



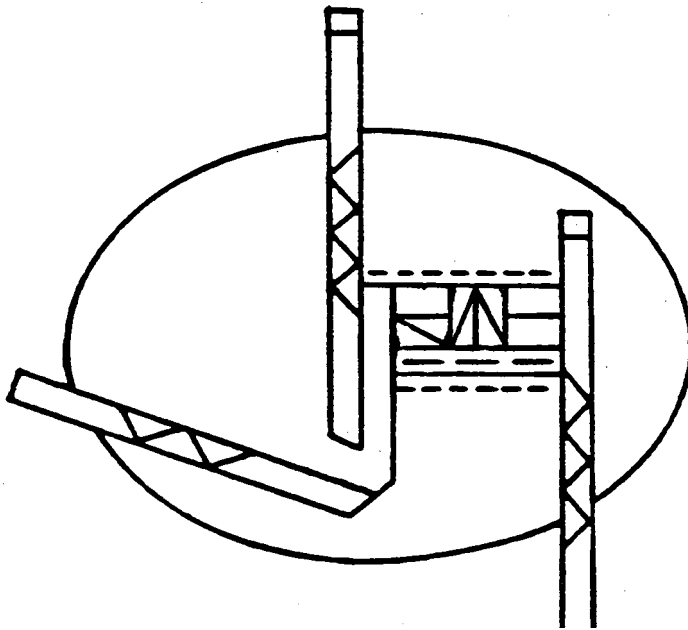
U.S. Department
of Transportation
Federal Aviation
Administration

AIRPORT DESIGN

/ INCORPORATES CHANGES 1 THRU 13 /

AC: 150/5300-13
Date: 9/29/89

Advisory Circular





U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: AIRPORT DESIGN

Date: 9/29/89
Initiated by: AAS-110

AC No: 150/5300-13
Change:

1. **PURPOSE.** This advisory circular (AC) contains the Federal Aviation Administration's (FAA) standards and recommendations for airport design.

2. **CANCELLATION.** This (AC) cancels the following publications:

a. AC 150/5300-2D, Airport Design Standards--Site Requirements for Terminal Navigational Facilities, dated March 10, 1980.

b. AC 150/5300-4B, Utility Airports--Air Access to National Transportation, dated June 24, 1975.

c. AC 150/5300-12, Airport Design Standards--Transport Airports, dated February 28, 1983.

d. AC 150/5325-5C, Aircraft Data, dated June 29, 1987.

e. AC 150/5335-2, Airport Aprons, dated January 27, 1965.

3. **APPLICATION.** The standards and recommendations contained in this advisory circular are recommended by the Federal Aviation Administration for use in the design of civil airports. For airport projects receiving Federal grant-in-aid assistance, the use of these standards is mandatory. At certificated airports, the standards and recommendations may be used to satisfy specific requirements of Federal Aviation Regulations (FAR) Part 139, Certification and Operations: Land Airports Serving Certain Air Carriers, Subpart D.

Leonard E. Mudd

Leonard E. Mudd, Director
Office of Airport Safety and Standards

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Chapter 1. REGULATORY REQUIREMENTS AND DEFINITION OF TERMS

1. **GENERAL.** Section 103 of the Federal Aviation Act of 1958 states in part, "In the exercise and performance of his power and duties under this Act, the Secretary of Transportation shall consider the following, among other things, as being in the public interest: (a) The regulation of air commerce in such manner as to best promote its development and safety and fulfill the requirements of defense; (b) The promotion, encouragement, and development of civil aeronautics"

This public charge, in effect, requires the development and maintenance of a national system of safe, delay-free, and cost-effective airports. The use of the standards and recommendations contained in this publication in the design of airports supports this public charge. These standards and recommendations, however, do not limit or regulate the operations of aircraft.

2. **DEFINITIONS.** As used in this publication, the following terms mean:

Aircraft Approach Category. A grouping of aircraft based on 1.3 times their stall speed in their landing configuration at the certificated maximum flap setting and maximum landing weight at standard atmospheric conditions. The categories are as follows:

Category A: Speed less than 91 knots.

Category B: Speed 91 knots or more but less than 121 knots.

Category C: Speed 121 knots or more but less than 141 knots.

Category D: Speed 141 knots or more but less than 166 knots.

Category E: Speed 166 knots or more.

Airplane Design Group (ADG). A grouping of airplanes based on wingspan or tail height. Where an airplane is in two categories, the most demanding category should be used. The groups are as follows:

Group I: Up to but not including 49 feet (15 m) wingspan or tail height up to but not including 20 feet.

Group II: 49 feet (15 m) up to but not including 79 feet (24 m) wingspan or tail height from 20 up to but not including 30 feet.

Group III: 79 feet (24 m) up to but not including 118 feet (36 m) wingspan or tail height from 30 up to but not including 45 feet.

Group IV: 118 feet (36 m) up to but not including 171 feet (52 m) wingspan or tail height from 45 up to but not including 60 feet.

Group V: 171 feet (52 m) up to but not including 214 feet (65 m) wingspan or tail height from 60 up to but not including 66 feet.

Group VI: 214 feet (65 m) up to but not including 262 feet (80 m) wingspan or tail height from 66 up to but not including 80 feet.

Table 1-1. Airplane Design Groups (ADG)

| Group # | Tail Height (ft) | Wingspan (ft) |
|------------|------------------|---------------|
| I | <20 | <49 |
| II | 20 - <30 | 49 - <79 |
| III | 30 - <45 | 79 - <118 |
| IV | 45 - <60 | 118 - <171 |
| V | 60 - <66 | 171 - <214 |
| VI | 66 - <80 | 214 - <262 |

Airport Elevation. The highest point on an airport's usable runway expressed in feet above mean sea level (MSL).

Airport Layout Plan (ALP). The plan of an airport showing the layout of existing and proposed airport facilities.

Airport Reference Point (ARP). The latitude and longitude of the approximate center of the airport.

Blast Fence. A barrier used to divert or dissipate jet blast or propeller wash.

Building Restriction Line (BRL). A line which identifies suitable building area locations on airports.

Clear Zone. See Runway Protection Zone.

Clearway (CWY). A defined rectangular area beyond the end of a runway cleared or suitable for use in lieu of runway to satisfy takeoff distance requirements.

Compass Calibration Pad. An airport facility used for calibrating an aircraft compass.

Declared Distances. The distances the airport owner declares available for the airplane's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. The distances are:

Takeoff run available (TORA). The runway length declared available and suitable for the ground run of an airplane taking off;

Takeoff distance available (TODA). The TORA plus the length of any remaining runway or clearway (CWY) beyond the far end of the TORA;

NOTE: The full length of TODA may not be usable for all takeoffs because of obstacles in the departure area. The usable TODA length is aircraft performance dependent and, as such, must be determined by the aircraft operator before each takeoff and requires knowledge of the location of each controlling obstacle in the departure area.

Accelerate-stop distance available (ASDA). The runway plus stopway (SWY) length declared available and suitable for the acceleration and deceleration of an airplane aborting a takeoff; and

Landing distance available (LDA). The runway length declared available and suitable for a landing airplane.

Fixed By Function NAVAID. An air navigation aid (NAVAID) that must be positioned in a particular location in order to provide an essential benefit for civil aviation is fixed by function. Exceptions are:

a. Equipment shelters, junction boxes, transformers, and other appurtenances that support a fixed by function NAVAID *are not* fixed by function unless operational requirements require them to be located in close proximity to the NAVAID.

b. Some NAVAIDs, such as localizers, can provide beneficial performance even when they are not located at their optimal location. These NAVAIDS are not fixed by function.

Frangible NAVAID. A navigational aid (NAVAID) which retains its structural integrity and stiffness up to a designated maximum load, but on impact from a greater load, breaks, distorts, or yields in such a manner as to present the minimum hazard to aircraft. The term NAVAID includes electrical and visual air navigational aids, lights, signs, and associated supporting equipment.

Hazard to Air Navigation. An object which, as a result of an aeronautical study, the FAA determines will have a substantial adverse effect upon the safe and efficient use of navigable airspace by aircraft, operation of air navigation facilities, or existing or potential airport capacity.

Large Airplane. An airplane of more than 12,500 pounds (5 700 kg) maximum certificated takeoff weight.

Low Impact Resistant Supports (LIRS). Supports designed to resist operational and environmental static loads and fail when subjected to a shock load such as that from a colliding aircraft.

Object. Includes, but is not limited to above ground structures, NAVAIDs, people, equipment, vehicles, natural growth, terrain, and parked aircraft.

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

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

Obstacle Free Zone (OFZ). The OFZ is the airspace below 150 feet (45 m) above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from the runway, and for missed approaches. The OFZ is sub-divided as follows:

Runway OFZ. The airspace above a surface centered on the runway centerline.

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

Inner-transitional OFZ. The airspace above the surfaces located on the outer edges of the runway OFZ and the inner-approach OFZ. It applies to runways with approach visibility minimums lower than 3/4-statute mile (1 200 m).

Obstruction to Air Navigation. An object of greater height than any of the heights or surfaces presented in Subpart C of Code of Federal Regulation (14 CFR), Part 77. (Obstructions to air navigation are presumed to be hazards to air navigation until an FAA study has determined otherwise.)

Precision Approach Category I (CAT I) Runway. A runway with an instrument approach procedure which provides for approaches to a decision height (DH) of not less than 200 feet (60 m) and visibility of not less than 1/2 mile (800 m) or Runway Visual Range (RVR) 2400 (RVR 1800 with operative touchdown zone and runway centerline lights).

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Precision Approach Category II (CAT II) Runway. A runway with an instrument approach procedure which provides for approaches to a minima less than CAT I to as low as a decision height (DH) of not less than 100 feet (30 m) and RVR of not less than RVR 1200.

Precision Approach Category III (CAT III) Runway. A runway with an instrument approach procedure which provides for approaches to minima less than CAT II.

Runway (RW). A defined rectangular surface on an airport prepared or suitable for the landing or takeoff of airplanes.

Runway Blast Pad. A surface adjacent to the ends of runways provided to reduce the erosive effect of jet blast and propeller wash.

Runway Protection Zone (RPZ). An area off the runway end to enhance the protection of people and property on the ground.

Runway Safety Area (RSA). A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway.

Shoulder. An area adjacent to the edge of paved runways, taxiways, or aprons providing a transition between the pavement and the adjacent surface; support for aircraft running off the pavement; enhanced drainage; and blast protection.

Small Airplane. An airplane of 12,500 pounds (5 700 kg) or less maximum certificated takeoff weight.

Stopway (SWY). A defined rectangular surface beyond the end of a runway prepared or suitable for use in lieu of runway to support an airplane, without causing structural damage to the airplane, during an aborted takeoff.

Taxilane (TL). The portion of the aircraft parking area used for access between taxiways and aircraft parking positions.

Taxiway (TW). A defined path established for the taxiing of aircraft from one part of an airport to another.

Taxiway Safety Area (TSA). A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway.

Threshold (TH). The beginning of that portion of the runway available for landing. In some instances, the landing threshold may be displaced.

Displaced Threshold. A threshold that is located at a point on the runway other than the designated beginning of the runway.

Visual Runway. A runway without an existing or planned straight-in instrument approach procedure.

3. RELATED/REFERENCED READING MATERIAL. The following is a listing of documents referenced in other parts of this advisory circular. Advisory Circulars 00-2 and 00-44 may be obtained by writing to: The U.S. Department of Transportation; Utilization and Storage Section, M-443.2; Washington, D.C. 20590. The most current versions of the ACs listed below are available online at www.faa.gov.

NOTE: Some of the ACs in this paragraph have been cancelled but are still referenced in the main document. They will continue to be listed here and shown as cancelled until the next complete revision of the document.

- a. AC 00-2, Advisory Circular Checklist.
- b. AC 00-44, Status of Federal Aviation Regulations.
- c. AC 20-35, Tiedown Sense.
- d. AC 70/7460-1, Obstruction Marking and Lighting.
- e. AC 70/7460-2, Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace. (Cancelled)
- f. AC 107-1, Aviation Security-Airports.
- g. AC 120-29, Criteria for Approving Category I and Category II Landing Minima for FAR Part 121 Operators.
- h. AC 150/5000-3, Address List for Regional Airports Divisions and Airports District/Field Offices. (Cancelled)
- i. AC 150/5060-5, Airport Capacity and Delay.
- j. AC 150/5070-3, Planning the Airport Industrial Park. (Cancelled)
- k. AC 150/5070-6, Airport Master Plans.
- l. AC 150/5190-1, Minimum Standards for Commercial Aeronautical Activities on Public Airports. (Cancelled by AC 150/5190-5)

m. AC 150/5190-4, A Model Zoning Ordinance to Limit Height of Objects Around Airports.

n. AC 150/5190-5, Exclusive Rights and Minimum Standards for Commercial Aeronautical Activities. (Cancelled by AC 150/5190-6 and AC 150/5190-7)

o. AC 150/5190-6, Exclusive Rights at Federally-Obligated Airports

p. AC 150/5190-7, Minimum Standards for Commercial Aeronautical Activities

q. AC 150/5200-33, Hazardous Wildlife Attractants On or Near Airports.

r. AC 150/5220-16, Automated Weather Observing Systems (AWOS) for Non-Federal Applications.

s. AC 150/5230-4, Aircraft Fuel Storage, Handling, and Dispensing on Airports.

t. AC 150/5320-5, Airport Drainage.

u. AC 150/5320-6, Airport Pavement Design and Evaluation.

v. AC 150/5320-14, Airport Landscaping for Noise Control Purposes.

w. AC 150/5325-4, Runway Length Requirements for Airport Design.

x. AC 150/5340-1, Standards for Airport Marking.

y. AC 150/5340-5, Segmented Circle Marker Systems.

z. AC 150/5340-14, Economy Approach Lighting Aids. (Cancelled by AC 150/5340-30)

aa. AC 150/5340-18, Standards for Airport Sign Systems.

bb. AC 150/5340-21, Airport Miscellaneous Lighting Visual Aids. (Cancelled by AC 150/5340-30)

cc. AC 150/5340-24, Runway and Taxiway Edge Lighting System. (Cancelled by AC 150/5340-30)

dd. AC 150/5340-28, Precision Approach Path Indicator (PAPI) Systems. (Cancelled by AC 150/5340-30)

ee. AC 150/5340-30, Design and Installation Details for Airport Visual Aids

ff. AC 150/5345-52, Generic Visual Slope Indicators (GVGI).

gg. AC 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities.

hh. AC 150/5370-10, Standards for Specifying Construction of Airports.

ii. AC 150/5390-2, Heliport Design.

jj. 14 CFR Part 23, Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes.

kk. 14 CFR Part 25, Airworthiness Standards: Transport Category Airplanes.

ll. 14 CFR Part 77, Objects Affecting Navigable Airspace.

mm. 14 CFR Part 97, Standard Instrument Approach Procedures.

nn. 14 CFR Part 135, Operating Requirements: Commuter and On Demand Operations and Rules Governing Persons On Board Such Aircraft.

oo. 14 CFR Part 139, Certification of Airports.

pp. 14 CFR Part 151, Federal Aid to Airports.

qq. 14 CFR Part 152, Airport Aid Program.

rr. 14 CFR Part 153, Acquisition of U.S. Land for Public Airports. (Removed from Title 14)

ss. 14 CFR Part 154, Acquisition of Land for Public Airports Under the Airport and Airway Development Act of 1970. (Removed from Title 14)

tt. 14 CFR Part 157, Notice of Construction, Alteration, Activation, and Deactivation of Airports.

uu. Order 1050.1, Policies and Procedures for Considering Environmental Impacts.

vv. Order 5050.4, Airport Environmental Handbook.

ww. Order 5100.38, Airport Improvement Program (AIP) Handbook.

xx. Order 7400.2, Procedures for Handling Airspace Matters.

yy. Order 8200.1, United States Standard Flight Inspection Manual.

zz. Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS).

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4. AIRPORT REFERENCE CODE (ARC). The ARC is a coding system used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at the airport.

a. Coding System. The airport reference code has two components relating to the airport design aircraft. The first component, depicted by a letter, is the *aircraft approach category* and relates to aircraft approach speed (operational characteristic). The second component, depicted by a Roman numeral, is the *airplane design group* and relates to airplane wingspan or tailheight (physical characteristics), whichever is the most restrictive. Generally, runways standards are related to aircraft approach speed, airplane wingspan, and designated or planned approach visibility minimums. Taxiway and taxilane standards are related to airplane design group.

b. Airport Design. Airport design first requires selecting the ARC(s), then the lowest designated or planned approach visibility minimums for each runway, and then applying the airport design criteria associated with the airport reference code and the designated or planned approach visibility minimums.

(1) An upgrade in the first component of the ARC may result in an increase in airport design standards. Table 1-1 depicts these increases.

(2) An upgrade in the second component of the ARC generally will result in a major increase in airport design standards.

(3) An airport upgrade to provide for lower approach visibility minimums may result in an increase in airport design standards. Table 1-2 depicts these increases.

(4) Operational minimums are based on current criteria, runways, airspace, and instrumentation. Unless this is taken into consideration in the development of the airport, the operational minimums may be other than proposed.

(5) For airports with two or more runways, it may be desirable to design all airport elements to meet the requirements of the most demanding ARC. However, it may be more practical to design some airport elements, e.g., a secondary runway and its associated taxiway, to standards associated with a lesser demanding ARC.

5. AIRPORT LAYOUT PLAN. An Airport Layout Plan (ALP) is a scaled drawing of existing and proposed land and facilities necessary for the operation and development of the airport. Any airport will benefit from a carefully developed plan that reflects current FAA design standards and planning criteria. For guidance on developing Airport Master Plans, refer to AC 150/5070-6, *Airport Master Plans*.

a. FAA-Approved ALP. All airport development carried out at Federally obligated airports must be done in accordance with an FAA-approved ALP. The FAA-approved

ALP, to the extent practicable, should conform to the FAA airport design standards existing at the time of its approval. Due to unique site, environmental, or other constraints, the FAA may approve an ALP not fully complying with design standards. Such approval requires an FAA study and finding that the proposed modification is safe for the specific site and conditions. When the FAA upgrades a standard, airport owners should, to the extent practicable, include the upgrade in the ALP before starting future development.

b. Guidance. AC 150/5070-6, Airport Master Plans, contains background information on the development of ALPs, as well as a detailed listing of the various components that constitute a well-appointed ALP.

c. Electronic Plans. The FAA recommends the development of electronic ALPs where practical.

6. MODIFICATION OF AIRPORT DESIGN STANDARDS TO MEET LOCAL CONDITIONS.

“Modification to standards” means any change to FAA design standards other than dimensional standards for runway safety areas. Unique local conditions may require modification to airport design standards for a specific airport. A modification to an airport design standard related to new construction, reconstruction, expansion, or upgrade on an airport which received Federal aid requires FAA approval. The request for modification should show that the modification will provide an acceptable level of safety, economy, durability, and workmanship. Appendixes 8 and 9 discuss the relationship between airplane physical characteristics and the design of airport elements. This rationale along with the computer program cited in appendix 11 may be used to show that the modification will provide an acceptable level of safety for the specified conditions, including the type of aircraft.

7. NOTICE TO THE FAA OF AIRPORT DEVELOPMENT.

14 CFR Part 157, Notice of Construction, Activation, and Deactivation of Airports, requires persons proposing to construct, activate, or deactivate an airport to give notice of their intent to the FAA. The notice applies to proposed alterations to the takeoff and landing areas, traffic patterns, and airport use, e.g., a change from private-use to public-use.

a. Notice Procedure. 14 CFR Part 157 requires airport proponents to notify the appropriate FAA Airports Regional or District Office at least 30 days before construction, alteration, deactivation, or the date of the proposed change in use. In an emergency involving essential public service, health, or safety, or when delay would result in a hardship, a proponent may notify the FAA by telephone and submit Form 7480-1, Notice of Landing Area Proposal, within 5 days.

b. The Notice. The notice consists of a completed FAA Form 7480-1, a layout sketch, and a location map. The layout sketch should show the airport takeoff and landing area configuration in relation to buildings, trees, fences, power lines, and other similar significant features. The preferred type of location map is the 7.5 minute U.S. Geological Survey

Quadrangle Map showing the location of the airport site. Form 7480-1 lists FAA Airports Office addresses.

c. FAA Action. The FAA evaluates the airport proposal for its impact upon the: safe and efficient use of navigable airspace; operation of air navigation facilities; existing or potential airport capacity; and safety of persons and property on the ground. The FAA notifies proponents of the results of the FAA evaluation.

d. Penalty for Failure to Provide Notice. Persons who fail to give notice are subject to civil penalty.

8. NOTICE TO THE FAA OF PROPOSED CONSTRUCTION. 14 CFR Part 77, Objects Affecting Navigable Airspace, requires persons proposing any construction or alteration described in 14 CFR Section 77.13(a) to give 30-day notice to the FAA of their intent. This includes any construction or alteration of structures more than 200 feet (61 m) in height above the ground level or at a height that penetrates defined imaginary surfaces located in the vicinity of a public-use airport.

a. Airport Data Requirements. Future airport development plans and feasibility studies on file with the FAA may influence the determinations resulting from 14 CFR Part 77 studies. To assure full consideration of future airport development in 14 CFR Part 77 studies, airport owners must have their plans on file with the FAA. The necessary plan data includes, as a minimum, planned runway end coordinates, elevation, and type of approach for any new runway or runway extension.

b. Penalty for Failure to Provide Notice. Persons who knowingly and willingly fail to give such notice are subject to criminal prosecution.

9. FAA STUDIES. The FAA studies existing and proposed objects and activities, on and in the vicinity of public-use airports. These objects and activities are not limited to obstructions to air navigation, as defined in 14 CFR Part 77. These studies focus on the efficient use of the airport and the safety of persons and property on the ground. As the result of these studies, the FAA may resist, oppose, or recommend against the presence of objects or activities in the vicinity of a public-use airport that conflict with an airport planning or design standard/recommendation. This policy is stated as a notice on page 32152 of Volume 54, No. 149, of the Federal Register, dated Friday, August 4, 1989. FAA studies conclude:

a. Whether an obstruction to air navigation is a hazard to air navigation;

b. Whether an object or activity on or in the vicinity of an airport is objectionable;

c. Whether the need to alter, remove, mark, or light an object exists;

d. Whether to approve an Airport Layout Plan;

e. Whether proposed construction, enlargement, or modification to an airport would have an adverse effect on the safe and efficient use of navigable airspace; or

f. Whether a change in an operational procedure is feasible.

10. FEDERAL ASSISTANCE. The FAA administers a grant program (per Order 5100.38, Airport Improvement Program (AIP) Handbook) which provides financial assistance for developing public-use airports. Persons interested in this program can obtain information from FAA Airports Regional or District Offices. Technical assistance in airport development is also available from these offices.

11. ENVIRONMENTAL ASSESSMENTS. Federal grant assistance in, or ALP approval of, new airport construction or major expansion normally requires an assessment of potential environmental impacts in accordance with FAA Order 5050.4B, National Environmental Policy Act (NEPA) Implementing Instructions for Airport Projects, and the National Environmental Policy Act of 1969.

12. STATE ROLE. Many State aeronautics commissions or similar departments require prior approval and, in some instances, a license for the establishment and operation of an airport. Some States administer a financial assistance program similar to the Federal program and technical advice. Proponents should contact their respective State aeronautics commissions or departments for information on licensing and assistance programs.

13. LOCAL ROLE. Most communities have zoning ordinances, building codes, and fire regulations which may affect airport development. Some have or are in the process of developing codes or ordinances regulating environmental issues such as noise and air quality. Others may have specific procedures for establishing an airport.

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Table 1-1. Increases in airport design standards associated with an upgrade in the first component (aircraft approach category) of the airport reference code

| ARC upgrade | Changes in airport design standards. |
|------------------|---|
| A-I s/ to B-I s/ | No change in airport design standards. |
| B-I s/ to C-I | Increase in crosswind component. Refer to paragraph 203.b. Increase in runway separation standards. Refer to tables 2-1 and 2-2. Increase in RPZ dimensions. Refer to table 2-4 and appendix 14, paragraph 5.b. Increase in OFZ dimensions. Refer to paragraph 306. Increase in runway design standards. Refer to tables 3-1, 3-2, and 3-3. Increase in surface gradient standards. Refer to paragraph 502. Increase in threshold siting standards. Refer to appendix 2, paragraph 5. |
| A-I to B-I | No change in airport design standards. |
| B-I to C-I | Increase in crosswind component. Refer to paragraph 203.b. Increase in runway separation standards. Refer to tables 2-1 and 2-2. Increase in RPZ dimensions. Refer to table 2-4 and appendix 14, paragraph 5.b. Increase in runway design standards. Refer to tables 3-1, 3-2, and 3-3. Increase in surface gradient standards. Refer to paragraph 502. |
| C-I to D-I | Increase in RSA width. Refer to table 3-3, Note 4/. |
| A-II to B-II | No change in airport design standards. |
| B-II to C-II | Increase in crosswind component. Refer to paragraph 203.b. Increase in runway separation standards. Refer to tables 2-1 and 2-2. Increase in RPZ dimensions. Refer to table 2-4 and appendix 14, paragraph 5.b. Increase in runway design standards. Refer to tables 3-1, 3-2, and 3-3. Increase in surface gradient standards. Refer to paragraph 502. |
| C-II to D-II | Increase in RSA width. Refer to table 3-3, Note 4/. |
| A-III to B-III | No change in airport standards. |
| B-III to C-III | Increase in runway separation standards. Refer to tables 2-1 and 2-2. Increase in RPZ dimensions. Refer to table 2-4 and appendix 14, paragraph 5.b. Increase in runway design standards. Refer to tables 3-1, 3-2, and 3-3. Increase in surface gradient standards. Refer to paragraph 502. |
| C-III to D-III | Increase in RSA width. Refer to table 3-3, Note 4/. |
| A-IV to B-IV | No change in airport design standards. |
| B-IV to C-IV | Increase in RPZ dimensions. Refer to table 2-4 and appendix 14, paragraph 5.b. Increase in surface gradient standards. Refer to paragraph 502. |
| C-IV to D-IV | Increase in RSA width. Refer to table 3-3, Note 4/. |
| C-V to D-V | Increase in RSA width. Refer to table 3-3, Note 4/. |
| C-VI to D-VI | Increase in RSA width. Refer to table 3-3, Note 4/. |

s/ These airport design standards pertain to facilities for small airplanes exclusively.

Table 1-2. Increases in airport design standards to provide for lower approach visibility minimums

| Visibility minimums decrease * | Changes in airport design standards. |
|--|---|
| Visual to Not lower than 1-Mile (1 600 m) | No change in airport design standards. |
| Not lower than 1-Mile (1 600 m) to Not lower than 3/4-Mile (1 200 m) | Increase in RPZ dimensions. Refer to table 2-4. Increase in threshold siting standards. Refer to appendix 2, paragraph 5. |
| Not lower than 3/4-Mile (1 200 m) to Not lower than CAT I | For aircraft approach categories A & B runways: Increase in runway separation standards. Refer to table 2-1. Increase in RPZ dimensions. Refer to table 2-4. Increase in OFZ dimensions. Refer to paragraph 306. Increase in runway design standards. Refer to tables 3-1 and 3-2. Increase in threshold siting standards. Refer to appendix 2, paragraph 5. |
| | For aircraft approach categories C & D runways: Increase in runway separation standards for ADG I & II runways. Refer to table 2-2. Increase in RPZ dimensions. Refer to table 2-4. Increase in OFZ dimensions. Refer to paragraph 306. Increase in threshold siting standards. Refer to appendix 2, paragraph 5. |
| Not lower than CAT I to Lower than CAT I | Increase in OFZ dimensions for runways serving large airplanes. Refer to paragraph 306. Increase in threshold siting standards. Refer to appendix 2, paragraph 5. |

* In addition to the changes in airport design standards as noted, providing for lower approach visibility minimums may result in an increase in the number of objects identified as obstructions to air navigation in accordance with 14 CFR Part 77. This may require object removal or marking and lighting. Refer to paragraph 211.a.(6).

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 than 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 taxiway 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 taxiways; 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

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computer program cited in appendix 11 may be used to determine the increase to these separation distances for elevation.

207. PARALLEL RUNWAY SEPARATION--SIMULTANEOUS VFR OPERATIONS.

a. **Standard.** For simultaneous landings and takeoffs using visual flight rules (VFR), the minimum separation between centerlines of parallel runways is 700 feet (214 m).

b. **Recommendations.** The minimum runway centerline separation distance recommended for Airplane Design Group V and VI runways is 1,200 feet (366 m). Air traffic control practices, such as holding airplanes between the runways, frequently justify greater separation distances. Runways with centerline spacings under 2,500 feet (762 m) are treated as a single runway by ATC when wake turbulence is a factor.

208. PARALLEL RUNWAY SEPARATION--SIMULTANEOUS IFR OPERATIONS.

To attain instrument flight rule (IFR) capability for simultaneous (independent) landings and takeoff on parallel runways, the longitudinal (in-trail) separation required for single runway operations is replaced, in whole or in part, by providing lateral separation between aircraft operating to parallel runways. Subparagraphs a and b identify the minimum centerline separations for parallel runways with operations under instrument flight rules (IFR). Where practical, parallel runway centerline separation of at least 5,000 feet (1 525 m) is recommended. Placing the terminal area between the parallel runways minimizes taxi operations across active runways and increases operational efficiency of the airport. Terminal area space needs may dictate greater separations than required for simultaneous IFR operations.

a. **Simultaneous Approaches.** Precision instrument operations require electronic navigational aids and monitoring equipment, air traffic control, and approach procedures.

(1) **Dual simultaneous precision instrument approaches** are normally approved on parallel runway centerline separation of 4,300 feet (1 310 m). Further on a case-by-case basis, the FAA will consider proposals utilizing separations down to a minimum of 3,000 feet (915 m) where a 4,300 foot (1 310 m) separation is impractical. This reduction of separation requires special high update radar, monitoring equipment, etc..

(2) **Triple simultaneous precision instrument approaches** for airports below 1,000 feet (305 m) elevation normally require parallel runway centerline separation of 5,000 feet (1 525 m) between adjacent runways. Triple simultaneous precision instrument approaches for airport elevations at and above 1,000 feet (305 m) and reduction in separation are currently under study by the FAA. In the interim, the FAA, on a case-by-case basis, will consider proposals utilizing separations down to a minimum of 4,300 feet (1 310 m) where a 5,000-foot (1 525 m) separation is impractical or the airport elevation is at or above 1,000 feet (305 m). Reduction of separation may require special radar, monitoring equipment, etc..

(3) **Quadruple simultaneous precision instrument approaches** are currently under study by the FAA. In the interim, the FAA, on a case-by-case basis, will consider proposals utilizing separations down to a minimum of 5,000 feet (1 525 m). Quadruples may require special radar, monitoring equipment, etc..

b. **Simultaneous Departures or Approaches and Departures.** Simultaneous departures do not always require radar air traffic control facilities. The following parallel runway centerline separations apply:

(1) **Simultaneous Departures.**

(a) Simultaneous nonradar departures require a parallel runway centerline separation of at least 3,500 feet (1 067 m).

(b) Simultaneous radar departures require a parallel runway centerline separation of at least 2,500 feet (762 m).

(2) **Simultaneous Approach and Departure.** Simultaneous radar-controlled approaches and departures require the following parallel runway centerline separations:

(a) When the thresholds are not staggered, at least 2,500 feet (762 m).

(b) When the thresholds are staggered and the approach is to the near threshold, the 2,500-foot (762 m) separation can be reduced by 100 feet (30 m) for each 500 feet (150 m) of threshold stagger to a minimum separation of 1,000 feet (305 m). For Airplane Design Groups V and VI runways, a separation of at least 1,200 feet (366 m) is recommended. See figure 2-2 for a description of "near" and "far" thresholds.

(c) When the thresholds are staggered and the approach is to the far threshold, the minimum 2,500-foot (762 m) separation requires an increase of 100 feet (30 m) for every 500 feet (152 m) of threshold stagger.

209. RUNWAY TO PARALLEL TAXIWAY AND TAXILANE SEPARATION.

a. **Standards.** Tables 2-1 and 2-2 present the runway centerline to parallel taxiway/taxilane centerline separation standard. This distance is such to satisfy the requirement that no part of an aircraft (tail tip, wing tip) on taxiway/taxilane centerline is within the runway safety area or penetrates the obstacle free zone (OFZ). The computer program cited in appendix 11 may be used to determine the increase to these separation distances for elevation.

b. **Recommendations.** To have room for the acute-angled exit taxiway, provide a runway centerline to parallel taxiway centerline of at least 400 feet (120 m) for Airplane Design Groups I and II, 500 feet (150 m) for Airplane Design Group III, and 600 feet (180 m) for Airplane Design Groups IV, V, and VI.

210. BUILDING RESTRICTION LINE (BRL). A BRL should be placed on an airport layout plan for identifying suitable building area locations on airports. The BRL should encompass the runway protection zones, the runway object free area, the runway visibility zone (see paragraph 503), NAVAID critical areas, areas required for terminal instrument procedures, and airport traffic control tower clear line of sight.

211. OBJECT CLEARING CRITERIA. Safe and efficient operations at an airport require that certain areas on and near the airport be clear of objects or restricted to objects with a certain function, composition, and/or height. The object clearing criteria subdivides the 14 CFR Part 77, Subpart C, airspace and the object free area (OFA) ground area by type of objects tolerated within each subdivision. Aircraft are controlled by the aircraft operating rules and not by this criteria.

a. **Standards.** Object clearance requirements are as follows:

(1) **Object Free Area (OFA).** Object free areas require clearing of objects as specified in paragraph 307, Runway Object Free Area, and paragraph 404, Taxiway and Taxilane Object Free Area (OFA).

(2) **Runway and Taxiway Safety Areas.**

Runway and taxiway safety areas require clearing of objects, except for objects that need to be located in the runway or taxiway 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. Underground fuel storage facilities should not be located within runway and taxiway safety areas (see AC 150/5230-4), Aircraft Fuel Storage, Handling, and Dispensing on Airports). Tables 3-1, 3-2, 3-3, and 4-1 specify runway and taxiway safety area standard dimensions.

(3) **Obstacle Free Zone (OFZ).** Obstacle Free Zones require clearing of object penetrations, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function. Paragraph 306 specifies OFZ standard dimensions.

(4) **Threshold.** The threshold obstacle clearance surfaces, defined in Appendix 2, paragraph 5, require clearing of object penetrations.

(5) **NAVAIDs.** Certain areas require clearing for the establishment and operation of NAVAIDs. These NAVAID critical areas are depicted in chapter 6.

(6) **14 CFR Part 77 Obstructions to Air Navigation.** Obstructions to air navigation must be removed unless an FAA aeronautical study, based on proposed operations, determined otherwise. To determine otherwise, the FAA must find no substantial adverse effect as defined in Order 7400.2, Procedures for Handling Airspace Matters, Chapter 7, Evaluating Aeronautical Effect, Section 1, General. The FAA, normally, limits aeronautical studies of existing objects to obstructions to air navigation which are not included in the criteria cited in paragraphs 211a(1) through (5).

(7) **Runway Protection Zone (RPZ).** The RPZ requires clearing of incompatible objects and activities as specified in paragraphs 212a(1)(a) and 212a(2).

(8) **General.** Other objects which require clearing are those which generally can have an adverse effect on the airport. These include objects in the inner part of the approach area (coinciding with the RPZ) such as fuel handling and storage facilities, smoke and dust generating activities, misleading lights, and those which may create glare or attract wildlife.

b. Recommendations. Other objects that are desirable to clear, if practicable, are objects that 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 that 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.

a. Standards.

(1) RPZ Configuration/Location. The RPZ is trapezoidal in shape and centered about the extended runway centerline. The central portion and controlled activity area 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 Central Portion of the RPZ. The central portion of the RPZ extends from the beginning to the end of the RPZ, centered on the runway centerline. Its width is equal to the width of the runway OFA (see Figure 2-3). Paragraph 307 contains the dimensional standards for the OFA.

(b) The Controlled Activity Area. The controlled activity area is the portion of the RPZ to the sides of the central portion of the RPZ.

(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*, and Appendix 17 for dimensional standards), 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 central portion of the RPZ. Fuel storage facilities may 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 may not be located in the RPZ.

b. 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.

c. 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. RUNWAY HOLDING POSITION (HOLDLINE). At airports with operating airport traffic control towers, runway holding positions (holdlines) identify the location on a taxiway where a pilot is to stop when he/she does not have clearance to proceed onto the runway. At airports without operating control towers, these holdlines identify the location where a pilot should assure there is adequate separation with other aircraft before proceeding onto the runway. The holdline standards, which assume a perpendicular distance from a runway centerline to an intersecting taxiway centerline, are in Tables 2-1 and 2-2. However, these distance standards may need to be longer and placed in such a way to take into account the largest aircraft (tail, body, or wing tip) expected to use the runway from penetrating the Obstacle Free Zone.

214. 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 3/4-statue mile (1200m) approach visibility minimums | | | | | | |
| Runway Centerline to: | | | | | | |
| Parallel Runway Centerline | H | Refer to paragraphs 207 and 208 | | | | |
| Holdline | | 125ft 7/ 38m | 200ft 60m | 200ft 60m | 200ft 5/ 60m | 250ft 75m |
| Taxiway/Taxilane/ Centerline 3/ | D | 150ft 45m | 225ft 67.5m | 240ft 72m | 300ft 90m | 400ft 120m |
| Aircraft Parking Area | G | 125ft 37.5m | 200ft 60m | 250ft 75m | 400ft 120m | 500ft 150m |
| Helicopter Touchdown Pad | | Refer to Advisory Circular 150/5390-2 | | | | |
| Runways with lower than 3/4-statue mile (1200m) approach visibility minimums 4/ | | | | | | |
| Runway Centerline to: | | | | | | |
| Parallel Runway Centerline | H | Refer to paragraphs 207 and 208 | | | | |
| Holdline | | 175ft 7/ 53m | 250ft 75m | 250ft 75m | 250ft 5/ 75m | 250ft 6/ 75m |
| Taxiway/Taxilane/ Centerline 3/ | D | 200ft 60m | 250ft 75m | 300ft 90m | 350ft 105m | 400ft 120m |
| Aircraft Parking Area | G | 400ft 120m | 400ft 120m | 400ft 120m | 400ft 120m | 500ft 150m |
| 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).
- 4/ For approaches with visibility less than 1/2-statue miles, runway centerline to taxiway/taxilane centerline separation increases to 400 feet (120m).
- 5/ This distance is increased 1 foot for each 100 feet above 5,100 feet above sea level.
- 6/ This distance is increased 1 foot for each 100 feet above sea level.
- 7/ The holdline dimension standards pertains to facilities for small airplanes exclusively, including airplane design groups I & II

Table 2-2. Runway Separation Standards for aircraft approach categories C & D 7/

| ITEM | DIM 1/ | AIRPLANE DESIGN GROUP | | | | | |
|---|-----------|---------------------------------------|---------------|---------------|-----------------|-----------------|-----------------|
| | | I | II | III | IV | V | VI |
| Visual runways and runways with not lower than 3/4-statue mile (1200m) approach visibility minimums | | | | | | | |
| Runway Centerline to: | | | | | | | |
| Parallel Runway Centerline | H | Refer to paragraphs 207 and 208 | | | | | |
| Holdline | | 250ft 75m | 250ft 75m | 250ft 75m | 250ft 75m | 250ft 6/ 75m | 280ft 6/ 85m |
| Taxiway/Taxilane/ Centerline 2/ | D | 300ft 90m | 300ft 90m | 400ft 120m | 400ft 120m | 3/ 3/ | 500ft 150m |
| Aircraft Parking Area | G | 400ft 120m | 400ft 120m | 500ft 150m | 500ft 150m | 500ft 150m | 500ft 150m |
| Helicopter Touchdown Pad | | Refer to Advisory Circular 150/5390-2 | | | | | |
| Runways with lower than 3/4-statue mile (1200m) approach visibility minimums | | | | | | | |
| Runway Centerline to: | | | | | | | |
| Parallel Runway Centerline | H | Refer to paragraphs 207 and 208 | | | | | |
| Holdline | | 250ft 75m | 250ft 75m | 250ft 75m | 250ft 6/ 75m | 280ft 6/ 85m | 280ft 6/ 85m |
| Taxiway/Taxilane/ Centerline 3/ | D | 400ft 120m | 400ft 120m | 400ft 120m | 400ft 120m | 3/ 4/ 3/ 4/ | 5/ 5/ |
| Aircraft Parking Area | G | 500ft 150m | 500ft 150m | 500ft 150m | 500ft 150m | 500ft 150m | 500ft 150m |
| 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 400ft (120m) for airports at or below an elevation of 1,345feet (410m); 450feet (135m) for airports between elevations for 1,345 feet (410m) and 6,560 feet (2,000m); and 500 feet (150m) for airports above an elevation of 6,560 feet (2,000m).
- 4/ For approaches with visibility less than 1/2-statue mile, the separation distance increases to 500 feet (150m) plus required OFZ elevation adjustment.
- 5/ For approaches with visibility down to 1/2-statue mile, the separation distance increases to 500 feet (150m) plus elevation adjustment. For approaches with visibility less than 1/2-statue mile, the separation distance increases to 550 feet (168m) plus required OFZ elevation adjustment.
- 6/ This distance is increased 1 foot for each 100 feet above sea level.
- 7/ For all airplane design groups under aircraft approach category D, this distance is increased 1 foot for each 100 feet above sea level.

Table 2-3. Taxiway and taxilane separation standards

| ITEM | DIM <u>1/</u> | AIRPLANE DESIGN GROUP | | | | | |
|---|------------------|-----------------------|-------------------|------------------|--------------------|------------------|----------------|
| | | I | II | III | IV | V | VI |
| <i>Taxiway Centerline to:</i> 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 <u>2</u> and <u>3/</u> | 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 |
| <i>Taxilane Centerline to:</i> Parallel Taxilane Centerline | | 64 ft 19.5 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 <u>2</u> and <u>3/</u> | | 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.

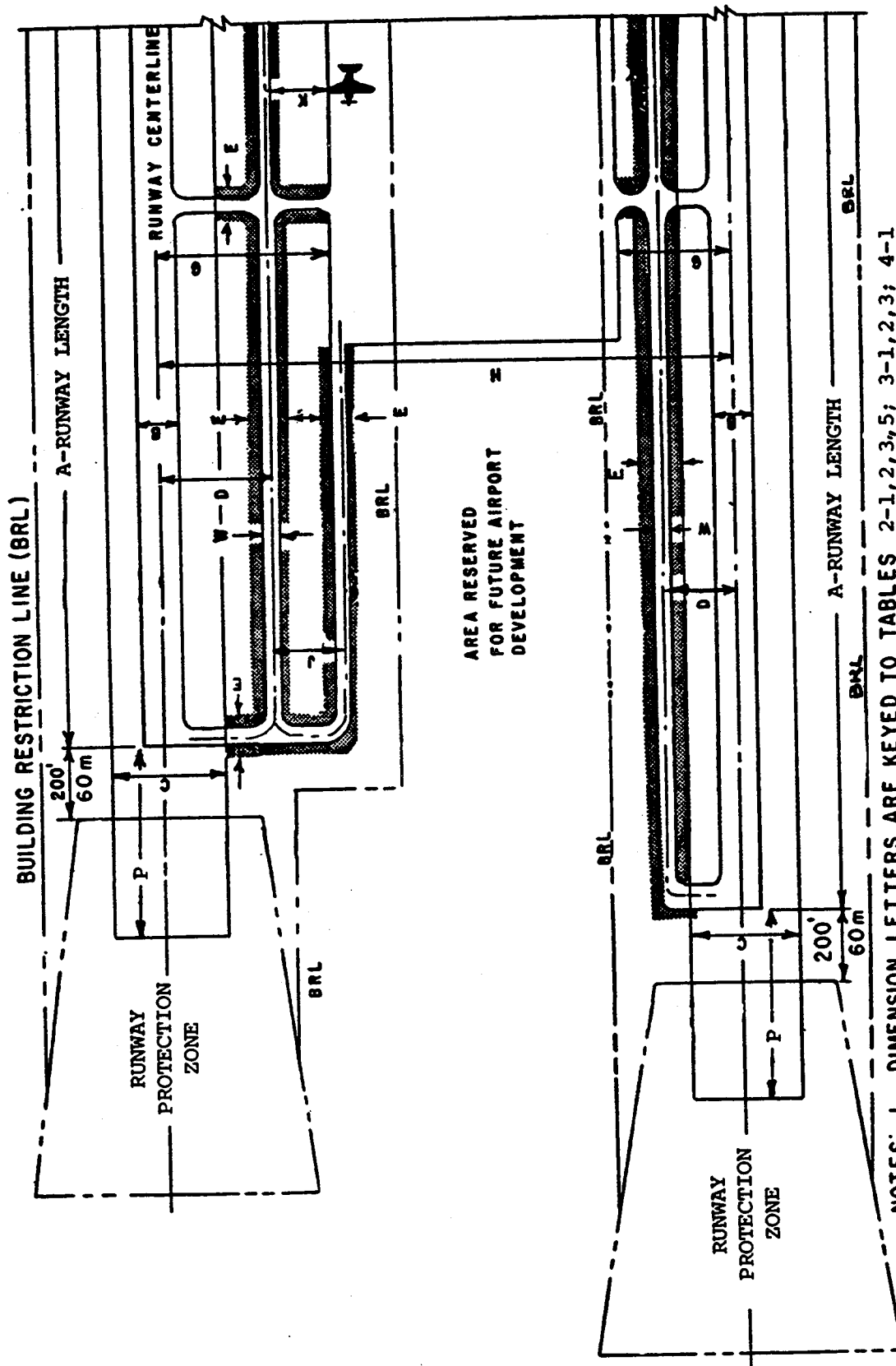
The values obtained from the following equations may be used to show that a modification of standards will provide an acceptable level of safety. Refer to paragraph 6 for guidance on modification of standard requirements.

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).



- NOTES: 1. DIMENSION LETTERS ARE KEYED TO TABLES 2-1, 2, 3, 5; 3-1, 2, 3; 4-1
 2. SHADED AREA SURROUNDING TAXIWAYS DELINEATES THE LIMITS OF THE TAXIWAY SAFETY AREA.
 3. PREFERRED LOCATION FOR BUILDING AND AIRPLANE PARKING AREA IS MIDPOINT OF RUNWAY. THE SIZE AND SHAPE ARE VARIABLE AS REQUIRED.

Figure 2-1. Typical airport layout

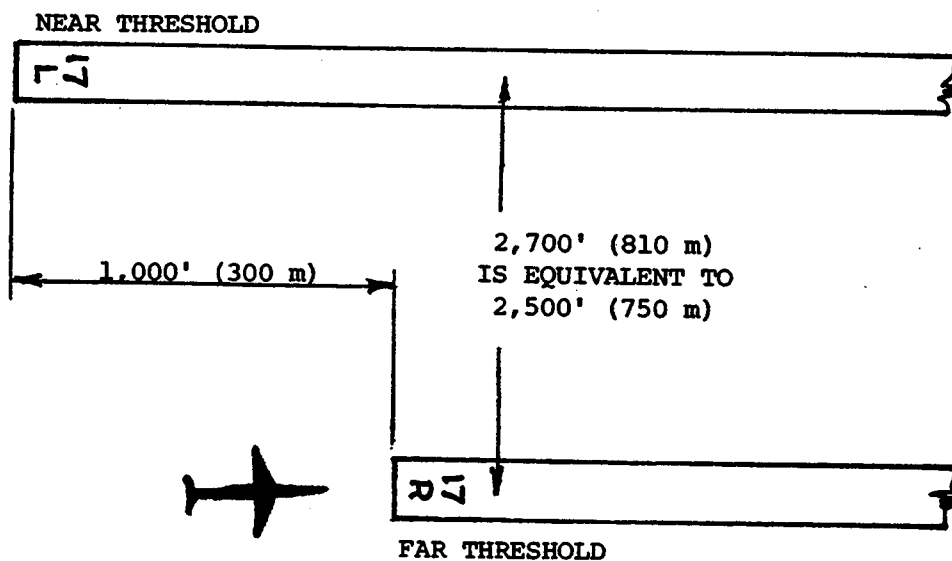
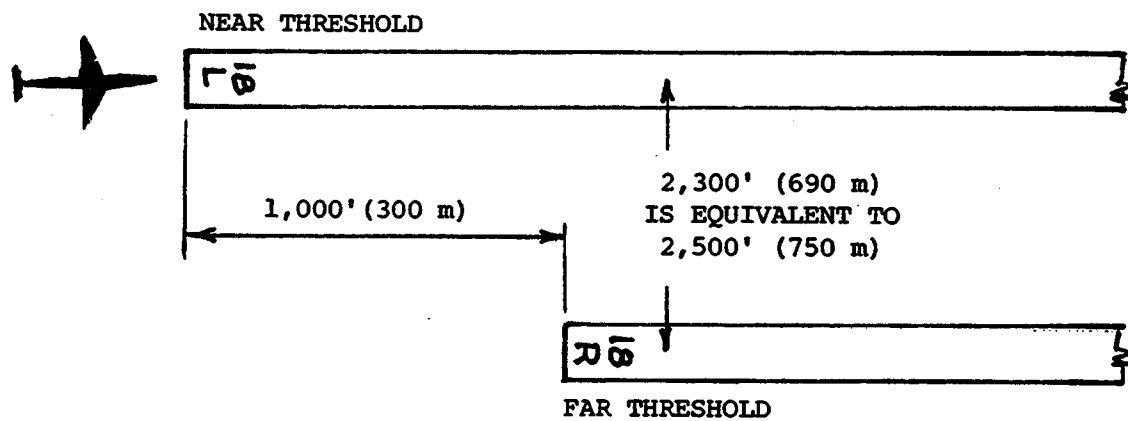


Figure 2-2. Parallel runway separation

Table 2-4. Runway protection zone (RPZ) dimensions

| Approach Visibility Minimums <u>1/</u> | Facilities Expected To Serve | Dimensions | | | |
|---|---|---------------------------------|---|---|--------------|
| | | Length L Feet (meters) | Inner Width W ₁ feet (meters) | Outer Width W ₂ feet (meters) | RPZ acres |
| Visual And Not lower than 1-Mile (1 600 m) | Small Aircraft Exclusively | 1,000 (300) | 250 (75) | 450 (135) | 8.035 |
| | Aircraft Approach Categories A & B | 1,000 (300) | 500 (150) | 700 (210) | 13.770 |
| | Aircraft Approach Categories C & D | 1,700 (510) | 500 (150) | 1,010 (303) | 29.465 |
| Not lower than ³ / ₄ -Mile (1 200 m) | All Aircraft | 1,700 (510) | 1,000 (300) | 1,510 (453) | 48.978 |
| Lower than ³ / ₄ -Mile (1 200 m) | All Aircraft | 2,500 (750) | 1,000 (300) | 1,750 (525) | 78.914 |

1/ The RPZ dimensional standards are for the runway end with the specified approach visibility minimums. The departure RPZ dimensional standards are equal to or less than the approach RPZ dimensional standards. When a RPZ begins other than 200 feet (60 m) beyond the runway end, separate approach and departure RPZs should be provided. Refer to Appendix 14 for approach and departure RPZs.

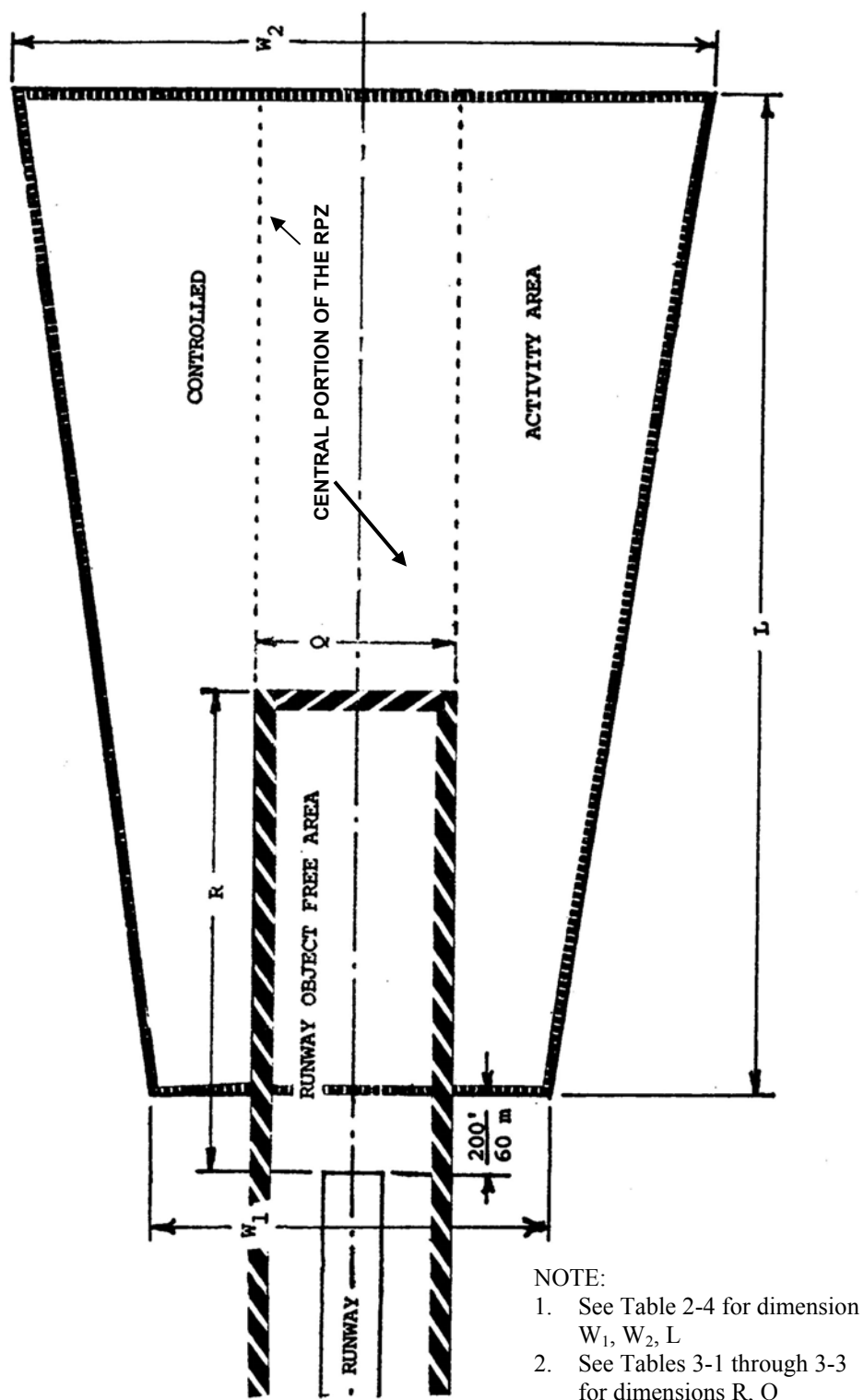


Figure 2-3. Runway protection zone

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 firefighting 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 firefighting 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, to the extent practicable, 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.

c. **Sub-standard RSAs.** RSA standards cannot be modified or waived like other airport design standards. The dimensional standards remain in effect regardless of the presence of natural or man-made objects or surface conditions that might create a hazard to aircraft that leave the runway surface. Facilities, including NAVAIDs, that would not normally be permitted in an RSA should not be installed inside the standard RSA dimensions even when the RSA does not meet standards in other respects. A continuous evaluation of all practicable alternatives for improving each sub-standard RSA is required until it meets all standards for grade, compaction, and object frangibility. FAA Order 5200.8, Runway Safety Area Program, explains the process for conducting this evaluation. Each FAA regional Airports division manager has a written determination of the best practicable alternative(s) for improving each RSA. Therefore, runway and RSA improvement projects must comply with the determination of the FAA regional Airports division manager.

d. Threshold Displacement. Incremental improvements that involve the displacement of a landing threshold need to be carefully planned so that they do not incur unnecessary costs or create situations that could compromise operational safety.

(1) Runway thresholds that are displaced temporarily pending the planned relocation of objects (such as Localizer antennas) should consider the extra costs associated with re-arranging the runway lights, approach lights and navigational aids.

(2) The displacement of a threshold that does not also include relocation of the lead-in taxiway can create an undesirable and confusing operating environment for the pilot. (See paragraph 204.)

e. Allowance for Navigational Aids. The RSA is intended to enhance the margin of safety for landing or departing aircraft. Accordingly, the design of an RSA must account for navigational aids that might impact the effectiveness of the RSA:

(1) RSA grades sometimes require approach lights to be mounted on massive towers that could create a hazard for aircraft. Therefore, consider any practicable RSA construction to a less demanding grade than the standard grade to avoid the need for massive structures.

(2) Instrument landing system (ILS) facilities (glide slopes and localizers) are not usually required to be located inside the RSA. However, they do require a graded area around the antenna. (See chapter 6 for more information on the siting of ILS facilities.) RSA construction that ends abruptly in a precipitous drop-off can result in design proposals where the facility is located inside the RSA. Therefore, consider any practicable RSA construction beyond the standard dimensions that could accommodate ILS facilities if and when they are installed.

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 precision OFZ, the inner-approach OFZ, and the inner-transitional OFZ comprise the obstacle free zone (OFZ). Figures 3-2, 3-3, 3-4, 3-5, and 3-6 show the OFZ.

a. Runway OFZ (ROFZ). 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,

$$H_{\text{feet}} = 61 - 0.094(S_{\text{feet}}) - 0.003(E_{\text{feet}}).$$

2) In SI units,

$$H_{\text{meters}} = 18.4 - 0.094(S_{\text{meters}}) - 0.003(E_{\text{meters}}).$$

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

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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,

$$H_{\text{feet}} = 53 - 0.13(S_{\text{feet}}) - 0.0022(E_{\text{feet}}) \text{ and distance}$$

$$Y_{\text{feet}} = 440 + 1.08(S_{\text{feet}}) - 0.024(E_{\text{feet}}).$$

- 2) In SI units,

$$H_{\text{meters}} = 16 - 0.13(S_{\text{meters}}) - 0.0022(E_{\text{meters}}) \text{ and distance}$$

$$Y_{\text{meters}} = 132 + 1.08(S_{\text{meters}}) - 0.024(E_{\text{meters}}).$$

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.

d. Precision OFZ. The Precision Obstacle Free Zone (POFZ) is defined as a volume of airspace above an area beginning at the runway threshold, at the threshold elevation, and centered on the extended runway centerline, 200 feet (60m) long by 800 feet (240m) wide. See figure 3-6.

The surface is in effect only when all of the following operational conditions are met:

- (1) Vertically guided approach
- (2) Reported ceiling below 250 feet and/or visibility less than $\frac{3}{4}$ statute mile (or RVR below 4000 feet)
- (3) An aircraft on final approach within two (2) miles of the runway threshold.

When the POFZ is in effect, a wing of an aircraft holding on a taxiway waiting for runway clearance may penetrate the POFZ; however neither the fuselage nor the tail may infringe on the POFZ.

The POFZ is applicable at all runway ends including displaced thresholds.

Note: POFZ takes effect no later than January 1, 2007 for all runway ends at which it applies.

307. OBJECT FREE AREA. The runway object free area (OFA) is centered on the runway centerline. The runway 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. Tables 3-1, 3-2, and 3-3 specify the standard dimensions of the runway OFA. Extension of the OFA beyond the standard length to the maximum extent feasible is encouraged. See figure 2-3.

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 for international airports) for each operational direction.

310. RESCUE AND FIREFIGHTING ACCESS.

Rescue and firefighting access roads are normally needed to provide unimpeded two-way access for rescue and firefighting 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 firefighting operations.

a. Recommendation. It is recommended that the entire runway safety area (RSA) and runway protection zone (RPZ) be accessible to rescue and firefighting 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 firefighting access roads are all weather roads designed to

support rescue and firefighting 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 firefighting 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 firefighting 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 firefighting 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 <u>1/</u> | AIRPLANE DESIGN GROUP | | | | |
|--|------------------|----------------------------|----------|-----------|------------|-----------|
| | | <u>1 2/</u> | I | II | III | IV |
| Runway Length | A | - Refer to paragraph 301 - | | | | |
| Runway Width | B | 60 ft | 60 ft | 75 ft | 100 ft | 150 ft |
| | | 18 m | 18 m | 23 m | 30 m | 45 m |
| Runway Shoulder Width | | 10 ft | 10 ft | 10 ft | 20 ft | 25 ft |
| | | 3 m | 3 m | 3 m | 6 m | 7.5 m |
| Runway Blast Pad Width | | 80 ft | 80 ft | 95 ft | 140 ft | 200 ft |
| | | 24 m | 24 m | 29 m | 42 m | 60 m |
| Runway Blast Pad Length | | 60 ft | 100 ft | 150 ft | 200 ft | 200 ft |
| | | 18 m | 30 m | 45 m | 60 m | 60 m |
| Runway Safety Area Width | C | 120 ft | 120 ft | 150 ft | 300 ft | 500 ft |
| | | 36 m | 36 m | 45 m | 90 m | 150 m |
| Runway Safety Area Length Prior to Landing Threshold <u>3/</u> , <u>4/</u> | | 240 ft | 240 ft | 300 ft | 600 ft | 600 ft |
| | | 72 m | 72 m | 90 m | 180 m | 180 m |
| Runway Safety Area Length Beyond RW End <u>3/</u> , <u>4/</u> | P | 240 ft | 240 ft | 300 ft | 600 ft | 1,000 ft |
| | | 72 m | 72 m | 90 m | 180 m | 300 m |
| Obstacle Free Zone Width and Length | | - Refer to paragraph 306 - | | | | |
| Runway Object Free Area Width | Q | 250 ft | 400 ft | 500 ft | 800 ft | 800 ft |
| | | 75 m | 120 m | 150 m | 240 m | 240 m |
| Runway Object Free Area Length Beyond RW End <u>5/</u> | R | 240 ft | 240 ft | 300 ft | 600 ft | 1,000 ft |
| | | 72 m | 72 m | 90 m | 180 m | 300 m |

- 1/ Letters correspond to the dimensions on figures 2-1 and 2-3. Use this table only when both ends of the runway provide not lower than 3/4-statute mile approach visibility minimums.
- 2/ These dimensional standards pertain to facilities for small airplanes exclusively.
- 3/ The runway safety area (RSA) length begins at each runway end when a stopway is not provided. When a stopway is provided, the length begins at the stopway end.
- 4/ The standard RSA length beyond the runway end may be reduced to the standard RSA length prior to landing threshold if a standard Engineered Materials Arresting System (EMAS) is provided. To qualify for this reduction, the EMAS installation must provide the ability to stop the critical aircraft exiting the end of the runway at 70 knots, and the runway must provide either instrument or visual vertical guidance for approaches in the opposite direction. See AC 150/5220-22.
- 5/ The runway object free area length beyond the end of the runway never exceeds the standard RSA length beyond the runway end as provided by note 4 above.

Table 3-2. Runway design standards for aircraft approach category 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 <u>1/</u> | AIRPLANE DESIGN GROUP | | | | |
|--|------------------|----------------------------|----------|-----------|------------|-----------|
| | | <u>1 2/</u> | <u>I</u> | <u>II</u> | <u>III</u> | <u>IV</u> |
| Runway Length | A | - Refer to paragraph 301 - | | | | |
| Runway Width | B | 75 ft | 100 ft | 100 ft | 100 ft | 150 ft |
| | | 23 m | 30 m | 30 m | 30 m | 45 m |
| Runway Shoulder Width | | 10 ft | 10 ft | 10 ft | 20 ft | 25 ft |
| | | 3 m | 3 m | 3 m | 6 m | 7.5 m |
| Runway Blast Pad Width | | 95 ft | 120 ft | 120 ft | 140 ft | 200 ft |
| | | 29 m | 36 m | 36 m | 42 m | 60 m |
| Runway Blast Pad Length | | 60 ft | 100 ft | 150 ft | 200 ft | 200 ft |
| | | 18 m | 30 m | 45 m | 60 m | 60 m |
| Runway Safety Area Width | C | 300 ft | 300 ft | 300 ft | 400 ft | 500 ft |
| | | 90 m | 90 m | 90 m | 120 m | 150 m |
| Runway Safety Area Length Prior to Landing Threshold <u>3/</u> , <u>4/</u> | | 600 ft | 600 ft | 600 ft | 600 ft | 600 ft |
| | | 180 m | 180 m | 180 m | 180 m | 180 m |
| Runway Safety Area Length Beyond RW End <u>3/</u> | P | 600 ft | 600 ft | 600 ft | 800 ft | 1,000 ft |
| | | 180 m | 180 m | 180 m | 240 m | 300 m |
| Obstacle Free Zone Width and Length | | - Refer to paragraph 306 - | | | | |
| Runway Object Free Area Width | Q | 800 ft | 800 ft | 800 ft | 800 ft | 800 ft |
| | | 240 m | 240 m | 240 m | 240 m | 240 m |
| Runway Object Free Area Length Beyond RW End <u>5/</u> | R | 600 ft | 600 ft | 600 ft | 800 ft | 1,000 ft |
| | | 180 m | 180 m | 180 m | 240 m | 300 m |

- 1/ Letters correspond to the dimensions on figures 2-1 and 2-3. Use this table for both ends of the runway even when one end does not have lower than 3/4-statute mile visibility minimums.
- 2/ These dimensional standards pertain to facilities for small airplanes exclusively.
- 3/ The runway safety area (RSA) length begins at each runway end when a stopway is not provided. When a stopway is provided, the length begins at the stopway end.
- 4/ The standard RSA length beyond the runway end may be reduced to the standard RSA length prior to landing threshold if a standard Engineered Materials Arresting System (EMAS) is provided. To qualify for this reduction, the EMAS installation must provide the ability to stop the critical aircraft exiting the end of the runway at 70 knots, and the runway must provide either instrument or visual vertical guidance for approaches in the opposite direction. See AC 150/5220-22.
- 5/ The runway object free area length beyond the end of the runway never exceeds the standard RSA length beyond the runway end as provided by note 4 above.

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 <u>1/</u> | AIRPLANE DESIGN GROUP | | | | | |
|--|------------------|----------------------------|----------|---------------------|----------|----------|----------|
| | | I | II | III | IV | V | VI |
| Runway Length | A | - Refer to paragraph 301 - | | | | | |
| Runway Width | B | 100 ft | 100 ft | 100 ft <u>2/</u> | 150 ft | 150 ft | 200 ft |
| | | 30 m | 30 m | 30 m <u>2/</u> | 45 m | 45 m | 60 m |
| Runway Shoulder Width <u>3/</u> | | 10 ft | 10 ft | 20 ft <u>2/</u> | 25 ft | 35 ft | 40 ft |
| | | 3 m | 3 m | 6 m <u>2/</u> | 7.5 m | 10.5 m | 12 m |
| Runway Blast Pad Width | | 120 ft | 120 ft | 140 ft <u>2/</u> | 200 ft | 220 ft | 280 ft |
| | | 36 m | 36 m | 42 m <u>2/</u> | 60 m | 66 m | 84 m |
| Runway Blast Pad Length | | 100 ft | 150 ft | 200 ft | 200 ft | 400 ft | 400 ft |
| | | 30 m | 45 m | 60 m | 60 m | 120 m | 120 m |
| Runway Safety Area Width <u>4/</u> | C | 500 ft | 500 ft | 500 ft | 500 ft | 500 ft | 500 ft |
| | | 150 m | 150 m | 150 m | 150 m | 150 m | 150 m |
| Runway Safety Area Length Prior to Landing Threshold <u>5/</u> , <u>6/</u> | | 600 ft | 600 ft | 600 ft | 600 ft | 600 ft | 600 ft |
| | | 180 m | 180 m | 180 m | 180 m | 180 m | 180 m |
| Runway Safety Area Length Beyond RW End <u>5/</u> , <u>6/</u> | P | 1,000 ft | 1,000 ft | 1,000 ft | 1,000 ft | 1,000 ft | 1,000 ft |
| | | 300 m | 300 m | 300 m | 300 m | 300 m | 300 m |
| Obstacle Free Zone Width and Length | | - Refer to paragraph 306 - | | | | | |
| Runway Object Free Area Width | Q | 800 ft | 800 ft | 800 ft | 800 ft | 800 ft | 800 ft |
| | | 240 m | 240 m | 240 m | 240 m | 240 m | 240 m |
| Runway Object Free Area Length Beyond RW End <u>7/</u> | R | 1,000 ft | 1,000 ft | 1,000 ft | 1,000 ft | 1,000 ft | 1,000 ft |
| | | 300 m | 300 m | 300 m | 300 m | 300 m | 300 m |

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 Code C-I and C-II, a runway safety area width of 400 feet (120 m) is permissible.

5/ The runway safety area (RSA) length begins at each runway end when a stopway is not provided. When a stopway is provided, the length begins at the stopway end.

6/ The standard RSA length beyond the runway end may be reduced to the standard RSA length prior to landing threshold if a standard Engineered Materials Arresting System (EMAS) is provided. To qualify for this reduction, the EMAS installation must provide the ability to stop the critical aircraft exiting the end of the runway at 70 knots, and the runway must provide either instrument or visual vertical guidance for approaches in the opposite direction. See AC 150/5220-22.

7/ The runway object free area length beyond the end of the runway never exceeds the standard RSA length beyond the runway end as provided by note 6 above.

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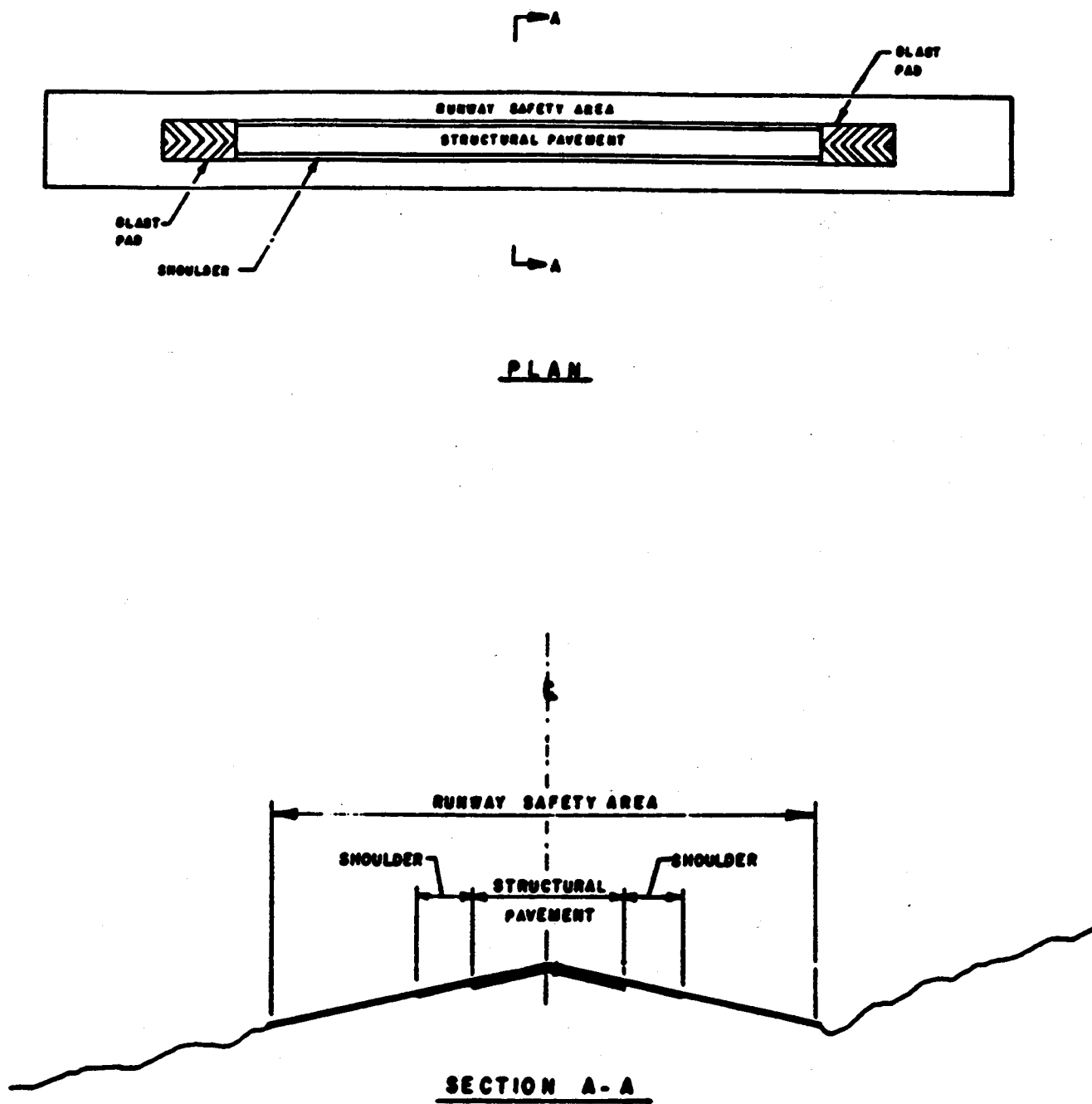


Figure 3-1. Runway safety area

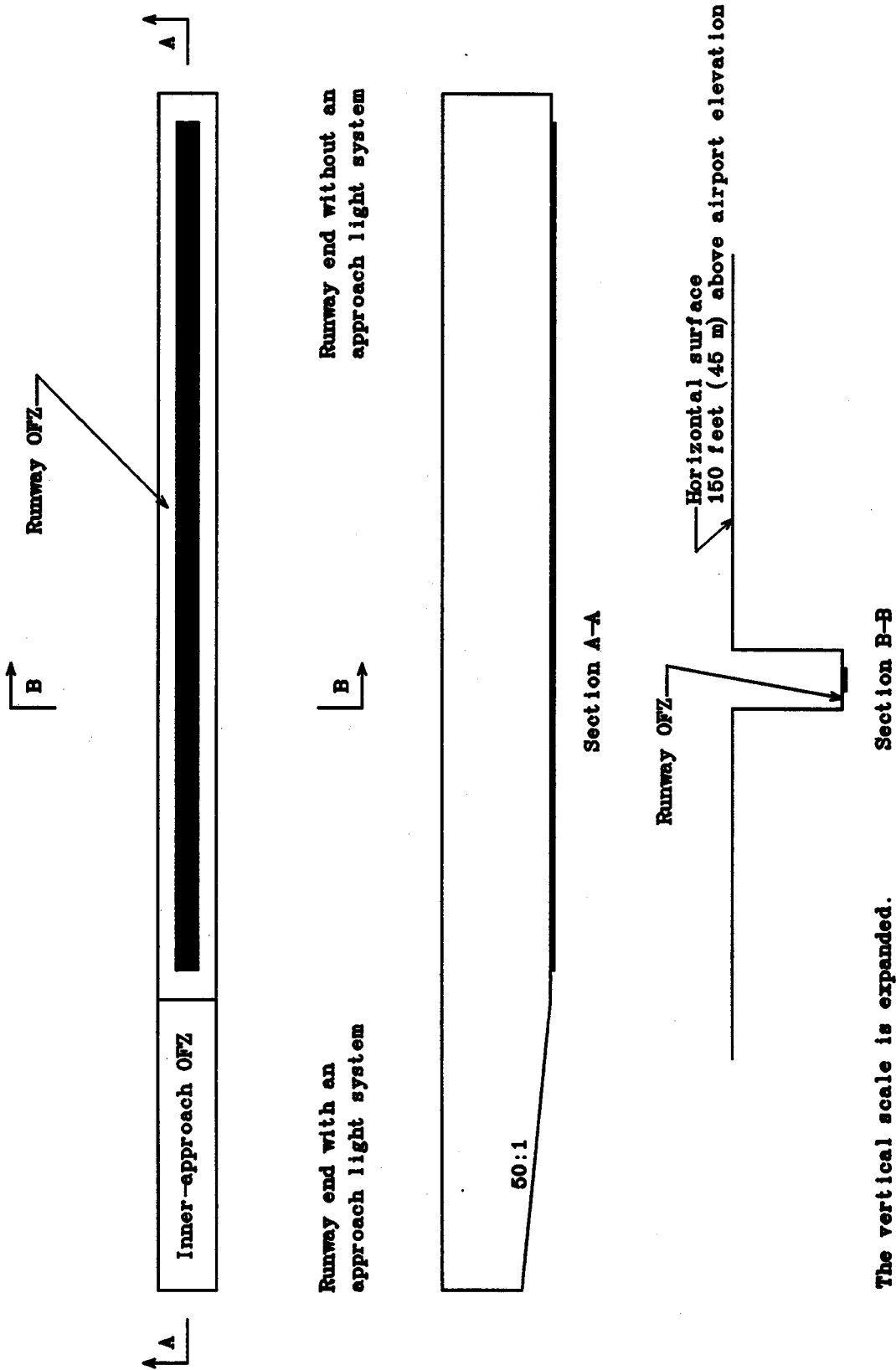


Figure 3-2. Obstacle free zone (OFZ) for visual runways and runways with not lower than 3/4-statute mile (1 200 m) approach visibility minimums

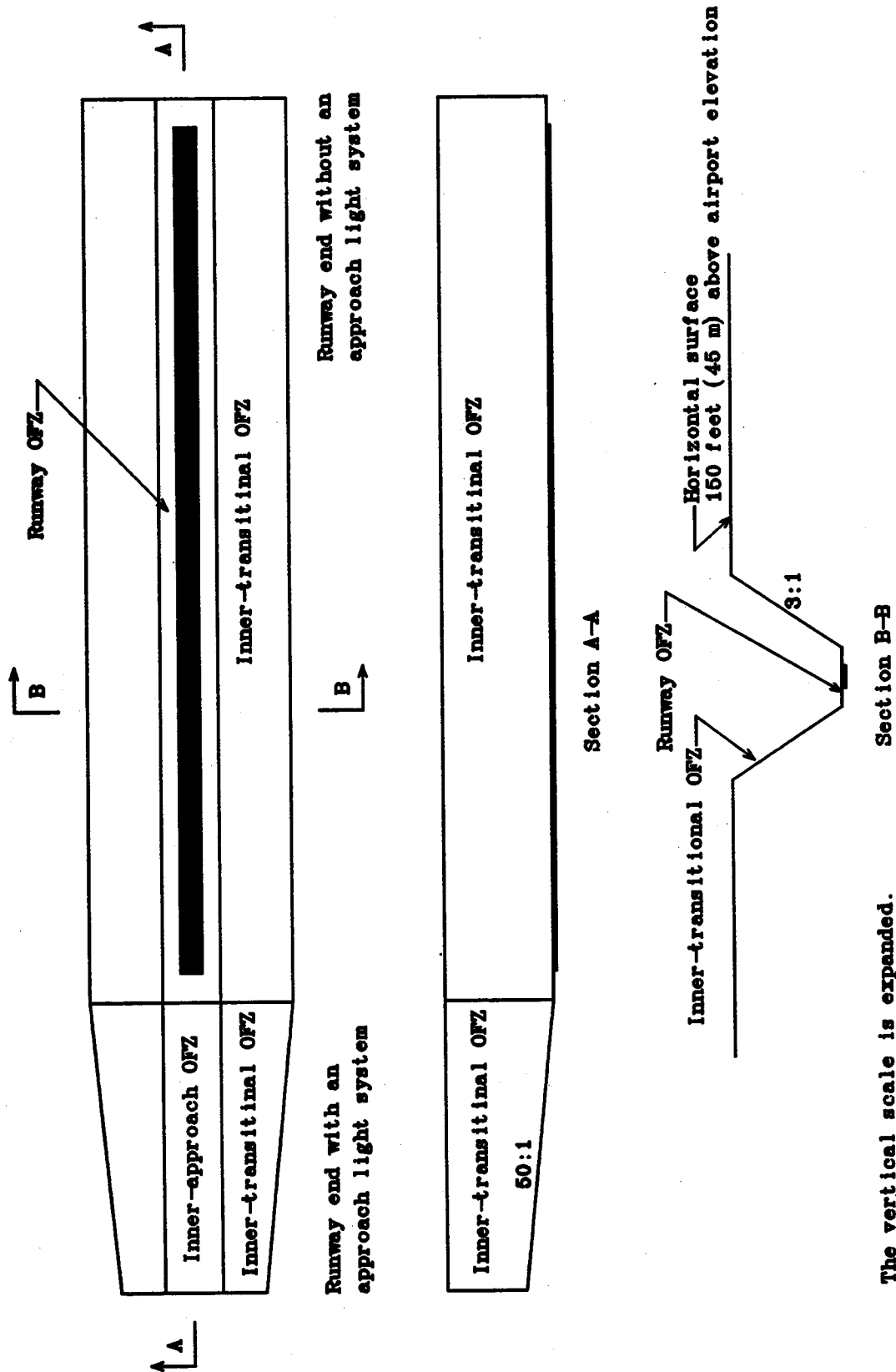


Figure 3-3. Obstacle free zone (OFZ) for runways serving small airplanes exclusively with lower than 3/4-statute mile (1 200 m) approach visibility minimums

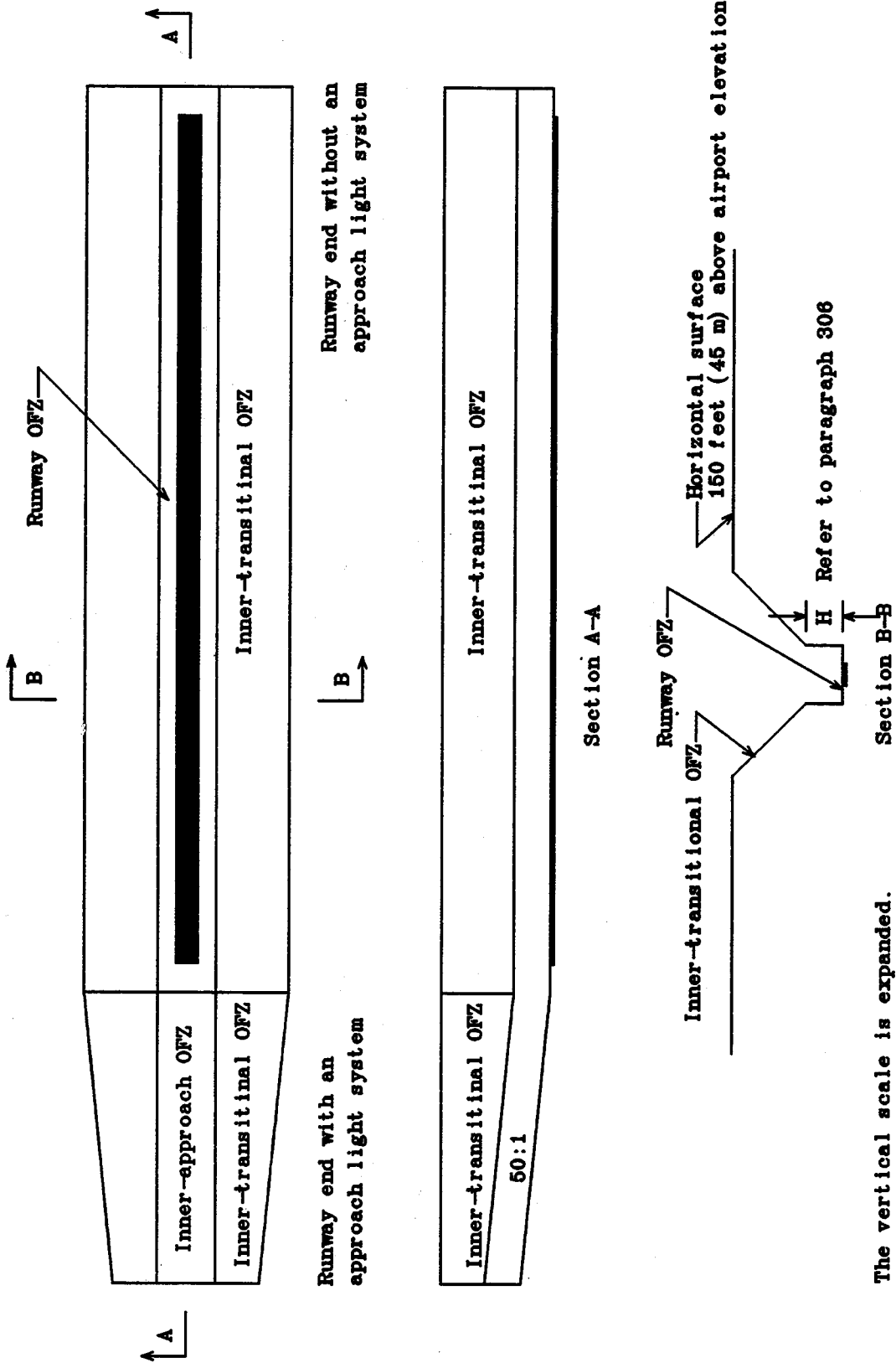


Figure 3-4. Obstacle free zone (OFZ) for runways serving large airplanes with lower than 3/4-statute mile (1 200 m) approach visibility minimums

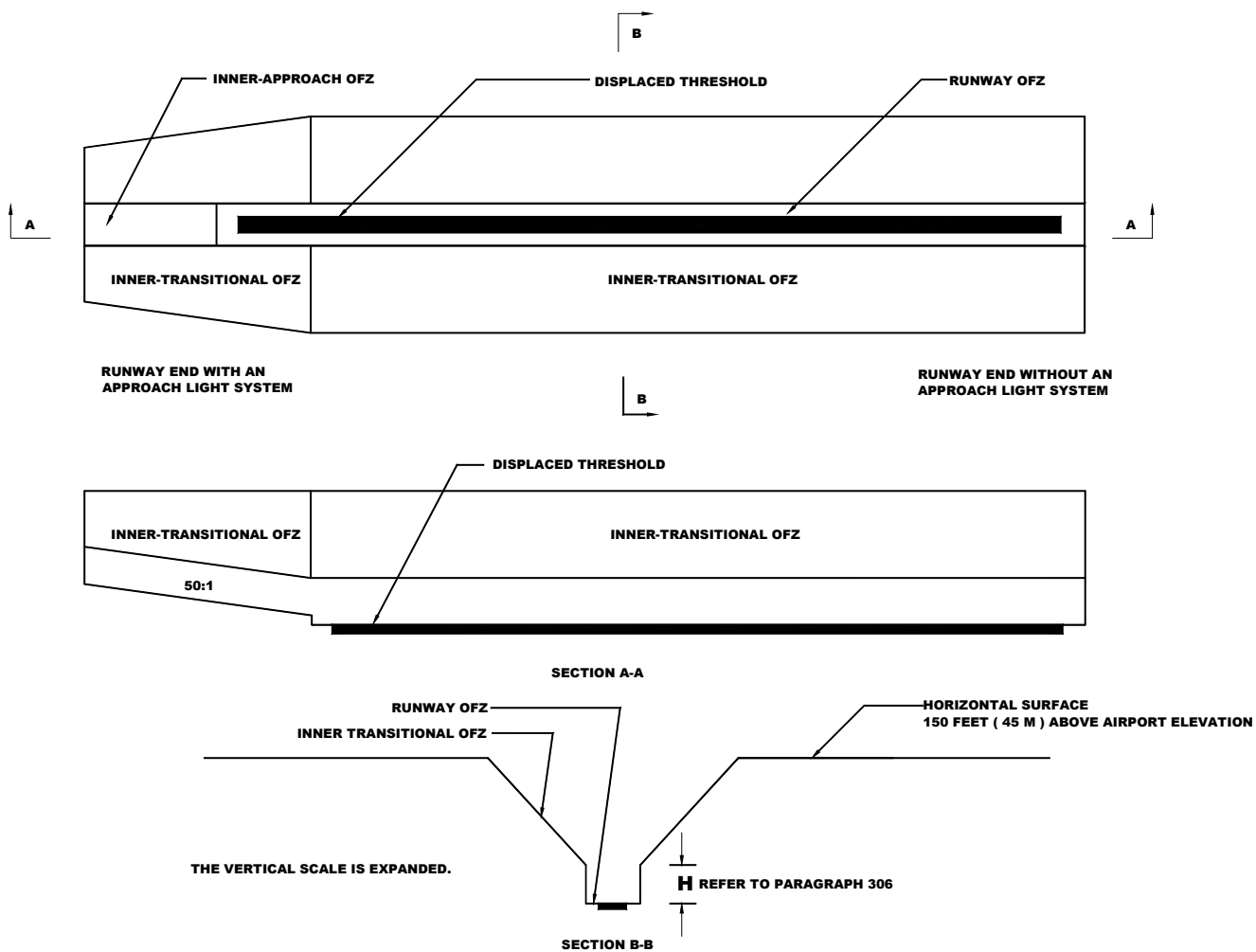


FIGURE 3-5. OBSTACLE FREE ZONE (OFZ) FOR RUNWAYS SERVING LARGE AIRPLANES WITH LOWER THAN 3/4-STATUTE MILE (1 200 M) APPROACH VISIBILITY MINMUMS AND DISPLACED THRESHOLD

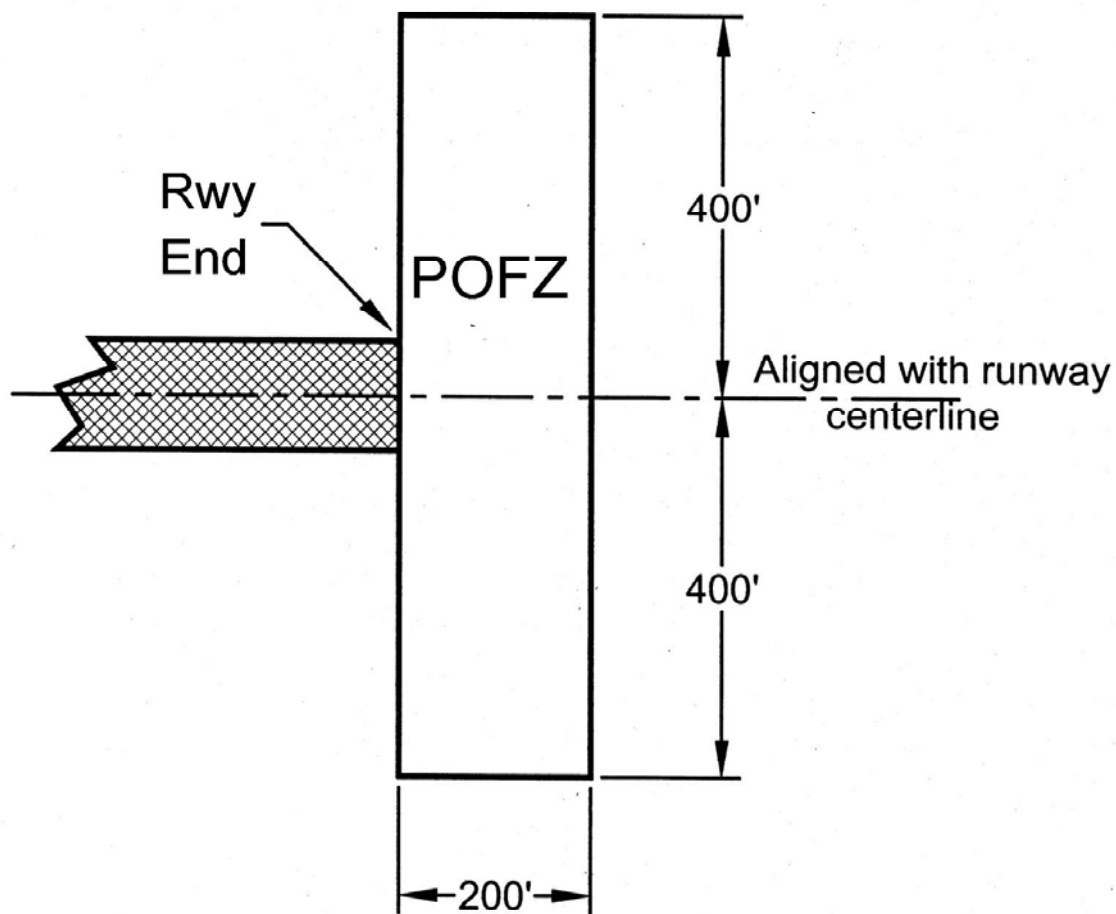


Figure 3-6. Precision Obstacle Free Zone

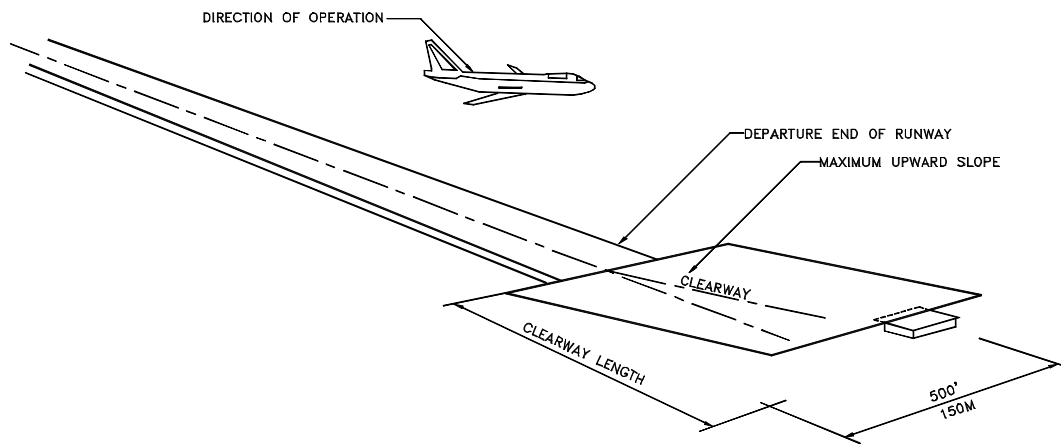


Figure 3-7. Clearway

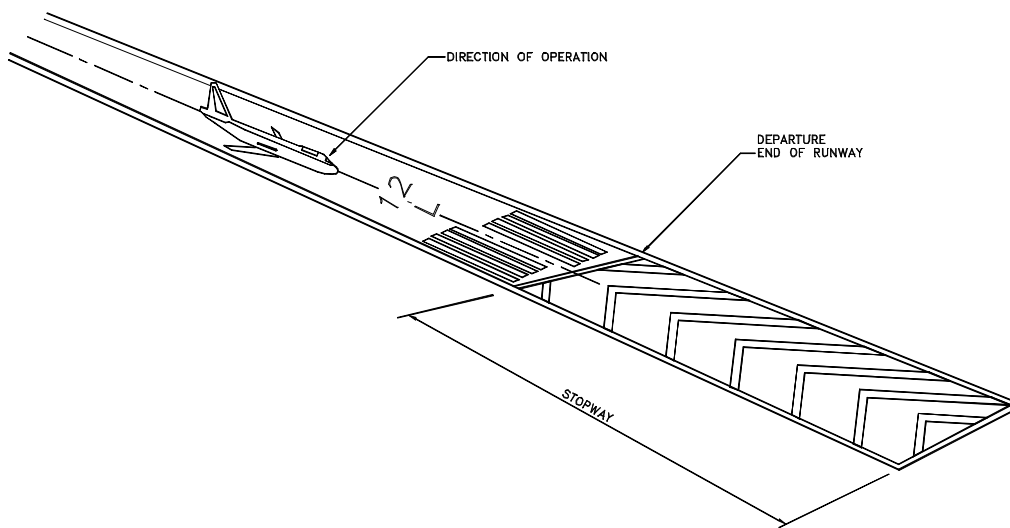


Figure 3-8. Stopway

Chapter 4. TAXIWAY AND TAXILANE DESIGN

400. INTRODUCTION. This chapter presents the design standards for taxiways, taxilanes, and associated airport elements.

401. DIMENSIONAL STANDARDS. Tables 4-1 and 4-2 present the dimensional standards for taxiway, taxilanes, and associated elements. Appendix 9 discusses the relationship between airplane physical characteristics and the design of taxiway and taxilane elements. The rationale presented there is useable, on a case-by-case basis, to adapt separation standards to meet unusual local conditions or to accommodate a specific airplane within an airplane design group.

402. TAXIWAY SHOULDERS. Provide stabilized or paved shoulders to reduce the possibility of blast erosion and engine ingestion problems associated with jet engines that overhang the edge of the taxiway pavement. Table 4-1 presents taxiway shoulder width standards. Soil with turf not suitable for this purpose requires a stabilized or low-cost paved surface. Chapter 8 contains additional information on this subject.

403. TAXIWAY SAFETY AREA (TSA). The taxiway safety area is centered on the taxiway centerline. Table 4-1 presents taxiway safety area dimensional standards.

a. Design Standards. The taxiway 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 firefighting 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 taxiway 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 taxiway safety areas shall be to FAA specification P-152 found in AC 150/5370-10.

404. TAXIWAY AND TAXILANE OBJECT FREE AREA (OFA). The taxiway and taxilane OFAs

are centered on the taxiway and taxilane centerlines as shown in figures A9-2, A9-3, and A9-4.

a. The taxiway and taxilane OFA clearing standards prohibit service vehicle roads, parked airplanes, and above ground objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes. Vehicles may operate within the OFA provided they give right of way to oncoming aircraft by either maintaining a safe distance ahead or behind the aircraft or by exiting the OFA to let the aircraft pass. Provide vehicular exiting areas along the outside of the OFA where required. Table 4-1 specifies the standard dimensions for OFAs.

b. OFA clearance fillets shall be provided at intersections and turns where curved taxiway or taxilane centerline pavement markings, reflectors, or lighting are provided. The OFA clearance fillets shall be configured to provide the standard wingtip clearance for the using aircraft. Appendix 9 provides guidance for finding the wingtip trace and Table 4-3 specifies the standard wingtip clearances.

c. Offset taxilane pavement markings may be used at existing facilities where it is impracticable to upgrade the facility to existing standards or as a temporary measure to assure adequate wingtip clearance until upgraded facilities meeting design standards are completed. The offset taxilane pavement markings should be located on an arc offset and parallel to the curved centerline. The radius of the offset arc should be approximately $(R^2 + d^2)^{0.5}$. R being the radius of the taxilane turn and d being a representative distance from the center of cockpit to the center of the main undercarriage of the larger wingspan aircraft. Increasing the offset radius increases the clearance inside of the curve while decreasing the clearance outside of the curve. Both clearances for each of the larger wingspan aircraft need to be examined. Where offset taxilane pavement markings are provided, centerline lighting or reflectors are required.

405. PARALLEL TAXIWAY. A basic airport consists of a runway with a full-length parallel taxiway, an apron, and connecting transverse taxiways between the runway, parallel taxiway, and the apron.

a. Separation Distance. Tables 2-1 and 2-2 show the standard separation distances between parallel taxiways and runways.

b. Centerline Profile. The centerline profile of a parallel taxiway should prevent excessive longitudinal grades on crossover or transverse taxiways. Chapter 5 provides the standards for taxiway longitudinal grades.

406. TAXIWAY INTERSECTIONS. An airplane pilot may negotiate a taxiway turn by either maintaining the cockpit over the centerline or by judgmental oversteering.

a. Cockpit Over Centerline. Taxiway intersections designed to accommodate cockpit over centerline steering require more pavement, but enable more rapid movement of traffic with minimal risk of aircraft excursions from the pavement surface. Intersections should be designed to accommodate cockpit over centerline steering to the extent practicable. Where taxiway centerline lighting or reflectors are installed, intersections shall be designed for cockpit over centerline steering.

b. Judgmental Oversteering. Taxiway intersections designed to accommodate the judgmental oversteering method of maneuvering require the least pavement widening. However, judgmental oversteering requires complex maneuvering, increases the risk of aircraft excursions from the pavement surface, and slows the flow of traffic.

c. Design. Figure 4-1 shows the most common designs of taxiway-taxiway intersections and tables 4-1 and 4-2 present associated dimensional standards. The designs also apply to taxiway-apron intersections. Adjusting these shapes to achieve more efficient construction procedures may be desirable and should be a cost basis consideration. For example, squaring the venturi areas or designing the pavement fillets, by using either the methodology presented in appendix 10 or a computer program to provide the standard taxiway edge safety margin, may produce a more cost-effective design. Figure 4-4 is a printout from such a program that is operable on an IBM PC compatible computer. Appendix 11 gives details on availability of this program.

d. Limitations. The criteria depicted in figure 4-1 apply to taxiway-taxiway intersections and taxiway-apron intersections and not to runway-taxiway intersections. Discussion and details on runway-taxiway intersections with accompanying figures are in subsequent paragraphs.

407. ENTRANCE TAXIWAYS.

a. Dual Use. An entrance taxiway also serves as the final exit taxiway on a bidirectional runway. It is normally in the form of an "L" taxiway intersection with a right angle connection to the runway.

b. Radius. The centerline radius of curvature should be as large as possible to accommodate higher speeds. The radius is dependent on the separation distance between the runway and parallel taxiway.

c. Design. The entrance design shown in figure 4-5, with a centerline radius of 200 feet (60 m), will allow entrance speeds of 20 mph (30 km per hour), the minimum design speed for the taxiway system. Larger radii will permit higher entrance speeds. The design width requires at least the taxiway edge safety margin specified in table 4-1.

408. BYPASS TAXIWAYS. Air traffic personnel at busy airports encounter occasional bottlenecks when moving airplanes ready for departure to the desired takeoff runway. Bottlenecks result when a preceding airplane is not ready for takeoff and blocks the access taxiway. Bypass taxiways provide flexibility in runway use by permitting ground maneuvering of steady streams of departing airplanes. An analysis of existing and projected traffic indicates if a bypass taxiway will enhance traffic flow.

a. Location. Bypass taxiway locations are normally at or near the runway end. They can be parallel to the main entrance taxiway serving the runway, as shown in figure 4-6, or used in combination with the dual parallel taxiways, as depicted in figure 4-7.

b. Design. Bypass taxiway widths require at least the standard taxiway edge safety margin. The separation and clearance standards are the same as for parallel taxiways.

409. HOLDING BAYS. Providing holding bays instead of bypass taxiways also enhances capacity. Holding bays provide a standing space for airplanes awaiting final air traffic control (ATC) clearance and to permit those airplanes already cleared to move to their runway takeoff position. By virtue of their size, they enhance maneuverability for holding airplanes while also permitting bypass operations. A holding bay should be provided when runway operations reach a level of 30 per hour.

a. Location. Although the most advantageous position for a holding bay is adjacent to the taxiway serving the runway end, it may be satisfactory in other locations. Place holding bays to keep airplanes out of the OFZ and the runway safety area, as well as avoiding interference with instrument landing system operations.

b. Design. Figure 4-8 shows some typical holding bay configurations. Paving the area between dual parallel taxiways may provide an acceptable holding bay.

410. TURNAROUNDS. A turnaround can serve as a combination holding bay and bypass taxiway, when it is not economically feasible to provide a parallel taxiway. The turnaround needs to extend far enough away from the runway so airplanes will be able to remain behind the hold line. Figure 4-9 shows a taxiway turnaround.

411. DUAL PARALLEL TAXIWAYS. To accommodate high-density traffic, airport planners should consider multiple access to runways. For example, to facilitate ATC handling when using directional flow releases, e.g., south departure, west departure, etc., airplanes may be selectively queued on dual (or even triple) parallel taxiways. A dual parallel taxiway need not extend the full length of runway. Crossover taxiways between dual parallel taxiways increase flexibility. See figure 4-10.

412. TAXIWAY BETWEEN PARALLEL RUNWAYS. A taxiway located between two parallel runways requires a centerline separation from each runway to meet the standard separation distance specified in table 2-1.

413. EXIT TAXIWAYS. Design and locate exit taxiways to meet the operational requirements of the airport.

a. Efficiency. Appendix 9 provides guidance on exit taxiway location utilization. AC 150/5060-5 provides guidance on the effect of exit taxiway location on runway capacity. Exit taxiways should permit free flow to the parallel taxiway or at least to a point where air traffic control considers the airplane clear of the runway.

b. Type. A decision to provide a right-angled exit taxiway or a standard acute-angled exit taxiway rests upon an analysis of the existing and contemplated traffic. The purpose of an acute-angled exit taxiway, commonly referred to as a “high speed exit,” is to enhance airport capacity. However, when the design peak hour traffic is less than 30 operations (landings and takeoffs), a properly located right-angled exit taxiway will achieve an efficient flow of traffic.

c. Separation. The type of exit taxiway influences runway and taxiway separation. The standard runway-taxiway separations specified in tables 2-1 and 2-2 are satisfactory for right-angled exit taxiways. A separation distance of at least 600 feet (180 m) is necessary for an efficient acute-angled exit taxiway, which includes a reverse curve for “double-back” operations. The runway-taxiway separations specified in tables 2-1 and 2-2 are adequate for acute-angled exits where the taxiway traffic flow is in the direction of landing.

d. Configuration. Figure 4-1 illustrates the configuration for a right-angled exit taxiway. An entrance spiral of at least 30 degrees and 300 feet (90 m) in length should be provided. Figure 4-12 illustrates the standard acute-angled exit taxiway with a 30-degree angle of intersection and a 1,400-foot (420 m) entrance spiral. When runway capacity needs justify the additional cost, high-visibility taxiway centerline lights can be added and the exit taxiway widened by doubling the taxiway edge safety margin. These design enhancements will increase pilot acceptance of an exit. Figures 4-13 and 4-14 present a computer printout of layout data for a 1,400-foot (420 m) spiral exit using a program operable on IBM compatible equipment. Appendix 11 gives details on the availability of this program.

414. APRON TAXIWAYS AND TAXILANES. Requirements often exist to provide through-taxi routes across an apron and to provide access to gate positions or other terminal areas.

a. Apron Taxiways. Apron taxiways may be located either inside or outside the movement area. Apron taxiways require the same separations as other taxiways. When the apron taxiway is along the edge of the

apron, locate its centerline inward from the apron edge at a distance equal to one-half of the width of the taxiway structural pavement. A shoulder is necessary along the outer edge in addition to the taxiway safety area and the separations specified in tables 2-1, 2-2, 2-3, and 4-1.

b. Taxilanes. Taxilanes are located outside the movement area. Taxilanes provide access from taxiways (usually an apron taxiway) to airplane parking positions and other terminal areas. When the taxilane is along the edge of the apron, locate its centerline inward from the apron edge at a distance equal to one-half of the width of the taxiway structural pavement and satisfy other apron edge taxiway criteria, i.e., a shoulder, safety area, and the separations specified in tables 2-1, 2-2, 2-3, and 4-1.

c. Visibility. Airport traffic control tower personnel require a clear line of sight to all apron taxiways under air traffic control (ATC). Although ATC is not responsible for controlling taxilane traffic, a clear line of sight to taxilanes is desirable.

415. END-AROUND TAXIWAYS. In an effort to increase operational capacity, airports have added dual and sometimes triple parallel runways, which can cause delays when outboard runway traffic has to cross active inboard runways to make its way to the terminal. To improve efficiency and provide a safe means of movement around the departure end of a runway, it might be feasible to construct a taxiway that allows aircraft to transition around the ends of the runway. This type of taxiway is called an End-Around Taxiway (EAT). Due to the safety critical nature of these operations, it is necessary for planners to work closely with the FAA prior to considering the use of an EAT. EATs should be done only to enhance safety and capacity. Before EAT projects are proposed and feasibility studies and/or design started, they must be pre-approved by the FAA Office of Airport Safety and Standards, Airport Engineering Division (AAS-100). Submission for project approval is through the local Airports District Office for coordination with the approval authority (AAS-100). See figure 4-15.

a. Design Considerations. End-around taxiways must remain outside of the standard runway safety area (RSA), which extends 1,000 feet along the centerline extended of the departure end of the runway (DER). In addition, the EAT must be entirely outside of the ILS critical area. An airspace study for each site should be performed to verify if the tail height of the critical design group aircraft operating on the EAT does not penetrate any FAA Order 8260.3 TERPS surface and meets the requirements of 14 CFR 121.189 for the net takeoff flight path to clear all obstacles either by a height of at least 35 feet vertically, or by at least 200 feet horizontally within the airport boundaries.

b. Visual Screen. The placement and configuration of EATs must take into account additional

restrictions to prevent interfering with navigational aids, approaches and departures from the runway(s) with which they are associated. In order to avoid potential issues where pilots departing from a runway with an EAT might mistake an aircraft taxiing on the EAT for one actually crossing near the departure end of the runway, a visual screen type device may be required, depending on the elevation changes at a specific location. Through a partial or complete masking effect, the visual screen will enable pilots to better discern when an aircraft is crossing the active runway versus operating on the EAT. The intent is to eliminate any false perceptions of runway incursions, which could lead to unnecessary aborted takeoffs, and alert pilots to actual incursion situations. A visual screen is required for any new EAT unless the elevation of the EAT centerline, at a point in line with the extended runway centerline, is at least 29 feet below the elevation at the DER, so the terrain creates a natural masking of the aircraft on the EAT. Research has shown that “masking” is accomplished at a height where a critical design group aircraft’s wing-mounted engine nacelle would be blocked from view, as discerned from the V-1 point during take-off. DO not locate the visual screen structure within any runway safety area, taxiway obstacle free zone, critical ILS area, or should it penetrate the inner approach OFZ, the approach light plane or other TERPS surfaces.

(1) Screen Sizing. The size of the EAT visual screen is dependent on the runway geometry, the size of the critical design group aircraft operating at that particular airport (on both the departing and EAT), and the elevation relationship between the EAT and the departing runway.

(a) Horizontal Geometry. The width of the screen should be designed to be perceived to originate and end at the taxiway/runway hold line(s) at the DER from a position on the runway equivalent to V1 (take-off decision speed under maximum conditions) for the critical design group aircraft. In order to calculate the screen width, the distance to where the screen will be located beyond the runway end must first be determined. From the runway centerline location of V1 for the design aircraft, lines are drawn through the runway hold line position closest to the DER (normally derived from the Aircraft Holding Position Location in Advisory Circular 150/5340-18) and extended until they intersect with a line perpendicular to the runway at the screen location. See figure 4-16. Use the formula in Figure 4-17 to calculate the width of the visual screen.

(b) Vertical Geometry. The vertical height of the screen must be designed so the top of the screen will mask that portion of an aircraft that extends up to where the top of a wing-mounted engine nacelle would be of a critical design group aircraft taxiing on the EAT, as viewed from the cockpit of the same design group aircraft at the typical V1 point on the departure runway. In a situation where the EAT and the

DER elevation are the same, the lower edge of the visual panels should be at the same vertical height as the centerline of the DER. The visual panels of the screen should extend from that point, up to the heights shown in table 4-4, depending on the design group aircraft. For the higher design groups, it is permissible to have the lower limit of the visual screen up to two (2) feet above the DER elevation, as shown in table 4-4. Variations in terrain at the site where the screen is to be constructed will need to be considered, and they may result in the screen being a sizeable distance off the ground. In the event the EAT and DER are at different elevations, either higher or lower, the overall screen height will have to be adjusted to ensure the same masking capability. Tables 4-5, 4-6, and 4-7 provide guidance on determining the height of the visual screen for the respective design groups if the elevation of the EAT is below the elevation of the DER. If the EAT is lower than 29 feet in elevation as compared to the centerline of the DER, a screen is not required. Table 4-8 provides guidance on determining the height of the visual screen for design groups 3 through 6 if the elevation of the EAT is above the elevation of the DER. It may be feasible to grade the site of the visual screen to allow for an additional 2-foot separation between the visual screen panels and the ground for mowing access.

(2) Screen Construction. The visual screen must be constructed to perform as designed and be durable, resistant to weather, frangible, and resistant to excessive wind speeds. The visual screen comprises foundations, frame, connection hardware, and front panels.

(a) Foundations. The foundation of the screen structure should be sufficient to hold the visual screen in position. The base of the foundation should have a sufficient mow strip around it to provide a safety buffer between mowing equipment and the screen structure.

(b) Frame. The frame structure of the screen should be constructed so it is durable, able to withstand wind loading, and frangible in construction. Figure 4-18 illustrates three methods for constructing the frame structure, depending on the overall height of the structure. The visual screen structure should be constructed to allow the front panels of the screen to be angled upward 12 ($\pm 1^\circ$) degrees from the vertical plane. All connections within the frame structure, the panels, and the foundations should be designed to break away from the structure in the event an aircraft impacts them.

(c) Front Panel. The front panel of the visual screen should be designed so it is conspicuous from the runway side of the screen. The front panel should be constructed of aluminum honeycomb material, as described in the next paragraph. The replaceable front panels should be 12 feet long and 4

feet high and attached to the frame structure so as to allow easy replacement if necessary. See figure 4-19.

(i) Aluminum

Honeycomb Performance Criteria. The screen panels should be constructed of aluminum honeycomb material, as described in this section. The front panel of the screen should be constructed of 4-foot-tall panels, with the remaining difference added as required. For example, three 4-foot-high panels plus one 1-foot-tall panel would be used to create a 13-foot-tall screen. These panels should be undersized by 0.50 inches to allow for thermal and deflection movements. The front and back panel faces should be specified to meet the required deflection allowance and should be a minimum 0.04 inches thick. The honeycomb material should be of sufficient thickness to meet the required deflection allowance, but should not be more than 3 inches thick. The internal aluminum honeycomb diameter should be of sufficient strength to meet the required deflection allowance, but should not be more than 0.75 inches in diameter. The panel edge closures should be of aluminum tube that is 1 inch times the thickness of the honeycomb and sealed. The deflection allowance for the screen is 0.50 inches maximum at the center of the panel when supported by four points at the corner of the panel. The panel faces should have a clear anodized finish on both front and back. The wind-loading deflection should be as specified in table 4-9.

(ii) Pattern. The front panel of the screen should visually depict a continuous, alternating red and white, diagonal striping of 12-foot-wide stripes set at a 45-degree angle \pm five (5) degrees, sloped either all to the left or all to the right. To provide maximum contrast, the slope of the diagonal striping on the screen should be opposite the slope of aircraft tails operating in the predominant flow on the EAT, as shown in Figure 4-20.

(iii) Color. The front panel of the screen should be reflective red and white. The colors of the retroreflective sheeting used to create the visual screen must conform to Chromaticity Coordinate Limits shown in table 4-10, when measured in accordance with Federal Specification FP-85, Section 718.01(a), or ASTM D 4956.

(iv) Reflectivity. The surface of the front panel should be reflective on the runway side of the screen. Measurements should be made in accordance with ASTM E810, *Standard Test Method for Coefficient of Retro-reflection of Retro-reflective Sheeting*. The sheeting must maintain at least 90 percent of its values, as shown in table 4-11, with water falling on the surface, when measured in accordance with the standard rainfall test of FP-85, Section 718.02(a), and Section 7.10.0 of AASHTO M 268.

(v) Adhesion. The screen surface material must have a pressure-sensitive adhesive,

which conforms to adhesive requirements of FP-85 (Class 1) and ASTM D 4956 (Class 1). The pressure-sensitive adhesive is recommended for application by hand or with a mechanical squeeze roller applicator. This type adhesive lends itself to large-scale rapid production of signs. Applications should be made with sheeting and substrate at temperatures above 65° F (18°C).

(3) Environmental Performance.

The front panel of the screen surface material and all its required components must be designed for continuous outdoor use under the following conditions:

(a) Temperature. Screen surface material must withstand the following ambient temperature ranges: -4 degrees to +131 degrees F (-20 degrees to +55 degrees C).

(b) Wind Loading. The screen must be able to sustain exposure to wind velocities of at least 90 mph or the appropriate velocity rating anticipated for the specific airport location, whichever is greater.

(c) Rain. The screen surface material must withstand exposure to wind-driven rain.

(d) Sunlight. The screen surface material must withstand exposure to direct sunlight.

(e) Lighting. If required, the top edge of the visual screen should be illuminated with steady burning, L-810 FAA-approved obstruction lighting, as provided in the current version of AC 150/5345-43, and positioned as specified in paragraph 58(b) of the current version of AC 70/7460-1.

(4) Provision for Alternate Spacing of Visual Screen. If access is needed through the area where the visual screen is constructed, various sections of the screen may be staggered up to 50 feet from each other, as measured from the runway end, so an emergency vehicle can safely navigate between the staggered sections of screen. The sections of screen must be overlapped so the screen appears to be unbroken when viewed from the runway, at the V1 takeoff position.

(5) Frangibility. The screen structure, including all of its components, should be of the lowest mass possible to meet the design requirements so as to minimize damage should the structure be impacted. The foundations at ground level should be designed so they will shear on impact, the vertical supports should be designed so they will give way, and the front panels should be designed so they will release from the screen structure if impacted. The vertical support posts should be tethered at the base so they will not tumble when struck. Figure 4-21 provides information on how this level of frangibility can be achieved.

(6) Navigational Aid Consideration. The following considerations should be given when determining

the siting and orientation of the visual screen. The visual screen may have adverse affects on navigational aids if it is not sited properly. The uniqueness and complexity of the airport siting environment requires that all installations be addressed on a case-by-case basis, so mitigations can be developed to ensure the installation of the visual screen does not significantly navigational aid performance.

(a) Approach Light Plane. No part of the visual screen may penetrate the approach light plane.

(b) Radar Interference. Research has shown that a visual screen erected on an airport equipped with Airport Surface Detection Equipment (ASDE) may reflect signals that are adverse to the ASDE operation. To avoid this, the visual screen should be tilted back/away (on the side facing the ASDE) 12 degrees ($\pm 1^\circ$). This will minimize or eliminate false radar

targets generated by reflections off the screen surface. Examples of this tilting are shown in figure 4-18.

(c) Instrument Landing System (ILS) Interference. Research has shown that the presence of visual screens on a runway instrumented with an ILS system (localizer and glide slope) will generally not affect or interfere with the operation of the system. An analysis must be performed for glide slopes, especially null reference glide slopes, prior to the installation of the screens. The uniqueness and complexity of the airport siting environment requires that all installations be addressed on a case-by-case basis, so mitigations can be developed to ensure the installation of the visual screen does not significantly impact the performance of the ILS.

416. to 499. RESERVED.

Table 4-1. Taxiway dimensional standards

| ITEM | DIM <u>1/</u> | AIRPLANE DESIGN GROUP | | | | | |
|---------------------------------------|------------------|------------------------|--------|-----------------|--------|------------------|-----------------|
| | | I | II | III | IV | V | VI |
| Taxiway Width | W | 25 ft | 35 ft | 50 ft <u>2/</u> | 75 ft | 75 ft | 100 ft |
| | | 7.5 m | 10.5 m | 15 m <u>2/</u> | 23 m | 23 m | 30 m |
| Taxiway Edge Safety Margin <u>3/</u> | | 5 ft | 7.5 ft | 10 ft <u>4/</u> | 15 ft | 15 ft | 20 ft |
| | | 1.5 m | 2.25 m | 3 m <u>4/</u> | 4.5 m | 4.5 m | 6 m |
| Taxiway Pavement Fillet Configuration | | - Refer to Table 4-2 - | | | | | |
| Taxiway Shoulder Width | | 10 ft | 10 ft | 20 ft | 25 ft | 35 ft <u>5/</u> | 40 ft <u>5/</u> |
| | | 3 m | 3 m | 6 m | 7.5 m | 10.5 m <u>5/</u> | 12 m <u>5/</u> |
| Taxiway Safety Area Width | E | 49 ft | 79 ft | 118 ft | 171 ft | 214 ft | 262 ft |
| | | 15 m | 24 m | 36 m | 52 m | 65 m | 80 m |
| Taxiway Object Free Area Width | | 89 ft | 131 ft | 186 ft | 259 ft | 320 ft | 386 ft |
| | | 27 m | 40 m | 57 m | 79 m | 97 m | 118 m |
| Taxilane Object Free Area Width | | 79 ft | 115 ft | 162 ft | 225 ft | 276 ft | 334 ft |
| | | 24 m | 35 m | 49 m | 68 m | 84 m | 102 m |

1/ Letters correspond to the dimensions on figures 2-1 and 4-1.

2/ For airplanes in Airplane Design Group III with a wheelbase equal to or greater than 60 feet (18 m), the standard taxiway width is 60 feet (18 m).

3/ The taxiway edge safety margin is the minimum acceptable distance between the outside of the airplane wheels and the pavement edge.

4/ For airplanes in Airplane Design Group III with a wheelbase equal to or greater than 60 feet (18 m), the taxiway edge safety margin is 15 feet (4.5 m).

5/ Airplanes in Airplane Design Groups V and VI normally require stabilized or paved taxiway shoulder surfaces.

Consideration should be given to objects near runway/taxiway/taxilane intersections, which can be impacted by exhaust wake from a turning aircraft.

The values obtained from 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 standards requirements.

Taxiway safety area width equals the airplane wingspan;

Taxiway OFA width equals 1.4 times airplane wingspan plus 20 feet (6 m); and

Taxilane OFA width equals 1.2 times airplane wingspan plus 20 feet (6 m).

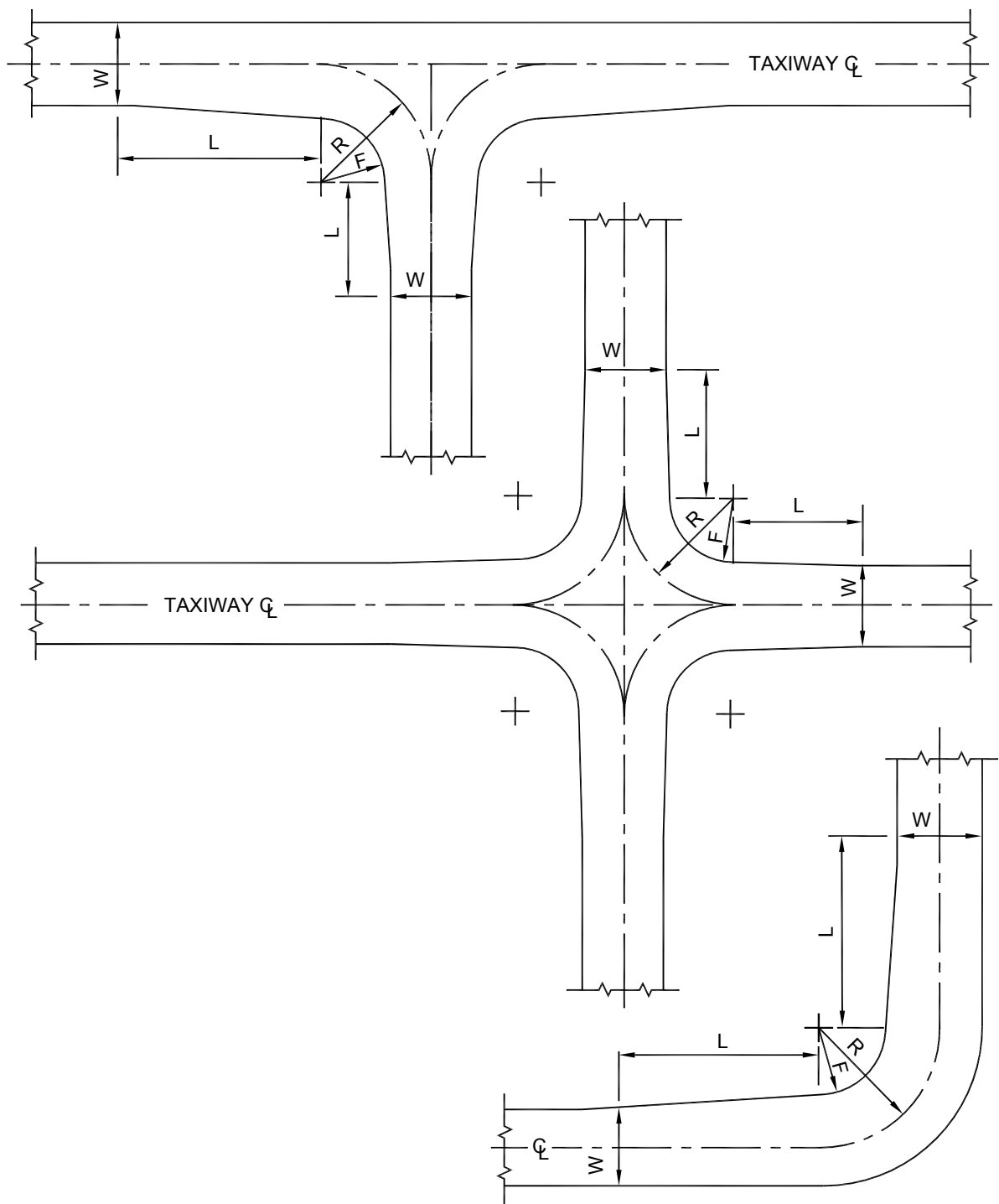


Figure 4-1. Taxiway intersection details

Table 4-2. Taxiway fillet dimensions

| ITEM | DIM 1/ | AIRPLANE DESIGN GROUP | | | | | |
|---|-----------|-----------------------|--------------------|-----------------|------------------|------------------|-----------------|
| | | I | II | III 2/ | IV | V | VI |
| Radius of Taxiway Turn 3/ | R | 75 ft 22.5 m | 75 ft 22.5 m | 100 ft 30 m | 150 ft 45 m | 150 ft 45 m | 170 ft 51 m |
| Length of Lead-in to Fillet | L | 50 ft 15 m | 50 ft 15 m | 150 ft 45 m | 250 ft 75 m | 250 ft 75 m | 250 ft 75 m |
| Fillet Radius for Tracking Centerline | F | 60 ft 18 m | 55 ft 16.5 m | 55 ft 16.5 m | 85 ft 25.5 m | 85 ft 25.5 m | 85 ft 25.5 m |
| Fillet Radius for Judgmental Oversteering Symmetrical Widening 4/ | F | 62.5 ft 18.75 m | 57.5 ft 17.25 m | 68 ft 20.4 m | 105 ft 31.5 m | 105 ft 31.5 m | 110 ft 33 m |
| Fillet Radius for Judgmental Oversteering One Side Widening 5/ | F | 62.5 ft 18.75 m | 57.5 ft 17.25 m | 60 ft 18 m | 97 ft 29 m | 97 ft 29 m | 100 ft 30 m |

1/ Letters correspond to the dimensions on figure 4-1.

2/ Airplanes in Airplane Design Group III with a wheelbase equal to or greater than 60 feet (18 m) should use a fillet radius of 50 feet (15 m).

3/ Dimensions for taxiway fillet designs relate to the radius of taxiway turn specified. Figures 4-2 and 4-3 show taxiway fillet designs that provide the standard taxiway edge safety margin for a range of wheelbase and undercarriage width combinations. Custom-designed pavement fillet are necessary when the specified "R" or the undercarriage (also undercarriage to cockpit) dimensions fall outside of the standard taxiway edge safety margin of figures 4-2 and 4-3. The equations in appendix 10 or the use of a computer program offer this ability. Appendix 11 gives details on availability of this program.

4/ The center sketch of figure 4-1 displays pavement fillets with symmetrical taxiway widening.

5/ The lower sketch of figure 4-1 displays a pavement fillet with taxiway widening on one side.

Table 4-3. Wingtip clearance standards

| ITEM | DIM | AIRPLANE DESIGN GROUP | | | | | |
|----------------------------|-----|-----------------------|----------------|-----------------|-----------------|----------------|---------------|
| | | I | II | III | IV | V | VI |
| Taxiway Wingtip Clearance | | 20 ft 6 m | 26 ft 8 m | 34 ft 10.5 m | 44 ft 13.5 m | 53 ft 16 m | 62 ft 19 m |
| Taxilane Wingtip Clearance | | 15 ft 4.5 m | 18 ft 5.5 m | 22 ft 6.5 m | 27 ft 8 m | 31 ft 9.5 m | 36 ft 11 m |

The values obtained from 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 standards requirements.

Taxiway wingtip clearance equals 0.2 times airplane wingspan plus 10 feet (3 m) and

Taxilane wingtip clearance equals 0.1 times airplane wingspan plus 10 feet (3 m).

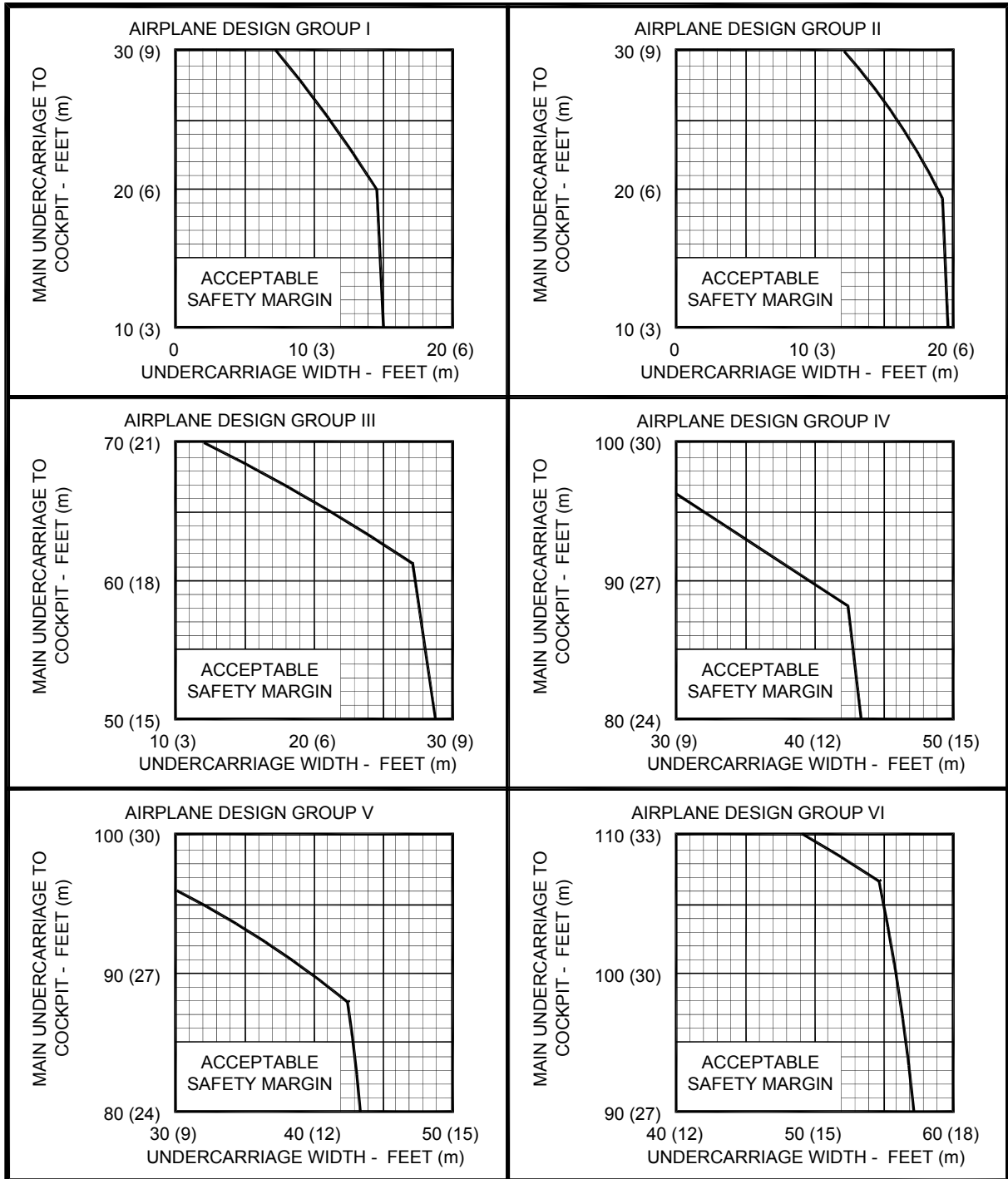


Figure 4-2. Maintaining cockpit over centerline

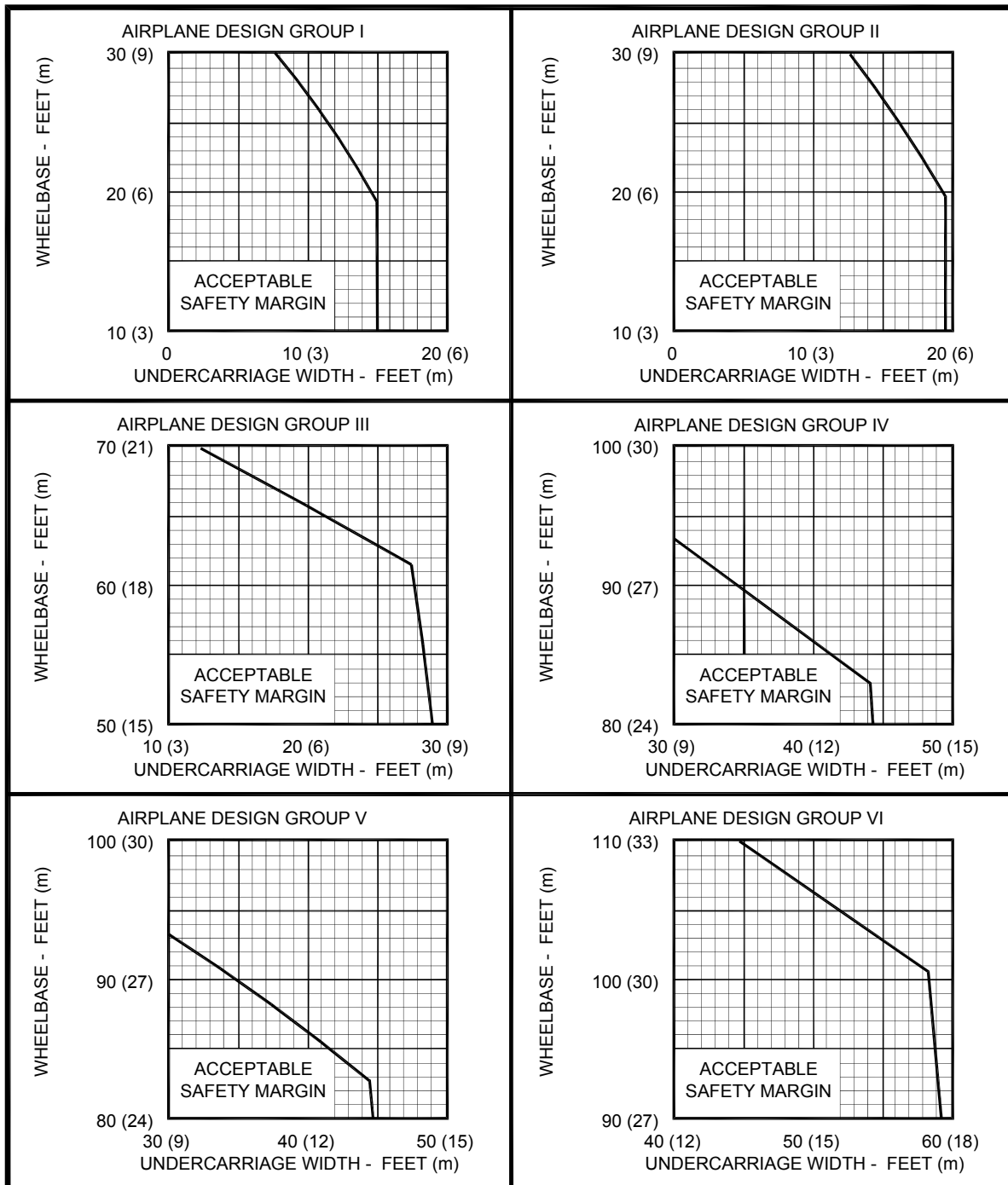


Figure 4-3. Judgmental oversteering

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AC 150/5300-13 CHG 2

OFFSET DISTANCES ON A TAXIWAY INTERSECTION OR CURVE

| | |
|---|--------|
| Airplane wheelbase | 84.000 |
| Center of airplane cockpit to nosewheel | 6.000 |
| Airplane undercarriage width [1.15 x main gear track] | 41.000 |
| Taxiway edge safety margin | 15.000 |
| Taxiway width | 75.000 |

AIRPLANE COCKPIT ON CENTERLINE

| | | | |
|--------------------|-----------|--------------|---------|
| Entrance Station | 0.000 | Radius | 150.000 |
| Tangent Length | ***** | | |
| Intersection Angle | 180.00000 | Curve Length | 471.239 |
| Tangent Length | ***** | | |
| Exit Station | 471.239 | Radius | 150.000 |
| Entrance Station | 471.239 | | |
| Tangent Length | 328.761 | | |
| Exit Station | 800.000 | | |

| STATION | LEFT OFFSET | RIGHT OFFSET | STEERING ANGLES | X COORDINATE | Y COORDINATE | CENTERLINE ANGLE |
|---------|----------------|-----------------|--------------------|-----------------|-----------------|---------------------|
| 0.000 | 43.57 | 28.58 | 0.000 | 0.000 | 0.000 | 0.00000 |
| 50.000 | 51.88 | 19.58 | 14.676 | 49.079 | 8.256 | 19.09859 |
| 100.000 | 56.92 | 15.00 | 23.246 | 92.755 | 32.117 | 38.19718 |
| 150.000 | 60.05 | 15.00 | 28.382 | 126.221 | 68.955 | 57.29577 |
| 200.000 | 62.03 | 15.00 | 31.528 | 145.791 | 114.714 | 76.39436 |
| 250.000 | 63.28 | 15.00 | 33.486 | 149.311 | 164.359 | 95.49295 |
| 300.000 | 64.08 | 15.00 | 34.717 | 136.395 | 212.422 | 114.59153 |
| 350.000 | 64.59 | 15.00 | 35.496 | 108.463 | 253.614 | 133.69012 |
| 400.000 | 64.74 | 15.00 | 35.992 | 68.591 | 283.399 | 152.78871 |
| 450.000 | 61.62 | 15.00 | 36.308 | 21.168 | 298.499 | 171.88730 |
| 471.239 | 58.29 | 15.00 | 36.405 | 0.000 | 300.000 | 180.00000 |
| 471.239 | 58.29 | 15.00 | 36.405 | 0.000 | 300.000 | 180.00000 |
| 500.000 | 51.79 | 19.88 | 26.870 | -28.761 | 300.000 | 180.00000 |
| 550.000 | 44.70 | 26.51 | 15.609 | -78.761 | 300.000 | 180.00000 |
| 600.000 | 40.74 | 30.32 | 8.993 | -128.761 | 300.000 | 180.00000 |
| 650.000 | 38.50 | 32.52 | 5.167 | -178.761 | 300.000 | 180.00000 |
| 700.000 | 37.22 | 33.79 | 2.966 | -228.761 | 300.000 | 180.00000 |
| 750.000 | 0.00 | 0.00 | 1.702 | -278.761 | 300.000 | 180.00000 |
| 800.000 | 0.00 | 0.00 | 0.977 | -328.761 | 300.000 | 180.00000 |

NOTE: The offset distance is a perpendicular distance measured from the taxiway centerline. The hard surface needs to be widened at stations where the offset distance extends beyond the hard surface.

REFERENCE: AC 150/5300-13, AIRPORT DESIGN.

Figure 4-4. Example of pavement fillet computer program printout

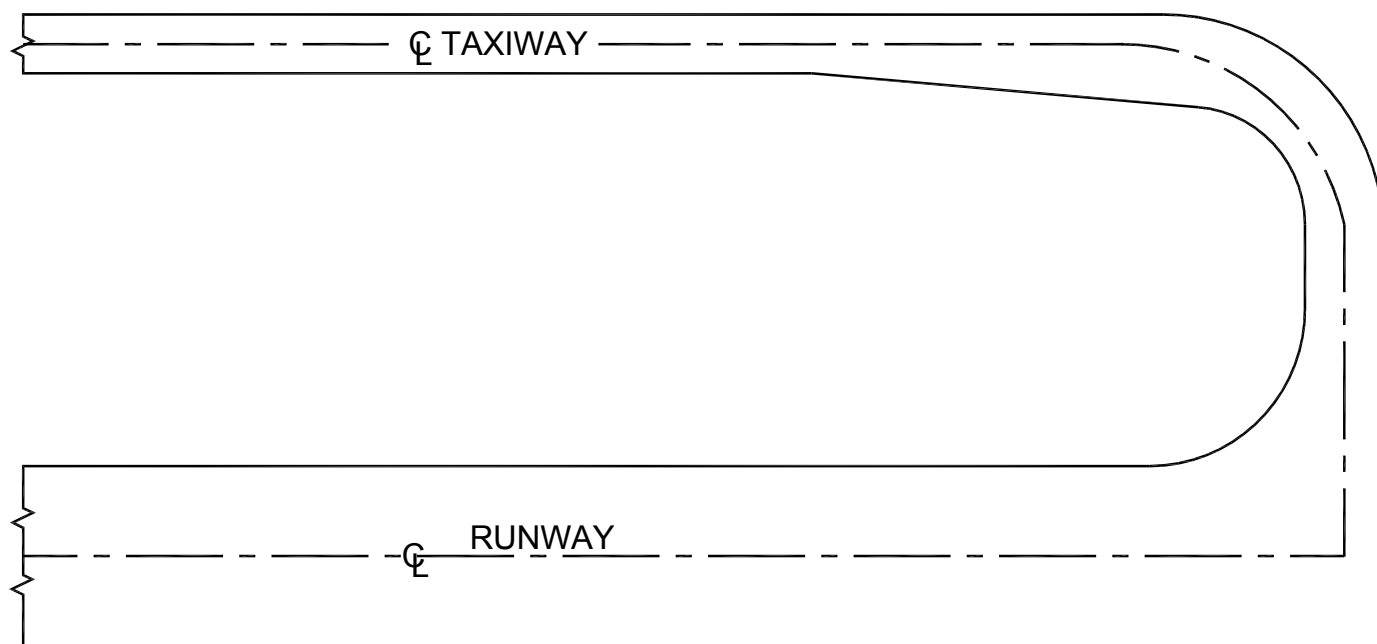


Figure 4-5. Entrance taxiway

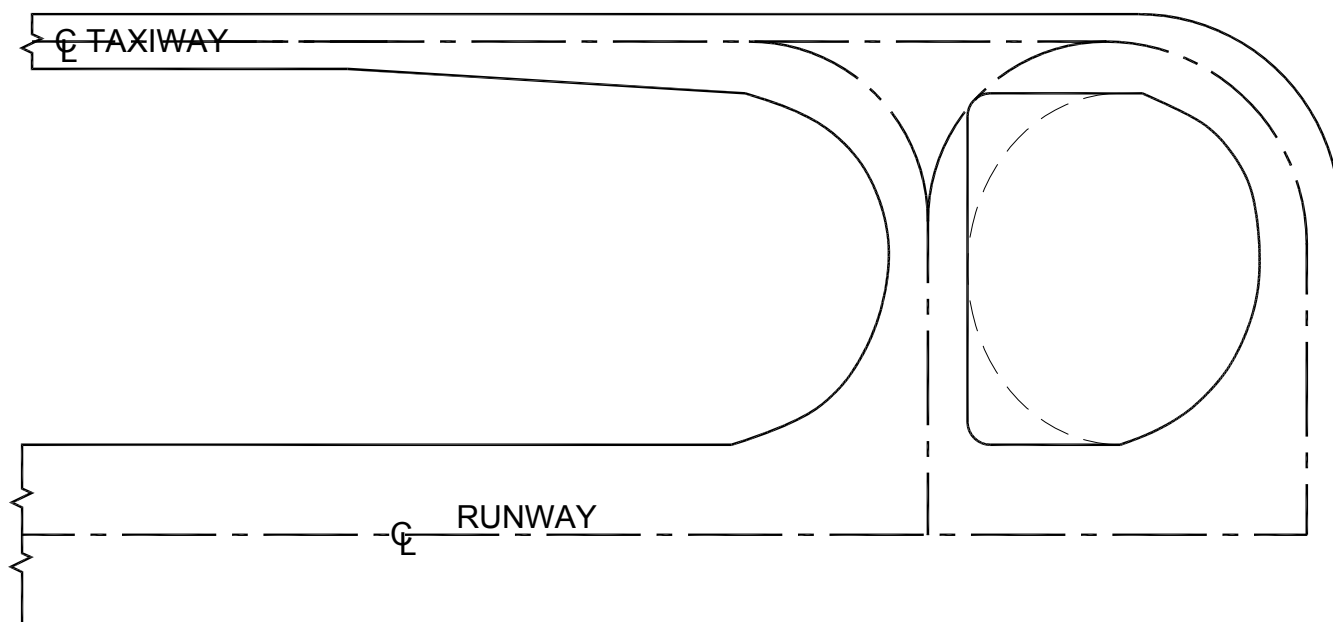


Figure 4-6. Bypass taxiway

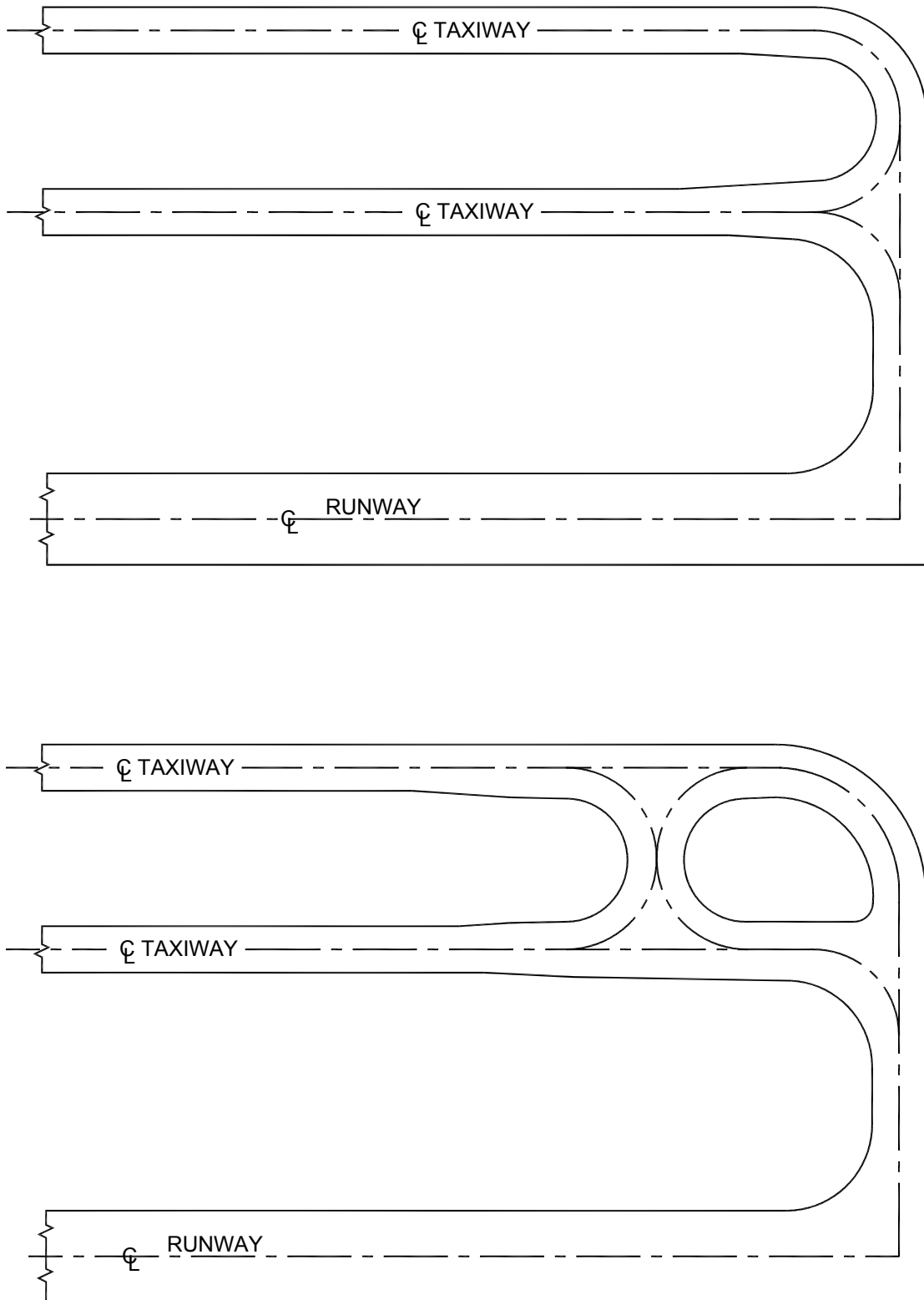


Figure 4-7. Dual parallel taxiway entrance

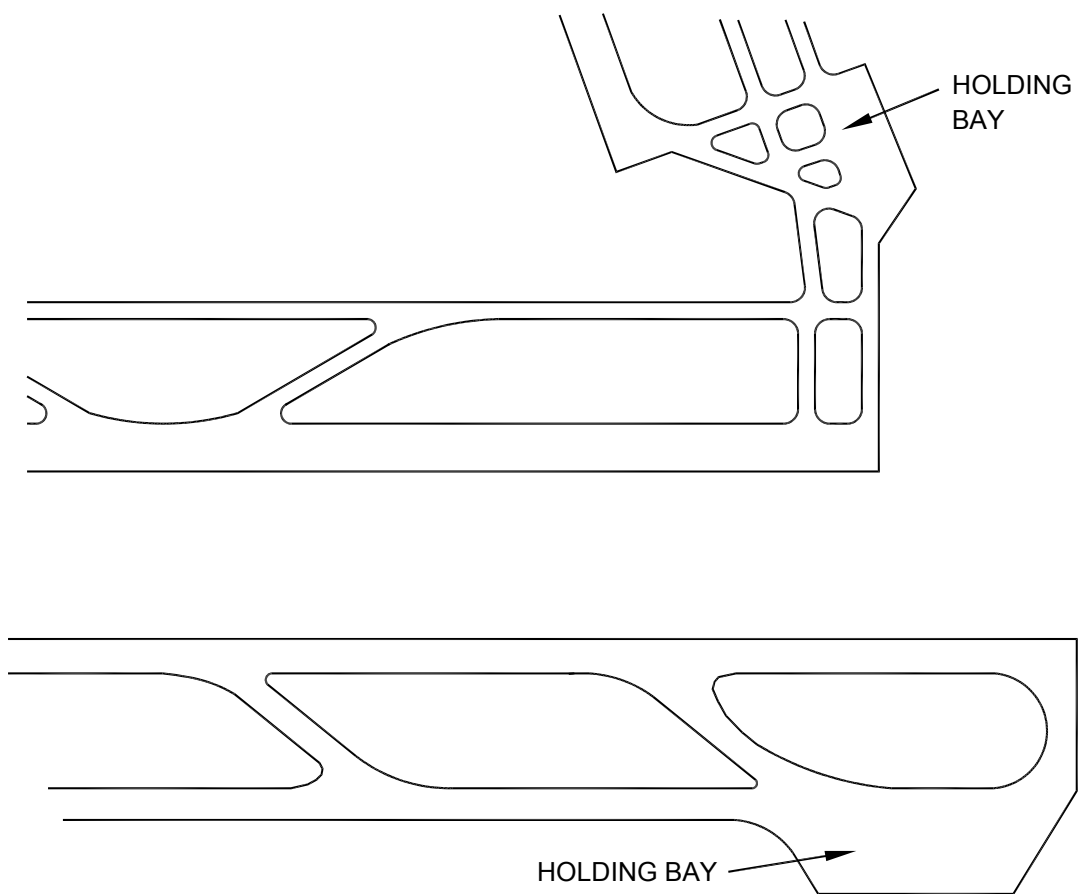


Figure 4-8. Typical holding bay configurations

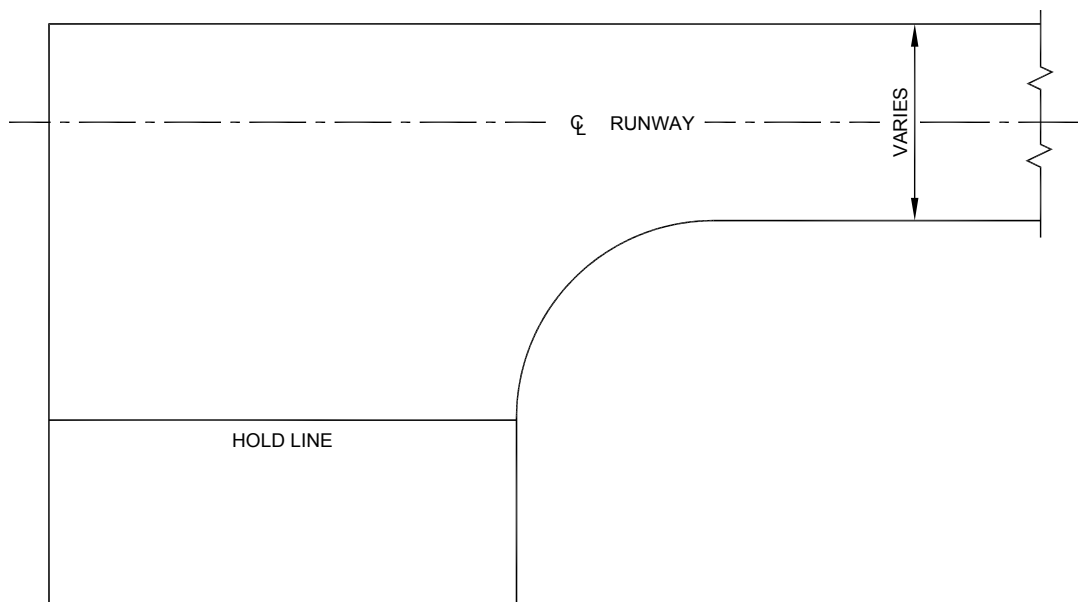


Figure 4-9. Taxiway turnaround

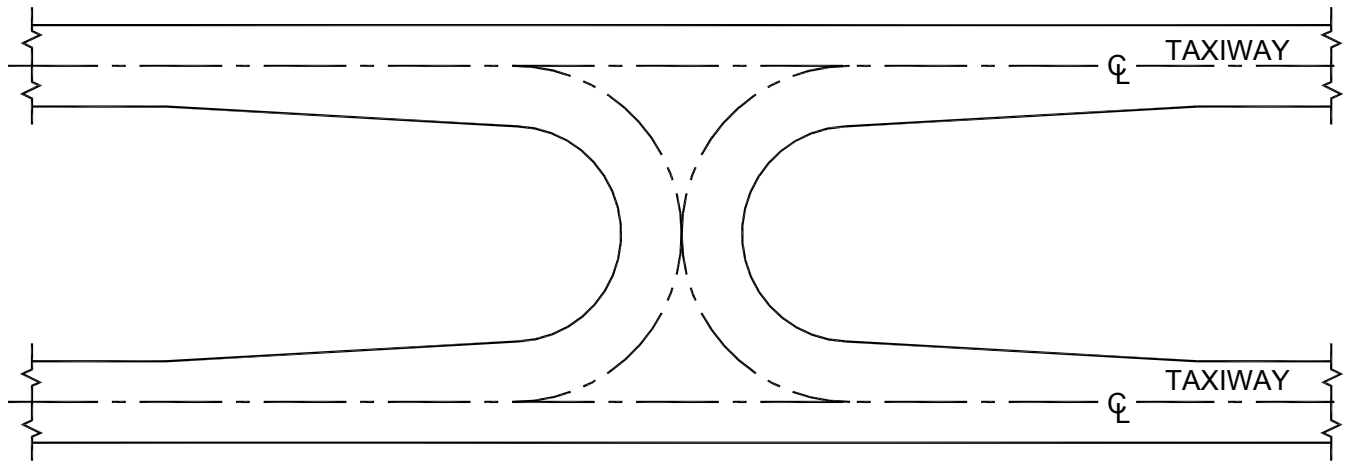


Figure 4-10. Crossover taxiway

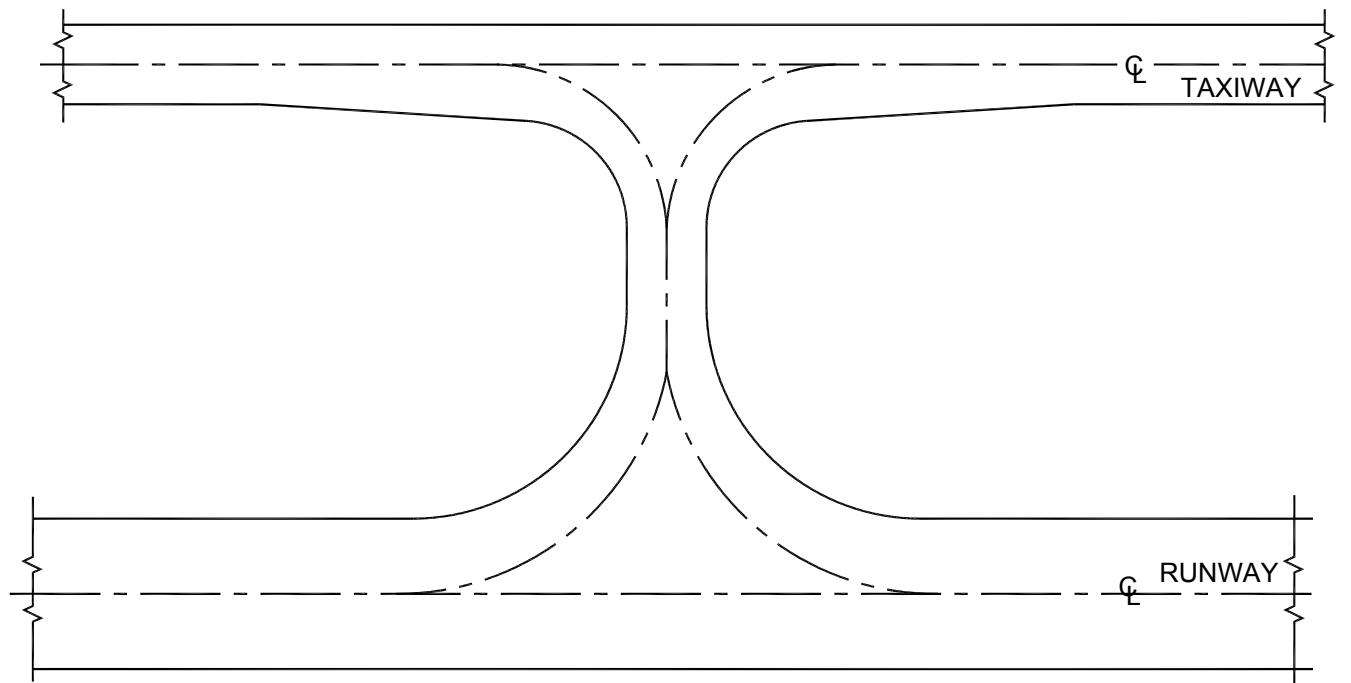


Figure 4-11. Right-angled exit taxiway

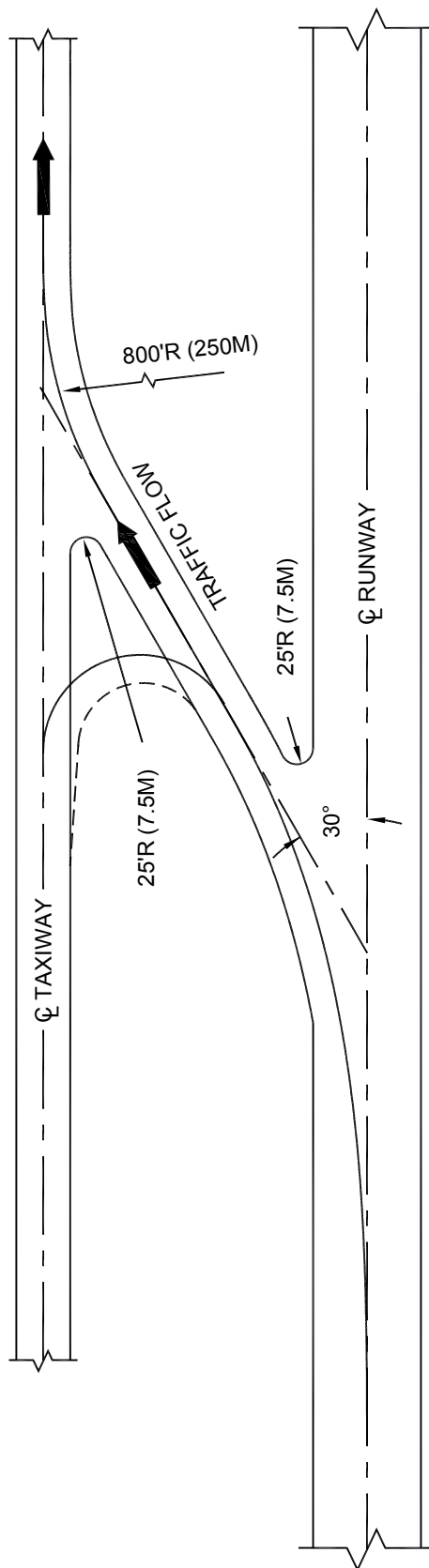


Figure 4-12. Acute-angled exit taxiway

2/24/92

AC 150/5300-13 CHG 2

OFFSET DISTANCES ON A RAPID RUNOFF EXIT TAXIWAY

| | |
|---|---------|
| Airplane wheelbase | 84.000 |
| Center of airplane cockpit to nosewheel | 6.000 |
| Airplane undercarriage width [1.15 x main gear track] | 41.000 |
| Taxiway edge safety margin | 15.000 |
| Taxiway width | 75.000 |
| Runway width | 150.000 |
| Runway centerline to parallel taxiway centerline | 600.000 |

AIRPLANE COCKPIT ON CENTERLINE

| | | | |
|--------------------|-----------|---------------|----------|
| Entrance Station | 0.000 | | |
| Tangent Length | 947.098 | | |
| Intersection Angle | 30.00000 | Spiral Length | 1400.000 |
| Tangent Length | 479.205 | | |
| Exit Station | 1400.000 | Radius | 1336.902 |
| Entrance Station | 1400.000 | | |
| Tangent Length | 506.435 | | |
| Exit Station | 1906.435 | | |
| Entrance Station | 1906.435 | Radius | 800.000 |
| Tangent Length | 214.359 | | |
| Intersection Angle | -30.00000 | Curve Length | 418.879 |
| Tangent Length | 214.359 | | |
| Exit Station | 2325.314 | Radius | 800.000 |
| Entrance Station | 2325.314 | | |
| Tangent Length | 274.686 | | |
| Exit Station | 2600.000 | | |

| STATION | LEFT OFFSET | RIGHT OFFSET | STEERING ANGLES | X COORDINATE | Y COORDINATE | CENTERLINE ANGLE |
|---------|----------------|-----------------|--------------------|-----------------|-----------------|---------------------|
| 0.000 | 75.01 | 74.99 | 0.000 | 0.000 | 0.000 | 0.00000 |
| 50.000 | 75.06 | 74.94 | 0.032 | 50.000 | 0.011 | 0.03827 |
| 100.000 | 75.13 | 74.86 | 0.109 | 100.000 | 0.089 | 0.15306 |
| 150.000 | 75.20 | 74.76 | 0.212 | 149.999 | 0.301 | 0.34439 |
| 200.000 | 75.27 | 74.63 | 0.330 | 199.998 | 0.712 | 0.61224 |
| 250.000 | 75.33 | 74.49 | 0.456 | 249.993 | 1.391 | 0.95663 |
| 300.000 | 75.37 | 74.32 | 0.587 | 299.983 | 2.404 | 1.37755 |
| 350.000 | 75.38 | 74.12 | 0.721 | 349.963 | 3.818 | 1.87500 |
| 400.000 | 75.36 | 73.89 | 0.857 | 399.927 | 5.698 | 2.44898 |
| 450.000 | 75.31 | 73.62 | 0.994 | 449.868 | 8.113 | 3.09949 |
| 500.000 | 75.22 | 73.31 | 1.131 | 499.777 | 11.127 | 3.82653 |
| 550.000 | 75.09 | 72.96 | 1.268 | 549.641 | 14.808 | 4.63010 |
| 600.000 | 74.90 | 72.57 | 1.406 | 599.445 | 19.222 | 5.51020 |
| 650.000 | 74.67 | 72.11 | 1.543 | 649.172 | 24.432 | 6.46684 |
| 700.000 | 74.38 | 71.61 | 1.681 | 698.802 | 30.506 | 7.50000 |
| 750.000 | 74.02 | 71.04 | 1.819 | 748.308 | 37.506 | 8.60969 |
| 800.000 | 73.61 | 70.40 | 1.956 | 797.665 | 45.497 | 9.79592 |

Figure 4-13. Example of acute-angled exit taxiway computer layout data page 1

| | | | | | | |
|----------|-------|-------|--------|----------|---------|----------|
| 850.000 | 73.12 | 69.70 | 2.094 | 846.839 | 54.541 | 11.05867 |
| 900.000 | 72.56 | 68.92 | 2.232 | 895.795 | 64.699 | 12.39796 |
| 950.000 | 71.92 | 68.07 | 2.370 | 944.493 | 76.031 | 13.81378 |
| 1000.000 | 71.20 | 67.13 | 2.508 | 992.887 | 88.595 | 15.30612 |
| 1050.000 | 70.40 | 66.11 | 2.646 | 1040.928 | 102.447 | 16.87500 |
| 1100.000 | 69.51 | 65.00 | 2.784 | 1088.562 | 117.640 | 18.52041 |
| 1150.000 | 68.52 | 63.80 | 2.921 | 1135.729 | 134.227 | 20.24235 |
| 1200.000 | 67.45 | 62.51 | 3.059 | 1182.363 | 152.255 | 22.04082 |
| 1250.000 | 66.27 | 61.11 | 3.197 | 1228.396 | 171.768 | 23.91582 |
| 1300.000 | 64.99 | 59.62 | 3.335 | 1273.752 | 192.807 | 25.86735 |
| 1350.000 | 63.53 | 58.11 | 3.473 | 1318.349 | 215.408 | 27.89541 |
| 1400.000 | 61.32 | 57.15 | 3.611 | 1362.102 | 239.603 | 30.00000 |
| 1400.000 | 61.32 | 57.15 | 3.611 | 1362.102 | 239.603 | 30.00000 |
| 1450.000 | 58.78 | 56.38 | 2.072 | 1405.404 | 264.603 | 30.00000 |
| 1500.000 | 56.62 | 55.25 | 1.189 | 1448.705 | 289.603 | 30.00000 |
| 1550.000 | 54.68 | 53.89 | 0.682 | 1492.006 | 314.603 | 30.00000 |
| 1600.000 | 52.87 | 52.42 | 0.391 | 1535.307 | 339.603 | 30.00000 |
| 1650.000 | 51.13 | 50.87 | 0.225 | 1578.609 | 364.603 | 30.00000 |
| 1700.000 | 49.43 | 49.28 | 0.129 | 1621.910 | 389.603 | 30.00000 |
| 1750.000 | 47.75 | 47.66 | 0.074 | 1665.211 | 414.603 | 30.00000 |
| 1800.000 | 46.08 | 46.04 | 0.042 | 1708.512 | 439.603 | 30.00000 |
| 1850.000 | 44.35 | 44.48 | 0.024 | 1751.814 | 464.603 | 30.00000 |
| 1900.000 | 41.70 | 43.86 | 0.014 | 1795.115 | 489.603 | 30.00000 |
| 1906.435 | 41.24 | 43.91 | 0.013 | 1800.688 | 492.820 | 30.00000 |
| 1906.435 | 41.24 | 43.91 | 0.013 | 1800.688 | 492.820 | 30.00000 |
| 1950.000 | 38.43 | 43.96 | -2.465 | 1838.991 | 513.565 | 26.87989 |
| 2000.000 | 36.05 | 43.54 | -4.163 | 1884.266 | 534.763 | 23.29890 |
| 2050.000 | 34.28 | 42.90 | -5.138 | 1930.776 | 553.092 | 19.71791 |
| 2100.000 | 32.94 | 42.21 | -5.699 | 1978.341 | 568.480 | 16.13693 |
| 2150.000 | 31.94 | 41.58 | -6.022 | 2026.774 | 580.867 | 12.55594 |
| 2200.000 | 31.21 | 41.08 | -6.208 | 2075.886 | 590.205 | 8.97495 |
| 2250.000 | 30.75 | 40.72 | -6.314 | 2125.485 | 596.457 | 5.39397 |
| 2300.000 | 31.03 | 40.03 | -6.376 | 2175.378 | 599.599 | 1.81298 |
| 2325.314 | 31.82 | 39.22 | -6.396 | 2200.688 | 600.000 | 0.00000 |
| 2325.314 | 31.82 | 39.22 | -6.396 | 2200.688 | 600.000 | 0.00000 |
| 2350.000 | 32.70 | 38.32 | -4.864 | 2225.374 | 600.000 | 0.00000 |
| 2400.000 | 33.89 | 37.12 | -2.792 | 2275.374 | 600.000 | 0.00000 |
| 2450.000 | 34.58 | 36.43 | -1.602 | 2325.374 | 600.000 | 0.00000 |
| 2500.000 | 34.97 | 36.03 | -0.919 | 2375.374 | 600.000 | 0.00000 |
| 2550.000 | 0.00 | 0.00 | -0.527 | 2425.374 | 600.000 | 0.00000 |
| 2600.000 | 0.00 | 0.00 | -0.303 | 2475.374 | 600.000 | 0.00000 |

NOTE: The offset distance is a perpendicular distance measured from the taxiway centerline. The hard surface needs to be widened at stations where the offset distance extends beyond the hard surface.

REFERENCE: AC 150/5300-13, AIRPORT DESIGN.

Figure 4-14. Example of acute-angled exit taxiway computer layout data page 2

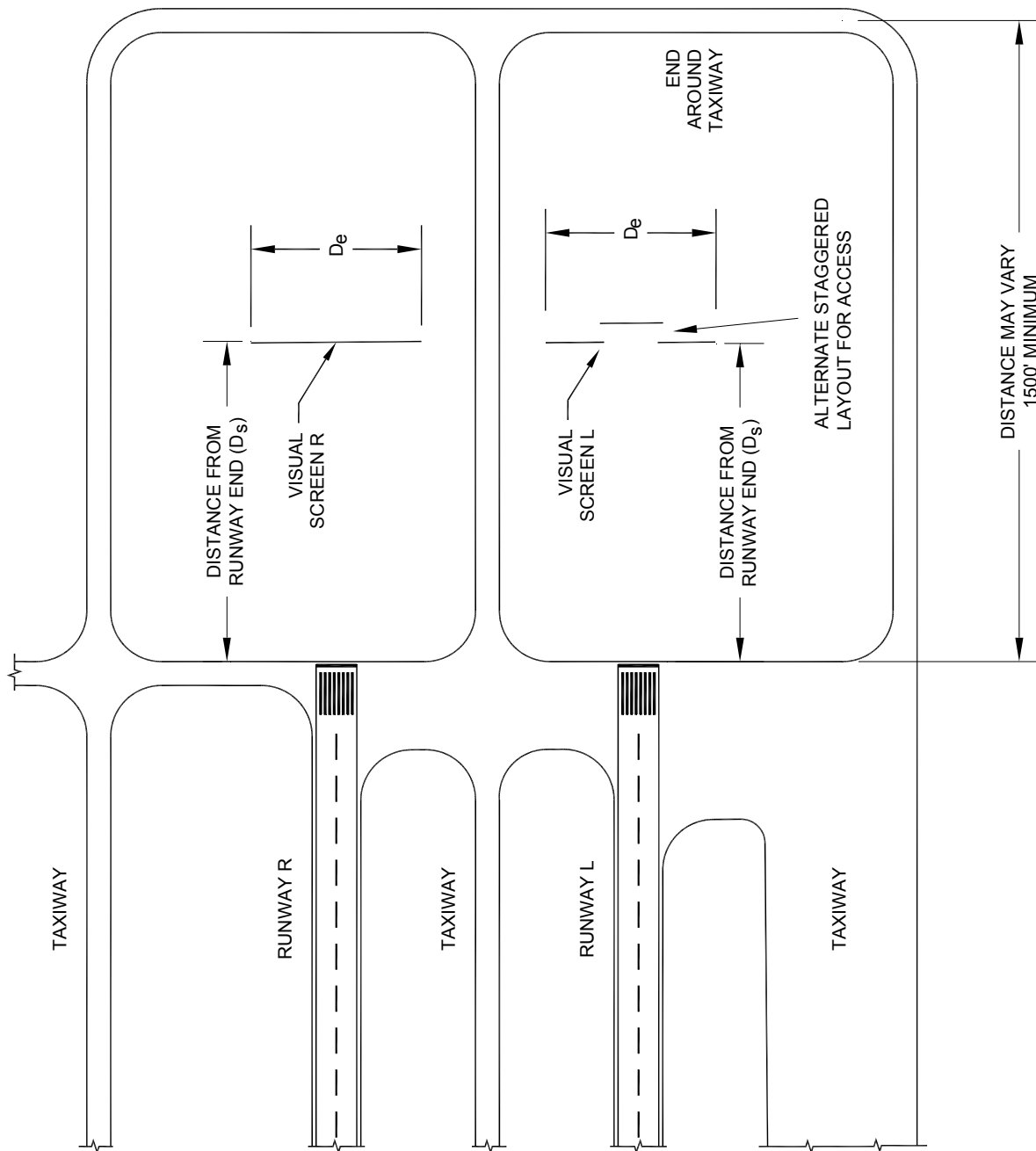


Figure 4-15. Typical end-around taxiway layout

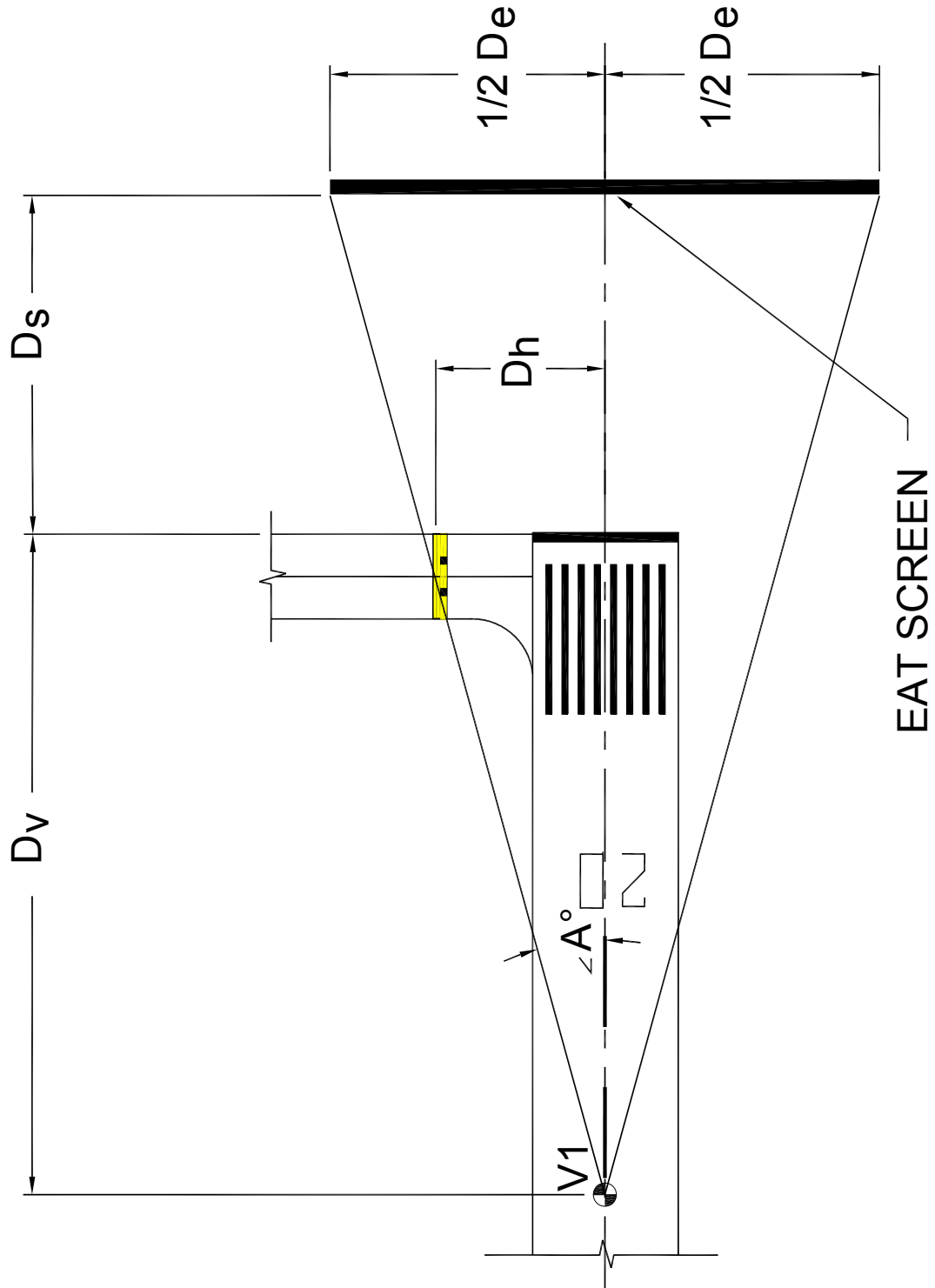


Figure 4-16. End-around taxiway visual screen width calculations

$$\angle A = \arctan \frac{D_h}{D_v}$$

$$(\tan \angle A (D_v + D_s)) = \frac{1}{2} D_e$$

Where: D_v = Distance from Average V1 location (defined in Federal Aviation Regulation 1.2 as takeoff decision speed) for Design Group aircraft to Departure Runway End.

D_s = Distance from Departure Runway End to the EAT Visual Screen Location

D_h = Distance from the Departure Runway End Centerline to the Centerline of Taxiway at Hold Position Marking

D_e = Total Width of EAT Visual Screen

Figure 4-17. Visual screen width calculation formula

Table 4-4. Visual screen height calculation formula (same elevation as runway)

EAT Visual Screen Height Calculation – EAT and Runway at Same Elevation

| Design Group | Typical Design Group Engine Nacelle Height | Required Screen Surface Height | Required Height of Top Edge of Screen (Above Runway Centerline Elevation) |
|---------------------|---|---------------------------------------|--|
| III | 9 ft | 10 ft | 10 ft |
| IV | 12 ft | 13 ft | 13 ft |
| V | 18 ft | 16 ft | 18 ft |
| VI | 18 ft | 16 ft | 18 ft |

Table 4-5. Visual screen height calculation formula (EAT below DER elevation) for Design Group III

**Design Group III Aircraft
EAT Visual Screen Height Calculation –
EAT At or Below DER Elevation**

| Elevation Difference (ft) | Required Screen Surface Height (ft) | Required Height of Top Edge of Screen (+ DER Centerline Elevation) (ft) |
|----------------------------------|--|--|
| 0 | 10 | 10 |
| 1 | 10 | 10 |
| 2 | 10 | 10 |
| 3 | 10 | 10 |
| 4 | 10 | 10 |
| 5 | 10 | 10 |
| 6 | 10 | 10 |
| 7 | 10 | 10 |
| 8 | 10 | 10 |
| 9 | 10 | 10 |
| 10 | 10 | 10 |
| 11 | 9 | 9 |
| 12 | 9 | 9 |
| 13 | 9 | 9 |
| 14 | 9 | 9 |
| 15 | 9 | 9 |
| 16 | 9 | 9 |
| 17 | 9 | 9 |
| 18 | 9 | 9 |
| 19 | 9 | 9 |
| 20 | 8 | 8 |
| 21 | 8 | 8 |
| 22 | 8 | 8 |
| 23 | 8 | 8 |
| 24 | 8 | 8 |
| 25 | 8 | 8 |
| 26 | 8 | 8 |
| 27 | 8 | 8 |
| 28 | 8 | 8 |
| 29+ | 0 | 0 |

Table 4-6. Visual screen height calculation formula (EAT below DER elevation) for Design Group IV

**Design Group IV Aircraft
EAT Visual Screen Height Calculation –
EAT At or Below DER Elevation**

| Elevation Difference (ft) | Required Screen Surface Height (ft) | Required Height of Top Edge of Screen (+/- DER Centerline Elevation) (ft) |
|----------------------------------|--|--|
| 0 | 13 | 13 |
| 1 | 13 | 13 |
| 2 | 13 | 13 |
| 3 | 13 | 13 |
| 4 | 13 | 13 |
| 5 | 13 | 13 |
| 6 | 13 | 13 |
| 7 | 13 | 13 |
| 8 | 13 | 13 |
| 9 | 13 | 13 |
| 10 | 13 | 13 |
| 11 | 13 | 13 |
| 12 | 13 | 13 |
| 13 | 13 | 13 |
| 14 | 12 | 12 |
| 15 | 12 | 12 |
| 16 | 12 | 12 |
| 17 | 11 | 11 |
| 18 | 11 | 11 |
| 19 | 11 | 11 |
| 20 | 10 | 10 |
| 21 | 10 | 10 |
| 22 | 10 | 10 |
| 23 | 9 | 9 |
| 24 | 9 | 9 |
| 25 | 9 | 9 |
| 26 | 8 | 8 |
| 27 | 8 | 8 |
| 28 | 8 | 8 |
| 29+ | 0 | 0 |

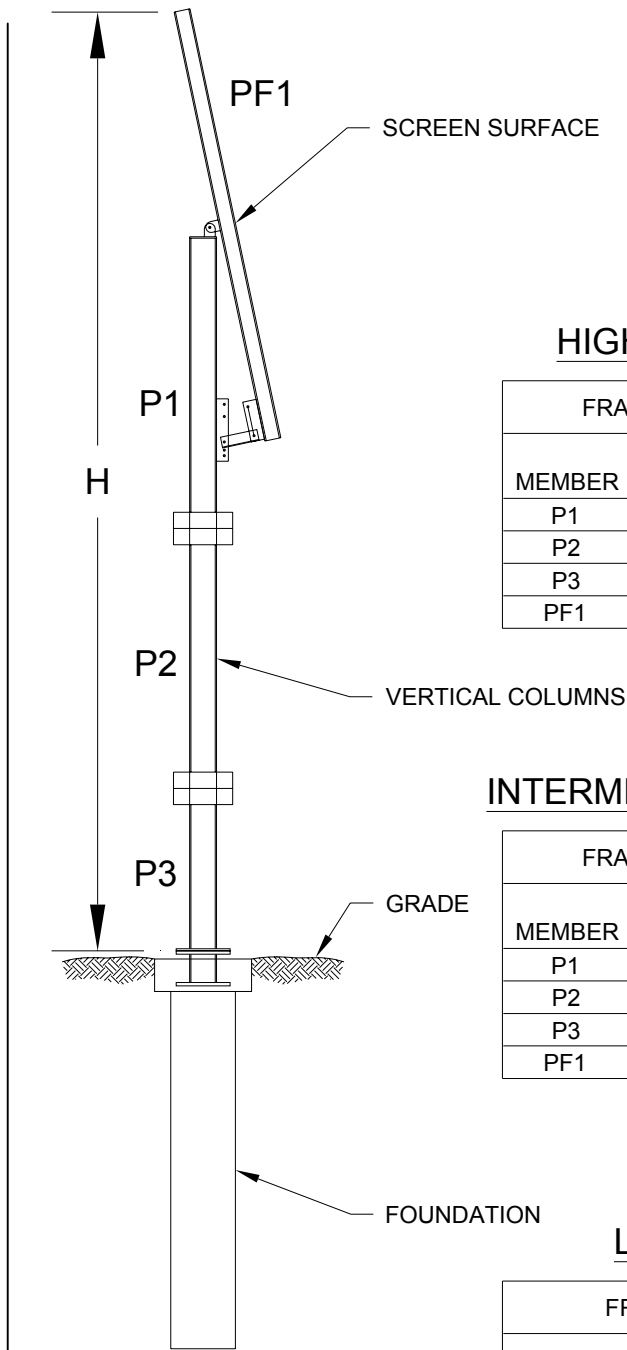
Table 4-7. Visual screen height calculation formula (EAT below DER elevation) for Design Groups V and VI

**Design Group V and VI Aircraft
EAT Visual Screen Height Calculation –
EAT At or Below DER Elevation**

| Elevation Difference (ft) | Required Screen Surface Height (ft) | Required Height of Top Edge of Screen (+/- DER Centerline Elevation) (ft) |
|----------------------------------|--|--|
| 0 | 13 | 18 |
| 1 | 13 | 18 |
| 2 | 13 | 18 |
| 3 | 13 | 18 |
| 4 | 13 | 18 |
| 5 | 13 | 17 |
| 6 | 13 | 16 |
| 7 | 13 | 15 |
| 8 | 13 | 14 |
| 9 | 13 | 13 |
| 10 | 13 | 13 |
| 11 | 13 | 13 |
| 12 | 13 | 13 |
| 13 | 13 | 13 |
| 14 | 12 | 12 |
| 15 | 12 | 12 |
| 16 | 12 | 12 |
| 17 | 11 | 11 |
| 18 | 11 | 11 |
| 19 | 11 | 11 |
| 20 | 10 | 10 |
| 21 | 10 | 10 |
| 22 | 10 | 10 |
| 23 | 9 | 9 |
| 24 | 9 | 9 |
| 25 | 9 | 9 |
| 26 | 8 | 8 |
| 27 | 8 | 8 |
| 28 | 8 | 8 |
| 29+ | 0 | 0 |

Table 4-8. Visual screen vertical height calculation tables**Design Group III -VI Aircraft EAT Visual Screen Height Calculation – EAT Above DER Elevation**

| Design Group | Required Height of Top Edge of Screen (Above Runway Centerline Elevation) (ft) | Add Elevation Difference – EAT above DER | Calculate: NEW Required Height of Top Edge of Screen (Above DER Centerline Elevation) (ft) |
|---------------------|---|---|---|
| III | 10 | + Elevation Difference | = New Required Height of Top Edge of Screen |
| IV | 13 | | |
| V | 18 | | |
| VI | 18 | | |



HIGH FRAME ELEV: $26' < H \leq 32'$

| FRAMING SCHEDULE - VISUAL SCREEN $26' < H \leq 32'$ | | | |
|---|------------------|---------------|--------------|
| MEMBER | WIND SPEED (MPH) | | |
| | 90 | 130 | 150 |
| P1 | HSS 8x6x5/16 | HSS 8x8x1/2 | HSS 12x8x3/8 |
| P2 | HSS 10x6x1/2 | HSS 12x8x9/16 | HSS 16x8x1/2 |
| P3 | HSS 12x6x1/2 | HSS 16x8x1/2 | HSS 20x8x1/2 |
| PF1 | HSS 6x4x3/16 | HSS 6x4x5/16 | HSS 6x4x5/16 |

INTERMEDIATE FRAME ELEV: $18' < H \leq 26'$

| FRAMING SCHEDULE - VISUAL SCREEN $18' < H \leq 26'$ | | | |
|---|------------------|---------------|--------------|
| MEMBER | WIND SPEED (MPH) | | |
| | 90 | 130 | 150 |
| P1 | HSS 8x6x5/16 | HSS 8x8x1/2 | HSS 12x8x3/8 |
| P2 | HSS 10x6x1/2 | HSS 12x8x9/16 | HSS 16x8x1/2 |
| P3 | | | |
| PF1 | HSS 6x4x3/16 | HSS 6x4x5/16 | HSS 6x4x5/16 |

LOW FRAME ELEV: $H \leq 18'$

| FRAMING SCHEDULE - VISUAL SCREEN $H \leq 18'$ | | | |
|---|------------------|--------------|--------------|
| MEMBER | WIND SPEED (MPH) | | |
| | 90 | 130 | 150 |
| P1 | HSS 8x6x5/16 | HSS 8x8x1/2 | HSS 12x8x3/8 |
| P2 | | | |
| P3 | | | |
| PF1 | HSS 6x4x3/16 | HSS 6x4x5/16 | HSS 6x4x5/16 |

Figure 4-18. Examples of mounting screen to vertical column

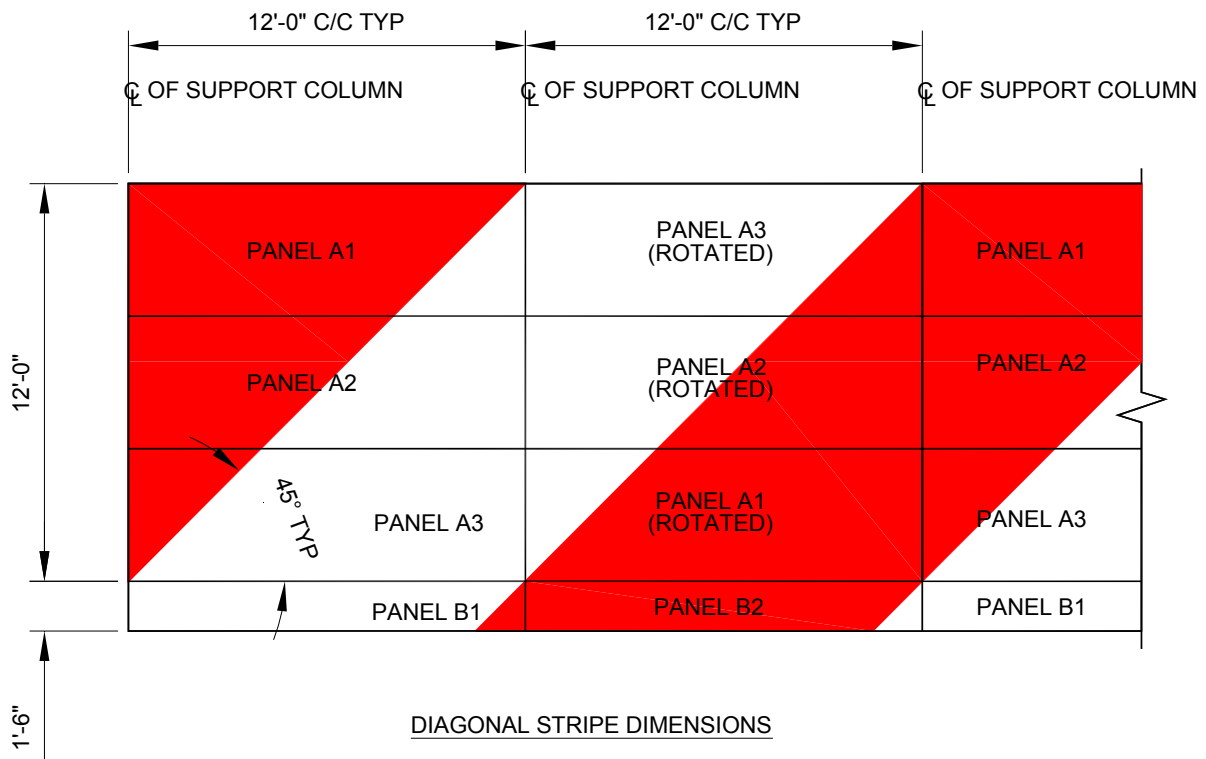
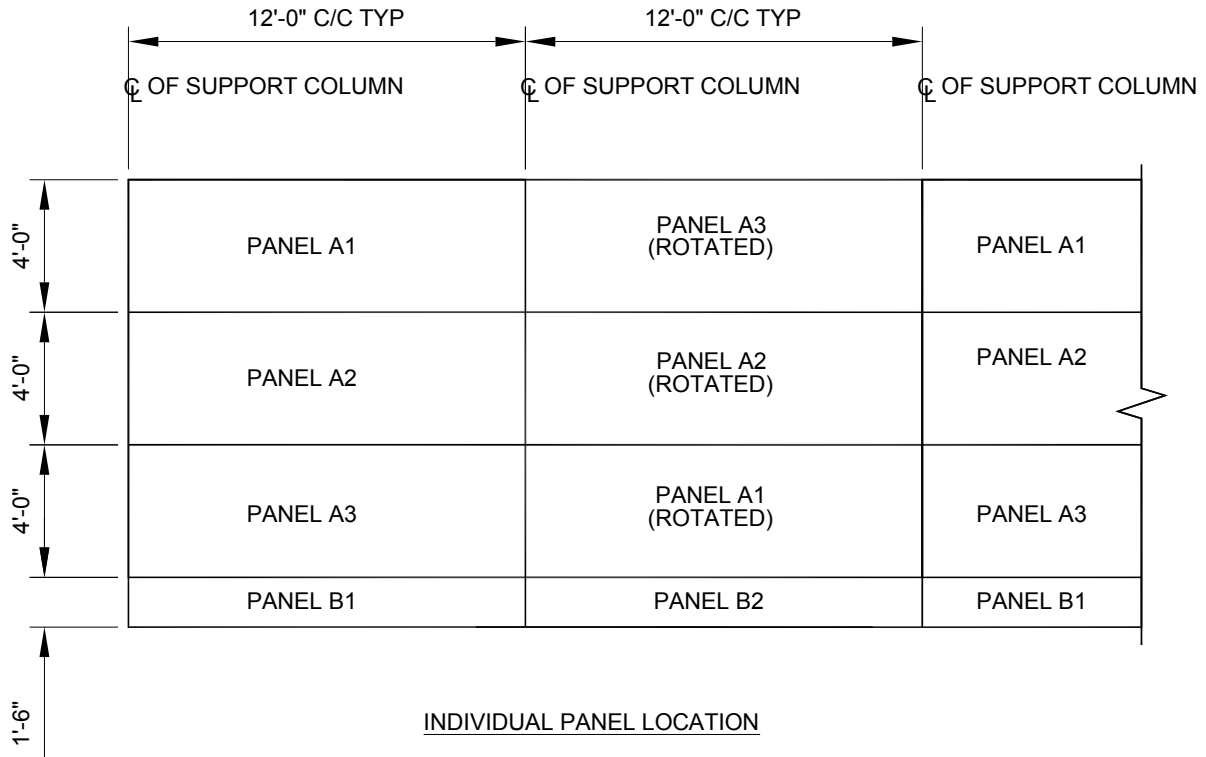
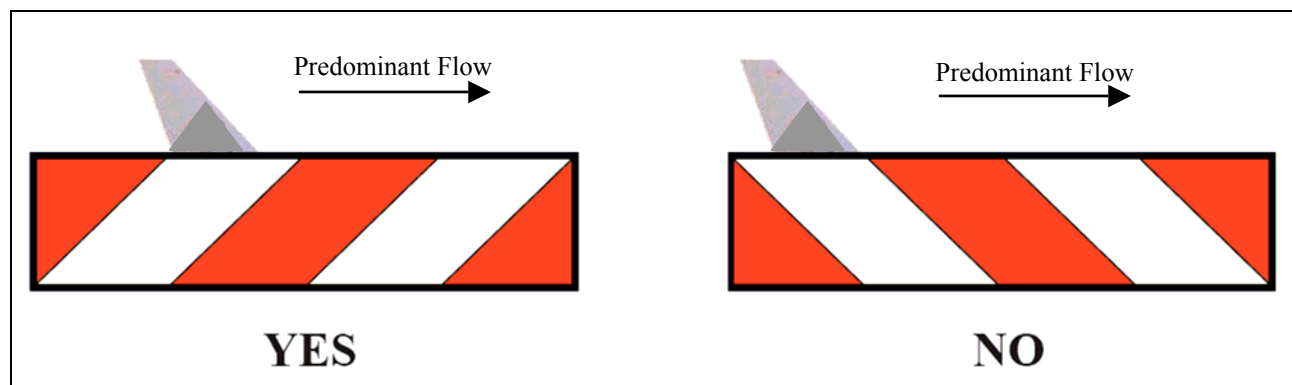


Figure 4-19. Examples of panel layout for 13-foot-high screen

Table 4-9. Visual screen panel wind-loading deflection allowance

| WIND SPEED (3 SEC GUST) | DEFLECTION | STRENGTH |
|----------------------------|------------|----------|
| 90 MPH | .074 PSI | .17 PSI |
| 130 MPH | .074 PSI | .35 PSI |
| 150 MPH | .074 PSI | .47 PSI |

**Figure 4-20. Diagonal stripe orientation****Table 4-10. CIE chromaticity coordinate limits**

| Color | \bar{x} | \bar{y} | \bar{X} | \bar{Y} | \underline{x} | \underline{y} | \underline{x} | \underline{y} | Min | Max | Munsell Paper |
|--------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------|------------|----------------------|
| White | .303 | .287 | .368 | .353 | .340 | .380 | .274 | .316 | 35.0 | | 6.3GY 6.77/0.8 |
| Red | .613 | .297 | .708 | .292 | .636 | .364 | .558 | .352 | 8.0 | 12.0 | 8.2R 3.78/14.0 |

Table 4-11. Minimum reflection levels

Minimum Coefficient of Retroreflection Candelas/Foot Candle/Square Foot/Candelas/Lux/Square Meter

| Observation Angle <u>1</u>/ (degrees) | Entrance Angle <u>2</u>/ (degrees) | White | Red |
|--|---|--------------|------------|
| 0.2 | -4 | 70 | 14.5 |
| 0.2 | +30 | 30 | 6.0 |
| 0.5 | -4 | 30 | 7.5 |
| 0.5 | +30 | 15 | 3.0 |

(Reflectivity must conform to Federal Specification FP-85 Table 718-1 and ASTM D 4956.)

- 1/ Observation (Divergence) Angle—The angle between the illumination axis and the observation axis.
- 2/ Entrance (Incidence) Angle—The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

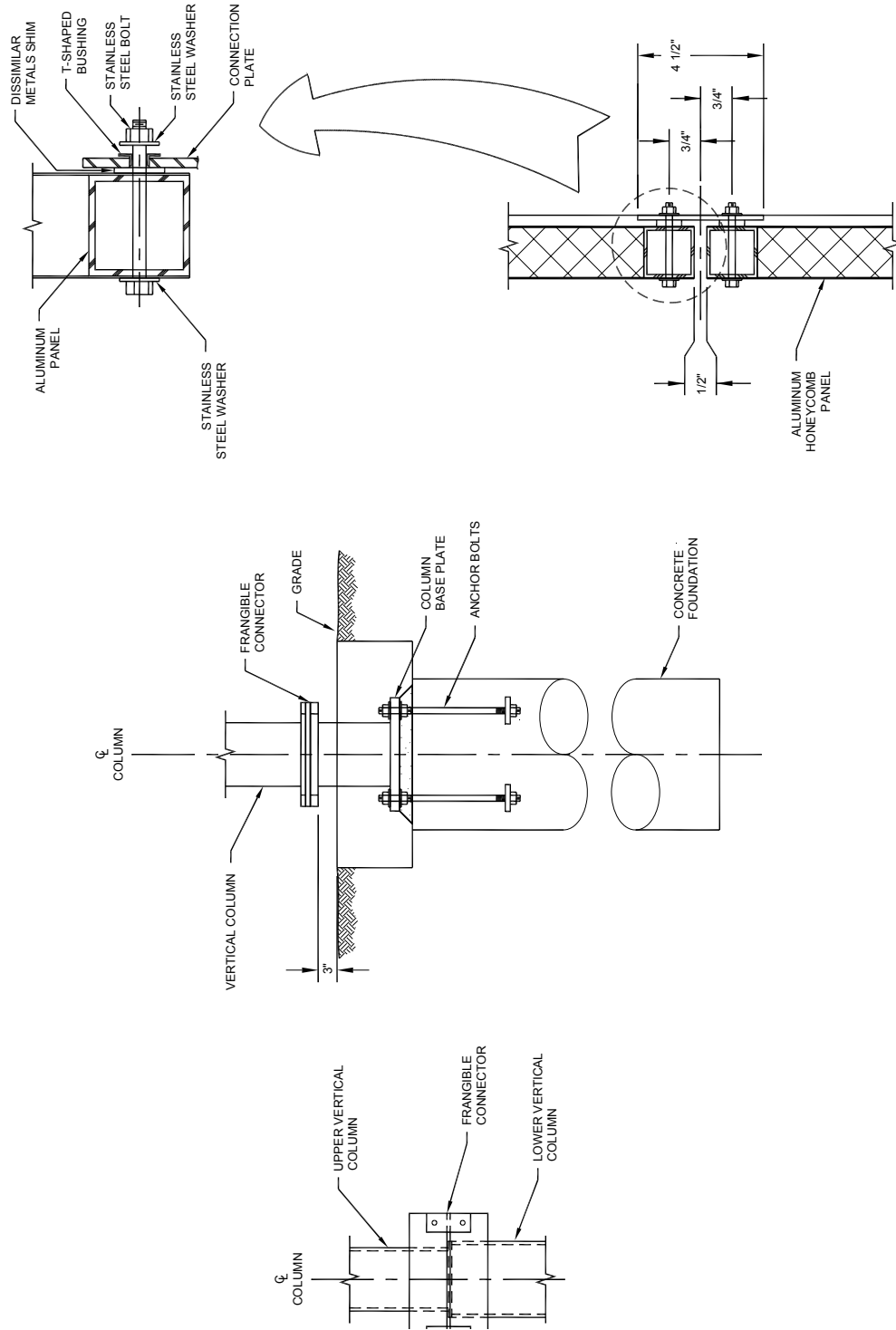


Figure 4-21. Examples of frangibility connections

FRANGIBLE CONNECTION ON PANELS

FRANGIBLE CONNECTION ON COLUMNS

FRANGIBLE CONNECTION BASE

Chapter 5. SURFACE GRADIENT AND LINE OF SIGHT

500. INTRODUCTION. This chapter presents gradient and line of sight standards. The standards apply to the design of airport surfaces required for the landing, takeoff, and ground movement of airplanes.

501. BACKGROUND. Surface gradients should allow design flexibility without adversely affecting operational safety. Line of sight standards impose additional restraints on surface gradients. It is important that the pilot and air traffic controller see the runway and taxiway surfaces to assure that the runways and taxiways are clear of aircraft, vehicles, wildlife, and other hazardous objects.

502. SURFACE GRADIENT STANDARDS.

a. Runway and Stopway.

(1) Aircraft Approach Categories A and B. The longitudinal and transverse gradient standards for runways and stopways are as follows and as illustrated in figures 5-1 and 5-2.

(a) The maximum longitudinal grade is ± 2 percent. It is desirable to keep longitudinal grades to a minimum.

(b) The maximum allowable grade change is ± 2 percent. Use longitudinal grade changes only when absolutely necessary.

(c) Vertical curves for longitudinal grade changes are parabolic. The length of the vertical curve is a minimum of 300 feet (90 m) for each 1 percent of change. No vertical curve is necessary when the grade change is less than 0.4 percent.

(d) The minimum allowable distance between the points of intersection of vertical curves is 250 feet (75 m) multiplied by the sum of the grade changes (in percent) associated with the two vertical curves.

(e) Figure 5-2 presents maximum and minimum transverse grades for runways and stopways. In all cases, keep transverse grades to a minimum, consistent with local drainage requirements.

(f) Provide a smooth transition between the intersecting pavement surfaces as well as adequate drainage of the intersection. Give precedence to the grades for the dominant runway

(e.g., higher speed, higher traffic volume, etc.) in a runway-runway situation and for the runway in a runway-taxiway situation.

(2) Aircraft Approach Categories C and D. The longitudinal and transverse gradient standards for runways and stopways are as follows and as illustrated in figures 5-3 and 5-4.

(a) The maximum longitudinal grade is ± 1.5 percent; however, longitudinal grades may not exceed ± 0.8 percent in the first and last quarter of the runway length. It is desirable to keep longitudinal grades to a minimum.

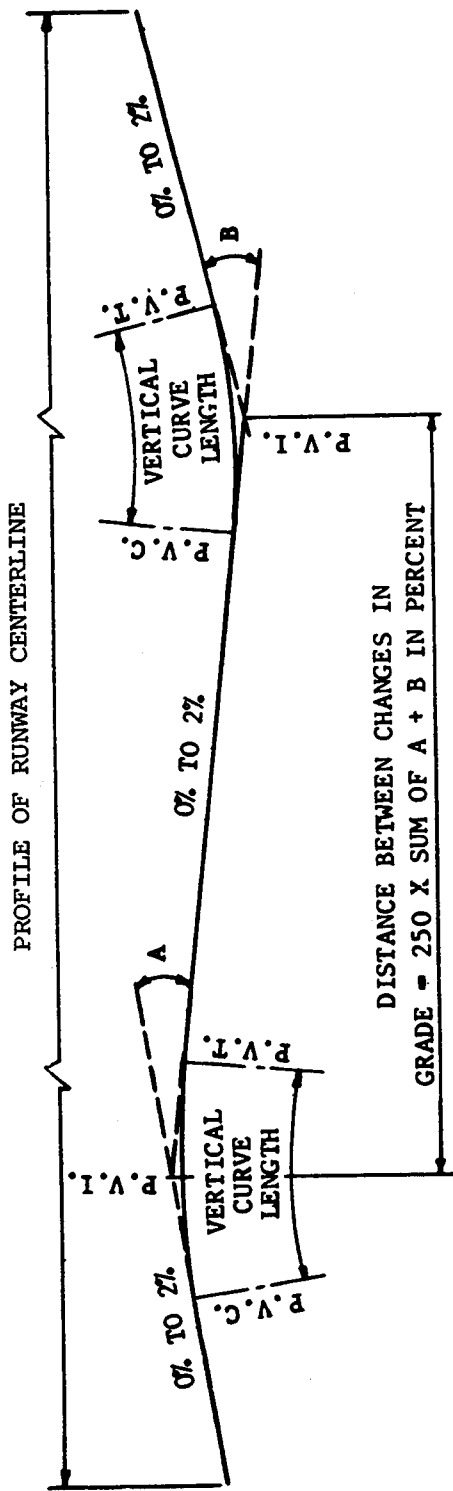
(b) The maximum allowable grade change is ± 1.5 percent. Use longitudinal grade changes only when absolutely necessary.

(c) Vertical curves for longitudinal grade changes are parabolic. The length of the vertical curve is a minimum of 1,000 feet (300 m) for each 1 percent of change.

(d) The minimum allowable distance between the points of intersection of vertical curves is 1,000 feet (300 m) multiplied by the sum of the grade changes (in percent) associated with the two vertical curves.

(e) Figure 5-4 presents maximum and minimum transverse grades for runways and stopways. In all cases, keep transverse grades to a minimum, consistent with local drainage requirements.

(f) Provide a smooth transition between intersecting pavement surfaces as well as adequate drainage of the intersection. Give precedence to the grades for the dominant runway (e.g., higher speed, higher traffic volume, etc.) in a runway-runway situation and for the runway in a runway-taxiway situation.



VERTICAL CURVES

LENGTH OF VERTICAL CURVES WILL NOT BE LESS THAN 300' FOR EACH 1% GRADE CHANGE, EXCEPT THAT NO VERTICAL CURVE WILL BE REQUIRED WHEN GRADE CHANGE IS LESS THAN 0.4%.

GRADE CHANGE

MAXIMUM GRADE CHANGE SUCH AS (A) OR (B) SHOULD NOT EXCEED 2%.

Figure 5-1. Longitudinal grade limitations for aircraft approach categories A & B

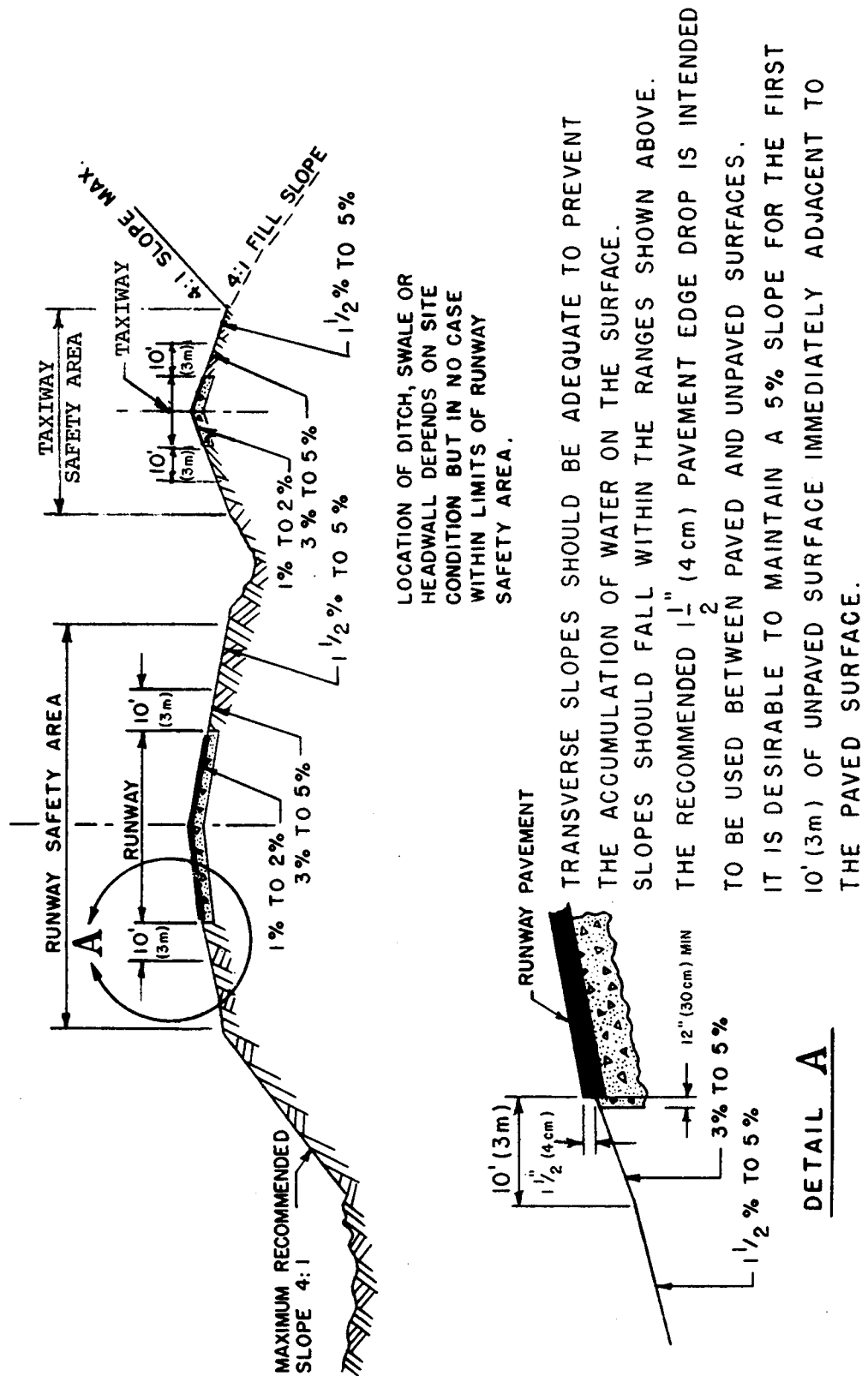
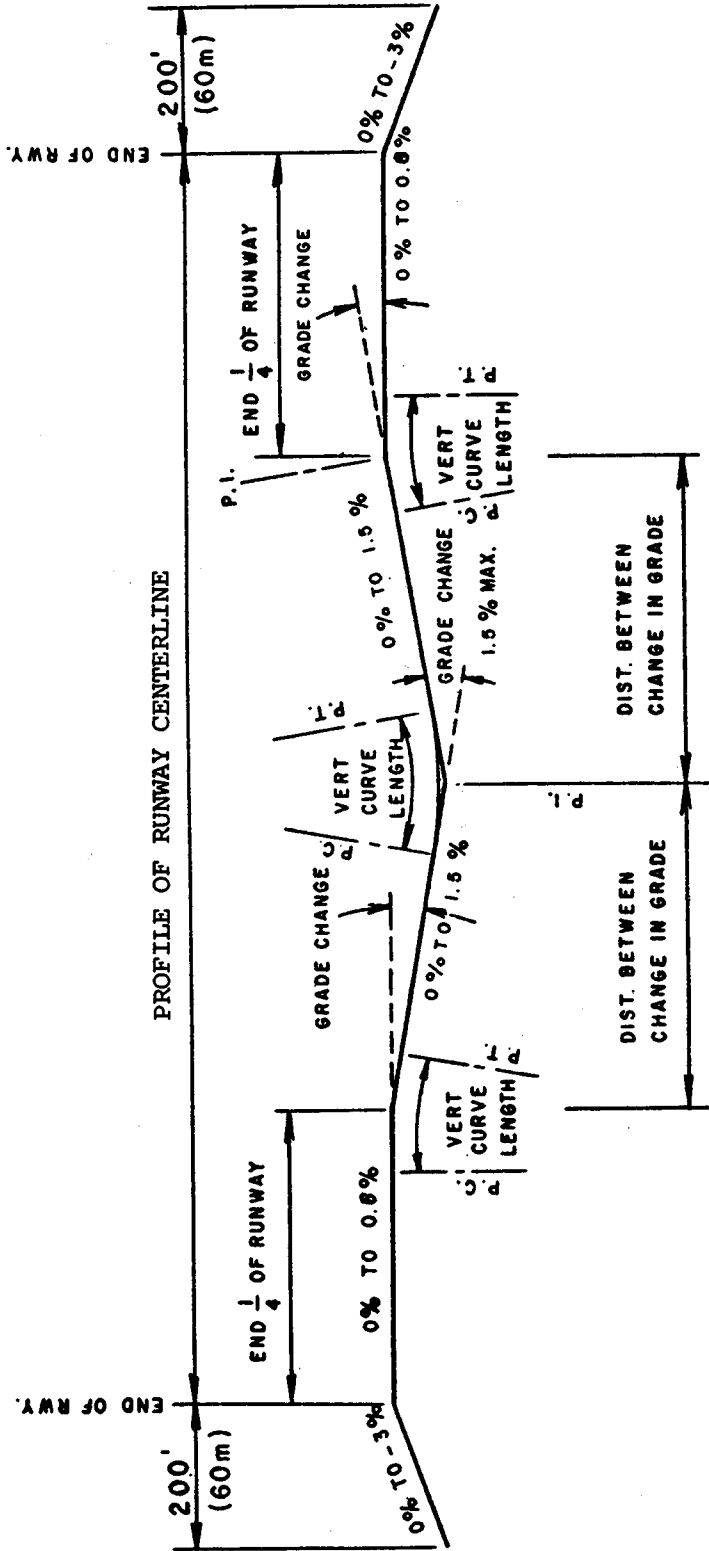


Figure 5-2. Transverse grade limitations for aircraft approach categories A & B



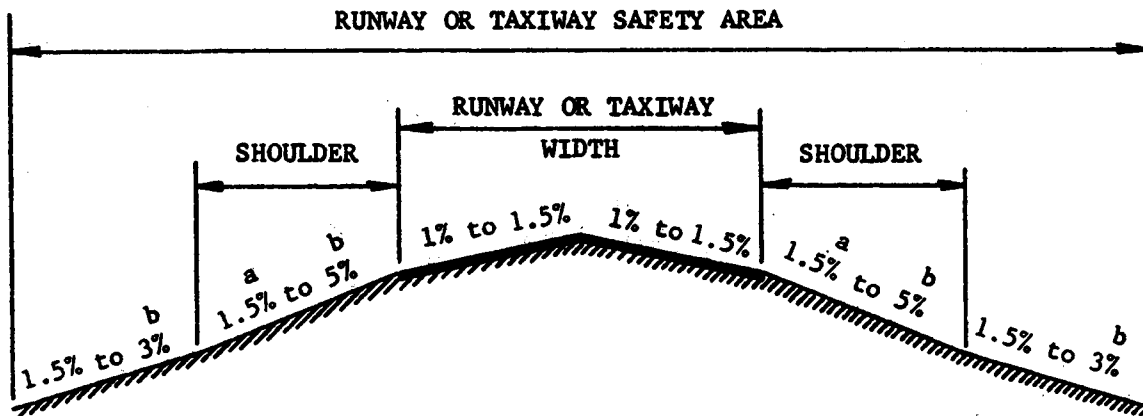
MINIMUM DISTANCE BETWEEN CHANGE IN GRADE = 1000' (300m) x SUM OF GRADE CHANGES (IN PERCENT).

MINIMUM LENGTH OF VERTICAL CURVES = 1000' (300m) x GRADE CHANGE (IN PERCENT)

Figure 5-3. Longitudinal grade limitations for aircraft approach categories C & D

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- a. 3% MINIMUM REQUIRED FOR TURF
- b. A slope of 5% is recommended for a 10-foot (3 m) width adjacent to the pavement edges to promote drainage.

GENERAL NOTES:

1. A 1.5 inch (3.8 cm) drop from paved to unpaved surfaces is recommended.
2. Drainage ditches may not be located within the safety area.

Figure 5-4. Transverse grade limitations for aircraft approach categories C & D

b. **Runway Safety Area.** The longitudinal and transverse gradient standards for runway safety areas are as follows and are illustrated in figures 5-1 through 5-5.

(1) Longitudinal grades, longitudinal grade changes, vertical curves, and distance between changes in grades for that part of the runway safety area between the runway ends are the same as the comparable standards for the runway and stopway. Exceptions are allowed when necessary because of taxiways or other runways within the area. In such cases, modify the longitudinal grades of the runway safety area by the use of smooth curves. For the first 200 feet (60 m) of the runway safety area beyond the runway ends, the longitudinal grade is between 0 and 3 percent, with any slope being downward from the ends. For the remainder of the safety area (figure 5-5), the maximum longitudinal grade is such that no part of the runway safety area penetrates the approach surface or clearway plane. The maximum allowable negative grade is 5 percent. Limitations on longitudinal grade changes are plus or minus 2 percent per 100 feet (30 m). Use parabolic vertical curves where practical.

(2) Figure 5-2 and 5-4 show the maximum and minimum transverse grades for paved shoulders and for the runway safety area along the runway up to 200 feet (60 m) beyond the runway end. In all cases, keep transverse grades to a minimum, consistent with local drainage requirements. Figure 5-5 illustrates the criteria for the transverse grade beginning 200 feet (60 m) beyond the runway end.

(3) Elevation of the concrete bases for NAVAIDs located in the runway safety area should not be higher than a maximum of 3 inches (7.6 cm) above the finished grade. Other grading requirements for NAVAIDs located in the runway safety area are, in most cases, more stringent than those stated above. See chapter 6.

c. **Runway Blast Pad.** For blast pads, follow the same longitudinal and transverse grades as the respective grades of the associated safety area.

d. **Taxiways and Taxiway Safety Areas.** Figures 5-2 and 5-4 illustrate the transverse gradient standards. The longitudinal and transverse gradient standards for taxiways and taxiway safety areas are as follows:

(1) The maximum longitudinal grade is 2 percent for Aircraft Approach Categories A and B and 1.5 percent for Aircraft Approach Categories C and D. Minimum longitudinal grades are desirable.

(2) Avoid changes in longitudinal grades unless no other reasonable alternative is available. The maximum longitudinal grade change is 3 percent.

(3) When longitudinal grade changes are necessary, the vertical curves are parabolic. The minimum length of the vertical curve is 100 feet (30 m) for each 1 percent of change.

(4) The minimum distance between points of intersection of vertical curves is 100 feet (30 m) multiplied by the sum of the grade changes (in percent) associated with the two vertical curves.

(5) At any point on a taxiway centerline, the allowable difference in elevation between the taxiway and the corresponding point on the associated parallel runway, taxiway, or apron edge is 1.5 percent of the shortest distance between the points. For the purposes of this item, a parallel taxiway is any taxiway functioning as a parallel taxiway whether it is exactly parallel or not. This will allow the subsequent placement of a stub taxiway at any point to satisfy capacity requirements.

(6) Figures 5-2 and 5-4 show the maximum and minimum transverse grades for taxiways and taxiway safety areas. In all cases, the transverse grades should be at a minimum, consistent with local drainage requirements.

(7) Elevation of the concrete bases for NAVAIDs located in the taxiway safety area should not be higher than a maximum of 3 inches (7.6 cm) above the finished grade. Other grading requirements for NAVAIDs located in the taxiway safety area are, in most cases, more stringent than those stated above. See chapter 6.

e. **Aprons.** To ease aircraft towing and taxiing, apron grades should be at a minimum, consistent with local drainage requirements. The maximum allowable grade in any direction is 2 percent for Aircraft Approach Categories A and B and 1 percent for Aircraft Approach Categories C and D. Where possible, design apron grades to direct drainage away from the any building, especially in fueling areas.

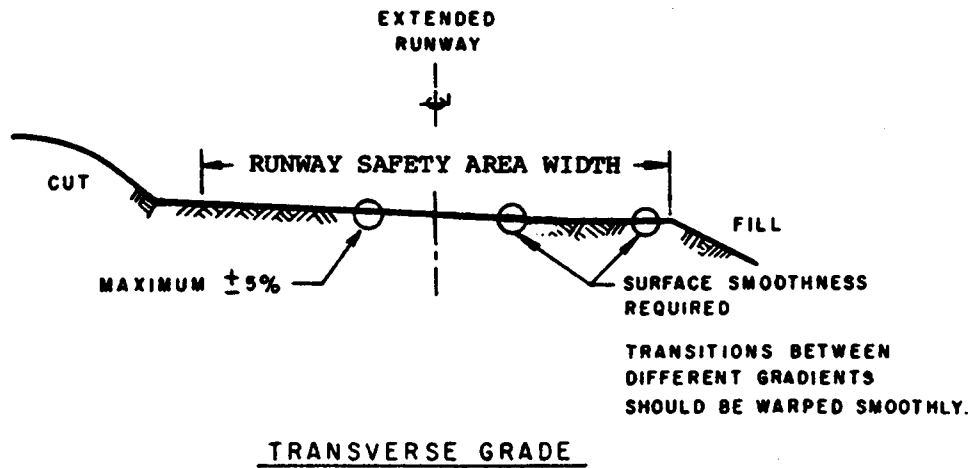
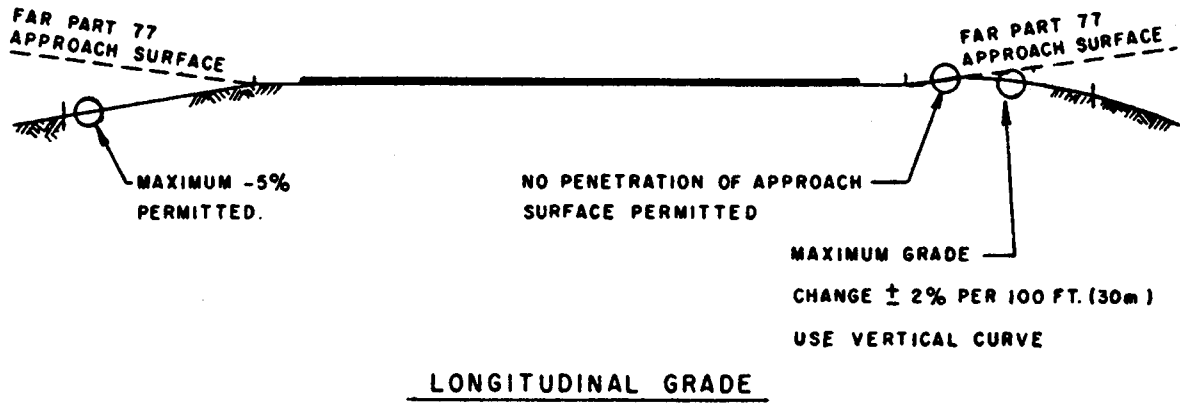


Figure 5-5. Runway safety area grade limitations beyond 200 feet (60 m) from the runway end

503. LINE OF SIGHT STANDARDS. The following standards provide the minimum line of sight:

a. Along Individual Runways. An acceptable runway profile permits any two points five feet (1.5 m) above the runway centerline to be mutually visible for the entire runway length. However, if the runway has a full length parallel taxiway, the runway profile may be such that an unobstructed line of sight will exist from any point five feet (1.5 m) above the runway centerline to any other point five feet (1.5 m) above the runway centerline for one-half the runway length.

b. Between Intersecting Runways. A clear line of site between the ends of intersecting runways is recommended. Terrain needs to be graded and permanent objects need to be designed or sited so that there will be an unobstructed line of sight from any point five feet (1.5 m) above one runway centerline to any point five feet (1.5 m) above an intersecting centerline, within the runway visibility zone. The runway visibility zone is an area formed by imaginary lines connecting the two runways' visibility points, as shown in figure 5-6. Determine the location of each runway's visibility point as follows:

(1) If the distance from the intersection of two runway centerlines to a runway end is 750 feet (250 m) or less, the visibility point is on the centerline of the runway end.

(2) If the distance from the intersection of two runway centerlines to a runway end is greater than 750 feet (250 m) but less than 1,500 feet (500 m), the visibility point is on the centerline, 750 feet (250 m) from the intersection of the runway centerlines.

(3) If the distance from the intersection of two runway centerlines to a runway end is equal to or greater than 1,500 feet (500 m), the visibility point is on the centerline equidistant from the runway end and the intersection of the centerlines.

c. Taxiways. There are no line of sight requirements for taxiways. However, the sight distance along a runway from an intersecting taxiway needs to be sufficient to allow a taxiing aircraft to enter safely or cross the runway.

504. to 599. RESERVED.

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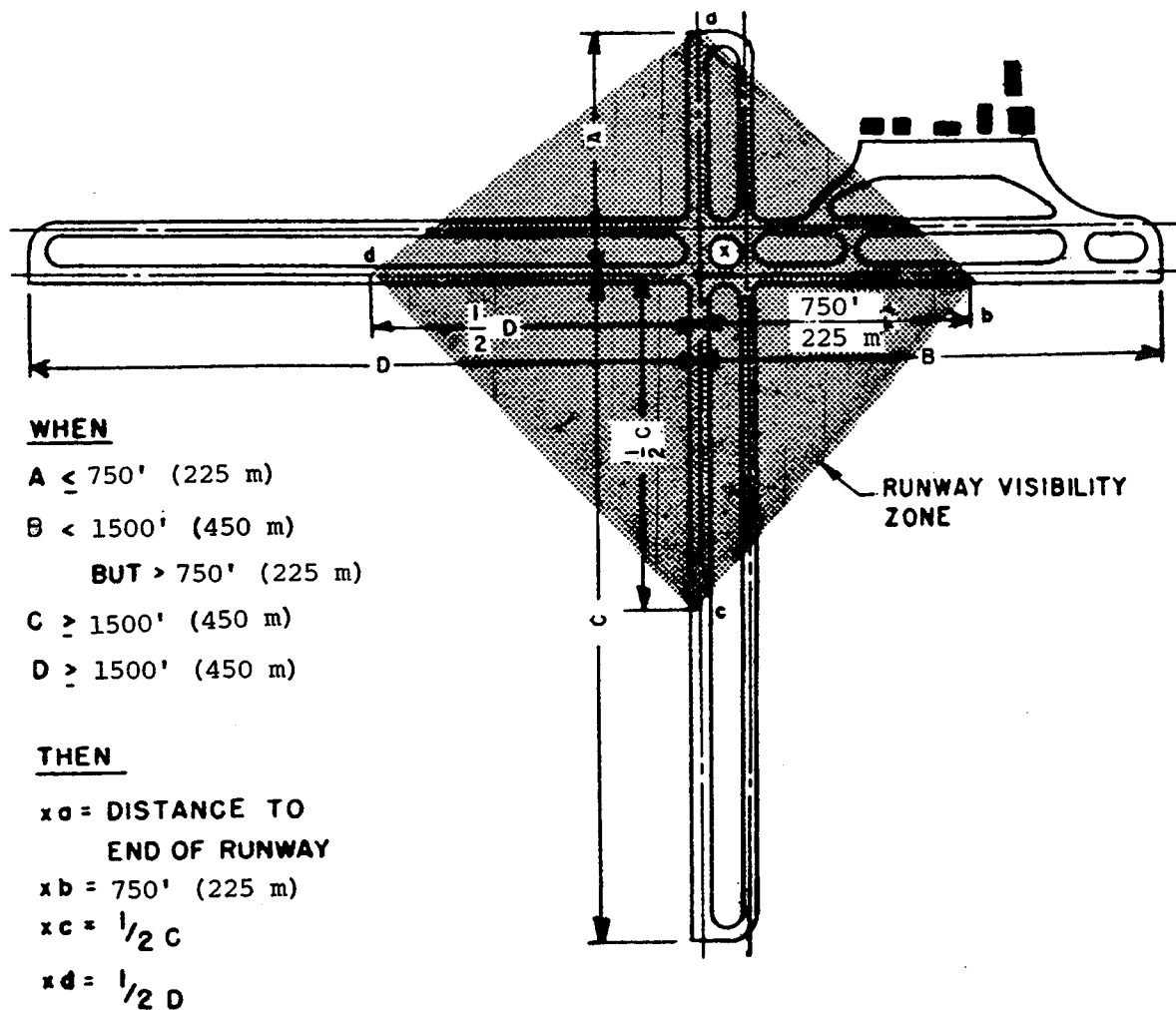


Figure 5-6. Runway visibility zone

Chapter 6. SITE REQUIREMENTS FOR NAVAID AND ATC FACILITIES

600. GENERAL. This chapter presents siting and clearing requirements for the navigational aids (NAVAID) and air traffic control (ATC) facilities which influence airport planning. The information is not readily available in other FAA Advisory Circulars. It is provided to minimize conflicts between NAVAIDs and ATC facilities and other airport developments. Figure 6-2 depicts the usual location of these NAVAIDs and ATC facilities on a typical airport.

CAUTION: The guidance herein is not in sufficient detail to be used to design or install a NAVAID or ATC facility.

a. **Limitations.** Siting and clearing criteria is representative of the ideal situation. It is advisable to contact the appropriate FAA regional office before planning any NAVAID or ATC facility.

b. **Federal NAVAID and ATC Programs.** Information on eligibility for FAA-installed NAVAIDs and ATC facilities or other FAA assistance programs can be obtained from an FAA regional office. FAA policy governing NAVAID and ATC facility relocations is found in AC 6030.1, FAA Policy on Facility Relocations Occasioned by Airport Improvements or Changes.

c. **Non-Federal NAVAIDs.** FAA policy concerning the establishment of instrument procedures using non-Federal NAVAIDs is found in FAR Part 171, Non-Federal Navigation Facilities.

d. **Jet Blast/Exhaust.** NAVAIDs, monitoring devices, and equipment shelters should be located at least 300 feet (90 m) behind the source of jet blast to minimize the accumulation of exhaust deposits on antennas.

601. MICROWAVE LANDING SYSTEM. The microwave landing system (MLS) provides the pilot of a properly equipped aircraft with electronic guidance to control the aircraft's alignment and descent until the runway environment is in sight. MLS is also used to define a missed approach course or a departure course. Figure 6-2 illustrates MLS component locations.

a. **General.** MLS operates on the direct signal from the transmitting antenna on the ground to the receiving antenna on the aircraft.

(1) MLS is not particularly susceptible to signal interference as a result of buildings, trees, power lines, metal fences, and other large objects. However, when these objects are in the coverage area, they may cause multipath (signal reflection) or shadowing (signal blockage) problems.

(2) MLS antenna systems do not use the ground to form the desired signal. Grading for MLS installations is usually limited to that needed for the antenna and monitors, a service road, and a vehicle parking area.

b. **Azimuth Antenna.** Alignment guidance is provided by the azimuth (AZ) antenna. The signal coverage area extends 40 degrees either side of the intended course (runway centerline).

(1) The AZ antenna is located on the extended runway centerline at a distance of 1,000 to 1,500 feet (300 to 450 m) beyond the stop end of the runway. AZ antennas are 8 feet (2.4 m) in height and are mounted on low impact resistant supports. AZ antennas should not violate any airport design or approach surface. Figure 6-1 illustrates AZ antenna siting.

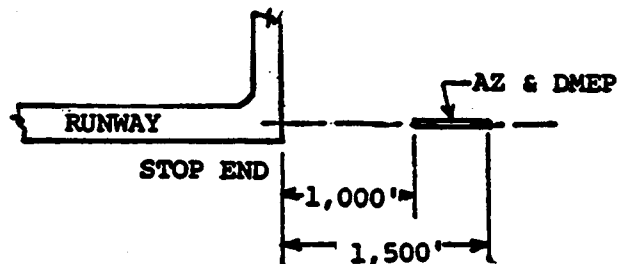


Figure 6-1. AZ antenna siting

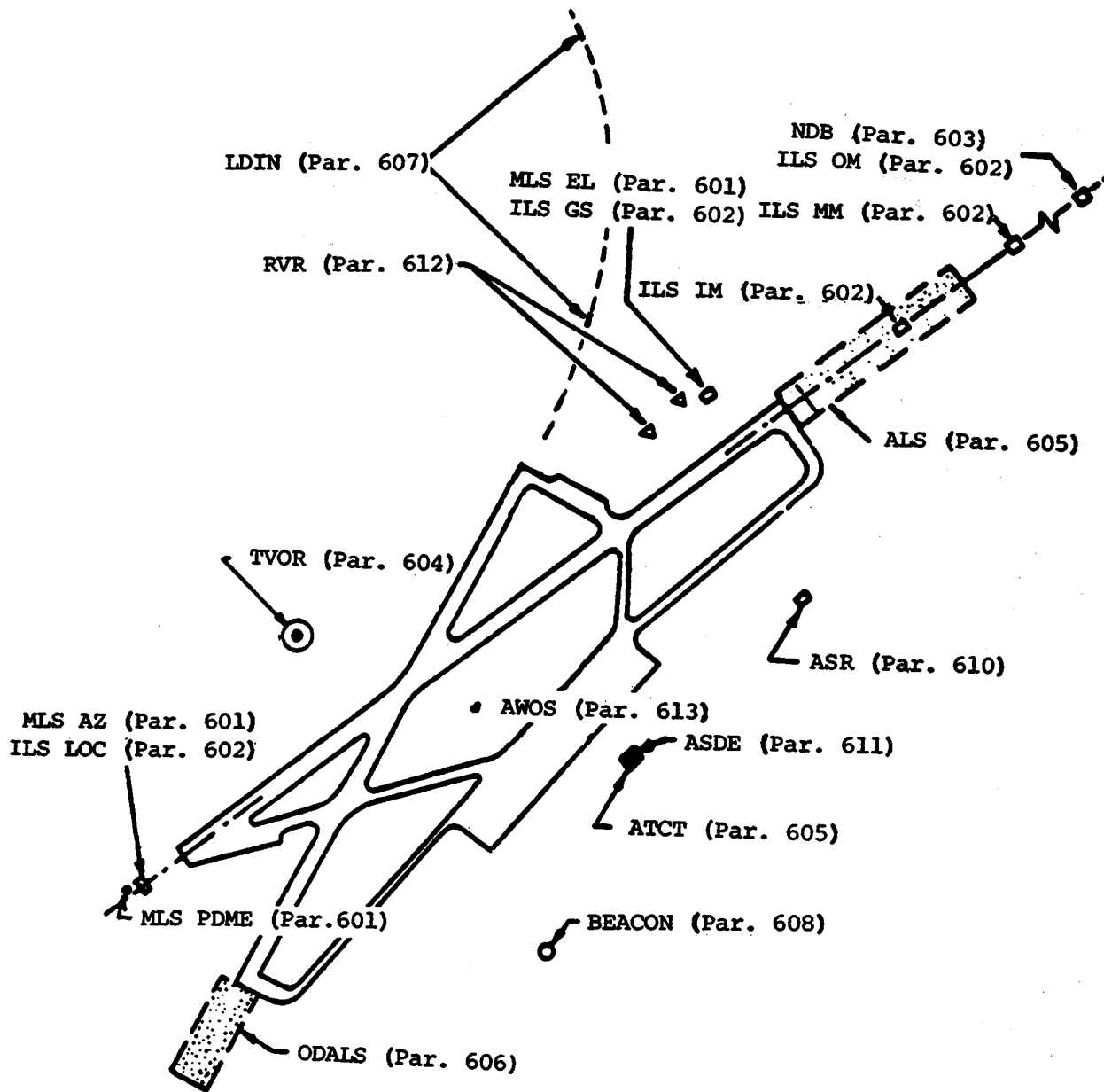


Figure 6-2. Typical NAVAID placement

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(2) AZ antennas require the area between the antenna and the stop end of the runway be cleared of objects that could reflect or block the signal. Figure 6-3 illustrates this area.

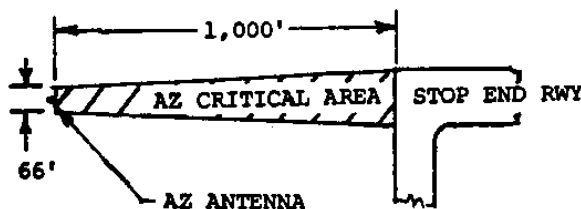


Figure 6-3. AZ antenna critical area

a. **Elevation Antenna.** Descent guidance is provided by the elevation (EL) antenna. The signal area extends from the horizon to 30 degrees above the horizon. The EL antenna height depends upon the beam width but would not exceed 18.6 feet (5.7 m).

(1) The EL antenna site is at least 400 feet (120 m) from the runway centerline and 800 to 1,000 feet (240 to 300 m) from the runway threshold and should provide a threshold crossing height of 50 feet (15 m). Figure 6-4 illustrates EL antenna siting.

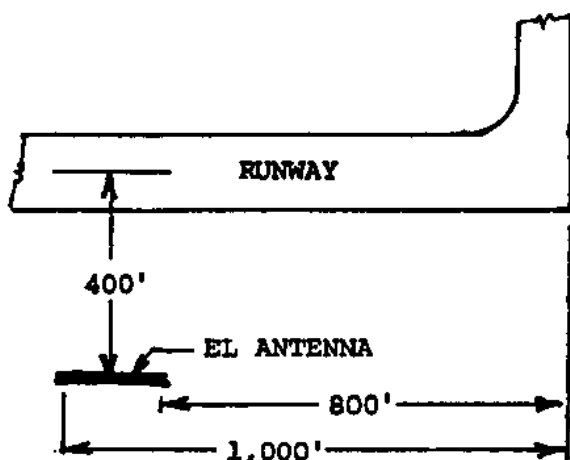


Figure 6-4. EL antenna siting

(2) EL antenna critical areas begin at the runway near edge and extend to 33 feet (10 m) outboard of the antenna site. They are 1,000 feet (300 m) in length, measured from the antenna toward the approaching aircraft. These areas should be clear of objects that could reflect or block the signal. Figure 6-5 illustrates this area.

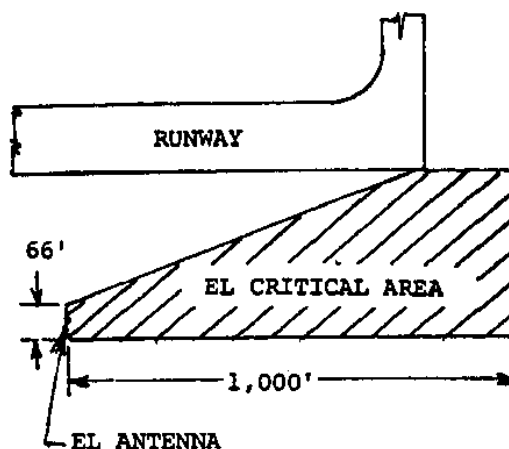


Figure 6-5. EL antenna critical area

b. **Distance Measuring Equipment.** Range information is provided by distance measuring equipment (DME). DME antennas are 22 feet (6.7 m) in height and normally are collocated with the AZ antenna. To preclude penetration of an approach surface, the collocated AZ/DME antennas should be placed 1,300 feet (390 m) from the runway end.

602. INSTRUMENT LANDING SYSTEM. The instrument landing system (ILS) provides pilots with electronic guidance for aircraft alignment, descent gradient, and position until visual contact confirms the runway alignment and location. Figure 6-2 illustrated ILS component locations.

a. **General.** The ILS uses a line-of-sight signal from the localizer antenna and marker beacons and a reflected signal from the ground plane in front of the glide slope antenna.

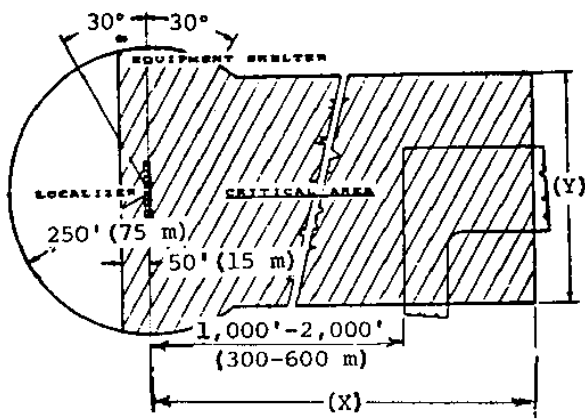
(1) ILS antenna systems are susceptible to signal interference sources such as power lines, fences, metal buildings, etc.

(2) Since ILS uses the ground in front of the glide slope antenna to develop the signal, this area should be graded to remove surface irregularities.

(3) ILS equipment shelters are located near but are not a physical part of the antenna installation.

b. **Localizer Antenna.** The localizer (LOC) signal is used to establish and maintain the aircraft's horizontal position until visual contact confirms the runway alignment and location.

(1) The LOC antenna is usually sited on the extended runway centerline outside the runway safety area between 1,000 to 2,000 feet (300 to 600 m) beyond the stop end of the runway. Where it is not practicable to locate the antenna beyond the end of the RSA, consult with the FAA Terminal Procedures Specialist (TERPS) and consider offsetting the localizer to the side to keep it clear of the RSA and to minimize the potential hazard to aircraft (See paragraph 305). The localizer critical area is illustrated in Figure 6-6.



NOTE: The X and Y dimensions vary depending on the system used.

X varies from 2,000 feet (600 m) to 7,000 feet (2100 m).

Y varies from 400 feet (120 m) to 600 feet (180 m).

Figure 6-6. ILS LOC siting and critical area

(2) The critical area depicted in figure 6-6 surrounding the LOC antenna and extending toward and overlying the stop end of the runway should be clear of objects.

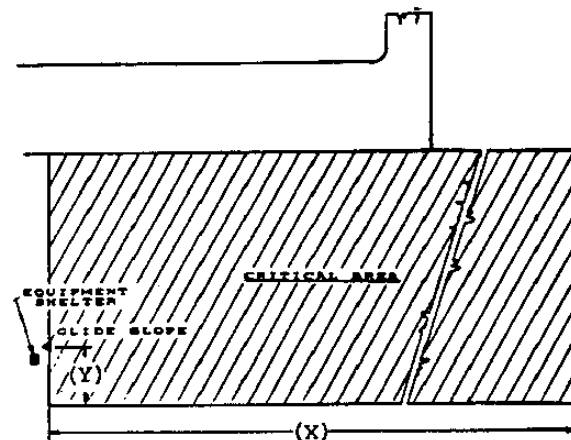
(3) The critical area should be smoothly graded. A constant +1 percent to -1.5 percent longitudinal grade is recommended. Transverse grades

should range from +1.0 percent to -3.0 percent, with smooth transitions between grade changes. Antenna supports shall be frangible and foundations should be flush with the ground.

(4) The LOC equipment shelter is placed at least 250 feet (75 m) to either side of the antenna array and within 30 degrees of the extended longitudinal axis of the antenna array.

c. **Glide Slope Antenna.** The glide slope (GS) signal is used to establish and maintain the aircraft's descent rate until visual contact confirms the runway alignment and location. A GS differentiates precision from nonprecision approaches.

(1) The GS antenna may be located on either side of the runway. The most reliable operation is obtained when the GS is located on the side of the runway offering the least possibility of signal reflections from buildings, power lines, vehicles, aircraft, etc. The glide slope critical area is illustrated in Figure 6-7.



NOTE: The X and Y dimensions vary depending on the system used.

X varies from 800 feet (240 m) to 3,200 feet (960 m).

Y varies from 100 feet (30 m) to 200 feet (60 m).

Figure 6-7. GS siting and critical area

(2) Signal quality is dependent upon the type of antenna used and the extent of reasonably level ground immediately in front of the antenna.

(3) The GS equipment shelter is located 10 feet (3 m) behind the antenna and a minimum of 400 feet (120 m) from the runway centerline.

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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.

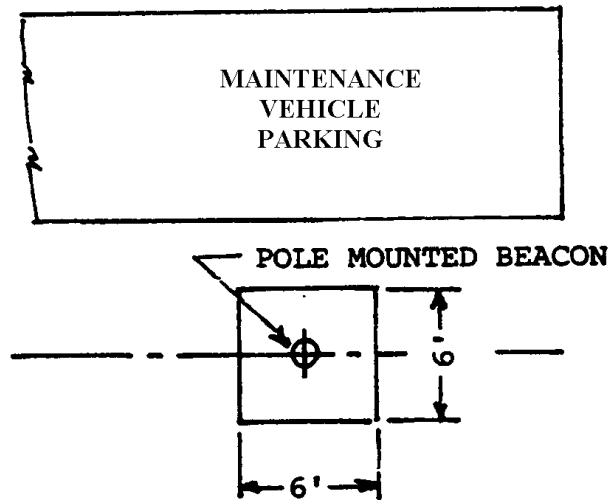


Figure 6-8. Marker beacon site

(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.

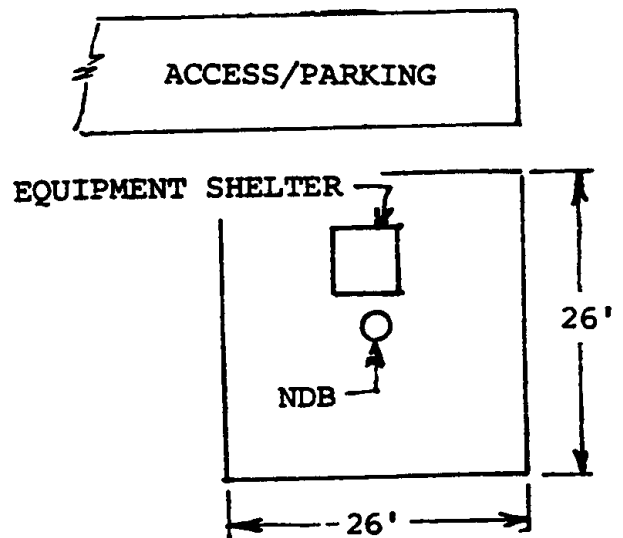


Figure 6-9. NDB site

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.

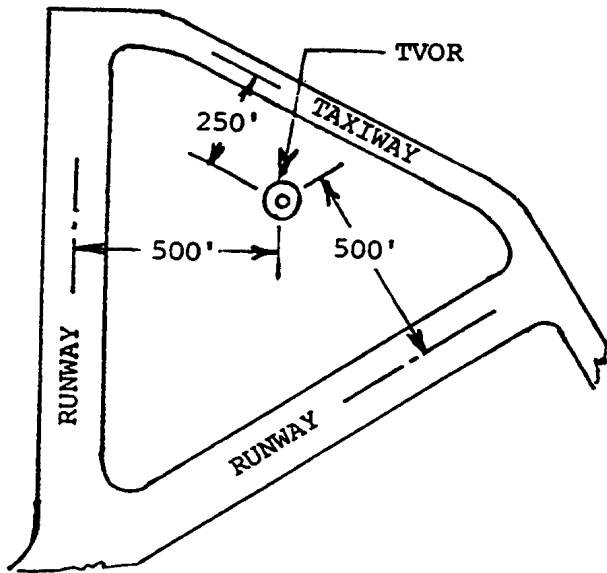


Figure 6-10. A TVOR installation

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.

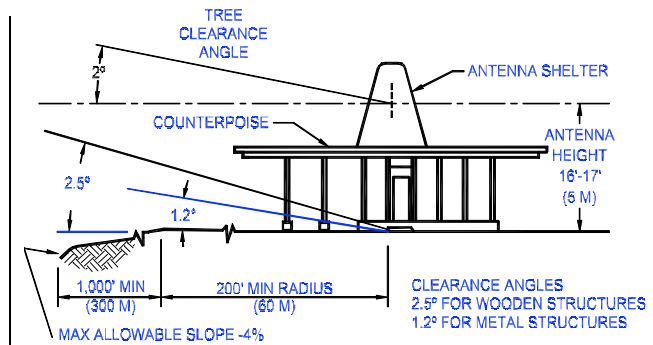


Figure 6-11, TVOR Clearances

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.

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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 1,700 feet (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.

9/29/89

AC 150/5300-13

614. PHYSICAL SECURITY. Airport facilities require protection from acts of vandalism. To provide a measure of protection, unauthorized persons must be precluded from having access to NAVAIDs and ATC facilities. Perimeter fencing should be installed to preclude inadvertent entry of people or animals onto the airport. In addition to airport perimeter fencing, the following security measures are recommended:

a. **Off-Airport Facilities.** Navigational and ATC facilities located off an airport, and in a location that is accessible to animals or the public, shall have a security perimeter fence installed at the time of construction.

b. **On-Airport Facilities.** Navigational and ATC facilities located on the airport have at least the protection of the operational areas. Any protection device, e.g., a guard rail or security fence, which penetrates an FAR 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.

615. CABLE PROTECTION. Most NAVAID and ATC facilities discussed in this chapter are served by buried power and control cables. FAA cables are typically buried approximately 24 inches (.6 m) below ground. They should be installed in conduit or duct beneath runways and taxiways, and in duct and manhole systems under aprons and paved parking areas. Information regarding the location of FAA cables and ducts may be obtained from the Manager of the Airways Facilities Maintenance Office serving the NAVAID or ATC facility. Questions relative to protecting or relocating cables can be obtained from the FAA Regional Airways Facilities Division Office.

616. to 699. RESERVED

Chapter 7. RUNWAY AND TAXIWAY BRIDGES

700. INTRODUCTION. Efforts to extend a runway are in many cases complicated by an existing or proposed street, highway, or railroad which is important to the community. When the closing or rerouting of an existing surface transportation mode is not practical, consider bridging the runway/taxiway over the impediment. This chapter presents guidance for this consideration.

701. SITING PRECEPTS. Minimize the extent of the required structure(s) by selection of:

a. **Route.** Achievement of the least number of required runway or taxiway bridges is possible through routing or rerouting of surface modes.

b. **Alignment.** A single bridge structure should handle all surface modes, including utilities, through proper routing or alignment.

c. **Locations.** Locations of bridges should be on straight portions of taxiways and away from taxiway intersections or angled taxiway exits. Such airport features as drainage systems, utility service lines, runway and taxiway lighting circuits, ILSs, and approach lighting systems (ALS), may also affect bridge location and design.

702. DIMENSIONS.

a. **Length.** Bridge length is parallel with the runway or taxiway centerline.

b. **Width.** Bridge width is perpendicular to the runway or taxiway centerline. The recommended bridge width (full strength structure) is the width of the runway or taxiway plus safety areas. It is recommended that bridges for a runway and parallel taxiway be continuous full-width, full-strength structures as illustrated in figures 7-1 and 7-2. In unusual situations, site conditions may limit taxiway bridges to a width of the taxiway plus shoulders. A minimum width taxiway bridge requires: positive edge protection; underwing engine clearance; adequate blast protection for vehicles or personnel crossing under the bridge; sufficient width for maneuvering rescue and firefighting equipment; and sufficient width to accommodate aircraft evacuation slides. Figure 7-3 illustrates a minimum width taxiway bridge.

c. **Height.** Bridge height is the vertical clearance provided over the crossed surface.

d. **Clearance.** Except for positive edge restraints on minimum width taxiway bridges, no structural members should project above the runway or taxiway surface.

703. LOAD CONSIDERATIONS. Runway and taxiway bridges must support both static and dynamic loads imposed by the heaviest airplane expected to use the structures. Airport authorities should evaluate the potential need to accommodate heavier airplanes and construct any runway or taxiway bridge accordingly. Overdesign is preferable to the cost and operational penalties of replacing or strengthening an underdesigned structure at a later date. Airplanes weighing up to 873,000 pounds (395 985 kg) are in use today. Airplanes weighing 1,000,000 pounds (453 600 kg) or more may exist by the turn of the century.

704. DECK DESIGN. Bridges should be designed to incorporate a layer of select earth between the bridge deck and the runway or taxiway pavement. The earth acts as an insulator to reduce the probability of ice forming on the bridge before the adjacent pavement freezes. Where bridge height is limited, the bridge's structural deck may be the runway or taxiway surface.

705. MARKING AND LIGHTING. The following marking and lighting is in addition to the standard marking and lighting specified in advisory circulars of the 150/5340 series. Figure 7-5 illustrates shoulder marking for minimum width taxiways.

a. Three equally-spaced L-810 obstruction lights on each side of the bridge.

b. Chevrons spaced 25 feet (7.5 m) apart on runway and taxiway shoulders.

c. Taxiway centerline lights or centerline reflectors.

d. Taxiway edge lights or edge reflectors.

e. Taxiway edge markings.

706. OTHER CONSIDERATIONS. The preceding paragraphs cover design requirements applicable to all runway and taxiway bridges. The following identify additional design features which may be necessary as part of a specific runway or taxiway bridge project.

a. Curbs. On minimum width taxiway bridges and where icing conditions may exist, a curb designed to hold the largest expected aircraft should be added to prevent aircraft from being blown from the bridges. Figure 7-3 shows a double-curb installation.

b. Security Fences. Security fences should be provided adjacent to the bridge-tunnel to prevent inadvertent entry of persons, vehicles, or animals into operational areas. AC 107-1 furnishes additional guidance on the subject.

c. Pavement Heating. Where freezing is a problem, in-pavement heating may be desirable on bridges which do not have sufficient earth cover to provide insulation. Accordingly, the drainage system needs to be capable of accepting melted runoff without refreezing or flooding the bridged surface.

d. Service Roads. Airport maintenance and service equipment may use a runway or taxiway bridge if its presence does not interfere with airplane operations. There should be a separate bridge if there is more than occasional use by these vehicles. Figure 7-6 illustrates a multi-use bridge over a public roadway.

e. Blast Protection. Minimum width taxiway bridges require special features to protect the surface from jet blast. One alternative is nonload-bearing decks beyond the limits of the load-bearing shoulders.

f. Approach Aprons. Aprons, similar to those used in highway construction, are recommended to minimize the effects of differential settlement between the bridge proper and its approaches.

g. Tunnel Ventilation. The need for mechanical ventilation will depend upon its length. When mechanical ventilation is necessary, all aboveground components need to be located so that they are not a hazard to aeronautical operations.

h. Tunnel Lighting. The need for artificial lighting of the tunnel depends on its length. Emergency lighting and lane-control signals may also be necessary. The American Association of State Highway Officials publication "Informational Guide for Roadway Lighting" contains a section on lighting tunnels and underpasses. Copies of this publication are available through state highway offices. Light poles shall not penetrate an FAR Part 77 surface unless an FAA aeronautical study determines they will not be hazards. Light from the fixtures shall not cause

glare or distract pilots or control tower personnel. Figure 7-4 illustrate roadway lighting applications.

i. Drainage. Tunnels which pass under a runway or taxiway, may require automatic, self-priming pumps.

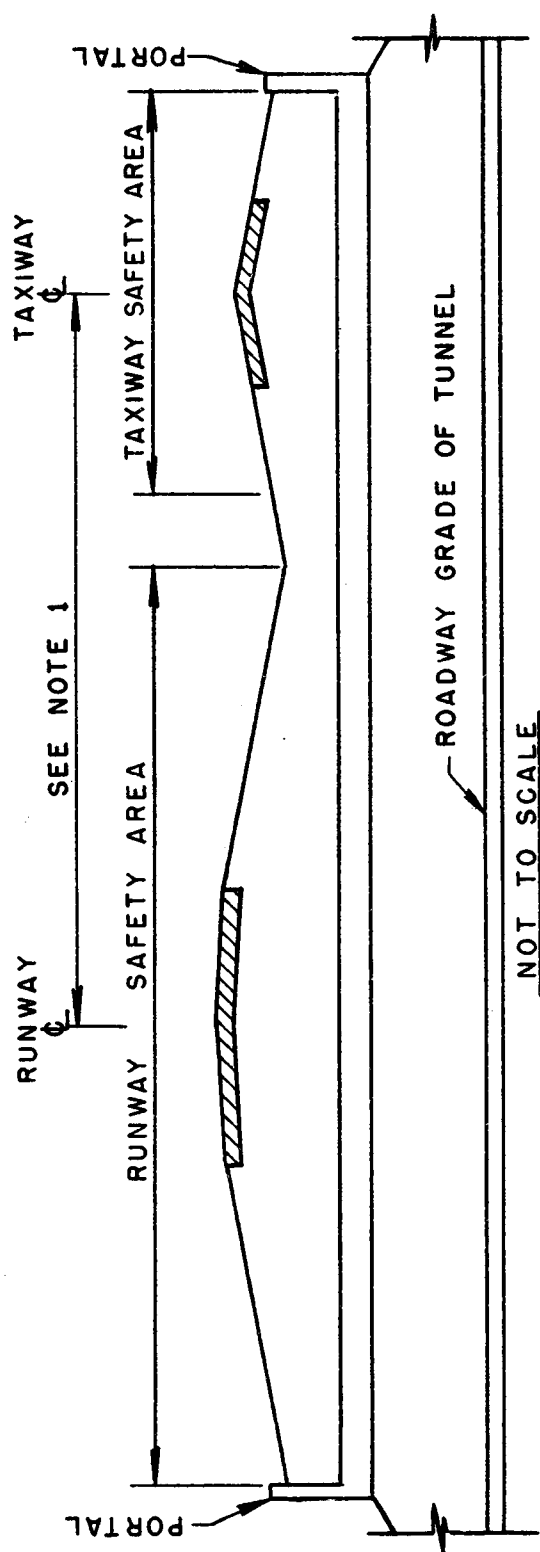
707. PASSENGER AND BAGGAGE TUNNELS.

Passenger and baggage tunnels connect main and satellite terminals. In essence, they are merely smaller versions of runway and taxiway bridges and have similar design considerations. Tunnels house walkways, baggage conveyers, subway-type people-mover systems, or a combination of these.

708. to 799. RESERVED.



Figure 7-1. Full width runway-taxiway bridge



NOTES:

1. WIDTH OF TAXIWAY SAFETY AREA AND RUNWAY / TAXIWAY SEPARATION DISTANCE VARY DEPENDING ON AIRPLANE / TAXIWAY DESIGN GROUP.
2. ROADWAY TUNNEL NORMALLY HAS SLIGHT LONGITUDINAL GRADIENT AND SOME TYPE OF RETAINING WALL AT PORTALS
3. UNIFORM TUNNEL CROSS SECTION IS NORMALLY USED; AND A CONTINUOUS STRUCTURE WITHOUT OPEN SECTION IN INFIELD AREA IS PREFERRED AND RECOMMENDED WHEREVER FEASIBLE

Figure 7-2. Cross-section full width runway-taxiway bridge

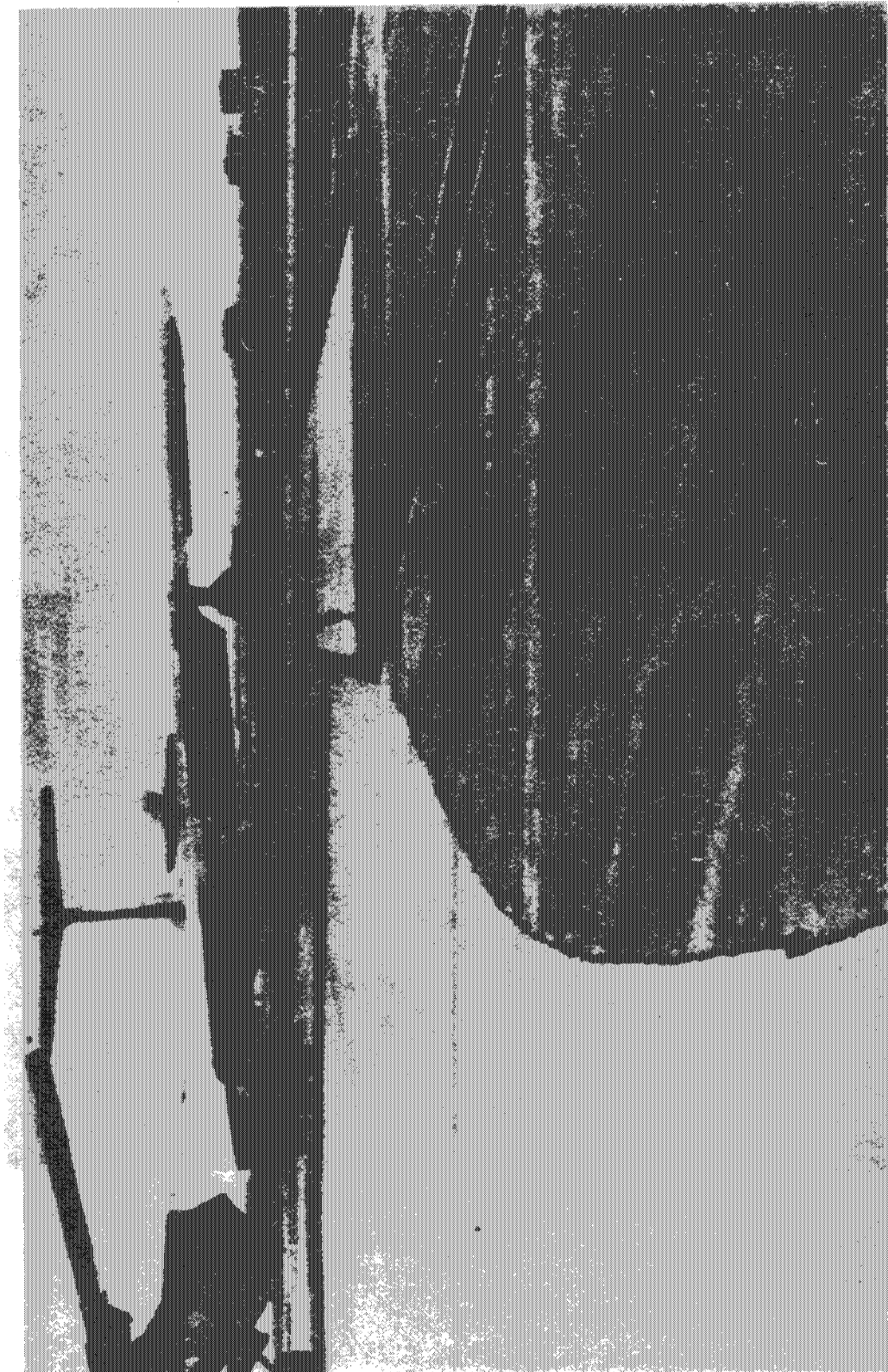


Figure 7-3. Minimum width taxiway bridge with positive edge protection, O'Hare Airport, Chicago, IL

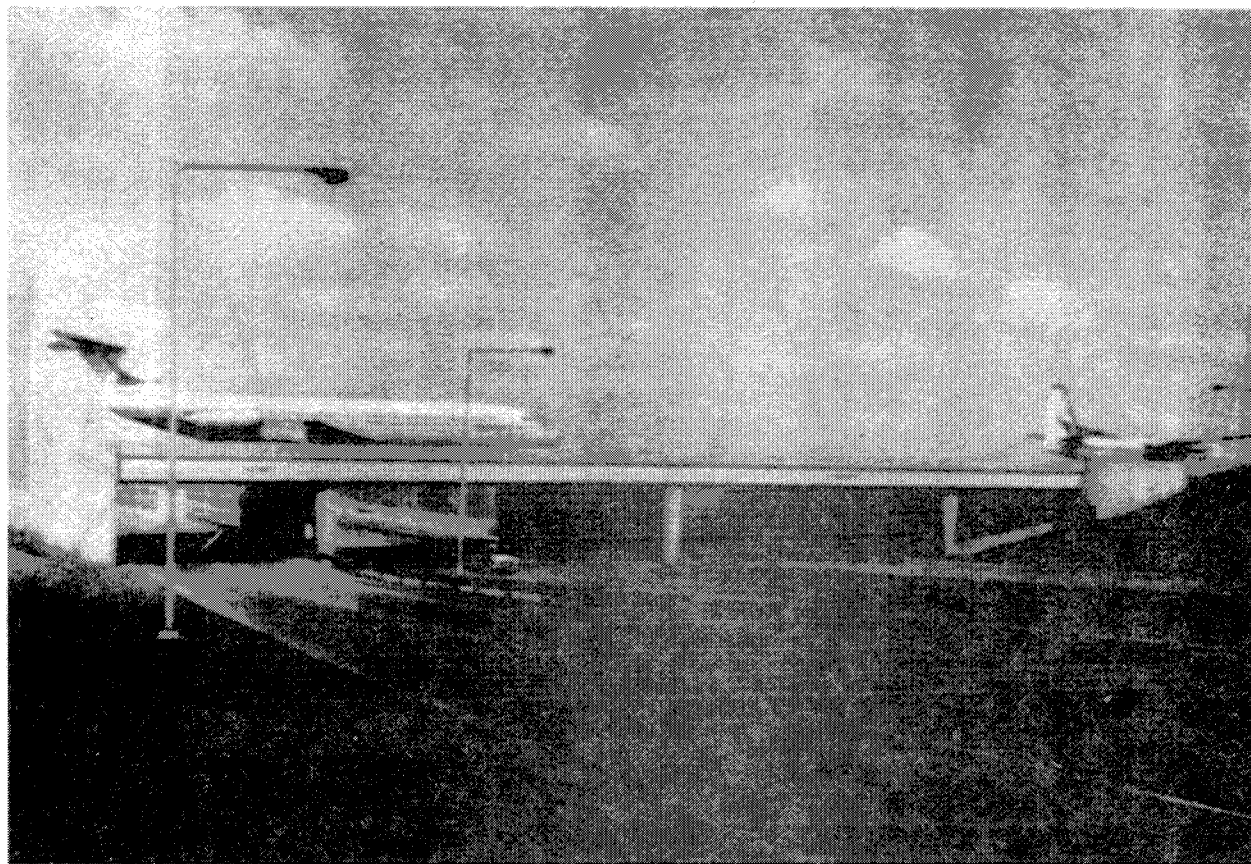


Figure 7-4. Example structural deck and depressed roadway, O'Hare Airport, Chicago, IL

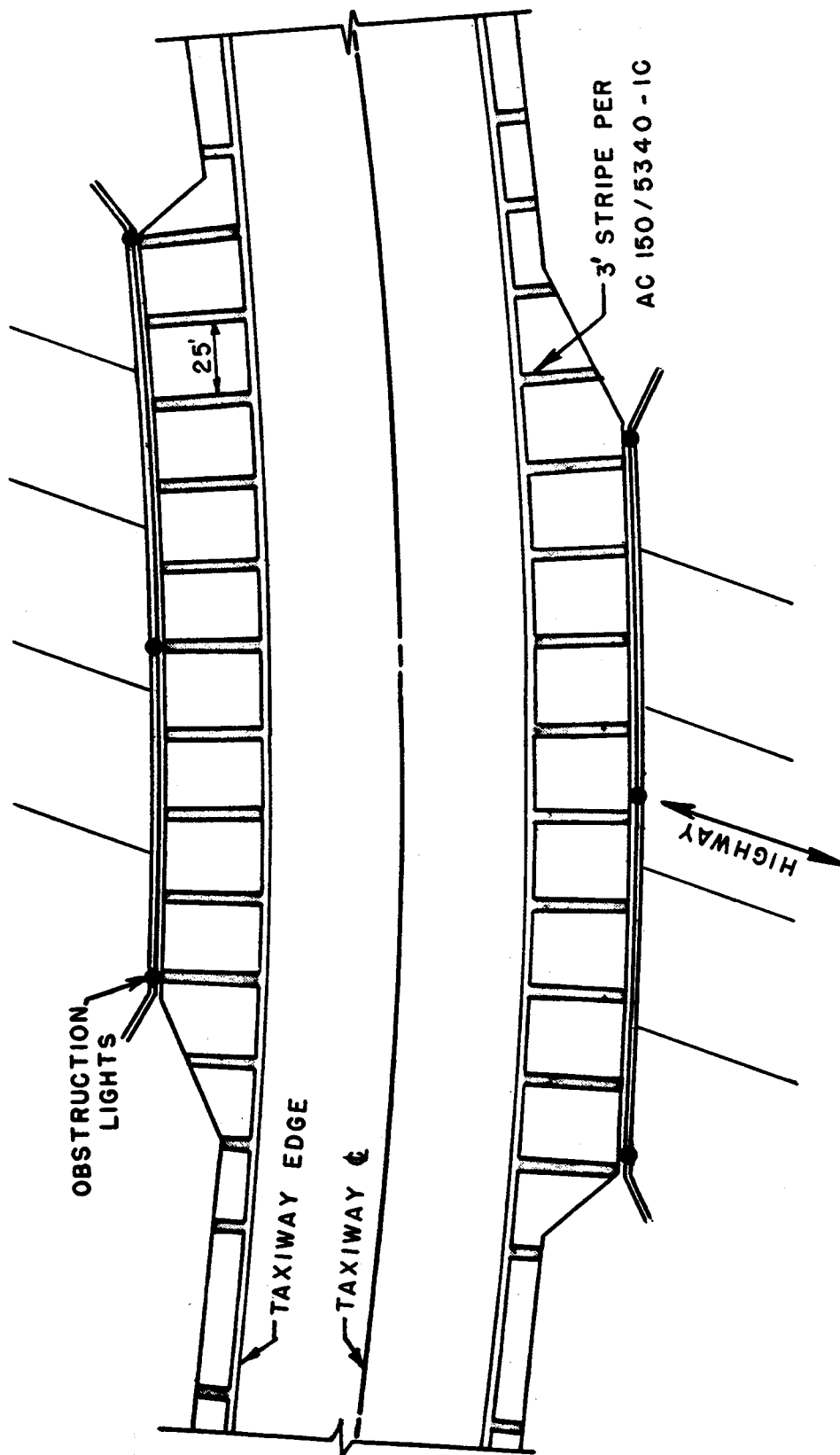


Figure 7-5. Suggested shoulder marking of minimum width taxiway bridge

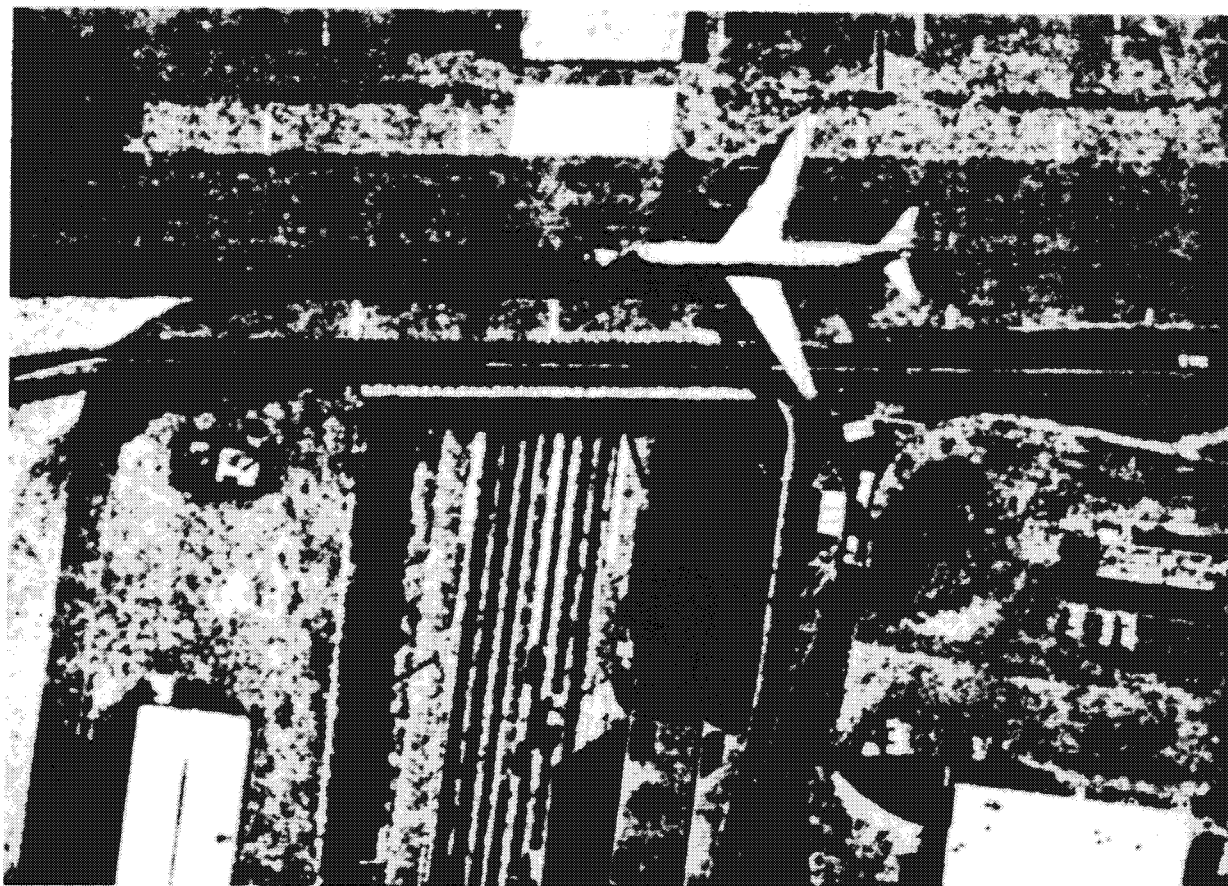


Figure 7-6. Controlled use service road, Los Angeles International Airport, Los Angeles, CA

Chapter 8. THE EFFECTS AND TREATMENT OF JET BLAST

800. INTRODUCTION. The forces of jet exhaust (jet blast) far exceed the forces of propwash from the most powerful propeller airplane. These high velocities are capable of causing bodily injury to personnel and damage to airport equipment or facilities. This chapter suggests means to minimize the effects of jet blast.

801. JET BLAST EFFECTS. Jet blast affects all operational areas of the airport. In terminal, maintenance, and cargo areas, personnel safety is the overriding consideration. Blast velocities greater than 30 m.p.h. (48 km/hr) can cause loose objects on the pavement to become missiles capable of causing injury to personnel who may be at a considerable distance behind the airplane. In other operational areas, sudden gusts averaging more than 20 m.p.h. (31 km/hr) are hazardous, and when striking moving vehicles or airplanes, are more dangerous than continuous velocities of the same magnitude. Velocities of this magnitude can occur over 2,000 feet (600 m) to the rear of certain airplanes when their engines are operating at takeoff thrust.

a. Jet Blast Pressures. Jet exhaust velocities are irregular and turbulent. The vibrations they induce over small areas should be considerations in designing a building or structure subjected to jet blast. Over areas of 10 to 15 square feet (3 to 5 m²), the velocities may be assumed to be periodic with peaks occurring 2 to 6 times per second. These peaks are not continuous laterally or vertically. The following equation computes the pressure produced on a surface perpendicular to the exhaust stream:

$$P = 0.00256 V^2, \text{ where:}$$

P = pressure in pounds per square foot; and
V = velocity in miles per hour.

$$P = 0.04733 V^2, \text{ where:}$$

P = pressure in pascals; and
V = velocity in kilometers per hour.

b. Blast Velocity Distances. The drag and uplift forces produced by jet engines are capable of moving large boulders. A jet engine operating at maximum thrust is capable of lifting a 2-foot (0.6 m) boulder 35 feet (10 m) behind the airplane completely off the ground. Fortunately, these forces which cause severe erosion decrease rapidly with distance so that beyond 1,200 feet (365 m) behind a jet airplane only sand and cohesionless soils are affected. Figures 8-1

through 8-5 illustrate the velocity versus distance plots for representative airplanes. The velocities shown represent maximum values, particularly for breakaway from a parked position. For site specific conditions, include manufacturers' jet blast data for the most demanding airplane in the analysis. The distances shown are measured from the rear of the airplane and the velocities are for takeoff, breakaway, and idle thrust power settings. Similar data for other airplanes, including lateral and vertical velocity contours, as well as site specific blast loads on structures, may be obtained from the engine manufacturers.

c. Heat Effects. High temperatures are also associated with jet exhaust; but the affected area is smaller than the area subject to hazardous jet blast velocities. Contours showing the level of heat at varying distances from jet engines are obtainable from airplane manufacturers.

802. BLAST FENCES. Properly designed blast fences can substantially reduce or eliminate the damaging effects of jet blast, as well as the related fumes and noise which accompany jet engine operation. Fences are permissible near apron areas to protect personnel, equipment, or facilities from the jet blast of airplanes moving into or out of parking positions. In addition, blast fences may be necessary near runway ends, run-up pads, etc., to shield off-airport, as well as, airport pedestrian or vehicular traffic.

a. Location. Generally, the closer the fence is to the source of blast, the better it performs, provided that the centerline of the exhaust stream falls below the top of the fence. To the extent practicable, blast fences should be located outside of the runway object free area.

b. Design. Figures 8-6 and 8-7 illustrate several types of blast fence design which are readily available from various manufacturers. Blast fences located inside the runway object free area should be as frangible as practicable.

c. Other Types of Blast Protection. Although blast fences are the most effective means of blast protection, other methods may achieve satisfactory results. Any surface, whether natural or manmade, located between the jet engine and the area to be protected will afford some measure of blast protection.

803. SHOULDERS AND BLAST PADS. Unprotected soils adjacent to runways and taxiways are susceptible to erosion. A dense, well-rooted turf cover can prevent erosion and support the occasional passage of aircraft, maintenance equipment, or emergency equipment under dry conditions. Paved shoulders are recommended for runways, taxiways, and aprons which will accommodate Group III and higher aircraft. Turf, aggregate-turf, soil cement, lime or bituminous stabilized soil are recommended adjacent to paved surfaces provided for Group I and II aircraft.

a. Shoulder and Blast Pad Dimensions. Paved shoulders should run the full length of the runway(s) and taxiway(s). Blast pads at runway ends should extend across the full width of the runway plus the shoulders. Table 3-1, 3-2, and 3-3 specify the standard blast pad dimensions and runway shoulder widths. Table 4-1 specifies the standard taxiway shoulder widths. Increases to these standard dimensions are permissible for unusual local conditions.

b. Pavement Strength. Shoulder and blast pad pavement needs to support the occasional passage of the most demanding airplane as well as the heaviest existing or future emergency or maintenance vehicle for the design life of the full strength pavement. These pavements may be constructed of bituminous or Portland Cement concrete materials. Specifications for materials and constructions standards for these pavements should be based on state highway requirements.

(1) For Airplane Design Groups III and IV, the minimum bituminous concrete surface thickness, constructed on an aggregate base, is 2 inches (51 mm) for shoulders and 3 inches (76 mm) for blast pads. These thicknesses should be increased by 1 inch (25 mm) for Airplane Design Groups V and VI. Aggregate base and subbase thicknesses should be determined using state highway design standards.

(2) The thickness of shoulders and blast pads constructed of Portland Cement concrete should be based on state highway standards. The minimum thickness of these pavements, as recommended in AC 150/5320-6, is 5 inches (127 mm).

(3) Shoulders and blast pads may have stabilized subbase and base. The stabilized subbase and base thicknesses should be determined using the equivalency factors in AC 150/5320-6 for converting aggregate subbase and base to stabilized subbase and base.

c. Drainage. Surface drainage should be maintained or improved in the shoulder and blast pad areas. Where a paved shoulder or blast pad abuts the runway, the joint should be flush, however, the shoulder may retain a 5 percent transverse slope. A 1.5 inch (3.8 cm) step is the standard at the edge of paved shoulders and blast pads to enhance drainage and to prevent fine graded debris from accumulating on the pavement. Base and subbase courses shall be of sufficient depth to maintain the drainage properties of granular base or subbase courses under the runway, taxiway, or apron pavement. An alternative is to provide a subdrain system with sufficient manholes to permit observation and flushing of the system.

d. Marking and Lighting. AC 150/5340-1 provides guidance for marking shoulders and blast pads. New construction should provide for edge lights to be base mounted and for the installation of any cable under the shoulder or blast pad pavement to be in conduit. When adding shoulders or blast pads to existing runways or taxiways, the existing runway or taxiway edge lighting circuitry, if not suitable, should be updated/modified prior to shoulder or blast pad paving.

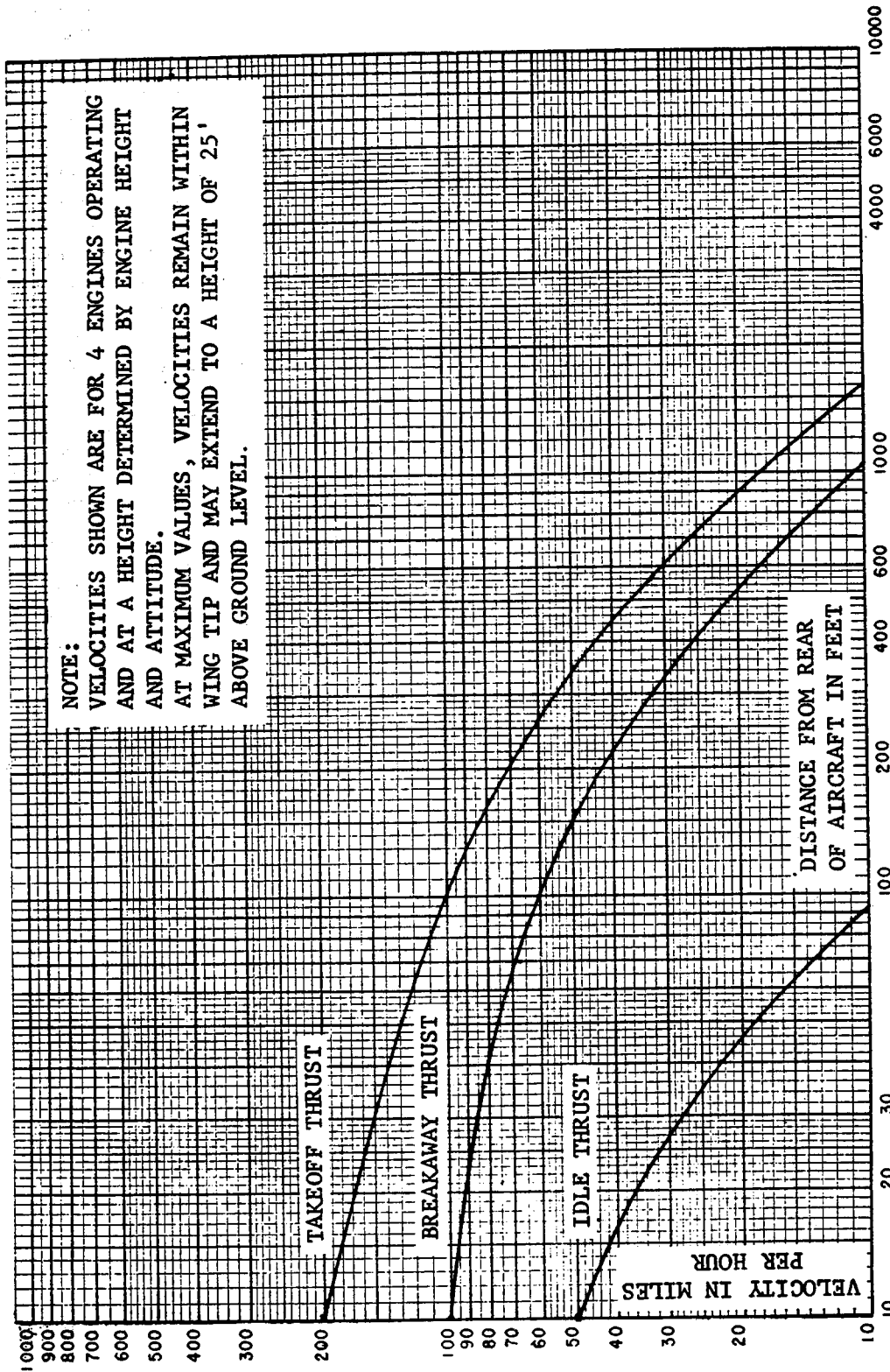


Figure 8-1. Velocity distance curves, DC-8

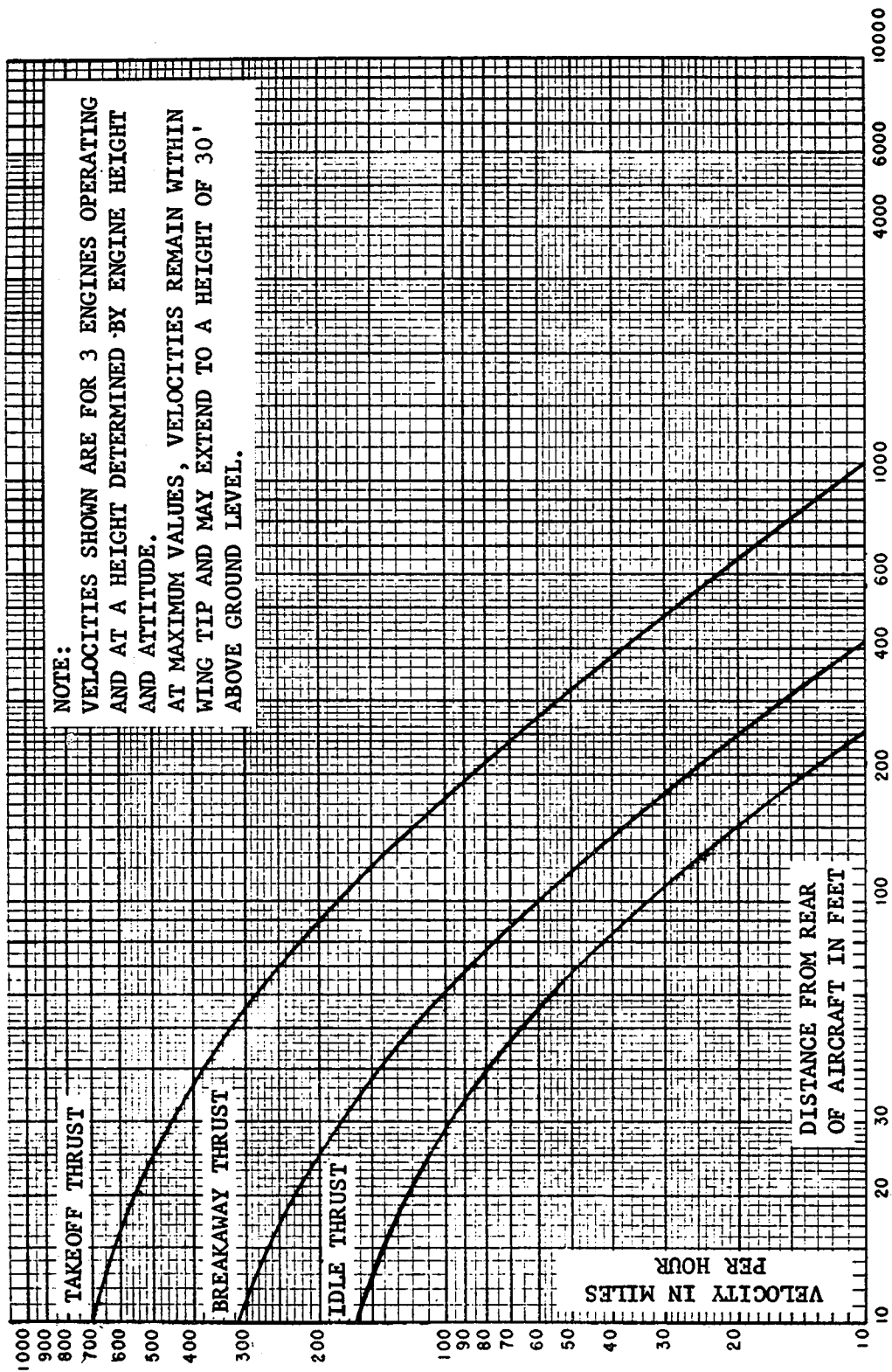


Figure 8-2. Velocity distance curves, B-727

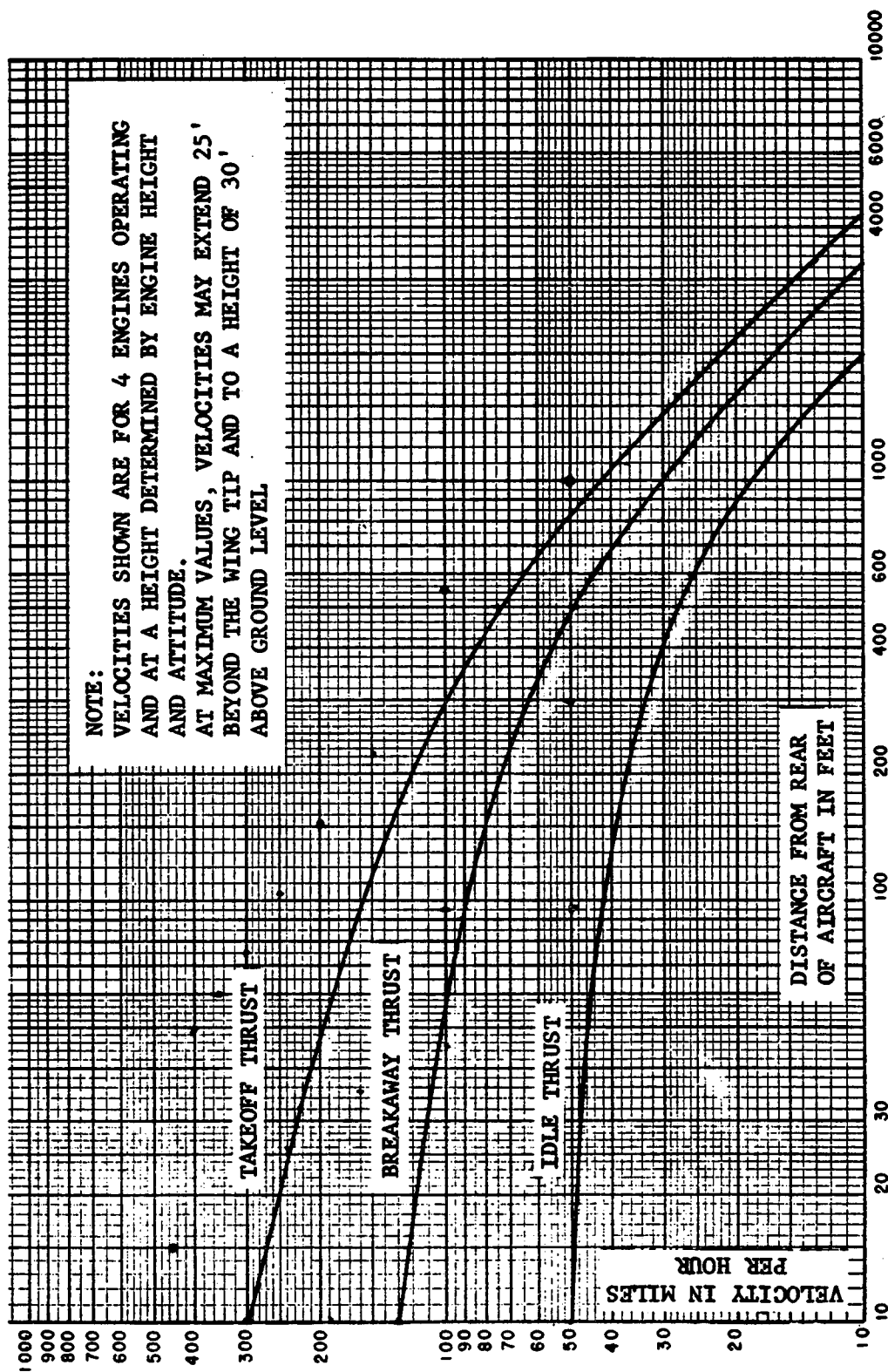


Figure 8-3. Velocity distance curves, B-747

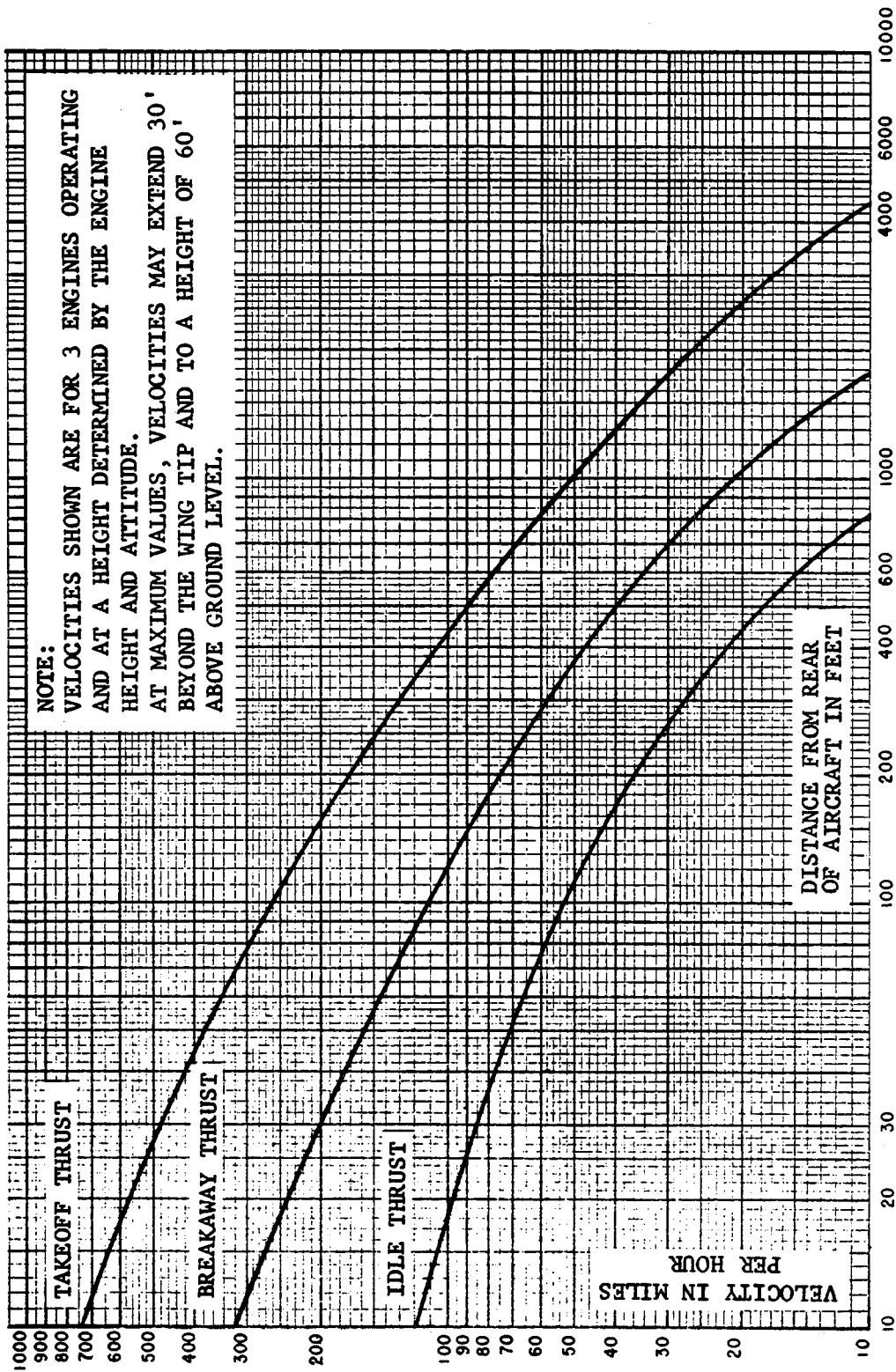


Figure 8-4. Velocity distance curves, DC-10

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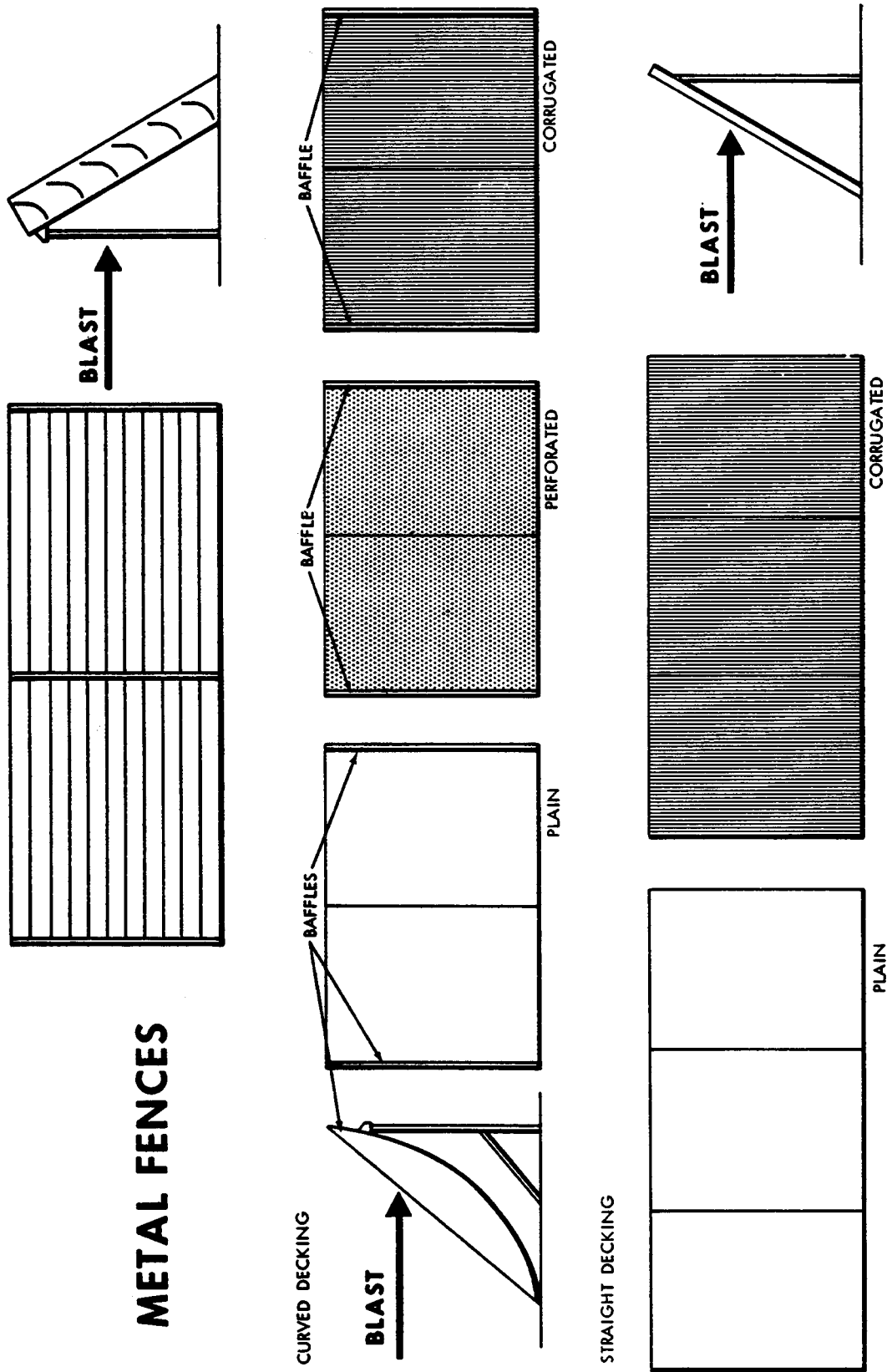
AC 150/5300-13

VELOCITY IN MILES/HOUR (KILOMETERS/HOUR)

| Distance Behind Engine Aircraft | 20' (6 m) | 40' (12 m) | 60' (18 m) | 80' (24 m) | 100' (30 m) |
|---|-----------------------|------------|------------|------------|-------------|
| | Fan Jet Falcon | | | | |
| Idle | 82(132) | 36(58) | 25(40) | 22(35) | 18(29) |
| Breakaway ^{1/} | 150(241) | 68(109) | 46(74) | 33(53) | 27(43) |
| Takeoff | 341(549) | 155(249) | 106(171) | 75(121) | 62(100) |
| Jet Commander, Lear Jet, & Hansa | | | | | |
| Idle | 54(87) | 24(39) | 15(24) | 11(18) | 9(14) |
| Breakaway | 114(183) | 50(80) | 31(50) | 22(35) | 18(29) |
| Takeoff | 259(417) | 114(183) | 68(109) | 52(84) | 42(68) |
| Jet Star & Sabreliner | | | | | |
| Idle | 92(148) | 41(66) | 25(40) | 18(29) | 15(24) |
| Breakaway | 195(314) | 85(137) | 52(84) | 39(63) | 31(50) |
| Takeoff | 443(713) | 194(312) | 119(192) | 89(143) | 72(116) |
| Gulfstream II | | | | | |
| Idle | 153(246) | 75(121) | 48(77) | 41(66) | 34(55) |
| Breakaway | 330(531) | 150(241) | 102(164) | 72(116) | 60(97) |
| Takeoff | 750(1207) | 341(549) | 232(373) | 164(264) | 136(219) |

^{1/} "Breakaway" is that percentage of power required to start airplanes moving and usually is approximately 55 percent of maximum continuous thrust.

Figure 8-5. Blast velocities of business jet airplanes



METAL FENCES

Figure 8-6. Typical blast deflector fences, metal

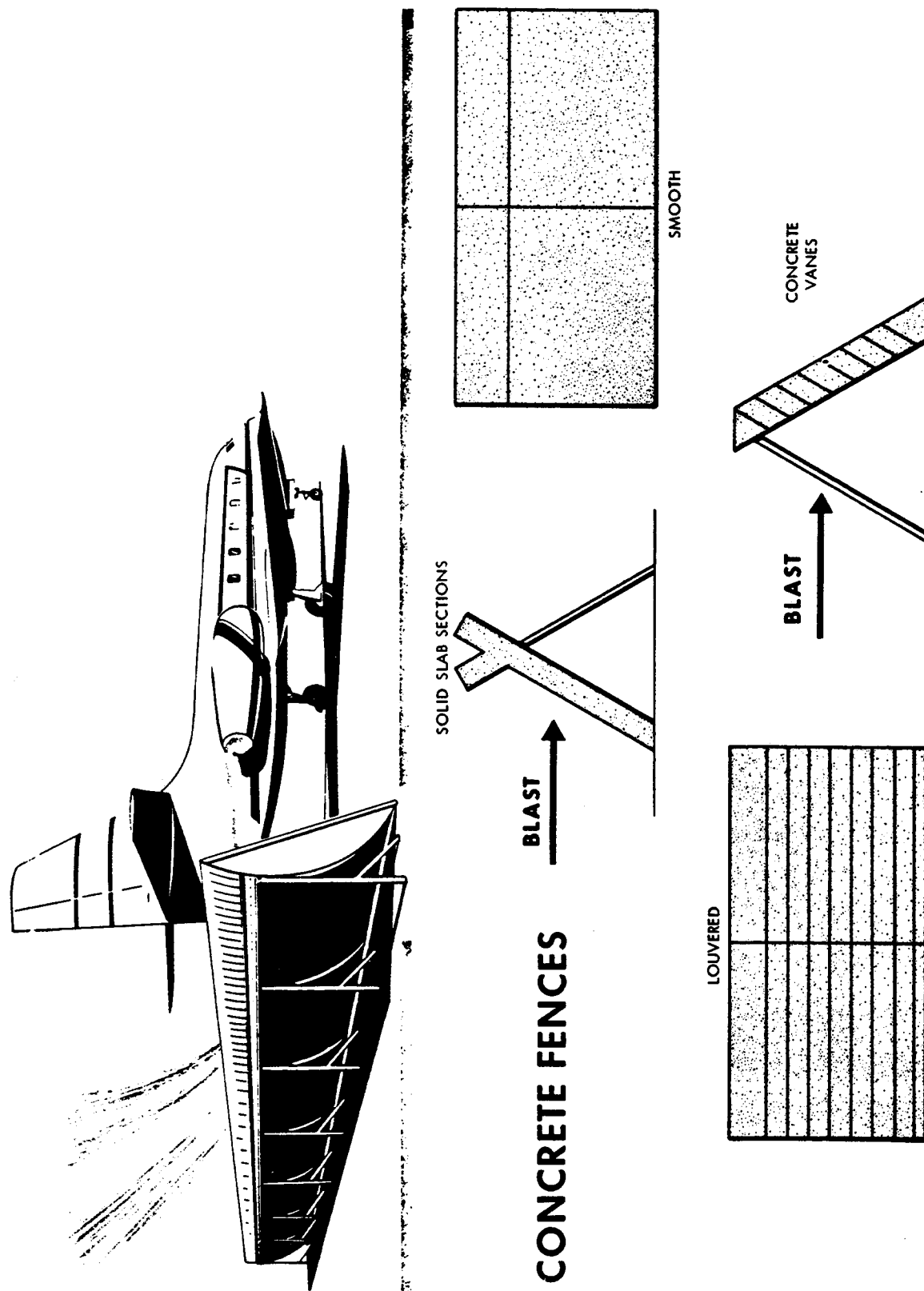


Figure 8-7. Typical blast deflector fences, concrete

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.

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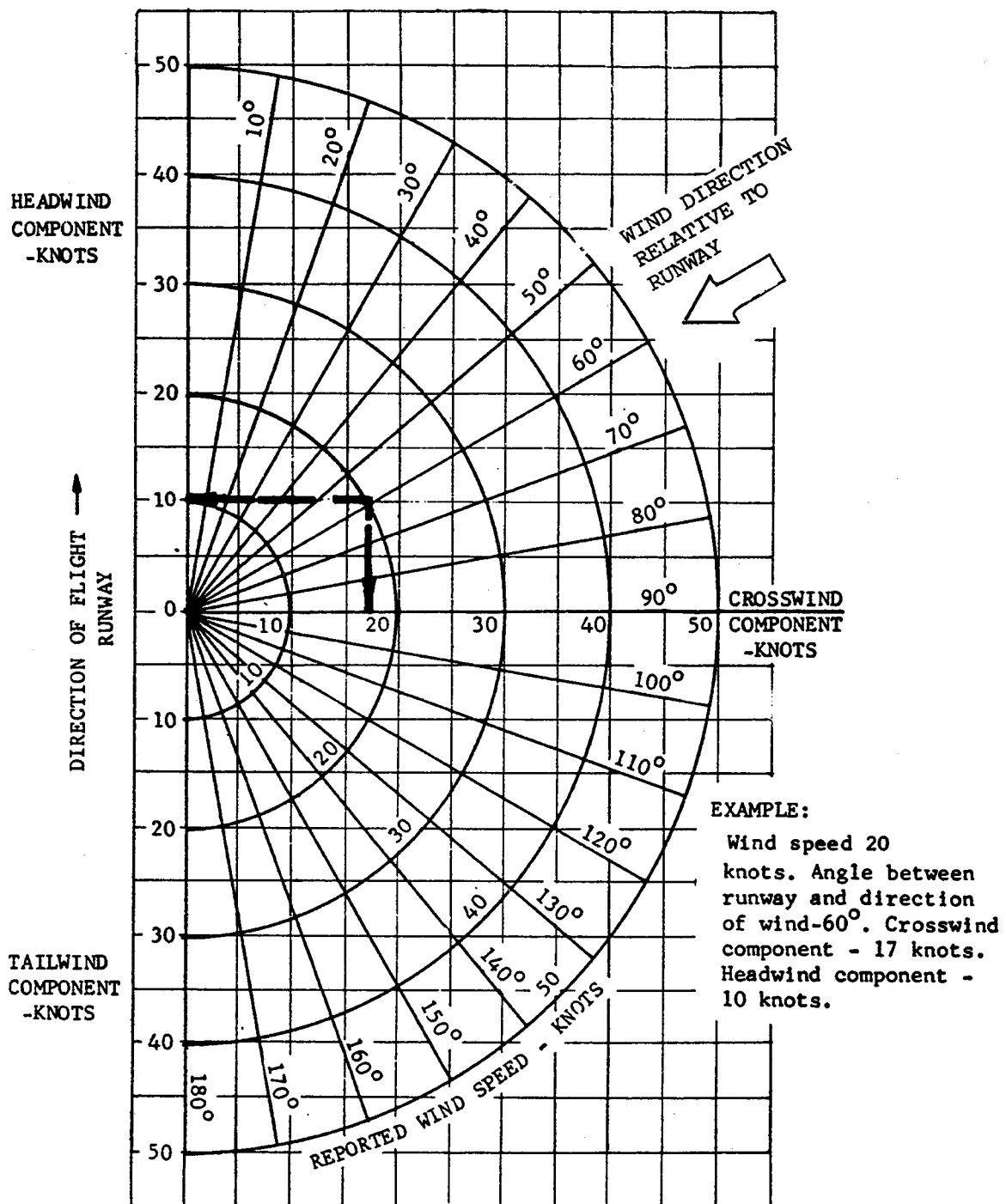
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Figure A1-1. Wind vector diagram

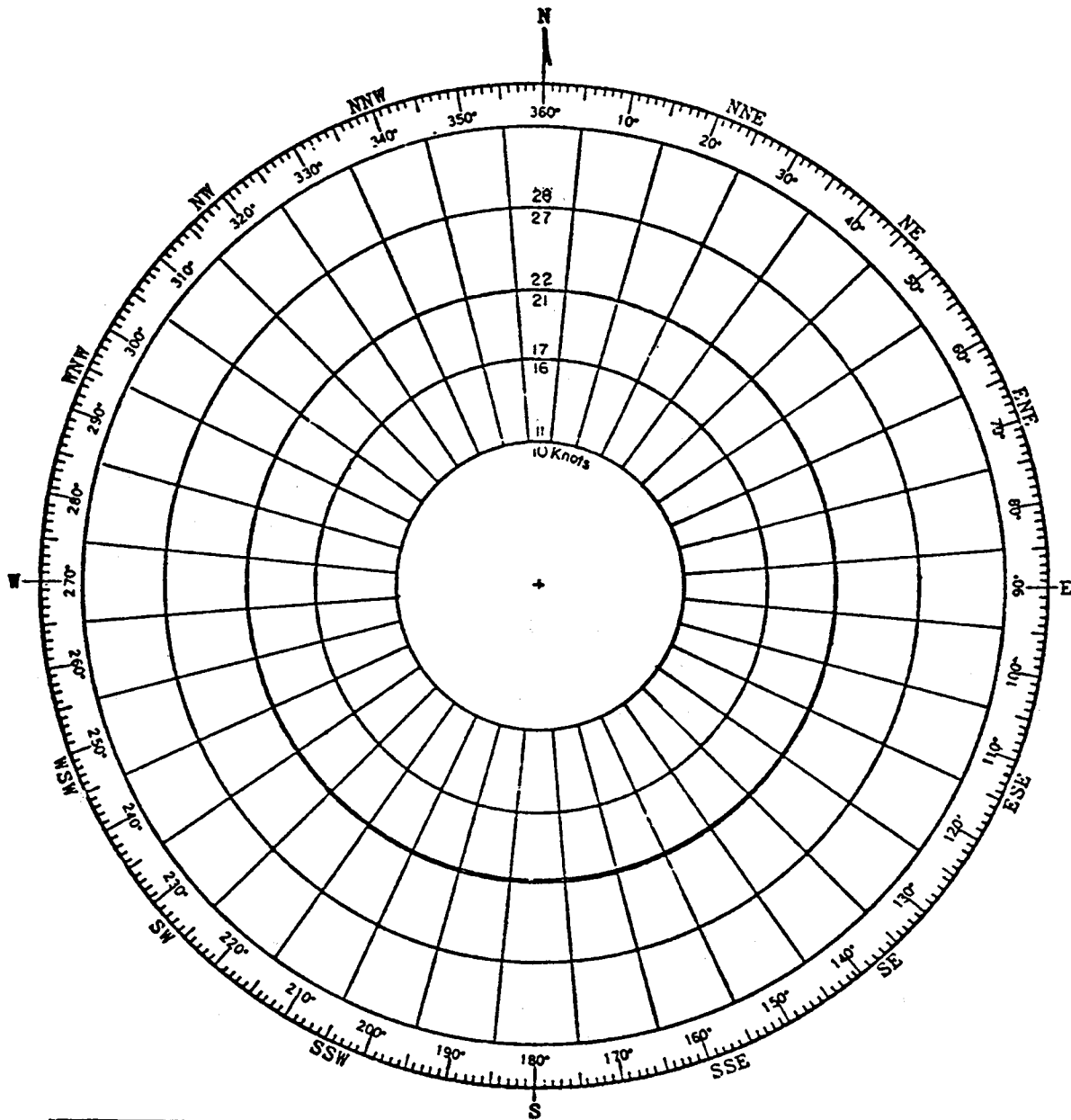
WIND DIRECTION VERSUS WIND SPEED

STATION: Anywhere, USA HOURS: 24 Observations/Day PERIOD OF RECORD: 1964-1973

| DIRECTION | HOURLY OBSERVATIONS OF WIND SPEED | | | | | | | | | | AVERAGE SPEED | |
|-----------|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|---------|-------|---------------|------|
| | 0-3 | 4-6 | 7-10 | 11-16 | 17-21 | KNOTS | | 34-40 | 41 OVER | TOTAL | KNOTS | MPH |
| | 0-3 | 4-7 | 8-12 | 13-18 | 19-24 | 22-27 | 28-33 | 34-40 | 41 OVER | | | |
| | | | | | | MPH | 32-38 | 39-46 | 47 OVER | | | |
| 01 | 469 | 842 | 568 | 212 | | | | | | 2091 | 6.2 | 7.1 |
| 02 | 568 | 1263 | 820 | 169 | | | | | | 2820 | 6.0 | 6.9 |
| 03 | 294 | 775 | 519 | 73 | 9 | | | | | 1670 | 5.7 | 6.6 |
| 04 | 317 | 872 | 509 | 62 | 11 | | | | | 1771 | 5.7 | 6.6 |
| 05 | 268 | 861 | 437 | 106 | | | | | | 1672 | 5.6 | 6.4 |
| 06 | 357 | 534 | 151 | 42 | 8 | | | | | 1092 | 4.9 | 5.6 |
| 07 | 369 | 403 | 273 | 84 | 36 | 10 | | | | 1175 | 6.6 | 7.6 |
| 08 | 158 | 261 | 138 | 69 | 73 | 52 | 41 | 22 | | 814 | 7.6 | 8.8 |
| 09 | 167 | 352 | 176 | 128 | 68 | 59 | 21 | | | 971 | 7.5 | 8.6 |
| 10 | 119 | 303 | 127 | 180 | 98 | 41 | 9 | | | 877 | 9.3 | 10.7 |
| 11 | 323 | 586 | 268 | 312 | 111 | 23 | 28 | | | 1651 | 7.9 | 9.1 |
| 12 | 618 | 1397 | 624 | 779 | 271 | 69 | 21 | | | 3779 | 8.3 | 9.6 |
| 13 | 472 | 1375 | 674 | 531 | 452 | 67 | | | | 3571 | 8.4 | 9.7 |
| 14 | 647 | 1377 | 574 | 781 | 129 | | | | | 3008 | 6.2 | 7.1 |
| 15 | 338 | 1093 | 348 | 135 | 27 | | | | | 1941 | 5.6 | 6.4 |
| 16 | 560 | 1399 | 523 | 121 | 19 | | | | | 2622 | 5.5 | 6.3 |
| 17 | 587 | 883 | 469 | 128 | 12 | | | | | 2079 | 5.4 | 6.2 |
| 18 | 1046 | 1984 | 1068 | 297 | 83 | 18 | | | | 4496 | 5.8 | 6.7 |
| 19 | 499 | 793 | 586 | 241 | 92 | | | | | 2211 | 6.2 | 7.1 |
| 20 | 371 | 946 | 615 | 243 | 64 | | | | | 2239 | 6.6 | 7.6 |
| 21 | 340 | 732 | 528 | 323 | 147 | 8 | | | | 2078 | 7.6 | 8.8 |
| 22 | 479 | 768 | 603 | 231 | 115 | 38 | 19 | | | 2253 | 7.7 | 8.9 |
| 23 | 187 | 1008 | 915 | 413 | 192 | | | | | 2715 | 7.9 | 9.1 |
| 24 | 458 | 943 | 800 | 453 | 96 | 11 | 18 | | | 2779 | 7.2 | 8.2 |
| 25 | 351 | 899 | 752 | 297 | 102 | 21 | 9 | | | 2431 | 7.2 | 8.2 |
| 26 | 368 | 731 | 379 | 208 | 53 | | | | | 1739 | 6.3 | 7.2 |
| 27 | 411 | 748 | 469 | 232 | 118 | 19 | | | | 1997 | 6.7 | 7.7 |
| 28 | 191 | 554 | 276 | 287 | 118 | | | | | 1426 | 7.3 | 8.4 |
| 29 | 271 | 642 | 548 | 479 | 143 | 17 | | | | 2100 | 8.0 | 9.3 |
| 30 | 379 | 873 | 526 | 543 | 208 | 34 | | | | 2563 | 8.0 | 9.3 |
| 31 | 299 | 643 | 597 | 618 | 222 | 19 | | | | 2398 | 8.5 | 9.8 |
| 32 | 397 | 852 | 521 | 559 | 158 | 23 | | | | 2510 | 7.9 | 9.1 |
| 33 | 236 | 721 | 324 | 238 | 48 | | | | | 1567 | 6.7 | 7.7 |
| 34 | 280 | 916 | 845 | 307 | 24 | | | | | 2372 | 6.9 | 7.9 |
| 35 | 252 | 931 | 918 | 487 | 23 | | | | | 2611 | 6.9 | 7.9 |
| 36 | 501 | 1568 | 1381 | 569 | 27 | | | | | 4046 | 7.0 | 8.0 |
| 00 | 7729 | | | | | | | | | 7720 | 0.0 | 0.0 |
| TOTAL | 21676 | 31828 | 19849 | 10437 | 3357 | 529 | 166 | 22 | | 87864 | 6.9 | 7.9 |

Figure A1-2. Typical environmental data service wind summary

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| WIND SPEED DIVISIONS | | RADIUS OF CIRCLE (KNOTS) |
|----------------------|-------------|--------------------------------|
| KNOTS | M.P.H. | |
| 0 - 3.5 | 0 - 3.5 | * 3.5 Units |
| 3.5 - 6.5 | 3.5 - 7.5 | * 6.5 " |
| 6.5 - 10.5 | 7.5 - 12.5 | 10.5 - " |
| 10.5 - 16.5 | 12.5 - 18.5 | 16.5 - " |
| 16.5 - 21.5 | 18.5 - 24.5 | 21.5 - " |
| 21.5 - 27.5 | 24.5 - 31.5 | 27.5 - " |
| 27.5 - 33.5 | 31.5 - 38.5 | *33.5 - " |
| 33.5 - 40.5 | 38.5 - 46.5 | *40.5 - " |
| 40.5 - over | 46.5 - over | |

*May not be needed for
most windrose analyses.

Figure A1-3. Windrose blank showing direction and divisions

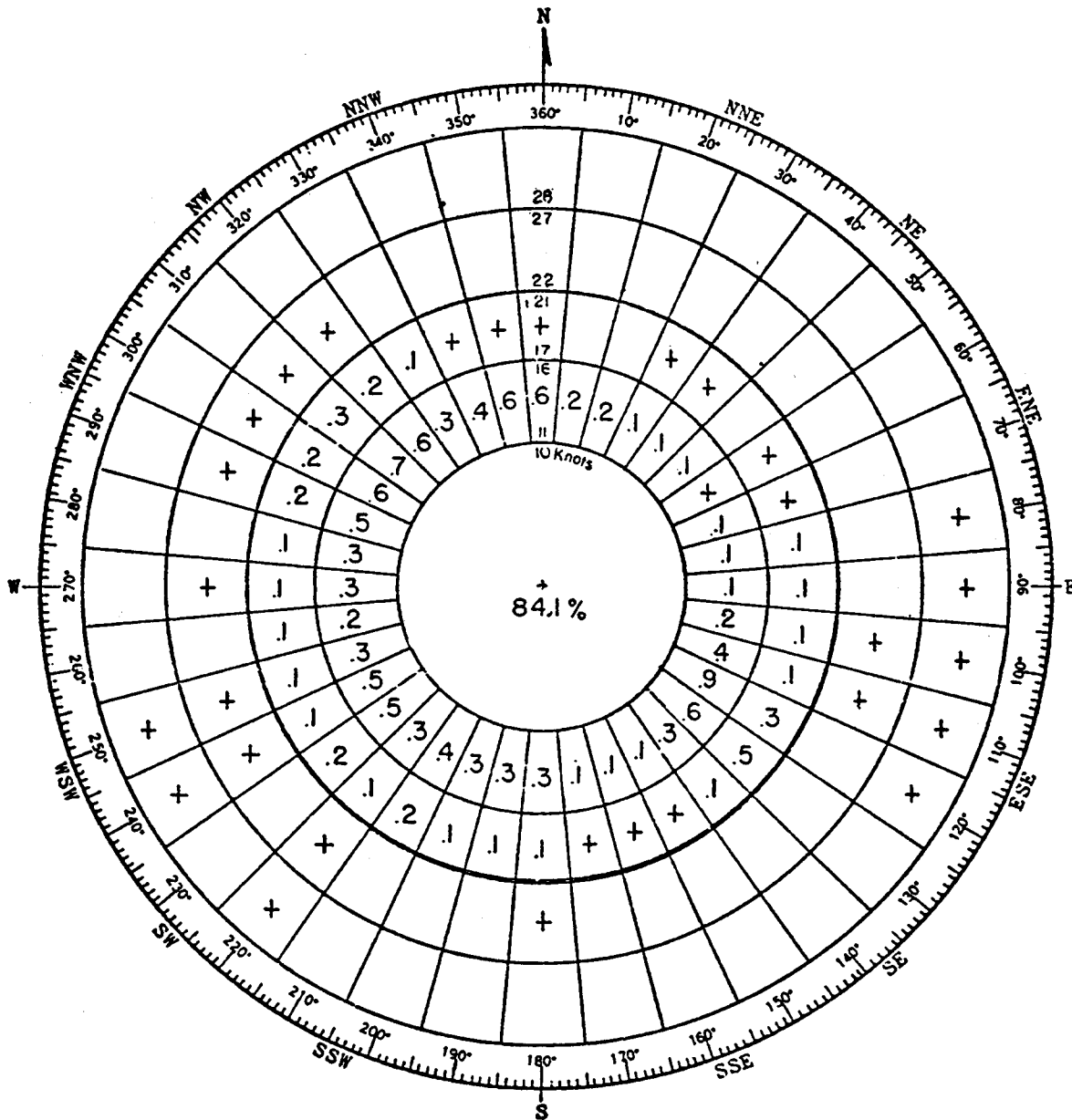
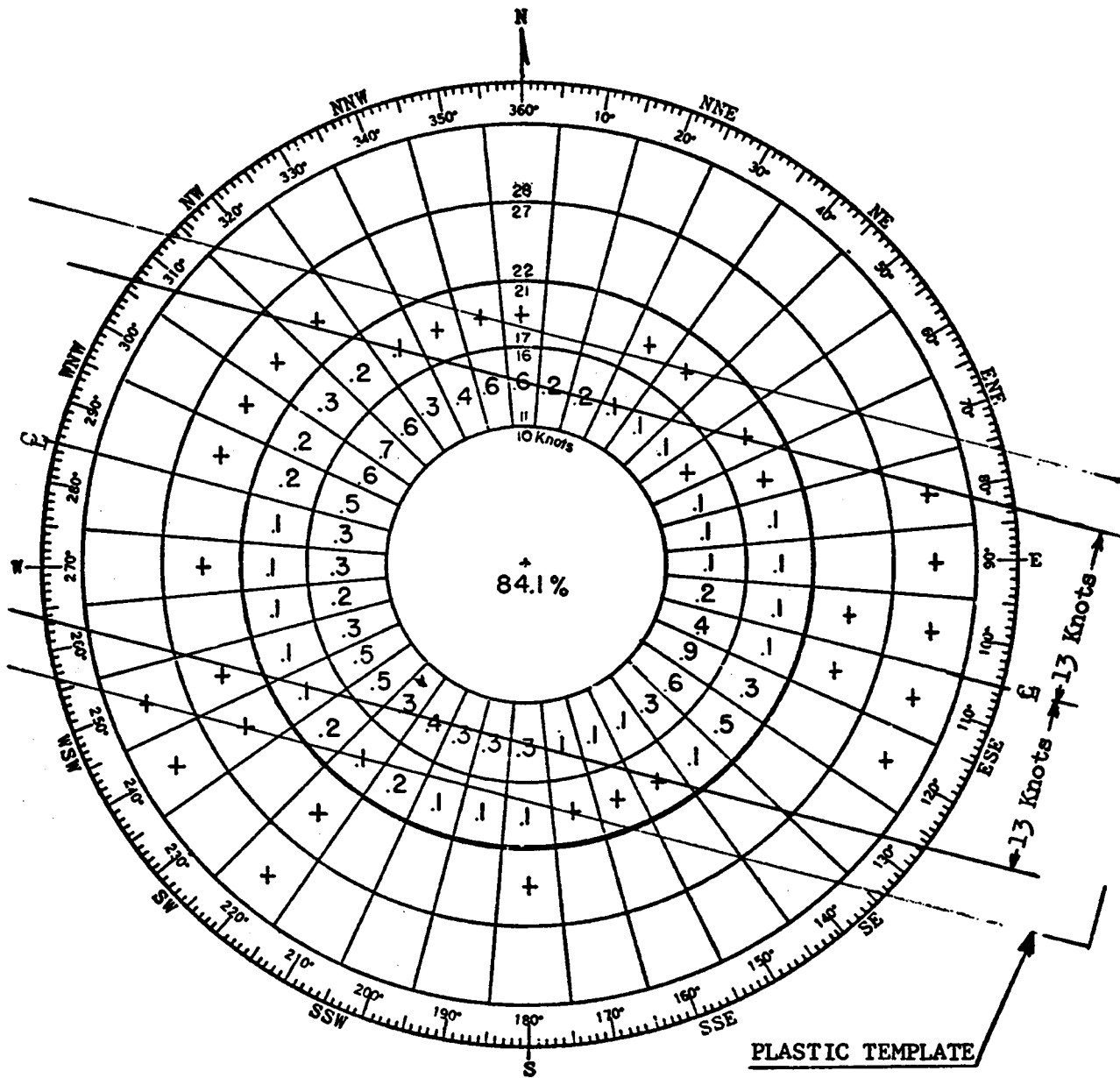


Figure A1-4. Completed windrose using figure A1-2 data

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A runway oriented 105°-285° (true) would have 2.72% of the winds exceeding the design crosswind/crosswind component of 13 knots.

Figure A1-5. Windrose analysis

| DIRECTION | ESTIMATED AREA NOT INCLUDED | | | |
|------------|-----------------------------|------------|------------|----------|
| | 11-16 | 17-21 | 22-27 | 28+ |
| 10 | .12 | | | |
| 20 | .12 | | | |
| 30 | .05 | + | | |
| 40 | .04 | + | | |
| 50 | .01 | | | |
| 60 | | + | | |
| 70 | | | | |
| 80 | | | .01 | + |
| 90 | | | | |
| 100 | | | | |
| 110 | | | | |
| 120 | | | | |
| 130 | | | .01 | |
| 140 | | .01 | | |
| 150 | | + | | |
| 160 | .01 | + | | |
| 170 | .04 | + | | |
| 180 | .14 | .10 | + | |
| 190 | .16 | .10 | | |
| 200 | .16 | .10 | | |
| 210 | .20 | .20 | + | |
| 220 | .11 | .10 | + | + |
| 230 | .03 | .19 | | |
| 240 | | .05 | + | + |
| 250 | | .01 | + | + |
| 260 | | | | |
| 270 | | | | |
| 280 | | | | |
| 290 | | | | |
| 300 | | | | |
| 310 | | | | |
| 320 | | .01 | + | |
| 330 | | .05 | | |
| 340 | .04 | + | | |
| 350 | .25 | + | | |
| 360 | .30 | + | | |
| SUM | 1.78 | .92 | .02 | + |

1.78
.92
.02
2.72

100.00
2.72
97.28

100.00 - SUM = Coverage

100.00 - 2.72 = 97.28%
Coverage

Figure A1-6. Windrose analysis--estimating area not included

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September 29, 1989 WIND OBSERVATIONS
 STATION: ANYWHERE, USA
 RUNWAY ORIENTATION: 105 DEGREE
 CROSSWIND COMPONENT: 13 KNOTS
 WIND COVERAGE: 96.746 %

| DIRECTION | WIND SPEED (KNOTS) | | | | | | | | | |
|-----------|--------------------|-------|-------|-------|------|-----|-----|----|----|-------|
| | 0 | 4 | 7 | 11 | 17 | 22 | 28 | 34 | 41 | |
| | 3 | 6 | 10 | 16 | 21 | 27 | 33 | 40 | 99 | |
| 1 | | | | 212 | | | | | | |
| 2 | | | | 169 | | | | | | |
| 3 | | | | 73 | 9 | | | | | |
| 4 | | | | 62 | 11 | | | | | |
| 5 | | | | 106 | | | | | | |
| 6 | | | | 42 | 8 | | | | | |
| 7 | | | | 84 | 36 | 10 | | | | |
| 8 | | | | 69 | 73 | 52 | 41 | 22 | | |
| 9 | | | | 128 | 68 | 59 | 21 | | | |
| 10 | | | | 180 | 98 | 41 | 9 | | | |
| 11 | | | | 312 | 111 | 23 | 28 | | | |
| 12 | | | | 779 | 271 | 69 | 21 | | | |
| 13 | | | | 531 | 452 | 67 | | | | |
| 14 | | | | 281 | 129 | | | | | |
| 15 | | | | 135 | 27 | | | | | |
| 16 | | | | 121 | 19 | | | | | |
| 17 | | | | 128 | 12 | | | | | |
| 18 | | | | 297 | 83 | 18 | | | | |
| 19 | | | | 241 | 92 | | | | | |
| 20 | | | | 243 | 64 | | | | | |
| 21 | | | | 323 | 147 | 8 | | | | |
| 22 | | | | 231 | 115 | 38 | 19 | | | |
| 23 | | | | 413 | 192 | | | | | |
| 24 | | | | 453 | 96 | 11 | 18 | | | |
| 25 | | | | 297 | 102 | 21 | 9 | | | |
| 26 | | | | 208 | 53 | | | | | |
| 27 | | | | 232 | 118 | 19 | | | | |
| 28 | | | | 287 | 118 | | | | | |
| 29 | | | | 479 | 143 | 17 | | | | |
| 30 | | | | 543 | 208 | 34 | | | | |
| 31 | | | | 618 | 222 | 19 | | | | |
| 32 | | | | 559 | 158 | 23 | | | | |
| 33 | | | | 238 | 48 | | | | | |
| 34 | | | | 307 | 24 | | | | | |
| 35 | | | | 487 | 23 | | | | | |
| 36 | | | | 569 | 27 | | | | | |
| 0 | 21676 | 31828 | 19849 | | | | | | | |
| TOTAL: | 21676 | 31828 | 19849 | 10437 | 3357 | 529 | 166 | 22 | 0 | 87864 |

Figure A1-7. Computer printout page 1

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AREA NOT INCLUDED
STATION: ANYWHERE, USA
RUNWAY ORIENTATION: 105 DEGREE
CROSSWIND COMPONENT: 13 KNOTS

| DIRECTION | WIND SPEED (KNOTS) | | | | | | | | | |
|-----------|--------------------|------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|
| | 0 3.5 | 3.5 6.5 | 6.5 10.5 | 10.5 16.5 | 16.5 21.5 | 21.5 27.5 | 27.5 33.5 | 33.5 40.5 | 40.5 99.5 | |
| 1 | | | 0.6212 | 1 | 1 | 1 | 1 | 1 | 13.200 | 13 |
| 2 | | | 0.6212 | 1 | 1 | 1 | 1 | 1 | 13.200 | 13 |
| 3 | | | 0.5532 | 1 | 1 | 1 | 1 | 1 | 13.834 | 13.200 |
| 4 | | | 0.3986 | 1 | 1 | 1 | 1 | 1 | 15.011 | 13.834 |
| 5 | | | 0.1185 | 0.9910 | 1 | 1 | 1 | 1 | 16.970 | 15.011 |
| 6 | | | | 0.6265 | 1 | 1 | 1 | 1 | 20.224 | 16.970 |
| 7 | | | | 0.0385 | 0.7588 | 1 | 1 | 1 | 26 | 20.224 |
| 8 | | | | | 0.0242 | 0.4669 | 0.9150 | 1 | 38.009 | 26 |
| 9 | | | | | | | 0.0243 | 0.8525 | 74.864 | 38.009 |
| 10 | | | | | | | | 0 | 1E+51 | 74.864 |
| 11 | | | | | | | | 0 | 1E+51 | 74.864 |
| 12 | | | | | | | 0.0243 | 0.8525 | 74.864 | 38.009 |
| 13 | | | | | 0.0242 | 0.4669 | 0.9150 | 1 | 38.009 | 26 |
| 14 | | | | 0.0385 | 0.7588 | 1 | 1 | 1 | 26 | 20.224 |
| 15 | | | | 0.6265 | 1 | 1 | 1 | 1 | 20.224 | 16.970 |
| 16 | | | 0.1185 | 0.9910 | 1 | 1 | 1 | 1 | 16.970 | 15.011 |
| 17 | | | 0.3986 | 1 | 1 | 1 | 1 | 1 | 15.011 | 13.834 |
| 18 | | | 0.5532 | 1 | 1 | 1 | 1 | 1 | 13.834 | 13.200 |
| 19 | | | 0.6212 | 1 | 1 | 1 | 1 | 1 | 13.200 | 13 |
| 20 | | | 0.6212 | 1 | 1 | 1 | 1 | 1 | 13.200 | 13 |
| 21 | | | 0.5532 | 1 | 1 | 1 | 1 | 1 | 13.834 | 13.200 |
| 22 | | | 0.3986 | 1 | 1 | 1 | 1 | 1 | 15.011 | 13.834 |
| 23 | | | 0.1185 | 0.9910 | 1 | 1 | 1 | 1 | 16.970 | 15.011 |
| 24 | | | | 0.6265 | 1 | 1 | 1 | 1 | 20.224 | 16.970 |
| 25 | | | | 0.0385 | 0.7588 | 1 | 1 | 1 | 26 | 20.224 |
| 26 | | | | | 0.0242 | 0.4669 | 0.9150 | 1 | 38.009 | 26 |
| 27 | | | | | | | 0.0243 | 0.8525 | 74.864 | 38.009 |
| 28 | | | | | | | | 0 | 1E+51 | 74.864 |
| 29 | | | | | | | | 0 | 1E+51 | 74.864 |
| 30 | | | | | | | 0.0243 | 0.8525 | 74.864 | 38.009 |
| 31 | | | | | 0.0242 | 0.4669 | 0.9150 | 1 | 38.009 | 26 |
| 32 | | | | 0.0385 | 0.7588 | 1 | 1 | 1 | 26 | 20.224 |
| 33 | | | | 0.6265 | 1 | 1 | 1 | 1 | 20.224 | 16.970 |
| 34 | | | 0.1185 | 0.9910 | 1 | 1 | 1 | 1 | 16.970 | 15.011 |
| 35 | | | 0.3986 | 1 | 1 | 1 | 1 | 1 | 15.011 | 13.834 |
| 36 | | | 0.5532 | 1 | 1 | 1 | 1 | 1 | 13.834 | 13.200 |

Figure A1-8. Computer printout page 2

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% WIND NOT COVERED

STATION: ANYWHERE, USA
 RUNWAY ORIENTATION: 105 DEGREE
 CROSSWIND COMPONENT: 13 KNOTS

| DIRECTION | WIND SPEED (KNOTS) | | | | | | | | | TOTAL: |
|-----------|--------------------|------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|
| | 0 3.5 | 3.5 6.5 | 6.5 10.5 | 10.5 16.5 | 16.5 21.5 | 21.5 27.5 | 27.5 33.5 | 33.5 40.5 | 40.5 99.5 | |
| 1 | | | | 0.1498 | 0 | 0 | 0 | 0 | 0 | 0.1498 |
| 2 | | | | 0.1194 | 0 | 0 | 0 | 0 | 0 | 0.1194 |
| 3 | | | | 0.0459 | 0.0102 | 0 | 0 | 0 | 0 | 0.0562 |
| 4 | | | | 0.0281 | 0.0125 | 0 | 0 | 0 | 0 | 0.0406 |
| 5 | | | | 0.0142 | 0 | 0 | 0 | 0 | 0 | 0.0142 |
| 6 | | | | | 0.0057 | 0 | 0 | 0 | 0 | 0.0057 |
| 7 | | | | | 0.0015 | 0.0086 | 0 | 0 | 0 | 0.0102 |
| 8 | | | | | | 0.0014 | 0.0217 | 0.0229 | 0 | 0.0461 |
| 9 | | | | | | | | 0 | 0 | 0 |
| 10 | | | | | | | | | | 0 |
| 11 | | | | | | | | | | 0 |
| 12 | | | | | | | | 0 | 0 | 0 |
| 13 | | | | | | 0.0018 | 0 | 0 | 0 | 0.0018 |
| 14 | | | | | 0.0056 | 0 | 0 | 0 | 0 | 0.0056 |
| 15 | | | | | 0.0192 | 0 | 0 | 0 | 0 | 0.0192 |
| 16 | | | | 0.0163 | 0.0214 | 0 | 0 | 0 | 0 | 0.0377 |
| 17 | | | | 0.0580 | 0.0136 | 0 | 0 | 0 | 0 | 0.0717 |
| 18 | | | | 0.1870 | 0.0944 | 0.0204 | 0 | 0 | 0 | 0.3019 |
| 19 | | | | 0.1704 | 0.1047 | 0 | 0 | 0 | 0 | 0.2751 |
| 20 | | | | 0.1718 | 0.0728 | 0 | 0 | 0 | 0 | 0.2446 |
| 21 | | | | 0.2033 | 0.1673 | 0.0091 | 0 | 0 | 0 | 0.3797 |
| 22 | | | | 0.1048 | 0.1308 | 0.0432 | 0.0216 | 0 | 0 | 0.3005 |
| 23 | | | | 0.0557 | 0.2165 | 0 | 0 | 0 | 0 | 0.2722 |
| 24 | | | | | 0.0684 | 0.0125 | 0.0204 | 0 | 0 | 0.1014 |
| 25 | | | | | 0.0044 | 0.0181 | 0.0102 | 0 | 0 | 0.0328 |
| 26 | | | | | | 0 | 0 | 0 | 0 | 0 |
| 27 | | | | | | | | 0 | 0 | 0 |
| 28 | | | | | | | | | | 0 |
| 29 | | | | | | | | | | 0 |
| 30 | | | | | | | | 0 | 0 | 0 |
| 31 | | | | | | 0.0005 | 0 | 0 | 0 | 0.0005 |
| 32 | | | | | 0.0069 | 0.0198 | 0 | 0 | 0 | 0.0267 |
| 33 | | | | | 0.0342 | 0 | 0 | 0 | 0 | 0.0342 |
| 34 | | | | 0.0414 | 0.0270 | 0 | 0 | 0 | 0 | 0.0684 |
| 35 | | | | 0.2209 | 0.0261 | 0 | 0 | 0 | 0 | 0.2471 |
| 36 | | | | 0.3582 | 0.0307 | 0 | 0 | 0 | 0 | 0.3890 |
| TOTAL: | 0 | 0 | 0 | 1.9459 | 1.0748 | 0.1357 | 0.0741 | 0.0229 | 0 | 3.2537 |

Figure A1-9. Computer printout page 3

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Lines starting with + are worksheet format instructions.
Lines starting with a cell address are cell-formulas.
Lines starting with COPY and DATA FILL are Lotus 1-2-3 commands.

To run the program fill RANGE(D2..D4) with airport data (airport name D2, runway orientation D3, and crosswind component in knots D4) and fill RANGE(B11..J47) with wind data.

+ Set Global Column-Width at 7

E1: 'WIND OBSERVATIONS
A2: 'STATION:
A3: 'RUNWAY ORIENTATION:
E3: 'DEGREE
A4: 'CROSSWIND COMPONENT:
E4: 'KNOTS
A5: 'WIND COVERAGE:
D5: 100-L148
E5: '*
A7: 'DIRECTION
E7: 'WIND SPEED (KNOTS)
B8: 0
C8: 4
D8: 7
E8: 11
F8: 17
G8: 22
H8: 28
I8: 34
J8: 41
K8: 100
A9: '
B9: 3
C9: 6
D9: 10
E9: 16
F9: 21
G9: 27
H9: 33
I9: 40
J9: 99
DATA FILL RANGE(A11..A46) WITH 1 TO 36
A47: 0
A48: 'TOTAL:
B48: @SUM(B11..B47)
COPY CELL B48 TO RANGE(B48..J48)
K48: @MAX(1,@SUM(B48..J48))
A50: |::

Figure A1-10. Lotus cell-formulas page 1

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```

E51: 'AREA NOT INCLUDED
A52: +A2
COPY CELL A52 TO RANGE(A52..A54)
D52: +D2
COPY CELL D52 TO RANGE(D53..E54)
A57: +A7
E57: +E7
B58: (A9+B8)/2
COPY CELL B58 TO RANGE(B58..J58)
B59: (B9+C8)/2
COPY CELL B59 TO RANGE(B59..J59)
A61: +A11
COPY CELL A61 TO RANGE(A61..A96)
B61: @IF($K61<=B$58,1,@IF($L61>B$59,$A$9,(B$59^2-$K61*$L61+
    @IF($K61<B$59,0,$L61*($K61-B$59)^2/($K61-$L61))-
    @IF($L61>B$58,0,$K61*(B$58-$L61)^2/($K61-$L61)))/(B$59^2-B$58^2))
COPY CELL B61 TO RANGE(B61..J96)
K61: @MAX($D$4/(@MAX(@ABS(@SIN(($D$3-A61*10+5)*@PI/180)),1.0000000E-50)),
    $D$4/(@MAX(@ABS(@SIN(($D$3-A61*10-5)*@PI/180)),1.0000000E-50)))
COPY CELL K61 TO RANGE(K61..K96)
L61: @MIN($D$4/(@MAX(@ABS(@SIN(($D$3-A61*10+5)*@PI/180)),1.0000000E-50)),
    $D$4/(@MAX(@ABS(@SIN(($D$3-A61*10-5)*@PI/180)),1.0000000E-50)))
COPY CELL L61 TO RANGE(L61..L96)
A100: |::
E101: '* WIND NOT COVERED
A102: +A2
COPY CELL A102 TO RANGE(A102..A104)
D102: +D2
COPY CELL D102 TO RANGE(D103..E104)
A107: +A7
E107: +E7
L107: 'TOTAL:
B108: +B58
COPY CELL B108 TO RANGE(B108..J109)
A111: +A61
COPY CELL A111 TO RANGE(A111..A146)
B111: @IF(B61=0,$A$9,100*(B61*B11)/$K$48)
COPY CELL B111 TO RANGE(B111..J146)
L111: @SUM(B111..J111)
COPY CELL L111 TO RANGE(L111..L146)
A148: 'TOTAL:
B148: @SUM(B111..B146)
COPY CELL B148 TO RANGE(B148..J148)
L148: @SUM(L111..L146)
A150: |::

```

Figure A1-11. Lotus cell-formulas page 2

Appendix 2. RUNWAY END SITING REQUIREMENTS

1. PURPOSE. This appendix contains guidance on siting thresholds to meet approach obstacle clearance requirements and departure 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 and/or departing 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 or reduction of the TODA 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 and reflect the 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, Declared Distances, for additional information.

d. Where specifically noted, the Glidepath Angle (GPA) and Threshold Crossing Height (TCH) of a vertically guided approach may be altered (usually increased) rather than displacing the threshold. Examples of approaches with positive vertical guidance include Instrument Landing System (ILS), Microwave Landing System (MLS), Localizer Performance with Vertical Guidance (LPV), Lateral Navigation/Vertical Navigation (LNAV/VNAV), and required navigation performance (RNP). Alternatively, a combination of threshold displacement and altering of the Glidepath Angle/Threshold Crossing Height (GPA/TCH) may also be accomplished. Guidelines for maximum and minimum values of TCH and GPA are contained in FAA Order 8260.3, *United States Standard for Terminal Instrument Procedures (TERPS)*. The tradeoff between threshold displacement, TCH, and GPA is complex, but can be analyzed by applying formula contained in the order. Contact the appropriate FAA Airports Regional or District Office for assistance on the specific requirements and effects of GPA and TCH changes.

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 applicable for identifying objects affecting navigable airspace. See Title 14 Code of Federal Regulations Part 77, Objects Affecting Navigable Airspace.

4. EVALUATION CONSIDERATIONS.

a. Possible Actions. When a penetration to a threshold siting surface defined in paragraph 5 exists, one or more of the following actions are required:

(1) Approach Surfaces.

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

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

(c) The GPA and/or TCH is/are modified, or a combination of threshold displacement and GPA/TCH increase is accomplished.

(d) Visibility minimums are raised.

(e) Night operations are prohibited unless the obstruction is lighted or an approved Visual Glide Slope Indicator (VGSI) is used.

(2) Departure Surfaces for Designated Runways. The applicability of the surface defined in Table A2-1 is dependant on the designation of primary runway(s) for departure. The Airport Sponsor, through the Airports District Office to the Regional Airspace Procedures Team (RAPT), will identify runway end(s) intended primarily for instrument departures. The determination of primary runway(s) for departure does not prohibit or negate the use of other runways. It only identifies the applicability of the surface in Table A2-1 to the runway end(s).

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(a) Remove, relocate, or lower (or both relocate and lower) the object to preclude penetration of applicable siting surfaces unless it is fixed by function and/or designated impracticable. Within 6000' of the Table A2-1 surface origin, objects less than or equal to an elevation determined by application of the formula below are allowable.

$$E + (0.025 \times D)$$

Where:

E = DER elevation

D = Distance from OCS origin to object in feet

(b) Decrease the Takeoff Distance Available (TODA) to preclude object penetration of applicable siting surfaces, with a resulting shorter takeoff distance (the Departure End of the Runway (DER) is coincident with the end of the TODA where a clearway is not in effect); or

(c) Modify instrument departures. Contact the Flight Procedures Office (FPO) for guidance. Objects penetrating by ≤ 35 feet may not require actions (a) or (b); however, they will impact departure minimums/climb gradients or departure procedures.

b. Relevant Factors for Evaluation.

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

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

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

(4) Effect of the reduced available landing/takeoff 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 aspects of a runway extension need to also be evaluated under this consideration.

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

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

5. CLEARANCE REQUIREMENTS. The standard shape, dimensions, and slope of the surface used for locating a threshold are 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.

a. Approaches with Positive Vertical Guidance.

Table A2-1 and Figure A2-1 describe the clearance surfaces required for instrument approach procedures with vertical guidance.

The Glidepath Qualification Surface (GQS) limits the height of obstructions between Decision Altitude (DA) and runway threshold (RWT). When obstructions exceed the height of the GQS, an approach procedure with positive vertical guidance is not authorized. Further information can be found in the appropriate TERPS criterion.

b. Instrument Approach Procedures Aligned with the Runway Centerline. Table A2-1 and Figure A2-1 describe the minimum clearance surfaces required for instrument approach procedures aligned with the runway centerline.

c. Procedures Not Aligned with the Runway Centerline. To accommodate for offset procedures, increase the lateral width at threshold by multiplying the width specified in the appropriate paragraph by 2 (offset side only). The outside offset boundary splays from this point at an angle equal to the amount of angular divergence between the final approach course and runway centerline + 10 degrees. Extend the outside offset boundary out to the distance specified in the applicable paragraph and connect it to runway centerline with an arc of the same radius. On the side opposite the offset, construct the area aligned with runway centerline as indicated (non-offset side only). The surface slope is as specified in the applicable paragraph, according to Table A2-1. Figure A2-2 is an example of the offset procedure.

d. Locating or Determining the DER. The standard shape, dimensions, and slope of the departure surface used for determining the DER, as defined in TERPS, is only dependent upon whether or not instrument departures are being used or planned for that runway end. See Table A2-1 and Figures A2-1 and A2-2 for dimensions.

Subparagraph 5d(2) applies only to runways supporting Air Carrier departures and is not to be considered a clearance surface.

(1) For Departure Ends at Designated Runways.

(a) No object should penetrate a surface beginning at the elevation of the runway at the DER or end of clearway, and slopes at 40:1. Penetrations by existing obstacles of 35 feet or less would not require TODA reduction or other mitigations found in paragraph 4; however, they may affect new or existing departure procedures.

(2) Departure Runway Ends Supporting Air Carrier Operations.

(a) Objects should be identified that penetrate a one-engine inoperative (OEI) obstacle identification surface (OIS) starting at the DER and at the elevation of the runway at that point, and slopes upward at 62.5:1. See Figure A2-4. **Note:** This surface is provided for information only and does not take effect until January 1, 2009.

Table A2-1. Approach/Departure Requirements Table

| | Runway Type | DIMENSIONAL STANDARDS* | | | | | Slope/ OCS |
|-------------------------------|---|--|----------------------------|-------|---------------------|-------|---------------|
| | | Feet | | | | | |
| | | A | B | C | D | E | |
| 1 | Approach end of runways expected to serve small airplanes with approach speeds less than 50 knots. (Visual runways only, day/night) | 0 | 60 | 150 | 500 | 2,500 | 15:1 |
| 2 | Approach end of runways expected to serve small airplanes with approach speeds of 50 knots or more. (Visual runways only, day/night) | 0 | 125 | 350 | 2,250 | 2,750 | 20:1 |
| 3 | Approach end of runways expected to serve large airplanes (Visual day/night); or instrument minimums \geq 1 statute mile (day only). | 0 | 200 | 500 | 1,500 | 8,500 | 20:1 |
| 4 | Approach end of runways expected to support instrument night circling. ¹ | 200 | 200 | 1,700 | 10,000 | 0 | 20:1 |
| 5 | Approach end of runways expected to support instrument straight in night operations, serving approach category A and B aircraft only. ¹ | 200 | 200 | 1,900 | 10,000 ² | 0 | 20:1 |
| 6 | Approach end of runways expected to support instrument straight in night operations serving greater than approach category B aircraft. ¹ | 200 | 400 | 1,900 | 10,000 ² | 0 | 20:1 |
| 7 ³ , 6,7, 8 | Approach end of runways expected to accommodate approaches with positive vertical guidance (GQS). | 0 | ½ width runway + 100 | 760 | 10,000 ² | 0 | 30:1 |
| 8 | Approach end of runways expected to accommodate instrument approaches having visibility minimums \geq 3/4 but < 1 statute mile, day or night. | 200 | 400 | 1,900 | 10,000 ² | 0 | 20:1 |
| 9 | Approach end of runways expected to accommodate instrument approaches having visibility minimums < 3/4 statute mile or precision approach (ILS, GLS, or MLS), day or night. | 200 | 400 | 1,900 | 10,000 ² | 0 | 34:1 |
| 10 | Approach runway ends having Category II approach minimums or greater. | The criteria are set forth in TERPS, Order 8260.3. | | | | | |
| 11 | Departure runway ends for all instrument operations. | 0 ⁴ | See Figure A2-3 | | | | 40:1 |
| 12 | Departure runway ends supporting Air Carrier operations. ⁵ | 0 ⁴ | See Figure A2-4 | | | | 62.5:1 |

* The letters are keyed to those shown in Figure A2-1.

Notes:

1. Lighting of obstacle penetrations to this surface or the use of a VGSI, as defined by the TERPS order, 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 for 20:1 and 34:1 and Decision Altitude point for the 30:1.
3. Any penetration to this surface will limit the runway end to nonprecision approaches. No vertical approaches will be authorized until the penetration(s) is/are removed except obstacles fixed by function and/or allowable grading.
4. Dimension A is measured relative to Departure End of Runway (DER) or TODA (to include clearway).
5. Data Collected regarding penetrations to this surface are provided for information and use by the air carriers operating from the airport. These requirements do not take effect until January 1, 2009.
6. Surface dimensions/Obstacle Clearance Surface (OCS) slope represent a nominal approach with 3 degree GPA, 50'

TCH, < 500' HAT. For specific cases refer to TERPS. The Obstacle Clearance Surface slope (30:1) represents a nominal approach of 3 degrees (also known as the Glide Path Angle). This assumes a threshold crossing height of 50 feet. Three degrees is commonly used for ILS systems and VGSI aiming angles. This approximates a 30:1 approach angle that is between the 34:1 and the 20:1 notice surfaces of Part 77. Surfaces cleared to 34:1 should accommodate a 30:1 approach without any obstacle clearance problems.

7. For runways with vertically guided approaches the criteria in Row 7 is in addition to the basic criteria established within the table, to ensure the protection of the Glidepath Qualification Surface.
8. For planning purposes, sponsors and consultants determine a tentative Decision Altitude based on a 3° Glidepath angle and a 50-foot Threshold Crossing Height.

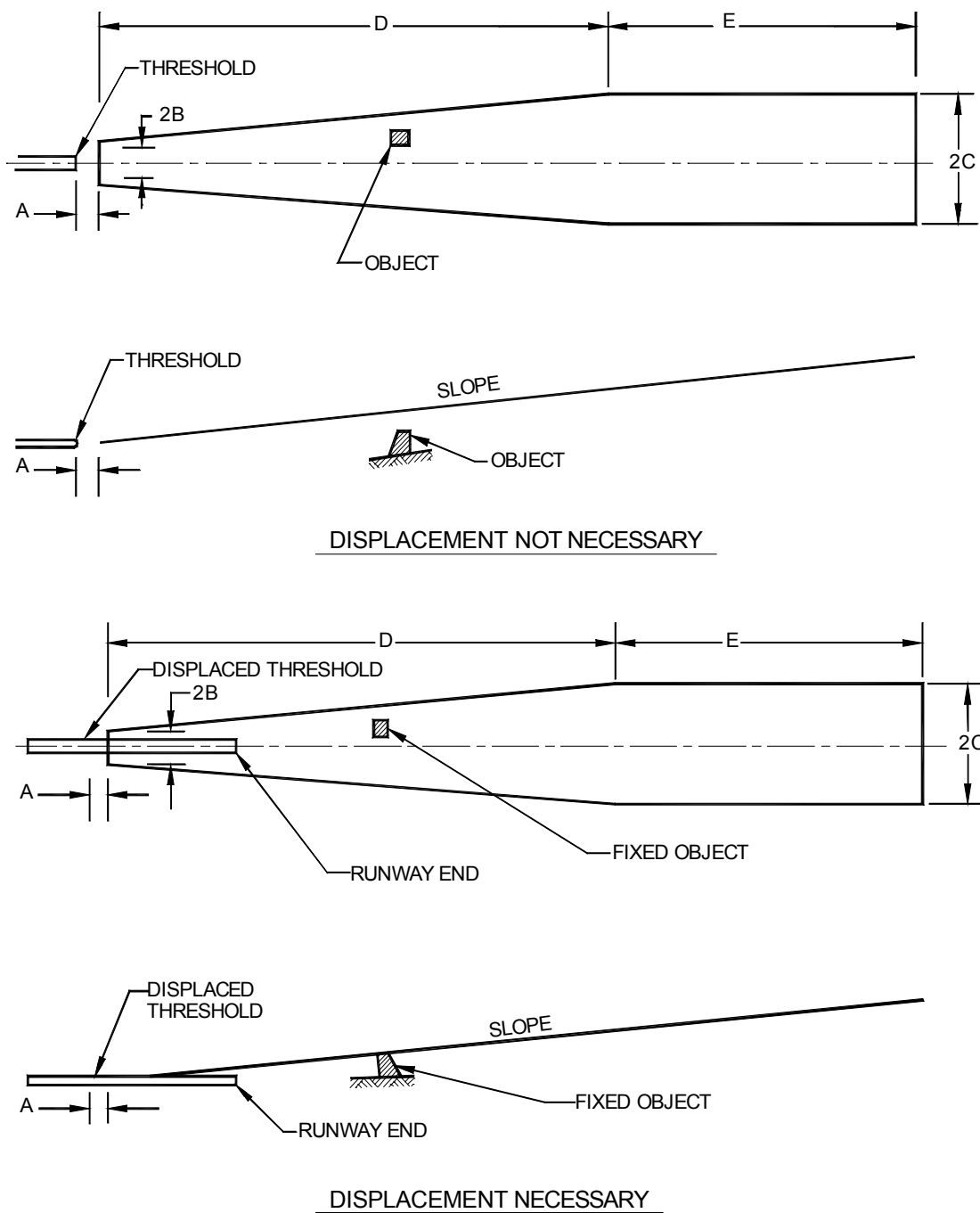


Figure A2-1. Approach slopes

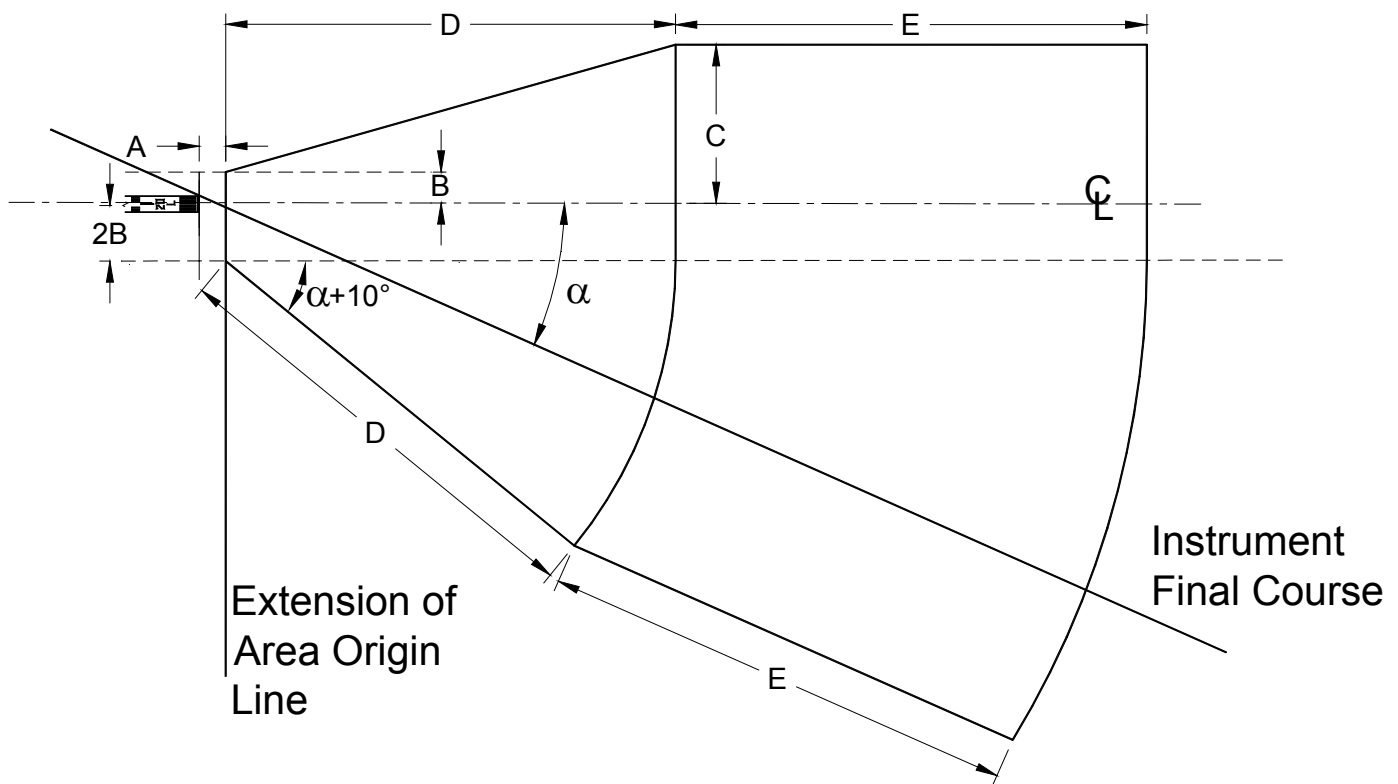
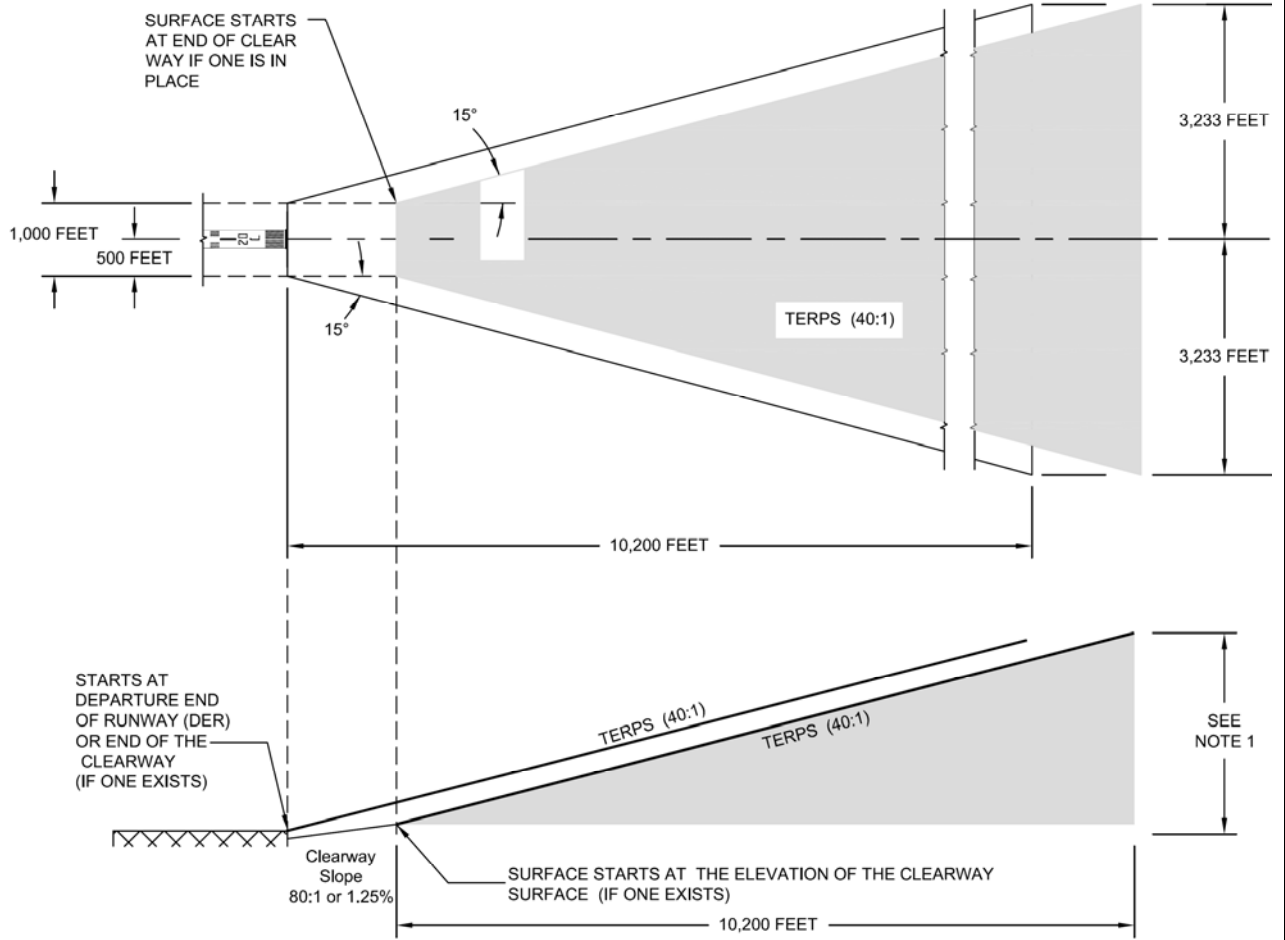


Figure A2-2. Approach Slopes—With Offset Approach Course



NOTES:

1. THIS IS AN INTERPRETATION OF THE APPLICATION OF THE TERPS SURFACE ASSOCIATED WITH A CLEARWAY.

Figure A2-3. Departure surface for Instrument Runways TERPS (40:1)

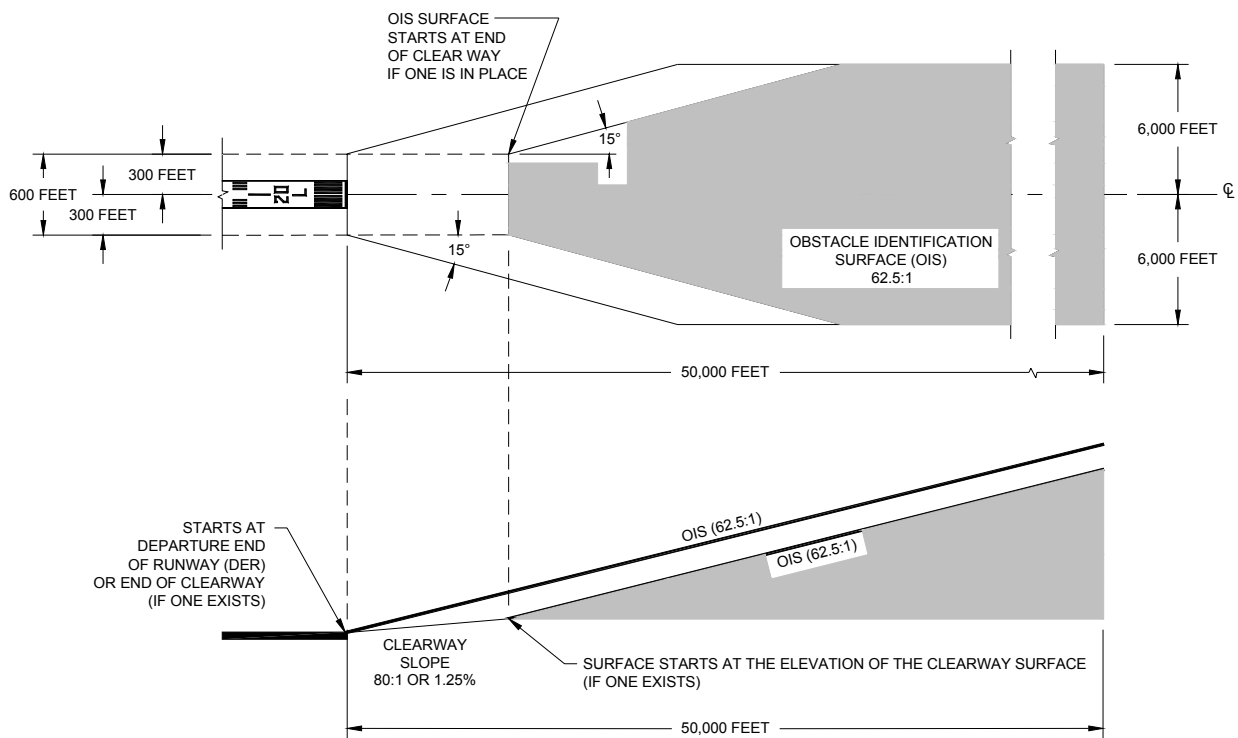


Figure A2-4. One-Engine Inoperative (OEI) Obstacle Identification Surface (62.5:1)

Appendix 3. AIRPORT REFERENCE POINT

1. DISCUSSION.

a. The airport reference point (ARP) geographically locates the airport horizontally. The ARP is normally not monumented or physically marked on the ground. The computation of this point uses only runway length.

b. Meaningful airport reference point computations use the ultimate runway lengths proposed for development. These computations do not use closed or abandoned areas. The FAA approved airport layout plan shows the ultimate development. If there is no airport layout plan, the ultimate runway lengths are the existing runways plus those that have airspace approval, less closed or abandoned areas.

c. The ARP is computed or recomputed as infrequently as possible. The only time that a recomputation is needed is when the proposed ultimate development is changed.

2. SAMPLE COMPUTATION. The following procedure determines the location of the airport reference point used in FAR Part 77 studies.

a. Establish two base lines perpendicular to each other as shown in Figure A3-1. Let the northerly base line be known as B and the westerly as A.

b. Establish the midpoint of each runway.

c. Determine the perpendicular distance from the base lines to the midpoints.

d. Calculate the moment of areas for each base line as shown in Figure A3-2.

e. Divide each moment of area by the sum of areas to determine distance of the ARP from each base line.

f. The location is converted into latitude and longitude.

3. ACCURACY. The latitude and longitude should be to the nearest second. Installation of navigational aids may need coordinates to the nearest tenth of a second. Coordinate with the appropriate FAA Airway Facilities field office to ascertain the need for accuracy closer than the nearest second.

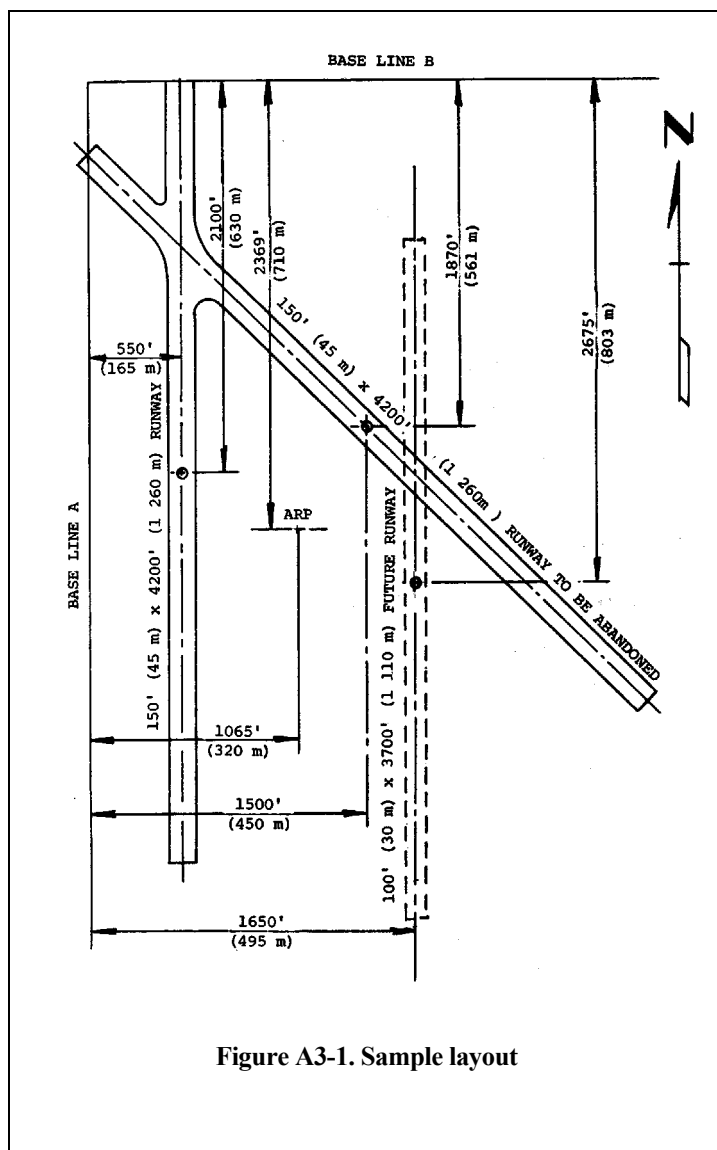


Figure A3-1. Sample layout

U.S. Customary Units**BASE LINE A:**

$$\begin{array}{r} 4,200 \\ \underline{3,700} \\ 7,900 \end{array} \begin{array}{l} \times 550 \\ \times 1,650 \\ \end{array} = \begin{array}{r} 2,310,000 \\ \underline{6,105,000} \\ 8,415,000 \end{array}$$

$$= \frac{8,415,000}{7,900} = 1,065'$$

BASE LINE B:

$$\begin{array}{r} 4,200 \\ \underline{3,700} \\ 7,900 \end{array} \begin{array}{l} \times 2,100 \\ \times 2,675 \\ \end{array} = \begin{array}{r} 8,820,000 \\ \underline{9,897,500} \\ 18,717,500 \end{array}$$

$$= \frac{18,717,500}{7,900} = 2,369'$$

Metric Units**BASE LINE A:**

$$\begin{array}{r} 1\ 266 \\ \underline{1\ 110} \\ 2\ 370 \end{array} \begin{array}{l} \times 165 \\ \times 495 \\ \end{array} = \begin{array}{r} 207\ 900 \\ \underline{549\ 450} \\ 757\ 350 \end{array}$$

$$= \frac{757\ 350}{2\ 370} = 320\ \text{m}$$

BASE LINE B:

$$\begin{array}{r} 1\ 266 \\ \underline{1\ 110} \\ 2\ 370 \end{array} \begin{array}{l} \times 630 \\ \times 803 \\ \end{array} = \begin{array}{r} 793\ 800 \\ \underline{891\ 330} \\ 1\ 685\ 130 \end{array}$$

$$= \frac{1\ 685\ 130}{2\ 370} = 710\ \text{m}$$

Note: Since the diagonal runway is to be abandoned, it is not used in the computation.

Figure A3-2. Sample computation – airport reference point

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Appendix 4. COMPASS CALIBRATION PAD

1. **PURPOSE.** This appendix provides guidelines for the design, location and construction of a compass calibration pad and basic information concerning its use in determining the deviation error in an aircraft magnetic compass.

2. **BACKGROUND.**

a. An aircraft magnetic compass is a navigation instrument with certain inherent errors resulting from the nature of its construction. All types of magnetic compasses indicate direction with respect to the earth's magnetic field. This is true even for the gyro-stabilized and/or fluxgate compasses. Aircraft navigation is based on applying the appropriate angular corrections to the magnetic reading in order to obtain the true heading.

b. The aircraft magnetic compass should be checked following pertinent aircraft modifications and on a frequent, routine schedule. One method of calibrating the compass is to use a compass calibration pad to align the aircraft on known magnetic headings and make adjustments to the compass and/or placard markings to indicate the required corrections. There are other methods available for calibrating a magnetic compass, but for small aircraft the method outlined herein is normally used.

3. **APPLICATION.**

a. The process of aligning an aircraft on known magnetic headings for the purpose of determining the degree of error in the magnetic compass is commonly referred to as "swinging the compass." The technique which should be used is as follows:

(1) Place the aircraft on a compass calibration pad.

(2) Place the aircraft in level flying position.

(3) Remove compensating magnets from chambers or reset the fixed compensating magnets to neutral position, whichever is applicable, before swinging.

(4) Check indicator for fluid level and cleanliness. If fluid is required, the compass is defective.

(5) Check the pivot friction of the indicator by deflecting the card with a small magnet. The card should rotate freely in a horizontal plane.

(6) If a radio is used in the aircraft, there should be corrections noted for "radio on" and "radio off" conditions.

(7) Align the aircraft with the north magnetic heading and make the indicated reading correspond to the actual magnetic reading by use of the compensating magnets. Repeat for the east magnetic heading. Then place on south and west magnetic headings and remove half of indicated error by adjusting compensators. Engine(s) should be running.

(8) Turn the aircraft on successive 30-degree headings through 360 degrees. Placards should be marked to indicate correction at each 30-degree heading showing "radio on" and "radio off" corrections.

b. Calibration and adjustment of remote indicating gyro compasses, polar path compasses, and other systems of this type should be by a qualified instrument technician.

4. **DESIGN OF COMPASS CALIBRATION PAD.**

The design details shown in this appendix should be considered as guidance only and variations of these designs are acceptable provided the general requirements are met.

a. The compass calibration pad provides a series of 12 radials, either painted on with nonmetallic paint or inlaid in the surface of the calibration pad, extending toward predetermined magnetic directions every 30 degrees beginning with magnetic north. Each radial should be marked with three separate magnetic headings; one at the end of the radial indicating the direction along which each line lies; and one on each side of the line which indicates the magnetic heading of the aircraft when it is oriented at 90 degrees to the radial. Markings facing the pilot must correspond to the airplane's heading when traveling in that direction. The markings must be large enough to be easily read from the aircraft cockpit as the radial is being approached. The last zero may be dropped from the heading designation. Figure A4-1 shows a layout of markings.

b. Figures A4-2 and A4-3 depict suggested types of calibration pads. Type I, as shown in figure A4-2, can be either rigid or flexible pavement construction. Type II, as shown in figure A4-3, is applicable only to rigid pavements. The pavement thickness of either type shall be as required to support the user aircraft in a critical area in accordance with AC 150/5320-6. The concrete pavements, joint type, and spacing shall conform to standard practices, without no magnetic materials. Therefore, dowels (where required) shall be of aluminum, brass, or bronze, rather than steel.

c. Make the size of the calibration pad compatible with the requirements of the user aircraft. For small airplanes make the radius of the pad 50 feet (15 m); for basic transports make the radius 60 feet (18 m); for large two- and three-engine jets, other than basic transports, and all large propeller-driven airplanes make the radius 80 feet (24 m); and for large four-engine jets, other than basic transports, make the radius 110 feet (33 m). For aircraft over 300,000 pounds (136 000 kg), an analysis of the turning area required for the aircraft will be necessary to determine adaptability to the dimensions specified herein.

d. The Type II compass calibration pad shown in figure A4-3 provides wheel slots to assist in true alignment of aircraft normal to each radial. It may be desirable to construct a special device for use in obtaining true alignment for the calibration pad shown in figure A4-2. One method of establishing control points consists of hollow shell non-magnetic inserts along each radial. A wooden block with aluminum or bronze bolts to fit into the center hole of the brass insert can then be used to provide an accurate alignment of the aircraft wheels. Figure A4-1 shows design details of this system.

e. There are many satisfactory ways of providing a device to wheelblock an aircraft to obtain the required alignment, and the exact method is left to the discretion of the design engineer. The method detailed in Figure A4-1 is one suggestion. One alternative which comes to mind is the possibility of forming holes in the concrete with some form of removable dowel, rather than constructing the specially built brass inserts.

5. LOCATION OF COMPASS CALIBRATION PAD. The requirements specified herein have been determined through consultation with instrument calibration specialists, fixed base operators, and persons

in the Geological Survey with considerable experience in performing surveys of compass calibration pads.

a. Locate the site at least 300 feet (90 m) from power and communication cables (both above and below ground) and from other aircraft. Locate the site at least 600 feet (180 m) from large magnetic objects such as buildings, railroad tracks, high voltage electrical transmission lines, or cables carrying direct current (either above or below ground). In order to prevent interference with electronic navigational aid facilities located on the airport, make sure that the required clearances are maintained as specified in chapter 6. Control cables, runway and taxiway light bases or sign fixtures, pipelines, ducts, grates for drainage, distance remaining signs, and aircraft arresting gear should be avoided when they contain ferrous materials.

b. The compass calibration pad must be located off the side of a taxiway or runway a sufficient distance to satisfy the runway and taxiway clearances applicable to the airport on which it is located.

c. After tentative selection of a site through visual application of appropriate criteria contained herein, make a thorough magnetic survey of the site. Many sites which meet all visually applied criteria regarding distances from structures, etc., still are unsatisfactory because of locally generated or natural magnetic anomalies. At locations near heavy industrial areas, intermittent magnetic variations may be experienced and sufficient surveys at various periods of time are necessary to ascertain if this situation exists.

d. The difference between magnetic and true north must be uniform in the vicinity of the site. Make sufficient surveys to determine that the angular difference between true and magnetic north measured at any point does not differ from the angular difference measured at any other point by more than one-half degree within a space between 2 and 10 feet (0.6 and 3 m) above the surface of the base and extending over an area within a 250-foot (75 m) radius from the center.

6. CONSTRUCTION OF COMPASS CALIBRATION PAD. For pavement construction, the applicable portions of AC 150/5320-6 should be used. The following additional information is important:

a. Do not use magnetic materials, such as reinforcing steel or ferrous aggregate, in the construction of the calibration pad or of any pavement within a 300-foot (90 m) radius of the center of the

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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.

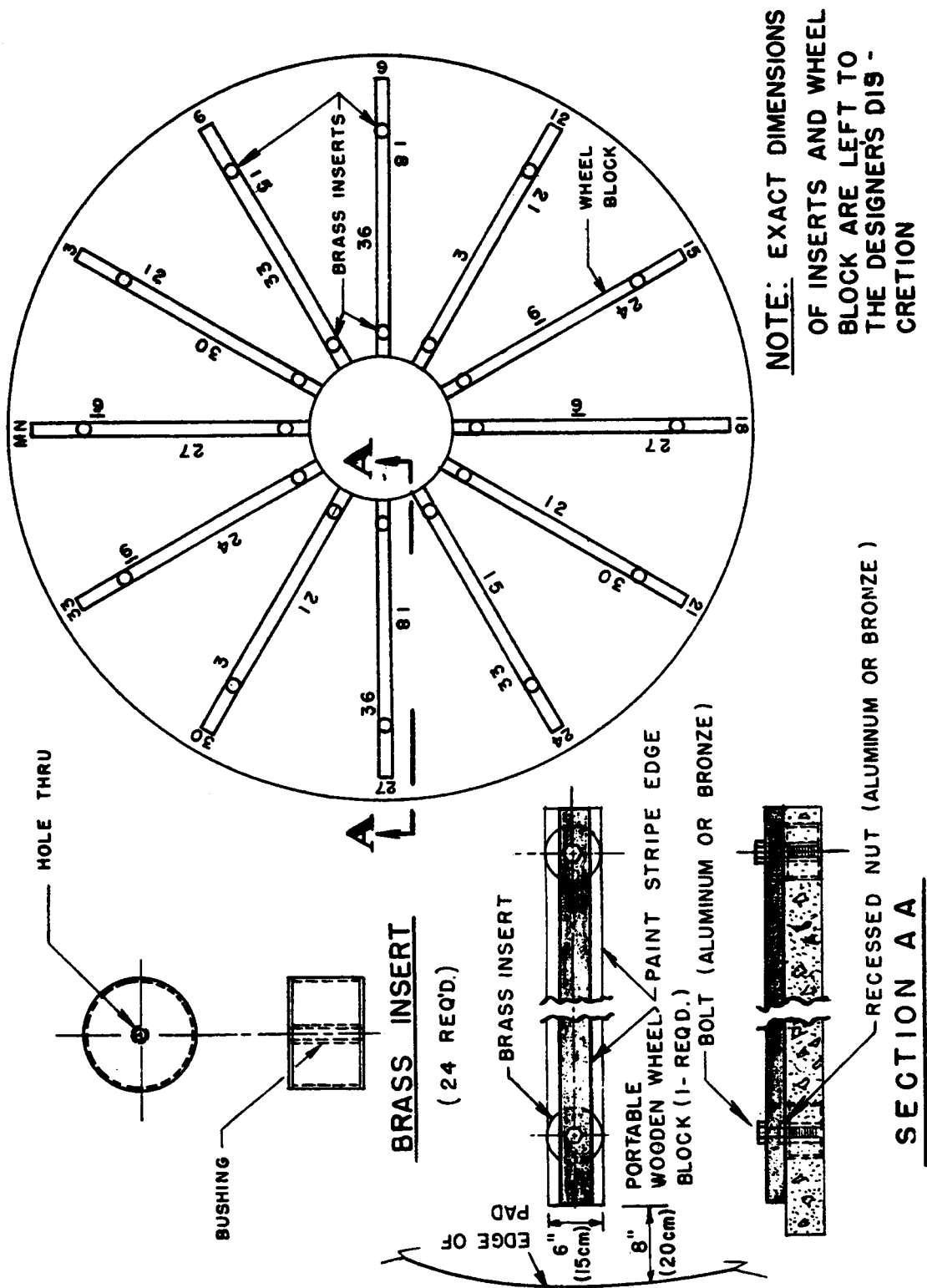


Figure A4-1. Marking layout and details of wheel block

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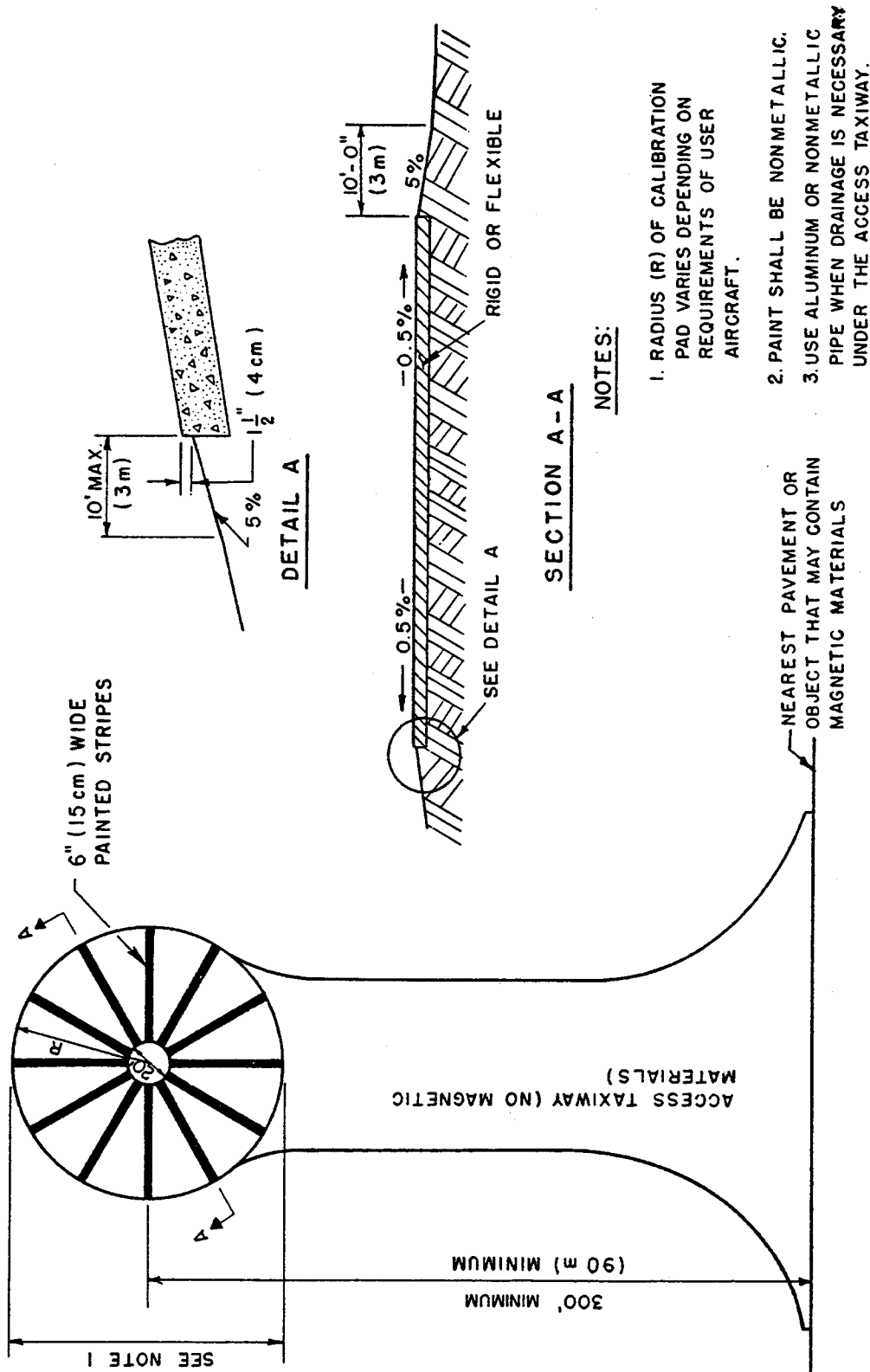


Figure A4-2. Type I. compass calibration pad

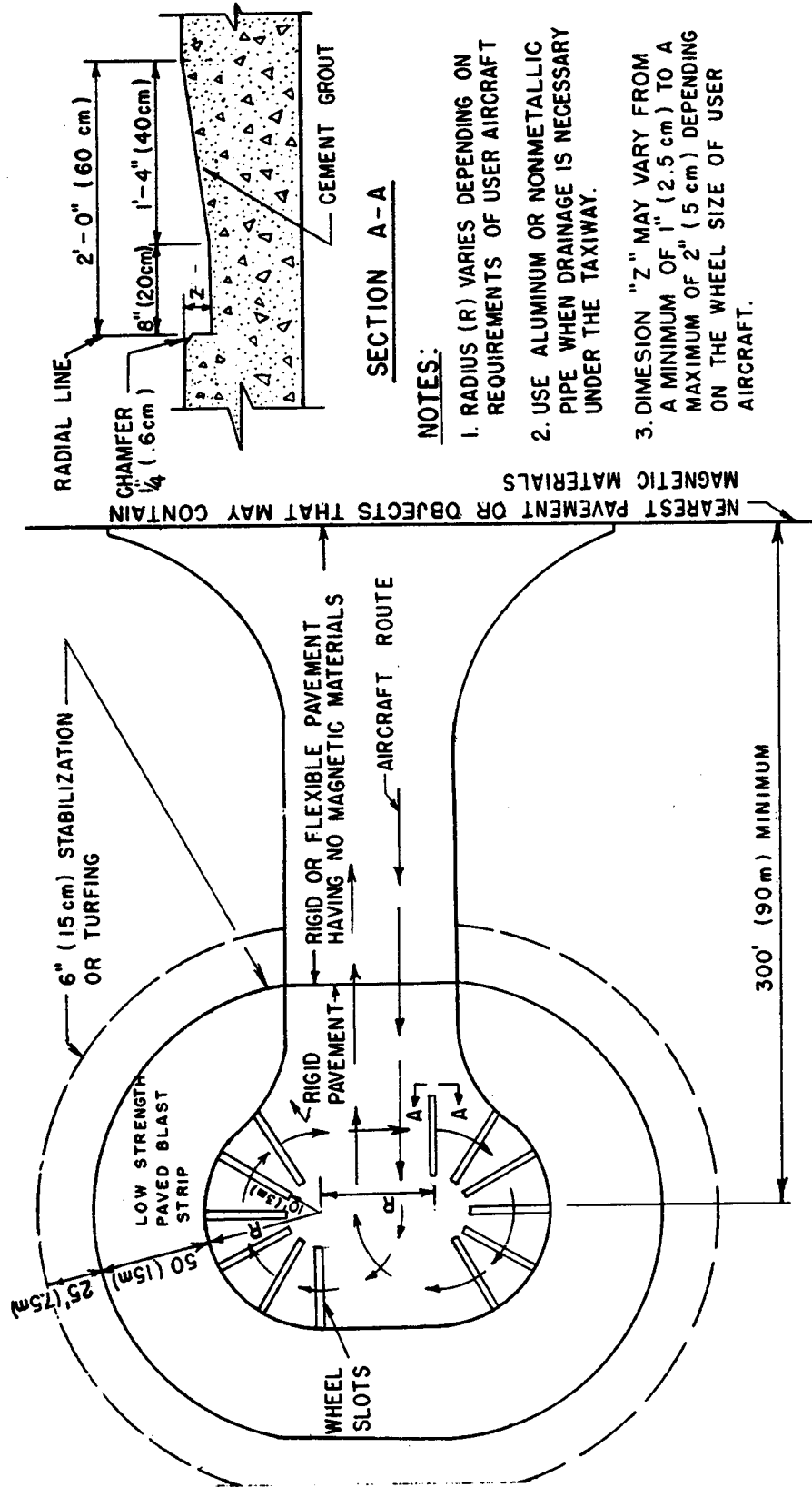


Figure A4-3. Type II. compass calibration pad

Appendix 5. SMALL AIRPORT BUILDINGS, AIRPLANE PARKING, AND TIEDOWNS

1. **GENERAL.** This chapter provides guidelines on airport buildings, airplane parking, and tiedowns at small airports. Airport buildings fulfill the needs of specific aviation activities. The fixed base operator's (FBO) building usually provides space for the commercial activities, maintenance and repair of aircraft, air charter, and the like. The administration building accommodates the public, pilots, passengers, visitors and also the airport manager's office. Constructed small airplane hangars generally house only airplanes.

a. Figure A5-1 illustrates a typical layout for the building area of a small airport. Siting the FBO building adjacent to the airplane parking apron offers both convenience for local and itinerate pilots. Apron frontage is a premium airport space and should be judiciously utilized. Most hangaring is essentially a garaging operation which usually does not require direct apron front access. The administration building should be near the FBO but sufficiently separated to preclude conflict between airplanes operating from these areas. Storage hangars are often T-hangars, grouped in multiunits in a separate area.

b. Other aviation-oriented buildings may be necessary on the airport. The function(s) of such a building in relation to other aviation activities helps determine its optimum location.

c. An airport master planning study indicates the number of based and transient airplanes expected to utilize the airport. This information will assist in the layout and design of the airplane parking apron(s) and tiedown area(s).

d. AC 150/5360-13 contains guidance on the planning and design of airport terminal buildings and related access facilities at large airports.

2. **TRANSIENT APRON.** Aprons provide parking for airplanes, access to the terminal facilities, fueling, and surface transportation. A determination on the total amount of apron area needed cannot be developed by formula or empirical relationship since local conditions often vary significantly from one airport to another. The ideal solution is conducting an onsite survey during typical busy days and counting the airplanes on the ground periodically during the day. This approach,

however, is impossible for new airports and likely impractical for many airports without a manager. Below is a method which includes factors that affect the determination of the area needed for transient parking and analyzes and estimates the demand for the transient airplane.

a. Calculate the total annual operations (local plus itinerant) from the best available source. Where specific data are not available, the following data, which reflect local plus itinerant operations, may be used: Non-NPIAS Public Use - 538/based aircraft; Reliever - 492/based aircraft; Other General Aviation - 637/based aircraft; and Primary - 700/based aircraft.

b. Obtain the record of aviation gas sales for the year for the airport.

c. Correlate gas sales with annual operations on a monthly basis.

d. Calculate the average daily operations for the most active month.

e. Assume the busy day is 10 percent more active than the average day.

f. Assume that a certain portion of the transient airplanes will be on the apron during the busy day. Consider fifty percent as a reasonable figure.

g. Allow an area of 360 square yards per transient airplane.

h. Adjust the calculated amount to accommodate expansion for at least the next 2-year period. A minimum suggested increase is 10 percent.

3. **APRON FOR BASED AIRPLANES.** The apron used for based airplanes should be separate from the transient airplanes. The area needed for parking based airplanes should be smaller per airplane than for transient. This is due to knowledge of the specific type of based airplanes and closer clearance allowed between airplanes. The following considerations apply in determining the total apron area required for based airplanes:

a. The total number of based airplanes.

b. The number of airplanes now hangared or expected to be within 2 years.

c. The number of airplane owners who will continue to tie down their airplane in a turf (unpaved) area. At many general aviation airports a certain percentage of airplane owners will prefer to tie down in the most inexpensive area.

d. An area of 300 square yards (250 m²) per airplane. This should be adequate for all single engine and light twin engine airplanes, such as the Cessna 310, which has a wingspan of 37 feet (11 m) and a length of 27 feet (8 m).

e. An increase in total area to accommodate expansion for at least the next 2-year period. A minimum suggested increase is 10 percent.

4. **TIEDOWNS.** Tiedown locations for based airplanes will vary with local preference. The purpose of a tiedown layout is to park the maximum number of airplanes while satisfying taxilane object free area width criteria. Figure A5-2 illustrates two tiedown layouts for small airplanes in Airplane Design Group I. General information on tiedown techniques and procedures is contained in AC 20-35.

5. **OTHER CONSIDERATIONS.**

a. As airport activity increases, the demand for an area to load and unload airplanes will increase. This activity may be in the form of charter, air taxi, business, or personal airplane operations. Generally, the area should be large enough to accommodate two airplanes in front of the terminal building. Also, investigate requirements for possible local air mail service.

b. At small general aviation airports, a gas pump facility is usually the most economical method of airplane fueling. A fueling area should be near the terminal building. Some larger general aviation airports use fuel truck operations. Such an operation eliminates the need for gas pump areas and allows more area for airplane parking. In either case, appropriate static grounding capability must be provided.

c. In summary, the apron design should allow for flexibility and expandability. The design should use empirical relationships only when field data are not available. Arrangement of tiedown installation should allow apron area alterations as needed. Keeping both

ends of the apron free of structures will enhance future expansion.

6. **HANGARS.** Figure A5-3 illustrates typical layouts of hangar areas for different types of hangars. As noted, the recommended clearance between T-hangars is 75 feet (23 m) for one-way traffic and 125 feet (38 m) for two-way traffic. These clearances will accommodate most twin engine general aviation airplanes.

a. Prefabricated T-hangars are available in various sizes and lengths. Details on their erection and cost may be obtained from any of several manufacturers throughout the country.

b. The number of T-hangars depends upon local demand. However, expect a greater demand for protection from weather in the more severe climate areas.

7. **ADMINISTRATION BUILDING.** The necessity of an administration building is a managerial question answered on the weight of at least the following two factors. First, operationally, the chief factor is whether the airport can take care of present and anticipated airplane activity. Second, economically, the chief factor is the kind of community the airport serves and how well this community can support general aviation activity. Note that lower activity airports may not initially justify the construction of either an FBO or administration building. In many cases, the initial airport building is a small maintenance hangar with an attached office. Prior to the construction of an administrative type of building on a general aviation airport, the following basic questions should receive consideration:

a. Are there a minimum of 10 airplane departures and arrivals, not including touch and go, during the peak hours of a typically busy day during the year?

b. Is there at least one active fixed base operator on the airport?

c. Is airplane fuel available on the airport?

d. Is a hangar with repair facilities in operation on the airport?

e. Is a full-time airport manager on duty during the normal day?

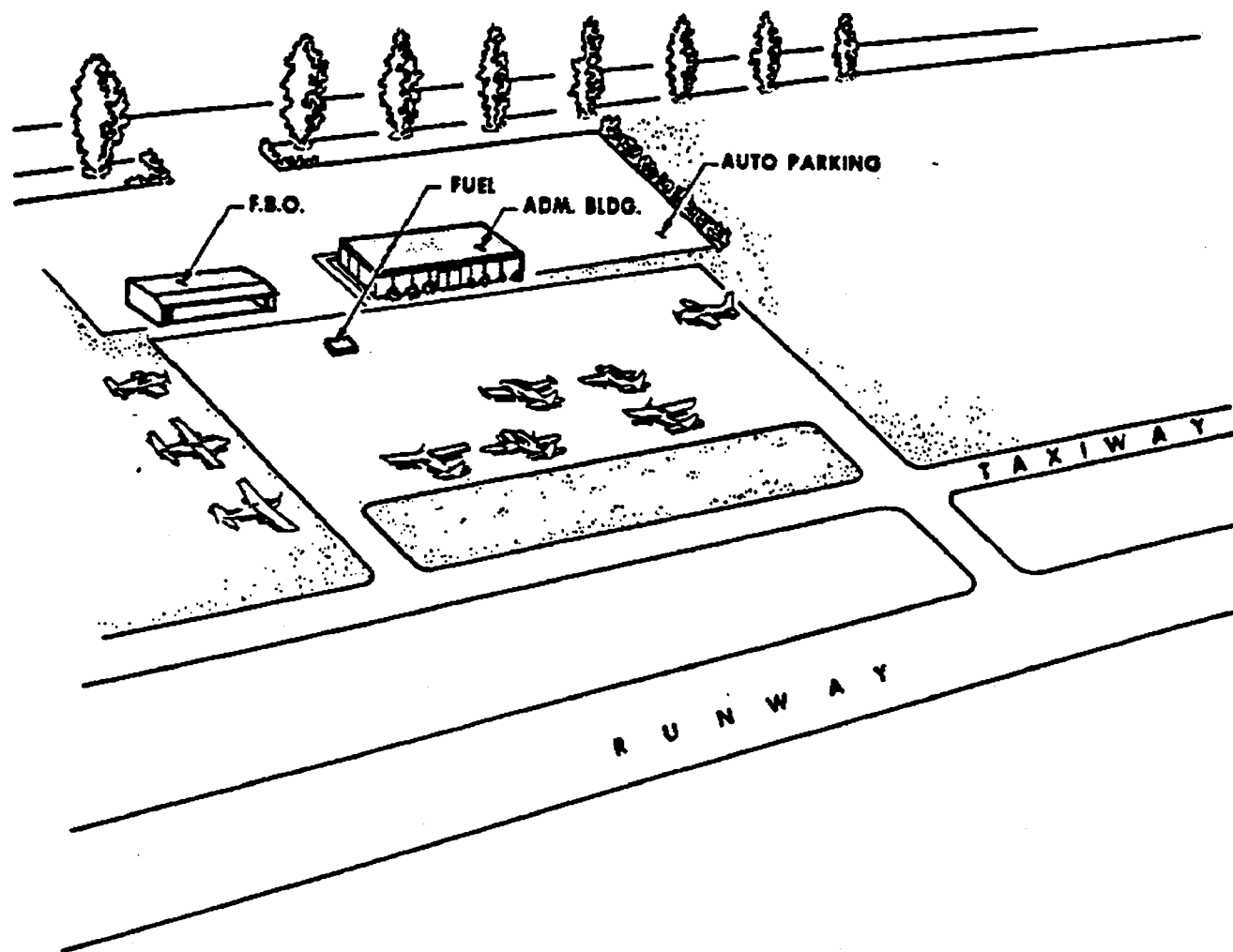
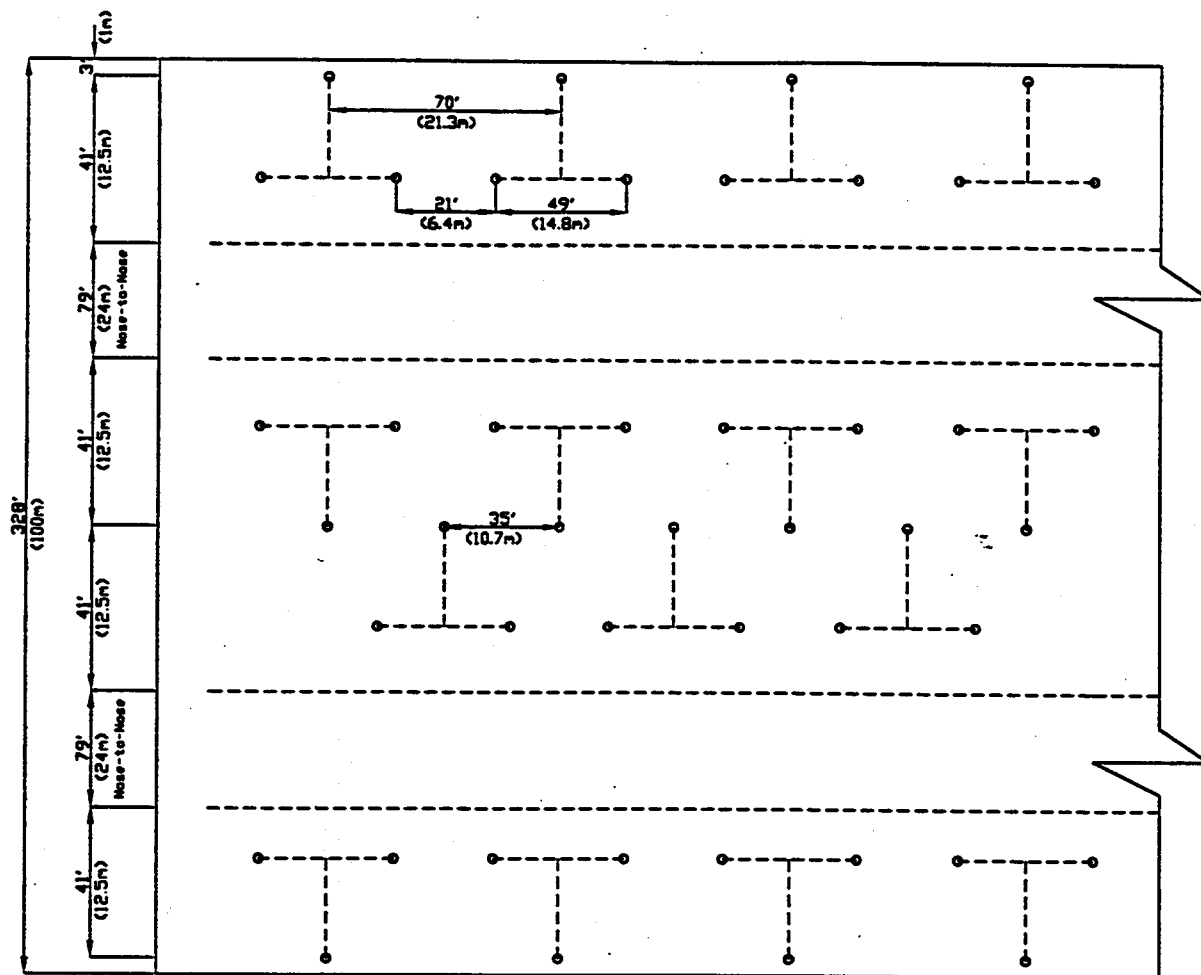
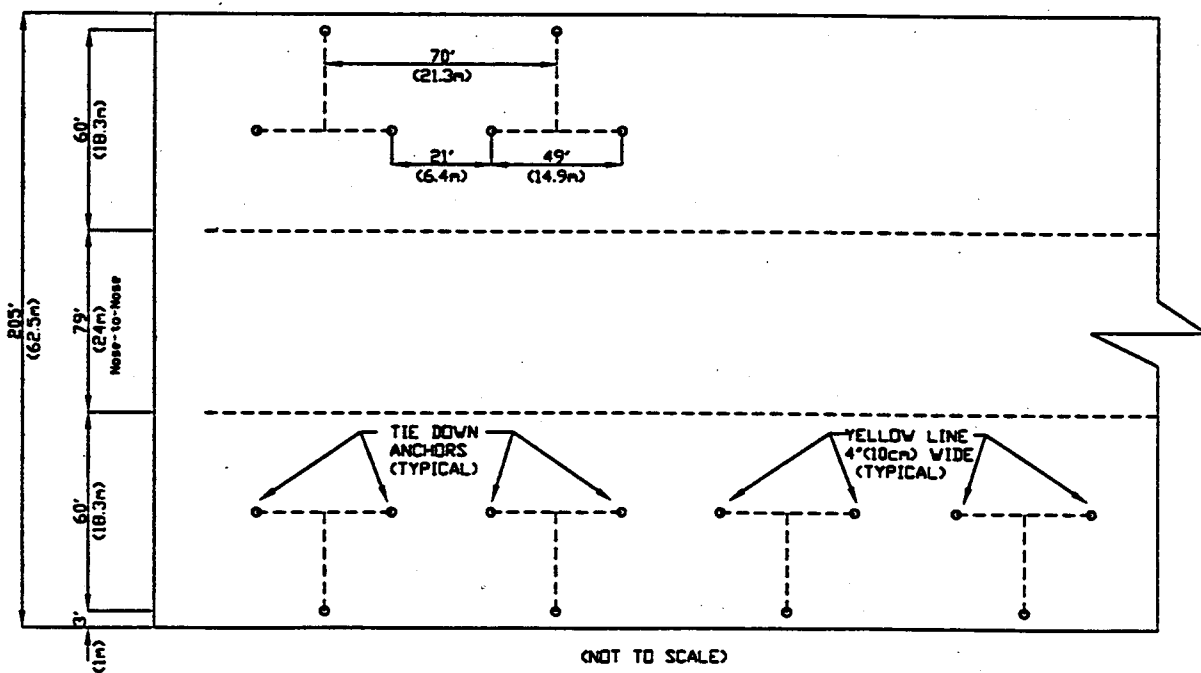


Figure A5-1. Parking apron area



(NOT TO SCALE)



(NOT TO SCALE)

Figure A5-2. Tiedown layouts

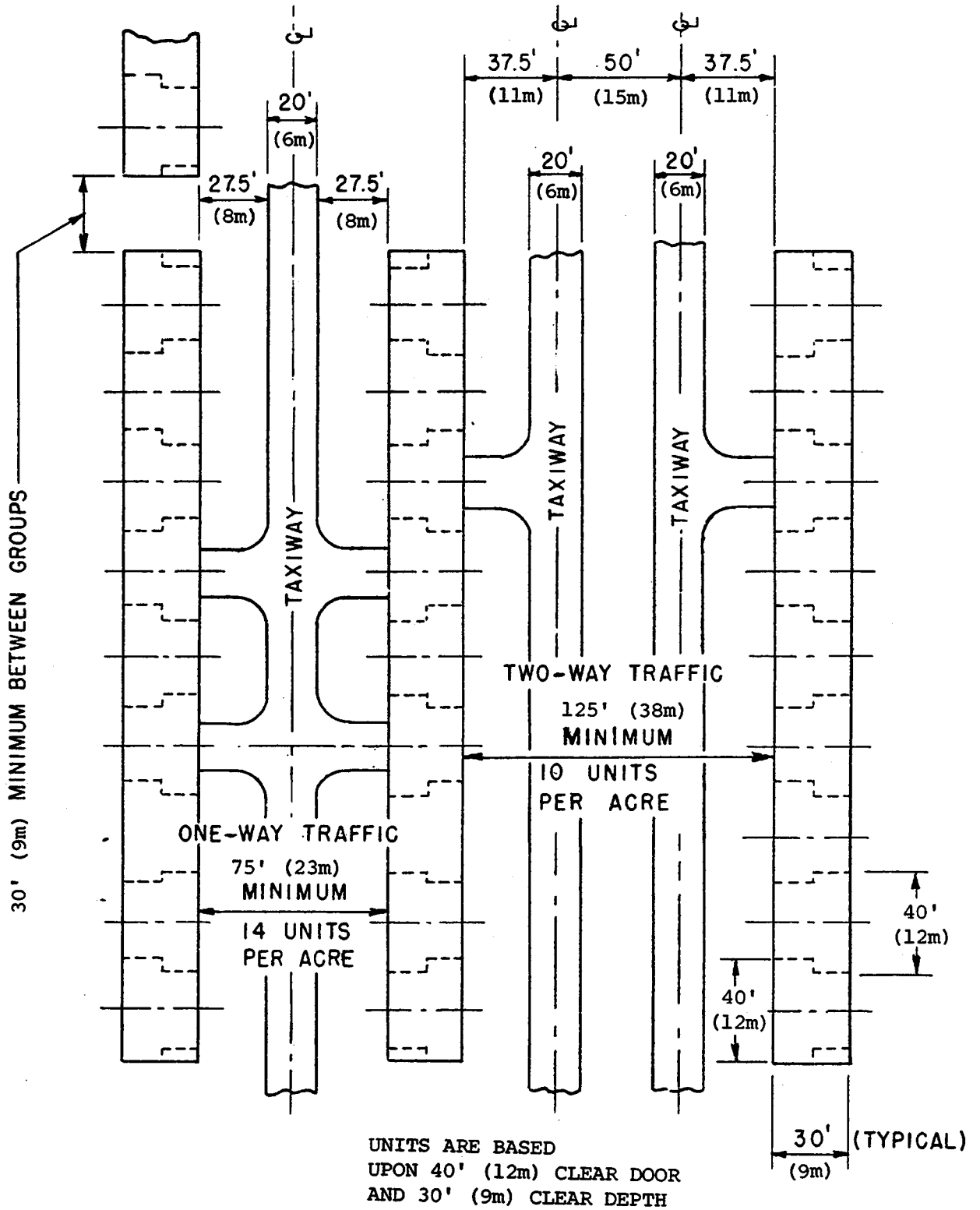


Figure A5-3. T-hanger layout

f. Are public waiting areas and restrooms already available in hangars or other buildings on the airport?

g. Is a public telephone available 24 hours a day for closing flight plans or requesting fuel or transportation to town?

8. **AIRPORT SURVEY.** A survey of an airport's aviation activity should precede the planning of an administration building. For survey purpose, "airport aviation activity" includes the number of active-based airplanes, the number of airplane operations (local and itinerant), and the number of pilots and passengers at the airport on a typically busy day.

a. A survey of current activity at the airport can determine what functional requirements need accommodating by and the total area of the administration building. Also surveys of other airports with similar aviation activity characteristics which already have administration buildings provide additional valuable data. The airport manager or a fixed base operator can gather the information on several typically busy days over a period of several weeks during the most active season. At many small airports, weekends are usually the busiest days and are a good time to measure peak activity. A Pilots Register is also useful in making a traffic count.

b. With respect to passengers, an airport manager obtains data on the two or three days in the week of the season historically known to be the busiest. This record of the plateau of high activity in terms of peak-hour operations and peak-hour passengers determines the typically busy hour by averaging the hourly activity for three or four of the busiest hours.

9. **BUILDING PLAN.** The specialized interior requirements of a small administration building are few and should reflect a basic simplicity by providing direct functional relationships between rooms and facilities.

a. The arrangement of elements within the building should address the airfield configuration, future building expansion, and the passenger and service driveways. In determining the details of space relations and requirements, the experienced general aviation airport manager is in the best position to assist in tailoring detailed building needs to actual aviation activity and should be a participant in the early planning conferences.

b. The building components should provide:

(1) Short and direct pedestrian routes from parking areas to public waiting areas or airport offices, and to the loading apron or tiedown areas; and

(2) A view of the airfield operations from the manager's office, the waiting room, and any eating facilities.

10. **EXPANSION.**

a. Identification of future expansion of the administration building should be from the outset. This is particularly important at a general aviation airport where it is difficult to accurately forecast and assess initial construction cost when based on actual measurable activity.

b. Normally, with the air field side of the building fixed, building expansion occurs only on the off-field side and the ends. When drives and walks resist expansion on the off-field side, all major expansion should proceed on the ends of the building.

11. **CIRCULATION.** The waiting room is the hub from which circulation routes radiate. Usually, an open plan with only the minimum essential partitioning allows better circulation and a more spacious building interior. The following items are important in assuring a satisfactory circulation of traffic through the building:

a. Short and direct routes from the entrance of the off-field side of the building to the exit on the field side.

b. Wide doorways at the main entry and exits.

c. Public corridors, as necessary, wide enough for comfortable traffic flow, but not excessive to raise initial and maintenance costs.

d. Adequate circulation aisles within the waiting area to assure free movement and comfort for the room occupants.

12. **WAITING ROOM.** As the central meeting and waiting space for passengers, visitors, pilots, and airport employees, the waiting room is the focal point of the building. It should merge with such other required spaces as the manager's office, eating facilities, and public restrooms. The closer this relationship, the more economical the building. Additional recommendations follow:

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a. A view of airfield activities. The public enjoys seeing airplanes and their operations. Do not put utility rooms, restrooms, and other service facilities on the field side of the building if possible.

b. A comfortable seating arrangement. Comfortable seating need not be fixed seats or stereotyped. Such an arrangement at a small airport is especially good to promote the waiting room informality usually associated with small airport operations.

c. Concession items such as coin-operated parcel lockers and small item dispensing machines.

d. A bulletin board for information of interest to private pilots and the aviation public; for example, weather reports, notices to airmen, and FAA information.

e. Space for the mounting of aeronautical charts.

f. A folding partition to provide dual space use. This flexible arrangement conserves building space and makes it possible to hold meetings in the administration building without disturbing the essential business routine.

g. A public phone for closing flight plans, weather briefings, calling public transportation, etc.

13. MANAGER'S OFFICE. Expect variation in the room space for management use at a particular airport. Determining the local management's space requirements should follow after an analysis of the management equipment, furnishings, and personnel space needs. As a general planning guide, the minimum office size sufficient for the furnishings and functions of an office for a manager and one secretary should be about 180 square feet (17 m²).

14. EATING FACILITIES. Normally, some provision for food services is in the administration building for the comfort and convenience of airport users. The scope of the eating facilities in the building varies with local and itinerant aviation activity. There may be dispenser items, a snack bar, a coffee shop, a dining room, or a combination of these. Frequently, the airport eating facility attracts additional patrons because of its convenient location, its unusual cuisine, or the interest which the patrons have in aviation activity.

a. Food and drink dispensers are usually enough to satisfy initial needs at general aviation airports. Dispenser service requires little attention to operate. Grouped dispensers can better be seen from the main circulation route between the waiting area and the operation/management office.

b. Usually a concessionaire operates the coffee shop or dining room service. It is important to select the concessionaire early enough to receive concessionaire input in planning that part of the administration building. Computing the required size of space should proceed in terms of seated patrons and the kind and amount of food service and preparation equipment. Additional recommended planning considerations are:

(1) Direct relation with the waiting room;

(2) Convenient route from public entrances;

(3) Direct access from the food preparation area to the outside service drive;

(4) View of the airfield activity from the seating area; and

(5) Compliance with public health agency requirements.

15. PUBLIC RESTROOMS. Restrooms should be immediately accessible from the waiting room and meet federal, state, and local requirements for the handicap impaired.

16. ROADS AND AUTO PARKING. Establishing roads and parking areas directly related to the administration building should follow after arranging the configuration of the building, including passenger entrances/exits and service entries. Other important considerations are as follows:

a. Location of short-limit parking or stopping spaces should be close to the main off-field public entrance with enough distance left between building and parking spaces for any future building expansion planned toward these parking spaces.

b. Consolidation of public and employee parking spaces should be into one centrally located parking area when both an administration building and a hangar area are contemplated. This plan is feasible when a convenient relation is established from the

outset between the administration building and the hangars.

c. For special events, there should be one or more well-drained turfed areas, located beside the airport access roads for overflow parking.

d. Additional parking areas should exist if the administration building contains eating facilities which outside customers regularly patronized.

e. There should be separate service drives for kitchens from public drives and parking. However, the service drive may often be adjacent to the apron access drive. This requires preventive measures to prohibit restaurant vehicles from inadvertently driving onto the apron.

f. Designated parking spaces for the handicap impaired are required to comply with applicable federal, state, and local requirements

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Appendix 6. METRIC CONVERSION AND TYPICAL AIRPORT LAYOUT PLAN

This appendix was cancelled by AC 150/5070-6, Airport Master Plans. Please replace pages 125–130. |

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Appendix 7

Appendix 7. AIRPORT LAYOUT PLAN COMPONENTS AND PREPARATION

This appendix was cancelled by AC 150/5070-6, Airport Master Plans. Please replace pages 131–138. |

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Appendix 8. RUNWAY DESIGN RATIONALE

1. SEPARATIONS. Dimensions shown in tables 2-1, 2-2, 3-1, 3-2, and 3-3 may vary slightly due to rounding off.

a. **Runway to holdline separation** is derived from landing and takeoff flight path profiles and the physical characteristics of airplanes. The runway to holdline standard satisfies the requirement that no part of an airplane (nose, wingtip, tail, etc.) holding at a holdline penetrates the obstacle free zone (OFZ). Additionally, the holdline standard keeps the nose of the airplane outside the runway safety area (RSA) when holding prior to entering the runway. When the airplane exiting the runway is beyond the standard holdline, the tail of the airplane is also clear of the RSA. Additional holdlines may be required to prevent airplane, from interfering with the ILS localizer and glide slope operations.

b. **Runway to parallel taxiway/taxilane separation** is determined by the landing and takeoff flight path profiles and physical characteristics of airplanes. The runway to parallel taxiway/taxilane standard precludes any part of an airplane (tail, wingtip, nose, etc.) on a parallel taxiway/taxilane centerline from being within the runway safety area or penetrating the OFZ.

c. **Runway to airplane parking areas** is determined by the landing and takeoff flight path profiles and physical characteristics of airplanes. The runway to parking area standard precludes any part of a parked airplane (tail, wingtip, nose, etc.) from being within the runway object free area or penetrating the OFZ.

2. OBSTACLE FREE ZONE (OFZ). The portion of the OFZ within 200 feet (60 m) of the runway centerline is required for departure clearance. The additional OFZ, beyond 200 feet (60 m) from runway centerline, is required to provide an acceptable accumulative target level of safety without having to adjust minimums. The level of safety for precision instrument operations is determined by the collision risk model. The collision risk model is a computer program developed from observed approaches and missed approaches. It provides the probability of an airplane passing through any given area along the flight path of the airplane. To obtain an acceptable accumulative target level of safety with objects in the OFZ, operating minimums may have to be adjusted.

3. RUNWAY SAFETY AREA.

a. **Historical Development.** In the early years of aviation, all airplanes operated from relatively unimproved

airfields. As aviation developed, the alignment of takeoff and landing paths centered on a well defined area known as a landing strip. Thereafter, the requirements of more advanced airplanes necessitated improving or paving the center portion of the landing strip. The term "landing strip" was retained to describe the graded area surrounding and upon which the runway or improved surface was constructed. The primary role of the landing strip changed to that of a safety area surrounding the runway. This area had to be capable, under normal (dry) conditions, of supporting airplanes without causing structural damage to the airplanes or injury to their occupants. Later, the designation of the area was changed to "runway safety area," to reflect its functional role. The runway safety area enhances the safety of airplanes which undershoot, overrun, or veer off the runway, and it provides greater accessibility for firefighting and rescue equipment during such incidents. Figure A8-1 depicts the approximate percentage of airplanes undershooting and overrunning the runway which stay within a specified distance from the runway end. The runway safety area is depicted in figure 3-1 and its dimensions are given in tables 3-1, 3-2, and 3-3.

b. **Recent Changes.** FAA recognizes that incremental improvements inside standard RSA dimensions can enhance the margin of safety for aircraft. This is a significant change from the earlier concept where the RSA was deemed to end at the point it was no longer graded and constructed to standards. Previously, a modification to standards could be issued if the actual, graded and constructed RSA did not meet dimensional standards as long as an acceptable level of safety was provided. Today, modifications to standards no longer apply to runway safety areas. (See paragraph 6) Instead, FAA airport regional division offices are required to maintain a written determination of the best practicable alternative for improving non-standard RSAs. They must continually analyze the non-standard RSA with respect to operational, environmental, and technological changes and revise the determination as appropriate. Incremental improvements are included in the determination if they are practicable and they will enhance the margin of safety.

4. RUNWAY OBJECT FREE AREA (ROFA).

The ROFA is a result of an agreement that a minimum 400-foot (120 m) separation from runway centerline is required for equipment shelters, other than localizer equipment shelters. The aircraft parking limit line no longer exists as a separate design standard. Instead, the separations required for parked aircraft and the building restriction line from the runway centerline are determined by object clearing criteria.

Appendix 8

5. RUNWAY SHOULDERS AND BLAST PADS.

Chapter 8 contains the design considerations for runway shoulders and blast pads.

6. CLEARWAY. The use of a clearway for takeoff computations requires compliance with the clearway definition of 14 CFR Part 1.

7. STOPWAY. The use of a stopway for takeoff computations requires compliance with the stopway definition of 14 CFR Part 1.

8. RUNWAY PROTECTION ZONE (RPZ).

Approach protection zones were originally established to define land areas underneath aircraft approach paths in which control by the airport operator was highly desirable to prevent the creation of airport hazards. Subsequently, a 1952 report by the President's Airport Commission (chaired by James Doolittle), entitled "The Airport and Its Neighbors," recommended the establishment of clear areas beyond runway ends. Provision of these clear areas was not only to preclude obstructions potentially hazardous to aircraft, but also to control building construction as a protection from nuisance and hazard to people on the

ground. The Department of Commerce concurred with the recommendation on the basis that this area was "primarily for the purpose of safety and convenience to people on the ground." The FAA adopted "Clear Zones" with dimensional standards to implement the Doolittle Commission's recommendation. Guidelines were developed recommending that clear zones be kept free of structures and any development which would create a place of public assembly.

In conjunction with the introduction of the RPZ as a replacement term for clear zone, the RPZ was divided into "object free" and "controlled activity" areas. The RPZ function is to enhance the protection of people and property on the ground. Where practical, airport owners should own the property under the runway approach and departure areas to at least the limits of the RPZ. It is desirable to clear the entire RPZ of all aboveground objects. Where this is impractical, airport owners, as a minimum, shall maintain the RPZ clear of all facilities supporting incompatible activities. Incompatible activities include, but are not limited to, those which lead to an assembly of people.

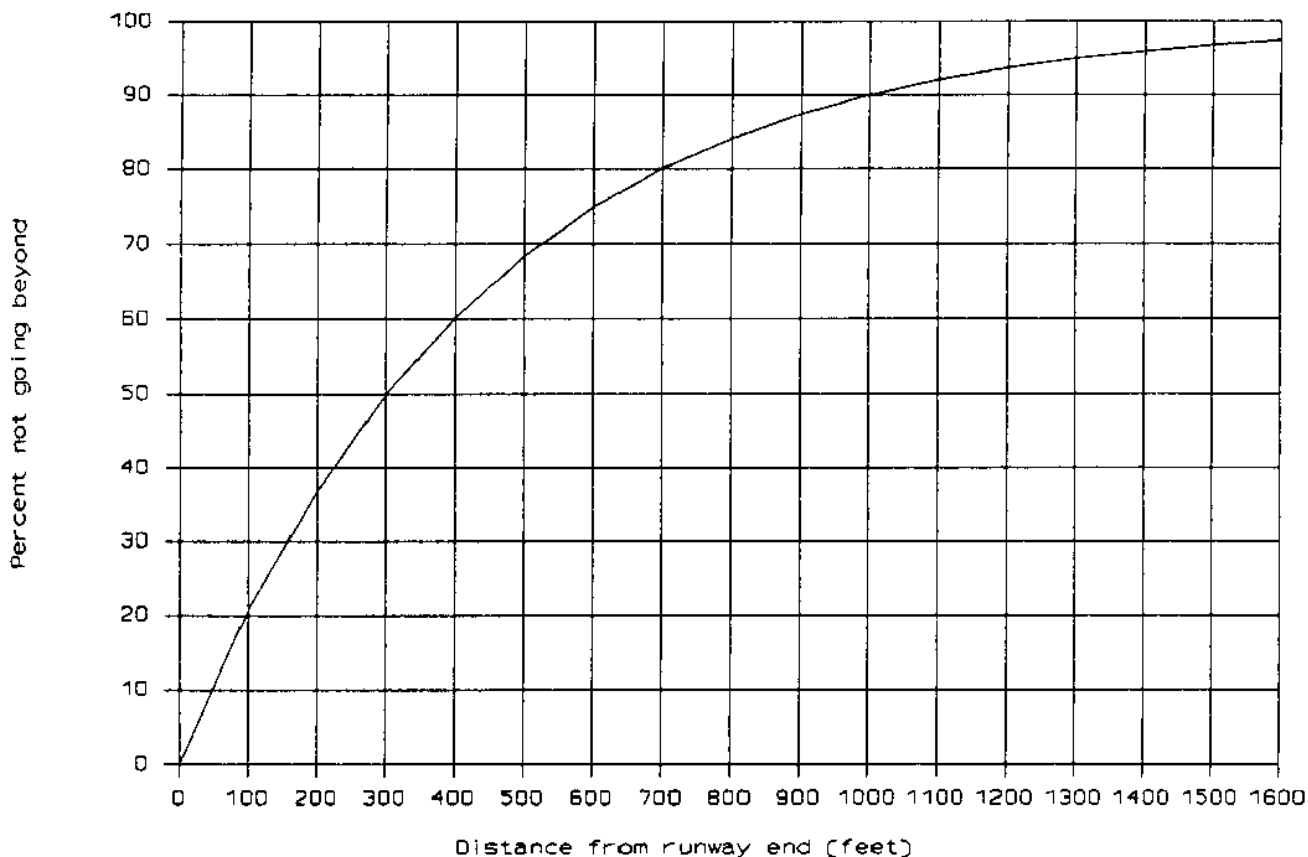


Figure A8-1. Approximate distance airplanes undershoot and overrun the runway end

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Appendix 9

Appendix 9. TAXIWAY AND TAXILANE DESIGN RATIONALE

1. **INTRODUCTION.** An airport operator is occasionally faced with the problem of having to cope with unusual terrain, local conditions, or the need to accommodate a specific airplane without accommodating other more demanding airplanes in the same airplane design group. This appendix provides the reasoning behind the selection of the various widths, clearances, and separations related to airplane physical characteristics. This rationale is usable, on a case-by-case basis, when local conditions or a specific airplane require modification of FAA airport design standards.

2. **BACKGROUND AND RATIONALE.** The minimum pavement widths, curve radii, and separations associated with airplane movement areas and airplane physical characteristics establish the taxiway system. Since the taxiway system is the transitional facility which supports airport operational capacity, the capability to maintain an average taxiing speed of at least 20 m.p.h. (30 km per hour) needs to be built into the system.

a. **Separations.** The parameters affecting separation criteria for taxiing airplanes, other than between a runway and its parallel taxiway, are wingspan and wingtip clearance. The need for ample wingtip clearance is driven by the fact that the pilots of most modern jets cannot see their airplane's wingtips.

(1) **Taxiway to taxiway centerline separation,** as shown in figure A9-1, is equal to 1.20 times the wingspan of the most demanding airplane plus 10 feet (3 m). This gives a wingtip clearance of 0.20 times the wingspan plus 10 feet (3 m). However, this separation may require an increase to accommodate minimum radius taxiway turns of 180 degrees, as shown in figure 4-10. The minimum acceptable radius is one which results in a maximum nosewheel steering angle (B) of 50 degrees. Appendix 10 discusses nosewheel steering angles.

(2) **Taxiway centerline to object separation,** as shown in figures A9-2 and A9-3, has the same wingtip clearances as taxiway to taxiway centerline separation. Thus, a minimum separation between a taxiway centerline and an object is 0.70 times the wingspan of the most demanding airplane, plus 10 feet (3 m).

(3) **Taxiway object free area width** is equal to twice the taxiway centerline to object separation.

(4) **Taxilane centerline to object separation,** as shown in figure A9-4, is equal to 0.60 times the wingspan of the most demanding airplane plus 10 feet (3 m). This gives a wingtip clearance of 0.10 times the wingspan plus 10 feet (3 m). This gives a wingtip clearance of one-half of that for an apron taxiway plus 5 feet (1.5 m). Reduced clearances are acceptable because taxi speed is very slow outside the movement area, taxiing is precise, and special operator guidance techniques and devices are normally present.

(5) **Taxilane object free area width** is twice the taxilane to object separation for a single lane width and 2.30 times the wingspan of the most demanding airplane plus 30 feet (9 m) for a dual lane width.

b. **Taxiway Width.** For a taxiway system to function safely and efficiently, the taxiway pavement needs to be of sufficient width to provide adequate clearance between the outside wheel and the pavement edge. This clearance permits normal deviations from the taxiway centerline or the intended path while taxiing at 20 mph (30 km per hour).

(1) Taxiway widths relate to the physical characteristics of airplanes. For example, a small high-performance jet airplane with long takeoff and landing requirement and a narrow undercarriage may operate on a relatively narrow taxiway. Conversely, a large airplane with short takeoff and landing capability, but with a wide undercarriage, requires a wider taxiway. Consequently, taxiway width is independent of runway length. The taxiway width should be at least equal to the sum of the undercarriage width plus two times the acceptable taxiway edge safety margin of the most demanding airplane.

(2) Table 4-1 specifies the clearance for tangents and curves, illustrated in figure A9-5, as taxiway edge safety margin.

c. **Curves and Fillets.** Taxiing around turns is difficult for pilots of airplanes with long wheelbases or when the cockpit is high and in front of the nosewheel. Appendix 10 covers detailed fillet design.

d. **Taxiway Shoulders.** Chapter 8 contains the design considerations for taxiway shoulders.

e. **Taxiway Safety Area.** To provide room for rescue and firefighting operations, the taxiway safety area width equals at least the wingspan of the most demanding airplane.

3. **EXIT TAXIWAY LOCATION.** Table A9-1 presents cumulative percentages of airplanes observed exiting existing runways at specific exit taxiway locations. In general, each 100-foot (30 m) reduction of the distance from the threshold to the exit taxiway reduces the runway occupancy time by approximately 3/4 of a second for each airplane using the exit. Conversely, the runway occupancy time of each additional airplane now overrunning the new exit location is increased by approximately 3/4 of a second for each 100 feet (30 m) from the old location to the next available exit.

For example, the percent of airplanes exiting at or before an exit located 4,000 feet (1220 m) from the threshold are:

a. When the runway is wet, 100 percent of A, 80 percent of B, 1 percent of C, and 0 percent of D airplanes;

b. When the runway is dry and the exit is right angled, 100 percent of A, 98 percent of B, 8 percent of C, and 0 percent of D airplanes; and

c. When the runway is dry and the exit is acute angled, 100 percent of A, 98 percent of B, 26 percent of C, and 3 percent of D airplanes.

When selecting the location and type of exit both the wet and dry runway conditions along with a balance between increases and decreases in runway occupancy time should be considered.

Table A9-1. Exit taxiway cumulative utilization percentages

| DISTANCE THRESHOLD TO EXIT | WET RUNWAYS | | | | DRY RUNWAYS | | | | | | | |
|----------------------------------|-------------------------------|-----|-----|-----|-----------------------|-----|-----|-----|-----------------------|-----|-----|-----|
| | RIGHT & ACUTE ANGLED EXITS | | | | RIGHT ANGLED EXITS | | | | ACUTE ANGLED EXITS | | | |
| | A | B | C | D | A | B | C | D | A | B | C | D |
| 0 ft (0 m) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 ft (152) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1000 ft (305 m) | 4 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 13 | 0 | 0 | 0 |
| 1500 ft (457 m) | 23 | 0 | 0 | 0 | 39 | 0 | 0 | 0 | 53 | 0 | 0 | 0 |
| 2000 ft (610 m) | 60 | 0 | 0 | 0 | 84 | 1 | 0 | 0 | 90 | 1 | 0 | 0 |
| 2500 ft (762 m) | 84 | 1 | 0 | 0 | 99 | 10 | 0 | 0 | 99 | 10 | 0 | 0 |
| 3000 ft (914 m) | 96 | 10 | 0 | 0 | 100 | 39 | 0 | 0 | 100 | 40 | 0 | 0 |
| 3500 ft (1067 m) | 99 | 41 | 0 | 0 | 100 | 81 | 2 | 0 | 100 | 82 | 9 | 0 |
| 4000 ft (1219 m) | 100 | 80 | 1 | 0 | 100 | 98 | 8 | 0 | 100 | 98 | 26 | 3 |
| 4500 ft (1372 m) | 100 | 97 | 4 | 0 | 100 | 100 | 24 | 2 | 100 | 100 | 51 | 19 |
| 5000 ft (1524 m) | 100 | 100 | 12 | 0 | 100 | 100 | 49 | 9 | 100 | 100 | 76 | 55 |
| 5500 ft (1676 m) | 100 | 100 | 27 | 0 | 100 | 100 | 75 | 24 | 100 | 100 | 92 | 81 |
| 6000 ft (1829 m) | 100 | 100 | 48 | 10 | 100 | 100 | 92 | 71 | 100 | 100 | 98 | 95 |
| 6500 ft (1981 m) | 100 | 100 | 71 | 35 | 100 | 100 | 98 | 90 | 100 | 100 | 100 | 99 |
| 7000 ft (2134 m) | 100 | 100 | 88 | 64 | 100 | 100 | 100 | 98 | 100 | 100 | 100 | 100 |
| 7500 ft (2286 m) | 100 | 100 | 97 | 84 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 8000 ft (2438 m) | 100 | 100 | 100 | 93 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 8500 ft (2591 m) | 100 | 100 | 100 | 99 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 9000 ft (2743 m) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

A - Small, single engine 12,500 lbs (5 700 kg) or less
 B - Small, twin engine 12,500 lbs (5 700 kg) or less
 C - Large 12,500 lbs (5 700 kg) to 300,000 lbs (136 000 kg)
 D - Heavy 300,000 lbs (136 000 kg)

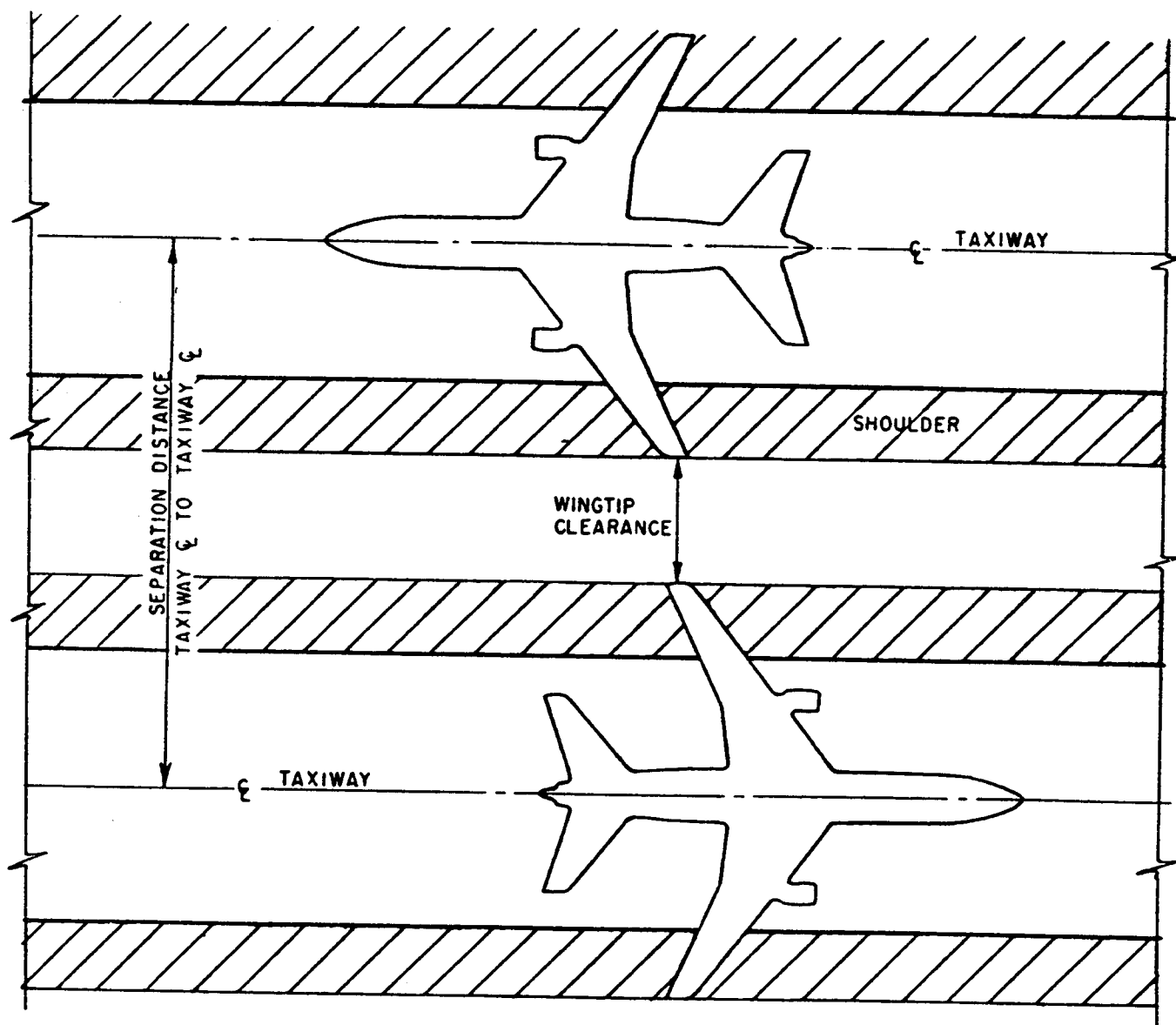


Figure A9-1. Wingtip clearance - parallel taxiways

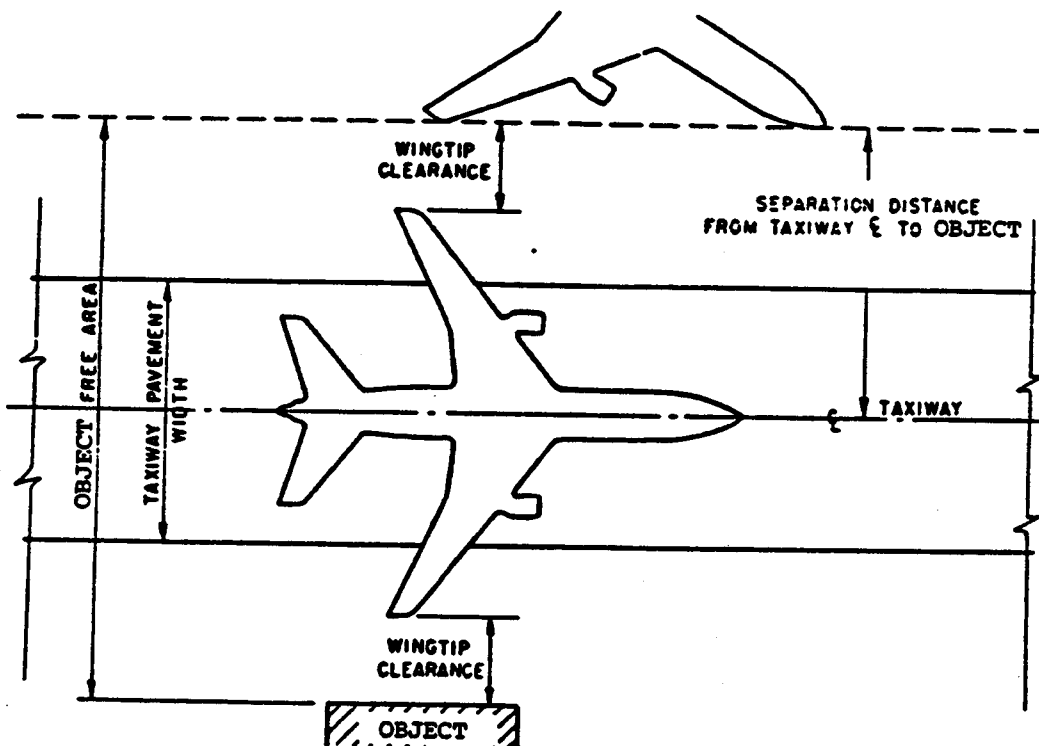


Figure A9-2. Wingtip clearance from taxiway

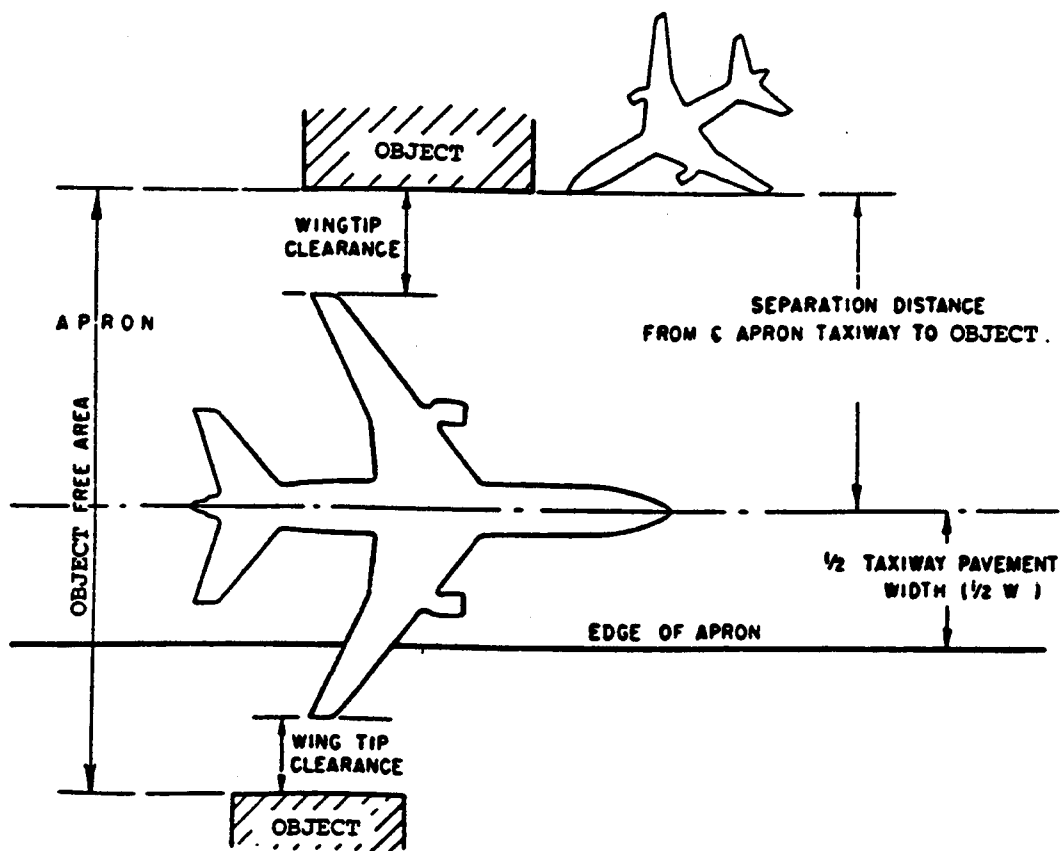


Figure A9-3. Wingtip clearance from apron taxiway

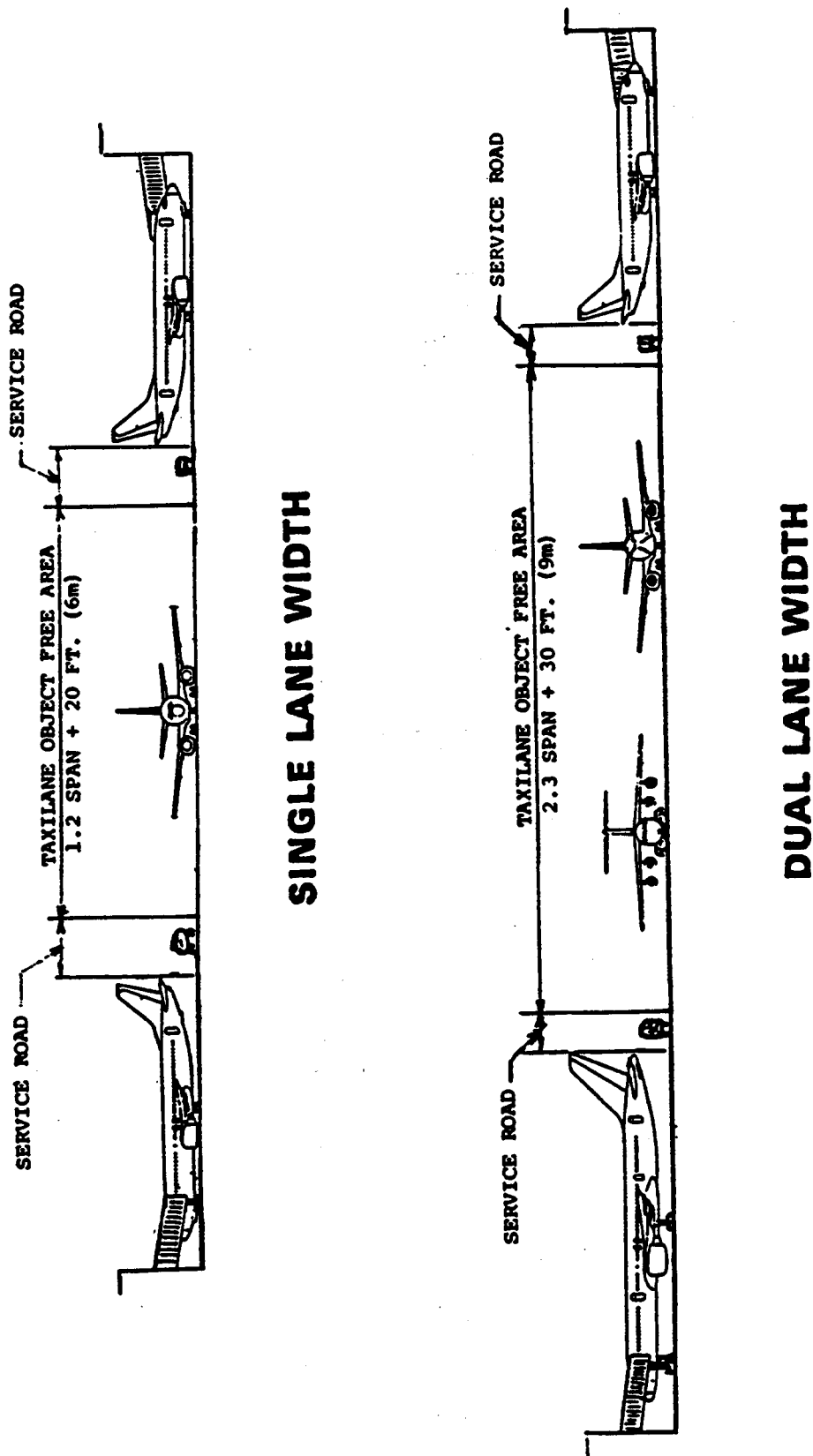
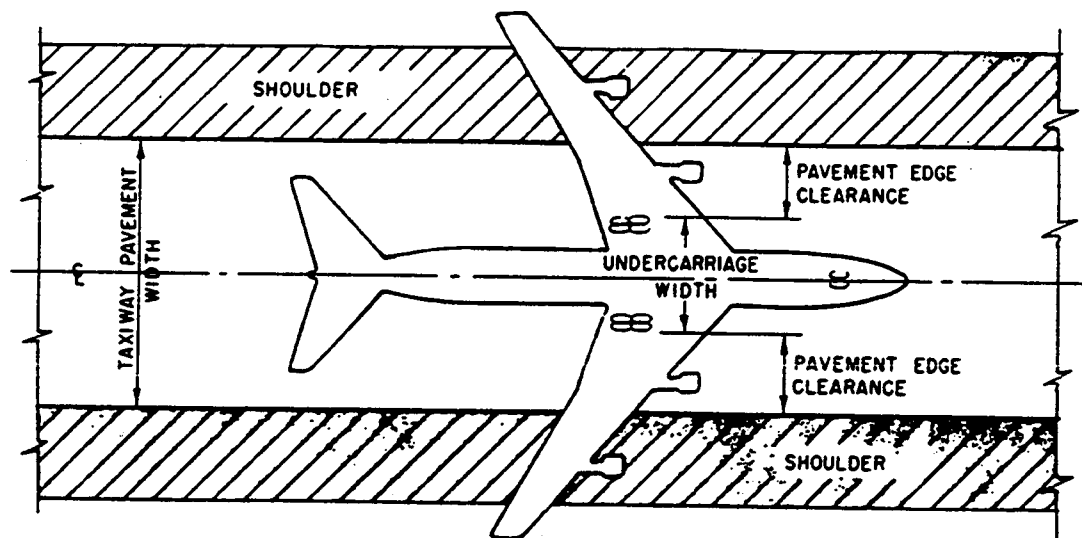


Figure A9-4. Wingtip clearance from taxiway



NOTE: UNDERCARRIAGE WIDTH AS USED IN THIS AC MEANS THE DISTANCE BETWEEN OUTSIDES OF TIRES.

Figure A9-5. Pavement edge clearance on tangent

4. **WINGTIP TRACE.** The following equations calculate the rectangular coordinates of points on the wingtip trace.

$$x = x_c - t \cos(A - B) \pm .5s \sin(A - B)$$

$$y = y_c + t \sin(A - B) \pm .5s \cos(A - B)$$

x_c and y_c are the rectangular coordinates of a selected point on the centerline pavement markings. One centerline point is required for each trace point.

A is the angle formed by the tangent to the centerline pavement markings and the longitudinal axis of the airplane at the selected point. Appendix 10 provides instructions for obtaining this angle.

B is the angle direction of the centerline pavement markings at the select centerline point.

t is the longitudinal distance from the center of airplane cockpit to the airplane wingtip.

s is the airplane wingspan.

To obtain the wingtip clearance trace, add the wingtip clearance to the wingtip trace.

a. The airport design computer program described in appendix 11 provides the OFA clearance fillet requirement directly.

(1) Figure A9-6 depicts the McDonnell-Douglas MD-88 wingtip clearance traces for a 100-foot (30.5m) radius of turn with centerline pavement markings.

(2) Figure A9-7 depicts the McDonnell-Douglas MD-88 wingtip clearance trace for a 100-foot (30.5 m) radius of turn with offset centerline pavement markings located on a 120-foot (30.5 m) radius arc.

(3) Figure A9-8 depicts the Boeing 727-200 wingtip clearance trace for a 100-foot (30.5 m) radius of turn with offset centerline pavement markings located on a 120-foot (30.5 m) radius arc.

(4) Figure A9-9 depicts the Boeing 727-100 wingtip clearance trace for a 100-foot (30.5 m) radius of turn with offset centerline pavement markings located on a 120-foot (30.5 m) radius arc.

b. The computer program treats the offset taxiway pavement markings arcs as five sections:

(1) A tangent section;

(2) A circular section comprised of a $\pm \cos^{-1}(\text{turn radius}/\text{offset radius})$ degree angle (same sign as the intersection angle) and a 0-foot radius;

(3) the offset arc (a circular section comprised of the intersection angle and the offset radius);

(4) A circular section comprised of a $\pm \cos^{-1}(\text{turn radius}/\text{offset radius})$ degree angle (opposite sign as the intersection angle) and a 0-foot radius; and

(5) A tangent section.

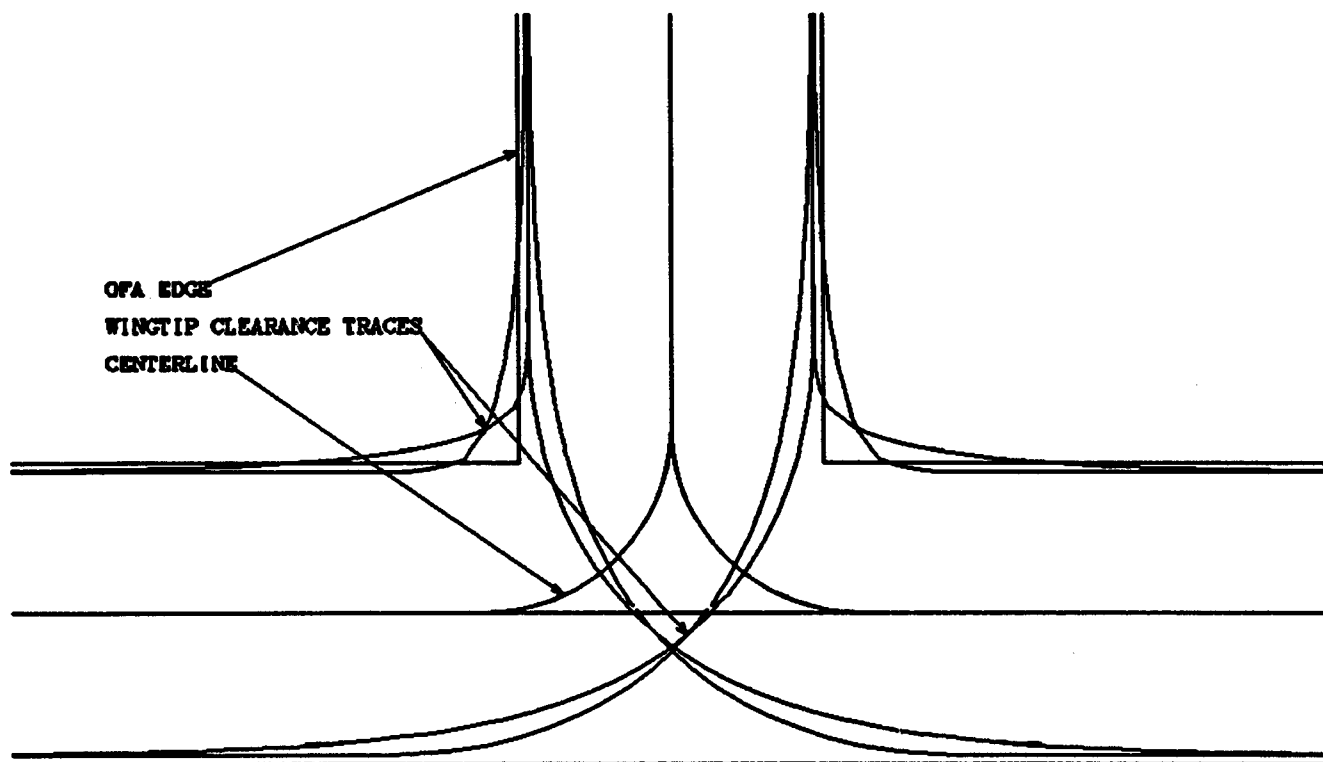


Figure A9-6. McDonnell-Douglas MD-88 wingtip clearance trace for a 100-foot (30.5 m) radius centerline

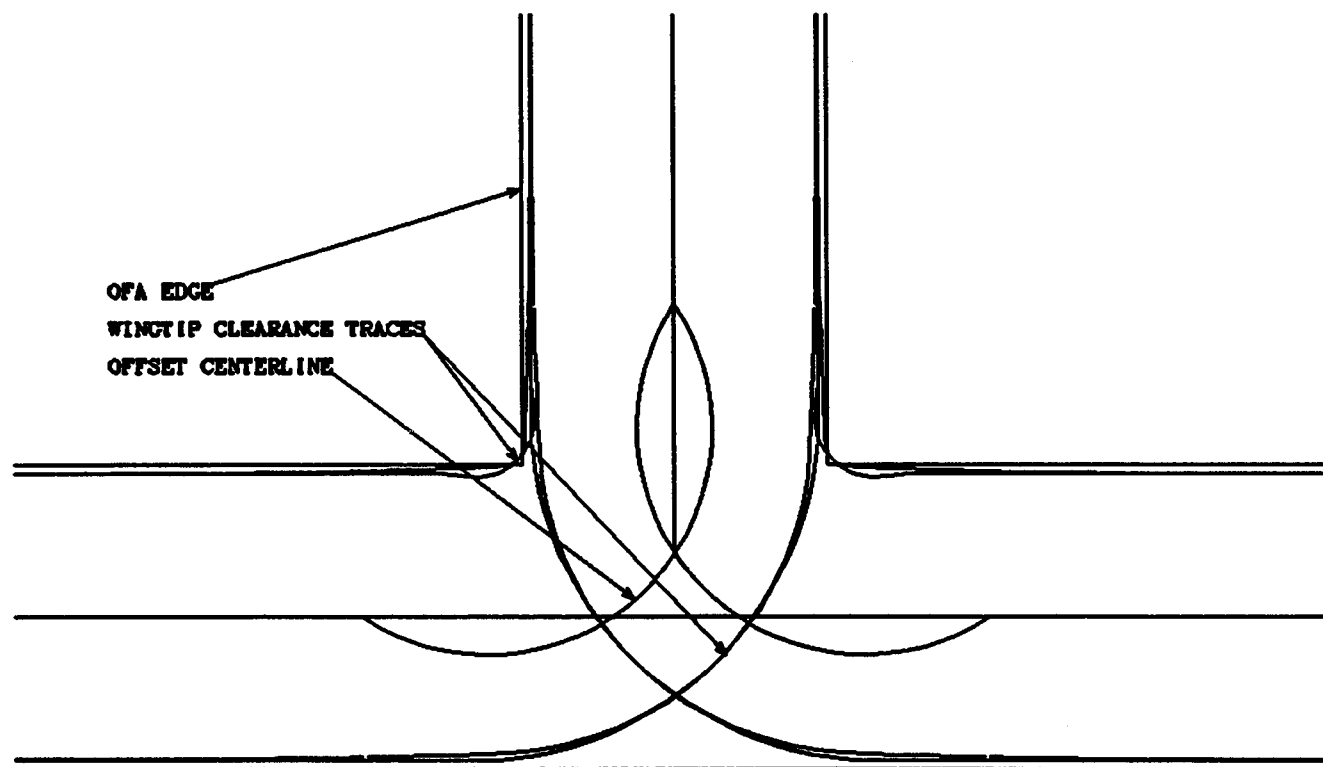


Figure A9-7. McDonnell-Douglas MD-88 wingtip clearance trace for a 120-foot (36.5 m) radius offset centerline

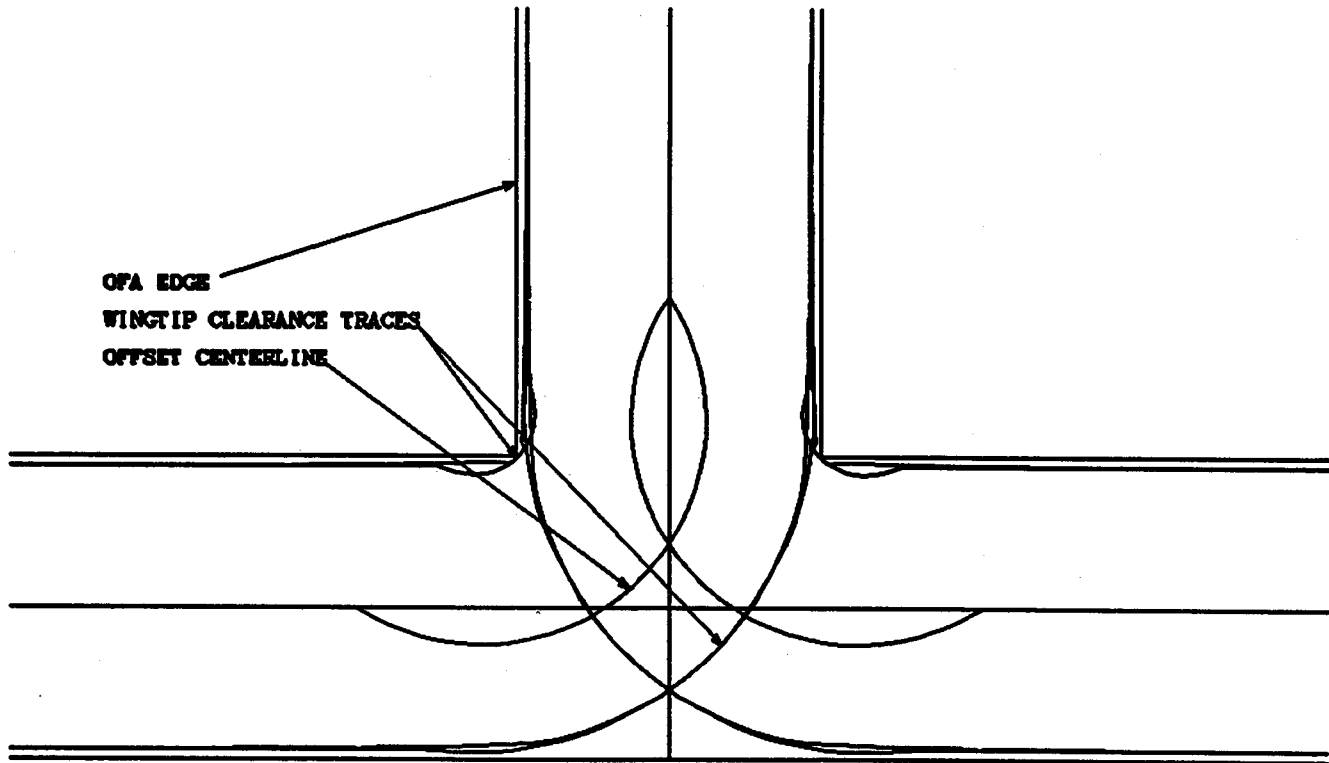


Figure A9-8. Boeing 727-200 wingtip clearance trace for a 120-foot (36.5 m) radius offset centerline

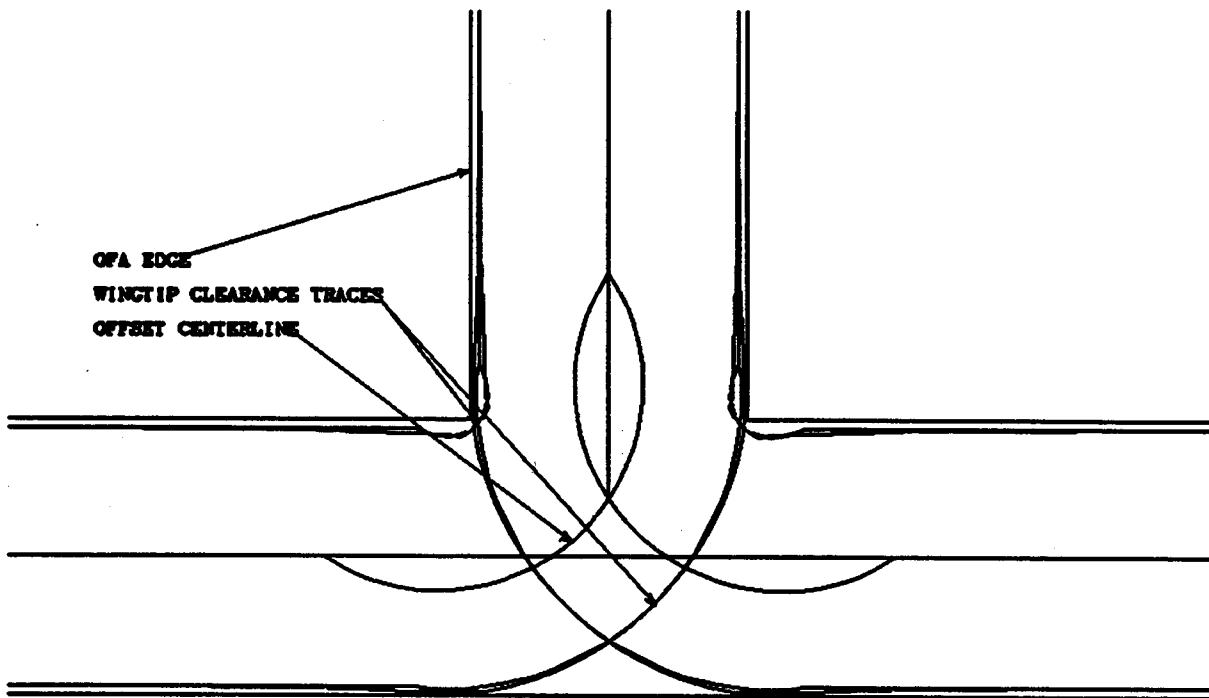


Figure A9-9. Boeing 727-100 wingtip clearance trace for a 120-foot (36.5 m) radius offset centerline

Appendix 10. TAXIWAY FILLET DESIGN

1. **INTRODUCTION.** This appendix details the methodology for the design of fillets for airport taxiways. This methodology is equally applicable for either the judgmental oversteering and the maintaining cockpit over centerline method of fillet design. The computer program cited in Appendix 11 computes these fillet dimensions for the maintaining cockpit over centerline method of fillet design. Figures A10-1 and A10-2 illustrate the terms and symbols used in the following equations:

a. **Angle A.** The angle formed by the tangent to the guideline and the longitudinal axis of airplane at point N.

(1) For R less than d:

$$A = 2 \tan^{-1} [x \tan(\tan^{-1}((\tan(.5A_o) - R/d)/x) + 28.648xS/R) + R/d]$$

(2) For R equal to d:

$$A = 2 \tan^{-1} [1/(1/(\tan(.5A_o) - 1) - .5S/R) + 1]$$

(3) For R greater than d:

$$A = 2 \tan^{-1} [y/(2/(1 - z) - 1) + R/d]$$

(4) For tangent section:

$$A = 2 \tan^{-1} [\tan(.5A_o)/2.7183^{S/d}]$$

b. **Angle A_{max}** Angle A with point N at the point of tangency (P.T.) or at the point of change of curvature (P.C.C.). At the end of a long curve:

$$A_{max} = \sin^{-1}(d/R)$$

c. **Angle A_o** Angle A with point N at the point of curvature (P.C.). The angle A_o at the end of a long tangent section is zero (0) degrees.

d. **Angle A_t** Angle A with point N at the point of tangency (P.T.).

e. **Nosewheel Steering Angle (B).** The angle the nosewheel makes with the longitudinal axis of the airplane. In the design of pavement fillets, check to ensure that the nosewheel steering angle does not exceed 50 degrees. If exceeded, choose a larger radius of arc (R).

$$B = \tan^{-1}[(w/d)\tan A]$$

$$B_{max} = \tan^{-1}[(w/d)\tan A_{max}]$$

f. **Airplane Datum Length (d).** The distance between point N and the center of the main undercarriage.

g. **Radius of Fillet Arc (F).** The radius of the fillet measured from the center of the taxiway longitudinal curvature (O). To provide an acceptable taxiway edge safety margin (M), the radius of fillet should be equal to or less than:

$$F = (R^2 + d^2 - 2Rd \sin A_{max})^{.5} - .5u - M$$

h. **Length of Lead-in to Fillet (L).** The distance from the P.T. to the end of the fillet. To provide an acceptable taxiway edge safety margin (M), the length of lead-in to the fillet should be equal to or greater than:

$$L = d\{\ln[4d \tan(.5A_o)/(W - u - 2M)]\} - d$$

i. **Taxiway Edge Safety Margin (M).** The minimum distance between the outside of the airplane wheels and the pavement edge. The minimum acceptable taxiway edge safety margin is given in table 4-1.

j. **Point N.** The point beneath the longitudinal axis of the airplane which tracks the guideline on the ground. Point N is located:

(1) For judgmental oversteering, beneath the longitudinal axis of the airplane at a distance from the center of the main undercarriage equal to the following. This distance provides a safety margin to compensate for the lack of positive guidance.

(a) Widening on only one side:

$$d = (R^2 - (R + .5W - 2M)^2 + w^2)^{.5}$$

(b) Widening symmetrical:

$$d = (R^2 - (2R - F - 2M)^2 + w^2)^{.5}$$

(2) For cockpit over centerline, beneath the cockpit of the airplane.

k. Radius of Arc (R). The radius of the arc at point N measured from center of curvature (O) to the point N.

l. Distance S. The distance from the P.C. to the point N along the arc for arc sections and from the P.T. to the point N along the tangent for tangent sections.

m. Undercarriage Width (u). The distance between the airplane's outer main wheels, including the width of the wheels. For airport design purposes, when the dimension "u" is not available, assume "u" to be 1.15 times the airplane's main gear track.

n. Wheelbase (w). The distance between the nosewheel and the center of the main undercarriage.

o. Taxiway Width (W). The taxiway pavement width on the tangent section. The taxiway width should be greater than the sum of the undercarriage width plus two times the acceptable taxiway edge safety margin (M).

p. Symbol x.

$$x = (1 - (R/d)^2)^5$$

q. Symbol y.

$$y = ((R/d)^2 - 1)^5$$

r. Symbol z.

$$z = 2.7183^{ySR} (R/d + y - \tan(.5A_o)) / (R/d - y - \tan(.5A_o))$$

2. EXAMPLE NO. 1, JUDGMENTAL OVERSTEERING. Given: Airplane wingspan 196 feet (59.7 m), wheelbase 84 feet (25.6 m), undercarriage width 41 feet (12.5 m), and R = 150 feet (45 m) for 180 degree turn. Taxiway width is 75 feet (23 m), fillet radius, widening on only one side, is 97 feet (29 m), and lead-in to fillet is 250 feet (75 m).

Step 1 - Acceptable M = 15.0 feet (4.5 m)

Step 2 - Calculate A_{max} = 27.3 degrees
(27.2 degrees)

Step 3 - Calculate B_{max} = 32.2 degrees
(32.6 degrees)

Step 4 - Calculate provided M = 15.8 feet
(4.8 m)

3. EXAMPLE NO. 2, MAINTAINING COCKPIT OVER CENTERLINE. Given: Airplane wingspan 196 feet (59.7 m), wheelbase 84 feet (25.6 m), distance between main undercarriage and cockpit 90 feet (27.4 m), undercarriage width 41 feet (12.5 m), and cockpit following R = 150 feet (45 m) for 180 degree turn. Taxiway width is 75 feet (22 m).

Step 1 - Acceptable M = 15.0 feet (4.5 m)

Step 2 - Calculate A_{max} = 36.4 degrees
(37.0 degrees)

Step 3 - Calculate B_{max} = 34.5 degrees
(35.1 degrees)

Step 4 - Calculate F_{max} = 85.2 feet (25.2 m)

Step 5 - Calculate L_{min} = 215 feet (60.2 m)

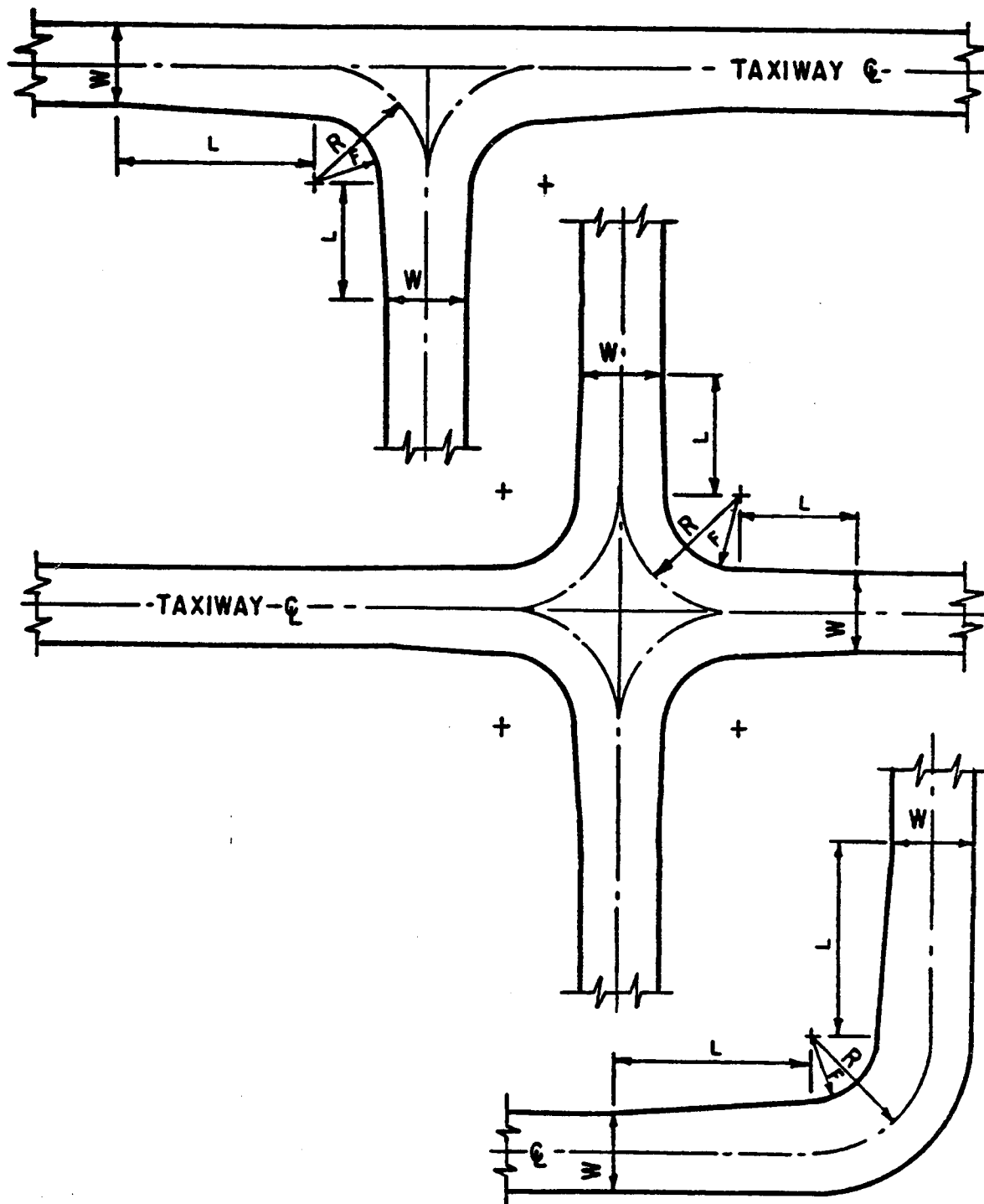


Figure A10-1. Taxiway intersection details

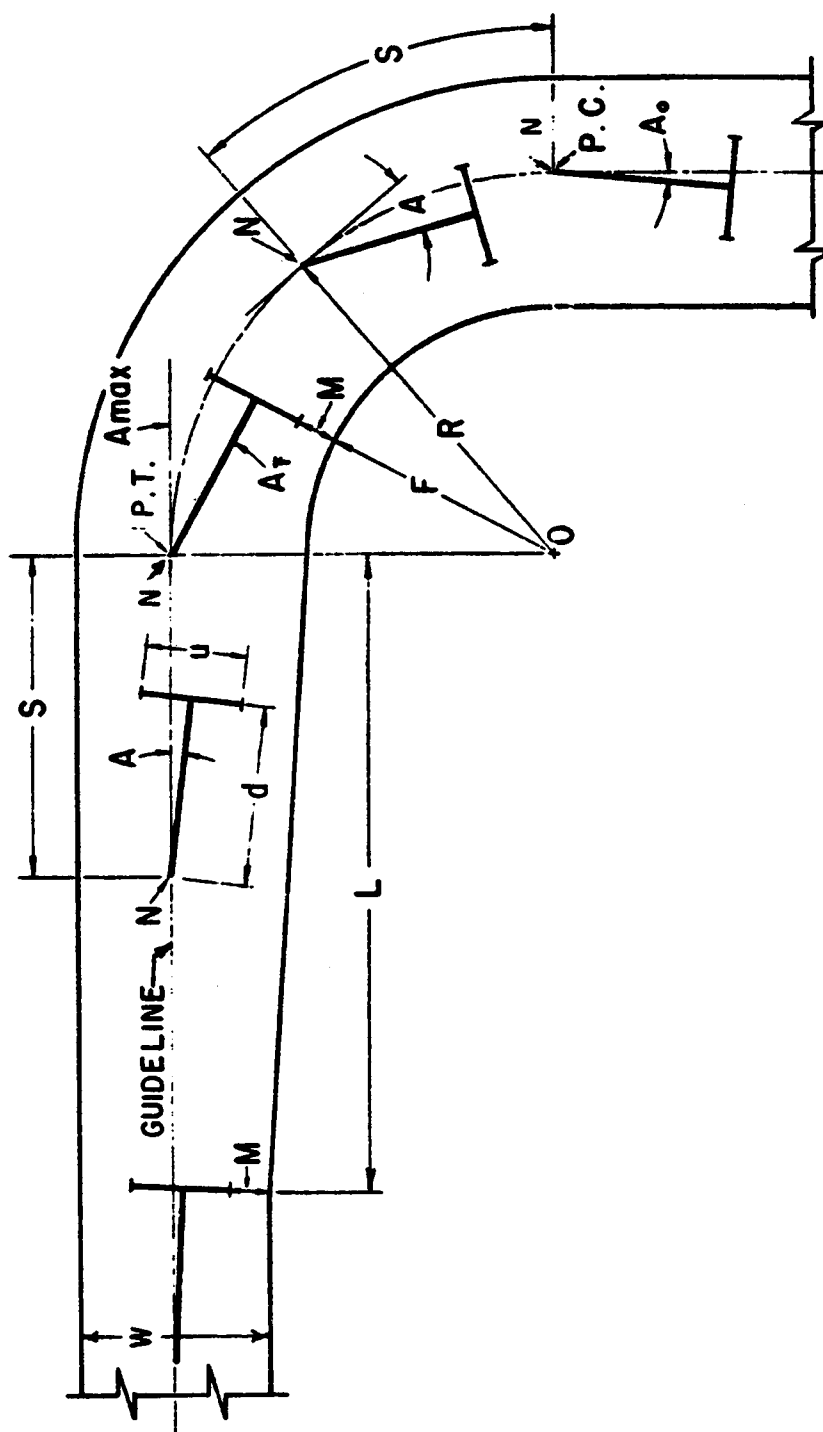


Figure A10-2. Depiction of symbols

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" (Climatology 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

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displays a one uni-directional runway configuration analysis printout.

a. To preform the wind analysis, select task 3 from the airport design task selection window, press Shift F3 to clear the wind data, and enter the wind data either from the keyboard, a DOS text file (retrieve by pressing F3), or a combination of both. Enter 60 knot tailwind component for bi-directional runways. Press F2 and enter the output file name to create a DOS text windrose file. Scroll to preview the entire file. Press F9 to create a windrose in the HP 7440A ColorPro plotter (HPGL) file format (PLT). Press Shift F9 to create a windrose in the Design CAD2D (formerly Prodesign II) file format (PD1). Press Alt F9 to create a windrose in the AutoCAD Drawing Interchange file format (DXF). Press <— or Esc to end the preview section. The PLT files are loadable into WordPerfect, Microsoft Word, and other CAD/CAM systems. The PD1 files are loadable into Design CAD2D or Prodesign II.

b. The DOS text file may have an unlimited number of lines with a maximum of 120 columns each.

(1) The first 80 columns of the third line contain the location name. The third, fourth, etc., words (numbers) of the fourth, fifth, and sixth lines are the runway orientations, the crosswind components, and the tailwind components of the first, second, etc., runways.

(2) Lines 12 through 48 are wind observation data. The first word is the wind direction, the second word is the number of 0-3 knot wind observations, the third word is the number of 4-6 knot wind observations, etc. For words which are not numbers or are omitted, the number of wind observations is zero. All other data are ignored. The WIND.PRN file in the Airport Design package is an example of this DOS text file.

c. Wind data in this FAA format on disk can be purchased from the National Climatic Data Center (NCDC), Federal Building, Asheville, NC 28801 at a cost of \$200.00 per summary plus an \$11.00 service and handling charge. A summary can be ordered with several tables. One table for each combination of all weather and various combinations of ceiling and visibility for monthly, seasonal, and annual periods, with 24 hourly and selected time-of-day observations. Ask for the wind data summary in the FAA format for use with the Airport Design Microcomputer Program. For details on availability, call (704) 254-6283 (CLIMATE).

10. **TAXIWAY DESIGN.** Task 4 from the airport design task selection window contains seven subtasks. Figure A11-10 and appendix 10 depict the nomenclature used in this task.

a. Subtask 1 calculates the data required for laying out circular and spiral curves by the offset method. To calculate this data, select subtask 1, the type of section, and update the data items. Due to the redundance in data items, more than one datum item may change with each data entry; the number of * after the data items define which data items will change to accommodate the new entry. When the data items are updated, press F2, enter the station interval and the file name, preview the output file, and press <— or Esc to end the preview.

b. Subtasks 2 through 5 calculate the offset distances from centerline to edge of pavement or object using the maintaining cockpit over centerline or the nosewheel on centerline method of pavement fillet design.

(1) To calculate the offset distances, select a subtask (2 through 5) and define the design airplane and conditions at the entrance of station 1 by updating the data items. The steering angle is the angle formed by the tangent to the guideline (centerline marking or lighting) and the longitudinal axis of the airplane. Angle A on figure A10-2 depicts the steering angle. All longitudinal distances are measured parallel to the airplane's longitudinal axis. Press F10 when the data items are updated.

(2) Subdivide the taxiway/taxilane centerline into sections (tangent, circular, and spiral). Select the type of section 1 and update the data items for section 1. Except for the last section, press F10 when the data items are updated. For the last section, press F2 when the data items are updated. When F10 is pressed, select the type of the next section and update the data items for that section. When F2 is pressed, enter the station interval and the file name, preview the output file, and press <— or Esc to end the preview.

c. Subtask 6 creates a HP 7440A ColorPro plotter (HPGL) offset distance file with a PLT extension. To create this file, select subtask 6, retrieve a file created with subtask 2 through 5, enter the output file name, and press <— or Esc to end the preview section. The HPGL files are loadable into WordPerfect, Microsoft Word, and other CAD/CAM systems.

d. Subtask 7 creates a Design CAD2D offset distance file with a PD1 extension. To create this file, select subtask 7, retrieve a file created with subtask 2 through 5, enter the output file name, and press <— or

Esc to end the preview section. The PD1 file are loadable into Design CAD2D or Prodesign II.

e. Subtasks 8, 9, and 0 create DOS text files of the centerline, left offset, and right offset X, Y coordinates. To create these files, select subtask 8, 9, or 0, retrieve a file created with subtask 2 through 5, enter the output file name, and press <—| or Esc to end the preview section.

f. Subtask A creates a file in the AutoCAD Drawing Interchange file format (DXF) from a subtask 2 through 5 file. To create this file, select subtask A, retrieve a file created with subtask 2 through 5, enter the output file name, and press <—| or Esc to end the preview section.

g. To familiarize yourself with the taxiway design task, design the taxiway pavement fillet depicted in figure 4-4 and the exit taxiway depicted in figure 4-13.

11. AIRPORT CAPACITY AND DELAY FOR LONG RANGE PLANNING. Task 5 from the airport capacity and delay for long range planning task selection window approximates the airport capacity and delay. Press F2 to save the approximations. Refer to AC 150/5060-5, Airport Capacity and Delay, for details on airport capacity and delay. Import graphics file HELPE.PLT or HELPM.PLT into WordPerfect or Microsoft Word and print to obtain a hard copy of the runway-use configuration sketches.

12. DECLARED DISTANCE LENGTHS. Task 6 from the airport design task selection window calculates the declared distance lengths. See appendix 14 for details on declared distances. Declared distance lengths may be calculated for standard or modified RSA and ROFA lengths. Press W within task 6 to alternate between the standard and the modified RSA and ROFA lengths applications. Figure A11-11 depicts the nomenclature used in this task.

a. The declared distance lengths obtained from the standard RSA and ROFA lengths application are displayed to scale on the screen except for the ARC C-III and D-III runway widths, and the ARC D-1 through D-VI+ RSA widths. Go to task 1 and enter the 150,000 pounds (68 100 kg) weight entry to display the ADG C-III and D-III runway width to scale and enter the airport elevation to display the ADG D-I through D-VI+ RSA width to scale.

b. The declared distance lengths obtained from the modified RSA and ROFA lengths are displayed to scale by setting items A through D for the standard RSA

and ROFA length application, as above, and then switching to the modified RSA and ROFA length application.

c. The dashed lines display the clearway. When present, the clearway extends between the TORA far end and the TODA far end. (The dotted lines display FAR Part 77 primary and approach surfaces and are provided for informational purposes only. The primary surface extends out to 200 feet (60 m) beyond the runway ends or out to the far ends of TODA, whichever is further.)

d. Items A through D on the modified RSA and ROFA lengths application. Enter the RSA and ROFA lengths which will exist beyond the end of the ASDA and the LDA when the ASDA and the LDA end at or prior to the end of the runway or the RSA and ROFA lengths which will exist beyond the end of ASDA when the LDA terminates at the runway end and the ASDA extends onto a stopway.

e. Item E. Enter the runway length from runway end to runway end. The area behind a threshold which is used for TORA in at least one direction or for LDA from the opposite direction is runway. The area behind a threshold which is used for ASDA from the opposite direction is either runway or stopway. The area behind a threshold which is used for TODA from the opposite direction is runway and/or clearway. The clearway may be located above a runway or stopway. The runway length is the same for both directions.

f. Items F and G. Enter 0 feet for runway ends without a stopway.

g. Items H and I. Enter 0 feet for runway ends without a clearway.

h. Items N and O. Enter 0 feet for runway ends without displaced threshold.

i. Items P and Q. Enter 0 feet for runway ends without displaced start of takeoff.

j. Items R and S. Enter 0 feet for runways without displaced clearway. Items R and S may not be longer than the clearway length items H and I.

k. Items T and U. Enter a negative (-) distance for runways extending into the departure runway protection zone (RPZ).

13. INPUT AIRPLANE DATA AVAILABILITY. Figure A11-2 provides estimated airplane data for which calculated data is not available in appendixes 12 or 13.

Figure A11-1. THIS FIGURE INTENTIONALLY LEFT BLANK

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| <u>Airplane</u> | <u>Airport</u> Reference Code | <u>OFZ-N</u> | | <u>OFZ-CL</u> | | <u>C-NG</u> | | <u>MU-W</u> | |
|-------------------|-------------------------------------|--------------|------|---------------|-------|-------------|-------|-------------|-------|
| | | feet | (m) | feet | (m) | feet | (m) | feet | (m) |
| A 300-600 | C-IV | 19.4 | 5.91 | 54.7 | 16.67 | 13.3 | 4.05 | 23.8 | 7.25 |
| A 320 | C-III | 14.5 | 4.42 | 39.1 | 11.92 | 8.5 | 2.59 | 14.5 | 4.42 |
| ATR-42,-200,-300 | B-III | 7.8 | 2.38 | 27.0 | 8.23 | -1.0 | -0.30 | 1.4 | 0.43 |
| BAe 146-100 | B-III | 9.0 | 2.74 | 33.2 | 10.12 | -2.5 | -0.76 | 6.2 | 1.89 |
| Beechcraft 95 | B-I | 4.7 | 1.43 | 10.1 | 3.08 | -5.6 | -1.71 | 1.5 | 0.46 |
| Beechcraft 1900 | B-II | 6.2 | 1.89 | 18.0 | 5.49 | -7.3 | -2.23 | 0.5 | 0.15 |
| Beechcraft C99 | B-I | 5.2 | 1.58 | 14.4 | 4.39 | -10.4 | -3.17 | 1.0 | 0.30 |
| Boeing 707-320 | C-IV | 13.0 | 3.96 | 42.1 | 12.83 | 10.0 | 3.05 | 31.8 | 9.69 |
| Boeing 727-200 | C-III | 12.0 | 3.66 | 38.0 | 11.58 | 6.9 | 2.10 | 21.5 | 6.55 |
| Boeing 737-200 | C-III | 11.8 | 3.60 | 37.3 | 11.37 | 4.8 | 1.46 | 13.4 | 4.08 |
| Boeing 747-400 | D-V | 25.4 | 7.74 | 64.3 | 19.60 | 7.7 | 2.35 | 57.5 | 17.53 |
| Boeing 747-SP | C-V | 24.9 | 7.59 | 65.8 | 20.10 | 5.0 | 1.52 | 54.0 | 16.46 |
| Boeing 757-200 | C-IV | 17.0 | 5.18 | 45.1 | 13.75 | 12.0 | 3.66 | 17.0 | 5.18 |
| Boeing 767-200 | C-IV | 18.5 | 5.64 | 52.9 | 16.12 | 7.5 | 2.29 | 28.8 | 8.78 |
| Boeing 767-300 | C-IV | 18.5 | 5.64 | 52.6 | 16.03 | 7.5 | 2.29 | 28.8 | 8.78 |
| C-130 H | C-IV | 10.9 | 3.32 | 39.4 | 12.01 | 3.1 | 0.94 | 3.3 | 1.01 |
| CASA CN-235 | B-III | 8.3 | 2.53 | 26.8 | 8.17 | 1.3 | 0.40 | 2.1 | 0.64 |
| Dash 7 | A-III | 7.5 | 2.29 | 31.0 | 9.45 | -2.3 | -0.70 | 1.7 | 0.52 |
| Dash 8-300 | A-III | 7.5 | 2.29 | 28.9 | 8.81 | -3.4 | -1.04 | 2.1 | 0.64 |
| DC-8-43 | C-IV | 13.4 | 4.08 | 43.4 | 13.23 | 6.0 | 1.83 | 26.7 | 8.14 |
| DC-8-55 | C-IV | 13.4 | 4.08 | 43.4 | 13.23 | 6.0 | 1.83 | 26.7 | 8.14 |
| DC-8-63/73 | D-IV | 13.4 | 4.08 | 43.0 | 13.11 | 6.0 | 1.83 | 26.7 | 8.14 |
| DC-9-32 | C-III | 10.7 | 3.26 | 31.0 | 9.45 | -2.0 | -0.61 | 11.5 | 3.51 |
| DC-10-10 | C-IV | 18.0 | 5.49 | 58.4 | 17.80 | 20.9 | 6.37 | 32.8 | 10.00 |
| Embraer EMB-110 | B-II | 6.9 | 2.10 | 16.5 | 5.03 | -2.0 | -0.61 | 1.5 | 0.46 |
| Fokker F-27,-200 | B-III | 7.6 | 2.32 | 28.7 | 8.75 | -4.1 | -1.25 | 2.0 | 0.61 |
| Fokker F-28,-3000 | C-III | 11.3 | 3.44 | 30.2 | 9.20 | 4.4 | 1.34 | 9.8 | 2.99 |
| Gulfstream III | D-II | 10.2 | 3.11 | 29.2 | 8.90 | -1.5 | -0.46 | 13.2 | 4.02 |
| JetStar II | C-II | 6.6 | 2.01 | 20.4 | 6.22 | 6.0 | 1.83 | 9.5 | 2.90 |
| L-1011-1,-100,-20 | C-IV | 20.4 | 6.22 | 55.8 | 17.01 | 21.9 | 6.68 | 36.6 | 11.16 |
| L-1011-500 | D-IV | 20.4 | 6.22 | 55.8 | 17.01 | 21.9 | 6.68 | 28.8 | 8.78 |
| MD-11 | D-IV | 21.3 | 6.49 | 58.8 | 17.92 | 20.9 | 6.37 | 38.9 | 11.86 |
| MD-81,-82,-83,-88 | C-III | 9.8 | 2.99 | 34.2 | 10.42 | -1.8 | -0.55 | 13.8 | 4.21 |
| MD-87 | C-III | 10.4 | 3.17 | 34.8 | 10.61 | -1.8 | -0.55 | 15.0 | 4.57 |
| SAAB/Fairchild | B-II | 9.1 | 2.77 | 21.7 | 6.61 | -0.9 | -0.27 | 2.2 | 0.67 |
| SAAB SF 340 A | B-II | 8.8 | 2.68 | 23.3 | 7.10 | -1.5 | -0.46 | 2.0 | 0.61 |
| Shorts 330-200 | B-II | 6.6 | 2.01 | 19.4 | 5.91 | -2.1 | -0.64 | 2.5 | 0.76 |
| Shorts 360-300 | B-II | 6.3 | 1.92 | 23.8 | 7.25 | -2.0 | -0.61 | 3.0 | 0.91 |
| Westwind 1124 | C-I | 7.0 | 2.13 | 15.8 | 4.82 | -4.3 | -1.31 | 4.4 | 1.34 |

OFZ-N: OFZ height at nose of airplane holding clear of OFZ (airplane perpendicular to runway centerline).

OFZ-CL: OFZ height at centerline of airplane taxiing clear of OFZ (airplane parallel to runway centerline).

C-NG: Center of airplane cockpit to nosewheel.

MU-W: Longitudinal distance from main undercarriage to wingtip.

Figure A11-2. Estimated airplane data elements for input in the computer program

| N RUNWAY AND TAXIWAY WIDTH AND CLEARANCE STANDARD DIMENSIONS | |
|---|--|
| AIRPORT DESIGN AIRPLANE AND AIRPORT DATA | |
| A | Aircraft Approach Category C |
| B | Airplane Design Group III |
| C | Airplane wingspan 107.85 feet |
| D | Primary runway end is precision instrument 1/2 statute mile or less |
| E | Other runway end is visual |
| G | Airplane maximum certificated takeoff weight is over 150,000 lbs |
| H | Airplane wheelbase is less than 60 feet |
| I | Airplane undercarriage width (1.15 x main gear track) 19.17 feet |
| J | Airport elevation 0 feet |
| K | Airplane tail height 30.00 feet |
| F2 Calculate airport design standard dimensions for the above airport | |

Figure A11-3. Example of the airport design airplane and airport data window

| AIRPORT DESIGN AIRPLANE AND AIRPORT DATA | |
|---|--------------------|
| Aircraft Approach Category C | |
| Airplane Design Group III | |
| Airplane wingspan | 107.85 feet |
| Primary runway end is precision instrument 1/2-statute mile or less | |
| Other runway end is visual | |
| Airplane maximum certificated takeoff weight is over 150,000 lbs | |
| Airplane wheelbase is less than 60 feet | |
| Airplane undercarriage width (1.15 x main gear track) | 19.17 feet |
| Airport elevation | 0 feet |
| Airplane tail height | 30.00 feet |
| RUNWAY AND TAXIWAY WIDTH AND CLEARANCE STANDARD DIMENSIONS | |
| | Airplane Group/ARC |
| Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is not treated as a factor: | |
| VFR operations | 700 feet |
| VFR operations with intervening taxiway | 800 feet |
| VFR operations with two intervening taxiways | 952 feet |
| IFR approach and departure with approach to near threshold 2500 feet less 100 ft for each 500 ft of threshold stagger to a minimum of 1000 ft. | |
| Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is a factor: | |
| VFR operations | 2500 feet |
| IFR departures | 2500 feet |
| IFR approach and departure with approach to near threshold | 2500 feet |
| IFR approach and departure with approach to far threshold 2500 feet plus 100 feet for each 500 feet of threshold stagger. | |
| IFR approaches | 3400 feet |
| Runway centerline to parallel taxiway/taxilane centerline | 303.9 400 feet |
| Runway centerline to edge of aircraft parking | 400.0 500 feet |

Figure A11-4. Example printout of width and clearance standard dimensions page 1

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| | | |
|--|-------|----------|
| Taxiway centerline to parallel taxiway/taxilane centerline | 139.4 | 152 feet |
| Taxiway centerline to fixed or movable object | 85.5 | 93 feet |
| Taxilane centerline to parallel taxilane centerline | 128.6 | 140 feet |
| Taxilane centerline to fixed or movable object | 74.7 | 81 feet |

Runway protection zone at the primary runway end:

| | |
|---------------------------------|-----------|
| Length | 2500 feet |
| Width 200 feet from runway end | 1000 feet |
| Width 2700 feet from runway end | 1750 feet |

Runway protection zone at other runway end:

| | |
|---------------------------------|-----------|
| Length | 1000 feet |
| Width 200 feet from runway end | 1000 feet |
| Width 1200 feet from runway end | 1100 feet |

Departure runway protection zone:

| | |
|--|-----------|
| Length | 1700 feet |
| Width 200 feet from the far end of TORA | 500 feet |
| Width 1900 feet from the far end of TORA | 1010 feet |

| | | |
|--|-------|----------|
| Runway obstacle free zone (OFZ) width | 400.0 | 400 feet |
| Runway obstacle free zone length beyond each runway end | | 200 feet |
| Approach obstacle free zone width | 400.0 | 400 feet |
| Approach obstacle free zone length beyond approach light system | | 200 feet |
| Approach obstacle free zone slope from 200 feet beyond threshold | | 50:1 |
| Inner-transitional surface obstacle free zone slope | | 3:1 |

| | |
|---|-----------|
| Runway width | 150 feet |
| Runway shoulder width | 25 feet |
| Runway blast pad width | 200 feet |
| Runway blast pad length | 200 feet |
| Runway safety area width | 500 feet |
| Runway safety area length beyond each runway end or stopway end, whichever is greater | 1000 feet |
| Runway object free area width | 800 feet |
| Runway object free area length beyond each runway end or stopway end, whichever is greater | 1000 feet |
| Clearway width | 500 feet |
| Stopway width | 150 feet |

| | | |
|---------------------------------|-------|----------|
| Taxiway width | 39.2 | 50 feet |
| Taxiway edge safety margin | | 10 feet |
| Taxiway shoulder width | | 20 feet |
| Taxiway safety area width | 107.8 | 118 feet |
| Taxiway object free area width | 171.0 | 186 feet |
| Taxilane object free area width | 149.4 | 162 feet |
| Taxiway wingtip clearance | 31.6 | 34 feet |
| Taxilane wingtip clearance | 20.8 | 22 feet |

Threshold surface at primary runway end:

| | |
|--|------------|
| Distance out from threshold to start of surface | 200 feet |
| Width of surface at start of trapezoidal section | 1000 feet |
| Width of surface at end of trapezoidal section | 4000 feet |
| Length of trapezoidal section | 10000 feet |
| Length of rectangular section | 0 feet |
| Slope of surface | 34:1 |

Threshold surface at other runway end:

| | |
|--|-----------|
| Distance out from threshold to start of surface | 0 feet |
| Width of surface at start of trapezoidal section | 400 feet |
| Width of surface at end of trapezoidal section | 1000 feet |
| Length of trapezoidal section | 1500 feet |
| Length of rectangular section | 8500 feet |
| Slope of surface | 20:1 |

REFERENCE: AC 150/5300-13, AIRPORT DESIGN.

Figure A11-5. Example printout of width and clearance standard dimensions page 2

WIND OBSERVATIONS

STATION: ANYWHERE, USA
 RUNWAY ORIENTATION: 105.00 195.00 DEGREE
 CROSSWIND COMPONENT: 10.50 10.50 KNOTS
 TAILWIND COMPONENT: 60.00 60.00 KNOTS
 WIND COVERAGE: 98.84 %

| | HOURLY OBSERVATIONS OF WIND SPEED (KNOTS) | | | | | | | | 41 OVER | TOTAL |
|--------|---|-------|-------|-------|-------|-------|-------|-------|------------|-------|
| | 0-3 | 4-6 | 7-10 | 11-16 | 17-21 | 22-27 | 28-33 | 34-40 | | |
| | DIRECTION | | | | | | | | | |
| 1 | 469 | 842 | 568 | 212 | 0 | 0 | 0 | 0 | 0 | 2091 |
| 2 | 568 | 1263 | 820 | 169 | 0 | 0 | 0 | 0 | 0 | 2820 |
| 3 | 294 | 775 | 519 | 73 | 9 | 0 | 0 | 0 | 0 | 1670 |
| 4 | 317 | 872 | 509 | 62 | 11 | 0 | 0 | 0 | 0 | 1771 |
| 5 | 268 | 861 | 437 | 106 | 0 | 0 | 0 | 0 | 0 | 1672 |
| 6 | 357 | 534 | 151 | 42 | 8 | 0 | 0 | 0 | 0 | 1092 |
| 7 | 369 | 403 | 273 | 84 | 36 | 10 | 0 | 0 | 0 | 1175 |
| 8 | 158 | 261 | 138 | 69 | 73 | 52 | 41 | 22 | 0 | 814 |
| 9 | 167 | 352 | 176 | 128 | 68 | 59 | 21 | 0 | 0 | 971 |
| 10 | 119 | 303 | 127 | 180 | 98 | 41 | 9 | 0 | 0 | 877 |
| 11 | 323 | 586 | 268 | 312 | 111 | 23 | 28 | 0 | 0 | 1651 |
| 12 | 618 | 1397 | 624 | 779 | 271 | 69 | 21 | 0 | 0 | 3779 |
| 13 | 472 | 1375 | 674 | 531 | 452 | 67 | 0 | 0 | 0 | 3571 |
| 14 | 647 | 1377 | 574 | 281 | 129 | 0 | 0 | 0 | 0 | 3008 |
| 15 | 338 | 1093 | 348 | 135 | 27 | 0 | 0 | 0 | 0 | 1941 |
| 16 | 560 | 1399 | 523 | 121 | 19 | 0 | 0 | 0 | 0 | 2622 |
| 17 | 587 | 883 | 469 | 128 | 12 | 0 | 0 | 0 | 0 | 2079 |
| 18 | 1046 | 1984 | 1068 | 297 | 83 | 18 | 0 | 0 | 0 | 4496 |
| 19 | 499 | 793 | 586 | 241 | 92 | 0 | 0 | 0 | 0 | 2211 |
| 20 | 371 | 946 | 615 | 243 | 64 | 0 | 0 | 0 | 0 | 2239 |
| 21 | 340 | 732 | 528 | 323 | 147 | 8 | 0 | 0 | 0 | 2078 |
| 22 | 479 | 768 | 603 | 231 | 115 | 38 | 19 | 0 | 0 | 2253 |
| 23 | 187 | 1008 | 915 | 413 | 192 | 0 | 0 | 0 | 0 | 2715 |
| 24 | 458 | 943 | 800 | 453 | 96 | 11 | 18 | 0 | 0 | 2779 |
| 25 | 351 | 899 | 752 | 297 | 102 | 21 | 9 | 0 | 0 | 2431 |
| 26 | 368 | 731 | 379 | 208 | 53 | 0 | 0 | 0 | 0 | 1739 |
| 27 | 411 | 748 | 469 | 232 | 118 | 19 | 0 | 0 | 0 | 1997 |
| 28 | 191 | 554 | 276 | 287 | 118 | 0 | 0 | 0 | 0 | 1426 |
| 29 | 271 | 642 | 548 | 479 | 143 | 17 | 0 | 0 | 0 | 2100 |
| 30 | 379 | 873 | 526 | 543 | 208 | 34 | 0 | 0 | 0 | 2563 |
| 31 | 299 | 643 | 597 | 618 | 222 | 19 | 0 | 0 | 0 | 2398 |
| 32 | 397 | 852 | 521 | 559 | 158 | 23 | 0 | 0 | 0 | 2510 |
| 33 | 236 | 721 | 324 | 238 | 48 | 0 | 0 | 0 | 0 | 1567 |
| 34 | 280 | 916 | 845 | 307 | 24 | 0 | 0 | 0 | 0 | 2372 |
| 35 | 252 | 931 | 918 | 487 | 23 | 0 | 0 | 0 | 0 | 2611 |
| 36 | 501 | 1568 | 1381 | 569 | 27 | 0 | 0 | 0 | 0 | 4046 |
| 0 | 7729 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7729 |
| TOTAL: | 21676 | 31828 | 19849 | 10437 | 3357 | 529 | 166 | 22 | 0 | 87864 |

Figure A11-6. Example printout of wind analysis (two bi-directional runways)

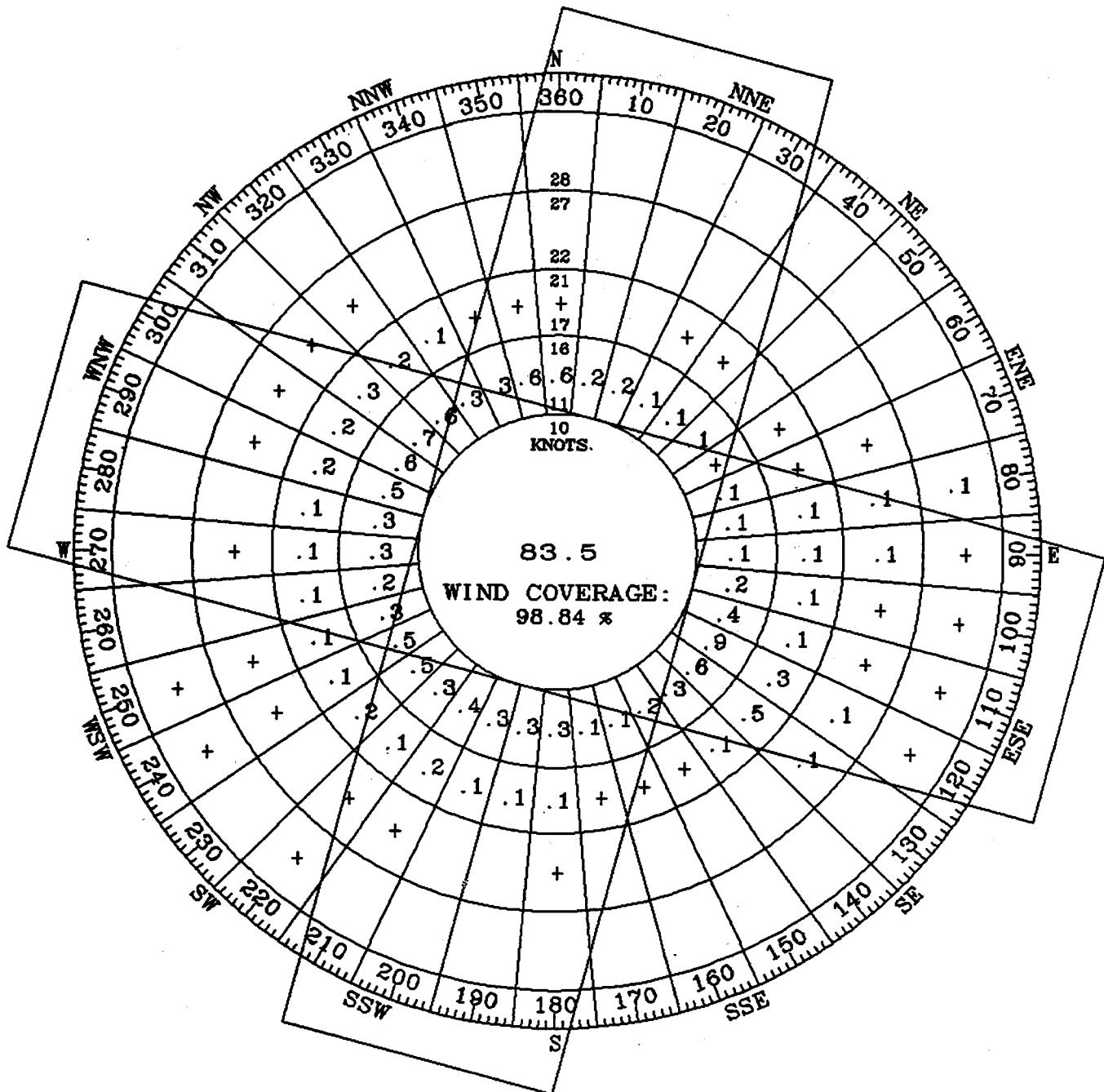


Figure A11-7. Example printout of windrose (two bi-directional runways)

WIND OBSERVATIONS

STATION: ANYWHERE, USA
 RUNWAY ORIENTATION: 105.00 DEGREE
 CROSSWIND COMPONENT: 13.00 KNOTS
 TAILWIND COMPONENT: 5.00 KNOTS
 WIND COVERAGE: 80.41 %

| | HOURLY OBSERVATIONS OF WIND SPEED (KNOTS) | | | | | | | | 41 OVER | TOTAL |
|--------|---|-------|-------|-------|-------|-------|-------|-------|------------|-------|
| | 0-3 | 4-6 | 7-10 | 11-16 | 17-21 | 22-27 | 28-33 | 34-40 | | |
| | DIRECTION | | | | | | | | | |
| 1 | 469 | 842 | 568 | 212 | 0 | 0 | 0 | 0 | 0 | 2091 |
| 2 | 568 | 1263 | 820 | 169 | 0 | 0 | 0 | 0 | 0 | 2820 |
| 3 | 294 | 775 | 519 | 73 | 9 | 0 | 0 | 0 | 0 | 1670 |
| 4 | 317 | 872 | 509 | 62 | 11 | 0 | 0 | 0 | 0 | 1771 |
| 5 | 268 | 861 | 437 | 106 | 0 | 0 | 0 | 0 | 0 | 1672 |
| 6 | 357 | 534 | 151 | 42 | 8 | 0 | 0 | 0 | 0 | 1092 |
| 7 | 369 | 403 | 273 | 84 | 36 | 10 | 0 | 0 | 0 | 1175 |
| 8 | 158 | 261 | 138 | 69 | 73 | 52 | 41 | 22 | 0 | 814 |
| 9 | 167 | 352 | 176 | 128 | 68 | 59 | 21 | 0 | 0 | 971 |
| 10 | 119 | 303 | 127 | 180 | 98 | 41 | 9 | 0 | 0 | 877 |
| 11 | 323 | 586 | 268 | 312 | 111 | 23 | 28 | 0 | 0 | 1651 |
| 12 | 618 | 1397 | 624 | 779 | 271 | 69 | 21 | 0 | 0 | 3779 |
| 13 | 472 | 1375 | 674 | 531 | 452 | 67 | 0 | 0 | 0 | 3571 |
| 14 | 647 | 1377 | 574 | 281 | 129 | 0 | 0 | 0 | 0 | 3008 |
| 15 | 338 | 1093 | 348 | 135 | 27 | 0 | 0 | 0 | 0 | 1941 |
| 16 | 560 | 1399 | 523 | 121 | 19 | 0 | 0 | 0 | 0 | 2622 |
| 17 | 587 | 883 | 469 | 128 | 12 | 0 | 0 | 0 | 0 | 2079 |
| 18 | 1046 | 1984 | 1068 | 297 | 83 | 18 | 0 | 0 | 0 | 4496 |
| 19 | 499 | 793 | 586 | 241 | 92 | 0 | 0 | 0 | 0 | 2211 |
| 20 | 371 | 946 | 615 | 243 | 64 | 0 | 0 | 0 | 0 | 2239 |
| 21 | 340 | 732 | 528 | 323 | 147 | 8 | 0 | 0 | 0 | 2078 |
| 22 | 479 | 768 | 603 | 231 | 115 | 38 | 19 | 0 | 0 | 2253 |
| 23 | 187 | 1008 | 915 | 413 | 192 | 0 | 0 | 0 | 0 | 2715 |
| 24 | 458 | 943 | 800 | 453 | 96 | 11 | 18 | 0 | 0 | 2779 |
| 25 | 351 | 899 | 752 | 297 | 102 | 21 | 9 | 0 | 0 | 2431 |
| 26 | 368 | 731 | 379 | 208 | 53 | 0 | 0 | 0 | 0 | 1739 |
| 27 | 411 | 748 | 469 | 232 | 118 | 19 | 0 | 0 | 0 | 1997 |
| 28 | 191 | 554 | 276 | 287 | 118 | 0 | 0 | 0 | 0 | 1426 |
| 29 | 271 | 642 | 548 | 479 | 143 | 17 | 0 | 0 | 0 | 2100 |
| 30 | 379 | 873 | 526 | 543 | 208 | 34 | 0 | 0 | 0 | 2563 |
| 31 | 299 | 643 | 597 | 618 | 222 | 19 | 0 | 0 | 0 | 2398 |
| 32 | 397 | 852 | 521 | 559 | 158 | 23 | 0 | 0 | 0 | 2510 |
| 33 | 236 | 721 | 324 | 238 | 48 | 0 | 0 | 0 | 0 | 1567 |
| 34 | 280 | 916 | 845 | 307 | 24 | 0 | 0 | 0 | 0 | 2372 |
| 35 | 252 | 931 | 918 | 487 | 23 | 0 | 0 | 0 | 0 | 2611 |
| 36 | 501 | 1568 | 1381 | 569 | 27 | 0 | 0 | 0 | 0 | 4046 |
| 0 | 7729 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7729 |
| TOTAL: | 21676 | 31828 | 19849 | 10437 | 3357 | 529 | 166 | 22 | 0 | 87864 |

Figure A11-8. Example printout of wind analysis (one uni-directional runway)

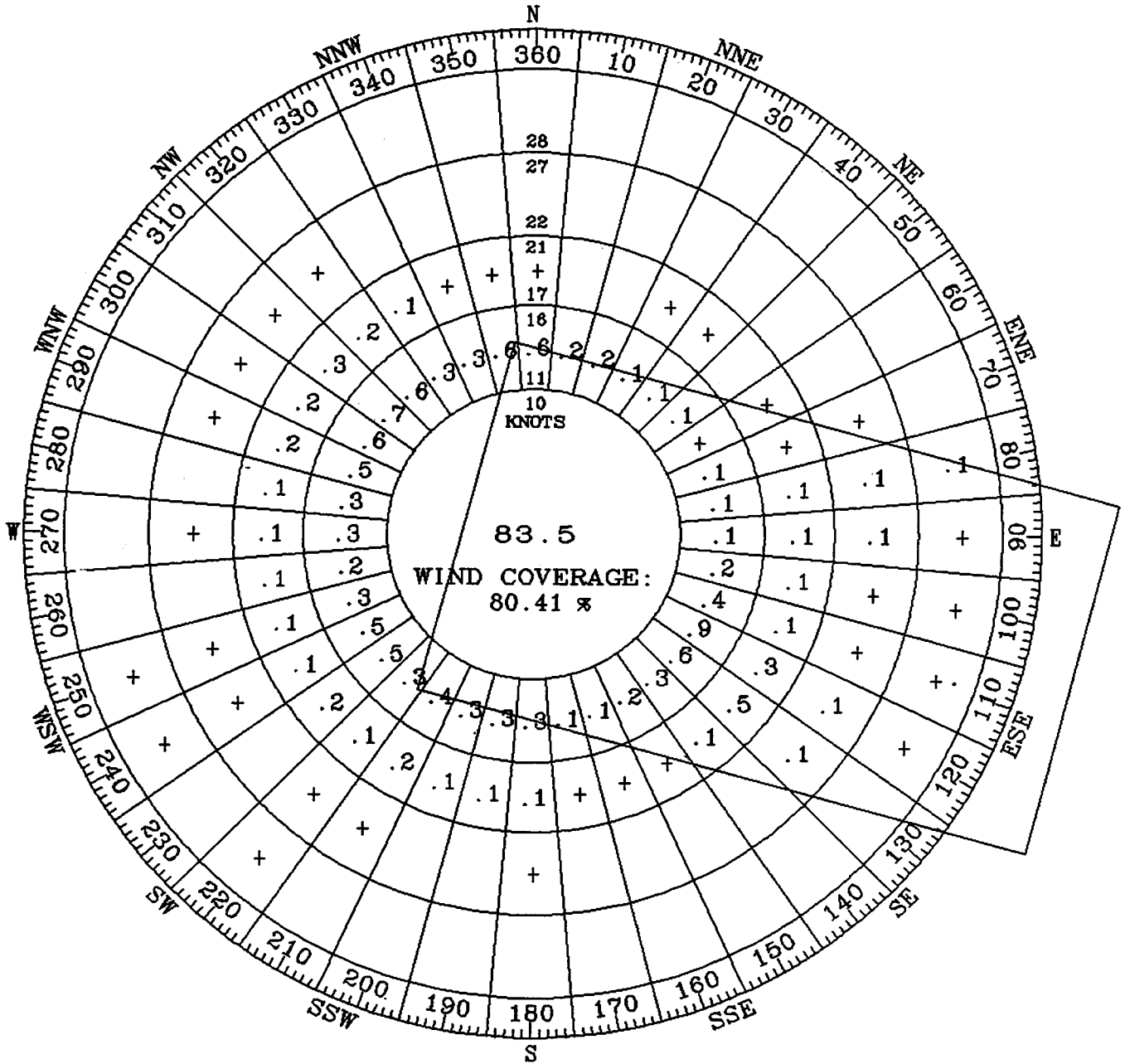


Figure A11-9. Example printout of windrose (one uni-directional runway)

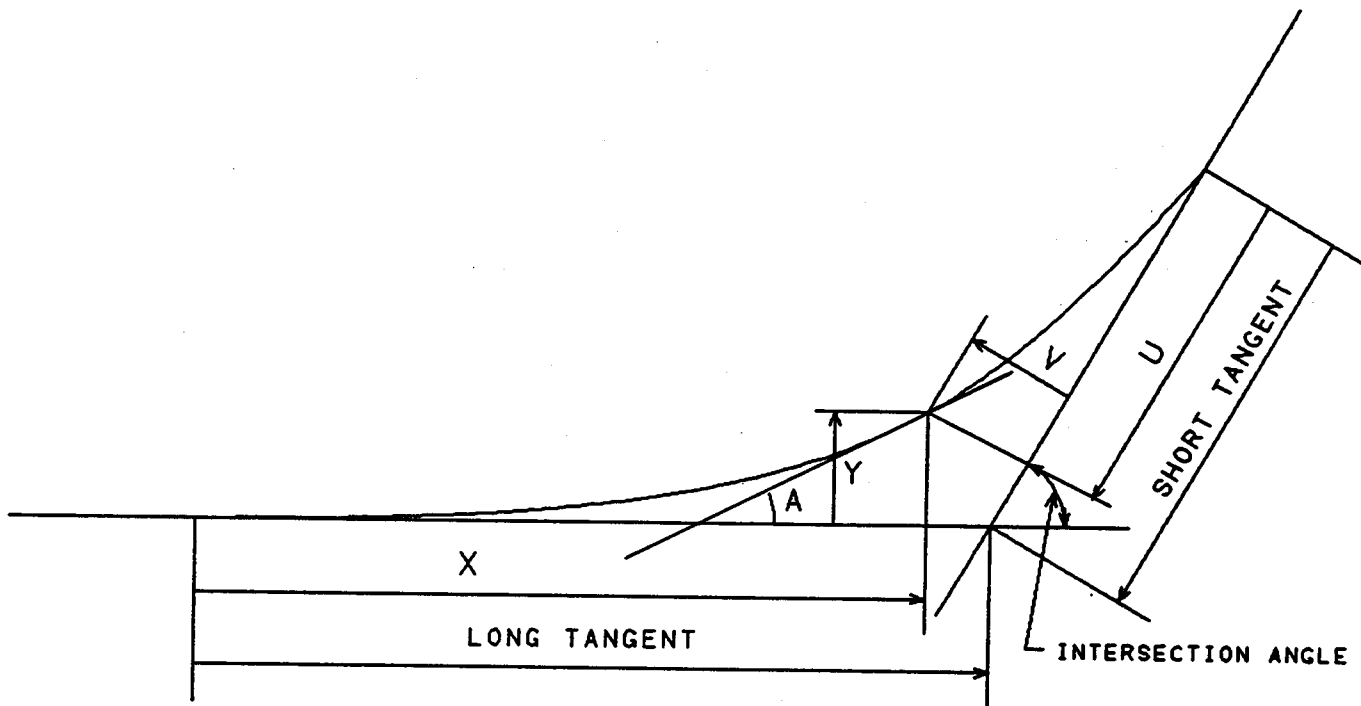


Figure A11-10. Nomenclature used in the taxiway design task

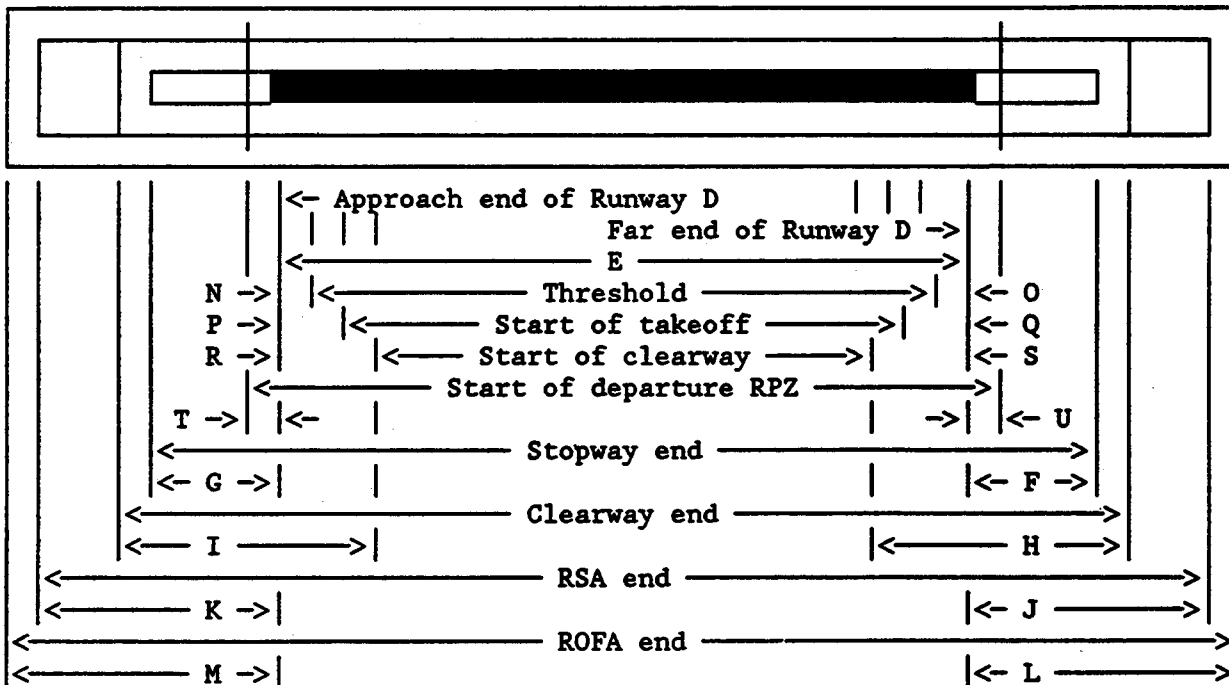


Figure A11-11. Nomenclature used in the declared distance task

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Appendix 12**Appendix 12. AIRPLANE DATA****1. BACKGROUND.**

a. Airplane physical characteristics have operational and economic significance which materially affect an airport's design, development, and operation. Their consideration when planning a new airport or improving existing airport facilities maximizes their possible utilization and safety within expected demands. For example, they influence the design aspects of runways, taxiways, ramps, aprons, servicing facilities, gates, and life safety facilities. In addition, airport designers should consider anticipated growth in air traffic and the effects of near future model airplane operating weights and physical dimensions on ground operating areas.

b. Military airplanes frequently operate at civil airports. Joint-use airports should also meet the physical characteristics of military airplanes. Hence, during airport facility design, consider routine military operations such as medical evacuation, strategic deployment and dispersal, and Reserve and National Guard training missions.

c. Civil airplane versions of military counterparts are shown below.

| MILITARY DESIGNATION | CIVIL DESIGNATION |
|-------------------------|---|
| C-7 | DeHavilland Caribou |
| C-9A | McDonnell Douglas DC-9-30 |
| C-12 | Beech Huron |
| C-45 | Twin Beech 18 |
| C-46 | Curtis-Wright Commando |
| C-47/R-5D | Douglas DC-3, Skytrain |
| C-54/R-4D | Douglas DC-4, Skymaster |
| C-97 | Boeing Stratocruiser |
| C-118/R-6D | Douglas DC-6, Liftmaster |
| C-119 | Fairchild/Republic Flying Box Car |
| C-121/R-7 | Lockheed 749, 1049 Constellation |
| C-123 | Fairchild/Republic Provider |
| C-130 | Lockheed L-382 Hercules |
| C-131, T-29 | Convair 240/340/580 |
| C-135 | Boeing 707-120B, Starlifter |
| C-137, VC-137B, C | Boeing 707-320B |
| C-140 | Lockheed 1329 JetStar |
| C-141 | Lockheed StarLifter |
| E-4 | Boeing 747-200B |
| KC-10A | McDonnell Douglas, DC-10-30CF, Extender |
| KC-135A | Boeing 707, Stratotanker |
| P-3 | Lockheed L-188 Electra, 185/285 Orion |
| T-34 | Beech Mentor |
| T-37 | Cessna 318 |
| T-39 | Rockwell International NA-265-40 Sabreliner |
| T-42 | Beech Cochise |
| T-43A | Boeing 737-200 |
| T-47A | Cessna 552 |
| U-3 | Cessna 310/T310 |
| U-9 | Aero Commander 560 |
| U-18 | DeHavilland Twin Otter |

2. EXPLANATORY INFORMATION.**a. Presentation of data is in three forms:**

(1) Figures A12-1 to A12-8 are representatives of general types of airplanes and not a specific model.

(2) Most figures illustrate a particular model with its specific data.

(3) Some figures present data for several similar models or series of airplanes by a single representative drawing (e.g., General Dynamics/Convair 880 and 990).

b. The alpha-symbols in the data tables and drawings use the following list of airplane physical characteristics:

Alpha-Symbol Airplane Physical Characteristics

| | |
|---|--|
| A | Wingspan |
| B | Length Overall |
| C | Height Overall |
| D | Wheelbase |
| E | Nose to centerline of main gear |
| F | Wheel track (tread) |
| G | Centerline of fuselage to centerline of inboard engine |
| H | Centerline of fuselage to centerline of outboard engine |
| J | Outside of main gear to wingtip |
| K | Vertical clearance of inboard engine or propeller at maximum weight |
| L | Vertical clearance of outboard engine or propeller at maximum weight |
| M | Centerline of fuselage to approximate pivot point based on maximum nosewheel steering angle or locked wheels |
| N | Vertical clearance of wingtip at maximum weight |
| P | Height of exhaust of jet engine on centerline of fuselage (three-engine jet airplane only) |

c. Measurement of turn radius is either at maximum nosewheel steering angle or with locked wheels, whichever produces the larger radius. It is a horizontal measurement from the pivot point to the farthest point of the airplane during execution of a turn. This dimension represents a maximum effort maneuver not normally used by the airlines due to excessive tire wear. THIS DIMENSION IS NOT FOR AIRPORT FACILITY DESIGN PURPOSES. Contact the airline(s) involved for the turn radius to use for design purposes.

d. The abbreviation "SRS" denotes "series."

e. The abbreviation "NA" denotes "datum is not available."

f. The weight and dimensional information for transport type airplanes are from aircraft manufacturer publications titled "Airplane Characteristics, Airport Planning." Each airplane model has a publication that is available from its manufacturer. Since each publication has considerably more information of interest to an airport designer than assembled in this advisory circular, revisions are frequent. For example, weight and dimensional data is subject to change as a result of modifications and improvements to the airplane that differs from this advisory circular. Hence, it is advisable during airport facility planning and design to contact manufacturers of applicable airplanes.

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| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-------------------|----------|-------------------|------------------------------|------------------------------|--------|-------|-------|-------|-------|-----------------|----------------|
| BSLANCA | 7 | CITABRIA | 1,650 LB | 1,650 LB | 33'5" | 22'8" | 6'8" | 16'1" | 6'4" | 2 | |
| | | | 748 KG | 748 KG | 10.19M | 6.91M | 2.03M | 4.90M | 1.93M | | |
| CESSNA | 120 | SKYWAGON | 1,450 LB | 1,450 LB | 32'10" | 21'0" | 6'3" | | 6'5" | 2 | |
| | 140 | | 658 KG | 658 KG | 10.00M | 6.40M | 1.91M | | 1.96M | | |
| | 170 | | 2,200 LB | 2,200 LB | 36'0" | 25'0" | 6'7" | | | 4 | |
| | | | 998 KG | 998 KG | 10.97M | 7.60M | 2.00M | | | | |
| | 180 | | 2,800 LB | 2,800 LB | 36'2" | 25'9" | 7'9" | | 7'8" | | |
| 185 | 1,270 KG | 1,270 KG | 11.04M | 7.85M | 2.34M | | 2.31M | | | | |
| HELIO AIRCRAFT | 190 | HELIO STALLION | 3,350 LB | 3,350 LB | 36'2" | 27'1" | 7'2" | | | 4 | |
| | 195 | | 1,520 KG | 1,520 KG | 11.04M | 8.26M | 2.16M | | | | |
| | H-250 | | 3,400 LB | 3,400 LB | 39'0" | 31'6" | 8'10" | 23'5" | 9'0" | 6 | |
| | H-295 | | 1,542 KG | 1,542 KG | 10.87M | 9.59M | 2.70M | 7.22M | 2.75M | | |
| | RST-550 | | 5,000 LB | 5,100 LB | 41'0" | 39'7" | 9'3" | | 9'8" | | |
| | 2,268 KG | 2,313 KG | 12.49M | 11.04M | 2.83M | | 2.96M | | | | |

MODEL 185 HAS MAXIMUM WEIGHTS OF 3,350 LB (1,520 KG) AND 6 SEATS.
MODEL 195 HAS LENGTH OF 27'4" (8.33M).

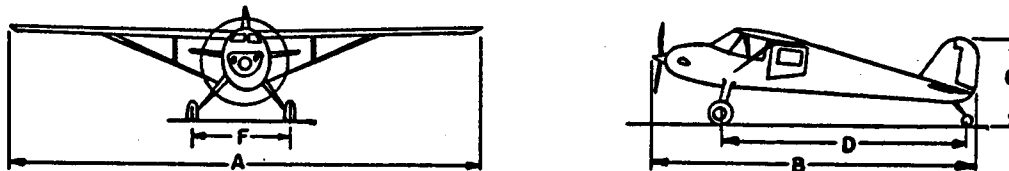


Figure A12-1. Single engine, high wing, tailwheel airplanes 8,000 lb. (3,628 Kg) or less

| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|---------------------|------------------|------------------|------------------------------|------------------------------|--------|-------|-------|-------|-------|-----------------|----------------|
| PIPER | PA-12, 14, 15 | SUPER CRUISER | 1,750 LB | 1,750 LB | 35'6" | 22'6" | 6'10" | | 6'3" | 3 | 20'8" |
| | | | 794 KG | 794 KG | 10.80M | 6.85M | 2.08M | 1.91M | | | |
| | PA-18 | SUPER CUB | 1,500 LB | 1,500 LB | 35'3" | 22'5" | 6'8" | | | 2 | 20'7" |
| | PA-20 | PACER | 1,650 LB | 1,650 LB | 29'4" | 20'5" | 6'3" | | | 4 | 20'6" |
| | | | 748 KG | 748 KG | 8.90M | 6.20M | 1.91M | | | | |
| SILVAIRE | 8 | | 1,400 LB | 1,400 LB | 35'0" | 20'0" | 6'3" | | 6'4" | 2 | |
| | | | 635 KG | 635 KG | 10.67M | 6.10M | 1.91M | | 1.93M | | |
| TAYLOR- CRAFT | BC-12 | | 1,150 LB | 1,150 LB | 36'0" | 22'0" | 6'8" | | 6'0" | 2 | |
| | | | 522 KG | 522 KG | 10.97M | 6.72M | 2.03M | | 1.83M | | |
| UNIVAIR AIRCRAFT | 108 | VOYAGER | 2,150 LB | 2,150 LB | 33'11" | 24'6" | 6'10" | 18'7" | 7'1" | 4 | 20'6" |
| | | | 975 KG | 975 KG | 10.34M | 7.46M | 2.08M | 5.66M | 2.16M | | 2.24M |

NOTE: MODEL PA-20 MAY HAVE MAXIMUM WEIGHTS OF 1,800 LB (816 KG).

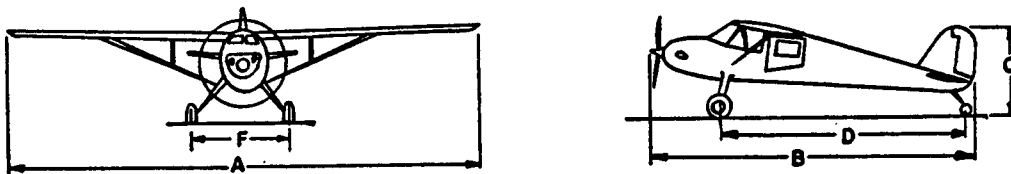


Figure A12-2. Single engine, high wing, tailwheel airplanes 8,000 lb. (3,628 Kg) or less (cont'd)

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| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|------------------|-------|-------------------|------------------------------|------------------------------|------------------|-----------------|----------------|----------------|----------------|-----------------|-----------------|
| BEDE AIRCRAFT | BD-4 | | 1,400 LB 635 KG | 1,400 LB 635 KG | 25'6" 7.77M | 21'11" 6.68M | 6'3" 1.91M | | 8'3" 2.51M | 4 | |
| | 150 | | 1,600 LB 726 KG | 1,600 LB 726 KG | 32'9" 9.98M | 23'10" 7.26M | 8'0" 2.44M | 4'10" 1.48M | 6'7" 2.01M | 2 | 19'10" 6.05M |
| CESSNA | 172 | SKYHAWK | 2,300 LB 1 043 KG | 2,300 LB 1 043 KG | 35'10" 10.93M | 26'11" 8.20M | 8'10" 2.84M | 5'4" 1.63M | 7'2" 2.23M | 4 | 19'8" 6.00M |
| | 177 | CARDINAL | 2,500 LB 1 134 KG | 2,500 LB 1 134 KG | 35'6" 10.82M | 27'2" 8.28M | 8'6" 2.59M | 6'5" 1.96M | 8'4" 2.54M | 4 | |
| | 182 | SKYLANE | 2,950 LB 1 338 KG | 2,950 LB 1 338 KG | 35'10" 10.93M | 28'1" 8.56M | 8'11" 2.72M | 5'7" 1.70M | 8'0" 2.44M | 4 | 21'4" 6.50M |
| | 206 | STATIONAIR | 3,600 LB 1 633 KG | 3,600 LB 1 633 KG | 35'10" 10.93M | 28'0" 8.53M | 9'8" 2.95M | 6'11" 2.11M | 8'2" 2.49M | 6 | |
| | 207 | SUPER SKYWAGON | 3,800 LB 1 724 KG | 3,800 LB 1 724 KG | 35'10" 10.93M | 31'9" 9.68M | 9'7" 2.92M | | 10'0" 3.04M | 6 | |
| | 210 | CENTURION | 3,800 LB 1 724 KG | 3,800 LB 1 724 KG | 36'9" 11.20M | 28'3" 8.61M | 9'8" 2.95M | 5'9" 1.76M | 8'6" 2.59M | 6 | 22'5" 6.84M |
| PIPER | PA-22 | TRI-PACER | 1,800 LB 816 KG | 1,800 LB 816 KG | 29'4" 8.97M | 20'4" 6.20M | 6'3" 1.91M | | | 3 | 19'11" 6.07M |

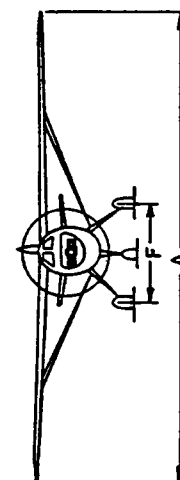
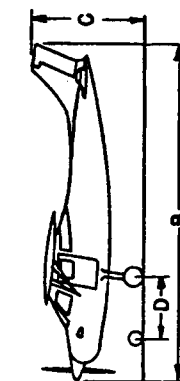


Figure A12-3. Single engine, high wing, tricycle gear airplanes 8,000 lb. (3,628 Kg) or less

| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|----------------------|-------|-----------|------------------------------|------------------------------|------------------|----------------|----------------|---------------|-----------------|-----------------|----------------|
| AEROSTAR AVIATION | 415 | ERCOUPE | 1,450 LB 658 KG | 1,450 LB 658 KG | 30'0" 9.14M | 20'7" 6.27M | 6'3" 1.91M | 5'4" 1.63M | 7'9" 2.36M | 2 | 18'9" 5.71M |
| | H-20 | | 2,525 LB 1,145 KG | 2,525 LB 1,145 KG | 35'0" 10.67M | 23'7" 7.06M | 8'4" 2.54M | 5'7" 1.70M | 9'1" 2.77M | 4 | 22'1" 6.72M |
| | H-22 | MARK 22 | 3,680 LB 1,669 KG | 3,680 LB 1,669 KG | 35'0" 10.67M | 27'0" 8.23M | 9'10" 3.00M | 8'3" 2.51M | 11'0" 3.35M | 5 | |
| BEECH- CRAFT | 23 | MUSKETEER | 2,450 LB 1,111 KG | 2,200 LB 998 KG | 32'9" 9.98M | 25'0" 7.62M | 8'3" 2.51M | 6'4" 1.91M | 11'10" 3.61M | 4 | |
| | V-35B | BONANZA | 3,400 LB 1,542 KG | 3,400 LB 1,542 KG | 33'6" 10.21M | 26'5" 8.05M | 6'7" 2.01M | 7'0" 2.13M | 9'7" 2.92M | 4 | 21'6" 6.55M |
| | F-33 | BONANZA | 3,050 LB 1,383 KG | 3,050 LB 1,383 KG | 32'10" 10.00M | 25'6" 7.77M | 8'3" 2.51M | 7'5" 2.26M | 9'7" 2.92M | 5 | 21'3" 6.48M |
| | F-33A | BONANZA | 3,400 LB 1,542 KG | 3,400 LB 1,542 KG | 33'6" 10.21M | 26'8" 8.13M | 8'3" 2.51M | 7'5" 2.26M | 9'7" 2.92M | 5 | 21'3" 6.48M |
| DELLANCA | 260 | VIKING | 3,000 LB | 3,000 LB | 24'2" | 23'6" | 7'4" | 6'8" | 9'0" | 4 | |
| | 300 | | 1,361 KG | 1,361 KG | 10.41M | 7.15M | 2.23M | 2.03M | 2.75M | | |

NOTE: MODEL H-20 MAY BE KNOWN AS: CHAPARRAL, EXECUTIVE, MUSTANG, RANGER, STATESMAN.

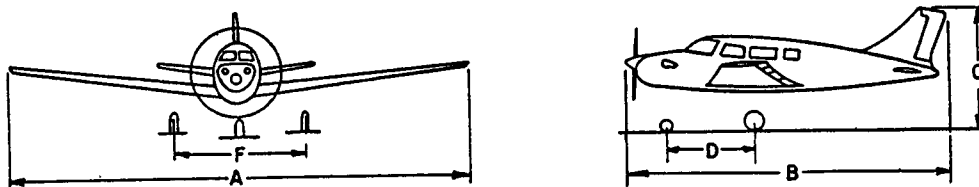


Figure A12-4. Single engine, low wing, tricycle gear airplanes 8,000 lb. (3,628 Kg) or less

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| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-----------------------|-----------|-------------------|------------------------------|------------------------------|------------------|----------------|----------------|----------------|----------------|-----------------|-----------------|
| GRUMMAN | AA-1 | YANKEE | 1,500 LB 680 KG | 1,500 LB 680 KG | 24'6" 7.47M | 19'3" 5.87M | 6'10" 2.08M | 4'5" 1.35M | 8'3" 2.51M | 2 | |
| NAVION | G-1 | RANGE- MASTER | 3,315 LB 1 504 KG | 3,150 LB 1 489 KG | 34'9" 10.59M | 27'6" 8.38M | 8'4" 2.54M | 5'8" 1.74M | 8'9" 2.67M | 4 | |
| PIPER | PA-24 | COMMANCHE | 2,550 LB 1 157 KG | 2,550 LB 1 157 KG | 36'0" 10.97M | 24'9" 7.54M | 7'5" 2.25M | 6'7" 2.01M | 9'8" 2.94M | 4 | 22'10" 6.96M |
| | PA-28-180 | CHEROKEE | 2,400 LB 1 089 KG | 2,400 LB 1 089 KG | 30'0" 9.14M | 23'6" 7.16M | 7'4" 2.22M | 6'3" 1.89M | 10'0" 3.04M | 4 | 20'0" 6.08M |
| | PA-28-200 | CHEROKEE ARROW | 2,600 LB 1 179 KG | 2,600 LB 1 179 KG | 30'0" 9.14M | 24'2" 7.37M | 8'0" 2.44M | 7'5" 2.26M | 10'6" 3.20M | 5 | 20'3" 6.17M |
| | PA-32 | CHEROKEE SIX | 3,400 LB 1 542 KG | 3,400 LB 1 542 KG | 32'10" 10.00M | 27'9" 8.45M | 7'11" 2.41M | 7'10" 2.39M | 10'7" 3.22M | 6 | 21'9" 6.63M |
| ROCKWELL INTERNAT. | 112 | | 2,475 LB 1 127 KG | 2,475 LB 1 127 KG | 35'0" 10.67M | 27'2" 8.28M | 10'1" 3.07M | | 7'2" 2.18M | 4 | |

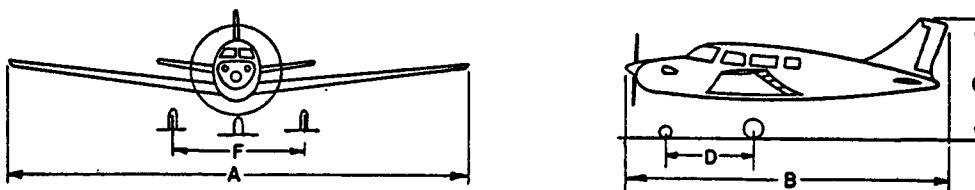


Figure A12-5. Single engine, low wing, tricycle gear airplanes 8,000 lb. (3,628 Kg) or less (cont'd)

| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|----------------------|------------|----------|------------------------------|------------------------------|------------------|------------------|----------------|---------------|----------------|-----------------|----------------|
| AEROSTAR AVIATION | 600 601 | AEROSTAR | 5,500 LB 2 495 KG | 5,500 LB 2 495 KG | 34'3" 10.44M | 34'10" 10.62M | 12'2" 3.71M | | 10'3" 3.12M | 5 | |
| BEECH- CRAFT | B-55 | BARRON | 5,100 LB 2 313 KG | 5,100 LB 3 313 KG | 37'10" 11.53M | 28'0" 8.53M | 9'2" 2.79M | 7'0" 2.13M | 7'0" 2.13M | 4 | 23'8" 7.21M |
| | E-55 | BARRON | 5,300 LB 2 404 KG | 5,300 LB 2 404 KG | 37'10" 11.53M | 29'0" 8.88M | 9'2" 2.79M | 8'0" 2.44M | 8'0" 2.44M | 4 | 23'8" 7.21M |
| | B-60 | DUKE | 6,775 LB 3 073 KG | 6,775 LB 3 073 KG | 39'3" 11.96M | 33'10" 10.32M | 12'4" 3.76M | 9'3" 2.82M | 11'0" 3.35M | 6 | |
| CSSNA | 310 | | 5,100 LB 2 313 KG | 5,100 LB 2 313 KG | 37'6" 11.43M | 29'7" 9.02M | 9'11" 3.03M | 9'6" 2.90M | 12'0" 3.66M | 6 | 24'0" 7.31M |

NOTE: E-55 TURBO HAS MAXIMUM WEIGHTS OF 5,900 LB (2 676 KG).
310 TURBO HAS MAXIMUM WEIGHTS OF 5,500 LB (2 495 KG).

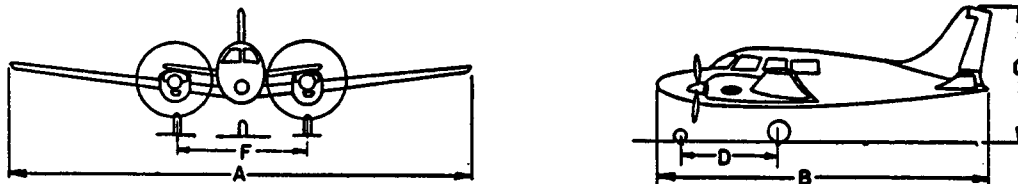


Figure A12-6. Twin engine, low or mid wing, tricycle gear airplanes 8,000 lb. (3,628 Kg) or less

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| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|---------|------------------|-------------------|------------------------------|------------------------------|------------------|-----------------|----------------|----------------|----------------|-----------------|----------------|
| CESSNA | 401, 402, 421 | TWIN CESSNA | 6,300 LB 2 858 KG | 6,200 LB 2 812 KG | 39'10" 12.27M | 36'2" 11.02M | 11'8" 3.56M | 10'6" 3.20M | 14'8" 4.47M | 6 | |
| PIPER | PA-23-160 | APACHE | 3,800 LB 1 724 KG | 3,800 LB 1 724 KG | 37'2" 11.32M | 27'5" 8.34M | 9'6" 2.87M | 7'6" 2.28M | 11'0" 3.35M | 5 | 24'0" 7.31M |
| | PA-23-250 | AZTEC | 4,800 LB 2 177 KG | 4,800 LB 2 177 KG | 37'0" 11.27M | 27'7" 8.42M | 10'4" 3.15M | 7'6" 2.28M | 11'4" 3.45M | 6 | 24'0" 7.31M |
| | PA-30 | TWIN CONQUACHE | 3,600 LB 1 633 KG | 3,600 LB 1 633 KG | 36'0" 10.97M | 25'2" 7.67M | 8'3" 2.51M | 7'4" 2.23M | 9'10" 2.98M | 4 | 22'8" 6.90M |
| | PA-31 | NAVAJO | 6,200 LB 2 812 KG | 6,200 LB 2 812 KG | 40'8" 12.40M | 32'8" 9.94M | 13'0" 3.96M | 8'8" 2.64M | 13'9" 4.19M | 7 | 27'3" 8.32M |

NOTE: MODEL (421) HAS OPTIONAL TAKEOFF WEIGHT OF 6,350 LB (2 880 KG).
(421B) 7,450 LB (3 379 KG).

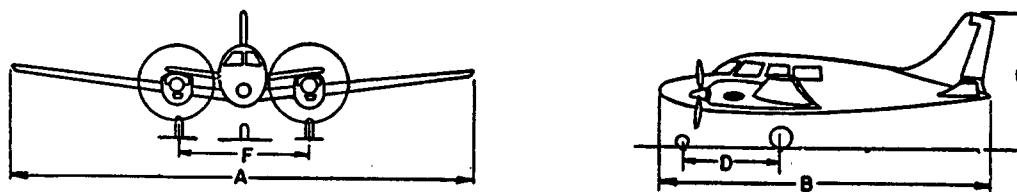
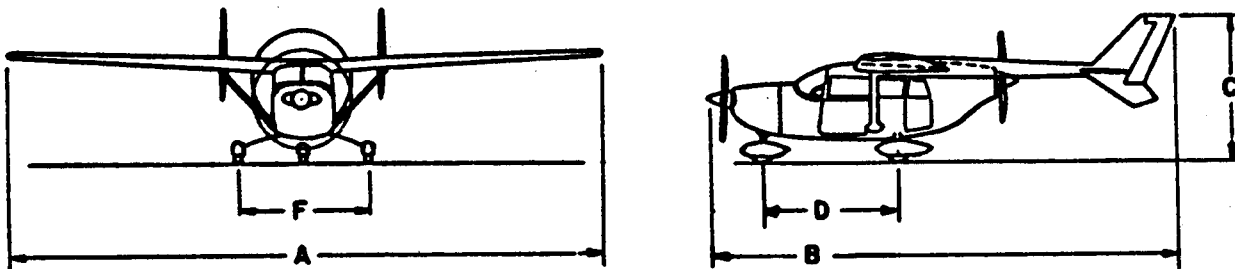


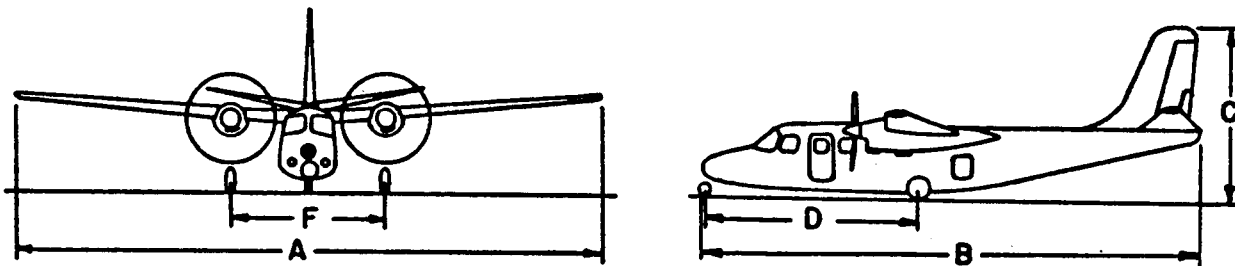
Figure A12-7. Twin engine, low or mid wing, tricycle gear airplanes 8,000 lb. (3,628 Kg) or less (cont,d)

| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-----------------------|----------|----------------------------|------------------------------|------------------------------|-----------------|-----------------|----------------|----------------|-----------------|-----------------|----------------|
| CESSNA | 336 | SUPER | 4,630 LB | 4,400 LB | 38'2" | 29'10" | 9'4" | 7'10" | 8'2" | 4 | |
| | 337 | SKYMASTER | 2,100 KG | 1,996 KG | 11.85M | 9.10M | 2.85M | 2.39M | 2.48M | | |
| ROCKWELL INTERNAT. | 500 | AERO | 6,500 LB | 6,500 LB | 49'6" | 35'1" | 14'6" | | 12'11" | 7 | 31'2" 9.50M |
| | | COMMANDER | 2,948 KG | 2,948 KG | 15.09M | 10.69M | 4.42M | | 3.94M | | |
| | 560, 680 | GRAND SHRIKE SHRIKE CDR | 7,700 LB 3,493 KG | 7,700 LB 3,493 KG | 49'1" 14.96M | 36'7" 11.15M | 14'6" 4.42M | 14'0" 4.28M | 12'11" 3.94M | 7 | |

NOTE: SHRIKE COMMANDER HAS MAXIMUM WEIGHTS OF 6,750 LB (3,062 KG).
MODEL 681, TURBO II, HAWK COMMANDER HAS WINGSPAN OF 44'0" (13.41M) AND
MAXIMUM WEIGHTS OF 9,400 LB (4,264 KG); OTHERWISE AS MODEL 560.



CESSNA SUPER SKYMASTER.



ROCKWELL INTERNATIONAL AERO COMMANDER SERIES.

Figure A12-8. Twin engine, high or mid wing, tricycle gear airplanes 8,000 lb. (3,628 Kg) or less

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|--------|------------------------|------------------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|
| MOHAWK | 23,480 LB | 22,710 LB | 71'11" | 63'4" | 20'5" | 23'9" | 29'9" | 10'3" | 9'8" | 30'5" | 5'5" | 5.2° | 12'6" | 41'1" |
| 298 | 10 653 KG | 10 301 KG | 21.92M | 19.30M | 6.22M | 7.24M | 9.07M | 3.12M | 2.95M | 9.27M | 1.65M | 1.60M | 3.84M | 12.52M |

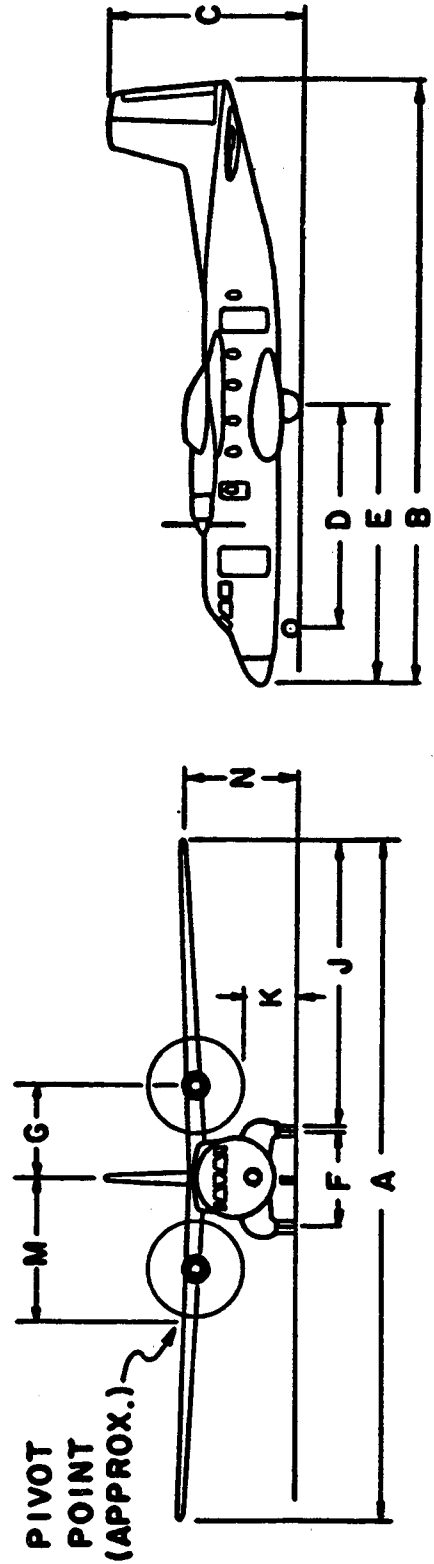


Figure A12-9. Aérospatiale Nord 262

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-----------|-------------------------|-------------------------|------------------|------------------|----------------|-----------------|-----------------|----------------|----------------|-----------------|---------------|-----------------|---------------|-----------------|
| CARAVELLE | 114,640 LB 52 000 KG | 104,990 LB 47 623 KG | 112'6" 34.29M | 105'0" 32.00M | 28'7" 8.72M | 38'6" 11.74M | 55'6" 16.92M | 17'1" 5.21M | 7'10" 2.39M | 46'7" 14.20M | 7'2" 2.18M | 33'2" 10.11M | 7'5" 2.26M | 90'3" 27.51M |

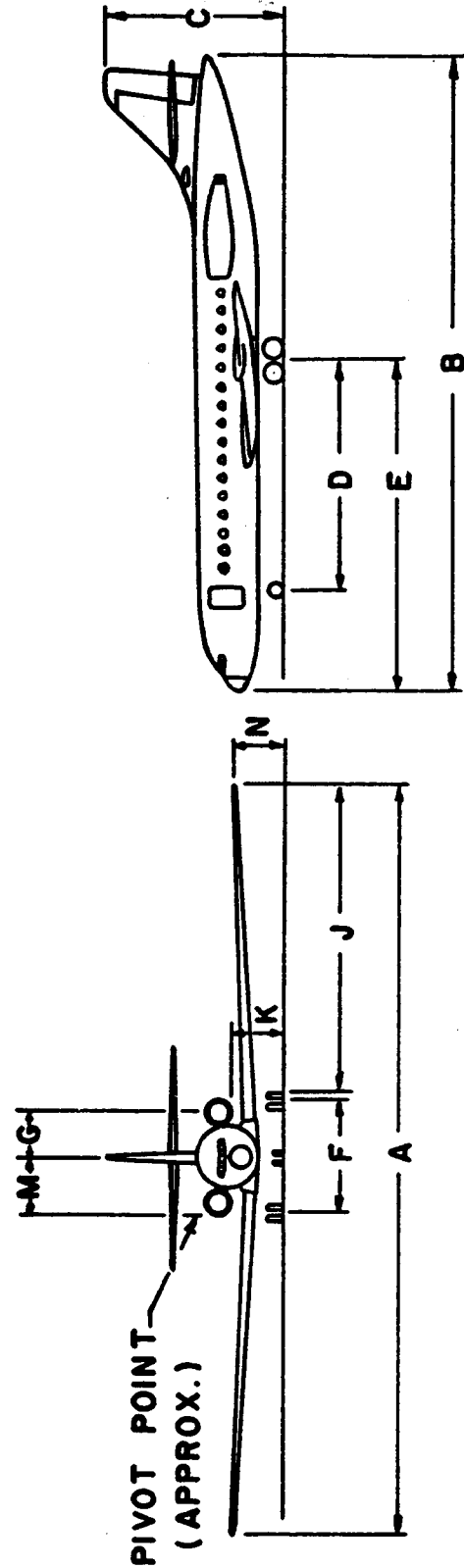


Figure A12-10. Aérospatiale/Sud SE-210 Caravelle

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| MODEL | MAXIMUM TANDOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|---------------|------------------------------|------------------------------|------------------|------------------|-----------------|------------------|------------------|-----------------|-----------------|------------------|----------------|------------------|-----------------|------------------|
| A-300 -82 | 302,000 LB 136,985 KG | 281,000 LB 127,459 KG | 147'1" 44.83M | 175'6" 53.49M | 55'6" 16.92M | 60'10" 18.54M | 82'8" 25.20M | 31'6" 9.60M | 26'0" 7.92M | 55'10" 17.02M | 2'7" 0.79M | 37'3" 11.35M | 19'4" 5.89M | 113'6" 34.59M |
| A-300 -84 | 330,700 LB 150,003 KG | 293,200 LB 132,993 KG | 147'1" 44.83M | 175'6" 53.49M | 55'6" 16.92M | 60'10" 18.54M | 82'8" 25.20M | 31'6" 9.60M | 26'0" 7.92M | 55'5" 16.89M | 2'7" 0.79M | 37'3" 11.35M | 19'4" 5.89M | 113'6" 34.59M |
| A-300 -600 | 363,763 LB 165,000 KG | 304,238 LB 138,000 KG | 147'1" 44.83M | 177'6" 54.08M | 54'8" 16.66M | 61'1" 18.26M | 82'11" 25.27M | 31'6" 9.60M | 26'0" 7.92M | 55'5" 16.89M | 3'3" 0.98M | 37'11" 11.35M | 18'9" 5.70M | 109'3" 33.31M |
| A-310 -300 | 330,693 LB 150,000 KG | 271,169 LB 123,000 KG | 144'1" 43.90M | 153'2" 46.67M | 52'4" 15.95M | 49'11" 15.21M | 71'9" 21.87M | 31'6" 9.60M | 25'3" 7.70M | 54'2" 16.51M | 2'2" 0.65M | 34'2" 10.41M | 16'11" 5.17M | 108'2" 32.97M |
| A-320 -100 | 145,505 LB 66,000 KG | 124,482 LB 56,000 KG | 111'3" 33.91M | 123'3" 37.57M | 39'1" 11.91M | 41'6" 12.64M | 58'1" 17.70M | 24'11" 7.59M | 18'10" 5.74M | 40'10" 12.45M | 1'10" 0.33M | 15'1" 4.61M | 13'5" 4.08M | 72'3" 21.99M |

NOTE: A-310-200 HAS OPTIONAL (TANDOFF) WEIGHT OF 305,560 LB (138 610 KG) AND 313,055 LB (141 999 KG).
269,963 LB (122 000 KG).

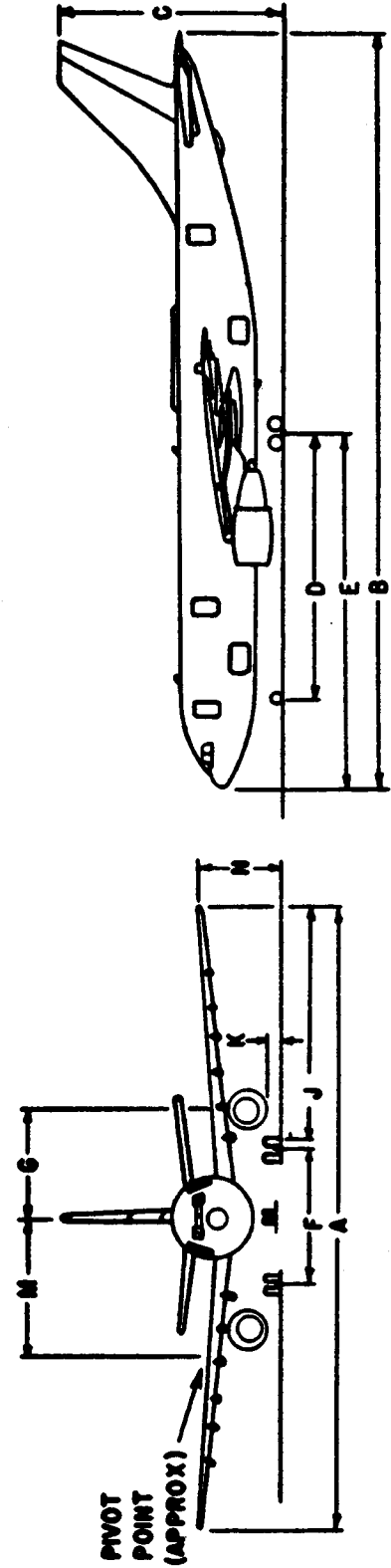
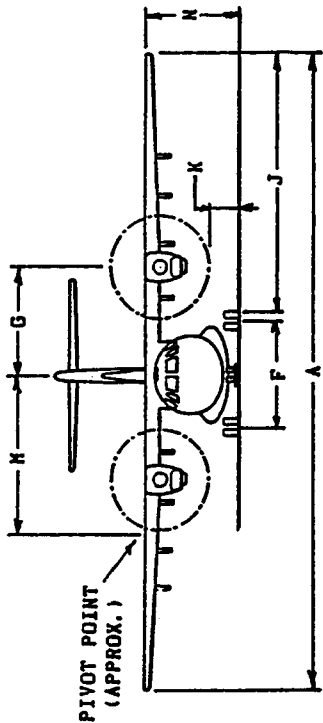
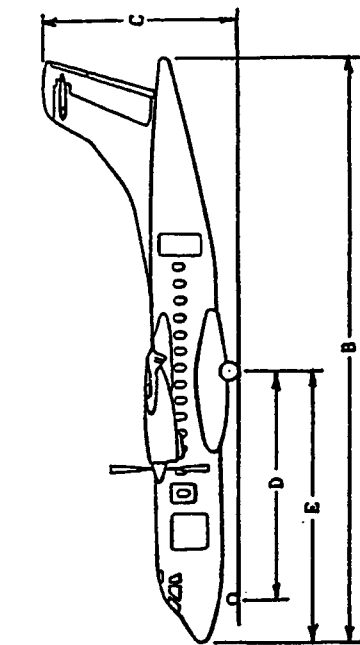
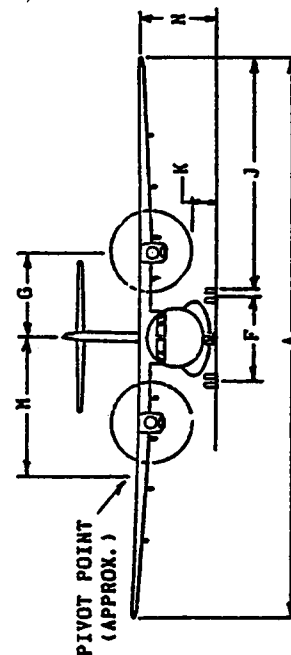
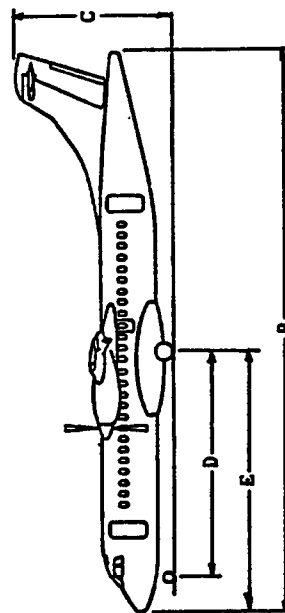


Figure A12-11. Airbus Industries A300, 310, and 320

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|--------|------------------------|------------------------|--------|--------|-------|--------|--------|-------|-------|--------|-------|-------|-------|-------------|
| ATR-42 | 34,725 LB | 34,170 LB | 80'7" | 74'5" | 25'5" | 28'10" | 34'4" | 13'5" | 13'3" | 32'5" | 3'6" | 16'8" | 12'1" | 57'1" |
| 200 | 15 751 KG | 15 499 KG | 24.56M | 22.66M | 7.75M | 8.75M | 10.46M | 4.09" | 4.04M | 9.88M | 1.07M | 5.08M | 3.68M | 17.40M |
| ATR-42 | 35,605 LB | 35,275 LB | 80'7" | 74'5" | 25'5" | 28'10" | 34'4" | 13'5" | 13'3" | 32'5" | 3'6" | 16'8" | 12'1" | 57'1" |
| 300 | 16 150 KG | 16 000 KG | 24.56M | 22.66M | 7.75M | 8.75M | 10.46M | 4.09M | 4.04M | 9.88M | 1.07M | 5.08M | 3.68M | 17.40M |
| ATR-72 | 44,070 LB | 43,870 LB | 88'9" | 89'2" | 25'1" | 35'1" | 40'11" | 13'5" | 13'3" | 36'6" | 3'6" | 20'5" | 12'3" | 64'10" |
| | 19 990 KG | 19 899 KG | 27.05M | 27.18M | 7.65M | 10.69M | 12.47M | 4.09M | 4.04M | 11.13M | 1.07M | 6.22M | 3.73M | 19.76M |



ATR - 42



ATR - 72

Figure A12-12. Avions de Transport Regional ATR-42 & -72

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | H | TURN RADIUS |
|-------|------------------------|------------------------|------------------|-----------------|-----------------|-----------------|----------------|---------------|-----------------|---------------|----------------|----------------|---|-----------------|
| 10 | 16,740 LB 8 500 KG | 17,640 LB 8 001 KG | 42'11" 13.08M | 45'6" 13.87M | 15'1" 4.60M | | | | | | | | | |
| 20 | 26,660 LB 13 000 KG | 27,320 LB 12 392 KG | 53'6" 16.31M | 56'3" 17.14M | 17'5" 5.31M | 18'10" 5.74M | 12'2" 3.71M | 5'6" 1.68M | 18'11" 5.77M | 5'8" 1.72M | 15'3" 4.65M | 4'10" 1.47M | | 42'0" 12.80M |
| 50 | 37,480 LB 17 001 KG | 35,715 LB 16 200 KG | 61'11" 18.87M | 60'9" 18.52M | 22'11" 6.98M | 23'9" 7.24M | 13'1" 3.99M | | | | | | | |
| 200 | 30,650 LB 13 903 KG | 28,800 LB 13 063 KG | 53'6" 16.31M | 56'3" 17.14M | 17'5" 5.31M | | | | | | | | | |
| 900 | 45,500 LB 20 638 KG | 42,000 LB 19 051 KG | 63'5" 19.33M | 66'3" 20.19M | 24'10" 7.57M | | | | | | | | | |

NOTE: MODEL 50 HAS OPTIONAL MAXIMUM TAKEOFF WEIGHT OF 40,760 LB (18 497 KG).

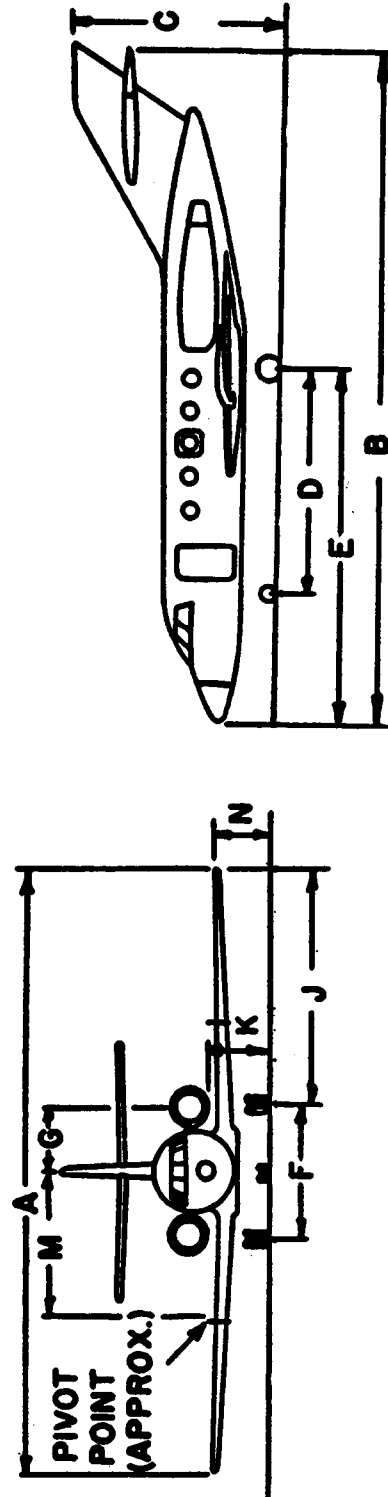


Figure A12-13. Avions Marcel Dassault Mystère 20 (Fan Jet Facon)

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | N | N | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|-------|--------|--------|-------|-------|--------|-------|-------|-------|-------------|
| 200 | 79,000 LB | 69,000 LB | 88'6" | 93'6" | 24'6" | 33'1" | 48'5" | 14'3" | 8'2" | 35'9" | 6'7" | 7'8" | 7'4" | 52'6" |
| 400 | 35,834 KG | 31,298 LB | 26.97M | 28.48M | 7.46M | 10.15M | 14.49M | 4.34M | 2.49M | 10.90M | 2.01M | 2.34M | 2.24M | 15.95M |
| 500 | 104,500 LB | 86,000 LB | 93'6" | 107'0" | 24'6" | 41'5" | 56'9" | 14'3" | 8'2" | 42'8" | 6'7" | 7'8" | 7'4" | |
| | 47,400 KG | 39,009 KG | 28.49M | 32.61M | 7.46M | 12.35M | 17.30M | 4.34M | 2.49M | 13.00M | 2.01M | 2.34M | 2.24M | |

SRS 400 HAS MAXIMUM (TAKEOFF) WEIGHT OF 87,000 LB (39 463 KG).
76,000 LB (35 360 KG).

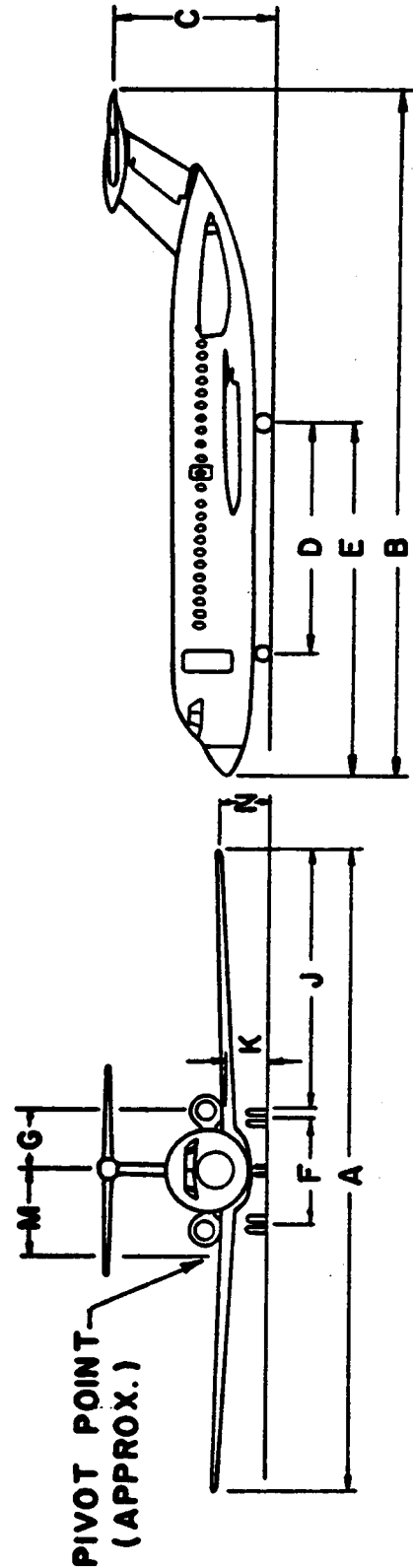


Figure A12-14. BAe 1-11

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|----------|------------------------------|------------------------------|------------------|------------------|-----------------|-----------------|-------------------|----------------|----------------|----------------|---------------|----------------|---------------|------------------|
| CONCORDE | 408,000 LB 185,066 KG | 245,000 LB 111,130 KG | 83'10" 25.55M | 205'5" 62.61M | 37'5" 11.40M | 59'8" 18.19M | 122'10" 37.44M | 25'4" 7.72M | 18'1" 5.51M | 27'3" 8.31M | 6'1" 1.85M | 32'5" 9.89M | 8'6" 2.59M | 127'0" 38.71M |

*TIP OF PROBE, NOSE FULLY LOWERED 8'6" (2.59M).

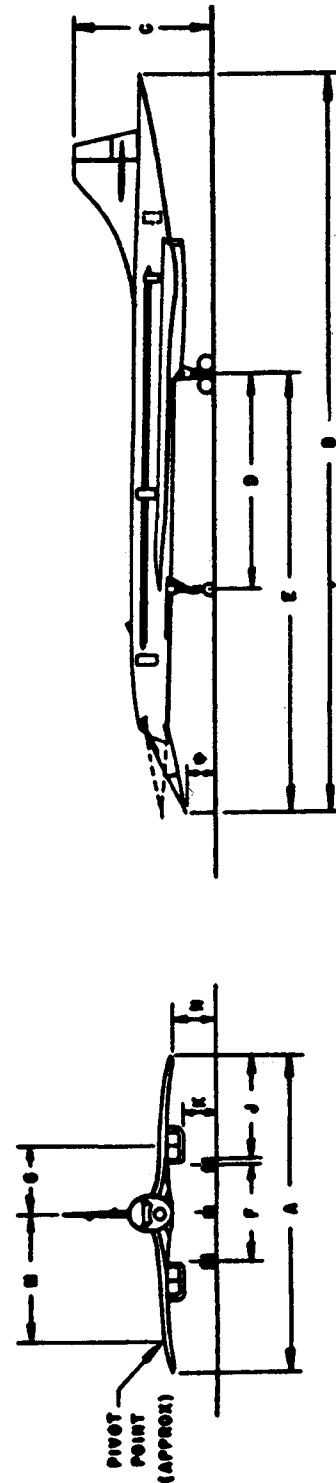


Figure A12-15. B.A.C./SNIAS Concorde

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|----------------|------------------------------|------------------------------|------------------|------------------|-----------------|------------------|---|----------------|---|---|---|---|---|----------------|
| VC-10 -1100 | 312,000 LB 141 521 KG | 216,000 LB 97 976 KG | 146'2" 44.60M | 156'9" 48.39M | 39'6" 12.04M | 65'10" 20.08M | | 21'5" 6.53M | | | | | | |
| VC-10 -1150 | 335,100 LB 151 999 KG | 237,000 LB 107 501 KG | 146'2" 44.60M | 171'8" 52.32M | 39'6" 12.04M | 72'1" 21.97M | | 21'5" 6.53M | | | | | | |

SRS 1150 KNOWN AS VC-10 SUPER.

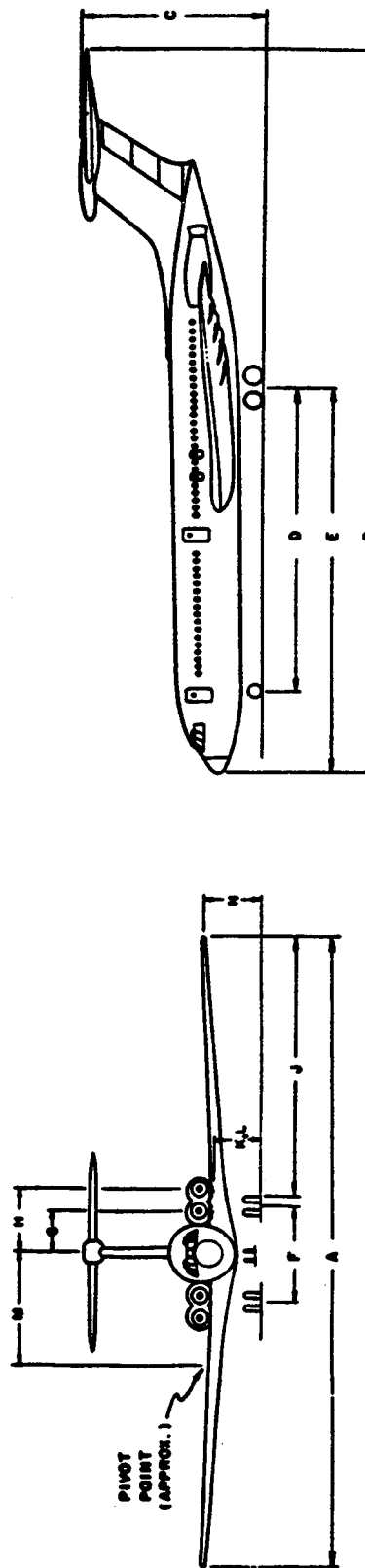


Figure A12-16. B.A.C./Vickers VC-10

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|------------------------|------------------------|-----------------|------------------|-----------------|----------------|-----------------|-----------------|----------------|---|-----------------|---------------|-----------------|---------------|---------------|-----------------|
| 745 | 64,500 LB 29,257 KG | 57,500 LB 26,082 KG | 93'9" 28.57M | 81'10" 24.94M | 26'9" 8.15M | 25'3" 7.70M | 35'8" 10.87M | 23'10" 7.32M | 12'9" 3.88M | | 33'9" 10.29M | 1'1" 0.33M | 20'10" 6.56M | 8'7" 2.62M | 8'7" 2.62M | 67'8" 20.62M |
| 810 | 72,500 LB 32,865 KG | 62,000 LB 28,123 KG | 94'0" 28.65M | 85'8" 25.83M | 26'10" 8.18M | 29'1" 8.86M | 39'6" 12.04M | 23'10" 7.32M | 12'9" 3.88M | | 33'9" 10.29M | 1'1" 0.33M | 24'5" 7.39M | 8'7" 2.62M | 8'7" 2.62M | 71'3" 21.72M |

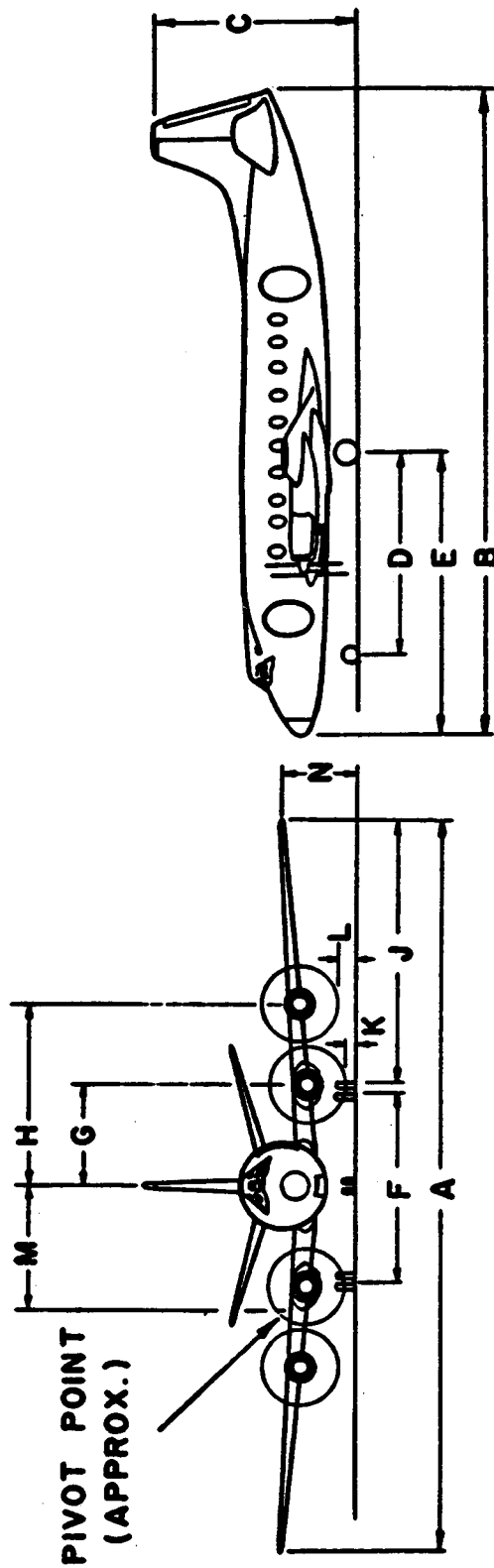


Figure A12-17. B.A.C./Vickers Viscount

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|-------|------------------------|------------------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|----------------|----------------|----------------|---|---------------|-------------|
| 1 | 14,000 LB 6 350 KG | 13,300 LB 6 033 KG | 54'5" 16.59M | 46'1" 14.05M | 12'11" 3.94M | 22'6" 6.86M | 28'8" 8.74M | 16'10" 5.13M | 4'10" 1.47M | 18.1" 5.51M | 2'11" 0.89M | | 4'6" 1.37M | |

NOTE: FORWARD WING SPAN:
AFT POSITION 20'11" (6.38M).
FORWARD POSITION 24'11" (7.59M).

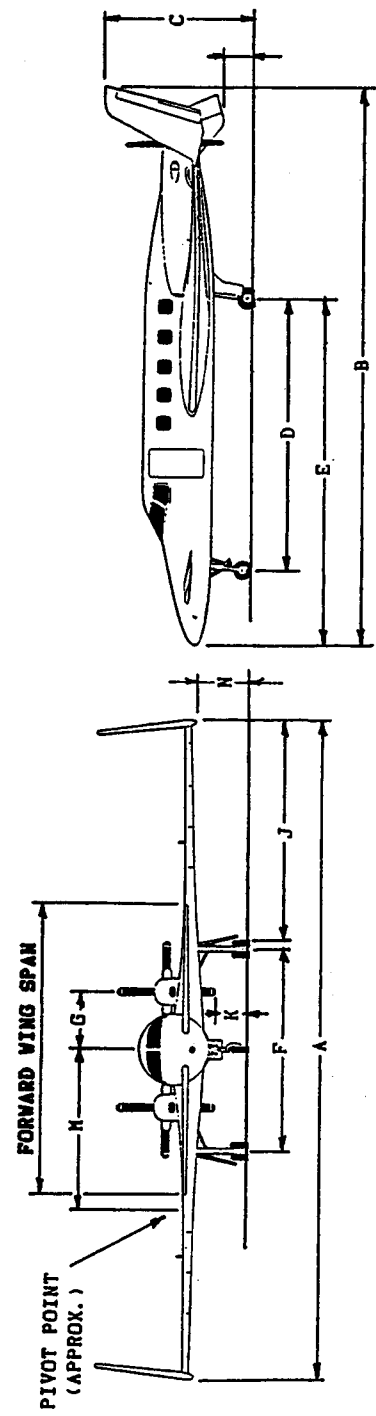
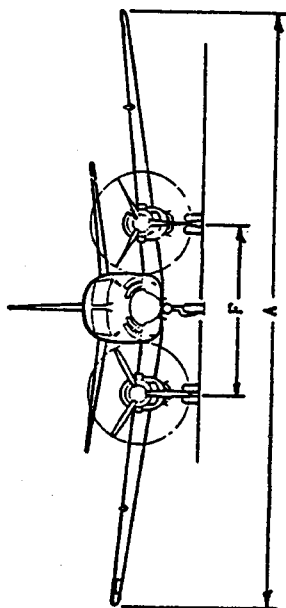


Figure A12-18. Beech Starship

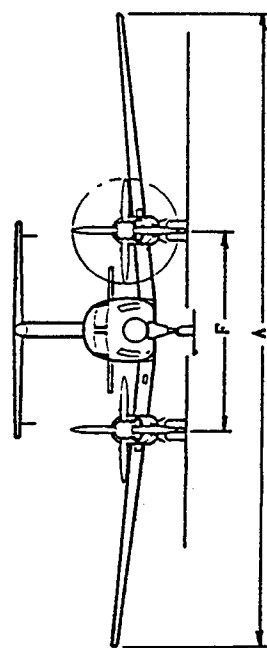
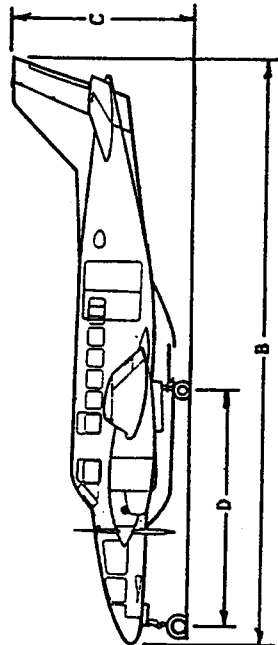
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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-------|------------------------|------------------------|------------------|------------------|-----------------|-----------------|----------------|--------------|-----------------|
| C99 | 11,300 LB 5 126 KG | 11,300 LB 5 126 KG | 45'11" 14.00M | 44'7" 13.59M | 14'5" 4.39M | 18'0" 5.49M | 13'0" 3.97M | 17 | 40'0" 12.19M |
| 1900 | 16,600 LB 7 530 KG | 16,100 LB 7 303 KG | 54'6" 16.61M | 57'10" 17.63M | 14'11" 4.55M | 23'10" 7.26M | 17'2" 5.23M | 19 | 39'4" 11.99M |



C 99 AIRLINER



1900 AIRLINER

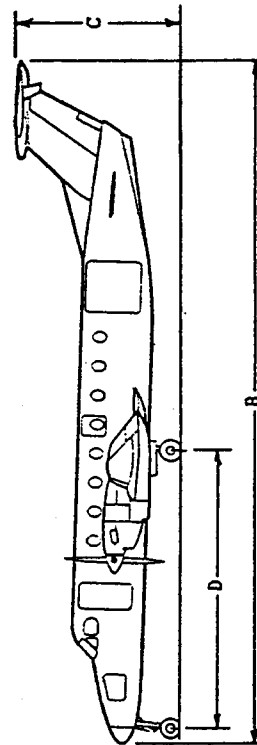


Figure A12-19. Beechcraft Airliner

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-------|------------------------------|------------------------------|------------------|------------------|----------------|-----------------|----------------|-----------------|----------------|
| A-90 | 9,650 LB 4,391 KG | 9,500 LB 4,323 KG | 50'3" 15.32M | 36'6" 11.14M | 14'8" 4.47M | 12'4" 3.76M | 12'9" 3.89M | 8 | |
| A-100 | 10,600 LB 4,823 KG | 10,500 LB 4,778 KG | 45'11" 14.00M | 39'11" 12.18M | 15'4" 4.67M | 14'11" 4.55M | 13'0" 3.97M | 10 | |

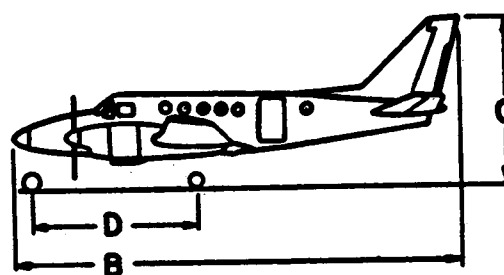
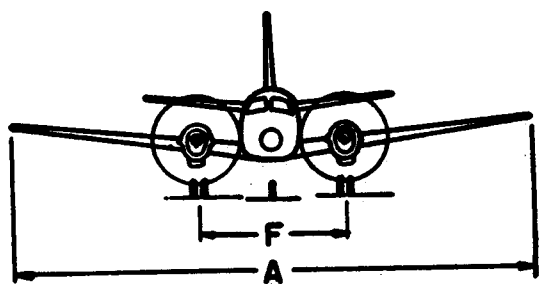


Figure A12-20. Beechcraft King Air

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|----------------------|------------------------------|------------------------------|-----------------|-----------------|---------------|----------------|-----------------|-----------------|----------------|
| 18 | 9,900 LB 4 500 KG | 9,500 LB 4 323 KG | 49'8" 15.14M | 35'3" 10.74M | 9'4" 2.87M | 23'9" 7.24M | 12'11" 3.94M | 10 | 30'3" 9.53M |
| TURBO 18 | 10,280 LB 4 673 KG | 9,775 LB 4 444 KG | 46'0" 14.03M | 37'5" 11.40M | 9'7" 2.95M | | | 12 | |
| VOLPAR TURBOLINER | 11,500 LB 5 324 KG | 11,000 LB 5 000 KG | 46'0" 14.03M | 44'3" 13.49M | 9'7" 2.95M | | | 15 | |

NOTES: MODEL 18 HAS RECIPROCATING ENGINES.
TURBOPROP CONVERSIONS HAVE TRICYCLE LANDING GEAR.

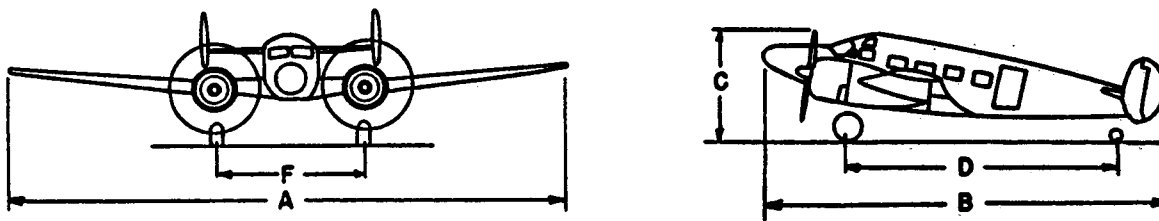


Figure A12-21. Beechcraft Model 18 and Conversions

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-------|------------------------------|------------------------------|------------------|-----------------|----------------|----------------|----------------|-----------------|----------------|
| A-65 | 7,700 LB 3 493 KG | 7,350 LB 3 334 KG | 45'11" 14.00M | 35'6" 10.83M | 14'3" 4.34M | 12'4" 3.76M | 12'9" 3.89M | 6 | 29'4" 8.94M |
| B-80 | 8,800 LB 3 992 KG | 8,800 LB 3 992 KG | 50'3" 15.31M | 35'6" 10.83M | 14'3" 4.34M | 12'4" 3.76M | 12'9" 3.89M | 8 | 29'4" 8.94M |

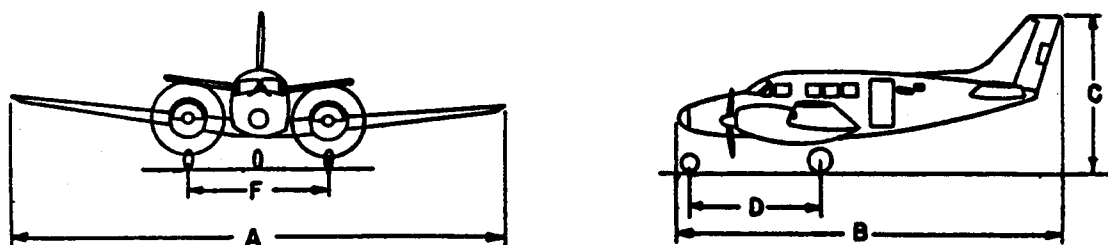


Figure A12-22. Beechcraft Queen Air

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-----------------|--------------------------|--------------------------|--------|--------|--------|--------|--------|-------|-------|--------|--------|-------|-------|--------|-------|-------------|
| STRATO-FORTRESS | 489,000 LB 221,353 KG | 450,000 LB 204,117 KG | 185'0" | 156'7" | 40'10" | 49'9" | 89'10" | 11'4" | 32'2" | 60'0" | 86'2" | 6'4" | 4'8" | 39'0" | 5'6" | 132'0" |
| | | | 56.39H | 47.73H | 12.45H | 15.16H | 17.16H | 3.45H | 9.80H | 18.29H | 26.26H | 1.93H | 1.42H | 11.89H | 1.68H | 40.23H |

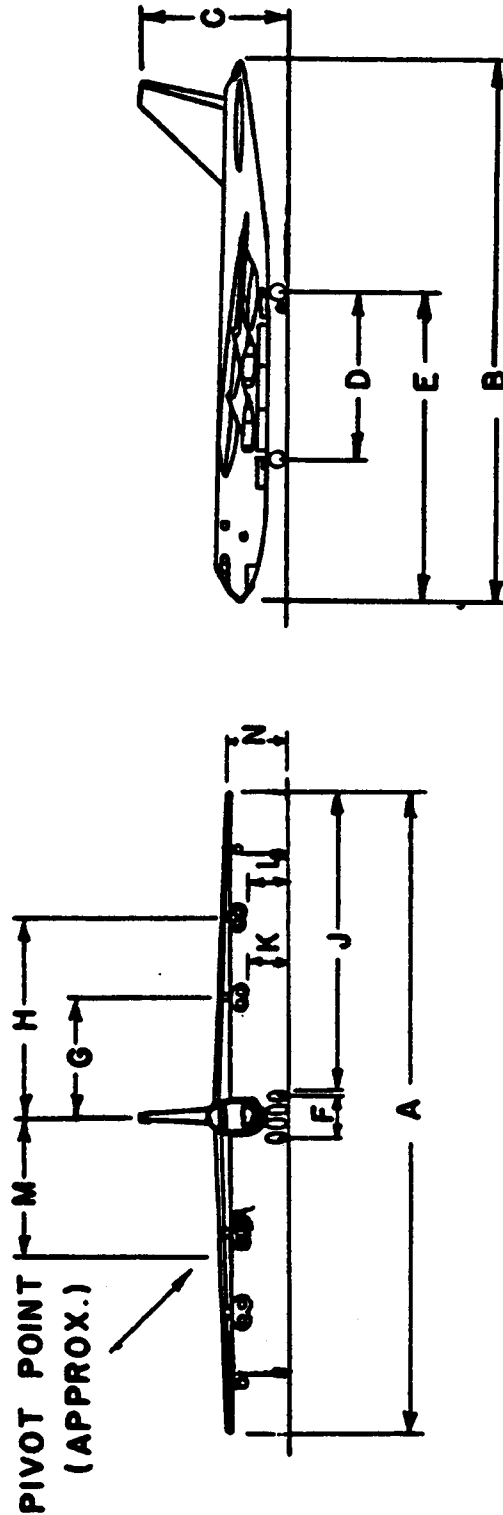


Figure A12-23. Boeing B-52 Stratofortress

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|--------------------|------------------------------|------------------------------|------------------|------------------|-----------------|-----------------|------------------|----------------|----------------|----------------|-----------------|---------------|---------------|----------------|---|------------------|
| STRATO- CRUISER | 145,800 LB 66 134 KG | 121,700 LB 55 202 KG | 141'3" 43.05M | 110'4" 33.63M | 38'3" 11.65M | 39'2" 11.93M | 42'10" 13.06M | 28'6" 8.70M | 14'1" 4.29M | 31'2" 9.50M | 55'4" 16.87M | 1'5" 0.43M | 2'7" 0.79M | 14'3" 4.34M | | 84'10" 25.86M |

NOTE: OPTIONAL TAKEOFF WEIGHTS: 153,000 LB (69 400 KG) AND 175,000 LB (79 379 KG).

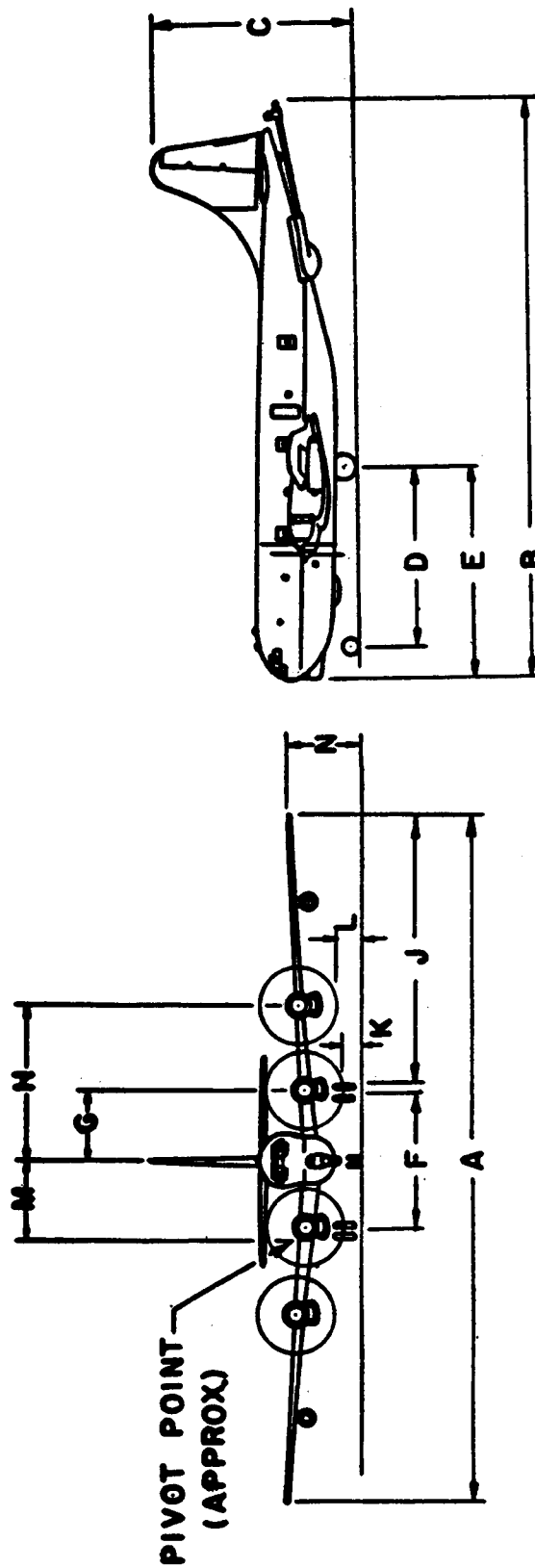


Figure A12-24. Boeing KC-97L

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|------------------------------|------------------------------|---------|--------|--------|--------|--------|-------|-------|--------|--------|-------|-------|--------|-------|----------------|
| | 301,600 LB | 185,000 LB | 130'10" | 136'3" | 38'5" | 45'8" | 63'1" | 22'1" | 27'2" | 46'1" | 51'11" | 2'4" | 4'8" | 36'7" | 12'4" | 107'0" |
| | 136,803 KG | 83,915 KG | 39.88M | 41.53M | 11.71M | 13.92M | 19.23M | 6.73M | 8.28M | 14.25M | 15.98M | 0.71M | 1.42M | 11.15M | 3.76M | 32.60M |

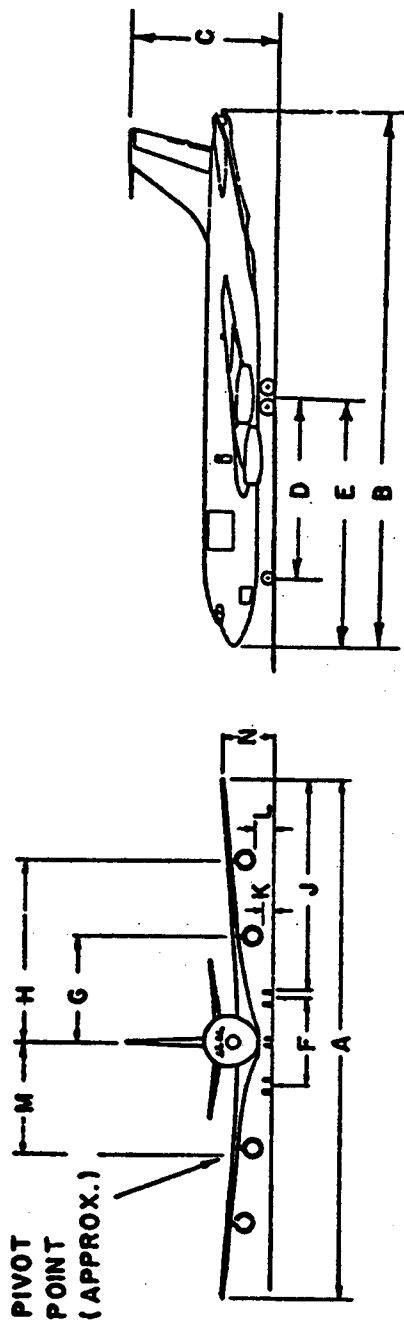


Figure A12-25. Boeing KC-135A

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------------|--------------------------|-------------------------|-------------------|-------------------|-----------------|-----------------|-----------------|-----------------|----------------|-----------------|-----------------|---------------|---------------|-----------------|-----------------|------------------|
| 720 | 229,300 LB 104,009 KG | 175,000 LB 79,379 KG | 130'10" 39.88M | 136'2" 41.50M | 41'5" 12.62M | 50'8" 15.44M | 68'1" 20.75M | 21'11" 6.67M | 27'2" 8.28M | 46'1" 14.05M | 52'6" 16.00M | 2'7" 0.79M | 4'3" 1.30M | 32'9" 9.98M | 10'10" 3.30M | 102'5" 31.22M |
| 720B | 234,300 LB 106,277 KG | 175,000 LB 79,379 KG | 130'10" 39.88M | 136'9" 41.68M | 41'2" 12.55M | 50'8" 15.44M | 68'1" 20.75M | 21'11" 6.67M | 27'2" 8.28M | 46'1" 14.05M | 52'6" 16.00M | 2'1" 0.64M | 3'9" 1.14M | 32'9" 9.98M | 10'10" 3.30M | 102'5" 31.22M |
| 707-120B | 257,340 LB 116,727 KG | 190,000 LB 86,183 KG | 130'10" 39.88M | 145'1" 44.22M | 41'8" 12.70M | 52'4" 15.95M | 69'9" 21.25M | 22'1" 6.73M | 27'2" 8.28M | 46'1" 14.05M | 52'3" 15.93M | 2'4" 0.71M | 4'2" 1.27M | 36'7" 11.15M | 11'7" 3.53M | 107'0" 32.61M |
| 707-320/420 | 312,000 LB 141,521 LB | 207,000 LB 93,894 KG | 142'5" 43.41M | 152'11" 46.61M | 42'2" 12.85M | 59'0" 17.98M | 76'5" 23.28M | 22'1" 6.73M | 32'6" 9.91M | 51'5" 15.67M | 58'1" 17.70M | 2'9" 0.84M | 4'7" 1.40M | 38'4" 11.68M | 12'1" 3.68M | 114'0" 34.75M |
| 707-320B,C | 327,000 LB 148,325 KG | 207,000 LB 93,894 KG | 145'9" 44.42M | 152'11" 46.61M | 42'1" 12.83M | 59'0" 17.98M | 76'5" 23.28M | 22'1" 6.73M | 32'6" 9.91M | 51'5" 15.67M | 59'9" 18.21M | 2'9" 0.84M | 4'7" 1.40M | 38'4" 11.68M | 12'1" 3.68M | 116'0" 35.36M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS:

707 333,600 LB (151,316 KG) MAXIMUM TAKEOFF WEIGHT.
320B 215,000 LB (97,522 KG) MAXIMUM LANDING WEIGHT.

707 333,600 LB (151,316 KG) MAXIMUM TAKEOFF WEIGHT.
320C 247,000 LB (112,037 KG) MAXIMUM LANDING WEIGHT.

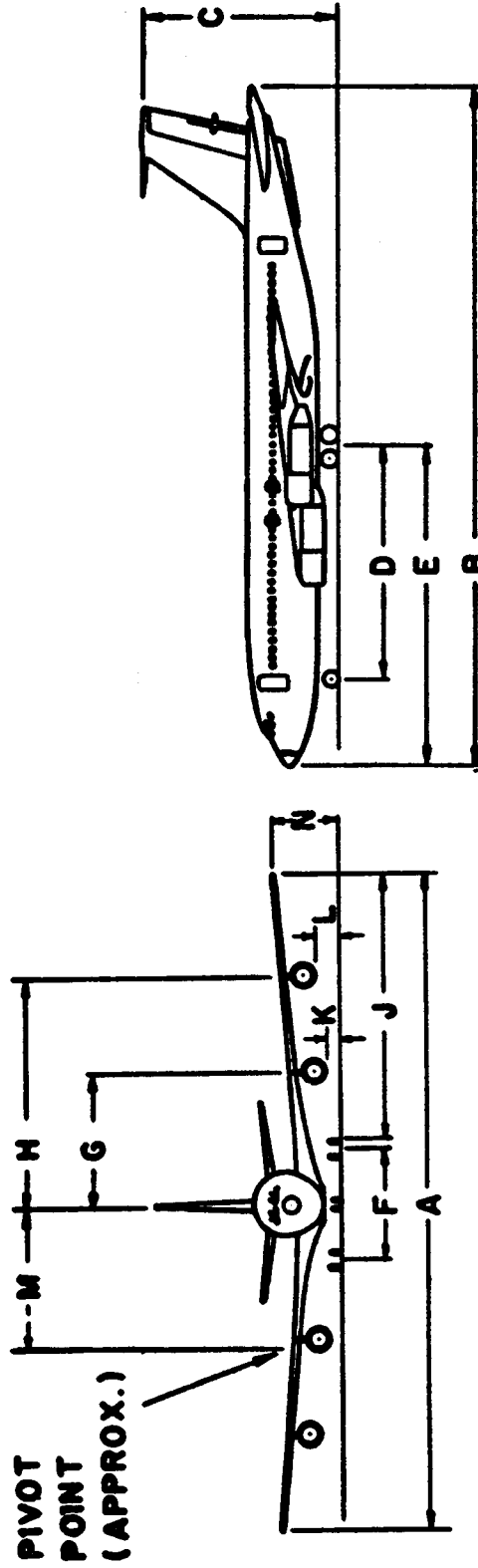


Figure A12-26. Boeing 707-720

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | P | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|--------|--------|--------|-------|-------|--------|-------|--------|-------|-------|-------------|
| 100 | 160,000 LB | 137,500 LB | 108'0" | 133'2" | 34'3" | 53'3" | 68'4" | 18'9" | 9'3" | 42'6" | 10'4" | 14'4" | 5'8" | 12'0" | 72'0" |
| | 72,575 KG | 62,369 KG | 32.92M | 40.59M | 10.44M | 16.23M | 20.83M | 5.72M | 2.82M | 12.95M | 3.15M | 4.37M | 1.72M | 3.66M | 21.95M |
| 100-C | 160,000 LB | 137,500 LB | 108'0" | 133'2" | 34'3" | 53'3" | 68'4" | 18'9" | 9'3" | 42'6" | 10'4" | 14'4" | 5'8" | 12'0" | 72'0" |
| | 72,575 KG | 62,369 KG | 32.92M | 40.59M | 10.44M | 16.23M | 20.83M | 5.72M | 2.82M | 12.95M | 3.15M | 4.37M | 1.72M | 3.66M | 21.95M |
| 200 | 172,000 LB | 150,000 LB | 108'0" | 153'2" | 34'11" | 63'3" | 78'4" | 18'9" | 9'3" | 42'4" | 10'4" | 16'11" | 4'9" | 12'0" | 82'0" |
| | 78,018 KG | 68,039 KG | 32.92M | 46.68M | 10.65M | 19.28M | 23.88M | 5.72M | 2.82M | 12.90M | 3.15M | 5.16M | 1.44M | 3.66M | 24.99M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS:

| | | | |
|------------------------|------------------------|-------------------------|-------------------------|
| 100 | 160,000 LB (72,575 KG) | 169,000 LB (76,657 KG) | MAXIMUM TAKEOFF WEIGHT. |
| 142,500 LB (64,637 KG) | 142,500 LB (64,637 KG) | MAXIMUM LANDING WEIGHT. | |
| 100C | 160,000 LB (72,575 KG) | 169,000 LB (76,657 KG) | MAXIMUM TAKEOFF WEIGHT. |
| 140,000 LB (63,503 KG) | 142,500 LB (64,637 KG) | MAXIMUM LANDING WEIGHT. | |
| 200 | 184,800 LB (83,824 KG) | 190,500 LB (86,409 KG) | MAXIMUM TAKEOFF WEIGHT. |
| 154,500 LB (70,080 KG) | 154,500 LB (70,080 KG) | 154,500 LB (70,080 KG) | MAXIMUM LANDING WEIGHT. |

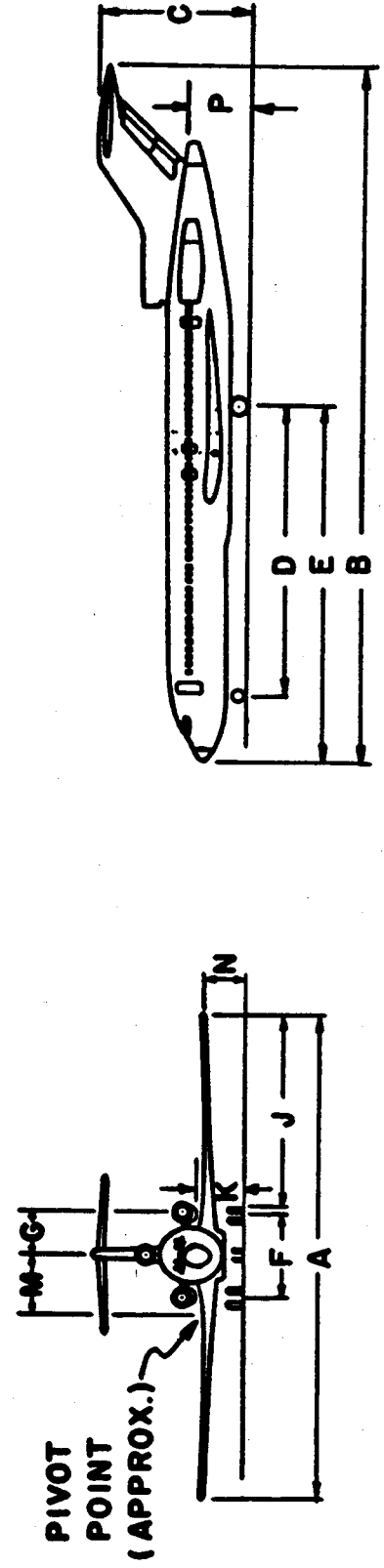


Figure A12-27. Boeing 727

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | M | TURN RADIUS |
|-------|------------------------------|------------------------------|-----------------|------------------|-----------------|------------------|-----------------|----------------|-----------------|------------------|---------------|----------------|----------------|-----------------|
| 100 | 97,000 LB 43 998 KG | 89,700 LB 40 687 KG | 93'0" 28.35M | 94'0" 28.65M | 37'2" 11.33M | 34'4" 10.46M | 47'4" 14.42M | 17'2" 5.23M | 15'10" 4.83M | 36'1" 11.00M | 1'8" 0.51M | 9'2" 2.80M | 10'0" 3.05M | 57'2" 17.42M |
| 200 | 100,000 LB 45 359 KG | 95,000 LB 43 091 KG | 93'0" 28.35M | 100'2" 30.53M | 37'3" 11.35M | 37'4" 11.38M | 50'4" 15.34M | 17'2" 5.23M | 15'10" 4.83M | 36'1" 11.00M | 1'8" 0.51M | 10'0" 3.05M | 10'0" 3.05M | 58'2" 17.73M |
| 300 | 124,500 LB 56 472 KG | 114,000 LB 51 710 KG | 94'9" 28.88M | 109'7" 33.40M | 36'7" 11.15M | 40'10" 12.45M | 54'0" 16.46M | 17'2" 5.23M | 15'10" 4.83M | 36'11" 11.25M | 1'6" 0.46M | 11'0" 3.35M | 10'0" 3.05M | 64'0" 19.51M |
| 400 | 138,500 LB 68 823 KG | 121,000 LB 54 885 KG | 94'9" 28.88M | 119'7" 36.45M | 36'7" 11.15M | 46'10" 14.27M | 60'0" 18.29M | 17'2" 5.23M | 15'10" 4.83M | 36'11" 11.25M | 1'6" 0.46M | 12'6" 3.81M | 10'0" 3.05M | 69'4" 20.83M |
| 500 | 115,500 LB 52 390 KG | 110,000 LB 49 895 KG | 94'9" 28.88M | 101'9" 30.01M | 36'7" 11.15M | 36'4" 11.07M | 49'6" 15.09M | 17'2" 5.23M | 15'10" 4.83M | 36'11" 11.25M | 1'6" 0.46M | 9'8" 2.95M | 10'0" 3.05M | 60'7" 18.47M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS.

| | | | |
|---------------------|--|--|--|
| 100 | 103,000 LB (46 720 KG) 96,000 LB (44 452 KG) | 110,000 LB (49 895 KG) 99,000 LB (44 906 KG) | MAXIMUM TAKEOFF WEIGHT. MAXIMUM LANDING WEIGHT. |
| 200 | 103,000 LB (46 720 KG) 95,000 LB (43 091 KG) | 109,000 LB (49 442 KG) 98,000 LB (44 452 KG) | 115,500 LB (52 390 KG) MAXIMUM TAKEOFF WEIGHT. 103,000 LB (46 720 KG) MAXIMUM LANDING WEIGHT. |
| 200 CONV | 109,000 LB (49 442 KG) 96,000 LB (44 452 KG) | 110,000 LB (49 895 KG) 99,000 LB (44 906 KG) | 115,500 LB (52 390 KG) MAXIMUM TAKEOFF WEIGHT. 103,000 LB (46 720 KG) MAXIMUM LANDING WEIGHT. |
| 200 ADV C, OC | 115,500 LB (52 390 KG) 103,000 LB (46 720 KG) | 117,000 LB (53 070 KG) 105,000 LB (47 627 KG) | 124,500 LB (56 472 KG) MAXIMUM TAKEOFF WEIGHT. 107,000 LB (48 534 KG) MAXIMUM LANDING WEIGHT. |
| 300 | 130,000 LB (58 967 KG) 114,000 LB (51 710 KG) | 135,000 LB (61 235 KG) 114,000 LB (51 710 KG) | 138,500 LB (62 823 KG) MAXIMUM TAKEOFF WEIGHT. 115,600 LB (52 526 KG) MAXIMUM LANDING WEIGHT. |
| 400 | 142,500 LB (64 637 KG) 121,000 LB (54 885 KG) | 150,000 LB (68 039 KG) 124,000 LB (56 245 KG) | 150,000 LB (68 039 KG) MAXIMUM TAKEOFF WEIGHT. 124,000 LB (56 245 KG) MAXIMUM LANDING WEIGHT. |
| 500 | 124,500 LB (56 472 KG) 110,000 LB (49 895 KG) | 133,500 LB (60 555 KG) 110,000 LB (49 895 KG) | 133,500 LB (60 555 KG) MAXIMUM TAKEOFF WEIGHT. 110,000 LB (49 895 KG) MAXIMUM LANDING WEIGHT. |

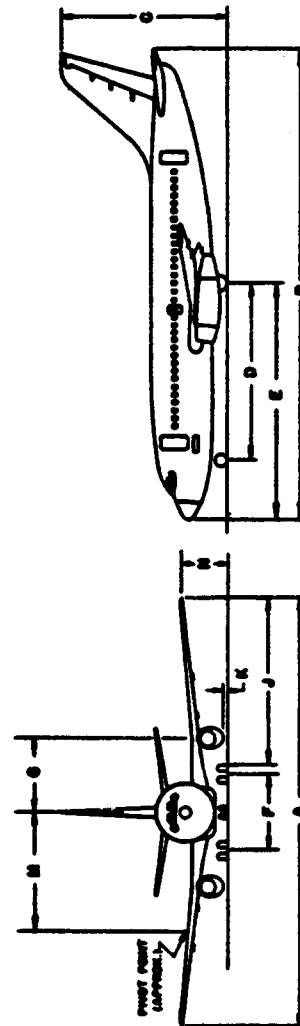


Figure A12-28. Boeing 737

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | TURN RADIUS | |
|------------|------------------------|------------------------|--------|---------|--------|--------|--------|--------|--------|--------|--------|-------|-------|--------|-------------|--------|
| 100B | SEE NOTE | SEE NOTE | 195'8" | 231'10" | 64'3" | 84'0" | 109'5" | 36'1" | 39'9" | 69'10" | 77'3" | 3'9" | 4'11" | 40'0" | 17'7" | 151'0" |
| 200B, C | SEE NOTE | SEE NOTE | 59.64M | 70.66M | 19.58M | 25.60M | 33.35M | 11.00M | 12.12M | 21.29M | 23.55M | 1.14M | 1.50M | 12.19M | 5.36M | 46.02M |
| 300PASS | | | | | | | | | | | | | | | | |
| 200C | SEE NOTE | SEE NOTE | 195'8" | 231'10" | 64'8" | 84'0" | 109'5" | 36'1" | 39'9" | 69'10" | 77'3" | 3'9" | 6'0" | 40'0" | 17'7" | 151'0" |
| 200F | SEE NOTE | SEE NOTE | 59.64M | 70.66M | 19.71M | 25.60M | 33.35M | 11.00M | 12.12M | 21.29M | 23.55M | 1.14M | 1.83M | 12.19M | 5.36M | 46.02M |
| 200C CARGO | | | | | | | | | | | | | | | | |
| SP | SEE NOTE | SEE NOTE | 195'8" | 184'9" | 65'10" | 67'4" | 92'9" | 36'1" | 39'2" | 69'6" | 77'4" | 3'7" | 5'7" | 40'0" | 17'2" | 151'0" |
| 400 | SEE NOTE | SEE NOTE | 59.64M | 56.31M | 20.07M | 20.52M | 28.27M | 11.00M | 11.94M | 21.18M | 23.57M | 1.09M | 1.70M | 12.19M | 5.23M | 46.02M |
| 400 | SEE NOTE | SEE NOTE | 213'0" | 231'10" | 64'3" | 84'0" | 109'5" | 36'1" | 39'2" | 69'6" | 85'10" | 3'9" | 6'0" | 40'0" | 16'9" | 159'0" |
| 400 | SEE NOTE | SEE NOTE | 64.92M | 70.66M | 19.58M | 25.60M | 33.35M | 11.00M | 11.94M | 21.18M | 26.16M | 1.14M | 1.83M | 12.19M | 5.11M | 48.46M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS. 564-585 DENOTES STANDARD AND OPTIONAL WEIGHT IN THOUSANDS OF POUNDS.

| METRIC CONVERSION TABLE | |
|-------------------------|-----------|
| POUNDS | KILOGRAMS |
| 450,000 | 204 117 |
| 465,000 | 210 920 |
| 515,000 | 233 600 |
| 520,000 | 235 868 |
| 535,000 | 242 672 |
| 564,000 | 255 826 |
| 571,000 | 250 001 |
| 574,000 | 260 362 |
| 585,000 | 265 352 |
| 600,000 | 272 155 |
| 605,000 | 274 423 |
| 630,000 | 285 763 |
| 660,000 | 299 371 |
| 670,000 | 303 907 |

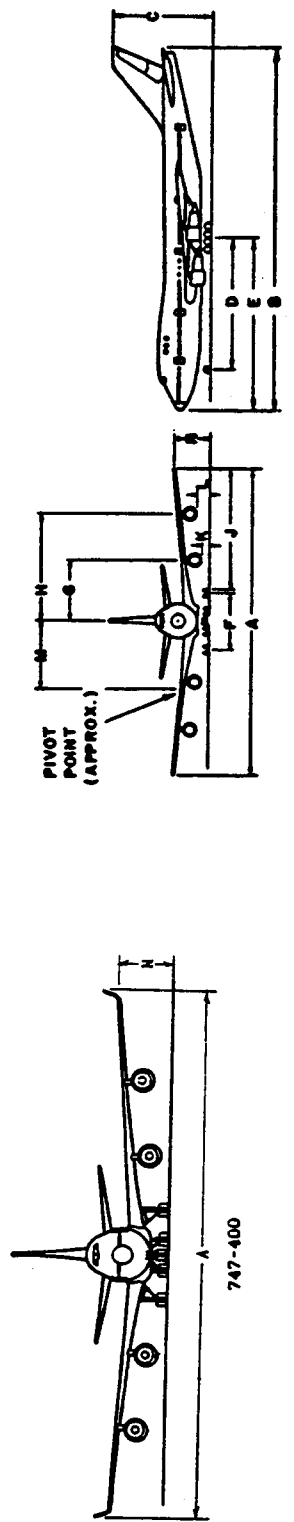


Figure A12-29. Boeing 747

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | N | N | TURN RADIUS |
|---------|------------------------------|------------------------------|---------|--------|--------|--------|--------|-------|-------|--------|-------|--------|-------|----------------|
| 757-200 | SEE NOTE | SEE NOTE | 124°10' | 155'3" | 45°1' | 60'0" | 79'4" | 24'0" | 21'3" | 48'2" | 2'5" | 35'0" | 15'4" | 90°0" |
| -200PF | | | 38.05M | 47.32M | 13.74M | 18.29M | 24.18M | 7.32M | 6.48M | 14.68M | 0.74M | 10.67M | 4.67M | 29.87M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS.

| | | | | | | |
|---------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| 757-300 | 220,000 LB (99 790 KG) | 230,000 LB (104 326 KG) | 240,000 LB (108 862 KG) | 250,000 LB (113 398 KG) | 255,000 LB (115 666 KG) | MAXIMUM TAKEOFF WEIGHT. |
| 82211 | 198,000 LB (89 811 KG) | 198,000 LB (89 811 KG) | 198,000 LB (89 811 KG) | 198,000 LB (89 811 KG) | 210,000 LB (95 254 KG) | MAXIMUM TAKEOFF WEIGHT. |
| -335C | | | | | | |
| -335E4 | | | | | | |
| -335E4B | | | | | | |
| FW2037 | | | | | | |
| FW2040 | | | | | | |

757 250,000 LB (113 399 KG) 255,000 LB (115 666 KG) MAXIMUM TAKEOFF WEIGHT.
 -200PF 210,000 LB (95 254 KG) 210,000 LB (95 254 KG) MAXIMUM LANDING WEIGHT.
 • 255,500 LB (115 893 KG) FOR AIRPORT ALTITUDES BELOW 1,500 FT.

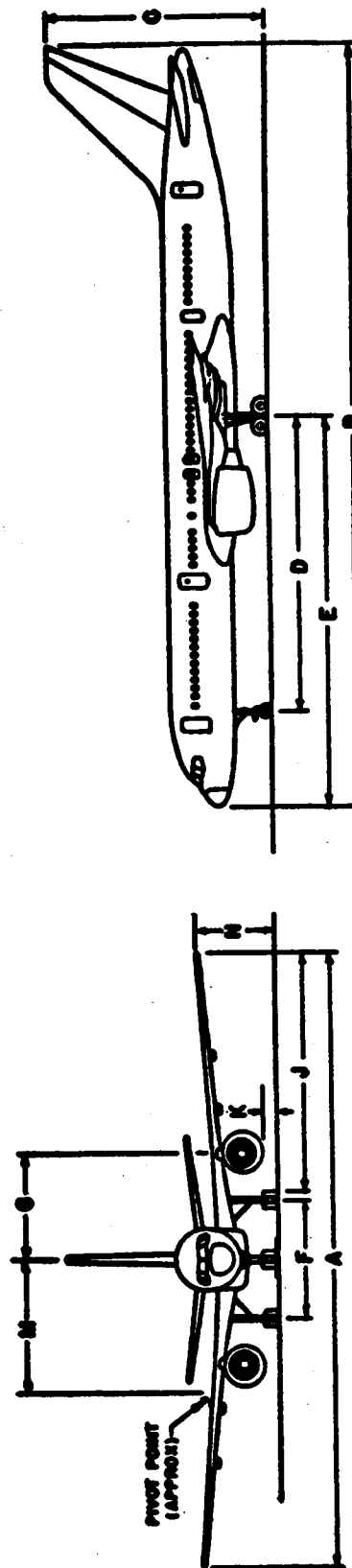


Figure A12-30. Boeing 757

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-------|-------------------------|-------------------------|--------|--------|--------|--------|--------|-------|-------|--------|-------|--------|-------|-------------|
| 200 | 282,000 LB (127 913 KG) | 257,000 LB (116 573 KG) | 159'2" | 159'2" | 52'11" | 64'7" | 79'6" | 30'6" | 26'0" | 60'1" | 2'8" | 36'0" | 16'3" | 117'0" |
| | | | 47.57M | 48.51M | 16.13M | 19.69M | 24.23M | 9.30M | 7.92M | 18.31M | 0.81M | 10.97M | 4.95M | 35.66M |
| 200ER | 335,000 LB (151 953 KG) | 278,000 LB (126 099 KG) | 156'1" | 159'2" | 52'11" | 64'7" | 79'6" | 30'6" | 26'0" | 60'1" | 2'8" | 36'0" | 16'3" | 117'0" |
| | | | 47.57M | 48.51M | 16.13M | 19.69M | 24.23M | 9.30M | 7.92M | 18.31M | 0.81M | 10.97M | 4.95M | 35.66M |
| 300 | 345,000 LB (156 489 KG) | 300,000 LB (136 078 KG) | 156'1" | 180'3" | 52'7" | 74'8" | 89'7" | 30'6" | 26'0" | 60'1" | 2'10" | 41'0" | 16'1" | 123'0" |
| | | | 47.57M | 54.94M | 16.03M | 22.76M | 27.31M | 9.30M | 7.92M | 18.31M | 0.86M | 12.50M | 4.90M | 37.49M |
| 300ER | 380,000 LB (172 365 KG) | 300,000 LB (136 078 KG) | 156'1" | 180'3" | 52'7" | 74'8" | 89'7" | 30'6" | 26'0" | 60'1" | 2'10" | 41'0" | 16'1" | 123'0" |
| | | | 47.57M | 54.94M | 16.03M | 22.76M | 27.31M | 9.30M | 7.92M | 18.31M | 0.86M | 12.50M | 4.90M | 37.49M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS:

| | | | | |
|-------|-------------------------|-------------------------|-------------------------|-------------------------|
| 200 | 300,000 LB (136 078 KG) | 310,000 LB (140 614 KG) | 315,000 LB (142 882 KG) | MAXIMUM TAKEOFF WEIGHT. |
| | 270,000 LB (122 470 KG) | 270,000 LB (122 470 KG) | 272,000 LB (123 377 KG) | MAXIMUM LANDING WEIGHT. |
| 200ER | 345,000 LB (156 489 KG) | 351,000 LB (159 211 KG) | 380,000 LB (172 365 KG) | MAXIMUM TAKEOFF WEIGHT. |
| | 278,000 LB (126 099 KG) | 278,000 LB (126 099 KG) | 285,000 LB (129 274 KG) | MAXIMUM LANDING WEIGHT. |
| 300 | 350,000 LB (158 757 KG) | MAXIMUM TAKEOFF WEIGHT. | MAXIMUM TAKEOFF WEIGHT. | MAXIMUM TAKEOFF WEIGHT. |
| | 300,000 LB (136 078 KG) | MAXIMUM LANDING WEIGHT. | MAXIMUM LANDING WEIGHT. | MAXIMUM LANDING WEIGHT. |
| 300ER | 387,000 LB (175 540 KG) | 400,000 LB (181 437 KG) | 407,000 LB (184 612 KG) | MAXIMUM TAKEOFF WEIGHT. |
| | 300,000 LB (136 078 KG) | 320,000 LB (145 150 KG) | 320,000 LB (145 150 KG) | MAXIMUM LANDING WEIGHT. |

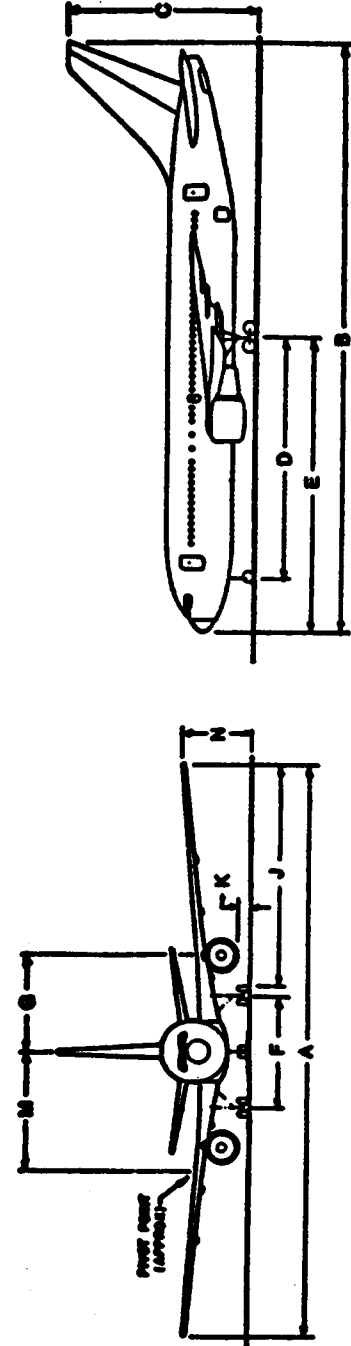


Figure A12-31. Boeing 767

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|-------------------------|------------------------|-----------------|------------------|----------------|-----------------|------------------|----------------|----------------|----------------|-----------------|---------------|---------------|----------------|-----------------|------------------|
| 100 | 74,600 LB 33,838 KG | 71,800 LB 32,591 KG | 86'5" 26.34M | 85'10" 26.16M | 28'3" 8.61M | 33'1" 10.08M | 40'7" 12.37M | 15'6" 4.72M | 13'7" 4.14M | 22'4" 6.81M | 33'8" 10.26M | 5'0" 1.52M | 4'8" 1.42M | 15'6" 4.72M | 13'11" 4.24M | 37'10" 11.53M |
| 200 | 88,250 LB 40,030 KG | 77,000 LB 34,927 KG | 86'5" 26.34M | 93'8" 28.55M | 28'3" 8.61M | 36'9" 11.20M | 44'2" 13.46M | 15'6" 4.72M | 13'7" 4.14M | 22'4" 6.81M | 33'8" 10.26M | 5'0" 1.52M | 4'7" 1.40M | 15'6" 4.72M | 13'11" 4.24M | 41'2" 12.55M |
| 300 | 104,000 LB 47,174 KG | 90,000 LB 40,823 KG | 86'5" 26.34M | 104'2" 31.75M | 28'1" 8.56M | 36'9" 11.20M | 48'10" 14.68M | 15'6" 4.72M | 13'7" 4.14M | 22'4" 6.81M | 33'8" 10.26M | 5'0" 1.52M | 4'7" 1.40M | 15'6" 4.72M | 13'11" 4.24M | 46'8" 14.22M |

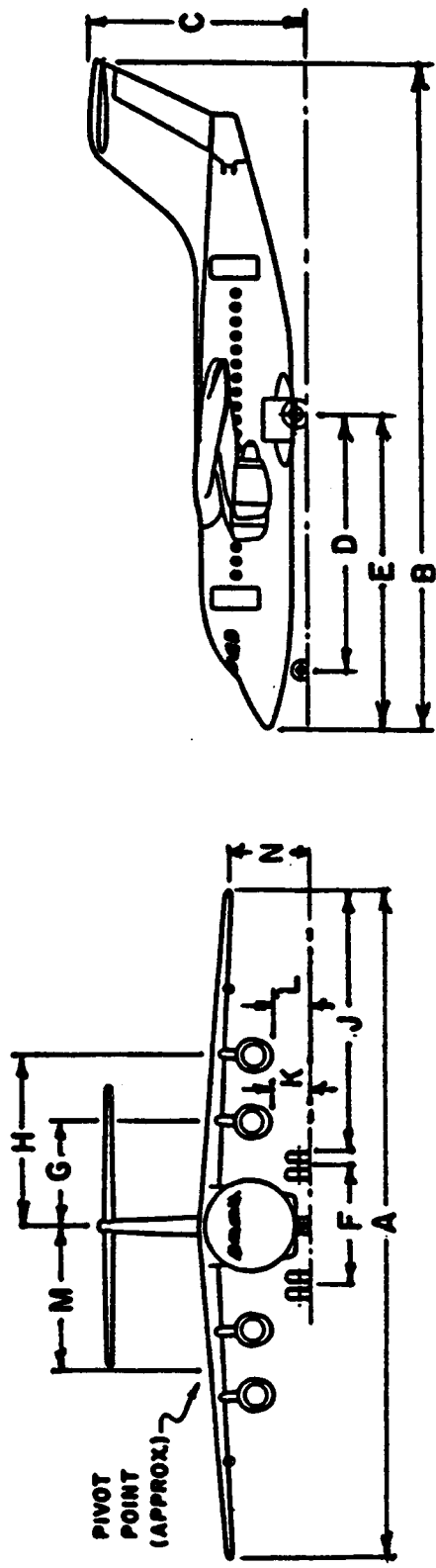


Figure A12-32. British Aerospace 146

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|-------------------------|-------------------------|------------------|-------------------|-----------------|------------------|-----------------|----------------|----------------|----------------|------------------|---------------|---------------|----------------|------------------|-------------|
| 44D4 | 210,000 LB 95 254 KG | 165,000 LB 74 843 KG | 142'4" 43.38M | 136'10" 41.71M | 38'5" 11.71M | 49'11" 15.21M | 62'8" 19.10M | 31'0" 9.45M | 15'6" 4.72M | 31'8" 9.65M | 53'11" 16.43M | 1'2" 0.36M | 1'8" 0.51M | 10'3" 3.12M | 113'0" 34.44M | |
| 44-6 | 205,000 LB 92 986 KG | 165,000 LB 74 843 KG | 142'4" 43.38M | 136'10" 41.71M | 38'5" 11.71M | 49'11" 15.21M | 62'8" 19.10M | 31'0" 9.45M | 15'6" 4.72M | 31'8" 9.65M | 53'11" 16.43M | 1'2" 0.36M | 1'8" 0.51M | 10'3" 3.12M | 113'0" 34.44M | |
| 44-J | 210,000 LB 95 254 KG | 175,000 LB 79 379 KG | 142'4" 43.38M | 152'0" 46.33M | 38'5" 11.71M | 60'0" 18.29M | 72'9" 22.17M | 31'0" 9.45M | 15'6" 4.72M | 31'8" 9.65M | 53'11" 16.43M | 1'2" 0.36M | 1'8" 0.51M | 10'3" 3.12M | 113'0" 34.44M | |

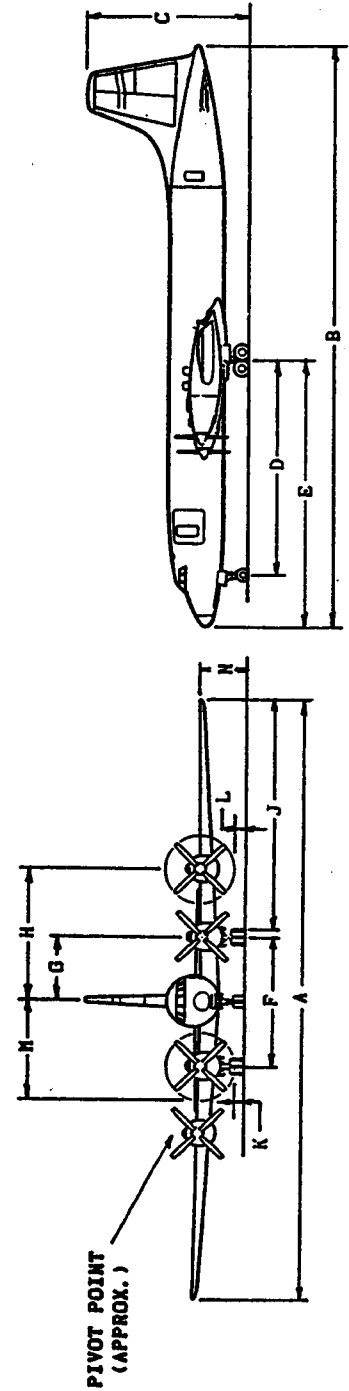


Figure A12-33. Canadiar CL-44

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-------|------------------------------|------------------------------|------------------|-----------------|----------------|----------------|-----------------|----------------|----------------|-----------------|---------------|---|----------------|-----------------|
| 66 | 58,156 LB 26,379 KG | 53,000 LB 24,040 KG | 105'4" 32.11M | 81'6" 24.84M | 29'2" 8.89M | 26'2" 7.98M | 35'3" 10.74M | 25'0" 7.62M | 12'6" 3.81M | 39'0" 11.89M | 1'0" 0.30M | | 13'0" 3.96M | 65'0" 19.81M |

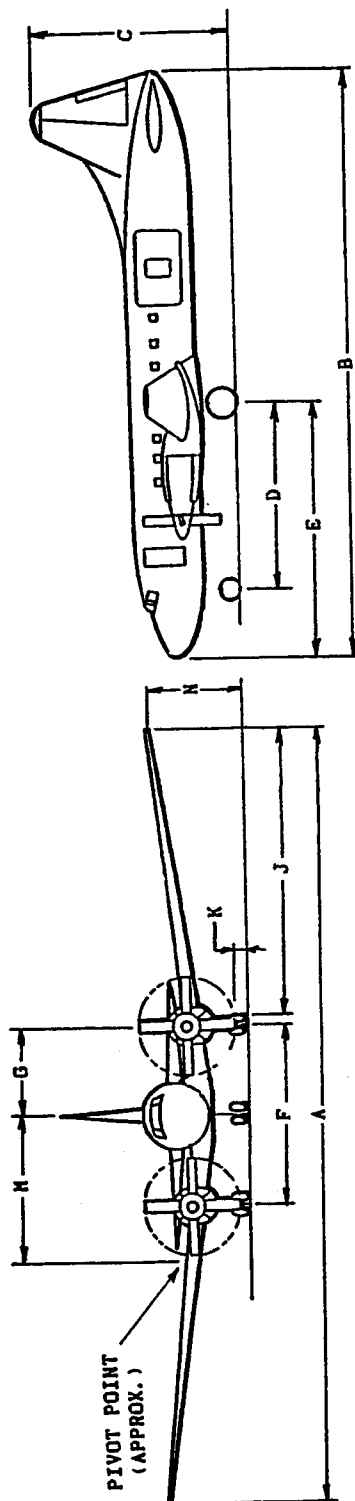


Figure A12-34. Canadiar CL-66

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | M | TURN RADIUS |
|-------|------------------------------|------------------------------|-----------------|------------------|-----------------|----------------|---|----------------|---|-----------------|---|---|---|----------------|
| I | 11,850 LB 5 375 KG | 11,350 LB 5 146 KG | 47'1" 14.35M | 43'6" 13.26M | 14'4" 4.37M | 15'2" 4.62M | | 12'7" 3.84M | | 14'11" 4.55M | | | | |
| II | 13,300 LB 6 033 KG | 12,700 LB 5 761 KG | 51'8" 15.75M | 47'2" 14.38M | 15'0" 4.57M | | | | | | | | | |
| 8/II | 15,100 LB 6 849 KG | 14,400 LB 6 532 KG | 52'2" 15.90M | 47'2" 14.38M | 15'0" 4.57M | | | | | | | | | |
| III | 22,000 LB 9 979 KG | 20,000 LB 9 072 KG | 53'6" 16.31M | 55'6" 16.92M | 16'10" 5.13M | | | | | | | | | |
| V | 16,100 LB 7 303 KG | | 52'2" 15.90M | 49'11" 14.91M | 15'0" 4.57M | | | | | | | | | |

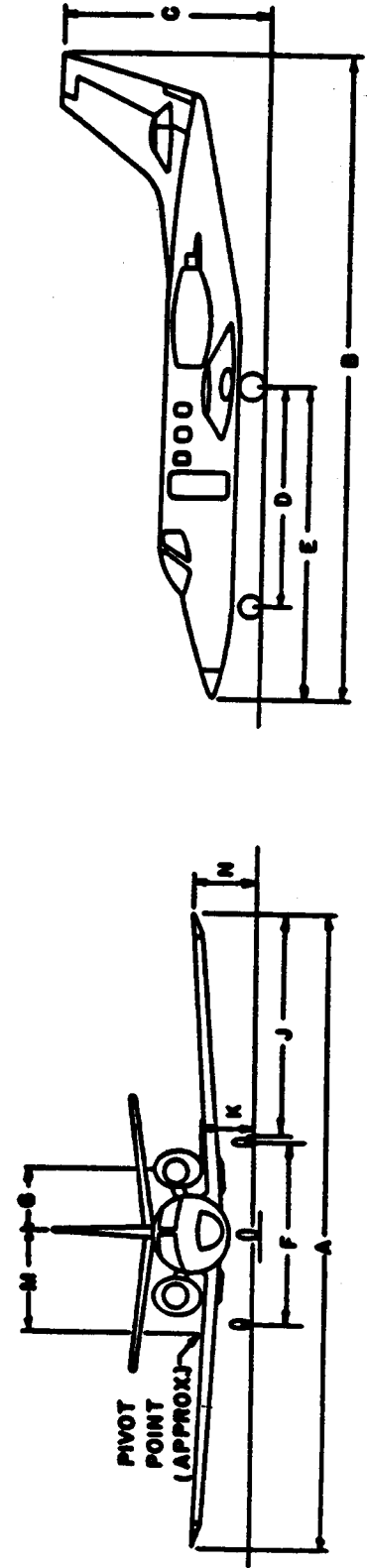
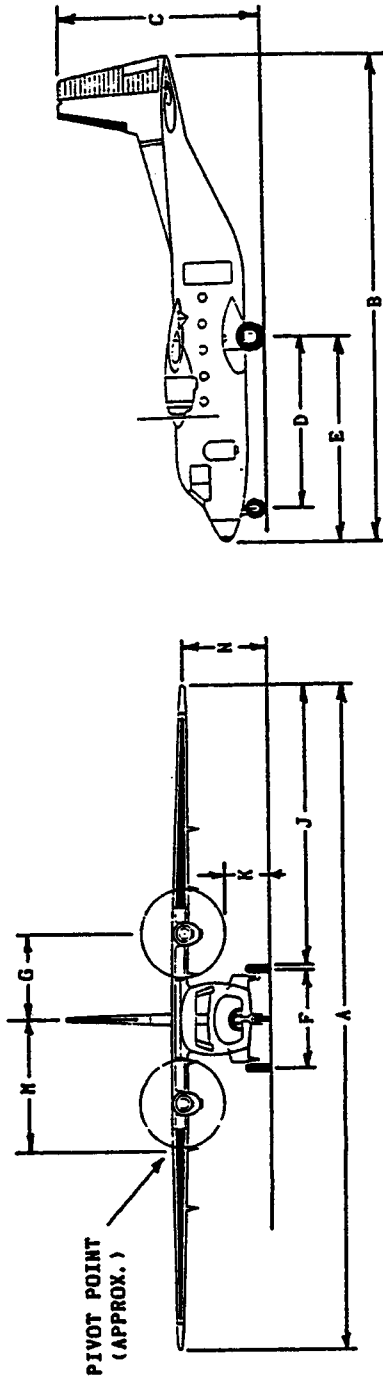
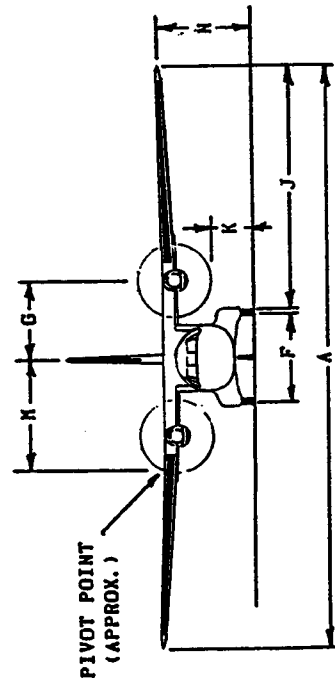


Figure A12-35. Cessna Citation

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|--------|--------|--------|-------|-------|--------|-------|-------|--------|-------------|
| C-212 | 16,976 LB | 16,424 LB | 62'3" | 49'10" | 20'8" | 17'10" | 10'2" | 3.10M | 8'8" | 26'1" | 4'2" | 9'2" | 2.79M | 49'2" |
| 200 | 7 700 KG | 7 450 KG | 18.97M | 15.19M | 6.30M | 5.44M | 3.10M | 2.64M | 2.64M | 7.95M | 1.27M | 2.79M | 2.79M | 14.95M |
| 235 | 31,752 LB | 31,311 LB | 84'8" | 70'3" | 26'10" | 22'8" | 12'10" | 3.91M | 11'6" | 35'11" | 5'2" | 3'51M | 10.95M | 1.57M |
| | 14 402 KG | 14 202 KG | 25.61M | 21.41M | 8.18M | 6.91M | 3.91M | 3.51M | 3.51M | 10.95M | 1.57M | 3.51M | 10.95M | 1.57M |



C-212



CN-235

Figure A12-36. Construcciones Aeronauticas CASA C-212 and 235

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | N | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|--------|--------|--------|-------|-------|--------|-------|-------|-------|-------------|
| 240 | 41,790 LB | 39,800 LB | 91'9" | 74'8" | 26'11" | 24'10" | 32'9" | 25'0" | 12'6" | 32'2" | 1'0" | 14'8" | 9'0" | 60'6" |
| | 18 956 KG | 18 053 KG | 27.97M | 22.76M | 8.20M | 7.57M | 9.98M | 7.62M | 3.81M | 9.80M | 0.31M | 4.47M | 2.74M | 18.44M |
| 340 | 49,100 LB | 46,500 LB | 105'4" | 81'6" | 28'2" | 26'2" | 34'1" | 25'0" | 12'6" | 38'7" | 1'0" | 14'8" | 11'0" | 67'4" |
| | 22 271 KG | 21 092 KG | 32.18M | 24.84M | 8.59M | 7.98M | 10.39M | 7.62M | 3.81M | 11.76M | 0.31M | 4.47M | 3.35M | 20.52M |
| 440 | 49,100 LB | 47,650 LB | 105'4" | 81'6" | 28'2" | 26'2" | 36'5" | 25'0" | 12'6" | 38'7" | 1'0" | 14'8" | 11'0" | 67'4" |
| | 22 271 KG | 21 614 KG | 32.18M | 24.84M | 8.59M | 7.98M | 11.10M | 7.62M | 3.81M | 11.76M | 0.31M | 4.47M | 3.35M | 20.52M |
| 580 | 54,600 LB | 52,000 LB | 105'4" | 81'6" | 29'2" | 26'2" | 36'5" | 25'0" | 12'6" | 38'7" | 1'0" | 14'8" | 11'0" | 67'4" |
| | 24 766 KG | 23 587 KG | 32.18M | 24.84M | 8.89M | 7.98M | 11.10M | 7.62M | 3.81M | 11.76M | 0.31M | 4.47M | 3.35M | 20.52M |
| 600 | 46,200 LB | 44,000 LB | 91'9" | 74'8" | 26'11" | 24'10" | 32'9" | 25'0" | 12'6" | 32'2" | 1'3" | 14'8" | 9'0" | 60'6" |
| | 20 956 KG | 19 958 KG | 27.97M | 22.76M | 8.20M | 7.57M | 9.98M | 7.62M | 3.81M | 9.80M | 0.38M | 4.47M | 2.74M | 18.44M |
| 640 | 55,000 LB | 52,500 LB | 105'4" | 81'6" | 28'2" | 26'2" | 36'5" | 25'0" | 12'6" | 38'7" | 1'1" | 14'8" | 11'0" | 67'4" |
| | 24 948 KG | 23 814 KG | 32.18M | 24.84M | 8.59M | 7.98M | 11.10M | 7.62M | 3.81M | 11.76M | 0.33M | 4.47M | 3.35M | 20.52M |

NOTE: MODELS 240, 340, 440 HAVE RECIPROCATING ENGINES. ALL OTHERS HAVE TURBOPROP ENGINES.

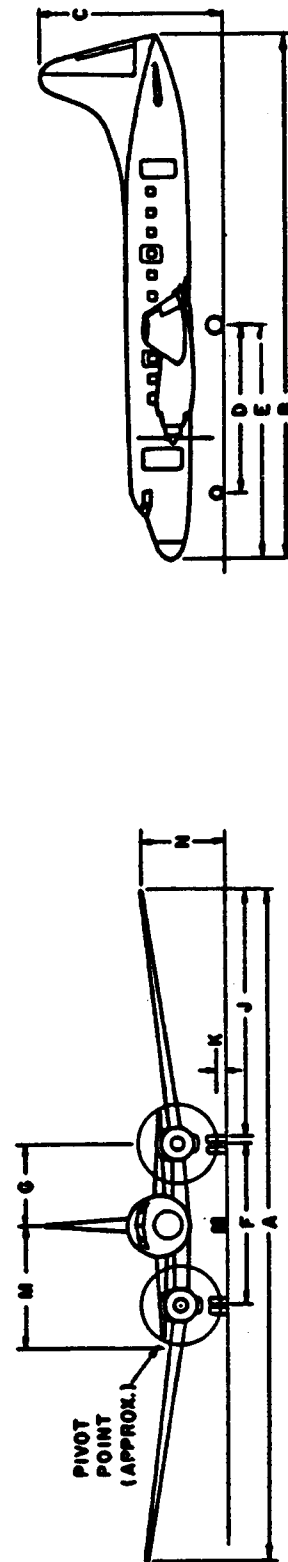


Figure A12-37. Convair-liner and Turboprop Conversions

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|---------|------------------------------|------------------------------|-----------------|-----------------|-----------------|---|---|----------------|---|-----------------|---|---|---|----------------|
| CARIBOU | 28,500 LB 12 927 KG | 28,500 LB 12 927 KG | 95'7" 29.13M | 72'7" 22.12M | 31'10" 9.70M | | | 23'1" 7.04M | | 35'3" 10.74M | | | | |

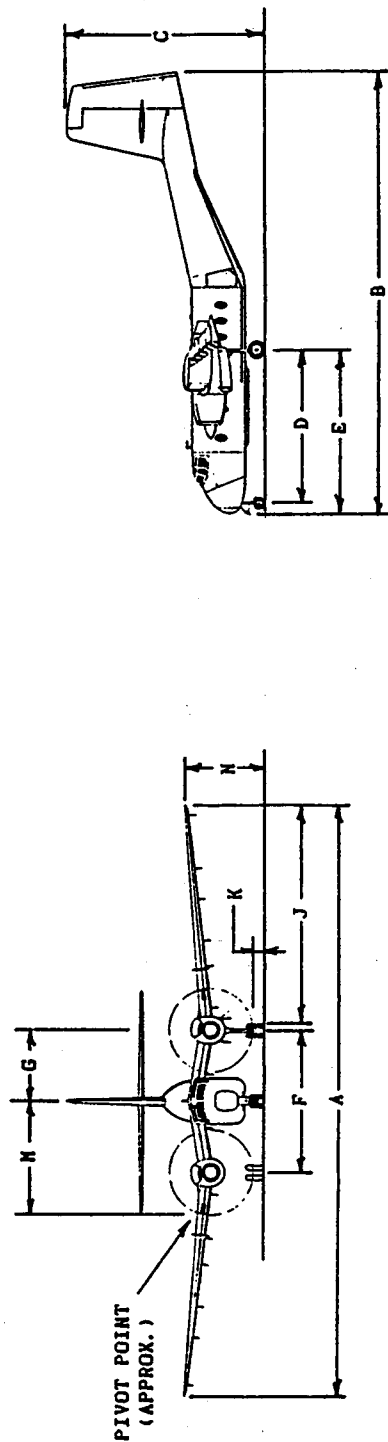


Figure A12-38. De Havilland Canada C-7 Caribou

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|---------------|------------------------|------------------------|-----------------|-----------------|----------------|----------------|---|-----------------|-----------------|-----------------|---------------|---|-----------------|-------------|
| DASH 7 | 43,000 LB 19,504 KG | 41,000 LB 18,597 KG | 93'0" 28.35M | 80'8" 24.59M | 26'2" 7.98M | 27'6" 8.38M | | 23'6" 7.16M | | 33'8" 10.26M | 5'3" 1.60M | | 14'2" 4.32M | |
| DASH 8 100 | 34,500 LB 15,649 KG | 33,900 LB 15,377 KG | 90'0" 27.43M | 84'3" 25.68M | 24'7" 7.49M | 32'2" 9.80M | | 25'10" 7.87M | 12'11" 3.94M | | 3'1" 0.94M | | 11'11" 3.63M | |
| DASH 8 300 | 41,100 LB 18,643 KG | 40,000 LB 18,144 KG | 90'0" 27.43M | 84'3" 25.68M | 24'7" 7.49M | 32'2" 9.80M | | 25'10" 7.87M | 12'11" 3.94M | | 3'1" 0.94M | | 11'11" 3.63M | |

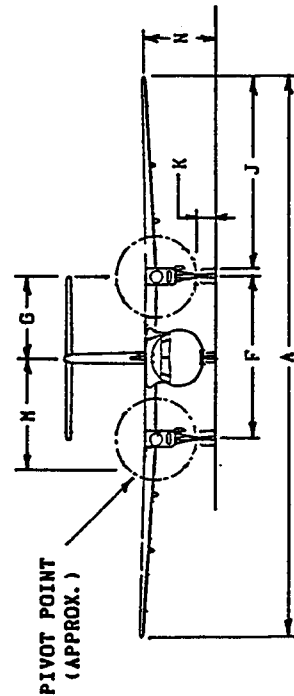
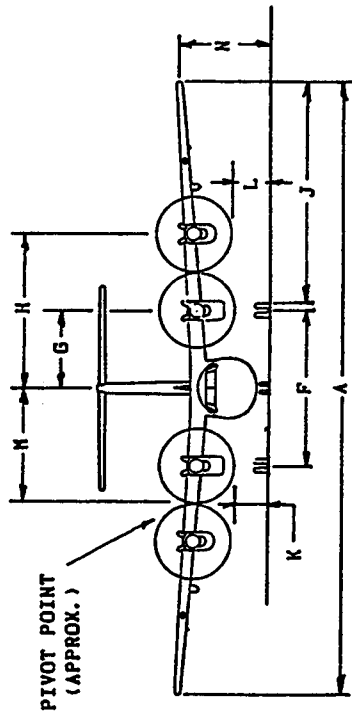


Figure A12-39. De Havilland Canada DASH 7 & DASH 8

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|----------------|-------------------------|-------------------------|--------|--------|-------|-------|-------|-------|-------|---|---|------|---|---|---|-------------|
| COLISEE-MASTER | 175,000 LB 79,379 KG | 110,000 LB 49,895 KG | 174°2' | 130°5' | 48°4' | 37°3' | 34°2' | 34°2' | 17°1' | | | 3°0' | | | | 0.91M |

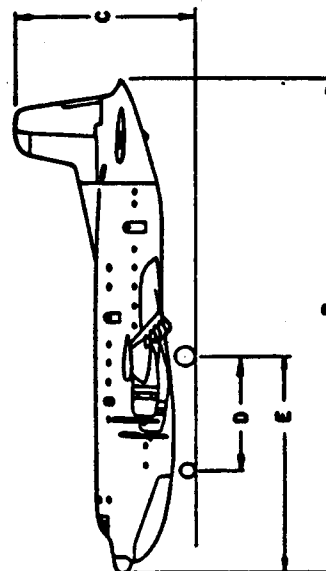
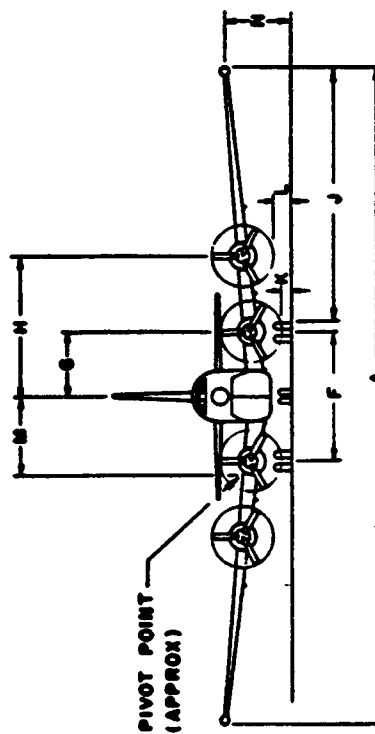


Figure A12-40. Douglas C-124 Globemaster

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|---------------|------------------------------|------------------------------|-----------------|-----------------|----------------|----------------|----------------|-----------------|-----------------|
| TWIN OTTER | 12,500 LB 5 670 KG | 12,300 LB 5 579 KG | 65'0" 19.81M | 51'8" 15.75M | 19'6" 5.94M | 14'9" 4.50M | 12'6" 3.81M | 21 | 48'0" 14.63M |

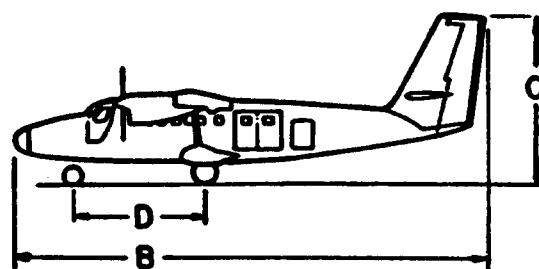
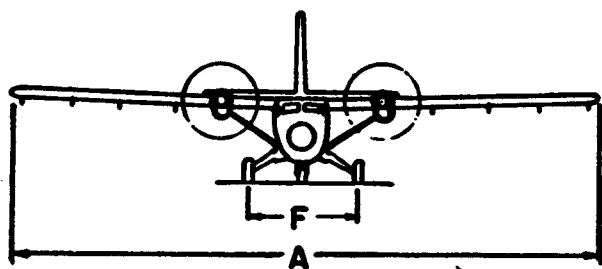


Figure A12-41. De Havilland Canada DHC-6 Twin Otter

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-------------|------------------------------|------------------------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|----------------|-----------------|---------------|----------------|---------------|-----------------|
| 228- 201 | 13,183 LB 5 900 KG | 13,007 LB 5 900 KG | 55'8" 16.97M | 54'4" 16.56M | 15'11" 4.85M | 20'8" 6.30M | 25'5" 7.75M | 10'10" 3.30M | 7'10" 2.39M | 21'11" 6.68M | 3'6" 1.07M | 21'4" 6.50M | 6'3" 1.91M | 48'6" 14.78M |
| 228- 202 | 13,669 LB 6 200 KG | 13,007 LB 5 900 KG | 55'8" 16.97M | 54'4" 16.56M | 15'11" 4.85M | 20'8" 6.30M | 25'5" 7.75M | 10'10" 3.30M | 7'10" 2.39M | 21'11" 6.68M | 3'6" 1.07M | 21'4" 6.50M | 6'3" 1.91M | 48'6" 14.78M |

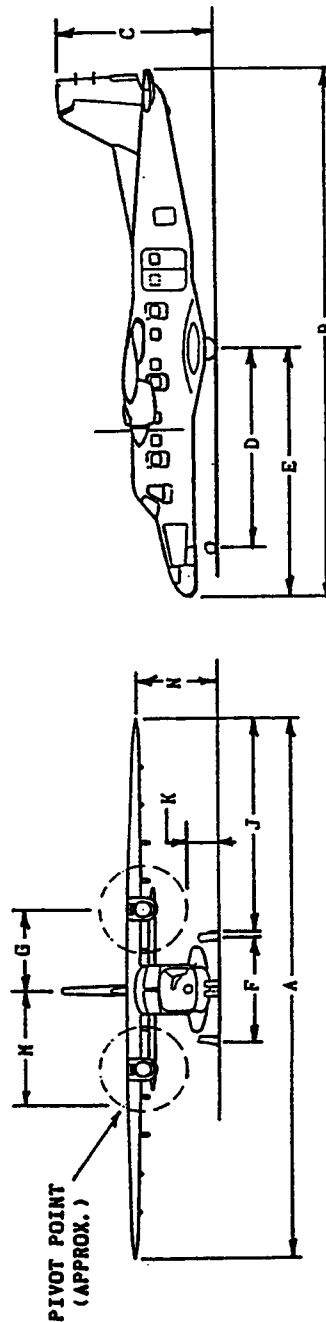


Figure A12-42. Dornier Gmb H

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|-------|------------------------------|------------------------------|--------|--------|-------|--------|-------|-------|-------|--------|-------|-------|-------|----------------|
| DC-3 | 25,200 LB | 25,200 LB | 95'0" | 64'6" | 23'6" | 37'11" | 18'6" | 18'6" | 9'3" | 37'7" | 1'4" | 9'3" | 9'4" | 57'3" |
| | 11 431 KG | 11 431 KG | 28.96M | 19.66M | 7.16M | 11.56M | 5.64M | 5.64M | 2.82M | 11.46M | 0.41M | 2.82M | 2.84M | 17.45M |

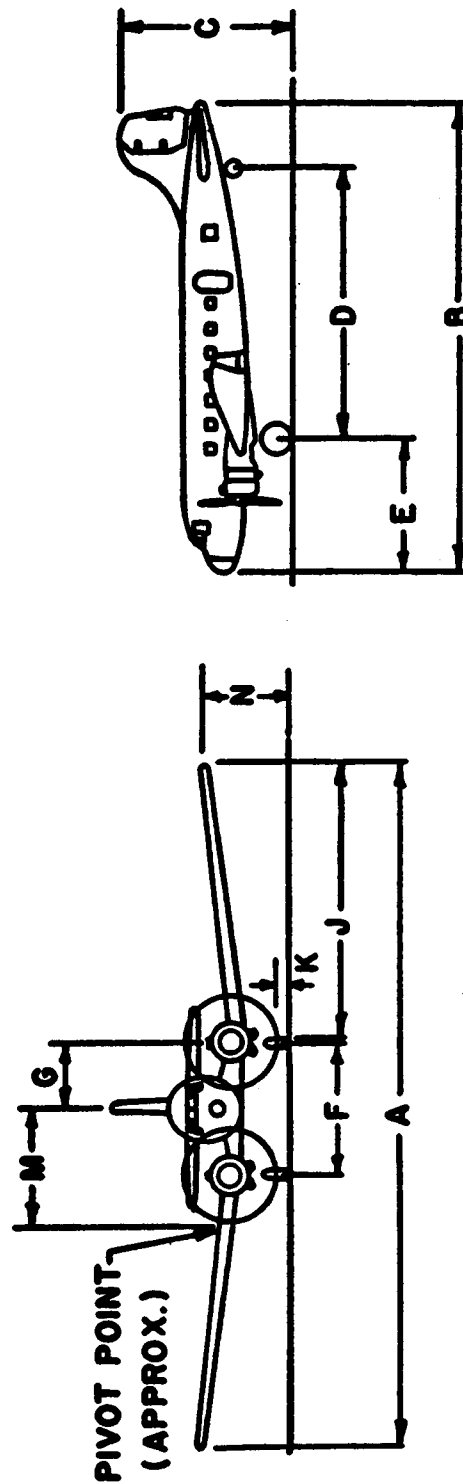


Figure A12-43. Douglas DC-3

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|-------------------------|-------------------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|----------------|----------------|-----------------|----------------|-----------------|
| DC-4 | 73,000 LB 33 112 KG | 63,500 LB 28 803 KG | 117'6" 35.81M | 93'11" 28.63M | 27'11" 8.51M | 27'5" 8.36M | 36'0" 10.99M | 24'8" 7.52M | 12'4" 3.76M | 26'4" 8.03M | 44'7" 13.59M | 2'2" 0.66M | 3'9" 1.14M | 13'9" 4.19M | 13'6" 4.11M | 86'2" 26.26M |
| DC-6 | 104,000 LB 47 174 KG | 86,200 LB 39 100 KG | 117'6" 35.81M | 105'7" 32.18M | 29'3" 8.92M | 36'2" 11.02M | 44'9" 13.64M | 24'8" 7.52M | 12'4" 3.76M | 26'4" 8.03M | 44'7" 13.59M | 1'11" 0.58M | 3'6" 1.07M | 13'11" 4.24M | 13'6" 4.11M | 72'8" 22.15M |
| DC-7 | 143,000 LB 64 864 KG | 111,000 LB 50 349 KG | 127'6" 38.86M | 112'3" 34.21M | 31'8" 9.65M | 39'6" 12.04M | 48'1" 14.66M | 34'8" 10.57M | 17'4" 5.28M | 31'4" 9.55M | 44'7" 13.59M | 1'3" 0.38M | 3'10" 0.87M | 17'4" 5.28M | 13'6" 4.11M | 81'1" 24.71M |

NOTE: MODEL DC-4 HAS ROUNDED VERTICAL STABILIZER AND CIRCULAR CABIN WINDOWS.

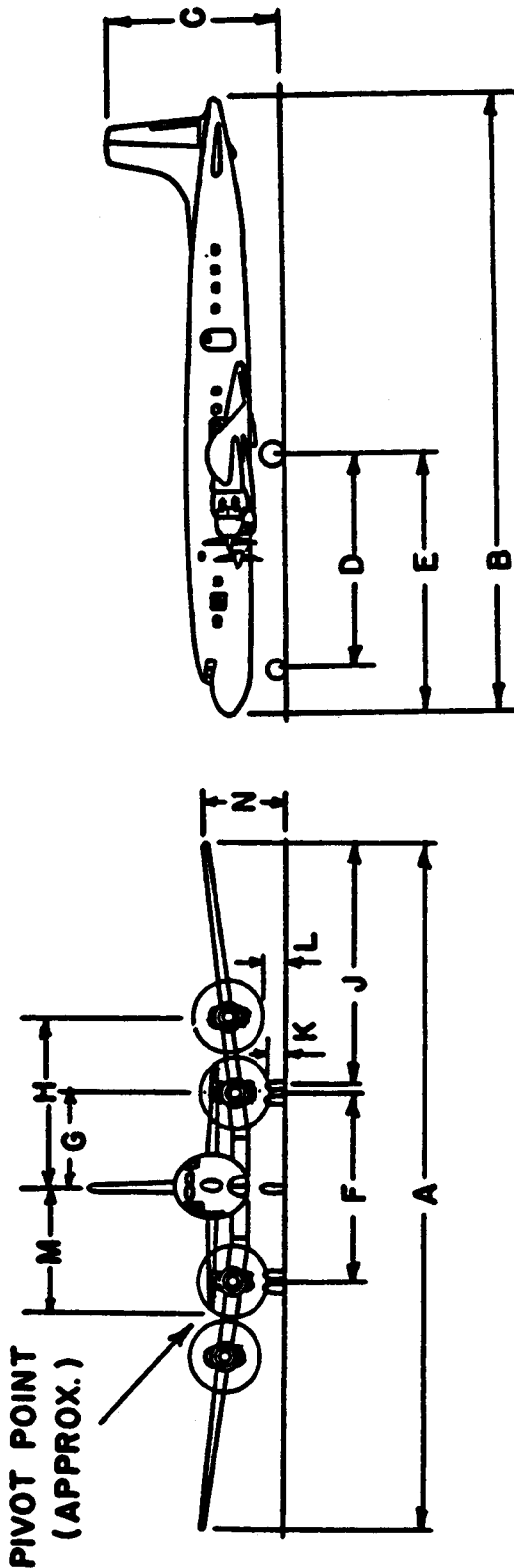


Figure A12-44. Douglas DC-4/6/7

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|--------------|------------------------------|------------------------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------|-----------------|
| EMB-110P1 | 12,500 LB 5 670 KG | 12,500 LB 5 670 KG | 30'3" 15.32M | 49'6" 15.09M | 16'6" 5.03M | 16'2" 4.93M | 23'8" 7.21M | 16'3" 4.95M | 7'11" 2.41M | 16'9" 5.11M | 0'10" 0.25M | 16'6" 5.03M | 6'7" 2.01M | 47'7" 14.50M |
| EMB-110P1/41 | 13,007 LB 5 900 KG | 12,566 LB 5 700 KG | | | | | | | | | | | | |
| EMB-110P2 | 12,500 LB 5 670 KG | 12,500 LB 5 670 KG | | | | | | | | | | | | |
| EMB-110P2/41 | 13,007 LB 5 900 KG | 12,599 LB 5 700 KG | | | | | | | | | | | | |

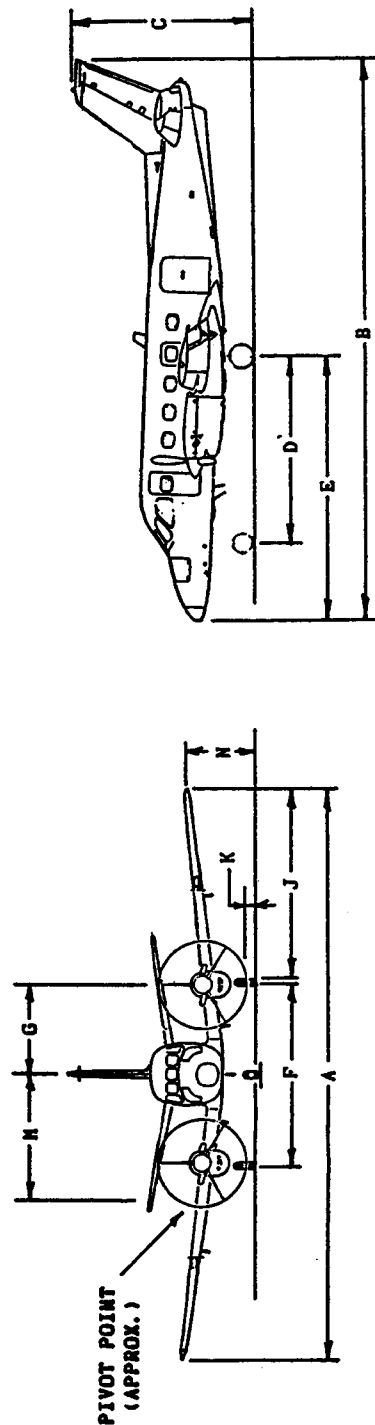


Figure A12-45. Embraer Emb 110

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|------------|------------------------------|------------------------------|------------------|-----------------|-----------------|-----------------|---|-----------------|-----------------|----------------|---------------|----------------|---|-----------------|
| EMB 120 | 11,500 LB 5,216 KG | 11,250 LB 5,103 KG | 64'11" 19.79M | 65'7" 19.99M | 20'10" 6.35M | 22'11" 6.99M | | 21'7" 21.96M | 10'10" 3.30M | 20'6" 6.25M | 1'9" 0.53M | 21'8" 6.60M | | 51'8" 15.75M |

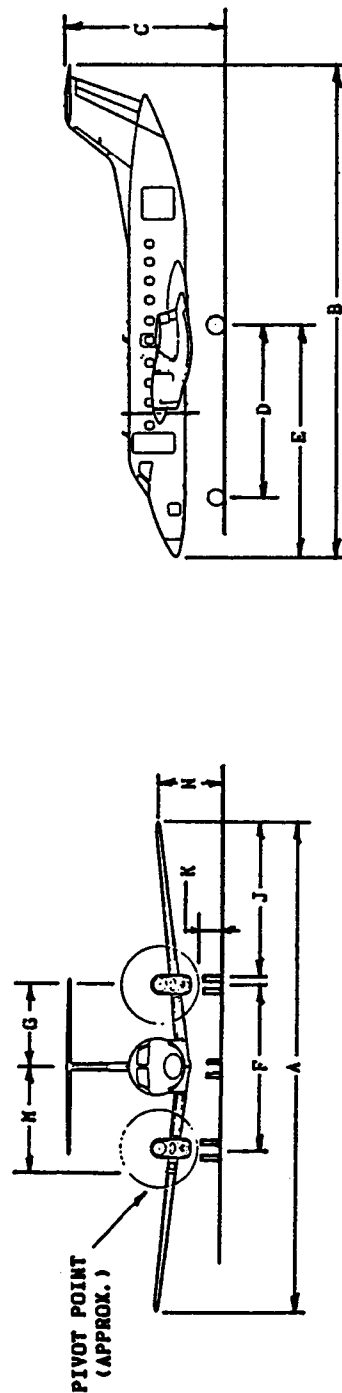


Figure A12-46. Embraer Emb 120

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | N | TURN RADIUS |
|--------|------------------------|------------------------|--------|--------|-------|---|---|-------|---|--------|-------|-------|-------------|
| FLYING | 77,000 LB | 72,700 LB | 109'3" | 86'6" | 27'6" | | | 29'2" | | 38'4" | 3'0" | 15'0" | 70'0" |
| BOXCAR | 34 927 KG | 32 976 KG | 33.32M | 26.38M | 8.38M | | | 8.89M | | 11.68M | 0.91M | 4.56M | 21.34M |

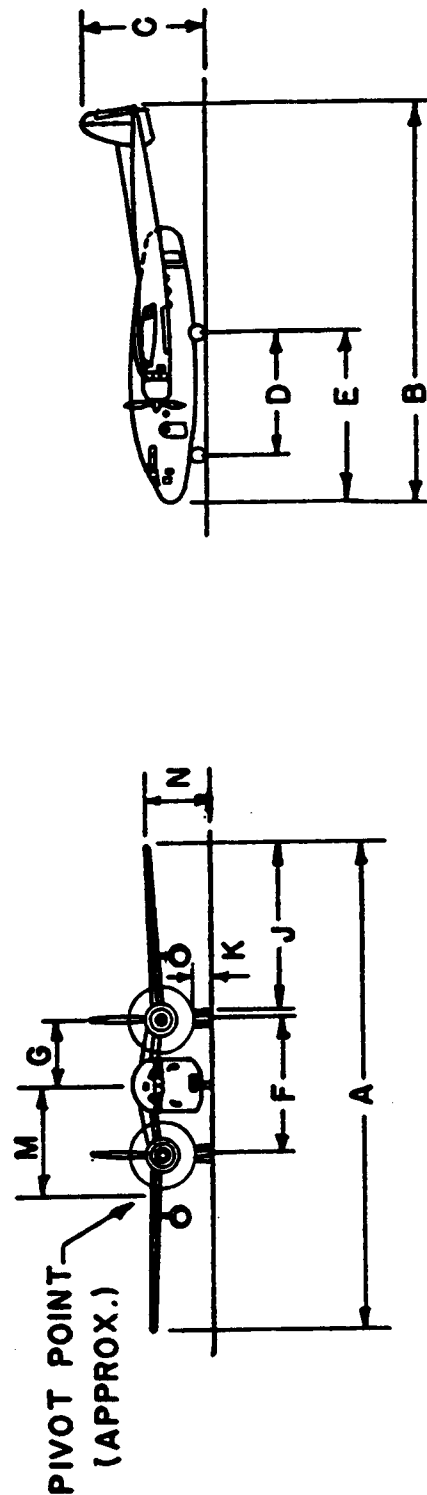


Figure A12-47. Fairchild C-119K Flying Boxcar

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | H | TURN RADIUS |
|----------|------------------------------|------------------------------|------------------|-----------------|-----------------|---|---|----------------|-----------------|-----------------|---------------|-----------------|----------------|-----------------|
| PROVIDER | 60,000 LB 27 216 KG | 54,000 LB 24 494 KG | 110'0" 33.52M | 76'3" 23.24M | 34'6" 10.52M | | | 12'1" 3.68M | 14'10" 4.52M | 48'0" 14.63M | 3'6" 1.12M | 14'10" 4.52M | 14'0" 4.27M | 70'0" 21.34M |

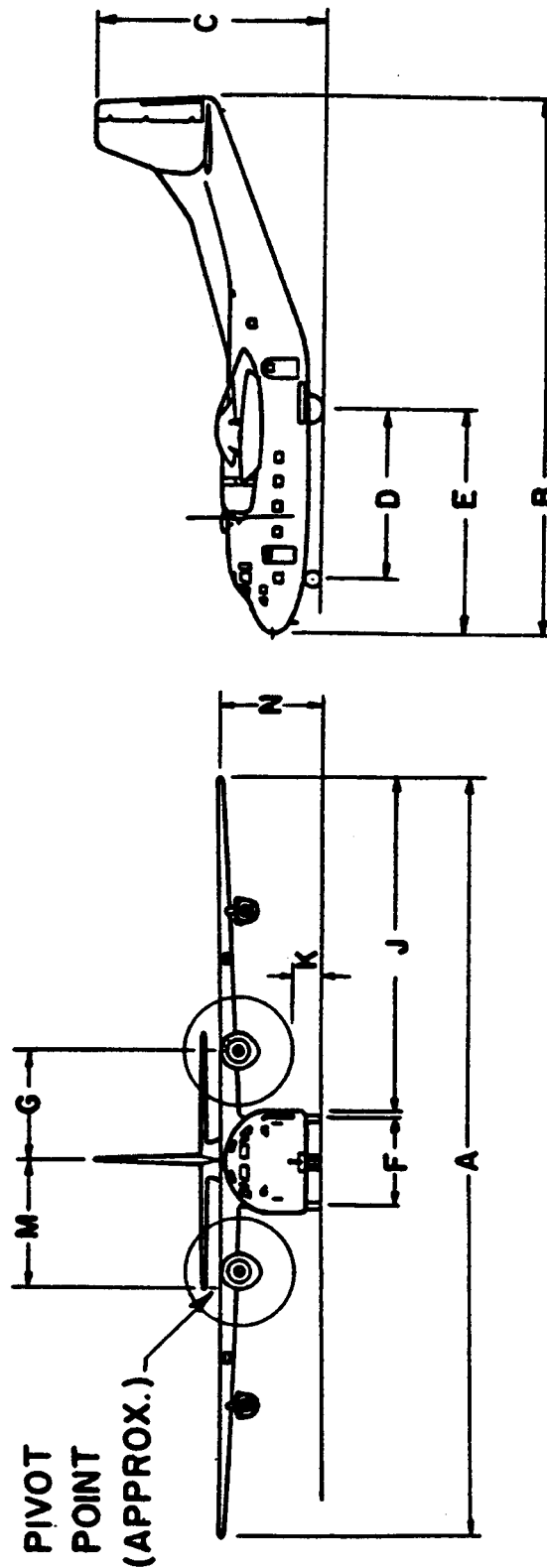


Figure A12-48. Fairchild C-123K Provider

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | TURN RADIUS | |
|--------------|------------------------|------------------------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------------|-------|
| F-27, B | 40,500 LB 18,370 KG | 38,500 LB 17,463 KG | 95'2" | 77'2" | 27'6" | 28'8" | 34'6" | 23'8" | 11'10" | 34'6" | 2'10" | 16'6" | 11'10" | 64'0" |
| FH-227, C, E | 43,500 LB 19,731 KG | 43,000 LB 19,504 KG | 95'2" | 83'1" | 27'6" | 34'7" | 40'3" | 23'8" | 11'10" | 34'9" | 3'2" | 12'4" | 11'10" | 59'7" |

NOTE: F-27A, J HAVE MAXIMUM (TAKEOFF) WEIGHT OF 42,000 LB (19 051 KG),
40,000 LB (18 144 KG).
FH-227B, D HAVE MAXIMUM (TAKEOFF) WEIGHT OF 45,500 LB (20 638 KG),
45,000 LB (20 412 KG).

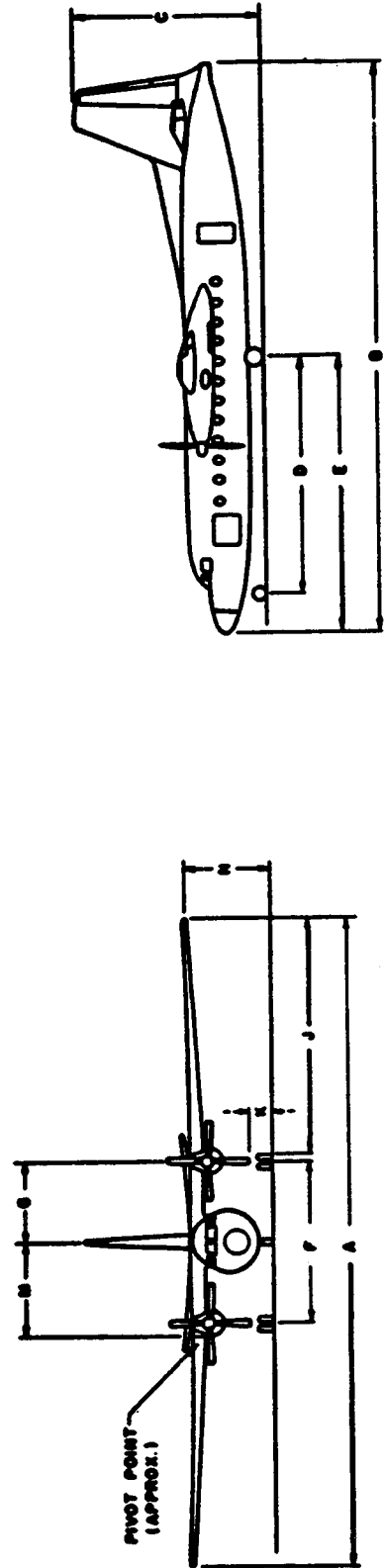


Figure A12-49. Fairchild F-27

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | NOTE | TURN RADIUS |
|--------------|------------------------|------------------------|--------|--------|--------|--------|--------|-------|--------|--------|-------|-------|--------|--------|-------------|
| 100 | 40,500 LB | 40,000 LB | 95'2" | 77'2" | 27'11" | 28'8" | 23'8" | 23'8" | 11'10" | 34'7" | 12'2" | 3.71H | 11'11" | 28'2" | 58'1" |
| | 18,370 KG | 18,144 KG | 29.01H | 23.52H | 8.51H | 8.74H | 7.21H | 7.21H | 3.61H | 10.54H | 3.71H | 3.63H | 8.59H | 17.70H | |
| 200,400, 600 | 45,000 LB | 41,000 LB | 95'2" | 77'4" | 28'8" | 28'8" | 34'6" | 23'8" | 11'10" | 34'7" | 12'2" | 3.71H | 11'11" | 28'2" | 58'1" |
| | 20,412 KG | 18,597 KG | 29.01H | 23.57H | 8.74H | 8.74H | 10.52H | 7.21H | 3.61H | 10.54H | 3.71H | 3.63H | 8.59H | 17.70H | |
| 500 | 45,000 LB | 42,000 LB | 95'2" | 82'3" | 29'3" | 31'11" | 37'9" | 23'8" | 11'10" | 34'7" | 13'7" | 4.14H | 12'2" | 28'2" | 59'5" |
| | 20,412 KG | 19,051 KG | 29.01H | 25.07H | 8.92H | 9.73H | 11.51H | 7.21H | 3.61H | 10.54H | 4.14H | 3.71H | 8.59H | 18.11H | |

NOTE: CENTERLINE OF FUSELAGE TO CENTERLINE OF PYLON TANKS IF INSTALLED.

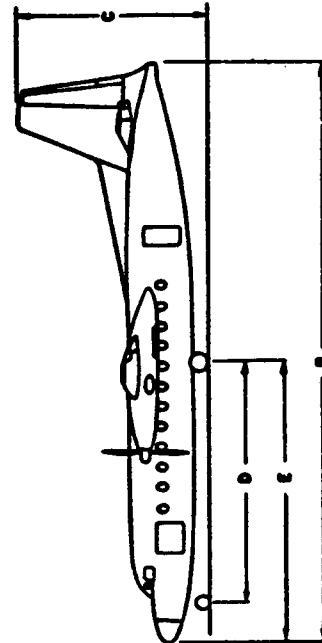
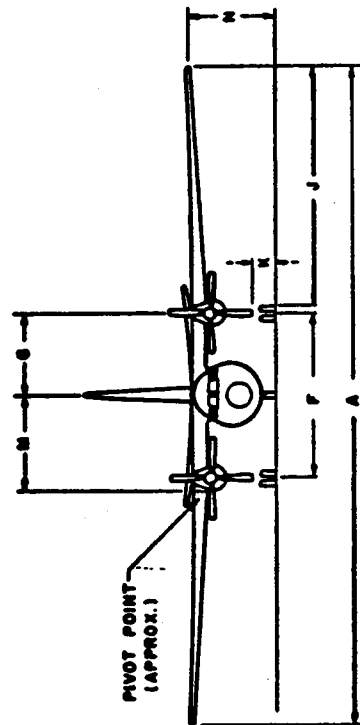


Figure A12-50. Fokker F-27

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-------|------------------------|------------------------|-----------------|------------------|-----------------|------------------|----------------|----------------|---------------|-----------------|---------------|---------------|---------------|-----------------|
| 1000 | 65,000 LB 29 484 KG | 59,000 LB 26 762 KG | 77'4" 23.57M | 89'11" 27.42M | 27'10" 8.48M | 29'3" 8.89M | 16'7" 5.11M | 16'7" 5.11M | 8'6" 2.59M | 28'10" 8.78M | 5'2" 1.60M | 8.3° 2.51N | 7'9" 2.37M | 50'0" 15.24M |
| 2000 | 65,000 LB 29 484 KG | 59,000 LB 26 762 KG | 77'4" 23.57M | 97'2" 29.62M | 27'10" 8.48M | 33'11" 10.34M | 16'7" 5.11M | 16'7" 5.11M | 8'6" 2.59M | 28'10" 8.78M | 5'2" 1.60M | 8.3° 2.51N | 7'9" 2.37M | 50'0" 15.24M |
| 3000 | 72,000 LB 33 112 KG | 64,000 LB 29 030 KG | 82'3" 25.07M | 89'11" 27.41M | 27'10" 8.48M | 29'3" 8.89M | 16'7" 5.11M | 16'7" 5.11M | 8'6" 2.59M | 28'10" 8.78M | 5'2" 1.60M | 8.3° 2.51N | 7'9" 2.37M | 50'0" 15.24M |
| 4000 | 72,000 LB 33 112 KG | 66,500 LB 30 164 KG | 82'3" 25.07M | 97'2" 29.62M | 27'10" 8.48M | 33'11" 10.34M | 16'7" 5.11M | 16'7" 5.11M | 8'6" 2.59M | 28'10" 8.78M | 5'2" 1.60M | 8.3° 2.51N | 7'9" 2.37M | 50'0" 15.24M |
| 5000 | 70,800 LB 32 114 KG | 64,000 LB 29 030 KG | 82'3" 25.07M | 89'11" 27.41M | 27'10" 8.48M | 29'3" 8.89M | 16'7" 5.11M | 16'7" 5.11M | 8'6" 2.59M | 28'10" 8.78M | 5'2" 1.60M | 8.3° 2.51N | 7'9" 2.37M | 50'0" 15.24M |
| 6000 | 72,000 LB 33 112 KG | 66,500 LB 30 164 KG | 82'3" 25.07M | 97'2" 29.62M | 27'10" 8.48M | 33'11" 10.34M | 16'7" 5.11M | 16'7" 5.11M | 8'6" 2.59M | 28'10" 8.78M | 5'2" 1.60M | 8.3° 2.51N | 7'9" 2.37M | 50'0" 15.24M |

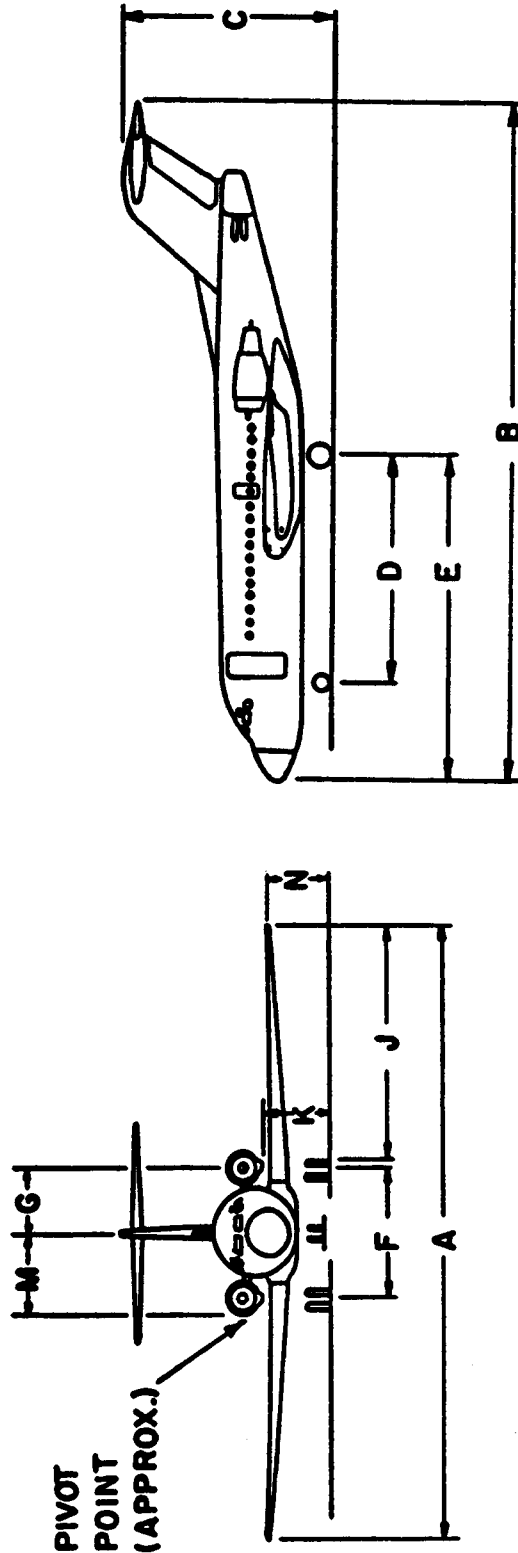


Figure A12-51. Fokker F-28

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-------------|------------------------|------------------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|
| 24 | 13,000 LB | 11,880 LB | 35'7" | 43'3" | 12'7" | 16'2" | 21'9" | 8'3" | 3'8" | 12'9" | 4'10" | 16'0" | 3'3" | 34'0" |
| 24D, F | 5 897 KG | 5 389 KG | 10.85M | 13.18M | 3.84M | 4.98M | 6.63M | 2.51M | 1.12M | 3.89M | 1.49M | 4.88M | 0.99M | 10.36M |
| 25 | 15,000 LB | 13,300 LB | 35'7" | 47'7" | 12'7" | 16'2" | 26'0" | 8'3" | 3'8" | 13'1" | 4'10" | 16'0" | 3'3" | 34'0" |
| 25B, C, D | 6 804 KG | 6 033 KG | 10.85M | 14.50M | 3.84M | 4.98M | 7.92M | 2.51M | 1.12M | 3.99M | 1.49M | 4.88M | 0.99M | 10.36M |
| 256 | 16,300 LB | 13,700 LB | 35'7" | 47'7" | 12'4" | 17'3" | 27'1" | 8'3" | 3'8" | 14'4" | 4'10" | 14'6" | 3'6" | 1.07M |
| | 7 394 KG | 6 214 KG | 10.85M | 14.50M | 3.76M | 5.26M | 8.25M | 2.51M | 1.12M | 4.26M | 1.49M | 4'10" | 3'6" | 1.07M |
| 28/29 | 15,000 LB | 6 804 KG | 43'9" | 47'7" | 12'4" | | | | | | | | | |
| | 6 804 KG | | 13.34M | 14.50M | 3.76M | | | | | | | | | |
| 35/36 | 17,000 LB | 13,300 LB | 38'1" | 48'8" | 12'4" | | | | | | | | | |
| | 7 711 KG | 6 033 KG | 11.61M | 14.83M | 3.76M | | | | | | | | | |
| 35A/36A | 18,300 LB | 15,300 LB | 39'6" | 48'8" | 12'4" | | | | | | | | | |
| | 8 301 KG | 6 940 KG | 12.07M | 14.83M | 3.76M | | | | | | | | | |
| 55/56 | 21,500 LB | 18,000 LB | 43'9" | 55'1" | 14'8" | | | | | | | | | |
| 55C, 56, LR | 9 752 KG | 8 165 KG | 13.34M | 16.79M | 4.47M | | | | | | | | | |

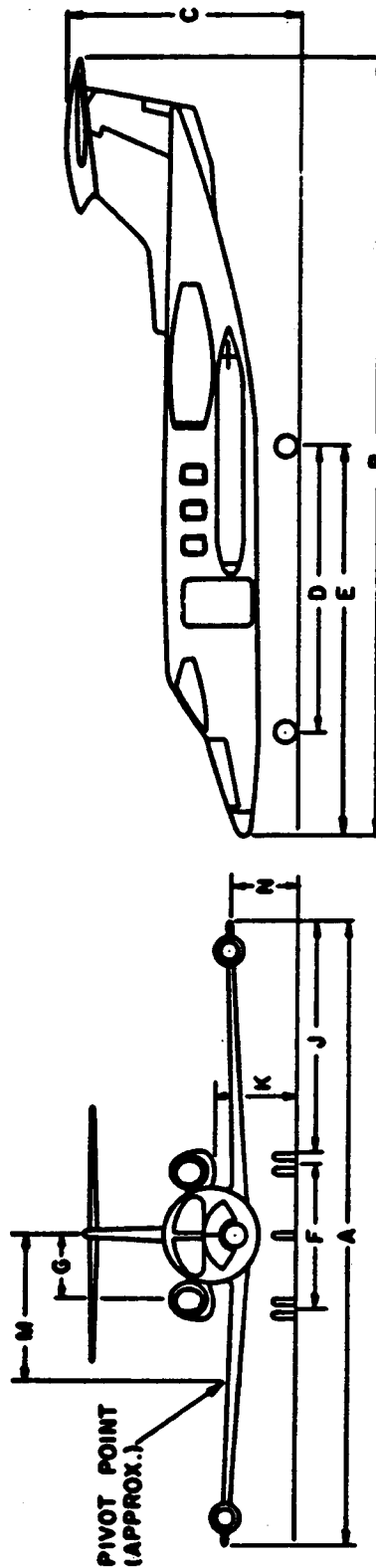


Figure A12-52. Gates Learjet

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | TURN RADIUS | |
|-------|------------------------|------------------------|--------|--------|--------|--------|--------|--------|-------|--------|--------|-------|-------|-------|-------------|--------|
| 880 | 184,500 LB | 137,000 LB | 120'0" | 129'4" | 36'0" | 53'1" | 64'10" | 18'10" | 22'2" | 41'4" | 49'3" | 2'8" | 3'11" | 19'5" | 10'11" | 84'0" |
| | 83,688 KG | 62,142 KG | 36.58M | 39.42M | 10.97M | 16.18M | 19.76M | 5.74M | 6.76M | 12.60M | 15.01M | 0.81M | 1.19M | 5.52M | 3.33M | 25.60M |
| 990 | 246,200 LB | 202,000 LB | 120'0" | 139'2" | 39'6" | 57'3" | 68'11" | 19'11" | 22'2" | 41'4" | 48'10" | 2'9" | 4'0" | 29'3" | 12'9" | 93'8" |
| | 111,674 KG | 91,626 KG | 36.58M | 42.42M | 12.04M | 17.45M | 21.01M | 6.07M | 6.76M | 12.60M | 14.88M | 0.84M | 1.22M | 8.92M | 3.89M | 28.55M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS.

880 193,500 LB (88 770 KG) MAXIMUM TAKEOFF WEIGHT.

155,000 LB (70 307 KG) MAXIMUM LANDING WEIGHT.

990 255,000 LB (115 666 KG) MAXIMUM TAKEOFF WEIGHT.

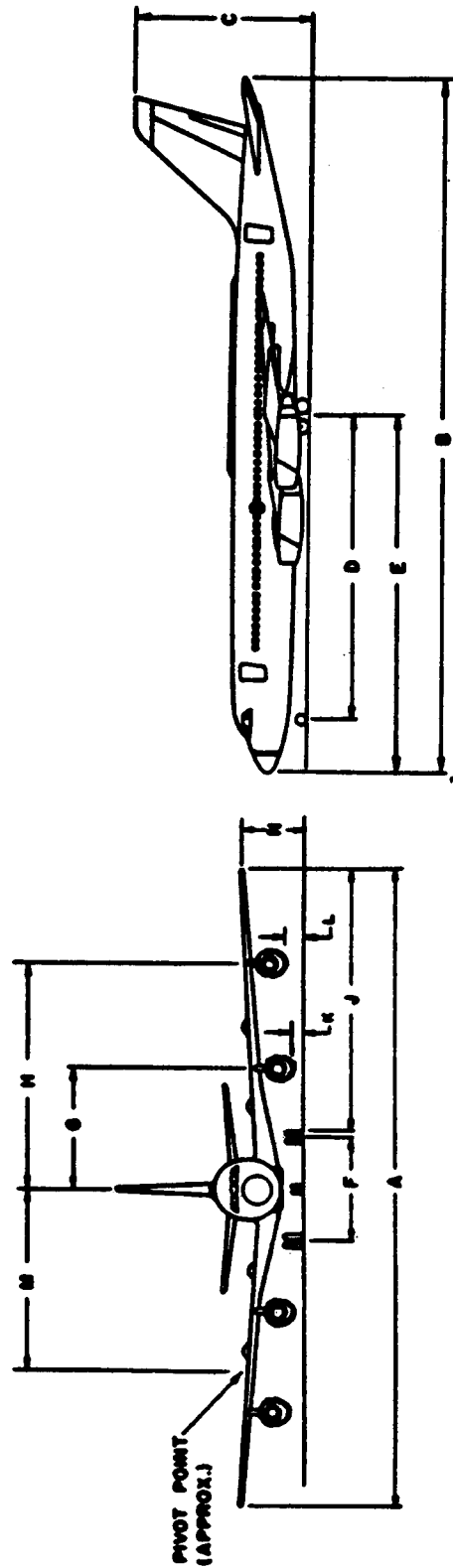


Figure A12-53. General Dynamics/Convair 880/990

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|--------|------------------------|------------------------|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------------|
| G-159C | 33,600 LB 15,241 KG | 30,400 LB 13,789 KG | 78'4" | 75'4" | 23'0" | 19'10" | 26'8" | 24'7" | 12'1" | 25'6" | 1'6" | 12'1" | 8'8" | 51'7" |
| | | | 23.88M | 22.96M | 7.01M | 6.04M | 8.11M | 7.47M | 3.68M | 7.77M | 0.45M | 3.68M | 2.65M | 15.67M |

NOTE: OPTIONAL MAXIMUM (TAKEOFF) WEIGHT 36,000 LB (16,329 KG).
(LANDING) 34,285 LB (15,551 KG).

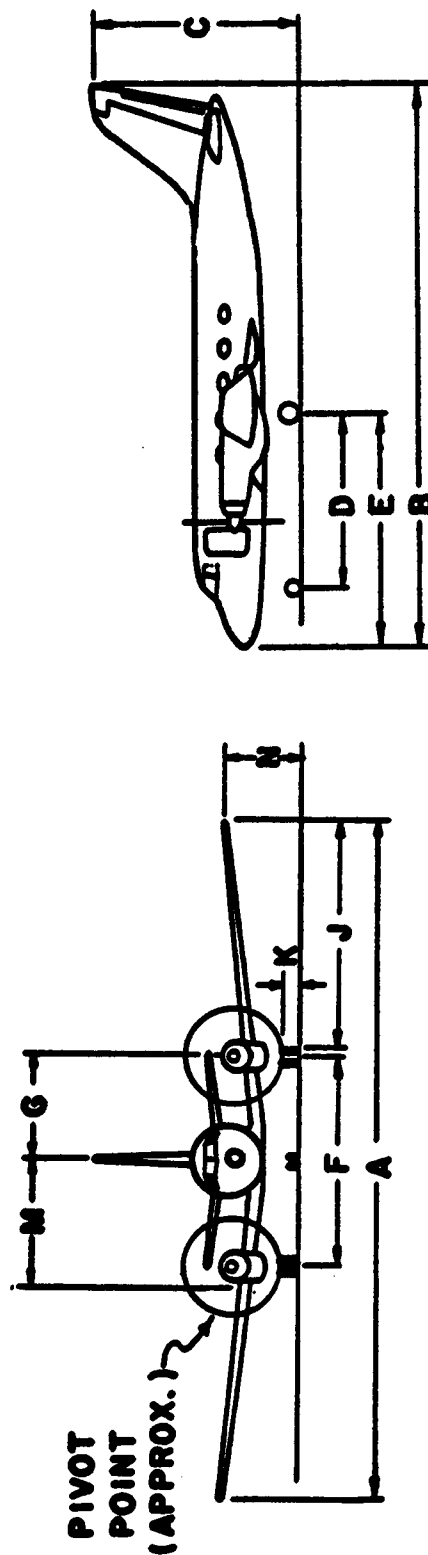


Figure A12-54. Grumman Gulfstream I

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|-------|--------|--------|-------|-------|-------|-------|-------|-------|-------------|
| II | 65,300 LB | 58,500 LB | 68'10" | 79'11" | 24'6" | 33'4" | 40'5" | 13'8" | 6'3" | 26'8" | 8'10" | 6'9" | 6'0" | 45'0" |
| | 29,620 KG | 26,535 KG | 20.98M | 24.36M | 7.47M | 10.16M | 12.32M | 4.15M | 1.91M | 8.11M | 2.69M | 2.07M | 1.83M | 13.72M |
| II-TT | 65,300 LB | | 71'8" | 79'11" | 24'6" | | | | | | | | | |
| | 29,620 KG | | 21.84M | 24.36M | 7.47M | | | | | | | | | |
| III | 69,700 LB | 58,500 LB | 77'10" | 83'1" | 24'5" | | | | | | | | | 47'6" |
| | 31,615 KG | 26,535 KG | 23.72M | 25.32M | 7.44M | | | | | | | | | 14.48M |
| IV | 71,780 LB | 58,500 LB | 77'10" | 87'10" | 24'5" | | | | | | | | | 48'2" |
| | 32,559 KG | 26,535 KG | 23.72M | 26.77M | 7.44M | | | | | | | | | 14.68M |

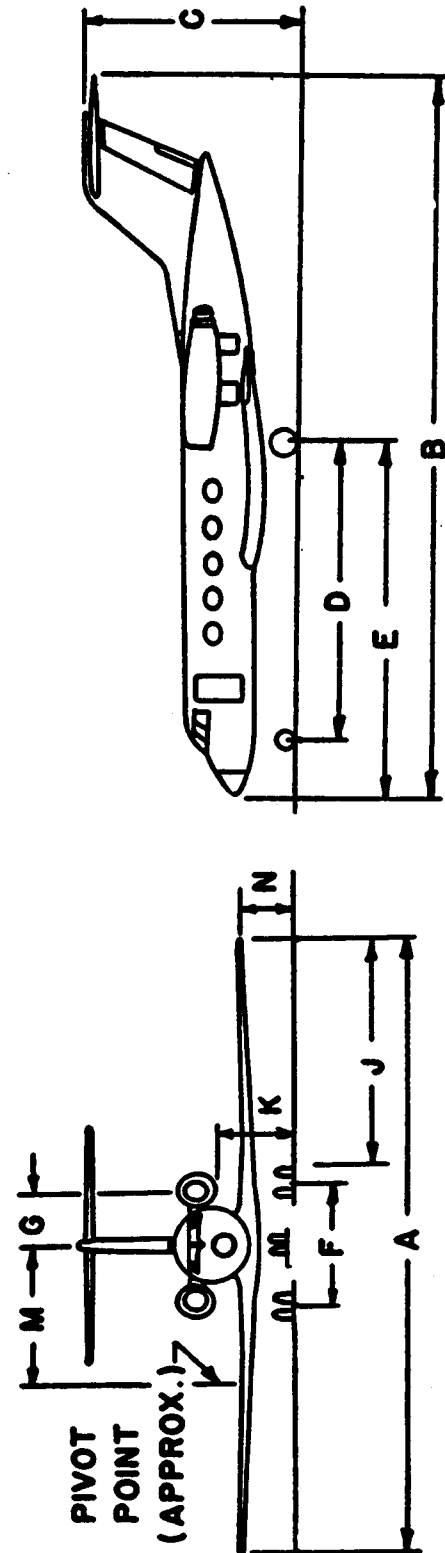


Figure A12-55. Grumman Gulfstream II

| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | DRAFT | NUMBER SEATS | TURN RADIUS |
|---------|----------------|-----------|------------------------------|------------------------------|-----------------|------------------|-----------------|----------------|----------------|---------------|-----------------|----------------|
| GRUMMAN | G-64/ G-111 | ALBATROSS | 31,150 LB 14 129 KG | 31,150 LB 14 129 KG | 96'8" 29.46M | 62'10" 19.15M | 25'10" 7.67M | 17'6" 5.33M | 17'8" 5.38M | 3'6" 1.07M | 28 | |

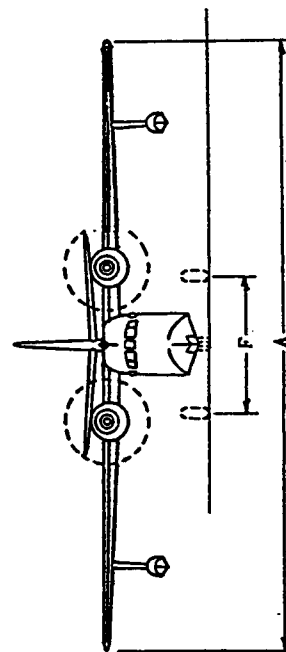
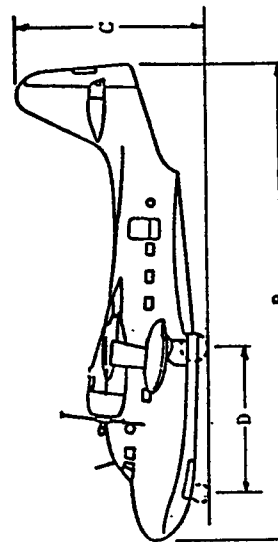


Figure A12-56. Grumman G-64/G-III

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| BUILDER | MODEL | NAME | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | DRAFT | NUMBER SEATS | TURN RADIUS |
|---------|-------|---------|------------------------|------------------------|-----------------|-----------------|----------------|-----------------|-----------------|-------|--------------|-------------|
| GRUMMAN | G-73 | MALLARD | 12,750 LB 5 783 KG | 12,750 LB 5 783 KG | 66'8" 20.32M | 48'4" 14.73M | 18'9" 5.72M | 14'10" 4.52M | 12'10" 3.91M | | 10 | |

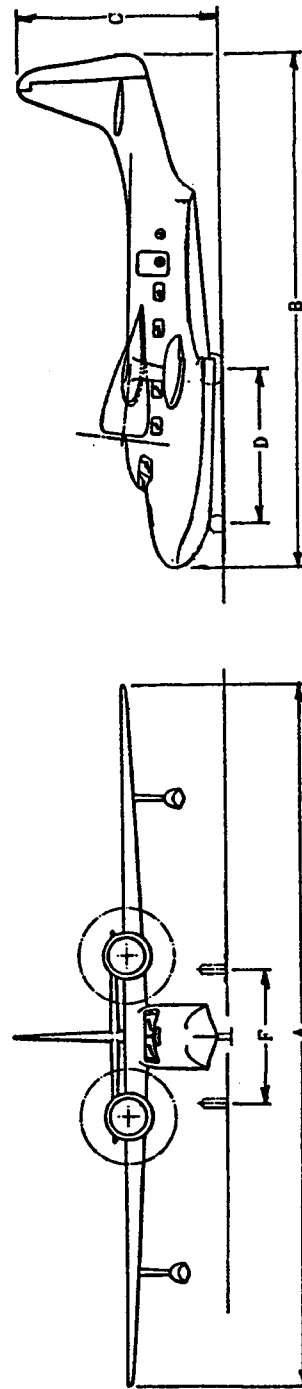


Figure A12-57. Grumman G-73

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|---------|------------------------|------------------------|-----------------|-----------------|----------------|----------------|----------------|---------------|---------------|----------------|----------------|---------------|---------------|----------------|
| HFB-320 | 20,280 LB 9,199 KG | 19,400 LB 8,800 KG | 47'6" 14.48M | 54'6" 16.61M | 16'2" 4.93M | 22'1" 6.73M | 28'2" 8.58M | 7'9" 2.39M | 4'8" 1.42M | 19'7" 5.97M | 5'11" 1.80M | 8'3" 2.51M | 7'3" 2.21M | 29'5" 8.94M |

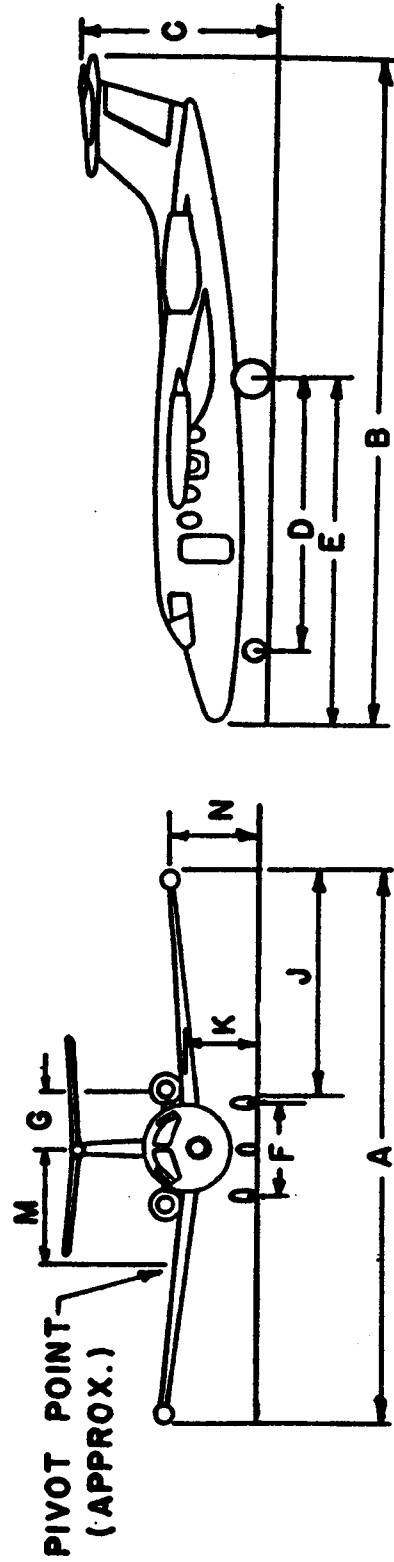


Figure A12-58. Hamburger-Flugzeugbau HFB-320 Hansa

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|---------|------------------------------|------------------------------|-----------------|-----------------|----------------|---|----------------|-----------------|-----------------|
| DH. 104 | 8,950 LB 4 060 KG | 8,500 LB 3 856 KG | 57'0" 17.61M | 39'3" 11.97M | 13'4" 4.07M | | 13'8" 4.17M | 9 | 35'4" 10.83M |

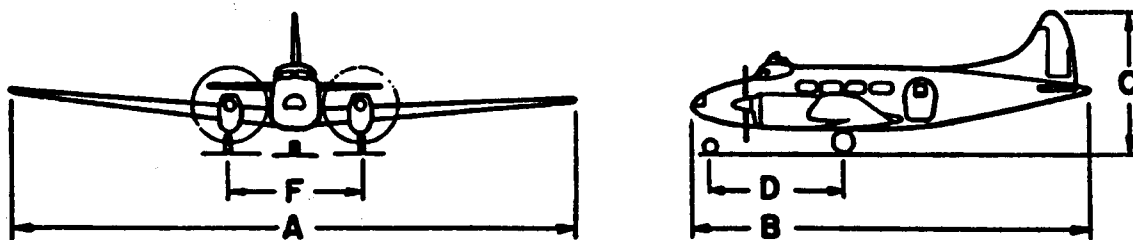


Figure A12-59. Hawker Siddeley DH. 104 Dove

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|--------|------------------------|------------------------|-----------------|-----------------|----------------|----------------|----------------|----------------|---|---|---|---|---|---|---|-------------|
| DH.114 | 13,500 LB 6,123 KG | 12,150 LB 5,965 KG | 71'6" 21.79M | 48'6" 14.78M | 15'7" 4.75M | 14'5" 4.39M | 16'8" 5.14M | 15'0" 4.57M | | | | | | | | |

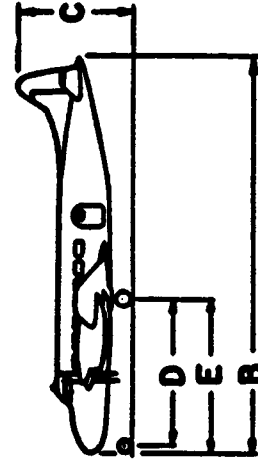
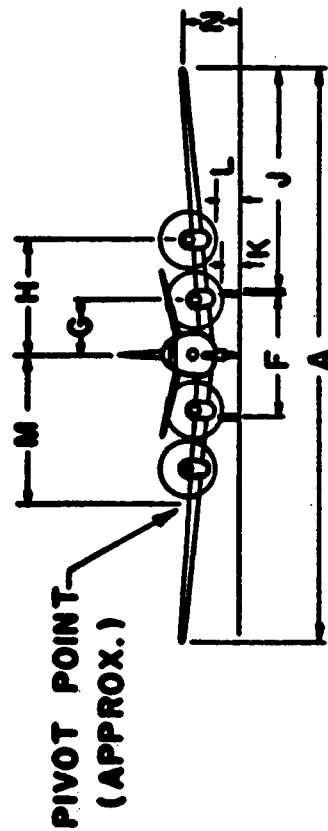


Figure A12-60. Hawker Siddeley DH. 114 Heron

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------|
| 400A | 23,300 LB | 20,000 LB | 47'0" | 47'3" | 16'6" | 18'9" | 26'3" | 9'2" | 4'2" | 18'7" | 4'9" | 19'0" | 4'4" | 43'0" |
| | 10,569 KG | 9,072 KG | 14.33M | 14.45M | 5.08M | 5.72M | 8.00M | 2.79M | 1.27M | 5.66M | 1.45M | 5.79M | 1.32M | 13.11M |
| 600A | 25,000 LB | 22,000 LB | 47'0" | 50'6" | 17'3" | | | | | | | | | |
| | 11,340 KG | 9,979 KG | 14.33M | 15.39M | 5.26M | | | | | | | | | |
| 700A | 24,200 LB | 22,000 LB | 47'0" | 50'8" | 17'7" | | | | | | | | | |
| | 10,977 KG | 9,979 KG | 14.33M | 15.44M | 5.36M | | | | | | | | | |
| 800A | 27,400 LB | 23,350 LB | 51'3" | 51'2" | 17'6" | | | | | | | | | |
| | 12,428 KG | 10,591 KG | 15.67M | 15.60M | 5.33M | | | | | | | | | |

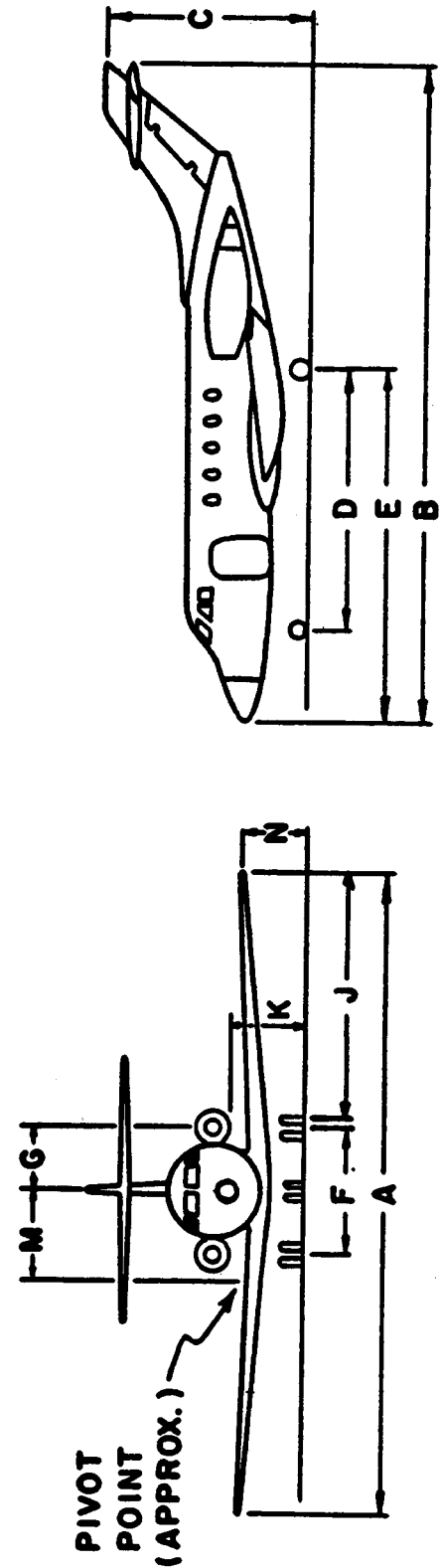


Figure A12-61. Hawker Siddeley HS-125

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | M | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|--------|-------|-------|-------|---|--------|-------|---|---|-------------|
| 2A | 44,490 LB | 42,100 LB | 98'6" | 67'0" | 24'10" | 20'8" | 24'9" | 24'9" | | 35'11" | 2'0" | | | 59'0" |
| | 20,180 KG | 19,096 KG | 30.02M | 20.49M | 7.63M | 6.32M | 7.60M | 7.60M | | 10.95M | 0.61M | | | 17.98M |
| 2B | 46,500 LB | | 102'6" | 67'0" | 24'10" | | | | | | | | | |
| | 21,092 KG | | 31.24M | 20.49M | 7.63M | | | | | | | | | |

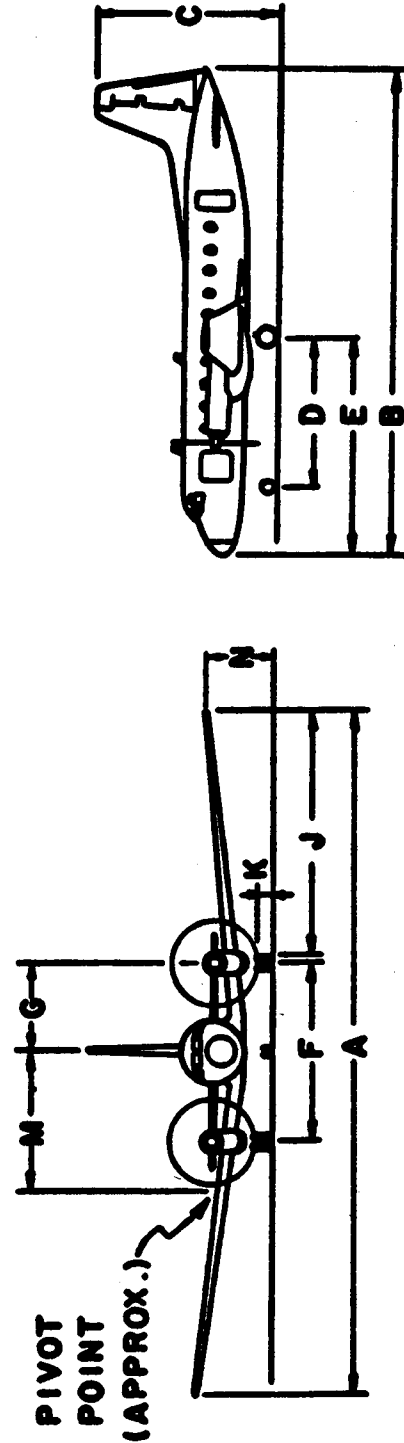


Figure A12-62. Hawker Siddeley HS-748

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|--------------------------|--------------------------|--------|--------|-------|-------|---|-------|---|---|-----------------|---|---|---|---|-------------|
| 11-62 | 357,000 LB 161,932 KG | 252,000 LB 114,305 KG | 141.9' | 174.4' | 40.6' | 80.5' | | 22.4' | | | 58.0° 17.76M | | | | | |

NOTE: OPTIONAL TAKEOFF WEIGHT 367,760 LB (166,813 KG).

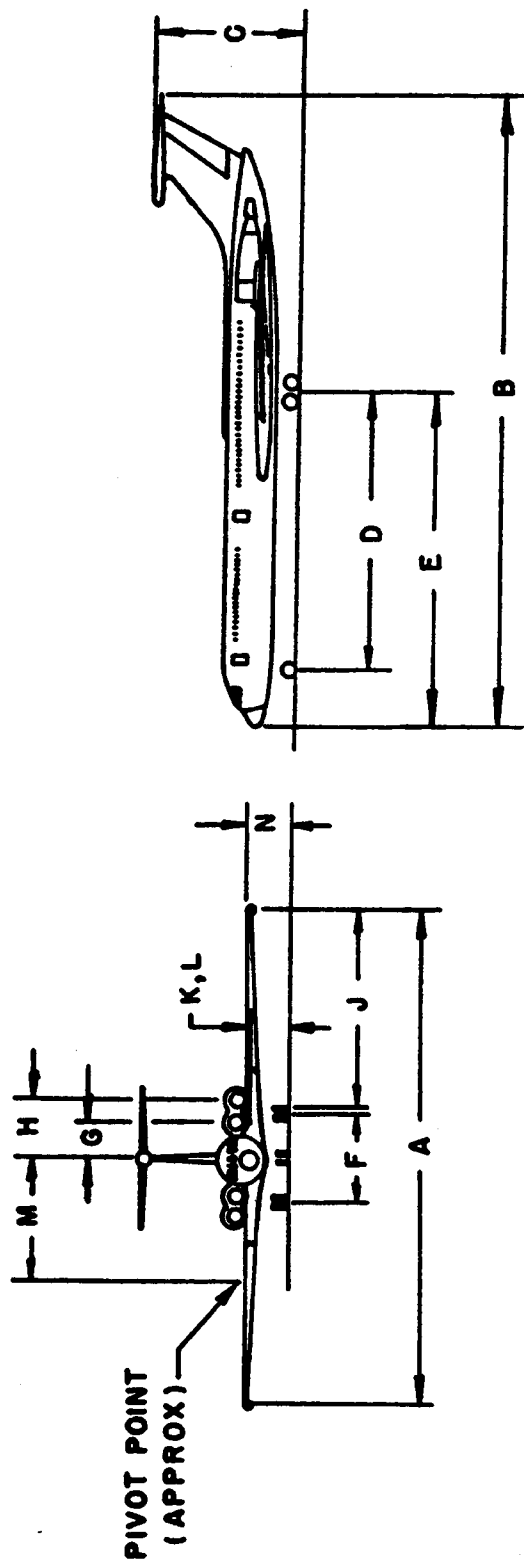


Figure A12-63. Ilyushin IL-62

| MODEL | MAXIMUM TAKSOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|-------|------------------------------|------------------------------|------------------|-----------------|-----------------|----------------|----------------|---------------|---------------|-----------------|---------------|----------------|----------------|-----------------|
| 1121 | 16,800 LB 7 620 KG | 16,000 LB 7 257 KG | 43'4" 13.21M | 50'5" 15.37M | 15'9" 4.80M | 23'9" 7.24M | 11'2" 3.40M | 3'4" 1.02M | 3'4" 1.02M | 15'9" 4.80M | 5'2" 1.60M | 23'8" 7.21M | 4'11" 1.50M | 45'5" 13.64M |
| 1123 | 20,500 LB 9 299 KG | 19,000 LB 8 618 KG | 43'4" 13.21M | 52'3" 15.93M | 15'9" 4.80M | 23'9" 7.24M | 12'0" 3.66M | 3'4" 1.02M | 3'4" 1.02M | 15'9" 4.80M | 5'2" 1.60M | | | |
| 1124 | 22,650 LB 10 365 KG | 19,000 LB 8 618 KG | 44'10" 13.67M | 52'3" 15.93M | 15'10" 4.83M | 25'7" 7.80M | 11'0" 3.35M | 4'2" 1.27M | 4'2" 1.27M | 16'10" 5.13M | 4'3" 1.30M | | 4'0" 1.22M | |
| 1124A | 23,500 LB 10 659 KG | 19,000 LB 8 618 KG | 44'10" 13.67M | 52'3" 15.93M | 15'10" 4.83M | 25'7" 7.80M | 11'0" 3.35M | 4'2" 1.27M | 4'2" 1.27M | 16'10" 5.13M | 4'3" 1.30M | | 4'0" 1.22M | |
| 1125 | 23,500 LB 10 659 KG | 20,700 LB 9 389 KG | 52'8" 16.05M | 55'7" 16.94M | 18'2" 5.54M | 24'1" 7.34M | 30'9" 9.37M | 9'1" 2.77M | 4'4" 1.32M | 21'1" 6.43M | 7'0" 2.13M | | 3'10" 1.17M | |

NOTE: MODEL 1121 FORMERLY PRODUCED BY NORTH AMERICAN ROCKWELL AS "JET COMMANDER."

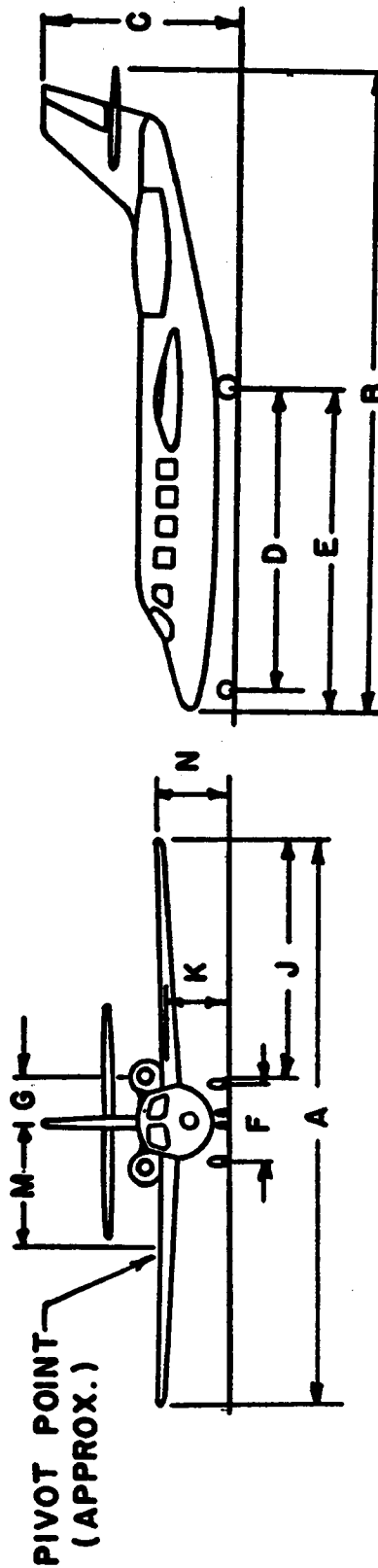


Figure A12-64. Israel Aircraft Industries Westwind

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|-------------------------|-------------------------|------------------|------------------|-----------------|-----------------|------------------|-----------------|----------------|-----------------|------------------|---------------|----------------|----------------|-----------------|------------------|
| 749A | 107,000 LB 48 534 KG | 69,500 LB 40 597 KG | 123'0" 37.49M | 95'2" 29.01M | 22'5" 6.83M | 33'0" 10.06M | 39'3" 11.96M | 28'0" 8.53M | 14'0" 4.27M | 29'10" 9.09M | 45'5" 13.64M | 1'9" 0.53M | 3'11" 1.19M | 31'1" 9.47M | 15'11" 4.83M | 92'7" 28.22M |
| 1049 | 120,000 LB 54 431 KG | 101,500 LB 46 040 KG | 123'0" 37.49M | 113'7" 34.62M | 24'10" 7.57M | 43'7" 13.28M | 49'11" 15.21M | 28'0" 8.53M | 14'0" 4.27M | 29'10" 9.09M | 45'5" 13.64M | 1'9" 0.53M | 3'11" 1.19M | 26'0" 7.92M | 16'3" 4.95M | 87'6" 20.07M |
| 1649A | 160,000 LB 72 575 KG | 123,000 LB 55 792 KG | 150'0" 45.72M | 116'2" 35.41M | 23'5" 7.14M | 45'7" 13.89M | 54'4" 16.56M | 38'5" 11.71M | 19'2" 5.84M | 37'4" 11.38M | 53'10" 16.41M | 1'5" 0.44M | 3'7" 1.09M | 28'4" 8.64M | 16'11" 5.16M | 103'5" 32.13M |

NOTE: MODEL 1049C HAS MAXIMUM (TAKEOFF) WEIGHT OF 137,500 LB (62 369 KG).
113,000 LB (51 256 KG).

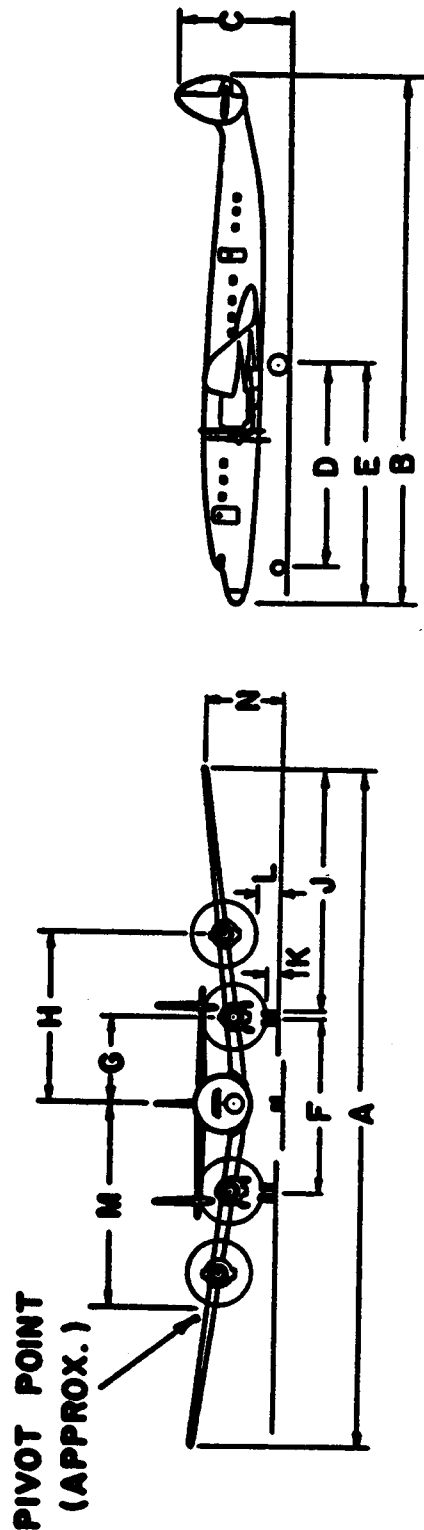


Figure A12-65. Lockheed Constellation and Super Constellation

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | H | H | TURN RADIUS |
|-------|------------------------------|------------------------------|--------|---------|--------|--------|---------|--------|--------|--------|--------|-------|-------|-------|--------|--------|----------------|
| C-5B | 769,000 LB 348,813 KG | 635,850 LB 288,417 KG | 222'8" | 247'10" | 65'1" | 82'1" | 116'11" | 37'5" | 39'8" | 61'11" | 92'8" | 10'9" | 7'11" | 13'7" | 38'4" | 38'4" | 162'6" |
| | | | 67.87M | 75.54M | 19.84M | 25.02M | 35.64M | 11.40M | 12.09M | 18.87M | 28.25M | 3.28M | 2.41M | 4.14M | 11.68M | 11.68M | 49.53M |

NOTE: OPTIONAL TAKEOFF WEIGHT 837,000 LB (379,637 KG).

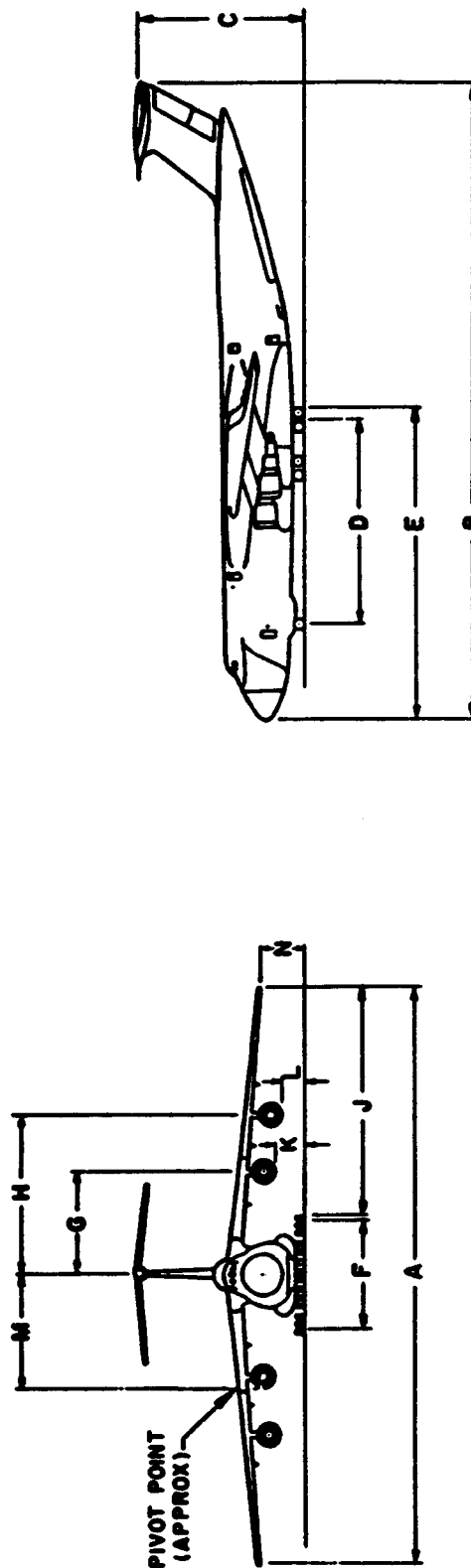


Figure A12-66. Lockheed C-5B Galaxy

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|--------|------------------------|------------------------|---------|--------|--------|--------|--------|-------|-------|--------|--------|-------|-------|-------|-------|-------------|
| C-141A | 316,600 LB | 316,100 LB | 159'11" | 145'0" | 39'4" | 55'0" | 60'7" | 17'6" | 23'9" | 38'4" | 70'0" | 3'11" | 3'4" | 10'0" | 6'0" | 92'0" |
| | 143,607 KG | 143,381 KG | 48.74M | 44.19M | 11.99M | 16.76M | 18.46M | 5.34M | 7.24M | 11.68M | 21.34M | 1.19M | 1.01M | 3.05M | 1.83M | 28.04M |
| C-141B | 342,000 LB | | 159'11" | 168'4" | 39'4" | | | | | | | | | | | |
| | 155,582 KG | | 48.74M | 51.31M | 11.99M | | | | | | | | | | | |

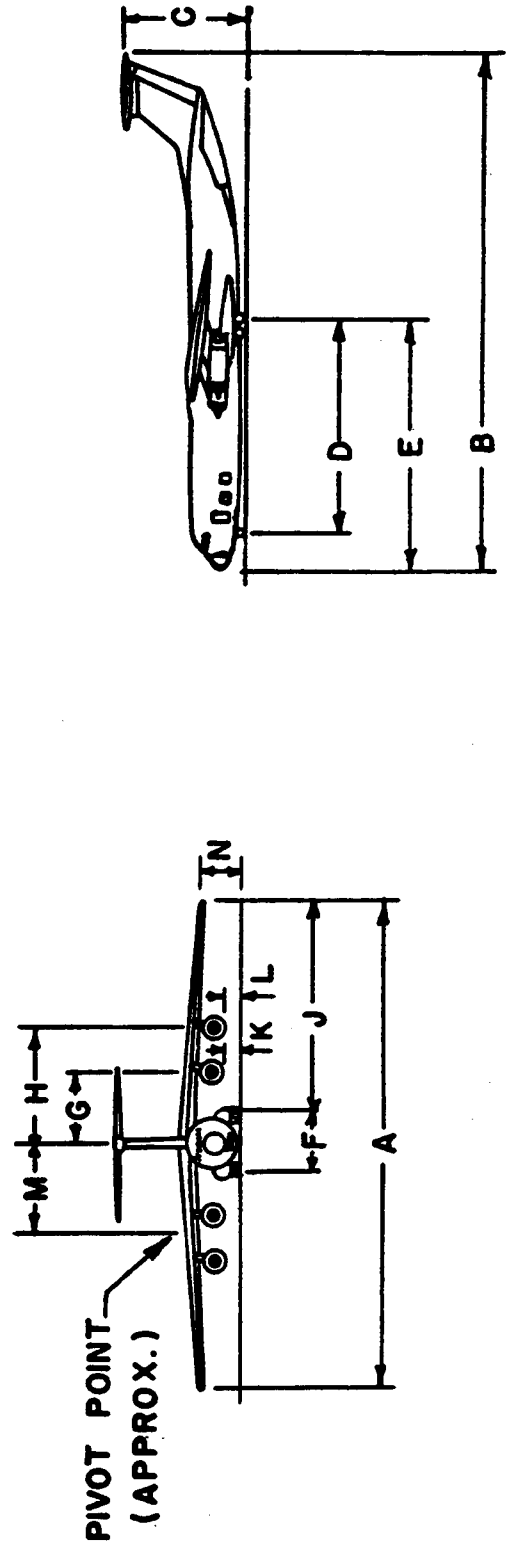


Figure A12-67. Lockheed C-141 Starlifter

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|------------------------------|------------------------------|-----------------|------------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|---------------|---------------|----------------|-----------------|-----------------|
| L-188 | 116,000 LB 52,617 KG | 95,650 LB 43,386 KG | 99'0" 29'91M | 104'7" 31.88M | 33'8" 10.26M | 37'0" 11.27M | 48'3" 14.71M | 31'2" 9.50M | 15'7" 4.75M | 29'9" 9.07M | 37'9" 9.98M | 1'3" 0.33M | 2'6" 0.76M | 15'7" 4.75M | 10'11" 3.33M | 65'1" 19.84M |

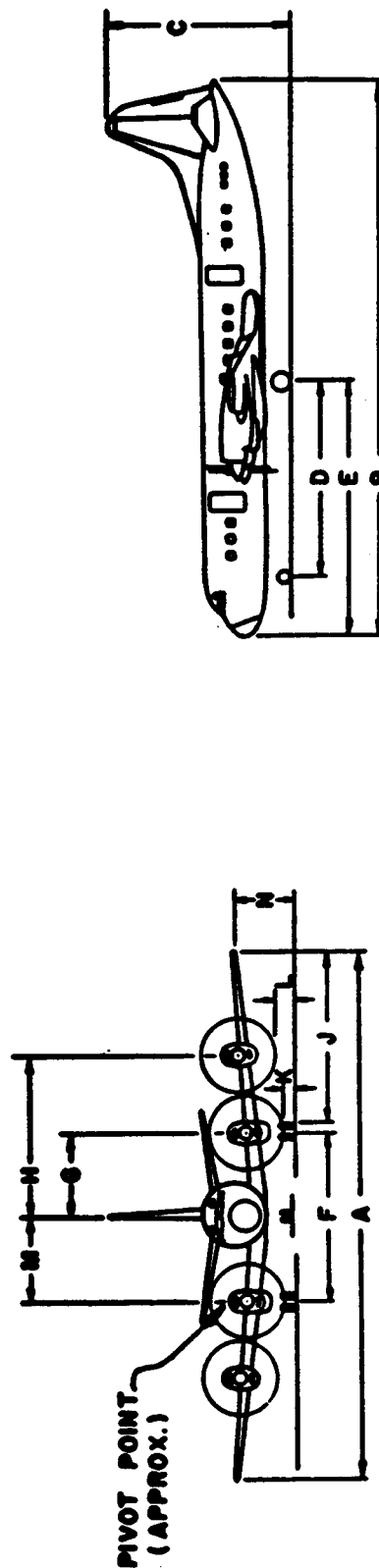


Figure A12-68. Lockheed L-188 Electra II

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|----------|------------------------------|------------------------------|--------|--------|--------|--------|--------|-------|-------|--------|--------|-------|-------|-------|-------|----------------|
| L-100-20 | 155,000 LB | 130,000 LB | 132'7" | 106'1" | 39'4" | 37'1" | 48'7" | 14'3" | 16'9" | 33'4" | 57'5" | 5'11" | 6'11" | 12'0" | 15'4" | 86'0" |
| | 70 307 KG | 58 967 KG | 40.41M | 32.33M | 11.98M | 11.30M | 14.80M | 4.34M | 5.11M | 10.16M | 17.50M | 1.80M | 2.11M | 3.65M | 4.67M | 26.82M |
| L-100-30 | 155,000 LB | 135,000 LB | 132'7" | 112'9" | 39'2" | 40'5" | 51'11" | 14'3" | 16'9" | 33'4" | 57'5" | 5'11" | 6'11" | 14'0" | 15'3" | 90'0" |
| | 70 307 KG | 61 235 KG | 40.41M | 34.36M | 11.93M | 12.31M | 15.81M | 4.34M | 5.11M | 10.16M | 17.50M | 1.80M | 2.11M | 4.27M | 4.64M | 27.43M |
| C-130H | 175,000 LB | 155,000 LB | 132'7" | 97'9" | 39'5" | 32'1" | 43'7" | 14'3" | 16'9" | 33'4" | 58'4" | 5'8" | | 13'8" | 13'8" | 85'0" |
| | 79 379 KG | 70 307 KG | 40.41M | 29.79M | 12.01M | 9.78M | 13.28M | 4.34M | 5.11M | 10.16M | 17.78M | 1.73M | | 4.17M | 4.17M | 25.91M |

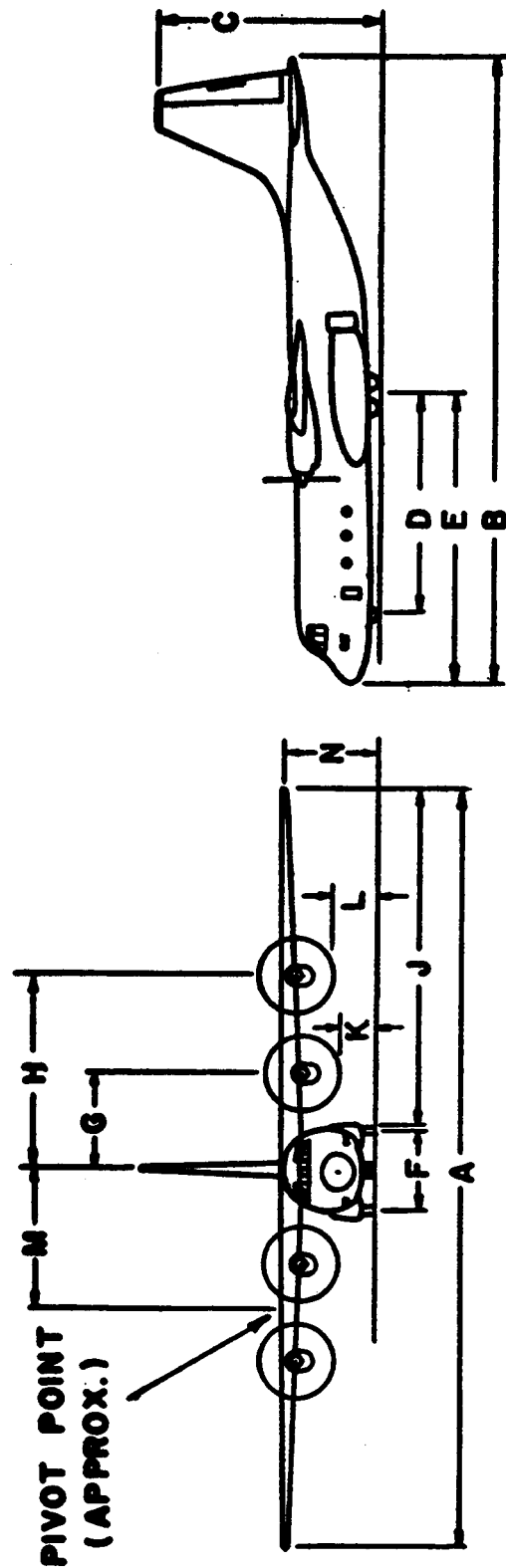


Figure A12-69. Lockheed L-100 Hercules

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | P | TURN RADIUS |
|--------------|------------------------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|--------|-------|-------------|
| 1 | 430,000 LB | 358,000 LB | 155'4" | 177'8" | 55'10" | 70'0" | 99'9" | 36'0" | 34'10" | 56'8" | 2'11" | 38'10" | 16'1" | 18'9" | 121'3" |
| | 195,045 KG | 162,386 KG | 47.35M | 54.15M | 17.02M | 21.34M | 30.40M | 10.97M | 10.62M | 17.27M | 0.89M | 11.84M | 4.90M | 5.72M | 36.96M |
| 100 | 466,000 LB | 368,000 LB | 155'4" | 177'8" | 55'10" | 70'0" | 99'9" | 36'0" | 34'10" | 56'8" | 2'11" | 38'10" | 16'1" | 18'9" | 121'3" |
| | 211,374 KG | 166,922 KG | 47.35M | 54.15M | 17.02M | 21.34M | 30.40M | 10.97M | 10.62M | 17.27M | 0.89M | 11.84M | 4.90M | 5.72M | 36.96M |
| 200 | 466,000 LB | 368,000 LB | 155'4" | 177'8" | 55'10" | 70'0" | 99'9" | 36'0" | 34'10" | 56'8" | 2'11" | 38'10" | 16'1" | 18'9" | 121'3" |
| | 211,374 KG | 166,922 KG | 47.35M | 54.15M | 17.02M | 21.34M | 30.40M | 10.97M | 10.62M | 17.27M | 0.89M | 11.84M | 4.90M | 5.72M | 36.96M |
| 500 | 496,000 LB | 368,000 LB | 155'4" | 164'2" | 55'10" | 61'8" | 91'5" | 36'0" | 34'10" | 56'8" | 2'11" | 34'0" | 16'10" | 20'0" | 116'10" |
| | 224,982 KG | 166,922 KG | 47.35M | 50.04M | 17.02M | 18.80M | 27.86M | 10.97M | 10.62M | 17.27M | 0.89M | 10.36M | 5.13M | 6.10M | 35.61M |
| 500 EX. WING | 496,000 LB | 368,000 LB | 164'4" | 164'2" | 55'10" | 61'8" | 91'5" | 36'0" | 34'10" | 61'2" | 2'11" | 34'0" | 16'10" | 20'0" | 122'0" |
| | 224,982 KG | 166,922 KG | 50.09M | 50.04M | 17.02M | 18.80M | 27.86M | 10.97M | 10.62M | 18.64M | 0.89M | 10.36M | 5.13M | 6.10M | 37.19M |

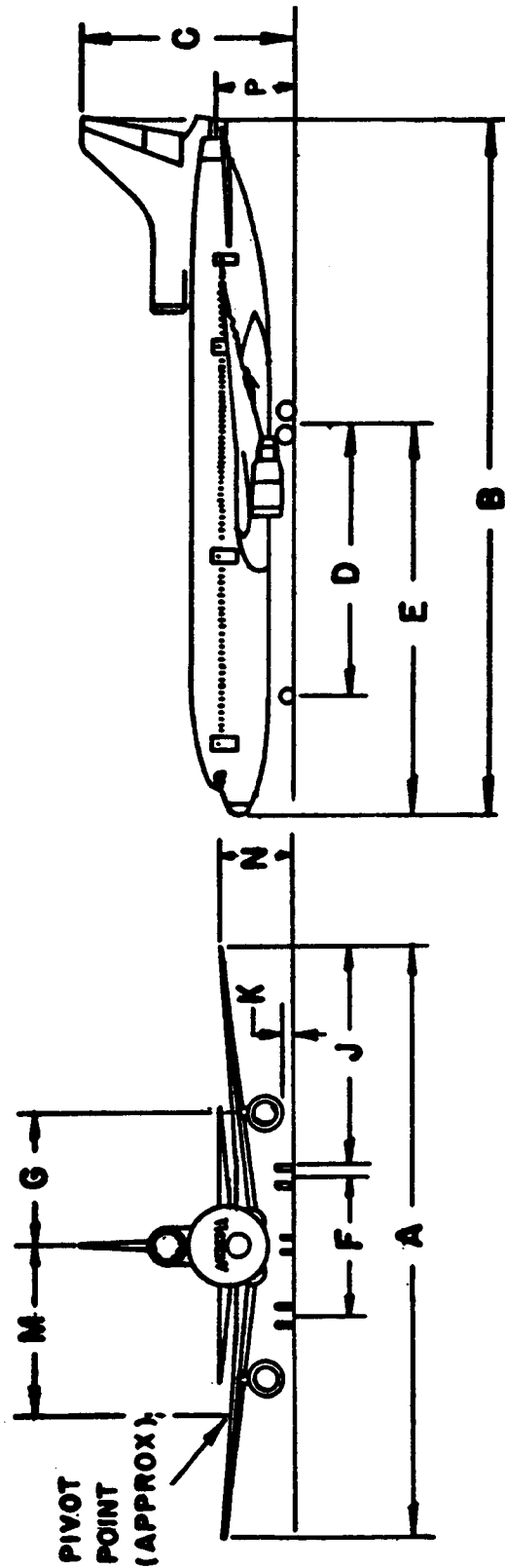


Figure A12-70. Lockheed L-1011 Tristar

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Appendix 12

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|-------|------------------------|------------------------|-----------------|-----------------|----------------|----------------|------------------|----------------|---------------|----------------|----------------|---------------|---------------|---------------|---------------|-----------------|
| 1329 | 42,000 LB 19,501 KG | 35,000 LB 15,876 KG | 54'5" 16.29M | 60'5" 18.42M | 20'5" 6.22M | 20'7" 6.28M | 34'11" 10.65M | 12'4" 3.76M | 5'7" 1.71M | 7'11" 2.42M | 19'4" 5.90M | 5'2" 1.60M | 5'2" 1.60M | 7'2" 2.19M | 4'5" 1.34M | 43'4" 13.21M |

JETSTAR II HAS OPTIONAL MAXIMUM (TAKEOFF) WEIGHT OF 43,750 LB (19,845 KG).
(LANDING) 36,000 LB (16,329 KG).

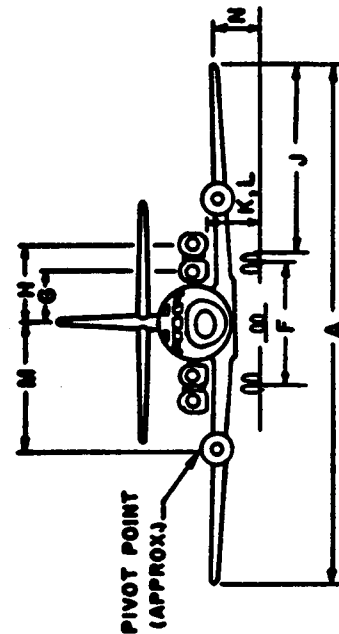
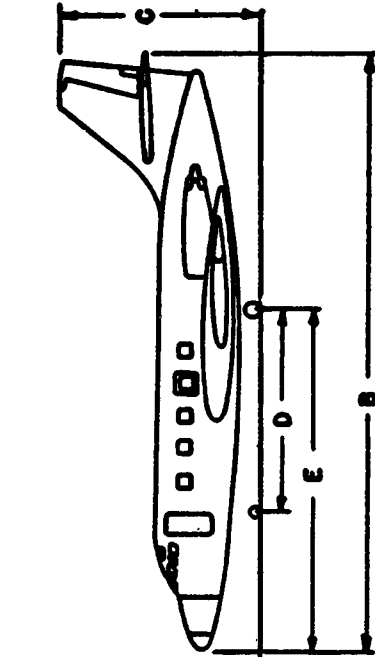


Figure A12-71. Lockheed L-1329 Jetstar

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | N | N | TURN RADIUS |
|-------|------------------------------|------------------------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| 404 | 44,900 LB 20,366 KG | 43,000 LB 19,504 KG | 93'4" 28.45M | 74'7" 22.73M | 28'8" 8.24M | 22'5" 6.83M | 32'3" 9.83M | 25'0" 7.62M | 12'6" 3.81M | 32'8" 9.96M | 0'11" 0.28M | 12'6" 3.81M | 12'6" 3.81M | 59'2" 18.03M |

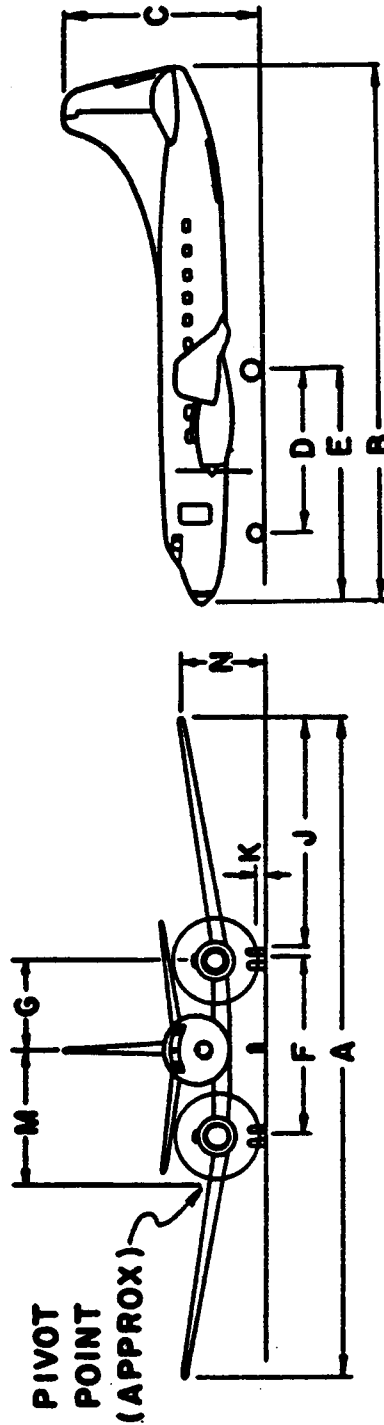


Figure A12-72. Martin 404

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AC 150/5300-13
Appendix 12

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|--------------|--------------------------|--------------------------|------------------|------------------|-----------------|------------------|-----------------|-----------------|----------------|-----------------|------------------|---------------|---------------|------------------|----------------|-------------------|
| 20, 30, 40 | 315,000 LB 142,884 KG | 207,000 LB 93,895 KG | 142'5" 43.41M | 150'9" 45.95M | 43'4" 13.21M | 57'6" 17.53M | 73'5" 22.38M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 58'10" 17.93M | 4'0" 1.22M | 5'5" 1.63M | 21'1" 6.43M | 15'3" 4.65M | 96'10" 29.51M |
| 55 | 325,000 LB 147,420 KG | 217,000 LB 98,431 KG | 142'5" 43.41M | 150'9" 45.95M | 43'4" 13.21M | 57'6" 17.53M | 73'5" 22.38M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 58'10" 17.93M | 3'1" 0.94M | 4'7" 1.40M | 21'1" 6.43M | 15'3" 4.65M | 96'10" 29.51M |
| 55F | 325,000 LB 147,420 KG | 240,000 LB 108,864 KG | 142'5" 43.41M | 150'9" 45.95M | 43'4" 13.21M | 57'6" 17.53M | 73'5" 22.38M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 58'10" 17.93M | 3'1" 0.94M | 4'7" 1.40M | 21'1" 6.43M | 15'3" 4.65M | 96'10" 29.51M |
| 61 | 325,000 LB 147,420 KG | 240,000 LB 108,864 KG | 142'5" 43.41M | 187'5" 57.12M | 43'0" 13.11M | 77'6" 23.62M | 93'5" 28.47M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 58'10" 17.93M | 3'3" 0.99M | 4'7" 1.40M | 27'0" 8.23M | 15'1" 4.60M | 106'11" 32.59M |
| 71 | 147,420 KG | 108,864 KG | 43.41M | 57.12M | 13.11M | 23.62M | 28.47M | 6.35M | 7.85M | 13.59M | 17.93M | 0.99M | 1.40M | 8.23M | 4.60M | 32.59M |
| 61F | 328,000 LB 148,760 KG | 258,000 LB 117,029 KG | 142'5" 43.41M | 187'5" 57.12M | 43'0" 13.11M | 77'6" 23.62M | 93'5" 28.47M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 58'10" 17.93M | 3'3" 0.99M | 4'7" 1.40M | 27'0" 8.23M | 15'1" 4.60M | 106'11" 32.59M |
| 71CF | 148,760 KG | 117,029 KG | 43.41M | 57.12M | 13.11M | 23.62M | 28.47M | 6.35M | 7.85M | 13.59M | 17.93M | 0.99M | 1.40M | 8.23M | 4.60M | 32.59M |
| 62, 72, 72AF | 350,000 LB 158,760 KG | 240,000 LB 108,864 KG | 148'5" 45.24M | 157'6" 48.00M | 43'5" 13.23M | 60'10" 18.54M | 76'9" 23.39M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 61'8" 18.80M | 2'7" 0.79M | 4'2" 1.27M | 39'4" 11.99M | 15'6" 4.72M | 116'5" 35.48M |
| 62F | 350,000 LB 158,760 KG | 250,000 LB 113,400 KG | 148'5" 45.24M | 157'6" 48.00M | 43'5" 13.23M | 60'10" 18.54M | 76'9" 23.39M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 61'8" 18.80M | 2'7" 0.79M | 4'2" 1.27M | 39'4" 11.99M | 15'6" 4.72M | 116'5" 35.48M |
| 72CF | 350,000 LB 158,760 KG | 250,000 LB 113,400 KG | 148'5" 45.24M | 157'6" 48.00M | 43'5" 13.23M | 60'10" 18.54M | 76'9" 23.39M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 61'8" 18.80M | 2'7" 0.79M | 4'2" 1.27M | 39'4" 11.99M | 15'6" 4.72M | 116'5" 35.48M |
| 63 | 355,000 LB 161,028 KG | 258,000 LB 117,029 KG | 148'5" 45.24M | 187'5" 57.12M | 43'0" 13.11M | 77'6" 23.62M | 93'5" 28.47M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 61'8" 18.80M | 2'7" 0.79M | 4'2" 1.27M | 38'10" 11.64M | 15'4" 4.67M | 116'11" 35.38M |
| 73 | 161,028 KG | 117,029 KG | 45.24M | 57.12M | 13.11M | 23.62M | 28.47M | 6.35M | 7.85M | 13.59M | 18.80M | 0.79M | 1.27M | 11.64M | 4.67M | 35.38M |
| 63F, 73CF | 355,000 LB 161,028 KG | 275,000 LB 124,740 KG | 148'5" 45.24M | 187'5" 57.12M | 43'0" 13.11M | 77'6" 23.62M | 93'5" 28.47M | 20'10" 6.35M | 25'9" 7.85M | 44'7" 13.59M | 61'8" 18.80M | 2'7" 0.79M | 4'2" 1.27M | 38'10" 11.64M | 15'4" 4.67M | 116'11" 35.38M |
| 73AF | 161,028 KG | 124,740 KG | 45.24M | 57.12M | 13.11M | 23.62M | 28.47M | 6.35M | 7.85M | 13.59M | 18.80M | 0.79M | 1.27M | 11.64M | 4.67M | 35.38M |

NOTE: OPTIONAL TAKEOFF AND LANDING WEIGHTS:
72 335,000 LB (151,953 KG) MAXIMUM TAKEOFF WEIGHT.
240,000 LB (108,864 KG) MAXIMUM LANDING WEIGHT.
72AF 335,000 LB (151,953 KG) MAXIMUM TAKEOFF WEIGHT.
250,000 LB (113,400 KG) MAXIMUM LANDING WEIGHT.

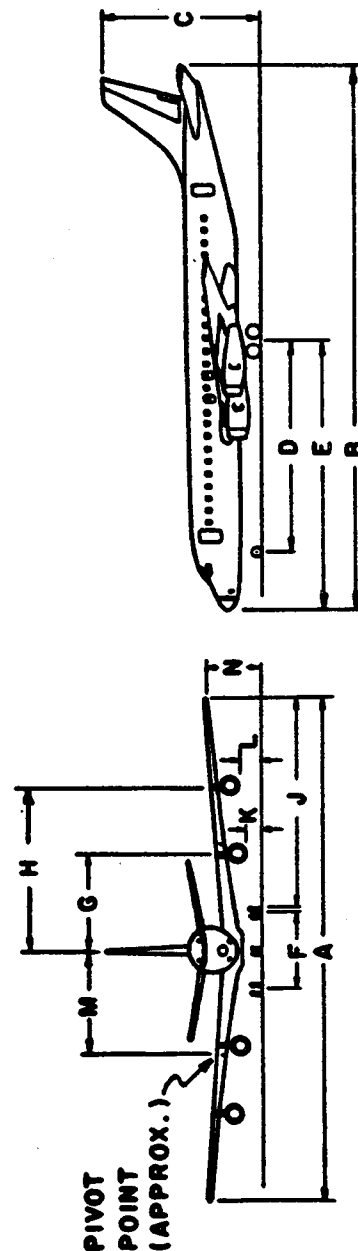


Figure A12-73. McDonnell-Douglas DC-8

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|-------------------|-------------------------|-------------------------|-------------------|-------------------|----------------|------------------|-----------------|----------------|----------------|------------------|----------------|-----------------|---------------|------------------|
| 15 | 90,700 LB 41 141 KG | 81,700 LB 37 058 KG | 89'5" 27.25M | 104'5" 31.83M | 27'7" 8.41M | 43'8" 13.31M | 51'4" 15.64M | 16'4" 4.98M | 8'11" 2.72M | 35'0" 10.67M | 6'5" 1.96M | 8'6" 2.59M | 7'2" 2.18M | 59'7" 18.16M |
| 15F | 90,700 LB 41 141 KG | 81,700 LB 37 058 KG | 89'5" 27.25M | 104'5" 31.83M | 27'7" 8.41M | 43'8" 13.31M | 51'4" 15.64M | 16'4" 4.98M | 8'11" 2.72M | 35'0" 10.67M | 6'5" 1.96M | 8'6" 2.59M | 7'2" 2.18M | 59'7" 18.16M |
| 21 | 98,000 LB 44 452 KG | 95,300 LB 43 227 KG | 93'4" 28.45M | 104'5" 31.83M | 27'5" 8.36M | 43'8" 13.31M | 51'4" 15.64M | 16'4" 4.98M | 8'11" 2.72M | 36'10" 11.23M | 6'5" 1.96M | 8'6" 2.59M | 7'3" 2.21M | 59'6" 18.14M |
| 32 | 110,000 LB 49 895 KG | 99,000 LB 44 906 KG | 93'4" 28.45M | 119'4" 36.37M | 27'9" 8.46M | 53'2" 16.21M | 60'9" 18.52M | 16'4" 4.98M | 8'11" 2.72M | 36'10" 11.23M | 6'5" 1.96M | 10'4" 3.15M | 7'3" 2.21M | 65'2" 19.86M |
| 33F | 110,000 LB 49 895 KG | 99,000 LB 44 906 KG | 93'4" 28.45M | 119'4" 36.37M | 27'9" 8.46M | 53'2" 16.21M | 60'9" 18.52M | 16'4" 4.98M | 8'11" 2.72M | 36'10" 11.23M | 6'5" 1.96M | 10'4" 3.15M | 7'3" 2.21M | 65'2" 19.86M |
| 41 | 114,000 LB 51 710 KG | 102,000 LB 46 266 KG | 93'4" 28.45M | 125'7" 38.28M | 28'5" 8.66M | 56'2" 17.12M | 63'8" 19.41M | 16'0" 4.88M | 8'11" 2.72M | 37'0" 11.28M | 6'11" 2.11M | 10'11" 3.33M | 7'2" 2.18M | 68'6" 20.88M |
| 51 | 121,000 LB 54 885 KG | 110,000 LB 49 895 KG | 93'4" 28.45M | 133'7" 40.72M | 28'9" 8.76M | 60'11" 18.57M | 68'6" 20.88M | 16'0" 4.88M | 8'11" 2.72M | 37'0" 11.28M | 6'10" 2.08M | 11'10" 3.61M | 7'1" 2.16M | 71'10" 21.89M |
| 81, 82, 83, 86 | SEE NOTE | SEE NOTE | 107'10" 32.87M | 147'10" 45.06M | 30'3" 9.22M | 72'5" 22.07M | 80'0" 24.38M | 16'8" 5.08M | 8'11" 2.72M | 43'9" 13.34M | 7'6" 2.29M | 14'0" 4.27M | 8'7" 2.62M | 81'2" 24.74M |
| 87 | SEE NOTE | SEE NOTE | 107'10" 32.87M | 130'5" 39.75M | 31'2" 9.50M | 62'11" 19.18M | 70'6" 21.49M | 16'8" 5.08M | 8'11" 2.72M | 43'9" 13.34M | 7'6" 2.29M | 12'2" 3.71M | 8'8" 2.64M | 71'7" 21.82M |

NOTE: TAKEOFF AND LANDING WEIGHTS:

- 81 140,000 LB (63 503 KG) MAXIMUM TAKEOFF WEIGHT.
128,000 LB (58 060 KG) MAXIMUM LANDING WEIGHT.
- 82 149,500 LB (67 812 KG) MAXIMUM TAKEOFF WEIGHT.
130,000 LB (58 967 KG) MAXIMUM LANDING WEIGHT.
- 83 160,000 LB (72 575 KG) MAXIMUM TAKEOFF WEIGHT.
139,500 LB (63 276 KG) MAXIMUM LANDING WEIGHT.

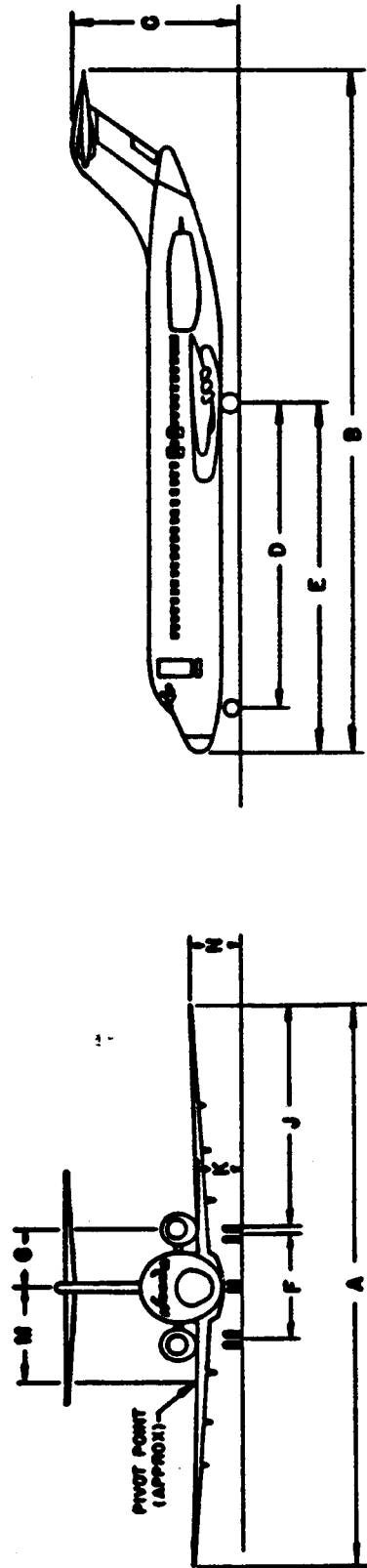


Figure A12-74. McDonnell-Douglas DC-9 and MD-80

9/29/89

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | P | TURN RADIUS |
|--------|------------------------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|-------|-------|-------------|
| 10 | 443,000 LB | 363,500 LB | 155'4" | 182'3" | 58'5" | 72'5" | 100'4" | 35'0" | 26'10" | 57'1" | 2'9" | 39'0" | 14'5" | 29'7" | 121'8" |
| | 200 941 KG | 164 881 KG | 47.35M | 55.55M | 17.81M | 22.07M | 30.58M | 10.67M | 8.18M | 17.40M | 0.84M | 11.89M | 4.32M | 9.02M | 37.08M |
| 30 | 590,000 LB | 411,000 LB | 165'4" | 181'7" | 58'7" | 72'5" | 100'4" | 35'0" | 26'10" | 62'1" | 2'10" | 37'2" | 14'4" | 29'6" | 125'4" |
| | 267 620 KG | 186 426 KG | 50.39M | 55.35M | 17.86M | 22.07M | 30.58M | 10.67M | 8.18M | 18.92M | 0.86M | 11.33M | 4.37M | 8.99M | 38.20M |
| 40 | 555,000 LB | 403,000 LB | 165'4" | 182'3" | 58'7" | 72'5" | 100'4" | 35'0" | 26'10" | 62'1" | 2'10" | 37'2" | 14'4" | 29'6" | 125'4" |
| | 251 744 KG | 182 798 KG | 50.39M | 55.55M | 17.86M | 22.07M | 30.58M | 10.67M | 8.18M | 18.92M | 0.86M | 11.33M | 4.37M | 8.99M | 38.20M |
| KC-10A | 590,000 LB | 426,000 LB | 165'4" | 181'7" | 58'7" | 72'5" | 100'4" | 35'0" | 26'10" | 62'1" | 2'10" | 37'2" | 14'4" | 29'6" | 125'4" |
| | 267 620 KG | 197 766 KG | 50.39M | 55.35M | 17.86M | 22.07M | 30.58M | 10.67M | 8.18M | 18.92M | 0.86M | 11.33M | 4.37M | 8.99M | 38.20M |

NOTE: TAKEOFF AND LANDING WEIGHTS:

10CF 440,000 LB (199 561 KG) MAXIMUM TAKEOFF WEIGHT.
363,500 LB (164 881 KG) MAXIMUM LANDING WEIGHT.

15 455,000 LB (206 384 KG) MAXIMUM TAKEOFF WEIGHT.
363,500 LB (164 881 KG) MAXIMUM LANDING WEIGHT.

DC-10-10CF HAS SAME DIMENSIONS AS MODEL 10.
DC-10-15 HAS SAME DIMENSIONS AS MODEL 10.
DC-10-30CF HAS SAME DIMENSIONS AS MODEL 30.

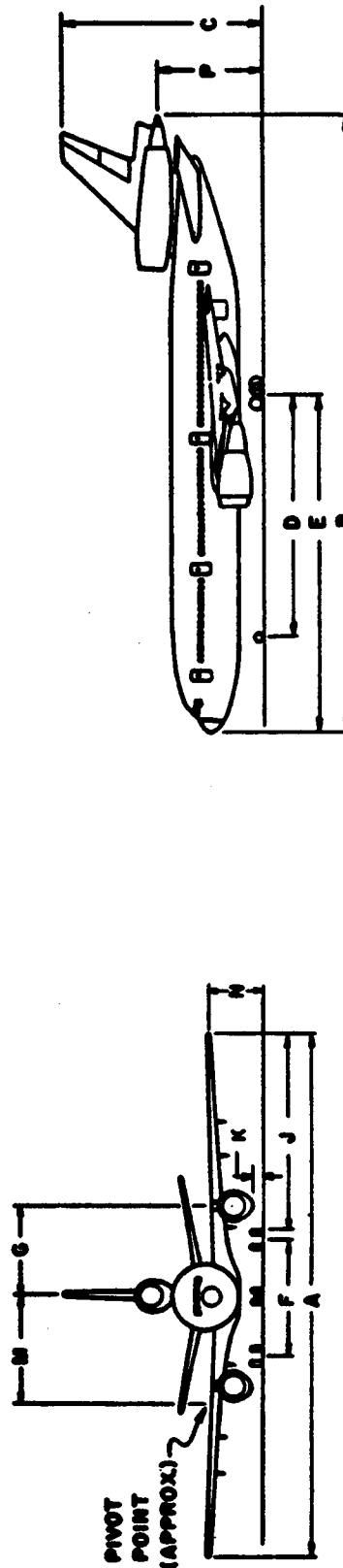


Figure A12-75. McDonnell-Douglas DC-10

| | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | P | TURN RADIUS |
|-----|------------------------------|------------------------------|-------------------|-------------|-----------------|-----------------|------------------|-----------------|-----------------|-----------------|---------------|----------------|-------------|----------------|------------------|
| 11 | 602,500 LB 273 289 KG | 430,000 LB 195 045 KG | 169'10" 51.77M | SEE NOTE | 57'9" 17.60M | 80'9" 24.61M | 108'9" 33.15M | 35'0" 10.67M | 26'10" 8.18M | 64'4" 19.61M | 3'1" 0.94M | 29'7" 9.02M | SEE NOTE | 29'2" 8.89M | 135'8" 41.35M |
| 11 | 602,500 LB 273 289 KG | 458,000 LB 207 745 KG | 169'10" 51.77M | SEE NOTE | 57'9" 17.60M | 80'9" 24.61M | 108'9" 33.15M | 35'0" 10.67M | 26'10" 8.18M | 64'4" 19.61M | 3'1" 0.94M | 29'7" 9.02M | SEE NOTE | 29'2" 8.89M | 135'8" 41.35M |
| 11F | 602,500 LB 273 289 KG | 471,500 LB 213 869 KG | 169'10" 51.77M | SEE NOTE | 57'9" 17.60M | 80'9" 24.61M | 108'9" 33.15M | 35'0" 10.67M | 26'10" 8.18M | 64'4" 19.61M | 3'1" 0.94M | 29'7" 9.02M | SEE NOTE | 29'2" 8.89M | 135'8" 41.35M |

NOTE: OPTIONAL MAXIMUM TAKEOFF WEIGHT: 605,500 LB (274 650 KG).

B 201' 4" (61.37M) WITH CFS-802CDIF ENGINES.

B 200' 11" (61.24M) WITH PW 4360 ENGINES.

M TOP OF WINGLET 23'5" (7.14M).

N BOTTOM OF WINGLET 13'9" (4.19M).

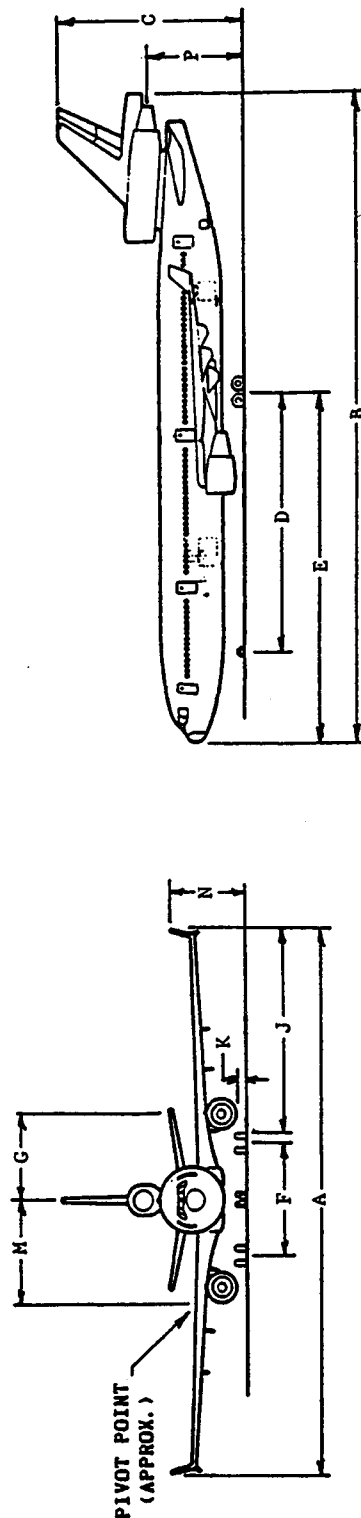


Figure A12-76. McDonnell-Douglas MD-11

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AC 150/5300-13
Appendix 12

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-----------|------------------------------|------------------------------|--------|--------|--------|-------|-------|-----------------|----------------|
| MU-2N | 11,575 LB | 10,260 LB | 39'2" | 39'6" | 13'8" | 14'5" | 7'11" | 7 | |
| MARQUISE | 5 250 KG | 4 654 KG | 11.94M | 12.04M | 4.17M | 4.39M | 2.41M | | |
| MU-2P | 10,470 LB | | 39'2" | 33'3" | 12'11" | | | 9 | |
| SOLITAIRE | 4 749 KG | | 11.94M | 10.13M | 3.94M | | | | |

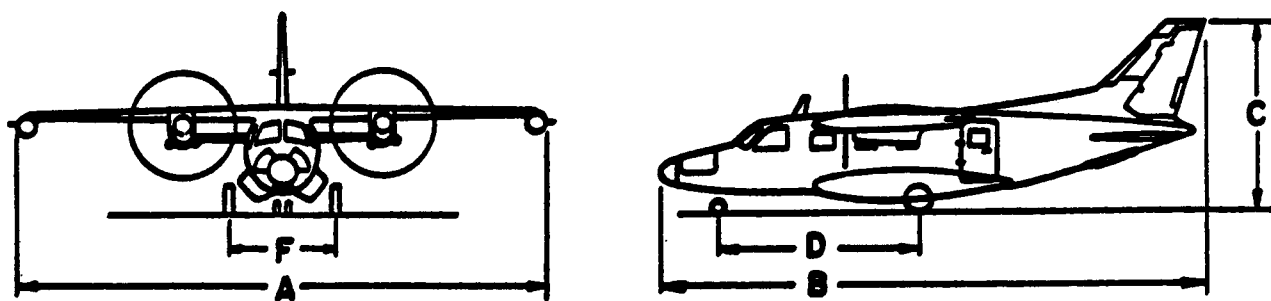


Figure A12-77. Mitsubishi MU-2

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | H | M | TURN RADIUS |
|--------|------------------------|------------------------|------------------|-----------------|----------------|----------------|----------------|-----------------|---|---|---|---|---|-------------|
| YS-11A | 54,010 LB 24 499KG | 52,910 LB 24 000 KG | 105'0" 32.00M | 86'4" 26.31M | 29'6" 8.99M | 31'3" 9.53M | 28'3" 8.61M | 37'8" 11.38M | | | | | | |

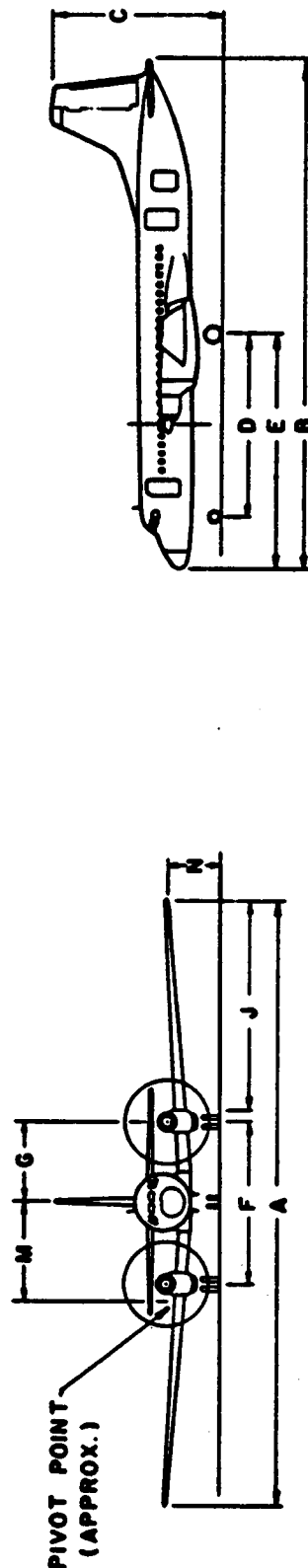


Figure A12-78. Nihon/N.A.M.C. YS-11A

9/29/89

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|---------|------------------------|------------------------|-----------------|-----------------|----------------|-----------------|----------------|---------------|---------------|----------------|----------------|----------------|---------------|-----------------|
| 40 | 18,650 LB 8 459 KG | 17,500 LB 7 938 KG | 44'6" 13.56M | 43'9" 13.34M | 16'0" 4.88M | 14'6" 4.42M | 22'9" 6.93M | 7'3" 2.21M | 4'6" 1.37M | 18'4" 5.59M | 3'10" 1.16M | 17'8" 5.38M | 3'8" 1.12M | 43'6" 13.26M |
| 60 | 20,000 LB 9 072 KG | 17,500 LB 7 938 KG | 44'6" 13.56M | 48'4" 14.73M | 16'0" 4.88M | 15'11" 4.85M | 24'1" 7.34M | 7'3" 2.21M | 4'6" 1.37M | 18'4" 5.59M | 3'10" 1.16M | 3'8" 1.12M | 3'8" 1.12M | |
| 70, 75A | 21,000 LB 9 525 KG | 18,500 LB 8 391 KG | 44'6" 13.56M | 47'2" 14.40M | 17'3" 5.24M | 15'10" 4.81M | | 8'4" 2.54M | 4'6" 1.37M | | 3'6" 1.05M | | 3'7" 1.08M | |

NOTE: MODEL 75A HAS MAXIMUM (TAKEOFF) WEIGHT OF 23,300 LB (10 569 KG).
22,000 LB (9 979 KG).

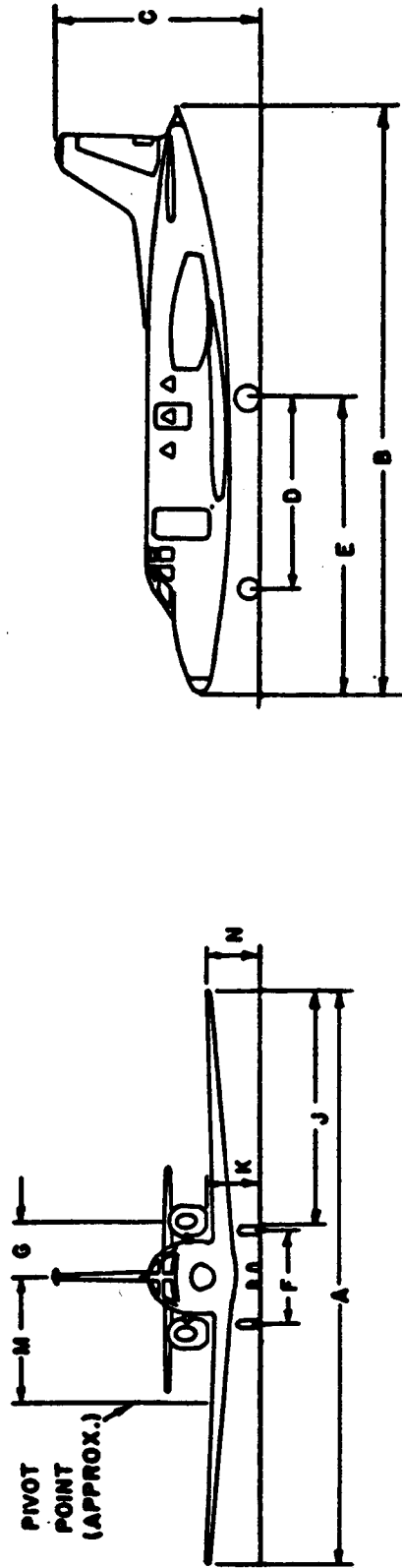


Figure A12-79. Rockwell International NA-265 Sabreliner

| MODEL | MAXIMUM TAKOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | J | K | M | N | TURN RADIUS |
|--------|-----------------------------|------------------------------|-----------------|-----------------|----------------|----------------|----------------|----------------|-----------------|----------------|----------------|----------------|---------------|----------------|
| SF 340 | 27,275 LB 12,372 KG | 26,500 LB 12,020 KG | 70'4" 21.44M | 64'8" 19.71M | 22'6" 6.86M | 23'5" 7.14M | 30'0" 9.14M | 22'0" 6.71M | 10'10" 3.30M | 23'3" 7.09M | 1'11" 0.58M | 18'8" 5.69M | 8'4" 2.54M | |

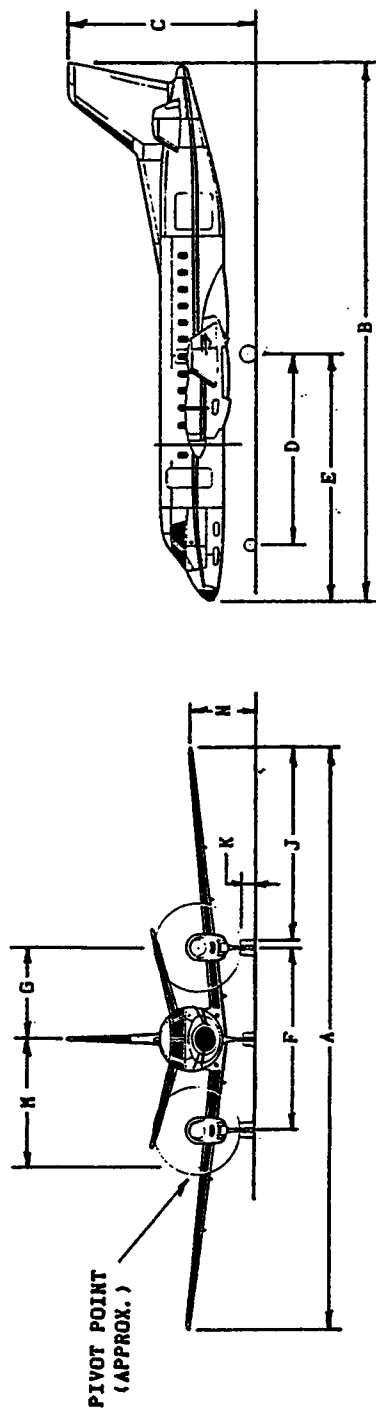
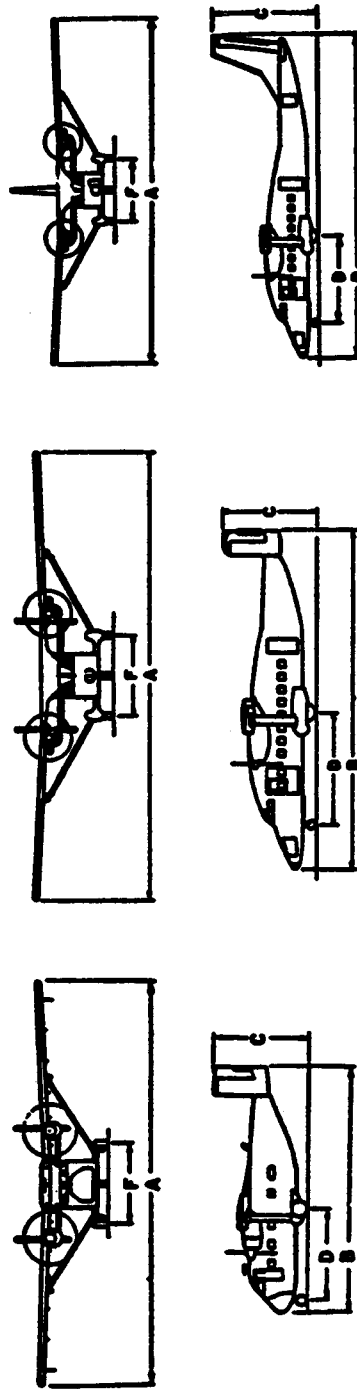


Figure A12-80. SAAB SF 340

9/29/89

AC 150/5300-13
Appendix 12

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-------------|------------------------------|------------------------------|------------------|------------------|----------------|-----------------|-----------------|-----------------|------------------|
| SC.7 | 12,500 LB 5 688 KG | 12,500 LB 5,688 KG | 64'11" 19.79M | 40'1" 12.22M | 15'0" 4.57M | 14'10" 4.52M | 13'10" 4.22M | 21 | |
| SC.7 -3M | 13,700 LB 6 214 KG | 13,500 LB 6 123 KG | 64'11" 19.79M | 40'1" 12.22M | 15'0" 4.57M | 14'10" 4.52M | 13'10" 4.22M | 22 | |
| SC.7 -3M | 14,500 LB 6 577 KG | 13,500 LB 6 123 KG | 64'11" 19.79M | 40'1" 12.22M | 15'0" 4.57M | 14'10" 4.52M | 13'10" 4.22M | 22 | |
| 330 | 22,600 LB 10 251 KG | 22,300 LB 10 115 KG | 74'8" 22.76M | 58'0" 17.68M | 16'3" 4.95M | 20'2" 6.15M | 13'11" 4.24M | 30 | 53'10" 16.41M |
| 330 -200 | 22,900 LB 10 387 KG | 22,600 LB 10 251 KG | 74'8" 22.76M | 58'0" 17.68M | 16'3" 4.95M | 20'2" 6.15M | 13'11" 4.24M | 30 | 53'10" 16.41M |
| 360 | 26,453 LB 11 999 KG | 26,100 LB 11 839 KG | 74'10" 22.81M | 70'10" 21.59M | 23'8" 7.21M | 23'2" 7.06M | 13'11" 4.24M | 36 | 53'10" 16.41M |



SC.7-3M

330

360

Figure A12-81. Short Brothers

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | E | F | G | H | J | K | L | M | N | TURN RADIUS |
|---------|--------------------------|-------------------------|-------------------|------------------|-----------------|------------------|---|----------------|---|---|---|---|---|---|---|-------------|
| BELFAST | 230,000 LB 104,326 KG | 215,000 LB 97,522 KG | 158'10" 48.41M | 136'5" 41.58M | 47'0" 14.33M | 48'11" 14.66M | | 19'4" 5.89M | | | | | | | | |

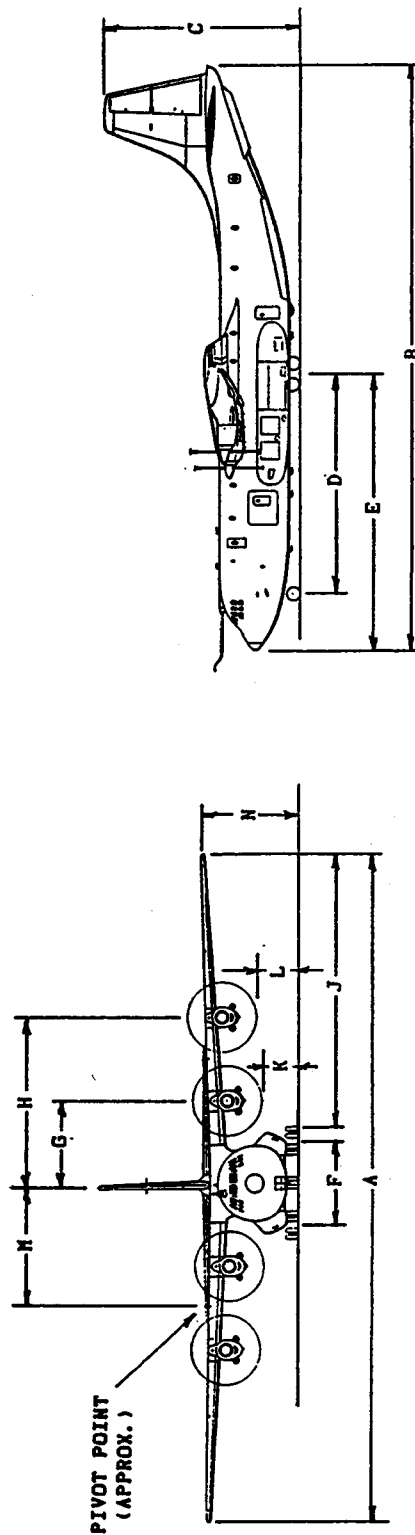


Figure A12-82. Shorts SC. 5/10 Belfast

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| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-------|------------------------|------------------------|--------|--------|-------|-------|-------|--------------|-------------|
| IIB | 10,000 LB | 9,300 LB | 45'11" | 40'1" | 14'4" | | 15'0" | 8 | |
| | 4 536 KG | 4 218 KG | 14.00M | 12.22M | 4.36M | | 4.57M | | |
| III | 12,500 LB | 11,500 LB | 46'3" | 42'2" | 16'8" | | 15'0" | 8 | |
| | 5 670 KG | 5 216 KG | 14.10M | 12.85M | 5.08M | | 4.57M | | |
| IV | 12,500 LB | 11,500 LB | 46'3" | 59'5" | 16'8" | 19'2" | 15'0" | 12 | |
| | 5 670 KG | 5 216 KG | 14.10M | 18.11M | 5.08M | 5.84M | 4.57M | | |
| IVC | 14,500 LB | 14,000 LB | 57'0" | 59'5" | 16'8" | | | 12 | |
| | 6 577 KG | 6 350 KG | 17.37M | 18.11M | 5.08M | | | | |

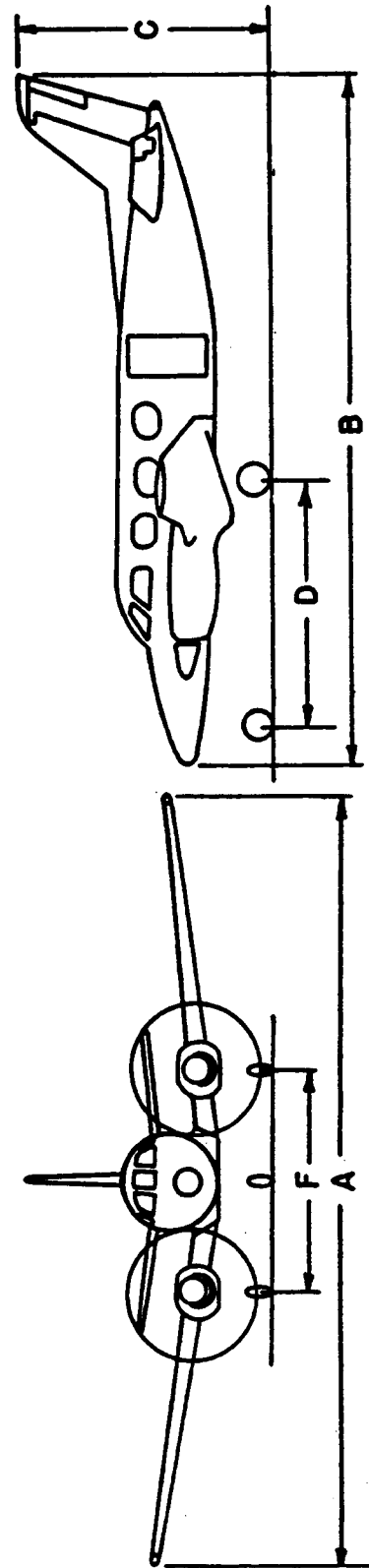


Figure A12-83. Swearingen Merlin

| MODEL | MAXIMUM TAKEOFF WEIGHT | MAXIMUM LANDING WEIGHT | A | B | C | D | F | NUMBER SEATS | TURN RADIUS |
|-------|------------------------|------------------------|-----------------|-----------------|----------------|----------------|----------------|--------------|-------------|
| II | 12,500 LB 5 670 KG | 12,500 LB 5 670 KG | 46'3" 14.10M | 59'5" 18.11M | 16'8" 5.08M | 19'2" 5.84M | 15'0" 4.57M | 22 | |
| IIA | 13,230 LB 6 001 KG | 13,000 LB 5 897 KG | 46'3" 14.10M | 59'5" 18.11M | 16'8" 5.08M | | | | |
| III | 14,500 LB 6 577 KG | 14,000 LB 6 350 KG | 57'0" 17.37M | 59'5" 18.11M | 16'8" 5.08M | | | | |
| IIIH | 16,000 LB 7 257 KG | 15,500 LB 7 031 KG | 57'0" 17.37M | 59'5" 18.11M | 16'8" 5.08M | | | | |
| V | 16,500 LB 7 484 KG | 15,675 LB 7 110 KG | | | | | | | |

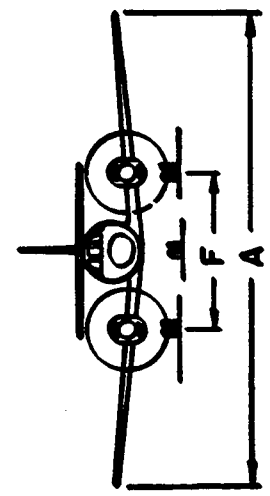
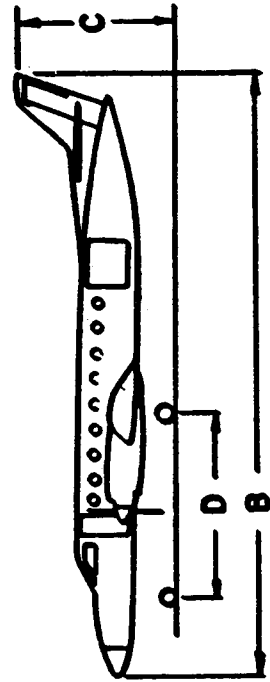


Figure A12-84. Swearingen Metro

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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 Britannia 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 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|--------------------------|------------------------------|-------------------------|------------------|----------------|------------------------|---------------------------|
| Cessna-177 Cardinal | A-I | 64 | 35.5 | 27.2 | 8.5 | 2,500 |
| Cessna-402 Businessliner | B-I | 95 | 39.8 | 36.1 | 11.6 | 6,300 |
| Cessna-404 Titan | B-I | 92 | 46.3 | 39.5 | 13.2 | 8,400 |
| Cessna-414 Chancellor | B-I | 94 | 44.1 | 36.4 | 11.5 | 6,785 |
| Cessna-421 Golden Eagle | B-I | 96 | 41.7 | 36.1 | 11.6 | 7,450 |
| Cessna-441 Conquest | B-II | 100 | 49.3 | 39.0 | 13.1 | 9,925 |
| Convair 240 | B-III | 107 | 91.8 | 74.7 | 26.9 | 41,790 |
| Convair 340 | B-III | 104 | 105.3 | 81.5 | 28.2 | 49,100 |
| Convair 440 | B-III | 106 | 105.3 | 81.5 | 28.2 | 49,100 |
| Convair 580 | B-III | 107 | 105.3 | 81.5 | 29.2 | 54,600 |
| Dassault 1150 Atlantic | C-IV | 130 * | 122.7 | 104.2 | 37.2 | 100,000 |
| Dassault 941 | A-II | 59 | 76.7 | 77.9 | 30.7 | 58,400 |
| Dassault FAL-10 | B-I | 104 | 42.9 | 45.5 | 15.1 | 18,740 |
| Dassault FAL-20 | B-II | 107 | 53.5 | 56.3 | 17.4 | 28,660 |
| Dassault FAL-200 | B-II | 114 | 53.5 | 56.3 | 17.4 | 30,650 |
| Dassault FAL-50 | B-II | 113 | 61.9 | 60.8 | 22.9 | 37,480 |
| Dassault FAL-900 | B-II | 100 | 63.4 | 66.3 | 24.8 | 45,500 |
| Dassault Mercure | B-III | 117 | 100.2 | 114.3 | 37.3 | 124,500 |
| DHC-2 Beaver | A-I | 50 | 48.0 | 30.3 | 9.0 | 5,100 |
| DHC-4 Caribou | A-III | 77 | 95.6 | 72.6 | 31.8 | 28,500 |
| DHC-5D Buffalo | B-III | 91 | 96.0 | 79.0 | 28.7 | 49,200 |
| DHC-6-300 Twin Otter | A-II | 75 | 65.0 | 51.7 | 19.5 | 12,500 |
| DHC-7 Dash 7-100 | A-III | 83 | 93.0 | 80.7 | 26.2 | 43,000 |
| DHC-8 Dash 8-300 | A-III | 90 | 90.0 | 84.3 | 24.6 | 41,100 |
| DH.104 Dove 8 | A-II | 84 | 57.0 | 39.2 | 13.3 | 8,950 |
| DH.106 Comet 4C | B-III | 108 | 115.0 | 118.0 | 29.5 | 162,000 |
| DH.114 Heron 2 | A-II | 85 | 71.5 | 48.5 | 15.6 | 13,500 |
| Dornier DO 28D-2 | A-II | 74 | 51.0 | 37.4 | 12.8 | 8,855 |
| Dornier LTA | A-II | 74 * | 58.4 | 54.4 | 18.2 | 15,100 |
| Embraer-110 Bandeirante | B-II | 92 | 50.3 | 49.5 | 16.5 | 13,007 |
| Embraer-121 Xingu | B-I | 92 | 47.4 | 40.2 | 15.9 | 12,500 |
| Embraer-326 Xavante | B-I | 102 | 35.6 | 34.9 | 12.2 | 11,500 |
| Embraer-820 Navajo Chief | A-I | 74 | 40.7 | 34.6 | 13.0 | 7,000 |
| Fairchild C-119 | C-III | 122 | 109.3 | 86.5 | 27.5 | 77,000 |
| Fairchild C-121 | A-III | 88 | 110.0 | 75.8 | 34.1 | 60,000 |
| Fairchild FH-227 B,D | B-III | 105 | 95.2 | 83.1 | 27.5 | 45,500 |
| Fairchild F-27 A,J | B-III | 109 | 95.2 | 77.2 | 27.5 | 42,000 |
| FMA IA-50 Guarni II | B-II | 101 | 64.1 | 48.8 | 19.1 | 15,700 |
| Fokker F-27-500 | B-III | 102 | 95.2 | 82.3 | 29.3 | 45,000 |
| Fokker F-28-1000 | B-II | 119 | 77.3 | 89.9 | 27.8 | 65,000 |
| Fokker F-28-2000 | B-II | 119 | 77.3 | 97.2 | 27.8 | 65,000 |
| Fokker F-28-3000 | C-III | 121 | 82.3 | 89.9 | 27.8 | 73,000 |
| Fokker F-28-4000 | C-III | 121 | 82.3 | 97.2 | 27.8 | 73,000 |
| Fokker F-28-6000 | B-III | 113 | 82.3 | 97.2 | 27.8 | 73,000 |
| Foxjet ST-600-8 | B-I | 97 | 31.6 | 31.8 | 10.2 | 4,550 |
| GAC-100 | A-II | 86 | 70.0 | 67.3 | 24.9 | 28,900 |
| Gates Learjet 24 | C-I | 128 | 35.6 | 43.3 | 12.6 | 13,000 |
| Gates Learjet 25 | C-I | 137 | 35.6 | 47.6 | 12.6 | 15,000 |
| Gates Learjet 28/29 | B-I | 120 | 43.7 | 47.6 | 12.3 | 15,000 |
| Gates Learjet 35A/36A | D-I | 143 | 39.5 | 48.7 | 12.3 | 18,300 |
| Gates Learjet 54-55-56 | C-I | 128 | 43.7 | 55.1 | 14.7 | 21,500 |

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| 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 |
| Grumman Gulfstream I | B-II | 113 | 78.3 | 75.3 | 23.0 | 36,000 |
| Grumman Gulfstream II | D-II | 141 | 68.8 | 79.9 | 24.5 | 65,300 |
| Grumman Gulfstream III | C-II | 136 | 77.8 | 83.1 | 24.4 | 68,700 |
| Grumman Gulfstream II-TT | D-II | 142 | 71.7 | 79.9 | 24.5 | 65,300 |
| Grumman Gulfstream IV | D-II | 145 | 77.8 | 87.8 | 24.4 | 71,780 |
| Hamilton Westwind II STD | B-I | 96 | 46.0 | 45.0 | 9.2 | 12,495 |
| HFB-320 Hansa | C-I | 125 | 47.5 | 54.5 | 16.2 | 20,280 |
| Hindustan HS.748-2 | B-III | 94 | 98.4 | 67.0 | 24.8 | 44,402 |
| HP Herald | A-III | 88 | 94.8 | 75.5 | 24.1 | 43,000 |
| HS 125 Series 400A | C-I | 124 | 47.0 | 47.4 | 16.5 | 23,300 |
| HS 125 Series 600A | C-I | 125 | 47.0 | 50.5 | 17.2 | 25,000 |
| HS 125 Series 700A | C-I | 125 | 47.0 | 50.7 | 17.6 | 24,200 |
| HS.121 Trident 1E | C-III | 137 | 95.0 | 114.8 | 27.0 | 135,500 |
| HS.121 Trident 2E | C-III | 138 | 98.0 | 114.8 | 27.0 | 144,000 |
| HS.121 Trident 3B | D-III | 143 | 98.0 | 131.2 | 28.3 | 150,000 |
| HS.121 Trident Super 3B | D-III | 146 | 98.0 | 131.2 | 28.3 | 158,000 |
| HS.748 Series 2A | B-III | 94 | 98.5 | 67.0 | 24.8 | 44,490 |
| HS.780 Andover C.Mk.1 | B-III | 100 | 98.2 | 78.0 | 30.1 | 50,000 |
| HS.801 Nimrod MR Mk.2 | C-III | 125 * | 114.8 | 126.8 | 29.7 | 177,500 |
| IAI 1121 Jet Comdr. | C-I | 130 | 43.3 | 50.4 | 15.8 | 16,800 |
| IAI Arava-201 | A-II | 81 | 68.6 | 42.7 | 17.1 | 15,000 |
| IAI-1124 Westwind | C-I | 129 | 44.8 | 52.3 | 15.8 | 23,500 |
| Ilyushin Il-12 | A-III | 78 | 104.0 | 70.0 | 30.5 | 38,000 |
| Ilyushin Il-18 | B-IV | 103 | 122.7 | 117.8 | 33.3 | 134,640 |
| Ilyushin Il-62 | D-IV | 152 | 141.8 | 174.3 | 40.5 | 363,760 |
| Ilyushin Il-76 | B-IV | 119 | 165.7 | 152.8 | 48.4 | 374,785 |
| Ilyushin Il-86 | D-IV | 141 | 157.7 | 195.3 | 51.8 | 454,150 |
| Kawasaki C-1 | B-III | 118 * | 100.4 | 95.1 | 32.9 | 85,320 |
| Lapan XT-400 | A-I | 75 | 47.9 | 33.5 | 14.1 | 5,555 |
| Learfan 2100 | A-I | 86 | 39.3 | 40.6 | 12.2 | 7,400 |
| LET L-410 UVP-E | A-II | 81 | 65.5 | 47.5 | 19.1 | 14,109 |
| 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 1011-250 | 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 |
| Lockheed 1011-600 | C-IV | 140 * | 142.8 | 141.0 | 53.0 | 264,000 |
| Lockheed 1049 Constellat'n | B-IV | 113 | 123.0 | 113.6 | 24.8 | 137,500 |
| Lockheed 1329 JetStar | C-II | 132 | 54.4 | 60.4 | 20.4 | 43,750 |
| Lockheed 1649 Constellat'n | A-IV | 89 | 150.0 | 116.2 | 23.4 | 160,000 |
| Lockheed 188 Electra | C-III | 123 | 99.0 | 104.6 | 33.7 | 116,000 |
| Lockheed 400 | C-IV | 121 * | 119.7 | 97.8 | 38.1 | 84,000 |
| Lockheed 749 Constellat'n | B-IV | 93 | 123.0 | 95.2 | 22.4 | 107,000 |
| 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 |
| Lockheed C-5B Galaxy | C-VI | 135 | 222.7 | 247.8 | 65.1 | 837,000 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|----------------------------|------------------------------|-------------------------|------------------|----------------|------------------------|---------------------------|
| Lockheed P-3 Orion | C-III | 134 | 99.7 | 116.8 | 33.8 | 135,000 |
| Lockheed SR-71 Blackbird | E-II | 180 | 55.6 | 107.4 | 18.5 | 170,000 |
| MAI-QSTOL | A-III | 85 | 100.3 | 98.4 | 32.8 | 85,300 |
| Marshall (Shorts) Belfast | C-IV | 126 | 158.8 | 136.4 | 47.0 | 230,000 |
| Martin-404 | B-III | 98 | 93.3 | 74.6 | 28.7 | 44,900 |
| MDC-C-133 | C-V | 128 | 179.7 | 157.5 | 48.2 | 300,000 |
| MDC-DC-10-10 | C-IV | 136 | 155.3 | 182.3 | 58.4 | 443,000 |
| 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-3 | A-III | 72 | 95.0 | 64.5 | 23.5 | 25,200 |
| MDC-DC-4 | B-III | 95 | 117.5 | 93.9 | 27.9 | 73,000 |
| MDC-DC-6A/B | B-III | 108 | 117.5 | 105.6 | 29.3 | 104,000 |
| MDC-DC-7 | B-IV | 110 | 127.5 | 112.3 | 31.7 | 143,000 |
| 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-8-61 | D-IV | 142 | 142.4 | 187.4 | 43.0 | 325,000 |
| MDC-DC-8-62 | C-IV | 124 | 148.4 | 157.5 | 43.4 | 350,000 |
| MDC-DC-8-63 | D-IV | 147 | 148.4 | 187.4 | 43.0 | 355,000 |
| MDC-DC-9-10/15 | C-III | 134 | 89.4 | 104.4 | 27.6 | 90,700 |
| MDC-DC-9-20 | C-III | 124 | 93.3 | 104.4 | 27.4 | 98,000 |
| MDC-DC-9-30 | C-III | 127 | 93.3 | 119.3 | 27.8 | 110,000 |
| MDC-DC-9-40 | C-III | 129 | 93.3 | 125.6 | 28.4 | 114,000 |
| MDC-DC-9-50 | C-III | 132 | 93.3 | 133.6 | 28.8 | 121,000 |
| MDC-DC-9-80 | C-III | 132 | 107.8 | 147.8 | 30.3 | 140,000 |
| MDC-DC-9-82 | C-III | 135 | 107.8 | 147.8 | 30.3 | 149,500 |
| MDC-MD-11 | D-IV | 155 | 169.8 | 201.3 | 57.8 | 602,500 |
| Mitsubishi Diamond MU-300 | B-I | 100 | 43.5 | 48.4 | 13.8 | 15,730 |
| Mitsubishi Marquise MU-2N | A-I | 88 | 39.2 | 39.5 | 13.7 | 11,575 |
| Mitsubishi MU-2G | B-I | 119 | 39.2 | 39.5 | 13.8 | 10,800 |
| Mitsubishi Solitaire MU-2P | A-I | 87 | 39.2 | 33.3 | 12.9 | 10,470 |
| Nihon YS-11 | B-III | 98 | 105.0 | 86.3 | 29.5 | 54,010 |
| Nomad N 22B | A-II | 69 | 54.0 | 41.2 | 18.1 | 8,950 |
| Nomad N 24A | A-II | 73 | 54.2 | 47.1 | 18.2 | 9,400 |
| Partenavia P.68B Victor | A-I | 73 | 39.3 | 35.6 | 11.9 | 6,283 |
| Piaggio PD-808 | B-I | 117 | 43.3 | 42.2 | 15.8 | 18,300 |
| Piaggio P-166 Portofino | A-I | 82 | 47.2 | 39.0 | 16.4 | 9,480 |
| Pilatus PC-6 Porter | A-II | 57 | 49.7 | 37.4 | 10.5 | 4,850 |
| Piper 31-310 Navajo | B-I | 100 | 40.7 | 32.7 | 13.0 | 6,200 |
| Piper 400LS Cheyenne | B-I | 110 | 47.7 | 43.4 | 17.0 | 12,050 |
| Piper 60-602P Aerostar | B-I | 94 | 36.7 | 34.8 | 12.1 | 6,000 |
| PZL-AN-2 | A-II | 54 | 59.8 | 41.9 | 13.1 | 12,125 |
| PZL-AN-28 | A-II | 85 | 72.4 | 42.9 | 16.1 | 14,330 |
| PZL-M-15 Belphegor | A-II | 62 | 73.6 | 41.9 | 17.6 | 12,465 |
| Rockwell 690A Turbo Comdr. | B-I | 97 | 46.5 | 44.3 | 14.9 | 10,300 |
| Rockwell 840 | B-II | 98 | 52.1 | 42.9 | 14.9 | 10,325 |
| Rockwell 980 | C-II | 121 | 52.1 | 42.9 | 14.9 | 10,325 |
| Rockwell B-1 | D-IV | 165 * | 137.0 | 147.0 | 34.0 | 477,000 |
| Rockwell Sabre 40 | B-I | 120 | 44.5 | 43.8 | 16.0 | 18,650 |
| Rockwell Sabre 60 | B-I | 120 | 44.5 | 48.3 | 16.0 | 20,000 |
| Rockwell Sabre 65 | B-II | 105 | 50.5 | 46.1 | 16.0 | 24,000 |

| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|----------------------|------------------------------|-------------------------|------------------|----------------|------------------------|---------------------------|
| Rockwell Sabre 75A | C-I | 137 | 44.5 | 47.2 | 17.2 | 23,300 |
| Rockwell Sabre 80 | C-II | 128 | 50.4 | 47.2 | 17.3 | 24,500 |
| Shorts 330 | B-II | 96 | 74.7 | 58.0 | 16.2 | 22,900 |
| Shorts 360 | B-II | 104 | 74.8 | 70.8 | 23.7 | 26,453 |
| Swearingen Merlin 3B | B-I | 105 | 46.2 | 42.2 | 16.7 | 12,500 |
| Swearingen Metro | B-I | 112 | 46.2 | 59.4 | 16.7 | 12,500 |
| Tupolev TU-114 | C-IV | 132 * | 167.6 | 177.5 | 50.0 | 361,620 |
| Tupolev TU-124 | C-III | 132 * | 83.8 | 100.3 | 50.0 | 80,482 |
| 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 |
| Tupolev TU-154 | D-IV | 145 | 123.3 | 157.2 | 37.4 | 216,050 |
| VFW-Fokker 614 | B-II | 111 | 70.5 | 67.5 | 25.6 | 44,000 |
| Vickers Vanguard 950 | B-IV | 119 | 118.0 | 122.9 | 34.9 | 146,500 |
| 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 |
| Vickers VC-2-810/840 | C-III | 122 | 94.0 | 85.7 | 26.8 | 72,500 |
| Volpar Turbo 18 | B-I | 100 | 46.0 | 37.4 | 9.6 | 10,280 |
| Yakovlev YAK-40 | C-III | 128 * | 82.2 | 65.9 | 21.3 | 35,275 |
| Yakovlev YAK-42 | C-III | 128 * | 112.2 | 119.3 | 32.2 | 117,950 |
| Yunshu-11 | A-II | 80 * | 55.7 | 39.4 | 15.1 | 7,150 |

* Approach speeds estimated.

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Appendix 13**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 Britannia 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 | |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|--------------------------|------------------------|-------------------|-----------------|---------------|--------------------|--------------------|
| Cessna-441 Conquest | B-II | 100 | 15.0 | 11.9 | 4.0 | 4,502 |
| Convair 240 | B-III | 107 | 28.0 | 22.8 | 8.2 | 18,956 |
| Convair 340 | B-III | 104 | 32.1 | 24.8 | 8.6 | 22,271 |
| Convair 440 | B-III | 106 | 32.1 | 24.8 | 8.6 | 22,271 |
| Convair 580 | B-III | 107 | 32.1 | 24.8 | 8.9 | 24,766 |
| Dassault 1150 Atlantic | C-IV | 130 * | 37.4 | 31.8 | 11.3 | 45,359 |
| Dassault 941 | A-II | 59 | 23.4 | 23.7 | 9.4 | 26,490 |
| Dassault FAL-10 | B-I | 104 | 13.1 | 13.9 | 4.6 | 8,500 |
| Dassault FAL-20 | B-II | 107 | 16.3 | 17.2 | 5.3 | 13,000 |
| Dassault FAL-200 | B-II | 114 | 16.3 | 17.2 | 5.3 | 13,903 |
| Dassault FAL-50 | B-II | 113 | 18.9 | 18.5 | 7.0 | 17,001 |
| Dassault FAL-900 | B-II | 100 | 19.3 | 20.2 | 7.6 | 20,638 |
| Dassault Mercure | B-III | 117 | 30.5 | 34.8 | 11.4 | 56,472 |
| DHC-2 Beaver | A-I | 50 | 14.6 | 9.2 | 2.7 | 2,313 |
| DHC-4 Caribou | A-III | 77 | 29.1 | 22.1 | 9.7 | 12,927 |
| DHC-5D Buffalo | B-III | 91 | 29.3 | 24.1 | 8.7 | 22,317 |
| DHC-6-300 Twin Otter | A-II | 75 | 19.8 | 15.8 | 5.9 | 5,670 |
| DHC-7 Dash 7-100 | A-III | 83 | 28.3 | 24.6 | 8.0 | 19,504 |
| DHC-8 Dash 8-300 | A-III | 90 | 27.4 | 25.7 | 7.5 | 18,643 |
| DH.104 Dove 8 | A-II | 84 | 17.4 | 11.9 | 4.1 | 4,060 |
| DH.106 Comet 4C | B-III | 108 | 35.1 | 36.0 | 9.0 | 73,482 |
| DH.114 Heron 2 | A-II | 85 | 21.8 | 14.8 | 4.8 | 6,123 |
| Dornier DO 28D-2 | A-II | 74 | 15.5 | 11.4 | 3.9 | 4,017 |
| Dornier LTA | A-II | 74 * | 17.8 | 16.6 | 5.5 | 6,849 |
| Embraer-110 Bandeirante | B-II | 92 | 15.3 | 15.1 | 5.0 | 5,900 |
| Embraer-121 Xingu | B-I | 92 | 14.4 | 12.3 | 4.8 | 5,670 |
| Embraer-326 Xavante | B-I | 102 | 10.9 | 10.6 | 3.7 | 5,216 |
| Embraer-820 Navajo Chief | A-I | 74 | 12.4 | 10.5 | 4.0 | 3,175 |
| Fairchild C-119 | C-III | 122 | 33.3 | 26.4 | 8.4 | 34,927 |
| Fairchild C-121 | A-III | 88 | 33.5 | 23.1 | 10.4 | 27,216 |
| Fairchild FH-227 B,D | B-III | 105 | 29.0 | 25.3 | 8.4 | 20,638 |
| Fairchild F-27 A,J | B-III | 109 | 29.0 | 23.5 | 8.4 | 19,051 |
| FMA IA-50 Guarni II | B-II | 101 | 19.5 | 14.9 | 5.8 | 7,121 |
| Fokker F-27-500 | B-III | 102 | 29.0 | 25.1 | 8.9 | 20,412 |
| Fokker F-28-1000 | B-II | 119 | 23.6 | 27.4 | 8.5 | 29,484 |
| Fokker F-28-2000 | B-II | 119 | 23.6 | 29.6 | 8.5 | 29,484 |
| Fokker F-28-3000 | C-III | 121 | 25.1 | 27.4 | 8.5 | 33,112 |
| Fokker F-28-4000 | C-III | 121 | 25.1 | 29.6 | 8.5 | 33,112 |
| Fokker F-28-6000 | B-III | 113 | 25.1 | 29.6 | 8.5 | 33,112 |
| Foxjet ST-600-8 | B-I | 97 | 9.6 | 9.7 | 3.1 | 2,064 |
| GAC-100 | A-II | 86 | 21.3 | 20.5 | 7.6 | 13,109 |
| Gates Learjet 24 | C-I | 128 | 10.9 | 13.2 | 3.8 | 5,897 |
| Gates Learjet 25 | C-I | 137 | 10.9 | 14.5 | 3.8 | 6,804 |
| Gates Learjet 28/29 | B-I | 120 | 13.3 | 14.5 | 3.7 | 6,804 |
| Gates Learjet 35A/36A | D-I | 143 | 12.0 | 14.8 | 3.7 | 8,301 |
| Gates Learjet 54-55-56 | C-I | 128 | 13.3 | 16.8 | 4.5 | 9,752 |
| 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 |
| Grumman Gulfstream I | B-II | 113 | 23.9 | 23.0 | 7.0 | 16,329 |
| Grumman Gulfstream II | D-II | 141 | 21.0 | 24.4 | 7.5 | 29,620 |
| Grumman Gulfstream III | C-II | 136 | 23.7 | 25.3 | 7.4 | 31,162 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|----------------------------|------------------------------|-------------------------|--------------------|------------------|--------------------------|--------------------------|
| Grumman Gulfstream II-TT | D-II | 142 | 21.9 | 24.4 | 7.5 | 29,620 |
| Grumman Gulfstream IV | D-II | 145 | 23.7 | 26.8 | 7.4 | 32,559 |
| Hamilton Westwind II STD | B-I | 96 | 14.0 | 13.7 | 2.8 | 5,668 |
| HFB-320 Hansa | C-I | 125 | 14.5 | 16.6 | 4.9 | 9,199 |
| Hindustan HS.748-2 | B-III | 94 | 30.0 | 20.4 | 7.6 | 20,140 |
| HP Herald | A-III | 88 | 28.9 | 23.0 | 7.3 | 19,504 |
| HS 125 Series 400A | C-I | 124 | 14.3 | 14.4 | 5.0 | 10,569 |
| HS 125 Series 600A | C-I | 125 | 14.3 | 15.4 | 5.2 | 11,340 |
| HS 125 Series 700A | C-I | 125 | 14.3 | 15.5 | 5.4 | 10,977 |
| HS.121 Trident 1E | C-III | 137 | 29.0 | 35.0 | 8.2 | 61,462 |
| HS.121 Trident 2E | C-III | 138 | 29.9 | 35.0 | 8.2 | 65,317 |
| HS.121 Trident 3B | D-III | 143 | 29.9 | 40.0 | 8.6 | 68,039 |
| HS.121 Trident Super 3B | D-III | 146 | 29.9 | 40.0 | 8.6 | 71,668 |
| HS.748 Series 2A | B-III | 94 | 30.0 | 20.4 | 7.6 | 20,180 |
| HS.780 Andover C.Mk.1 | B-III | 100 | 29.9 | 23.8 | 9.2 | 22,680 |
| HS.801 Nimrod MR Mk.2 | C-III | 125 * | 35.0 | 38.6 | 9.1 | 80,513 |
| IAI 1121 Jet Comdr. | C-I | 130 | 13.2 | 15.4 | 4.8 | 7,620 |
| IAI Arava-201 | A-II | 81 | 20.9 | 13.0 | 5.2 | 6,804 |
| IAI-1124 Westwind | C-I | 129 | 13.7 | 15.9 | 4.8 | 10,659 |
| Ilyushin Il-12 | A-III | 78 | 31.7 | 21.3 | 9.3 | 17,237 |
| Ilyushin Il-18 | B-IV | 103 | 37.4 | 35.9 | 10.1 | 61,072 |
| Ilyushin Il-62 | D-IV | 152 | 43.2 | 53.1 | 12.3 | 164,999 |
| Ilyushin Il-76 | B-IV | 119 | 50.5 | 46.6 | 14.8 | 170,000 |
| Ilyushin Il-86 | D-IV | 141 | 48.1 | 59.5 | 15.8 | 205,999 |
| Kawasaki C-1 | B-III | 118 * | 30.6 | 29.0 | 10.0 | 38,701 |
| Lapan XT-400 | A-I | 75 | 14.6 | 10.2 | 4.3 | 2,520 |
| Learfan 2100 | A-I | 86 | 12.0 | 12.4 | 3.7 | 3,357 |
| LET L-410 UVP-E | A-II | 81 | 20.0 | 14.5 | 5.8 | 6,400 |
| 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 1011-250 | 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 |
| Lockheed 1011-600 | C-IV | 140 * | 43.5 | 43.0 | 16.2 | 119,748 |
| Lockheed 1049 Constellat'n | B-IV | 113 | 37.5 | 34.6 | 7.6 | 62,369 |
| Lockheed 1329 JetStar | C-II | 132 | 16.6 | 18.4 | 6.2 | 19,845 |
| Lockheed 1649 Constellat'n | A-IV | 89 | 45.7 | 35.4 | 7.1 | 72,575 |
| Lockheed 188 Electra | C-III | 123 | 30.2 | 31.9 | 10.3 | 52,617 |
| Lockheed 400 | C-IV | 121 * | 36.5 | 29.8 | 11.6 | 38,102 |
| Lockheed 749 Constellat'n | B-IV | 93 | 37.5 | 29.0 | 6.8 | 48,534 |
| 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 |
| Lockheed C-5B Galaxy | C-VI | 135 | 67.9 | 75.5 | 19.8 | 379,657 |
| Lockheed P-3 Orion | C-III | 134 | 30.4 | 35.6 | 10.3 | 61,235 |
| Lockheed SR-71 Blackbird | E-II | 180 | 16.9 | 32.7 | 5.6 | 77,111 |
| MAI-QSTOL | A-III | 85 | 30.6 | 30.0 | 10.0 | 38,691 |
| Marshall (Shorts) Belfast | C-IV | 126 | 48.4 | 41.6 | 14.3 | 104,326 |
| Martin-404 | B-III | 98 | 28.4 | 22.7 | 8.7 | 20,366 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|----------------------------|------------------------|-------------------|-----------------|---------------|--------------------|--------------------|
| MDC-C-133 | C-V | 128 | 54.8 | 48.0 | 14.7 | 136,078 |
| MDC-DC-10-10 | C-IV | 136 | 47.3 | 55.6 | 17.8 | 200,941 |
| 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-3 | A-III | 72 | 29.0 | 19.7 | 7.2 | 11,431 |
| MDC-DC-4 | B-III | 95 | 35.8 | 28.6 | 8.5 | 33,112 |
| MDC-DC-6A/B | B-III | 108 | 35.8 | 32.2 | 8.9 | 47,174 |
| MDC-DC-7 | B-IV | 110 | 38.9 | 34.2 | 9.7 | 64,864 |
| 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-8-61 | D-IV | 142 | 43.4 | 57.1 | 13.1 | 147,418 |
| MDC-DC-8-62 | C-IV | 124 | 45.2 | 48.0 | 13.2 | 158,757 |
| MDC-DC-8-63 | D-IV | 147 | 45.2 | 57.1 | 13.1 | 161,025 |
| MDC-DC-9-10/15 | C-III | 134 | 27.2 | 31.8 | 8.4 | 41,141 |
| MDC-DC-9-20 | C-III | 124 | 28.4 | 31.8 | 8.4 | 44,452 |
| MDC-DC-9-30 | C-III | 127 | 28.4 | 36.4 | 8.5 | 49,895 |
| MDC-DC-9-40 | C-III | 129 | 28.4 | 38.3 | 8.7 | 51,710 |
| MDC-DC-9-50 | C-III | 132 | 28.4 | 40.7 | 8.8 | 54,885 |
| MDC-DC-9-80 | C-III | 132 | 32.9 | 45.0 | 9.2 | 63,503 |
| MDC-DC-9-82 | C-III | 135 | 32.9 | 45.0 | 9.2 | 67,812 |
| MDC-MD-11 | D-IV | 155 | 51.8 | 61.4 | 17.6 | 273,289 |
| Mitsubishi Diamond MU-300 | B-I | 100 | 13.3 | 14.8 | 4.2 | 7,135 |
| Mitsubishi Marquise MU-2N | A-I | 88 | 11.9 | 12.0 | 4.2 | 5,250 |
| Mitsubishi MU-2G | B-I | 119 | 11.9 | 12.0 | 4.2 | 4,899 |
| Mitsubishi Solitaire MU-2P | A-I | 87 | 11.9 | 10.1 | 3.9 | 4,749 |
| Nihon YS-11 | B-III | 98 | 32.0 | 26.3 | 9.0 | 24,499 |
| Nomad N 22B | A-II | 69 | 16.5 | 12.6 | 5.5 | 4,060 |
| Nomad N 24A | A-II | 73 | 16.5 | 14.4 | 5.5 | 4,264 |
| Partenavia P.68B Victor | A-I | 73 | 12.0 | 10.9 | 3.6 | 2,850 |
| Piaggio PD-808 | B-I | 117 | 13.2 | 12.9 | 4.8 | 8,301 |
| Piaggio P-166 Portofino | A-I | 82 | 14.4 | 11.9 | 5.0 | 4,300 |
| Pilatus PC-6 Porter | A-II | 57 | 15.1 | 11.4 | 3.2 | 2,200 |
| Piper 31-310 Navajo | B-I | 100 | 12.4 | 10.0 | 4.0 | 2,812 |
| Piper 400LS Cheyenne | B-I | 110 | 14.5 | 13.2 | 5.2 | 5,466 |
| Piper 60-602P Aerostar | B-I | 94 | 11.2 | 10.6 | 3.7 | 2,722 |
| PZL-AN-2 | A-II | 54 | 18.2 | 12.8 | 4.0 | 5,500 |
| PZL-AN-28 | A-II | 85 | 22.1 | 13.1 | 4.9 | 6,500 |
| PZL-M-15 Belphegor | A-II | 62 | 22.4 | 12.8 | 5.4 | 5,654 |
| Rockwell 690A Turbo Comdr. | B-I | 97 | 14.2 | 13.5 | 4.5 | 4,672 |
| Rockwell 840 | B-II | 98 | 15.9 | 13.1 | 4.5 | 4,683 |
| Rockwell 980 | C-II | 121 | 15.9 | 13.1 | 4.5 | 4,683 |
| Rockwell B-1 | D-IV | 165 * | 41.8 | 44.8 | 10.4 | 216,364 |
| Rockwell Sabre 40 | B-I | 120 | 13.6 | 13.4 | 4.9 | 8,459 |
| Rockwell Sabre 60 | B-I | 120 | 13.6 | 14.7 | 4.9 | 9,072 |
| Rockwell Sabre 65 | B-II | 105 | 15.4 | 14.1 | 4.9 | 10,886 |
| Rockwell Sabre 75A | C-I | 137 | 13.6 | 14.4 | 5.2 | 10,569 |
| Rockwell Sabre 80 | C-II | 128 | 15.4 | 14.4 | 5.3 | 11,113 |
| Shorts 330 | B-II | 96 | 22.8 | 17.7 | 4.9 | 10,387 |
| Shorts 360 | B-II | 104 | 22.8 | 21.6 | 7.2 | 11,999 |
| Swearingen Merlin 3B | B-I | 105 | 14.1 | 12.9 | 5.1 | 5,670 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|----------------------|------------------------------|-------------------------|--------------------|------------------|--------------------------|--------------------------|
| Swearingen Metro | B-I | 112 | 14.1 | 18.1 | 5.1 | 5,670 |
| Tupolev TU-114 | C-IV | 132 * | 51.1 | 54.1 | 15.2 | 164,028 |
| Tupolev TU-124 | C-III | 132 * | 25.5 | 30.6 | 15.2 | 36,506 |
| 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 |
| Tupolev TU-154 | D-IV | 145 | 37.6 | 47.9 | 11.4 | 97,999 |
| VFW-Fokker 614 | B-II | 111 | 21.5 | 20.6 | 7.8 | 19,958 |
| Vickers Vanguard 950 | B-IV | 119 | 36.0 | 37.5 | 10.6 | 66,451 |
| 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 |
| Vickers VC-2-810/840 | C-III | 122 | 28.7 | 26.1 | 8.2 | 32,885 |
| Volpar Turbo 18 | B-I | 100 | 14.0 | 11.4 | 2.9 | 4,663 |
| Yakovlev YAK-40 | C-III | 128 * | 25.1 | 20.1 | 6.5 | 16,000 |
| Yakovlev YAK-42 | C-III | 128 * | 34.2 | 36.4 | 9.8 | 53,501 |
| Yunshu-11 | A-II | 80 * | 17.0 | 12.0 | 4.6 | 3,243 |

* Approach speeds estimated.

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Section 3. Listing Small Airplanes by Airport Reference Code (U.S. customary units)

| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|----------------------------|------------------------|-------------------|---------------|-------------|------------------|---------------------|
| 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 |
| 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 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-G23 | A-I | 68 | 32.8 | 25.7 | 8.2 | 2,450 |
| Cessna-150 | A-I | 55 | 32.7 | 23.8 | 8.0 | 1,600 |
| Cessna-177 Cardinal | A-I | 64 | 35.5 | 27.2 | 8.5 | 2,500 |
| DHC-2 Beaver | A-I | 50 | 48.0 | 30.3 | 9.0 | 5,100 |
| Embraer-820 Navajo Chief | A-I | 74 | 40.7 | 34.6 | 13.0 | 7,000 |
| Lapan XT-400 | A-I | 75 | 47.9 | 33.5 | 14.1 | 5,555 |
| Learfan 2100 | A-I | 86 | 39.3 | 40.6 | 12.2 | 7,400 |
| Mitsubishi Marquise MU-2N | A-I | 88 | 39.2 | 39.5 | 13.7 | 11,575 |
| Mitsubishi Solitaire MU-2P | A-I | 87 | 39.2 | 33.3 | 12.9 | 10,470 |
| Partenavia P.68B Victor | A-I | 73 | 39.3 | 35.6 | 11.9 | 6,283 |
| Piaggio P-166 Portofino | A-I | 82 | 47.2 | 39.0 | 16.4 | 9,480 |
| AJI Hustler 400 | B-I | 98 | 28.0 | 34.8 | 9.8 | 6,000 |
| 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 Duke B60 | B-I | 98 | 39.2 | 33.8 | 12.3 | 6,775 |
| Beech King Air B100 | B-I | 111 | 45.8 | 39.9 | 15.3 | 11,800 |
| Beech King Air F90 | B-I | 108 | 45.9 | 39.8 | 15.1 | 10,950 |
| Cessna Citation I | B-I | 108 | 47.1 | 43.5 | 14.3 | 11,850 |
| Cessna-402 Businessliner | B-I | 95 | 39.8 | 36.1 | 11.6 | 6,300 |
| Cessna-404 Titan | B-I | 92 | 46.3 | 39.5 | 13.2 | 8,400 |
| Cessna-414 Chancellor | B-I | 94 | 44.1 | 36.4 | 11.5 | 6,785 |
| Cessna-421 Golden Eagle | B-I | 96 | 41.7 | 36.1 | 11.6 | 7,450 |
| Embraer-121 Xingu | B-I | 92 | 47.4 | 40.2 | 15.9 | 12,500 |
| Embraer-326 Xavante | B-I | 102 | 35.6 | 34.9 | 12.2 | 11,500 |
| Foxjet ST-600-8 | B-I | 97 | 31.6 | 31.8 | 10.2 | 4,550 |
| Hamilton Westwind II STD | B-I | 96 | 46.0 | 45.0 | 9.2 | 12,495 |
| Mitsubishi MU-2G | B-I | 119 | 39.2 | 39.5 | 13.8 | 10,800 |
| Piper 31-310 Navajo | B-I | 100 | 40.7 | 32.7 | 13.0 | 6,200 |
| Piper 400LS Cheyenne | B-I | 110 | 47.7 | 43.4 | 17.0 | 12,050 |
| Piper 60-602P Aerostar | B-I | 94 | 36.7 | 34.8 | 12.1 | 6,000 |
| Rockwell 690A Turbo Comdr. | B-I | 97 | 46.5 | 44.3 | 14.9 | 10,300 |
| Swearingen Merlin 3B | B-I | 105 | 46.2 | 42.2 | 16.7 | 12,500 |
| Swearingen Metro | B-I | 112 | 46.2 | 59.4 | 16.7 | 12,500 |
| Volpar Turbo 18 | B-I | 100 | 46.0 | 37.4 | 9.6 | 10,280 |
| Aerocom Skyliner | A-II | 88 | 54.0 | 54.3 | 16.5 | 12,500 |
| Antonov AN-14 | A-II | 52 | 72.1 | 37.2 | 15.2 | 7,607 |
| Antonov AN-28 | A-II | 88 | 72.1 | 42.6 | 16.1 | 12,350 |
| Beech E18S | A-II | 87 | 49.7 | 35.2 | 9.5 | 9,300 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|---------------------------|------------------------|-------------------|---------------|-------------|------------------|---------------------|
| BN-2A Mk.3 Trislander | A-II | 65 | 53.0 | 45.7 | 14.2 | 10,000 |
| DHC-6-300 Twin Otter | A-II | 75 | 65.0 | 51.7 | 19.5 | 12,500 |
| DH.104 Dove 8 | A-II | 84 | 57.0 | 39.2 | 13.3 | 8,950 |
| Dornier DO 28D-2 | A-II | 74 | 51.0 | 37.4 | 12.8 | 8,855 |
| Nomad N 22B | A-II | 69 | 54.0 | 41.2 | 18.1 | 8,950 |
| Nomad N 24A | A-II | 73 | 54.2 | 47.1 | 18.2 | 9,400 |
| Pilatus PC-6 Porter | A-II | 57 | 49.7 | 37.4 | 10.5 | 4,850 |
| PZL-AN-2 | A-II | 54 | 59.8 | 41.9 | 13.1 | 12,125 |
| PZL-M-15 Belphegor | A-II | 62 | 73.6 | 41.9 | 17.6 | 12,465 |
| Yunshu-11 | A-II | 80 * | 55.7 | 39.4 | 15.1 | 7,150 |
| Beech King Air C90-1 | B-II | 100 | 50.2 | 35.5 | 14.2 | 9,650 |
| Beech Super King Air B200 | B-II | 103 | 54.5 | 43.8 | 15.0 | 12,500 |
| Cessna-441 Conquest | B-II | 100 | 49.3 | 39.0 | 13.1 | 9,925 |
| Rockwell 840 | B-II | 98 | 52.1 | 42.9 | 14.9 | 10,325 |
| Rockwell 980 | C-II | 121 | 52.1 | 42.9 | 14.9 | 10,325 |

* Approach speeds estimated.

Section 4. Listing Large Airplanes by Airport Reference Code (U.S. customary units)

| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|---------------------------|------------------------|-------------------|---------------|-------------|------------------|---------------------|
| Aerospatiale SN 601 Corv. | B-I | 118 | 42.2 | 45.4 | 13.9 | 14,550 |
| Dassault FAL-10 | B-I | 104 | 42.9 | 45.5 | 15.1 | 18,740 |
| Gates Learjet 28/29 | B-I | 120 | 43.7 | 47.6 | 12.3 | 15,000 |
| Mitsubishi Diamond MU-300 | B-I | 100 | 43.5 | 48.4 | 13.8 | 15,730 |
| Piaggio PD-808 | B-I | 117 | 43.3 | 42.2 | 15.8 | 18,300 |
| Rockwell Sabre 40 | B-I | 120 | 44.5 | 43.8 | 16.0 | 18,650 |
| Rockwell Sabre 60 | B-I | 120 | 44.5 | 48.3 | 16.0 | 20,000 |
| Gates Learjet 24 | C-I | 128 | 35.6 | 43.3 | 12.6 | 13,000 |
| Gates Learjet 25 | C-I | 137 | 35.6 | 47.6 | 12.6 | 15,000 |
| Gates Learjet 54-55-56 | C-I | 128 | 43.7 | 55.1 | 14.7 | 21,500 |
| HFB-320 Hansa | C-I | 125 | 47.5 | 54.5 | 16.2 | 20,280 |
| HS 125 Series 400A | C-I | 124 | 47.0 | 47.4 | 16.5 | 23,300 |
| HS 125 Series 600A | C-I | 125 | 47.0 | 50.5 | 17.2 | 25,000 |
| HS 125 Series 700A | C-I | 125 | 47.0 | 50.7 | 17.6 | 24,200 |
| IAI 1121 Jet Comdr. | C-I | 130 | 43.3 | 50.4 | 15.8 | 16,800 |
| IAI-1124 Westwind | C-I | 129 | 44.8 | 52.3 | 15.8 | 23,500 |
| Rockwell Sabre 75A | C-I | 137 | 44.5 | 47.2 | 17.2 | 23,300 |
| Gates Learjet 35A/36A | D-I | 143 | 39.5 | 48.7 | 12.3 | 18,300 |
| Casa C-212-200 Aviocar | A-II | 81 | 62.3 | 49.8 | 20.7 | 16,976 |
| Dassault 941 | A-II | 59 | 76.7 | 77.9 | 30.7 | 58,400 |
| DH.114 Heron 2 | A-II | 85 | 71.5 | 48.5 | 15.6 | 13,500 |
| Dornier LTA | A-II | 74 * | 58.4 | 54.4 | 18.2 | 15,100 |
| GAC-100 | A-II | 86 | 70.0 | 67.3 | 24.9 | 28,900 |
| IAI Arava-201 | A-II | 81 | 68.6 | 42.7 | 17.1 | 15,000 |
| LET L-410 UVP-E | A-II | 81 | 65.5 | 47.5 | 19.1 | 14,109 |
| PZL-AN-28 | A-II | 85 | 72.4 | 42.9 | 16.1 | 14,330 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|--------------------------|------------------------|-------------------|---------------|-------------|------------------|---------------------|
| Aerospatiale NORD-262 | B-II | 96 | 71.9 | 63.3 | 20.4 | 23,480 |
| Ahrens AR 404 | B-II | 98 | 66.0 | 52.7 | 19.0 | 18,500 |
| Air-Metal AM-C 111 | B-II | 96 | 63.0 | 55.2 | 21.0 | 18,629 |
| 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 |
| 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 |
| Dassault FAL-20 | B-II | 107 | 53.5 | 56.3 | 17.4 | 28,660 |
| Dassault FAL-200 | B-II | 114 | 53.5 | 56.3 | 17.4 | 30,650 |
| Dassault FAL-50 | B-II | 113 | 61.9 | 60.8 | 22.9 | 37,480 |
| Dassault FAL-900 | B-II | 100 | 63.4 | 66.3 | 24.8 | 45,500 |
| Embraer-110 Bandeirante | B-II | 92 | 50.3 | 49.5 | 16.5 | 13,007 |
| FMA IA-50 Guarni II | B-II | 101 | 64.1 | 48.8 | 19.1 | 15,700 |
| Fokker F-28-1000 | B-II | 119 | 77.3 | 89.9 | 27.8 | 65,000 |
| Fokker F-28-2000 | B-II | 119 | 77.3 | 97.2 | 27.8 | 65,000 |
| Grumman Gulfstream I | B-II | 113 | 78.3 | 75.3 | 23.0 | 36,000 |
| Rockwell Sabre 65 | B-II | 105 | 50.5 | 46.1 | 16.0 | 24,000 |
| Shorts 330 | B-II | 96 | 74.7 | 58.0 | 16.2 | 22,900 |
| Shorts 360 | B-II | 104 | 74.8 | 70.8 | 23.7 | 26,453 |
| VFW-Fokker 614 | B-II | 111 | 70.5 | 67.5 | 25.6 | 44,000 |
| Canadair CL-600 | C-II | 125 | 61.8 | 68.4 | 20.7 | 41,250 |
| Grumman Gulfstream III | C-II | 136 | 77.8 | 83.1 | 24.4 | 68,700 |
| Lockheed 1329 JetStar | C-II | 132 | 54.4 | 60.4 | 20.4 | 43,750 |
| Rockwell Sabre 80 | C-II | 128 | 50.4 | 47.2 | 17.3 | 24,500 |
| Grumman Gulfstream II | D-II | 141 | 68.8 | 79.9 | 24.5 | 65,300 |
| Grumman Gulfstream II-TT | D-II | 142 | 71.7 | 79.9 | 24.5 | 65,300 |
| Grumman Gulfstream IV | D-II | 145 | 77.8 | 87.8 | 24.4 | 71,780 |
| Lockheed SR-71 Blackbird | E-II | 180 | 55.6 | 107.4 | 18.5 | 170,000 |
| AIDC/CAF XC-2 | A-III | 86 | 81.7 | 65.9 | 25.3 | 27,500 |
| Antonov AN-72 | A-III | 89 * | 84.7 | 84.7 | 27.0 | 66,000 |
| DHC-4 Caribou | A-III | 77 | 95.6 | 72.6 | 31.8 | 28,500 |
| DHC-7 Dash 7-100 | A-III | 83 | 93.0 | 80.7 | 26.2 | 43,000 |
| DHC-8 Dash 8-300 | A-III | 90 | 90.0 | 84.3 | 24.6 | 41,100 |
| Fairchild C-121 | A-III | 88 | 110.0 | 75.8 | 34.1 | 60,000 |
| HP Herald | A-III | 88 | 94.8 | 75.5 | 24.1 | 43,000 |
| Ilyushin Il-12 | A-III | 78 | 104.0 | 70.0 | 30.5 | 38,000 |
| MAI-QSTOL | A-III | 85 | 100.3 | 98.4 | 32.8 | 85,300 |
| MDC-DC-3 | A-III | 72 | 95.0 | 64.5 | 23.5 | 25,200 |
| Aeritalia G-222 | B-III | 109 | 93.8 | 74.4 | 32.0 | 61,700 |
| Antonov AN-24 | B-III | 119 | 95.8 | 77.2 | 27.3 | 46,305 |
| Antonov AN-30 | B-III | 112 | 96.4 | 80.1 | 27.3 | 51,040 |
| AW.660 Argosy C.Mk.1 | B-III | 113 | 115.0 | 89.1 | 27.0 | 97,000 |
| 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 |
| Casa C-207A Azor | B-III | 102 | 91.2 | 68.4 | 25.4 | 36,400 |
| Convair 240 | B-III | 107 | 91.8 | 74.7 | 26.9 | 41,790 |
| Convair 340 | B-III | 104 | 105.3 | 81.5 | 28.2 | 49,100 |
| Convair 440 | B-III | 106 | 105.3 | 81.5 | 28.2 | 49,100 |
| Convair 580 | B-III | 107 | 105.3 | 81.5 | 29.2 | 54,600 |
| Dassault Mercure | B-III | 117 | 100.2 | 114.3 | 37.3 | 124,500 |
| DHC-5D Buffalo | B-III | 91 | 96.0 | 79.0 | 28.7 | 49,200 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Feet | Length Feet | Tail Height Feet | Maximum Takeoff Lbs |
|----------------------------|------------------------------|-------------------------|------------------|----------------|------------------------|---------------------------|
| DH.106 Comet 4C | B-III | 108 | 115.0 | 118.0 | 29.5 | 162,000 |
| Fairchild FH-227 B,D | B-III | 105 | 95.2 | 83.1 | 27.5 | 45,500 |
| Fairchild F-27 A,J | B-III | 109 | 95.2 | 77.2 | 27.5 | 42,000 |
| Fokker F-27-500 | B-III | 102 | 95.2 | 82.3 | 29.3 | 45,000 |
| Fokker F-28-6000 | B-III | 113 | 82.3 | 97.2 | 27.8 | 73,000 |
| Hindustan HS.748-2 | B-III | 94 | 98.4 | 67.0 | 24.8 | 44,402 |
| HS.748 Series 2A | B-III | 94 | 98.5 | 67.0 | 24.8 | 44,490 |
| HS.780 Andover C.Mk.1 | B-III | 100 | 98.2 | 78.0 | 30.1 | 50,000 |
| Kawasaki C-1 | B-III | 118 * | 100.4 | 95.1 | 32.9 | 85,320 |
| Martin-404 | B-III | 98 | 93.3 | 74.6 | 28.7 | 44,900 |
| MDC-DC-4 | B-III | 95 | 117.5 | 93.9 | 27.9 | 73,000 |
| MDC-DC-6A/B | B-III | 108 | 117.5 | 105.6 | 29.3 | 104,000 |
| Nihon YS-11 | B-III | 98 | 105.0 | 86.3 | 29.5 | 54,010 |
| Aerospatiale SE 210 Carav. | C-III | 127 | 112.5 | 105.0 | 28.6 | 114,640 |
| Airbus A-320-100 | C-III | 138 | 111.3 | 123.3 | 39.1 | 145,505 |
| Antonov AN-26 | C-III | 121 | 95.8 | 78.1 | 28.1 | 52,920 |
| AW.650 Argosy 220 | C-III | 123 | 115.0 | 86.8 | 27.0 | 93,000 |
| 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 |
| BAe 146-300 | C-III | 121 | 86.4 | 104.2 | 28.1 | 104,000 |
| 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 |
| Fairchild C-119 | C-III | 122 | 109.3 | 86.5 | 27.5 | 77,000 |
| Fokker F-28-3000 | C-III | 121 | 82.3 | 89.9 | 27.8 | 73,000 |
| Fokker F-28-4000 | C-III | 121 | 82.3 | 97.2 | 27.8 | 73,000 |
| HS.121 Trident 1E | C-III | 137 | 95.0 | 114.8 | 27.0 | 135,500 |
| HS.121 Trident 2E | C-III | 138 | 98.0 | 114.8 | 27.0 | 144,000 |
| HS.801 Nimrod MR Mk.2 | C-III | 125 * | 114.8 | 126.8 | 29.7 | 177,500 |
| Lockheed 188 Electra | C-III | 123 | 99.0 | 104.6 | 33.7 | 116,000 |
| Lockheed P-3 Orion | C-III | 134 | 99.7 | 116.8 | 33.8 | 135,000 |
| MDC-DC-9-10/15 | C-III | 134 | 89.4 | 104.4 | 27.6 | 90,700 |
| MDC-DC-9-20 | C-III | 124 | 93.3 | 104.4 | 27.4 | 98,000 |
| MDC-DC-9-30 | C-III | 127 | 93.3 | 119.3 | 27.8 | 110,000 |
| MDC-DC-9-40 | C-III | 129 | 93.3 | 125.6 | 28.4 | 114,000 |
| MDC-DC-9-50 | C-III | 132 | 93.3 | 133.6 | 28.8 | 121,000 |
| MDC-DC-9-80 | C-III | 132 | 107.8 | 147.8 | 30.3 | 140,000 |
| MDC-DC-9-82 | C-III | 135 | 107.8 | 147.8 | 30.3 | 149,500 |
| Tupolev TU-124 | C-III | 132 * | 83.8 | 100.3 | 50.0 | 80,482 |
| Vickers VC-2-810/840 | C-III | 122 | 94.0 | 85.7 | 26.8 | 72,500 |
| Yakovlev YAK-40 | C-III | 128 * | 82.2 | 65.9 | 21.3 | 35,275 |
| Yakovlev YAK-42 | C-III | 128 * | 112.2 | 119.3 | 32.2 | 117,950 |
| BAC 111-500 | D-III | 144 | 93.5 | 107.0 | 24.5 | 104,500 |
| BAC/Aerospatiale Concorde | D-III | 162 | 83.8 | 205.4 | 37.4 | 408,000 |
| HS.121 Trident 3B | D-III | 143 | 98.0 | 131.2 | 28.3 | 150,000 |

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| 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 Britannia 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.

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Section 5. Listing Small Airplanes by Airport Reference Code (SI units)

| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|----------------------------|------------------------|-------------------|-----------------|---------------|--------------------|--------------------|
| 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 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 |
| 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 |
| DHC-2 Beaver | A-I | 50 | 14.6 | 9.2 | 2.7 | 2,313 |
| Embraer-820 Navajo Chief | A-I | 74 | 12.4 | 10.5 | 4.0 | 3,175 |
| Lapan XT-400 | A-I | 75 | 14.6 | 10.2 | 4.3 | 2,520 |
| Learfan 2100 | A-I | 86 | 12.0 | 12.4 | 3.7 | 3,357 |
| Mitsubishi Marquise MU-2N | A-I | 88 | 11.9 | 12.0 | 4.2 | 5,250 |
| Mitsubishi Solitaire MU-2P | A-I | 87 | 11.9 | 10.1 | 3.9 | 4,749 |
| Partenavia P.68B Victor | A-I | 73 | 12.0 | 10.9 | 3.6 | 2,850 |
| Piaggio P-166 Portofino | A-I | 82 | 14.4 | 11.9 | 5.0 | 4,300 |
| AJI Hustler 400 | B-I | 98 | 8.5 | 10.6 | 3.0 | 2,722 |
| 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 Duke B60 | B-I | 98 | 11.9 | 10.3 | 3.7 | 3,073 |
| Beech King Air B100 | B-I | 111 | 14.0 | 12.2 | 4.7 | 5,352 |
| Beech King Air F90 | B-I | 108 | 14.0 | 12.1 | 4.6 | 4,967 |
| Cessna Citation I | B-I | 108 | 14.4 | 13.3 | 4.4 | 5,375 |
| 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 |
| Embraer-121 Xingu | B-I | 92 | 14.4 | 12.3 | 4.8 | 5,670 |
| Embraer-326 Xavante | B-I | 102 | 10.9 | 10.6 | 3.7 | 5,216 |
| Foxjet ST-600-8 | B-I | 97 | 9.6 | 9.7 | 3.1 | 2,064 |
| Hamilton Westwind II STD | B-I | 96 | 14.0 | 13.7 | 2.8 | 5,668 |
| Mitsubishi MU-2G | B-I | 119 | 11.9 | 12.0 | 4.2 | 4,899 |
| Piper 31-310 Navajo | B-I | 100 | 12.4 | 10.0 | 4.0 | 2,812 |
| Piper 400LS Cheyenne | B-I | 110 | 14.5 | 13.2 | 5.2 | 5,466 |
| Piper 60-602P Aerostar | B-I | 94 | 11.2 | 10.6 | 3.7 | 2,722 |
| Rockwell 690A Turbo Comdr. | B-I | 97 | 14.2 | 13.5 | 4.5 | 4,672 |
| Swearingen Merlin 3B | B-I | 105 | 14.1 | 12.9 | 5.1 | 5,670 |
| Swearingen Metro | B-I | 112 | 14.1 | 18.1 | 5.1 | 5,670 |
| Volpar Turbo 18 | B-I | 100 | 14.0 | 11.4 | 2.9 | 4,663 |
| Aerocom Skyliner | A-II | 88 | 16.5 | 16.6 | 5.0 | 5,670 |
| Antonov AN-14 | A-II | 52 | 22.0 | 11.3 | 4.6 | 3,450 |
| Antonov AN-28 | A-II | 88 | 22.0 | 13.0 | 4.9 | 5,602 |
| Beech E18S | A-II | 87 | 15.1 | 10.7 | 2.9 | 4,218 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|---------------------------|------------------------|-------------------|-----------------|---------------|--------------------|--------------------|
| BN-2A Mk.3 Trislander | A-II | 65 | 16.2 | 13.9 | 4.3 | 4,536 |
| DHC-6-300 Twin Otter | A-II | 75 | 19.8 | 15.8 | 5.9 | 5,670 |
| DH.104 Dove 8 | A-II | 84 | 17.4 | 11.9 | 4.1 | 4,060 |
| Dornier DO 28D-2 | A-II | 74 | 15.5 | 11.4 | 3.9 | 4,017 |
| Nomad N 22B | A-II | 69 | 16.5 | 12.6 | 5.5 | 4,060 |
| Nomad N 24A | A-II | 73 | 16.5 | 14.4 | 5.5 | 4,264 |
| Pilatus PC-6 Porter | A-II | 57 | 15.1 | 11.4 | 3.2 | 2,200 |
| PZL-AN-2 | A-II | 54 | 18.2 | 12.8 | 4.0 | 5,500 |
| PZL-M-15 Belphegor | A-II | 62 | 22.4 | 12.8 | 5.4 | 5,654 |
| <u>Yunshu-11</u> | A-II | 80 * | 17.0 | 12.0 | 4.6 | 3,243 |
| Beech King Air C90-1 | B-II | 100 | 15.3 | 10.8 | 4.3 | 4,377 |
| Beech Super King Air B200 | B-II | 103 | 16.6 | 13.4 | 4.6 | 5,670 |
| Cessna-441 Conquest | B-II | 100 | 15.0 | 11.9 | 4.0 | 4,502 |
| <u>Rockwell 840</u> | B-II | 98 | 15.9 | 13.1 | 4.5 | 4,683 |
| Rockwell 980 | C-II | 121 | 15.9 | 13.1 | 4.5 | 4,683 |

* Approach speeds estimated.

Section 6. Listing Large Airplanes by Airport Reference Code (SI units)

| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|------------------------------|------------------------|-------------------|-----------------|---------------|--------------------|--------------------|
| Aerospatiale SN 601 Corv. | B-I | 118 | 12.9 | 13.8 | 4.2 | 6,600 |
| Dassault FAL-10 | B-I | 104 | 13.1 | 13.9 | 4.6 | 8,500 |
| Gates Learjet 28/29 | B-I | 120 | 13.3 | 14.5 | 3.7 | 6,804 |
| Mitsubishi Diamond MU-300 | B-I | 100 | 13.3 | 14.8 | 4.2 | 7,135 |
| Piaggio PD-808 | B-I | 117 | 13.2 | 12.9 | 4.8 | 8,301 |
| Rockwell Sabre 40 | B-I | 120 | 13.6 | 13.4 | 4.9 | 8,459 |
| <u>Rockwell Sabre 60</u> | B-I | 120 | 13.6 | 14.7 | 4.9 | 9,072 |
| Gates Learjet 24 | C-I | 128 | 10.9 | 13.2 | 3.8 | 5,897 |
| Gates Learjet 25 | C-I | 137 | 10.9 | 14.5 | 3.8 | 6,804 |
| Gates Learjet 54-55-56 | C-I | 128 | 13.3 | 16.8 | 4.5 | 9,752 |
| HFB-320 Hansa | C-I | 125 | 14.5 | 16.6 | 4.9 | 9,199 |
| HS 125 Series 400A | C-I | 124 | 14.3 | 14.4 | 5.0 | 10,569 |
| HS 125 Series 600A | C-I | 125 | 14.3 | 15.4 | 5.2 | 11,340 |
| HS 125 Series 700A | C-I | 125 | 14.3 | 15.5 | 5.4 | 10,977 |
| IAI 1121 Jet Comdr. | C-I | 130 | 13.2 | 15.4 | 4.8 | 7,620 |
| IAI-1124 Westwind | C-I | 129 | 13.7 | 15.9 | 4.8 | 10,659 |
| <u>Rockwell Sabre 75A</u> | C-I | 137 | 13.6 | 14.4 | 5.2 | 10,569 |
| <u>Gates Learjet 35A/36A</u> | D-I | 143 | 12.0 | 14.8 | 3.7 | 8,301 |
| Casa C-212-200 Aviocar | A-II | 81 | 19.0 | 15.2 | 6.3 | 7,700 |
| Dassault 941 | A-II | 59 | 23.4 | 23.7 | 9.4 | 26,490 |
| DH.114 Heron 2 | A-II | 85 | 21.8 | 14.8 | 4.8 | 6,123 |
| Dornier LTA | A-II | 74 * | 17.8 | 16.6 | 5.5 | 6,849 |
| GAC-100 | A-II | 86 | 21.3 | 20.5 | 7.6 | 13,109 |
| IAI Arava-201 | A-II | 81 | 20.9 | 13.0 | 5.2 | 6,804 |
| LET L-410 UVP-E | A-II | 81 | 20.0 | 14.5 | 5.8 | 6,400 |
| <u>PZL-AN-28</u> | A-II | 85 | 22.1 | 13.1 | 4.9 | 6,500 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|--------------------------|------------------------|-------------------|-----------------|---------------|--------------------|--------------------|
| Aerospatiale NORD-262 | B-II | 96 | 21.9 | 19.3 | 6.2 | 10,650 |
| Ahrens AR 404 | B-II | 98 | 20.1 | 16.1 | 5.8 | 8,391 |
| Air-Metal AM-C 111 | B-II | 96 | 19.2 | 16.8 | 6.4 | 8,450 |
| 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 |
| 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 |
| Dassault FAL-20 | B-II | 107 | 16.3 | 17.2 | 5.3 | 13,000 |
| Dassault FAL-200 | B-II | 114 | 16.3 | 17.2 | 5.3 | 13,903 |
| Dassault FAL-50 | B-II | 113 | 18.9 | 18.5 | 7.0 | 17,001 |
| Dassault FAL-900 | B-II | 100 | 19.3 | 20.2 | 7.6 | 20,638 |
| Embraer-110 Bandeirante | B-II | 92 | 15.3 | 15.1 | 5.0 | 5,900 |
| FMA IA-50 Guarni II | B-II | 101 | 19.5 | 14.9 | 5.8 | 7,121 |
| Fokker F-28-1000 | B-II | 119 | 23.6 | 27.4 | 8.5 | 29,484 |
| Fokker F-28-2000 | B-II | 119 | 23.6 | 29.6 | 8.5 | 29,484 |
| Grumman Gulfstream I | B-II | 113 | 23.9 | 23.0 | 7.0 | 16,329 |
| Rockwell Sabre 65 | B-II | 105 | 15.4 | 14.1 | 4.9 | 10,886 |
| Shorts 330 | B-II | 96 | 22.8 | 17.7 | 4.9 | 10,387 |
| Shorts 360 | B-II | 104 | 22.8 | 21.6 | 7.2 | 11,999 |
| VFW-Fokker 614 | B-II | 111 | 21.5 | 20.6 | 7.8 | 19,958 |
| Canadair CL-600 | C-II | 125 | 18.8 | 20.8 | 6.3 | 18,711 |
| Grumman Gulfstream III | C-II | 136 | 23.7 | 25.3 | 7.4 | 31,162 |
| Lockheed 1329 JetStar | C-II | 132 | 16.6 | 18.4 | 6.2 | 19,845 |
| Rockwell Sabre 80 | C-II | 128 | 15.4 | 14.4 | 5.3 | 11,113 |
| Grumman Gulfstream II | D-II | 141 | 21.0 | 24.4 | 7.5 | 29,620 |
| Grumman Gulfstream II-TT | D-II | 142 | 21.9 | 24.4 | 7.5 | 29,620 |
| Grumman Gulfstream IV | D-II | 145 | 23.7 | 26.8 | 7.4 | 32,559 |
| Lockheed SR-71 Blackbird | E-II | 180 | 16.9 | 32.7 | 5.6 | 77,111 |
| AIDC/CAF XC-2 | A-III | 86 | 24.9 | 20.1 | 7.7 | 12,474 |
| Antonov AN-72 | A-III | 89 * | 25.8 | 25.8 | 8.2 | 29,937 |
| DHC-4 Caribou | A-III | 77 | 29.1 | 22.1 | 9.7 | 12,927 |
| DHC-7 Dash 7-100 | A-III | 83 | 28.3 | 24.6 | 8.0 | 19,504 |
| DHC-8 Dash 8-300 | A-III | 90 | 27.4 | 25.7 | 7.5 | 18,643 |
| Fairchild C-121 | A-III | 88 | 33.5 | 23.1 | 10.4 | 27,216 |
| HP Herald | A-III | 88 | 28.9 | 23.0 | 7.3 | 19,504 |
| Ilyushin Il-12 | A-III | 78 | 31.7 | 21.3 | 9.3 | 17,237 |
| MAI-QSTOL | A-III | 85 | 30.6 | 30.0 | 10.0 | 38,691 |
| MDC-DC-3 | A-III | 72 | 29.0 | 19.7 | 7.2 | 11,431 |
| Aeritalia G-222 | B-III | 109 | 28.6 | 22.7 | 9.8 | 27,987 |
| Antonov AN-24 | B-III | 119 | 29.2 | 23.5 | 8.3 | 21,004 |
| Antonov AN-30 | B-III | 112 | 29.4 | 24.4 | 8.3 | 23,151 |
| AW.660 Argosy C.Mk.1 | B-III | 113 | 35.1 | 27.2 | 8.2 | 43,998 |
| 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 |
| Casa C-207A Azor | B-III | 102 | 27.8 | 20.8 | 7.7 | 16,511 |
| Convair 240 | B-III | 107 | 28.0 | 22.8 | 8.2 | 18,956 |
| Convair 340 | B-III | 104 | 32.1 | 24.8 | 8.6 | 22,271 |
| Convair 440 | B-III | 106 | 32.1 | 24.8 | 8.6 | 22,271 |
| Convair 580 | B-III | 107 | 32.1 | 24.8 | 8.9 | 24,766 |
| Dassault Mercure | B-III | 117 | 30.5 | 34.8 | 11.4 | 56,472 |
| DHC-5D Buffalo | B-III | 91 | 29.3 | 24.1 | 8.7 | 22,317 |

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| Aircraft | Airport Reference Code | Appch Speed Knots | Wingspan Meters | Length Meters | Tail Height Meters | Maximum Takeoff Kg |
|----------------------------|------------------------|-------------------|-----------------|---------------|--------------------|--------------------|
| DH.106 Comet 4C | B-III | 108 | 35.1 | 36.0 | 9.0 | 73,482 |
| Fairchild FH-227 B,D | B-III | 105 | 29.0 | 25.3 | 8.4 | 20,638 |
| Fairchild F-27 A,J | B-III | 109 | 29.0 | 23.5 | 8.4 | 19,051 |
| Fokker F-27-500 | B-III | 102 | 29.0 | 25.1 | 8.9 | 20,412 |
| Fokker F-28-6000 | B-III | 113 | 25.1 | 29.6 | 8.5 | 33,112 |
| Hindustan HS.748-2 | B-III | 94 | 30.0 | 20.4 | 7.6 | 20,140 |
| HS:748 Series 2A | B-III | 94 | 30.0 | 20.4 | 7.6 | 20,180 |
| HS.780 Andover C.Mk.1 | B-III | 100 | 29.9 | 23.8 | 9.2 | 22,680 |
| Kawasaki C-1 | B-III | 118 * | 30.6 | 29.0 | 10.0 | 38,701 |
| Martin-404 | B-III | 98 | 28.4 | 22.7 | 8.7 | 20,366 |
| MDC-DC-4 | B-III | 95 | 35.8 | 28.6 | 8.5 | 33,112 |
| MDC-DC-6A/B | B-III | 108 | 35.8 | 32.2 | 8.9 | 47,174 |
| Nihon YS-11 | B-III | 98 | 32.0 | 26.3 | 9.0 | 24,499 |
| Aerospatiale SE 210 Carav. | C-III | 127 | 34.3 | 32.0 | 8.7 | 52,000 |
| Airbus A-320-100 | C-III | 138 | 33.9 | 37.6 | 11.9 | 66,000 |
| Antonov AN-26 | C-III | 121 | 29.2 | 23.8 | 8.6 | 24,004 |
| AW.650 Argosy 220 | C-III | 123 | 35.1 | 26.5 | 8.2 | 42,184 |
| 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 |
| BAe 146-300 | C-III | 121 | 26.3 | 31.8 | 8.6 | 47,174 |
| 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 |
| Fairchild C-119 | C-III | 122 | 33.3 | 26.4 | 8.4 | 34,927 |
| Fokker F-28-3000 | C-III | 121 | 25.1 | 27.4 | 8.5 | 33,112 |
| Fokker F-28-4000 | C-III | 121 | 25.1 | 29.6 | 8.5 | 33,112 |
| HS.121 Trident 1E | C-III | 137 | 29.0 | 35.0 | 8.2 | 61,462 |
| HS.121 Trident 2E | C-III | 138 | 29.9 | 35.0 | 8.2 | 65,317 |
| HS.801 Nimrod MR Mk.2 | C-III | 125 * | 35.0 | 38.6 | 9.1 | 80,513 |
| Lockheed 188 Electra | C-III | 123 | 30.2 | 31.9 | 10.3 | 52,617 |
| Lockheed P-3 Orion | C-III | 134 | 30.4 | 35.6 | 10.3 | 61,235 |
| MDC-DC-9-10/15 | C-III | 134 | 27.2 | 31.8 | 8.4 | 41,141 |
| MDC-DC-9-20 | C-III | 124 | 28.4 | 31.8 | 8.4 | 44,452 |
| MDC-DC-9-30 | C-III | 127 | 28.4 | 36.4 | 8.5 | 49,895 |
| MDC-DC-9-40 | C-III | 129 | 28.4 | 38.3 | 8.7 | 51,710 |
| MDC-DC-9-50 | C-III | 132 | 28.4 | 40.7 | 8.8 | 54,885 |
| MDC-DC-9-80 | C-III | 132 | 32.9 | 45.0 | 9.2 | 63,503 |
| MDC-DC-9-82 | C-III | 135 | 32.9 | 45.0 | 9.2 | 67,812 |
| Tupolev TU-124 | C-III | 132 * | 25.5 | 30.6 | 15.2 | 36,506 |
| Vickers VC-2-810/840 | C-III | 122 | 28.7 | 26.1 | 8.2 | 32,885 |
| Yakovlev YAK-40 | C-III | 128 * | 25.1 | 20.1 | 6.5 | 16,000 |
| Yakovlev YAK-42 | C-III | 128 * | 34.2 | 36.4 | 9.8 | 53,501 |
| BAC 111-500 | D-III | 144 | 28.5 | 32.6 | 7.5 | 47,400 |
| BAC/Aerospatiale Concorde | D-III | 162 | 25.5 | 62.6 | 11.4 | 185,066 |
| HS.121 Trident 3B | D-III | 143 | 29.9 | 40.0 | 8.6 | 68,039 |

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| 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 Britannia 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 | |
| Aerospatale 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.

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Appendix 14

Appendix 14. DECLARED DISTANCES

1. **APPLICATION.** The use of declared distances for airport design shall be limited to cases of existing constrained airports where it is impracticable to provide the runway safety area (RSA), the runway object free area (ROFA), or the runway protection zone (RPZ) in accordance with the design standards in chapters 2 and 3.

a. This appendix, by treating the airplane's runway performance distances independently, provides an alternative airport design methodology by declaring distances to satisfy the airplane's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. The declared distances are takeoff run available (TORA), takeoff distance available (TODA), accelerate-stop distance available (ASDA), and landing distance available (LDA) which when treated independently may include clearway and stopway and may limit runway use. This alternative design methodology may affect the beginning and ending of the RSA, ROFA, RPZ, and primary surface.

b. Where declared distances differ, the primary surface extends 200 feet (60 m) beyond each end of the runway or the far end of each TODA whichever is further to protect departures to the extent of the 14 CFR Part 77 approach surface for that runway end i.e. 20:1, 34:1, and 50:1 originating at or beyond the end of TODA.

2. **BACKGROUND.** In applying declared distances in airport design, it is helpful to understand the relationship between airplane certification, aircraft operating rules, airport data, and airport design.

a. **Airplane certification** provides the airplane's performance distances. The performance speeds, e.g., V_1 , takeoff decision speed, V_{LOF} , lift-off speed, V_2 , takeoff safety speed, V_{SO} , stalling speed or the minimum steady flight speed in the landing configuration, and the following distances to achieve or decelerate from these speeds are established by the manufacturer and confirmed during certification testing for varying climatological conditions, operating weights, etc.

(1) **Takeoff run** - the distance to accelerate from brake release to lift-off, plus safety factors.

(2) **Takeoff distance** - the distance to accelerate from brake release past lift-off to start of takeoff climb, plus safety factors.

(3) **Accelerate-stop distance** - the distance to accelerate from brake release to V_1 and then decelerate to a stop, plus safety factors.

(4) **Landing distance** - the distance from the threshold to complete the approach, touchdown, and decelerate to a stop, plus safety factors.

b. **Aircraft operating rules** provide a minimum acceptable level of safety by controlling the airplane maximum operating weights by limiting the airplane's performance distances as follows:

(1) **Takeoff run** shall not exceed the length of runway.

(2) **Takeoff distance** shall not exceed the length of runway plus clearway.

(3) **Accelerate-stop distance** shall not exceed the length of runway plus stopway.

(4) **Landing distance** shall not exceed the length of runway.

c. **Airport data** provides the runway length and/or the following declared distance information for calculating maximum operating weights and/or operating capability.

(1) **Takeoff run available (TORA)** - the length of runway declared available and suitable for satisfying takeoff run requirements.

(2) **Takeoff distance available (TODA)** - the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA available for satisfying takeoff distance requirements. The usable TODA length is controlled by obstacles present in the departure area vis-a-vis aircraft performance. As such, the usable TODA length is determined by the aircraft operator before each takeoff and requires knowledge of the location of each controlling obstacle in the departure area. Extending the usable TODA lengths requires the removal of existing objects limiting the usable TODA lengths.

(3) **Accelerate-stop distance available (ASDA)** - the length of runway plus stopway declared available and suitable for satisfying accelerate-stop distance requirements.

(4) **Landing distance available (LDA)** - the length of runway declared available and suitable for satisfying landing distance requirements.

3. **FAA APPROVAL FOR APPLYING DECLARED DISTANCES IN AIRPORT DESIGN.** The application of declared distances at a specific location requires prior FAA approval on a case-by-case basis. Approval is reflected on the FAA-approved Airport Layout Plan.

4. RUNWAY SAFETY AREA (RSA) AND RUNWAY OBJECT FREE AREA (ROFA) LENGTHS. The standard RSA length P in the following paragraphs is the length specified in tables 3-1, 3-2, and 3-3 for the RSA length beyond the runway ends. The standard ROFA length R in the following paragraphs is the length specified in tables 3-1, 3-2, and 3-3 for the ROFA length beyond the runway ends. The RSA and the ROFA shall extend for the full length of the runway plus the greater of the following lengths beyond the runway ends for takeoff and landing in both directions.

a. For takeoff.

(1) At the start of takeoff end of runway. The RSA and the ROFA need to extend behind the start of takeoff to continue the entrance taxiway safety area and taxiway object free area and/or provide an area for jet blast protection. The portion of runway behind the start of takeoff is unavailable and/or unsuitable for takeoff run, takeoff distance, and accelerate-stop distance computations.

(2) At the far end of runway with stopway. The RSA shall extend P and the ROFA shall extend R beyond the far end of stopway.

(3) At the far end of runway without stopway. The RSA shall extend P and the ROFA shall extend R beyond the far end of ASDA. The portion of runway beyond the ASDA is unavailable and/or unsuitable for accelerate-stop distance computations.

b. For landing.

(1) At the approach end of runway. The RSA shall extend P and the ROFA shall extend R before the threshold. The portion of runway behind the threshold is unavailable and/or unsuitable for landing distance computations.

(2) At the rollout end of runway. The RSA shall extend P and the ROFA shall extend R beyond the rollout end of LDA. The portion of runway beyond the LDA is unavailable and/or unsuitable for landing distance computations.

5. RUNWAY PROTECTION ZONE (RPZ) LOCATION AND SIZE. The RPZ function may be fulfilled by the RPZ beginning at a location other than 200 feet (60 m) beyond the end of the runway. When an RPZ begins at a location other than 200 feet (60 m) beyond the end of runway, two RPZs are required, i.e., a departure RPZ and an approach RPZ. The two RPZs normally overlap.

a. Approach RPZ. The approach RPZ shall begin 200 feet (60 m) before the threshold. Table 2-4 contains standard dimensions for approach RPZs. The portion of runway behind the threshold is unavailable and/or unsuitable for landing distance computations.

b. Departure RPZ. The departure RPZ shall begin 200 feet (60 m) beyond the far end of TORA. The portion of runway beyond the TORA is unavailable and/or unsuitable for takeoff run computations. The standard dimensions for departure RPZs are:

(1) Starting 200 feet (60 m) beyond the far end of TORA, 1,000 feet (300 m) long, 250 feet (75 m) wide, and at the far end of RPZ 450 feet (135 m) wide--for runways serving only small airplanes in Aircraft Approach Categories A and B.

(2) Starting 200 feet (60 m) beyond the far end of TORA, 1,000 feet (300 m) long, 500 feet (150 m) wide, and at the far end of RPZ 700 feet (210 m) wide--for runways serving large airplanes in Aircraft Approach Categories A and B.

(3) Starting 200 feet (60 m) beyond the far end of TORA, 1,700 feet (510 m) long, 500 feet (150 m) wide, and at the far end of RPZ 1,010 feet (303 m) wide--for runways serving Aircraft Approach Categories C and D.

6. CLEARWAY LOCATION. The clearway is located at the far end of TORA. The portion of runway extending into the clearway is unavailable and/or unsuitable for takeoff run and takeoff distance computations.

7. NOTIFICATION. The clearway and stopway lengths and the following declared distances shall be provided in the Airport/Facility Directory (and in the Aeronautical Information Publication (AIP), for international airports) for each operational direction:

a. The TORA -- the length of the runway less any length of runway unavailable and/or unsuitable for takeoff run computations. See figure A14-1.

b. The TODA -- the TORA plus the length of any remaining runway and/or clearway beyond the far end of the TORA. See figure A14-2.

c. The ASDA -- the length of the runway plus the length of any stopway beyond the far end of the runway less any length of runway and/or stopway unavailable and/or unsuitable for accelerate-stop distance computations. See figure A14-3.

d. The LDA -- the length of the runway less any length of runway unavailable and/or unsuitable for landing distance computations. See figure A14-4. **Note:** When the threshold is sited for small airplanes (see appendix 2, paragraphs 5a and 5b), report LDA as "LDA for airplanes of 12,500 pounds (5 700 kg) or less maximum certificated takeoff weight."

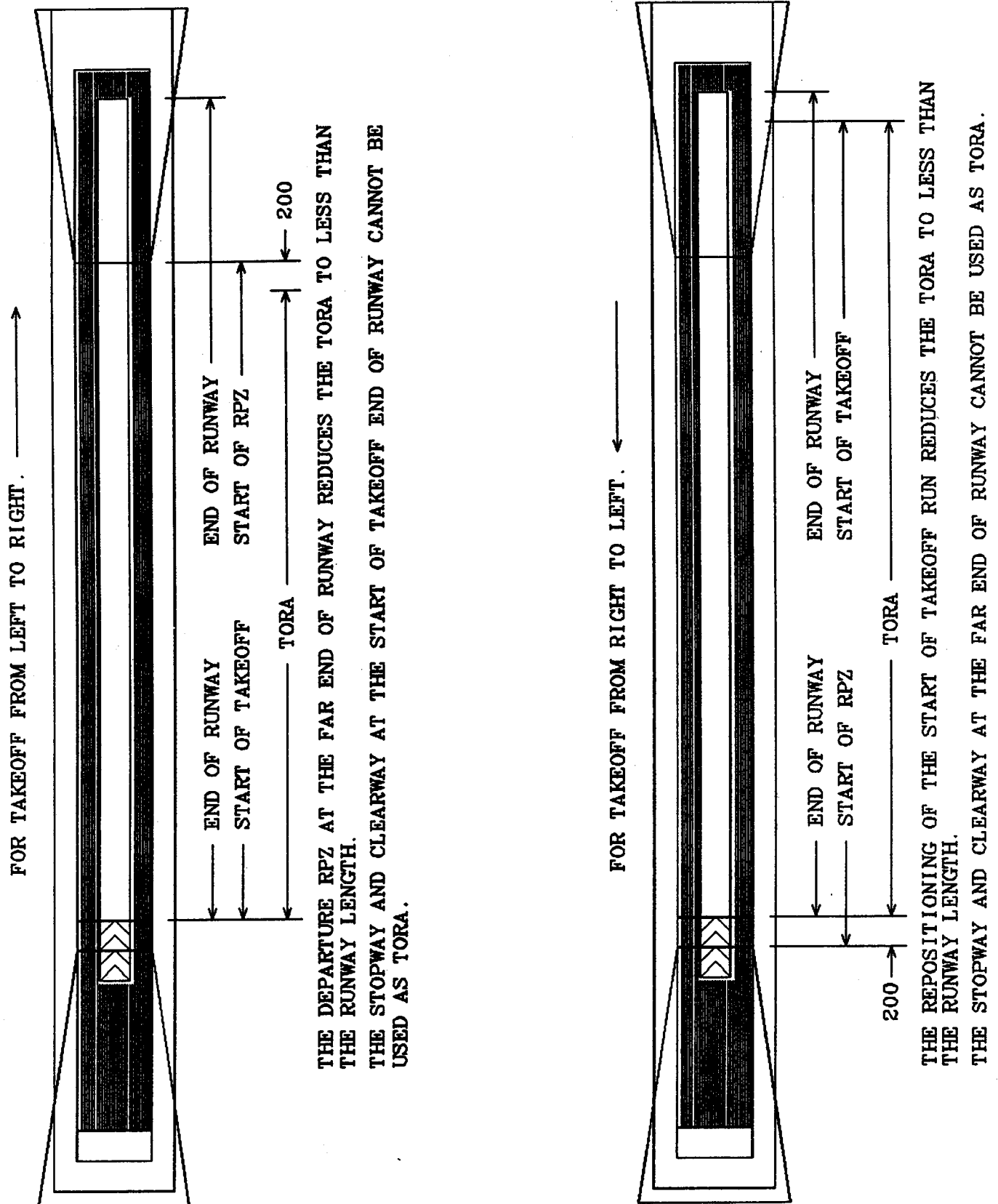


Figure A14-1. Takeoff run available (TORA)

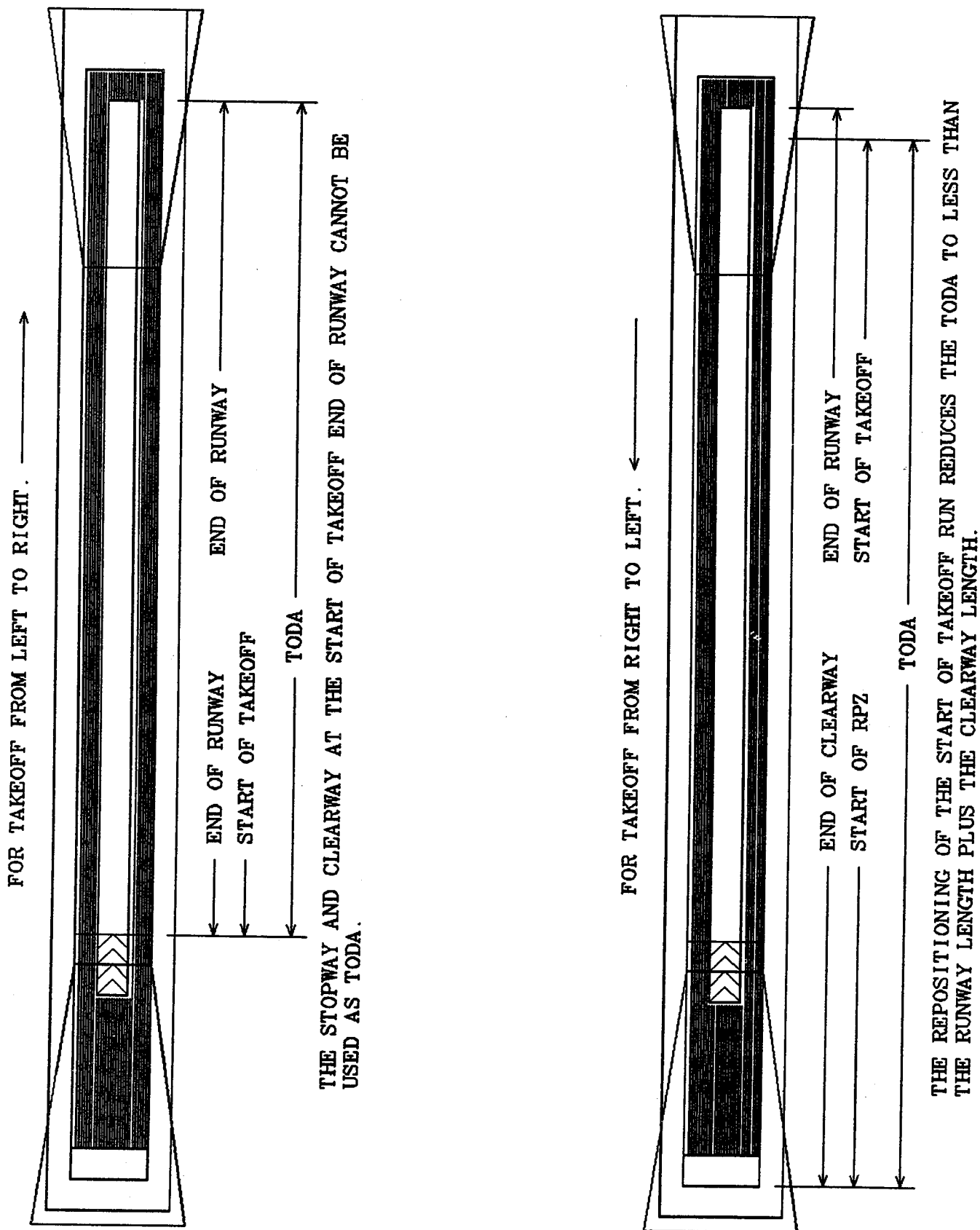


Figure A14-2. Takeoff distance available (TODA)

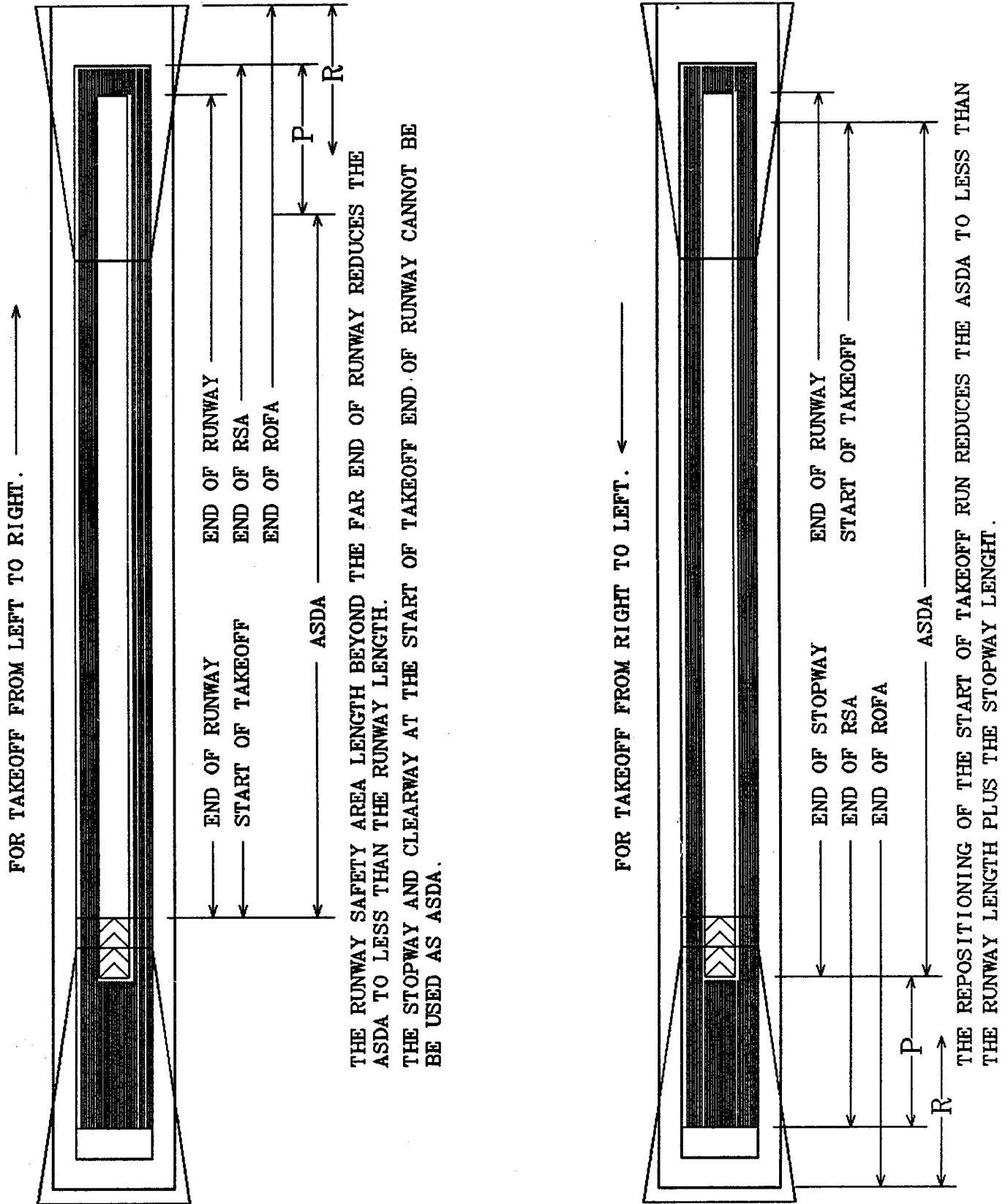


Figure A14-3. Accelerate-stop distance available (ASDA)

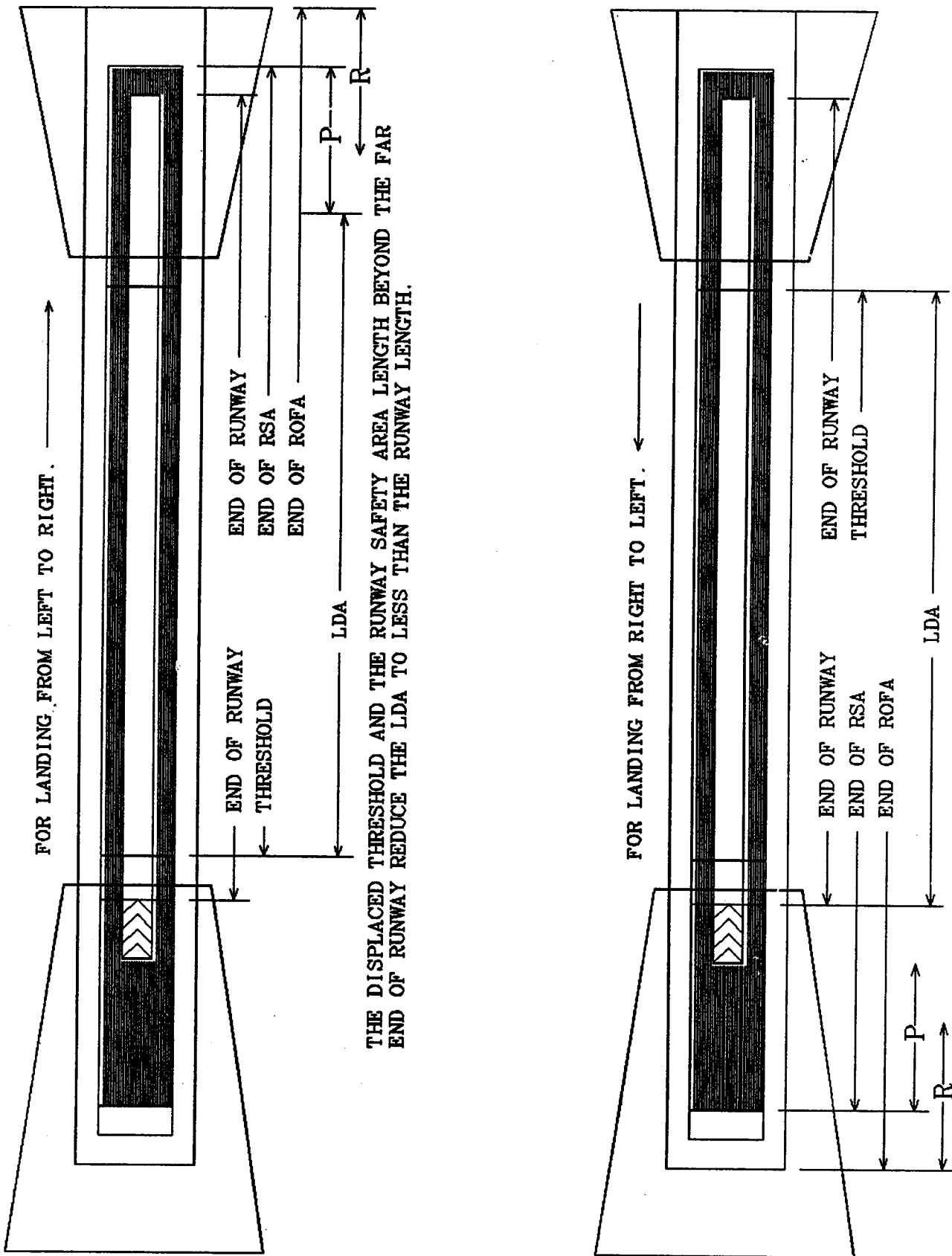


Figure A14-4. Landing distance available (LDA)

Example:

The following situation is for a runway which is to be extended to 7000 feet. The threshold at the 9 end is displaced 420 feet for obstructions in the approach. The runway safety area at the 27 end can only be extended to 375 feet beyond the runway end. By entering the following airport data into the Airport Design (for microcomputers) program, we find that the runway safety area at the Runway 27 end is 625 feet less than standard.

AIRPORT DESIGN AIRPLANE AND RUNWAY DATA

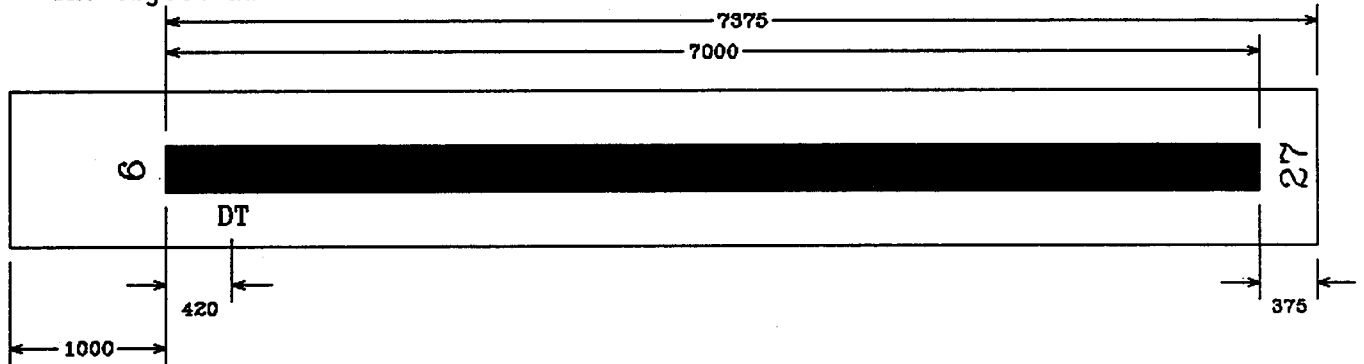
Aircraft Approach Categories C and D
Airplane Design Group III
Precision Instrument Runway

| | |
|--|-----------|
| Runway 9/27 length | 7000 feet |
| Stopway length at the far end of Runway 9 | 0 feet |
| Stopway length at the far end of Runway 27 | 0 feet |
| Clearway length at the far end of Runway 9 | 375 feet |
| Clearway length at the far end of Runway 27 | 0 feet |
| Runway safety area length beyond the far end of Runway 9 | 375 feet |
| Runway safety area length beyond the far end of Runway 27 | 1000 feet |
| Object free area length beyond the far end of Runway 9 | 375 feet |
| Object free area length beyond the far end of Runway 27 | 1000 feet |
| Distance from approach end of Runway 9 to the threshold | 420 feet |
| Distance from approach end of Runway 27 to the threshold | 0 feet |
| Distance from start end of Runway 9 to the start of takeoff | 0 feet |
| Distance from start end of Runway 27 to the start of takeoff | 0 feet |
| Distance from far end of Runway 9 to the start of clearway | 0 feet |
| Distance from far end of Runway 27 to the start of clearway | 0 feet |
| Distance from far end of Runway 9 to the start of departure RPZ | 200 feet |
| Distance from far end of Runway 27 to the start of departure RPZ | 200 feet |

DECLARED DISTANCES

| | Runway 9 (feet) | Runway 27 (feet) |
|---|-----------------|------------------|
| Takeoff run available (TORA) | 7000 | 7000 |
| Takeoff distance available (TODA) | 7375 | 7000 |
| Accelerate-stop distance available (ASDA) | 6375 | 7000 |
| Landing distance available (LDA) | 5955 | 7000 |

The runway safety area before RW 27 threshold is 625 feet less than standard.
The object free area before RW 27 threshold is 625 feet less than standard.



By displacing the threshold at the 27 end 625 feet and providing declared distances, the runway safety area length and runway object free area length standards can be satisfied. See figure A14-6.

Figure A14-5. Example of a runway extended to 7000 feet

AIRPORT DESIGN AIRPLANE AND RUNWAY DATA

Aircraft Approach Categories C and D

Airplane Design Group III

Precision Instrument Runway

| | |
|--|-----------|
| Runway 9/27 length | 7000 feet |
| Stopway length at the far end of Runway 9 | 0 feet |
| Stopway length at the far end of Runway 27 | 0 feet |
| Clearway length at the far end of Runway 9 | 375 feet |
| Clearway length at the far end of Runway 27 | 0 feet |
| Runway safety area length beyond the far end of Runway 9 | 375 feet |
| Runway safety area length beyond the far end of Runway 27 | 1000 feet |
| Object free area length beyond the far end of Runway 9 | 375 feet |
| Object free area length beyond the far end of Runway 27 | 1000 feet |
| Distance from approach end of Runway 9 to the threshold | 420 feet |
| Distance from approach end of Runway 27 to the threshold | 625 feet |
| Distance from start end of Runway 9 to the start of takeoff | 0 feet |
| Distance from start end of Runway 27 to the start of takeoff | 0 feet |
| Distance from far end of Runway 9 to the start of clearway | 0 feet |
| Distance from far end of Runway 27 to the start of clearway | 0 feet |
| Distance from far end of Runway 9 to the start of departure RPZ | 200 feet |
| Distance from far end of Runway 27 to the start of departure RPZ | 200 feet |

DECLARED DISTANCES

| | Runway 9 (feet) | Runway 27 (feet) |
|---|-----------------|------------------|
| Takeoff run available (TORA) | 7000 | 7000 |
| Takeoff distance available (TODA) | 7375 | 7000 |
| Accelerate-stop distance available (ASDA) | 6375 | 7000 |
| Landing distance available (LDA) | 5955 | 6375 |

RSA length limits RW 9 ASDA
 ROFA length limits RW 9 ASDA
 RSA length limits RW 9 LDA
 ROFA length limits RW 9 LDA

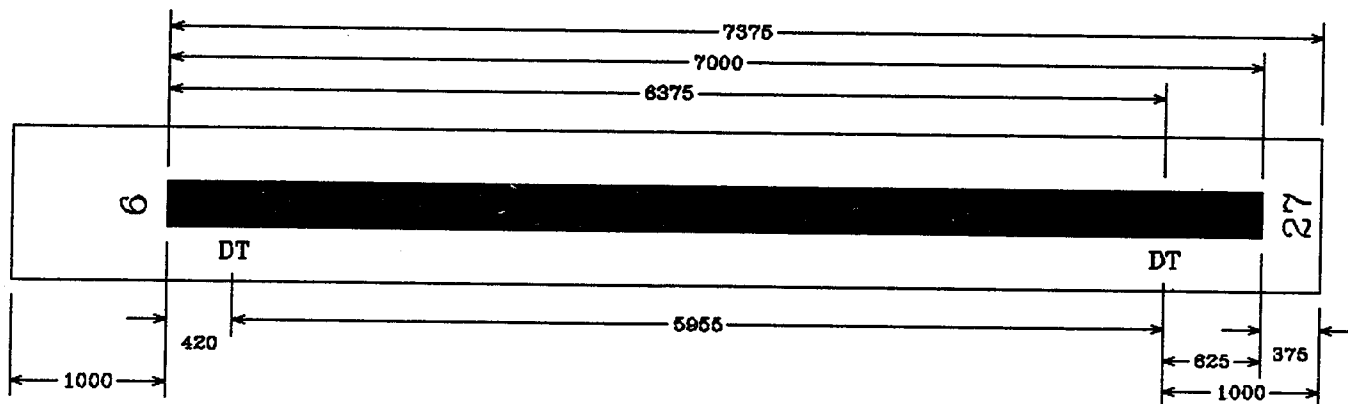


Figure A14-6. Example of a runway with threshold displaced for runway safety area

Appendix 15. TRANSFER OF ELECTRONIC DATA

1. **INTRODUCTION.** This appendix provides guidance for the preparation of Computer Aided Design and Drafting (CADD) drawings, databases, and photogrammetric data electronic files for electronic data transfer between the FAA, airport sponsors, and consultants. The objective of this guidance is to establish software-independent standards to encourage an open and free exchange of airport design related data without undue burden on airport sponsors or consultants. Reference to proprietary products is for information only and should not be considered as an endorsement or an intent to create a de facto standard.

2. **BACKGROUND.** Electronic data is used by the FAA, airport sponsors, and airport consultants for conducting airspace reviews, for developing Airport Layout Plans (ALPs), and for other airport data recording activities.

a. This data should be entered only once. Once entered, it should be reusable for multiple applications. Reasons historically advanced for reentering data include:

(1) **Inaccessibility.** *We don't have the data in our data bases. We can't get it in the right format for entry into our data base by scanning.* Most data in FAA, airport sponsors, and airport consultants data bases is or can be made available. Contact the sources.

(2) **Insufficient Deliverable Information.** *We can't read the data files. We don't have sufficient descriptive information for using the files.* Paragraph 9 provides guidance on the information about the deliverables, medium, and data files that should accompany the deliverables. Provide this information with each deliverable.

(3) **Nonstandard Features and Objects Code.** *We can't merge the data into our data base. The features and objects codes are incompatible.* Paragraph 8 provides the FAA standard code. It should be used to the extent practicable.

(4) **Untranslatable Entities.** *We can't translate the files. We lost most of the data in transition.* Paragraph 5 provides guidance on Autodesk AutoCAD DXF and Intergraph IGDS/MicroStation entities that traditionally have not translated well. Avoid these entities to the extent practicable.

b. The FAA obtains data from various sources and stores the data in a neutral database for FAA use and

electronic transfer. Airport sponsors and consultants normally obtain and transfer electronic data in DXF or IGDS/MicroStation CADD files. The limitations in translation from one CADD format to another CADD format and from a CADD format to a neutral format, have restricted the useful data that could have been transferred between the FAA, airport sponsors, and consultants.

c. Successful transfer of data requires that the data format be acceptable for the recipient's use. To be able to use data provided by airport sponsors and consultants, the FAA has developed capability to translate DXF files to a database format and a limited capability with IGDS/MicroStation files. To be imported successfully into database, the data must be provided in a real coordinate system, both horizontal and vertical.

d. Translators available within the FAA will accept files in the DXF, the IGDS/MicroStation, or a format translatable to a database file format. Further, the FAA will provide this stored data to airport sponsors and consultants.

3. **DEFINITIONS.** As used in this publication:

a. The "classic" Airport Layout Plan (ALP) is the drawing on paper or vellum of an airport showing the layout of existing and proposed airport facilities. This drawing will have approval signatures affixed in the legend.

b. The "modern" Airport Layout Plan (ALP) is the electronic database of an airport containing the geographical data of existing and proposed airport facilities which can be analyzed with standard database routines, retrieved into reports, and displayed graphically to show the layout of existing and proposed airport facilities. This data base does not reflect approval signatures.

c. The "classic" satisfies the ALP approval and record keeping processes but not the requirements for electronic data transfer. To achieve satisfactory electronic data transfer we must go "modern".

4. **APPLICATION.** The FAA recognizes the use of CADD systems within the aviation community and the need for data transfer utilizing these systems.

a. Further, the FAA desires to promote on-going data transfer with airport sponsors and consultants.

This AC, while not representing mandatory requirements, offers guidelines to facilitate the translation, conversion, and transfer of data.

b. To better manipulate the data, the FAA requests, except possibly for construction drawings, that the information be submitted in a set of files. The FAA uses this set of files to categorize data and facilitate data input into a database or drawing file for conversion into a database. The following are the recommended categories for the sets of files:

- (1) Ground features and objects;
- (2) Above-ground features and objects;
- (3) Treetops;
- (4) Contours;
- (5) Control points;
- (6) Text; and
- (7) Listing.

5. **CADD FILE DELIVERABLES.** Drawings created in AutoCAD DXF and Intergraph IGDS/MicroStation can be converted as outlined below. This includes any symbols or standards that are required for the project. To reduce problems in translation, airport sponsors and consultants can prepare a sample typical file and either check or have the potential recipient of the deliverables check for translation interface problems. If checked by the FAA, feasible alternatives to eliminate the problems will be suggested.

a. **DXF Format (AutoCAD).** DXF drawings can be translated to a database format with FAA developed translation software. Since AutoCAD is the dominant software which uses DXF format, the following information is provided for users of AutoCAD.

(1) **AutoCAD Version 12.** The translation software owned by the FAA accepts AutoCAD Version 12 and below.

(2) **Entities to avoid.** Avoid the following entities since they traditionally have not translated well:

- (a) Doughnuts, Solids, and Tracers;
- (b) Shapes;

(c) Text Justifications of A (align), F (fit), and M (middle);

(d) Plines;

(e) Point entities;

(f) Custom Fonts; and

(g) Special characters such as %%d, &&p, %%c, and %%%.

(3) **Significant Digits.** If DXFOUT is used, select 6 decimal places.

(4) **Layers.** FAA has the capability to map AutoCAD layers. However, the FAA translation software is limited to layer number 1 through 249. FAA desires to receive the data categorized by layers to facilitate the conversion. Paragraph 8 provides a list of element categories used to differentiate the information by relating the features or objects with a number and a description. The number can be referenced to a layer number and the description to a layer name if so used by the provider.

(5) **Line Weights.** The provider should assign the line weights to the AutoCAD drawings at plot time based on the AutoCAD color attribute. FAA requests that the provider put together a standard for color to pen assignment for submission to the FAA one time prior to the first delivery and adhere to this standard.

(6) **Text.** Only two text fonts can be used.

(a) Font TXT with Style TXT.

(b) Font SIMPLEX with STYLE SIMPLEX.

When text entities are entered, only baseline justification (left, center, and right) should be used. Aligned text (A), Fitted (F), or Middle text (M) should not be used. These justifications cause translation problems.

(7) **Dimensions.** In order to conform to translation dimensioning requirements, the provider should set the following dimensioning variables as shown:

(a) DIMTAD to ON;

(b) DINTIH to OFF;

(c) DIMTOH to OFF;

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(d) DINBLK to NONE; and

(c) Stacked Fractions.

(e) DIMTSZ to appropriate size of tick mark.

(d) Custom Line Fonts.

(8) Nested Blocks and XREF Files. The following items do not translate well; therefore, the consultants should do the following:

(a) Nested blocks should not be used.

(b) External reference files (XREF) are output to the DXF file by AutoCad as special blocks. If XREFs are used, special attention is required to XREFed files to avoid nested blocks. XREF files should be made a permanent part of the drawing file with XREF BIND, prior to exporting the file to DXF. An alternative would be to detach the XREF file, attach the file as a standard block and explode the newly attached block.

(c) All drawings should be created using model space.

(9) Filename. The provider must submit with each electronic deliverable an index relating filenames to actual drawing numbers.

(10) Translation Setup Checklist. The following actions are required before delivery:

(a) Remove all construction entities/layers and other unnecessary data from the drawing file (PURGE command).

(b) Produce file/layer naming index.

b. IGDS (Intergraph including MicroStation). The following is recommended for organizing Intergraph IGDS or MicroStation drawings for proper translation.

(1) Entities to avoid. Avoid the following entities since they traditionally have not translated well:

(a) Symbols. These are entities which are entered as a single text character with special IGDS fonts 85 through 126. Because these are stored simply as text in the IGDS file, they translate only as text. The provider should instead use cells in all cases where symbols might otherwise be used.

(b) Infinite Lines. Most translation does not support infinite lines. Use normal fixed-length line segments.

(2) Coordinate Setup. Intergraph uses an integer-based method of string coordinate data based on user-defined "Working Units" or "units of resolution". This limits the range of X and Y coordinates which can be stored in the "Design Plane". The provider must define the Master and Sub Unit readouts to FT (') for Master, and IN (") for Sub Units, as appropriate. Unless these readouts and the Working Units are correctly defined, translation software cannot determine the true X Y coordinates representation.

(3) Standard Symbols. All of the standard symbols that appear in the IGDS drawings should be created and inserted as Cells.

(4) Text. The provider should only use "Font 50" font.

(5) Dimensions. Since IGDS stores Dimensions as a text and lines, translation of IGDS Dimensions will not be a problem. The provider can simply select from the menu the appropriate IGDS dimensioning commands which produce the AEC dimensioning with oblique strokes (tick marks).

(6) Filename. The provider must submit with each electronic deliverable an index relating filenames to actual drawing numbers.

(7) Reference Files. Most translation software does not support the concept of reference files. All reference files should be merged into the design file prior to submission. This can be accomplished by the following command sequence.

(a) Turn OFF all levels of the design file.

(b) Turn Locate ON for all reference files.

(c) Place CLIP fence around reference files.

(d) COPY fence into design file with zero displacement.

(e) DETACH all reference files.

(f) Turn ON all levels of the design file.

(8) **Complex Elements.** Complex elements 2, 7, 12, and 14 do not translate consistently. Drop these elements.

c. **Application Programs.** If the provider chooses to use any special application program, it is recommended that the program be customized to conform to the above translation guidelines. If the application program does not permit customization, the provider will have to review the Layers, Colors, Line Weights, and Text Styles/Fonts that the application program uses and develop a mapping strategy to produce database files. The provider will also need to check that the application program does not use any of the problem entities listed in "Entities to avoid" subsection above.

6. **DATABASES DELIVERABLES.** FAA can accept database information in ASCII format with a separator character between each field within each record. Any record length can be accepted as long as it is stated on the media and the record structures with field definitions are provided as part of the deliverables.

7. **PHOTOGRAMMETRY DELIVERABLES.** Electronic deliverables from a photogrammetric survey comprise a set of files depicting the geographical outlines, features, and objects of the photographed areas. These files are to present the raw information in a descriptive manner, ASCII format, in lieu of drawing-type binary data. To differentiate between life-cycle state of the data, such as "existing" or "proposed," the data should be provided in separate file sets and so noted. If separate file sets are not feasible, linetype and/or symbol designators should be specifically assigned for the life-cycle state and so noted in the listing file."

a. Subject to survey requirements, the recommended set of files is as follows:

(1) **Ground Features and Objects.** This file includes all features and objects found at ground elevation, such as roads, runways, ridges, peaks, valleys, catch-basins, tree/shrub outlines, individual elevation points, foundations (FAA and non-FAA), etc..

(2) **Above-Ground Features and Objects.** This file includes all data which is above ground elevation, except for tree data. The data includes house outlines, roof peak outlines, tanks, fences, chimneys, air vents, poles, FAA and non-FAA facilities such as

NAVAIDS, and other elements where the elevation component is above the surrounding terrain.

(3) **Treetops.** This file includes representative treetop points within forested areas defined by tree outline, individual trees, shrubs, and associated greenery.

(4) **Contours.** This file includes all major and minor contour features.

(5) **Control Points.** This file includes the control survey points used in the photogrammetric interpretation.

(6) **Text.** If available, this file includes text information of a map product.

(7) **Listing.** This file is a listing defining the line type or string and symbol numbers used which should correspond to the respective FAA codes as outlined in paragraph 8.

b. The preferred format of these files is the standard plot file, such as Calcomp or HP, generated from the digitizing process to be used as input to a plotter system, or an output listing file produced by the PTLIST program from a KORK System, or KLT/ATLAS System, or equivalent.

c. Typically, this plot file contains mapping parameters, such as scale and rotation, and defines the features/outlines by line type or string numbers, and objects as symbol numbers with their respective horizontal coordinates and elevation. Certain rules must be followed in order to assure the integrity of data during conversion and compilation on the CADD system. These rules are as follows:

(1) Each feature/outline, designated as a specific line type, and object, designated as a specific symbol, must be enclosed within a set of commands or ranges which define the start and continuing or end coordinates of the items. Typical set commands used in plot files are "pen up or start" to define the start and "pen down or quit" to define continuing and end point. A change in line type or symbol is permitted only with a "pen up" type command to flag the change.

(2) Coordinates are to be based on the respective State Plane Grid Projections with elevation based on mean sea level datum, either NAD-27 or NAD-83.

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(3) Accuracy level of data is determined by the scale of the map being produced for the provider as part of the product, usually ± 1 foot in horizontal control with ± 6 inches in elevation.

(4) For tree/shrub outline, the horizontal coordinates shall be of the extreme edge point with the corresponding ground elevation (i.e. "drip line").

(5) For above ground data such as a building, the data shall define the perimeter of the feature. For roof peaks, the data shall define the peak line and orientation.

(6) For above ground data where the items lean from vertical, the horizontal coordinates shall be of the top of the item and the elevation shall be of the top,

(7) Additional ground spots with elevations should be included in the Ground Features and Objects file to define the ground elevation surrounding above ground data such as buildings, tanks, fences, etc.. These points, being ground reference, are not required to have the same horizontal coordinates as the above ground data but should be in as close proximity to the item as feasible.

(8) For ground and above ground data defining NAVAIDS and/or visual aids facilities (SYMBOLS above 135), the horizontal coordinates shall represent the geographic centroid of the facility with the elevation of the respective foundation.

8. FEATURES AND OBJECTS CODE. The following codes associate information from photogrammetry, database, and drawings. These codes are specific in order to develop a database with multiple applications. FAA requests, if possible, that these codes be incorporated in the project. However, FAA has developed an internal translator to convert a provider's listing to the FAA's listing.

a. The designator code LTP refers to Line type or a feature comprised of multi-points, whereas SYM refers to Symbols, Markers, or objects of a single point. The associated number represents a unique code and can also represent layers. The last column provides the description of the feature or object, and can be used for layer name convention.

b. The respective FAA codes are as follows:

| | |
|-----|---------------|
| LTP | 1 PAVED ROAD |
| LTP | 2 CURBED ROAD |
| LTP | 3 FOOT PATH |

| | |
|-----|-----------------------|
| LTP | 4 PAVED DRIVEWAY |
| LTP | 5 UNPAVED DRIVEWAY |
| LTP | 6 PARKING SPACES |
| LTP | 7 DIRT ROAD |
| LTP | 8 PAVED PARKINGS |
| LTP | 9 UNPAVED PARKINGS |
| LTP | 10 MOTORCYCLE TRAIL |
| LTP | 11 RAMPS/DOCKS |
| LTP | 12 DEBRIS/RUINS |
| LTP | 13 PATIO |
| LTP | 14 DECK |
| LTP | 15 ACTIVE RAILROAD |
| LTP | 16 INACTIVE RAILROAD |
| LTP | 20 SIDEWALKS |
| LTP | 21 CONCRETE SLABS |
| LTP | 22 PAVED SHOULDERS |
| LTP | 23 UNPAVED SHOULDERS |
| LTP | 24 TOWERS |
| LTP | 25 LARGE SIGNS |
| LTP | 26 DRAINAGE GATE |
| LTP | 27 STEPS |
| LTP | 28 BLEACHERS |
| LTP | 36 BUILDING U/C |
| LTP | 37 BUILDING |
| LTP | 38 CROSS-HATCHING |
| LTP | 39 BLDG FOUNDATION |
| LTP | 40 HOUSE BLD |
| LTP | 41 EQUIPMENT SHELTER |
| LTP | 56 FUEL TANK |
| LTP | 57 PIPELINE |
| LTP | 58 TANK OR SILO |
| LTP | 59 FUEL STORAGE BLDG |
| LTP | 60 WOODEN FENCE |
| LTP | 61 OBSCURED FENCE |
| LTP | 62 BOULDERS |
| LTP | 63 RECREATION EQUIP |
| LTP | 64 STANDING WALL |
| LTP | 65 METAL FENCE |
| LTP | 66 STONE WALL |
| LTP | 67 RETAINING WALL |
| LTP | 68 GUARD RAIL |
| LTP | 69 ROCK FACE |
| LTP | 70 ROOF PEAK |
| LTP | 71 FOOTBRIDGE |
| LTP | 72 RAILROAD BRIDGE |
| LTP | 73 ROAD/HWAY BRIDGE |
| LTP | 74 RUNWAY CENTERLINE |
| LTP | 75 RUNWAY EDGES |
| LTP | 76 TAXIWAY CENTERLINE |
| LTP | 77 TAXIWAY EDGES |
| LTP | 78 AIRPORT APRONS |
| LTP | 79 AIR. PVMT FILLET |
| LTP | 80 TREE OUTLINE |
| LTP | 81 SCRUB LINE |
| LTP | 82 SHRUBS |

| | | | | | |
|-----|-----|----------------------|-----|-----|-------------------------|
| LTP | 83 | GOLF GREENS | SYM | 83 | SCRUB |
| LTP | 84 | SAND TRAPS | SYM | 84 | INDIVIDUAL SHRUB |
| LTP | 86 | HEDGES | SYM | 85 | DENSE TREES |
| LTP | 86 | ORCHARD | SYM | 86 | INDIVIDUAL TREE |
| LTP | 87 | TREE NURSERY | SYM | 87 | STUMP |
| LTP | 97 | WHARF/PIERS | SYM | 110 | MARSH/SWAMPS |
| LTP | 98 | DAM | SYM | 111 | RAPIDS |
| LTP | 99 | CULVERTS | SYM | 118 | HORIZONTAL POINT |
| LTP | 100 | DRAINAGE DITCH | SYM | 119 | VERTICAL POINT |
| LTP | 101 | CANAL | SYM | 121 | BOUNDARY CORNER |
| LTP | 102 | STORM DRAIN | SYM | 122 | FLAGPOLE |
| LTP | 103 | CREEK OR STREAM | SYM | 123 | B-BALL HOOP |
| LTP | 104 | RIVER | SYM | 124 | RESIDENTIAL LAMP |
| LTP | 105 | DRY DITCH | SYM | 125 | LAMP POLE |
| LTP | 106 | POOL | SYM | 126 | POST |
| LTP | 107 | LAKE | SYM | 127 | TRAFFIC SIGNAL |
| LTP | 108 | SEAWALL | SYM | 128 | PHONE BOOTH |
| LTP | 109 | SEASHORE | SYM | 129 | R.R. SIGNAL |
| LTP | 110 | SWAMP OUTLINE | SYM | 130 | POLE |
| LTP | 120 | CONTOUR LINE | SYM | 131 | GAS PUMPS |
| LTP | 121 | INDEX CONTOUR | SYM | 132 | HEAD STONES |
| LTP | 122 | DEPRESSION CONTOUR | SYM | 133 | ELEC. BOX/A.C.U. |
| LTP | 123 | INDEX DEPRSS CONTR | SYM | 134 | TRAFFIC CNTRL BOX |
| LTP | 124 | DASHED CONTOUR | SYM | 135 | R.R. SWITCH BOX |
| LTP | 125 | DASHED INDEX CONTOUR | SYM | 136 | WIND CONE |
| LTP | 126 | DASHED DEPRSS CONTR | SYM | 137 | SEGMENTED CIRCLE |
| LTP | 127 | DASHED IDX DPS CONTR | SYM | 138 | T/W EDGE ELEV LT |
| LTP | 128 | RUNWAY NUMBERS | SYM | 139 | T/W EDGE INPVT LT |
| LTP | 129 | THRESHOLD MARKING | SYM | 140 | T/W CENTERLINE LT |
| LTP | 130 | HOLD LINE | SYM | 141 | T/W STOP BAR |
| SYM | 2 | HOUSE TOP POINT | SYM | 142 | R/W EDGE ELEV LT |
| SYM | 3 | ROAD SIGN | SYM | 143 | R/W EDGE INPVT LT |
| SYM | 6 | TREETOP ELEV | SYM | 144 | R/W CENTERLINE LT |
| SYM | 7 | MAIL BOX | SYM | 145 | R/W THLD ELEV LT |
| SYM | 9 | FIRE HYDRANT | SYM | 146 | R/W THLD INPVT LT |
| SYM | 10 | UNKNOWN OBJECT | SYM | 147 | R/W TDZ INPVT LT |
| SYM | 11 | SILL ELEV/DTM PTS | SYM | 148 | R/W HOLD BAR LT |
| SYM | 12 | CATCH BASIN | SYM | 151 | ALS THLD ELEV BAR |
| SYM | 13 | MANHOLE | SYM | 152 | ALS THLD INPVT BAR |
| SYM | 14 | WATER GATE | SYM | 153 | ALS ELEV LIGHT BAR |
| SYM | 15 | GAS GATE | SYM | 154 | ALS INPVT LIGHT BAR |
| SYM | 16 | DROP INLET | SYM | 158 | VASI BOXES FDN |
| SYM | 17 | CHIMNEY | SYM | 159 | REAL LIGHTS FDN |
| SYM | 18 | AIR VENT | SYM | 160 | LOCALIZER FDN |
| SYM | 19 | BUTTERFLY VALE | SYM | 161 | G/S ANTENNA FDN |
| SYM | 20 | BORING HOLE | SYM | 162 | G/S ANTENNA TOP |
| SYM | 21 | PROBE | SYM | 163 | G/S MONITOR FDN |
| SYM | 22 | TOWER SUPPORT | SYM | 164 | RVR TOWER CTR PT |
| SYM | 23 | UTILITY POLE | SYM | 165 | VOR CENTER PT |
| SYM | 24 | SMALL POLE | SYM | 166 | ASR CENTER PT |
| SYM | 25 | AERIAL ANTENNA | SYM | 167 | ODALS |
| SYM | 26 | LIGHT POLE | SYM | 168 | COMPASS CALIBRATION PAD |
| SYM | 62 | SIGN | | | |
| SYM | 81 | IND. EVERGREEN | | | |
| SYM | 82 | IND. DECIDUOUS TREE | | | |

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c. FAA recognizes that, during a project, new features or objects will be recognized. The provider should highlight these new features or objects in the submitted listing so that the FAA can assure capture during translation.

9. **MEDIA.** FAA can accept electronic deliverables on the following magnetic medium:

a. 5.25 inches, 1.2 MB, AEGIS or UNIX formatted floppy diskettes for reading on a HP/Apollo computer system.

b. 5.25 inch, 1.2 MB, or 3.5 inch, 1.44 MB, MS-DOS Version 3.0 or higher formatted floppy diskettes. Each file should consist of no more than 1 MB of information per file. Multi-files are preferred.

c. 1600 or 6250 BPI, 9 track tape reels, labeled or unlabeled, in ASCII, or EBCDIC. Records shall be 80 to 512 bytes long in no more than 2048 byte blocks written using a copy or equivalent command to produce files to be read on foreign systems. The recommended format for IGDS is 512 bytes record length with 2048 bytes block length.

d. 1/4 inch cartridge tape formatted for reading on a HP/Apollo computer running under the AEGIS or UNIX operating system.

e. In addition, each electronic deliverable shall be accompanied by a legible label affixed to the outside of each magnetic medium's protective case and a document that lists the files contained in that medium. The label shall bear the following:

- (1) The name of the sender;
- (2) The name of the intended recipient;
- (3) A sender-unique identifier or title that can be used to reference the collective contents of the transmittal;
- (4) Format descriptions necessary for reading the medium; and
- (5) List file of the features and objects contained in the submittal.
- (6) The contract or project number and/or name.

10. **FAA POINT OF CONTACT.** The FAA Airports Regional and/or District Office is the FAA point of contact dealing with the transfer of electronic data.

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 "overlying" an existing authorized instrument procedure does not constitute a new procedure. However, a significant reduction in minima (i.e. ¼ mile reduction in visibility and/or 50 foot reduction in decision altitude or minimum descent altitude) 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, *TERPS*, 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 A16-1B defines the requirements for WAAS and authorized barometric VNAV.

c. Nonprecision Approach. An instrument approach procedure providing course guidance without vertical path guidance. Table A16-1C defines the requirements for VOR, NDB, LDA, GPS (TS0-129) or other authorized RNAV system.

5. AIRPORT AIRSPACE ANALYSIS SURVEYS.

a. Use the standards identified in ACs 150/5300-16, 1505300-17, and 150/5300-18 to survey and compile the appropriate data to support the development of instrument procedures.

b. When the runway has or is planned to have an approach that has vertical guidance (ILS, MLS or PAR, APV, LPV, RNP, TLS, LNAV/VNAV, etc.), use the Vertically Guided Airport Airspace Analysis Survey criteria in AC 150/5300-18.

c. When the runway has or is planned to have an approach without vertical guidance (VOR, VOR/DME, TACAN, NDB, LNAV, LP, etc.), use the Non-Vertically Guided Airport Airspace Analysis Survey criteria in AC 150/5300-18.

Table A16-1A. Precision Instrument Approach Requirements.

| | | |
|---|---|---|
| Visibility Minimums¹ | <3/4 statute mile | < 1-statute mile |
| Height Above Touchdown (HAT)² | 200 | |
| TERPS Glidepath Qualification Surface (GQS)³ | Table A2-1, Row 7, Criteria, and Appendix 2, par. 5a Clear | |
| TERPS precision "W" surfaces⁴ | Clear | See Note 5 |
| TERPS Paragraph 251 | 34:1 Clear | 20:1 Clear |
| Precision Obstacle Free Zone (POFZ) 200 x 800⁶ | Required | Not Required |
| Airport Layout Plan⁷ | Required | |
| Minimum Runway Length | 4,200 ft (1,280 m) (Paved) | |
| Runway Markings (See AC 150/5340-1) | Precision | Nonprecision |
| Holding Position Signs & Markings (See AC 150/5340-1 and AC 150/5340-18) | Precision | Nonprecision |
| Runway Edge Lights⁸ | HIRL / MIRL | |
| Parallel Taxiway⁹ | Required | |
| Approach Lights¹⁰ | MALS, 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 Met¹² | Table A2-1, Row 9, Criteria | Table A2-1, Row 8, Criteria |
| Survey Required for Lowest Minima | Vertically Guided Airport Airspace Analysis Survey | |

1. Visibility minimums are subject to application of FAA Order 8260.3 (TERPS) and associated orders or this table, whichever are higher.
2. The HAT indicated is for planning purposes only. Actual obtainable HAT is determined by TERPS.
3. The 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. Its 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 3° 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 306).
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 Order paragraph 251 criteria.

**Table A16-1B. Approach Procedure With Vertical Guidance (APV-RNP)
Approach Requirements**

| | | | | |
|---|---|---|---|-------------------------------|
| Visibility Minimums¹ | < 3/4-statute mile | < 1-statute mile | 1-statute mile | >1-statute mile ¹⁴ |
| Height Above Touchdown (HAT)² | 250 | 300 | 350 | 400 |
| TERPS Glidepath Qualification Surface (GQS)³ | Table A2-1, Row 7, Criteria, and Appendix 2, par. 5a 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 Obstacle Free Zone (POFZ) 200 x 800⁴ | Required | Recommended | | |
| Airport Layout Plan⁵ | 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 <i>(precision recommended)</i> | Nonprecision ⁷ | |
| Holding Position Signs & Markings (See AC 150/5340-1 and AC 150/5340-18) | Precision | Nonprecision <i>(precision recommended)</i> | Nonprecision ⁷ | |
| Runway Edge Lights⁸ | HIRL / MIRL | | MIRL/LIRL | |
| Parallel Taxiway⁹ | Required | | Recommended | |
| Approach Lights¹⁰ | <i>Required¹¹</i> | | Recommended | |
| Runway Design Standards; e.g., Obstacle Free Zone (OFZ)¹² | <3/4-statute mile approach visibility minimums | ≥ 3/4-statute mile approach visibility minimums | | |
| Threshold Siting Criteria To Be Met¹³ | Table A2-1, Row 4 and 9, Criteria | | Appendix 2, Table A2-1, Lines 4 and 8, Criteria | |
| Survey Required for Lowest Minima | Vertically Guided Airport Airspace Analysis Survey | | | |

1. Visibility minimums are subject to the application of FAA Order 8260.3 (TERPS) and associated orders or this table, whichever is higher.
2. The HAT indicated is for planning purposes only. Actual obtainable HAT is determined by TERPS.
3. The 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. Its 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 306).
5. An ALP is only required for obligated airports in the NPIAS; it is recommended for all others.
6. Runways less than 3,200 feet are protected by 14 CFR Part 77 to a lesser extent (77.23(a)(2) is not applicable for runways less than 3,200 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. ODALS, MALS, SSALS are acceptable. For LPV based minima approach lights are recommended not required.
12. Indicates what chart should be followed in the related chapters in this document.
13. 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.
14. For circling requirements, see Table 16-1C.

Table A16-1C. Nonprecision Approach Requirements

| | | | | | |
|---|--|--|---|-----------------|--|
| Visibility Minimums¹ | < 3/4-statute mile | < 1-statute mile | 1-statute mile | >1-statute mile | Circling |
| Height Above Touchdown² | 300 | 340 | 400 | 450 | Varies |
| TERPS Paragraph 251 | 34:1 clear | 20:1 clear | 20:1 clear or penetrations lighted for night minimums (See AC 70/7460-1) | | |
| Airport Layout Plan³ | Required | | | | Recommended |
| Minimum Runway Length | 4,200 ft (1,280 m) (Paved) | 3,200 ft (975 m) ⁴ (Paved) | 3,200 ft (975 m) ^{4,5} | | |
| Runway Markings (See AC 150/5340-1) | Precision | Nonprecision ⁵ | | | Visual (Basic) ⁵ |
| Holding Position Signs & Markings (See AC 150/5340-1 and AC 150/5340-18) | Precision | Nonprecision | | | Visual (Basic) ⁵ |
| Runway Edge Lights⁶ | HIRL / MIRL | | MIRL / LIRL | | MIRL / LIRL (Required only for night minima) |
| Parallel Taxiway⁷ | Required | | Recommended | | |
| Approach Lights⁸ | MALS, SSALS, or ALSF Required | Required ⁹ | Recommended ⁹ | | Not Required |
| Runway Design Standards, e.g. Obstacle Free Zone (OFZ)¹⁰ | <3/4-statute mile approach visibility minimums | ≥ 3/4-statute mile approach visibility minimums | | | Not Required |
| Threshold Siting Criteria To Be Met¹¹ | Table A2-1, Row 9, Criteria | Table A2-1, Row 8, Criteria | Table A2-1, Row 1-5, Criteria | | Table A2-1, Row 1-2, Criteria |
| Survey Required for Lowest Minima | Vertically Guided Airport Airspace Analysis Survey | Non-Vertically Guided Airport Airspace Analysis Survey | Non-Vertically Guided Airport Airspace Analysis Survey | | Non-Vertically Guided Airport Airspace Analysis Survey |

1. Visibility minimums are subject to the application of FAA Order 8260.3 (TERPS) and associated orders or this table, whichever is higher.
2. The Height Above Touchdown (HAT) indicated is for planning purposes only. Actual obtainable HAT is determined by TERPS.
3. An ALP is only required for obligated airports in the NPIAS; it is recommended for all others.
4. Runways less than 3,200 feet 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.
5. Unpaved runways require case-by-case evaluation by regional Flight Standards personnel.
6. Runway edge lighting is required for night minimums. High intensity lights are required for RVR-based minimums.
7. A parallel taxiway must lead to the threshold and, with airplanes on centerline, keep the airplanes outside the OFZ.
8. To achieve lower visibility minimums based on credit for lighting, a TERPS specified approach lighting system is required.
9. ODALS, MALS, SSALS, SALS are acceptable.
10. Indicates what chart should be followed in the related chapters in this document.
11. 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 Order, 8260.3 paragraph 251, criteria.

Appendix 17. MINIMUM DISTANCES BETWEEN CERTAIN AIRPORT FEATURES AND ANY ON-AIRPORT AGRICULTURE CROPS

Table A17-1. Minimum Distances Between Certain Airport Features and Any On-Airport Agriculture Crops

| Aircraft Approach Category and Design Group ¹ | Distance in Feet From Runway Centerline to Crop | | Distance in Feet From Runway End to Crop | | Distance in Feet from Centerline of Taxiway to Crop | Distance in Feet from Edge of Apron to Crop |
|--|---|----------------------|--|----------------------|---|---|
| | Visual & $\geq \frac{3}{4}$ mile | < $\frac{3}{4}$ mile | Visual & $\geq \frac{3}{4}$ mile | < $\frac{3}{4}$ mile | | |
| Category A & B Aircraft | | | | | | |
| Group I | 200 ² | 400 | 300 ³ | 600 | 45 | 40 |
| Group II | 250 | 400 | 400 ³ | 600 | 66 | 58 |
| Group III | 400 | 400 | 600 | 800 | 93 | 81 |
| Group IV | 400 | 400 | 1,000 | 1,000 | 130 | 113 |
| Category C, D, & E Aircraft | | | | | | |
| Group I | 530 ³ | 575 ³ | 1,000 | 1,000 | 45 | 40 |
| Group II | 530 ³ | 575 ³ | 1,000 | 1,000 | 66 | 58 |
| Group III | 530 ³ | 575 ³ | 1,000 | 1,000 | 93 | 81 |
| Group IV | 530 ³ | 575 ³ | 1,000 | 1,000 | 130 | 113 |
| Group V | 530 ³ | 575 ³ | 1,000 | 1,000 | 160 | 138 |
| Group VI | 530 ³ | 575 ³ | 1,000 | 1,000 | 193 | 167 |

1. Design Groups are based on wing span or tail height, and Category depends on approach speed of the aircraft as shown below:

| Design Group | Category |
|---|---|
| Group I: Wing span up to 49 ft. | Category A: Speed less than 91 knots |
| Group II: Wing span 49 ft. up to 73 ft. | Category B: Speed 91 knots up to 120 knots |
| Group III: Wing span 79 ft. up to 117 ft. | Category C: Speed 121 knots up to 140 knots |
| Group IV: Wing span 113 ft. up to 170 ft. | Category D: Speed 141 knots up to 165 knots |
| Group V: Wing span 171 ft. up to 213 ft. | Category E: Speed 166 knots or more |
| Group VI: Wing span 214 ft. up to 261 ft. | |

2. If the runway will only serve small airplanes (12,500 lb. and under) in Design Group I, this dimension may be reduced to 125 feet; however, this dimension should be increased where necessary to accommodate visual navigational aids that may be installed. For example, farming operations should not be allowed within 25 feet of a Precision Approach Path Indicator (PAPI) light box.
3. These dimensions reflect the Threshold Siting Surface (TSS) as defined in AC 150/5300-13, Appendix 2. The TSS cannot be penetrated by any object. Under these conditions, the TSS is more restrictive than the OFA, and the dimensions shown here are to prevent penetration of the TSS by crops and farm machinery.

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Appendix 18. ACRONYMS

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

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

| | | | |
|----------------|----------------------------------|------------------|--|
| USGS | United States Geological Service | V _{LOF} | Lift-off speed |
| V | Visual (Markings) | V _{SO} | Stalling speed or the minimum steady flight speed in the landing configuration |
| V ₁ | Takeoff decision speed | VNAV | Vertical Navigation |
| V ₂ | Takeoff safety speed | VOR | Very High Frequency Omirange |
| VFR | Visual Flight Rules | WAAS | Wide Area Augmentation System |

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