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SECTION 5

PERFORMANCE

SECTION 5

PERFORMANCE

5.1 GENERAL

All of the required (FAA regulations) and complementary performance information is provided by this section.

Performance information associated with those optional systems and equipment which require handbook supplements is provided by Section 9 (Supplements).

5.3 INTRODUCTION - PERFORMANCE AND FLIGHT PLANNING

The performance information presented in this section is based on measured Flight Test Data corrected to I.C.A.O. standard day conditions and analytically expanded for the various parameters of weight, altitude, temperature, etc.

The performance charts are unfactored and do not make any allowance for varying degrees of pilot proficiency or mechanical deterioration of the aircraft. This performance, however, can be duplicated by following the stated procedures in a properly maintained airplane.

Effects of conditions not considered on the charts must be evaluated by the pilot, such as the effect of soft or grass runway surface on takeoff and landing performance, or the effect of winds aloft on cruise and range performance. Endurance can be grossly affected by improper leaning procedures, and inflight fuel flow and quantity checks are recommended.

REMEMBER! To get chart performance, follow the chart procedures.

The information provided by paragraph 5.5 (Flight Planning Example) outlines a detailed flight plan using the performance charts in this section. Each chart includes its own example to show how it is used.

WARNING

> Performance information derived by extrapolation beyond the limits shown on the charts should not be used for flight planning purposes.

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5.5 FLIGHT PLANNING EXAMPLE

(a) Aircraft Loading

The first step in planning the flight is to calculate the airplane weight and center of gravity by utilizing the information provided by Section 6 (Weight and Balance) of this handbook.

The basic empty weight for the airplane as licensed at the factory has been entered in Figure 6-5. If any alterations to the airplane have been made effecting weight and balance, reference to the aircraft logbook and Weight and Balance Record (Figure 6-7) should be made to determine the current basic empty weight of the airplane.

Make use of the Weight and Balance Loading Form (Figure 6-11) and the C.G. Range and Weight graph (Figure 6-15) to determine the total weight of the airplane and the center of gravity position.

After proper utilization of the information provided, the following weights have been determined for consideration in the flight planning example.

The landing weight cannot be determined until the weight of the fuel to be used has been established [refer to item (g)(1)].

(1)	Basic Empty Weight	1890 lbs.
(2)	Occupants (2 x 170 lbs.)	340 lbs.
(3)	Baggage and Cargo	70 lbs.
(4)	Fuel (6 lb./gal. x 51.3)	308 lbs.
(5)	Engine Start, Taxi, and Run Up	-8 lbs.
(6)	Takeoff Weight	2600 lbs.
(7)	Landing Weight (a)(6) minus (g)(1), (2600 lbs. minus 73.2 lbs.)	2526 lbs.

The takeoff weight is below the maximum of 2750 lbs., and the weight and balance calculations have determined the C.G. position to be within approved limits.

5.5 FLIGHT PLANNING EXAMPLE (continued)

(b) Takeoff and Landing

Now that the airplane loading has been determined, all aspects of the takeoff and landing must now be considered.

All of the existing conditions at the departure and destination airport must be acquired, evaluated and maintained throughout the flight.

Apply the departure airport conditions and takeoff weight to the appropriate Takeoff Performance and Takeoff Ground Roll graph (Figures 5-9, 5-11, 5-13 and 5-15) to determine the length of runway necessary for the takeoff and/or the barrier distance.

The landing distance calculations are performed in the same manner using the existing conditions at the destination airport and, when established, the landing weight.

The conditions and calculations for the example flight are listed below. The takeoff and landing distances required for the flight have fallen well below the available runway lengths.

	Departure Airport	Destination Airport
(1) Pressure Altitude	1900 ft.	1900 ft.
(2) Temperature	20°C	20°C
(3) Wind Component	4 KTS	2 KTS
(4) Runway Length Available	3000 ft.	4600 ft.
(5) Runway Required	2550 ft.*	1490 ft.**

NOTE

The remainder of the performance charts used in this flight planning example assume a no wind condition. The effect of winds aloft must be considered by the pilot when computing climb, cruise and descent performance.

*reference Figure 5-13
**reference Figure 5-39

5.5 FLIGHT PLANNING EXAMPLE (continued)

(c) Climb

The next step in the flight plan is to determine the necessary climb segment components.

The desired cruise pressure altitude and corresponding cruise outside air temperature values are the first variables to be considered in determining climb components from the Fuel, Time and Distance to Climb graph (Figure 5-21). After the fuel, time and distance for the cruise pressure altitude and outside air temperature values have been established, apply the existing conditions at the departure field to the graph (Figure 5-21). Subtract the values obtained from the graph for the field of departure conditions for those for the cruise pressure altitude.

The remaining values are the true fuel, time and distance components for the climb segment of the flight plan corrected for field pressure altitude and temperature.

The following values were determined from the above instructions in the flight planning example:

(1)	Cruise Pressure Altitude	6000 ft.
(2)	Cruise OAT	10°C
(3)	Fuel to Climb (4 gal. minus 1.0 gal.)	3.0 gal.*
(4)	Time to Climb (10 min. minus 3.5 min.)	6.5 min.*
(5)	Distance to Climb (17 naut. miles minus 6 naut. miles)	11 naut. miles*

(d) Descent

The descent data will be determined prior to the cruise data to provide the descent distance for establishing the total cruise distance.

Utilizing the cruise pressure altitude and OAT, determine the basic fuel, time, and distance for descent (Figure 5-35). These figures must be adjusted for the field pressure altitude and temperature at the destination airport. To find the necessary adjustment values, use the existing pressure altitude and temperature conditions at the destination airport as variables to find the fuel, time and distance

*reference Figure 5-21

5.5 FLIGHT PLANNING EXAMPLE (continued)

values from the graph (Figure 5-35). Subtract the values obtained from the field conditions from the values obtained from the cruise conditions to find the true fuel, time and distances values needed for the flight plan.

The values obtained by proper utilization of the graphs for the descent segment of the example are shown below:

(1) Fuel to Descend (1.0 gal. minus 0.5 gal.)	0.5 gal.*
(2) Time to Descend (7 min. minus 3 min.)	4 min.*
(3) Distance to Descend (18 naut. miles minus 7.5 naut. miles)	10.5 naut. miles*

(e) Cruise

Using the total distance to be traveled during the flight, subtract the previously calculated distance to climb and distance to descend to establish the total cruise distance. Refer to the Power Setting Table (Figure 5-23 or 5-23a) when selecting the cruise power setting. The established pressure altitude and temperature values and the selected cruise power should now be utilized to determine the true airspeed from the appropriate Speed Power graph (Figure 5-25 through 5-27c).

For this example, 65% Economy Cruise at 2500 RPM was used. Calculate the cruise flow for the cruise power setting from the information provided by the Best Economy Range chart (Figure 5-31a).

The cruise time is found by dividing the cruise distance by the cruise speed and the cruise fuel is found by multiplying the cruise fuel flow by the cruise time.

The cruise calculations established for the cruise segment of the flight planning example are as follows:

(1) Total Distance	130 naut. miles
(2) Cruise Distance (e)(1) minus (c)(5) minus (d)(3), (130 naut. miles minus 11 naut. miles minus 10.5 naut. miles)	108.5 naut. miles

*reference Figure 5-35

5.5 FLIGHT PLANNING EXAMPLE (continued)

(3) Cruise Power (Best Economy)	65% rated power (2500 RPM)
(4) Cruise Delta OAT from ISA (10° C - 3° C)	7 ° C
(5) Cruise Manifold Press. (23.1 + [7/5.5 x .16])	23.3 in Hg
(6) Cruise Speed	130 Kts TAS*
(7) Cruise Fuel Consumption	10.3 gph*
(8) Cruise Time (e)(2) divided by (e)(6), (108.5 naut. miles divided by 130 KTS)	.84 hrs. (51 min.)
(9) Cruise Fuel (e)(7) multiplied by (e)(8), (10.3 gph mulitiplied by .84 hrs.)	8.7 gal.

(f) Total Flight Time

The total flight time is determined by adding the time to climb, the time to descend and the cruise time. Remember! The time values taken from the climb and descent graphs are in minutes and must be converted to hours before adding them to the cruise time.

The following flight time is required for the flight planning example:

(1) Total Flight Time (c)(4) plus (d)(2) plus (e)(8), (.11 hrs. plus .07 hrs. plus .84 hrs.) (6.5 min. plus 4 min. plus 51 min.)	1.02 hrs., 61.5 min.

(g) Total Fuel Required

Determine the total fuel required by adding the fuel to climb, the fuel to descend and the cruise fuel. When the total fuel (in gallons) is determined, multiply this value by 6 lb./gal. to determine the total fuel weight used for the flight.

The total fuel calculations for the example flight plan are shown below:

(1) Total Fuel Required (c)(3) plus (d)(1) plus (e)(9), (3.0 gal. plus 0.5 gal. plus 8.7 gal.)	12.2 gal.
(12.2 gal. multiplied by 6 lb./gal.)	73.2 lbs.

*reference Figure 5-27c

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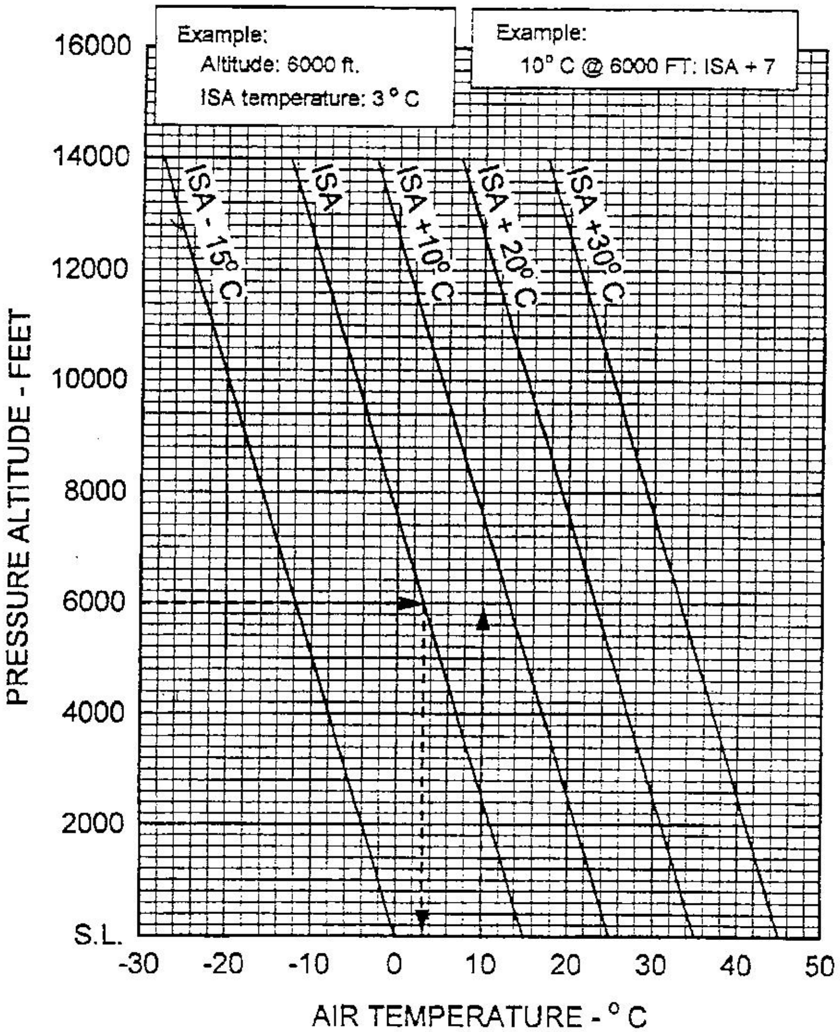
5.7 PERFORMANCE GRAPHS

LIST OF FIGURES

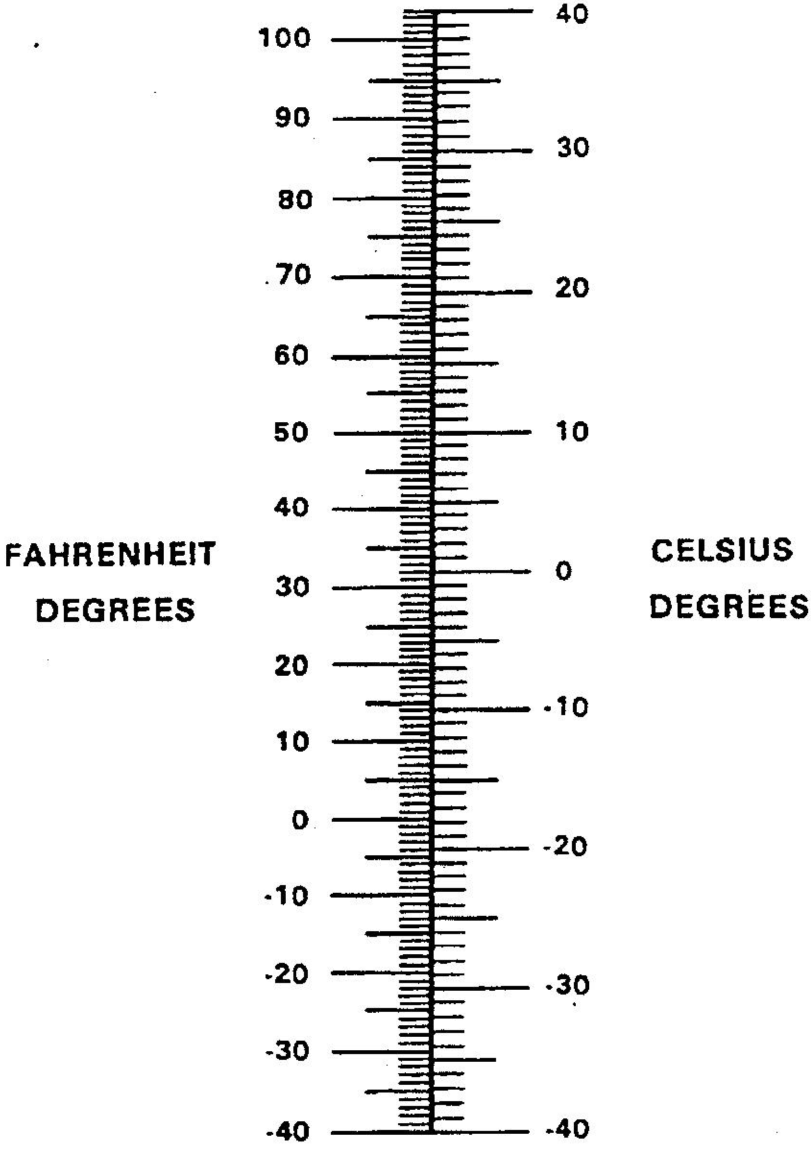
5.7 PERFORMANCE GRAPHS (Cont'd)

LIST OF FIGURES (Cont'd)

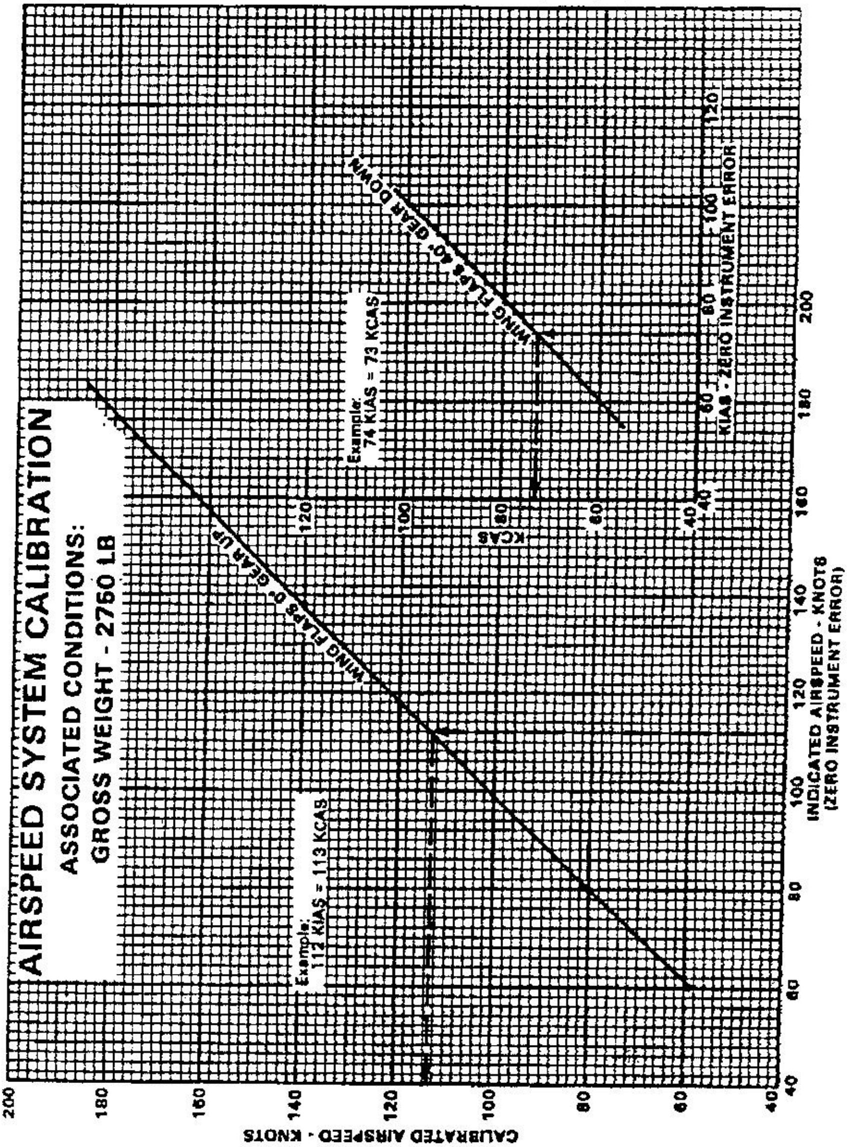


AIR TEMPERATURES ABOVE & BELOW ISA

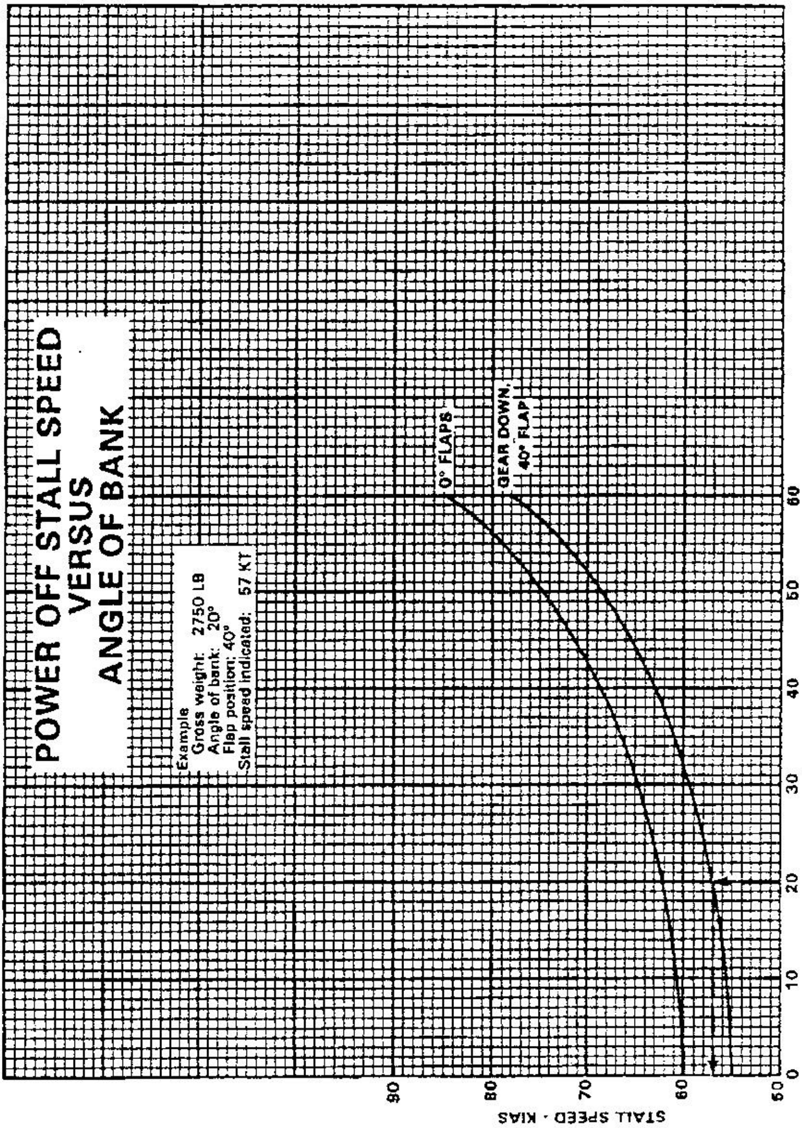
Figure 5-1a



TEMPERATURE CONVERSION
Figure 5-1



AIRSPEED SYSTEM CALIBRATION
Figure 5-3

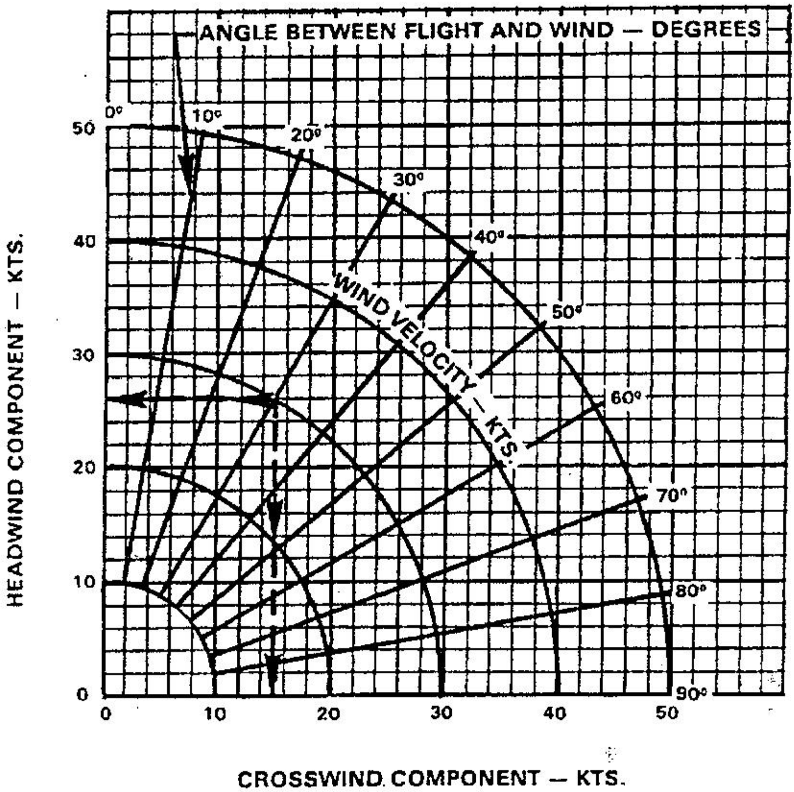


POWER OFF STALL SPEED VS. ANGLE OF BANK

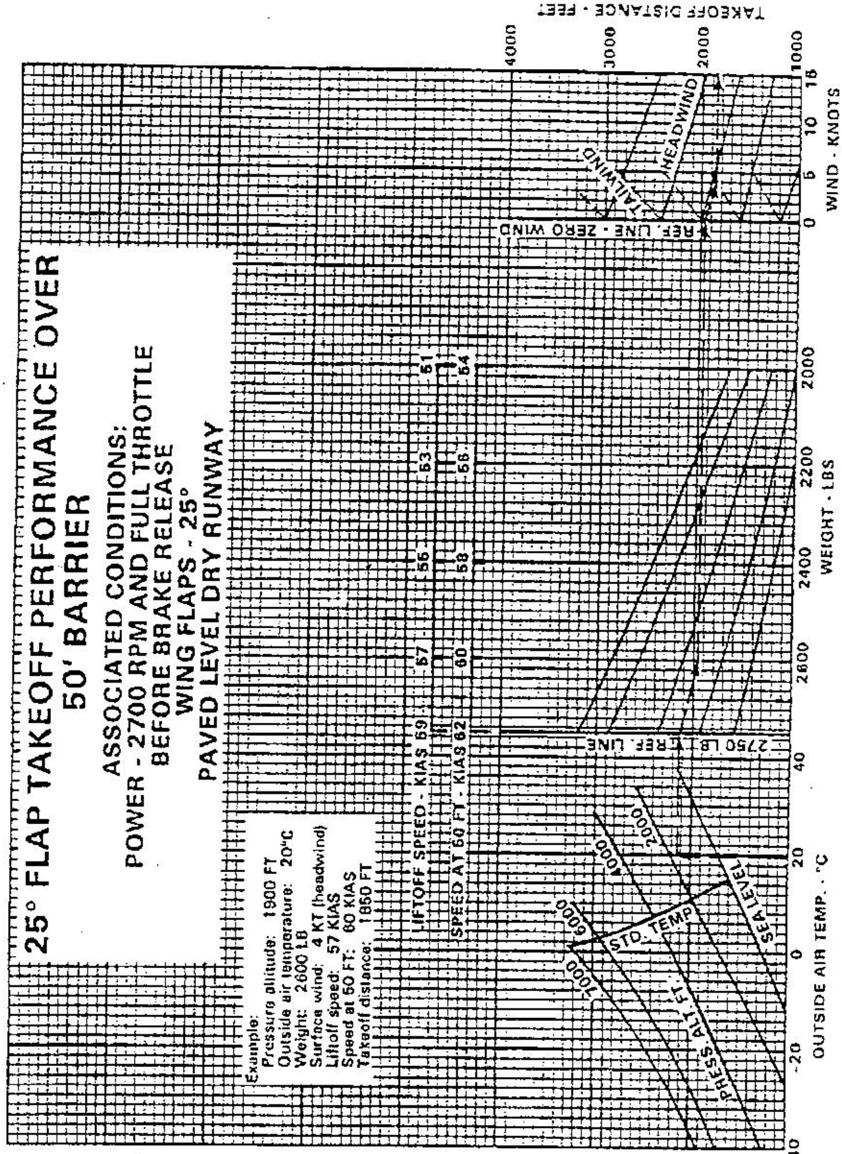
Figure 5-5

WIND COMPONENTS

Example:
Wind velocity: 30 knots
Angle between flight path and wind: 30°
Headwind component: 26 knots
Crosswind components: 15 knots

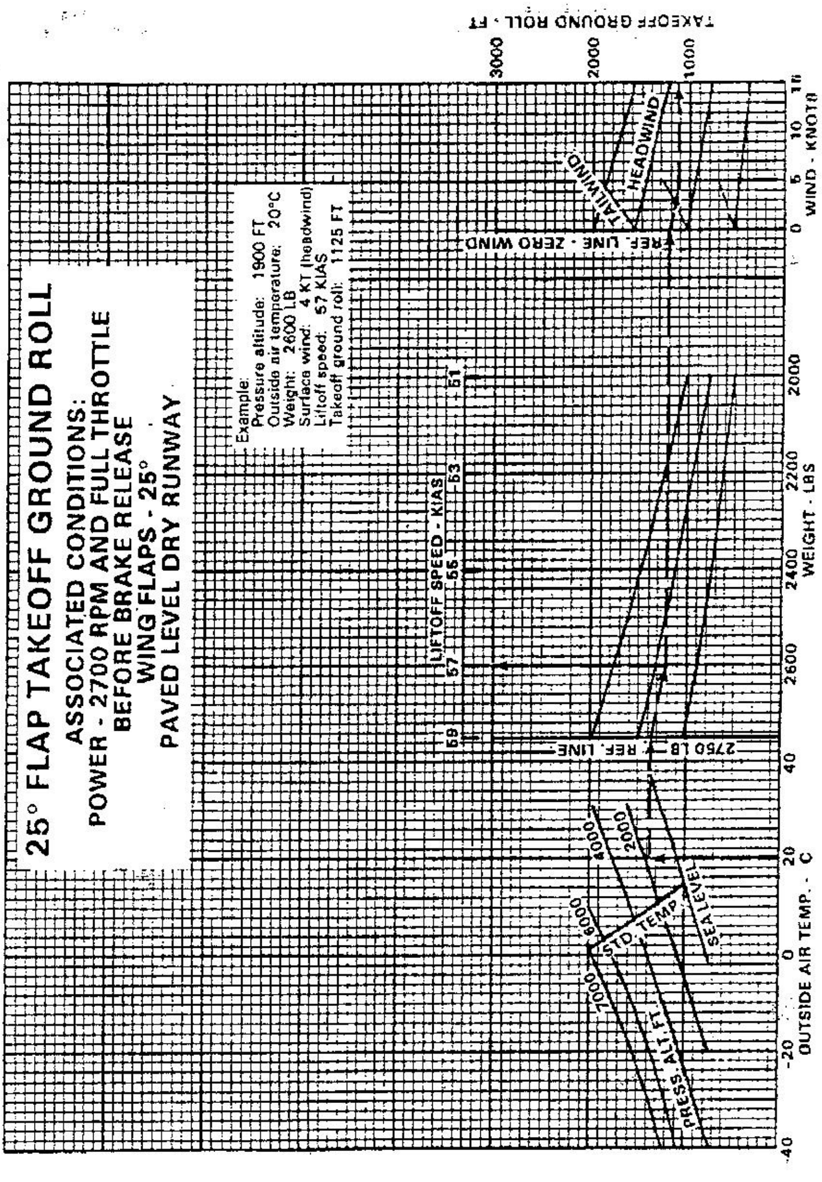


WIND COMPONENTS
Figure 5-7

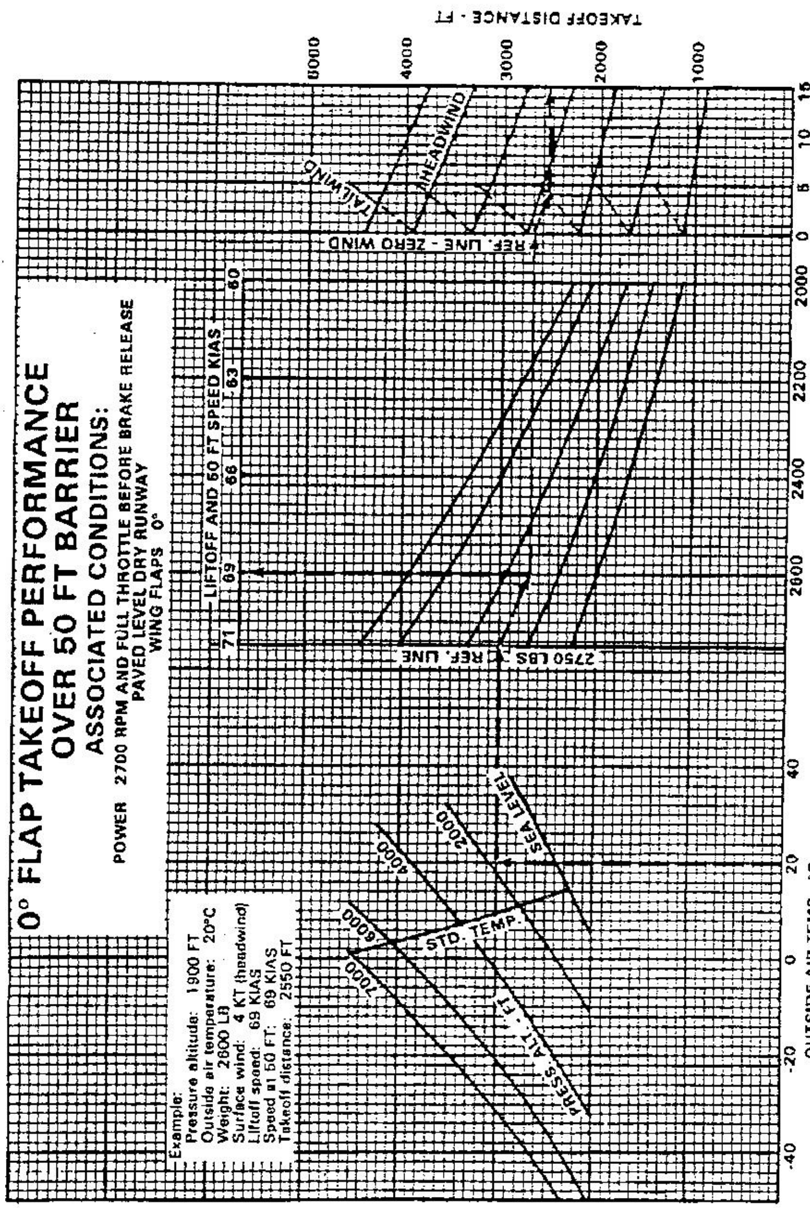


25° FLAP TAKEOFF PERFORMANCE

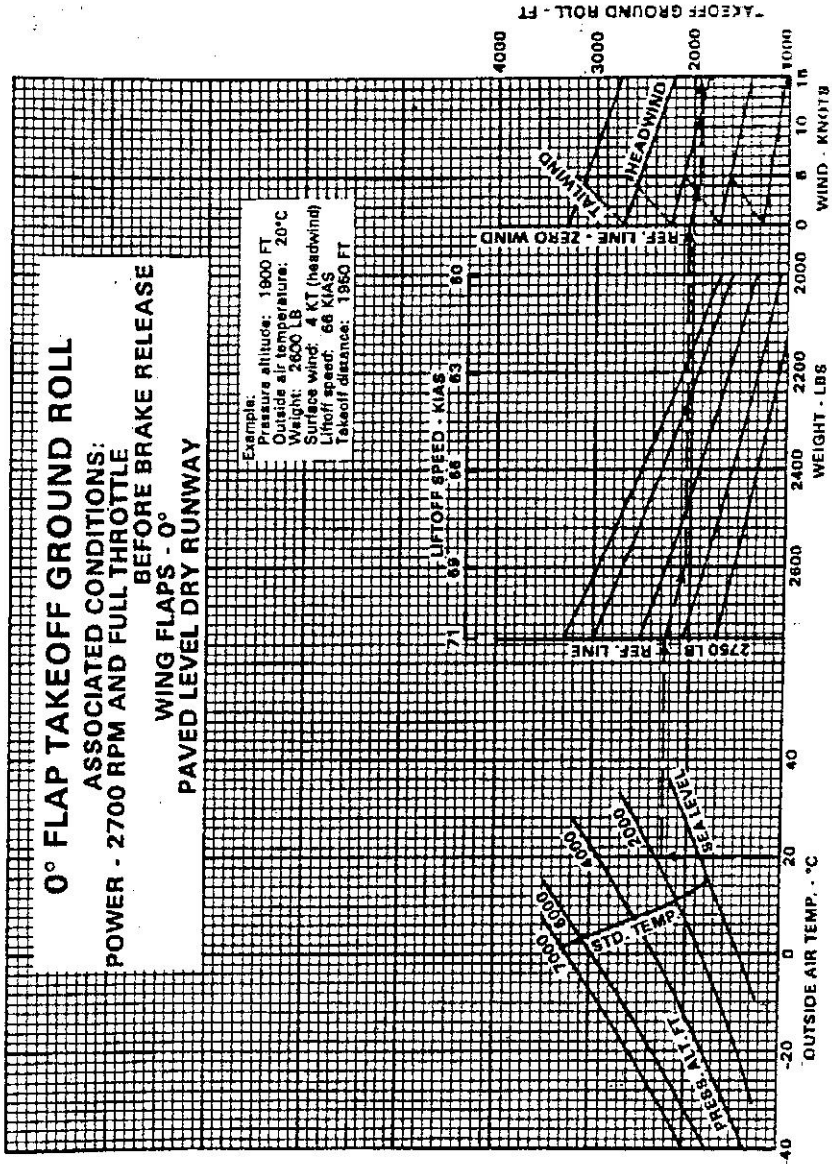
Figure 5-9



25° FLAP TAKEOFF GROUND ROLL
Figure 5-11



0° FLAP TAKEOFF PERFORMANCE
Figure 5-13



0° FLAP TAKEOFF GROUND ROLL
Figure 5-15