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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 Chieftain is provided in this section.

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

The pilot should use the full Maximum Continuous Power rating of the engine when safety considerations so dictate.

5.3 INTRODUCTION - PERFORMANCE AND FLIGHT PLANNING

The performance information 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 airplane. This performance can, however, be duplicated by following the stated procedures in a properly maintained airplane.

Effects of conditions not considered on the charts, such as the effect of a soft or grass runway surface on takeoff and landing performance, or the effect of winds aloft on cruise and range performance, must be evaluated by the pilot. 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 in item 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.

5.5 FLIGHT PLANNING EXAMPLE

The following Flight Planning Example illustrates the correct utilization of pertinent data presented in this section of the manual.

(a) Associated Conditions

Certain basic information must be gathered when planning a flight. This information includes departure and destination airport conditions, en route conditions, and basic aircraft conditions. Such factors as weather, the status of the runway, the distance of the flight, the number of passengers, etc., must be determined. Assume, for example, the following conditions:

(1) Departure Airport Conditions

Outside Air Temperature	17°C
Pressure Altitude	2000 ft.
Wind and Direction	15 kts at 360°
Runway Direction	300°

(2) Cruise Conditions

Outside Air Temperature	-5°C
Pressure Altitude	10,000 ft.
En route Distance	800 naut. mi.
Power Setting	230 BHP (2300 RPM)
Mixture Setting	Best Economy

(3) Destination Airport Conditions

Outside Air Temperature	20°C
Pressure Altitude	2000 ft.
Wind and Direction	10 kts. at 330°
Runway Direction	270°

(4) Aircraft Configuration

Basic Weight (assumed for example)	4200 lbs.
Fuel Tanks (total capacity)	192 gal.
Occupants	8 at 170 lbs. each
Baggage	240 lbs.

(b) Aircraft Loading

The airplane weight and center of gravity may be determined by utilizing the information given in 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 6-7. If any alterations to the airplane affecting weight and balance have been made, reference to the aircraft logbook, Weight and Balance Record (Figure 6-9) or latest FAA Major Repair or Alteration Form should be made to determine the current basic empty weight of the airplane.

Use the Weight and Balance Loading Chart (Figure 6-17) and the Weight, Moment and C.G. Limit graph (Figure 6-19) to determine the total weight of the airplane and the center of gravity position.

After proper utilization of the information provided, assume that the following weights have been determined for consideration in the Flight Planning Example:

(1)	Basic Weight (assumed for example)	4200 lbs.
(2)	Occupants (8 at 170 lbs. each)	1360 lbs.
(3)	Baggage	240 lbs.
(4)	Fuel (182 gal. at 6 lbs./gal.)	1092 lbs.
(5)	Ramp Weight (total of above)	6892 lbs.
(6)	Landing Weight (takeoff weight minus item (h), Total Fuel Required)	6030 lbs.

The landing weight cannot be determined until the weight of the fuel to be used has been established.

Ramp weight is below the approved maximum of 7045 lbs. Determine that weight and balance calculations have shown the C.G. position to be within the approved limits.

(c) Takeoff Distance

After determining the aircraft loading, all aspects of takeoff must be considered. Conditions of the departure airport and takeoff weight should be applied to the appropriate Takeoff Distance graph to determine the length of runway necessary. Takeoff conditions for the Flight Planning Example are listed below:

(1)	Wind	15 kts. at 360°
(2)	Angle between Flight Path and Wind	360° -300° = 60°
(3)	Head Wind Component (from Wind Component Graph. Figure 5-13)	8 kts.
(4)	Outside Air Temperature	17°C
(5)	Pressure Altitude	2000 ft.

Using the Normal Takeoff over 50 Feet graph (Figure 5-15) the takeoff distances are as follows:

Total Distance	2740 ft.
Ground Run	1820 ft.

(d) Climb

Entering the example conditions of the departure airport and the cruise altitude into the Time, Fuel and Distance to Climb graph (Figure 5-25) yields the following:

(1)	Time to Climb	9.0 - 1.5 = 7.5 minutes
(2)	Fuel to Climb	55 - 10 = 45 lbs.
(3)	Distance to Climb	20 - 3 = 17 naut. miles

NOTE

The effect of winds aloft must be considered by the pilot when computing climb, cruise, and descent performance.

(e) Descent

Entering the cruise and destination airport conditions into the Time, Distance and Fuel to Descend graph (Figure 5-51) yields the following:

(1)	Time to Descend	20 - 4 = 16 minutes
(2)	Distance to Descend	51 - 10 = 41 naut. miles
(3)	Fuel to Descend	33 - 6 = 27 lbs.

(f) Cruise

Subtracting the previously calculated distance to climb and distance to descend figures from the total en route distance yields the total cruise distance. For example:

Cruise Distance
= En route Distance - Climb Distance - Descent Distance
= 800 - 17 - 41
= 742 naut. miles

The average cruise weight is estimated as:

Average Cruise Weight

$$= \text{Takeoff Wt.} - \frac{\text{En route Distance x Cruise Fuel Flow}}{\text{Cruise Airspeed at 7000 lbs. x 2}}$$

= 6492 lbs.

From the Cruise Performance Table (Figure 5-35) for 230 BHP (2300 RPM) Best Economy Mixture, the cruise airspeed is 184 kts at 6400 lbs.

From the same table, Fuel Flow is 30.8 gallons/hour (184.8 lbs./hr.).

Cruise time and fuel may be calculated by the following formula:

Cruise Time = Cruise Distance/Cruise speed
= 742/184
= 4.03 hours or 241.9 minutes

Cruise Fuel = Fuel Flow x Cruise Time
= 184.8 x 4.03
= 745 lbs.

The above data can be used to calculate an average cruise weight in the following manner:

Average Cruise Weight

$$= \text{Takeoff Wt.} - \text{Ramp Fuel} - \text{Climb Fuel} - \frac{\text{Cruise Fuel}}{2}$$

$$= 6892 - 45 - 45 - \frac{745}{2}$$

= 6430 lbs.

If the average cruise weight was found to be significantly different from the estimated cruise weight, the cruise airspeed would be changed to coincide with this weight by interpolating between the appropriate two aircraft weights. For example, had the average cruise weight been found to be 6600 lbs., then the cruise speed would be corrected to 183 kts.

(g) Total Flight Time

The total flight time is determined by adding the time to climb, cruise time, and time to descend. The following flight time is required for this Flight Planning Example:

Total Flight Time
= Time to Climb + Cruise Time + Time to Descend
= 7.5 + 241.9 + 16
= 265.4 minutes

(h) Total Fuel Required

Determine the total fuel required by adding fuel for taxi and takeoff, fuel to climb, cruise fuel, and fuel to descend. When the total fuel (in pounds) is determined, dividing this value by 6 lbs./gal. will give the total fuel in gallons to be used for the flight. Total fuel calculations for the Flight Planning Example are shown below:

Total Fuel Required
= Fuel for taxi and takeoff + Fuel to Climb + Cruise Fuel + Fuel to Descend
= 45 + 45 + 745 + 27
= 862 lbs. (143.6 gallons)

(i) Landing Distance

Subtracting the total fuel required from the takeoff weight of the airplane gives the landing weight:

Landing Weight
= Takeoff Weight - Total Fuel Required
= 6892 - 862
= 6030 lbs.

Destination airport conditions applied to the Wind Component graph (Figure 5-13) gives the following headwind component for the Flight Planning Example:

The angle between the flight path and wind is 330°-270° or 60°

Therefore, the Head Wind Component is 5 kts.

From the Landing Distance over 50 Feet graph (Figure 5-55), with the destination airport conditions, the distances required for landing for the Flight Planning Example are as follows:

(1)	Total Distance	1600 ft.
(2)	Ground Roll	750 ft.

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5.7 PERFORMANCE GRAPHS

LIST OF FIGURES

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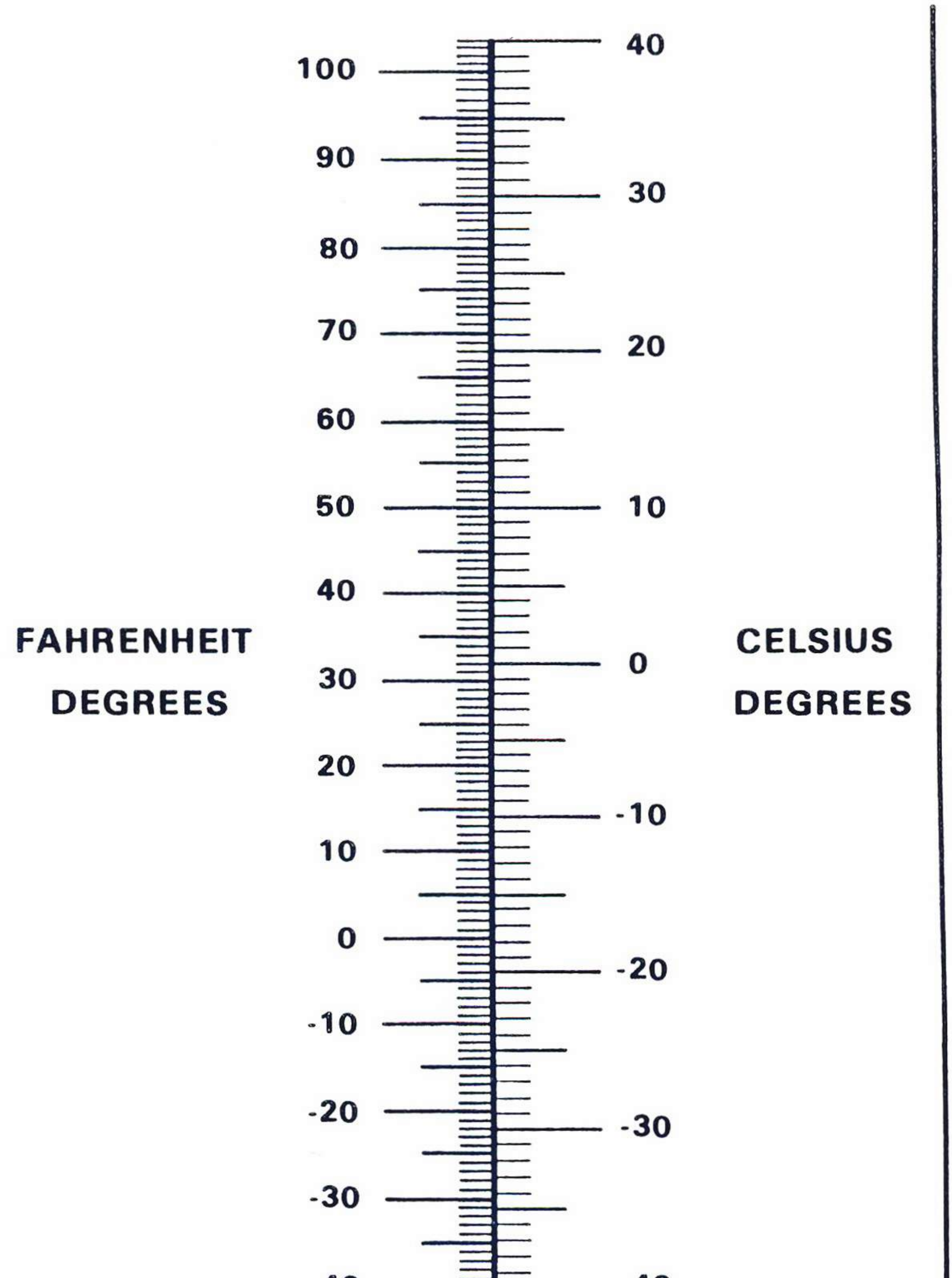
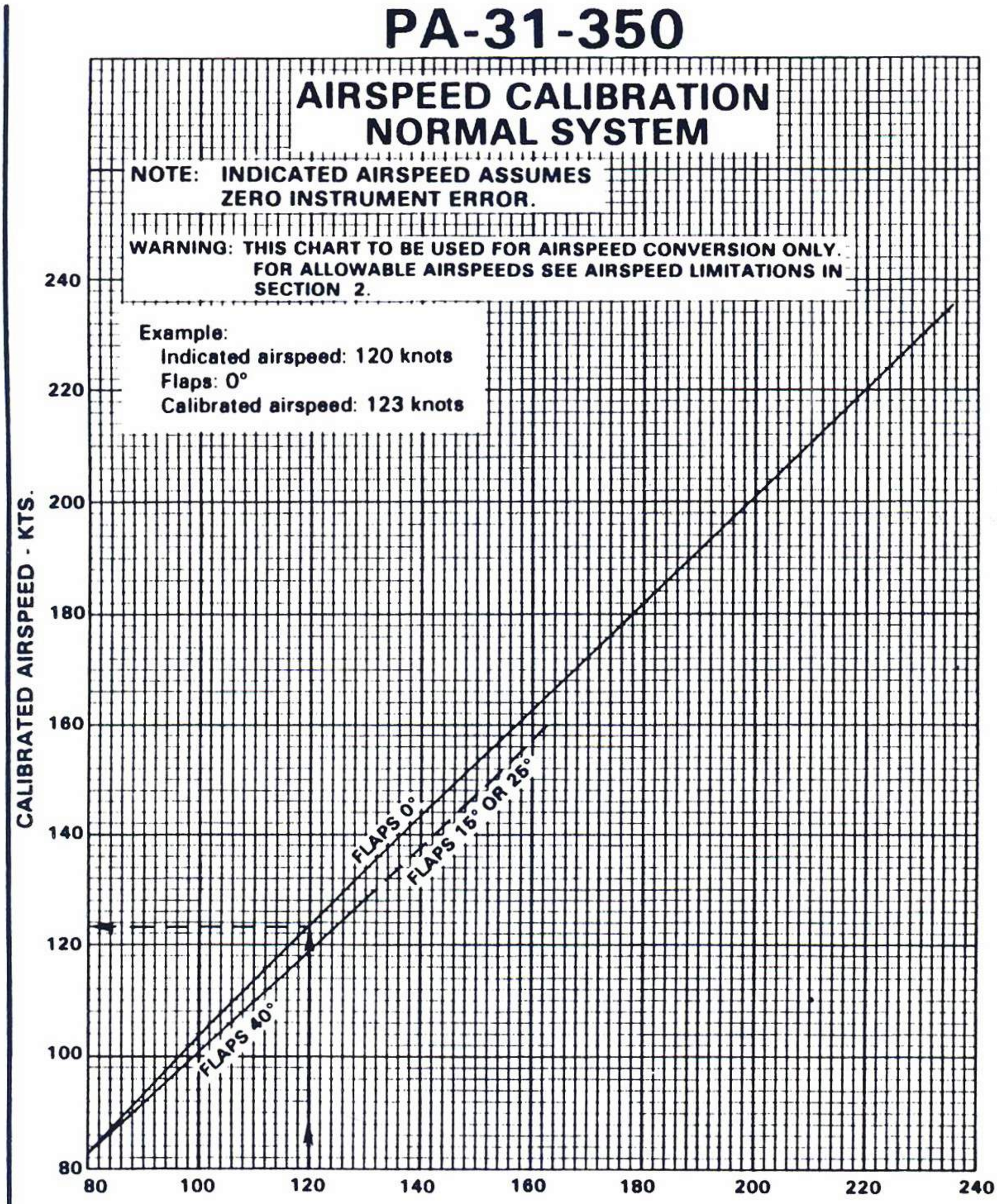


TEMPERATURE CONVERSION
Figure 5-1



AIRSPEED CALIBRATION - NORMAL SYSTEM
Figure 5-3

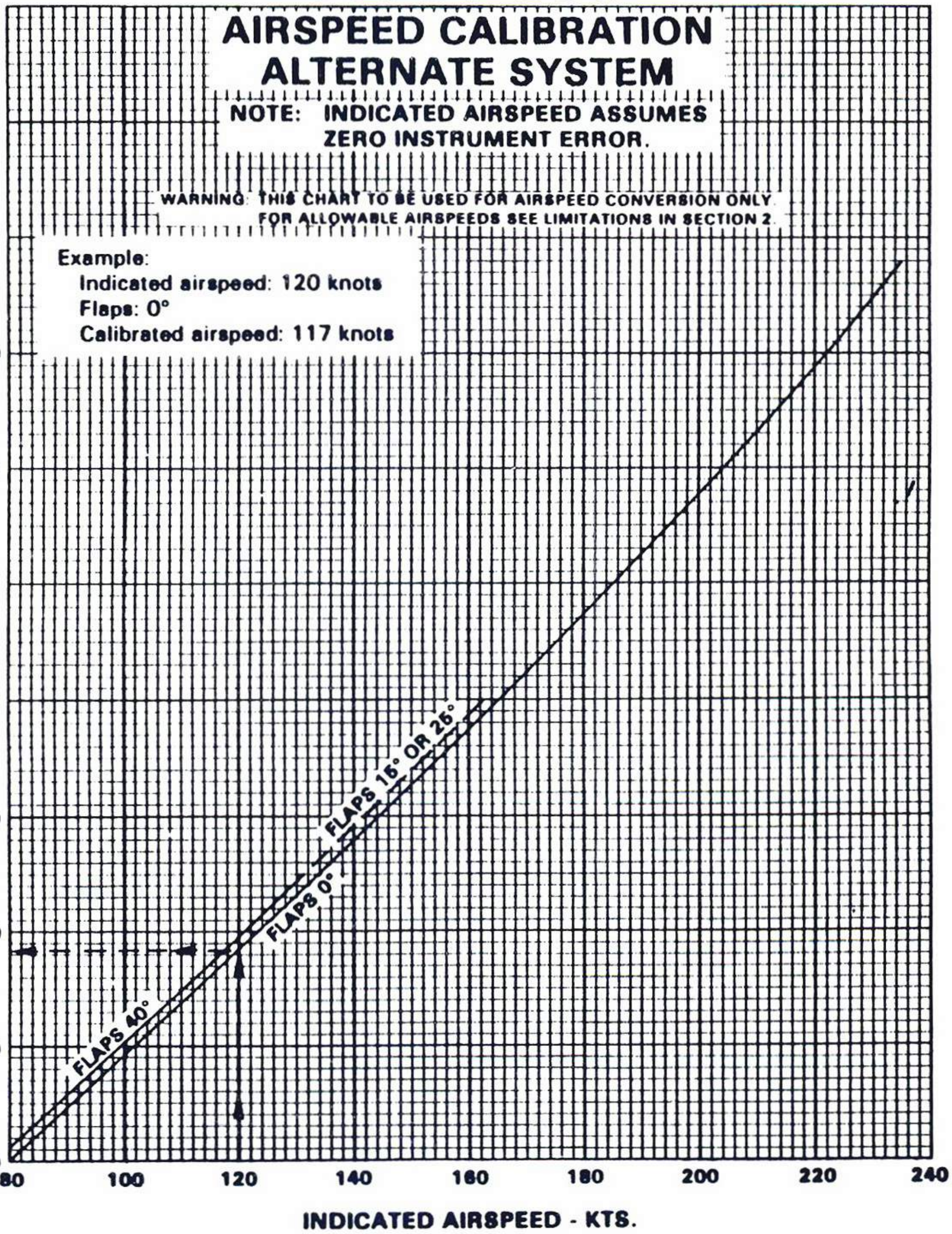
PA-31-350

AIRSPEED CALIBRATION
ALTERNATE SYSTEM

NOTE: INDICATED AIRSPEED ASSUMES ZERO INSTRUMENT ERROR.

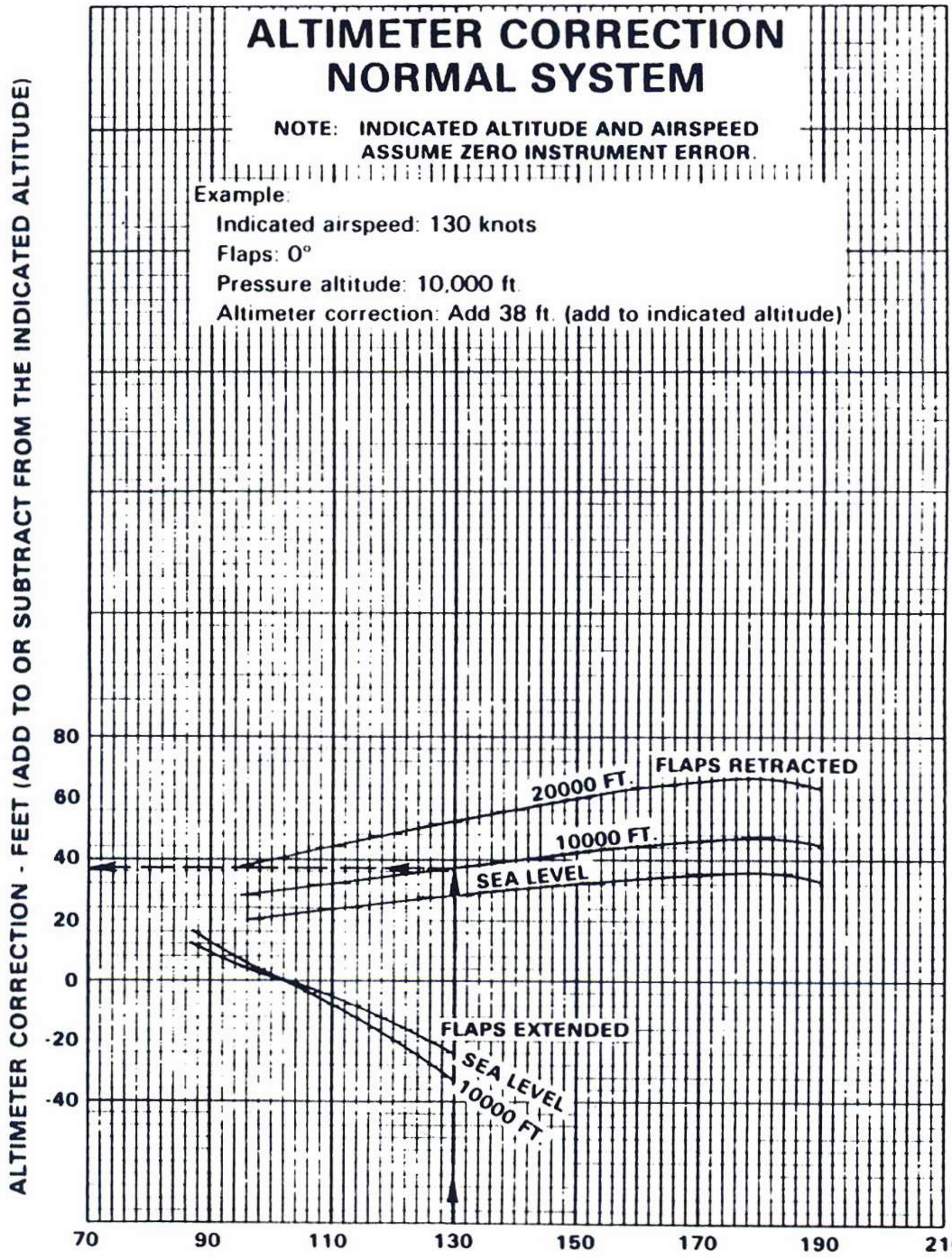
WARNING: THIS CHART TO BE USED FOR AIRSPEED CONVERSION ONLY. FOR ALLOWABLE AIRSPEEDS SEE LIMITATIONS IN SECTION 2.

Example:
Indicated airspeed: 120 knots
Flaps: 0°
Calibrated airspeed: 117 knots



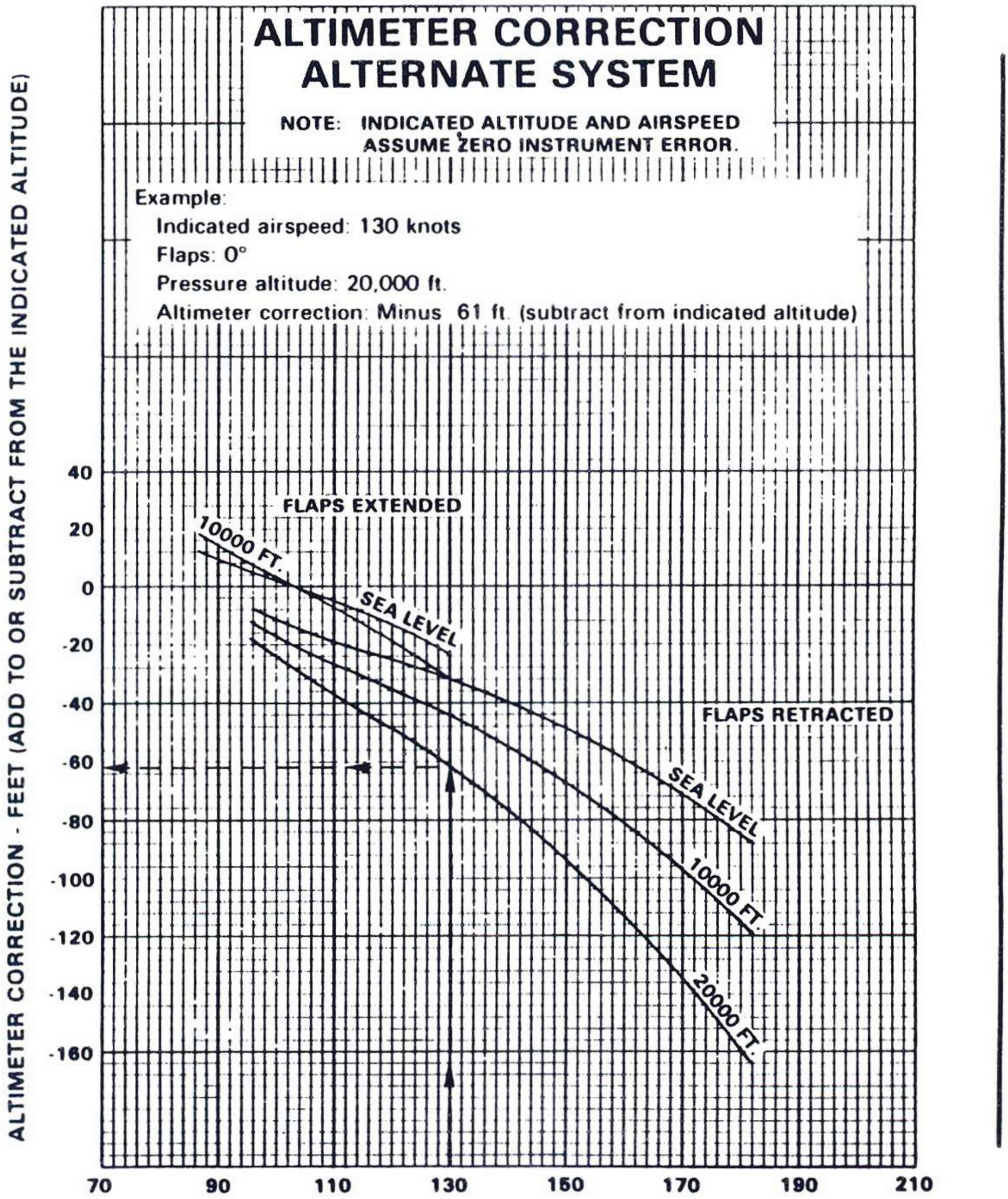
AIRSPEED CALIBRATION - ALTERNATE SYSTEM
Figure 5-5

PA-31-350

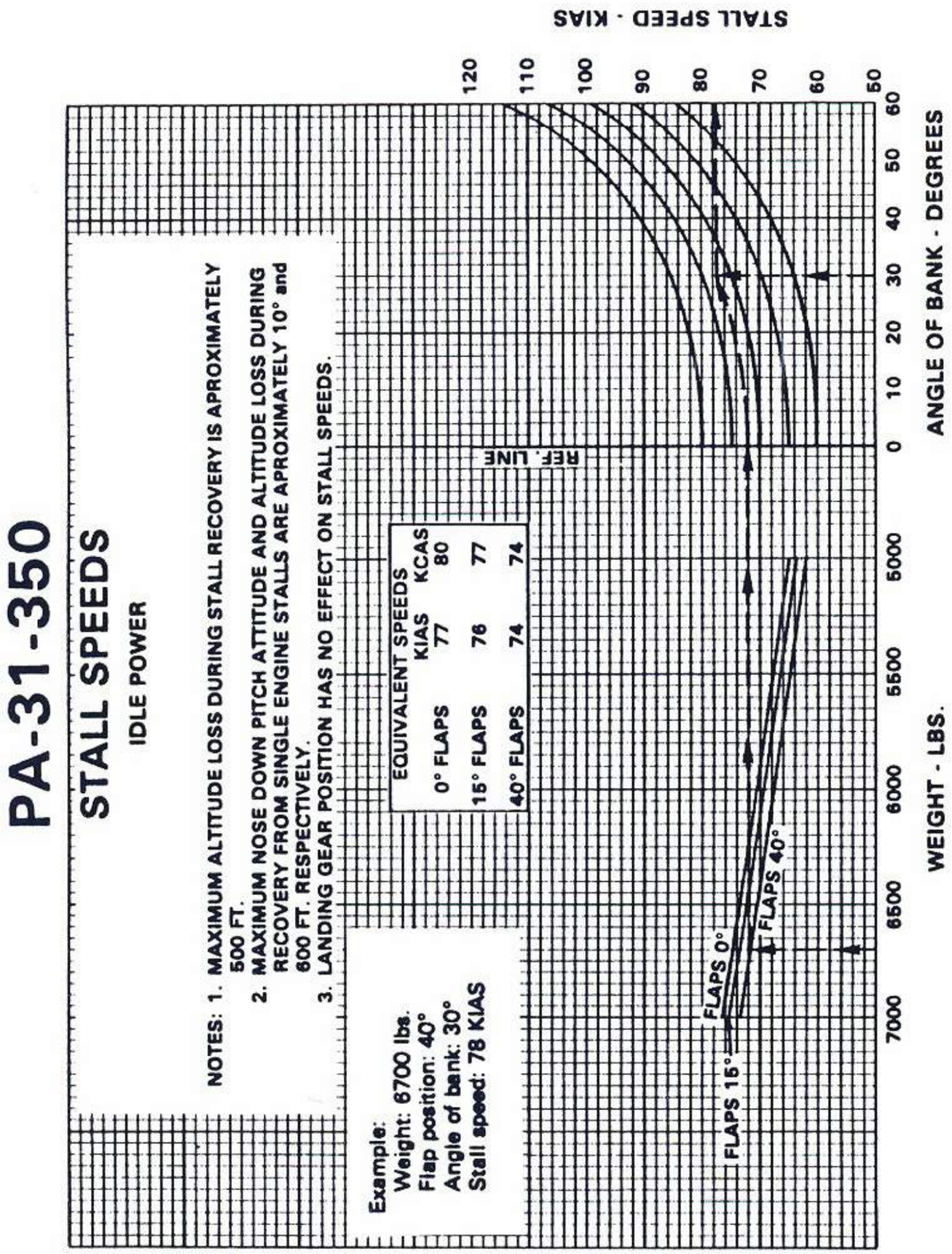


ALTIMETER CORRECTION - NORMAL SYSTEM
Figure 5-7

PA-31-350



ALTIMETER CORRECTION - ALTERNATE SYSTEM
Figure 5-9

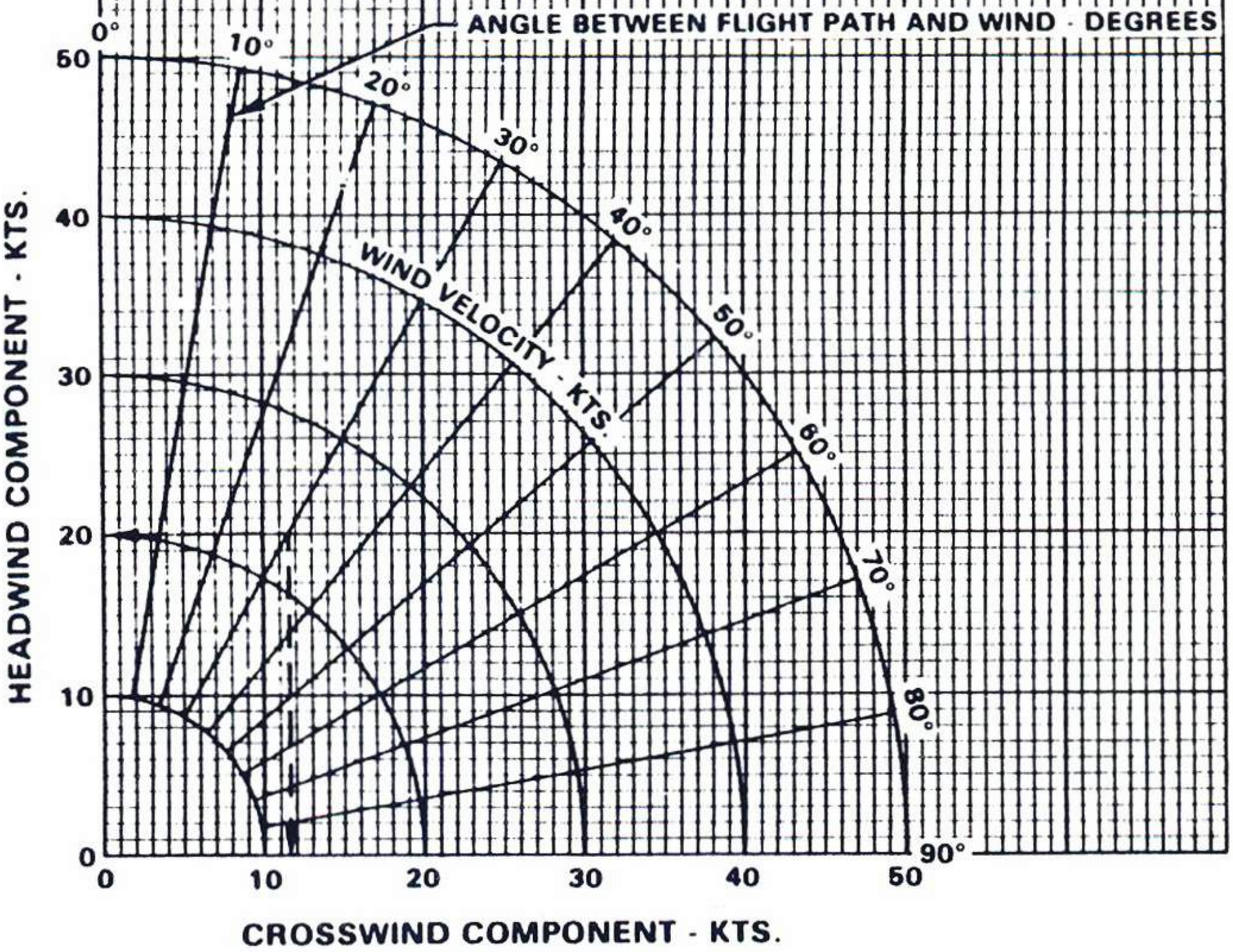


STALL SPEEDS
Figure 5-11

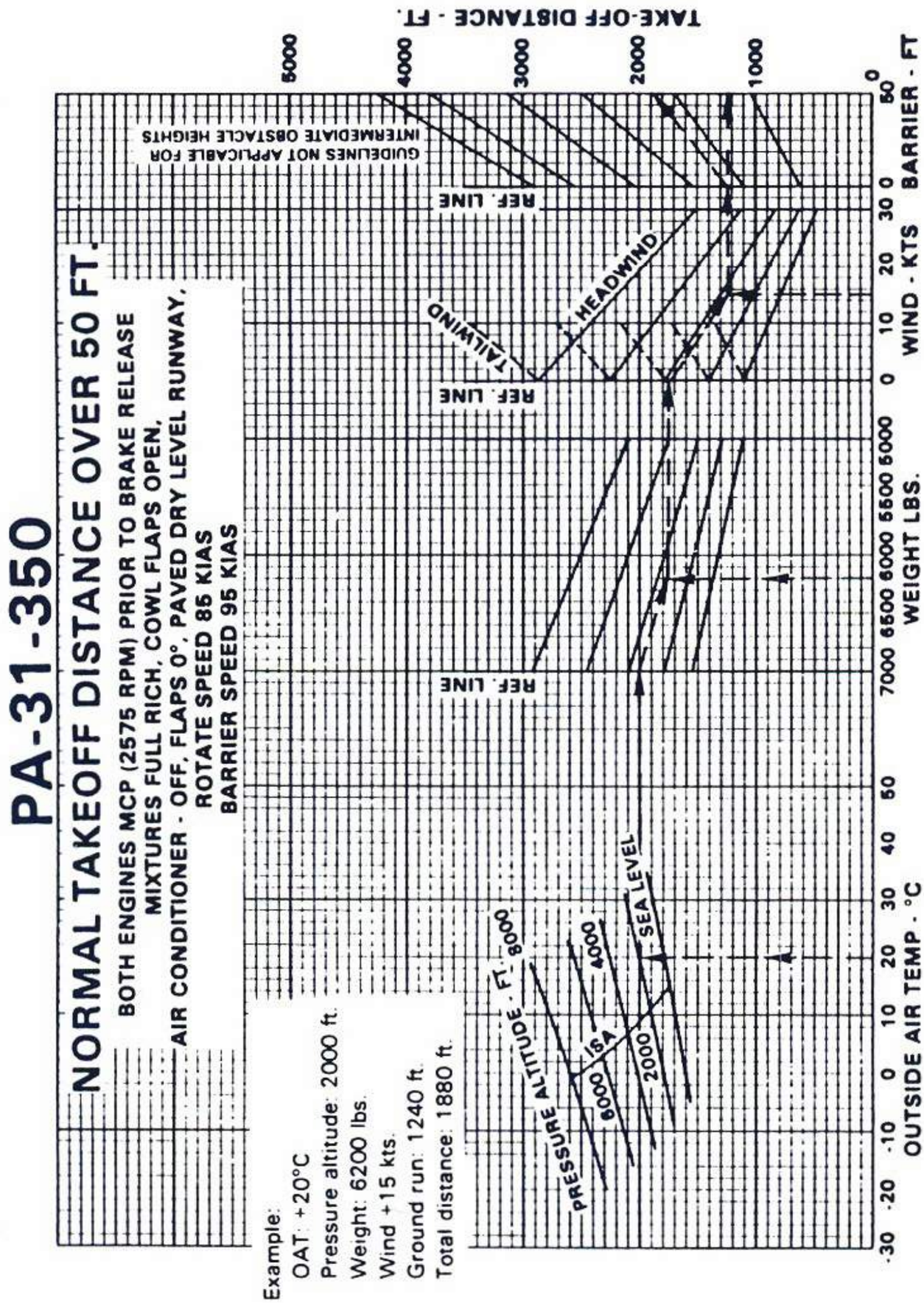
PA-31-350

WIND COMPONENTS

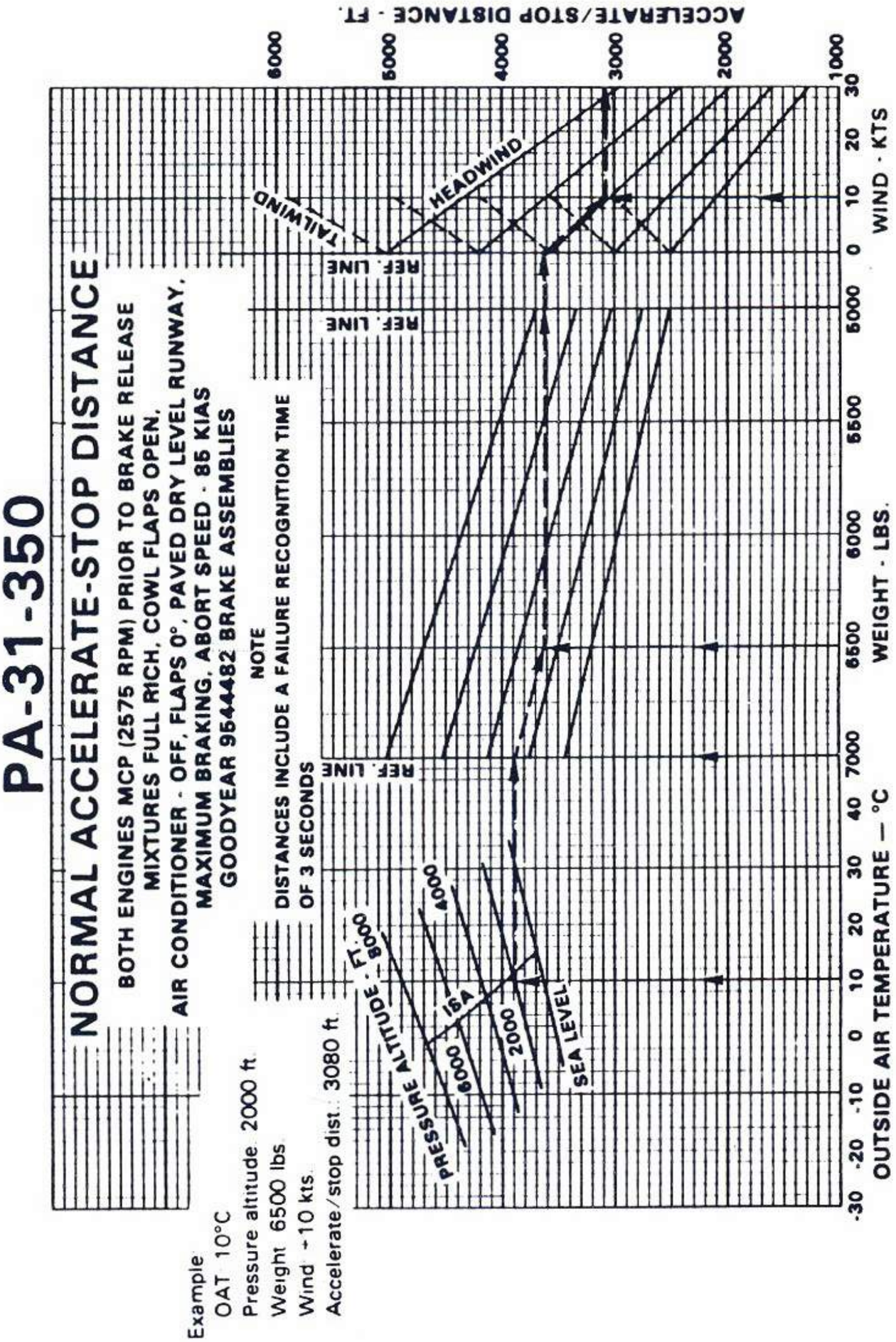
Example:
Wind velocity: 23 knots
Angle between flight path and wind: 30°
Headwind component: 20 knots
Crosswind component: 12 knots



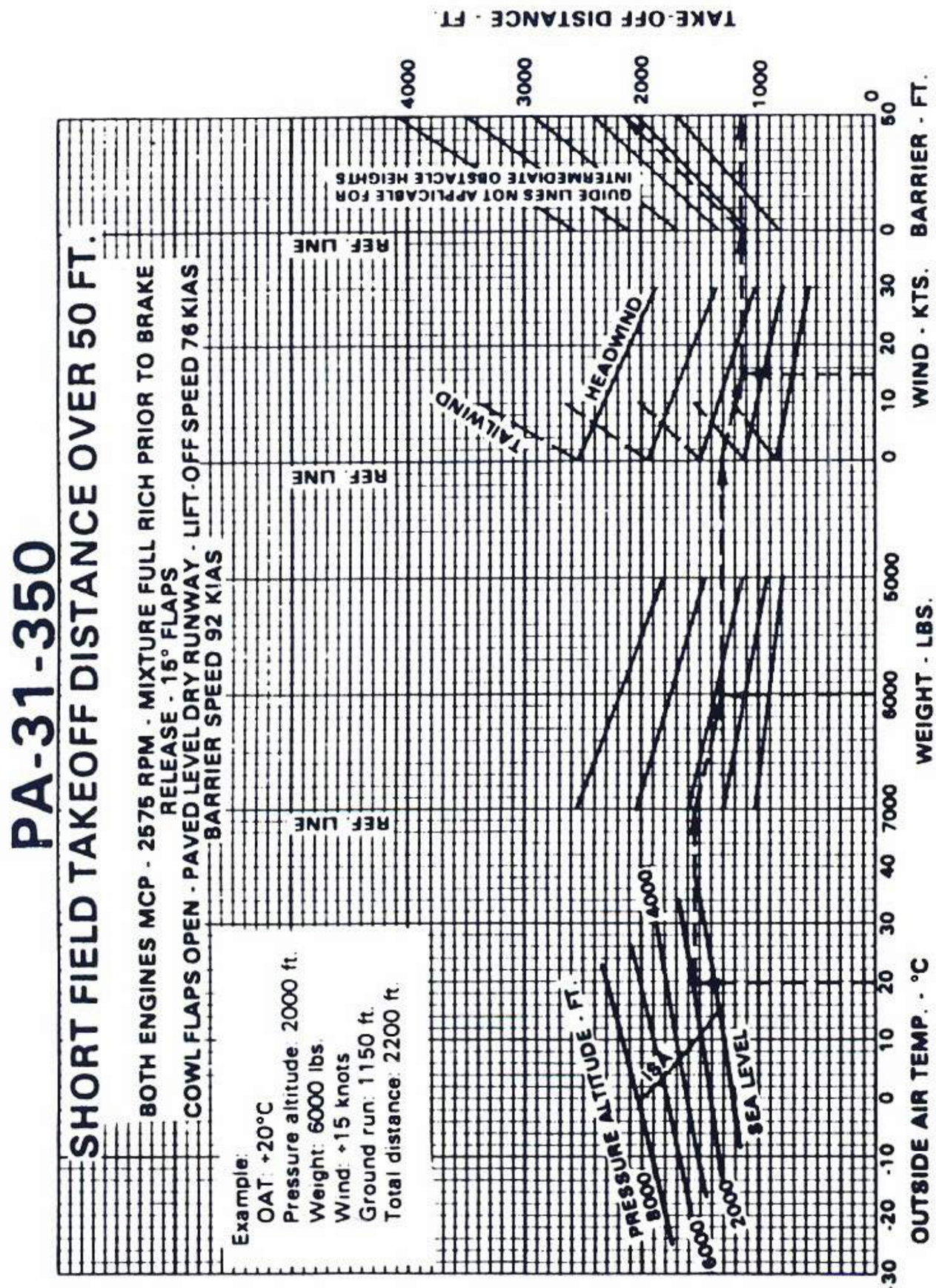
WIND COMPONENTS
Figure 5-13



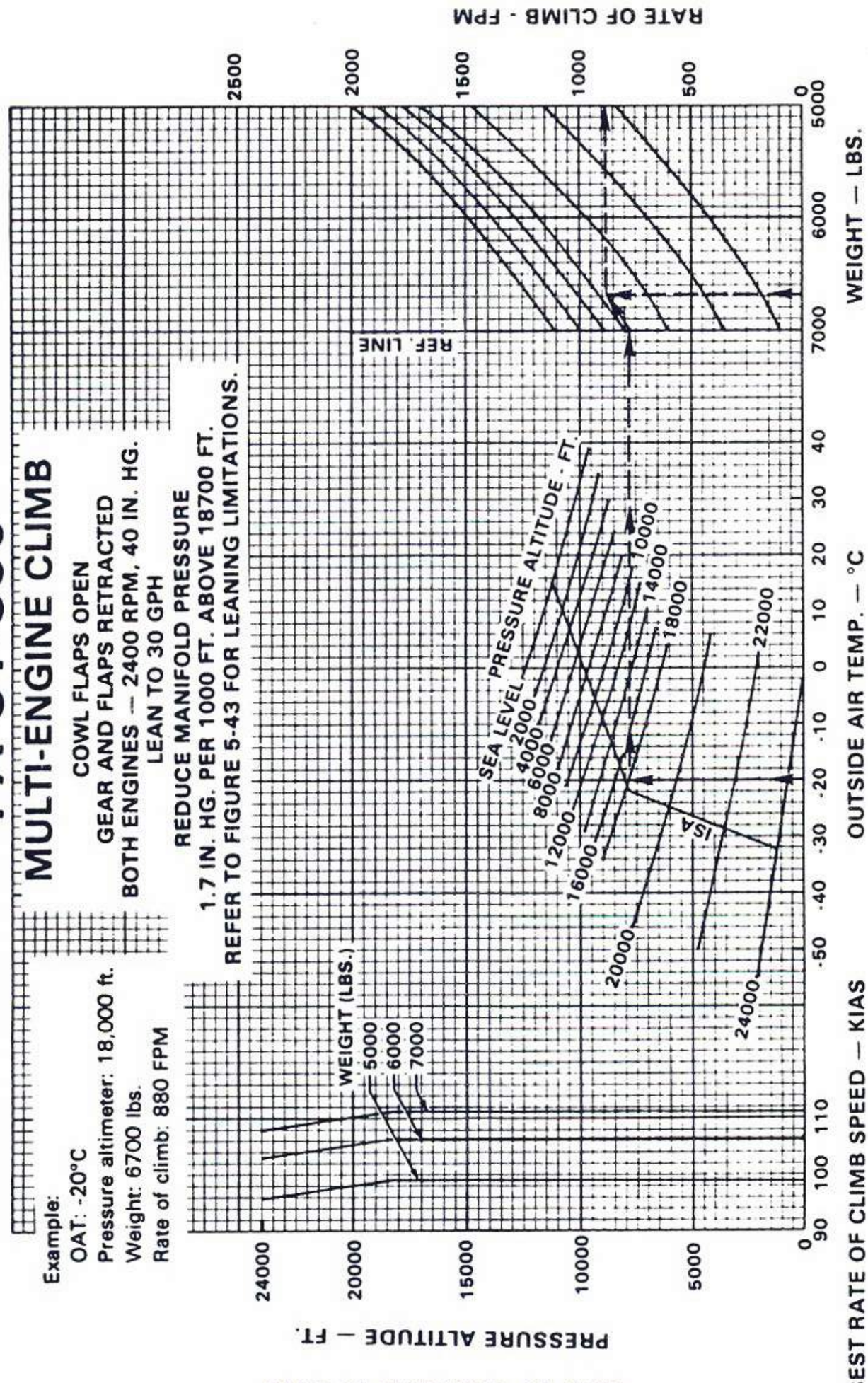
NORMAL TAKEOFF DISTANCE OVER 50 FEET
Figure 5-15



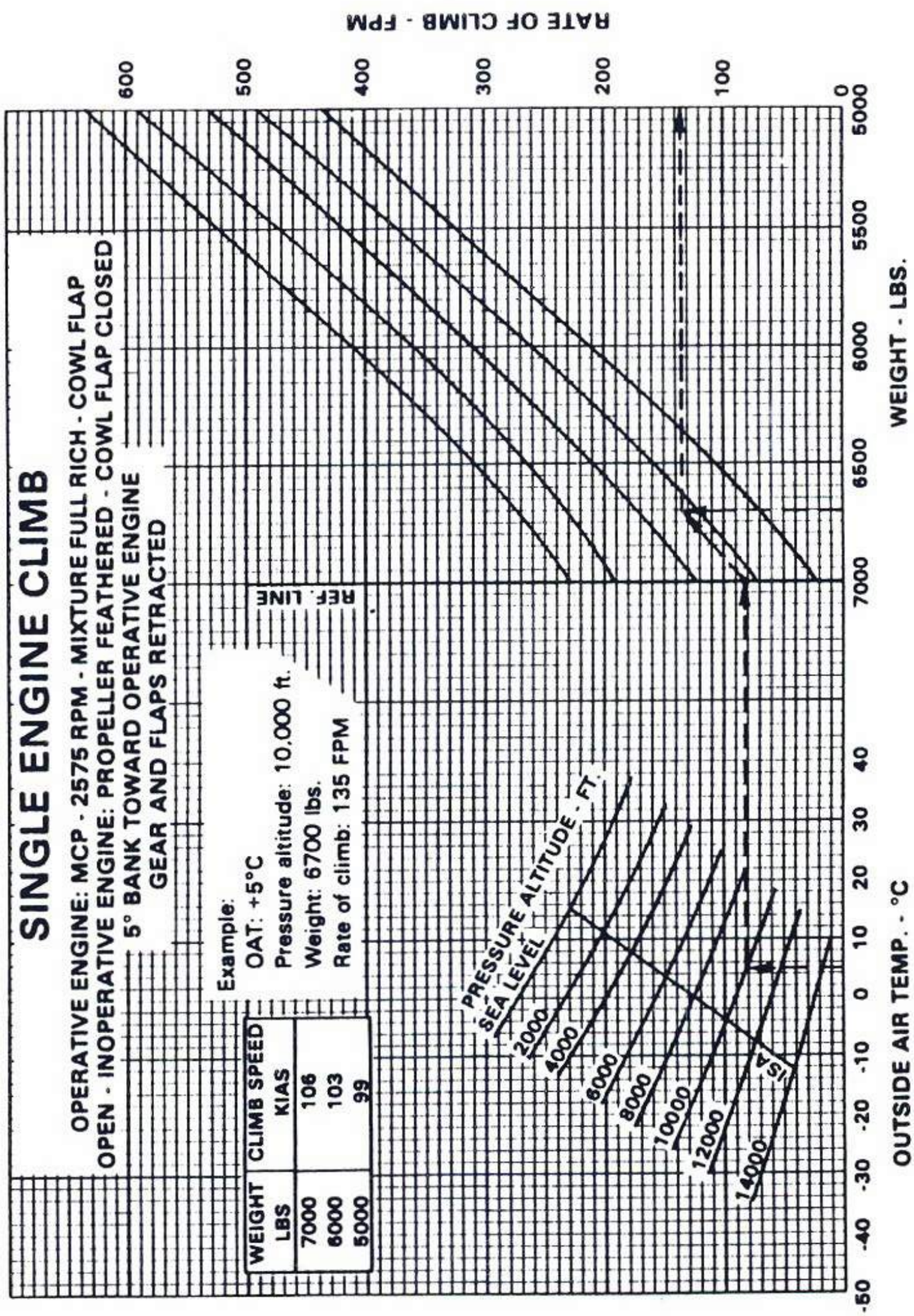
NORMAL ACCELERATE - STOP DISTANCE
Figure 5-17



SHORT FIELD TAKEOFF DISTANCE OVER 50 FT.
Figure 5-18



MULTI-ENGINE CLIMB
(Maximum Normal Operating Power)
Figure 5-19



SINGLE-ENGINE CLIMB
Figure 5-21

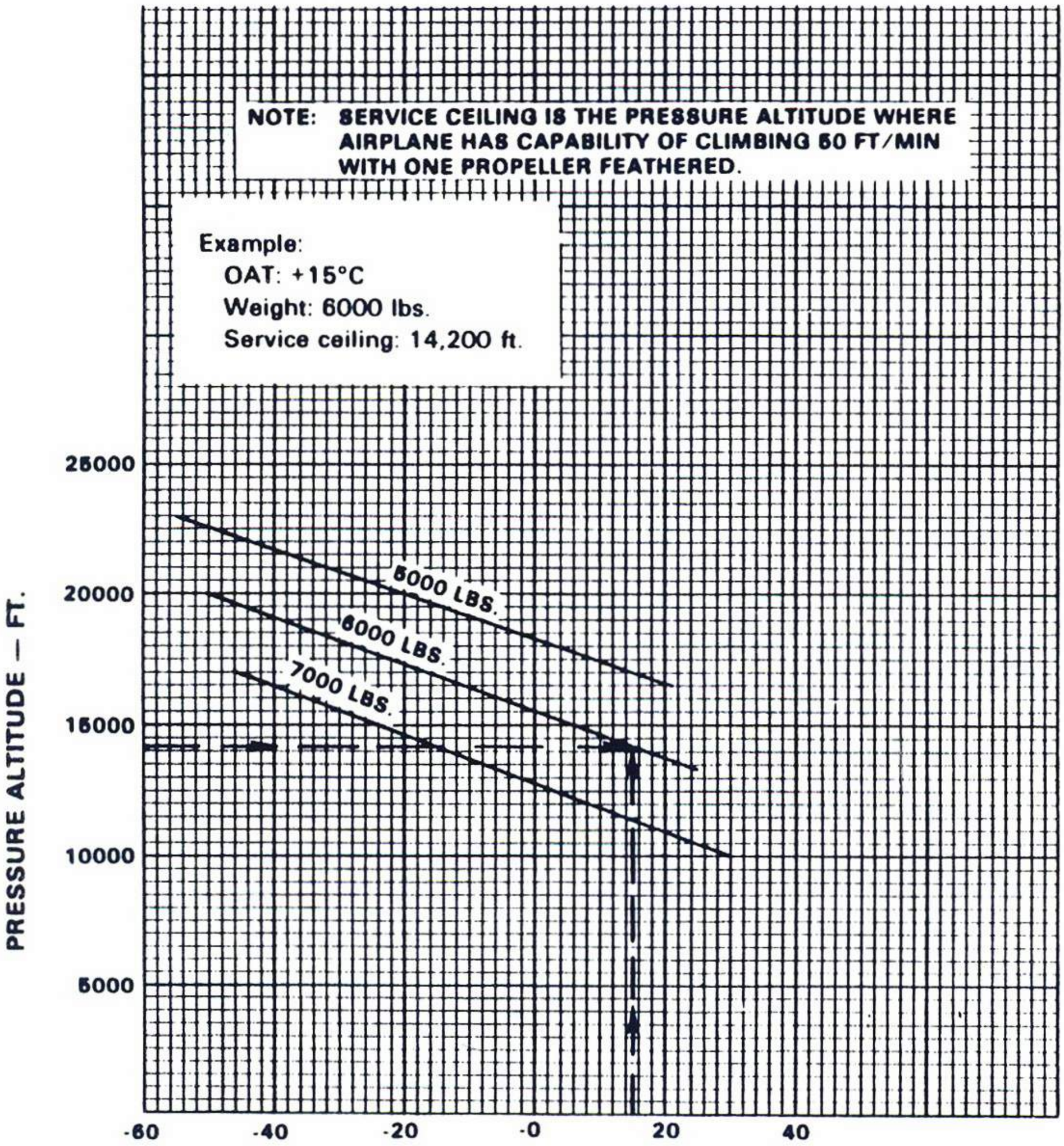
PA-31-350

SINGLE ENGINE SERVICE CEILING

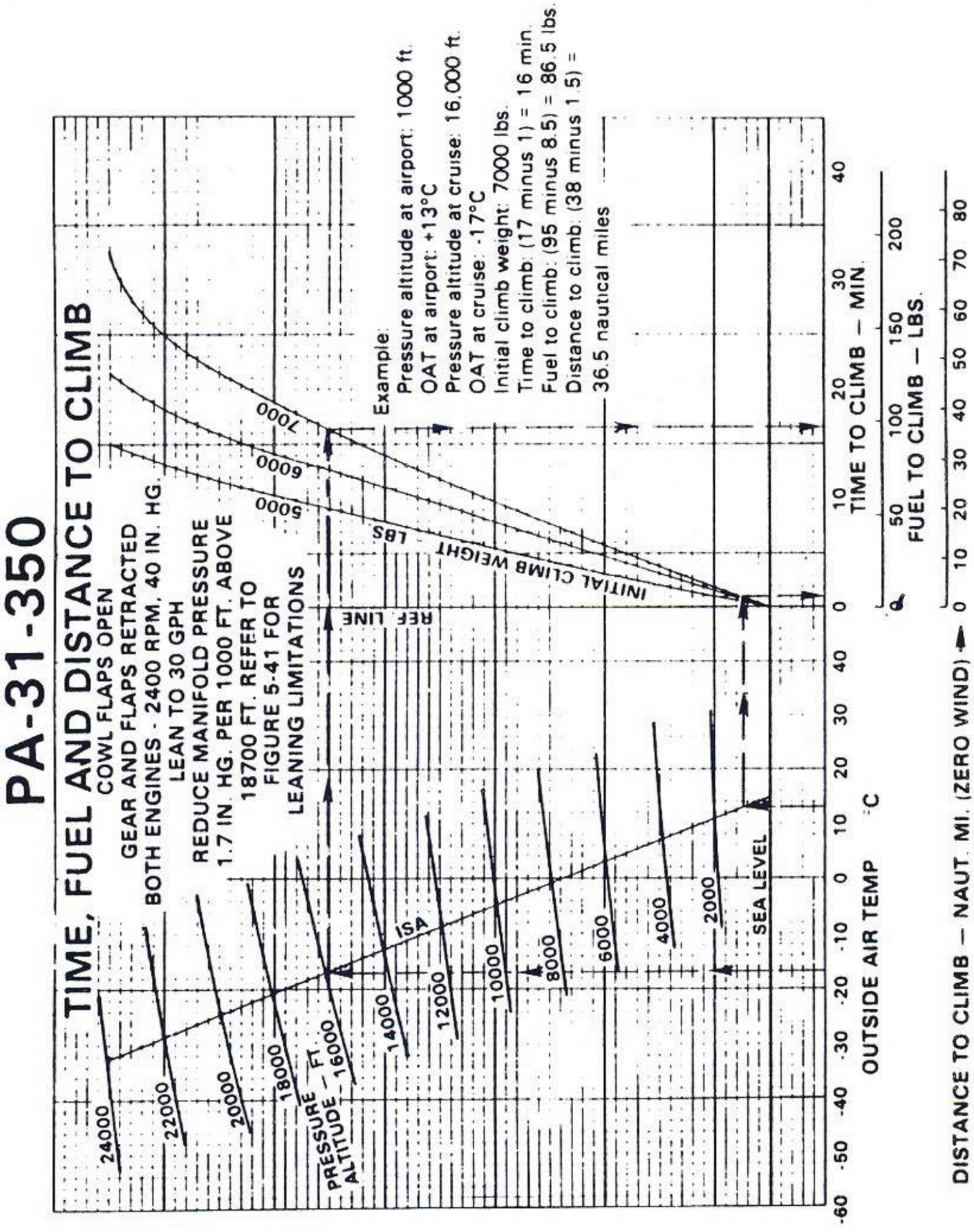
OPERATIVE ENGINE: MCP - 2575 RPM - MIXTURE FULL RICH
COWL FLAP OPEN
INOPERATIVE ENGINE: PROPELLER FEATHERED - COWL FLAP CLOSED
GEAR AND FLAPS RETRACTED

NOTE: SERVICE CEILING IS THE PRESSURE ALTITUDE WHERE AIRPLANE HAS CAPABILITY OF CLIMBING 50 FT/MIN WITH ONE PROPELLER FEATHERED.

Example:
OAT: +15°C
Weight: 6000 lbs.
Service ceiling: 14,200 ft.



SINGLE-ENGINE SERVICE CEILING
Figure 5-23



TIME, FUEL, AND DISTANCE TO CLIMB
(Maximum Normal Operating Power)
Figure 5-25

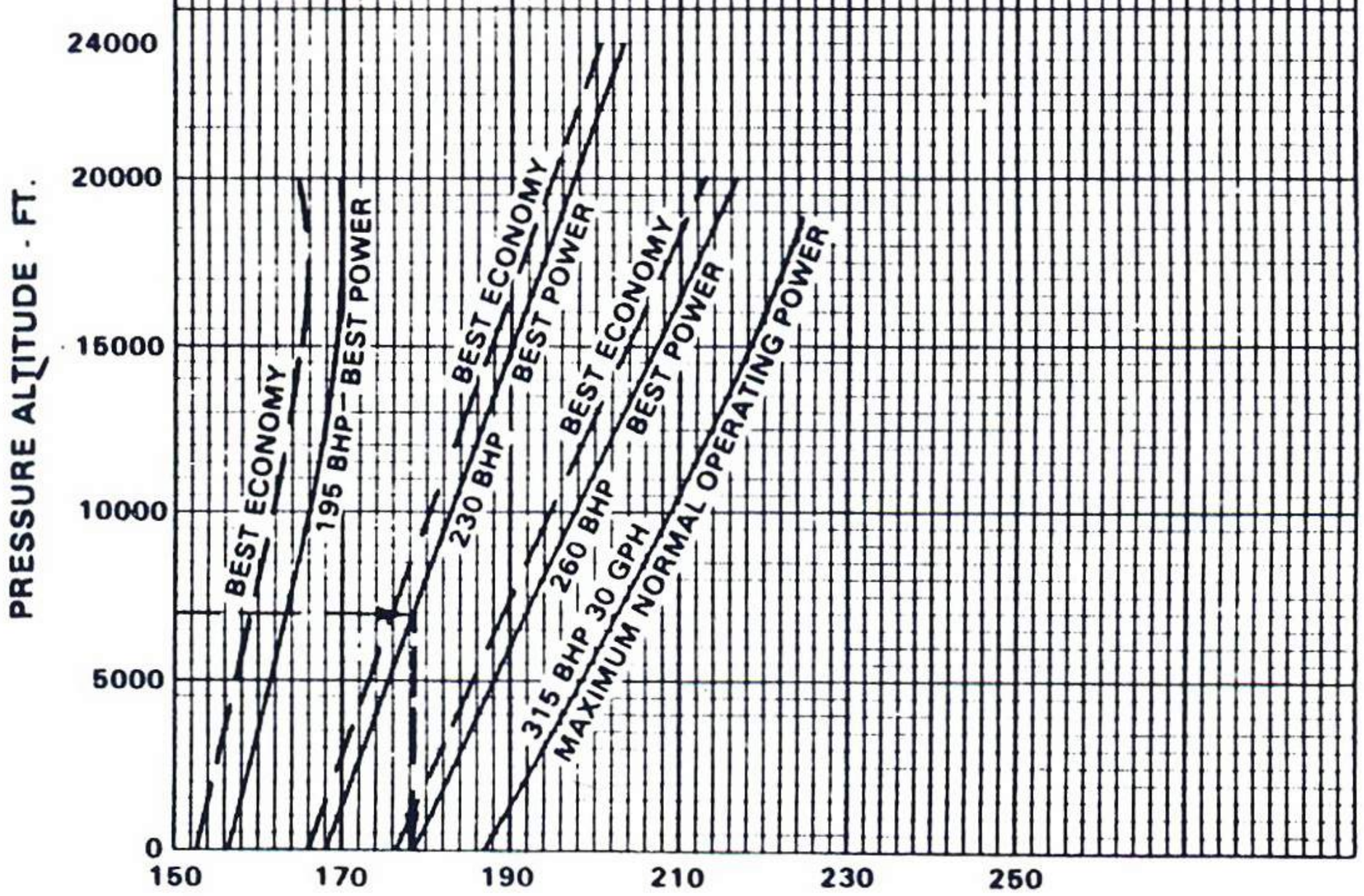
PA-31-350

TRUE AIRSPEED VS. PRESSURE ALTITUDE

GEAR AND FLAPS RETRACTED - COWL FLAPS CLOSED
7000 LBS - STANDARD DAY

Example:
Pressure altitude: 7000 ft.
BHP (Best Power): 230
True airspeed: 179 knots

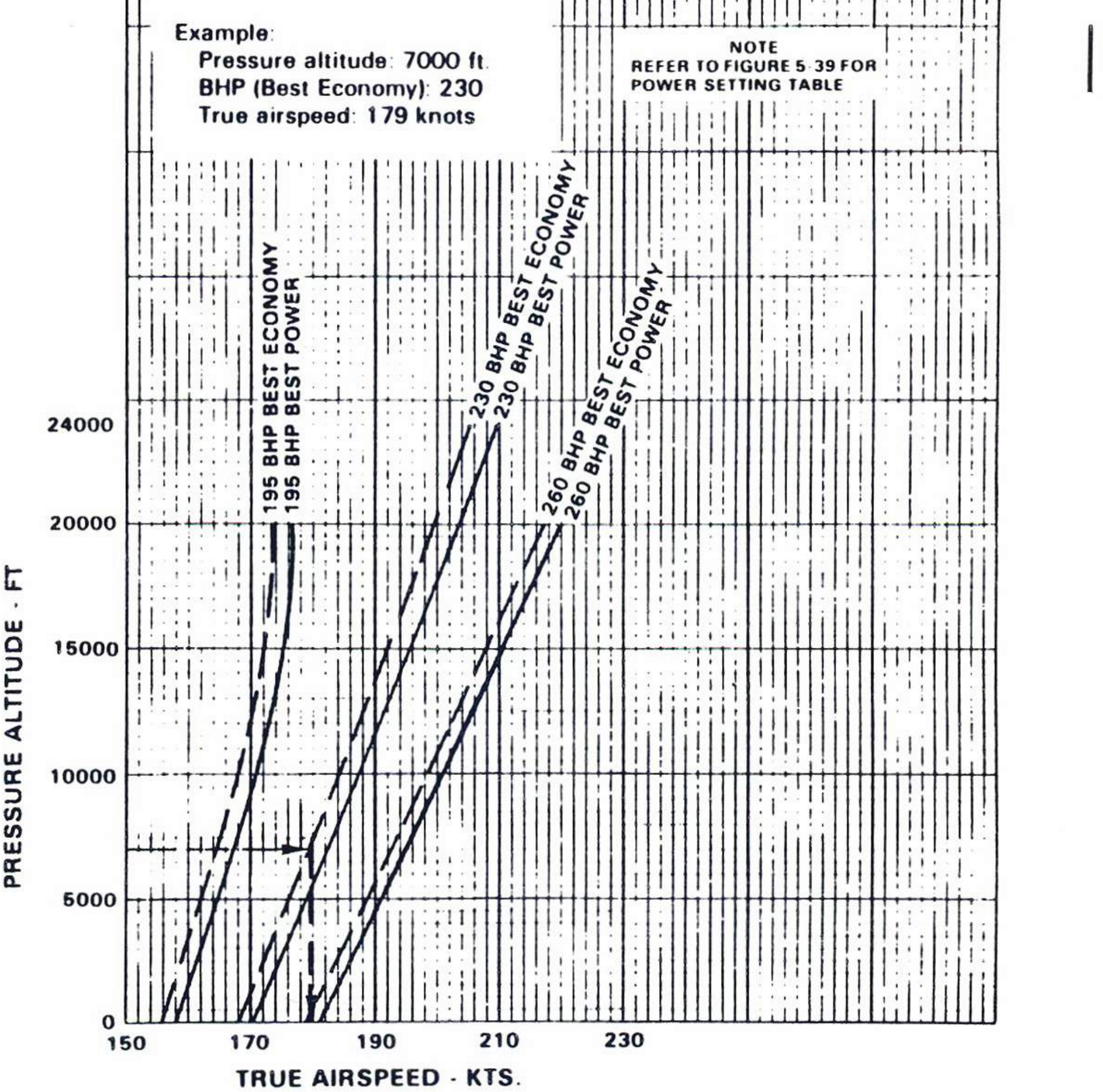
NOTE
Refer to Fig. 5-39 for Power Setting Table.



TRUE AIRSPEED VS. PRESSURE ALTITUDE (7000 LBS.)
Figure 5-27

PA-31-350

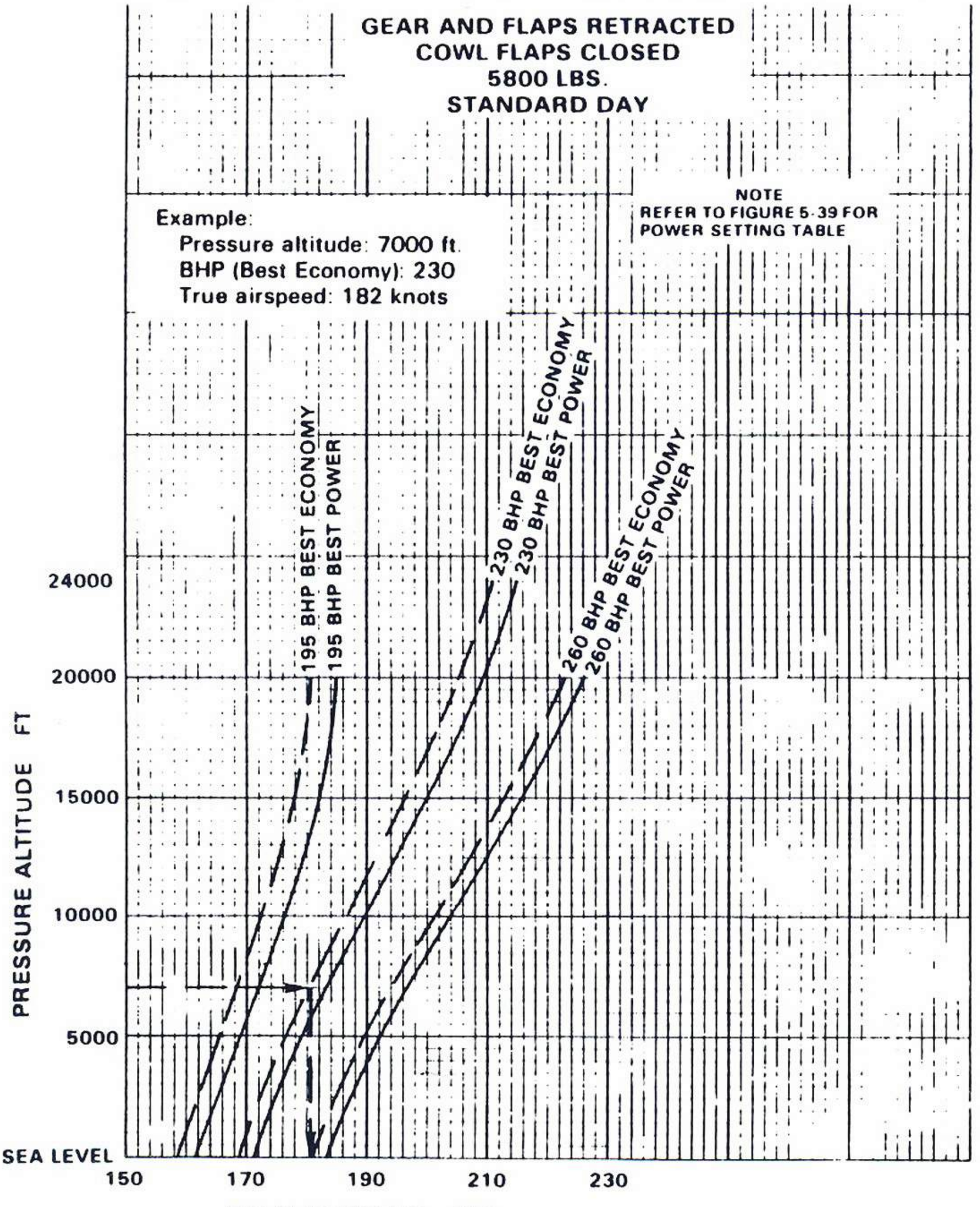
TRUE AIRSPEED VS. PRESSURE ALTITUDE



TRUE AIRSPEED VS. PRESSURE ALTITUDE (6400 LBS.)
Figure 5-29

PA-31-350

TRUE AIRSPEED VS. PRESSURE ALTITUDE



TRUE AIRSPEED VS. PRESSURE ALTITUDE (5800 LBS.)
Figure 5-31

	Pressure Altitude Feet	OAT °C	Fuel Flow GPH Total B.P. B.E.	Cruise True Airspeed - Kts. 7000 Lbs. Best Power	7000 Lbs. Best Economy	6400 Lbs. Best Power	6400 Lbs. Best Economy	5800 Lbs. Best Power	5800 Lbs. Best Economy
ISA + 20° C	SL	35.0	32.6 26.3	158	155	162	159	165	162
	5000	25.1	32.6 26.3	162	159	167	164	172	169
	10000	15.2	32.6 26.3	167	163	172	170	177	175
	15000	5.3	32.6 26.3	171	167	176	173	182	179
ISA	SL	15.0	32.6 26.3	156	153	159	156	162	159
	5000	5.1	32.6 26.3	161	158	165	163	169	166
	10000	-4.8	32.6 26.3	165	162	170	168	175	172
	15000	-14.7	32.6 26.3	169	166	175	172	181	178
	20000	-24.6	32.6 26.3	169	165	177	173	184	181
ISA - 20° C	SL	-5.0	32.6 26.3	153	151	156	154	159	157
	5000	-14.9	32.6 26.3	158	155	162	159	166	163
	10000	-24.8	32.6 26.3	163	160	168	165	172	169
	15000	-34.7	32.6 26.3	167	164	173	170	178	175
	20000	-44.6	32.6 26.3	171	166	176	173	182	179

CRUISE PERFORMANCE - 195 BHP - 2200 RPM (Approx. 55%)
Figure 5-33

	Pressure Altitude Feet	OAT °C	Fuel Flow GPH Total B.P./B.E.	Cruise True Airspeed - Kts.					
				7000 Lbs.		6400 Lbs.		5800 Lbs.	
				Best Power	Best Economy	Best Power	Best Economy	Best Power	Best Economy
ISA +20°C	SL	35.0	38.2/30.8	171	169	174	171	176	174
	5000	25.1	38.2/30.8	179	177	182	179	185	183
	10000	15.2	38.2/30.8	187	184	191	188	195	191
	15000	5.3	38.2/30.8	195	191	199	196	204	200
	20000	-4.6	38.2/30.8	202	198	207	204	213	208
	24000	-12.6	38.2/30.8	206	202	213	210	219	215
ISA	SL	15.0	38.2/30.8	168	166	170	168	172	170
	5000	5.1	38.2/30.8	176	173	179	176	181	178
	10000	-4.8	38.2/30.8	184	181	187	184	190	187
	15000	-14.7	38.2/30.8	192	188	196	192	200	196
	20000	-24.6	38.2/30.8	199	195	204	200	209	205
	24000	-32.5	38.2/30.8	204	201	210	206	215	211
ISA -20°C	SL	-5.0	38.2/30.8	163	161	165	163	167	165
	5000	-14.9	38.2/30.8	172	170	175	173	177	175
	10000	-24.8	38.2/30.8	180	177	183	180	186	183
	15000	-34.7	38.2/30.8	187	184	192	189	195	192
	20000	-44.6	38.2/30.8	195	192	200	197	205	201
	24000	-52.5	38.2/30.8	201	197	206	203	211	208

CRUISE PERFORMANCE - 230 BHP - 2300 RPM (Approx. 65%)
Figure 5-35

	Pressure Altitude Feet	OAT °C	Fuel Flow GPH Total B.P./B.E.	Cruise True Airspeed - Kts. 7000 Lbs. Best Power	7000 Lbs. Best Economy	6400 Lbs. Best Power	6400 Lbs. Best Economy	5800 Lbs. Best Power	5800 Lbs. Best Economy
ISA +20°C	SL	35.0	43.6/35.3	183	181	185	183	188	186
	5000	25.1	43.6/35.3	193	191	195	193	198	196
	10000	15.2	43.6/35.3	202	200	205	203	208	206
	15000	5.3	43.6/35.3	212	209	215	213	219	217
ISA	SL	15.0	43.6/35.3	179	177	181	179	183	181
	5000	5.1	43.6/35.3	188	186	191	188	193	191
	10000	-4.8	43.6/35.3	198	196	201	199	204	202
	15000	-14.7	43.6/35.3	208	205	211	208	215	212
	20000	-24.6	43.6/35.3	217	214	221	218	225	223
ISA -20°C	SL	-5.0	43.6/35.3	174	172	176	174	178	176
	5000	-14.9	43.6/35.3	184	182	186	184	189	186
	10000	-24.8	43.6/35.3	193	191	196	194	199	197
	15000	-34.7	43.6/35.3	203	201	206	203	210	207
	20000	-44.6	43.6/35.3	212	210	216	213	220	217

CRUISE PERFORMANCE - 260 BHP - 2400 RPM (Approx. 75%)
Figure 5-37

POWER SETTING TABLE

LYCOMING MODEL LTIO AND TIO-540-J2BD ENGINES

P.A. Alt. Ft.	Std. Temp. °F	195 BHP (Approx. 55%) RPM & M.P. 2200	2300	2400	230 BHP (Approx. 65%) RPM & M.P. 2200	2300	2400	260 BHP (Approx. 75%) RPM & M.P. 2400	P.A. Alt. Ft.
S.L.	59	27.2	26.6	26.0	31.5	30.7	29.9	33.7	S.L.
5000	41	26.6	25.7	24.8	31.2	30.1	29.0	33.3	5000
10000	23	26.0	25.0	24.0	31.1	29.8	28.5	33.0	10000
15000	5	25.9	24.8	23.8	31.2	29.7	28.3	33.2	15000
18000	- 5	25.9	24.6	23.8	31.4	29.8	28.2	33.3	18000
20000	-13	25.8	24.7	23.6	31.5	29.9	28.3	33.8	20000
22000	-20	—	—	—	31.6	30.2	28.7	—	22000
24000	-27	—	—	—	--	30.5	29.0	—	24000

1. To maintain constant power, correct manifold pressure approximately 1% MAP for each 10° F variation in induction air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard. Observe maximum allowable manifold pressure limitations, see maximum manifold pressure limitation chart.
2. Maximum Normal Operating Power 2400 RPM at 40.0 IN. HG. to 18,700 feet (permissible to lean to 1500° EGT or 30 GPH fuel flow, whichever occurs first, provided cylinder head temperatures (475°) and oil temperatures (245°) remain within limits). Above 18,700 feet maintain maximum allowable manifold pressure (turbine speed limit).

POWER SETTING TABLE
Figure 5-39

ISSUED: SEPTEMBER 14, 1979
REVISED: JANUARY 29, 1980

LEANING - MAXIMUM NORMAL OPERATING POWER - 2400 RPM

LIMITS - DO NOT EXCEED				
Alt.	MP	FF	EGT	CHT
SL	40.0	30	1500	475
8,000	40.0	30	1500	475
10,000	40.0	30	1500	475
12,000	40.0	30	1500	475
14,000	40.0	30	1500	475
16,000	40.0	30	1500	475
18,000	40.0	30	1500	475
18,700	40.0	30	1500	475
20,000	37.7		1500	475
22,000	34.3		1500	475
24,000	31.0		1500	475

Note that a minimum fuel flow of 30 GPH must be maintained through 18,700 feet, then EGT limit can be used as a guide for leaning which should result in less than 30 GPH fuel flow.

LEANING - MAXIMUM NORMAL OPERATING POWER - 2400 RPM
Figure 5-41

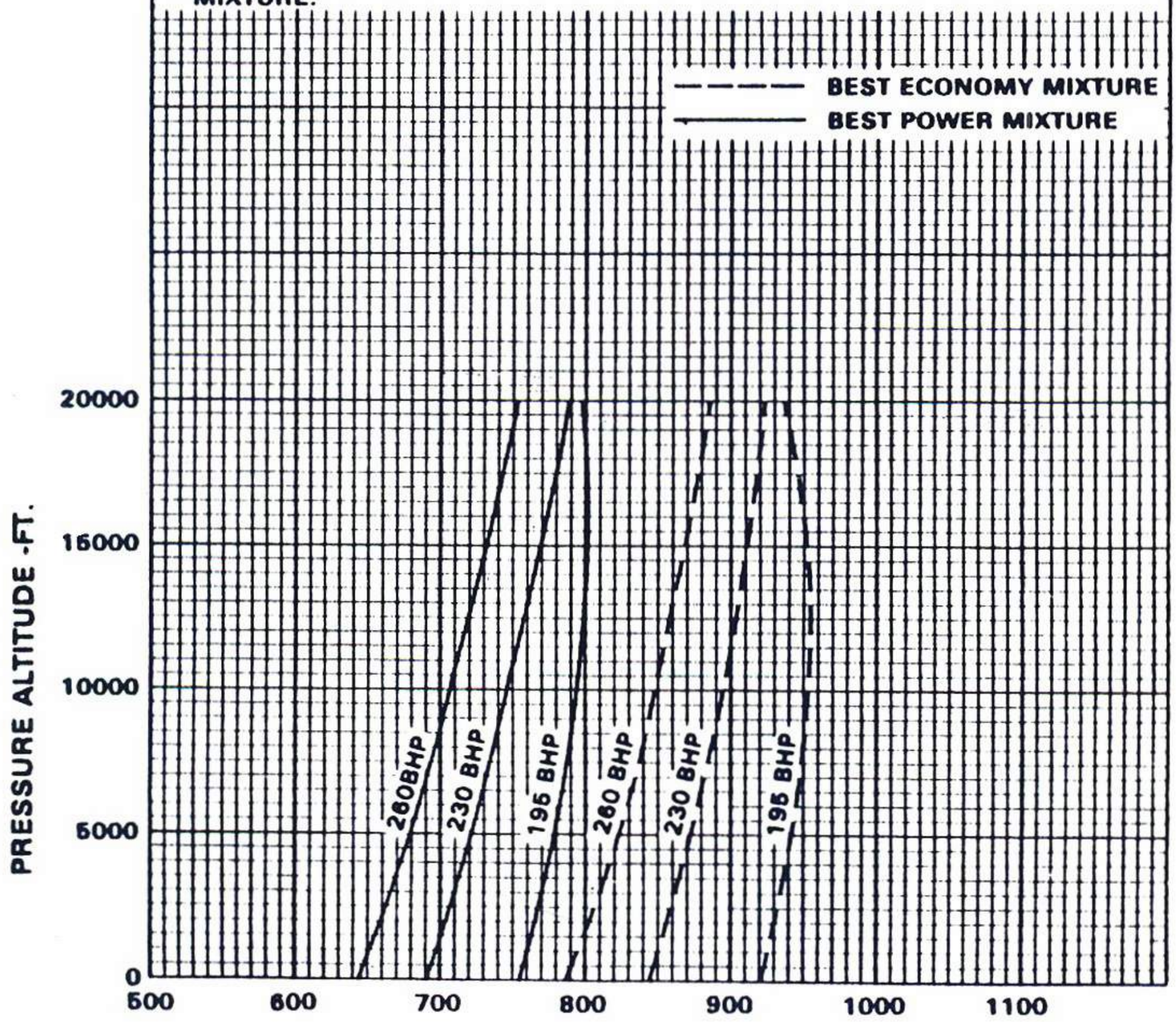
PA-31-350

RANGE PROFILE

STANDARD DAY
WEIGHT 7000 LBS.
FUEL LOAD 182 GAL. USABLE

NOTE: CHART ASSUMES

1. FIVE MINUTES FUEL CONSUMPTION AT TAKEOFF POWER.
2. CLIMP AT MCP.
3. CRUISE AT STATED POWER SETTING AND MIXTURE.
4. DESCEND AT 130 KIAS AND 500 FPM, BEST ECONOMY MIXTURE, POWER AS REQUIRED TO MAINTAIN RATE OF DESCENT AND AIRSPEED.
5. 45 MINUTES RESERVE AT CRUISE ALTITUDE AT 195 BHP, BEST ECONOMY MIXTURE.



RANGE PROFILE
Figure 5-43

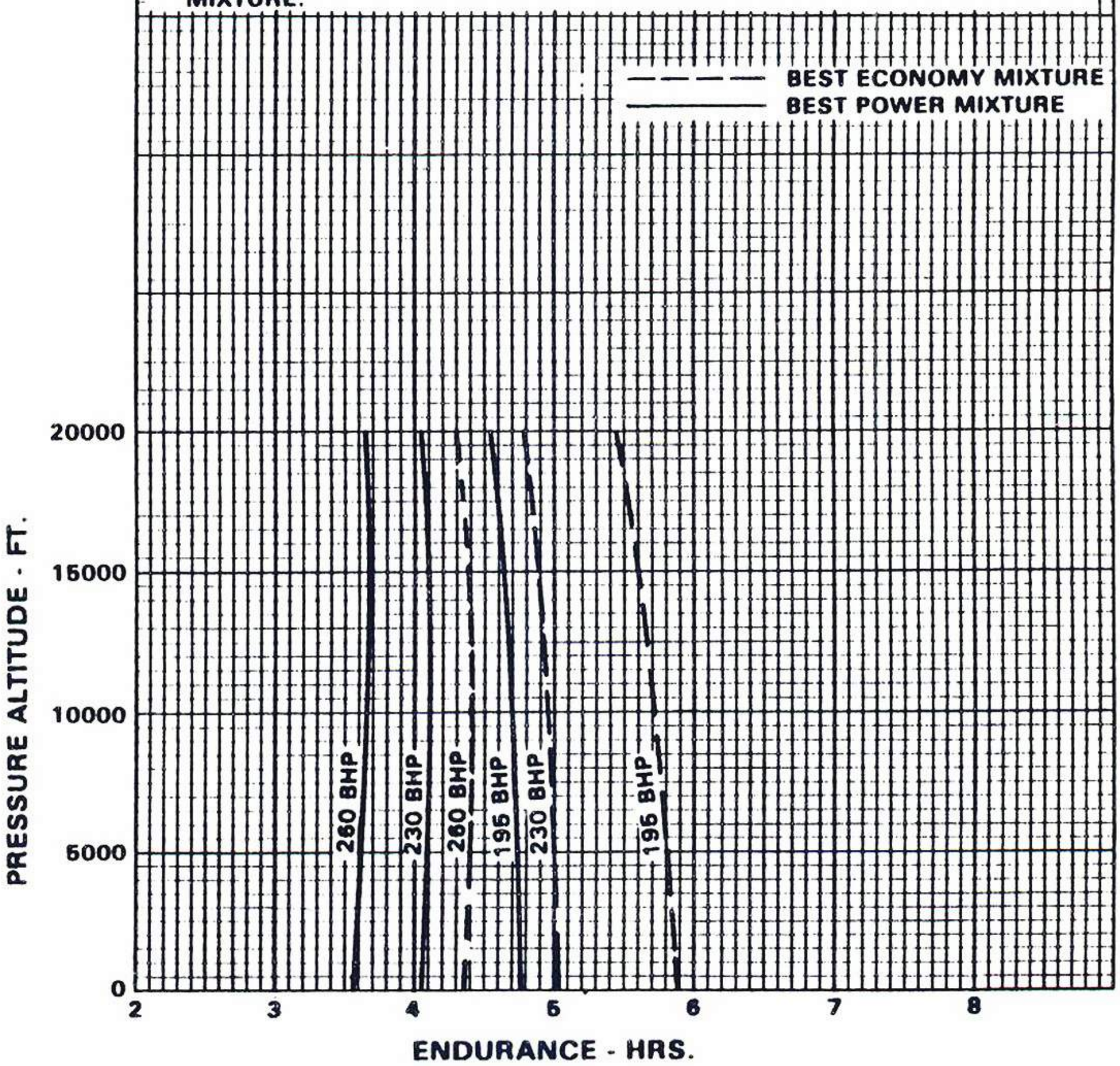
PA-31-350

ENDURANCE PROFILE

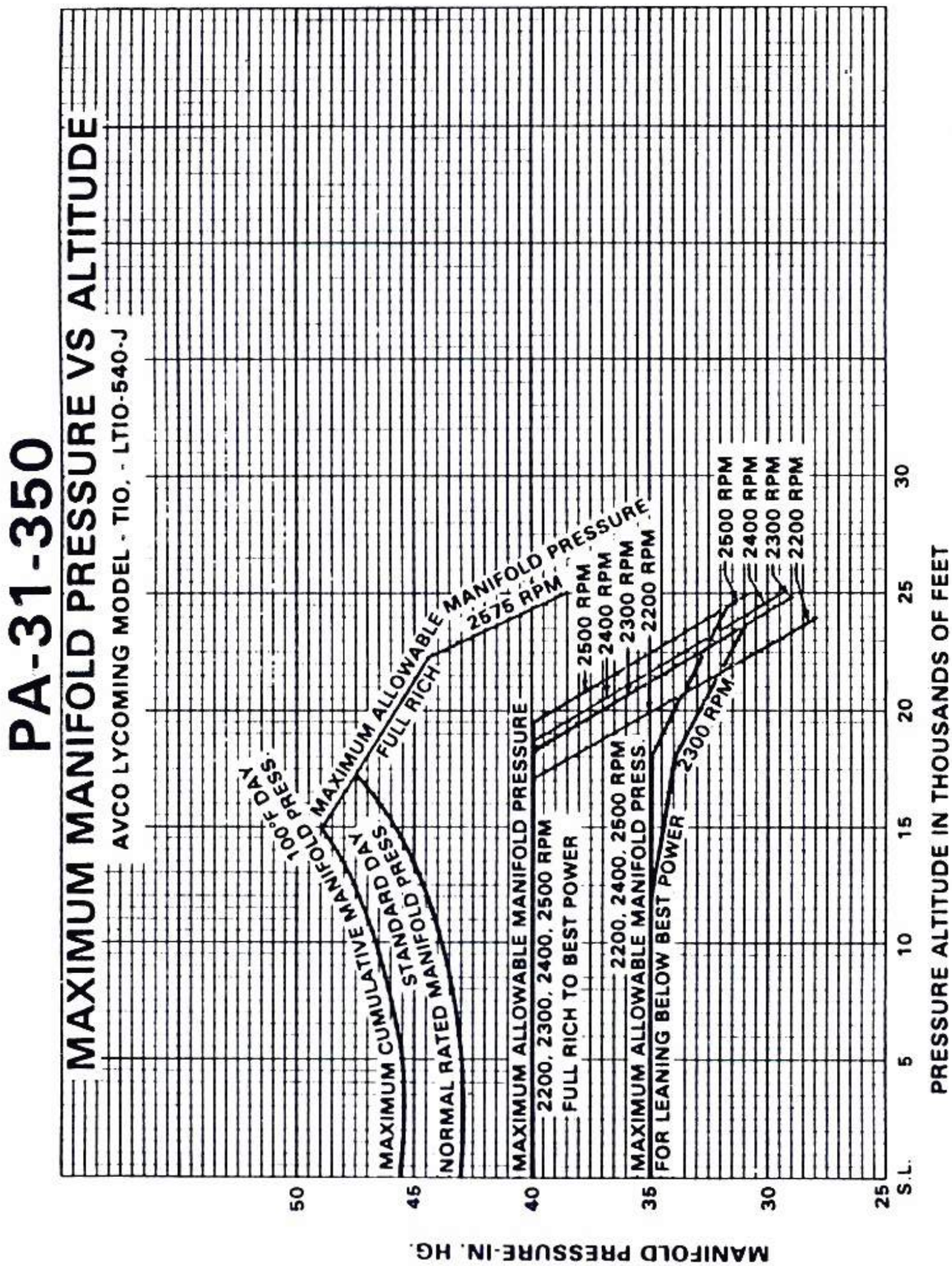
STANDARD DAY
WEIGHT 7000 LBS.
FUEL LOAD 182 GAL. USABLE

NOTE: CHART ASSUMES

1. FIVE MINUTES FUEL CONSUMPTION AT TAKEOFF POWER.
2. CLIMB AT MCP.
3. CRUISE AT STATED POWER SETTING AND MIXTURE.
4. DESCEND AT 130 KIAS AND 500 FPM, BEST ECONOMY MIXTURE, POWER AS REQUIRED TO MAINTAIN RATE OF DESCENT AND AIRSPEED.
5. 45 MINUTES RESERVE AT CRUISE ALTITUDE AT 196 BHP, BEST ECONOMY MIXTURE.



ENDURANCE PROFILE
Figure 5-45



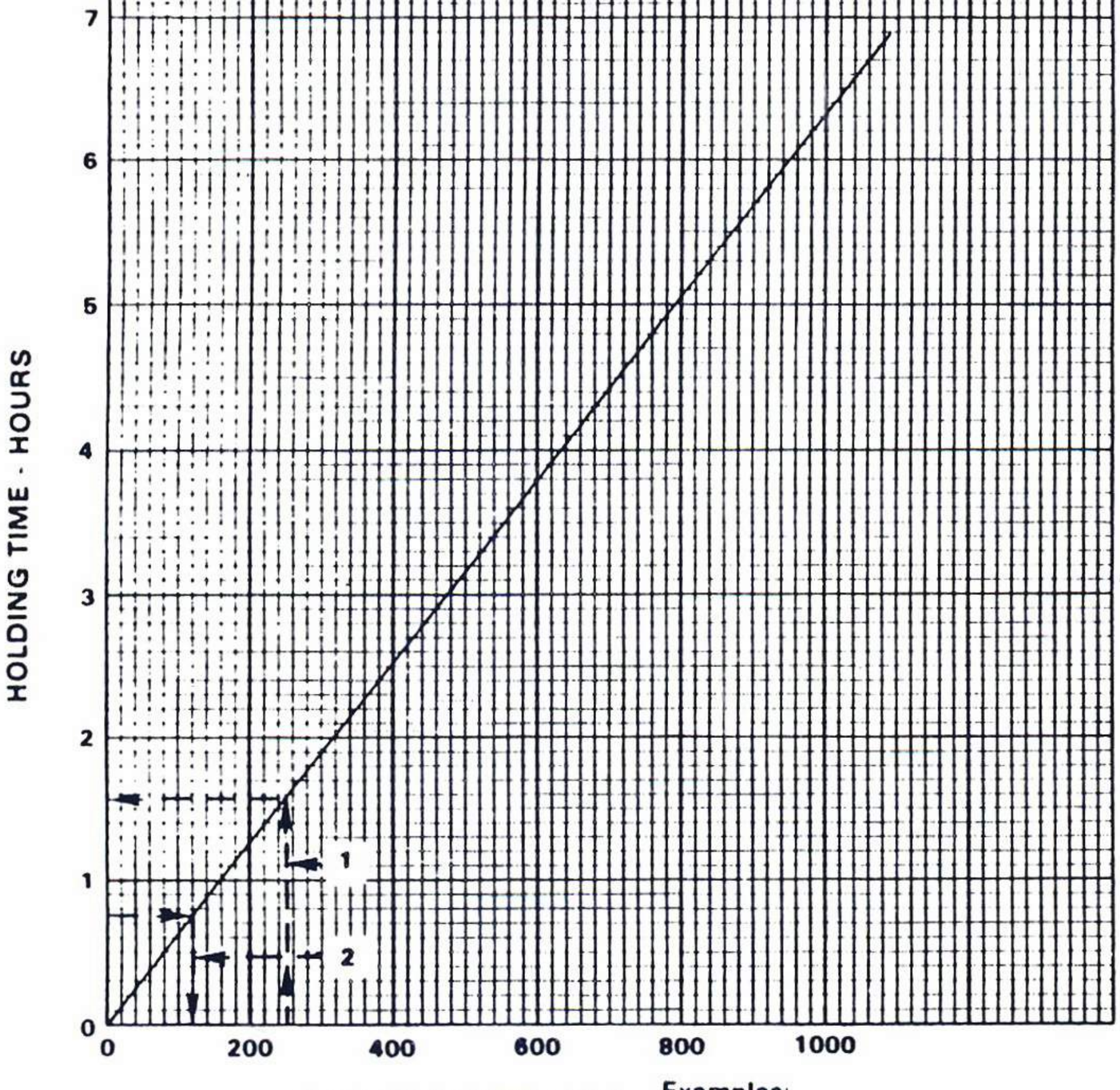
MAXIMUM MANIFOLD PRESSURE VS. ALTITUDE
Figure 5-47

PA-31-350

HOLDING TIME

195 BHP
LEANED TO BEST ECONOMY
2200 RPM

NOTE: APPLICABLE FOR ALL TEMPERATURES AND ALTITUDES.

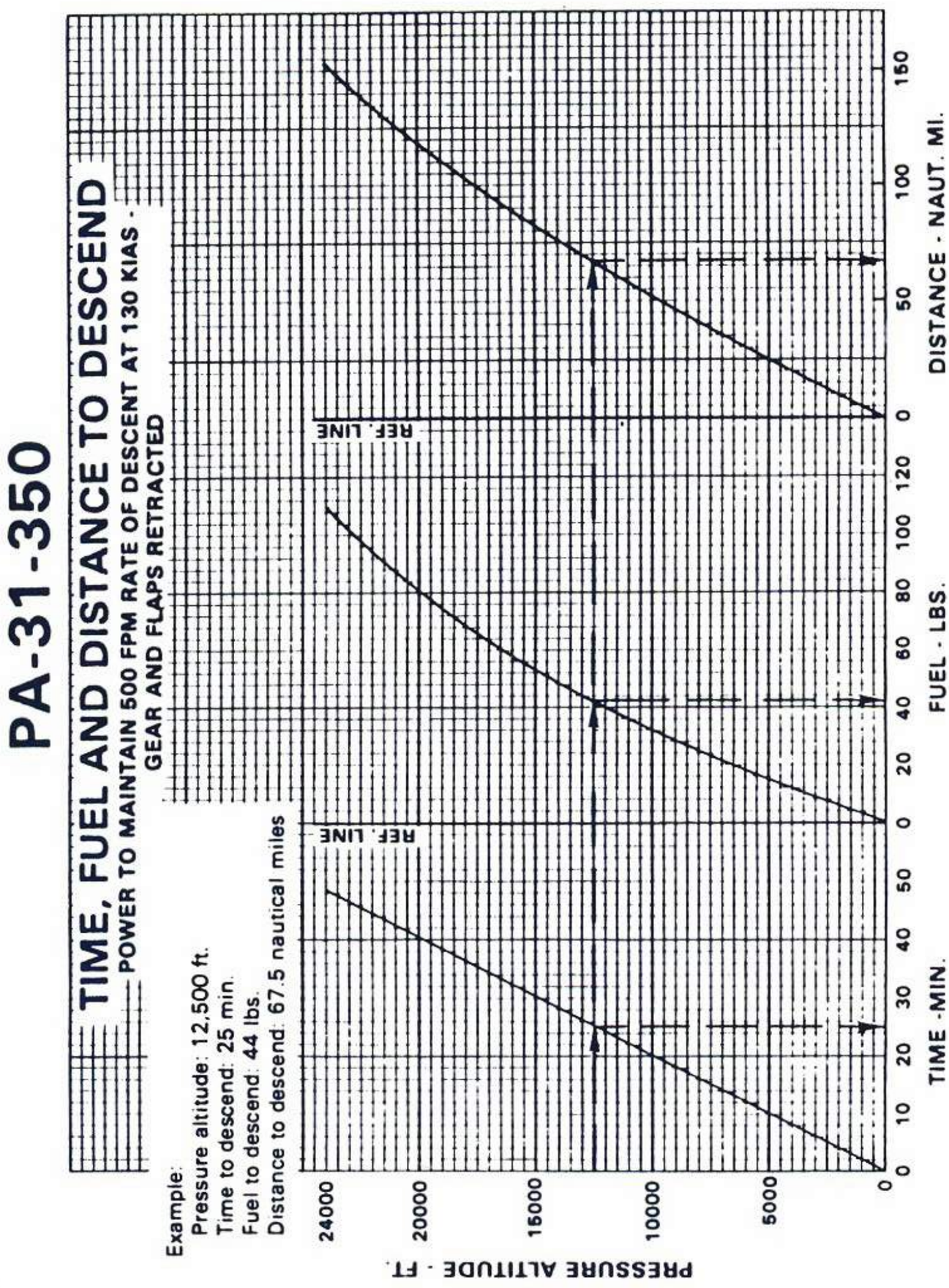


Examples:

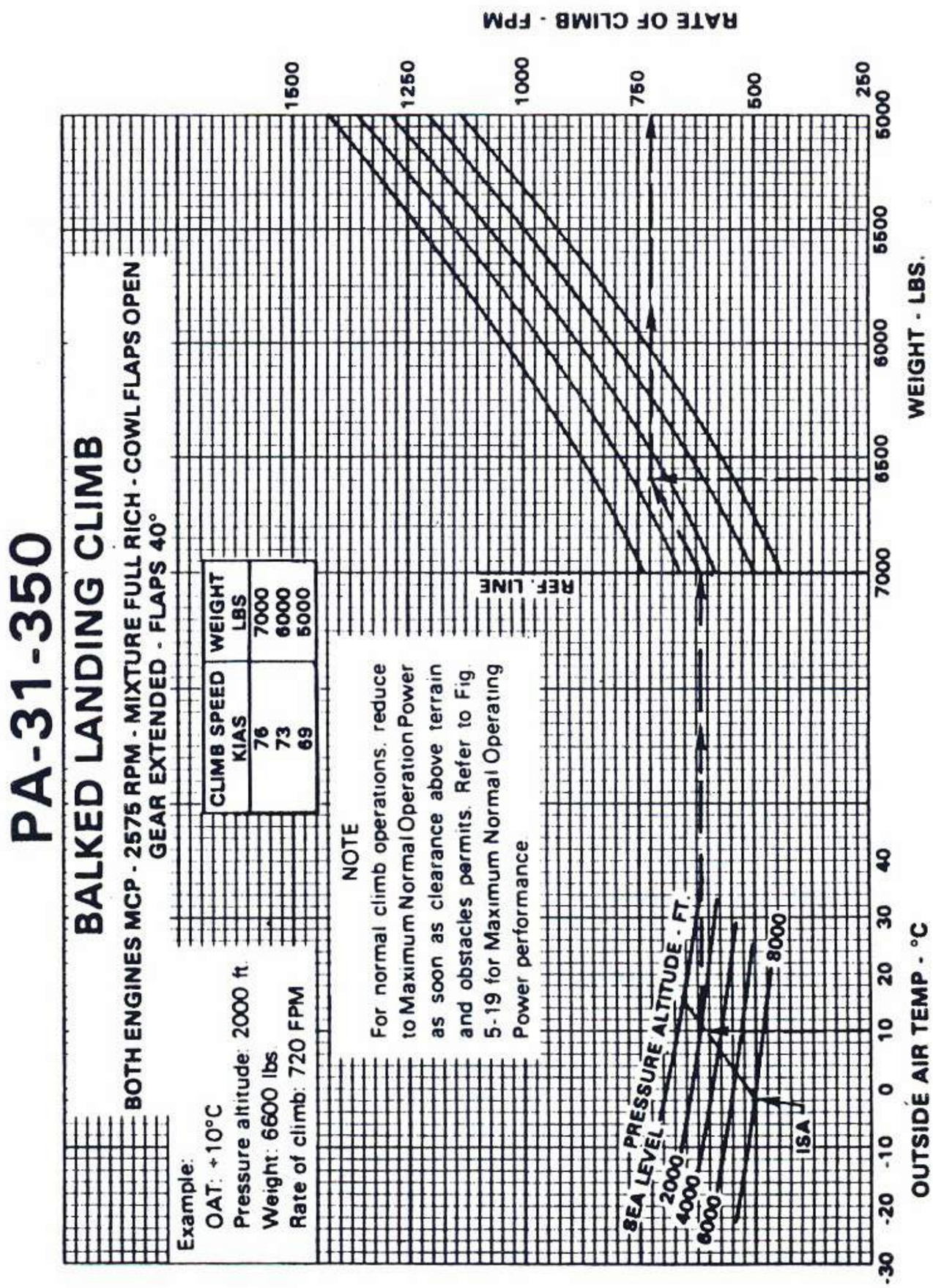
1. Fuel available for holding: 250 lbs.
   Holding time: 1:33 hours

2. Required holding time: 45 min.
   Fuel required: 120 lbs.

HOLDING TIME
Figure 5-49

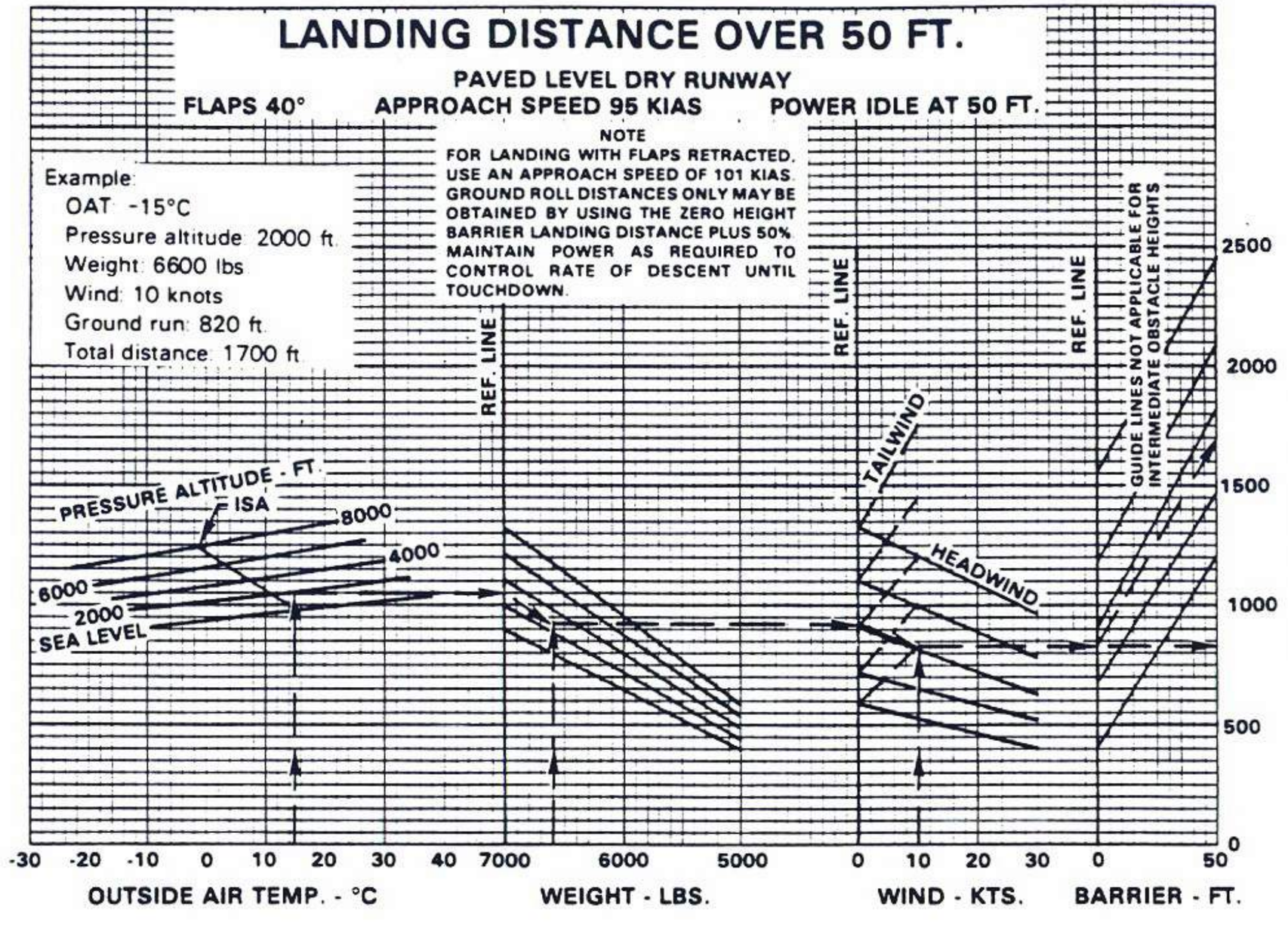


TIME, FUEL AND DISTANCE TO DESCEND
Figure 5-51



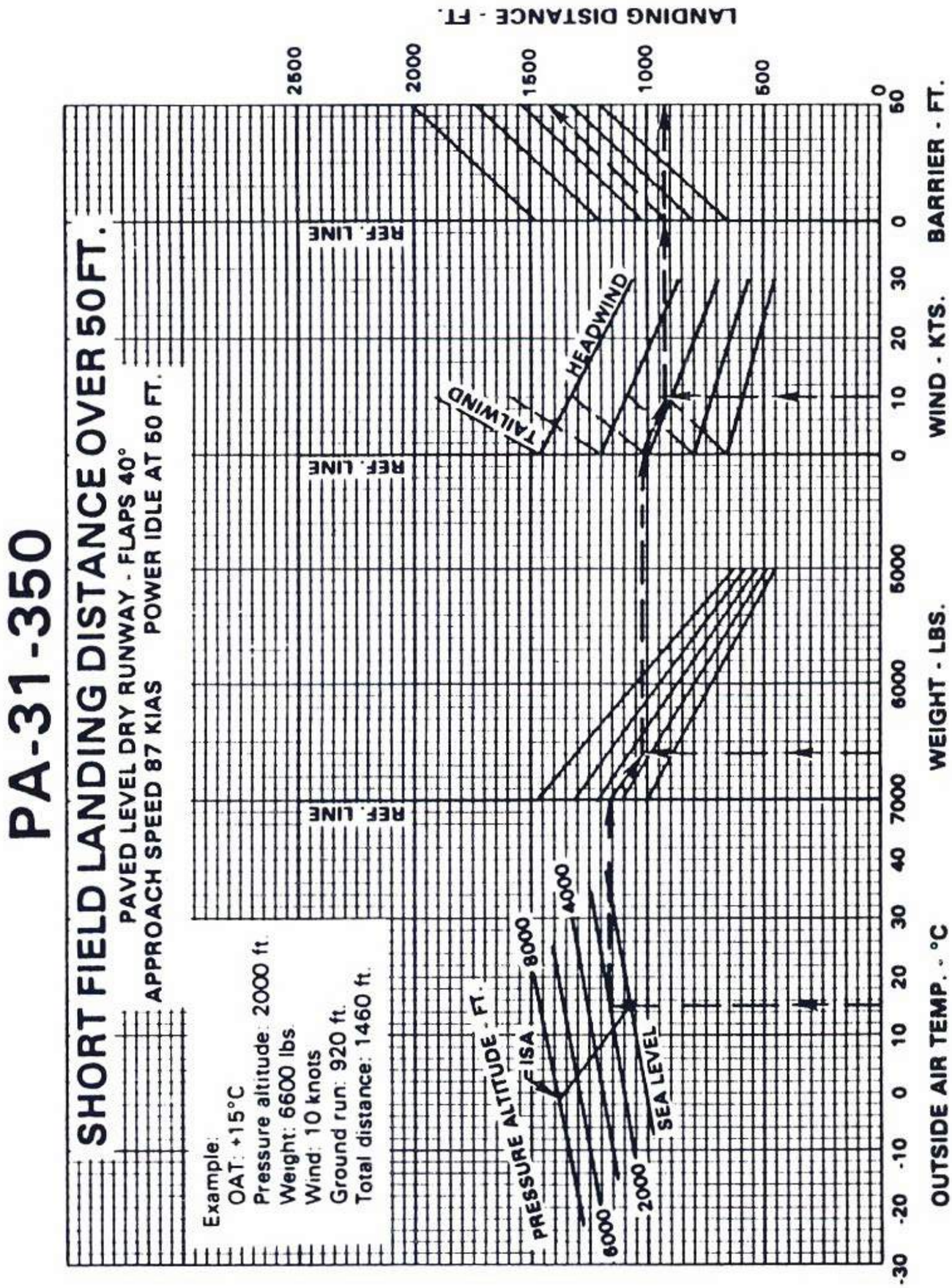
BALKED LANDING CLIMB
(Maximum Continuous Power)
Figure 5-53

PA-31-350



LANDING DISTANCE OVER 50 FEET
Figure 5-55

ISSUED: SEPTEMBER 14, 1979
REVISED: MAY 4, 1984



SHORT FIELD LANDING DISTANCE OVER 50 FEET
Figure 5-57