SECTION V
PERFORMANCE

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SECTION V

PERFORMANCE

INTRODUCTION

This section contains performance information presented in graphical and tabular charts. In addition to the stall speeds, calibrations for indicated airspeed and altitude (normal and alternate static source) as well as conversion diagrams for wind components and temperatures are provided. The second part of this section contains all the performance information required for flight planning.

The data have been compiled from actual flight testing with the airplane and engines in good operating condition and are based on normal piloting skills. The expansion of the flight test data for different ambient conditions and airplane weights has been done analytically by using conventional methods.

Note

Performance data have been obtained from an aircraft equipped with typical IFR avionics and the corresponding external antennas. For aircraft with standard equipment, cruise performance data are approx. 2 % better.

STALL SPEEDS

The following table shows the stalling speeds as a function of airplane configuration, weight and bank angle for the takeoff, cruise and landing configuration.

Associated conditions: Forward Center of Gravity Position,
Engine : Idle
Cowl Flap : closed

Weight	Landing Gear and Flap Setting	Bank Angle 0° KCAS	0° KIAS	30° KCAS	30° KIAS	45° KCAS	45° KIAS	60° KCAS	60° KIAS
2977 lbs (1350) (kg) CG 25%	Ldg. Gear UP Flaps 0°	69	71	74	74	82	83	98	99
	Ldg. Gear UP Flaps 15°	61	62	66	67	73	74	86	87
	Gear DOWN Flaps 30°	60	59	64	64	71	71	85	86
2536 lbs (1150) (kg) CG 20%	Ldg. Gear UP Flaps 0°	66	65	71	71	78	79	93	94
	Ldg. Gear UP Flaps 15°	60	61	64	65	71	72	85	86
	Gear DOWN Flaps 30°	56	56	60	60	67	67	79	80

Example:

Weight:	2977 lbs (1350 kg)
Landing Gear:	DOWN
Flaps:	30°
Bank Angle:	45°
Stalling Speed:	71 KCAS (71 KIAS)

Note

At a maximum weight of 2977 lbs (1350 kg), stalls may result in an altitude loss of up to 400 ft.

AIRSPEED CORRECTION

NORMAL STATIC SOURCE

The following three tables show calibrated airspeed vs. indicated airspeed for takeoff, cruise and landing configuration. Given data are valid only when using the normal static pressure source.

Note

The instrument error is assumed to be zero for "indicated airspeed".

AIRSPEED CORRECTION
(Normal Static Source, Takeoff Configuration)

Conditions :	
Landing Gear:	UP
Flaps:	15°
Cowl Flaps:	OPEN
Power:	Takeoff

KIAS	KCAS = KIAS +
60	+1
70	-1
80	0
90	0
100	0

Example
Indicated Airspeed: 70 KIAS
Calibrated Airspeed: 69 KCAS

Note

The instrument error is assumed to be zero for "indicated airspeed".

AIRSPEED CORRECTION
(Normal Static Source, Cruise Configuration)

Conditions :	
Landing Gear:	UP
Flaps:	0°
Cowl Flaps:	CLOSED
Power:	≈ 75 %

KIAS	KCAS = KIAS +
60	---
70	0
80	0
90	+1
100	+1
110	+1
120	0
130	0
140	0
150	0
160	0
170	0
180	0
190	+1

Example
Indicated Airspeed: 110 KIAS
Calibrated Airspeed: 111 KCAS

Note

The instrument error is assumed to be zero for "indicated airspeed".

AIRSPEED CORRECTION
(Normal Static Source, Landing Configuration)

Conditions :

Landing Gear:	DOWN
Flaps:	30°
Cowl Flaps:	CLOSED
Power:	Idle

KIAS	KCAS = KIAS +
60	+1
70	-1
80	0
90	0
100	0

Example

Indicated Airspeed:	70 KIAS
Calibrated Airspeed:	69 KCAS

Note

The instrument error is assumed to be zero for "indicated airspeed".

ALTERNATE STATIC SOURCE

The following table shows calibrated airspeed vs. indicated airspeed for takeoff, cruise and landing configuration. Given data are valid only when using the alternate static pressure source.

Conditions :
Heater: ON
Ventilation: CLOSED

KIAS	Landing Gear UP Flaps 0° KCAS = KIAS +	Landing Gear UP Flaps 15° KCAS = KIAS +		Ldg. Gear DOWN Flaps 30° KCAS = KIAS +	
	Power 75 %	Power 75 %	Idle	Power 75 %	Idle
60	--	0	-1	-1	0
70	-2	-2	-1	-2	-2
80	-2	-3	-1	-2	-2
90	-2	-3	-1	-2	-1
100	-2	-3	-1	-2	-2
110	-2				
120	-3				
130	-4				
140	-4				
150	-4				
160	-4				
170	-5				
180	-5				
190	-5				

Example
Indicated Airspeed: 100 KIAS
Flaps: 30°
Landing Gear: DOWN
Power: Idle
Calibrated Airspeed: 100 KIAS - 2 = 98 KCAS

Note

The instrument error is assumed to be zero for "indicated airspeed".

ALTITUDE CORRECTION

NORMAL STATIC SOURCE

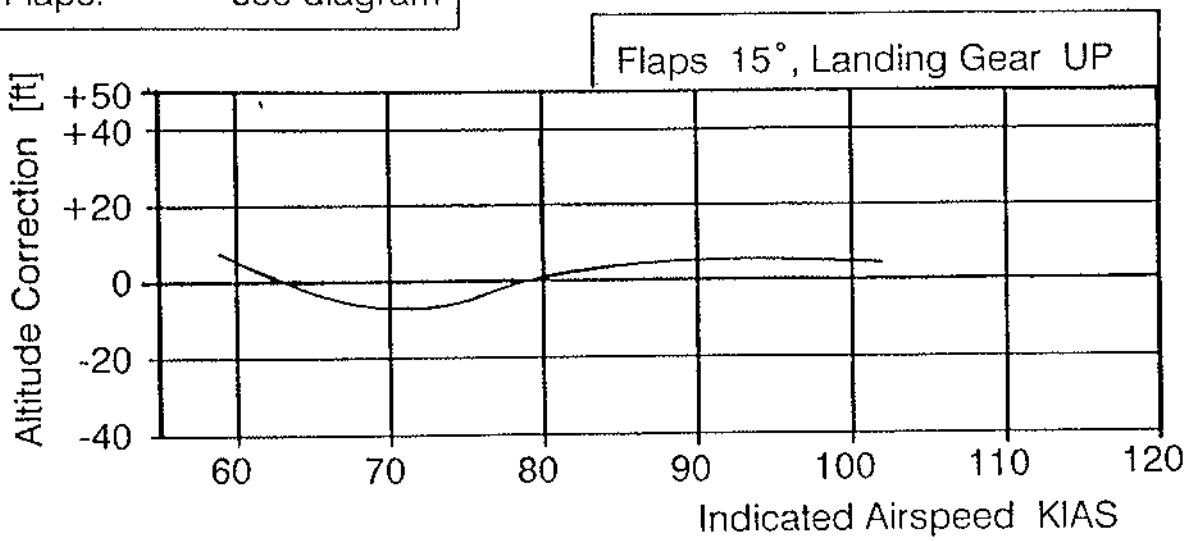
The following two charts contain altitude correction data as a function of indicated airspeed and indicated pressure altitude for takeoff, cruise and landing configuration. Given data are valid only when using the normal static pressure source.

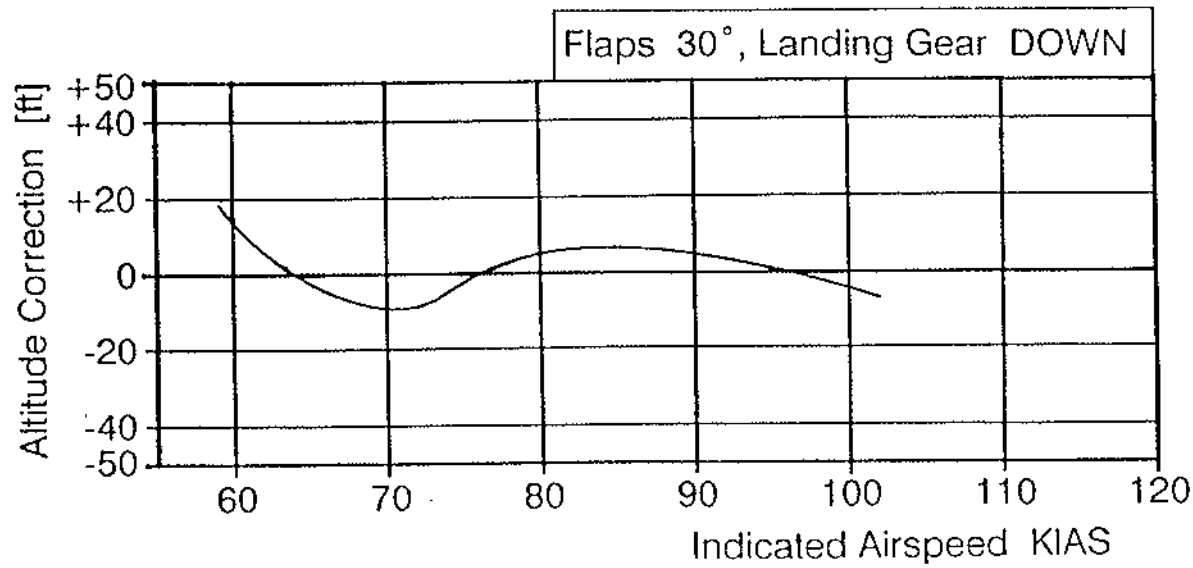
Note

The instrument error is assumed to be zero for "indicated airspeed" and "indicated altitude".

ALTITUDE CORRECTION
(Normal Static Source, Takeoff and Landing Configuration)

Conditions :
Landing Gear: UP/DOWN
Flaps: see diagram





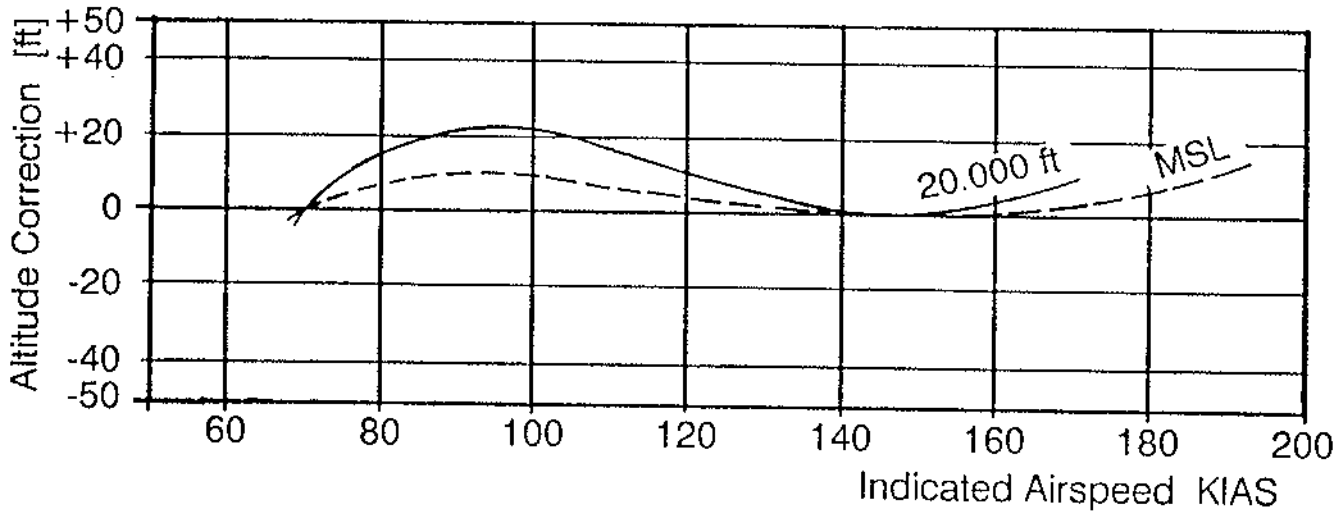
For positive values (+), add altitude correction to the indicated altitude to obtain calibrated altitude.

Note

The instrument error is assumed to be zero for "indicated airspeed" and "indicated altitude".

ALTITUDE CORRECTION
(Normal Static Source, Cruise Configuration)

Conditions :	
Landing Gear:	UP
Flaps:	0°
Cowl Flaps:	CLOSED
Power:	75 %



For positive values (+), add altitude correction to the indicated altitude to obtain calibrated altitude.

Note

The instrument error is assumed to be zero for "indicated airspeed" and "indicated altitude".

ALTERNATE STATIC SOURCE

The following two charts contain altitude correction data as a function of indicated airspeed and indicated pressure altitude for takeoff, cruise and landing configuration. Given data are valid only when using the alternate static pressure source.

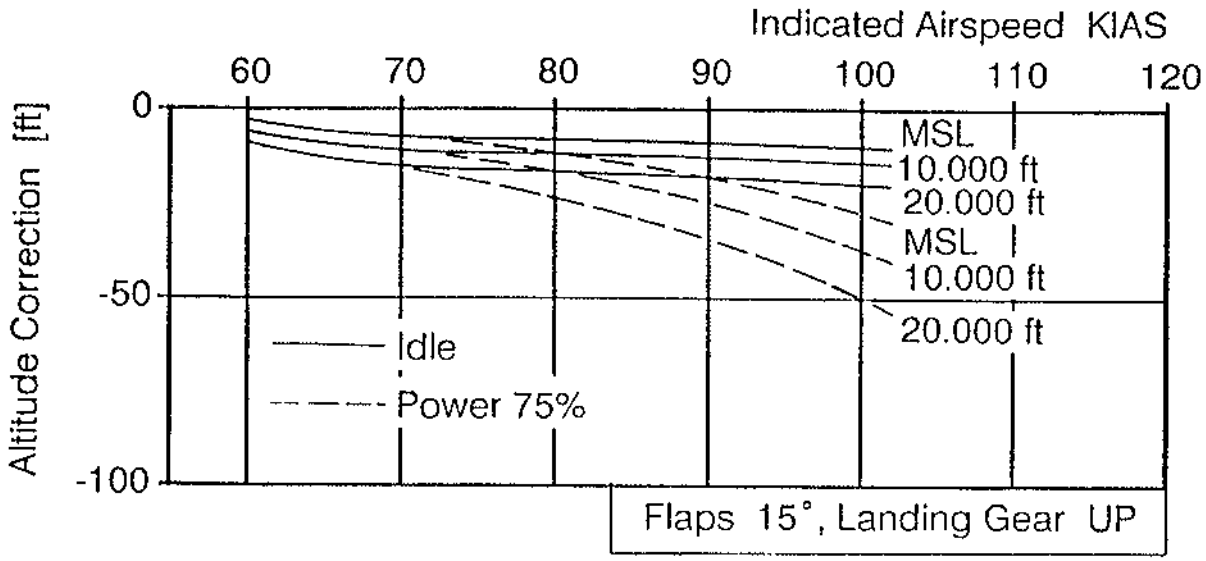
Note

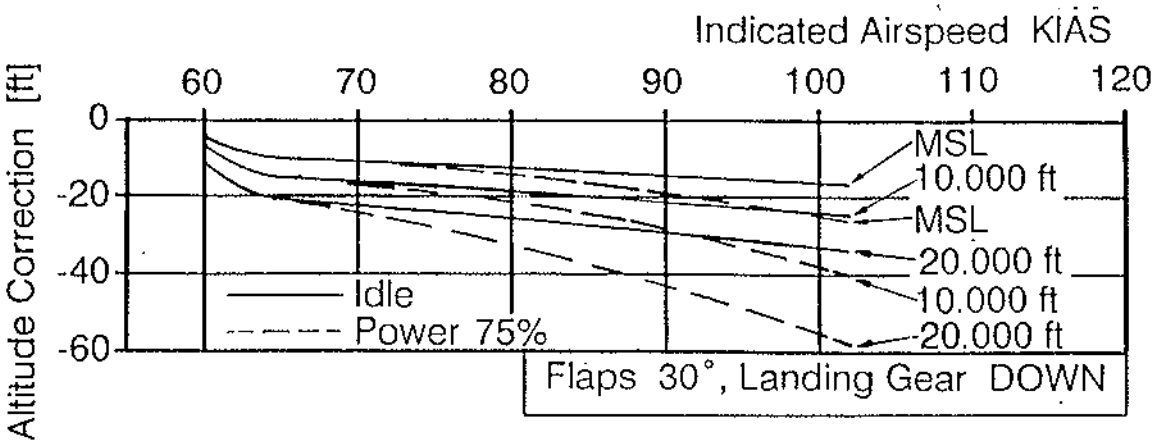
The instrument error is assumed to be zero for "indicated airspeed" and "indicated altitude".

ALTITUDE CORRECTION
(Alternate Static Source, Takeoff and Landing Configuration)

Conditions :

Heater:	ON
Ventilation:	CLOSED
Landing Gear:	UP/DOWN
Flaps:	see diagram





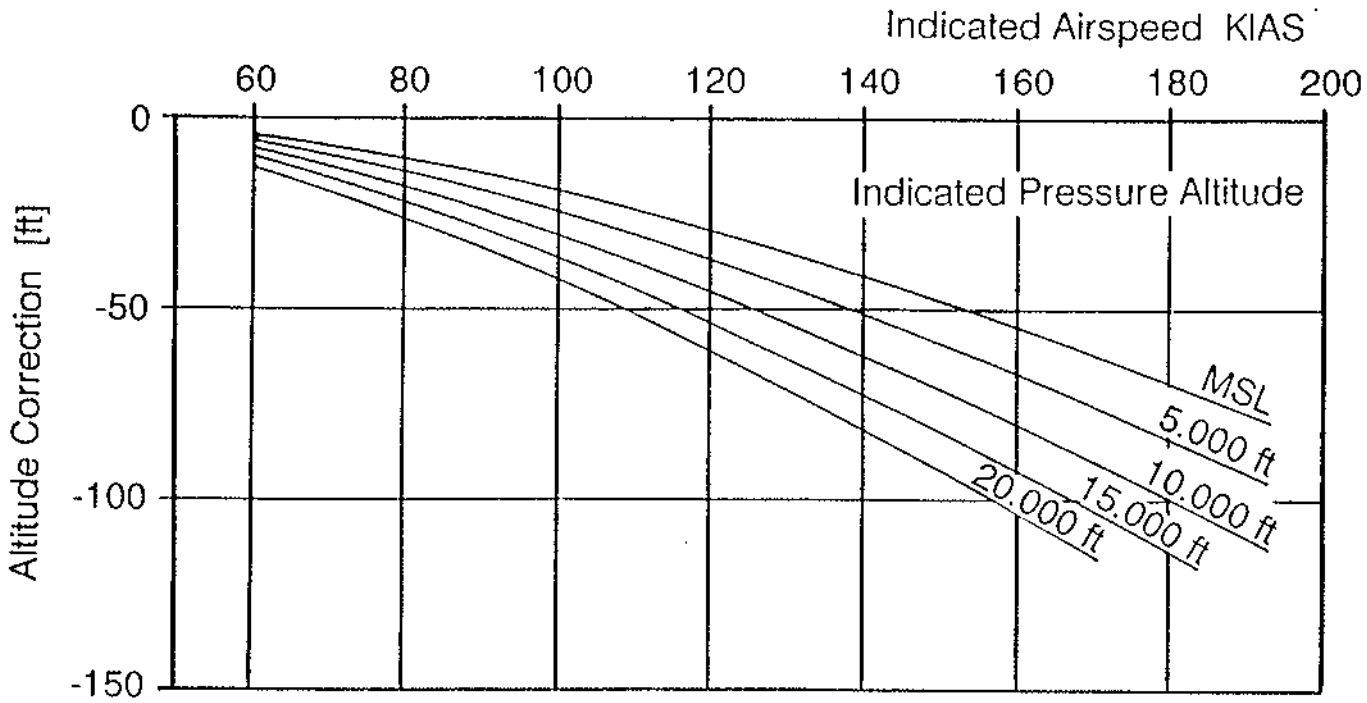
For positive values (+), add altitude correction to the indicated altitude to obtain calibrated altitude.

Note

The instrument error is assumed to be zero for "indicated airspeed" and "indicated altitude".

ALTITUDE CORRECTION
(Alternate Static Source, Cruise Configuration)

Conditions :	
Heater:	ON
Ventilation:	CLOSED
Landing Gear:	UP
Flaps:	0°
Power:	75 %



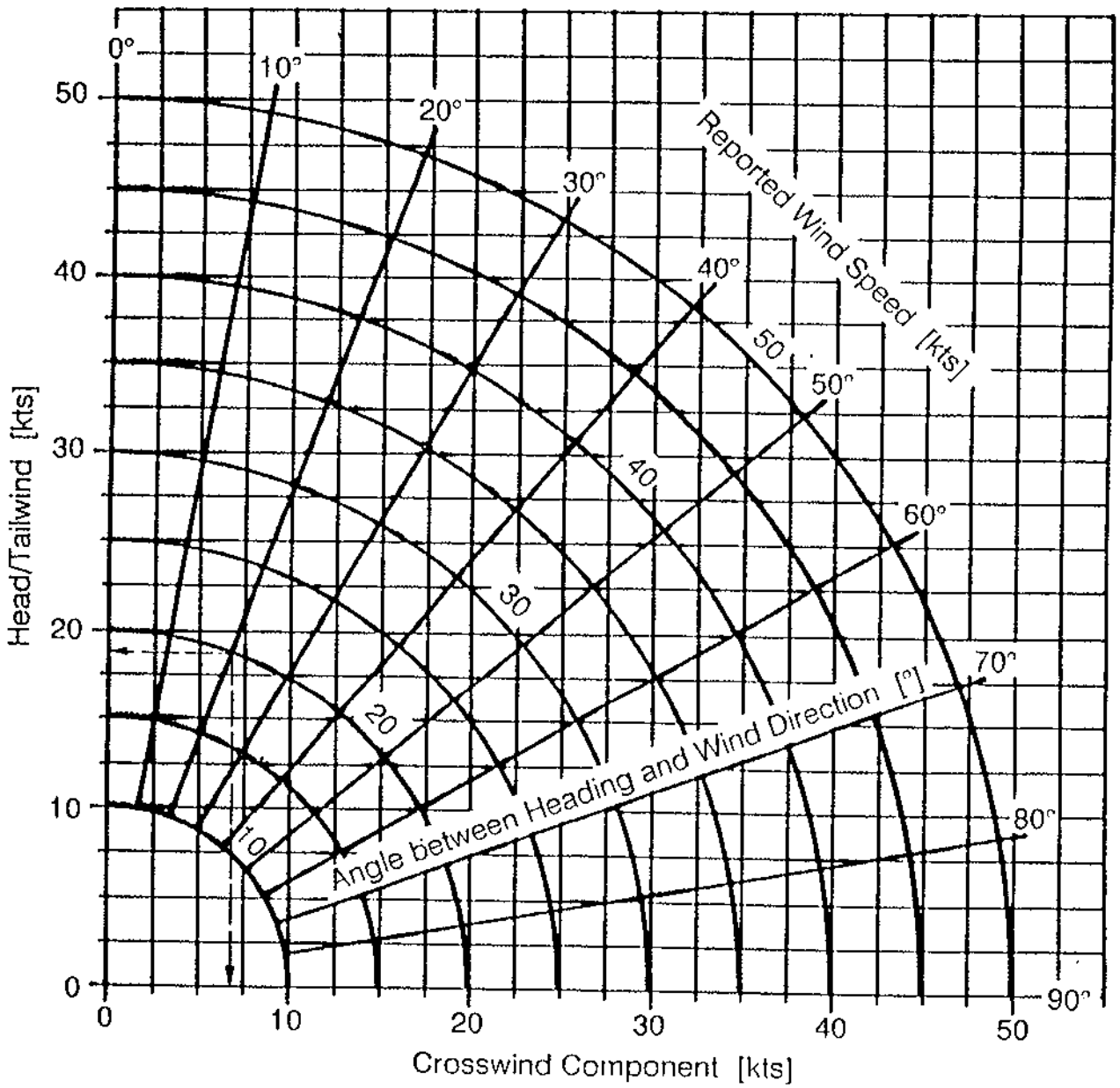
For positive values (+), add altitude correction to the indicated altitude to obtain calibrated altitude.

Note

The instrument error is assumed to be zero for "indicated airspeed" and "indicated altitude".

CROSSWIND COMPONENTS

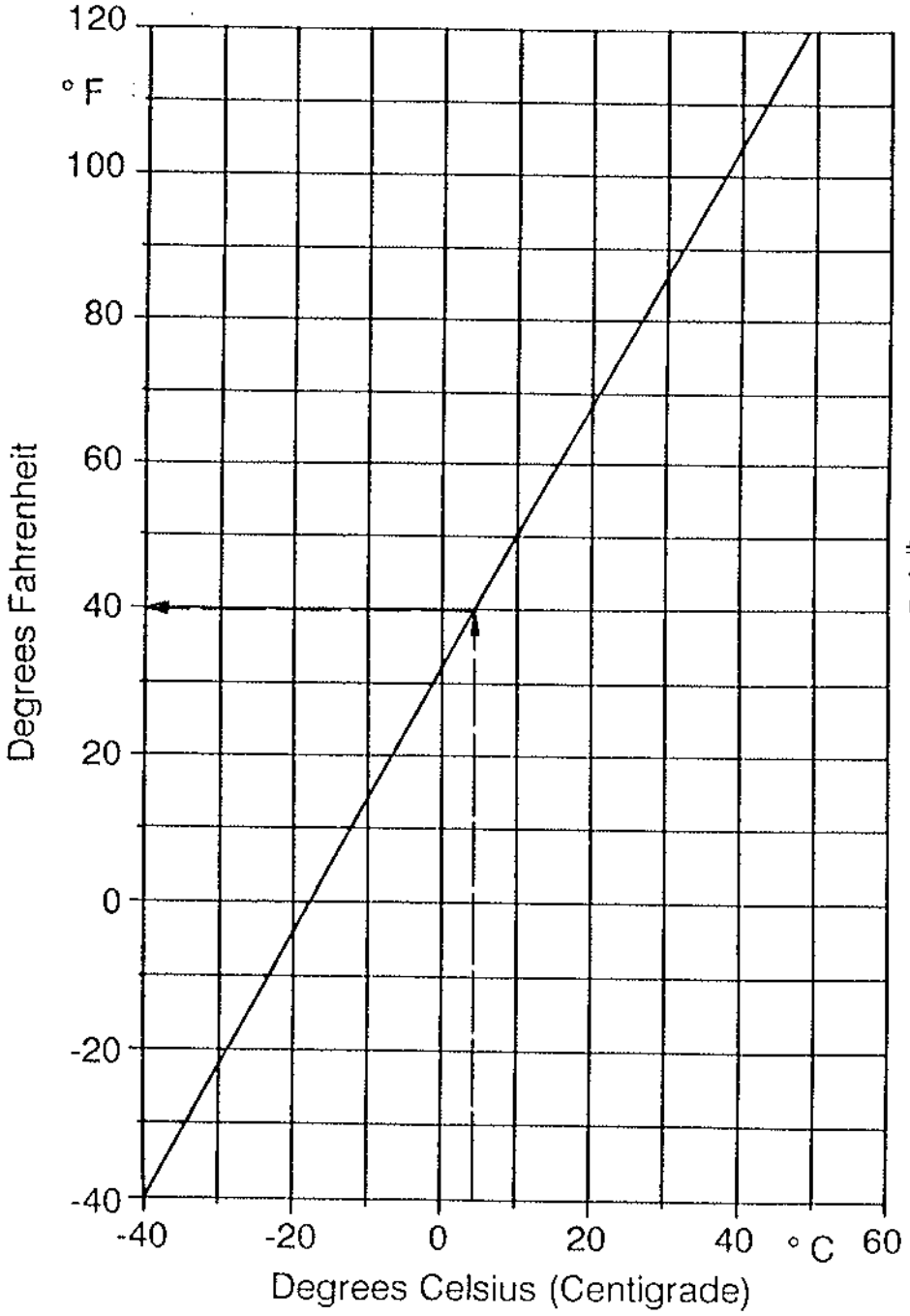
Use the following diagram to determine the wind components from reported wind speed and angle between heading and wind direction.



Example:
Reported Wind : 250°/20 kts
Heading resp.
Runway Direction : 270°
Angular Difference : 20°
➥ *Headwind Component : 19 kts*
Crosswind Component : 6 kts from the left

TEMPERATURE CONVERSION

The following diagram serves for conversion of temperatures from °C to °F and vice versa.



Example:
4,5° Celsius
➥ *40° Fahrenheit*

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FLIGHT PLANNING

The flight planning data provided on the following pages contain any necessary data for planning a flight from takeoff at the departure aerodrome to landing at the destination.

According to experience, the results determined by using the provided flight planning data are very close to the actual data obtained in flight. This requires, however, thorough planning, a good maintenance condition of airframe and powerplant and sufficient experience of the pilot. The correct mixture setting of the engine (see page 4-33) is of special importance.

CAUTION

Any performance information provided in this section is based on optimum mixture setting. Incorrect mixture setting may increase cruise fuel consumption by up to 30 % compared to the data used to calculate the following performance figures.

If a fuel flow meter is installed, fuel consumption can be maintained and controlled very precisely.

For the purpose of flight planning always use conservative data derived from the tables and diagrams. This will cater for possible performance deviations of the type aircraft or the effect of turbulence etc. These effects may cause deviations in range and endurance of up to 10 %.

Note

Insects or other contamination on propeller and wing leading edge may reduce performance considerably.

The effect of altitude and ambient temperature on performance has to be determined as follows:

1. Set altimeter to 29,9 inHg (1013 hPa) in order to determine pressure altitude.
2. Use the ambient temperature entry of the diagrams to determine the effect of density altitude on performance.

CAUTION

Reset altimeter to local QNH to obtain altitude above sea level indication.

The use of the diagrams and tables is explained at the end of this section by means of a flight planning example.

TAKEOFF DISTANCE

Use the diagram provided on page 5-21 to determine takeoff distance. The wind components relative to the runway direction may be obtained from page 5-16 (crosswind components).

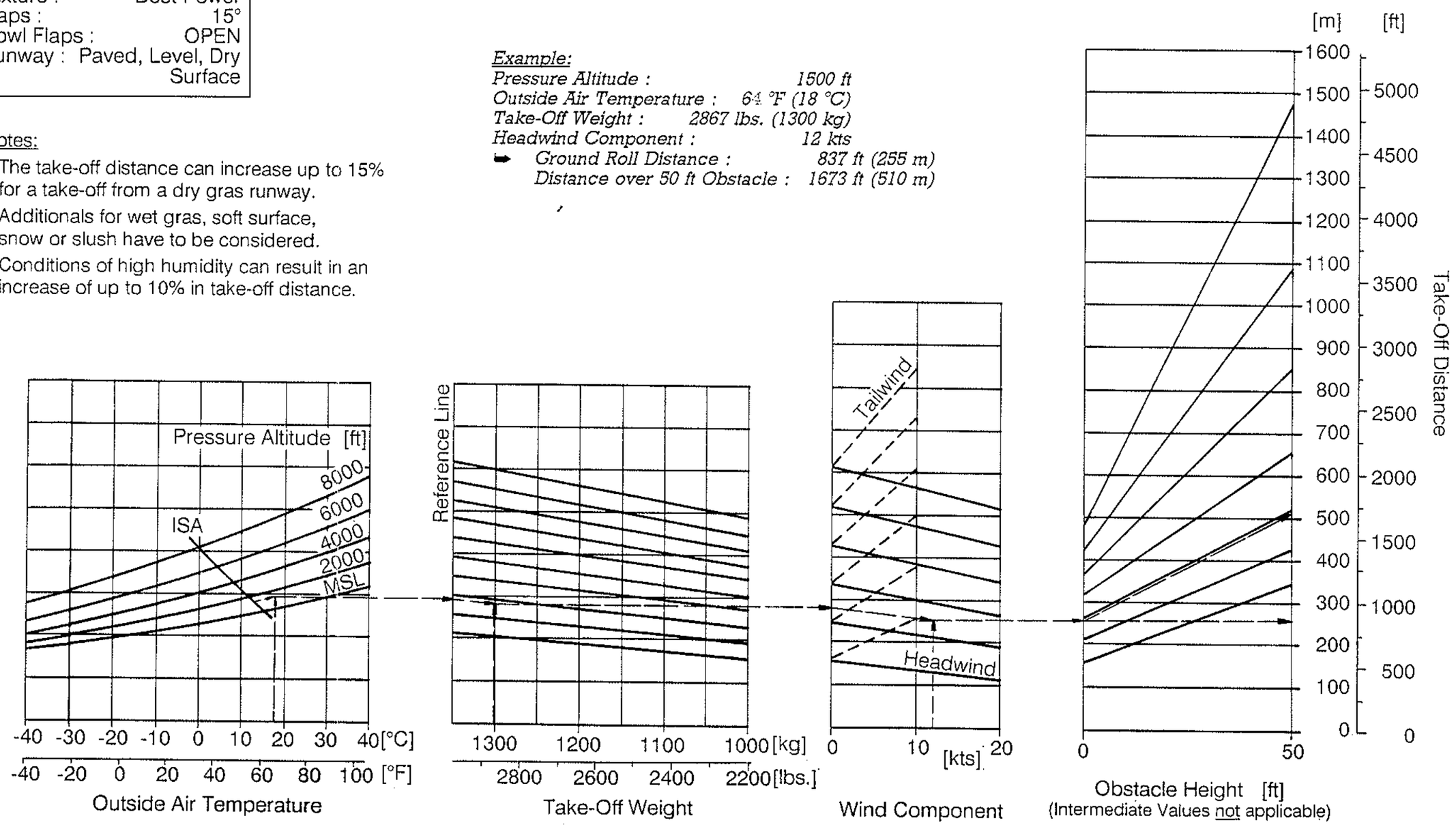
TAKEOFF DISTANCE

Take-Off Weight	Take-Off Speed KIAS	
	Rotation	50 ft
2426 lbs. (1100 kg)	58	72
2977 lbs. (1350 kg)	62	76

Associated Conditions :
Power : Take-Off Power
Propeller : 2400 RPM
Mixture : Best Power
Flaps : 15°
Cowl Flaps : OPEN
Runway : Paved, Level, Dry Surface

Notes:
- The take-off distance can increase up to 15% for a take-off from a dry gras runway.
- Additionals for wet gras, soft surface, snow or slush have to be considered.
- Conditions of high humidity can result in an increase of up to 10% in take-off distance.

Example:
Pressure Altitude : 1500 ft
Outside Air Temperature : 64 °F (18 °C)
Take-Off Weight : 2867 lbs. (1300 kg)
Headwind Component : 12 kts
➥ *Ground Roll Distance : 837 ft (255 m)*
Distance over 50 ft Obstacle : 1673 ft (510 m)



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CLIMB

At full throttle climb, mixture is to be leaned to best power setting above 5000 ft, i.e. 100°F below peak EGT on the rich side.

With some experience, this value is well known and EGT may be maintained constant during the entire climb.

The installation of a precise fuel flow meter may help to keep the correct values.

CAUTION

The maximum cylinderhead and oil temperature has to be observed when leaning during climb. A rich mixture reduces temperatures.

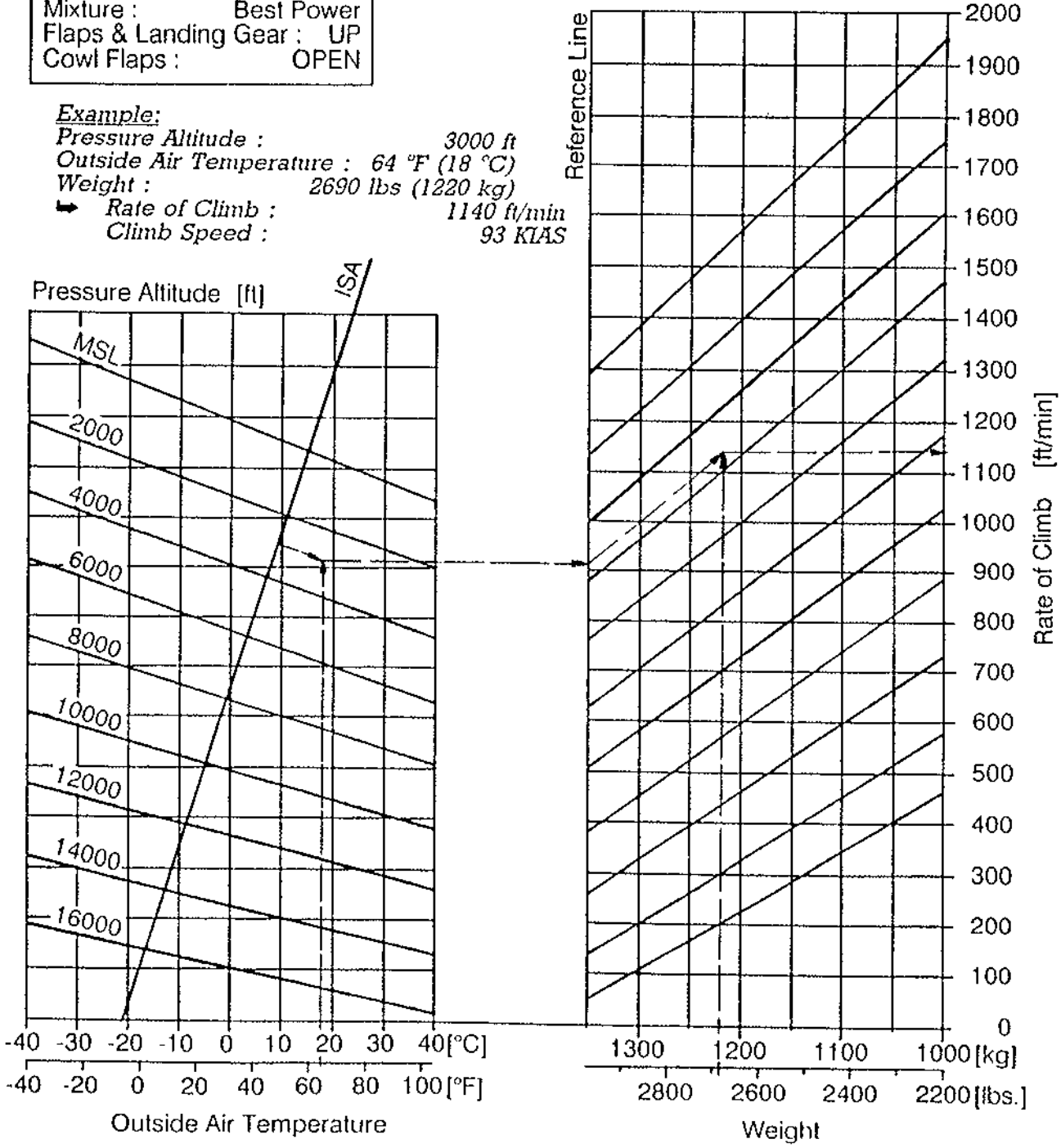
The diagram shows the data for two weights. Performance data for other weights may be obtained by interpolation.

MAXIMUM CLIMB RATE

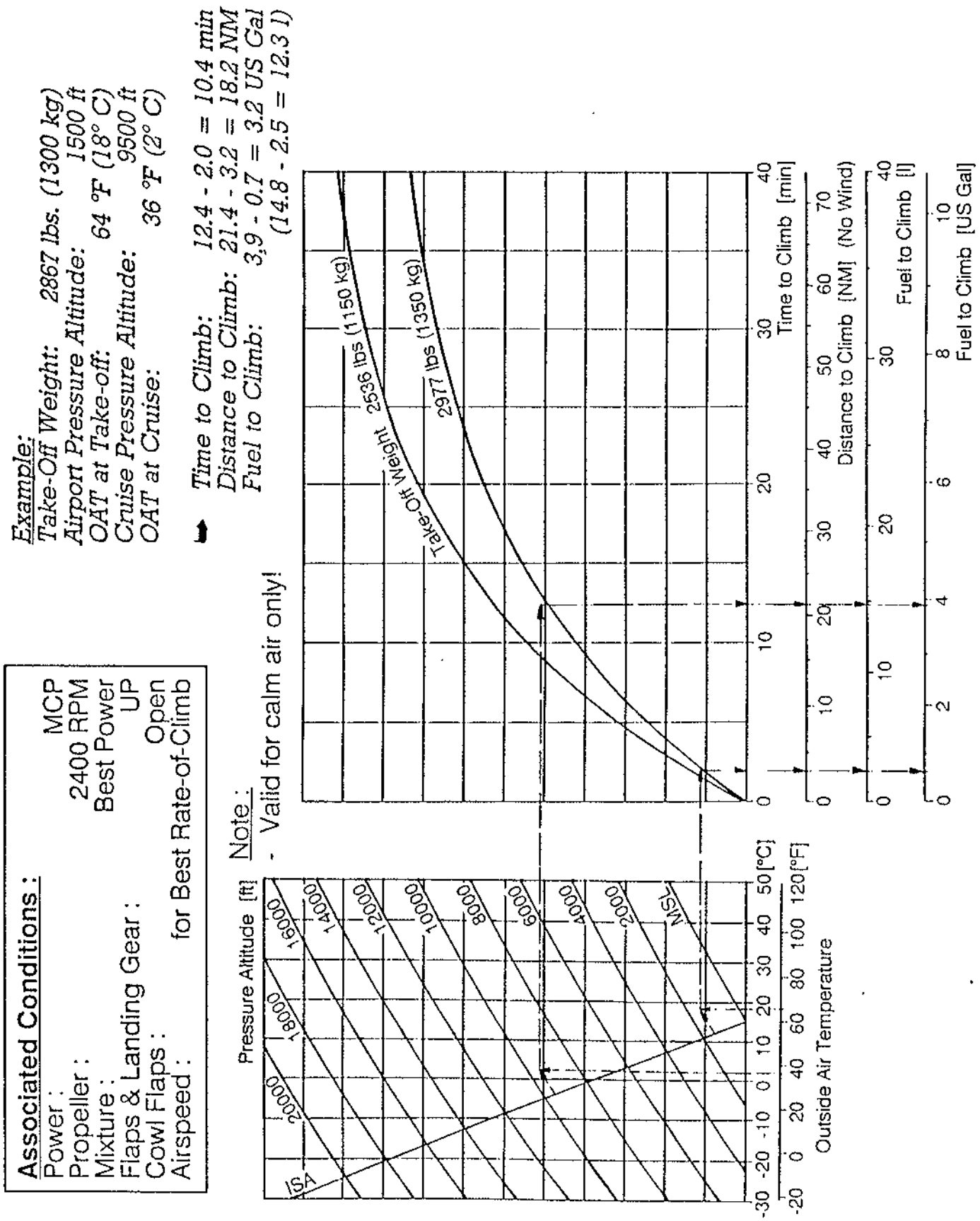
Weight	Climb Speed KIAS				Service Ceiling [ft]
[lbs (kg)]	MSL	5000 ft	10000 ft	15000 ft	
2536 (1150)	92	89	85	82	20.000
2977 (1350)	98	96	94	92	16.000

Associated Conditions :
Power : MCP
Propeller : 2400 RPM
Mixture : Best Power
Flaps & Landing Gear : UP
Cowl Flaps : OPEN

Example:
Pressure Altitude : 3000 ft
Outside Air Temperature : 64 °F (18 °C)
Weight : 2690 lbs (1220 kg)
➥ *Rate of Climb : 1140 ft/min*
Climb Speed : 93 KIAS



TIME, FUEL AND DISTANCE TO CLIMB



CRUISE

The R 90-230 RG aircraft is a fast, comfortable cruising plane.

In order to make full use of the excellent cruise performance it is essential to exactly follow the information and recommendations provided in this section.

In calm air, best performance is obtained by climbing approx. 300 ft above cruising altitude and then levelling off at cruise altitude with slightly increased speed. Always fly free from yawing during cruise (slip-ball centered). Keep the VSI (Vertical Speed Indicator)-needle as close to zero as possible. Cowl flaps may be closed in most cases.

It goes without saying that the airplane itself and the propeller in particular should be maintained in a clean condition.

Select the desired cruising altitude by taking account of the distance of the flight, winds at altitude and desired power setting. Different factors have to be considered for selecting cruise power setting, among which are the cruise performance data, presented on pages 5-28 to 5-37.

Engine speed and manifold pressure to be set as well as the resulting fuel burn may be obtained from the cruise power setting tables for given power, altitude and ambient temperature. The relationship between engine power, altitude and ambient temperature and the resulting true airspeed, range and endurance is presented on pages 5-33 to 5-37.

CRUISE PERFORMANCE

The rated power of the Lycoming IO-540-C4D5 engine is 248 hp = 184 kW at 2575 RPM. As noise requirements cannot be fulfilled at this engine speed, maximum RPM has been reduced to 2400 RPM, thus reducing power to 231 hp = 172 kW , i.e. 94 % of the original power.

For the purpose of this manual, any engine power data are related to 231 hp = 172 kW = 100 %.

The engine may be operated at full manifold pressure at sea level between 2200 and 2400 RPM.

As the propeller efficiency increases with decreasing RPM, it is recommended for best economy to use low RPM and high manifold pressure. The cruise power setting tables are organized accordingly.

The data presented in the tables can be obtained only if the mixture has been leaned carefully. Below 80 % power, max. exhaust gas temperature (peak EGT) has to be set in order to obtain best economy. A lean mixture during cruise does not only help to minimize fuel burn but also to prevent deposits and sooting in the combustion chamber, at the spark plugs and valves.

CAUTION

At full throttle mixture has to be set to "FULL RICH". This is of special importance at low altitudes.

Cruise Power Setting with 45% Max. Continous Power (or Full Throttle)

		Outside Air Temperature [°F (°C)]																			
		-40 (-40)		-22 (-30)		-4 (-20)		14 (-10)		32 (0)		50 (10)		68 (20)		86 (30)		104 (40)		122 (50)	
Press. Alt.	RPM	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F
MSL	1 800	20.7	30.9 (8.2)	21.1	30.9 (8.2)	21.4	30.9 (8.2)	21.7	30.9 (8.2)	21.9	30.9 (8.2)	22.2	30.9 (8.2)	22.5	30.9 (8.2)	22.7	30.9 (8.2)	22.9	30.9 (8.2)	23.1	30.9 (8.2)
2 000 ft	1 800	20.1	30.9 (8.2)	20.5	30.9 (8.2)	20.8	30.9 (8.2)	21.1	30.9 (8.2)	21.3	30.9 (8.2)	21.6	30.9 (8.2)	21.9	30.9 (8.2)	22.1	30.9 (8.2)	22.3	30.9 (8.2)	22.5	30.9 (8.2)
4 000 ft	1 800	19.6	30.9 (8.2)	19.9	30.9 (8.2)	20.2	30.9 (8.2)	20.5	30.9 (8.2)	20.8	30.9 (8.2)	21.1	30.9 (8.2)	21.3	30.9 (8.2)	21.6	30.9 (8.2)	21.8	30.9 (8.2)	–	–
6 000 ft	1 800	19.2	30.8 (8.2)	19.6	30.9 (8.2)	19.9	30.9 (8.2)	20.1	30.9 (8.2)	20.4	30.9 (8.2)	20.7	30.9 (8.2)	20.9	30.9 (8.2)	21.2	30.9 (8.2)	21.4	30.9 (8.2)	–	–
8 000 ft	1 800	18.9	30.9 (8.2)	19.3	30.9 (8.2)	19.6	30.9 (8.2)	19.9	30.9 (8.2)	20.1	30.9 (8.2)	20.4	30.9 (8.2)	20.6	30.9 (8.2)	20.9	30.9 (8.2)	–	–	–	–
10 000 ft	2 000	16.6	32.5 (8.6)	16.8	32.5 (8.6)	17.1	32.5 (8.6)	17.4	32.5 (8.6)	17.6	32.5 (8.6)	17.8	32.5 (8.6)	18.0	32.5 (8.6)	18.2	32.5 (8.6)	–	–	–	–
12 000 ft	2 000	16.3	32.5 (8.6)	16.6	32.5 (8.6)	16.8	32.5 (8.6)	17.1	32.5 (8.6)	17.3	32.5 (8.6)	17.5	32.5 (8.6)	17.7	32.5 (8.6)	–	–	–	–	–	–
14 000 ft	2 200	15.2	33.8 (8.9)	15.4	33.8 (8.9)	15.6	33.8 (8.9)	15.8	33.8 (8.9)	16.0	33.8 (8.9)	16.2	33.8 (8.9)	16.4	33.8 (8.9)	–	–	–	–	–	–
16 000 ft	2 200	14.9	33.8 (8.9)	15.1	33.8 (8.9)	15.4	33.8 (8.9)	15.6	33.8 (8.9)	15.7	33.8 (8.9)	15.9	33.8 (8.9)	–	–	–	–	–	–	–	–
18 000 ft	2 400	12.1	36.5 (9.6)	12.3	36.5 (9.6)	12.5	36.5 (9.6)	12.7	36.5 (9.6)	12.9	36.5 (9.6)	13.1	36.5 (9.6)	–	–	–	–	–	–	–	–

Notes:

1. Shaded areas contain values for full throttle operation
2. Manifold Pressure (MP) in [in.Hg]
3. Fuel Flow (F/F) in [l/h], Values in brackets () in [US Gal/h]
4. Above fuel flow data refer to minimum fuel consumption, refer to Section I, Performance Definitions

Cruise Power Setting with 55% Max. Continous Power (or Full Throttle)

		Outside Air Temperature [°F (°C)]																			
		-40 (-40)		-22 (-30)		-4 (-20)		14 (-10)		32 (0)		50 (10)		68 (20)		86 (30)		104 (40)		122 (50)	
Press. Alt.	RPM	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F
MSL	1 900	22.6	37.6 (9.9)	23.0	37.6 (9.9)	23.4	37.6 (9.9)	23.8	37.6 (9.9)	24.1	37.6 (9.9)	24.4	37.6 (9.9)	24.7	37.6 (9.9)	25.0	37.6 (9.9)	25.3	37.6 (9.9)	25.6	37.6 (9.9)
2 000 ft	1 900	21.9	37.6 (9.9)	22.3	37.6 (9.9)	22.7	37.6 (9.9)	23.0	37.6 (9.9)	23.4	37.6 (9.9)	23.7	37.6 (9.9)	24.0	37.6 (9.9)	24.3	37.6 (9.9)	24.6	37.6 (9.9)	24.8	37.6 (9.9)
4 000 ft	1 900	21.2	37.6 (9.9)	21.6	37.6 (9.9)	22.0	37.6 (9.9)	22.4	37.6 (9.9)	22.7	37.6 (9.9)	23.0	37.6 (9.9)	23.3	37.6 (9.9)	26.6	37.6 (9.9)	23.9	37.6 (9.9)	–	–
6 000 ft	1 900	20.7	37.6 (9.9)	21.1	37.6 (9.9)	21.5	37.6 (9.9)	21.8	37.6 (9.9)	22.2	37.6 (9.9)	22.5	37.6 (9.9)	22.8	37.6 (9.9)	23.1	37.6 (9.9)	23.3	37.6 (9.9)	–	–
8 000 ft	2 000	19.5	38.1 (10.1)	19.8	38.1 (10.1)	20.1	38.1 (10.1)	20.5	38.1 (10.1)	20.8	38.1 (10.1)	21.0	38.1 (10.1)	21.3	38.1 (10.1)	21.5	38.1 (10.1)	–	–	–	–
10 000 ft	2 200	17.7	39.1 (10.3)	18.0	39.1 (10.3)	18.3	39.1 (10.3)	18.5	39.1 (10.3)	18.8	39.1 (10.3)	19.0	39.1 (10.3)	19.2	39.1 (10.3)	19.4	39.1 (10.3)	–	–	–	–
12 000 ft	2 200	17.2	39.1 (10.3)	17.5	39.1 (10.3)	17.8	39.1 (10.3)	18.0	39.1 (10.3)	18.3	39.1 (10.3)	18.5	39.1 (10.3)	18.7	39.1 (10.3)	–	–	–	–	–	–
14 000 ft	2 400	16.0	41.7 (11.0)	16.3	41.7 (11.0)	16.5	41.7 (11.0)	16.8	41.7 (11.0)	17.0	41.7 (11.0)	17.2	41.7 (11.0)	17.4	41.7 (11.0)	–	–	–	–	–	–
16 000 ft	2 400	15.6	41.7 (11.0)	15.9	41.7 (11.0)	16.2	41.7 (11.0)	16.4	41.1 (10.9)	16.4	40.5 (10.7)	16.4	40.0 (10.6)	–	–	–	–	–	–	–	–
18 000 ft	2 400	15.0	39.8 (10.5)	15.0	39.3 (10.4)	15.0	38.7 (10.2)	15.0	38.3 (10.1)	15.0	37.8 (10.0)	15.0	37.4 (9.9)	–	–	–	–	–	–	–	–

Notes:

1. Shaded areas contain values for full throttle operation
2. Manifold Pressure (MP) in [in.Hg]
3. Fuel Flow (F/F) in [l/h], Values in brackets () in [US Gal/h]
4. Above fuel flow data refer to minimum fuel consumption, refer to Section I, Performance Definitions

Cruise Power Setting with 65% Max. Continous Power (or Full Throttle)

		Outside Air Temperature [°F (°C)]																			
		-40 (-40)		-22 (-30)		-4 (-20)		14 (-10)		32 (0)		50 (10)		68 (20)		86 (30)		104 (40)		122 (50)	
Press. Alt.	RPM	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F
MSL	2 000	24.1	44.6 (11.8)	24.5	44.6 (11.8)	24.9	44.6 (11.8)	25.3	44.6 (11.8)	25.7	44.6 (11.8)	26.0	44.6 (11.8)	26.3	44.6 (11.8)	26.6	44.6 (11.8)	26.9	44.6 (11.8)	27.2	44.6 (11.8)
2 000 ft	2 000	23.3	44.6 (11.8)	23.7	44.6 (11.8)	24.1	44.6 (11.8)	24.5	44.6 (11.8)	24.8	44.6 (11.8)	25.2	44.6 (11.8)	25.5	44.6 (11.8)	25.8	44.6 (11.8)	26.1	44.6 (11.8)	26.3	44.6 (11.8)
4 000 ft	2 000	22.7	44.6 (11.8)	23.1	44.6 (11.8)	23.5	44.6 (11.8)	23.9	44.6 (11.8)	24.3	44.6 (11.8)	24.6	44.6 (11.8)	24.9	44.6 (11.8)	25.2	44.6 (11.8)	25.5	44.6 (11.8)	–	–
6 000 ft	2 200	20.9	45.3 (12.0)	21.2	45.3 (12.0)	21.6	45.3 (12.0)	21.9	45.3 (12.0)	22.2	45.3 (12.0)	22.4	45.3 (12.0)	22.7	45.3 (12.0)	22.9	45.3 (12.0)	23.2	45.3 (12.0)	–	–
8 000 ft	2 200	20.3	45.3 (12.0)	20.7	45.3 (12.0)	21.0	45.3 (12.0)	21.3	45.3 (12.0)	21.6	45.3 (12.0)	21.9	45.3 (12.0)	22.1	45.3 (12.0)	22.3	45.3 (12.0)	–	–	–	–
10 000 ft	2 400	18.7	47.8 (12.6)	19.1	47.8 (12.6)	19.4	47.8 (12.6)	19.7	47.8 (12.6)	19.9	47.8 (12.6)	20.2	47.8 (12.6)	20.4	47.8 (12.6)	20.6	47.8 (12.6)	–	–	–	–
12 000 ft	2 400	18.3	47.8 (12.6)	18.6	47.8 (12.6)	18.9	47.8 (12.6)	19.2	47.8 (12.6)	19.4	47.1 (12.4)	19.4	46.4 (12.3)	19.4	45.7 (12.1)	–	–	–	–	–	–
14 000 ft	2 400	17.8	46.5 (12.3)	17.8	45.7 (12.1)	17.8	45.0 (11.9)	17.8	44.3 (11.7)	17.8	43.6 (11.5)	17.8	43.0 (11.4)	17.8	42.4 (11.2)	–	–	–	–	–	–
16 000 ft	2 400	16.4	43.0 (11.4)	16.4	42.3 (11.2)	16.4	41.7 (11.0)	16.4	41.1 (10.9)	16.4	40.5 (10.7)	16.4	40.0 (10.6)	–	–	–	–	–	–	–	–
18 000 ft	2 400	15.0	39.8 (10.5)	15.0	39.3 (10.4)	15.0	38.7 (10.2)	15.0	38.3 (10.1)	15.0	37.8 (10.0)	15.0	37.4 (9.9)	–	–	–	–	–	–	–	–

Notes:

1. Shaded areas contain values for full throttle operation
2. Manifold Pressure (MP) in [in.Hg]
3. Fuel Flow (F/F) in [l/h], Values in brackets () in [US Gal/h]
4. Above fuel flow data refer to minimum fuel consumption, refer to Section I, Performance Definitions

Cruise Power Setting with 75% Max. Continous Power (or Full Throttle)

		Outside Air Temperature [°F (°C)]																			
		-40 (-40)		-22 (-30)		-4 (-20)		14 (-10)		32 (0)		50 (10)		68 (20)		86 (30)		104 (40)		122 (50)	
Press. Alt.	RPM	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F
MSL	2 200	24.2	52.3 (13.8)	24.6	52.3 (13.8)	25.0	52.3 (13.8)	25.4	52.3 (13.8)	25.7	52.3 (13.8)	26.0	52.3 (13.8)	26.3	52.3 (13.8)	26.6	52.3 (13.8)	26.9	52.3 (13.8)	27.2	52.3 (13.8)
2 000 ft	2 200	24.1	52.3 (13.8)	24.5	52.3 (13.8)	24.9	52.3 (13.8)	25.3	52.3 (13.8)	25.6	52.3 (13.8)	25.9	52.3 (13.8)	26.2	52.3 (13.8)	26.5	52.3 (13.8)	26.8	52.3 (13.8)	27.0	52.3 (13.8)
4 000 ft	2 400	22.2	54.8 (14.5)	22.5	54.8 (14.5)	22.9	54.8 (14.5)	23.2	54.8 (14.5)	23.6	54.8 (14.5)	23.9	54.8 (14.5)	24.1	54.8 (14.5)	24.4	54.8 (14.5)	24.7	54.8 (14.5)	–	–
6 000 ft	2 400	21.6	54.8 (14.5)	22.0	54.8 (14.5)	22.4	54.8 (14.5)	22.7	54.8 (14.5)	23.0	54.8 (14.5)	23.3	54.8 (14.5)	23.6	54.8 (14.5)	23.9	54.8 (14.5)	24.2	54.8 (14.5)	–	–
8 000 ft	2 400	21.0	54.8 (14.5)	21.3	54.8 (14.5)	21.7	54.8 (14.5)	22.0	54.8 (14.5)	22.4	54.8 (14.5)	22.7	54.4 (14.4)	22.7	53.5 (14.1)	22.7	52.6 (13.9)	–	–	–	–
10 000 ft	2 400	20.4	54.8 (14.5)	20.8	54.8 (14.5)	21.0	53.0 (14.0)	21.0	52.0 (13.7)	21.0	51.0 (13.5)	21.0	50.2 (13.3)	21.0	49.4 (13.0)	21.0	48.6 (12.8)	–	–	–	–
12 000 ft	2 400	19.4	50.7 (13.4)	19.4	49.7 (13.1)	19.4	48.7 (12.9)	19.4	47.9 (12.7)	19.4	47.1 (12.4)	19.4	46.4 (12.3)	19.4	45.7 (12.1)	–	–	–	–	–	–
14 000 ft	2 400	17.8	46.5 (12.3)	17.8	45.7 (12.1)	17.8	45.0 (11.9)	17.8	44.3 (11.7)	17.8	43.6 (11.5)	17.8	43.0 (11.4)	17.8	42.4 (11.2)	–	–	–	–	–	–
16 000 ft	2 400	16.4	43.0 (11.4)	16.4	42.3 (11.2)	16.4	41.7 (11.0)	16.4	41.1 (10.9)	16.4	40.5 (10.7)	16.4	40.0 (10.6)	–	–	–	–	–	–	–	–
18 000 ft	2 400	15.0	39.8 (10.5)	15.0	39.3 (10.4)	15.0	38.7 (10.2)	15.0	38.3 (10.1)	15.0	37.8 (10.0)	15.0	37.4 (9.9)	–	–	–	–	–	–	–	–

Notes:

1. Shaded areas contain values for full throttle operation
2. Manifold Pressure (MP) in [in.Hg]
3. Fuel Flow (F/F) in [l/h], Values in brackets () in [US Gal/h]
4. Above fuel flow data refer to minimum fuel consumption, refer to Section I, Performance Definitions

Cruise Power Setting with 85% Max. Continous Power (or Full Throttle)

		Outside Air Temperature [°F (°C)]																			
		-40 (-40)		-22 (-30)		-4 (-20)		14 (-10)		32 (0)		50 (10)		68 (20)		86 (30)		104 (40)		122 (50)	
Press. Alt.	RPM	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F	MP	F/F
MSL	2 400	24.7	62.7 (16.6)	25.1	62.7 (16.6)	25.5	62.7 (16.6)	25.9	62.7 (16.6)	26.3	62.7 (16.6)	26.6	62.7 (16.6)	27.0	62.7 (16.6)	27.3	62.7 (16.6)	27.6	62.7 (16.6)	27.9	62.7 (16.6)
2 000 ft	2 400	24.5	62.7 (16.6)	24.9	62.7 (16.6)	25.3	62.7 (16.6)	25.7	62.7 (16.6)	26.1	62.7 (16.6)	26.4	62.7 (16.6)	26.7	62.7 (16.6)	27.1	62.7 (16.6)	27.4	62.7 (16.6)	27.6	62.7 (16.6)
4 000 ft	2 400	24.2	62.7 (16.6)	24.6	62.7 (16.6)	25.0	62.7 (16.6)	25.4	62.7 (16.6)	25.8	62.7 (16.6)	26.1	62.7 (16.6)	26.4	62.7 (16.6)	26.5	61.9 (16.4)	26.5	60.8 (16.1)	–	–
6 000 ft	2 400	23.9	62.7 (16.6)	24.3	62.7 (16.6)	24.5	62.2 (16.6)	24.5	61.7 (16.3)	24.5	60.3 (15.9)	24.5	59.2 (15.6)	24.5	58.0 (15.3)	24.5	57.0 (15.1)	24.5	56.1 (14.8)	–	–
8 000 ft	2 400	22.7	60.3 (15.9)	22.7	58.9 (15.6)	22.7	57.7 (15.2)	22.7	56.5 (14.9)	22.7	55.4 (14.6)	22.7	54.4 (14.4)	22.7	53.5 (14.1)	22.7	52.6 (13.9)	–	–	–	–
10 000 ft	2 400	21.0	55.2 (14.6)	21.0	54.0 (14.3)	21.0	53.0 (14.0)	21.0	52.0 (13.7)	21.0	51.0 (13.5)	21.0	50.2 (13.3)	21.0	49.4 (13.0)	21.0	48.6 (12.8)	–	–	–	–
12 000 ft	2 400	19.4	50.7 (13.4)	19.4	49.7 (13.1)	19.4	48.7 (12.9)	19.4	47.9 (12.7)	19.4	47.1 (12.4)	19.4	46.4 (12.3)	19.4	45.7 (12.1)	–	–	–	–	–	–
14 000 ft	2 400	17.8	46.5 (12.3)	17.8	45.7 (12.1)	17.8	45.0 (11.9)	17.8	44.3 (11.7)	17.8	43.6 (11.5)	17.8	43.0 (11.4)	17.8	42.4 (11.2)	–	–	–	–	–	–
16 000 ft	2 400	16.4	43.0 (11.4)	16.4	42.3 (11.2)	16.4	41.7 (11.0)	16.4	41.1 (10.9)	16.4	40.5 (10.7)	16.4	40.0 (10.6)	–	–	–	–	–	–	–	–
18 000 ft	2 400	15.0	39.8 (10.5)	15.0	39.3 (10.4)	15.0	38.7 (10.2)	15.0	38.3 (10.1)	15.0	37.8 (10.0)	15.0	37.4 (9.9)	–	–	–	–	–	–	–	–

Notes:

1. Shaded areas contain values for full throttle operation
2. Manifold Pressure (MP) in [in.Hg]
3. Fuel Flow (F/F) in [l/h], Values in brackets () in [US Gal/h]
4. Above fuel flow data refer to minimum fuel consumption, refer to Section I, Performance Definitions

CRUISING SPEEDS

Associated Conditions :

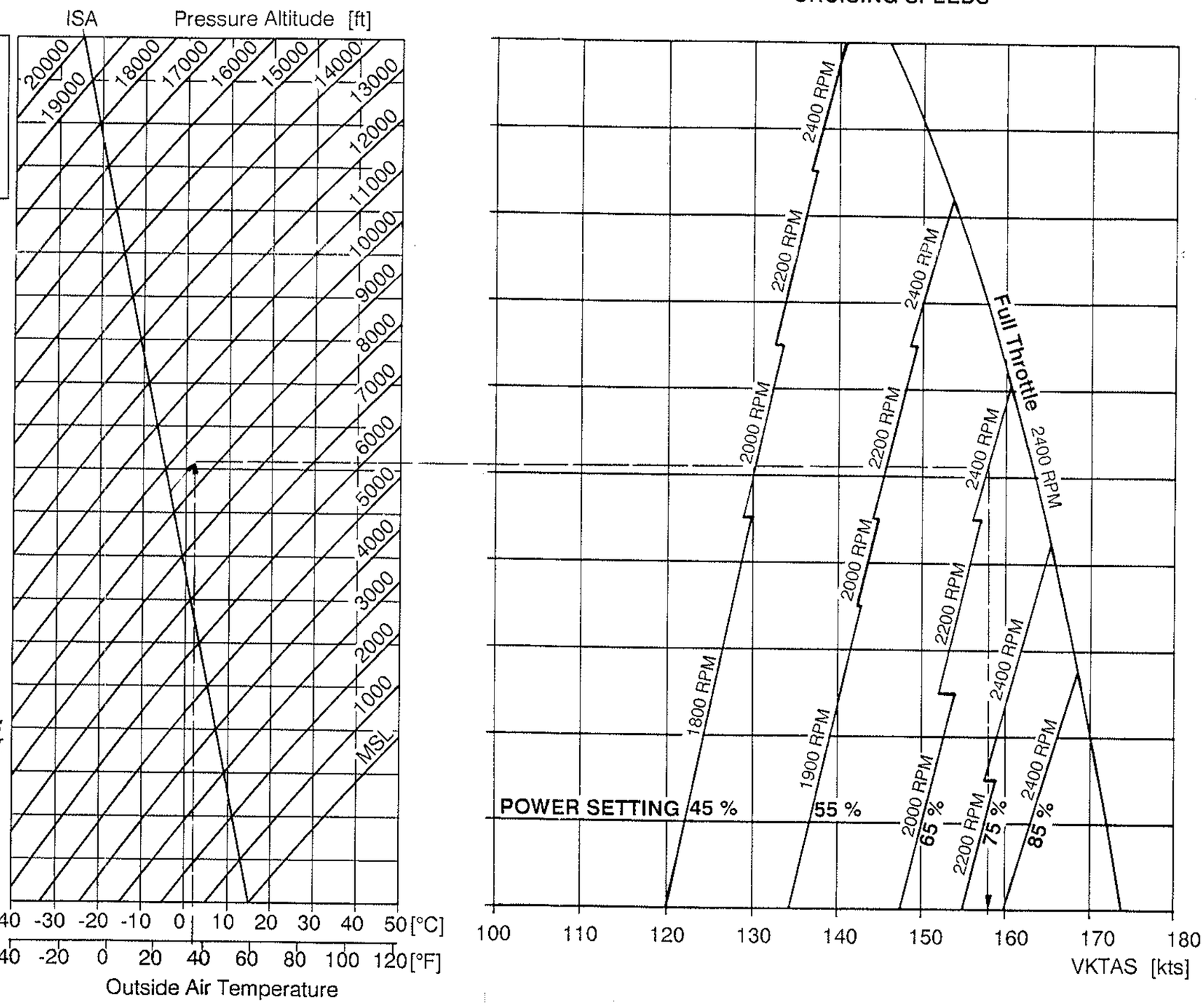
Mixture :	Best Economy (at 85 % Best Power)
Flaps :	0°
Landing Gear :	UP
Cowl Flaps :	Closed
Weight :	2977 lbs (1350 kg)

Note:

Given airspeeds are valid for an aircraft including all antennas required for IFR operation.

Example:

Cruising Press. Alt. : 9500 ft
OAT : 36 °F (2° C)
Power Setting : 65 %
➥ *Airspeed : 158 KTAS*
at : 2400 RPM



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RANGE

Associated Conditions :

Mixture :	Best Economy (at 85 % Best Power)
Flaps :	0°
Landing Gear :	UP
Cowl Flaps :	Closed
Wind :	No Wind
Weight :	2977 lbs (1350 kg)

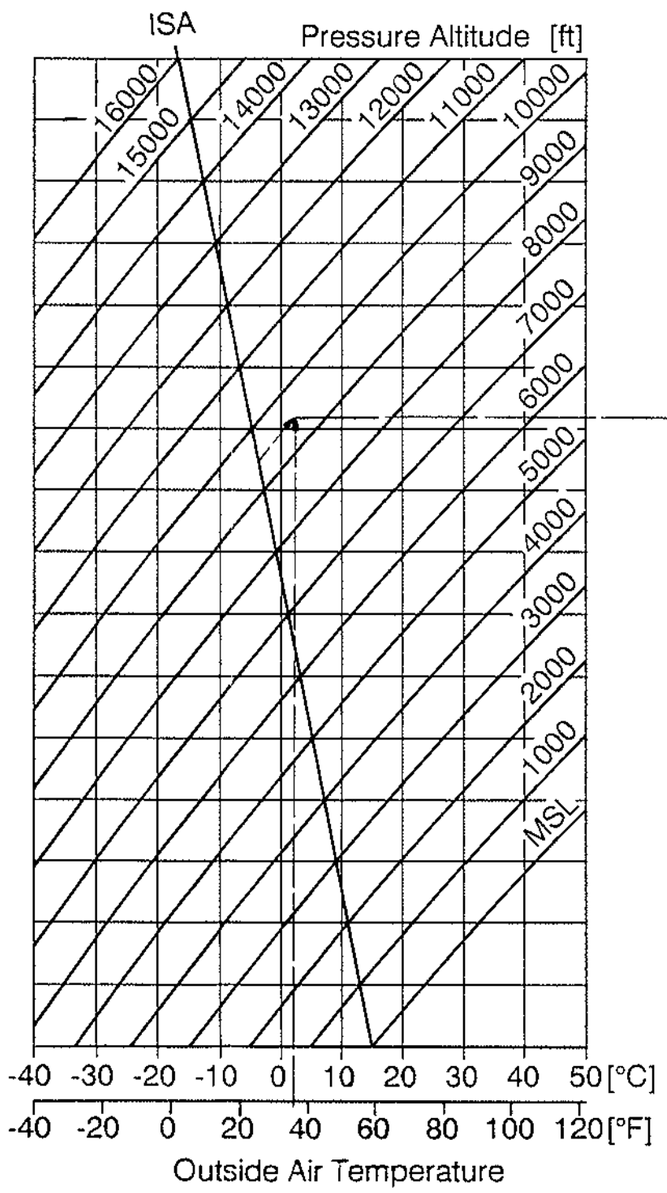
Fuel Capacity :

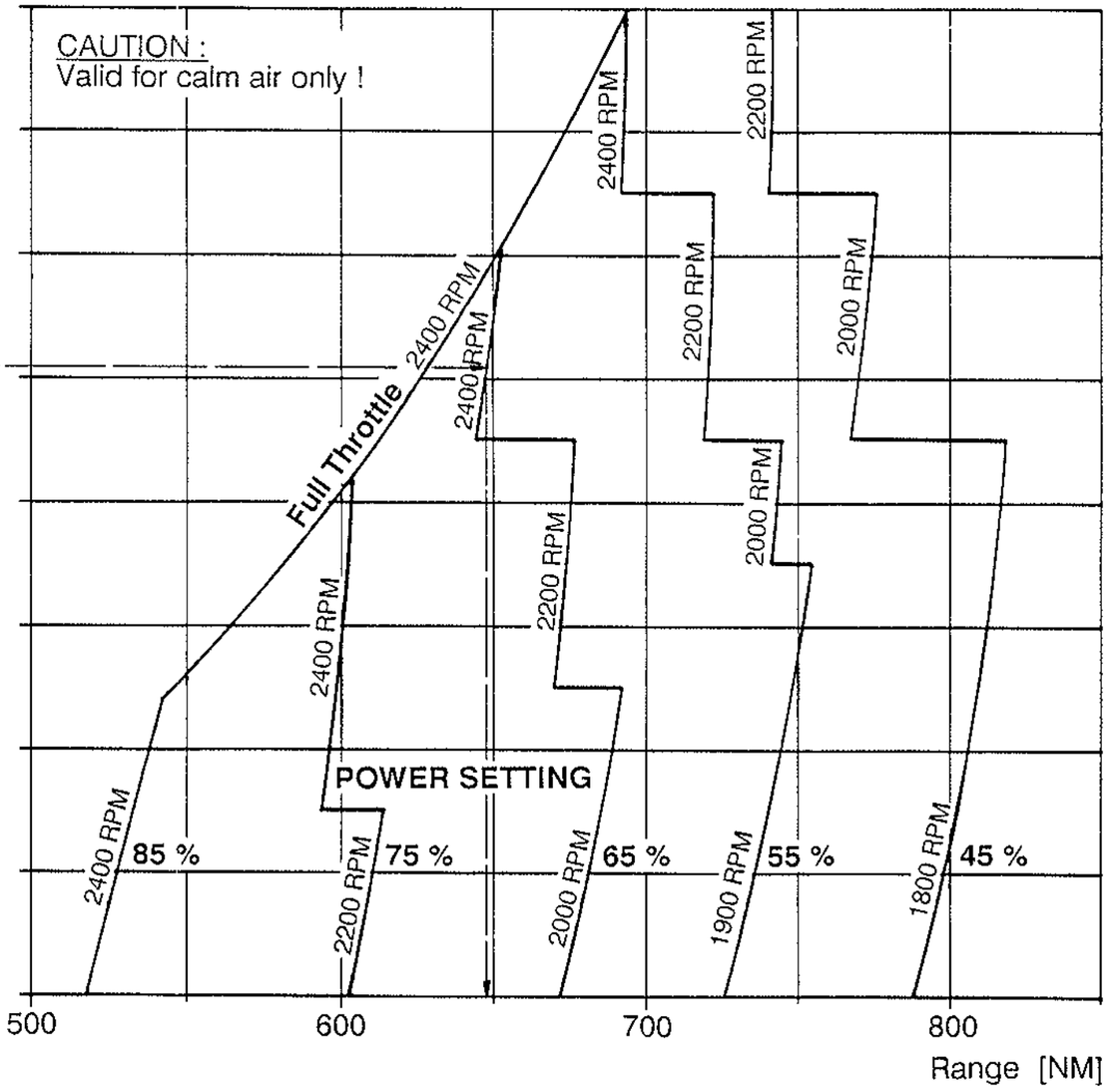
Usable Fuel : 236 l

The range calculation considers :

1. Fuel for starting and taxiing 1.3 US Gal. (5 l).
2. Fuel for take-off, climb to cruising altitude at max. continuos power and descent.
3. Reserve fuel for 45 min holding at 45% power = 6.9 US Gal. (26 l).

Example:
Cruising Press. Alt. : 9500 ft
OAT : 36 °F (2° C)
Power Setting : 65 %
➥ *Range : 648 NM*





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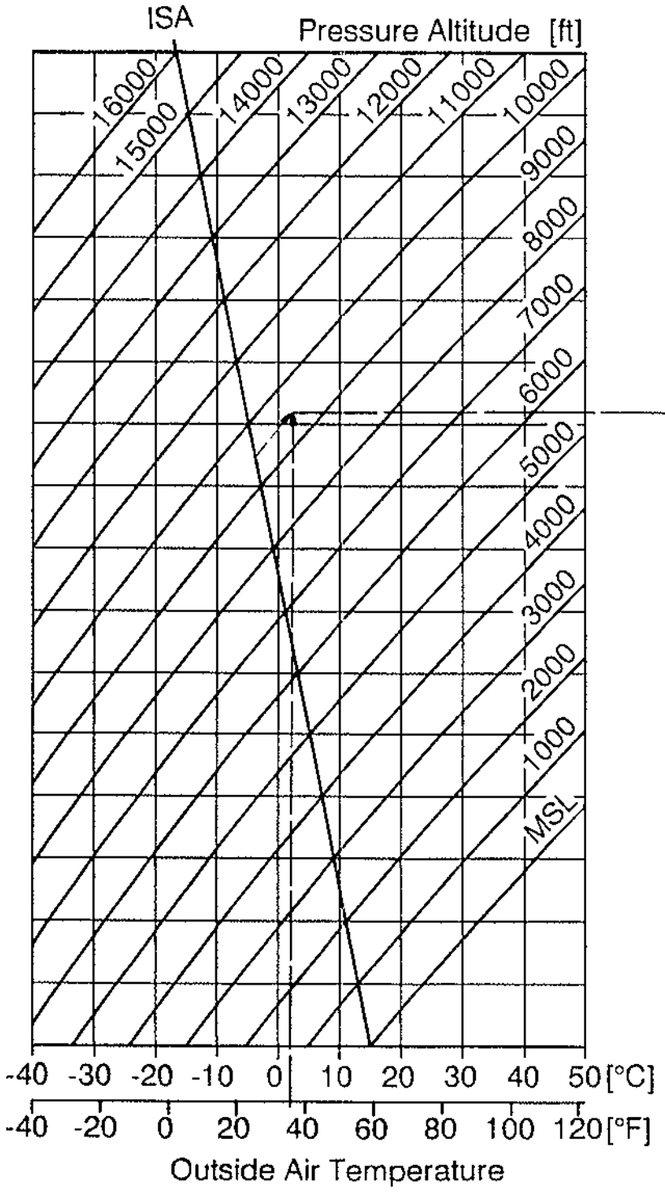
ENDURANCE

Associated Conditions :

Mixture :	Best Economy (at 85 % Best Power)
Flaps :	0°
Landing Gear :	UP
Cowl Flaps :	Closed
Weight :	2977 lbs (1350 kg)

Example :
Cruising Press. Alt. : 9500 ft
OAT : 36 °F (2° C)
Power Setting : 65 %
➡ *Endurance : 4.2 Hrs (4 Hrs, 12 Min)*

Note:
Endurance includes cruise climb and allows for taxi, runup, and 45 minutes reserve fuel at 45% economy cruise power.



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DESCENT

Time, fuel and distance to descent may be obtained from the diagram on page 5-40.

CAUTION

Never forget to reset the altimeter to the local QNH in time during descent to determine the actual altitude above sea level.

TIME, FUEL AND DISTANCE TO DESCENT

Procedure : Maintain an airspeed of 150 KIAS during descent. Set descent power to obtain a rate of descent of 1000 ft/min. Keep engine temperatures within green range.

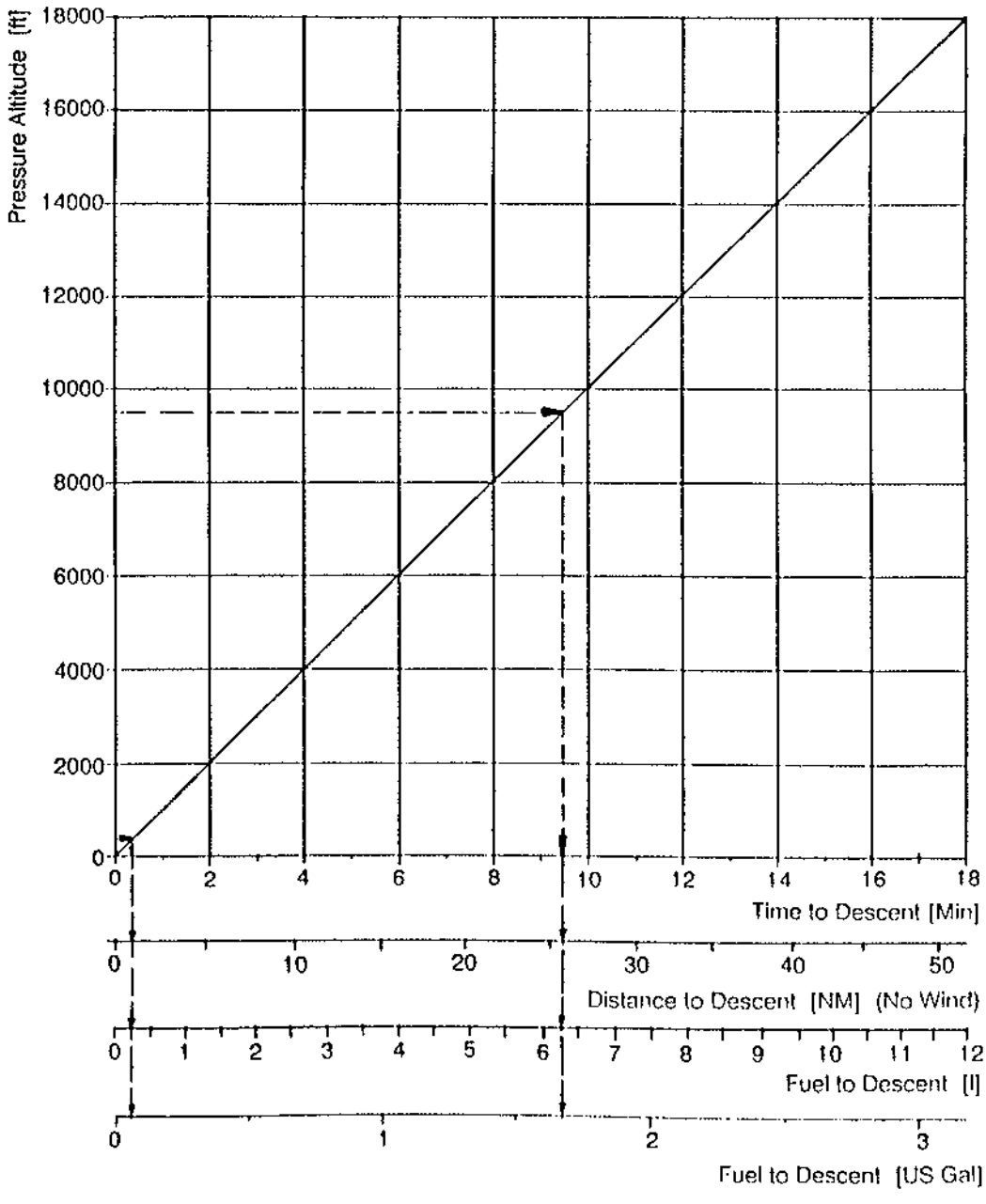
Associated Conditions :

Manifold Pressure :	as required, appr. 15 inHg
Propeller :	2400 RPM
Flaps & Ldg. Gear :	UP
Cowl Flaps :	Closed

Example :

Landing Weight:	*2558 lbs(1160 kg)*
Airport Press. Altitude:	*380 ft*
Cruise Press. Altitude:	*9500 ft*
➥ *Time to Descent:*	*9.5 - 0.4 = 9.1 Min*
Distance to Descent:	*26.2 - 1.0 = 25.2 NM*
Fuel to Descent:	*1.7 - 0.1 = 1.6 US Gal*
	6.3 - 0.2 = 6.1 l

Notes :
- Distance to descent valid for calm air only.
- Valid for any approved weight and outside air temperature.



LANDING DISTANCE

The landing distance may be obtained from the diagram on page 5-43. For calculation of the wind components relative to runway direction page 5-16 (crosswind components) may be used.

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LANDING DISTANCE

Landing Weight	Airspeed KIAS	
	at 50 ft	Touchdown
2426 lbs. (1100 kg)	75	60
2977 lbs. (1350 kg)	80	65

Associated Conditions :

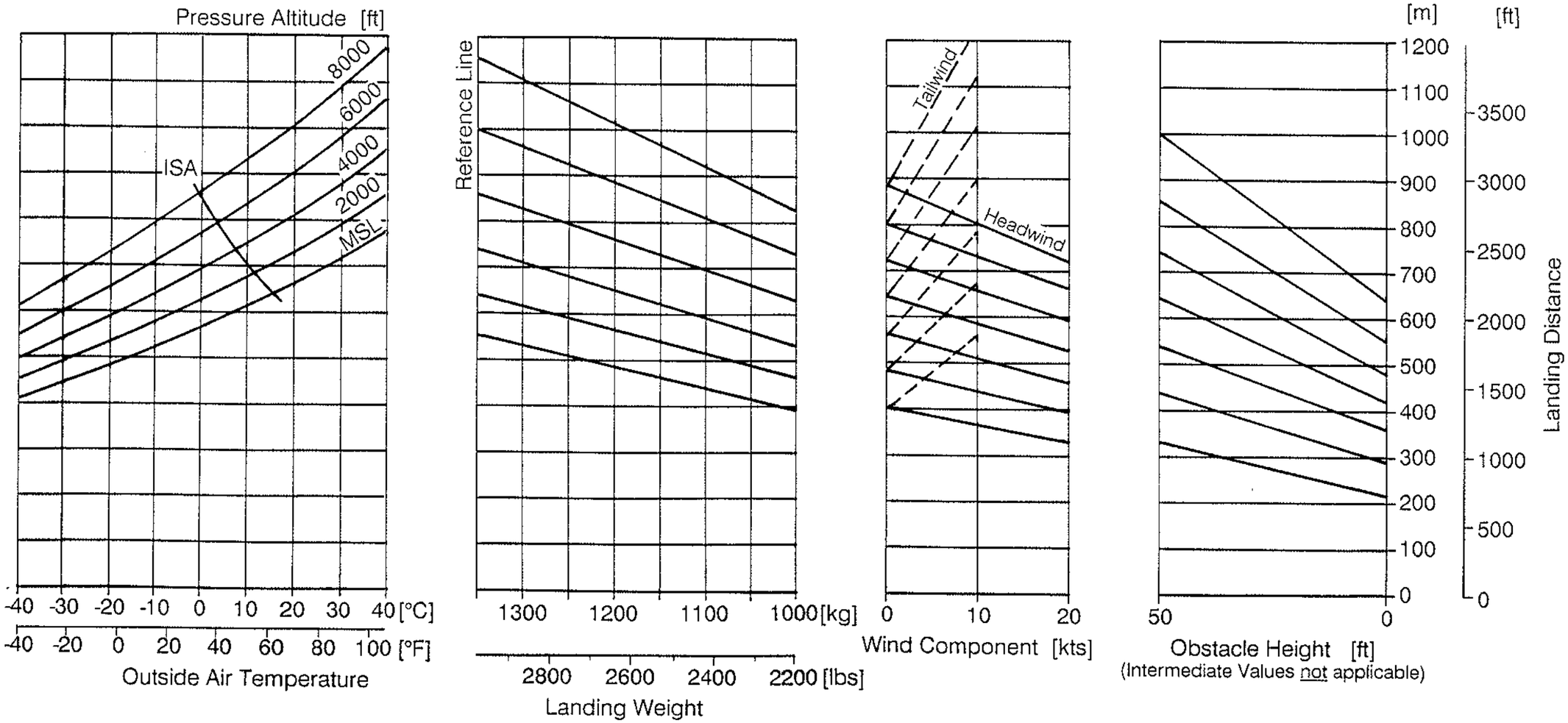
Power :	Idle
Propeller :	Low Pitch (High RPM)
Flaps :	30°
Landing Gear :	DOWN
Runway :	Paved, Level, Dry Surface
Braking :	Maximum

Notes:

- The landing distance can increase up to 15% for a landing on a dry gras runway.
- Additionals for wet gras, soft surface, snow or slush have to be considered.

Example:

Pressure Altitude : 380 ft
OAT : 68 °F (20 °C)
Landing Weight : 2558 lbs (1160 kg)
Headwind Component : 18 kts
➡ *Landing Distance : 1066 ft (325 m)*
Landing Disctance over 50 ft : 1575 ft (480 m)



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FLIGHT PLANNING EXAMPLE

The following is an example of a typical flight with the R 90-230 RG, explaining the use of the diagrams and information provided in this section of the Airplane Flight Manual.

Note

This flight planning example is based on the assumption that there are two standard tanks with a total fuel capacity of 62 US Gal. (236 l) usable fuel.

Airplane

Takeoff Weight	2867 lbs (1300 kg)
Usable Fuel	62 US Gal (236 l)

Takeoff Airport Conditions

Pressure Altitude	1500 ft
Temperature	+64 °F (+18 °C)
Runway	24 (240°)
Reported Wind	280°/15 kts
Runway Length (hard surface, dry, level)	2231 ft (680 m)

Cruise Conditions

Total Distance	650 NM (1200 km)
Cruising Level (altim. sett. 29.9 (1013))	9500 ft
Temperature at Cruising Level	+36 °F (+2 °C)
Reported Wind	10 kts Tailwind-component

Landing Airport Conditions

Pressure Altitude	380 ft
Temperature	+68 °F (+20 °C)
Runway	18 (180°)
Reported Wind	200°/20 kts
Runway Length (hard surface, dry, level)	1968 ft (600 m)

TAKEOFF DISTANCE

Use the diagram provided on page 5-21 to determine takeoff distance. The wind components relative to the runway direction may be obtained from page 5-16 (crosswind components).

The wind velocity is 15 kts and the angle between the runway and the prevailing wind is 40° headwind from the right side.

The headwind component obtained from the diagram on page 5-16 is 12 kts and the crosswind is 10 kts.

Takeoff Run ..... 837 ft (255 m)
Rotation at ..... 62 KIAS
Takeoff distance to clear 50 ft ..... 1673 ft (510 m)
Airspeed at 50 ft ..... 76 KIAS

These values are within the available runway length of 2231 ft (680 m).

CLIMB

Time, fuel and distance to climb may be obtained from the diagram on page 5-25.

As the departure airport already has an elevation of 1500 ft, the corresponding values for time, fuel and distance to climb to this altitude must be subtracted from the values determined for a climb to the cruising level (9500 ft).

Time to Climb	12.4 min -	2.0 min	= 10.4 min
Distance to Climb ...	21.4 NM -	3.2 NM	= 18.2 NM
Climb Fuel	3.9 US Gal -	0.7 US Gal	= 3.2 US Gal
	(14.8 l -	2.5 l	= 12.3 l)

The tailwind of 10 kts reported for cruising altitude does not affect time and fuel burn but only the distance flown until reaching cruising level.

As wind velocity usually increases with altitude, a tailwind component of 8 kts is assumed for the entire climb.

To determine the additional distance flown, multiply the wind velocity by the time to climb of 10.4 min:

$$\frac{8 \text{ kts} \times 10.4 \text{ min}}{60} = 1.4 \text{ NM}$$

This result shows that a considerable effect of wind only exists at very strong winds or high altitude climbs. For this sample flight the effect of wind on the climb data might be neglected.

DESCENT

Time, fuel and distance to descent may be obtained from the diagram on page 5-40. The descent starts at 9500 ft and ends at 380 ft. During descent, the altimeter has to be reset to local QNH in time.

Time to Descent	9.5 min -	0.4 min	= 9.1 min
Distance to Descent	26.2 NM -	1.0 NM	= 25.2 NM
Descent Fuel	1.7 US Gal -	0.1 US Gal	= 1.6 US Gal
	(6.3 l -	0.2 l	= 6.1 l)

CRUISE

Select the desired cruising level by taking account of the distance of the flight, winds at altitude and desired power setting. For this flight planning example, a typical cruising altitude and typical winds-at-altitude information have been selected.

The range diagram on page 5-35 shows range vs. power setting. Low power settings result in considerable fuel savings and increased range.

According to this diagram, a range of 648 NM at 158 KTAS may be obtained at 65 % power at 9500 ft.

The endurance diagram on page 5-37 shows an endurance of 4.2 h (at 65 % power). This time as well as the range noted above include a reserve of 45 min. at a power setting of 45 %.

Considering an expected tailwind of 10 kts at 9500 ft, the range of 648 NM has to be corrected as follows:

Range at no wind conditions	648 NM
Increase due to 10 kts of tailwind (4.2 h x 10 kts)	42 NM
Corrected Range	690 NM

The performance data determined show that the flight may be performed safely, including sufficient reserve fuel.

DETERMINATION OF TRIP FUEL REQUIRED

Starting and Taxiing	1.3 US Gal	(5.0 l)
Climb (Page 5-25)	3.2 US Gal	(+ 12.3 l)
	4.5 US Gal	(17.3 l)

Climb Distance	18.2 NM
Wind correction (Tailwind)	+ 1.4 NM
	19.6 NM

During descent from 9500 ft to 380 ft, a distance of 25.2 NM will be covered and 6.1 l of fuel be burnt. The effect of wind is not considered in this case.

Total Distance	650.0 NM
Climb Distance	- 19.6 NM
Descent Distance	- 25.2 NM
Cruising Distance	605.2 NM
	======

The expected tailwind of 10 kts will result in a ground speed of :

158 kts + 10 kts = 168 kts

Therefore, the time required for the cruise portion of the flight is:

$$\frac{605.2 \text{ NM}}{168 \text{ kts}} = 3.6 \text{ h}$$

The required cruise fuel is:

3.6 h x 12.6 US Gal/h = 45.4 US Gal
(3.6 h x 47.8 l/h = 172 l)

The fuel flow of 12.6 US Gal/h (47.8 l/h) is determined from the table on page 5-30 for a cruise power setting of 65 % of max. continuous power. At 8000 ft, the fuel flow is 12.0 US Gal/h (45.3 l/h) at any temperature and 12.6 US Gal/h (47.8 l/h) at 10000 ft. Due to the fact that an engine speed of 2400 RPM has to be used already at 9500 ft, the higher value of 12.6 US Gal/h (47.8 l/h) has to be used.

The total calculated fuel required is as follows:

Climb incl. Starting and Taxiing	4.5 US Gal	(17.3 l)
Cruise	+ 45.4 US Gal	(+ 172.0 l)
Descent	+ 1.6 US Gal	(+ 6.1 l)
Fuel required	51.5 US Gal	(195.4 l)

This results in a fuel reserve of:

Usable Fuel	62.3 US Gal	(236.0 l)
Fuel required	- 51.5 US Gal	(- 195.4 l)
Reserve Fuel	10.8 US Gal	(40.6 l)

The actual ground speed has to be monitored during the entire flight to be used as the basis of flight time and fuel burn calculation. So if, for instance, there is less tailwind than expected (10 kts), the power setting has to be reduced to 55 % in order to increase range accordingly.

LANDING DISTANCE

The landing distance may be obtained from the diagram on page 5-43. For calculation of the wind components relative to runway direction, page 5-16 (crosswind components) may be used.

The headwind component is 18 kts, the crosswind component 7 kts.

The landing weight is:

Takeoff Weight	2867 lbs	(1300 kg)
Fuel used	- 309 lbs	(- 140 kg)
Landing Weight	2558 lbs	(1160 kg)

(51.5 US Gal • 6.0 lbs/US Gal = 309 lbs)
(195.4 l • 0.72 kg/l = 140 kg)

Landing Distance from 50 ft	1575 ft (480 m)
Landing Roll	1066 ft (325 m)

The available runway length of 1968 ft (600 m) is sufficient.

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SECTION VI

WEIGHT AND BALANCE, EQUIPMENT LIST

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