B-II	114		53.5	55.5	16.8	22,000
Cessna-150	A-I	55		32.7	23.8	8.0	1,600

Section 2. Alphabetical Listing (SI Units)

Aircraft	Airport Reference Code	Appch Speed Knots	Wingspan Meters	Length Meters	Tail Height Meters	Maximum Takeoff Kg
Aeritalia G-222	B-III	109	28.6	22.7	9.8	27,987
Aerocom Skyliner	A-II	88	16.5	16.6	5.0	5,670
Aerospatiale C 160 Trans.	C-IV	124	40.0	32.4	11.8	49,258
Aerospatiale NORD-262	B-II	96	21.9	19.3	6.2	10,650
Aerospatiale SE 210 Carav.	C-III	127	34.3	32.0	8.7	52,000
Aerospatiale SN 601 Corv.	B-I	118	12.9	13.8	4.2	6,600
Ahrens AR 404	B-II	98	20.1	16.1	5.8	8,391
AIDC/CAF XC-2	A-III	86	24.9	20.1	7.7	12,474
Airbus A-300-600	C-IV	135	44.8	54.1	16.7	165,000
Airbus A-300-B4	C-IV	132	44.8	53.5	16.9	150,003
Airbus A-310-300	C-IV	125	43.9	46.7	15.9	150,000
Airbus A-320-100	C-III	138	33.9	37.6	11.9	66,000
Air-Metal AM-C 111	B-II	96	19.2	16.8	6.4	8,450
AJI Hustler 400	B-I	98	8.5	10.6	3.0	2,722
Antonov AN-10	C-IV	126	38.0	37.0	9.8	55,111
Antonov AN-12	C-IV	127	38.0	33.2	10.5	55,111
Antonov AN-124	C-VI	124	70.7	68.0	20.2	362,874
Antonov AN-14	A-II	52	22.0	11.3	4.6	3,450
Antonov AN-22	C-V	140 *	64.3	50.9	12.6	226,796
Antonov AN-24	B-III	119	29.2	23.5	8.3	21,004
Antonov AN-26	C-III	121	29.2	23.8	8.6	24,004
Antonov AN-28	A-II	88	22.0	13.0	4.9	5,602
Antonov AN-30	B-III	112	29.4	24.4	8.3	23,151
Antonov AN-72	A-III	89 *	25.8	25.8	8.2	29,937
AW.650 Argosy 220	C-III	123	35.1	26.5	8.2	42,184
AW.660 Argosy C.Mk.1	B-III	113	35.1	27.2	8.2	43,998
BAC 111-200	C-III	129	27.0	28.5	7.5	35,834
BAC 111-300	C-III	128	27.0	28.5	7.5	40,143
BAC 111-400	C-III	137	27.0	28.5	7.5	39,463
BAC 111-475	C-III	135	28.5	28.5	7.5	44,679
BAC 111-500	D-III	144	28.5	32.6	7.5	47,400
BAC/Aerospatiale Concord	D-III	162	25.5	62.6	11.4	185,066
BAe 146-100	B-III	113	26.3	26.2	8.6	33,838
BAe 146-200	B-III	117	26.3	28.6	8.6	40,030
BAe 146-300	C-III	121	26.3	31.8	8.6	47,174
BAe Jetstream 31	B-II	99	15.8	14.4	5.3	6,600
Beech Airliner 1900-C	B-II	120 *	16.6	17.6	4.5	7,530
Beech Airliner C99	B-I	107	14.0	13.6	4.4	5,126
Beech Baron 58	B-I	96	11.5	9.1	3.0	2,495
Beech Baron 58P	B-I	101	11.5	9.1	2.8	2,812
Beech Baron 58TC	B-I	101	11.5	9.1	2.8	2,812
Beech Baron B55	A-I	90	11.5	8.5	2.8	2,313
Beech Baron E55	A-I	88	11.5	8.8	2.8	2,404
Beech Bonanza A36	A-I	72	10.2	8.4	2.6	1,656
Beech Bonanza B36TC	A-I	75	11.5	8.4	2.6	1,746
Beech Bonanza F33A	A-I	70	10.2	8.1	2.5	1,542
Beech Bonanza V35B	A-I	70	10.2	8.0	2.0	1,542
Beech Duchess 76	A-I	76	11.6	8.8	2.9	1,769
Beech Duke B60	B-I	98	11.9	10.3	3.7	3,073

Aircraft	Airport Reference Code	Appch Speed Knots		Wingspan Meters	Length Meters	Tail Height Meters	Maximum Takeoff Kg
Beech E18S	A-II	87		15.1	10.7	2.9	4,218
Beech King Air B100	B-I	111		14.0	12.2	4.7	5,352
Beech King Air C90-1	B-II	100		15.3	10.8	4.3	4,377
Beech King Air F90	B-I	108		14.0	12.1	4.6	4,967
Beech Sierra 200-B24R	A-I	70		10.0	7.8	2.5	1,247
Beech Skipper 77	A-I	63		9.1	7.3	2.1	760
Beech Sundowner 180-C23	A-I	68		10.0	7.8	2.5	1,111
Beech Super King Air B200	B-II	103		16.6	13.4	4.6	5,670
BN-2A Mk.3 Trislander	A-II	65		16.2	13.9	4.3	4,536
Boeing 707-100	C-IV	139		39.9	44.2	12.7	116,727
Boeing 707-200	D-IV	145		39.9	44.2	12.7	116,727
Boeing 707-320	C-IV	139		43.4	46.6	12.9	141,521
Boeing 707-320B	C-IV	136		44.4	46.6	12.8	152,679
Boeing 707-420	C-IV	132		43.4	46.6	12.9	141,521
Boeing 720	C-IV	133		39.9	41.5	12.6	104,009
Boeing 720B	C-IV	137		39.9	41.7	12.6	106,277
Boeing 727-100	C-III	125		32.9	40.6	10.5	76,657
Boeing 727-200	C-III	138		32.9	46.7	10.6	95,028
Boeing 737-100	C-III	137		28.3	28.7	11.3	49,895
Boeing 737-200	C-III	137		28.3	30.5	11.4	52,390
Boeing 737-300	C-III	137		28.9	33.4	11.2	61,235
Boeing 737-400	C-III	139		28.9	36.5	11.2	68,039
Boeing 737-500	C-III	140	*	28.9	31.0	11.2	60,555
Boeing 747-100	D-V	152		59.6	70.7	19.6	272,155
Boeing 747-200	D-V	152		59.6	70.7	19.7	377,842
Boeing 747-300SR	D-V	141		59.6	70.7	19.6	272,155
Boeing 747-400	D-V	154		64.9	70.7	19.6	394,625
Boeing 747-SP	C-V	140		59.6	56.3	20.1	315,700
Boeing 757	C-IV	135		38.0	47.3	13.7	115,666
Boeing 767-200	C-IV	130		47.6	48.5	16.1	142,882
Boeing 767-300	C-IV	130		47.6	55.0	16.0	158,757
Boeing 777-200	D-V	145		60.9	63.7	18.8	286,900
Boeing 777-300	D-V	145		60.9	73.9	18.8	299,370
Boeing B-52	D-V	141	*	56.4	48.0	12.4	221,353
Boeing C97 Stratocruiser	B-IV	105		43.1	33.6	11.7	66,134
Boeing E-3	C-IV	137		44.5	46.6	12.8	147,418
Boeing E-4 (747-200)	D-V	152		59.6	70.7	19.7	377,842
Boeing YC-14	A-IV	89		39.3	40.1	14.7	97,976
Bristol Brittania 300/310	B-IV	117		43.4	37.9	11.4	83,915
Canadair CL-44	C-IV	123		43.4	41.7	11.7	95,254
Canadair CL-600	C-II	125		18.8	20.8	6.3	18,711
Casa C-207A Azor	B-III	102		27.8	20.8	7.7	16,511
Casa C-212-200 Aviocar	A-II	81		19.0	15.2	6.3	7,700
Cessna Citation I	B-I	108		14.4	13.3	4.4	5,375
Cessna Citation II	B-II	108		15.8	14.4	4.6	6,033
Cessna Citation III	B-II	114		16.3	16.9	5.1	9,979
Cessna-150	A-I	55		10.0	7.3	2.4	726
Cessna-177 Cardinal	A-I	64		10.8	8.3	2.6	1,134
Cessna-402 Businessliner	B-I	95		12.1	11.0	3.5	2,858
Cessna-404 Titan	B-I	92		14.1	12.0	4.0	3,810
Cessna-414 Chancellor	B-I	94		13.4	11.1	3.5	3,078
Cessna-421 Golden Eagle	B-I	96		12.7	11.0	3.5	3,379

Aircraft	Airport Reference Code	Appch Speed Knots		Wingspan Feet	Length Feet	Tail Height Feet	Maximum Takeoff Lbs
HS.121 Trident Super 3B	D-III	146		98.0	131.2	28.3	158,000
Tupolev TU-134	D-III	144		95.2	121.5	30.0	103,600
Tupolev TU-144	E-III	178		94.8	212.6	42.2	396,000
Boeing YC-14	A-IV	89		129.0	131.7	48.3	216,000
Lockheed 1649 Constellat’n	A-IV	89		150.0	116.2	23.4	160,000
Boeing C97 Stratocruiser	B-IV	105		141.3	110.3	38.3	145,800
Bristol Brittania 300/310	B-IV	117		142.3	124.2	37.5	185,000
Ilyushin Il-18	B-IV	103		122.7	117.8	33.3	134,640
Ilyushin Il-76	B-IV	119		165.7	152.8	48.4	374,785
Lockheed 1049 Constellat’n	B-IV	113		123.0	113.6	24.8	137,500
Lockheed 749 Constellat’n	B-IV	93		123.0	95.2	22.4	107,000
MDC-DC-7	B-IV	110		127.5	112.3	31.7	143,000
Vickers Vanguard 950	B-IV	119		118.0	122.9	34.9	146,500
Aerospatiale C 160 Trans.	C-IV	124		131.3	106.3	38.7	108,596
Airbus A-300-600	C-IV	135		147.1	177.5	54.7	363,763
Airbus A-300-B4	C-IV	132		147.1	175.5	55.5	330,700
Airbus A-310-300	C-IV	125		144.1	153.2	52.3	330,693
Antonov AN-10	C-IV	126		124.8	121.4	32.2	121,500
Antonov AN-12	C-IV	127		124.8	109.0	34.6	121,500
Boeing 707-100	C-IV	139		130.8	145.1	41.7	257,340
Boeing 707-320	C-IV	139		142.4	152.9	42.2	312,000
Boeing 707-320B	C-IV	136		145.8	152.9	42.1	336,600
Boeing 707-420	C-IV	132		142.4	152.9	42.2	312,000
Boeing 720	C-IV	133		130.8	136.2	41.4	229,300
Boeing 720B	C-IV	137		130.8	136.8	41.2	234,300
Boeing 757	C-IV	135		124.8	155.3	45.1	255,000
Boeing 767-200	C-IV	130		156.1	159.2	52.9	315,000
Boeing 767-300	C-IV	130		156.1	180.3	52.6	350,000
Boeing E-3	C-IV	137		145.9	153.0	42.0	325,000
Canadair CL-44	C-IV	123		142.3	136.8	38.4	210,000
Dassault 1150 Atlantic	C-IV	130	*	122.7	104.2	37.2	100,000
Lockheed 100-20 Hercules	C-IV	137		132.6	106.1	39.3	155,000
Lockheed 100-30 Hercules	C-IV	129		132.6	112.7	39.2	155,000
Lockheed 1011-1	C-IV	138		155.3	177.7	55.8	430,000
Lockheed 1011-100	C-IV	140		155.3	177.7	55.8	466,000
Lockheed 1011-200	C-IV	140		155.3	177.7	55.8	466,000
Lockheed 1011-600	C-IV	140	*	142.8	141.0	53.0	264,000
Lockheed 400	C-IV	121	*	119.7	97.8	38.1	84,000
Lockheed C-141A Starlifter	C-IV	129		159.9	145.0	39.3	316,600
Lockheed C-141B Starlifter	C-IV	129		159.9	168.3	39.3	343,000
Marshall (Shorts) Belfast	C-IV	126		158.8	136.4	47.0	230,000
MDC-DC-10-10	C-IV	136		155.3	182.3	58.4	443,000
MDC-DC-8-10	C-IV	131		142.4	150.8	43.3	276,000
MDC-DC-8-20/30/40	C-IV	133		142.4	150.8	43.3	315,000
MDC-DC-8-50	C-IV	137		142.4	150.8	43.3	325,000
MDC-DC-8-62	C-IV	124		148.4	157.5	43.4	350,000
Tupolev TU-114	C-IV	132	*	167.6	177.5	50.0	361,620
Vickers VC-10-1100	C-IV	128		146.2	158.7	39.5	312,000
Vickers VC-10-1150	C-IV	138		146.2	171.7	39.5	335,100
Boeing 707-200	D-IV	145		130.8	145.1	41.7	257,340

Aircraft	Airport Reference Code	Appch Speed Knots		Wingspan Feet	Length Feet	Tail Height Feet	Maximum Takeoff Lbs
General Dynamics 880	D-IV	155		120.0	129.3	36.0	193,500
General Dynamics 990	D-IV	156		120.0	139.2	39.5	255,000
Ilyushin Il-62	D-IV	152		141.8	174.3	40.5	363,760
Ilyushin Il-86	D-IV	141		157.7	195.3	51.8	454,150
Lockheed 1011-250	D-IV	144		155.3	177.7	55.8	496,000
Lockheed 1011-500	D-IV	144		155.3	164.2	55.8	496,000
Lockheed 1011-500 Ex. Wing	D-IV	148		164.3	164.2	55.8	496,000
MDC-DC-10-30	D-IV	151		165.3	181.6	58.6	590,000
MDC-DC-10-40	D-IV	145		165.4	182.3	58.6	555,000
MDC-DC-8-61	D-IV	142		142.4	187.4	43.0	325,000
MDC-DC-8-63	D-IV	147		148.4	187.4	43.0	355,000
MDC-MD-11	D-IV	155		169.8	201.3	57.8	602,500
Rockwell B-1	D-IV	165	*	137.0	147.0	34.0	477,000
Tupolev TU-154	D-IV	145		123.3	157.2	37.4	216,050
Antonov AN-22	C-V	140	*	211.0	167.0	41.2	500,000
Boeing 747-SP	C-V	140		195.7	184.8	65.8	696,000
MDC-C-133	C-V	128		179.7	157.5	48.2	300,000
Boeing 747-100	D-V	152		195.7	231.8	64.3	600,000
Boeing 747-200	D-V	152		195.7	231.8	64.7	833,000
Boeing 747-300SR	D-V	141		195.7	231.8	64.3	600,000
Boeing 747-400	D-V	154		213.0	231.8	64.3	870,000
Boeing 777-200	D-V	145		199.9	209.1	18.8	286,900
Boeing 777-300	D-V	145		199.9	242.3	18.8	299,370
Boeing B-52	D-V	141	*	185.0	157.6	40.8	488,000
Boeing E-4 (747-200)	D-V	152		195.7	231.8	64.7	833,000
Antonov AN-124	C-VI	124		232.0	223.0	66.2	800,000
Lockheed C-5B Galaxy	C-VI	135		222.7	247.8	65.1	837,000

* Approach speeds estimated.

Aircraft	Airport Reference Code	Appch Speed Knots		Wingspan Meters	Length Meters	Tail Height Meters	Maximum Takeoff Kg
HS.121 Trident Super 3B	D-III	146		29.9	40.0	8.6	71,668
Tupolev TU-134	D-III	144		29.0	37.0	9.1	46,992
Tupolev TU-144	E-III	178		28.9	64.8	12.9	179,623
Boeing YC-14	A-IV	89		39.3	40.1	14.7	97,976
Lockheed 1649 Constellat'n	A-IV	89		45.7	35.4	7.1	72,575
Boeing C97 Stratocruiser	B-IV	105		43.1	33.6	11.7	66,134
Bristol Brittania 300/310	B-IV	117		43.4	37.9	11.4	83,915
Ilyushin Il-18	B-IV	103		37.4	35.9	10.1	61,072
Ilyushin Il-76	B-IV	119		50.5	46.6	14.8	170,000
Lockheed 1049 Constellat'n	B-IV	113		37.5	34.6	7.6	62,369
Lockheed 749 Constellat'n	B-IV	93		37.5	29.0	6.8	48,534
MDC-DC-7	B-IV	110		38.9	34.2	9.7	64,864
Vickers Vanguard 950	B-IV	119		36.0	37.5	10.6	66,451
Aerospatiale C 160 Trans.	C-IV	124		40.0	32.4	11.8	49,258
Airbus A-300-600	C-IV	135		44.8	54.1	16.7	165,000
Airbus A-300-B4	C-IV	132		44.8	53.5	16.9	150,003
Airbus A-310-300	C-IV	125		43.9	46.7	15.9	150,000
Antonov AN-10	C-IV	126		38.0	37.0	9.8	55,111
Antonov AN-12	C-IV	127		38.0	33.2	10.5	55,111
Boeing 707-100	C-IV	139		39.9	44.2	12.7	116,727
Boeing 707-320	C-IV	139		43.4	46.6	12.9	141,521
Boeing 707-320B	C-IV	136		44.4	46.6	12.8	152,679
Boeing 707-420	C-IV	132		43.4	46.6	12.9	141,521
Boeing 720	C-IV	133		39.9	41.5	12.6	104,009
Boeing 720B	C-IV	137		39.9	41.7	12.6	106,277
Boeing 757	C-IV	135		38.0	47.3	13.7	115,666
Boeing 767-200	C-IV	130		47.6	48.5	16.1	142,882
Boeing 767-300	C-IV	130		47.6	55.0	16.0	158,757
Boeing E-3	C-IV	137		44.5	46.6	12.8	147,418
Canadair CL-44	C-IV	123		43.4	41.7	11.7	95,254
Dassault 1150 Atlantic	C-IV	130	*	37.4	31.8	11.3	45,359
Lockheed 100-20 Hercules	C-IV	137		40.4	32.3	12.0	70,307
Lockheed 100-30 Hercules	C-IV	129		40.4	34.4	11.9	70,307
Lockheed 1011-1	C-IV	138		47.3	54.2	17.0	195,045
Lockheed 1011-100	C-IV	140		47.3	54.2	17.0	211,374
Lockheed 1011-200	C-IV	140		47.3	54.2	17.0	211,374
Lockheed 1011-600	C-IV	140	*	43.5	43.0	16.2	119,748
Lockheed 400	C-IV	121	*	36.5	29.8	11.6	38,102
Lockheed C-141A Starlifter	C-IV	129		48.7	44.2	12.0	143,607
Lockheed C-141B Starlifter	C-IV	129		48.7	51.3	12.0	155,582
Marshall (Shorts) Belfast	C-IV	126		48.4	41.6	14.3	104,326
MDC-DC-10-10	C-IV	136		47.3	55.6	17.8	200,941
MDC-DC-8-10	C-IV	131		43.4	46.0	13.2	125,191
MDC-DC-8-20/30/40	C-IV	133		43.4	46.0	13.2	142,882
MDC-DC-8-50	C-IV	137		43.4	46.0	13.2	147,418
MDC-DC-8-62	C-IV	124		45.2	48.0	13.2	158,757
Tupolev TU-114	C-IV	132	*	51.1	54.1	15.2	164,028
Vickers VC-10-1100	C-IV	128		44.6	48.4	12.0	141,521
Vickers VC-10-1150	C-IV	138		44.6	52.3	12.0	151,999
Boeing 707-200	D-IV	145		39.9	44.2	12.7	116,727
General Dynamics 880	D-IV	155		36.6	39.4	11.0	87,770
General Dynamics 990	D-IV	156		36.6	42.4	12.0	115,666

Aircraft	Airport Reference Code	Appch Speed Knots		Wingspan Meters	Length Meters	Tail Height Meters	Maximum Takeoff Kg
Ilyushin Il-62	D-IV	152		43.2	53.1	12.3	164,999
Ilyushin Il-86	D-IV	141		48.1	59.5	15.8	205,999
Lockheed 1011-250	D-IV	144		47.3	54.2	17.0	224,982
Lockheed 1011-500	D-IV	144		47.3	50.0	17.0	224,982
Lockheed 1011-500 Ex. Wing	D-IV	148		50.1	50.0	17.0	224,982
MDC-DC-10-30	D-IV	151		50.4	55.4	17.9	267,619
MDC-DC-10-40	D-IV	145		50.4	55.6	17.9	251,744
MDC-DC-8-61	D-IV	142		43.4	57.1	13.1	147,418
MDC-DC-8-63	D-IV	147		45.2	57.1	13.1	161,025
MDC-MD-11	D-IV	155		51.8	61.4	17.6	273,289
Rockwell B-1	D-IV	165	*	41.8	44.8	10.4	216,364
Tupolev TU-154	D-IV	145		37.6	47.9	11.4	97,999
Antonov AN-22	C-V	140	*	64.3	50.9	12.6	226,796
Boeing 747-SP	C-V	140		59.6	56.3	20.1	315,700
MDC-C-133	C-V	128		54.8	48.0	14.7	136,078
Boeing 747-100	D-V	152		59.6	70.7	19.6	272,155
Boeing 747-200	D-V	152		59.6	70.7	19.7	377,842
Boeing 747-300SR	D-V	141		59.6	70.7	19.6	272,155
Boeing 747-400	D-V	154		64.9	70.7	19.6	394,625
Boeing 777-200	D-V	145		60.9	63.7	18.8	286,900
Boeing 777-300	D-V	145		60.9	73.9	18.8	299,370
Boeing B-52	D-V	141	*	56.4	48.0	12.4	221,353
Boeing E-4 (747-200)	D-V	152		59.6	70.7	19.7	377,842
Antonov AN-124	C-VI	124		70.7	68.0	20.2	362,874
Lockheed C-5B Galaxy	C-VI	135		67.9	75.5	19.8	379,657

* Approach speeds estimated.

Appendix 16. NEW INSTRUMENT APPROACH PROCEDURES

1. BACKGROUND. This appendix applies to the establishment of new authorized instrument approach procedures. For purposes of this appendix, an Instrument Approach Procedure (IAP) amendment or the establishment of a Global Positioning System (GPS) instrument procedure "overlaying" an existing authorized instrument procedure, does not constitute a new procedure. However, a significant reduction in minima would constitute a new procedure.

a. This appendix identifies airport landing surface requirements to assist airport sponsors in their evaluation and preparation of the airport landing surface to support new instrument approach procedures. It also lists the airport data provided by the procedure sponsor that the FAA needs to conduct the airport airspace analysis specified in FAA Order 7400.2, *Procedures for Handling Airspace Matters*. The airport must be acceptable for IFR operations based on an Airport Airspace Analysis (AAA), under FAA Order 7400.2.

b. FAA Order 8260.19, *Flight Procedures and Airspace*, reflects the contents of this appendix as the minimum airport landing surface requirements that must be met prior to the establishment of instrument approach procedures at a public use airport. This order also references other FAA requirements, such as a safety analysis to determine the need for approach lighting and other visual enhancements to mitigate the effects of a difficult approach environment. This is a consideration regardless of whether or not a reduction in approach minimums is desired. Airport sponsors are always encouraged to consider an approach lighting system to enhance the safety of an instrument procedure. In the absence of any identified benefits or safety enhancement from an approach light system, sponsors should at least consider installing lower cost visual guidance aids such as REIL or PAPI.

c. The tables provided in this appendix are for planning purposes only and should be used in conjunction with the rest of the document. All pertinent requirements within this AC and other FAA documents, as well as local siting conditions, ultimately will determine the lowest minimums obtainable.

2. INTRODUCTION. To be authorized a new instrument approach procedure, the runway must have an instrument runway designation. Instrument runways are runway end specific. The runway end designation is based on the findings of an AAA study (Refer to Order 7400.2). In addition, the instrument runway designation for the desired minimums must be depicted on the FAA-approved ALP. If not depicted, a change to the ALP is required. As part of the ALP approval process, the FAA will conduct an AAA study to determine the runway's acceptability for the desired minimums.

3. ACTION. The airport landing surface must meet the standards specified in tables A16-1 A through C, for each specified runway, direction and have adequate airspace to support the instrument approach procedure. When requesting an instrument procedure, the sponsor must specify the runway direction, the desired approach minimums, whether circling approach procedures are desired, and the survey needed to support the procedure. For all obligated National Plan of Integrated Airport Systems (NPIAS) airports, the sponsor must also provide a copy of the FAA-approved ALP showing the instrument procedure(s) requested. An ALP is also recommended for all other airports.

4. DEFINITIONS.

a. Precision Approach. An instrument approach procedure providing course and vertical path guidance conforming to ILS, or MLS, precision system performance standards contained in ICAO annex 10. Table A16-1A defines the requirements for ILS, LAAS, WAAS, MLS, and other precision systems.

b. Approach Procedure with Vertical Guidance (APV). An instrument approach procedure providing course and vertical path guidance that does not conform to ILS or MLS system performance standards contained in ICAO annex 10, or a precision approach system that does not meet TERPS alignment criteria. Table A16-2B defines the requirements for WAAS and authorized barometric VNAV.

c. Nonprecision Approach. An instrument approach procedure providing course guidance without vertical path guidance. Table A16-3C defines the requirements for VOR, NDB, LDA, GPS (TS0-129) or other authorized RNAV system.

Table A16-1A. Precision Instrument Approach Requirements.

Visibility Minimums[1]	<3/4 statute mile	< 1-statute mile
Height Above Touchdown[2]	200	
TERPS Glidepath Qualification Surface (GQS)[3]	Clear	
TERPS precision "W" surfaces [4]	Clear	See Note 5
TERPS Paragraph 251	34:1 Clear	20:1 Clear
Precision Object Free Area (POFA) 200 x 800[6]	Required	Not Required
Airport Layout Plan[7]	Required	
Minimum Runway Length	4,200 ft (1,280 m) (Paved)	
Runway Markings (See AC 150/5340-1)	Precision	Non Precision
Holding Position Signs & Markings (See AC 150/5340-1 and AC 150/5340-18)	Precision	Non Precision
Runway Edge Lights[8]	HIRL / MIRL	
Parallel Taxiway [9]	Required	
Approach Lights[10]	MALSR, SSALR, or ALSF	Recommended
Runway Design Standards; e.g., Obstacle Free Zone (OFZ) [11]	< 3/4-statute mile approach visibility minimums	≥ 3/4-statute mile approach visibility minimums
Threshold Siting Criteria To Be Met [12]	Appendix 2, Paragraph 5g Criteria	Appendix 2, Paragraph 5f Criteria
Survey Required (see Table 16-2)	Line 9	Line 8

1. Minimums are subject to application of FAA Order 8260.3 (TERPS) and associated orders.
2. The Height Above Touchdown (HAT) indicated is for planning purposes only. Actual obtainable HAT may vary.
3. The Glidepath Qualification Surface (GQS) is applicable to approach procedures providing vertical path guidance. It limits the magnitude of penetration of the obstruction clearance surfaces overlying the final approach course. The intent is to provide a descent path from DA to landing free of obstructions that could destabilize the established glidepath angle. The GQS is centered on a course from the DA point to the runway threshold. It's width is equal to the precision "W" surface at DA, and tapers uniformly to a width 100 feet from the runway edges. If the GQS is penetrated, vertical guidance instrument approach procedures (ILS/MLS/WAAS/LAAS/Baro-VNAV) are not authorized
4. The "W" surface is applicable to precision approach procedures. It is a sloping obstruction clearance surface (OCS) overlying the final approach course centerline. The surface slope varies with glidepath angle. The "W" surface must be clear to achieve lowest precision minimums. Surface slope varies with glide path angle, 102/angle; e.g., for optimum 3º glide path 34:1 surface must be clear.
5. If the W surface is penetrated, HAT and visibility will be increased as required by TERPS.
6. This is a new airport surface (see paragraph 307). 250-foot minimum HAT is required without POFA.
7. An ALP is only required for airports in the NPIAS; it is recommended for all others.
8. Runway edge lighting is required for night minimums. High intensity lights are required for RVR-based minimums.
9. A parallel taxiway must lead to the threshold and, with airplanes on centerline, keep the airplanes outside the OFZ.
10. To achieve lower visibility minimums based on credit for lighting, a TERPS specified approach light system is required.
11. Indicates what chart should be followed in the related chapters of this document.
12. Circling procedures to a secondary runway from the primary approach will not be authorized when the secondary runway does not meet threshold siting (reference Appendix 2), OFZ (reference paragraph 306) criteria, and TERPS paragraph 251 criteria.

Table A16-1B. Approach Procedure With Vertical Guidance (APV) Approach Requirements (LNAV/VNAV)

Visibility Minimums[1]	< 3/4-statute mile	< 1-statute mile	1-statute mile	>1-statute mile
Height Above Touchdown[2]	250	300	350	400
TERPS Glidepath Qualification Surface (GQS)[3]	Clear			
TERPS Paragraph 251	34:1 clear	20:1 clear	20:1 clear, or penetrations lighted for night minimums (See AC 70/7460-1)	
Precision Object Free Area (POFA) 200 x 800[4]	Required	Not Required		
Airport Layout Plan[5]	Required			
Minimum Runway Length	4,200 ft (1,280 m) (Paved)	3,200 ft (975 m)[6] (Paved)	3,200 ft(975 m)[6,7]	
Runway Markings (See AC 150/5340-1)	Precision	Nonprecision[7]		Visual (Basic)[7]
Holding Position Signs & Markings(See AC 150/5340-1 and AC 150/5340-18)	Precision	Nonprecision		
Runway Edge Lights[8]	HIRL / MIRL		MIRL/LIRL	
Parallel Taxiway[9]	Required		Recommended	
Approach Lights[10]	MALSR, SSALR, or ALSF	Recommended		
Runway Design Standards; e.g., Obstacle Free Zone (OFZ)[11]	<3/4-statute mile approach visibility minimums	≥ 3/4-statute mile approach visibility minimums		
Threshold Siting Criteria To Be Met[12]	Appendix 2, Paragraph 5g Criteria	Appendix 2, Paragraph 5f Criteria	Appendix 2, Paragraph 5 a,b,c,d,e Criteria	
Survey Required (see Table 16-2)	Line 7	Line 6	Line 6	Line 6

1. Minimums are subject to the application of FAA Order 8260.3 (TERPS) and associated orders.
2. The Height Above Touchdown (HAT) indicated is for planning purposes only. Actual obtainable HAT may vary.
3. The Glidepath Qualification Surface (GQS) is applicable to approach procedures providing vertical path guidance. It limits the magnitude of penetration of the obstruction clearance surfaces overlying the final approach course. The intent is to provide a descent path from DA to landing free of obstructions that could destabilize the established glidepath angle. The GQS is centered on a course from the DA point to the runway threshold. It's width is equal to the precision "W" surface at DA, and tapers uniformly to a width 100 feet from the runway edges. If the GQS is penetrated, vertical guidance instrument approach procedures (ILS/MLS/WAAS/LAAS/Baro-VNAV) are not authorized
4. This is a new airport surface (see paragraph 307).
5. An ALP is only required for obligated airports in the NPIAS; it is recommended for all others.
6. Runways less than 3,200' are protected by 14 CFR Part 77 to a lesser extent (77.23(a)(2) is not applicable for runways less than 3200 feet). However runways as short as 2400 feet could support an instrument approach provided the lowest HAT is based on clearing any 200-foot obstacle within the final approach segment.
7. Unpaved runways require case-by-case evaluation by regional Flight Standards personnel.
8. Runway edge lighting is required for night minimums. High intensity lights are required for RVR-based minimums.
9. A parallel taxiway must lead to the threshold and, with airplanes on centerline, keep the airplanes outside the OFZ.
10. To achieve lower visibility minimums based on credit for lighting, a TERPS specified approach light system is required.
11. Indicates what chart should be followed in the related chapters in this document.
12. Circling procedures to a secondary runway from the primary approach will not be authorized when the secondary runway does not meet threshold siting (reference Appendix 2), OFZ (reference paragraph 306) and TERPS paragraph 251 criteria.

Table A16-1C. Nonprecision Approach Requirements

Visibility Minimums[1]	< 3/4-statute mile	< 1-statute mile	1-statute mile	>1-statute mile
Height Above Touchdown [2]	300	350	400	450
TERPS Paragraph 251	34:1 clear	20:1 clear	20:1 clear or penetrations lighted for night minimums (See AC 70/7460-1)	
Precision Object Free Area (POFA) 200 x 800[3]	Required	Not Required		
Airport Layout Plan[4]	Required			
Minimum Runway Length	4,200 ft (1,280 m) (Paved)	3,200 ft (975 m)[5] (Paved)	3,200 ft (975 m)[5,6]	
Runway Markings (See AC 150/5340-1)	Precision	Nonprecision[6]		Visual (Basic)[6]
Holding Position Signs & Markings (See AC 150/5340-1 and AC 150/5340-18)	Precision	Nonprecision		
Runway Edge Lights[7]	HIRL / MIRL		MIRL / LIRL	
Parallel Taxiway [8]	Required		Recommended	
Approach Lights[9]	MALSR, SSALR, or ALSF Required	Required [10]	Recommended	
Runway Design Standards, e.g. Obstacle Free Zone (OFZ)[11]	<3/4-statute mile approach visibility minimums	≥ 3/4-statute mile approach visibility minimums		
Threshold Siting Criteria To Be Met [12]	Appendix 2, Paragraph 5g Criteria	Appendix 2, Paragraph 5f Criteria	Appendix 2, Paragraph 5 a,b,c,d,e Criteria	
Survey Required (see Table 16-2)	Line 5	Line 4	Line 3	Line 3 Line 2

1. Minimums are subject to the application of FAA Order 8260.3 (TERPS) and associated orders.
2. The Height Above Touchdown (HAT) indicated is for planning purposes only. Actual obtainable HAT may vary.
3. This is a new airport surface (see paragraph 307).
4. An ALP is only required for obligated airports in the NPIAS; it is recommended for all others.
5. Runways less than 3,200' are protected by 14 CFR Part 77 to a lesser extent. However runways as short as 2400 feet could support an instrument approach provided the lowest HAT is based on clearing any 200-foot obstacle within the final approach segment.
6. Unpaved runways require case-by-case evaluation by regional Flight Standards personnel.
7. Runway edge lighting is required for night minimums. High intensity lights are required for RVR-based minimums.
8. A parallel taxiway must lead to the threshold and, with airplanes on centerline, keep the airplanes outside the OFZ.
9. To achieve lower visibility minimums based on credit for lighting, a TERPS specified approach lighting system is required.
10. ODALS, MALS, SSALS, SALS are acceptable.
11. Indicates what chart should be followed in the related chapters in this document
12. Circling procedures to a secondary runway from the primary approach will not be authorized when the secondary runway does not meet threshold siting (reference Appendix 2), OFZ (reference paragraph 306), and TERPS paragraph 251 criteria.

Table A16-2. Survey Requirements for Instrument Approach Procedures:

The Table indicates the acceptable runway obstruction survey needed to support an instrument approach procedure.

		Runway Survey Type								
	Approach	None	AV	BV	ANP	C	SUPLC	D	ANAPC	PIR
1	Night Circling			X	X	X	X	X	X	X
2	Non-Precision Approach ≥ 1SM, Day Only	X	X	X	X	X	X	X	X	X
3	Non-Precision Approach ≥ 1SM				X	X	X	X	X	X
4	Non-Precision Approach < 1SM					X	X	X	X	X
5	Non-Precision Approach < ¾ SM								X	X
6	NPV Approach ≥ ¾ SM							X	X	X
7	NPV Approach < ¾ SM								X	X
8	Precision CAT I Approach < 1SM							X	X	X
9	Precision CAT I Approach < ¾ SM								X	X
10	Precision CAT II Approach									X
11	Precision CAT III Approach									X

Note:
An “X” in each column for a given Approach (1 through 11) denotes a survey that is acceptable to support that approach. As shown, multiple surveys may support the approach, however the “X” farthest to the left indicates the minimum survey needed.

Runway survey types from FAA No. 405, Standards for Aeronautical Surveys and Related Products:

AV - FAR77 Visual Approach **-** Utility runway, includes approach and primary surfaces only.
BV - FAR77 Visual Approach, includes approach and primary surfaces only.
ANP - FAR77 Nonprecision Approach **-** Utility runway, includes approach and primary surfaces only.
C - FAR77 Nonprecision Approach **-** Visibility minimums greater than 3/4 mile includes approach and primary surfaces only.
SUPLC - C Approach underlying a BV approach, includes approach and primary surfaces only.
D - FAR77 Nonprecision Approach **-** Visibility minimums as low as 3/4 mile includes approach and primary surfaces only.
ANAPC - Area Navigation Approach **-** Precision, conventional landing, includes approach, primary, transition, and missed approach surfaces.
PIR - FAR77 Precision Instrument Approach, includes approach and primary surfaces only.

Appendix 17. Acronyms

The acronyms presented herein are intended for use with this publication only.

AAA	Airport Airspace Analysis
AC	Advisory Circular
AD	Airport Design
AFD	Airport Facility Directory
ADG	Airplane Design Group
AIP	Airport Improvement Program or Aeronautical Information Publication
ALP	Airport Layout Plan
ALS	Approach Lighting System
ALSF(-1,-2)	Approach Lighting System with Sequenced Flashers
APV	Approach Procedure with Vertical Guidance
ARC	Airport Reference Code
ARP	Airport Reference Point
ASDA	Accelerate-Stop Distance Available
ASDE	Airport Surface Detection Equipment
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
AWOS	Automated Weather Observing System
AZ	Azimuth
BRL	Building Restriction Line
CAT	Category
CFR	Code of Federal Regulation
CFW	Center Field Wind
CWY	Clearway
DA	Decision Altitude
DME	Distance Measuring Equipment
DXF	AutoCAD Drawing Interchange file format
EDS	Environmental Data Service
EL	Elevation
FBO	Fixed Base Operator
GPS	Global Positioning System
GQS	Glidepath Qualification Surface
GS	Glide Slope
GVGI	Generic Visual Slope Indicator
HAT	Height Above Touchdown
HIRL	High Intensity Runway Lights
IFR	Instrument Flight Rules
IGES	Initial Graphics Exchange Specification file format
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
LAAS	Local Area Augmentation System
LDA	Landing Distance Available or Localizer Type Directional Aid
LDIN	Lead-In Lights
LIRS	Low Impact Resistant Supports
LNAV	Lateral Navigation
LOC	Localizer
MALS	Medium Intensity Approach Lighting System
MALSF	Medium Intensity Approach Lighting System with Sequenced Flashers
MALSR	Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights
MIRL	Medium Intensity Runway Lights
MLS	Microwave Landing System
MM	Middle Marker
MSL	Mean Sea Level
NAVAID	Navigational Aid
NCDC	National Climatic Data Center
NDB	Nondirectional Beacon
NP	Mon-Precision (Markings
NPIAS	National Plan of Integrated Airport Systems
NTIS	National Technical Information Service
ODALS	Omnidirectional Approach Lighting System
OFA	Object Free Area
OFZ	Obstacle Free Zone
OM	Outer Marker
NPA	Non-Precision Approach
P	Precision (Markings)
PA	Precision Approach
PAPI	Precision Approach Path Indicator
POFA	Precision Object Free Area
RAIL	Runway Alignment Indicator Lights
REIL	Runway End Identifier Lights
RNAV	Area Navigation
ROFA	Runway Object Free Area
RPZ	Runway Protection Zone
RSA	Runway Safety Area
RVR	Runway Visual Range
RW	Runway
SALS	Short Approach Lighting System
SSALR	Simplified Short Approach Lighting System with Runway Alignment Indicator Lights
SSALS	Simplified Short Approach Lighting System
SWY	Stopway
TERPS	FAA Order 8260.3, *United States Standard for Terminal Instrument Procedures*
TH	Threshold
TL	Taxilane
TODA	Takeoff Distance Available
TORA	Takeoff Run Available
TSA	Taxiway Safety Area
TVOR	Very High Frequency Omnirange located on an airport
TW	Taxiway
USGS	United States Geological Service
V	Visual (Markings)
V_1	Takeoff decision speed
V_2	Takeoff safety speed
VFR	Visual Flight Rules
V_{LOF}	Lift-off speed

V_{SO}	Stalling speed or the minimum steady flight speed in the landing configuration
VNAV	Vertical Navigation
VOR	Very High Frequency Omnirange
WAAS	Wide Area Augmentation System

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