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SECTION 5

PERFORMANCE

SECTION 5

PERFORMANCE

5.1 GENERAL

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

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

The performance data presented in this section is applicable to both two and three bladed propeller installations.

5.3 INTRODUCTION TO 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 our 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 delivered from 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 we have found the following weights for consideration in our 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	2790 lbs.
(2)	Occupants (3 x 170 lbs.)	510 lbs.
(3)	Baggage and Cargo	420 lbs.
(4)	Zero Fuel Weight (4000 lb. max. allowable)	3720 lbs.
(5)	Fuel (6 lb./gal. x 95)	570 lbs.
(6)	Takeoff Weight (4407 lb. max. allowable)	4290 lbs.
(7)	Landing Weight (4342 lb. max. allowable) (a)(6) minus (g)(1), (4290 lbs. minus 303 lbs.)	3987 lbs.

Our takeoff and landing weights are below the maximums and our weight and balance calculations have determined our C.G. position within the approved limits.

(b) Takeoff and Landing

Now that we have determined our aircraft loading, we must consider all aspects of our takeoff and landing.

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 5-11, 5-13, 5-15 and 5-17) 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 our example flight are listed below. The takeoff and landing distances required for our example flight have fallen well below the available runway lengths.

		Departure Airport	Destination Airport
(1)	Pressure Altitude	7586 ft.	4411 ft.
(2)	Temperature	40°F	50°F
(3)	Wind Component	10 KTS (Headwind)	5 KTS (Headwind)
(4)	Runway Length Available	7400 ft.	9000 ft.
(5)	Runway Required		
	Takeoff	1540 ft.*	
	Accelerate and Stop	4200 ft.**	
	Landing		2590 ft.***

NOTE

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

(c) Climb

The next step in our 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 the climb components from the Time, Fuel, and Distance to Climb graph (Figure 5-21). After the time, fuel and distance for the cruise pressure altitude and outside air temperature values have been established, apply the existing conditions at the departure field to graph (Figure 5-21). Now, subtract the values obtained from the graph for the field of departure conditions from those for the cruise pressure altitude.

The remaining values are the true time, fuel 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 our flight planning example.

(1)	Cruise Pressure Altitude	16,500 ft.
(2)	Cruise OAT	8°F
(3)	Time to Climb (15 min. minus 6 min.)	9 min.****
(4)	Distance to Climb (26 naut. miles minus 10 naut. miles)	16 naut. miles****
(5)	Fuel to Climb (12 gal. minus 4 gal.)	8 gal.****

*reference Figure 5-15
**reference Figure 5-7
***reference Figure 5-39
****reference Figure 5-21

(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 we determine the basic time, fuel and distance for descent (Figure 5-37). 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 time, fuel and distance values from the graph (Figure 5-37). Now, subtract the values obtained from the field conditions from the values obtained from the cruise conditions to find the true time, fuel and distance values needed for the flight plan.

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

(1)	Time to Descend (18.5 min. minus 4.5 min.)	14 min.*
(2)	Distance to Descend (40 naut. miles minus 10 naut. miles)	30 naut. miles*
(3)	Fuel to Descend (5 gal. minus 1.5 gal.)	3.5 gal.*

(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 appropriate Teledyne Continental Motors Operator's Manual and the Power Setting Tables (Figures 5-23 or 5-25) 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 Speed Power graph (Figure 5-35).

Calculate the cruise fuel flow for the cruise power setting from the information provided by the Teledyne Continental Motors Operator's Manual.

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 our flight planning example are as follows:

(1)	Total Distance	394 miles
(2)	Cruise Distance (e)(1) minus (c)(4) minus (d)(2), (394 naut. miles minus 16 naut. miles minus 30 naut. miles)	348 naut. miles
(3)	Cruise Power	55% rated power
(4)	Cruise Speed	161 KTS TAS**
(5)	Cruise Fuel Consumption	18 GPH***
(6)	Cruise Time (e)(2) divided by (e)(4), (348 naut. miles divided by 161 KTS)	2.16 hrs.
(7)	Cruise Fuel (e)(5) multiplied by (e)(6), (18 GPH multiplied by 2.16 hrs.)	39 gal.

*reference Figure 5-37
**reference Figure 5-35
***reference Figure 5-23

(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 our flight planning example.

(1) Total Flight Time
(c)(3) plus (d)(1) plus (e)(6), (.15 hrs. plus .23 hrs. plus 2.16 hrs.) 2.54 hrs.

(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 our example flight plan are shown below.

(1) Total Fuel Required
(c)(5) plus (d)(3) plus (e)(7), (8 gal. plus 3.5 gal. plus 39 gal.) 50.5 gal.
(50.5 gal. multiplied by 6 lb./gal.) 303 lbs.

5.7 PERFORMANCE GRAPHS

LIST OF FIGURES

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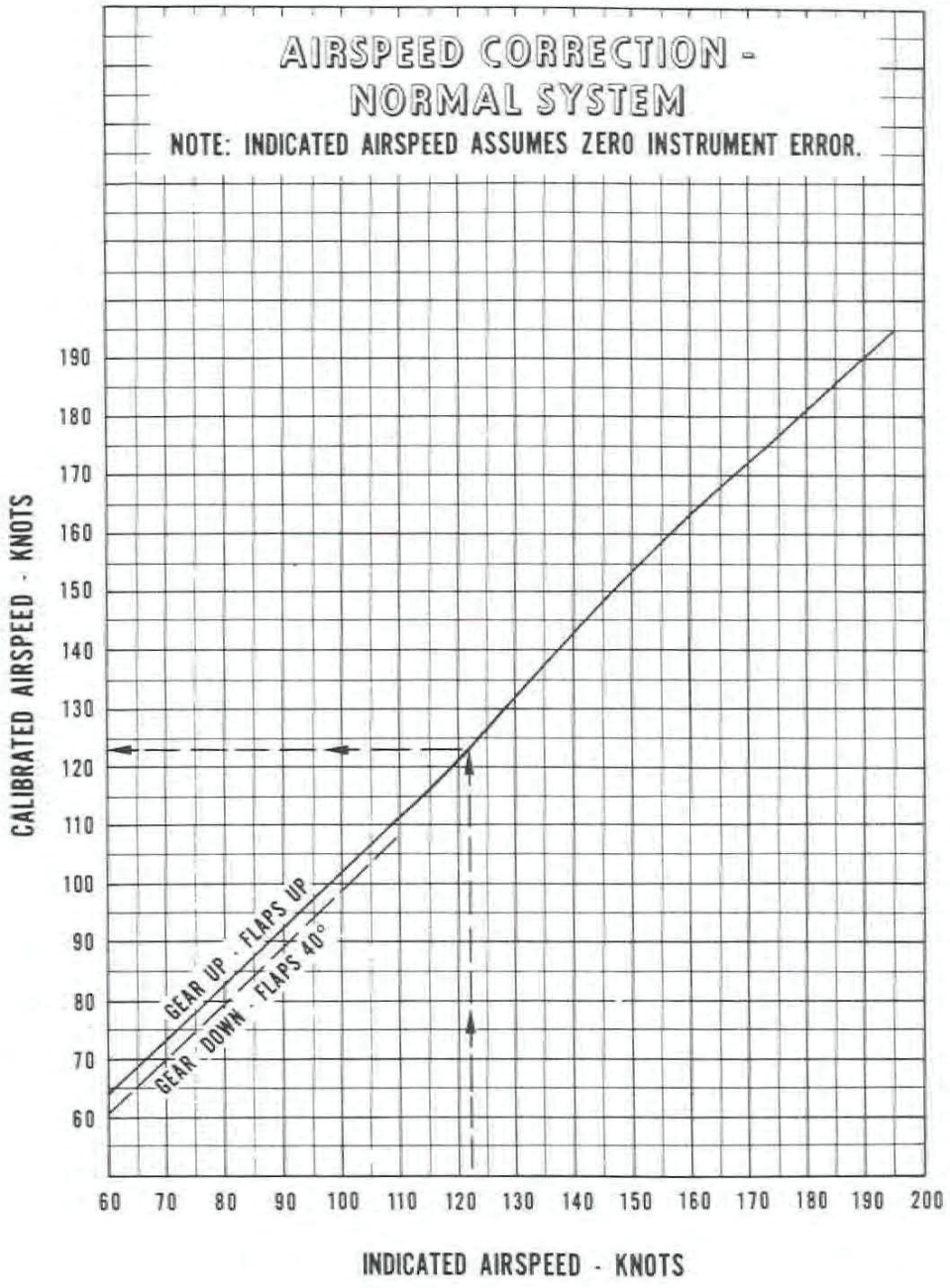
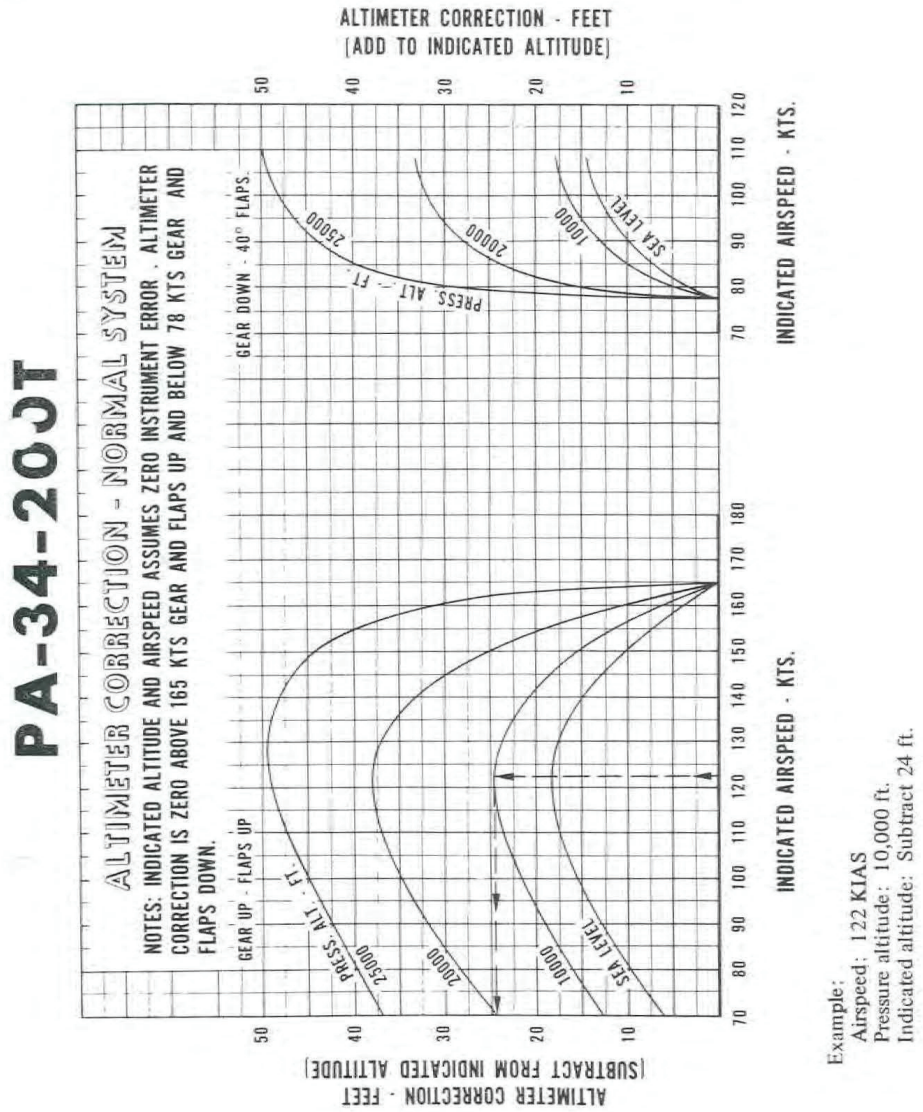
PA-34-200T



Example:
122 KIAS = 123 KCAS

AIRSPEED CORRECTION - NORMAL SYSTEM

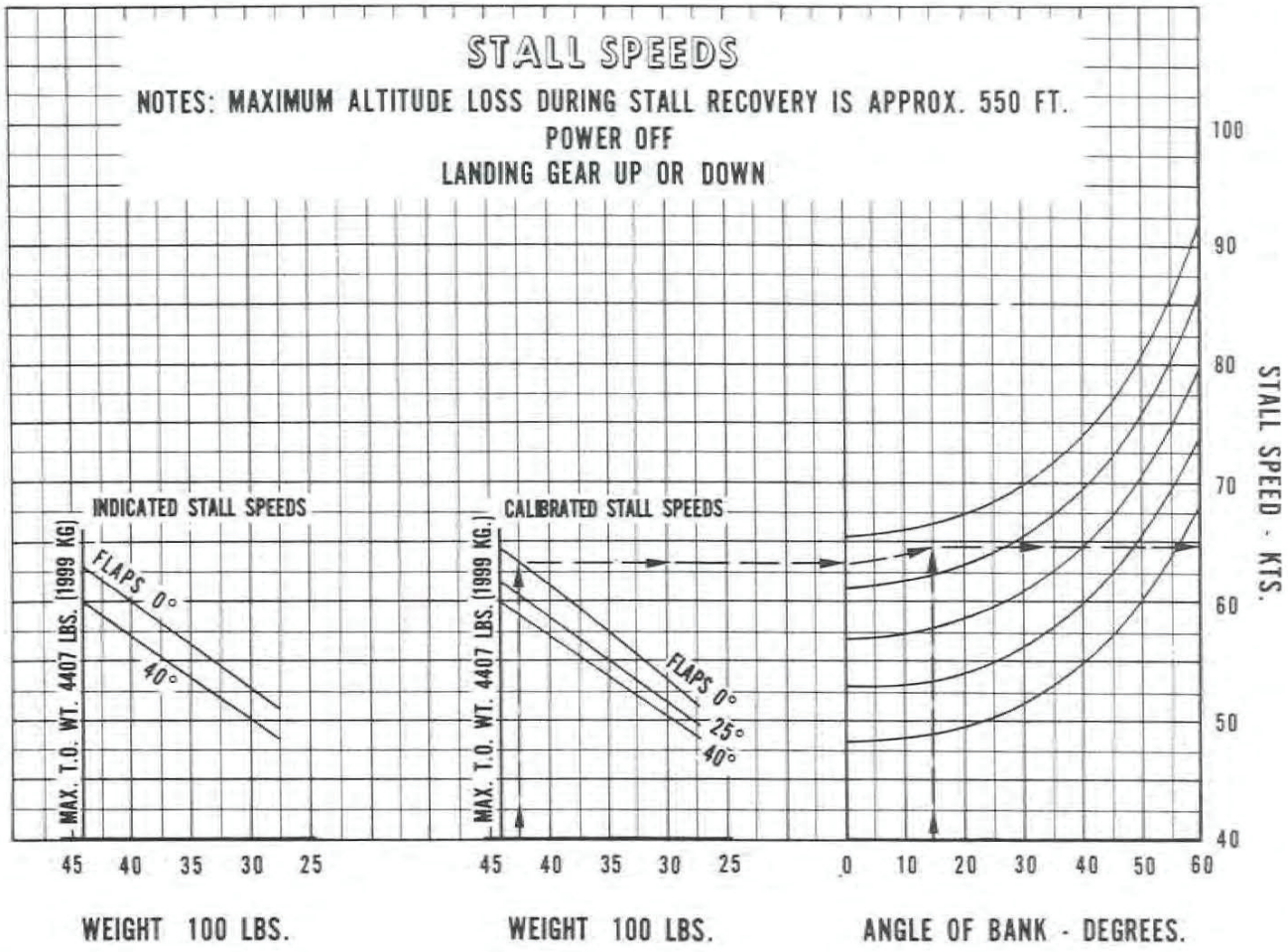
Figure 5-1



ALTIMETER CORRECTION - NORMAL SYSTEM

Figure 5-3

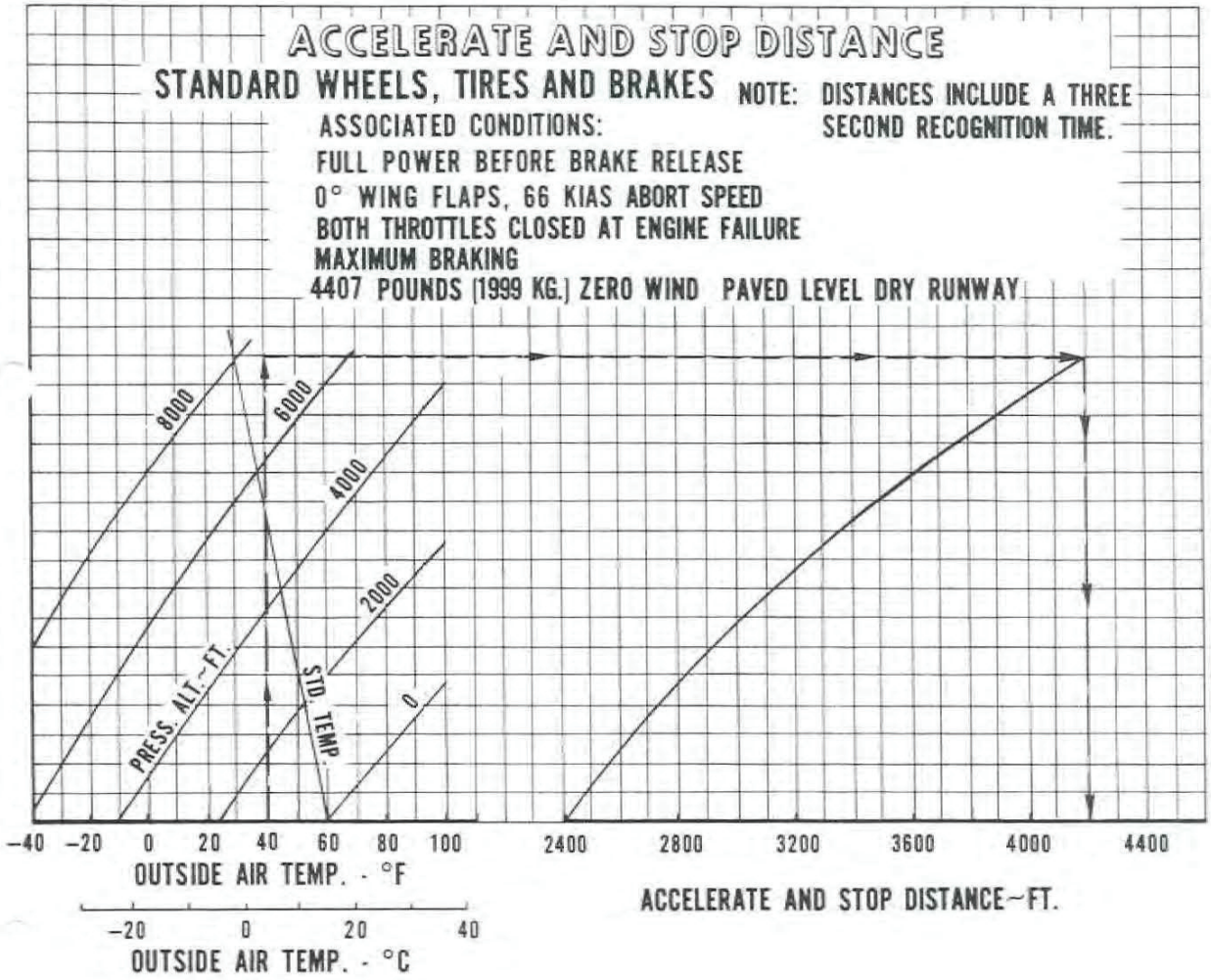
PA-34-200T



Example:
Gross weight: 4250 lbs.
Angle of bank: 15°
Flap position: 0°
Calibrated stall speed: 64 knots

STALL SPEEDS
Figure 5-5

PA-34-200T

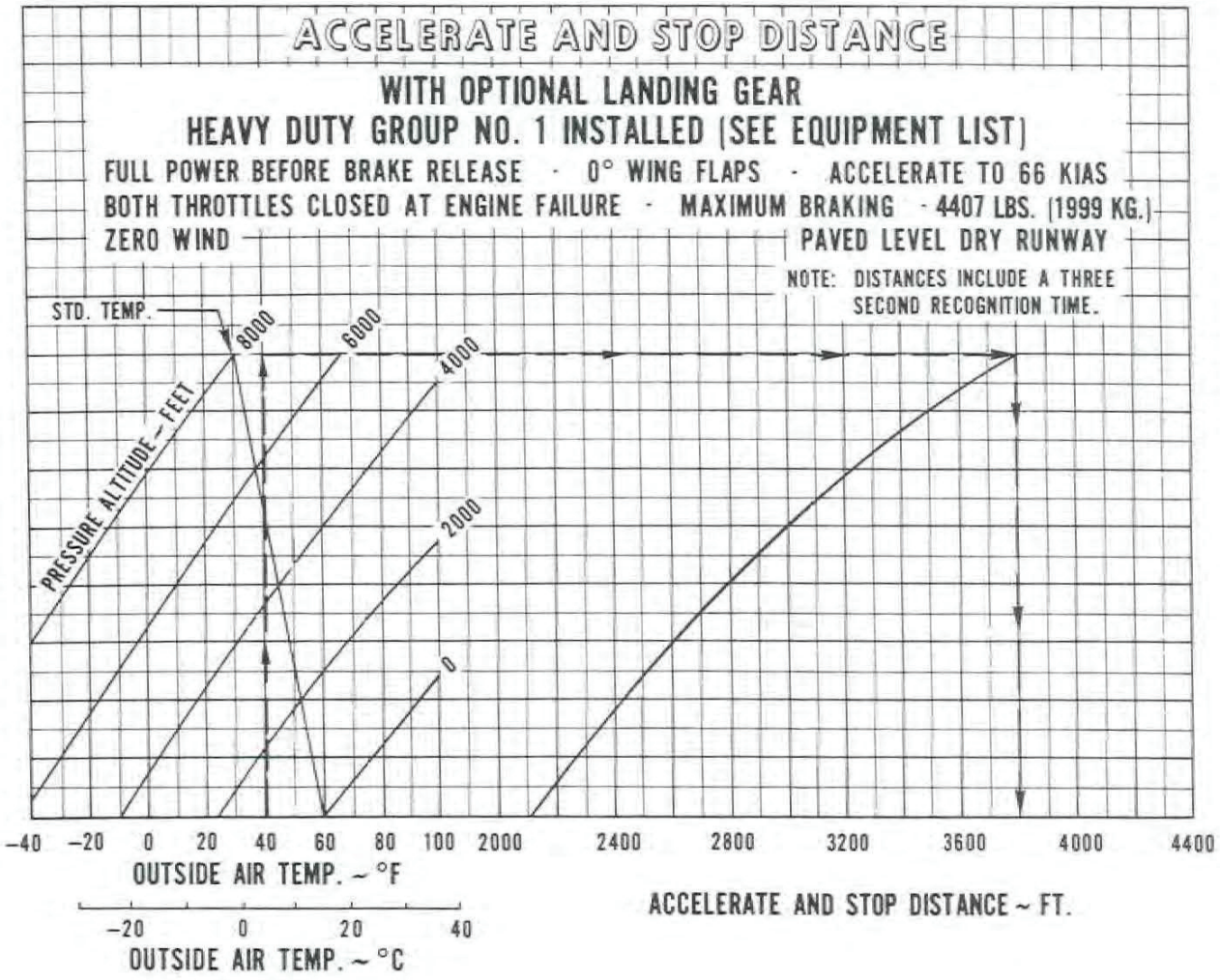


Example:
OAT: 40° F
Pressure altitude: 7586 ft.
Accelerate and stop distance: 4200 ft.

ACCELERATE AND STOP DISTANCE (STANDARD)

Figure 5-7

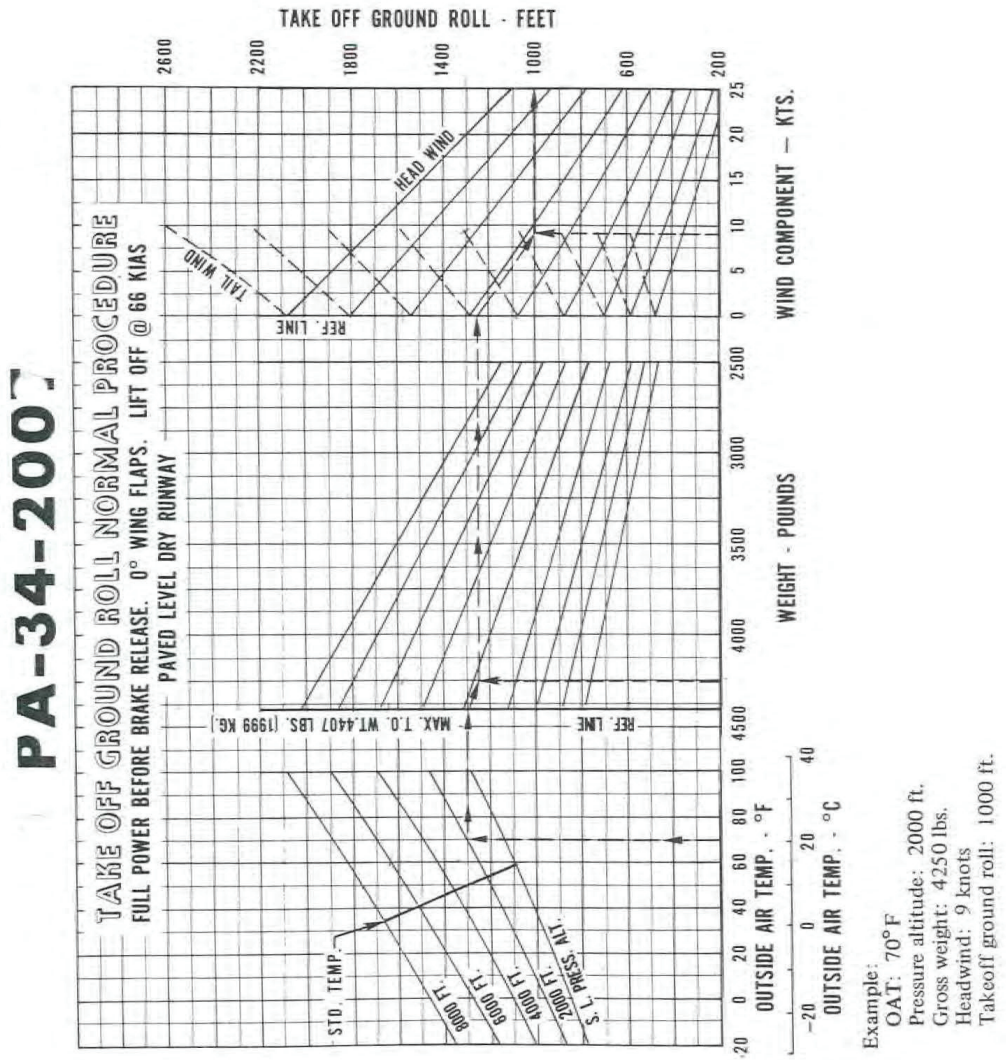
PA-34-200T



Example:
OAT: 40° F
Pressure altitude: 7586 ft.
Accelerate and stop distance: 3800 ft.

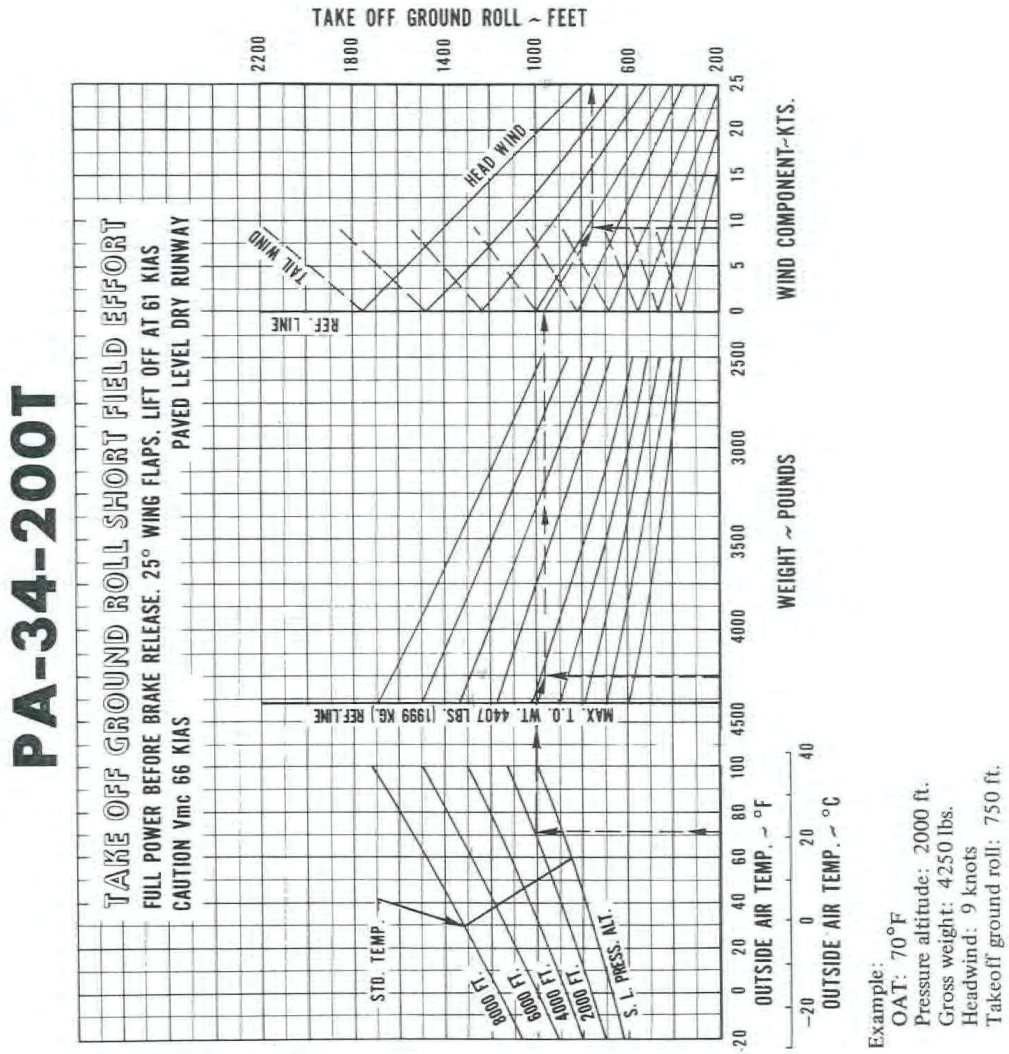
ACCELERATE AND STOP DISTANCE (HEAVY DUTY GROUP 1)

Figure 5-9



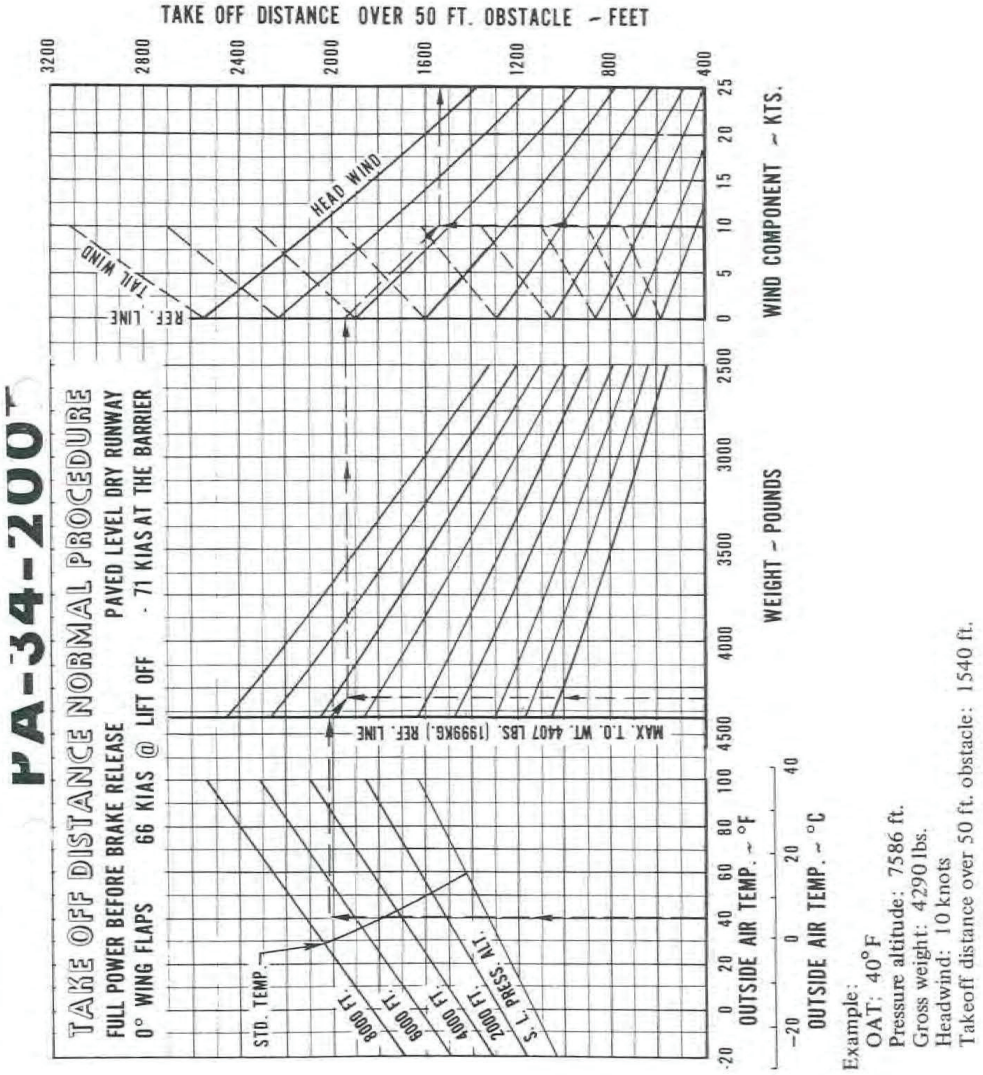
TAKEOFF GROUND ROLL - NORMAL PROCEDURE

Figure 5-11



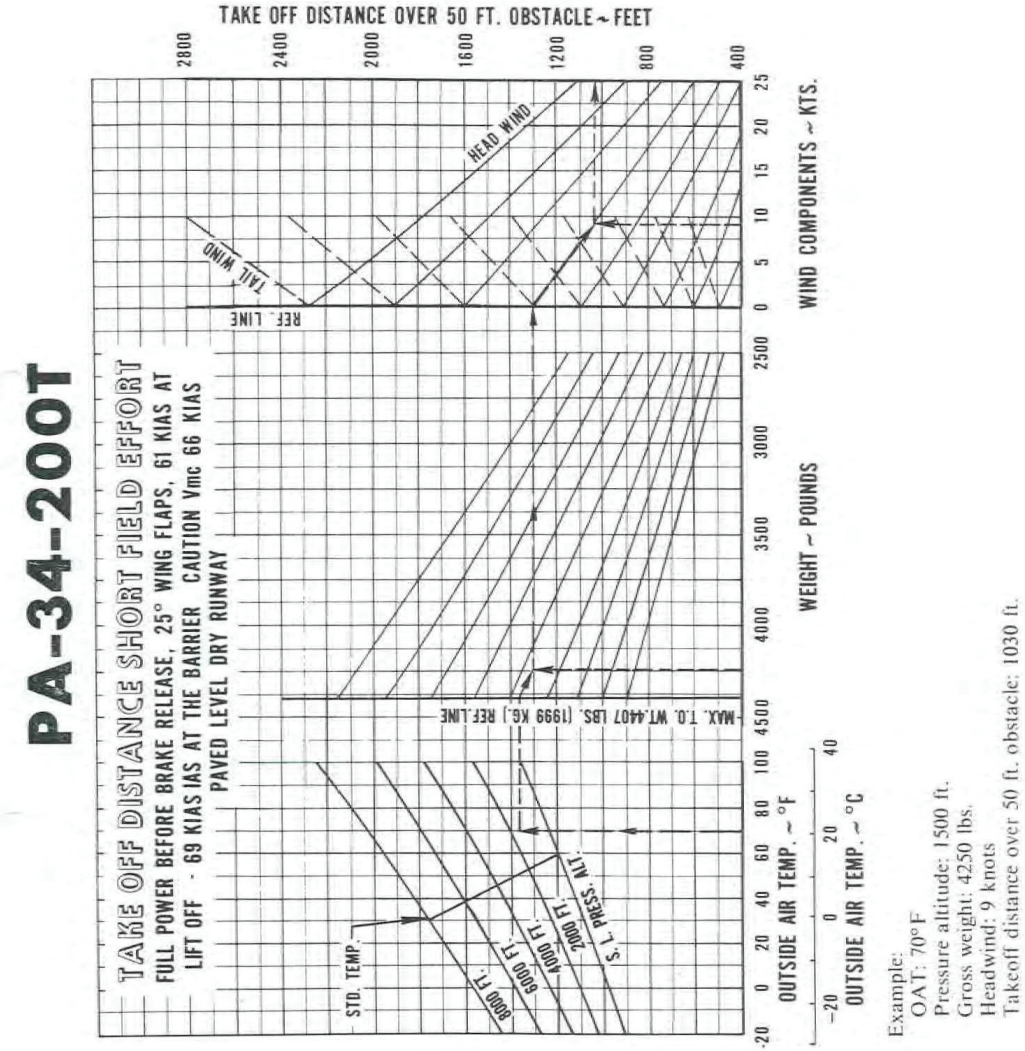
TAKEOFF GROUND ROLL - SHORT FIELD EFFORT

Figure 5-13



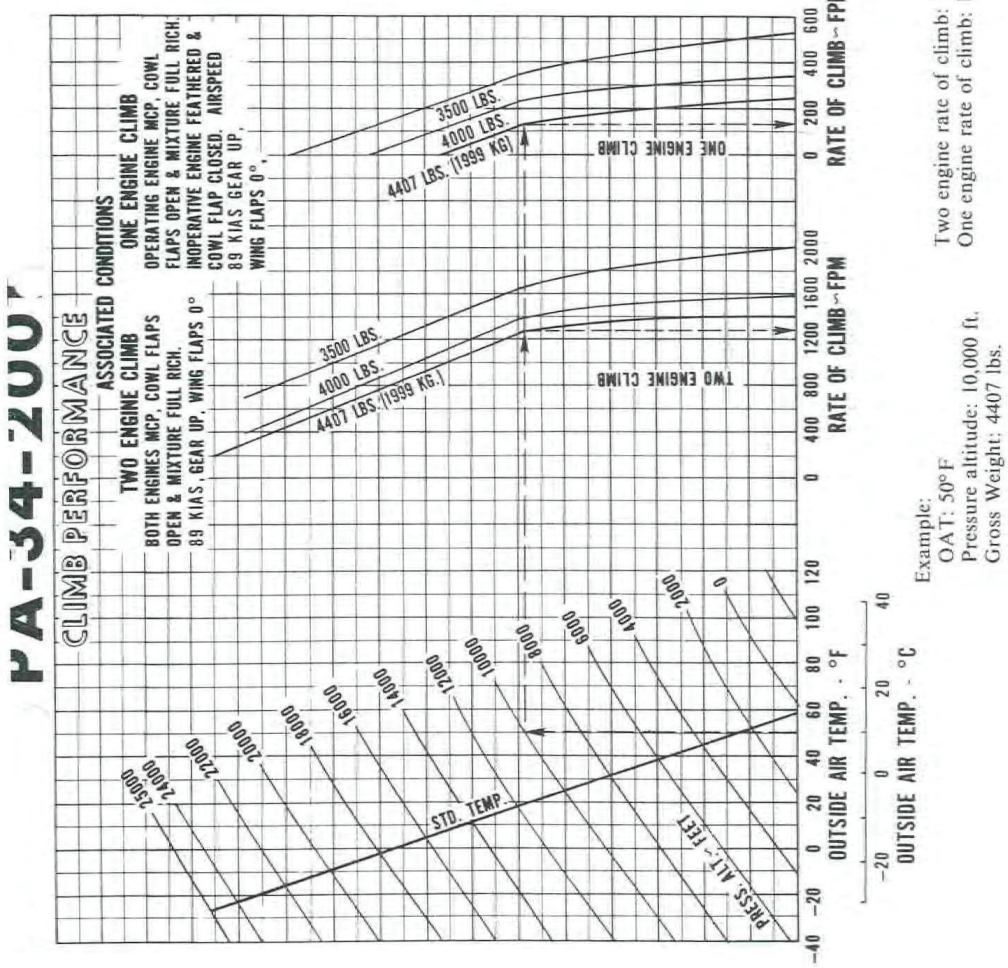
TAKEOFF DISTANCE - NORMAL PROCEDURE

Figure 5-15

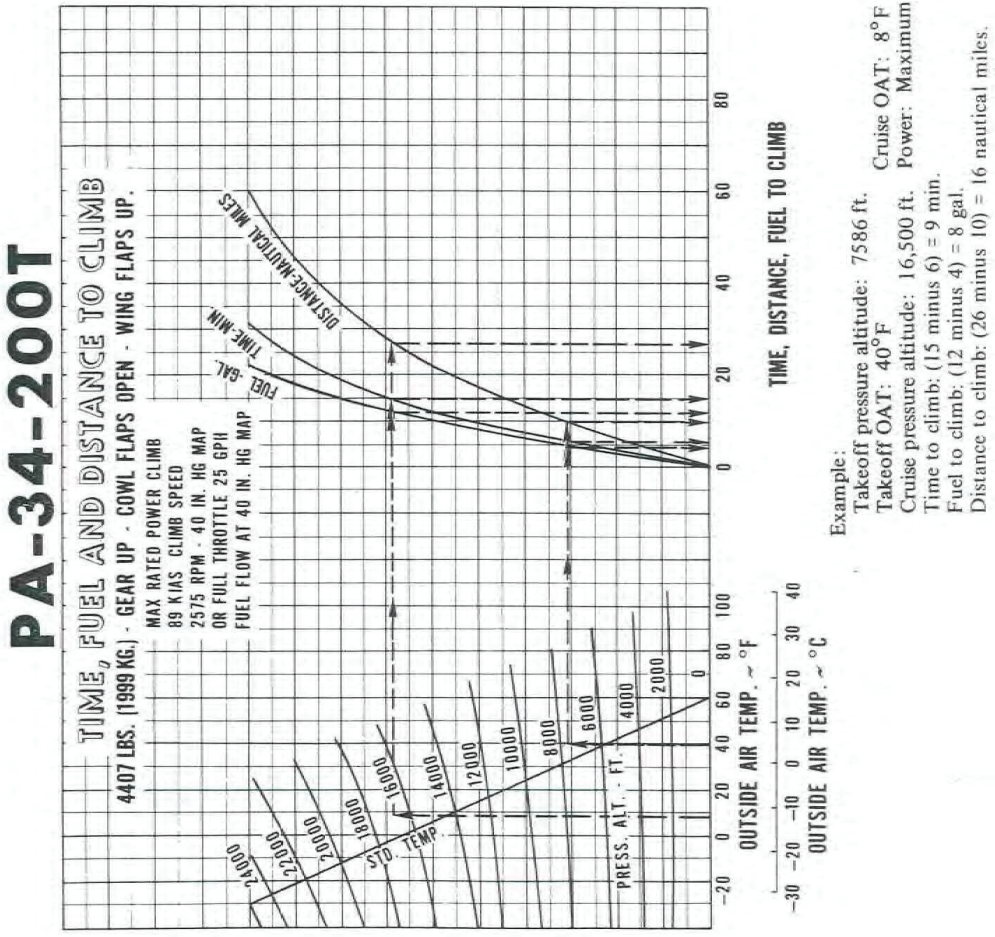


TAKEOFF DISTANCE - SHORT FIELD EFFORT

Figure 5-17



CLIMB PERFORMANCE
Figure 5-19



Example:
Takeoff pressure altitude: 7586 ft.
Takeoff OAT: 40°F
Cruise pressure altitude: 16,500 ft.
Cruise OAT: 8°F
Power: Maximum power climb
Time to climb: (15 minus 6) = 9 min.
Fuel to climb: (12 minus 4) = 8 gal.
Distance to climb: (26 minus 10) = 16 nautical miles.

TIME, FUEL AND DISTANCE TO CLIMB
Figure 5-21

POWER SETTING TABLE – T.C.M. TSIO 360E SERIES

PRESS. ALT. FEET	STD. ALT. TEMP. °C	RPM	45% POWER (APPROX. 16.1 GPH FUEL CONS.)				55% POWER (APPROX. 18 GPH FUEL CONS.)					
		RPM	2000	2100	2200	2300	2000	2200	2300	2400	2500	2575
			MANIFOLD PRESSURE – INCHES MERCURY									
S.L.	15		27.6	26.4	25.6	24.6	31.8	29.6	28.4	27.0	26.0	25.6
2000	11		26.8	25.6	25.0	24.0	30.8	28.5	27.6	26.4	25.4	25.0
4000	7		26.0	25.0	24.0	23.4	29.8	28.0	27.0	25.8	25.0	24.6
6000	3		25.0	24.4	23.6	22.8	29.0	27.4	26.4	25.2	24.4	24.0
8000	-1		24.6	23.6	22.8	22.3		26.6	25.6	24.8	24.0	23.8
10000	-5		23.8	23.0	22.4	21.8		26.0	25.0	24.2	23.6	23.2
12000	-9		23.0	22.4	21.7	21.0		25.0	24.4	23.8	23.0	22.8
14000	-13		22.6	21.8	21.0	20.6		24.5	23.8	23.0	22.6	22.4
16000	-17			21.0	20.4	20.0		24.0	23.4	22.6	22.0	22.0
18000	-21				19.8	19.4			22.8	22.0	21.0	21.7
20000	-25					18.8				21.6	20.8	21.0
22000	-28										20.6	20.8
24000	-33										20.4	20.4
25000	-34										20.0	20.0

To maintain constant power, add approximately 1% for each 6°C above standard, subtract approximately 1% for each 6°C below standard.

NOTE: Full throttle manifold pressure values may not be obtainable when atmospheric conditions are non-standard.

POWER SETTING TABLE (45% AND 55%)
Figure 5-23

POWER SETTING TABLE – T.C.M. TSIO 360E SERIES

PRESS. ALT. FEET	STD. ALT. TEMP. °C	RPM	65% POWER (APPROX. 20.5 GPH FUEL CONS.)						75% POWER (APPROX. 23.6 GPH FUEL CONS.)			
		RPM	2200	2300	2400	2500	2575		2300	2400	2500	2575
			MANIFOLD PRESSURE – INCHES MERCURY									
S.L.	15		33.5	32.0	30.6	29.8	29.2		35.5	34.0	33.0	32.8
2000	11		32.8	31.5	30.0	29.0	28.8		35.0	33.4	32.6	32.0
4000	7		32.0	30.8	29.6	28.6	28.2		34.4	32.8	32.0	31.6
6000	3		31.4	30.0	29.0	28.0	27.8		33.6	32.0	31.4	30.9
8000	-1		30.6	29.6	28.4	27.6	27.4		33.0	31.6	30.8	30.3
10000	-5			28.8	27.8	27.0	27.0		32.4	31.0	30.2	29.8
12000	-9			28.0	27.2	26.6	26.4		31.6	30.4	29.8	29.3
14000	-13			27.4	26.6	26.0	26.0			29.8	29.2	29.0
16000	-17			26.7	26.0	25.8	25.6			29.4	28.8	28.6
18000	-21				25.6	25.2	25.0				28.4	28.3
20000	-25					24.8	24.8					28.0
22000	-28					24.4	24.4					
24000	-33						24.0					
25000	-34											

To maintain constant power, add approximately 1% for each 6°C above standard, subtract approximately 1% for each 6°C below standard.

NOTE: Full throttle manifold pressure values may not be obtainable when atmospheric conditions are non-standard.

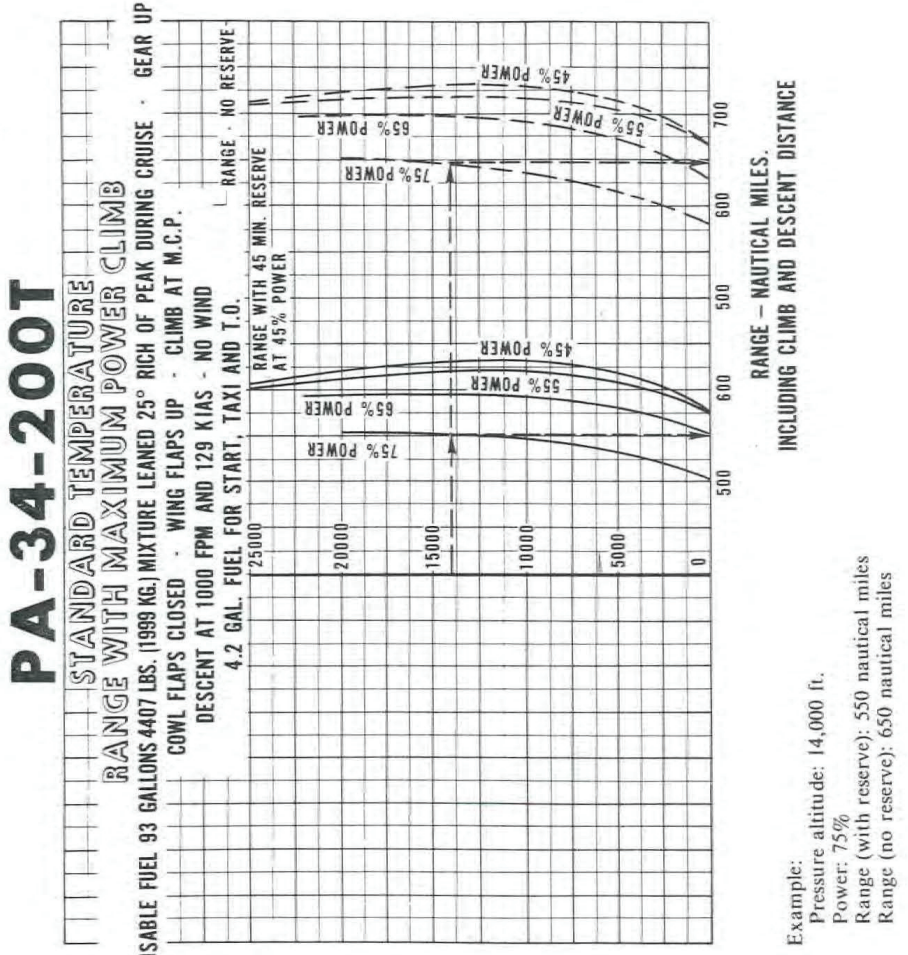
POWER SETTING TABLE (65% AND 75%)
Figure 5-25

NON-STANDARD TEMPERATURE RANGE WITH MAXIMUM POWER CLIMB

USABLE FUEL 93 GALLONS - 4407 LBS. (1999 KG.) - MIXTURE LEANED 25° RICH OF PEAK DURING CRUISE - GEAR UP - COWL FLAPS CLOSED WING FLAPS UP - CLIMB AT M.C.P. - DESCENT AT 1000 FPM AND 129 KIAS NO WIND - 4.2 GAL. FUEL FOR START, TAXI AND T.O.

PRESS. ALT. FEET	O.A.T. °C		45 MIN RESERVE % POWER				NO RESERVE % POWER			
			75	65	55	45	75	65	55	45
0	ISA + 30° C	-15	475	506	537	529	549	585	621	612
5000		-25	505	540	562	575	584	627	664	668
10,000		-35	526	564	593	607	613	657	693	708
15,000		-45	533	574	599	613	625	673	703	720
20,000		-55	539	575	596	606	635	679	704	716
25,000		-65		576	590	595		682	700	703
0	ISA + 15° C	0	491	526	558	555	568	608	646	642
5000		-10	520	558	590	598	604	648	685	695
10,000		-20	537	577	606	623	626	673	708	727
15,000		-30	542	584	607	620	636	685	713	728
20,000		-40	548	582	602	612	646	687	711	723
25,000		-50		580	597	606		686	703	715
0	ISA - 15° C	30	521	561	594	600	603	649	688	694
5000		20	544	585	617	632	634	680	716	734
10,000		10	553	598	623	638	645	697	728	745
15,000		0	560	598	620	632	657	702	728	742
20,000		-10								
25,000		-20								
0	ISA -30° C	45	536	576	610	619	620	667	706	716
5000		35	553	596	627	643	642	692	728	748
10,000		25	561	605	630	644	655	706	736	752
15,000		15	567	604	626	635	665	709	735	747
20,000		5								
25,000		-5								

NON-STANDARD TEMPERATURE RANGE WITH MAXIMUM POWER CLIMB (93 USABLE GAL.)
Figure 5-27



STANDARD TEMPERATURE RANGE WITH
MAXIMUM POWER CLIMB (93 USABLE GAL.)

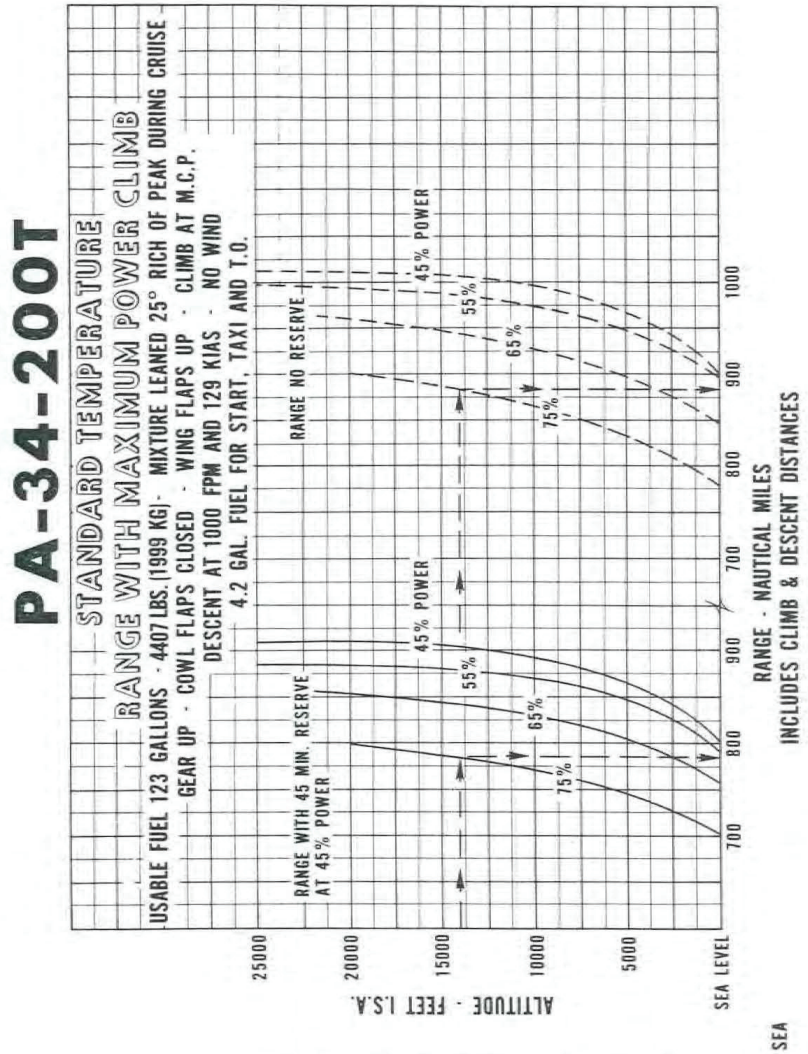
Figure 5-29

NON-STANDARD TEMPERATURE RANGE WITH MAXIMUM POWER CLIMB

USABLE FUEL 123 GALLONS - 4407 LBS. (1999 KG.) - MIXTURE LEANED 25° RICH PEAK DURING CRUISE - GEAR UP - COWL FLAPS CLOSED - WING FLAPS UP CLIMB AT M.C.P. - DESCENT AT 1000 FPM AND 129 KIAS - NO WIND 4.2 GAL. FUEL FOR START, TAXI AND T.O.

PRESS. ALT. FEET	O.A.T. °C		45 MIN RESERVE % POWER				NO RESERVE % POWER			
			75	65	55	45	75	65	55	45
0	ISA + 30° C	-15	660	702	746	735	734	782	830	818
5000		-25	705	756	800	807	785	843	893	901
10,000		-35	742	797	840	859	829	891	939	961
15,000		-45	761	821	857	878	852	920	961	985
20,000		-55	778	832	864	880	874	936	971	990
25,000		-65		835	860	874		941	970	988
0	ISA + 15° C	0	682	731	775	771	759	813	863	858
5000		-10	728	782	827	838	812	870	921	934
10,000		-20	759	816	858	882	848	912	960	987
15,000		-30	775	839	870	888	868	936	975	997
20,000		-40	792	843	874	888	890	948	923	999
25,000		-50		841	869	882		945	978	990
0	ISA - 15° C	30	724	780	826	833	806	868	919	927
5000		20	762	819	864	886	850	914	964	989
10,000		10	781	846	883	904	873	945	987	1011
15,000		0	800	857	889	905	897	960	998	1016
20,000		-10								
25,000		-20								
0	ISA -30° C	-45	745	801	848	860	829	891	943	957
5000		35	774	835	879	903	864	930	980	1007
10,000		25	793	857	892	912	887	958	998	1021
15,000		15	812	866	897	912	910	970	1007	1024
20,000		15								
25,000		-5								

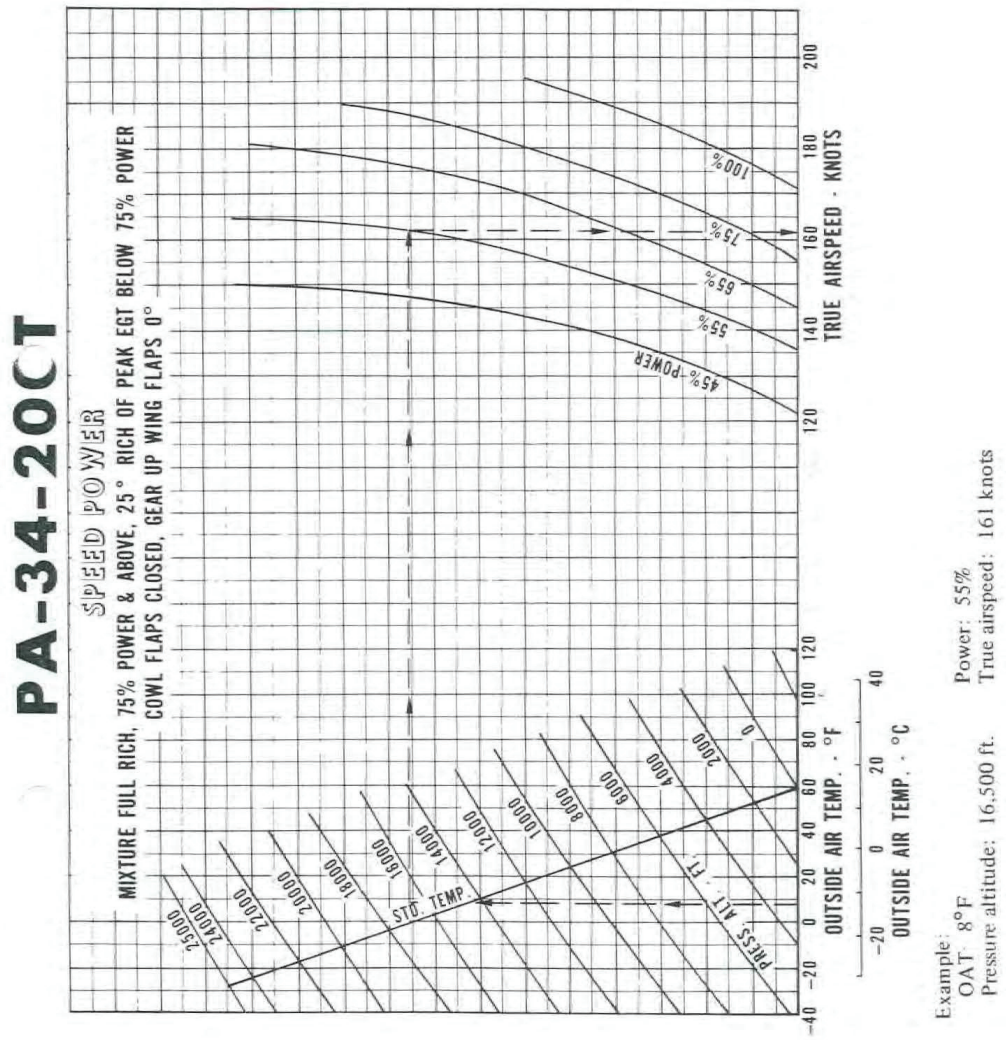
NON-STANDARD TEMPERATURE RANGE WITH MAXIMUM POWER CLIMB (123 USABLE GAL.)
Figure 5-31



Example:
Pressure altitude: 14,000 ft.
Power: 75%
Range (with reserve): 785 nautical miles
Range (no reserve): 880 nautical miles

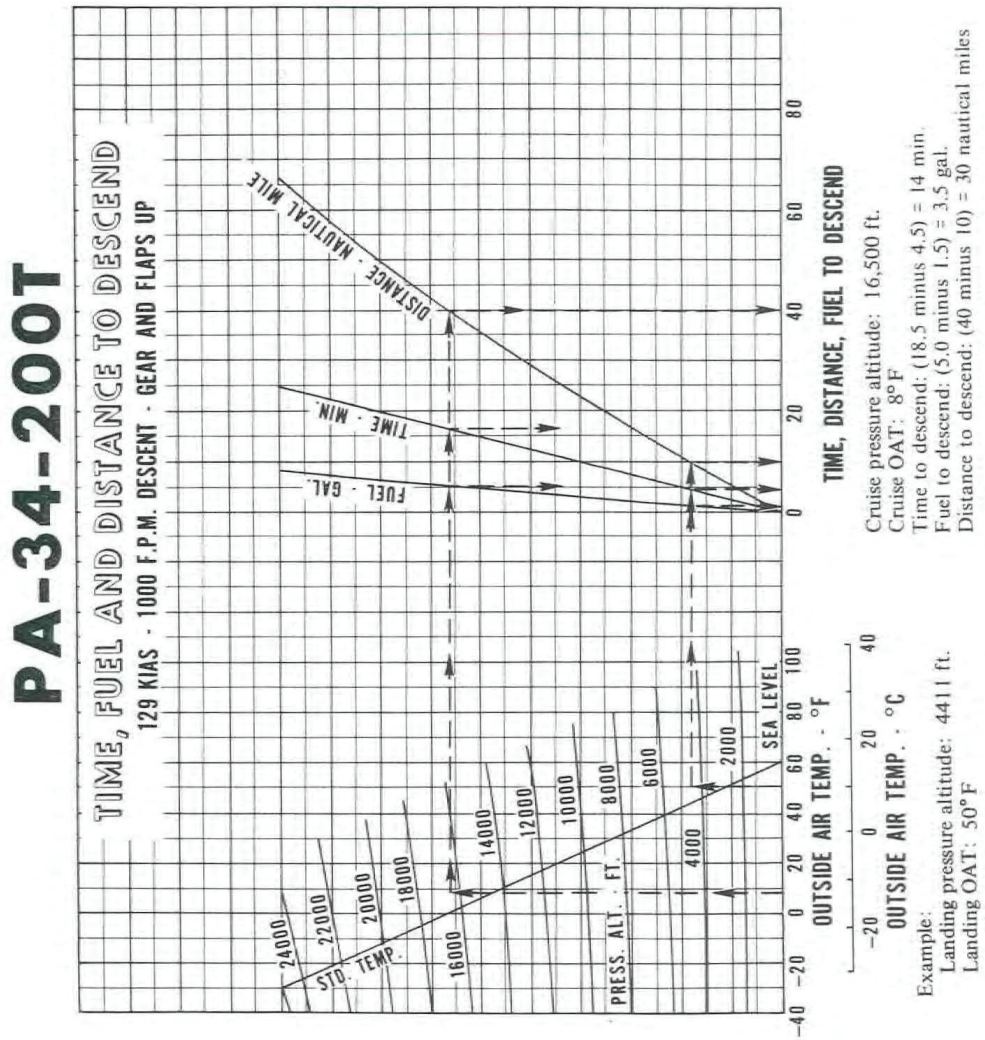
STANDARD TEMPERATURE RANGE WITH MAXIMUM POWER CLIMB (123 USABLE GAL.)

Figure 5-33



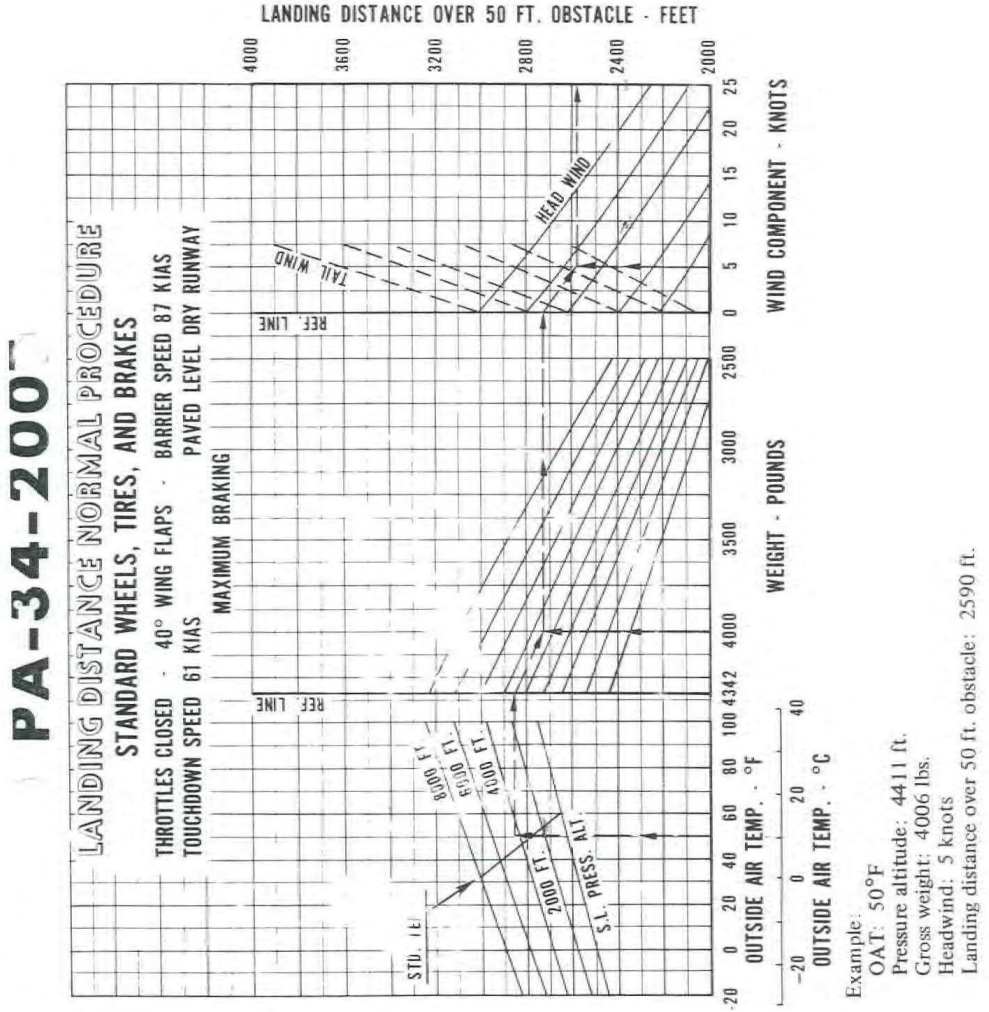
SPEED POWER

Figure 5-35



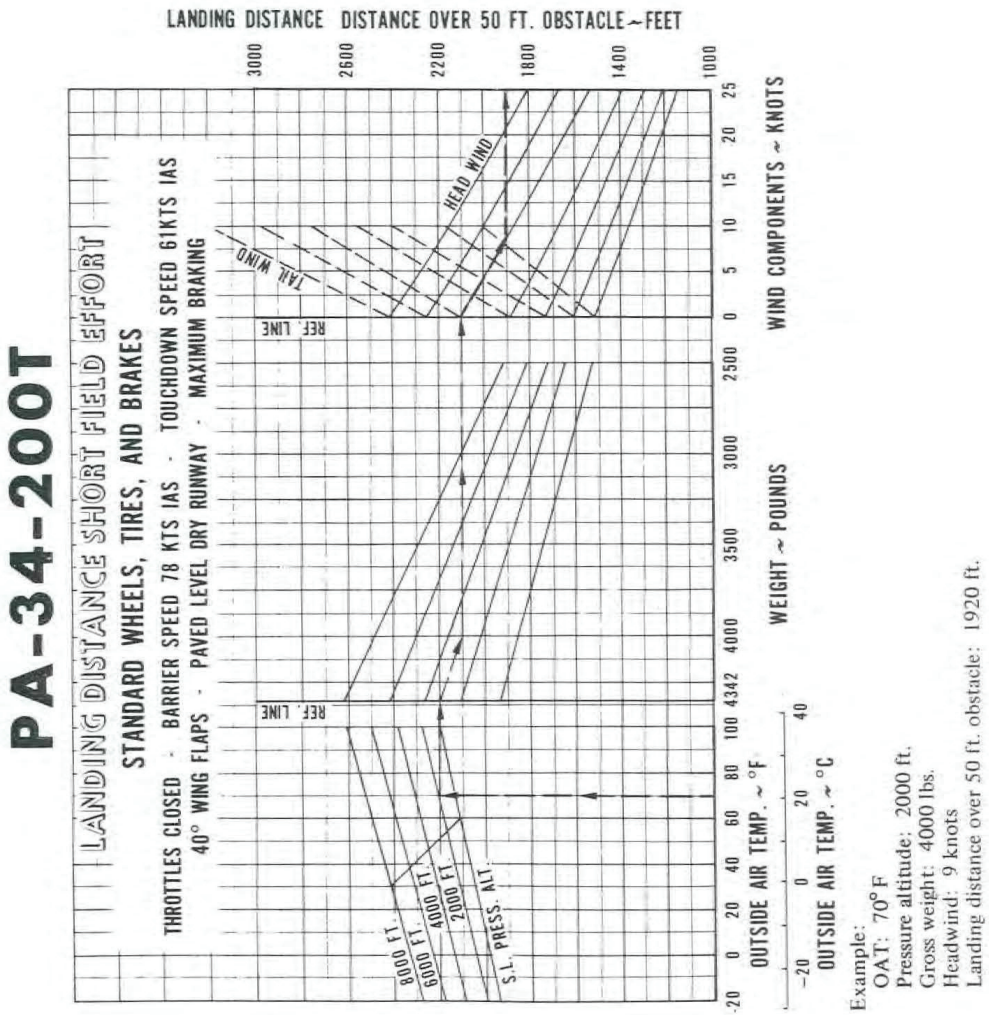
TIME, FUEL AND DISTANCE TO DESCEND

Figure 5-37



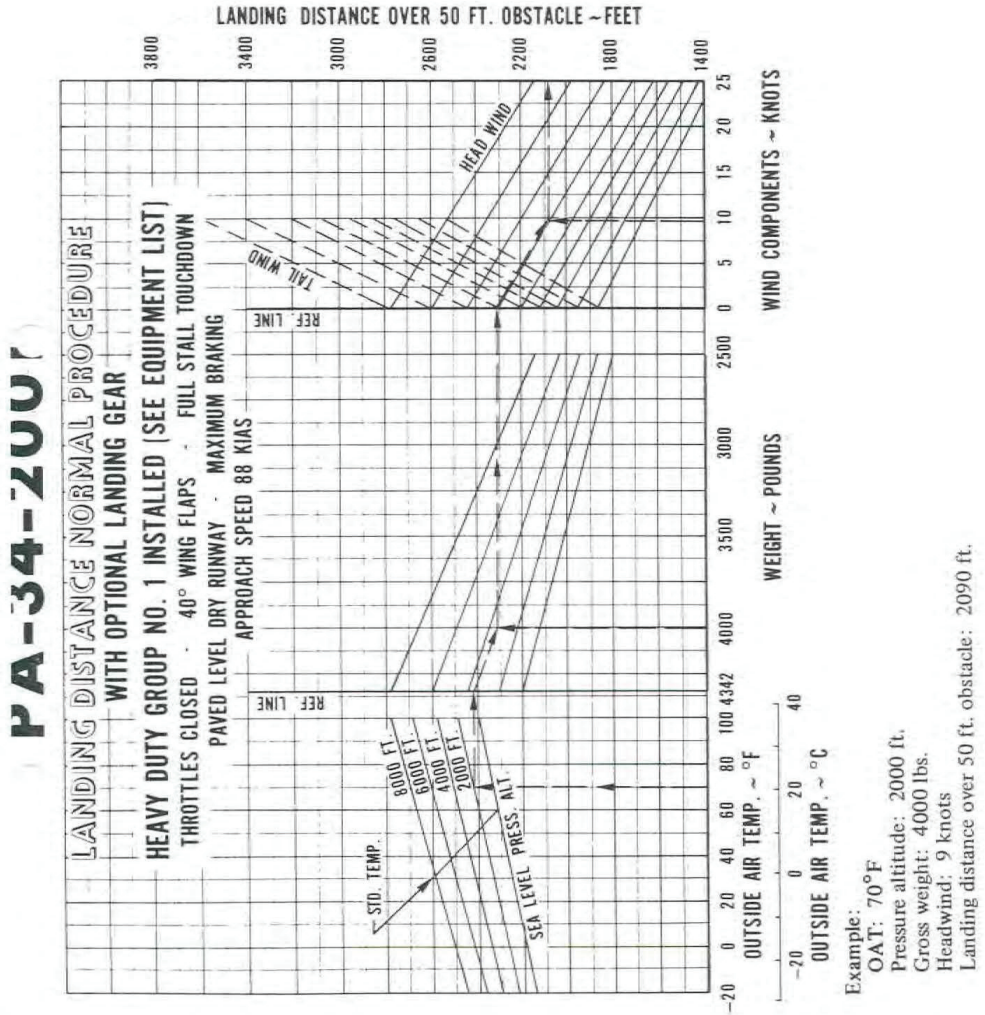
LANDING DISTANCE - NORMAL PROCEDURE (STANDARD)

Figure 5-39



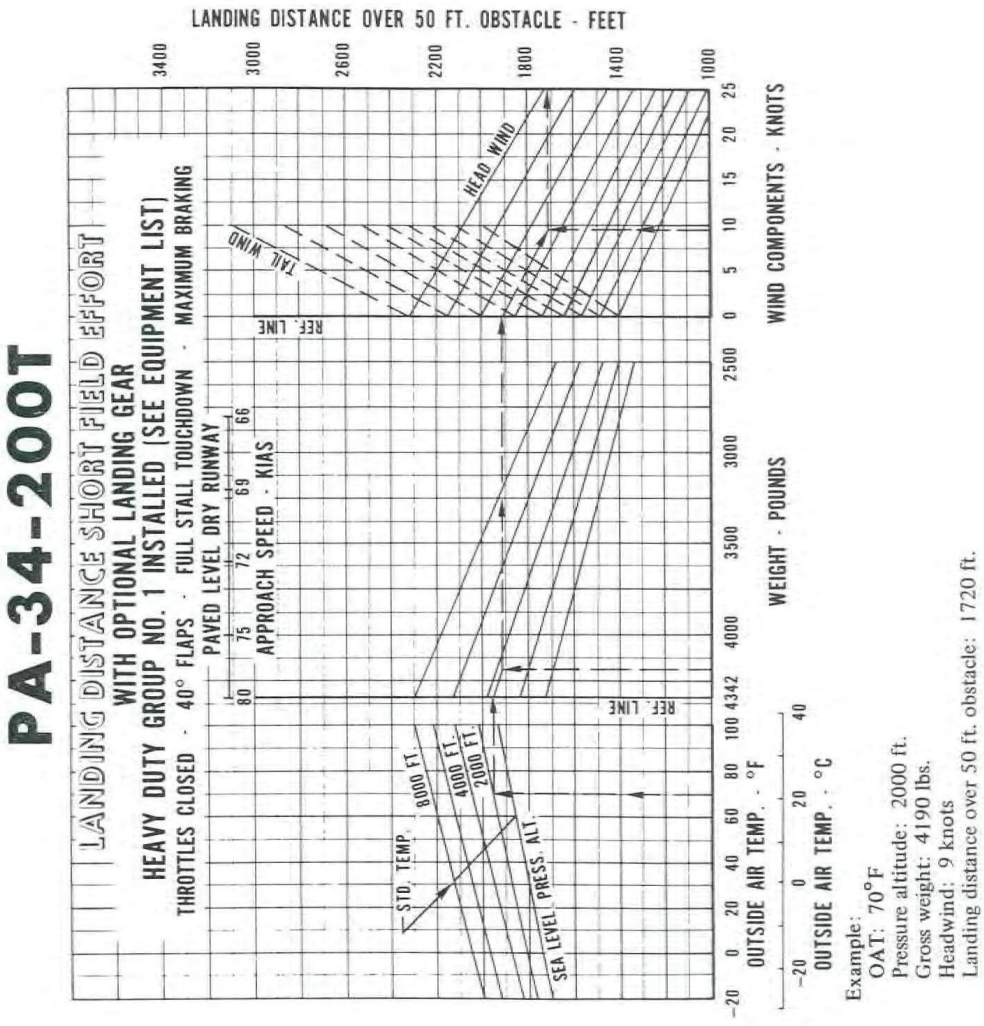
LANDING DISTANCE - SHORT FIELD EFFORT (STANDARD)

Figure 5-41



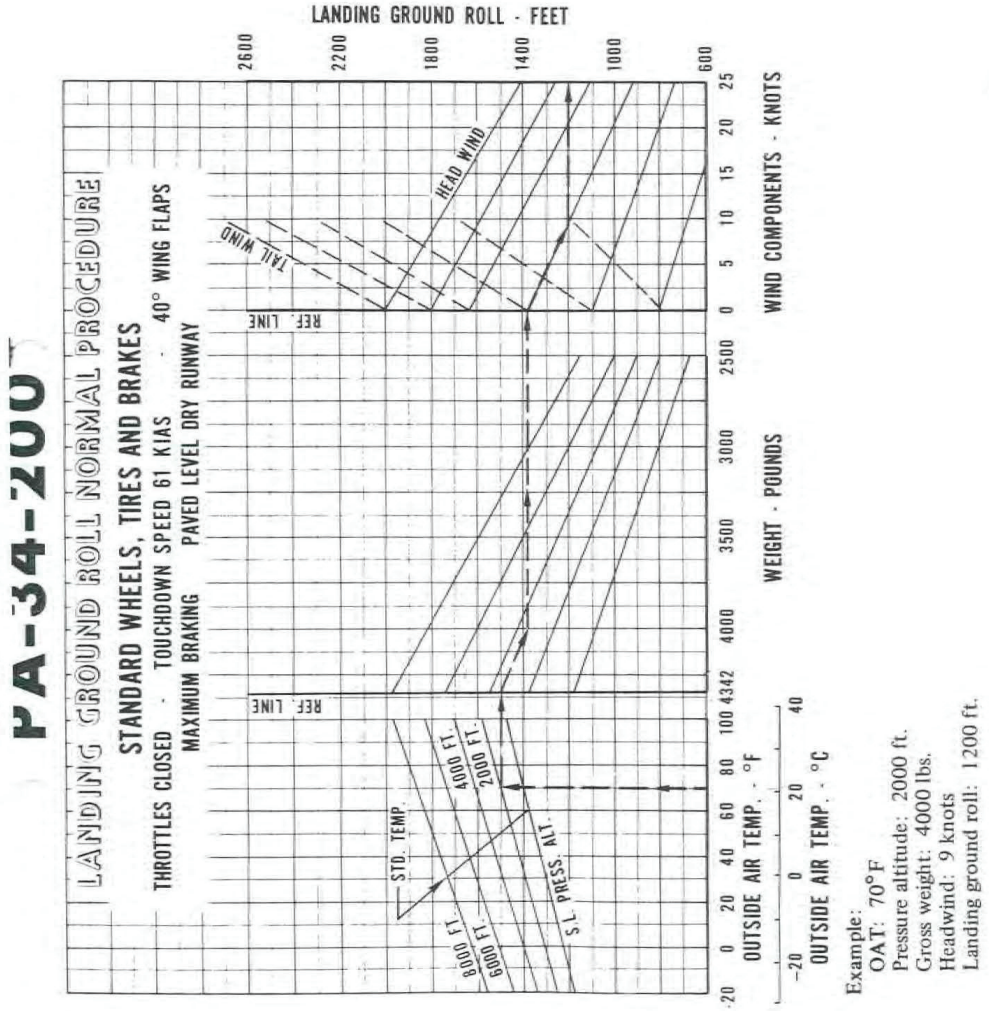
LANDING DISTANCE - NORMAL PROCEDURE (HEAVY DUTY GROUP 1)

Figure 5-43



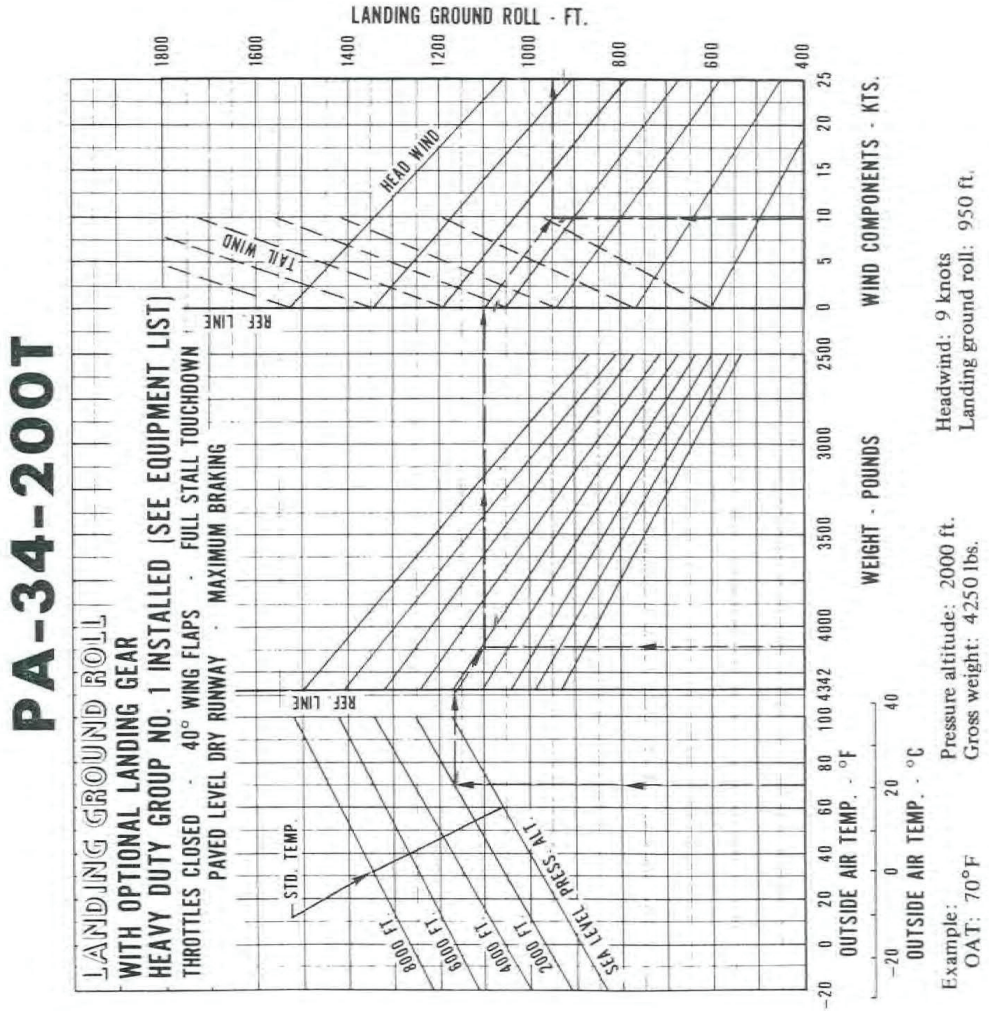
LANDING DISTANCE - SHORT FIELD EFFORT (HEAVY DUTY GROUP 1)

Figure 5-45



LANDING GROUND ROLL - NORMAL PROCEDURE (STANDARD)

Figure 5-47



LANDING GROUND ROLL (HEAVY DUTY GROUP 1)

Figure 5-49