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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 this aircraft 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 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	1391 lbs.
(2) Occupants (4 x 170 lbs.)	680 lbs.
(3) Baggage and Cargo	50 lbs.
(4) Fuel (6 lb/gal x 30)	180 lbs.
(5) Takeoff Weight	2316 lbs.
(6) Landing Weight	
(a)(5) minus (g)(1), (2316 lbs. minus 134.4 lbs.)	2181.6 lbs.

Our takeoff weight is below the maximum of 2325 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 graph (Figures 5-5 and 5-6 or 5-7 and 5-8) 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	1500 ft.	2500 ft.
(2) Temperature	80° F (27° C)	75° F (24° C)
(3) Wind Component	15 KTS (Headwind)	0 KTS
(4) Runway Length Available	4800 ft.	7600 ft.
(5) Runway Required	2100 ft.*	1190**

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, Distance, and Fuel to Climb graph (Figure 5-13). After the time, distance and fuel for the cruise pressure altitude and outside air temperature values have been established, apply the existing conditions at the departure field to graph (Figure 5-13). 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, distance and time 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	5000 ft.
(2) Cruise OAT	60° F (16° C)
(3) Time to Climb (10.0 min. minus 2.5 min.)	7.5 min.***
(4) Distance to Climb (13.5 miles minus 3.5 miles)	10.0 miles***
(5) Fuel to Climb (2 gal. minus .5 gal.)	1.5 gal.***

\*reference Figure 5-6

\*\*reference Figure 5-29

\*\*\*reference Figure 5-13

(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, distance and fuel for descent (Figure 5-25). 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, distance and fuel values from the graph (Figure 5-25). Now, subtract the values obtained from the field conditions from the values obtained from the cruise conditions to find the true time, distance and fuel 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 (6.5 min. minus 3.5 min.)	3.0 min.*
(2) Distance to Descend (14 miles minus 7.5 miles)	6.5 miles*
(3) Fuel to Descend (1.0 gal. minus .5 gal.)	.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 Avco Lycoming Operator's Manual 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 Cruise Performance graph (Figures 5-15 through 5-18).

Calculate the cruise fuel consumption for the cruise power setting from the information provided by the Avco Lycoming 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 consumption by the cruise time.

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

(1) Total Distance	300 miles
(2) Cruise Distance	
(e)(1) minus (c)(4) minus (d)(2), (300 minus 10 miles minus 6.5 miles)	283.5 miles
(3) Cruise Power, Best Economy Mixture	75% rated power (2645 RPM)
(4) Cruise Speed	118 KTS TAS**
(5) Cruise Fuel Consumption	8.5 GPH
(6) Cruise Time	
(e)(2) divided by (c)(4), (283.5 miles divided by 118 KTS)	2.40 hrs.
(7) Cruise Fuel	
(e)(5) multiplied by (e)(6), (8.5 GPH multiplied by 2.40 hrs.)	20.4 gal.

\*reference Figure 5-25

\*\*reference Figure 5-17

(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), (.13 hrs. plus .05 hrs. plus 2.40 hrs.) 2.58 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), (1.5 gal. plus .5 gal. plus 20.4 gal.) 22.4 gal.  
(22.4 gal. multiplied by 6 lb/gal.) 134.4 lbs.

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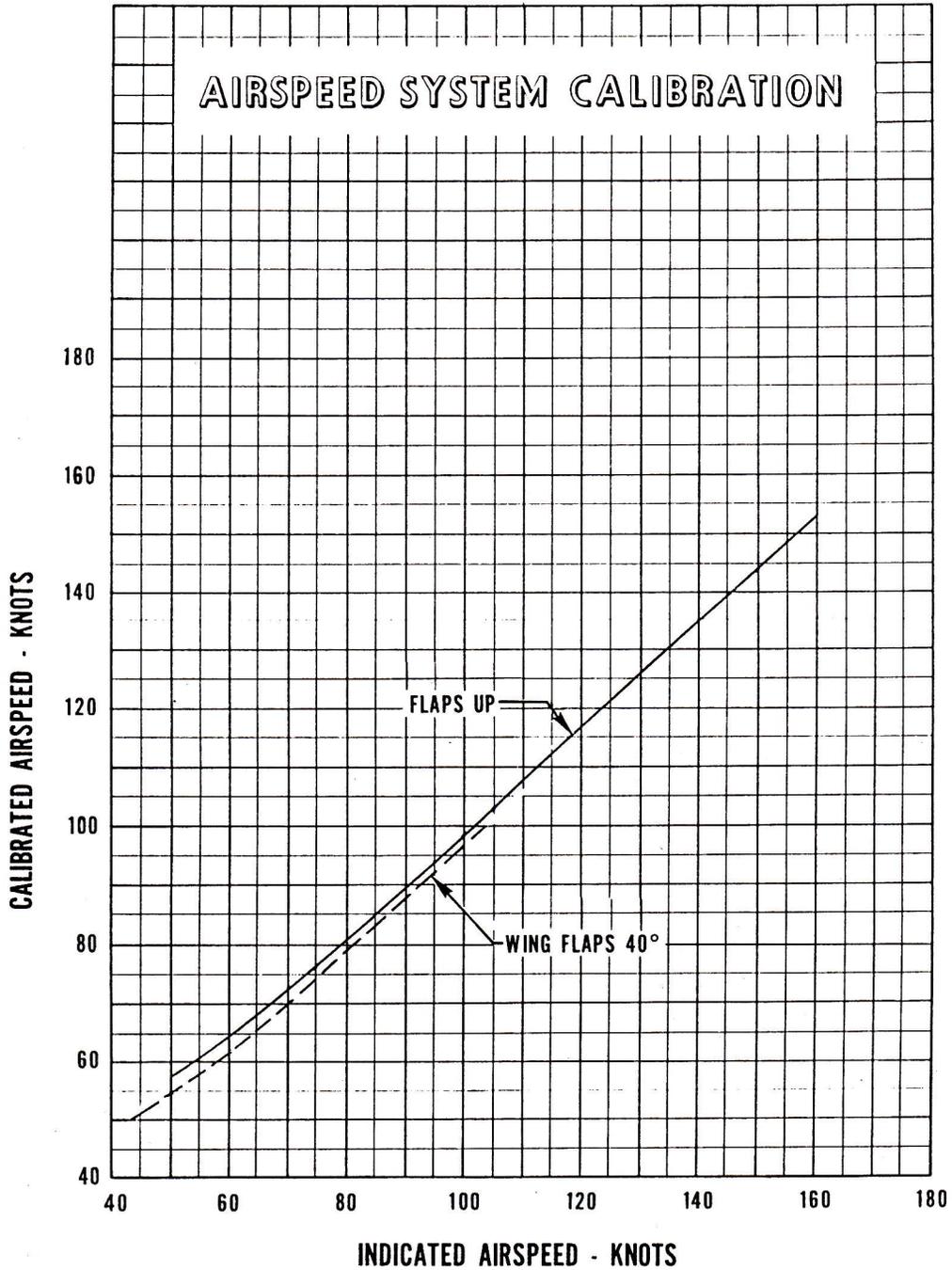
5.7 PERFORMANCE GRAPHS

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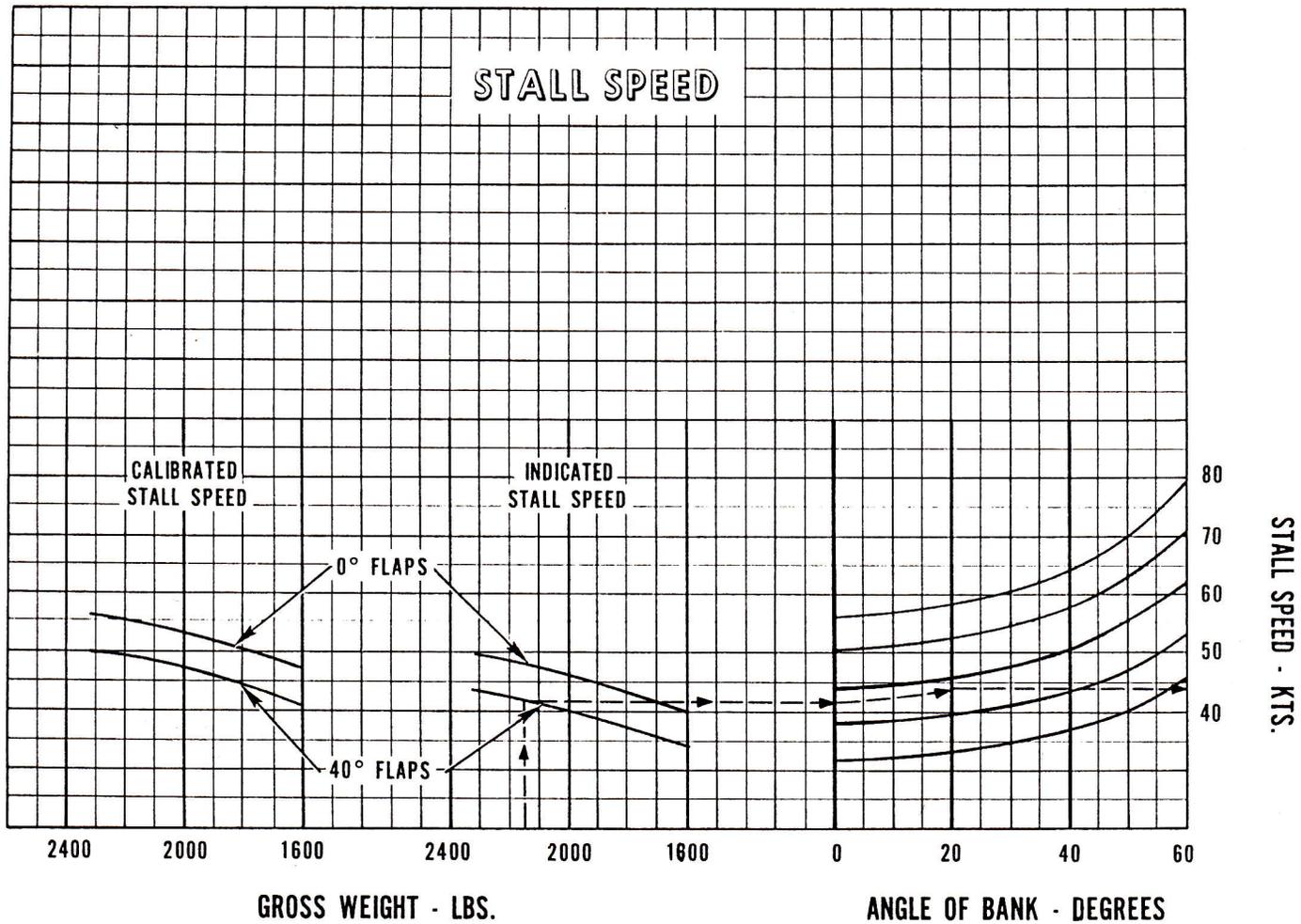
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**AIRSPEED SYSTEM CALIBRATION**

Figure 5-1

# PA-28-161



Example:

Gross weight: 2170 lbs.

Angle of bank: 20°

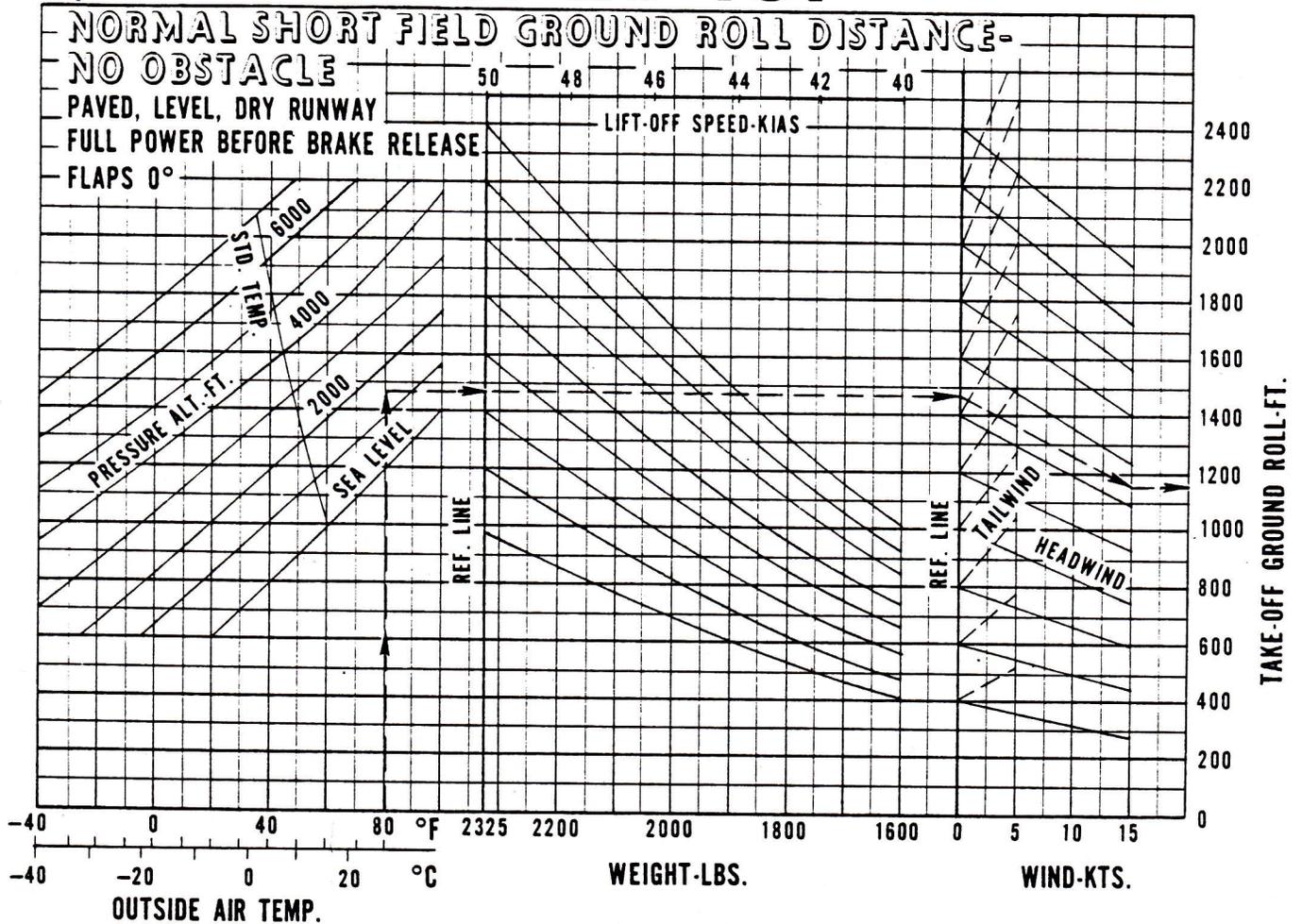
Flap position: 40°

Stall speed, indicated: 44 KTS

## STALL SPEED

Figure 5-3

# PA-28-161



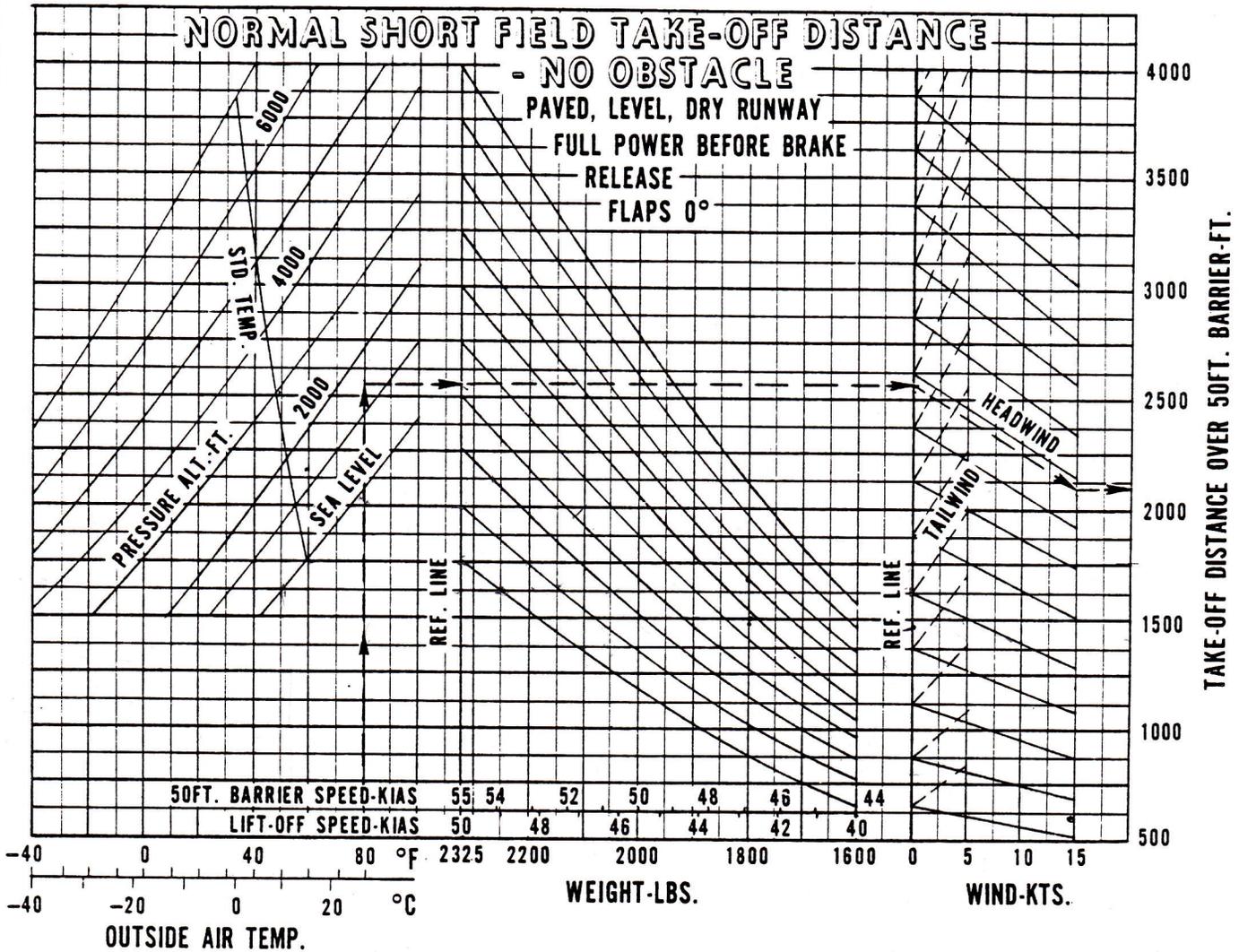
**Example:**

- Departure airport pressure altitude: 1500 ft.
- Departure airport temperature: 80° F
- Weight: 2325 lbs.
- Wind: 15 KTS headwind
- Ground roll: 1150 ft.
- Lift-off speed: 50 KIAS

**NORMAL SHORT FIELD GROUND ROLL DISTANCE - NO OBSTACLE**

Figure 5-5

# PA-28-161



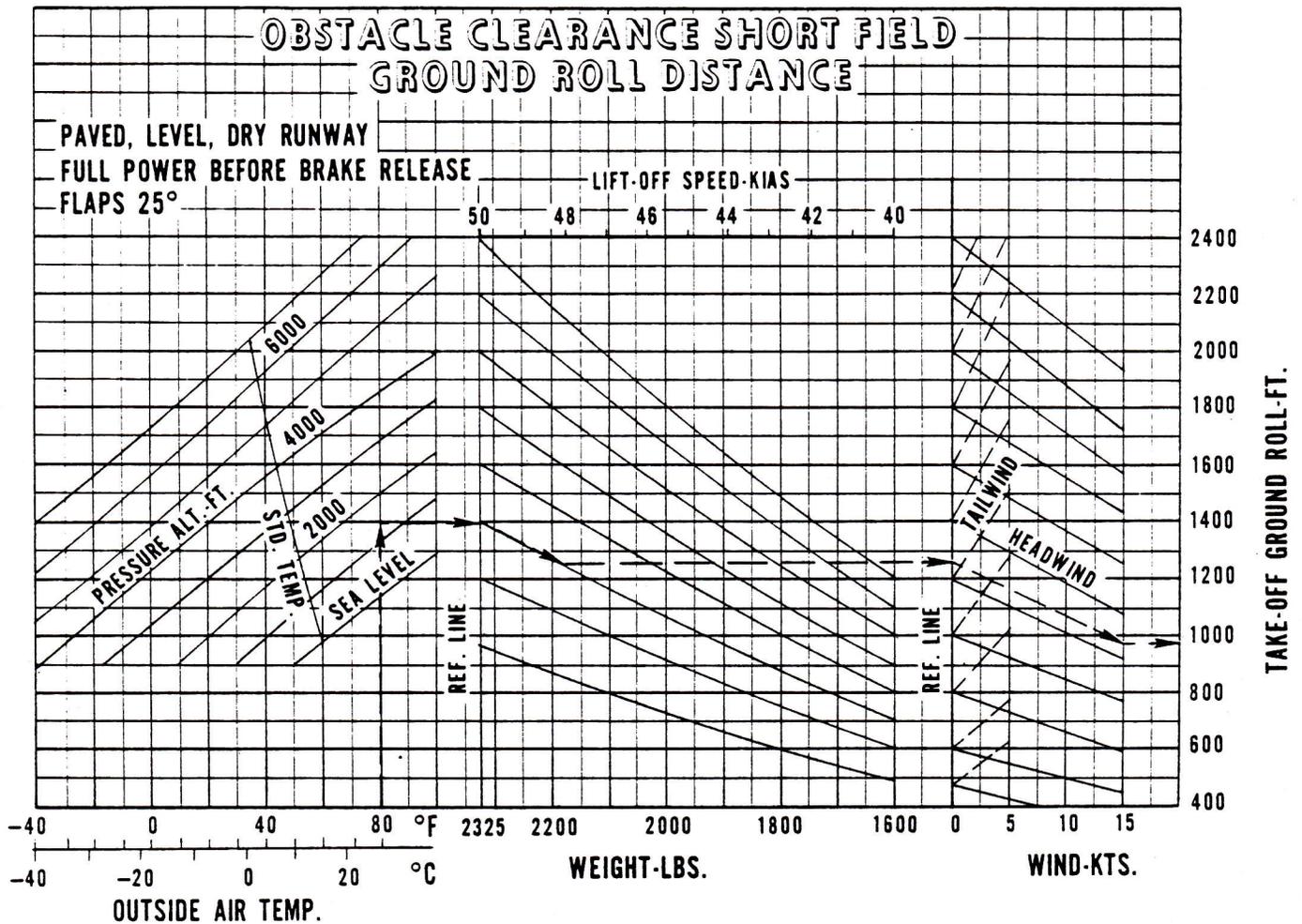
**Example:**

- Departure airport pressure altitude: 1500 ft.
- Departure airport temperature: 80° F
- Weight: 2325 lbs.
- Wind: 15 KTS headwind
- Distance over 50 ft. barrier: 2100 ft.
- Lift-off speed: 50 KIAS
- Barrier speed: 55 KIAS

**NORMAL SHORT FIELD TAKEOFF DISTANCE - NO OBSTACLE**

Figure 5-6

# PA-28-161

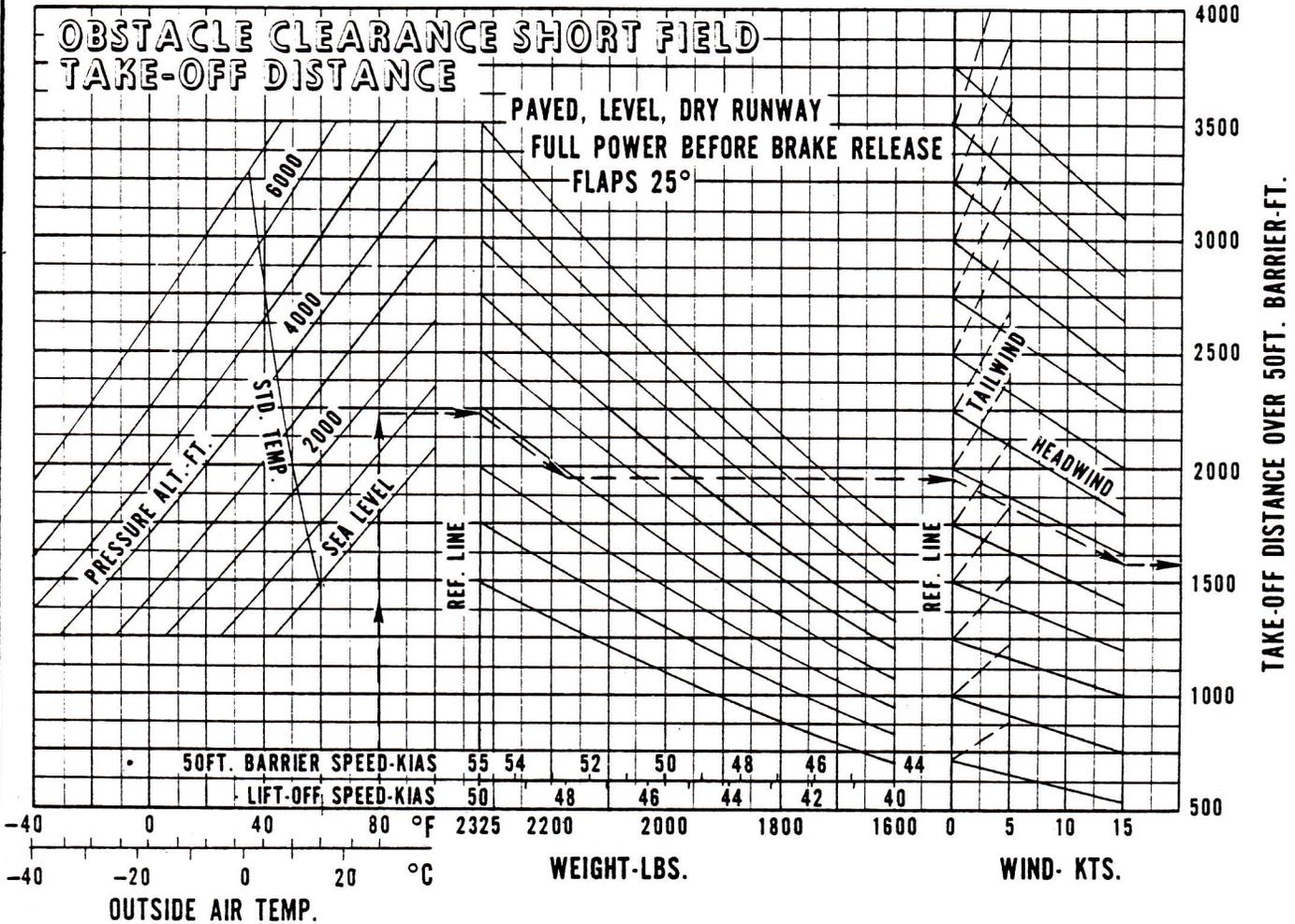


Example:  
 Departure airport pressure altitude: 1500 ft.  
 Departure airport temperature: 80°F  
 Weight: 2175 lbs.  
 Wind: 15 KTS headwind  
 Ground roll: 975 ft.  
 Lift-off speed: 48 KIAS

OBSTACLE CLEARANCE SHORT FIELD GROUND ROLL DISTANCE

Figure 5-7

# PA-28-161



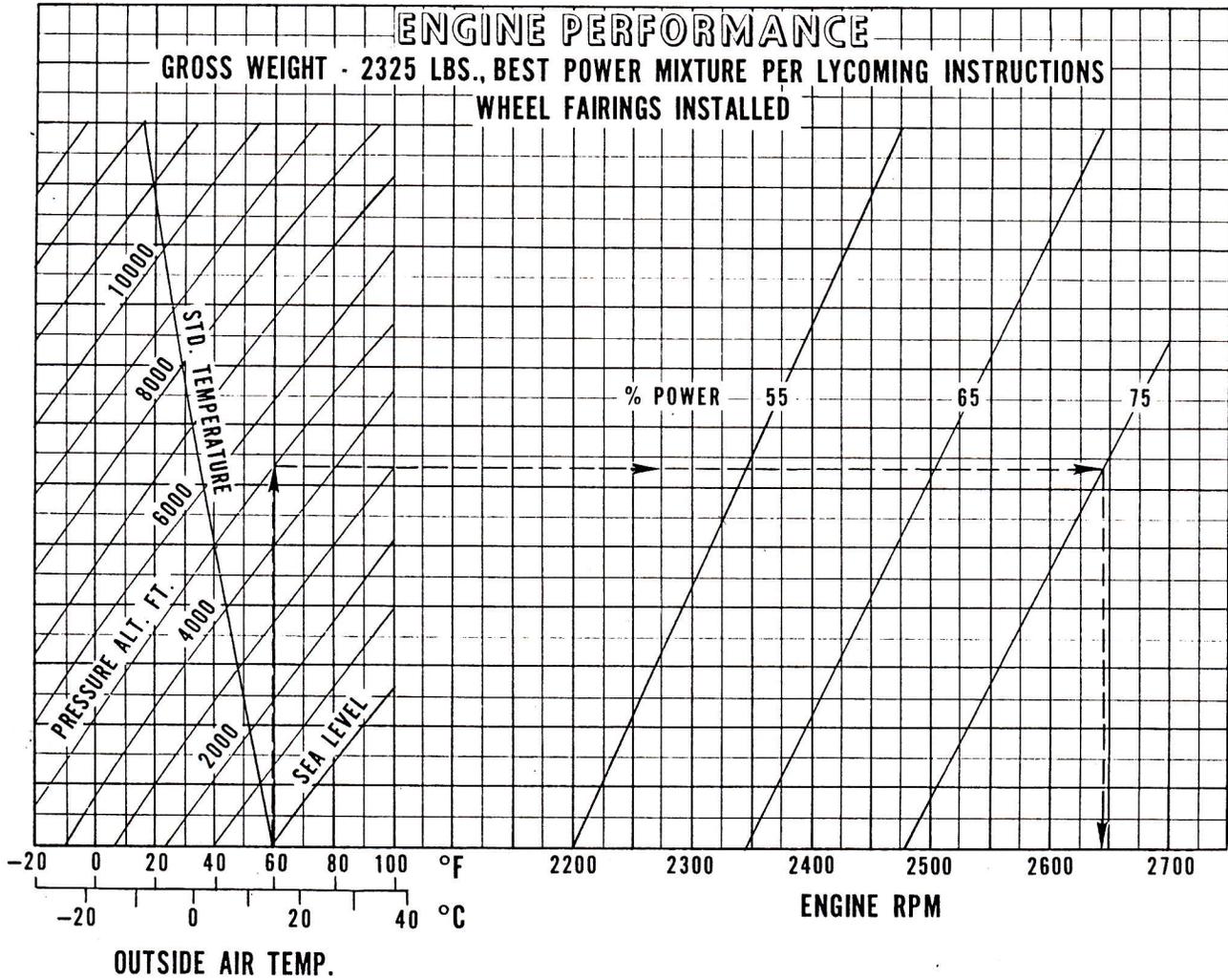
**Example:**

- Departure airport pressure altitude: 1500 ft.
- Departure airport temperature: 80° F
- Weight: 2175 lbs.
- Wind: 15 KTS headwind
- Distance over 50 ft. barrier: 1600 ft.
- Lift-off speed: 48 KIAS
- Barrier speed: 53 KIAS

**OBSTACLE CLEARANCE SHORT FIELD TAKEOFF DISTANCE**

Figure 5-8

# PA-28-161



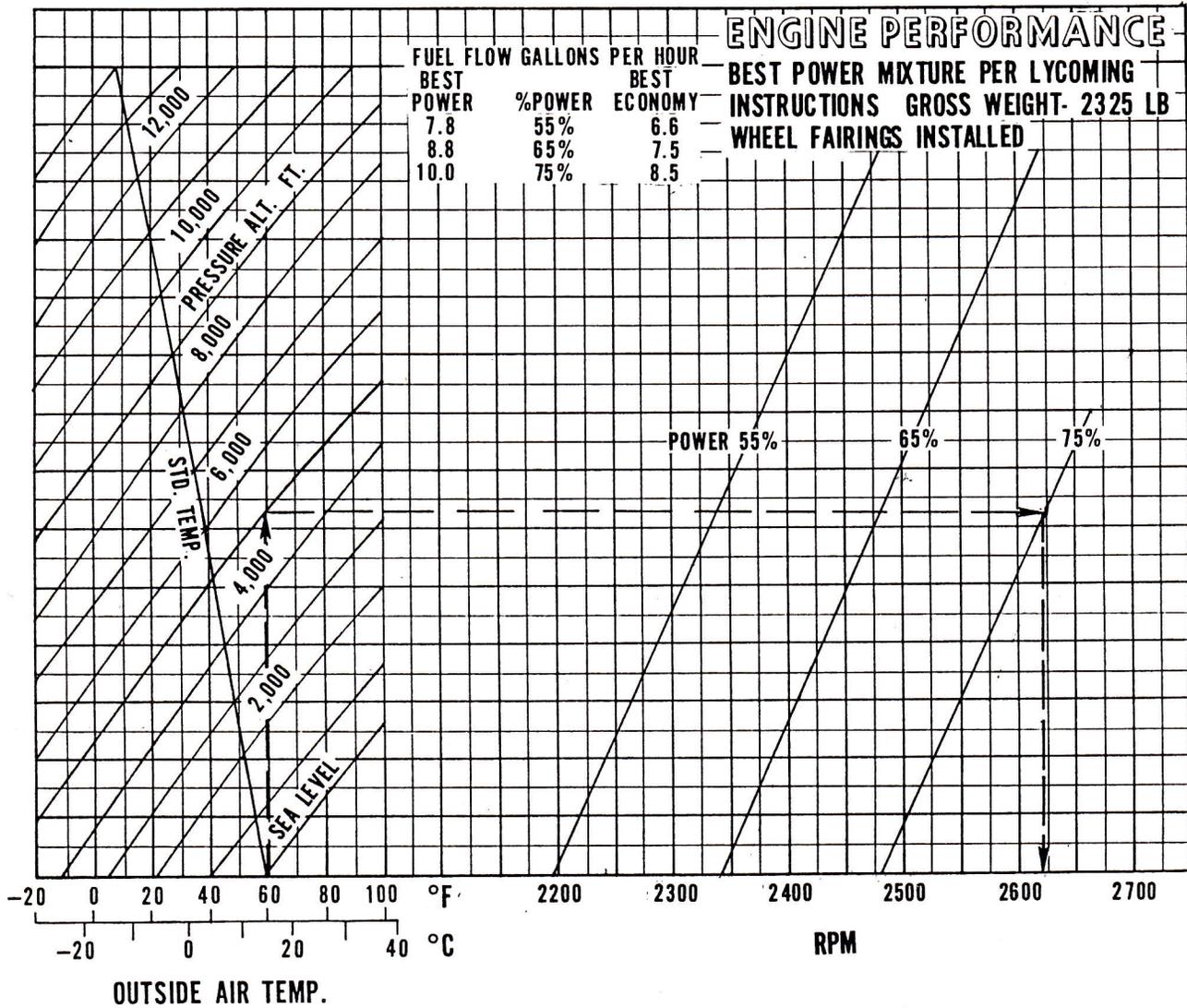
Example:

- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 60°F
- Cruise power: 75%
- Engine RPM: 2645

ENGINE PERFORMANCE (SERIAL NOS. 28-7716001 THROUGH 7716323)

Figure 5-9

# PA-28-161



Example:

Cruise pressure altitude: 5000 ft.

Cruise OAT: 60° F

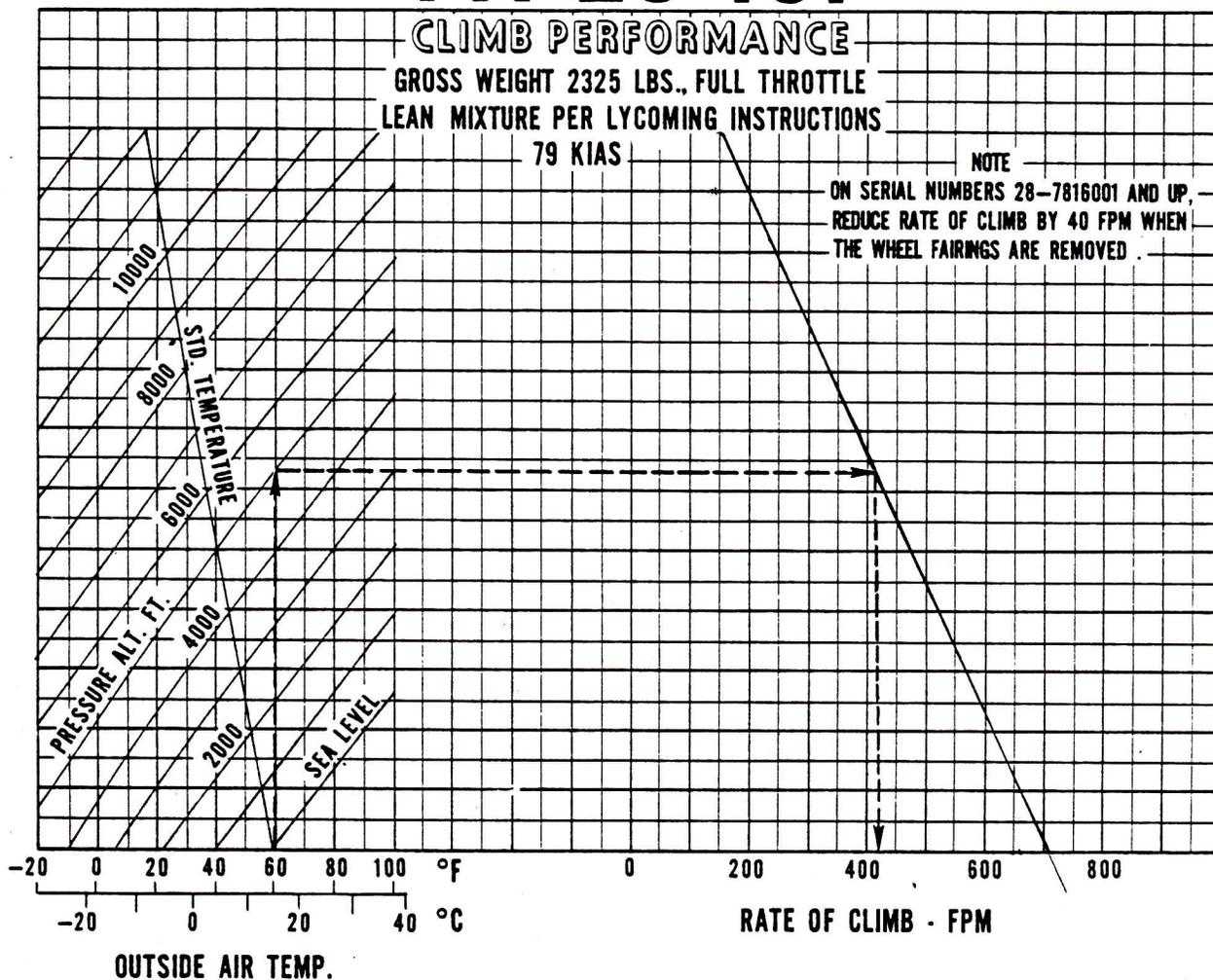
Cruise power: 75%

Engine RPM: 2620

ENGINE PERFORMANCE (SERIAL NOS. 28-7816001 AND UP) SE-6VE

Figure 5-10

# PA-28-161

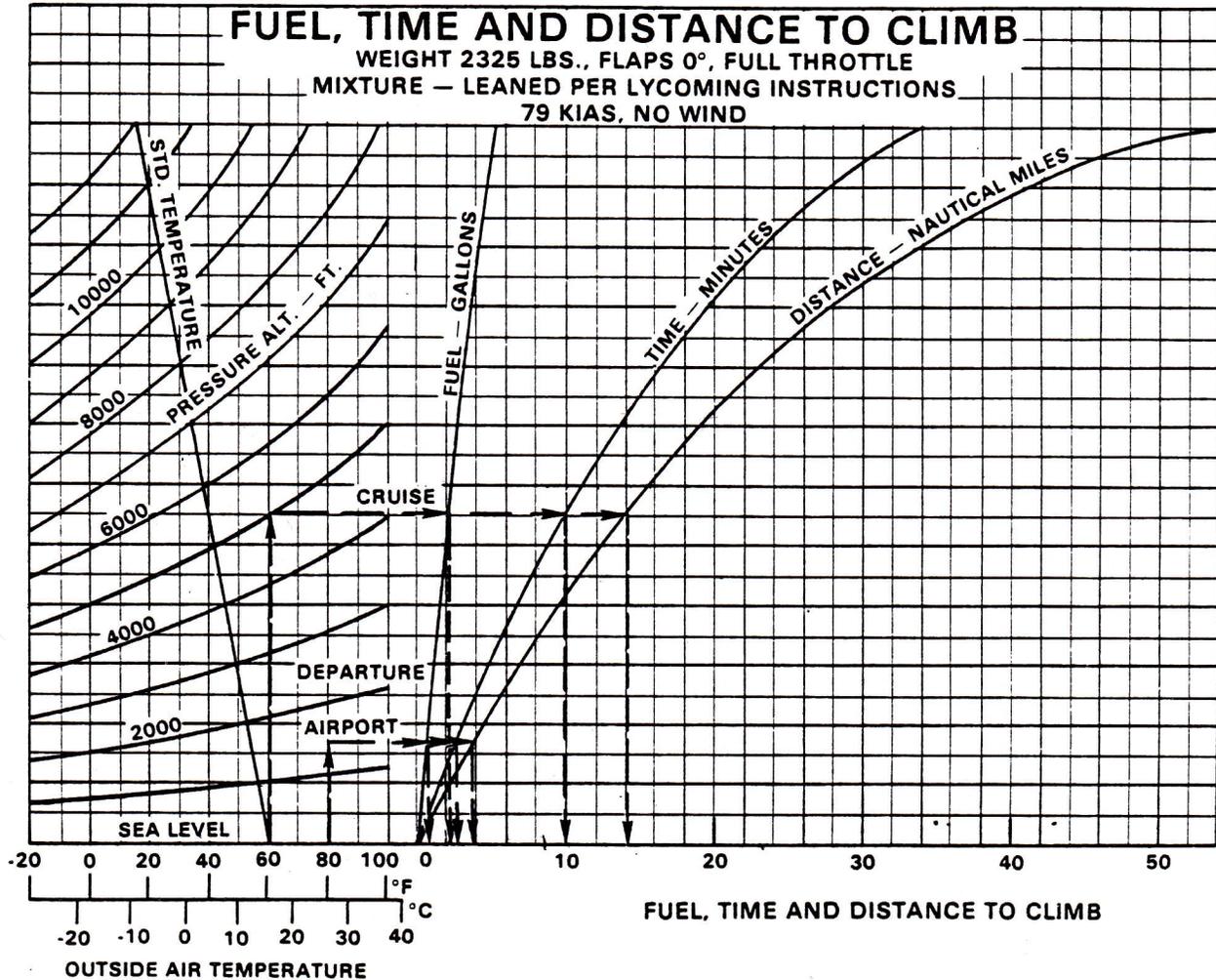


Example:  
 Climb pressure altitude: 5000 ft.  
 Climb OAT: 60°F  
 Rate of climb: 420 ft/min.

CLIMB PERFORMANCE

Figure 5-11

# PA-28-161



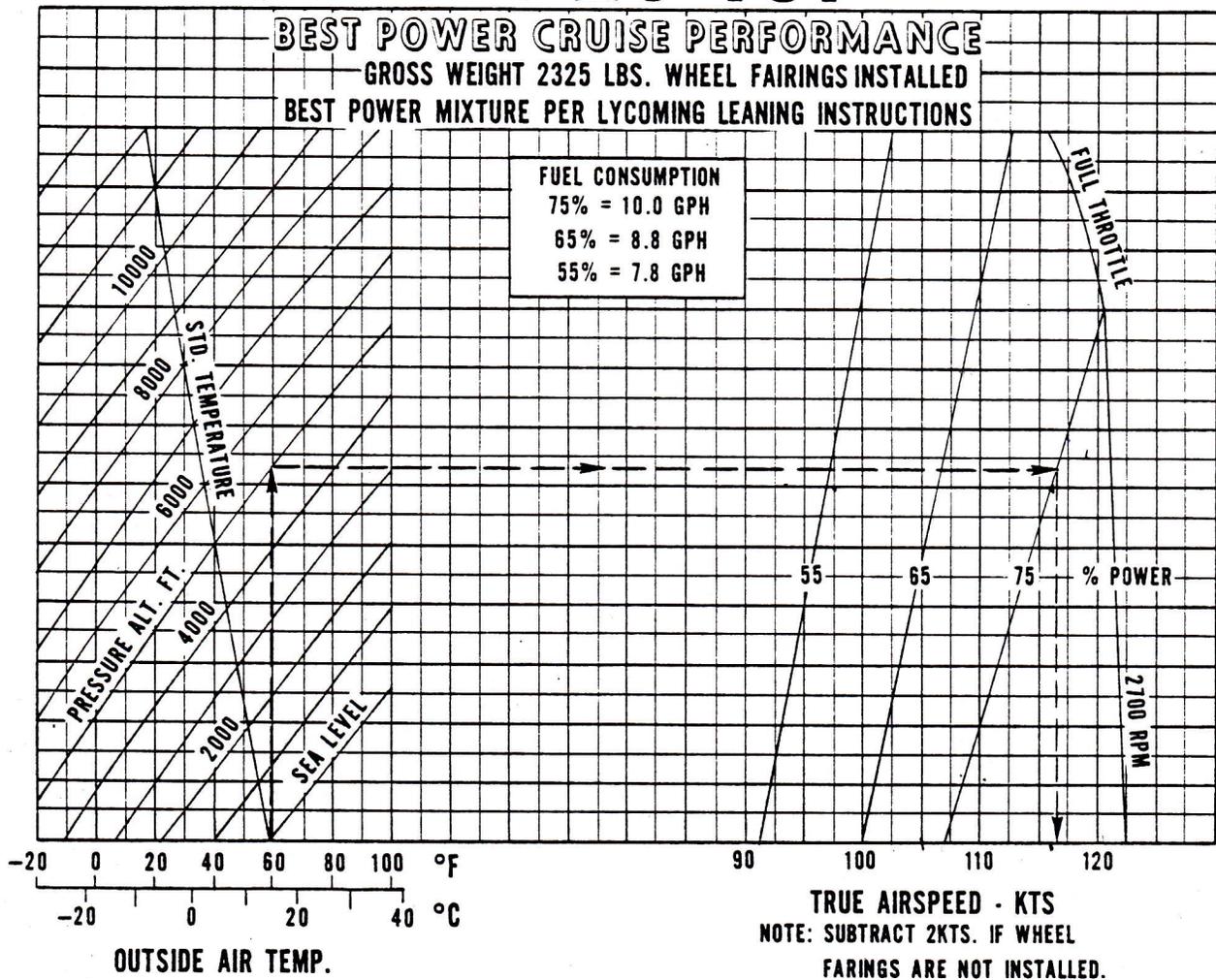
**Example:**

- Departure airport pressure altitude: 1500 ft.
- Departure airport temperature: 80° F (27°C)
- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 60° F (16°C)
- Time to climb (10 min. minus 2.5 min.): 7.5 min.
- Distance to climb (13.5 miles minus 3.5 miles): 10 nautical miles
- Fuel to climb (2 gal. minus .5 gal.): 1.5 gal.

**FUEL, TIME AND DISTANCE TO CLIMB**

Figure 5-13

# PA-28-161

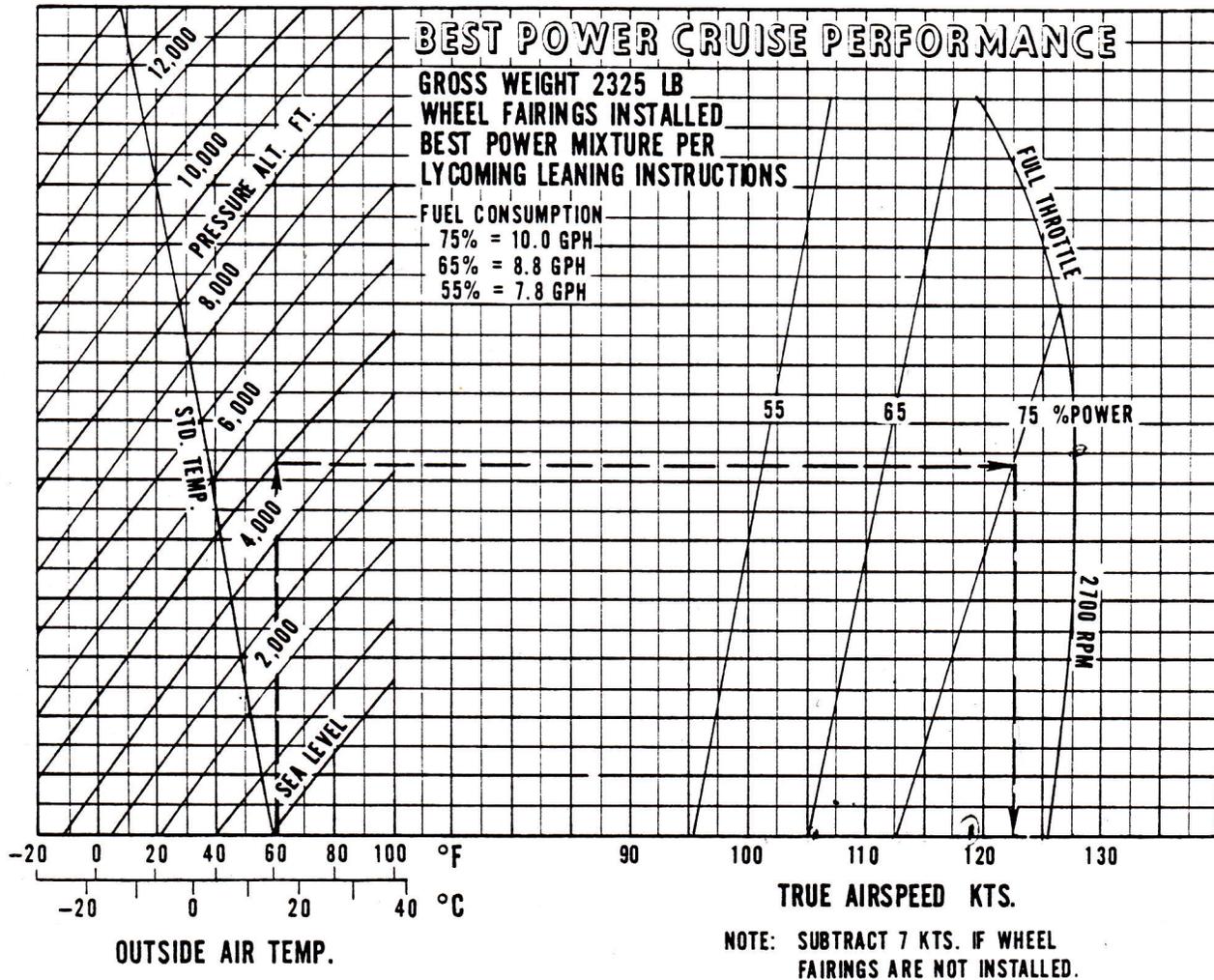


Example:  
 Cruise pressure altitude: 5000 ft.  
 Cruise OAT: 60°F  
 Cruise power: 75% best power mixture  
 Cruise speed: 116.5 KTS TAS

BEST POWER CRUISE PERFORMANCE (SERIAL NOS. 28-7716001 THROUGH 7716323)

Figure 5-15

# PA-28-161



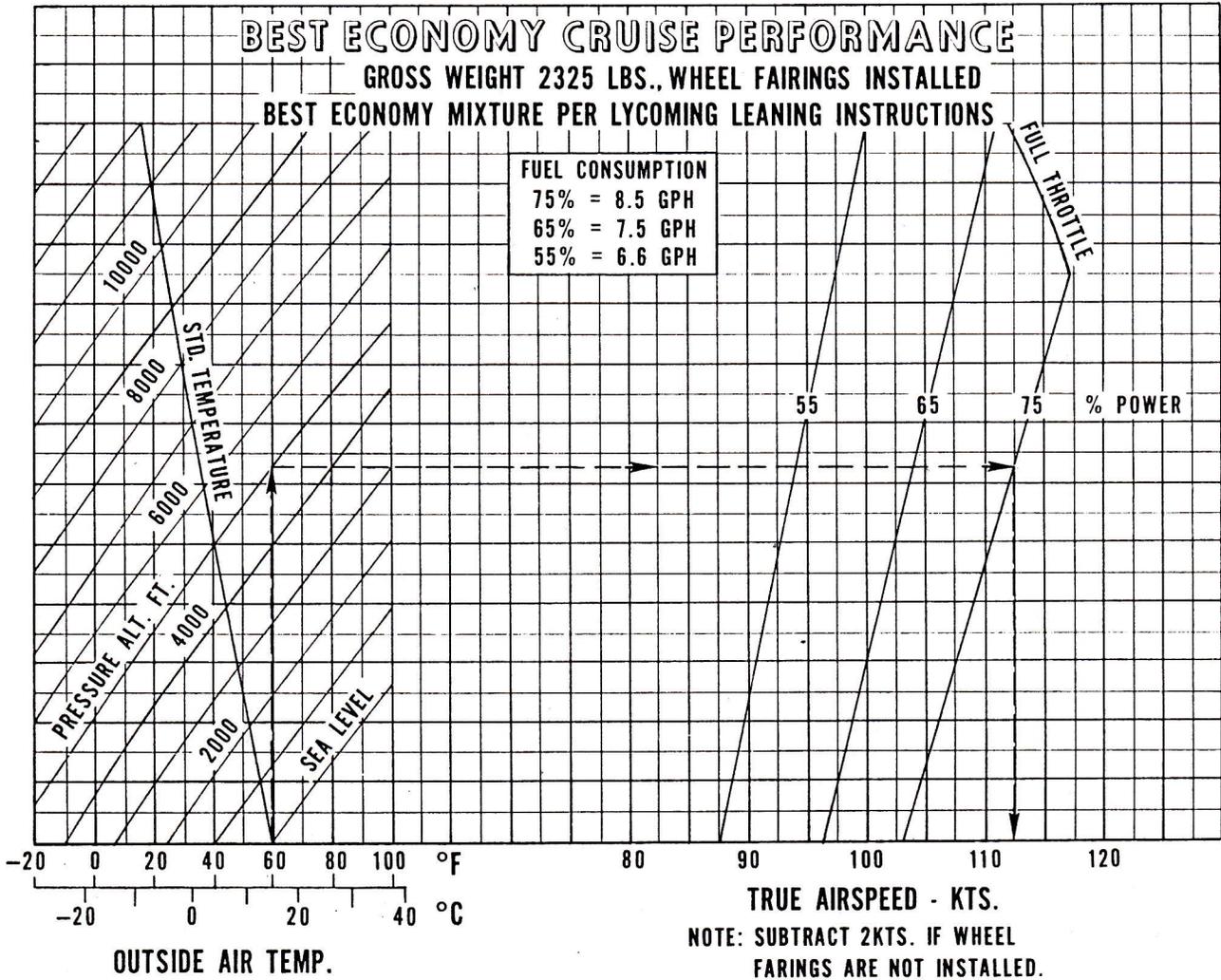
Example:

- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 60°F
- Cruise power: 75% best power mixture
- Cruise speed: 122.5 KTS TAS

BEST POWER CRUISE PERFORMANCE (SERIAL NOS. 28-7816001 AND UP) SE-6VE

Figure 5-16

# PA-28-161



Example:

- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 60° F
- Cruise power: 75% best economy mixture
- Cruise speed: 112.5 KTS TAS

BEST ECONOMY CRUISE PERFORMANCE (SERIAL NOS. 28-7716001 THROUGH 7716323)

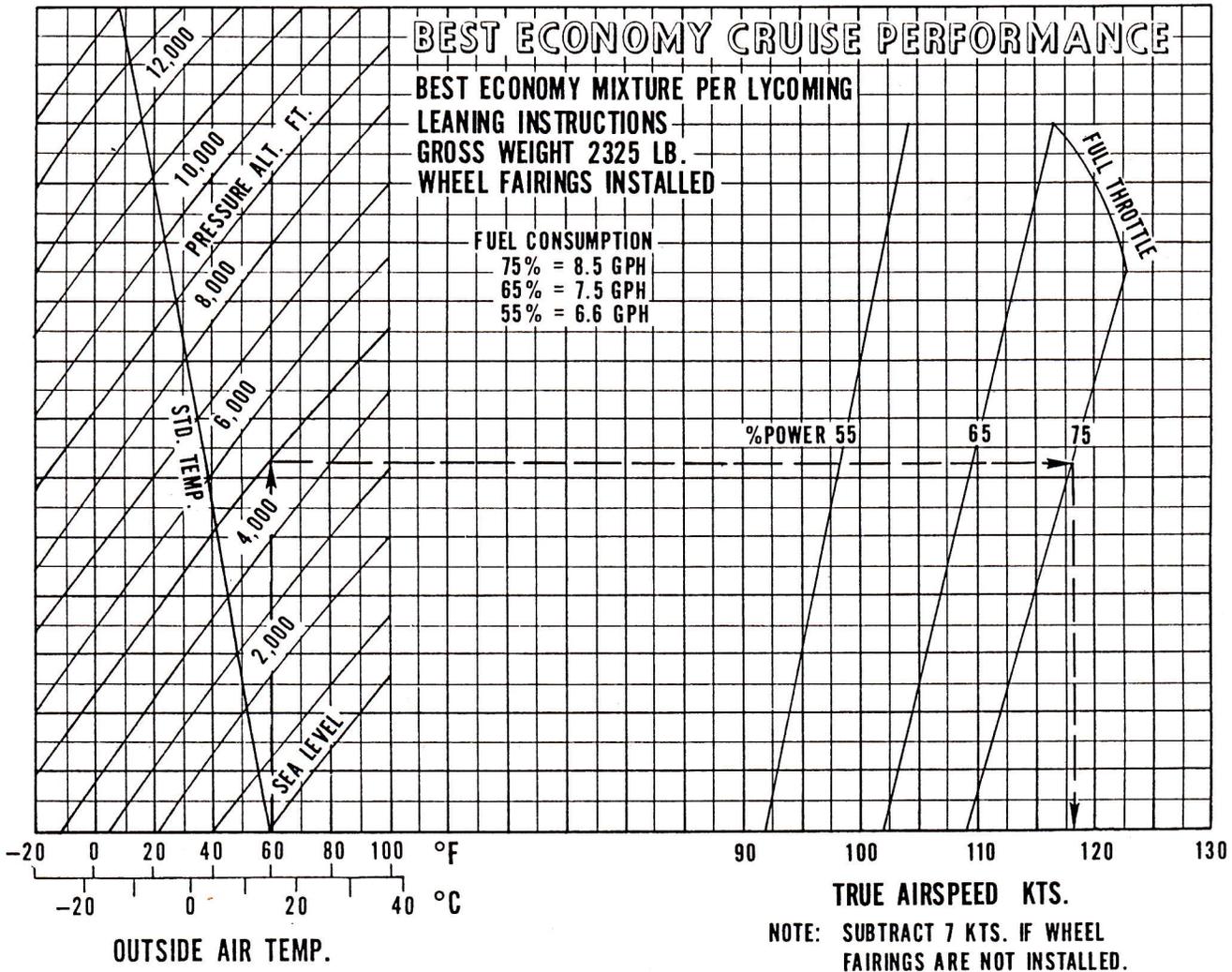
Figure 5-17

# PA-28-161

## BEST ECONOMY CRUISE PERFORMANCE

BEST ECONOMY MIXTURE PER LYCOMING  
LEANING INSTRUCTIONS  
GROSS WEIGHT 2325 LB.  
WHEEL FAIRINGS INSTALLED

FUEL CONSUMPTION  
75% = 8.5 GPH  
65% = 7.5 GPH  
55% = 6.6 GPH



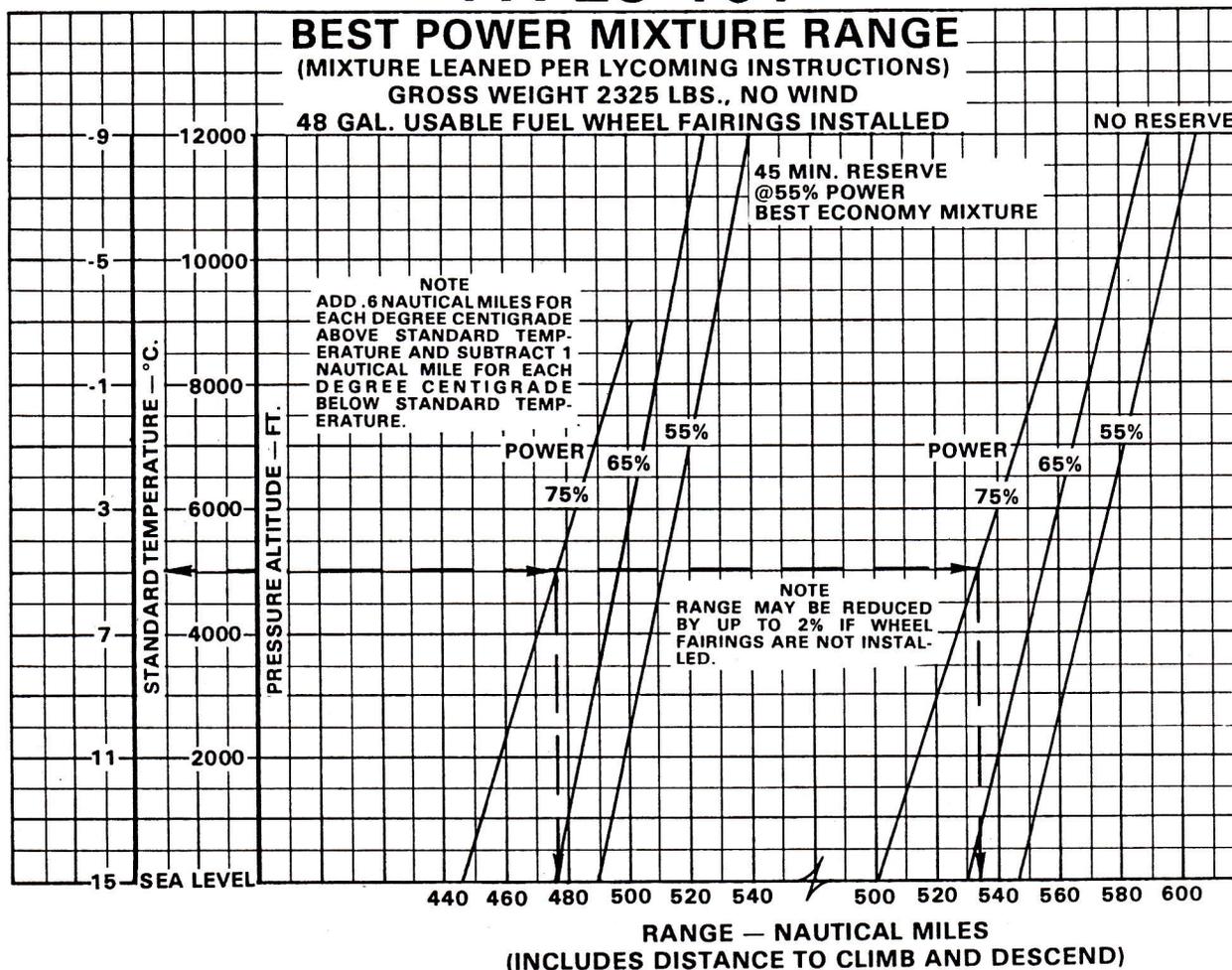
Example:

Cruise pressure altitude: 5000 ft.  
Cruise OAT: 60°F  
Cruise power: 75% best power mixture  
Cruise speed: 118 KTS TAS

BEST ECONOMY CRUISE PERFORMANCE (SERIAL NOS. 28-7816001 AND UP) SE6VE

Figure 5-18

# PA-28-161



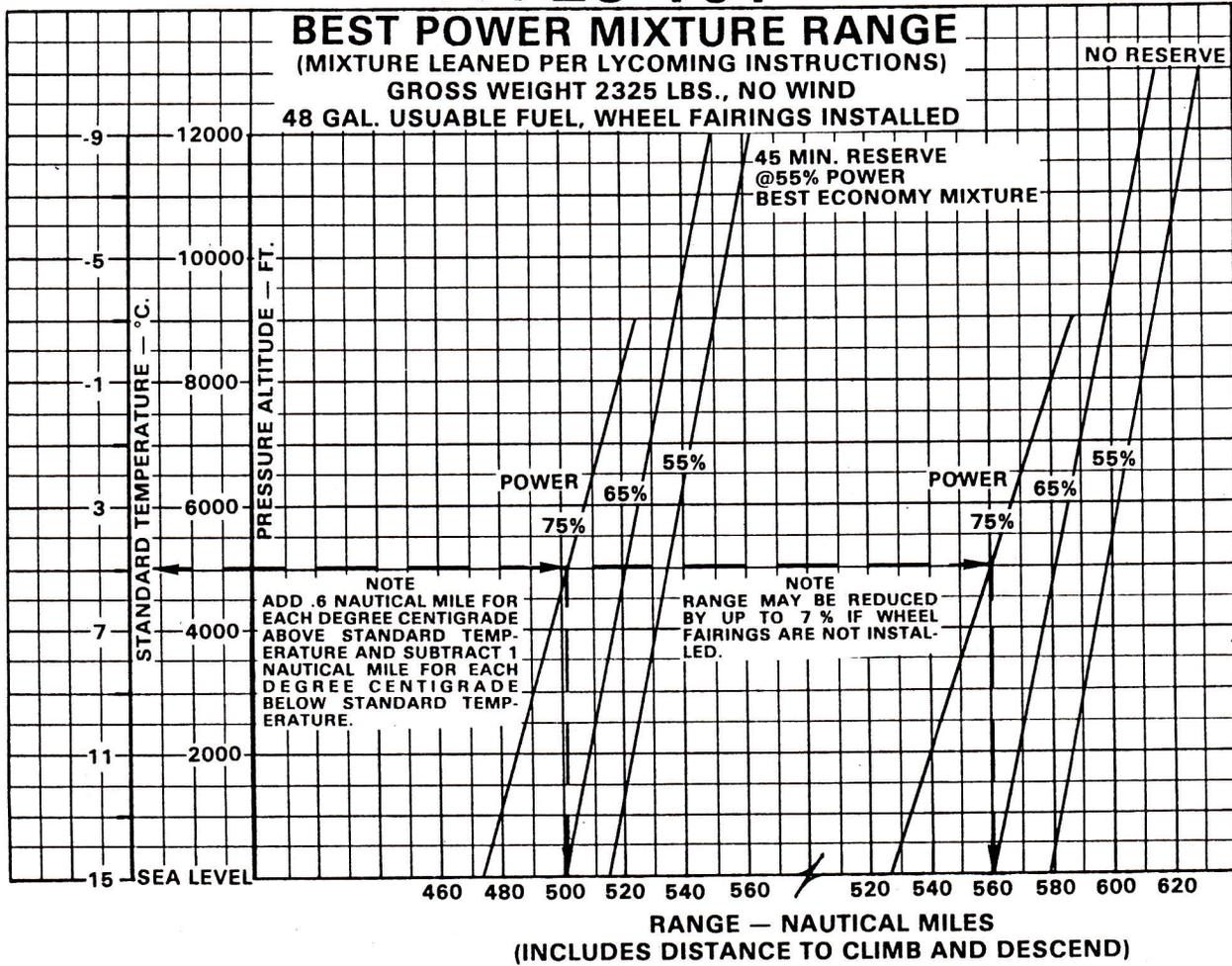
**Example:**

- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 16°C (11°C above standard)
- Cruise power: 75% best power mixture
- Range w/45 min. reserve @ 55% power:  $476 + (.6 \times 11) = 482.6$  nautical miles
- Range w/no reserve:  $533 + (.6 \times 11) = 539.6$  nautical miles

BEST POWER MIXTURE RANGE (SERIAL NOS. 28-7716001 THROUGH 7716323)

Figure 5-19

# PA-28-161



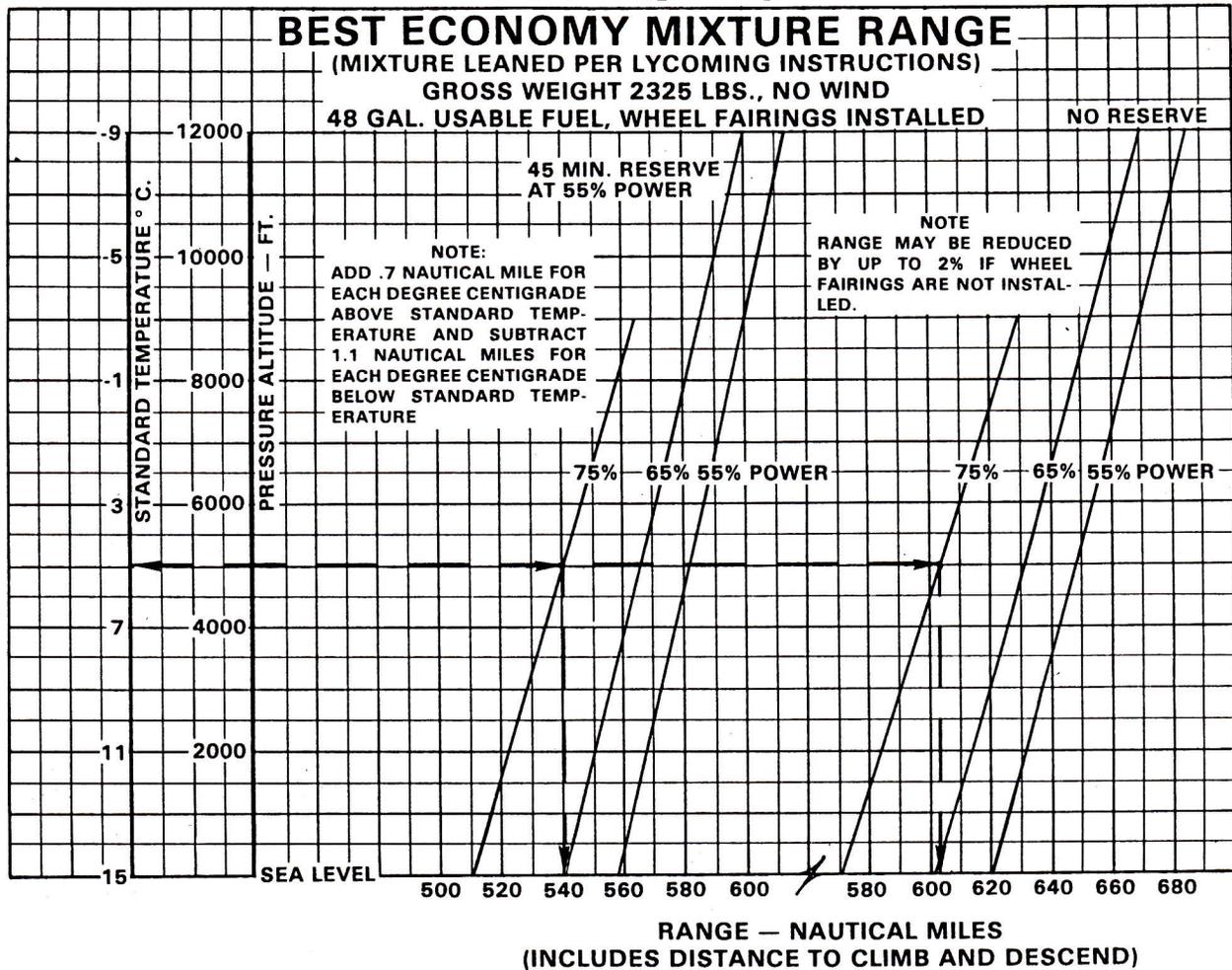
**Example:**

- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 16°C (11°C above standard)
- Cruise power: 75% best power mixture
- Range w/45 min. reserve @ 55% power:  $501 + (.6 \times 11) = 507.6$  nautical miles
- Range w/no reserve:  $561 + (.6 \times 11) = 567.6$  nautical miles.

BEST POWER MIXTURE RANGE (SERIAL NOS. 28-7816001 AND UP)

Figure 5-20

# PA-28-161



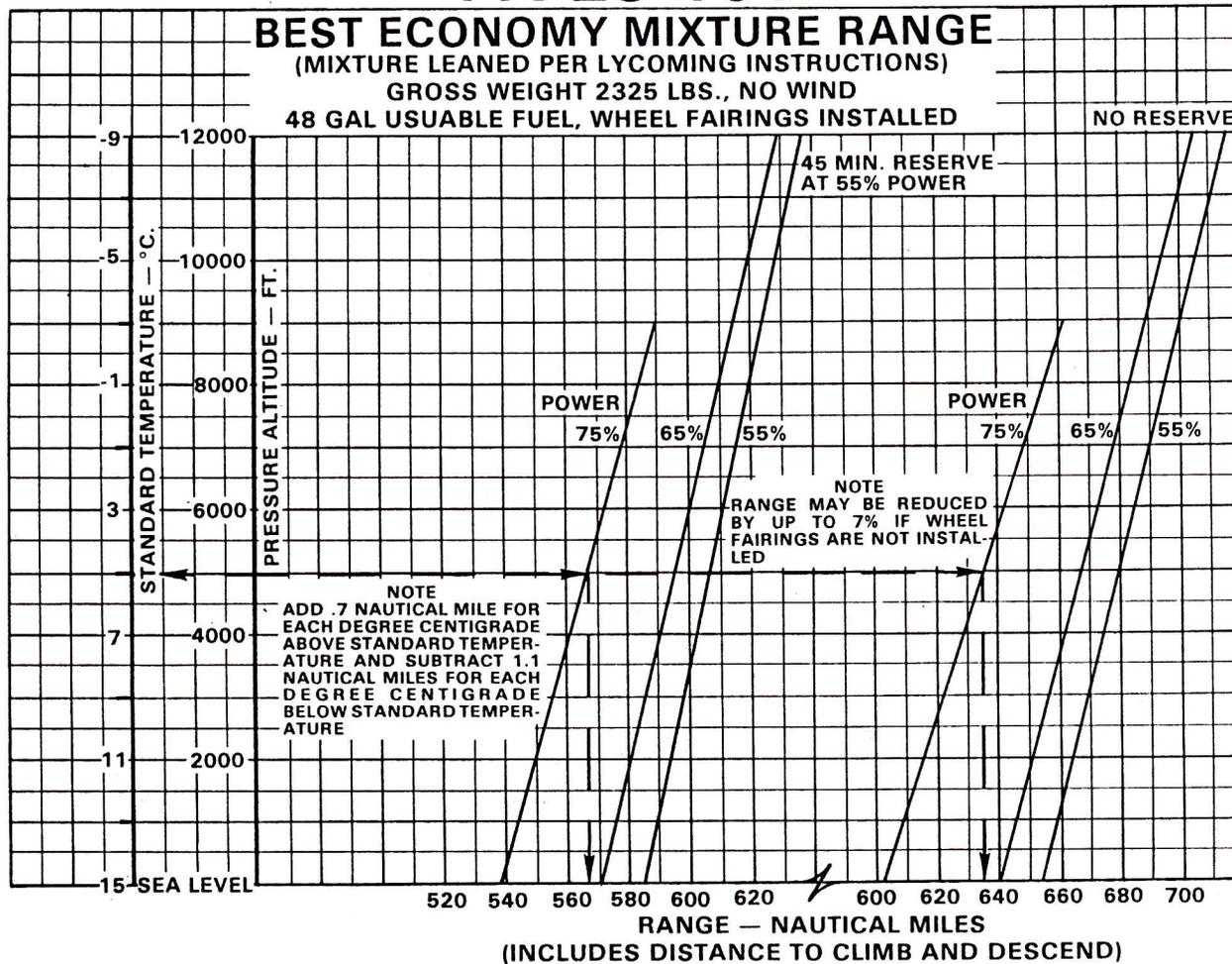
**Example:**

- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 16°C (11°C above standard)
- Cruise power: 75% best economy mixture
- Range w/ 45 min. reserve @ 55% power:  $540 + (.7 \times 11) = 547.7$  nautical miles
- Range w/ no reserve:  $602 + (.7 \times 11) = 609.7$  nautical miles

BEST ECONOMY MIXTURE RANGE (SERIAL NOS. 28-7716001 THROUGH 7716323)

Figure 5-21

# PA-28-161

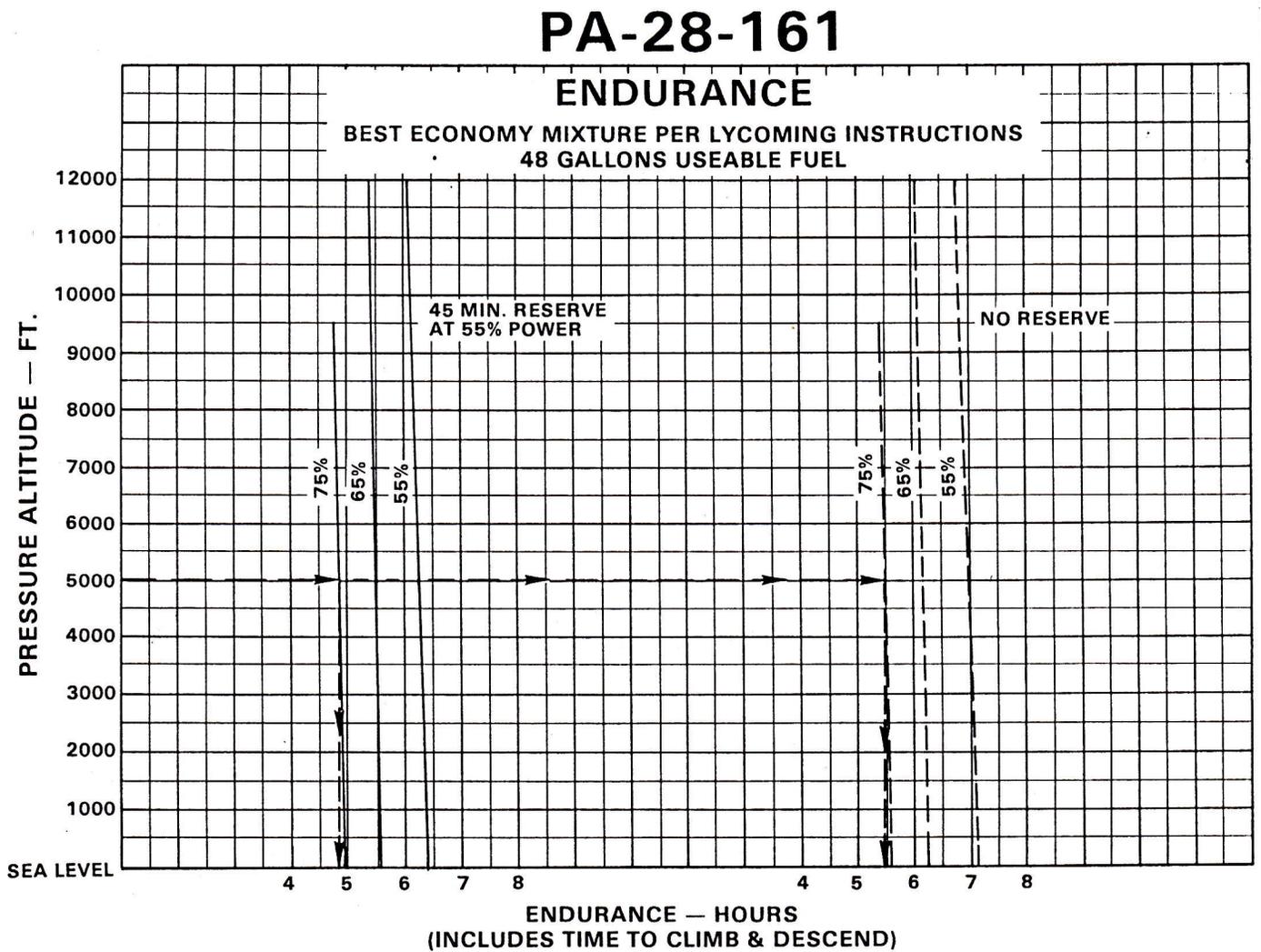


**Example:**

Cruise pressure altitude: 5000 ft.  
 Cruise OAT: 16°C (11°C above standard)  
 Cruise power: 75% best economy mixture  
 Range w/45 min. reserve @ 55% power:  $567 + (.7 \times 11) = 574.7$  nautical miles  
 Range w/no reserve:  $635 + (.7 \times 11) = 642.7$  nautical miles

**BEST ECONOMY MIXTURE RANGE (SERIAL NOS. 28-7816001 AND UP)**

Figure 5-22



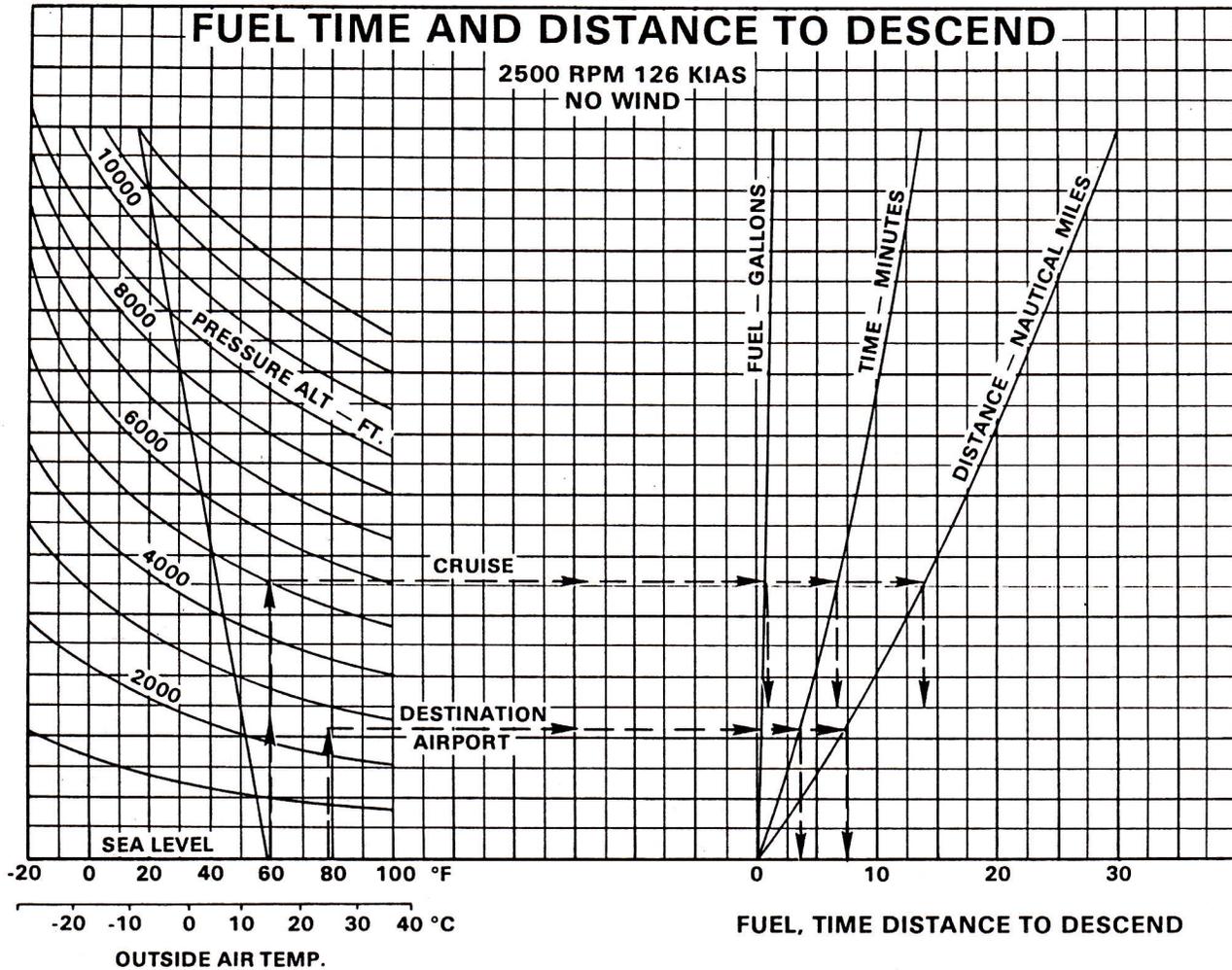
Example:

- Cruise pressure altitude: 5000 ft.
- Cruise power: 75% best economy mixture
- Endurance w/45 min. reserve @ 55% power: 4.85 hrs.
- Endurance w/no reserve: 5.45 hrs.

ENDURANCE

Figure 5-23

# PA-28-161



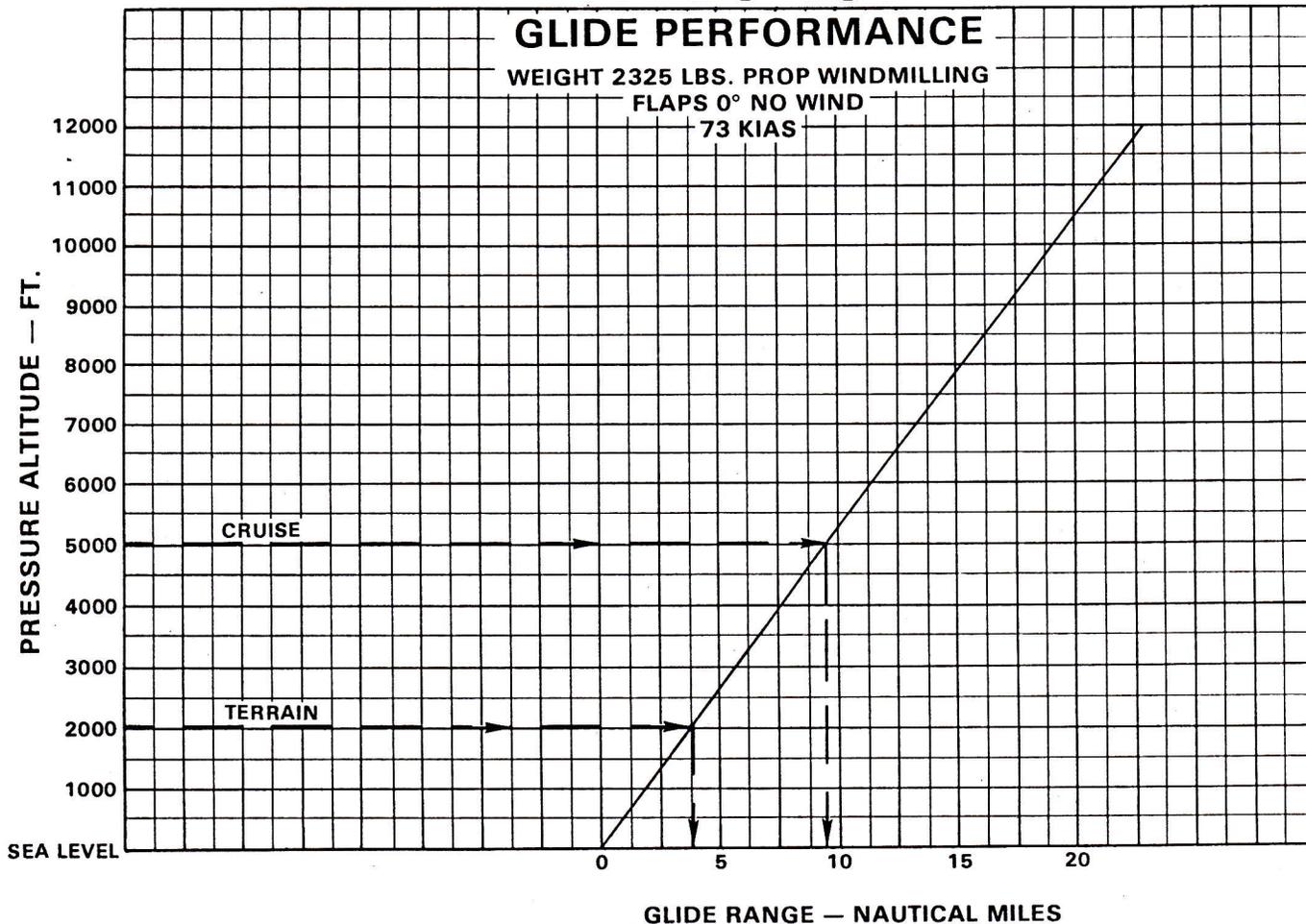
**Example:**

- Destination airport pressure altitude: 2500 ft.
- Destination airport temperature: 75°F (24°C)
- Cruise pressure altitude: 5000 ft.
- Cruise OAT: 60°F (16°C)
- Time to descend (6.5 min. minus 3.5 min.): 3 min.
- Distance to descend (14 miles minus 7.5 miles): 6.5 nautical miles
- Fuel to descend: (1 gal. minus .5 gal.): .5 gal.

FUEL , TIME AND DISTANCE TO DESCEND

Figure 5-25

# PA-28-161



Example:

Cruise pressure altitude: 5000 ft.

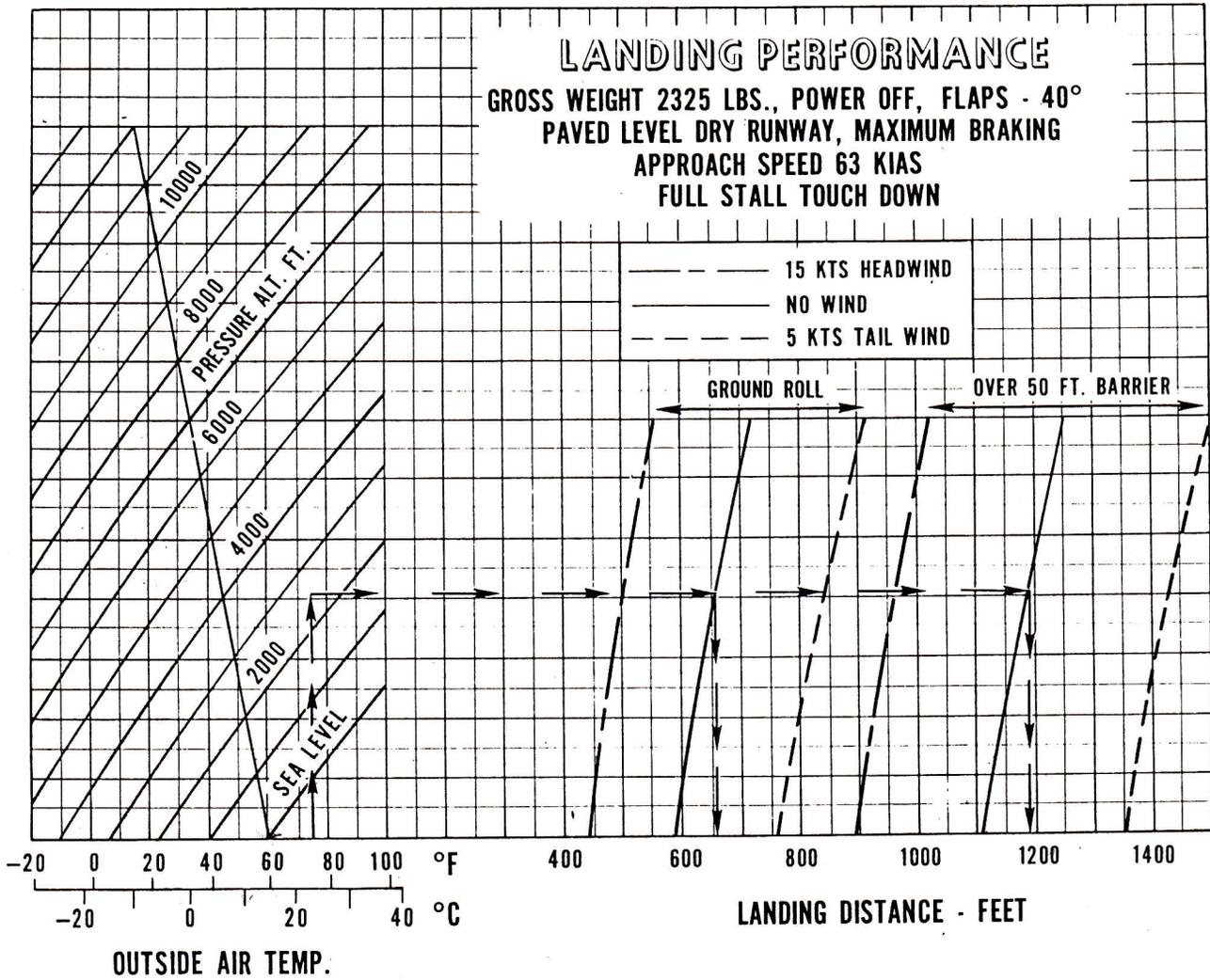
Terrain pressure altitude: 2000 ft.

Glide distance (9.5 miles minus 3.8 miles): 5.7 nautical miles

## GLIDE PERFORMANCE

Figure 5-27

# PA-28-161



Example:

- Destination airport pressure altitude: 2500 ft.
- Destination airport temperature: 75°F
- Destination airport wind: 0 KTS
- Ground roll: 660 ft.
- Distance over 50 ft. barrier: 1190 ft.

**LANDING PERFORMANCE**

Figure 5-29