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SECTION 5

PERFORMANCE

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SECTION 5

PERFORMANCE

5.1 GENERAL

All of the required (FAA regulations) and complementary performance information applicable to the Arrow IV 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.

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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	1890 lbs.
(2) Occupants (2 x 170 lbs.)	340 lbs.
(3) Baggage and Cargo	70 lbs.
(4) Fuel (6 lb./gal. x 50)	300 lbs.
(5) Takeoff Weight	2600 lbs.
(6) Landing Weight	
(a)(5) minus (g)(1), (2600 lbs. minus 62 lbs.)	2538 lbs.

Our takeoff weight is below the maximum of 2750 lbs., 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 5-5, 5-7, 5-9 and 5-11) 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	1900 ft.	1900 ft.
(2) Temperature	20°C	20°C
(3) Wind Component (Headwind)	4 KTS	2 KTS
(4) Runway Length Available	3000 ft.	4600 ft.
(5) Runway Required	2250 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 5-9
**reference Figure 5-35

(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 Fuel, Time and Distance to Climb graph (Figure 5-17). 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 5-17). 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 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 our flight planning example.

(1) Cruise Pressure Altitude	6000 ft.
(2) Cruise OAT	3°C
(3) Time to Climb (9.2 min. minus 2.8 min.)	6.4 min.*
(4) Distance to Climb (15 naut. miles minus 4 naut. miles)	11 naut. miles*
(5) Fuel to Climb (2 gal. minus 0.5 gal.)	1.5 gal.*

(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 fuel, time and distance for descent (Figure 5-31). 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 5-17

values from the graph (Figure 5-31). Now, subtract the values obtained from the field conditions from the values obtained from the cruise conditions to find the true fuel, time 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 (6 min. minus 2 min.)	4 min.*
(2) Distance to Descend (15.7 naut. miles minus 4.8 naut. miles)	10.9 naut. miles*
(3) Fuel to Descend (1.5 gal. minus 0.5 gal.)	1.0 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 Power Setting Table (Figure 5-19) 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 5-21 or 5-23).

Calculate the cruise fuel flow for the cruise power setting (65% Power Best Economy for this example) from the information provided by the Best Economy Range chart (Figure 5-27).

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	130 naut. miles
(2) Cruise Distance (e)(1) minus (c)(4) minus (d)(2), (130 naut. miles minus 11 naut. miles minus 10.9 naut. miles)	108.1 naut. miles

*reference Figure 5-31

(3) Cruise Power (Best Economy) — 65% rated power
(4) Cruise Speed — 126 KTS TAS*
(5) Cruise Fuel Consumption — 9.2 GPH*
(6) Cruise Time
(e)(2) divided by (e)(4), (108 naut. miles divided by 126 KTS) — .86 hrs. (52 min.)

(7) Cruise Fuel
(e)(5) multiplied by (e)(6), (9.2 GPH mulitiplied by .86 hrs.) — 7.9 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 our flight planning example.

(1) Total Flight Time
(c)(3) plus (d)(1) plus (e)(6),
(.11 hrs. plus .07 hrs. plus .86 hrs.)
(6.4 min. plus 4 min. plus 52 min.) — 1.04 hrs. 62.4 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 our example flight plan are shown below.

(1) Total Fuel Required
(c)(5) plus (d)(3) plus (e)(7),
(1.5 gal. plus 1.0 gal. plus 7.9 gal.) — 10.4 gal.
(10.4 gal. multiplied by 6 lb./gal.) — 62 lbs.

*reference Figure 5-23

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5.7 PERFORMANCE GRAPHS

LIST OF FIGURES

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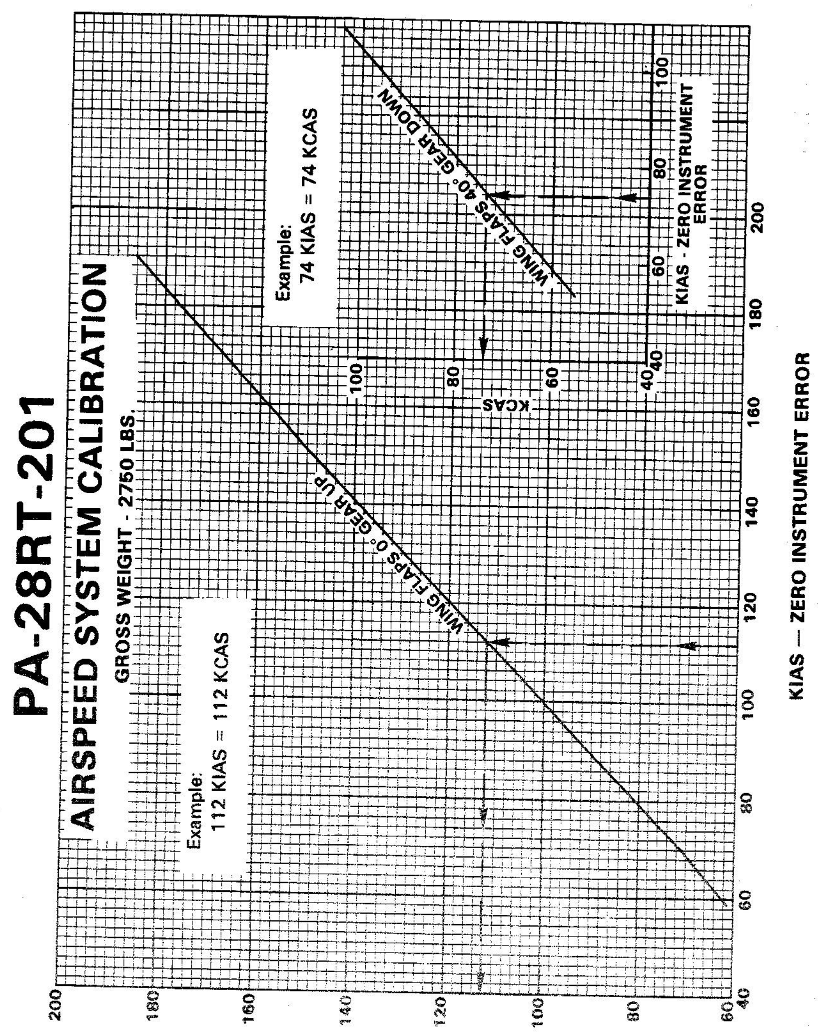
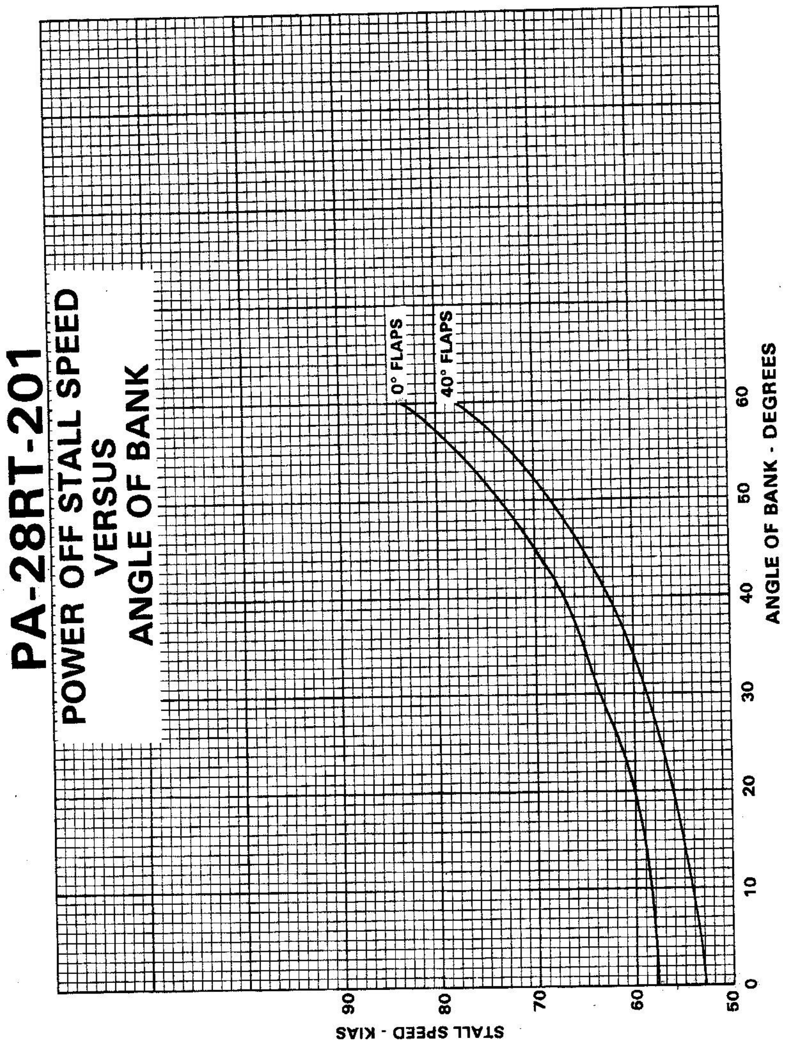
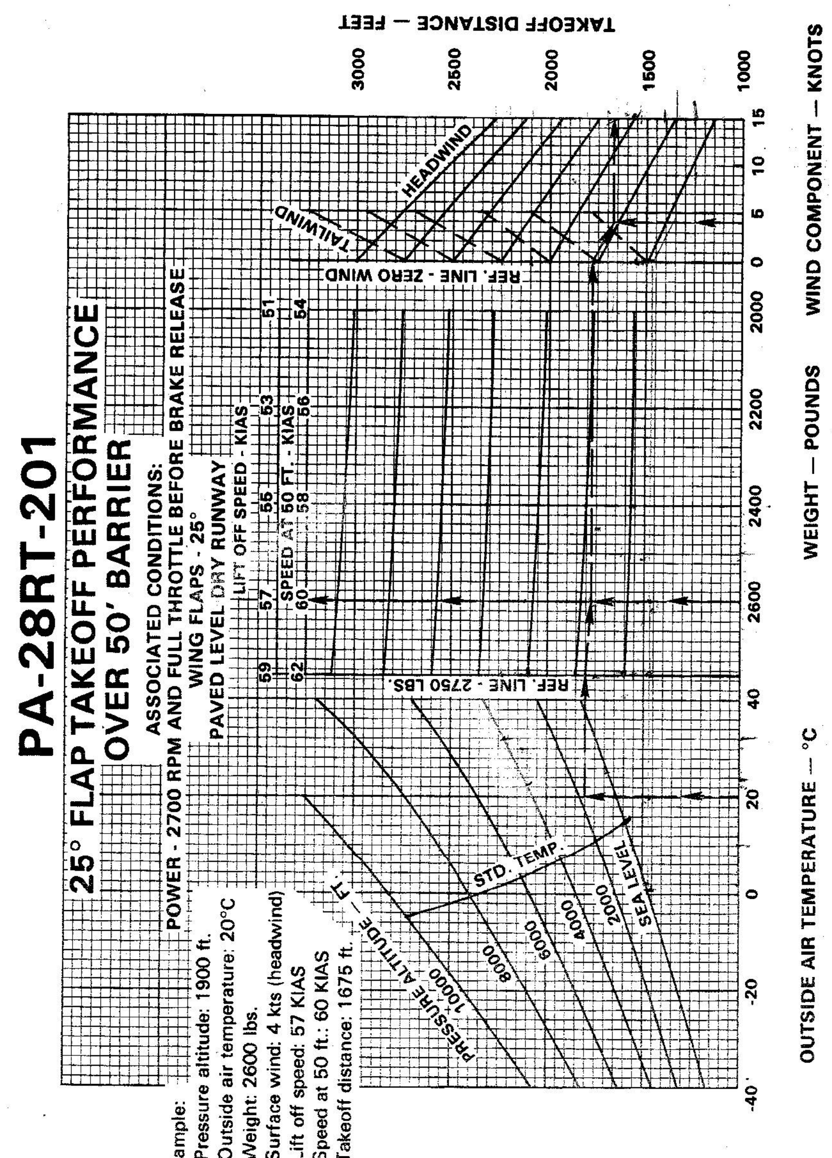


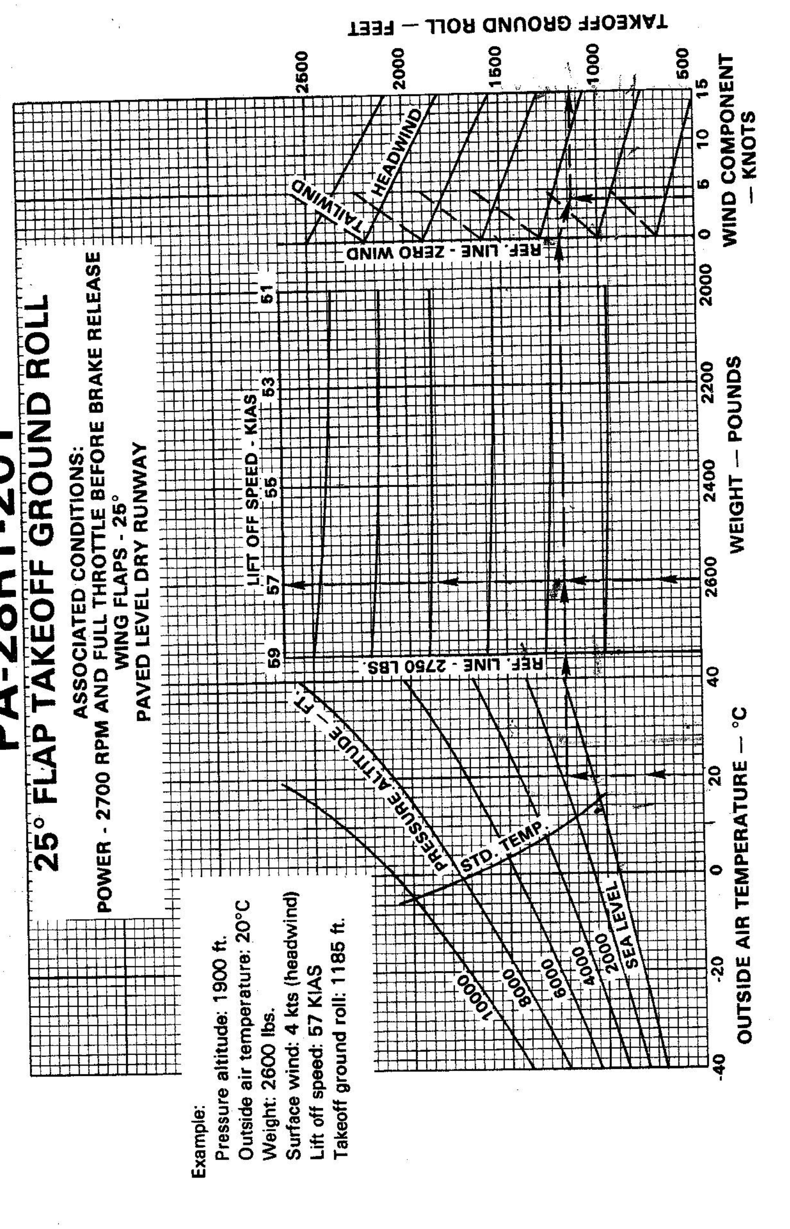
AIRSPEED SYSTEM CALIBRATION
Figure 5-1



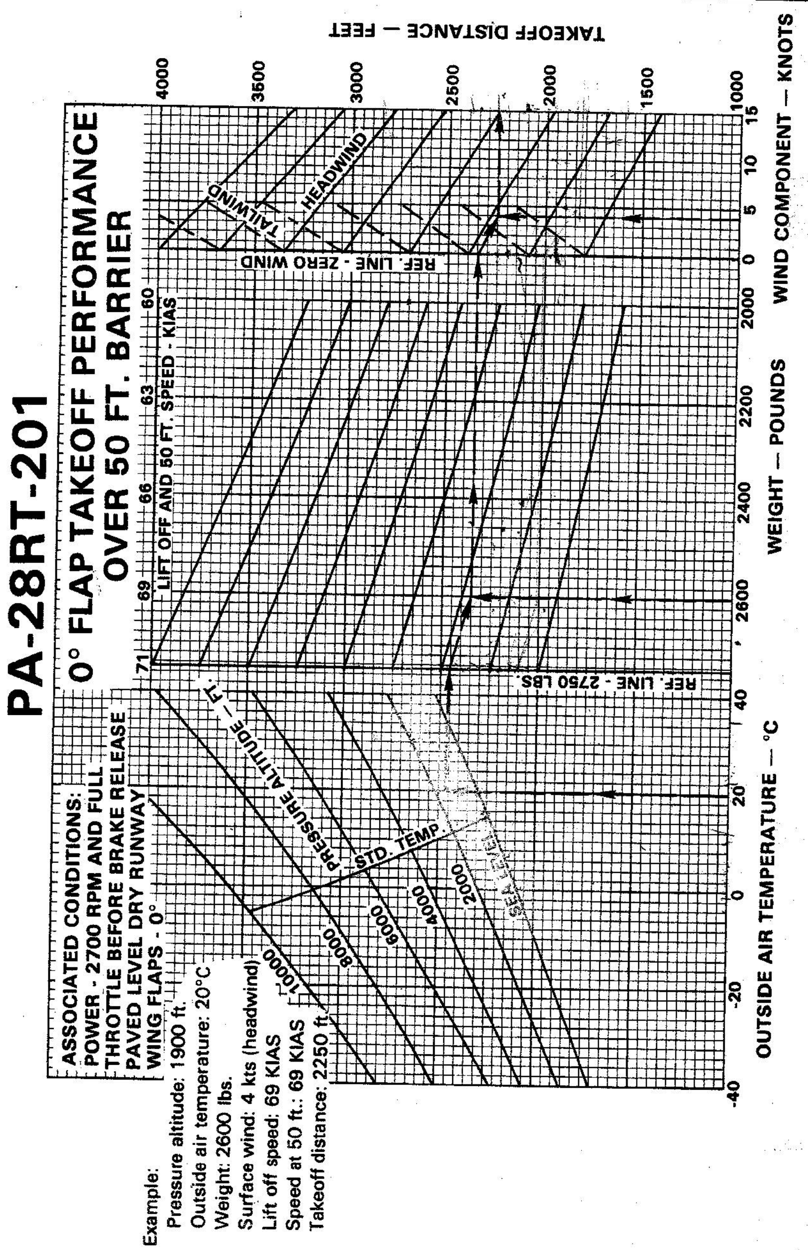
POWER OFF STALL SPEED VS. ANGLE OF BANK
Figure 5-3


PA-28RT-201
25° FLAP TAKEOFF PERFORMANCE
OVER 50' BARRIER
ASSOCIATED CONDITIONS:
POWER - 2700 RPM AND FULL THROTTLE BEFORE BRAKE RELEASE
WING FLAPS - 25°
PAVED LEVEL DRY RUNWAY
LIFT OFF SPEED - KIAS
59 57 55 53 51
SPEED AT 50 FT. - KIAS
62 60 58 56 54
REF. LINE - 2750 LBS.
REF. LINE - ZERO WIND
TAILWIND
HEADWIND
STD. TEMP.
PRESSURE ALTITUDE — FT.
10000
8000
6000
4000
2000
SEA LEVEL
TAKEOFF DISTANCE — FEET
3000
2500
2000
1500
1000
-40
-20
0
20
40
2600
2400
2200
2000
0
5
10
15
OUTSIDE AIR TEMPERATURE — °C
WEIGHT — POUNDS
WIND COMPONENT — KNOTS
ample:
Pressure altitude: 1900 ft.
Outside air temperature: 20°C
Weight: 2600 lbs.
Surface wind: 4 kts (headwind)
Lift off speed: 57 KIAS
Speed at 50 ft.: 60 KIAS
akeoff distance: 1675 ft.

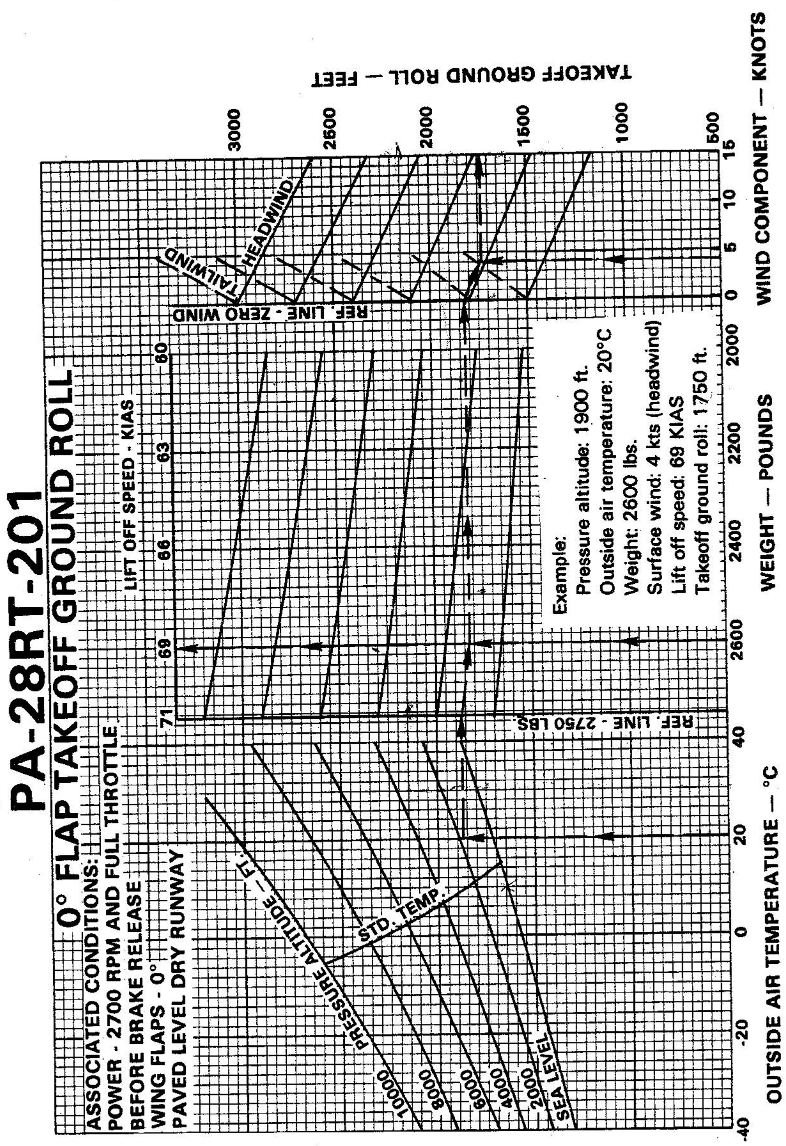
25° FLAP TAKEOFF PERFORMANCE
Figure 5-5



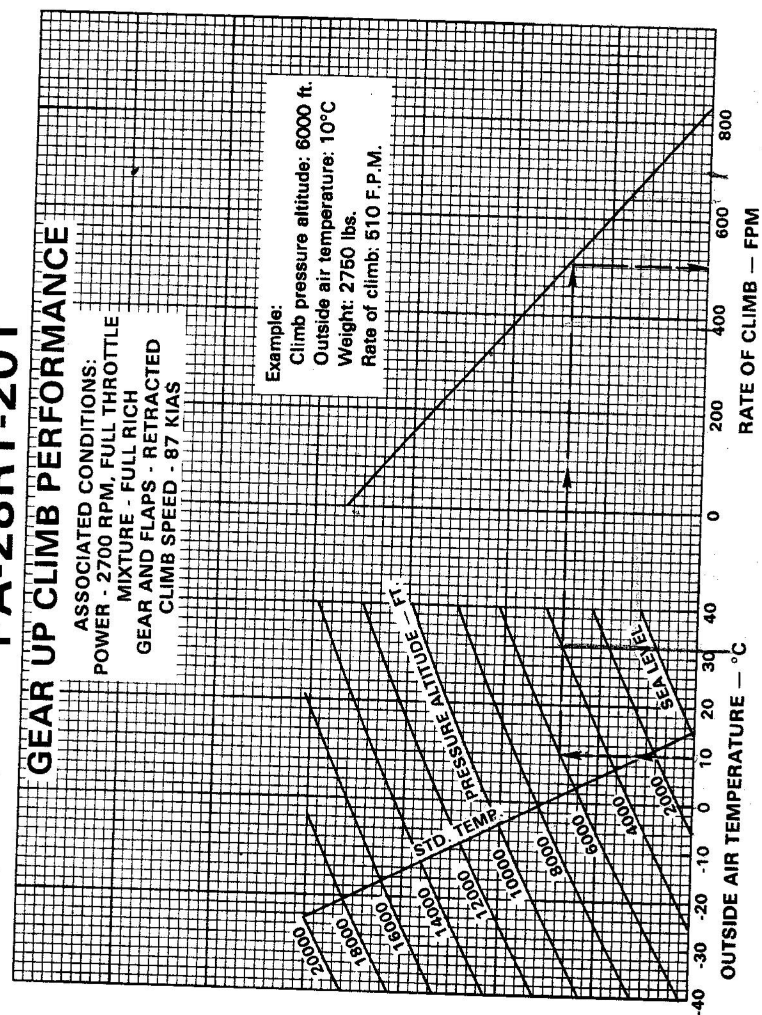
25° FLAP TAKEOFF GROUND ROLL
Figure 5-7



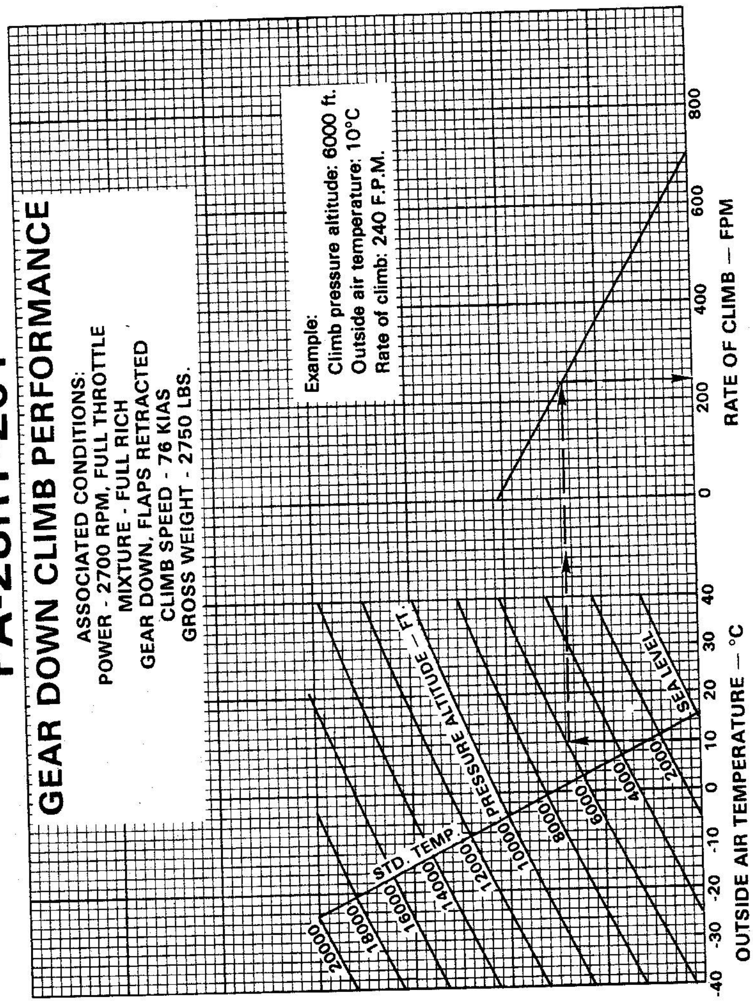
0° FLAP TAKEOFF PERFORMANCE
Figure 5-9



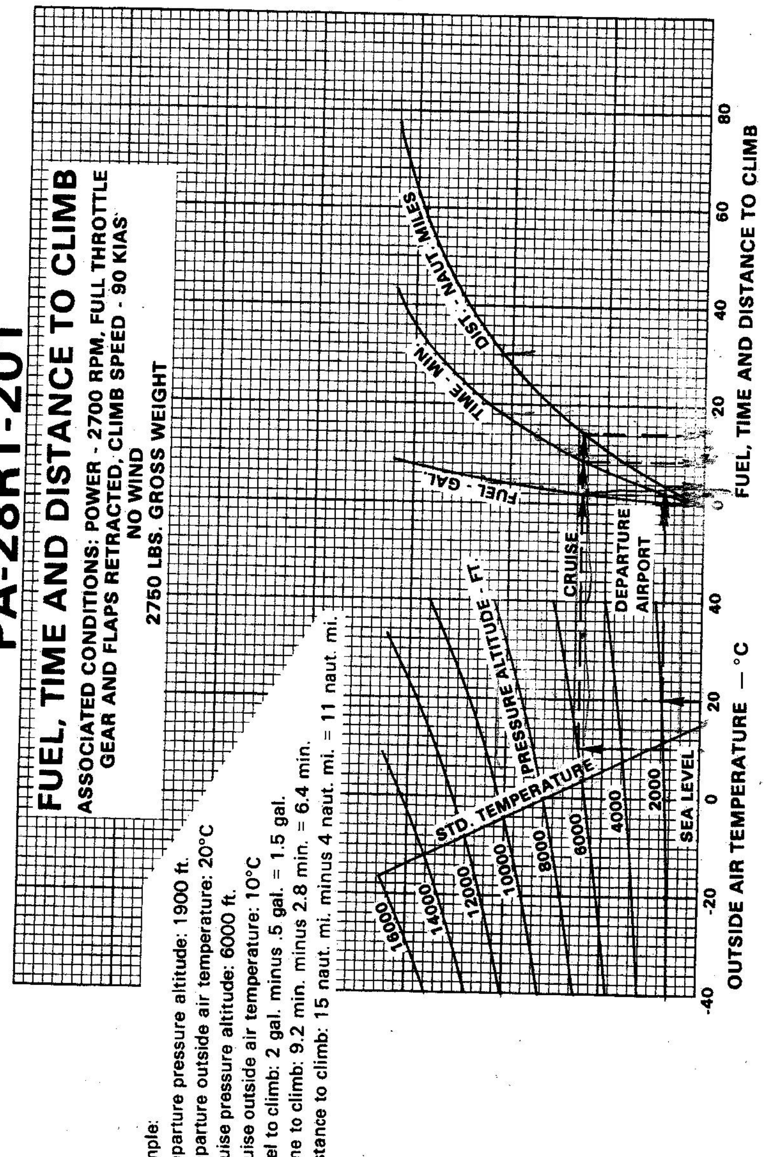
0° FLAP TAKEOFF GROUND ROLL
Figure 5-11



GEAR UP CLIMB PERFORMANCE
Figure 5-13



GEAR DOWN CLIMB PERFORMANCE
Figure 5-15



FUEL, TIME AND DISTANCE TO CLIMB
Figure 5-17

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Power Setting Table - Lycoming Model IO-360-C Series, 200 HP Engine

Press. Alt. Feet	Std. Alt. Temp. °F	110 HP - 55% Rated RPM AND MAN. PRESS. 2100	110 HP - 55% Rated RPM AND MAN. PRESS. 2400	130 HP - 65% Rated RPM AND MAN. PRESS. 2100	130 HP - 65% Rated RPM AND MAN. PRESS. 2400	150 HP - 75% Rated RPM AND MAN. PRESS. 2400	Press. Alt. Feet
S.L.	59	22.9	20.4	25.9	22.9	25.5	S.L.
1000	55	22.7	20.2	25.6	22.7	25.2	1000
2000	52	22.4	20.0	25.4	22.5	25.0	2000
3000	48	22.2	19.8	25.1	22.2	24.7	3000
4000	45	21.9	19.5	24.8	22.0	24.4	4000
5000	41	21.7	19.3	FT	21.7	FT	5000
6000	38	21.4	19.1	- -	21.5	- -	6000
7000	34	21.2	18.9	- -	21.3	- -	7000
8000	31	21.0	18.7	- -	21.0		8000
9000	27	FT	18.5	- -	FT		9000
10000	23	- -	18.3				10000
11000	19	- -	18.1				11000
12000	16	- -	17.8				12000
13000	12	- -	17.6				13000
14000	9	- -	FT				14000

To maintain constant power, correct manifold pressure approximately 0.16" Hg for each 10°F variation in inlet air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard.

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

POWER SETTING TABLE
Figure 5-19

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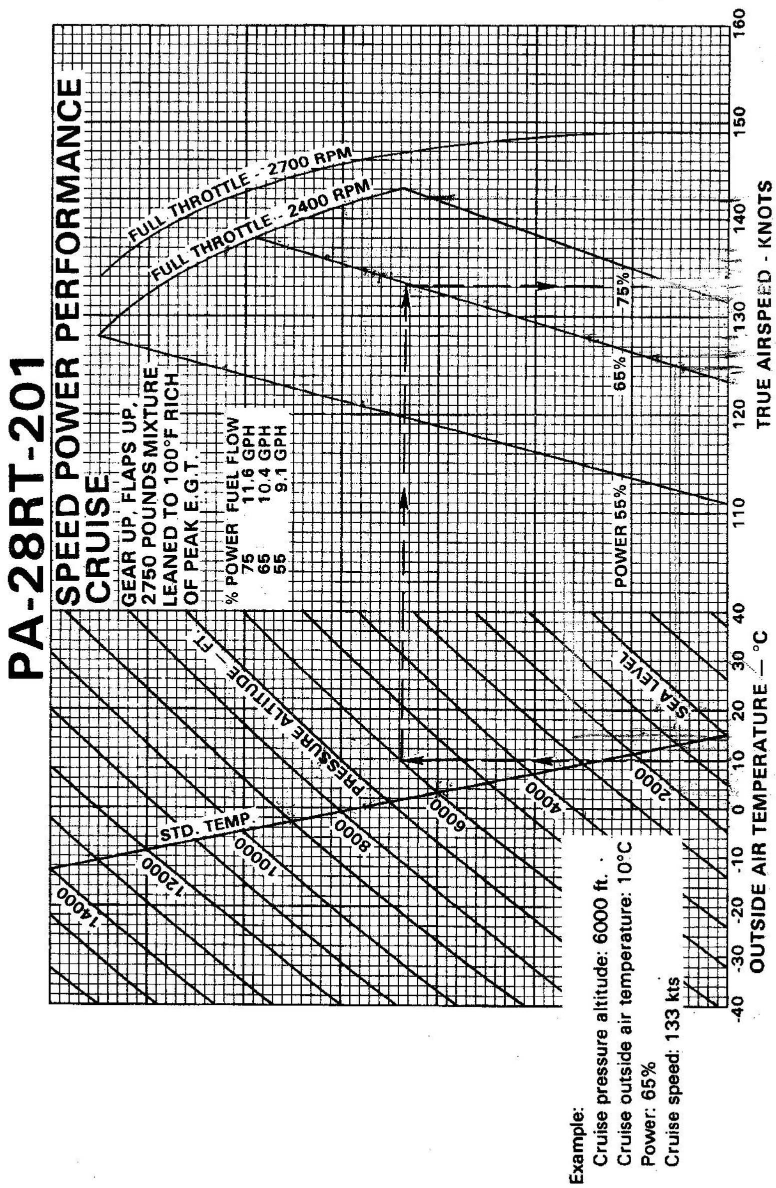

SPEED POWER - PERFORMANCE CRUISE
Figure 5-21

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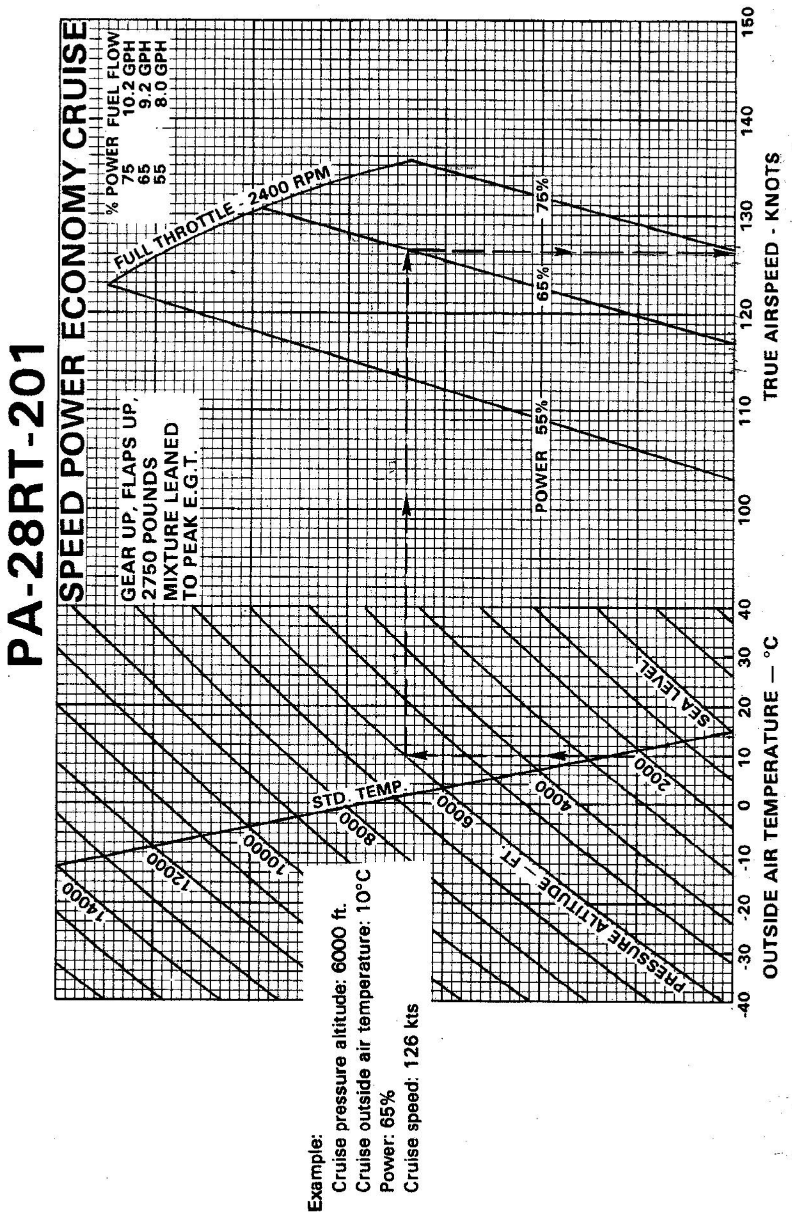
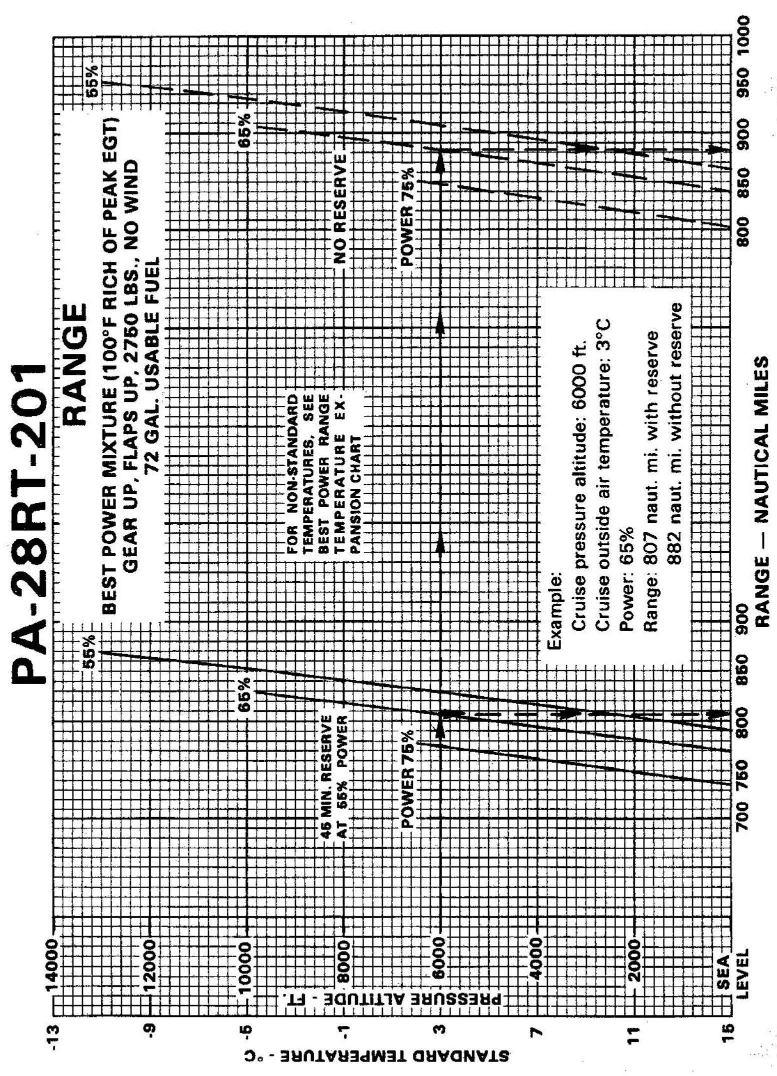


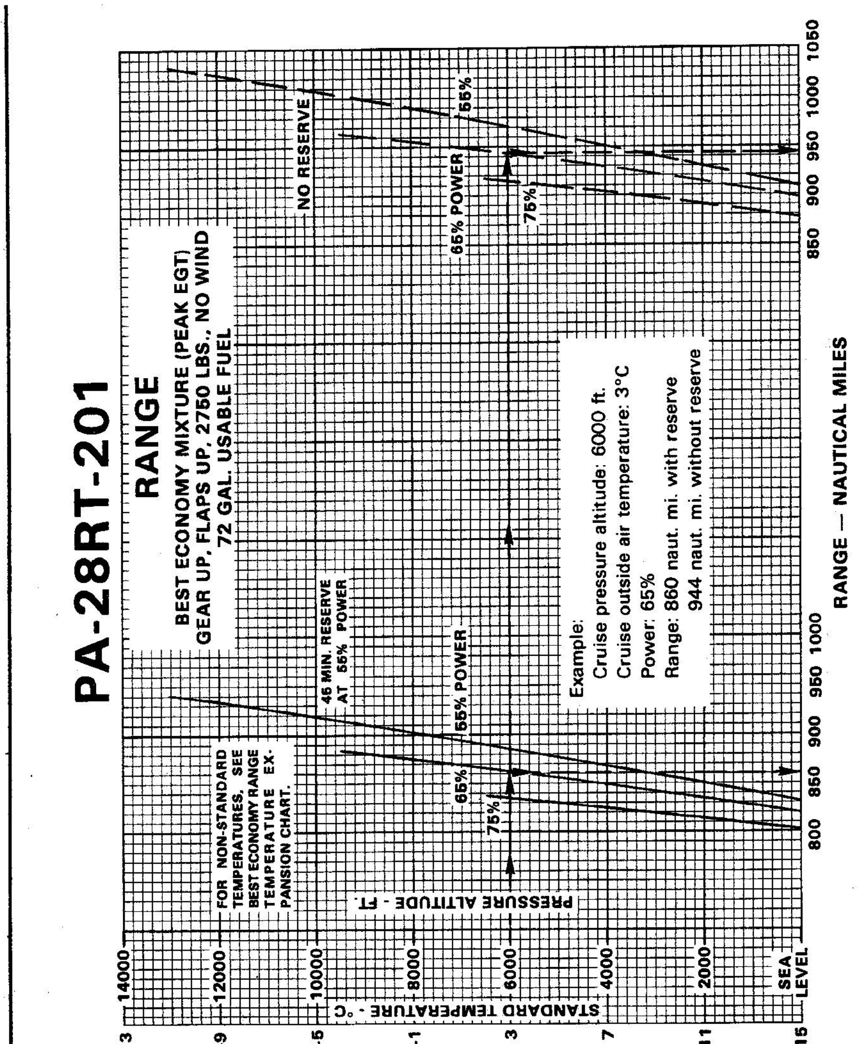
SPEED POWER - ECONOMY CRUISE
Figure 5-23

Pressure Altitude Feet	Outside Air Temp. °C	45 Min. Reserve % Power			No Reserve % Power		
		75	65	55	75	65	55
0	-15	699	737	754	764	805	824
2000	-19	712	748	766	778	818	838
4000	-23	725	759	778	793	831	852
6000	-27	737	771	790	807	844	865
8000	-31	—	782	802	—	857	879
10000	-35	—	793	814	—	869	892
12000	-39	—	—	825	—	—	905
14000	-43	—	—	836	—	—	918
0	0	717	754	772	783	824	844
2000	-4	730	765	785	798	837	858
4000	-8	743	777	797	813	850	872
6000	-12	756	789	809	827	863	886
8000	-16	—	800	821	—	876	900
10000	-20	—	811	833	—	889	913
12000	-24	—	—	844	—	—	926
14000	-28	—	—	855	—	—	939
0	30	749	785	805	819	858	880
2000	26	763	797	818	834	871	894
4000	22	776	809	831	849	885	909
6000	18	790	821	843	864	898	923
8000	14	—	832	855	—	912	937
10000	10	—	844	867	—	925	950
12000	6	—	—	878	—	—	963
14000	2	—	—	887	—	—	974
0	45	764	799	820	835	873	896
2000	41	778	811	833	850	887	911
4000	37	791	823	846	866	901	925
6000	33	805	835	858	881	914	940
8000	29	—	847	871	—	928	954
10000	25	—	858	882	—	940	967
12000	21	—	—	892	—	—	978
14000	17	—	—	898	—	—	987

**BEST POWER RANGE
TEMPERATURE EXPANSION CHART**
Figure 5-24



RANGE - BEST POWER MIXTURE
Figure 5-25



RANGE - BEST ECONOMY MIXTURE
Figure 5-27

Pressure Altitude Feet	Outside Air Temp. °C	45 Min. Reserve % Power			No Reserve % Power		
		75	65	55	75	65	55
0	-15	770	784	784	841	857	857
2000	-19	780	797	802	853	871	877
4000	-23	791	809	819	865	886	897
6000	-27	801	822	837	877	900	916
8000	-31	—	834	854	—	914	935
10000	-35	—	846	870	—	928	954
12000	-39	—	—	886	—	—	972
14000	-43	—	—	901	—	—	990
0	0	787	803	808	860	878	883
2000	-4	797	816	827	872	893	904
4000	-8	808	829	844	884	907	924
6000	-12	818	842	862	896	922	943
8000	-16	—	854	878	—	936	963
10000	-20	—	866	895	—	950	981
12000	-24	—	—	911	—	—	999
14000	-28	—	—	925	—	—	1017
0	30	817	838	853	893	916	932
2000	26	828	852	871	905	931	953
4000	22	839	865	889	918	946	973
6000	18	850	877	906	930	961	992
8000	14	—	890	923	—	975	1011
10000	10	—	902	939	—	988	1029
12000	6	—	—	953	—	—	1046
14000	2	—	—	965	—	—	1060
0	45	831	854	873	908	933	954
2000	41	842	868	891	920	949	975
4000	37	853	881	909	933	963	995
6000	33	864	893	926	946	978	1014
8000	29	—	906	943	—	992	1033
10000	25	—	917	958	—	1005	1050
12000	21	—	—	970	—	—	1065
14000	17	—	—	977	—	—	1074

BEST ECONOMY RANGE
TEMPERATURE EXPANSION CHART
Figure 5-28

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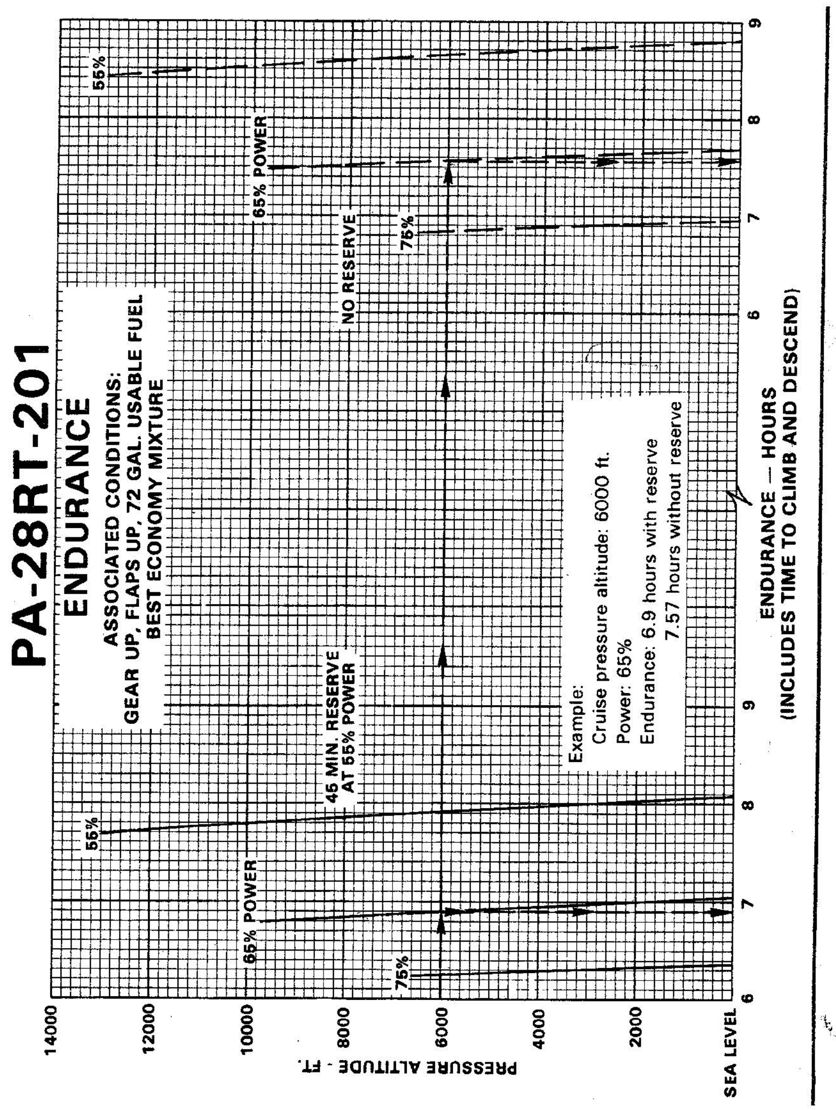
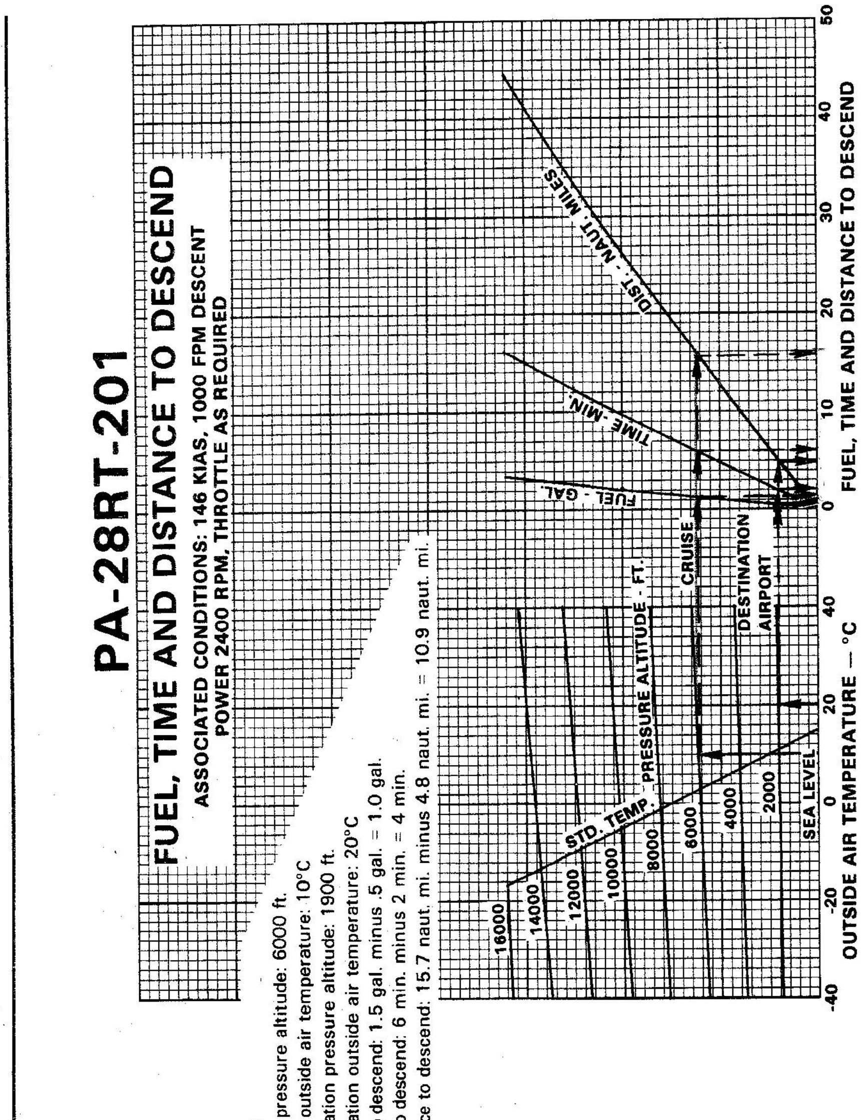
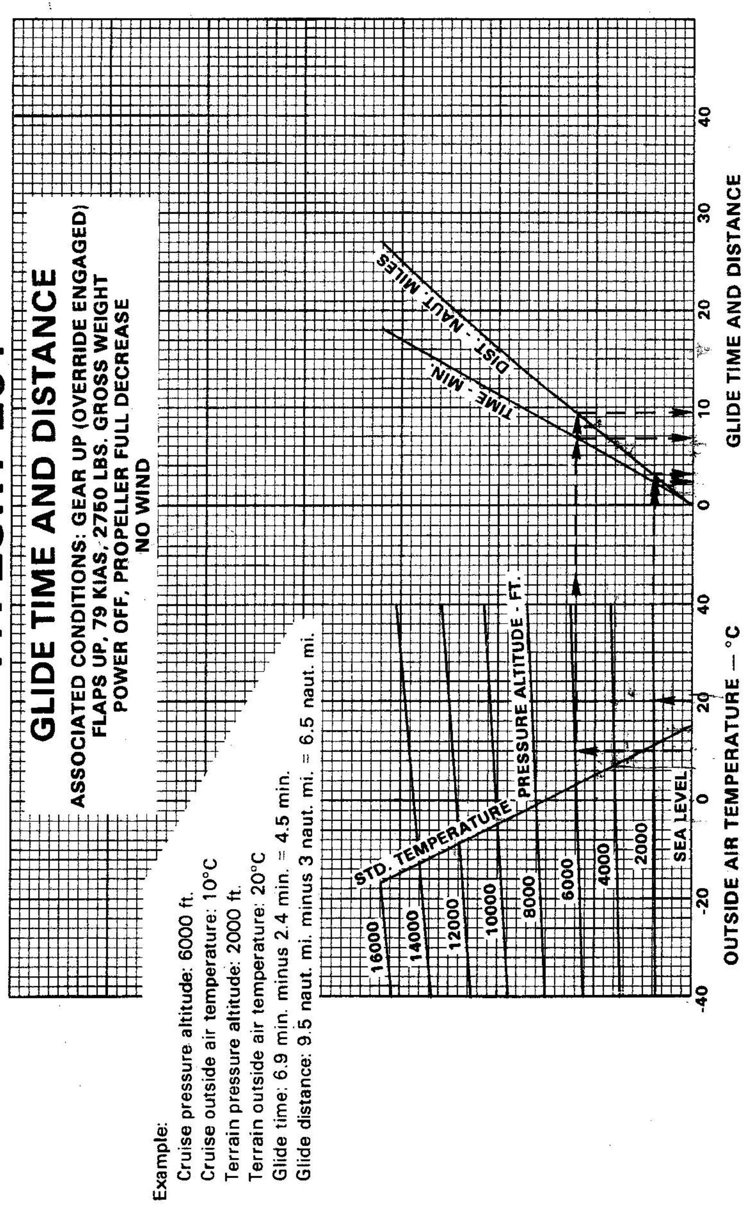


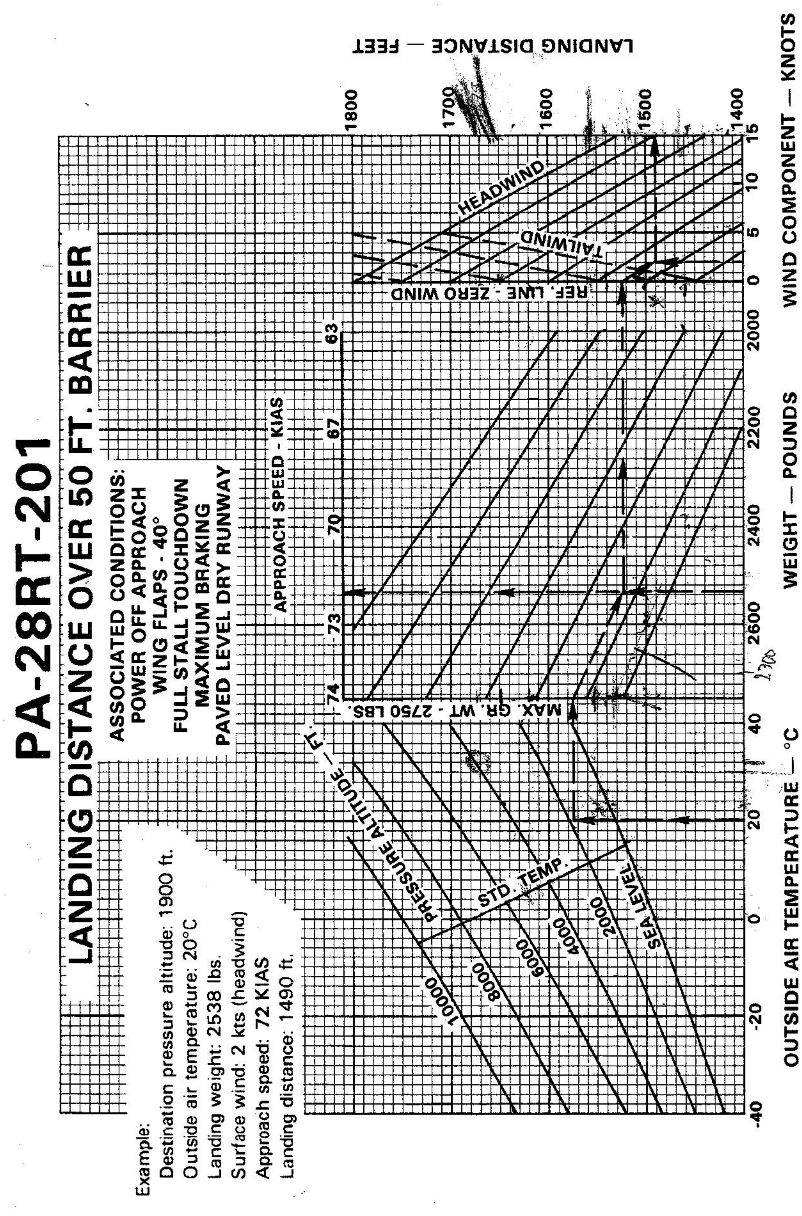
ENDURANCE
Figure 5-29



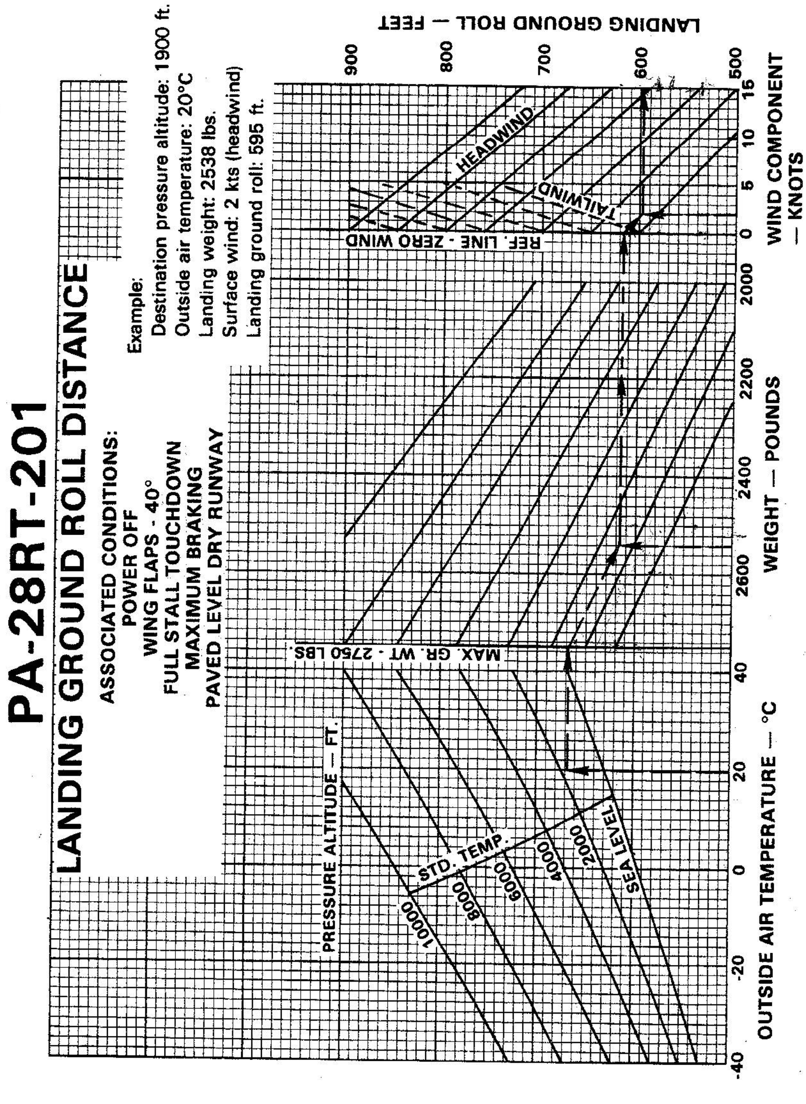
FUEL, TIME AND DISTANCE TO DESCEND
Figure 5-31



GLIDE TIME AND DISTANCE
Figure 5-33



LANDING DISTANCE OVER 50 FT.
Figure 5-35



LANDING GROUND ROLL DISTANCE
Figure 5-37