AC NO: 150/5300-1

Cancelled - See 150/5300-4 and 150/5100-3

MINIMUM DIMENSIONS FOR

VFR AIRPORTS

TO SERVE AIRCRAFT OPERATING UNDER VISUAL FLIGHT RULES

ADVISORY CIRCULAR

Federal Aviation Agency

MARCH 1963

Federal Aviation Agency

ADVISORY CIRCULAR CHANGE

AC NO: AC 150/5300-1 CH 2

AIRPORTS

EFFECTIVE: 7/15/64

SUBJECT: CH 2 TO CIRCULAR NO. 150/5300-1
SUBJECT: VFR AIRPORTS

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1. PURPOSE. This change provides additional guidance on FAA policy in regard to application of criteria and incorporates additional aircraft performance curves and dimensional data.

2. CHANGES.

   a. Cover sheet, page 1, paragraph 1 has been revised to more properly identify the objectives of this circular.

   b. Cover sheet, page 1, paragraph 2 has been revised to include cancellation of related written material in the publication, "Airport Design".

   c. Cover sheet, pages 1 and 2, paragraph 3 has been revised to omit the reference to advisory circular numbers for certain publications since these number are no longer applicable.

   d. Cover sheet, page 2, paragraph 4 has been deleted since reference to FAAP legislation is covered under Purpose on the cover sheet, page 1.

   e. Paragraphs 1.a. and 1.b. have been revised to clarify the intent and scope of this circular.

   f. Paragraph 2-1, Application, has been added to provide further recommendations and guidance regarding the conditions under which these criteria should be applied.

   g. In paragraph 4, the term "master plan layout" has been changed to "airport layout plan" to conform to the terminology contained in the current Federal Airport Act.

   h. A sentence has been added in Paragraph 11 to describe the length required for an unpaved landing strip.

i. In paragraph 22.c.(1), a sentence has been added to clarify the use of recommended dimensions and spacing of numbers for runway designation marking.

j. Paragraph 26, Summation of Design Criteria, has been expanded to note maximum dimensions for certain criteria.

k. In Appendix 2, Section 1, the introductory paragraph has been revised to more clearly indicate the source and basis from which the curves were developed.

l. In Appendix 2, Section 1, paragraph 1.a., landing strip is changed to runway.

m. In Appendix 2, Section 1, performance curves for five additional aircraft have been added on pages 12 and 12-1.

n. In Appendix 2, Section 2, aircraft data have been added for five aircraft as follows: three on page 15, one on page 17, and one on page 19.

3. PAGE CONTROL CHART.

PAGE CONTROL CHART			
Remove Pages	Dated	Insert Pages	Dated
1 and 2 (cover sheet)	3/15/63	1 and 2 (cover sheet)	7/15/64
i	2/13/64	i and ii	7/15/64
1 thru 4	3/15/63	3-3/15/63; 1,2,2-1&4	7/15/64
7 thru 10	3/15/63	8-3/15/63; 7,9&10	7/15/64
APPENDIX 2, SECTION 1		APPENDIX 2, SECTION 1	
1 and 2	3/15/63	2-3/15/63; 1	7/15/64
11 and 12	3/15/63	11-3/15/63; 12 and 12-1	7/15/64
APPENDIX 2, SECTION 2		APPENDIX 2, SECTION 2	
15 thru 20	3/15/63	16,18,20-3/15/63; 15,17&19	7/15/64

Cole Morrow

Cole Morrow, Director
Airports Service

Federal Aviation Agency

ADVISORY CIRCULAR CHANGE

FEDERAL AVIATION AGENCY · UNITED STATES OF AMERICA

AC NO:
AC 150/5300-1 CH 1
AIRPORTS
EFFECTIVE:
2/13/64

SUBJECT: CH 1 TO CIRCULAR NO. 150/5300-1
SUBJECT: VFR AIRPORTS

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1. PURPOSE. This change transmits performance curves for airport design and planning guidance.

2. CANCELLATION. This change cancels performance curves for the Aero 560E, Beech C18S, Beech D18S, Beech E18S, Cessna 170, A, B, and Piper PA-12 on pages 3, 4, 5, 7, and 10 of Appendix 2.

3. ADDITION. Performance curves for use up to a 10,000-foot elevation are added to Appendix 2.

4. PAGE CONTROL CHART.

PAGE CONTROL CHART			
Remove Pages	Dated	Insert Pages	Dated
i	3/15/63	i	2/13/64
APPENDIX 2		APPENDIX 2	
3 thru 10	3/15/63	3 thru 5	2/13/64
		6	3/15/63
		7	2/13/64
		8 and 9	3/15/63
		10	2/13/64
		21 thru 28	2/13/64

Chester G. Bowers
for Cole Morrow, Director
Airports Service

Federal Aviation Agency

ADVISORY CIRCULAR

FEDERAL AVIATION AGENCY · UNITED STATES OF AMERICA

AC NO:
AC 150/5300-1 CH 2
AIRPORTS
EFFECTIVE:
7/15/64

SUBJECT: VFR AIRPORTS

1. PURPOSE. This Advisory Circular sets forth Federal Aviation Agency (FAA) minimum standards for VFR airports to serve aircraft operating under
* visual flight rules. The recommendations described are acceptable in accomplishing a project meeting the eligibility requirements of the Federal-aid Airport Program. *

2. CANCELLATION. This Advisory Circular cancels Table 4, "Recommended Runway Lengths for Takeoff and Landing of Airplanes under 12,500 Pounds
* Maximum Weight", on pages 57 and 58 and the paragraphs under the same title on pages 23 and 59 of the "Airport Design" manual, July 1961.

3. REFERENCES. The following publications provide further guidance and technical information as may be required:

   a. Federal Aviation Regulations (FAR) Part 157, "Notice of Construction, Alteration, or Deactivation of Airport", (new) effective February 11, 1963.

   b. Model Airport Zoning Ordinance, July 1960.

   c. Airport Engineering Data Sheet No. 38, "Wind Data Analysis", July 1962.

   d. Airport Engineering Data Sheet No. 15, "Airport Control References", May 15, 1958.

   e. Administration Buildings for General Aviation Airports, 1960.

   f. Airport Paving, October 1956, or reprint of November 1962.

   g. Airport Drainage, 1960.

   h. Technical Standard Order N7c, "Aeronautical Beacons", August 1, 1961.

i. Technical Standard Order N1c, "Runway and Landing Strip Lighting", May 15, 1957.

j. AC 150/5340-1, "Marking of Serviceable Runways and Taxiways", November 6, 1963.

k. AC 150/5370-1, "Standard Specifications for Construction of Airports", June 1959 (with Supplement No. 1 and Admendment No. 1).

l. AC 150/5345-8, "Specification for L-840 Low Intensity Runway, Landing Strip and Taxiway Light", November 4, 1963.

m. Drawing No. LI-60-3, L-840, "Low Intensity Lighting System Using 120/240 Volt Power Supply", November 1960.

n. Airport Engineering Data Sheet No. 33, "Descriptive Guide for Preparation of Airport Plans", July 1961.

o. Airport Design, July 1961. *

4. <u>HOW TO GET THIS PUBLICATION</u>. Obtain additional copies of this circular, AC 150/5300-1, "VFR Airports", from the Federal Aviation Agency, Distribution Section, HQ-438, Washington, D. C. 20553.

Cole Morrow

Cole Morrow, Director
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TABLE OF CONTENTS

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1. INTRODUCTION.

a. This advisory circular contains minimum acceptable dimensions for VFR airports to serve aircraft operating under visual flight rules at the airport. Also presented is basic information concerning land requirements, site selection, dimensions, lighting, marking, and other considerations. For purposes of planning and designing, VFR airports are those developed to satisfy the requirements of aircraft with a maximum gross weight of 12,500 pounds or less. These airports are not designed to satisfy the requirements of instrument landing operations.

b. These recommendations are provided in order to encourage the development of minimum economical airport facilities that will safely accommodate these aircraft. It may be necessary to increase some of the dimensions to satisfy a specific need or to meet the requirements of state or local regulations.

2. BACKGROUND.

a. The need to develop and preserve airports serving general aviation is clearly recognized by all who are associated with this fast growing segment of aviation. In a report to the President entitled "National Aviation Goals" (Project Horizon), a requirement for 150 general aviation airports was indicated in addition to a complex of airstrips throughout the country to provide national air accessibility comparable to that afforded the automobile by our highway system. Recommendations also called for the encouragement and preservation of private airports.

b. In establishing and maintaining a national airport system, it is essential that communities of all sizes and economic levels be considered. The growth of general aviation during the past decade, especially that segment employing light single- and twin-engine aircraft, has emphasized the need for providing appropriate guidance material to design airports which will safely and economically serve this already large portion of our total active aircraft.

2-1. APPLICATION.

a. The criteria contained in this circular (except for aircraft performance curves and data given in Appendix 2) are applicable only to those airports developed under these standards.

b. "VFR Airports" criteria should not be applied for any future development of existing airports which have been established according to "Airport Design" or other equivalent criteria.

3. SITE SELECTION.

a. The selection of a site is one of the more important factors in the development of a new airport. The site should be readily accessible to the users, and the landing strip should be properly oriented in relation to the prevailing wind and in relation to other airports, otherwise its usefulness will be impaired and its construction unjustified. Generally, a site adjacent to a highway will provide accessibility and, in many locations, reduce the cost of the airport development. Other important factors that must be considered are cost of land, capability of being expanded, topography, subsoil condition, and proximity to other airports. The latter consideration refers to air traffic generated at other airports and the use of airspace. To determine the effect that an airport may have upon the efficient use of airspace and the safety of aircraft, it is required by FAR Part 157 (see References 3a) that a notice of construction, alteration, or deactivation be submitted to the nearest Federal Aviation Agency's District Airport Engineer's office or Regional office (see Appendix 3).

b. The effect of noise on adjacent property, especially in the airport approach-departure areas, should also be considered. Residential areas and places of public assembly, schools and churches in particular, could be adversely affected if care is not exercised to maintain adequate separation between these land uses and the airport site.

4. MASTER PLAN. A master plan is a record of the present and ultimate development of an airport. The development of such a plan is encouraged since it is a desirable aid to assure an orderly, economically, and functionally sound development -- one in which all component parts will have been carefully studied and planned in advance. The
* airport layout plan is the basic element of the master plan and shows *
all existing and proposed facilities or structures, property lines, topography, utilities, approach-departure surfaces, and clear zones in addition to the ultimate runway and taxiway layout.

5. ZONING. In the planning and designing of any airport, it is important for the safety of aeronautical operations that all existing obstructions to air navigation be cleared or marked and lighted and future obstructions be prevented. Where legally possible, airport zoning regulations or ordinances should be adopted to prevent the establishment of hazards and other obstructions to air navigation (see References 3b).

6. ORIENTATION. The landing strip should be oriented so that the airport has a usability factor as large as possible.

a. Number of Landing Strips. Only one landing strip needs to be developed provided that it can be oriented so as to attain at least a 95 percent wind coverage with a crosswind component not greater than 10 knots. A crosswind component is one that acts at a right angle to the longitudinal axis of the landing strip. In those areas where this coverage cannot be attained, a second landing strip may be considered.

b. Wind Data Information. Wind data information for many locations is available in the Federal Aviation Agency's District Airport Engineer's office or the local office of the Weather Bureau. Data from the nearest wind recording station may be used; however, where no recorded data are available, an evaluation should be made of the best local information (see References 3c).

c. Other Considerations. Additional important considerations affecting landing strip orientation are neighboring airports, adjacent built-up areas, restricted areas, topography, and obstructions.

7. IMAGINARY SURFACES REFERENCED TO THE AIRPORT. Imaginary surfaces are established in order to define those objects that are considered obstructions to air navigation. The following surfaces are recommended to be free of obstructions and are established about the airport reference point (ARP). The ARP (see References 3d) is an established point at the approximate geometric center of the landing strips of an airport.

a. Horizontal Surface. This surface is a circular plane, centered above the ARP at a height of 150 feet above the established airport elevation. The established airport elevation is the highest point on the landing strips of the airport. The radius of this surface is 7,000 feet except where any combination of temperature and altitude requires a landing strip length greater than 5,200 feet for which a radius of 10,000 feet is necessary.

b. Conical Surface. This surface extends from the periphery of the horizontal surface, upward and outward at a slope of 1 to 20 for a horizontal distance of 7,000 feet to a height of 500 feet above the established airport elevation.

8. IMAGINARY SURFACES REFERENCED TO THE LANDING STRIPS. It is recommended that the following imaginary surfaces, as shown in Appendix 1, Figure 5, be free of obstructions to air navigation:

a. Primary Surface. This surface is symmetrically located with respect to the centerline of the landing strip. The length of the primary surface is equal to the length of the landing strip. It has a minimum width of 200 feet and in all cases is at least 50 feet wider than the width of the landing strip. The elevation of any point on the transverse or longitudinal profile of the surface coincides with that of the highest ground elevation along the width of the landing strip. Any transverse profile of this surface is horizontal.

b. Approach-Departure Surface. This surface begins at the end of the primary surface and rises outward and upward to a height of 150 feet above the established airport elevation. The surface is symmetrical about the extended centerline of the landing strip and has a minimum width of 200 feet at the end of the primary surface. It then widens uniformly at a flare of 1 foot on each side for each 20 feet from the end of the primary surface. Thus this surface will have a minimum width of 500 feet at a distance of 3,000 feet from the end of the primary surface. The slope of the approach-departure surface is 20:1 except where any combination of temperature and altitude requires a landing strip length greater than 5,200 feet for which a 40:1 slope is desirable.

c. Vertical Surface. A vertical surface extends upward from each side of the primary and approach-departure surfaces to a height of 150 feet above the established airport elevation. There are no transitional surfaces associated with the primary or approach-departure surfaces.

9. CLEAR ZONES.

a. Clear zones are land areas beginning at the ends of the primary surface and lying directly beneath the approach-departure surfaces, as shown in Appendix 1, Figure 5. The standard configurations of these areas conform to the inner portions of the approach-departure surface. The standard length is determined by the horizontal distance required for the approach-departure surface slope to reach a height of 50 feet above the terrain or 50 feet above the elevation of the end of the landing strip, whichever distance is shorter.

b. There should be adequate property interests in the clear zone areas to provide for the unobstructed passage of aircraft landing or taking off. All existing obstructions should be cleared, and future obstructions should be prevented. It is desirable to completely clear these areas, but grading is not necessary.

10. CLEARANCE OVER HIGHWAYS AND RAILROADS. The basic requirement is that no portion of the highway or railroad under the approach-departure surface shall have less than the minimum vertical clearance as described in current FAA publications. This information may be obtained from FAA field offices, the locations of which are noted in Appendix 3.

11. LANDING STRIP LENGTH. The landing strip is a graded area used or intended for use in takeoff and landing of aircraft. Where a hard surface runway exists, the strip extends 100 feet beyond either end of the runway. The minimum recommended landing strip length is 2,200 feet. Lengths to be used should accommodate the critical aircraft that will normally operate from the airport. Appendix 2, pages 1 through 28, depicts the actual performance for the majority of those
* aircraft weighing 12,500 pounds or less. To determine the length required for an unpaved landing strip, at least 200 feet should be added to the figure determined from the aircraft performance curves to obtain the minimum landing strip length. *

12. LANDING STRIP AND RUNWAY WIDTHS.

a. The recommended minimum runway width is 50 feet. This width is considered adequate for small aircraft that may land on either side of the runway centerline due to normal deviations in judgment or adverse crosswinds during a landing or takeoff operation.

b. The recommended minimum landing strip width is 100 feet. Where a hard surface exists, the landing strip area, 25 feet wide, on each side of the runway is considered capable of supporting aircraft without damage.

13. <u>TAXIWAYS</u>. The requirement for a taxiway is dictated by the activity at the airport. Turnaround taxiways, as shown in Appendix 1, Figure 1, are the minimum recommendation. As activity increases, it may be necessary to add parallel taxiways as well as stub taxiways providing access to aircraft parking and building areas. The minimum recommended taxiway width is 20 feet.

14. <u>APRONS</u>. Aprons may be designed for holding at the ends of runways, transient parking, access to hangars, servicing aircraft, or any combination of these operations. The types and sizes of aprons required will vary for each airport depending on the amount of activity and size of aircraft to be accommodated. Parking aprons centrally located with respect to the landing strip ends are usually necessary for loading and unloading aircraft.

15. <u>CLEARANCES</u>. To assure the safe movement of aircraft on the runway or landing strip, it is necessary to have lateral clearances to the various other facilities on the airport. These include clearances to taxiways, aircraft parking areas, building lines, and property lines. The minimum recommended clearances are 100 feet between the runway centerline and taxiway centerline, 140 feet between the runway centerline and edge of aircraft tiedown area, and 200 feet between the runway centerline and property or building lines. However, these clearances are based on the minimum widths established for runways and taxiways and any increases to those widths will require corresponding increases to the clearance dimensions.

16. <u>STORAGE AND TIEDOWN AREAS</u>. Most airports will have a need for some type of aircraft storage or tiedown area to accommodate based and transient aircraft. These requirements may be met either by an unsheltered area where the aircraft are exposed to the weather or by some type of hangar structure. Sufficient clearance must be provided within the tiedown areas for maneuvering the aircraft either by hand or under their own power. Appendix 2, pages 13 through 20, gives dimensions for the majority of those aircraft weighing 12,500 pounds or less.

17. <u>BUILDING AREA</u>. This is the focal point for airport operations and, when possible, should be located adjacent to the midpoint of the landing strip. Any increases to the building area should be made in the direction in which further extensions to the landing strip are planned. Where a second landing strip is planned, the building area should be located between the landing strips so as to allow minimum taxiing distances to the ends of both landing strips. This area usually includes aircraft storage and maintenance structures, apron areas, auto parking areas, and access and service roads.

18. ADMINISTRATION BUILDING. The current or anticipated number of aircraft operations at the airport may indicate the need for a separate building devoted mainly to pilot, passenger, and managerial activities. The size of the building should be based on the current aviation activity at the airport (see References 3e).

19. HANGARS.

a. The T-hangar structure is generally the most economical and efficient type for the storage of light aircraft. The corners of this structure provide convenient space for a small office, first-aid facilities, fire protection equipment, and miscellaneous storage. The location of this space and the minimum clearances recommended in positioning the aircraft within the building are indicated in Appendix 1, Figure 8. Rows or clusters of T-hangars may also be arranged.

b. A large, unpartitioned rectangular hangar structure is often utilized for group storage of aircraft. This type of structure is primarily used where acreage is limited or where it is desired to store aircraft of mixed sizes. A disadvantage in using a building of this type is that considerable care must be employed to avoid damage when moving aircraft within a crowded building.

c. In determining the size of storage hangars needed for these airports, consideration should be given to the maximum wingspans, lengths, and heights of aircraft that are expected to use these facilities. Proposals to provide such storage should be examined to determine whether the apparent benefits will outweigh their initial as well as annual maintenance costs.

20. FENCING. Fences may be required for safety to prevent animals and unauthorized vehicles or personnel from interfering with aircraft operations. The nature of land use surrounding the airport will indicate the type and extent of fencing necessary.

21. LAND REQUIREMENTS. The amount of land required for these airports will vary considerably. It will be dependent upon such factors as the length of landing strip, the lateral clearances, the areas required to accommodate buildings, hangars, aircraft and automobile parking facilities, and the future expansion of the airport. The minimum area that would be required for landing facilities, exclusive of the building area, is about 22 acres plus approximately 10.5 acres for the clear zones.

22. CONSTRUCTION OF LANDING STRIP OR RUNWAY. Briefly outlined below are the basic requirements for constructing the landing strip, runway, taxiway, and apron. If additional information and/or guidance is desired, the publications as noted in References 3f, g, h, i, j, k, l, and m are recommended.

a. Grading and Drainage. The purpose of grading is to provide areas on which aircraft can operate safely and to insure adequate drainage control. Aircraft operating areas must be free of abrupt grade changes and excessive grades. Appendix 1, Figure 4, shows suggested grade limitations for these areas. The grading should be planned to provide for runoff of surface water to the fullest extent possible in order to minimize ponding and saturation. When grading alone cannot provide satisfactory drainage, some system of ditches and/or pipelines must be utilized to provide for uninterrupted aircraft operation.

b. Pavement Construction. In order that facilities may be utilized on a year-round basis, most localities will require a paved runway, taxiway, and apron. The pavements may consist of stabilized local soil or aggregate with a bituminous surface treatment. The pavement thickness requirements will vary with the type of soil and climatic conditions. The type of surface that will serve the needs of the airport most economically from the standpoint of initial cost and maintenance required should be selected.

c. Marking.

(1) For daytime use, the landing strip should be clearly outlined by the use of landing strip markers, the details of which are shown in Appendix 1, Figure 7. It is desirable that these markers be mounted on frangible fittings. They should be placed at the four corners and along both edges of the landing strip. As an additional aid in the landing and takeoff of aircraft when a hard surface runway is constructed, basic
* runway marking (see References 3j) should be provided. A proportional reduction, up to 50 percent of the standard size and transverse spacing, may be made for runway designation markers used on runways that are less than 75 feet in width. *

(2) It is also recommended that, as a minimum, an airport identifier be installed to aid pilots in locating airports and to provide a centralized location for such indicators and signal devices as may be required on the airport. The basic element is a segmented circle that must be installed in a position affording maximum visibility to pilots in the air and on the ground. A wind cone should be located at the center of the segmented circle. Landing strip indicators are needed to show the direction of the landing strips. In addition to this

minimum installation, traffic pattern indicators are necessary where there is any variation from the normal left-hand traffic pattern. The airport identifier, including segmented circle, wind cone, landing strip indicators, and traffic pattern indicators are shown in Appendix 1, Figure 6.

(3) All landing strip markers and airport identifier segments should be painted to provide a good contrast with the surrounding area. The color scheme should be either black and white, black and yellow, or white and yellow.

d. Lighting. When use of the facility is contemplated during hours of darkness, a minium lighting system and hard surface runway should be provided. A lighted landing strip is not desirable since the surface is not as reliable and is subject to erosion and rutting which would not be easily discernible during night operations. This system should include low-intensity runway lights, an aeronautical beacon, and a lighted wind direction indicator. The runway lights should be placed within ten feet of the pavement edge, and the longitudinal spacing should not exceed 200 feet.

23. PLANS AND SPECIFICATIONS. An effort should be made to avoid excessive details on the plans that will increase costs with little or no benefit to the quality of construction (see References 3n). The specifications should be concise and simple with maximum emphasis on the use of local materials.

24. MAINTENANCE OF LANDING STRIP OR RUNWAY.

a. The maintenance required for an airport will vary with the climate, terrain, type of soil, frequency of operations, and the surfacing provided on the operational areas. In order to keep major repair work to a minimum, the airport should be checked at frequent intervals and routine maintenance work performed as required. A schedule of maintenance should be sufficiently flexible so as to permit optimum use of the operational areas. The landing strip areas may need regrading at frequent intervals whereas runways with hard surfaces will need periodic maintenance in the same manner as streets or roads. Airport maintenance work should be under the direct supervision of the airport manager. Arrangements for maintenance of publicly owned airports may be made with existing park maintenance or highway organizations which usually have the equipment and trained personnel to handle this type of work.

b. In many cases, the necessary maintenance work will justify the purchase of equipment. A light truck, suitable mowing equipment, a roller, and hand tools will normally be adequate to handle the major portion of the work of maintaining these airports.

25. ADVISORY SERVICES. The FAA's Airports Service maintains a staff of engineers and other specialists who are available for consultation on airport design and construction problems including site selection, layout, grading, drainage, surfacing, lighting, building design, and maintenance. This advisory service may be obtained by contacting the nearest FAA field office. Advisory assistance may also be obtained from State Aeronautics Departments.

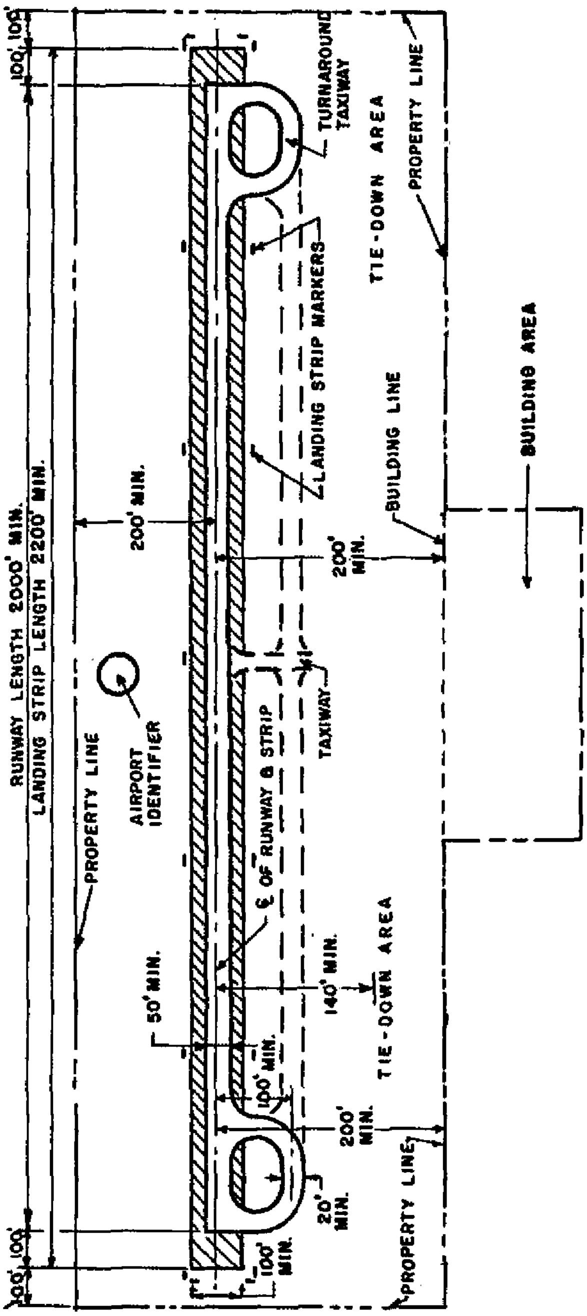
26. SUMMATION OF DESIGN CRITERIA. The following criteria are minimum acceptable dimensions unless otherwise indicated. Dimensions above these minima are encouraged.

Design Features	Criterion
Length of runway	2,000 feet
Length of landing strip and primary surface	2,200
* Width of runway	50 (75 maximum)
Width of landing strip	100 (250 maximum)
Width of primary surface	200 (300 maximum)
Width of taxiway	20 (40 maximum)
Distance between runway end and beginning of approach-departure surface	100 *
Distance between runway centerline and taxiway centerline	100
Distance between runway centerline and property or building line	200
Distance between runway centerline and edge of tiedown area	140
Distance between landing strip end and property line	100
Approach-departure surface length	3,000
Approach-departure surface width at end of landing strip	200

Design Features	Criterion
Approach-departure surface width at 3,000 feet from end of landing strip	500 feet
Clear zone width at end of landing strip	200
Clear zone width at 1,000 feet from end of landing strip	300
Longitudinal runway and landing strip grade	2% maximum
Longitudinal runway and landing strip grade change	2% maximum
Length of vertical curves for runways and landing strips for each one percent grade change 1/	300
* Distance between points of intersection for vertical curves for runways and landing strips	250 x algebraic sum of changes of adjacent grades in percent *
Transverse runway grade	1½% maximum
Transverse landing strip grade	3% maximum
Effective gradient	2% maximum
Minimum sight 2/ distance	$\frac{\text{landing strip length}}{2}$ or 2,000 feet (whichever is less)
Longitudinal taxiway grade	2% maximum
Transverse taxiway grade	1½% maximum

1/ Vertical curves not required for less than 0.4 percent change in grade.

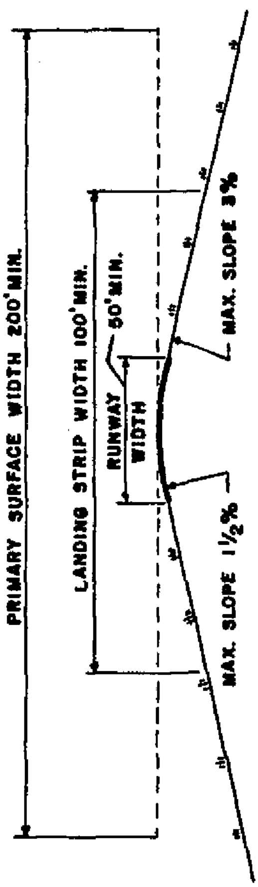
2/ Unobstructed line of sight from any point five feet above the landing strip to any other point also five feet above the landing strip.



TYPICAL AIRPORT LAYOUT

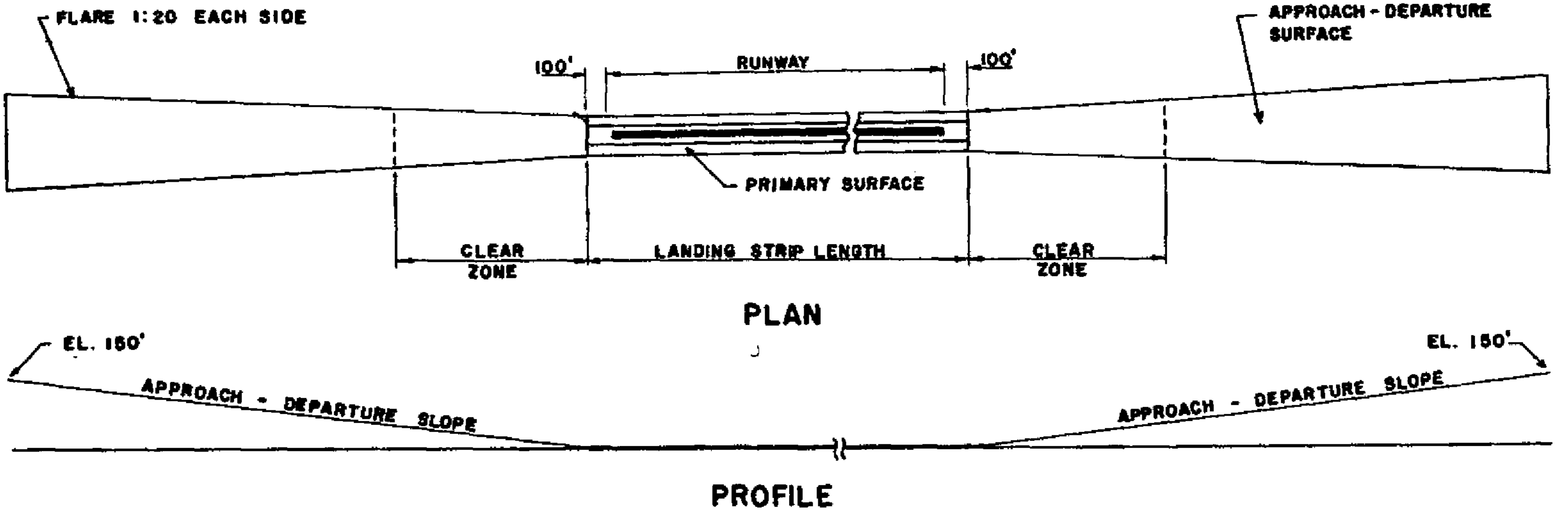
NOT TO SCALE

FIGURE 1



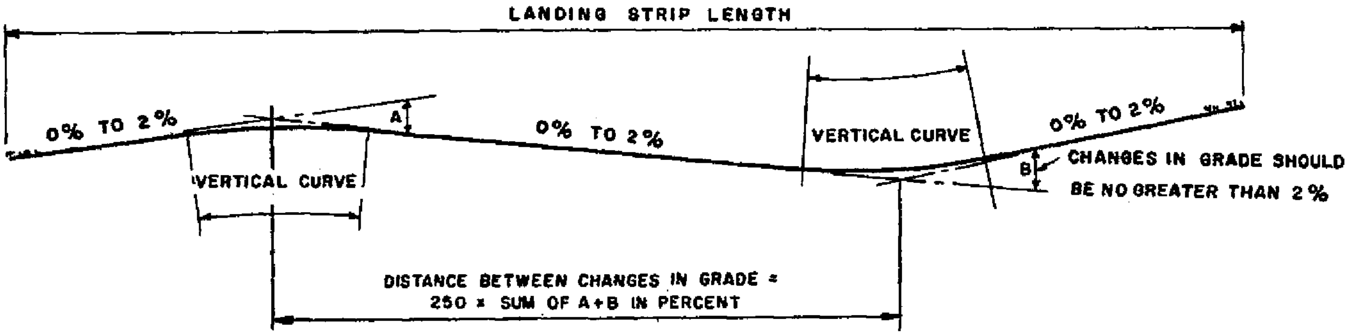
TYPICAL CROSS SECTION

FIGURE 2



AIRPORT SURFACES

FIGURE 3



GRADE LIMITATIONS IN LENGTH OF LANDING STRIP

FIGURE 4

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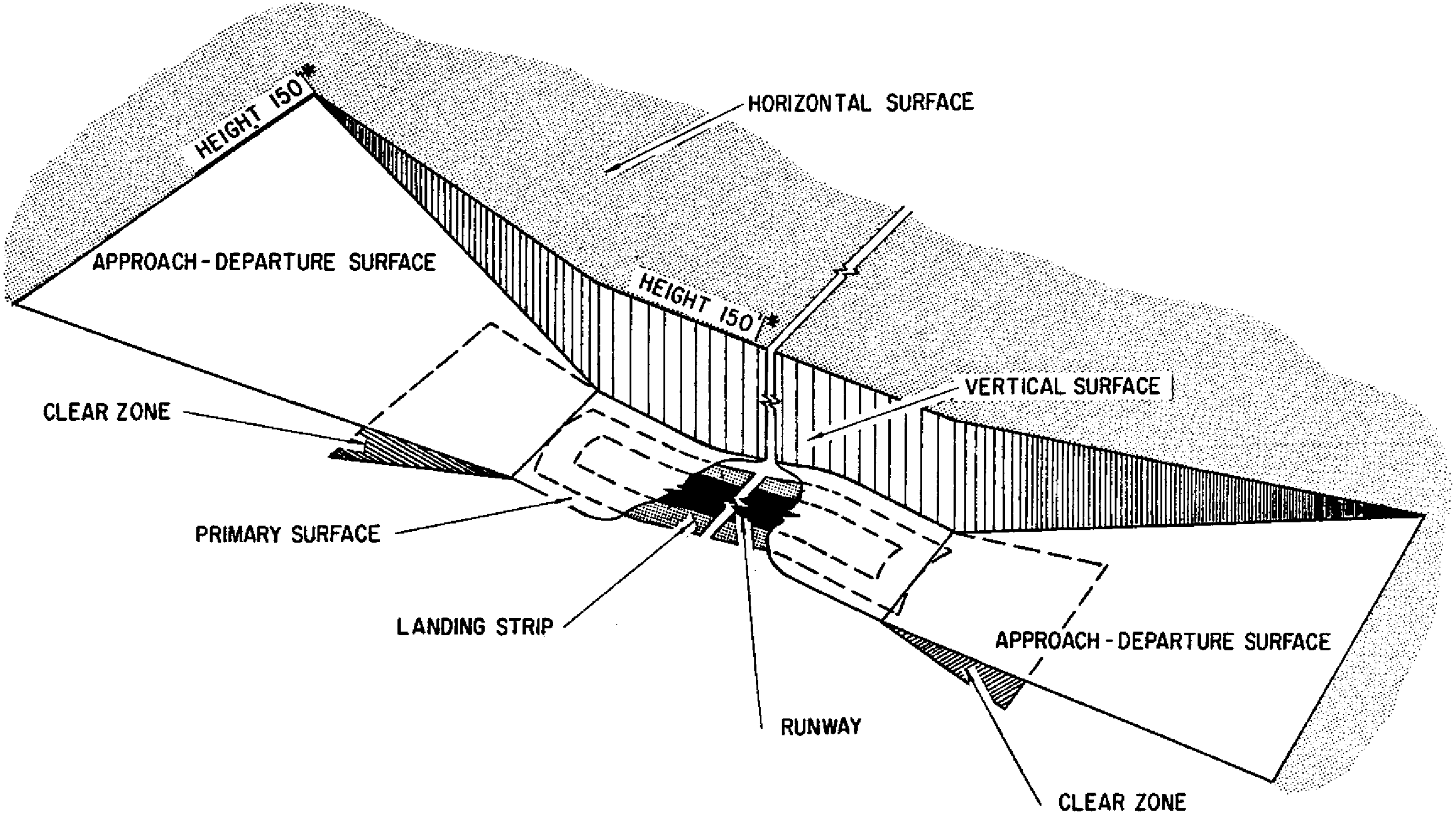
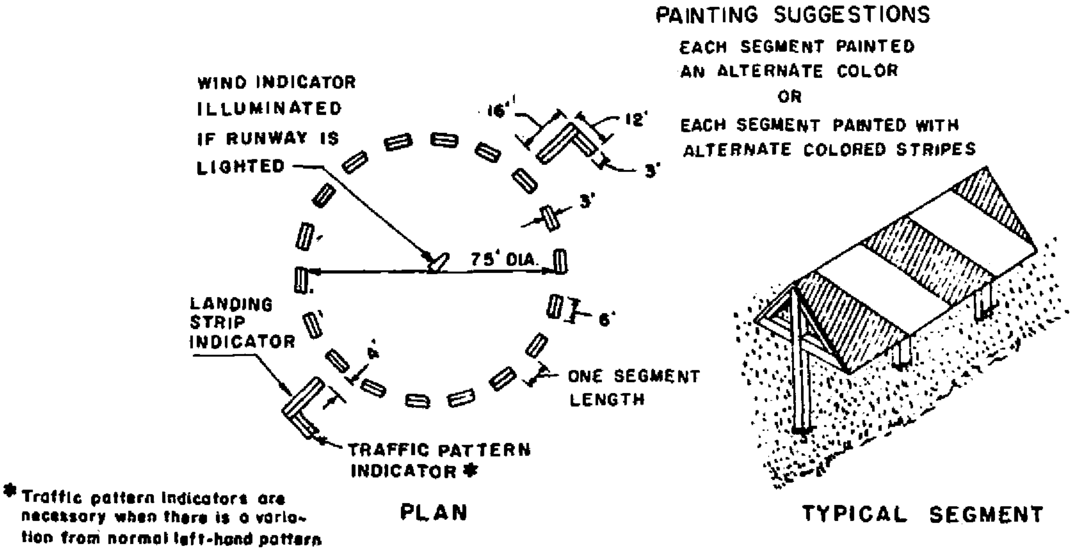


* ABOVE ESTABLISHED AIRPORT ELEVATION

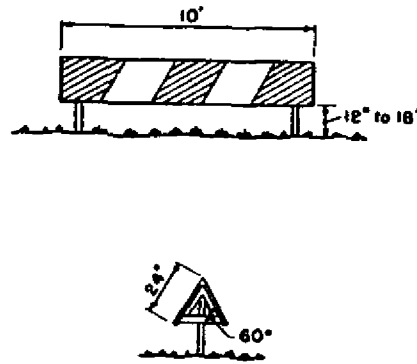
VFR AIRPORT SURFACES

FIGURE 5



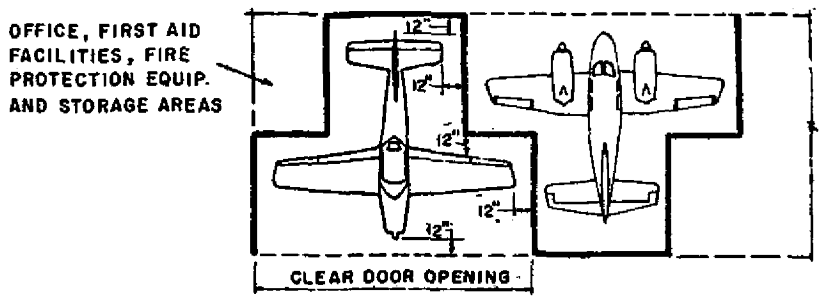
DETAIL FOR AIRPORT IDENTIFIER

FIGURE 6



DETAIL FOR LANDING STRIP MARKER

FIGURE 7



DRAWINGS NOT TO SCALE

PLAN OF T-HANGAR INDICATING MINIMUM CLEARANCES

FIGURE 8

APPENDIX 2. AIRCRAFT

SECTION 1. PERFORMANCE CURVES

1. PERFORMANCE CURVES. The following curves were developed from actual
* values obtained from aircraft manufacturers' data based on flight tests utilizing paved runway surfaces. Therefore, the curves establish the length required for a paved runway and are furnished for use in the design of airports and are not to be used for operational purposes.

   a. To determine the runway length required at an airport for any specific aircraft, the following information is necessary:

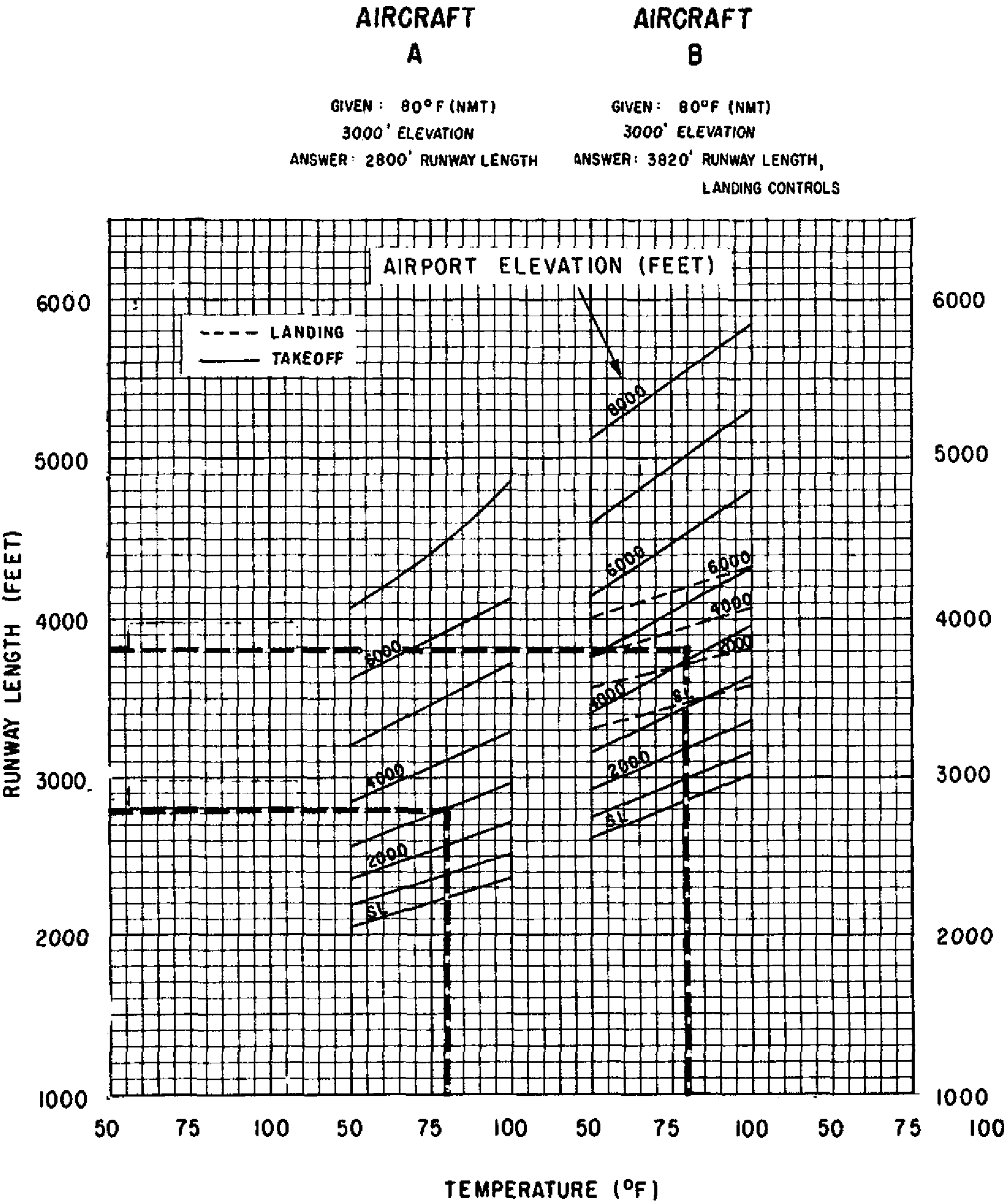
      (1) Elevation of the airport above mean sea level (MSL).

      (2) Normal maximum Fahrenheit temperature for the hottest month (°F). *

   b. Where the landing and takeoff curves are given, both must be considered and the greater of the two values should be used for design. The lengths obtained are for aircraft at maximum gross weight for a zero wind and zero landing strip gradient.

   c. The takeoff length determined from these curves must be increased at a rate of 20 percent for each 1 percent of effective gradient.
* The effective gradient is determined by dividing the maximum difference in centerline elevation of the runway (or the landing strip if no hard surface is planned) by whichever length is applicable. *

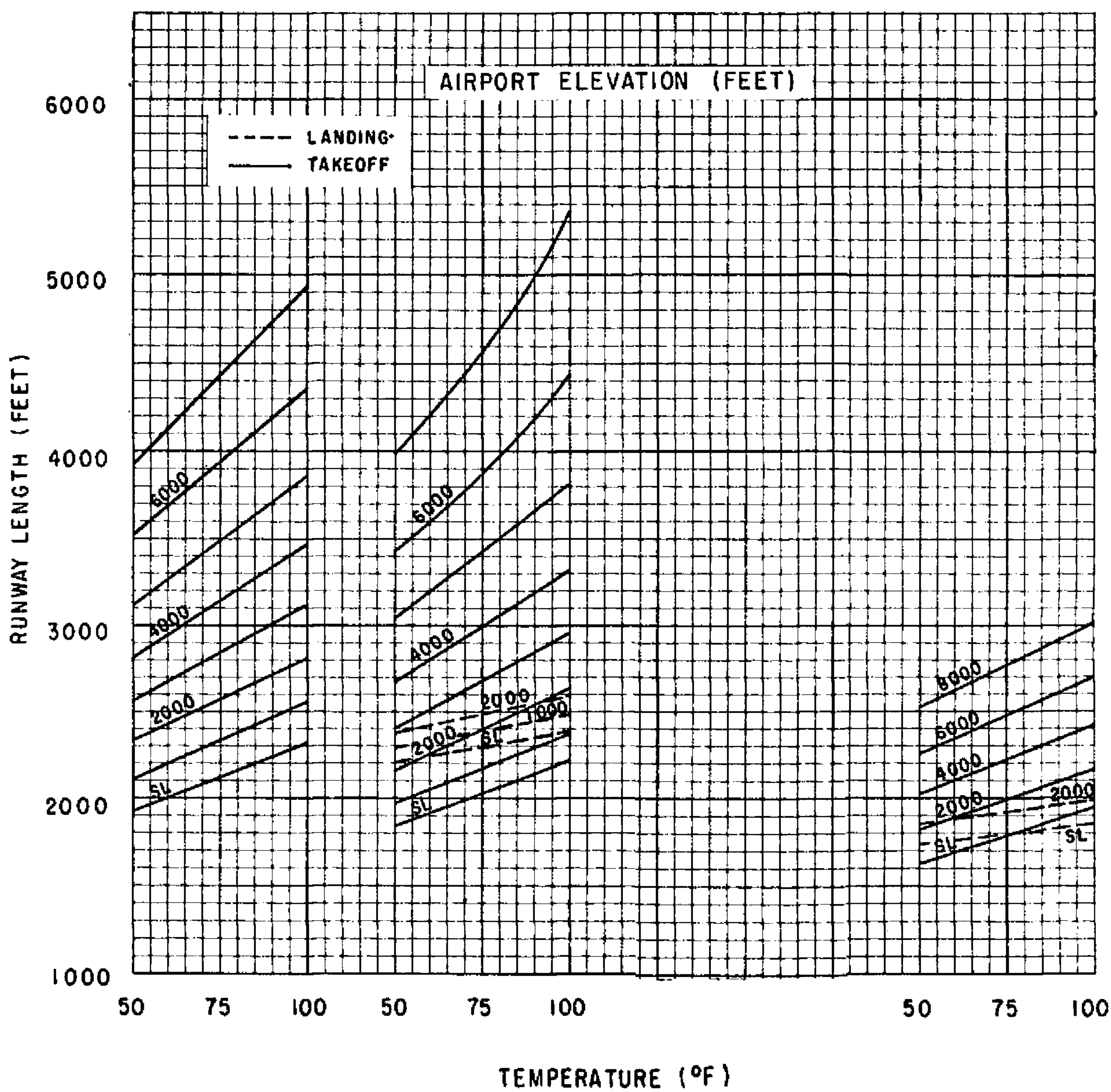
EXAMPLE CURVES

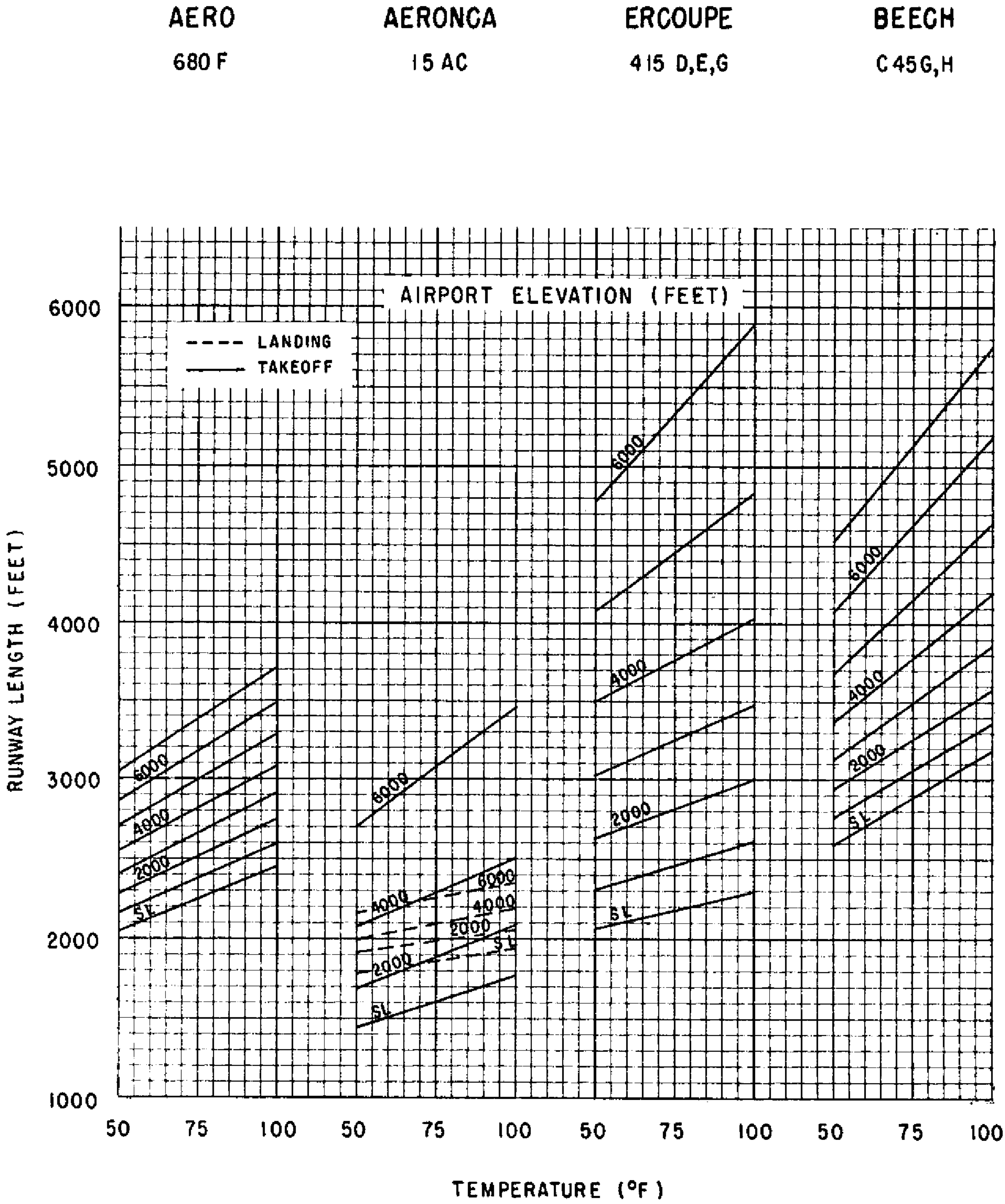


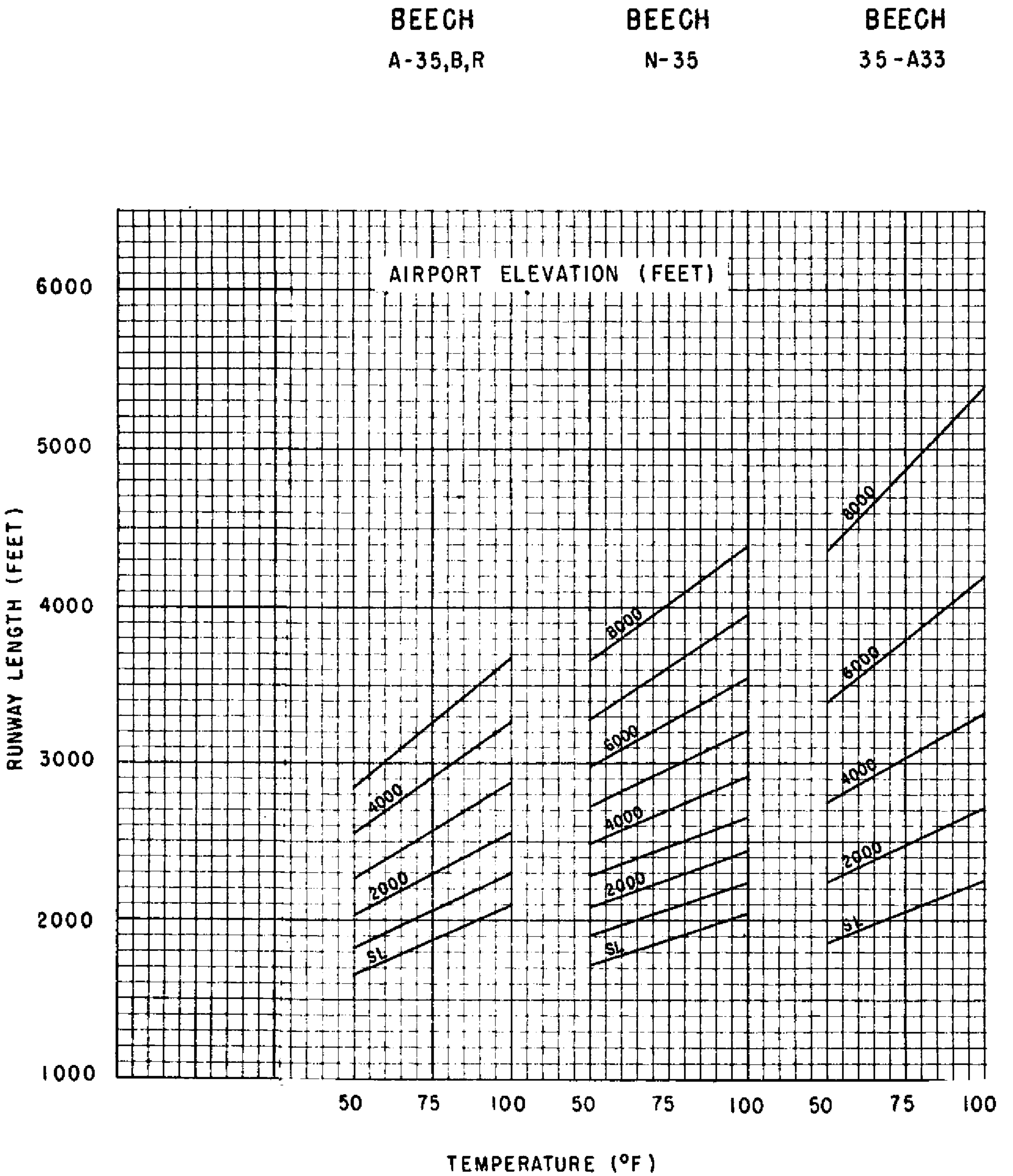
AERO 500 A

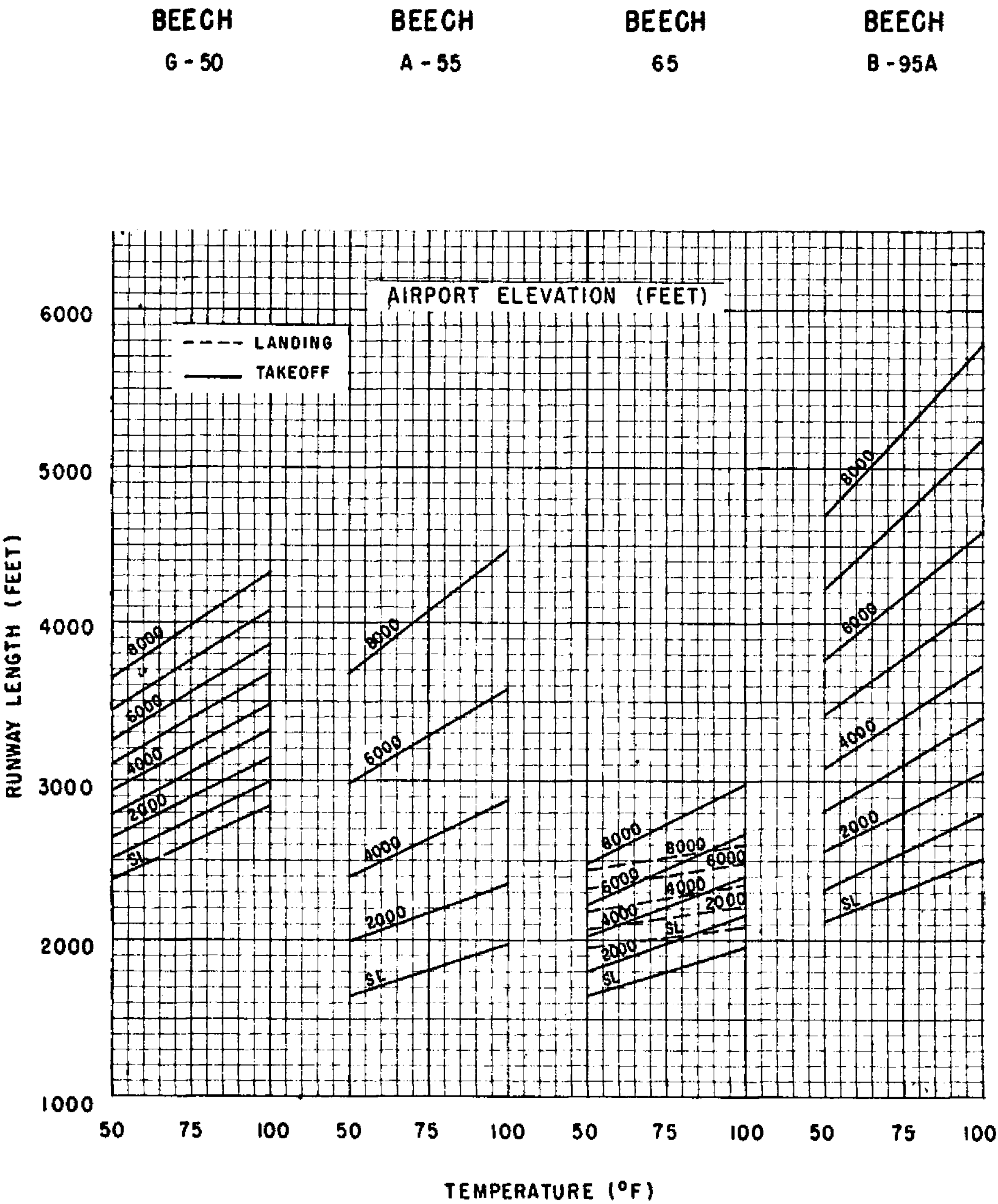
AERO 500 B

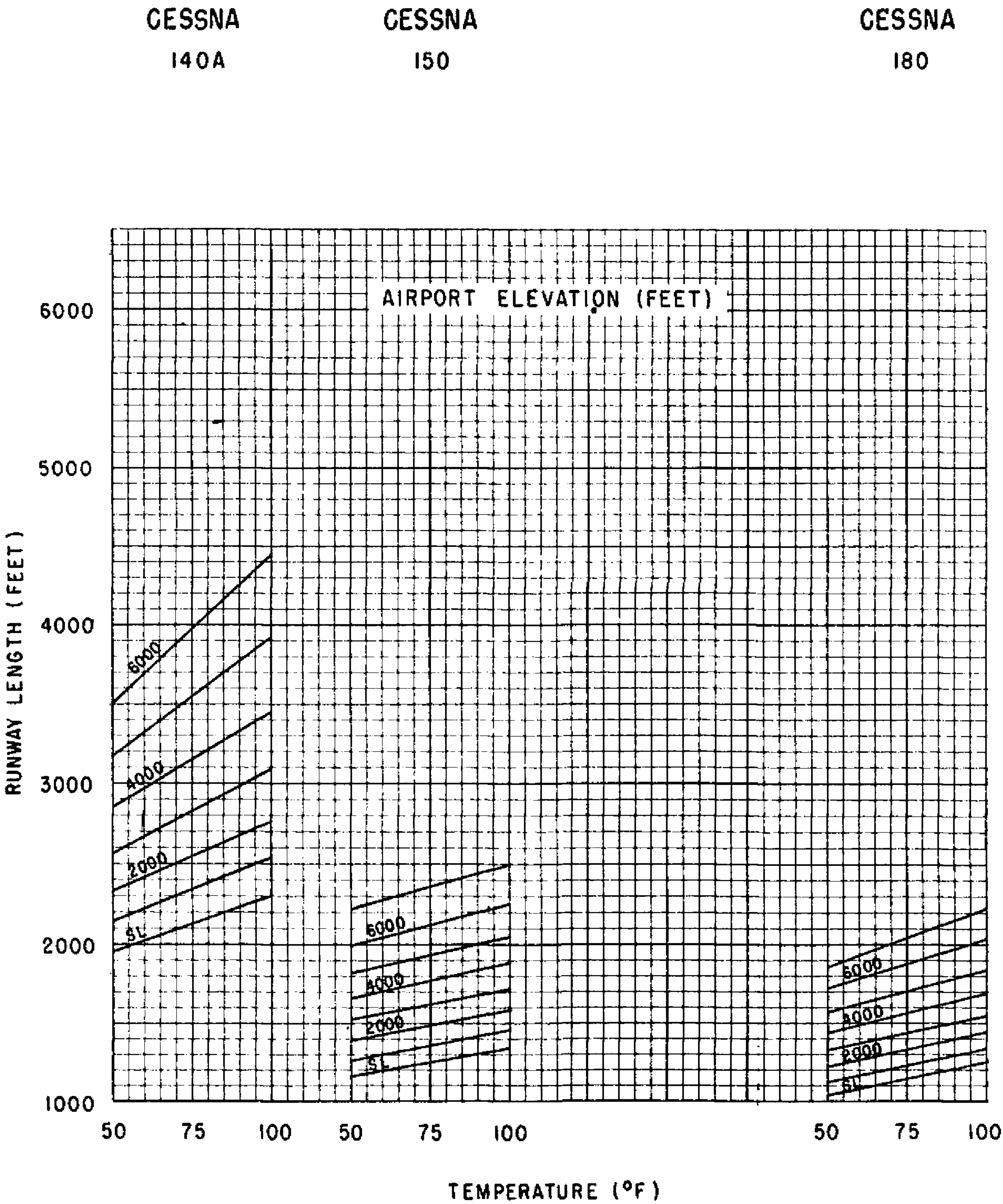
AERO 680 E

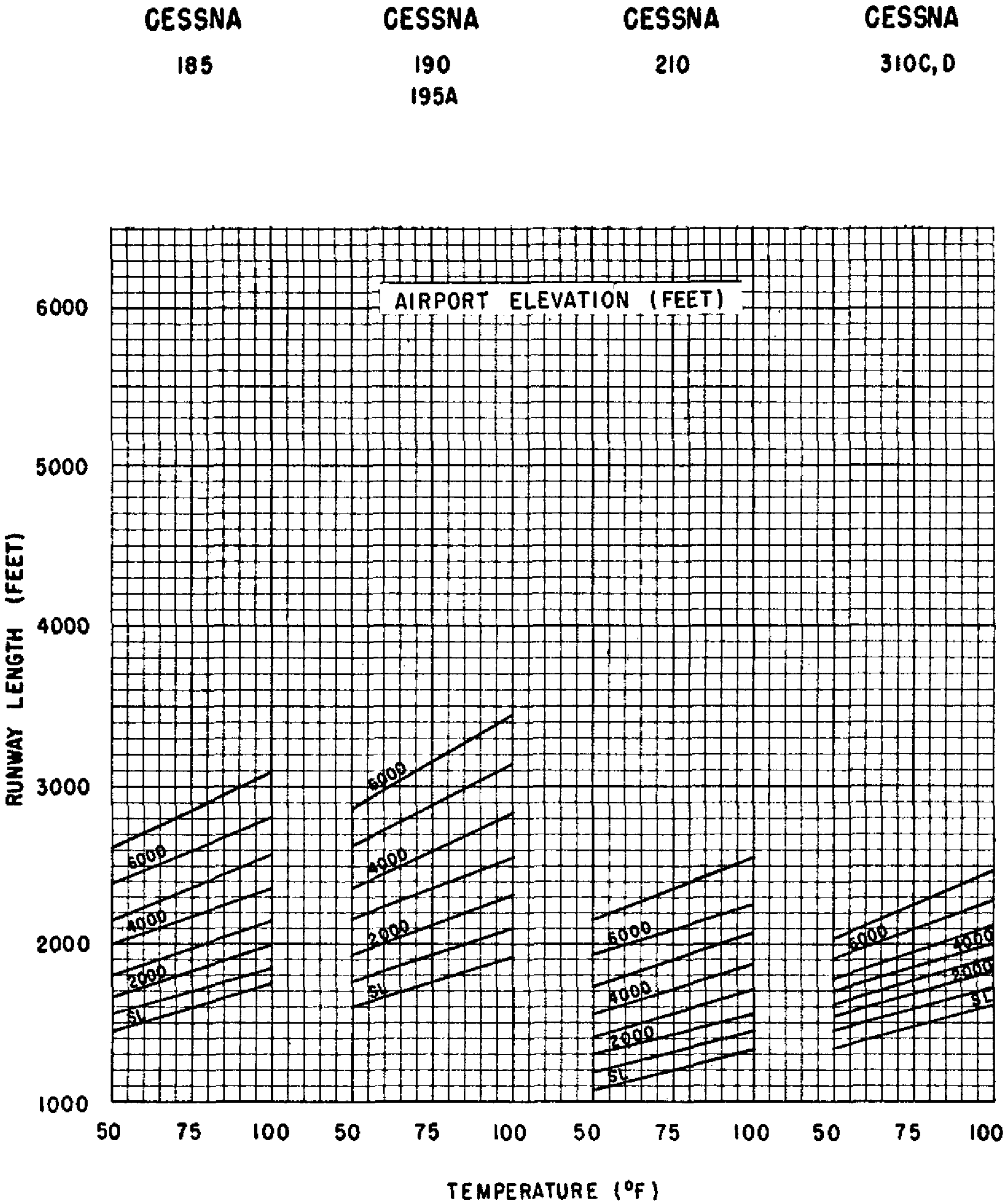


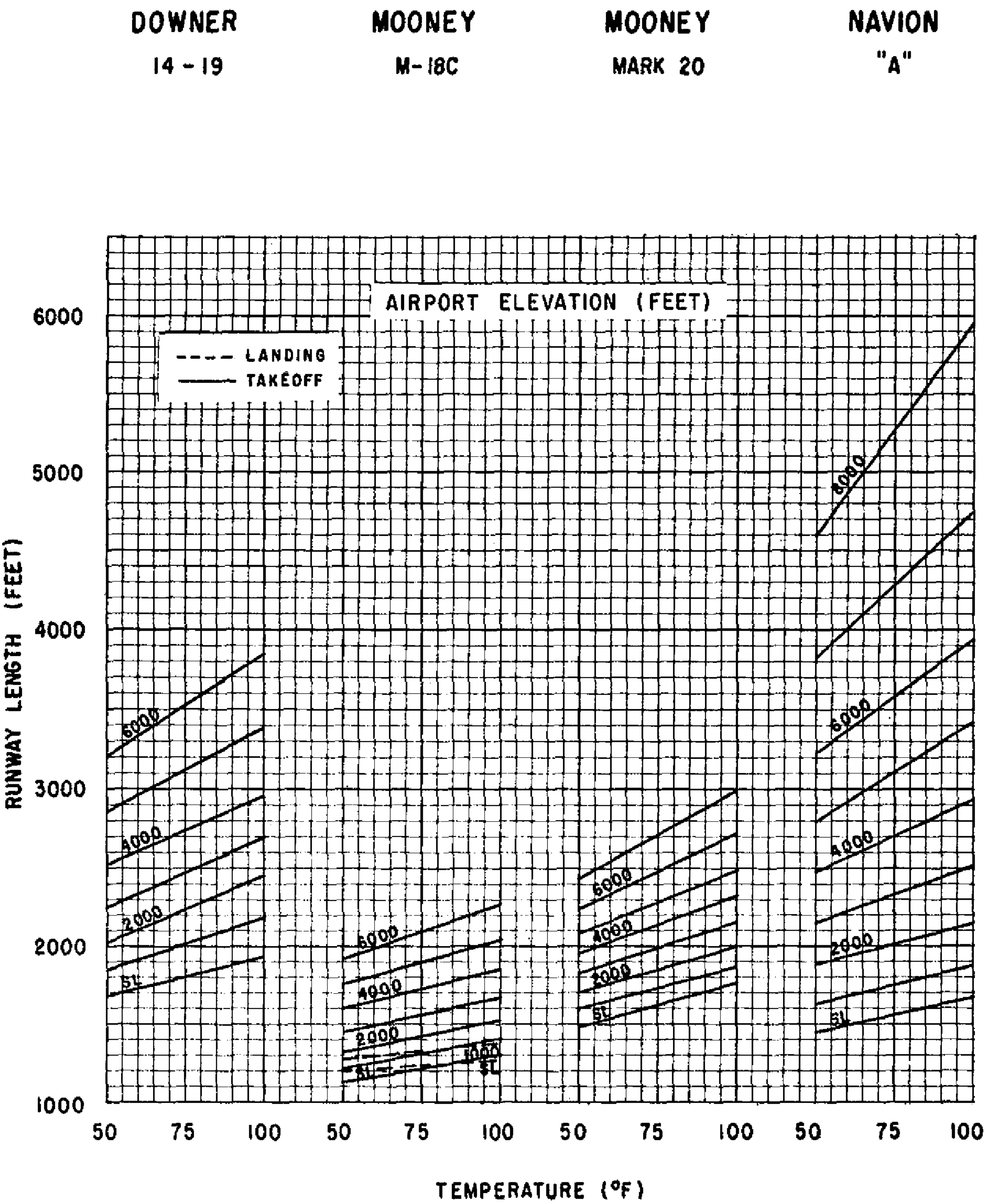

AERO
680 F
AERONCA
15 AC
ERCOUPE
415 D,E,G
BEECH
C 45 G,H
AIRPORT ELEVATION (FEET)
LANDING
TAKEOFF
6000
4000
2000
SL
RUNWAY LENGTH (FEET)
1000
2000
3000
4000
5000
6000
50
75
100
TEMPERATURE (°F)


BEECH
A-35,B,R
BEECH
N-35
BEECH
35-A33
AIRPORT ELEVATION (FEET)
RUNWAY LENGTH (FEET)
6000
5000
4000
3000
2000
1000
4000
2000
SL
8000
6000
4000
2000
SL
8000
6000
4000
2000
SL
50
75
100
50
75
100
50
75
100
TEMPERATURE (°F)

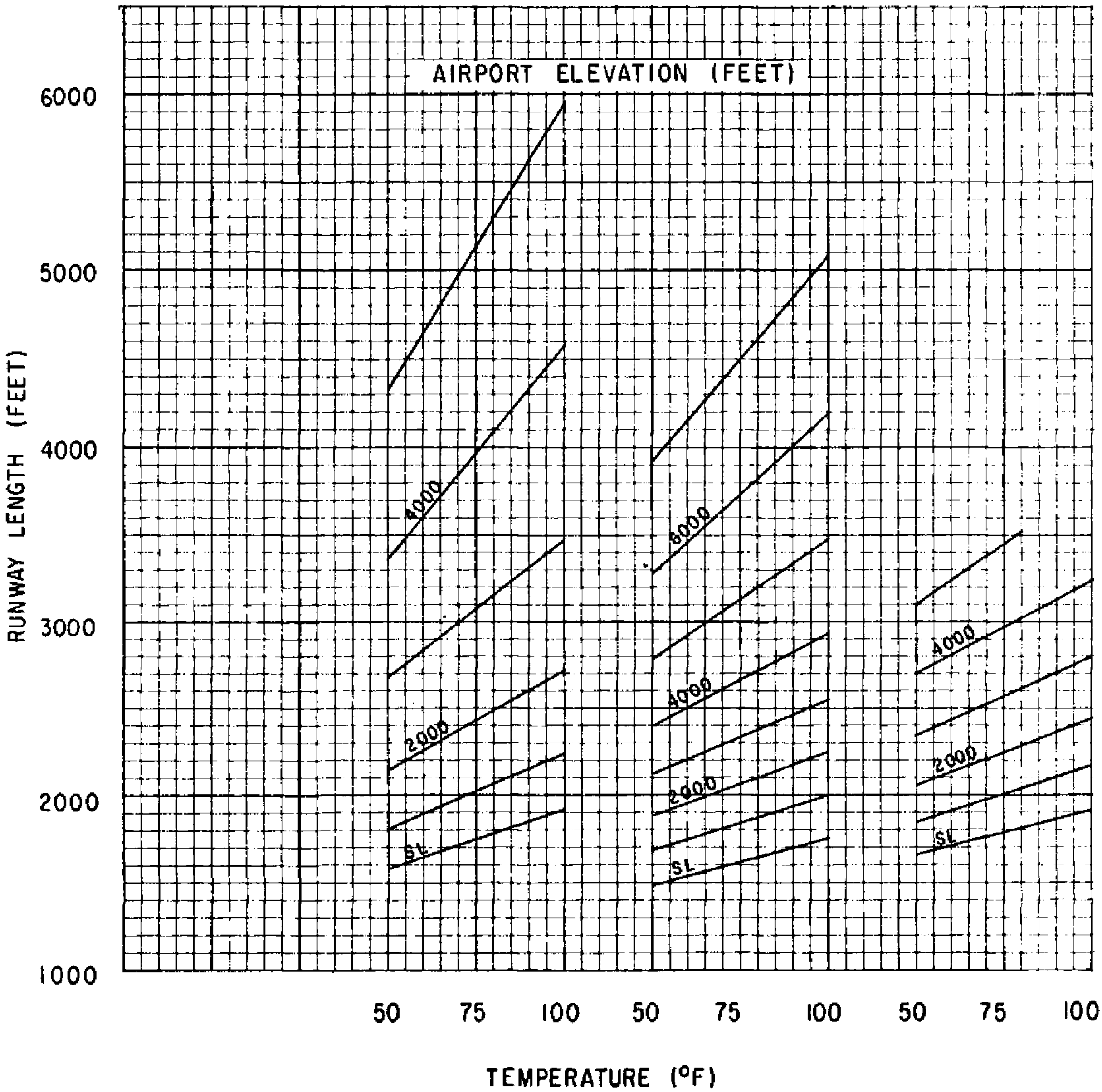

BEECH
G-50
BEECH
A-55
BEECH
65
BEECH
B-95A
AIRPORT ELEVATION (FEET)
LANDING
TAKEOFF
RUNWAY LENGTH (FEET)
6000
5000
4000
3000
2000
1000
8000
6000
4000
2000
SL
50
75
100
TEMPERATURE (°F)

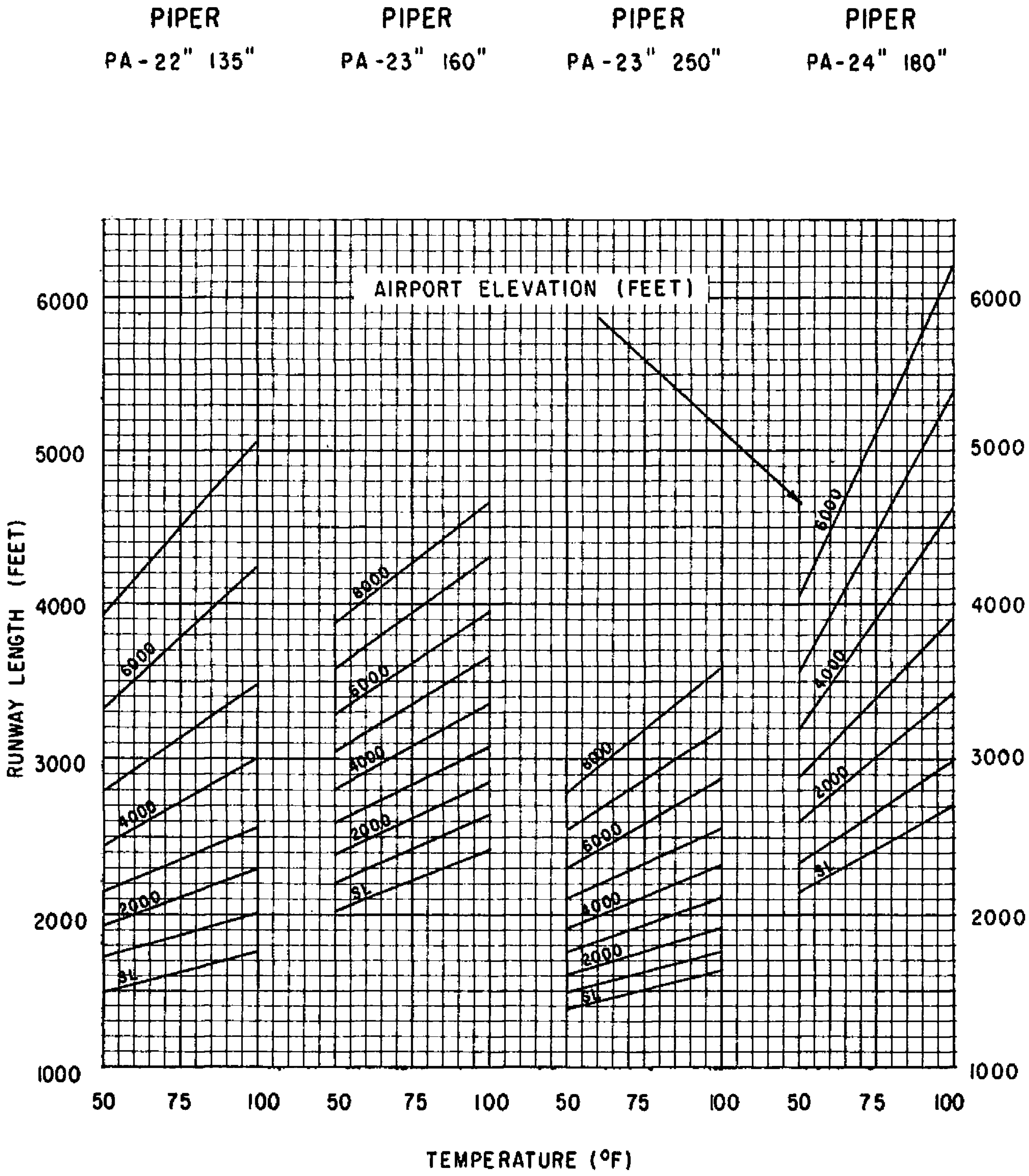

CESSNA
140A
CESSNA
150
CESSNA
180
AIRPORT ELEVATION (FEET)
RUNWAY LENGTH (FEET)
6000
5000
4000
3000
2000
1000
6000
4000
2000
SL
6000
4000
2000
SL
6000
4000
2000
SL
50
75
100
50
75
100
50
75
100
TEMPERATURE (°F)

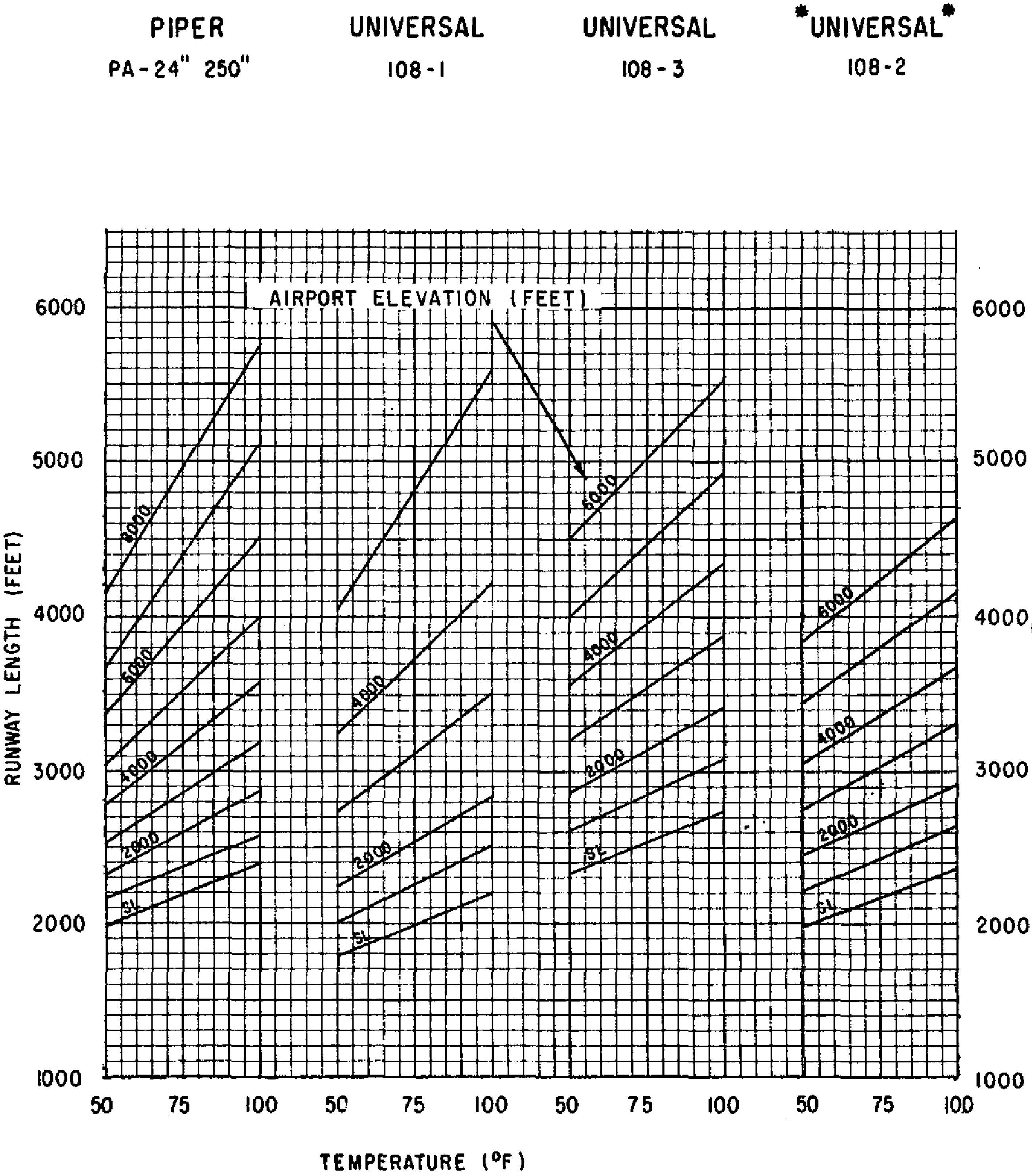

CESSNA
185
CESSNA
190
195A
CESSNA
210
CESSNA
310C, D
AIRPORT ELEVATION (FEET)
RUNWAY LENGTH (FEET)
6000
5000
4000
3000
2000
1000
6000
4000
2000
SL
50
75
100
TEMPERATURE (°F)

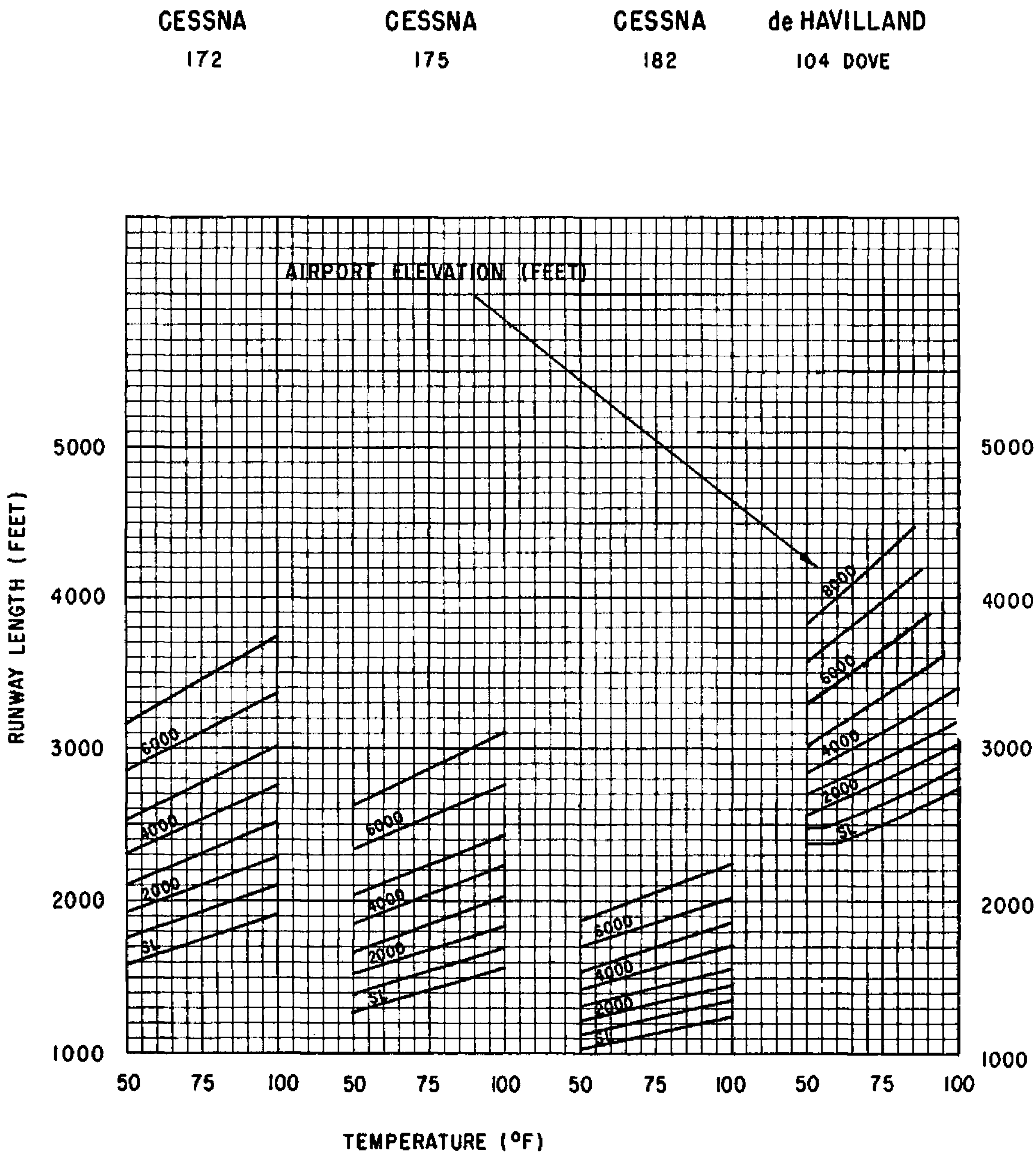

DOWNER
14 - 19
MOONEY
M-18C
MOONEY
MARK 20
NAVION
"A"
AIRPORT ELEVATION (FEET)
LANDING
TAKEOFF
RUNWAY LENGTH (FEET)
6000
5000
4000
3000
2000
1000
SL
50
75
100
TEMPERATURE (°F)

PIPER PA-18 | PIPER PA-20 | PIPER PA-22-108




PIPER
PA-22" 135"
PIPER
PA-23" 160"
PIPER
PA-23" 250"
PIPER
PA-24" 180"
AIRPORT ELEVATION (FEET)
RUNWAY LENGTH (FEET)
6000
5000
4000
3000
2000
1000
6000
4000
2000
SL
50
75
100
TEMPERATURE (°F)


PIPER
PA-24" 250"
UNIVERSAL
108-1
UNIVERSAL
108-3
UNIVERSAL
108-2
AIRPORT ELEVATION (FEET)
RUNWAY LENGTH (FEET)
TEMPERATURE (°F)
1000
2000
3000
4000
5000
6000
50
75
100
8000
6000
4000
2000
SL


CESSNA
172
CESSNA
175
CESSNA
182
de HAVILLAND
104 DOVE
AIRPORT ELEVATION (FEET)
RUNWAY LENGTH (FEET)
TEMPERATURE (°F)
5000
4000
3000
2000
1000
50
75
100
6000
4000
2000
SL
8000

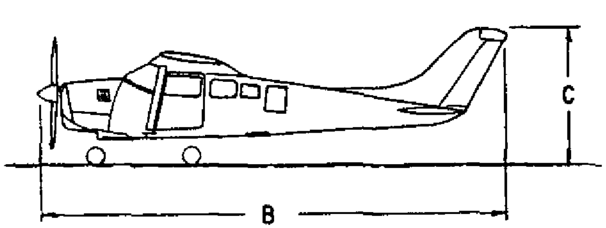
SECTION 2. DATA

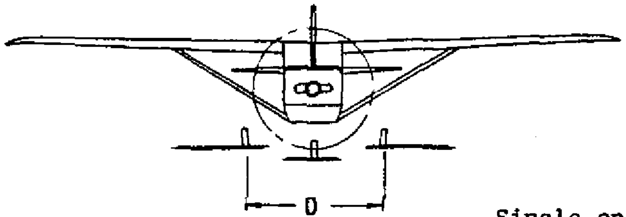
1. DATA. The following data presents aircraft dimensions and general information. To insure proper interpretation of certain column headings, the following explanations are given:

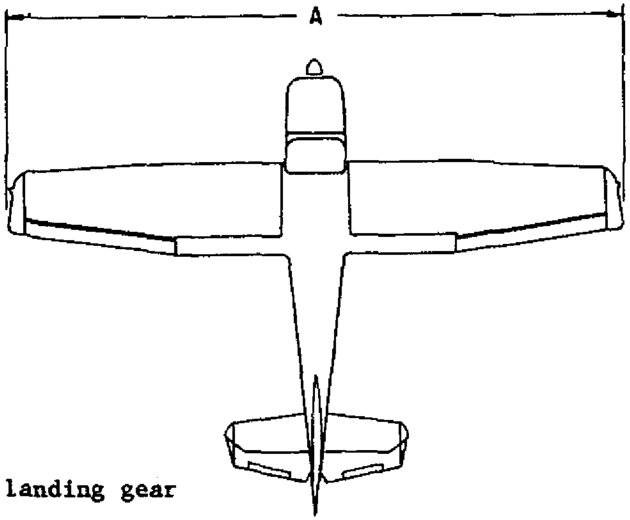
   a. The horsepower shown is obtained from the aircraft specifications, and in all cases the maximum rated horsepower is shown.

   b. The maximum gross weight is the certificated weight of the specific aircraft model for which the curves have been developed.

   c. The minimum turning radius, as presented, is a factor of the wing-span and the tread dimension. The aircraft is assumed to turn on one locked wheel with no forward roll.







Single engine, tri-cycle landing gear

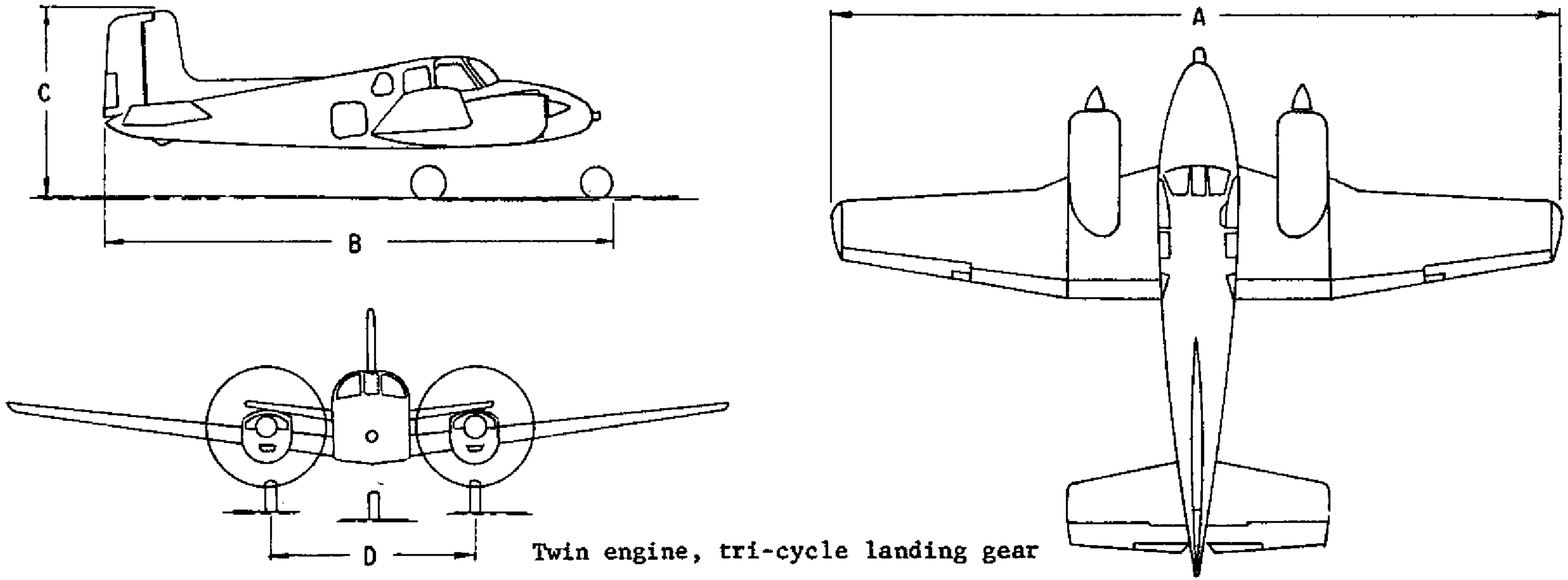
AIRCRAFT DATA										
TYPE CERTIFICATE HOLDER	MODEL	POPULAR NAME	NO. SEATS	HORSE-POWER	MAX. GROSS WEIGHT	A WING SPAN	B LENGTH	C HEIGHT	D TREAD	MIN. TURNING RADIUS
Air Products	415 D,E,G	Evcoupe	2	75	1400	30'-0"	20'-9"	5'-11"	7'-5"	18'-9"
Beech	A 35,B,R	Bonanza	4	185	2650	32'-10"	25'-2"	6'-6"	9'-7"	21'-3"
Beech	N-35	Bonanza	5	260	3125	33'-5"	25'-2"	7'-7"	9'-7"	21'-6"
Beech	35-A33	Debonair	4	225	3000	32'-10"	25'-6"	8'-3"	9'-7"	21'-3"
Cessna	150	150	2	100	1500	33'-4"	21'-11"	6'-11"	6'-5"	19'-10"
Cessna	210	210	4	260	2900	36'-7"	27'-9"	8'-8"	8'-2"	22'-5"
Mooney	M-18C	Mite	1	65	850	26'-10"	17'-7"	6'-2"	5'-9"	16'-4"
Mooney	M-20	Mark 20	4	150	2450	35'-0"	23'-3"	8'-3"	9'-2"	22'-1"
Navion	A	Navion	4	205	2750	33'-5"	27'-8"	8'-8"	8'-2"	20'-10"
Piper	PA-22-108	Colt	2	108	1650	30'-0"	20'-0"	6'-3"	9'-11"	19'-11"

Single engine, tri-cycle landing gear aircraft

AIRCRAFT DATA										
TYPE CERTIFICATE HOLDER	MODEL	POPULAR NAME	NO. SEATS	HORSE-POWER	MAX. GROSS WEIGHT	A WING SPAN	B LENGTH	C HEIGHT	D TREAD	MIN. TURNING RADIUS
Piper	PA-22-135	Tri-Pacer	4	135	1850	29'-3"	20'-6"	8'-4"	9'-11"	19'-7"
Piper	PA-24-180	Comanche	4	180	2550	36'-0"	24'-8"	7'-3"	9'-9"	22'-10"
Piper	PA-24-250	Comanche	4	250	2900	36'-0"	24'-11"	7'-3"	9'-9"	22'-10"
*Cessna	172	172	4	145	2200	36'-0"	26'-6"	8'-11"	7'-2"	19'-8"
Cessna	175	175	4	175	2350	36'-0"	26'-6"	8'-11"	7'-2"	21'-9"
Cessna	182	182	4	230	2550	36'-0"	27'-4"	7'-4½"	7'-8"	21'-4"*

Single engine, tail wheel landing gear aircraft

AIRCRAFT DATA										
TYPE CERTIFICATE HOLDER	MODEL	POPULAR NAME	NO. SEATS	HORSE-POWER	MAX. GROSS WEIGHT	A WING SPAN	B LENGTH	C HEIGHT	D TREAD	MIN. TURNING RADIUS
Universal	108-1	Voyager	4	150	2230	33'-11"	24'-6"	6'-10"	7'-1"	20'-6"
Universal	108-3	Voyager	4	165	2230	33'-11"	25'-2"	7'-6"	7'-1"	20'-6"
*Universal	108-2	Voyager	4	165	2230	33'-11"	25'-2"	7'-6"	7'-1"	20'-6" *

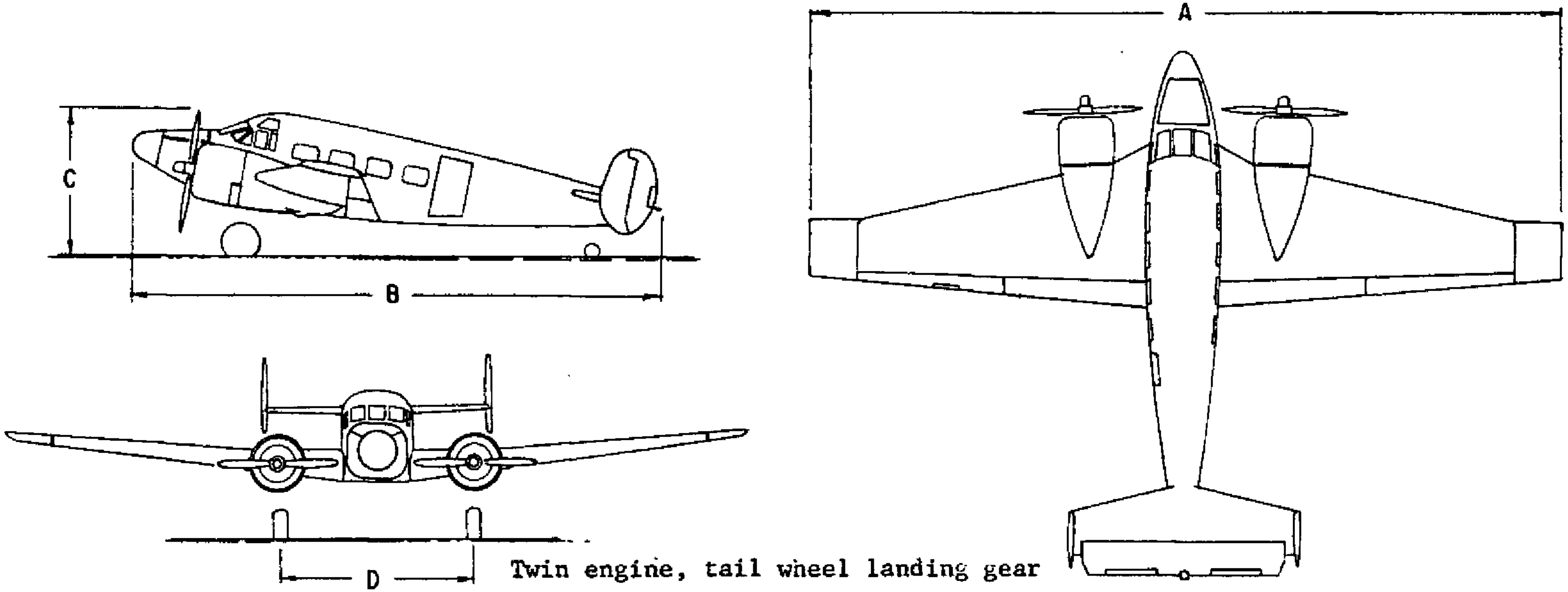


Twin engine, tri-cycle landing gear

AIRCRAFT DATA										
TYPE CERTIFICATE HOLDER	MODEL	POPULAR NAME	NO. SEATS	HORSE-POWER	MAX. GROSS WEIGHT	A WING SPAN	B LENGTH	C HEIGHT	D TREAD	MIN. TURNING RADIUS
Aero	500 A	Commander	7	260	6250	49'-6"	35'-1"	14'-6"	12'-11"	31'-2"
Aero	500 B	Commander	7	290	6750	49'-6"	35'-1"	14'-6"	12'-11"	31'-2"
Aero	560 E	Commander	7	255	6500	49'-6"	35'-1"	14'-6"	12'-11"	31'-2"
Aero	680 E	Commander	7	340	7500	49'-6"	35'-1"	14'-6"	12'-11"	31'-2"
Aero	680 F	Commander	7	380	8000	49'-0"	35'-1"	14'-6"	12'-11"	30'-11"
Beech	G 50	Twin-Bonanza	7	340	7150	45'-3"	31'-6"	11'-6"	12'-9"	29'-0"
Beech	A 55	Baron	4-6	260	4880	37'-10"	26'-8"	9'-7"	9'-7"	23'-8"
Beech	65	Queen Air	7-8	340	7700	45'-10"	33'-4"	14'-2"	12'-9"	29'-4"
Beech	95 A	Travel Air	4-5	180	4200	37'-10"	25'-4"	9'-6"	9'-7"	23'-8"
Cessna	310 C,D	310 C, D	5	260	4830	36'-0"	29'-7"	9'-11"	12'-0"	24'-0"

Twin engine, tri-cycle landing gear aircraft

AIRCRAFT DATA										
TYPE CERTIFICATE HOLDER	MODEL	POPULAR NAME	NO. SEATS	HORSE-POWER	MAX. GROSS WEIGHT	A WING SPAN	B LENGTH	C HEIGHT	D TREAD	MIN. TURNING RADIUS
Piper	PA-23-160	Apache G	4-5	160	3800	37'-0"	27'-1"	9'-6"	11'-0"	24'-0"
Piper	PA-23-250	Aztec	5	250	4800	37'-0"	27'-7"	10'-3"	11'-0"	24'-0"
* de Havilland	104 Series 1	Dove	10-11-13	340 / 315	8500	57'-0"	39'-3"	13'-4"	13'-8"	35'-4" *



Twin engine, tail wheel landing gear

AIRCRAFT DATA

TYPE CERTIFICATE HOLDER	MODEL	POPULAR NAME	NO. SEATS	HORSE-POWER	MAX. GROSS WEIGHT	A WING SPAN	B LENGTH	C HEIGHT	D TREAD	MIN. TURNING RADIUS
Beech	C 18S	Twin-Beech	7-10	450	8240	47'-8"	34'-3"	9'-9"	12'-11"	30'-3"
Beech	C 45 G,H	Twin-Beech	7-10	450	9000	47'-7"	33'-11"	9'-2"	12'-11"	30'-3"
Beech	D 18S	Twin-Beech	7-10	450	9000	47'-7"	33'-11"	9'-2"	12'-11"	30'-3"
Beech	E 18S	Super 18	7-10	450	9300	49'-8"	35'-2"	9'-6"	12'-11"	31'-3"

SECTION 3. PERFORMANCE CURVES - 10,000-FOOT ELEVATION

1. PERFORMANCE CURVES. The following curves are furnished for airport design and planning guidance and are not to be used for operational purposes.

a. INSTRUCTIONS. To determine the length of runway required at an airport to accommodate a particular aircraft, it is necessary to consider the aircraft's takeoff and landing length requirements where both are given. To do so, the following basic information is necessary:

(1) Airport elevation above mean sea level (MSL).

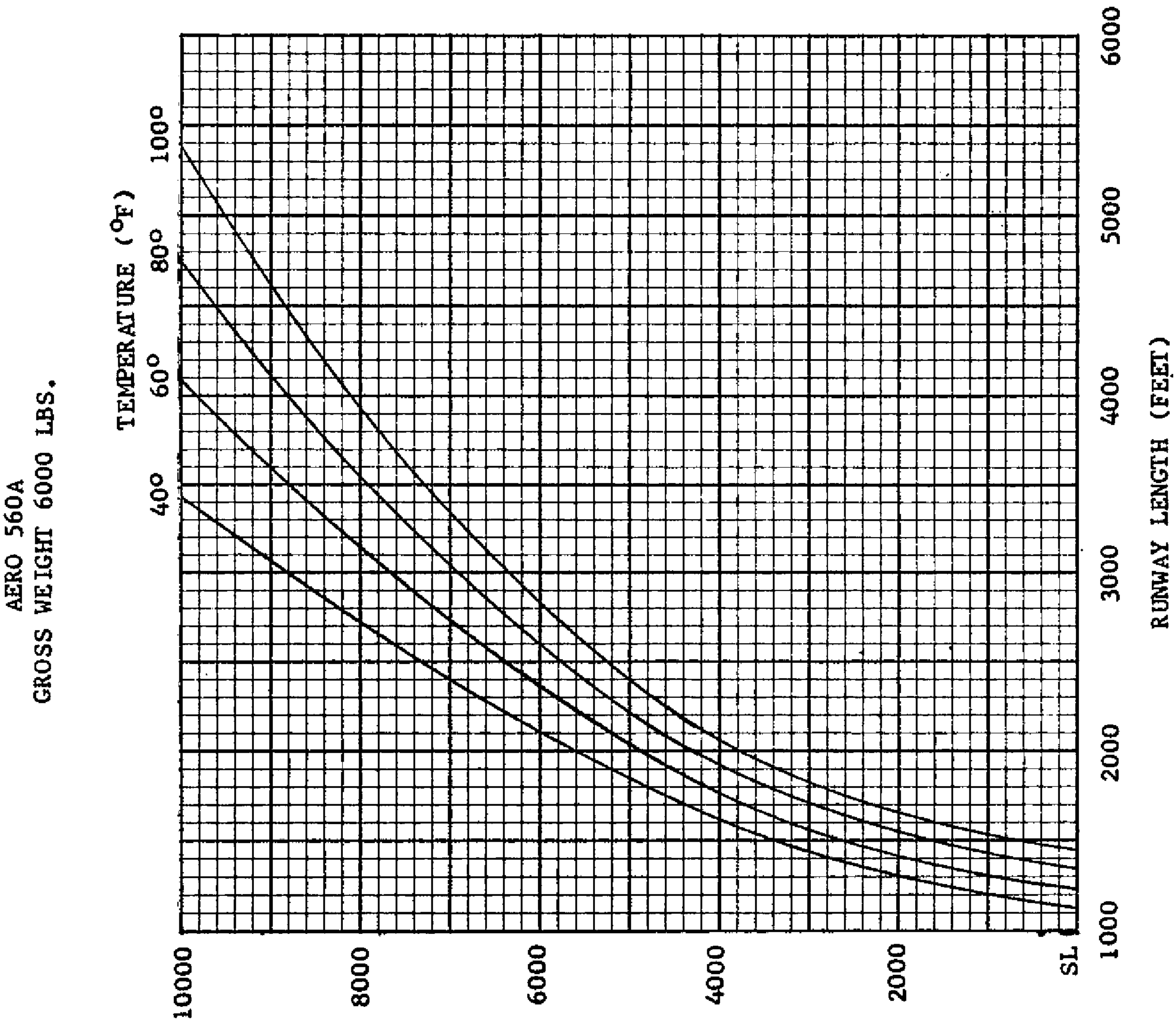
(2) Normal maximum Fahrenheit temperature for the hottest month (^{o}F).

b. EXAMPLE PROBLEM. Assume it is desired to determine the length of runway required to accommodate an Aero 560A at an airport having the following conditions:

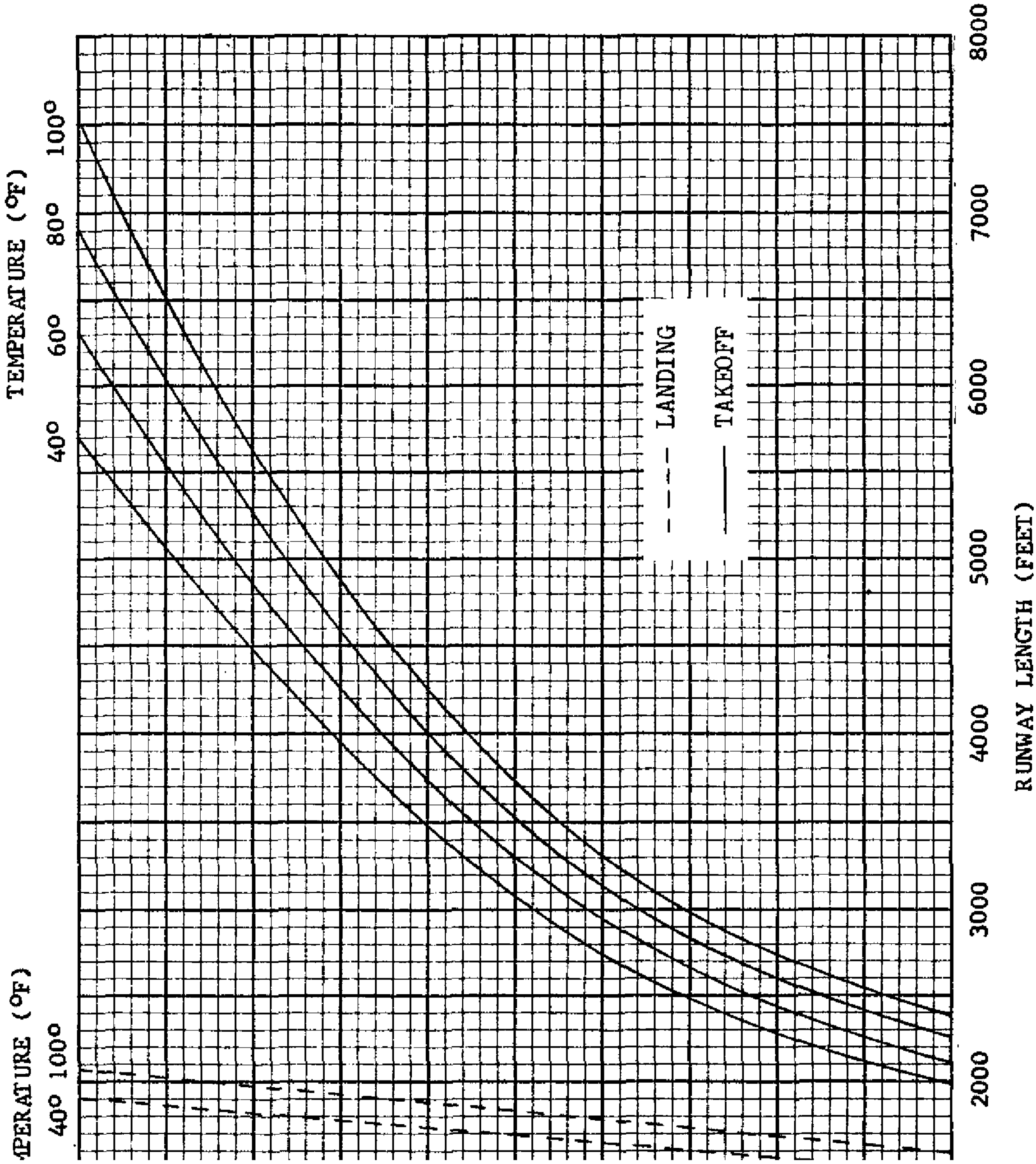
(1) Airport elevations. . . . . .4,000 feet

(2) Normal maximum temperature. . . . . . 90 degrees Fahrenheit

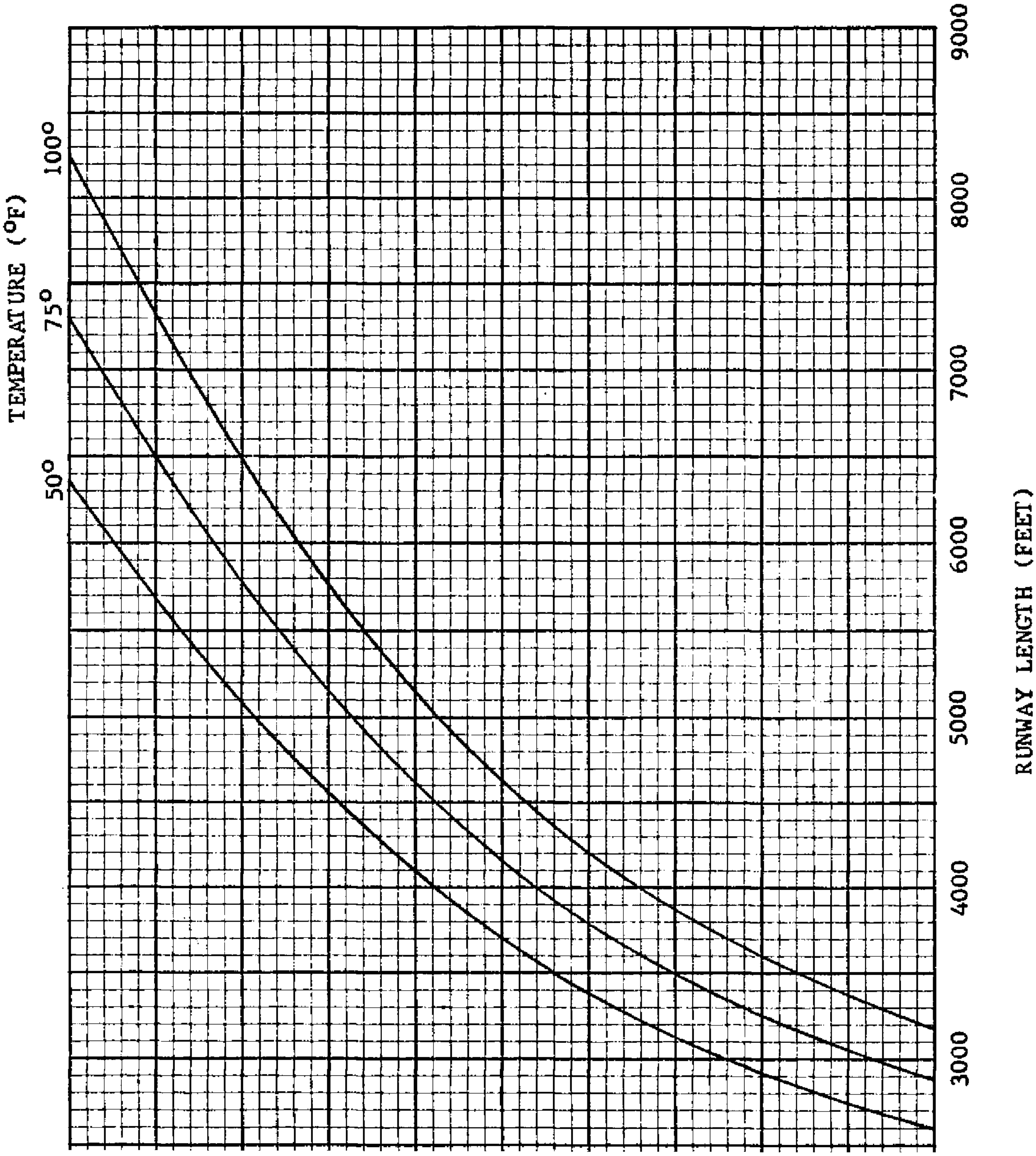
c. PROBLEM SOLUTION. From page 22 of Appendix 2, read runway length of 2,000 feet.


AERO 560A
GROSS WEIGHT 6000 LBS.
TEMPERATURE (°F)
40°
60°
80°
100°
RUNWAY LENGTH (FEET)
1000
2000
3000
4000
5000
6000
10000
8000
6000
4000
2000
SL

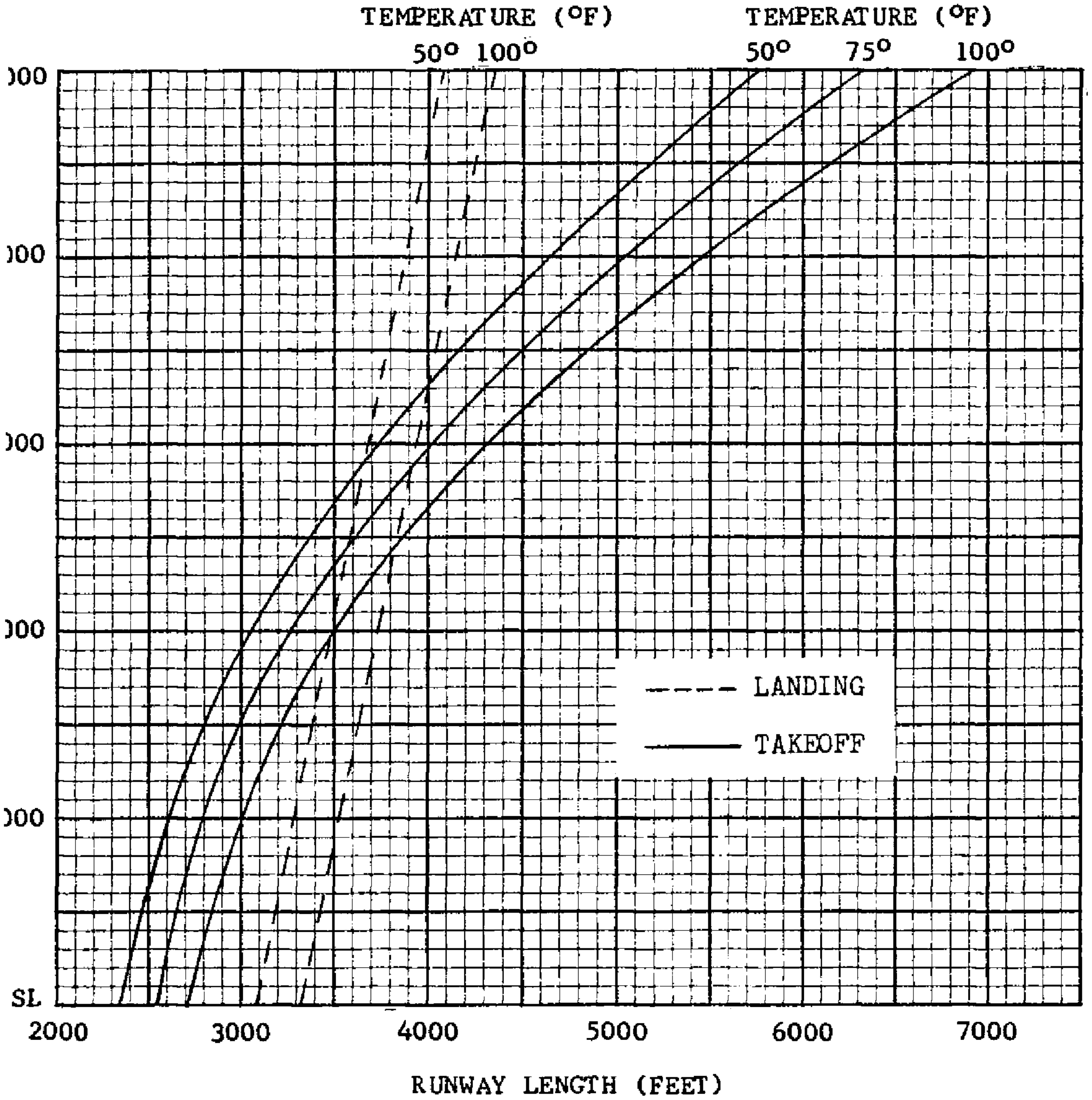
AERO 560E
GROSS WEIGHT 6500 LBS.



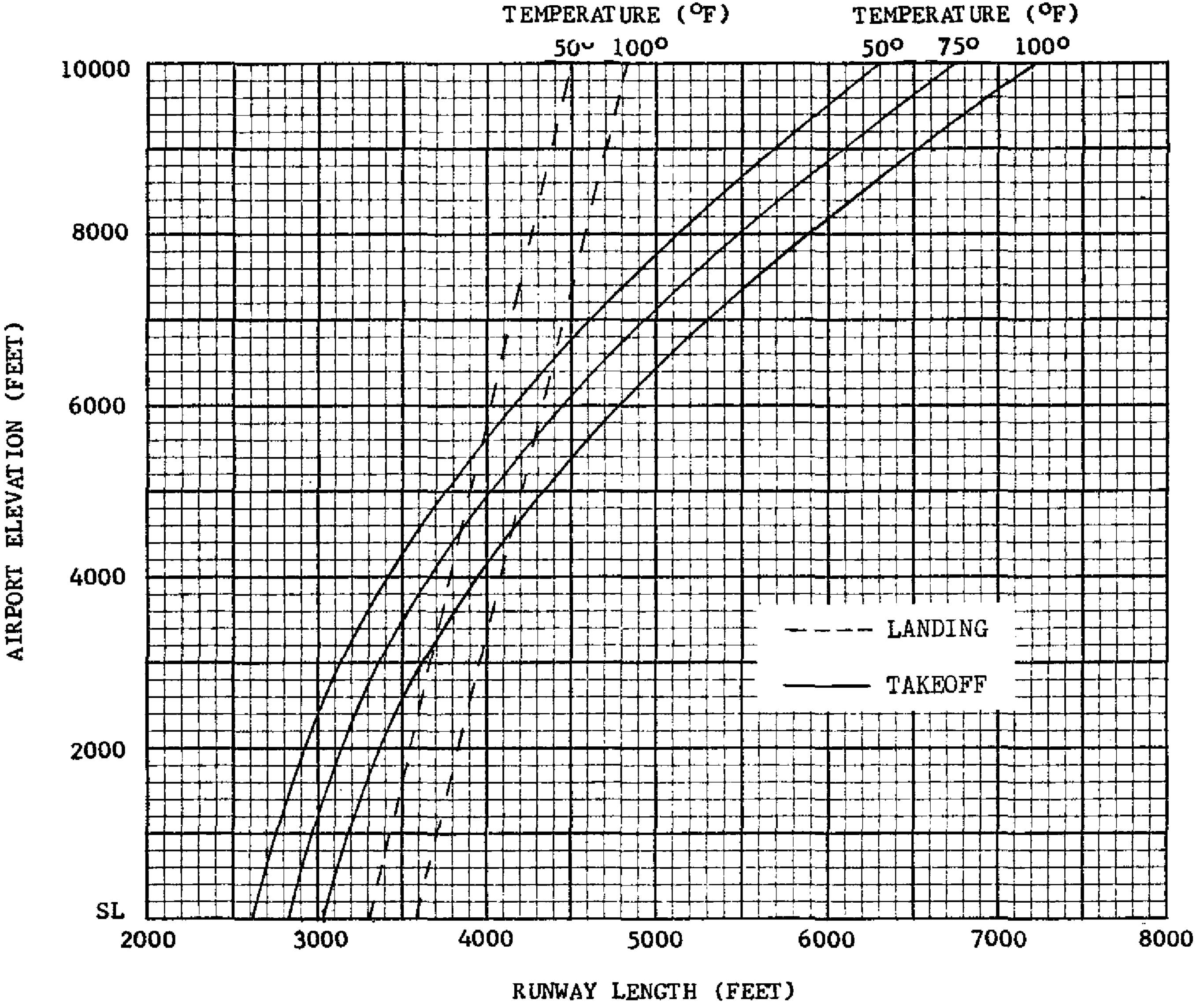
BEECH C18S
GROSS WEIGHT 8240 LBS.



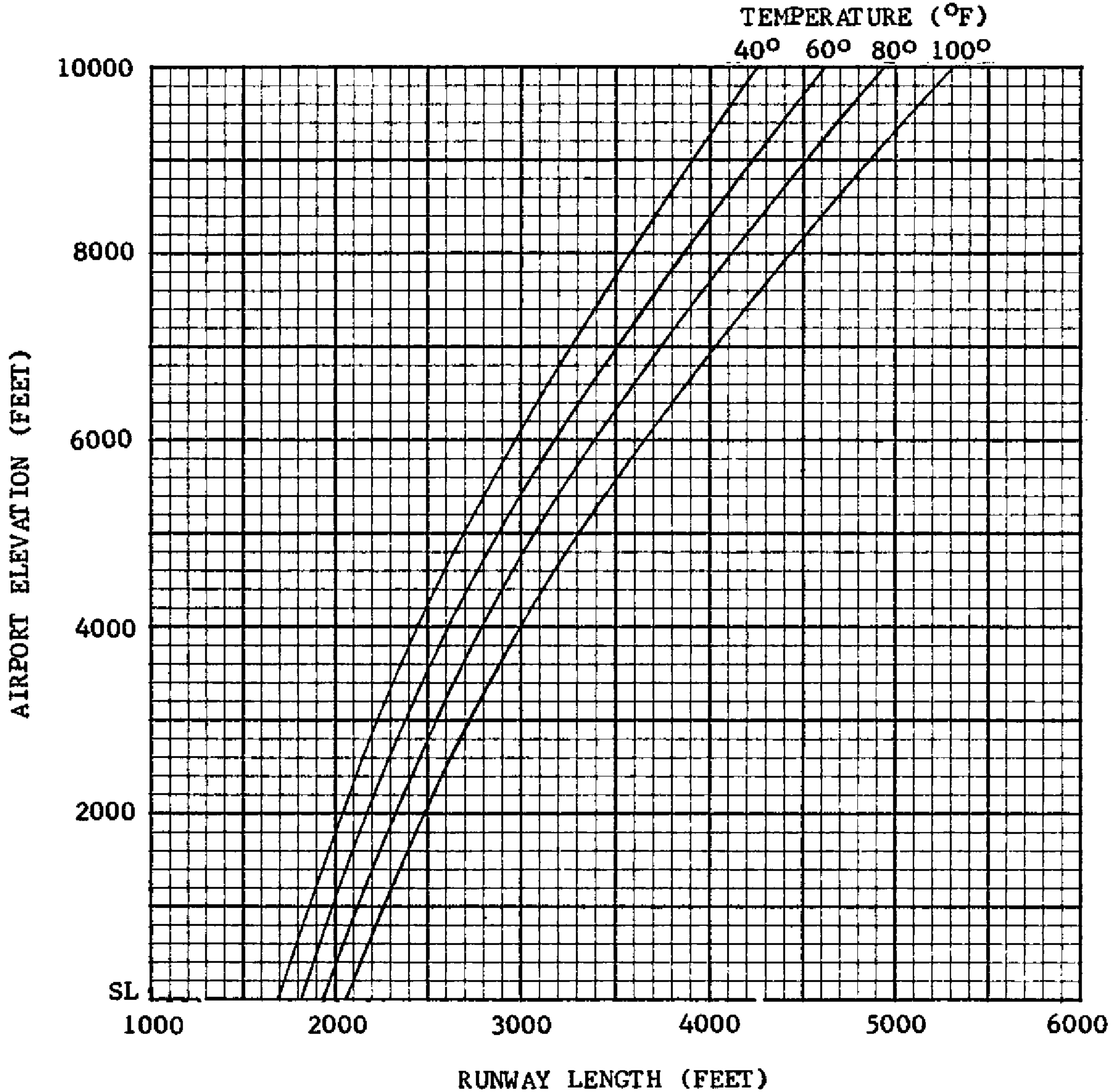
BEECH D18S
R&W R985-AN-14B ENGINE
GROSS WEIGHT 9000 LBS.



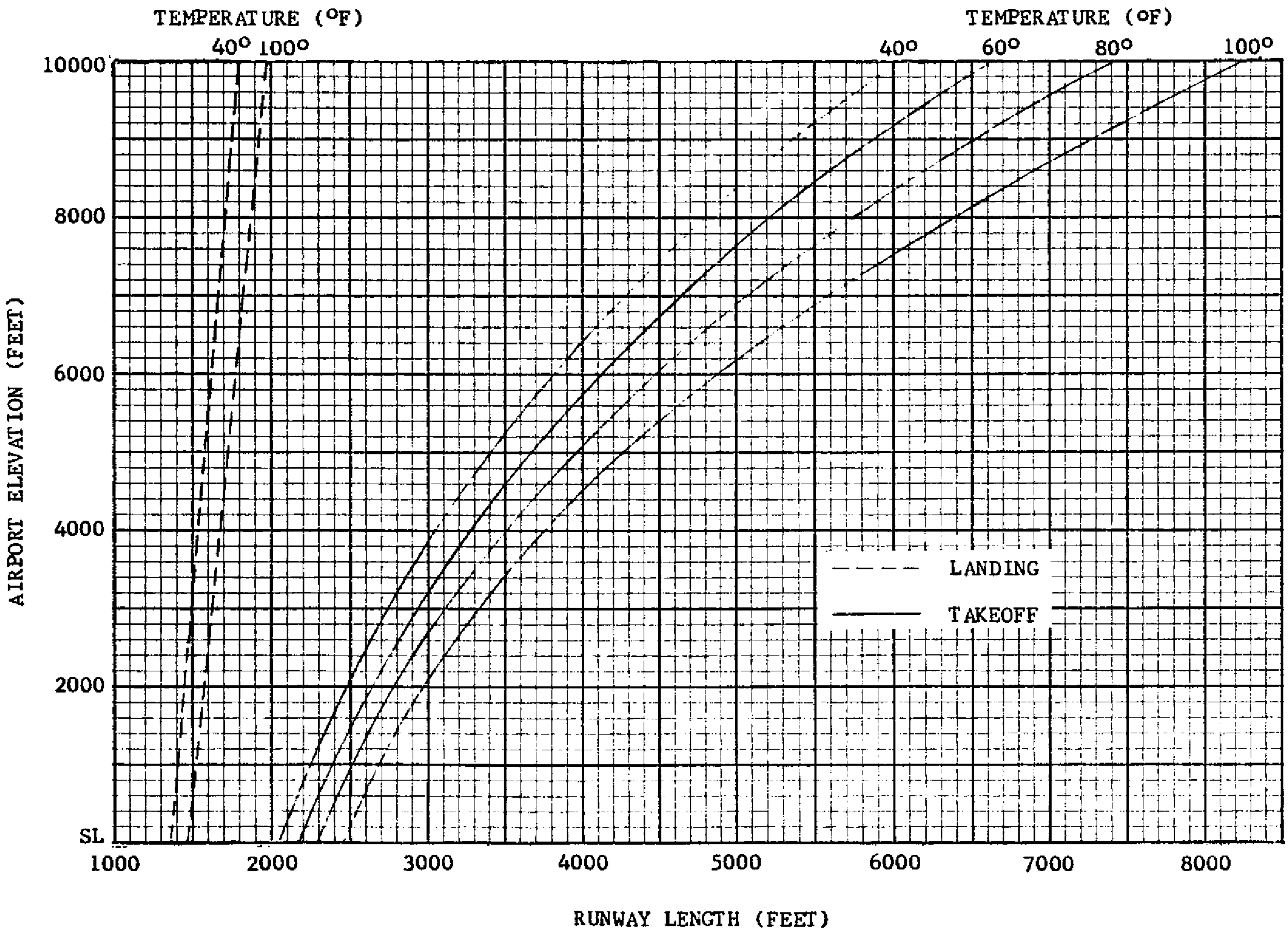
BEECH E18S
GROSS WEIGHT 9300 LBS.



CESSNA 170
170A
170B
GROSS WEIGHT 2200 LBS.



PIPER PA-12
GROSS WEIGHT 1750 LBS.



APPENDIX 3. FAA FIELD OFFICES

LOCATIONS	GEOGRAPHIC AREAS OF JURISDICTION
EASTERN UNITED STATES	
Boston, Massachusetts	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
Jamaica, L. I., New York	New Jersey and New York
Columbus, Ohio	Kentucky and Ohio
New Cumberland, Pennsylvania	Pennsylvania
Baileys Crossroads, Virginia	Delaware, Maryland, Virginia, and West Virginia
CENTRAL UNITED STATES	
Chicago, Illinois	Illinois
Lansing, Michigan	Indiana and Michigan
St. Paul, Minnesota	Minnesota, North Dakota, and Wisconsin
Kansas City, Missouri	Kansas and Missouri
Helena, Montana	Montana
Lincoln, Nebraska	Iowa, Nebraska, and South Dakota
SOUTHERN UNITED STATES	
Miami, Florida	Florida, Puerto Rico, and Virgin Islands
Atlanta, Georgia	Georgia and Tennessee
Jackson, Mississippi	Alabama and Mississippi
Charlotte, North Carolina	North Carolina and South Carolina

LOCATIONS	GEOGRAPHIC AREAS OF JURISDICTION
SOUTHWEST UNITED STATES	
Shreveport, Louisiana	Arkansas and Louisiana
Oklahoma City, Oklahoma	New Mexico and Oklahoma
Fort Worth, Texas	Texas
WESTERN UNITED STATES	
Phoenix, Arizona	Arizona
Los Angeles, California	Southern California
Oakland, California	Northern California
Denver, Colorado	Colorado and Wyoming
Reno, Nevada	Nevada and Utah
Seattle, Washington	Idaho, Oregon, and Washington
ALASKA	
Anchorage, Alaska	Alaska
HAWAII	
Honolulu, Hawaii	Hawaii

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