APPENDIX: PERFORMANCE DATA

APPENDIX
PERFORMANCE DATA

TABLE OF CONTENTS

PART ONE
INTRODUCTION

TABLE OF CONTENTS

LIST OF CHARTS

GENERAL INFORMATION.

The information in the Appendix is presented to assist operating personnel to a better understanding of the performance capabilities and limitations of the aircraft. The objective of the Appendix is to provide specific performance values in graphical form covering all reasonable conditions under which the aircraft will be operated to enable operating personnel to utilize the aircraft efficiently.

DISCUSSION OF CHARTS.

The take-off charts are presented in such a manner that performance may be determined for any set of atmospheric conditions. The climb data is presented for standard day and hot day atmospheric conditions. Range performance may be determined for any atmospheric temperature condition by considering the altitude specified in the charts as density altitude. The performance charts are identified according to their type and condition of operation by colored page borders conforming to the following code:

Normal Operation ....Plain Corner
Emergency Operation .... Red Corner
Hot Day Operation .... Yellow Corner

DEFINITION OF TERMS

AIRSPEED – the speed of the aircraft relative to the air through which it is moving.

AMBIENT CONDITIONS – conditions of the air surrounding the aircraft at any given time under consideration.

AUTO-LEAN – the mixture control lever at the lean detent.

AUTO-RICH – the mixture control lever at the rich detent.

CALIBRATED AIRSPEED – indicated airspeed corrected for instrument and position error.

COMPRESSIBILITY ERROR – an error in the airspeed indicator reading and the outside air temperature indicator reading caused by air being slightly compressed by the moving aircraft.

DENSITY ALTITUDE – the altitude obtained from a standard density altitude chart for any given pressure altitude and temperature or for any density ratio factor ($1/\sqrt{\sigma}$).

DEW POINT – the temperature at which consensation occurs in a cooling mass of air.

DRY BULB TEMPERATURE – the air temperature as indicated by a thermometer with a dry bulb (true air temperature).

EFFECTIVE WIND (HEAD OR TAILWIND) – The component of the existing wind condition which acts opposite to or in the direction of travel. For takeoff or landing, this component will be computed from the take-off and landing crosswind chart.

EQUIVALENT AIRSPEED – calibrated airspeed corrected for compressibility.

INCHES HG – a measure of air pressure which compares it to the weight of a column of mercury.

INDICATED AIRSPEED – airspeed indicator reading uncorrected (assuming the mechanical error in the instrument is negligible).

LOW BLOWER – the engine supercharger in low gear ratio.

NAUTICAL MILES PER POUND – the number of nautical miles traveled while consuming a pound of fuel.

OPERATING WEIGHT EMPTY – the weight of the aircraft and its contents, not including payload, fuel or regular engine oil, when the aircraft is equipped with all provisions necessary to complete a mission.

POSITION ERROR – the error in the airspeed indicator reading and the altimeter reading caused by the inability of the static orifices to experience the true ambient air pressure.

PRESSURE ALTITUDE – the altitude obtained from a standard atmosphere table, for any given value of air pressure (measured in inches Hg). This is the altitude that an altimeter will show (after correcting for position error) when set to 29.92 inches Hg.

RAM – the increase in air pressure at the entrance to an airscoop due to the speed of the aircraft.

RECOMMENDED LONG RANGE CRUISE SPEED – the speed at which it is recommended to fly the aircraft when long range is of more concern than high speed.

REFUSAL DISTANCE – the distance required to accelerate to the refusal speed.

REFUSAL SPEED – maximum speed to which the aircraft can accelerate and then stop in the available runway length.

RELATIVE HUMIDITY – the ratio of the amount of water vapor in a given mass of air to the maximum amount of water vapor that the mass of air could hold at the same temperature.

SPECIFIC HUMIDITY – the ratio of the amount of water vapor in a given mass of air to the mass of dry air, measured in pounds.

SPECIFIC RANGE – nautical miles per pound of fuel.

STANDARD ATMOSPHERIC CONDITIONS – an arbitrarily selected set of atmospheric conditions chosen to approximate the average atmosphere of the world.

STANDARD DAY – a day on which standard atmospheric conditions are assumed to exist.

THRESHOLD SPEED – the speed at which the aircraft crosses the end of the runway during a normal landing (120 percent of the stall speed for wing flaps in the landing position).

TOUCHDOWN SPEED – the speed at which the aircraft comes in contact with the runway during a normal landing (110 percent of the stall speed for wing flaps in the landing position).

TRUE AIRSPEED – the true speed of the aircraft relative to the air through which it is moving (equal to EAS time $1/\sqrt{\sigma}$).

TRUE ALTITUDE – altitude above sea level.

VAPOR PRESSURE – the partial pressure of water vapor existing in the air.

$V_{L/D}$ – the speed for maximum lift to drag ratio.

V_{SO} – the zero thrust stalling speed with wing flaps in the landing configuration.

V_{TO} – takeoff speed (110 percent of the stalling speed with the wing flaps in the takeoff configuration).

WET BULB TEMPERATURE – the temperature indicated by a thermometer whose bulb has been kept moist with water and which has been circulated in the air. This temperature, along with the dry bulb temperature, is used in conjunction with a psychrometric chart to determine the degree of humidity.

LIST OF ABBREVIATIONS

Alt.	Altitude
BHP	Brake horsepower
BMEP	Brake mean effective pressure
°C	Degrees Centigrade
CAS	Calibrated airspeed
CAT	Carburetor air temperature
CHT	Cylinder head temperature
Crit.	Critical
EAS	Equivalent airspeed
Eng.	Engine
°F	Degrees Fahrenheit
Fld.	Field
Ft.	Feet
Hg.	Mercury
IAS	Indicated airspeed
ICAO	International Civil Aviation Organization
In.	Inch
Kts.	Knots
Lbs.	Pounds
MP	Manifold pressure
METO	Maximum except takeoff
Min.	Minute
OAT	Outside air temperature
PSI	Pounds per square inch
Pt.	Point
RPM	Revolutions per minute
S. L.	Sea level
Std.	Standard
T	Absolute temperature
TAS	True airspeed
V_{CO}	Climbout speed
$V_{L/D}$	Speed for maximum lift to drag ratio
V_{MC}	Minimum control speed
V_{NE}	Maximum dive speed
V_{NO}	Maximum speed for normal operation
V_R	Refusal speed
V_S	Stalling speed
V_{SO}	Stalling speed with zero thrust and wing flaps in landing configuration
V_{TO}	Takeoff speed
Wt.	Weight
δ	Delta; ratio of ambient air pressure to standard sea level air pressure
σ	Sigma; ratio of ambient air density to standard sea level air density

AIRSPEED TERMINOLOGY

Airspeed terminology used in this Appendix is defined as follows:

TERM	ABBREVIATION	DEFINITION
Indicated Airspeed	IAS	*Airspeed Indicator reading uncorrected.
Calibrated Airspeed	CAS	Indicated airspeed corrected for position error.
Equivalent Airspeed	EAS	Calibrated airspeed corrected for compressibility.
True Airspeed	TAS	TAS = EAS X $1/\sqrt{\sigma}$

*IAS is used in this Appendix as though the mechanical error in the instrument is zero.

All airspeeds of importance in takeoff and landing procedures are shown in this Appendix as indicated airspeed (IAS).

All airspeed data relating to take-off and landing procedures are given as indicated airspeed. Indicated airspeed for ground run is based on an estimated position error equal to zero. Since all cruise and climb data is given as calibrated airspeed, the airspeed position error charts are included to obtain the corresponding indicated airspeed. The characteristic take-off speeds chart and the characteristic landing speeds chart give indicated airspeed based on inflight calibrations. The take-off performance--ground run chart and the take-off performance--refusal speed chart give indicated airspeed based on negligible ground run position error.

AIRSPEED POSITION ERROR CORRECTION.

This chart (figure A1-1) shows the correction that must be applied to the indicated airspeed to determine the calibrated airspeed.

CALIBRATED AIRSPEED CORRECTION FOR COMPRESSIBILITY.

The calibrated airspeed correction for compressibility chart (figure A1-2) is used in determining EAS from CAS. A sample problem on the chart illustrates its use.

TEMPERATURE CORRECTION FOR COMPRESSIBILITY CHART.

This chart (figure A1-3) shows the correction that must be subtracted from the outside air temperature indicator reading to determine the true outside air temperature. For example, assume that the airplane is cruising at 125 knots CAS (point A) at an altitude of 10,000 feet (point B). The chart shows that the correction is 2.5°C (point C). This amount must be subtracted from the indicated air temperature to determine the outside air temperature. If the instrument read 6°C, then the outside air temperature would be 6-2.5, or 3.5°C. If the instrument read −12°C, then the outside air temperature would be −12-2.5, or −14.5°C.

DENSITY ALTITUDE CHART.

The density altitude chart (figure A1-4) is used in determining the density altitude and the value $1/\sqrt{\sigma}$ for any pressure altitude and ambient temperature.

SAMPLE PROBLEM:

(A) Free air temperature -8 C

(B) Pressure altitude 18,000 ft.

(C) Density altitude 19,400 ft.

(D) $1/\sqrt{\sigma} = 1.356$

ICAO STANDARD ATMOSPHERE TABLE.

The ICAO standard altitude table (figure A1-5) presents the density altitude factor tabulated for thousands and hundreds of feet; and the values of sigma (σ), the density ratio of ambient air to standard sea level air, tabulated for thousands of feet. The value $1/\sqrt{\sigma}$ is chiefly used in obtaining the true airspeed (TAS) from equivalent airspeed (EAS) by the relationship, TAS = EAS X $1/\sqrt{\sigma}$.

TEMPERATURE CONVERSION CHART.

The temperature conversion chart (figure A1-6) is provided to facilitate the conversion of either Fahrenheit temperatures to Centigrade, or Centigrade temperatures to Fahrenheit.

PSYCHROMETRIC CHART.

The Psychrometric Chart (Figure A1-8) graphically relates the various measures of water vapor in the atmosphere. Although it is the dew point which is commonly furnished the pilot, occasionally humidity may be available as wet and dry bulb temperatures, and less often, as relative humidity. To meet all such situations the psychrometric chart provides a means of converting from one variable to another. Three examples for obtaining specific humidity are given below which differ as to which quantities are known.

Example 1:

Given: Pressure altitude = 5000 ft.

Dew Point = 54.5°F

Find: Specific humidity

1. Locate 54.5°F dew point temperature on curved line for 100% relative humidity (point B). This point can be found either by interpolation between 50°F and 60°F along curved line or by entering at 54.5°F on dry bulb temperature scale (point A) and projecting vertically upward to curved line for 100% relative humidity.

2. From point B, proceed horizontally to left base line and then follow along curved path interpolated between guide lines to 5000 ft. pressure altitude (point C).

3. Project horizontally to specific humidity scale at extreme left (point D) and read .0108.

4. If vapor pressure is desired, project horizontally from point B to extreme right (point E) and read 0.425 inches Hg.

Example 2:

Given: Pressure altitude = 5000 ft.

Wet bulb temperature = 17°C

Dry bulb temperature = 26°C

Find: Dew point and specific humidity

1. Enter with 26°C dry bulb temperature (point F) and proceed vertically upward to intersection with imaginary slant line for 17°C wet bulb temperature (point G). Note that the 17°C wet bulb temperature line can be located by interpolation between the 15°C and 20°C wet bulb lines for 5000 ft. altitude. To assist interpolation, the upper end of this line can be located by entering the dry bulb temperature scale at 17°C (point H) and projecting vertically upward to the 100% relative humidity line (point I). Draw slant line through point I parallel to 5000 ft. wet bulb dashed lines to intersection (point G) with vertical projection of point F.

2. From point G, project horizontally to left to dew point scale (point B) and read dew point, 54.5°F.

3. Continue left as in Example 1 (points C and D) to obtain a specific humidity of .0108.

4. From point G, project horizontally to right to obtain 0.425 inches Hg vapor pressure (point E).

Example 3:

Given: Relative humidity = 43%

Dry bulb temperature = 26°C

Find: Dew point and specific humidity

1. Enter dry bulb temperature scale at 26°C (point F) and proceed vertically upward to intersection with 43% relative humidity line, interpolated between 40% and 60% (point G).

2. Project horizontally to the left to the dew point scale (point B) and read dew point, 54.5°F.

3. To obtain specific humidity project horizontally to left base line and continue as in example 1 (points C and D) to read .0108.

4. From point G project horizontally to right to obtain 0.425 inches Hg vapor pressure (point E).

FUEL DENSITY TABLE.

The fuel density table (figure A1-9) presents variations in fuel density of 100/130 and 115/145 grades fuel as related to variations in temperature.

AIRSPEED POSITION ERROR CORRECTION

(NO INSTRUMENT ERROR INCLUDED)

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) A-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

THIS CHART APPLIES TO ALL FLAP AND LANDING GEAR CONFIGURATIONS

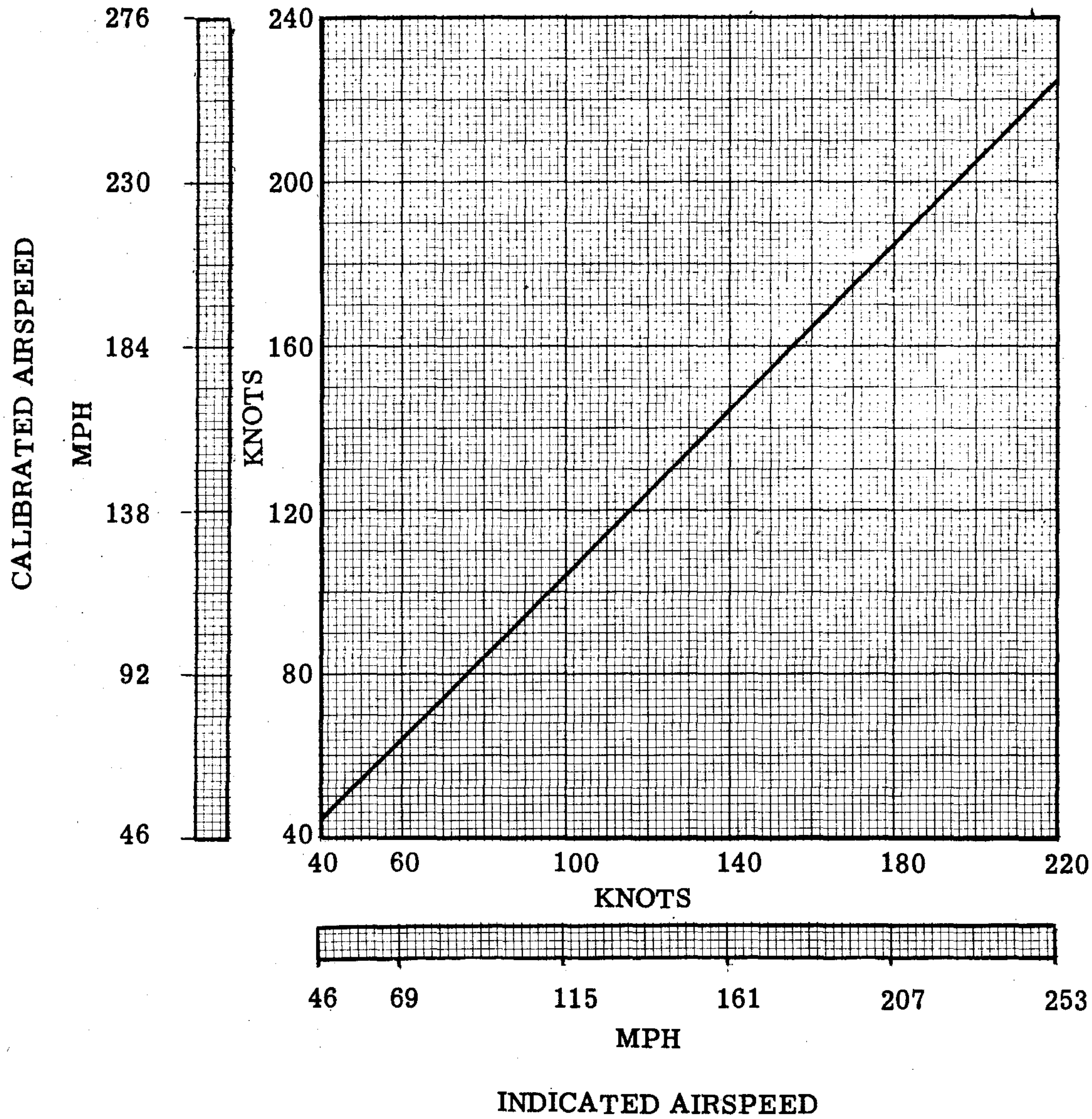


Figure A1-1. Airspeed Position Error Correction.

CALIBRATE AIRSPEED CORRECTION FOR COMPRESSIBILITY

SAMPLE PROBLEM

GIVEN: PRESSURE ALTITUDE = 15000 FEET
CALIBRATED AIRSPEED = 120 KNOTS

A = ENTER CHART AT 120 KNOTS
B = AT 15000 FEET READ CORRECTION
C = CORRECTION = 0. 6 KNOTS OR MPH

NOTE
SUBTRACT CORRECTION FROM CALIBRATED AIRSPEED TO OBTAIN EQUIVALENT AIRSPEED

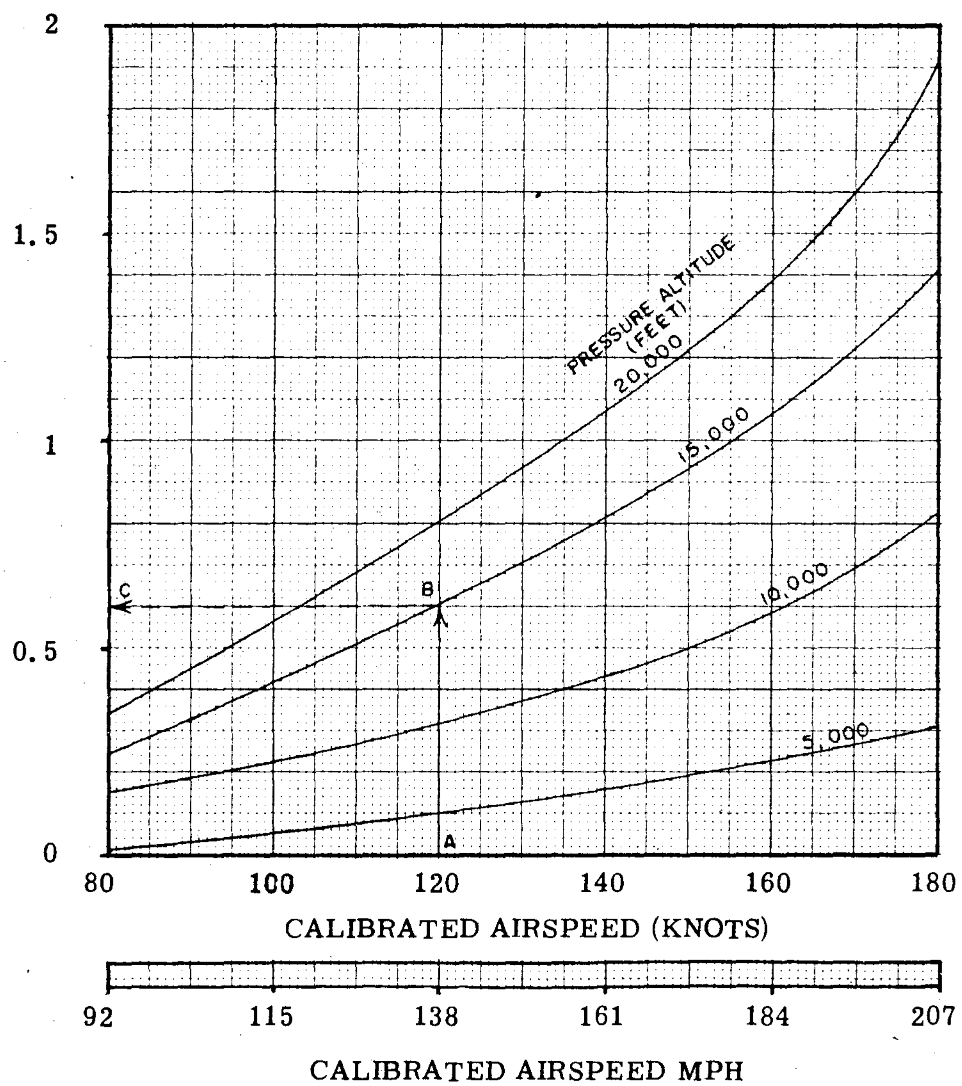


Figure A1-2. Calibrate Airspeed Correction For Compressibility.

TEMPERATURE CORRECTION FOR COMPRESSIBILITY

NOTE:
A SUBTRACT CORRECTION FROM INDICATED AIR TEMPERATURE TO OBTAIN FREE AIR TEMPERATURE ^{o}C OR ^{o}F
B TEMPERATURE RECOVERY COFFICIENT 80%

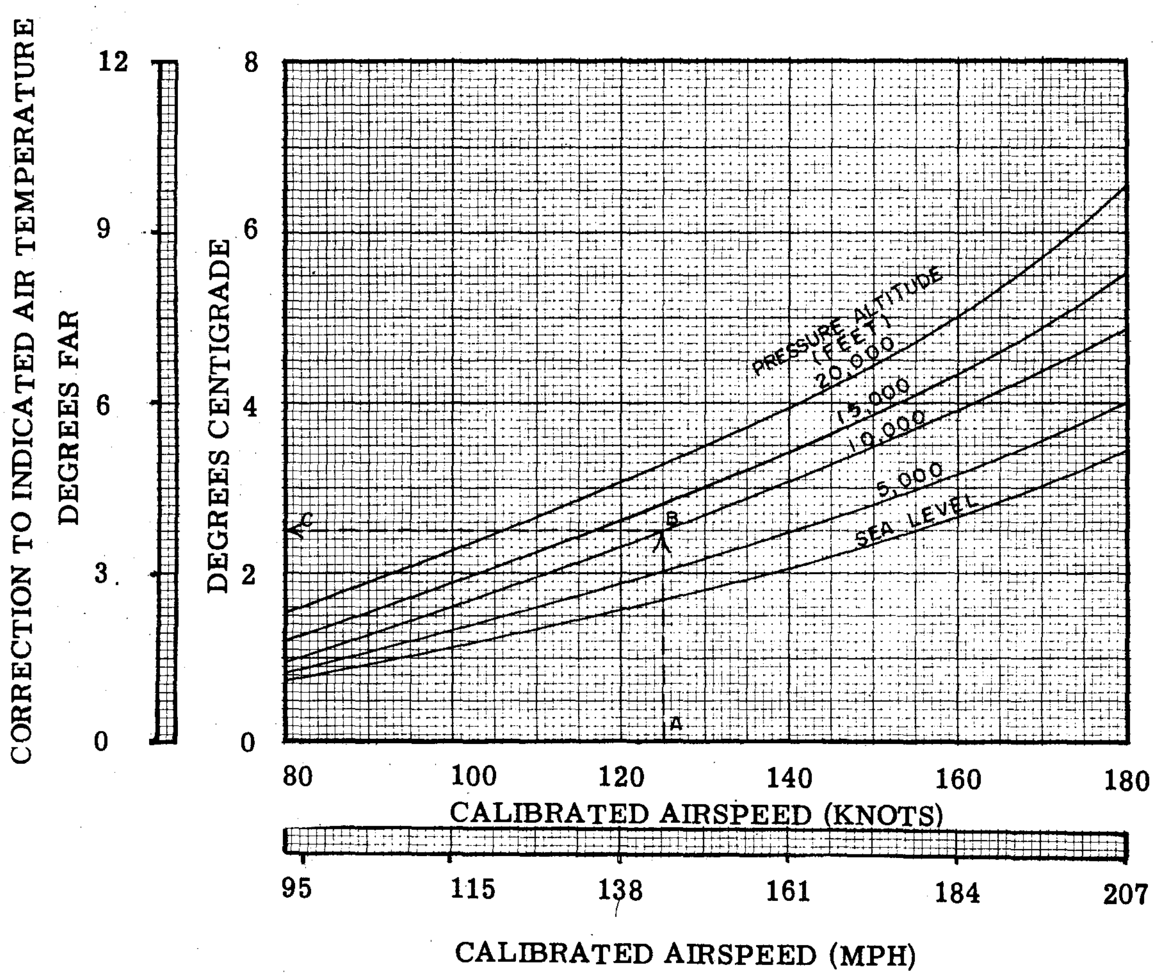


Figure A1-3. Temperature Correction For Compressibility.

DENSITY ALTITUDE CHART

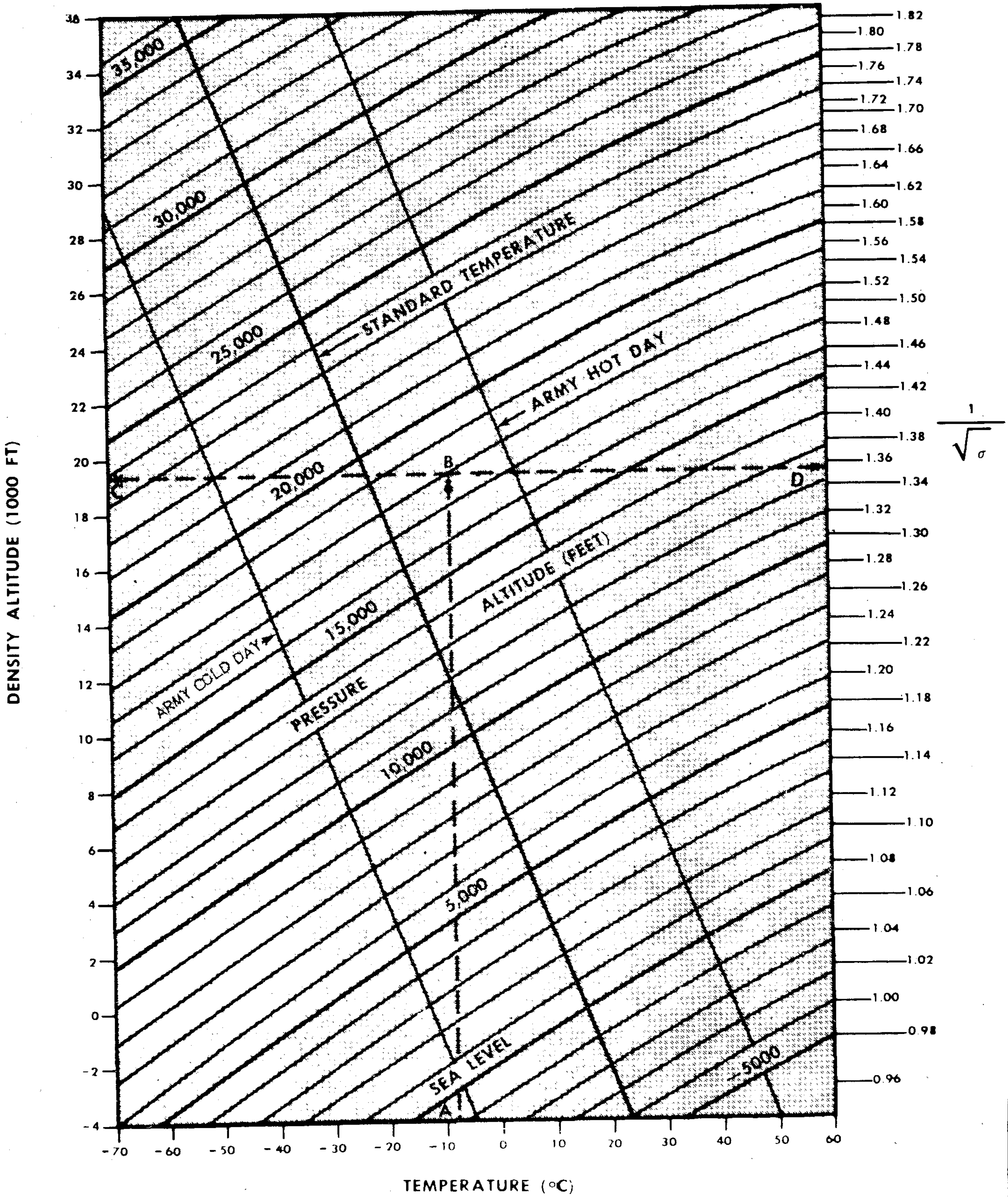


Figure A1-4. Density Altitude.

ICAO STANDARD ATMOSPHERE TABLE

STANDARD S. L. CONDITIONS:

Temperature = 15°C (59°F)
Pressure = 29.921 In. Hg (2116.216 psf)
Density = .0023769 slugs/cu ft
Speed of sound = 1116.89 fps (661.7 knots)

CONVERSION FACTORS:

1 In. Hg = 70.727 psf
1 In. = 0.49116 psi
1 Knot = 1.151 mph
1 Knot = 1.688 fps

Altitude Feet	Density Ratio σ	$\frac{1}{\sqrt{\sigma}}$	Temperature °C	Temperature °F	Speed of Sound (Knots)	Pressure In. Hg	Pressure Ratio δ
0	1.000	1.0000	15.000	59.000	661.7	29.921	1.0000
1000	.9711	1.0148	13.019	55.434	659.5	28.856	.9644
2000	.9428	1.0299	11.038	51.868	657.2	27.821	.9298
3000	.9151	1.0454	9.056	48.302	654.9	26.817	.8962
4000	.8881	1.0611	7.076	44.735	652.6	25.842	.8637
5000	.8617	1.0773	5.094	41.169	650.3	24.896	.8320
6000	.8359	1.0938	3.113	37.603	648.7	23.978	.8014
7000	.8106	1.1107	1.132	34.037	645.6	23.088	.7716
8000	.7860	1.1279	−0.850	30.471	643.3	22.225	.7428
9000	.7620	1.1456	−2.831	26.905	640.9	21.388	.7148
10,000	.7385	1.1637	−4.812	23.338	638.6	20.577	.6877
11,000	.7155	1.1822	−6.793	19.772	636.2	19.791	.6614
12,000	.6932	1.2011	−8.774	16.206	633.9	19.029	.6360
13,000	.6713	1.2205	−10.756	12.640	631.5	18.292	.6113
14,000	.6500	1.2403	−12.737	9.074	629.0	17.577	.5875
15,000	.6292	1.2606	−14.718	5.508	626.6	16.886	.5643
16,000	.6090	1.2815	−16.699	1.941	624.2	16.216	.5420
17,000	.5892	1.3028	−18.680	−1.625	621.8	15.569	.5203
18,000	.5699	1.3246	−20.662	−5.191	619.4	14.942	.4994
19,000	.5511	1.3470	−22.643	−8.757	617.0	14.336	.4791
20,000	.5328	1.3700	−24.624	−12.323	614.6	13.750	.4595
21,000	.5150	1.3935	−26.605	−15.889	612.1	13.184	.4406
22,000	.4976	1.4176	−28.587	−19.456	609.6	12.636	.4223
23,000	.4800	1.4424	−30.568	−23.022	607.1	12.107	.4046
24,000	.4642	1.4678	−32.549	−26.588	604.6	11.597	.3876
25,000	.4481	1.4938	−34.530	−30.154	602.1	11.103	.3711
26,000	.4325	1.5206	−36.511	−33.720	599.6	10.627	.3552
27,000	.4173	1.5480	−38.492	−37.286	597.1	10.168	.3398
28,000	.4025	1.5762	−40.474	−40.852	594.6	9.725	3250
29,000	.3881	1.6052	−42.455	−44.419	592.1	9.297	.3107
30,000	.3741	1.6349	−44.436	−47.985	589.5	8.885	.2970
31,000	.3605	1.6654	−46.417	−51.551	586.9	8.488	.2837
32,000	.3473	1.6968	−48.398	−55.117	584.4	8.106	.2709
33,000	.3345	1.7291	−50.379	−58.683	581.8	7.737	.2586
34,000	.3220	1.7623	−52.361	−62.249	579.2	7.382	.2467
35,000	.3099	1.7964	−54.342	−65.816	576.6	7.041	.2353
36,000	.2981	1.8315	−56.323	−69.382	574.0	6.712	.2243
36,089	.2971	1.8347	−56.500	−69.700	573.7	6.683	.2234
37,000	.2843	1.8753	−56.500	−69.700	573.7	6.397	.2138
38,000	.2710	1.9209	−56.500	−69.700	573.7	6.097	.2038
39,000	.2583	1.9677	−56.500	−69.700	573.7	5.811	.1942
40,000	.2462	2.0155	−56.500	−69.700	573.7	5.538	.1851
41,000	.2346	2.0645	−56.500	−69.700	573.7	5.278	.1764
42,000	.2236	2.1148	−56.500	−69.700	573.7	5.030	.1681
43,000	.2131	2.1662	−56.500	−69.700	573.7	4.794	.1602
44,000	.2031	2.2189	−56.500	−69.700	573.7	4.569	.1527
45,000	.1936	2.2728	−56.500	−69.700	573.7	4.355	.1455

Figure A1-5. ICAO Standard Atmosphere Table (Sheet 1 of 2).

ICAO STANDARD ATMOSPHERE TABLE

ALTITUDE IN 100-FOOT INCREMENTS AND $\frac{1}{\sqrt{\sigma}}$

Altitude Feet	$\frac{1}{\sqrt{\sigma}}$	*Altitude Feet*	$\frac{1}{\sqrt{\sigma}}$	*Altitude Feet*	$\frac{1}{\sqrt{\sigma}}$	*Altitude Feet*	$\frac{1}{\sqrt{\sigma}}$	*Altitude Feet*	$\frac{1}{\sqrt{\sigma}}$
100	1.0015	6100	1.0955	12,100	1.2030	18,100	1.3269	24,100	1.4704
200	1.0029	6200	1.0971	12,200	1.2049	18,200	1.3291	24,200	1.4729
300	1.0044	6300	1.0988	12,300	1.2069	18,300	1.3313	24,300	1.4755
400	1.0059	6400	1.1005	12,400	1.2088	18,400	1.3335	24,400	1.4781
500	1.0074	6500	1.1022	12,500	1.2107	18,500	1.3358	24,500	1.4807
600	1.0088	6600	1.1039	12,600	1.2127	18,600	1.3380	24,600	1.4833
700	1.0103	6700	1.1056	12,700	1.2146	18,700	1.3403	24,700	1.4860
800	1.0118	6800	1.1073	12,800	1.2166	18,800	1.3425	24,800	1.4886
900	1.0133	6900	1.1090	12,900	1.2185	18,900	1.3448	24,900	1.4912
1000	1.0148	7000	1.1107	13,000	1.2205	19,000	1.3470	25,000	1.4938
1100	1.0163	7100	1.1124	13,100	1.2224	19,100	1.3493	25,100	1.4965
1200	1.0178	7200	1.1141	13,200	1.2244	19,200	1.3516	25,200	1.4991
1300	1.0193	7300	1.1158	13,300	1.2264	19,300	1.3539	25,300	1.5018
1400	1.0208	7400	1.1175	13,400	1.2284	19,400	1.3561	25,400	1.5045
1500	1.0223	7500	1.1193	13,500	1.2303	19,500	1.3584	25,500	1.5071
1600	1.0238	7600	1.1210	13,600	1.2323	19,600	1.3607	25,600	1.5098
1700	1.0253	7700	1.1227	13,700	1.2343	19,700	1.3630	25,700	1.5125
1800	1.0269	7800	1.1245	13,800	1.2363	19,800	1.3653	25,800	1.5152
1900	1.0284	7900	1.1262	13,900	1.2383	19,900	1.3677	25,900	1.5179
2000	1.0299	8000	1.1279	14,000	1.2403	20,000	1.3700	26,000	1.5206
2100	1.0314	8100	1.1297	14,100	1.2423	20,100	1.3723	26,100	1.5233
2200	1.0330	8200	1.1314	14,200	1.2444	20,200	1.3746	26,200	1.5260
2300	1.0345	8300	1.1332	14,300	1.2464	20,300	1.3770	26,300	1.5287
2400	1.0360	8400	1.1350	14,400	1.2484	20,400	1.3793	26,400	1.5315
2500	1.0376	8500	1.1367	14,500	1.2504	20,500	1.3817	26,500	1.5342
2600	1.0391	8600	1.1385	14,600	1.2525	20,600	1.3840	26,600	1.5370
2700	1.0407	8700	1.1403	14,700	1.2545	20,700	1.3864	26,700	1.5397
2800	1.0422	8800	1.1420	14,800	1.2565	20,800	1.3888	26,800	1.5425
2900	1.0438	8900	1.1438	14,900	1.2586	20,900	1.3911	26,900	1.5453
3000	1.0454	9000	1.1456	15,000	1.2606	21,000	1.3935	27,000	1.5480
3100	1.0469	9100	1.1474	15,100	1.2627	21,100	1.3958	27,100	1.5508
3200	1.0485	9200	1.1492	15,200	1.2648	21,200	1.3983	27,200	1.5536
3300	1.0501	9300	1.1510	15,300	1.2668	21,300	1.4007	27,300	1.5564
3400	1.0516	9400	1.1528	15,400	1.2689	21,400	1.4031	27,400	1.5592
3500	1.0532	9500	1.1546	15,500	1.2710	21,500	1.4055	27,500	1.5620
3600	1.0548	9600	1.1564	15,600	1.2731	21,600	1.4079	27,600	1.5649
3700	1.0564	9700	1.1582	15,700	1.2752	21,700	1.4103	27,700	1.5677
3800	1.0580	9800	1.1600	15,800	1.2773	21,800	1.4128	27,800	1.5705
3900	1.0595	9900	1.1618	15,900	1.2794	21,900	1.4152	27,900	1.5734
4000	1.0611	10,000	1.1637	16,000	1.2815	22,000	1.4176	28,000	1.5762
4100	1.0627	10,100	1.1655	16,100	1.2836	22,100	1.4201	28,100	1.5791
4200	1.0643	10,200	1.1673	16,200	1.2857	22,200	1.4225	28,200	1.5819
4300	1.0659	10,300	1.1692	16,300	1.2878	22,300	1.4250	28,300	1.5848
4400	1.0676	10,400	1.1710	16,400	1.2899	22,400	1.4275	28,400	1.5877
4500	1.0692	10,500	1.1729	16,500	1.2921	22,500	1.4299	28,500	1.5906
4600	1.0708	10,600	1.1747	16,600	1.2942	22,600	1.4324	28,600	1.5935
4700	1.0724	10,700	1.1766	16,700	1.2963	22,700	1.4349	28,700	1.5964
4800	1.0740	10,800	1.1784	16,800	1.2985	22,800	1.4374	28,800	1.5993
4900	1.0757	10,900	1.1803	16,900	1.3006	22,900	1.4399	28,900	1.6022
5000	1.0773	11,000	1.1822	17,000	1.3028	23,000	1.4424	29,000	1.6052
5100	1.0789	11,100	1.1840	17,100	1.3049	23,100	1.4449	29,100	1.6081
5200	1.0806	11,200	1.1859	17,200	1.3071	23,200	1.4474	29,200	1.6110
5300	1.0822	11,300	1.1878	17,300	1.3093	23,300	1.4499	29,300	1.6140
5400	1.0838	11,400	1.1897	17,400	1.3115	23,400	1.4525	29,400	1.6170
5500	1.0855	11,500	1.1916	17,500	1.3136	23,500	1.4550	29,500	1.6199
5600	1.0871	11,600	1.1935	17,600	1.3158	23,600	1.4576	29,600	1.6229
5700	1.0888	11,700	1.1954	17,700	1.3180	23,700	1.4601	29,700	1.6259
5800	1.0905	11,800	1.1973	17,800	1.3202	23,800	1.4627	29,800	1.6289
5900	1.0921	11,900	1.1992	17,900	1.3224	23,900	1.4652	29,900	1.6319
6000	1.0938	12,000	1.2011	18,000	1.3246	24,000	1.4678	30,000	1.6349

Figure A1-5. ICAO Standard Atmosphere Table (Sheet 1 of 2).

TEMPERATURE CONVERSION CHART

SAMPLE PROBLEM

A. AIR TEMPERATURE 60° F
C. AIR TEMPERATURE 18° C

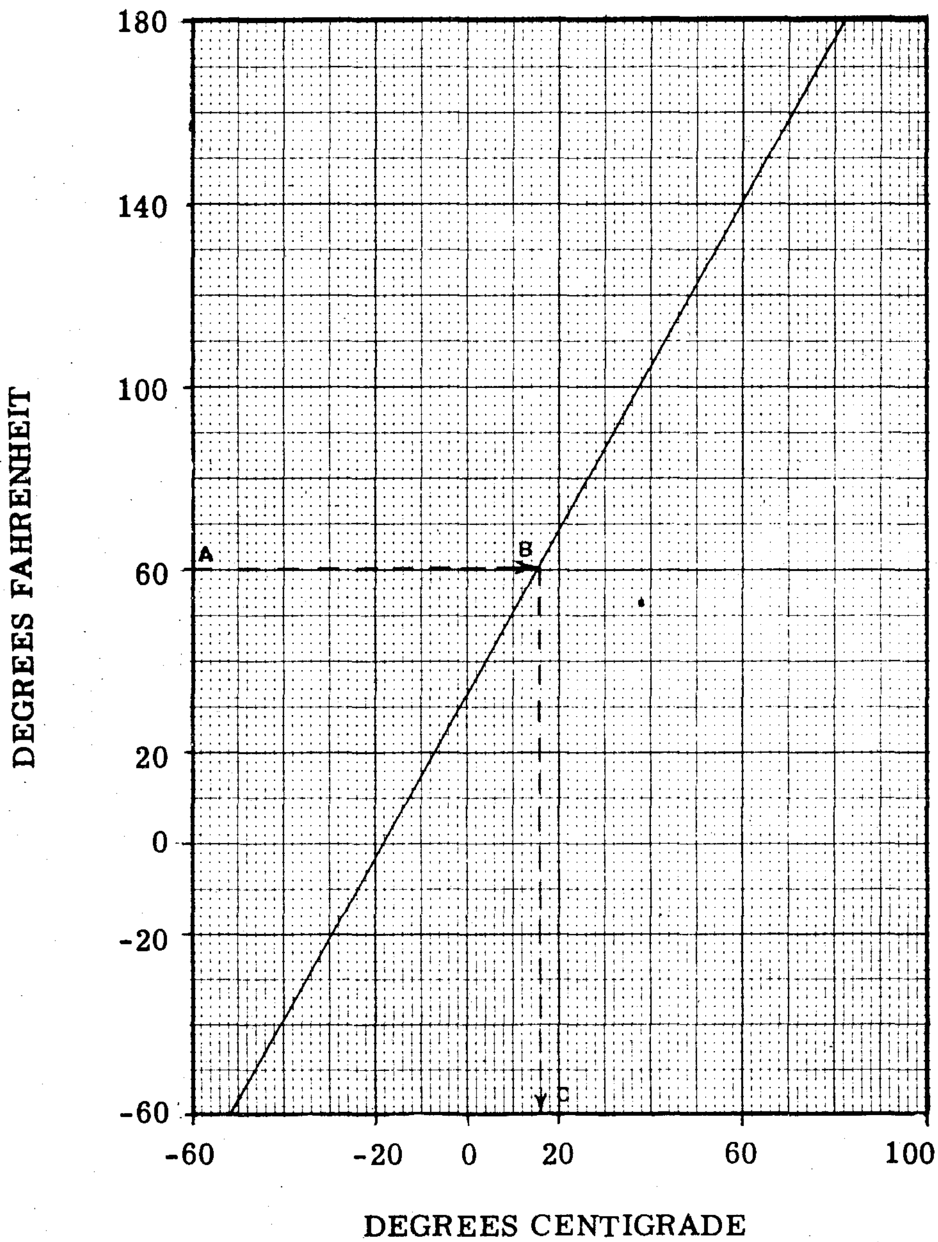


Figure A1-6. Temperature Conversion.

MPH - KNOTS CONVERSION CHART

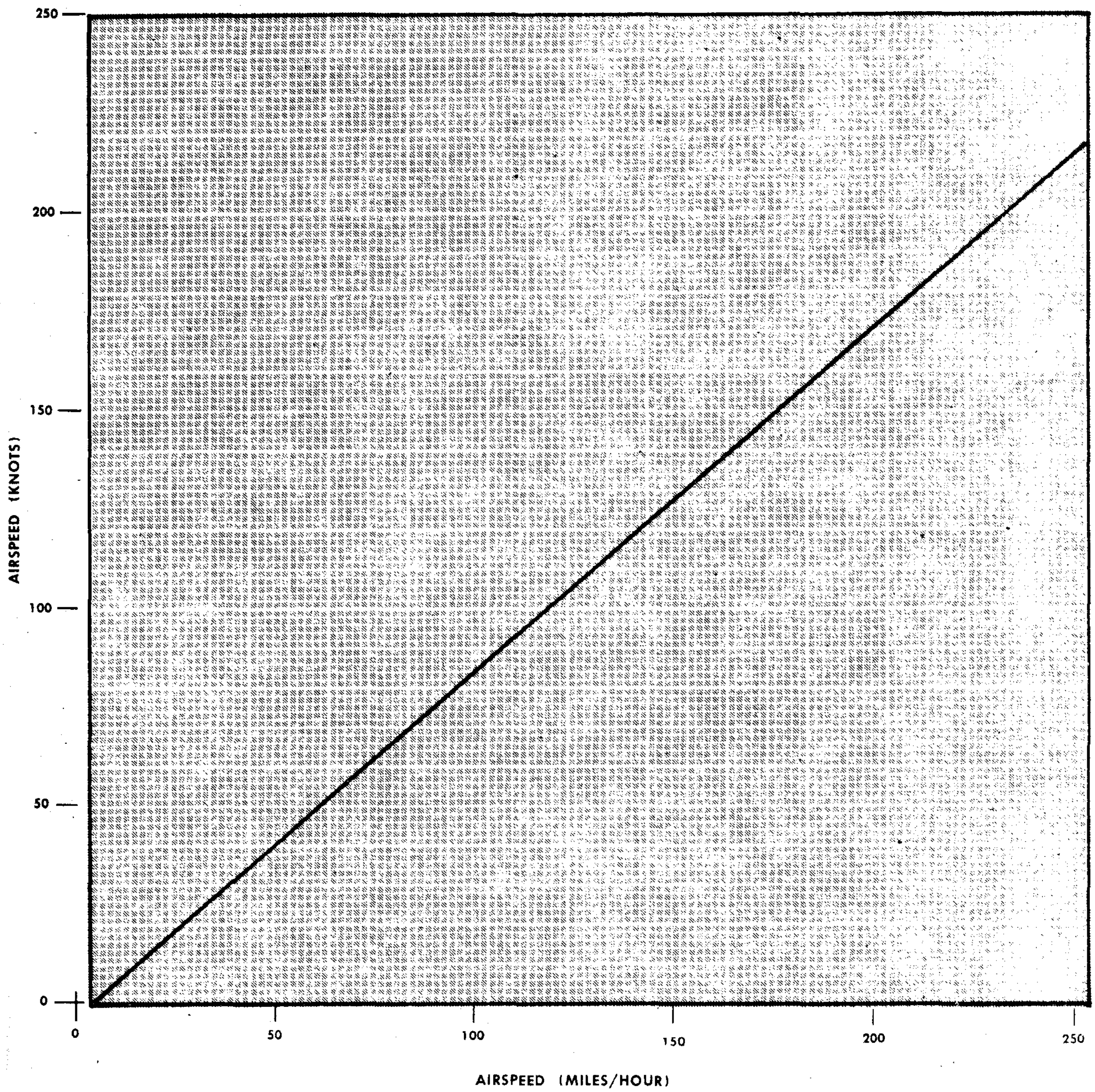


Figure A1-7. MPH - Knots Conversion.

PSYCHROMETRIC CHART

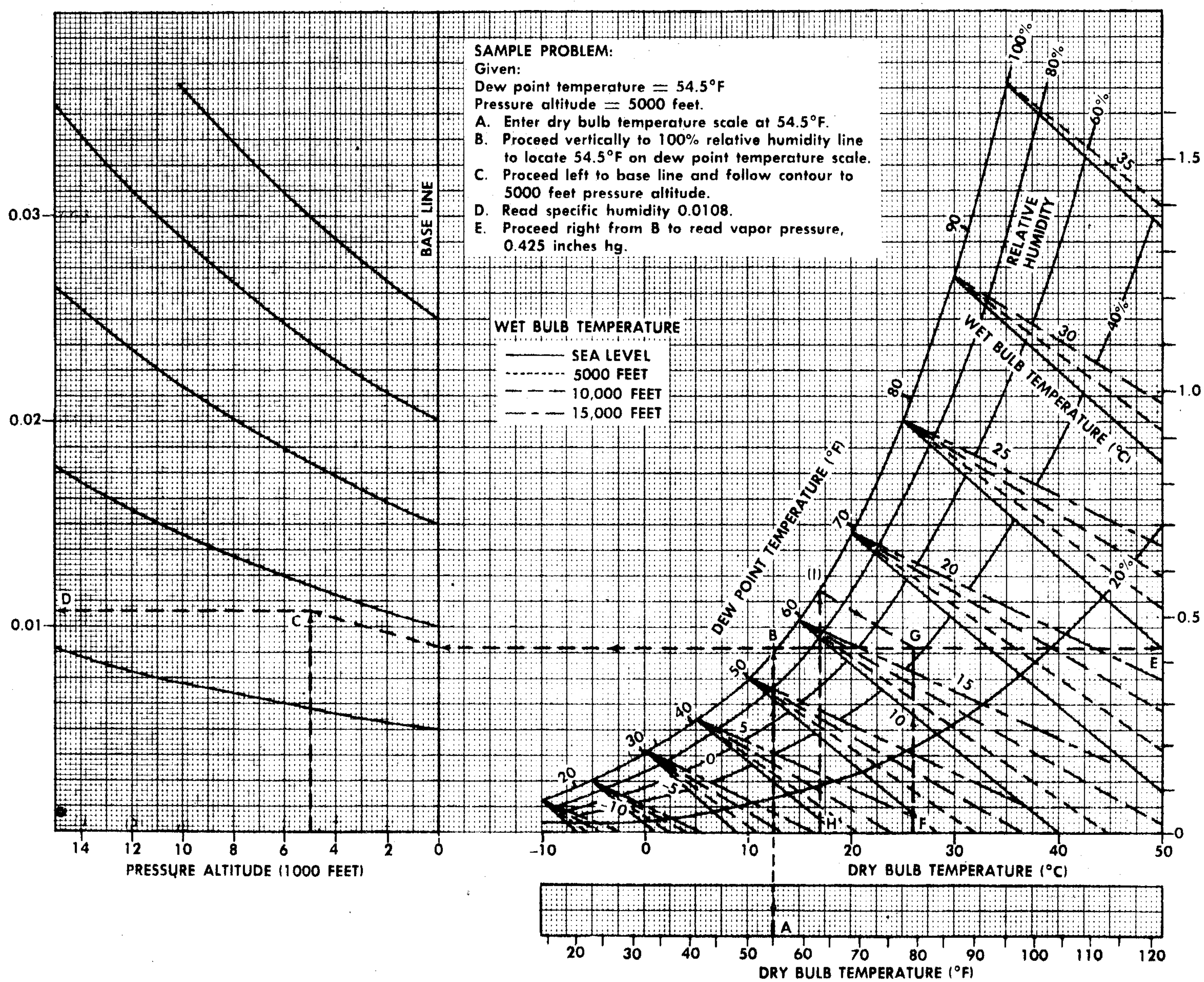


Figure A1-8. Pyschrometric Chart.

FUEL DENSITY TABLE 100/130 AND 115/145 GRADE FUEL		
FUEL TEMPERATURE		FUEL DENSITY
°C	°F	LB/GAL
50	122	5.67
40	104	5.73
30	86	5.80
20	68	5.87
10	50	5.93
0	32	6.00
−10	14	6.07
−20	−4	6.14
−30	−22	6.21
−40	−40	6.27
−50	−58	6.34

Figure A1-9

PART TWO
ENGINE DATA

TABLE OF CONTENTS

LIST OF CHARTS

DISCUSSION OF CHARTS.

Engine characteristics are presented in the engine calibration curve charts (figures A2-12 and A2-13) for the "no ram" condition. Recommended rpm and manifold pressure settings for desired cruising power are given on the constant cruise power setting charts. These settings are based on standard atmospheric conditions.

Manifold pressure (MP) is intake manifold pressure given in inches Hg. absolute (based on zero pressure).

All performance charts specify engine operation with auto rich or auto lean with 100/130 grade fuel.

All flight performance is based on the carburetor air levers remaining in the COLD position. If carburetor heat is applied at a constant manifold pressure, engine power will be decreased because of the higher carburetor air temperature. In addition, the normal air induction system is partially restricted and the carburetor air is taken from a location behind the cylinders. This air, having passed over the engine section, has less ram energy remaining, so that lower manifold pressures will be obtained with a fixed throttle setting.

The power looses attributable to atmospheric conditions may be estimated. The effect of temperature on brake horsepower can be approximated by the following equations, where T_1 and T std are absolute temperatures:

$$\frac{bhp_{std}}{bhpT_1} = \sqrt{\frac{T_2}{T_{std}}}$$ For part throttle constant manifold pressure operation

$$\frac{bhp\ std}{bhpT_1} = \frac{T_1}{T_{std}}$$ For full throttle operation

Absolute temperature = ambient temperature (degrees centigrade) + 273.

The following rules of thumb may be used to quickly approximate the effect of temperature on power:

1. For part throttle, constant manifold pressure operation, a 10°C temperature increase above standard results in approximately 1.7 percent power loss. Similarly, a 10°C temperature decrease below standard results in approximately 1.7 percent power gain.

2. For full throttle operation, a 10°C temperature increase above standard results in approximately 3.5 percent power loss. Similarly, a 10°C temperature decrease below standard results in approximately 3.5 percent power gain.

3. The variation in manifold pressure with temperature in order to maintain constant power is approximately 1/2-inch Hg increase for every 10°C above standard OAT. In order to maintain constant power for cold day cruise operation, the manifold pressure should be decreased approximately 1/2-inch Hg for every 10°C below standard OAT. During take-off under cold temperature conditions, when overpowering is possible, reduce manifold pressure approximately 1 inch Hg for every 10°C below standard OAT.

$$MP_{corr} = MP_{std}\sqrt{\frac{\text{CAT absolute Temperature}}{\text{Std. Absolute Temperature}}}$$

The effect of humidity on engine power output is as follows:

1. Effective pressure and density altitudes are increased because of the presence of vapor pressure.

2. Fuel-air ratio is increased because fuel is metered on total flow through the venturi, and the total flow includes water vapor as well as air.

3. The thermal efficiency of the combustion process is reduced because of the presence of water vapor. The effect of humidity on power output for take-off is shown on figure A2-1.

4. For cruise operation, the bhp loss associated with humidity is normally cancelled out by the gain in bhp due to increased ram effect with airspeed; therefore, although the engine calibration charts are labeled zero ram, data obtained will approximate actual performance.

NOTE

On all charts in the Appendix, the term METO (Maximum Except Take-Off) is substituted for normal rated power and the term MAXIMUM for take-off power.

POWER SETTINGS

Various permissable combinations of manifold pressure, and rpm settings for pressure altitudes from sea level to 20,000 feet and carburetor air temperatures from −20°C to 30°C are presented in the constant cruise power settings charts (figures A2-3B through A2-10), the METO power settings chart (figure A2-2), and the climb power settings chart (figure A2-3). The constant cruise power settings charts are based on auto lean operation and the METO power settings and climb power settings charts are based on auto rich operation. Resultant bhp, and resultant fuel flow in pounds per hour for one engine and for two engines are also indicated on the charts.

CAUTION

If flying conditions in descent require a large reduction in power, reduce rpm as well as manifold pressure. For descents or other low power maneuvers, or prehaps a simulated engine failure, it is important to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure. As a rule of thumb, it is well to remember that each 100 rpm requires at least 1 inch Hg manifold pressure; for example, 23 inches Hg at 2300 rpm. Operation at high rpm and low manifold pressure should be kept to a minimum.

Enter the chart with the given altitude and carburetor air temperature to determine the correct manifold pressure. Without crossing the guide lines, proceed to the right of the chart to obtain the corresponding RPM, and fuel flow.

ENGINE CALIBRATION CURVE

The engine calibration curve charts (figure A2-12 and A2-13) are presented in facing pairs of charts, and provide the necessary information to calculate manifold pressure, brake horsepower, RPM and/or critical altitude (the maximum altitude that may be reached with a given manifold pressure and rpm). A pair of charts is included for both the auto-lean and auto-rich condition.

These charts are the basis for take-off, climb, and cruise data shown throughout the Appendix. They are intended to provide a graphic presentation of the two types of engine power limitations; those imposed by the engine manufacturer to prevent detonation and other effects of overboosting, and those due to the decreasing density of air with increasing altitude. From these charts, power and altitude conditions, not covered in Part 4 CLIMB, or Part 5 RANGE, may be found.

The first chart of each pair (Sheet 1 of 2) shows the variation of BHP with manifold pressure for the range of operating rpm's for sea level calibration.

The second chart (Sheet 2 of 2) shows the variation of BHP and manifold pressure with altitude for operating RPM when maintaining full throttle. On both charts, the upper end of each RPM line is terminated at the BHP limit for that RPM. This altitude is known as the critical altitude for that particular RPM, MP, mixture setting, and atmospheric condition.

The problems which involve the use of operating curves fall generally into one of two types, A– The calculation of BHP, when manifold pressure, RPM, and altitude are known and B– The calculation of manifold pressure, when BHP, RPM and altitude are known.

NOTE

In the interest of clarity sample problem "A" is shown on figure A2-12 and sample problem "B" is shown on figure A2-13. However, both problems can be applied to either chart.

SAMPLE PROBLEM "A":

Given:

1. Manifold pressure = 27.2 in. Hg

2. RPM = 2000

3. Altitude = 9000 feet

To Find:

BRAKE HORSEPOWER

Solution:

1. Locate the intersection of the given RPM and manifold pressure lines on the sea level calibration curve (Point A).

2. Project this intersection (Point A) horizontally to the BHP scale and read 500 BHP (Point B).

3. Enter the altitude calibration curve with this value (Point C).

4. Locate the intersection (Point D) of the full throttle, constant RPM line and the full throttle constant manifold pressure line, corresponding respectively to the given RPM (2000) and manifold pressure (27.2 in. Hg).

5. Connect C and D with a straight line.

6. Locate the intersection of the line CD with the given altitude line – 9000 feet (Point E).

7. Project this intersection horizontally to the BHP axis (Point F). The required BHP is 560.

EXPLANATION:

The engine's sea level BHP at the given combination of RPM and manifold pressure is found from the sea level calibration curve at B. The BHP at the full throttle critical altitude for the same combination is found from the altitude calibration curve at D. The line CD is, therefore, the part throttle, constant RPM, constant manifold pressure line for the given combination of RPM and manifold pressure. The BHP for any altitude between sea level and critical altitude is then determined by the location of the intersection of the given altitude line with the part throttle line, CD.

SAMPLE PROBLEM "B":

Given:

1. Brake horsepower = 750

2. RPM = 2200

3. Altitude = 9000 feet

FIND:

MANIFOLD PRESSURE

Solution:

1. Locate the intersection of the given altitude and BHP lines on the altitude calibration chart (Point A).

2. Select any constant manifold pressure line (33 in Hg) estimated to be close to the required answer, and locate its intersection with the full throttle, constant RPM line corresponding to the given RPM line (Point B).

3. Transfer these values (33 in Hg manifold pressure and 2200 RPM) to the sea level calibration curve, and locate this intersection (Point C).

4. Project this intersection horizontally to the BHP scale and read 730 BHP (Point D).

5. Enter the altitude calibration curve with this value (Point E).

6. Construct line EB.

7. Through Point A draw line FG parallel to line EB.

8. Locate the intersection of line FG and the full throttle constant (2200) RPM line (Point H). The required manifold pressure is 32.2 inches Hg.

EXPLANATION:

Since all part throttle, constant RPM, constant manifold pressure lines are approximately parallel, it follows that, if we determine the slope of one such line, EB, we can draw the corresponding line, FG, through the given BHP–altitude point, A. Inasmuch as manifold pressure is constant at all points on the line, FG, its value may be found at that point, H, where the part throttle, constant RPM, constant manifold pressure line, intersects (or, better, terminates in) the full throttle, constant given RPM line. The more closely we can estimate the desired manifold pressure, the more accurate will be our construction; and in this case experience might have suggested that we use 32 in. Hg for our preliminary estimate of manifold pressure instead of 33 in.

FUEL FLOW PER ENGINE

The fuel flow per engine chart (figure A2-13) is used to determine fuel consumption for various brake horsepower and RPM settings when using either auto lean or auto rich mixture settings. Fuel flow may be determined in either pounds per hour or gallons per hour.

SAMPLE PROBLEM:

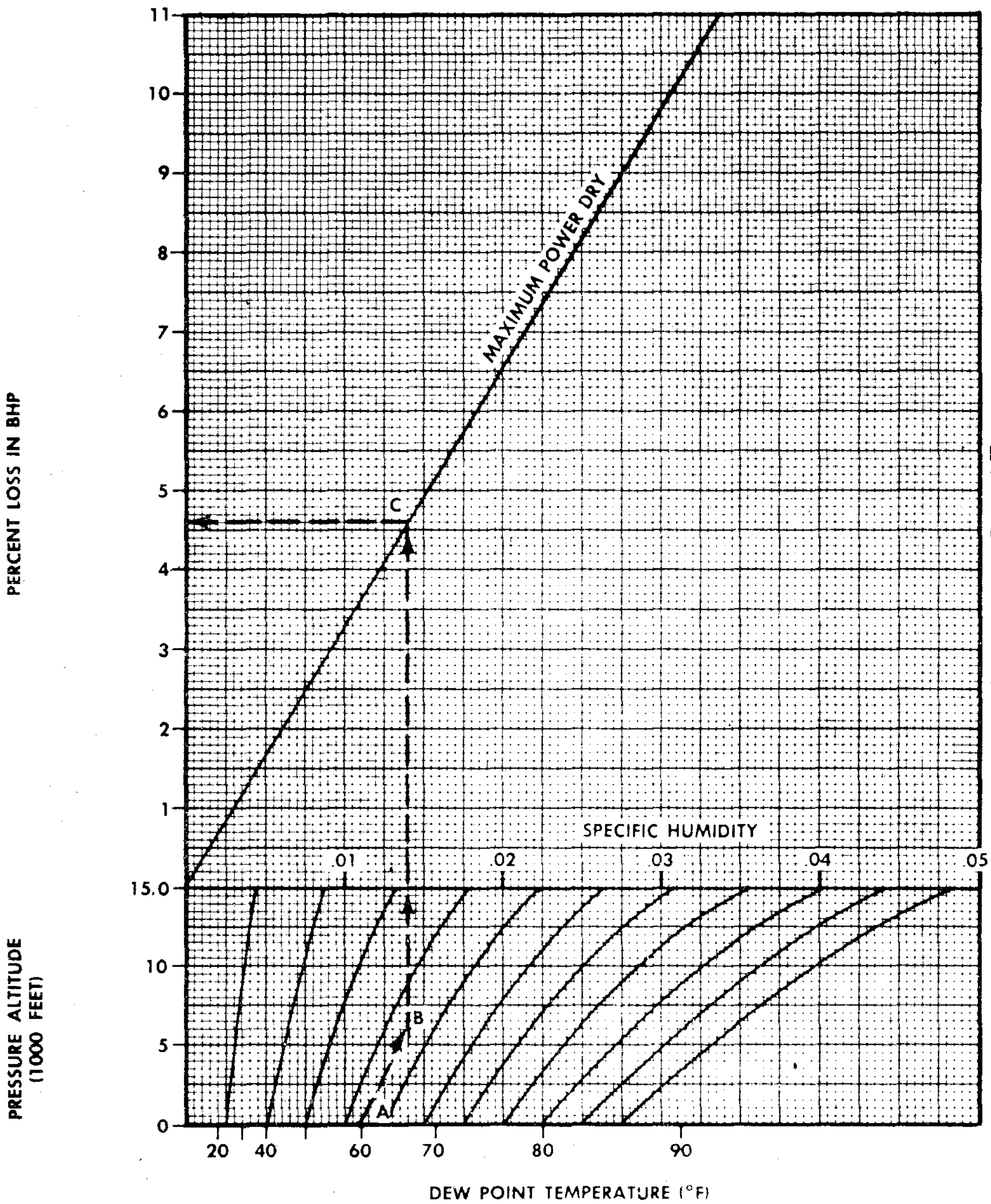
Enter Chart at brake horse power, point A. Project a line vertically to intersect the fuel flow line at a given RPM, point B. Project a line CD horizontally from point B and read fuel flow pounds per hour at point C, and gallons per hour at point D.

EFFECT OF HUMIDITY ON POWER OUTPUT

MODEL: C-47, C-117, AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D, AND -92

SAMPLE PROBLEM:
A. Dew point temperature = 60°F.
B. Pressure altitude = 6000 feet.
C. Effect of humidity on maximum power is a 4.6% loss in power.



Note:
This chart shows the percent loss in BHP for any given manifold pressure. However, it is permissible to regain some of this loss by increasing manifold pressure by an amount equal to the water vapor pressure present in the air, up to a limit of 1.5 inches Hg.

BASED ON: ESTIMATED DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100 130
FUEL DENSITY: 6.0 LB GAL

Figure A2-1. Effect of Humidity on Power Output.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

METO POWER SETTINGS

1050 BRAKE HORSEPOWER PER ENGINE

AUTO RICH

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000									
9,000									
8,000									
7,000	39.4	40.2	40.9						
6,000	39.3	40.1	40.9	41.6	42.3				
5,000	39.5	40.3	41.1	41.8	42.6	43.3			
4,000	39.7	40.5	41.3	42.0	42.8	43.5			
3,000	39.9	40.7	41.5	42.2	43.0	43.7			
2,000	40.0	40.8	41.6	42.3	43.1	43.8	2550	735.00	1470.00
1,000	40.0	40.8	41.6	42.3	43.1	43.8			
0	40.0	40.8	41.6	42.3	43.1	43.8			

Figure A2-2. METO Power Settings.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CLIMB POWER SETTINGS

850 BRAKE HORSEPOWER SETTINGS
AUTO RICH

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000	33.7	34.3							
9,000	33.7	34.4	34.8	35.3	35.7	36.1			
8,000	33.8	34.4	34.8	35.4	35.8	36.2			
7,000	33.8	34.5	34.9	35.5	35.9	36.3	2350	500	1000
6,000	33.8	34.5	34.9	35.6	36.0	36.4			
5,000	33.9	34.6	35.0	35.6	36.0	36.4			
4,000	33.9	34.6	35.0	35.7	36.1	36.5			
3,000	34.0	34.7	35.1	35.8	36.2	36.6			
2,000	34.2	34.7	35.2	35.9	36.3	36.7			
1,000	34.3	34.8	35.3	35.9	36.3	36.7			
0	34.4	34.8	35.4	36.0	36.4	36.8			

Figure A2-3. Climb Power Settings

MODEL: C 47, C 117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

700 BRAKE HORSEPOWER PER ENGINE
AUTO-RICH

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+10°	+20°	+30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000									
9,000	30.4	31.0	31.6						
8,000	30.5	31.1	31.6	32.2	32.8				
7,000	30.6	31.1	31.7	32.3	32.9	33.4			
6,000	30.7	31.3	31.9	32.5	33.1	33.6			
5,000	30.9	31.5	32.1	32.7	33.3	33.8			
4,000	31.0	31.6	32.2	32.8	33.3	33.9	2050	336.00	672.00
3,000	31.2	31.8	32.4	33.0	33.5	34.1			
2,000	31.2	31.8	32.4	33.0	33.6	34.2			
1,000	31.3	31.9	32.5	33.1	33.7	34.3			
0	31.4	32.0	32.6	33.2	33.8	34.4			

Figure A2-3A: Constant Cruise Power Settings 700 Bhp Per Engine

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

640 BRAKE HORSEPOWER PER ENGINE
AUTO-RICH

ENGINE (S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+10°	+20°	+30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000	28.2	28.7	29.3	29.8					
10,000	28.2	28.7	29.3	29.8	30.3	30.8			
9,000	28.4	28.9	29.4	30.0	30.5	31.0			
8,000	28.4	29.0	29.5	30.1	30.6	31.1			
7,000	28.6	29.2	29.7	30.3	30.8	31.3			
6,000	28.7	29.3	29.8	30.4	31.0	31.4	2050	332.50	665.00
5,000	28.8	29.4	29.9	30.5	31.0	31.5			
4,000	28.8	29.4	29.9	30.5	31.0	31.5			
3,000	29.0	29.5	30.1	30.6	31.2	31.7			
2,000	29.2	29.7	30.3	30.8	31.4	31.9			
1,000	29.2	29.8	30.4	30.9	31.5	32.0			
0	29.4	30.0	30.6	31.1	31.7	32.2			

Figure A2-3B. Constant Cruise Power Settings 640 Bhp Per Engine

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

600 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000	27.0	27.6							
12,000	27.1	27.6	28.2	28.7					
11,000	27.2	27.7	28.3	28.8	29.3	29.8			
10,000	27.4	27.9	28.5	29.0	29.5	30.0	2050	265.50	531.00
9,000	29.2	29.8	30.3	29.2	29.7	30.2			
8,000	29.2	29.8	30.3	30.9	31.4	32.0			
7,000	29.2	29.8	30.3	30.9	31.4	32.0			
6,000	29.3	29.9	30.4	31.0	31.5	32.1			
5,000	29.4	29.9	30.5	31.1	31.6	32.1			
4,000	29.5	30.0	30.6	31.2	31.7	32.2	1900	255.00	510.00
3,000	29.5	30.1,	30.7	31.2	31.8	32.3			
2,000	29.7	30.3	30.9	31.4	32.0	32.5			
1,000	29.9	30.5	31.1	31.6	32.2	32.7			
0	30.0	30.6	31.2	31.7	32.3	32.8			

Figure A2-4. Constant Cruise Power Settings, 600 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

550 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000	25.2								
14,000	25.2	25.7	26.2	26.7					
13,000	25.4	25.9	26.3	26.8	27.3	27.7			
12,000	26.9	27.2	26.3	26.8	27.3	27.7	2050	241.90	483.80
11,000	27.1	27.5	27.9	28.3	27.3	27.7			
10,000	28.4	27.6	28.0	28.4	28.7	29.0			
9,000	28.5	29.0	29.5	28.7	28.9	29.2	1900	236.50	473.00
8,000	28.7	29.2	29.5	30.0	30.4	30.7			
7,000	28.8	29.3	29.6	30.1	30.5	30.8			
6,000	28.9	29.5	29.8	30.3	30.6	30.9			
5,000	29.0	29.6	29.9	30.4	30.7	31.0			
4,000	29.1	29.7	30.0	30.5	30.8	31.1	1800	232.65	465.30
3,000	29.3	29.8	30.1	30.6	31.0	31.3			
2,000	29.4	30.0	30.3	30.8	31.1	31.4			
1,000	29.6	30.1	30.4	30.9	31.3	31.6			
0	29.7	30.2	30.5	31.0	31.4	31.7			

Figure A2-5. Constant Cruise Power Settings, 550 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

500 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	-20°	-10°	0°	+10°	+20°	+30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000	23.0	23.5							
16,000	23.0	23.5	23.9	24.4					
15,000	23.2	23.7	24.2	24.6	25.0				
14,000	24.8	25.2	24.4	24.8	25.2	25.7			
13,000	25.0	25.3	25.6	25.9	25.4	25.8	2050	224.20	448.40
12,000	25.9	25.5	25.8	26.1	26.4	26.7			
11,000	26.1	26.5	27.0	26.3	26.7	27.0	1900	219.00	438.00
10,000	27.5	26.6	27.0	27.3	27.5	27.8			
9,000	27.7	28.0	28.5	27.5	27.9	28.2	1800	215.00	430.00
8,000	27.9	28.4	28.7	29.1	29.5	29.8			
7,000	28.0	28.5	28.9	29.3	29.6	29.9			
6,000	28.2	28.6	29.0	29.4	29.8	30.1			
5,000	28.3	28.7	29.2	29.6	29.9	30.2			
4,000	28.4	28.8	29.3	29.8	30.0	30.3	1700	210.00	420.00
3,000	28.5	28.9	29.4	29.9	30.2	30.5			
2,000	28.7	29.1	29.6	30.0	30.4	30.7			
1,000	28.8	29.2	29.7	30.2	30.5	30.8			
0	28.9	29.4	29.8	30.3	30.7	31.0			

Figure A2-6. Constant Cruise Power Settings, 500 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

450 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000	20.9								
19,000	21.0	21.4	21.8						
18,000	21.0	21.4	21.9	22.3	22.6				
17,000	22.5	21.7	22.1	22.5	22.9	23.3			
16,000	22.5	23.0	23.4	22.6	23.0	23.4	2050	202.50	405.00
15,000	22.8	23.3	23.4	23.8	24.0	24.3			
14,000	23.8	24.2	23.6	23.8	24.3	24.5	1900	199.80	399.60
13,000	24.0	24.3	24.5	24.8	25.3	25.6			
12,000	25.0	25.5	24.6	25.0	25.3	25.6	1800	197.55	395.10
11,000	25.1	25.5	25.9	26.3	25.5	25.8			
10,000	25.4	25.7	26.0	26.3	26.5	26.8			
9,000	25.5	25.8	26.3	26.5	26.9	27.1			
8,000	25.5	25.8	26.3	26.7	26.9	27.1			
7,000	25.7	26.0	26.4	26.9	27.1	27.4			
6,000	25.9	26.2	26.6	27.1	27.3	27.6			
5,000	26.1	26.3	26.8	27.2	27.5	27.8	1700	193.50	387.00
4,000	26.3	26.5	27.0	27.4	27.7	28.0			
3,000	26.4	26.7	27.2	27.6	27.9	28.2			
2,000	26.6	27.0	27.4	27.8	28.1	28.4			
1,000	26.7	27.2	27.6	27.9	28.2	28.5			
0	26.9	27.4	27.8	28.1	28.4	28.7			

Figure A2-7. Constant Cruise Power Settings, 450 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

400 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000	22.5	22.0	22.2	22.4	22.8	23.2	1800	184.00	368.00
14,000	22.8	23.1	23.4	23.7	23.0	23.4			
13,000	22.8	23.2	23.7	23.9	24.3	24.5			
12,000	23.0	23.5	23.8	24.2	24.4	24.6			
11,000	23.1	23.6	23.9	24.3	24.5	24.7			
10,000	23.3	23.7	24.0	24.3	24.6	24.9			
9,000	23.4	23.7	24.1	24.4	24.7	25.0	1700	177.50	355.00
8,000	23.5	23.8	24.3	24.4	24.8	25.1			
7,000	23.6	24.0	24.4	24.6	24.9	25.2			
6,000	23.8	24.1	24.5	24.8	25.1	25.4			
5,000	23.9	24.3	24.6	25.0	25.3	25.6			
4,000	24.0	24.4	24.8	25.2	25.5	25.8			
3,000	24.2	24.6	24.9	25.4	25.7	26.0			
2,000	24.4	24.8	25.1	25.5	25.9	26.3			
1,000	24.6	25.0	25.3	25.7	26.1	26.5			
0	24.8	25.3	25.5	25.8	26.3	26.8			

Figure A2-8. Constant Cruise Power Settings, 400 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

350 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000	21.1	21.4	21.7	22.0	22.2	22.4			
9,000	21.3	21.6	21.9	22.2	22.4	22.6			
8,000	21.4	21.7	22.0	22.3	22.5	22.7			
7,000	21.6	21.9	22.2	22.5	22.7	22.9	1700	158.50	317.00
6,000	21.7	22.0	22.3	22.6	22.8	23.0			
5,000	21.9	22.2	22.5	22.8	23.0	23.2			
4,000	22.0	22.3	22.6	22.9	23.1	23.3			
3,000	22.2	22.6	22.9	23.1	23.4	23.7			
2,000	22.4	22.8	23.1	23.4	23.6	23.8			
1,000	22.6	23.1	23.4	23.6	23.9	24.1			
0	22.8	23.3	23.6	23.8	24.1	24.4			

Figure A2-9. Constant Cruise Power Settings, 350 Bhp Per Engine.

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962

CONSTANT CRUISE POWER SETTINGS

300 BRAKE HORSEPOWER PER ENGINE

AUTO LEAN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

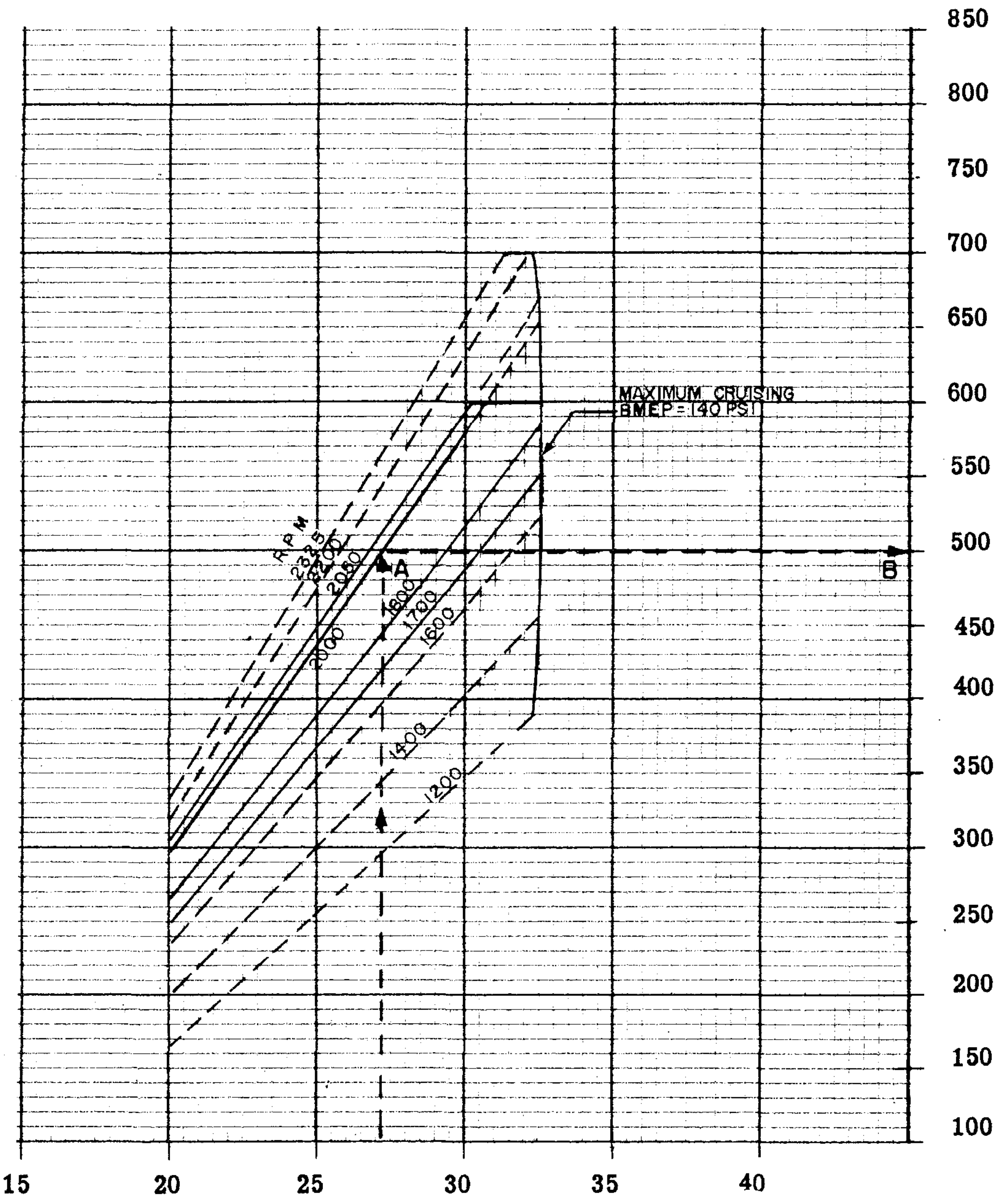
PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. Hg) AT CARBURETOR AIR TEMPERATURE (°C)						RPM	FUEL FLOW LB/HR	
	- 20°	- 10°	0°	+ 10°	+ 20°	+ 30°		PER ENG	2 ENG
20,000									
19,000									
18,000									
17,000									
16,000									
15,000									
14,000									
13,000									
12,000									
11,000									
10,000	18.8	19.2	19.4	19.6	19.9	20.2			
9,000	19.0	19.3	19.6	19.8	20.1	20.3	1700	142.00	284.00
8,000	19.2	19.5	19.8	20.0	20.3	20.6			
7,000	19.4	19.7	19.9	20.2	20.5	20.8			
6,000	19.6	19.9	20.1	20.5	20.7	20.9			
5,000	19.8	20.0	20.2	20.7	20.9	21.1			
4,000	20.0	20.2	20.4	20.9	21.1	21.3			
3,000	20.2	20.5	20.7	21.1	21.3	21.5			
2,000	20.4	20.7	20.95	21.3	21.5	21.7			
1,000	20.6	21.0	21.2	21.5	21.7	21.9			
0	20.8	21.2	21.5	21.7	21.9	22.1			

Figure A2-10. Constant Cruise Power Settings, 300 Bhp Per Engine.

ENGINE CALIBRATION CURVE
AUTO-LEAN
SEA LEVEL CALIBRATION

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962



FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

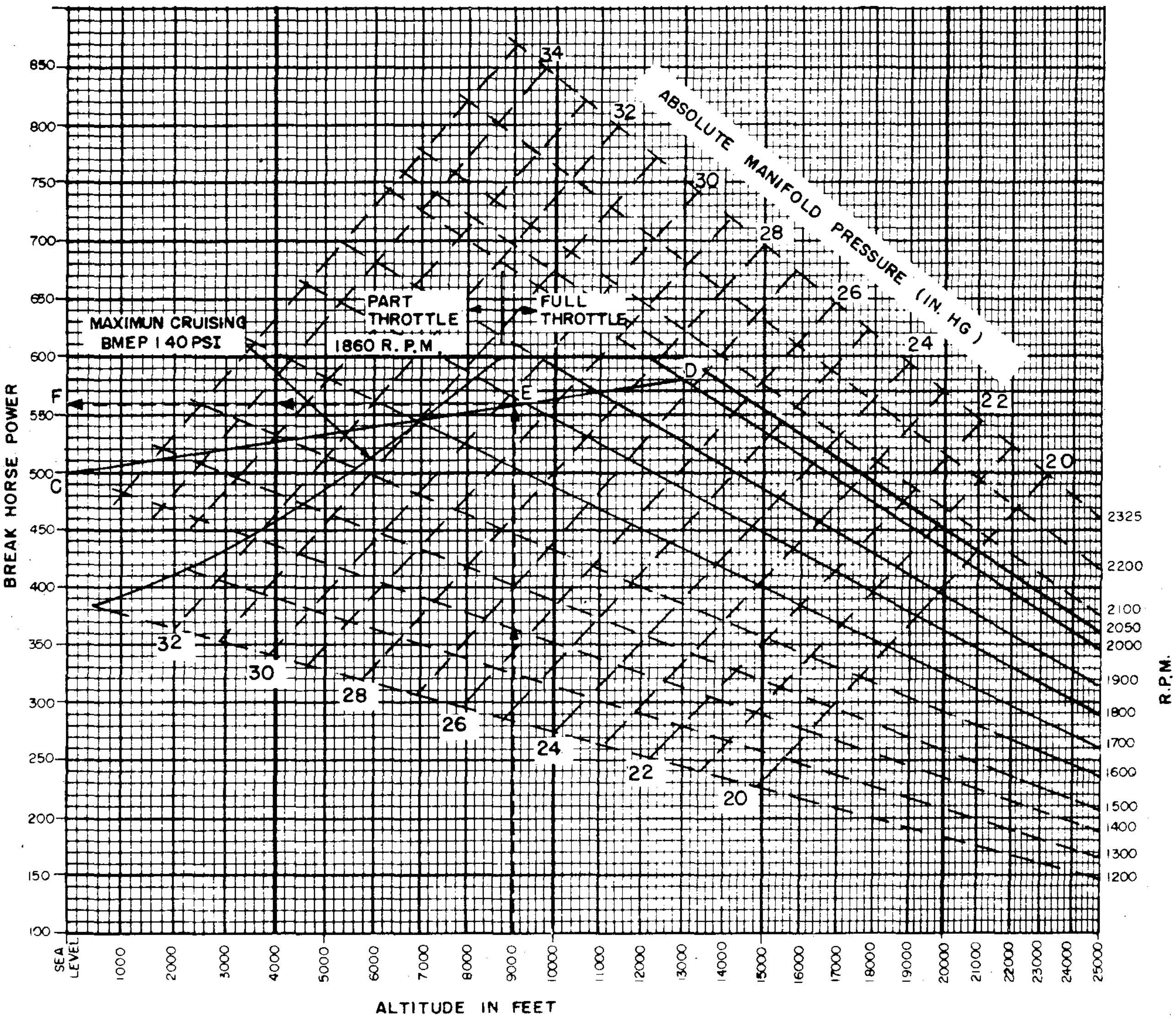
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE
-90D AND -92

Figure A2-11. Engine Calibration Curve - Auto Lean (Sheet 1 of 2).

ENGINE ALTITUDE CALIBRATION CURVE
AUTO-LEAN
WITHOUT RAM
NACA STANDARD DAY

MODEL: C-47, C-117 AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962



FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAl

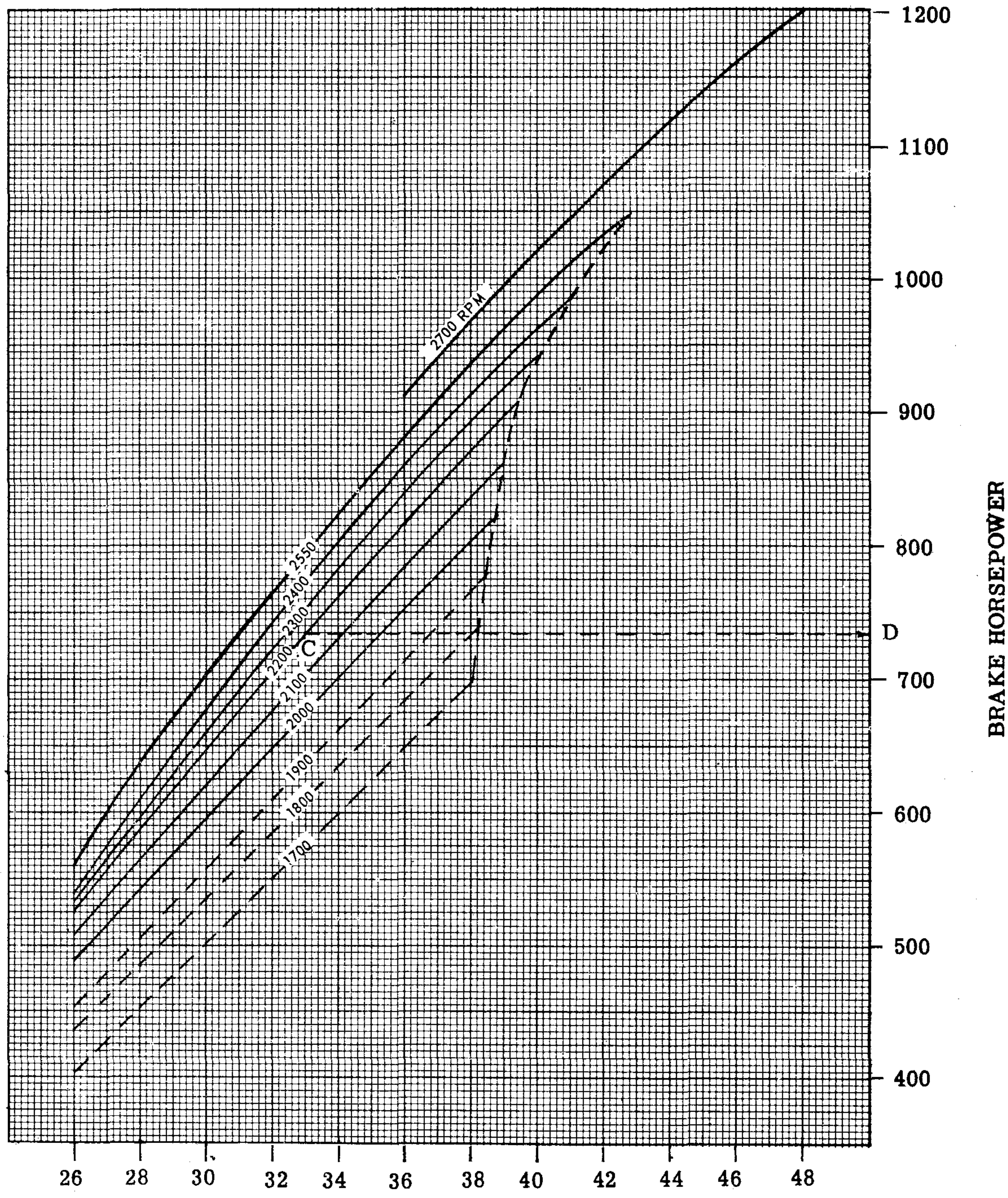
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE
-90D AND -92

Figure A2-11. Engine Calibration Curve - Auto Lean (Sheet 2 of 2).

ENGINE CALIBRATION CURVE

MODEL: C-47, C-117
AND R4D

AUTO-RICH
SEA LEVEL CALIBRATION



ENGINE (S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

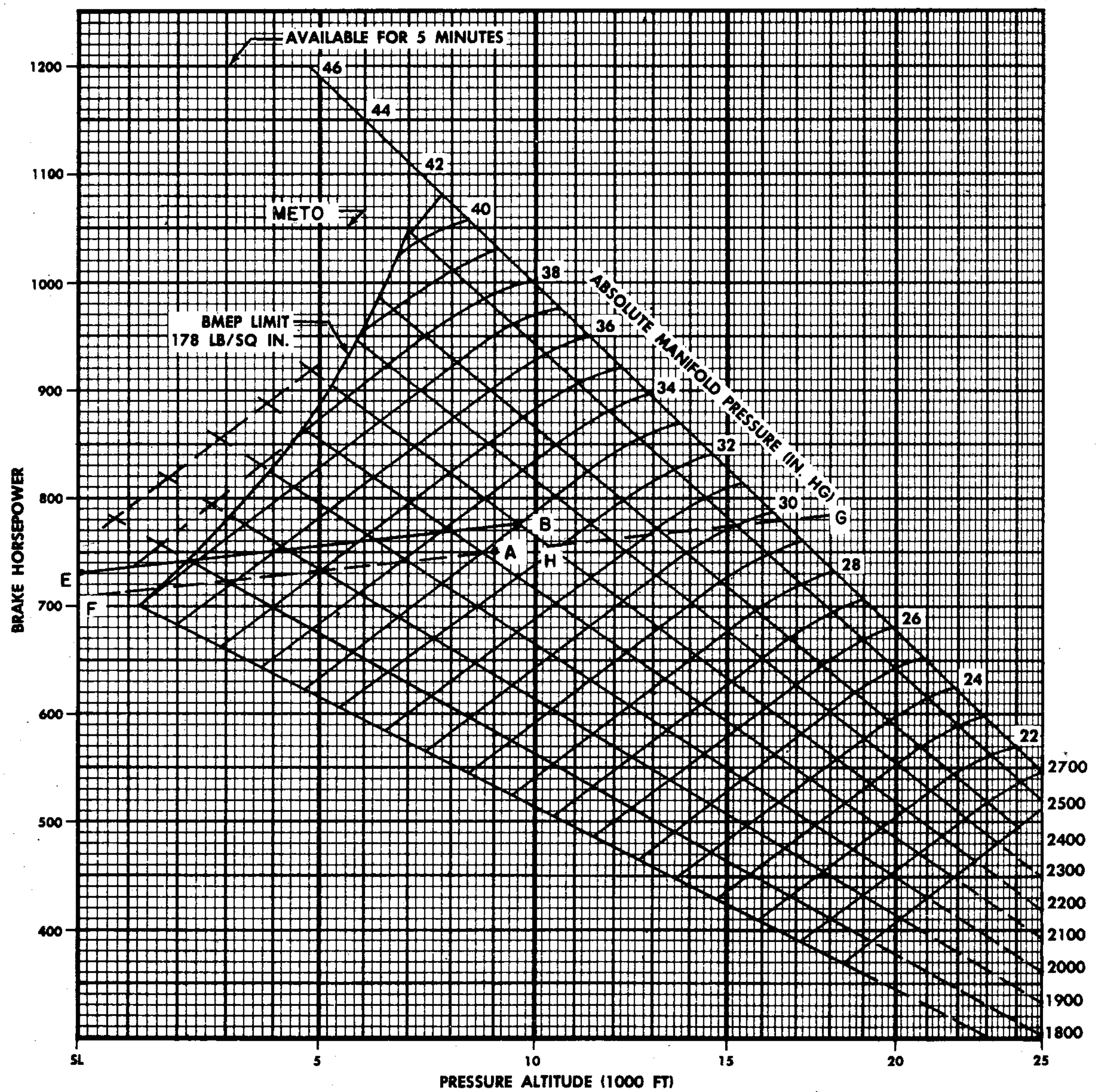
Figure A2-12. Engine Calibration Curve-Auto Rich (Sheet 1 of 2)

ENGINE ALTITUDE CALIBRATION CURVE

AUTO-RICH
WITHOUT RAM
NACA STANDARD DAY

MODEL: C-47, C-117
AND R4D

BASED ON P & W INST 72
DATA AS OF: 25 OCTOBER 1962



ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

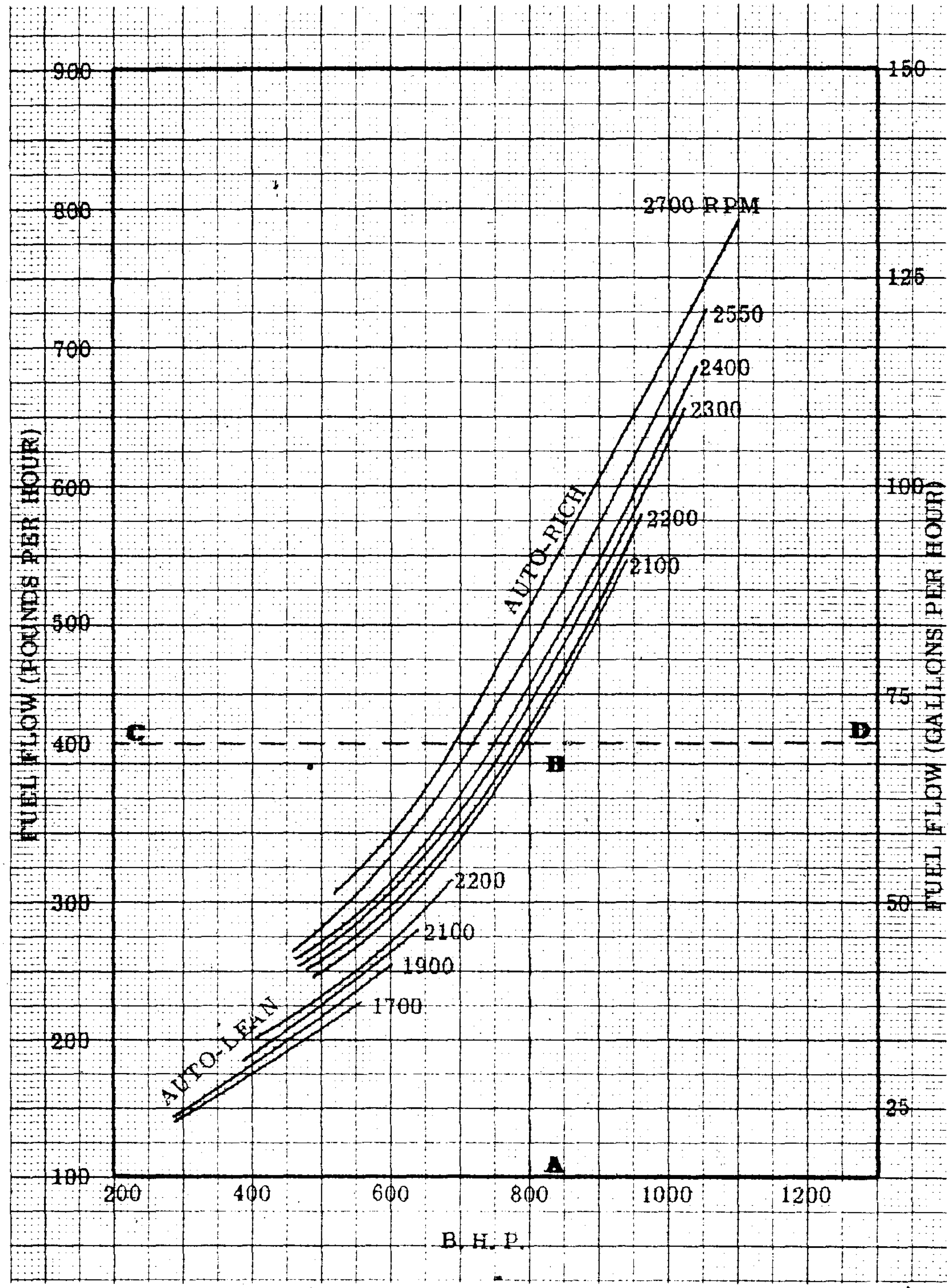
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A2-12. Engine Calibration Curve - Auto Rich (Sheet 2 of 2).

FUEL FLOW PER ENGINE

MODEL: C-47, C-117
AND R4D

BASED ON P&W INST 72
DATA AS OF: 25 OCT 62



FUEL GRADE: 100/130
FUEL DENSITY: 6 0 LB/GAL

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

Figure A2-13. Fuel Flow Per Engine.

PART THREE
TAKE - OFF

TABLE OF CONTENTS

LIST OF CHARTS

DISCUSSION OF CHARTS.

INTRODUCTION.

The take-off and climbout charts are presented for various gross weights and altitudes for standard atmospheric conditions. Headwind, runway surface condition, specific humidity, and nonstandard temperatures may be taken into account by use of the correction plots. A runway slope correction chart is also included.

Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid. This allows a safety margin for fluctuation of wind velocity. It is assumed that the wind velocity is measured at a height of 50 feet above the ground. Allowance is made for wind gradient from 50 feet down to the approximate height of the aircraft on the ground, where the wind velocity is slightly reduced.

The engine manufacturer's limiting maximum brake horsepower of 1200 is observed. The take-off and climbout performance charts are discussed in detail in the following paragraphs.

MAXIMUM TAKE-OFF GROSS WEIGHT.

Safe operation of the aircraft requires that take-offs not be attempted at gross weights for which acceleration, rate-of-climb, or obstacle clearance capability are marginal. There are four primary factors which must be considered when determining a safe limit for the take-off gross weight.

1. The ability of the structure to withstand taxiing loads and inflight maneuvering loads are shown as design take-off gross weights in the weight limitations chart (figure 5-2).

2. The ability to take off within the available runway is shown on the take-off performance chart (figure A3-11).

3. The ability to have adequate rate of climb when airborne is shown on the take-off gross weight limited by single-engine climb performance chart (figure A3-1).

4. The ability to clear obstacles within the take-off corridor is shown on the take-off path chart (figure A3-13).

For a given set of take-off conditions, each of these four considerations will permit a different gross weight. Any one of the four weights may be the lowest, depending on the conditions. For this reason, all four factors must be considered for each take-off, even though in many cases one or more of them may be eliminated after cursory examination. The lowest weight determined by these factors will be the maximum take-off gross weight.

TAKE-OFF GROSS WEIGHT LIMITED BY SINGLE-ENGINE CLIMB PERFORMANCE.

This chart (figure A3-1), based on one engine operating at maximum power, cowl flaps trail position, wing flaps up, landing gear up, and propeller on inoperative engine feathered, shows the maximum gross weights at which a 100 FPM rate of climb may be maintained for single-engine operation for various altitudes. For structural gross weight limitations, refer to figure 5-2 in Section V.

SAMPLE PROBLEM:

Given

1. Outside Air Temperature = 20°C (Point A)
2. Pressure Altitude = 2000 feet (Point B)
3. No Ski Configuration (Point C)

Find:

1. Maximum gross weight for 100 feet per minute single - engine rate of climb = 30200 pounds (Point D)

TAKE-OFF GROUND RUN DISTANCE CHARTS

The Take-Off Ground Run Charts (figure A3-2 through A3-8) are provided for several aircraft configurations, to determine the take-off ground run distance at various field altitudes, outside air temperatures, specific humidities, and gross weights, corrected for wind and runway surface conditions. The effect of runway slope on take-off ground run may be determined from the runway slope correction chart (figure A3-10).

SAMPLE PROBLEM:

A. Outside Air Temperature - 10°C

B. Pressure Altitude - 2000 feet

C. Base Line

D. Specific Humidity - .015

E. Gross Weight - 27000 pounds

F. Base Line

G. Reported Headwind - 20 knots.

H. Base Line and Take-off ground Run Distance Hard Surface Runway - 1350 feet.

I. Runway Surface - Sod.

J. Take-off Ground Roll-1550 feet.

TAKE-OFF PERFORMANCE – SPEED DURING GROUND RUN

The take-off performance – speed during ground run chart (figure A3-9) is based on the average acceleration characteristics of the aircraft during the take-off ground run with both engines operating at maximum power. Each line gives a particular relationship of indicated speed to the distance from the start of the take-off run for various aircraft configurations. The configuration of the aircraft is accounted for by entering the chart with the take-off ground run distance from the appropriate take-off ground run chart corrected for run way slope. Speed is obtained from the characteristic take-off speed chart. In this way the appropriate contour is located. This chart is also used to determine refusal distance.

Sample Problem:

Given:

1. Takeoff gross weight = 27,000 pounds, wing flaps - up, without skis or JATO.
2. Outside air temperature = 10 °C, pressure altitude = 2,000 feet, specific humidity = .015, reported headwind = 20 knots, reported headwind = 20 knots, effective headwind 10 knots, runway length = 2,500 feet, runway surface = sod.

Find:
Indicated airspeed at 1,000 feet of take-off run.

1. From Figure A3-2, determine that ground run distance = 1550 feet.
2. From Figure A3-14, determine that indicated airspeed at lift off - 74.5 knots.
3. Correct lift-off speed to ground speed = lift-off speed - reported headwind (+ reported tailwind) = 74.5-20 = 54.5 KIAS.
4. Enter chart at 1550 feet (point A) and 54.5 knots (point B) to determine contour line (point C).
5. Enter chart at desired distance, 1,000 feet (point D).
6. Extend line horizontally until it intersects the predetermined contour line (point E).
7. Extend a line vertically from point E to the indicated airspeed scale (point F) and read the ground speed (43.7 knots) to be attained at 1,000 feet of the takeoff run.
8. Correct ground speed to KIAS = ground speed + reported headwind (- reported tailwind) = 43.7 + 20 = 63.7 KIAS to be attained at 1,000 feet of the takeoff run.

Refusal Distance

Sample Problem:

Given:

1. Takeoff gross weight = 27,000 pounds, wing flaps - up, without skis or JATO.
2. Outside air temperature = 10 °C, pressure altitude = 2,000 feet, specific humidity = .015, reported headwind = 20 knots, effective headwind = 10 knots, runway length = 2,500 feet, runway surface sod.

Find:

1. Determine contour line using the above method.
2. Using Figure A3-11, determine the refusal speed (65 KIAS).
3. Correct refusal speed to ground speed = refusal speed - reported headwind (+ reported tailwind) = 65-20 = 45 KIAS.
4. Using this ground speed (45 KIAS), enter chart (point G).
5. Draw a line vertically to the predetermined contour line (point H).
6. Draw a line horizontally from point H to the distance scale (point J) and read the refusal distance, 1050 feet.

RUNWAY SLOPE CORRECTION

This chart (figure A3-10) is to be used to correct data obtained from the Ground Run charts (figure A3-2 through A3-8) when runways have other than zero slopes.

SAMPLE PROBLEM:

A. For Zero Runway Slope: Take-off Ground

Run Distance = 1350 feet.

B. Correction For Runway Slope of .005 (5 feet rise per 1000 feet of runway).

C. Take-off Ground Run Distance - 1400 feet.

TAKE-OFF PERFORMANCE – REFUSAL SPEED

The refusal speed as shown on this chart (figure A3-11) is the maximum speed which may be reached, accelerating from a standstill with two engines operating at maximum power, and from which a stop may be made within a given runway length. This chart is based on a dry, hard surface runway and includes correction grids for outside air temperature, pressure altitude, specific humidity, wind component and gross weight. In addition, a three second time delay after reaching refusal speed is allowed before cutting the engines and applying the brakes. Refusal speeds are given in indicated airspeeds. Refusal speeds above take-off speeds are not shown.

Enter the chart with outside air temperature (point A). Draw a line horizontally from Point A to the pressure altitude line (point B). Draw a vertical line from Point B to the specific humidity base line (Point C) and a line parallel to the contour line from Point C to the given specific humidity (Point D). Then enter chart at the given runway length (Point E) and draw a horizontal line to intersect the base line (Point F). From Point F, draw a line following the trend of the contour lines until it intersects a vertical line drawn from Point D. This intersection is (Point G). From Point G, draw a horizontal line to the zero wind line (Point H). From Point H, draw a line following the trend of the contour lines, to the given wind component (Point I). Then enter chart at given gross weight (Point J) and draw a vertical line to intersect a horizontal line drawn from Point I. This intersection (Point K) is the refusal speed.

DISTANCE TO STOP – ABORTED TAKE-OFF CHART

The distance to stop - - aborted take-off chart (figure A3-12) provides the distance required to stop from any indicated speed up to the highest take-off speed at altitudes from sea level to 16000 feet. The stopping curves assume windmilling propellers and a take-off wing flap deflection of zero degrees. No runway slope correction has been included. See the characteristic take-off speeds chart (figure A3-14) for the recommended take-off speed.

SAMPLE PROBLEM:

A. Indicated Airspeed = 40 knots.

B. Pressure Altitude = 4000 feet.

C. Gross Weight = 27000 Pounds.

D. Stopping Distance = 650 feet.

TAKE-OFF ABORT CRITERIA

Due to the take-off characteristics of C-47 aircraft, the abort criteria is based on refusal speed and refusal distance. The refusal speed is determined from the take-off performance – refusal speed chart (figure A3-11) and is based on temperature, pressure altitude, specific humidity, runway length, wind component and gross weight. The refusal distance is obtained from the take-off performance speed during ground run chart (figure A3-9).

TAKE-OFF PATH

A take-off path - - chart (figure A3-13) is included for a two-engine take-off climb with a wing flap deflection of zero degrees. This curve is presented to enable study of terrain or obstacle clearance problems peculiar to various airfields.

The flight path chart gives relationship between height attained above the runway surface and horizontal distance traveled from the start of the take-off roll. Each curve is for a specified two-engine take-off distance over a 50-foot height. This curve can be used for the various combinations of gross weight, altitudes, and atmospheric conditions that result in the given take-off distance. It is for this reason that gross weight and altitude do not appear explicitly.

This chart was prepared assuming a constant acceleration to 95 knots; zero degree flaps. Landing gear retraction is initiated at take-off and requires approximately 7 seconds to be completed. The drag of the fully extended landing gear is assumed to exist until the landing gear is completely retracted. The flight path chart terminates at a height of 400 feet. In no case is the 5-minute maximum power limit exceeded.

For a known obstacle height and location (distance from start of take-off roll), the flight path chart can be used to read the take-off distance over a 50-foot height for a zero wind, zero runway slope, and hard surface runway condition.

SAMPLE PROBLEM:

Given:

1. Headwind Component = 20 Knots (Point A)
2. Distance of Obstacle From Start of Take-off Roll = 4000 Feet (Point B).
3. Obstacle Height = 100 Feet (Point C)

Find:

1. Gear Down Take-off Distance Over a 50-Foot height = 5500 Feet (Point D)
2. Ground Roll Distance to Lift Off $= \frac{5500}{1.95} =$ 2820 Ft.

Enter chart with given headwind component (Point A). Draw a horizontal line from Point A to the given obstacle distance contour line (Point B) (distance from start of take-off run). Then enter chart at obstacle height (Point C) and draw a horizontal line from Point C to intersect a vertical line drawn from Point B. This intersection is Point D and is the gear down take-off distance to clear a 50-foot height with zero wind and zero runway slope. Divide this distance by 1.95 (ratio of distance over a 50-foot obstacle to take-off ground roll distance) to obtain the ground roll distance with zero wind, zero runway slope and hard surface runway. Using given outside air temperature, pressure altitude and specific humidity determine density altitude. Using the above derived ground roll distance, enter takeoff ground roll distance chart through the ground roll scale. Draw a vertical line from this point until it intersects a horizontal line drawn from the predetermined density altitude. This intersection indicates the maximum gross weight which will allow a take-off over the given obstacle under the given conditions.

CHARACTERISTIC TAKE-OFF SPEED CHART

The characteristic take-off speeds chart (figure A3-14), presents lift off speeds (1.1Vs) for zero and 1/4 wing flap settings for the range of probable take-off gross weights.

SAMPLE PROBLEM:

Given:

1. Gross weight = 25,550 Pounds (Point A)
2. Wing Flap Setting = Zero (Point B)

Find:

1. Lift-off Speed=72.2 Knots (Point C)

TAKE-OFF AND LANDING CROSS-WIND CHART.

The minimum touchdown or lift-off speed, under cross-wind conditions, may be determined by reference to the take-off and landing cross-wind chart (figure A3-15). A diagonal line (recommended touchdown or lift-off speed) indicates the minimum speed at which directional control can be maintained with the use of rudder ONLY for various combinations of aircraft and cross-wind velocities. If take-off or touchdown is accomplished at a speed less than recommended, the aircraft will turn into the wind, tending to veer off the runway.

After obtaining the runway heading and existing surface winds, compute the wind angle relative to the runway. Using the wind angle, enter the chart at zero headwind and zero cross-wind component. Proceed parallel with the appropriate wind angle line (as determined by interpolation) to the appropriate wind velocity curve (Point A). From Point A project a line vertically to the diagonal line and from the diagonal line horizontally to the speed scale (Point B), and read the minimum touchdown or lift-off speed. If the speed as determined from figure A3-14 is less than the speed shown at Point B, the speed shown at Point B should be used for takeoff or touchdown. If the speed as determined from figure A3-14 is greater than the speed shown at Point B, the speed as determined from figure A3-14 should be used for takeoff or touchdown.

The headwind component can be determined by projecting a line from Point A horizontally to the headwind component scale (Point C). The cross-wind component can be determined by projecting a line vertically from Point A to the cross-wind component scale (Point D).

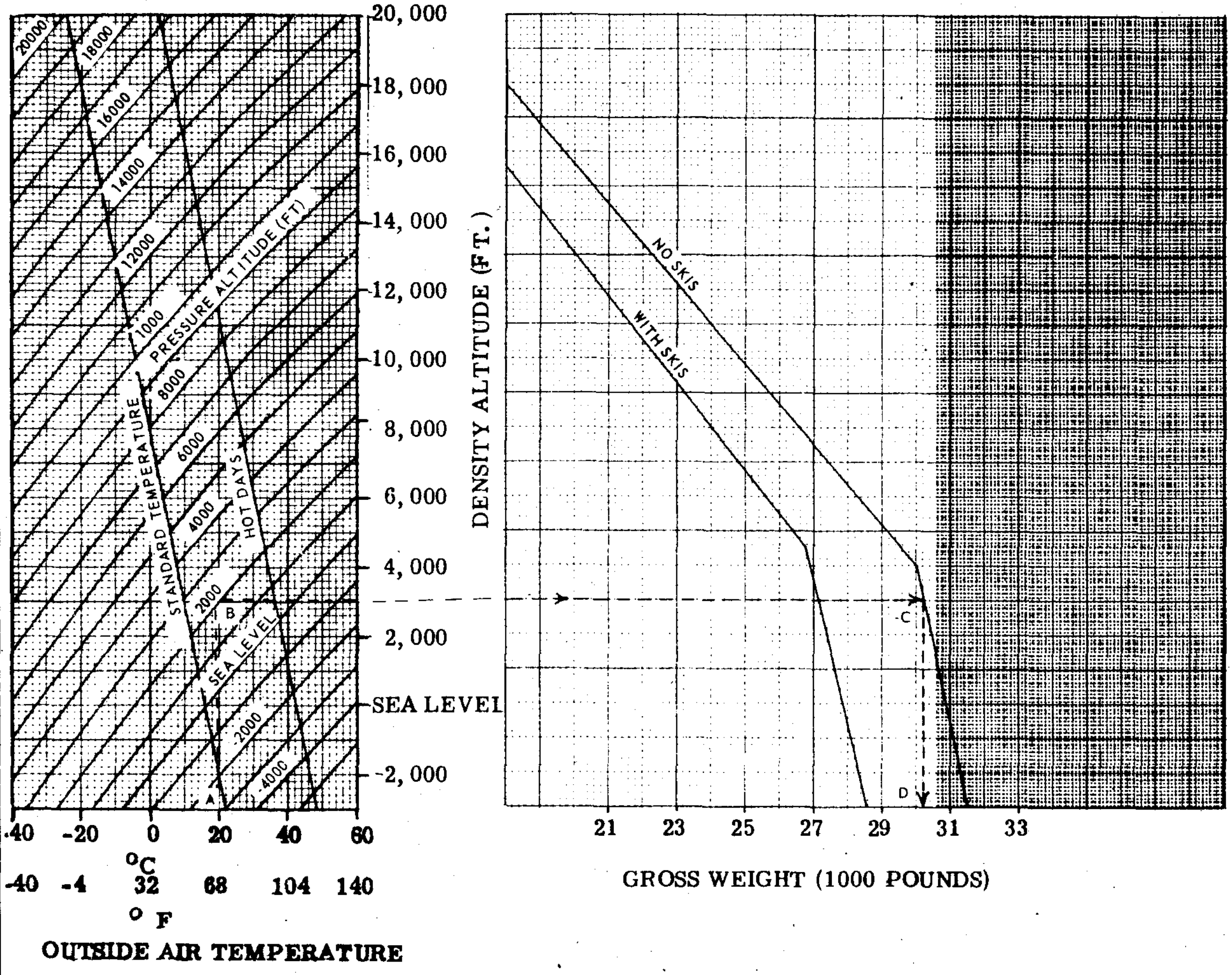
TAKE - OFF GROSS WEIGHT LIMITED BY 100 FEET PER MINUTE SINGLE ENGINE RATE OF CLIMB

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47
C-117 AND R4D

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92



ONE ENGINE OPERATING AT MAXIMUM POWER (48 IN HG, 2700 RPM)
COWL FLAPS TRAIL
LANDING GEAR UP
WING FLAPS = UP
PROPELLER - FEATHERED ON INOPERATIVE ENGINE

Figure A3-1. Take-Off Gross Weight Limited by 100 Ft/Min - Single-Engine Rate of Climb.

TAKE - OFF PERFORMANCE GROUND RUN DISTANCE

WING FLAPS = UP | TAKE-OFF SPEED = 1.1 V_s | MAXIMUM POWER WITH 2700 RPM

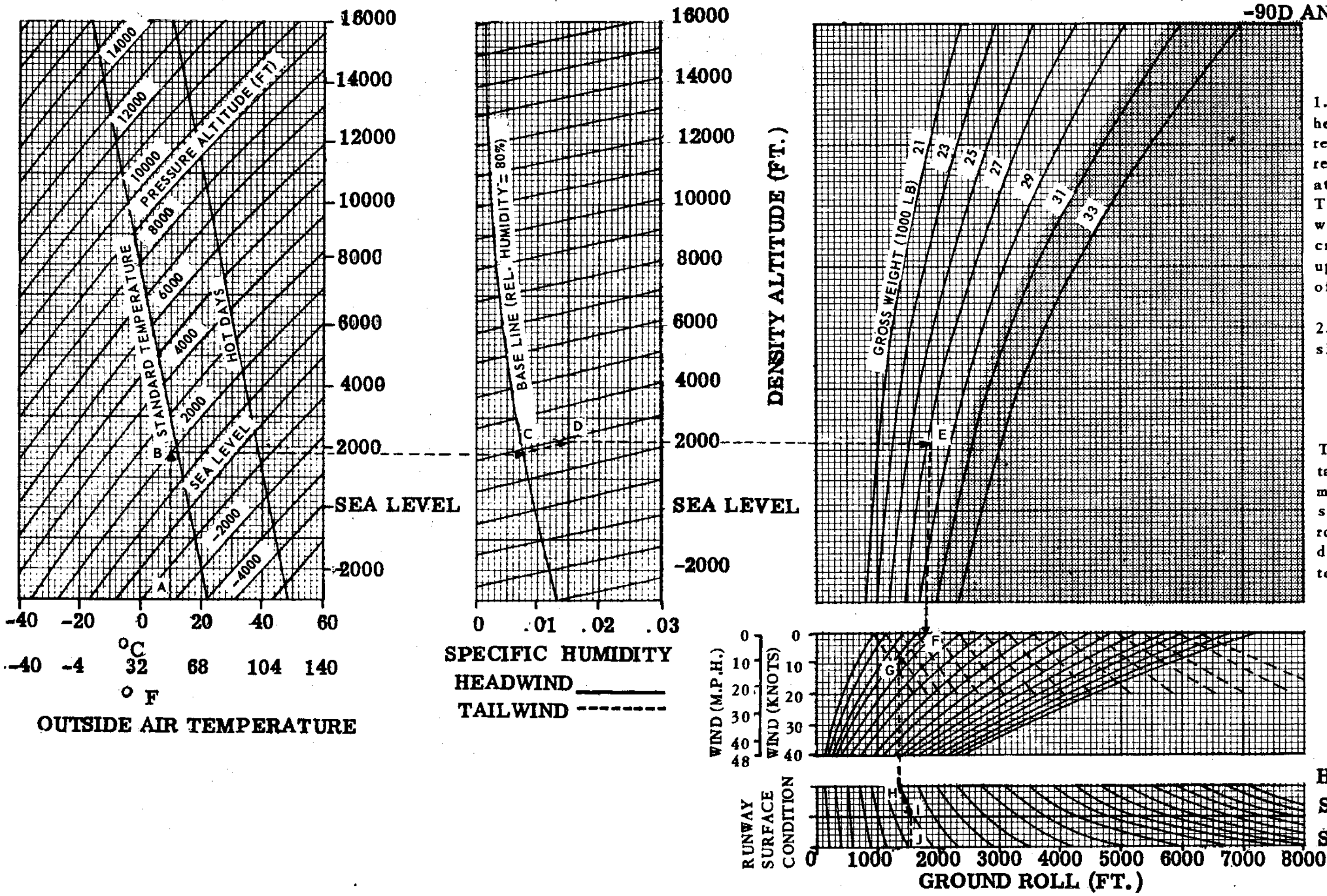
COWL FLAPS - TRAIL POSITION

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92



NOTE

1. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

2. See figure A3-10 for runway slope correction.

NOTE

To obtain the approximate distance over a 50 foot obstacle, multiply the zero wind, hard surface runway take-off ground roll distance by 1.95 (ratio of distance over a 50 foot obstacle to take-off ground roll distance).

Figure A3-2. Take-Off Performance Ground Run Distance - Flaps Up.

TAKE - OFF PERFORMANCE GROUND RUN

WING FLAPS = 1/4 DOWN | MAXIMUM POWER WITH 2700 RPM | COWL FLAPS - TRAIL POSITION

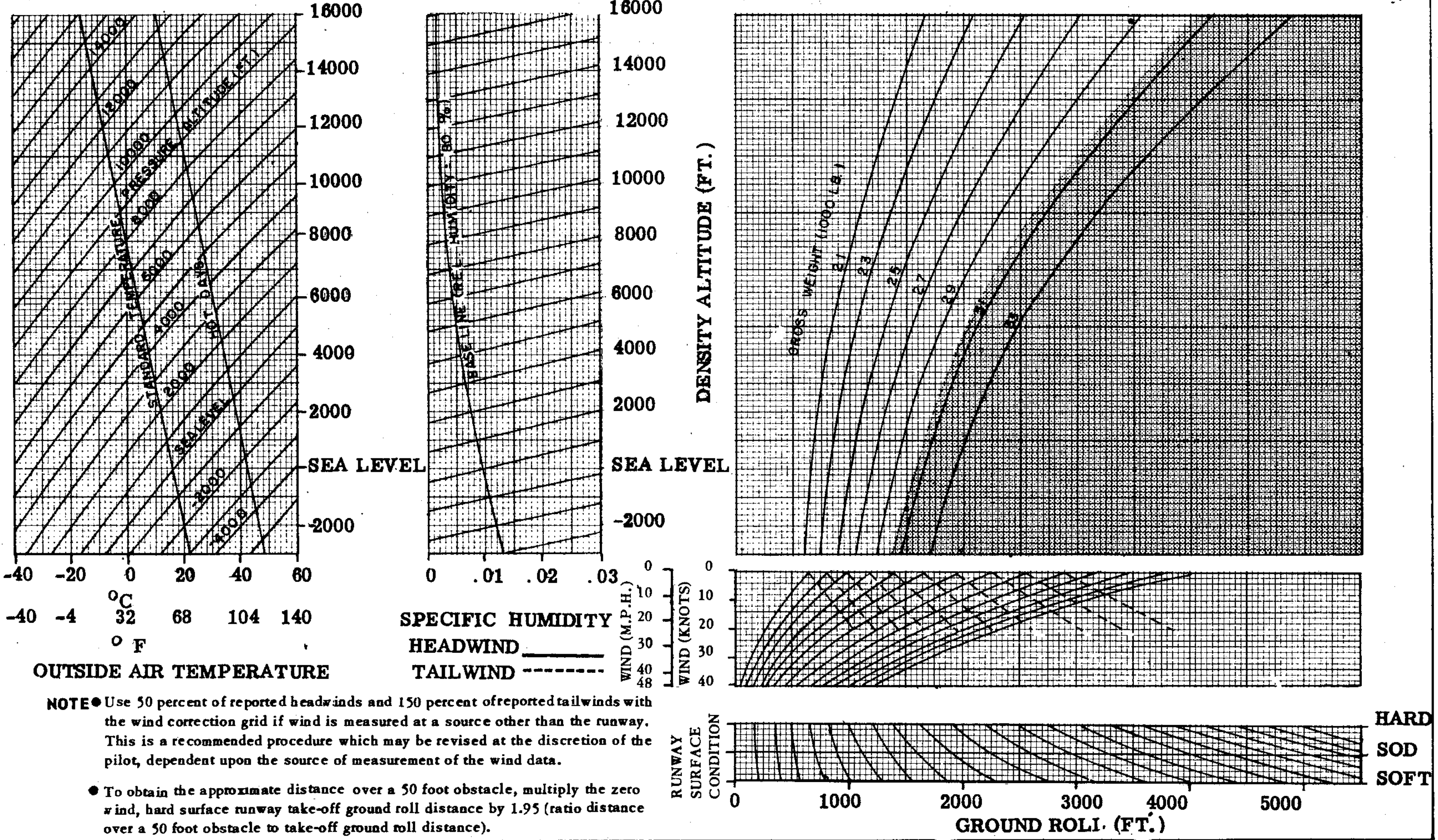
TAKE-OFF SPEED = 1.1 V_S

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL (S): C-47, C-117 AND R4D

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL.

ENGINE(S): (2) R-1830 - 90C(HIGH BLOWER INOPERATIVE ON -90D AND -92)



NOTE • Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

• To obtain the approximate distance over a 50 foot obstacle, multiply the zero wind, hard surface runway take-off ground roll distance by 1.95 (ratio distance over a 50 foot obstacle to take-off ground roll distance).

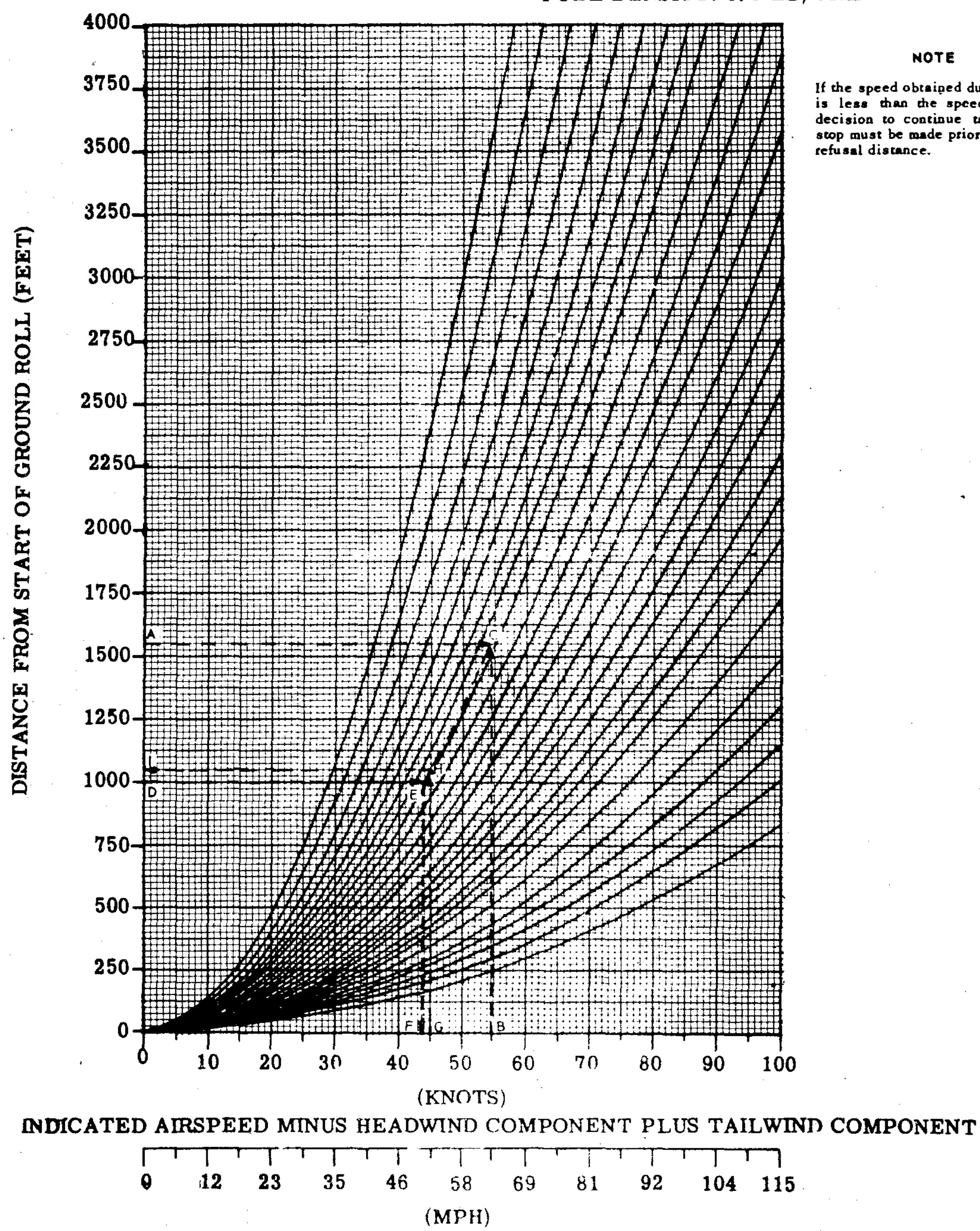
Figure A3-3. Take-Off Performance Ground Run - Wing Flaps - 1/4 Down.

TAKE - OFF PERFORMANCE - SPEED DURING GROUND RUN

TWO ENGINE TAKE-OFF ACCELERATION

BASED ON: FLIGHT TEST DATA
DATA AS OF: 24 APRIL 1964
MODEL(S): C-47, C117 AND R4D

ENGINE (S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE) -90D AND -92
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



NOTE

If the speed obtained during take-off is less than the speed shown, the decision to continue take-off or to stop must be made prior to reaching refusal distance.

Figure A3-9. Take-Off Performance - Speed During Ground Run - Two-Engine Take-Off Acceleration.

TAKE - OFF GROUND RUN DISTANCE

RUNWAY SLOPE CORRECTION

BASED ON: FLIGHT TEST
DATA AS OF: 16 NOVEMBER 1967

MODEL(S): C-47, C-117 and R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) - 90D AND -92

RUNWAY SLOPE - RUNWAY RISE (FT) / RUNWAY LENGTH (FT)

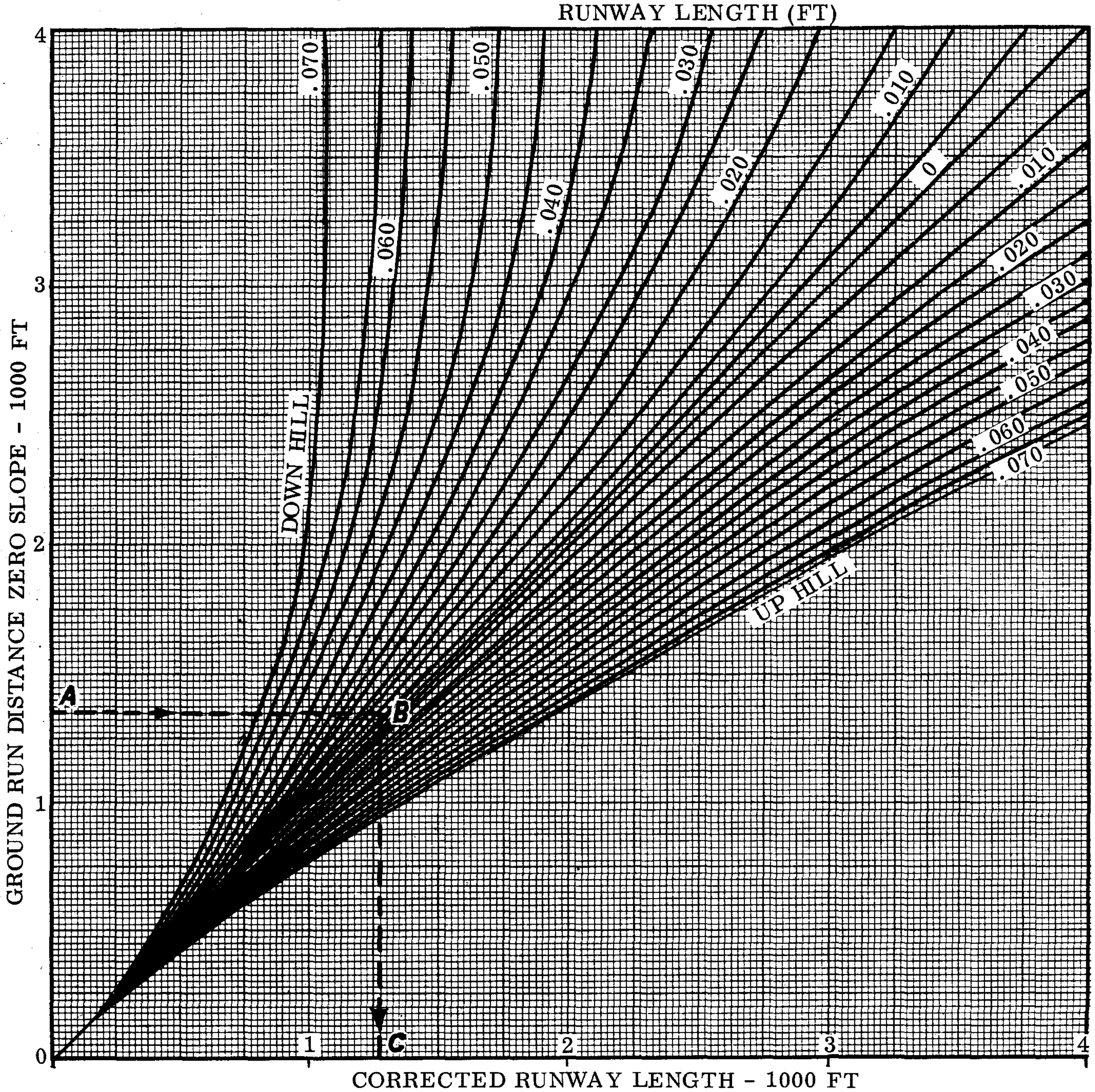


Figure A3-10. Take-Off Ground Run Distance, Runway Slope Correction

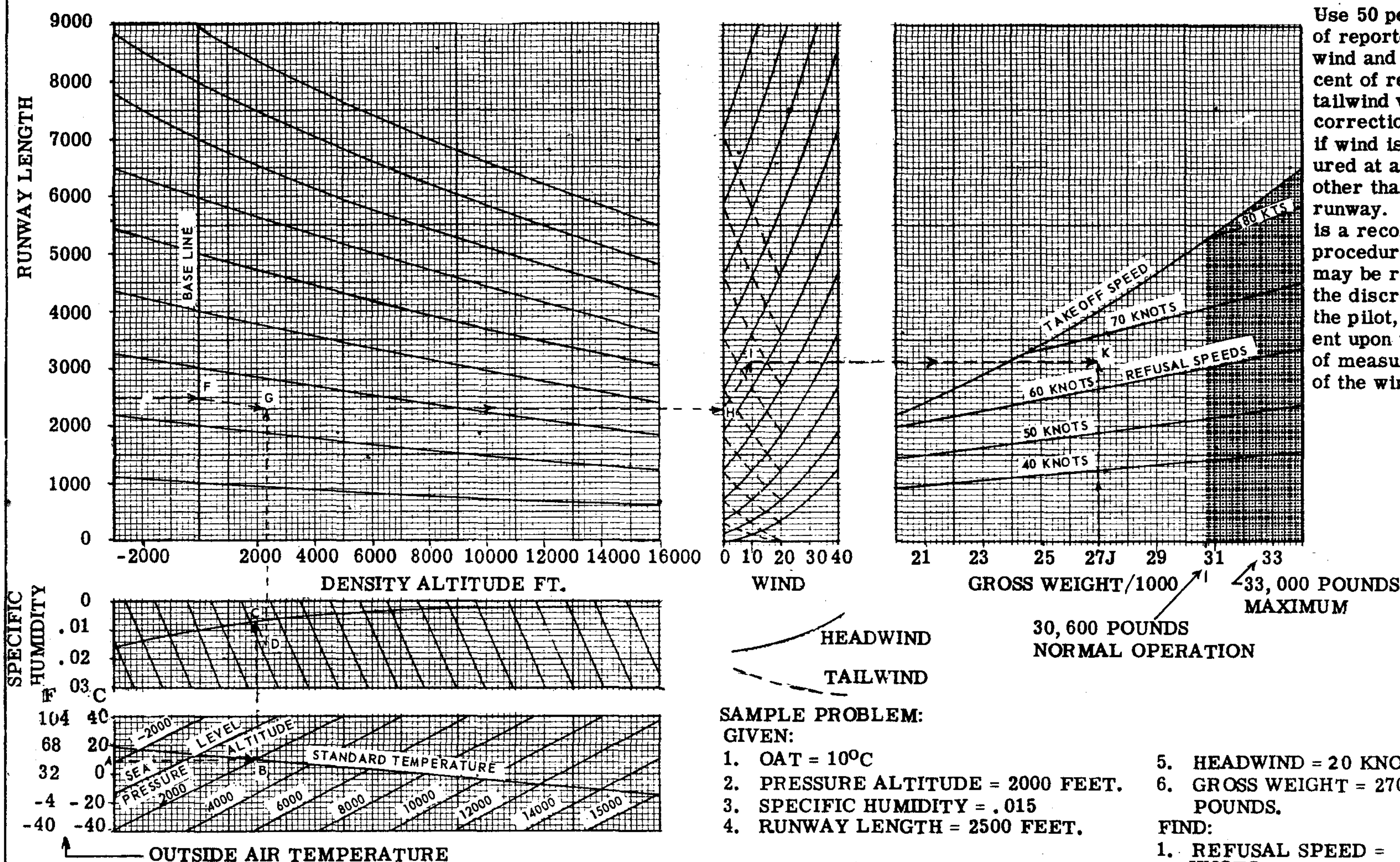
TAKE - OFF PERFORMANCE - REFUSAL SPEED

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117, AND R4D

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92



NOTE

Use 50 percent of reported headwind and 150 percent of reported tailwind with the correction grid if wind is measured at a source other than the runway. This is a recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

SAMPLE PROBLEM:

GIVEN:

1. OAT = 10°C
2. PRESSURE ALTITUDE = 2000 FEET.
3. SPECIFIC HUMIDITY = .015
4. RUNWAY LENGTH = 2500 FEET.
5. HEADWIND = 20 KNOTS.
6. GROSS WEIGHT = 27000 POUNDS.

FIND:

1. REFUSAL SPEED = 65 KNOTS.

Figure A3-11. Take-Off Performance - Refusal Speed.

DISTANCE TO STOP - ABORTED TAKE - OFF PROPELLERS WINDMILLING

WING FLAPS = UP

STANDARD ATMOSPHERIC CONDITIONS

ZERO WIND - ZERO RUNWAY SLOPE

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2)R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

MODEL(S): C-47,
C-117 AND R4D

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

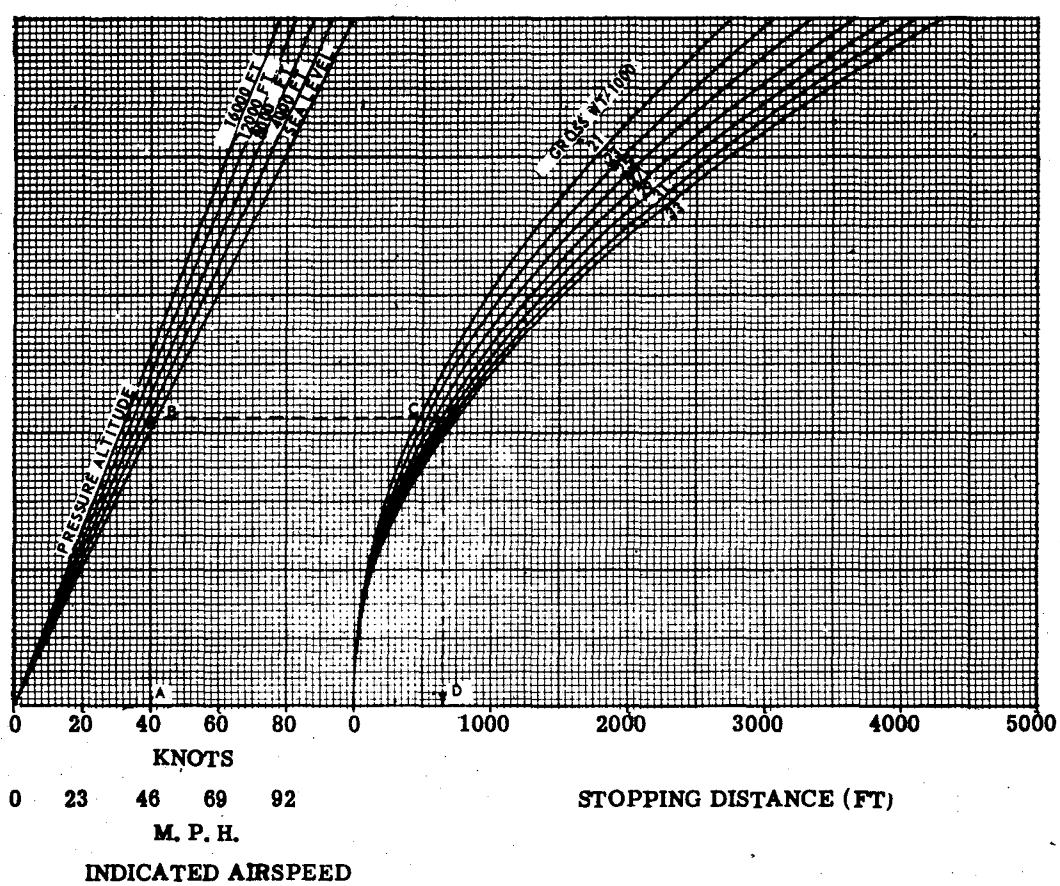
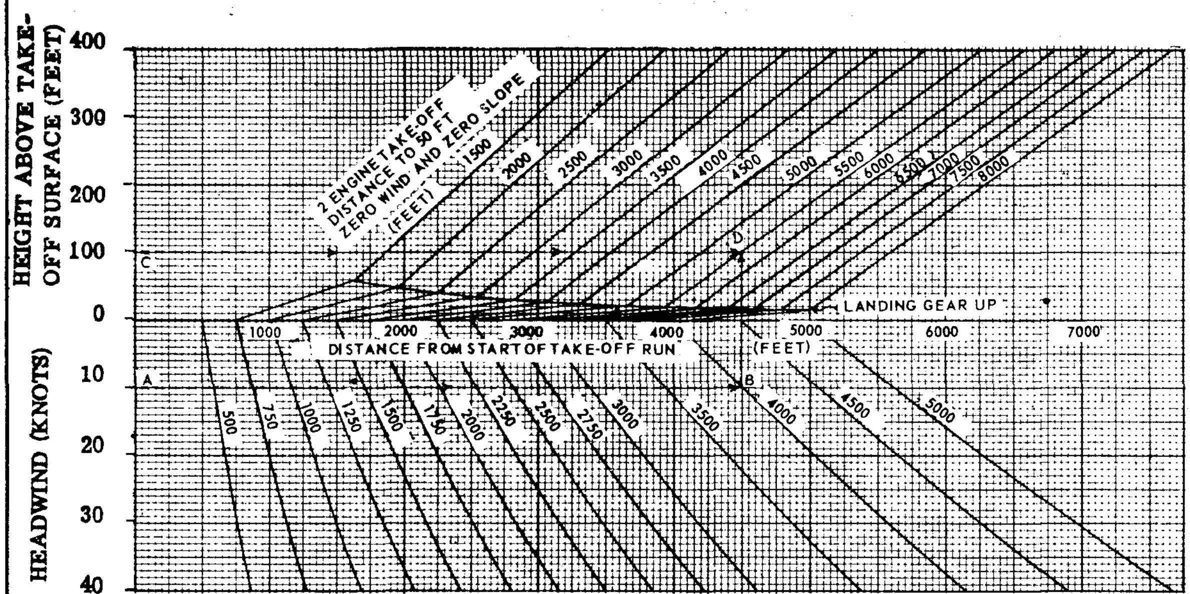


Figure A3-12. Distance to Stop - Aborted Take-Off.

TAKE - OFF PATH

DATA BASIS: FLIGHT TEST
11 JULY 1957

MODEL(S): C-47; R4D
ENGINE(S): (2) R-1830



GEAR RETRACTION INITIATED
AT TAKE-OFF
(7 SEC. RETRACTION TIME)

NOTE

USE 50% OF REPORTED HEADWINDS WITH THE WIND CORRECTION GRID IF WIND IS MEASURED AT A SOURCE OTHER THAN THE RUNWAY. THIS IS A RECOMMENDED PROCEDURE WHICH MAY BE REVISED AT THE DISCRETION OF THE PILOT, DEPENDENT UPON THE SOURCE OF MEASUREMENT OF THE WIND DATA.

WARNING

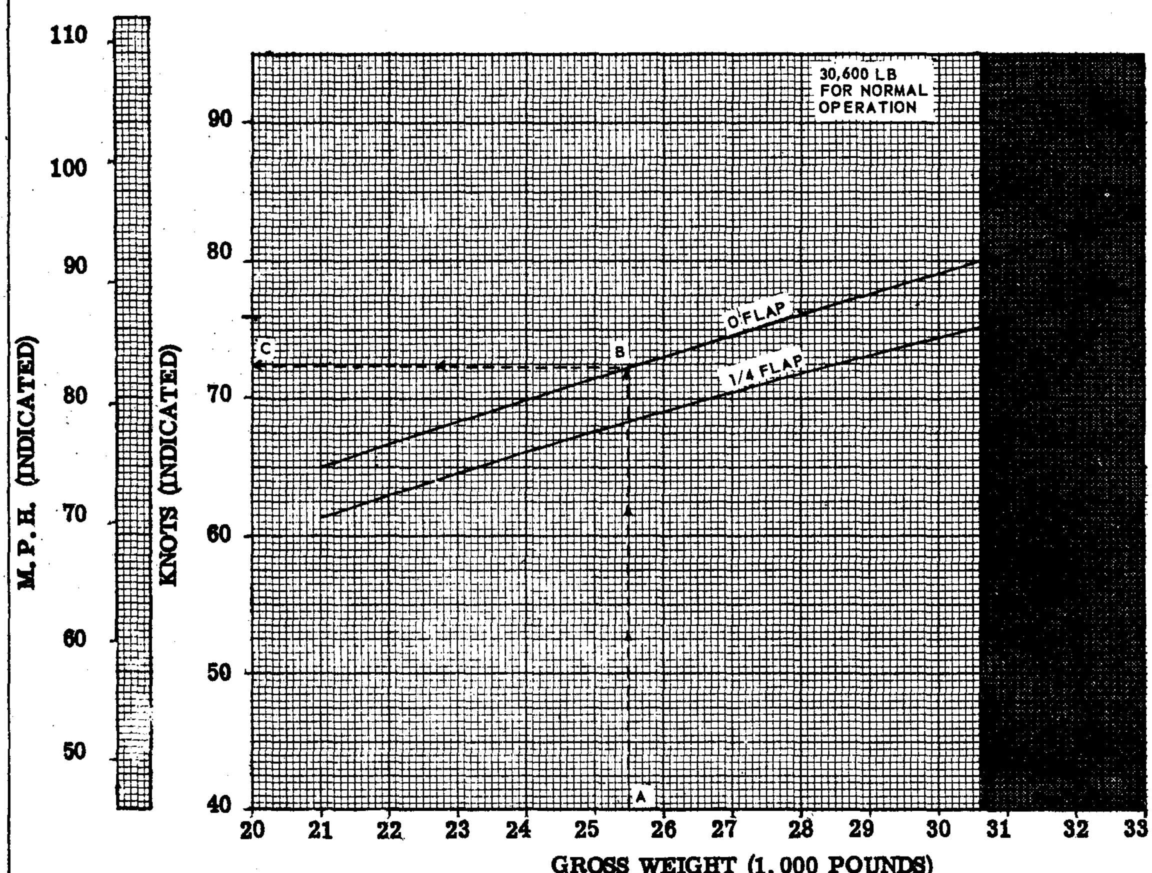
THIS CHART DOES NOT APPLY TO AIRCRAFT IN THE SKI CONFIGURATION.

Figure A3-13. Take-Off Path.

CHARACTERISTIC TAKE-OFF SPEEDS LIFT-OFF AT 1.1 Vs

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

1. SPEEDS GIVEN ARE AIRSPEED INDICATOR READINGS.
2. A 5 KNOT CORRECTION FOR POSITION ERROR HAS BEEN SUBTRACTED.
3. NO INSTRUMENT ERROR IS INCLUDED.



MODEL(S): C-47; C-117; R4D
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND - 92

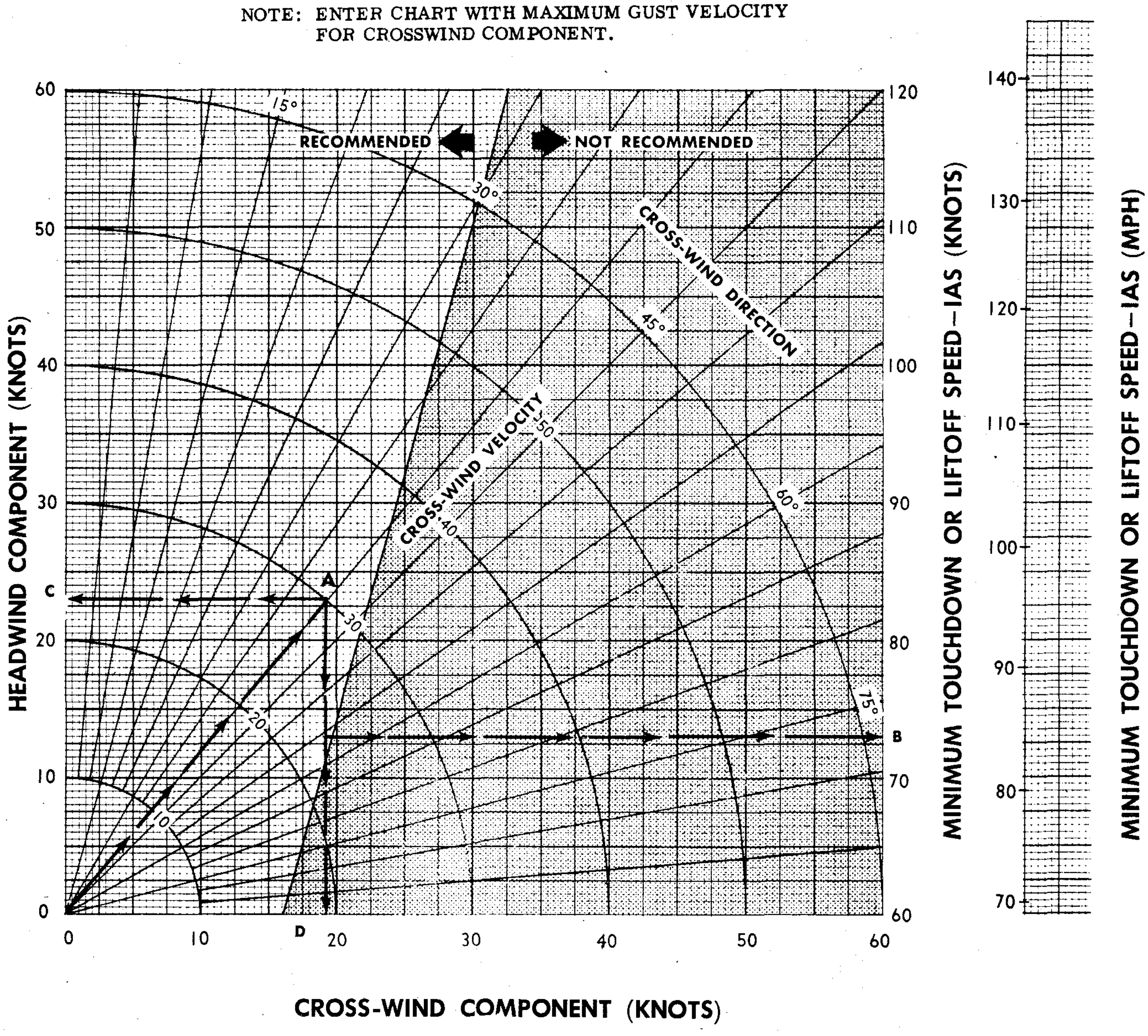
Figure A3-14. Characteristic Take-Off Speeds - Liftoff at 1.1Vs.

TAKE-OFF AND LANDING CROSS-WIND CHART

MODEL: C-47, C-117
AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

NOTE: ENTER CHART WITH MAXIMUM GUST VELOCITY
FOR CROSSWIND COMPONENT.



SAMPLE PROBLEM:

GIVEN CONDITIONS:

TAKE-OFF RUNWAY — 30°
WIND GIVEN 70° AT 30 KNOTS
CROSS-WIND DIRECTION = 70° — 30° = 40° (POINT A)

CHART INDICATES:

B. MINIMUM LIFT OFF SPEED — 73 KIAS (84 MPH)
C. HEADWIND COMPONENT — 23 KNOTS
D. CROSS-WIND COMPONENT — 19.5 KNOTS

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A3-15. Take-Off and Landing Crosswind Chart.

PART FOUR
CLIMB

TABLE OF CONTENTS

LIST OF CHARTS

DISCUSSION OF CHARTS

The time and distance to climb charts (figures A4-1 through A4-14) are used for determining time and distance traveled and the fuel consumed during a climb. Curves are shown for METO and climb power, standard and hot days for the two-engine configurations (with and without skis). Curves are also presented for maximum and METO power for standard day, with and without skis and maximum power for hot day with and without skis in the single engine configuration.

The rate of climb charts (figures A4-15 through A4-24) show the rate of climb for METO and climb power for the two-engine configurations (with and without skis), and the rate of climb for maximum, METO, and climb power for the single-engine configurations (with and without skis).

The emergency ceiling chart (figure A4-26) presents the weights and altitudes at which the rate of climb is 100 feet per minute with METO power for two or one engine operating (with and without skis). Figure A3-1 (take-off gross weight limited by 100 feet per minute rate of climb, single-engine, maximum power) may be used as the emergency ceiling chart for one engine operating at maximum power.

TIME AND DISTANCE TO CLIMB

The time and distance to climb charts (figures A4-1 through A4-14) are presented in facing pairs and are used to determine time and distance traveled and the fuel consumed during a climb to a given altitude for two-engine operation at either METO power or climb power with an without skis for standard and hot day conditions. Charts are also included for maximum and METO power, standard day, with and without skis and maximum power, hot day, with and without skis for the single-engine configuration. To obtain time to climb, enter the time to climb chart (Sheet 1 of 2) on the gross weight scale, with the aircraft gross weight at the start of climb, and project a line parallel to the gross weight guide lines, until the desired pressure altitude curve is intersected. From this intersection, project a line horizontally to the left and read time to climb in minutes. To obtain distance to climb use same procedure on distance to climb chart (Sheet 2 of 2). The gross weight at the end of the climb may be found by projecting a vertical line down from the intersection on the initial gross weight and pressure altitude. The weight at the end of the climb is read on the gross weight scale. Fuel consumed during the climb may be determined from either sheet 1 of 2 or 2 of 2 by subtracting the gross weight at the end of the climb from the gross weight at the beginning of the climb. Recommended climb speeds are presented on each chart.

TIME TO CLIMB.

SAMPLE PROBLEM:

1. 27,000 pounds gross weight at start of climb at sea level.
2. Pressure altitude = 10,000 feet.
3. Eleven minutes = time to climb.
4. Fuel used = the difference between the weight at start of climb (point A), and the weight at end of climb (point D) = 250 pounds.

Distance to Climb:

SAMPLE PROBLEM:

1. 27,000 pounds gross weight at start of climb at sea level.
2. Pressure altitude = 10,000 feet.
3. 20.2 nautical miles flown during climb.
4. Fuel used = the difference between the weight at start of climb (point A), and the weight at end of climb (point D) = 250 pounds.

RATE OF CLIMB

The rate of climb charts (figures A4-15 through A4-24), are presented for two and single-engine operation at METO and climb power with and without skis. An additional chart is included for single-engine operation at maximum power with and without skis. The charts are used to determine the rate of climb in feet per minute at a given gross weight. A sample problem is shown on the first of this series to illustrate its use.

Enter the chart at the outside air temperature (Point A) and draw a line vertically to the pressure altitude line (Point B). From this point draw a horizontal line to intersect the given gross weight line (Point C). From Point C, draw a line vertically to the rate of climb scale (Point D), and read the rate of climb in feet per minute.

SAWTOOTH CLIMB

The single engine sawtooth climb chart (figure A4-25) is presented to show the relationship between rate of climb and velocity for given conditions.

EMERGENCY CEILING

The emergency ceiling chart (figure A4-26) shows the gross weight versus pressure altitude at which the aircraft will maintain a rate of climb of 100 feet per minute on a standard day at METO power. These curves are for two and single engine operation with and without skis.

Enter chart at given gross weight (Point A). Draw a line vertically to intersect the appropriate curve (Point B). Draw a line horizontally from Point B to the pressure altitude scale (Point C) and read the pressure altitude in feet.

TIME TO CLIMB-STANDARD DAY

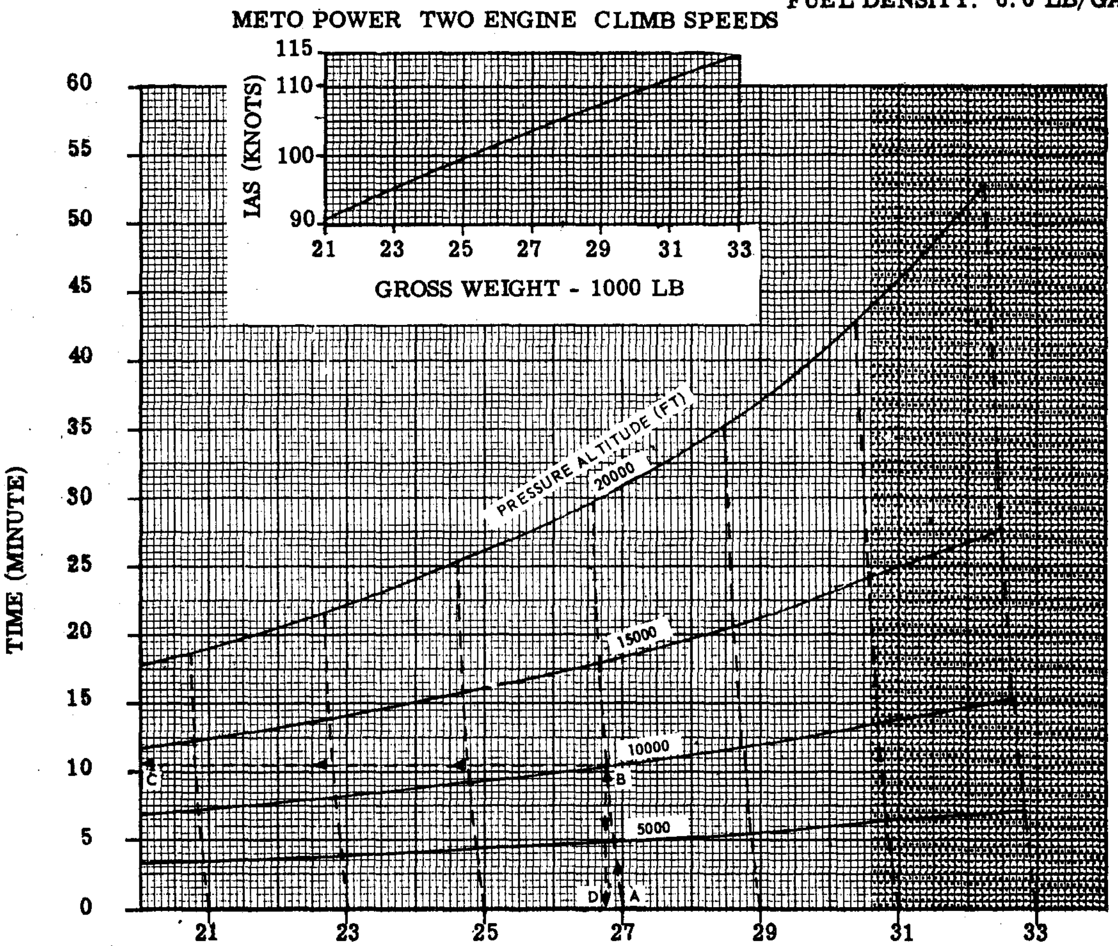
METO POWER TWO ENGINES

LANDING GEAR - UP WING FLAPS - UP COWL FLAPS - TRAIL

⊡ R/C = 100 FT/MIN

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

MODEL(S): C-47 C-117 AND R4D

Figure A4-1. Time To Climb - Standard Day - METO Power - Two Engines. (Sheet 1 of 2)

DISTANCE TO CLIMB-STANDARD DAY

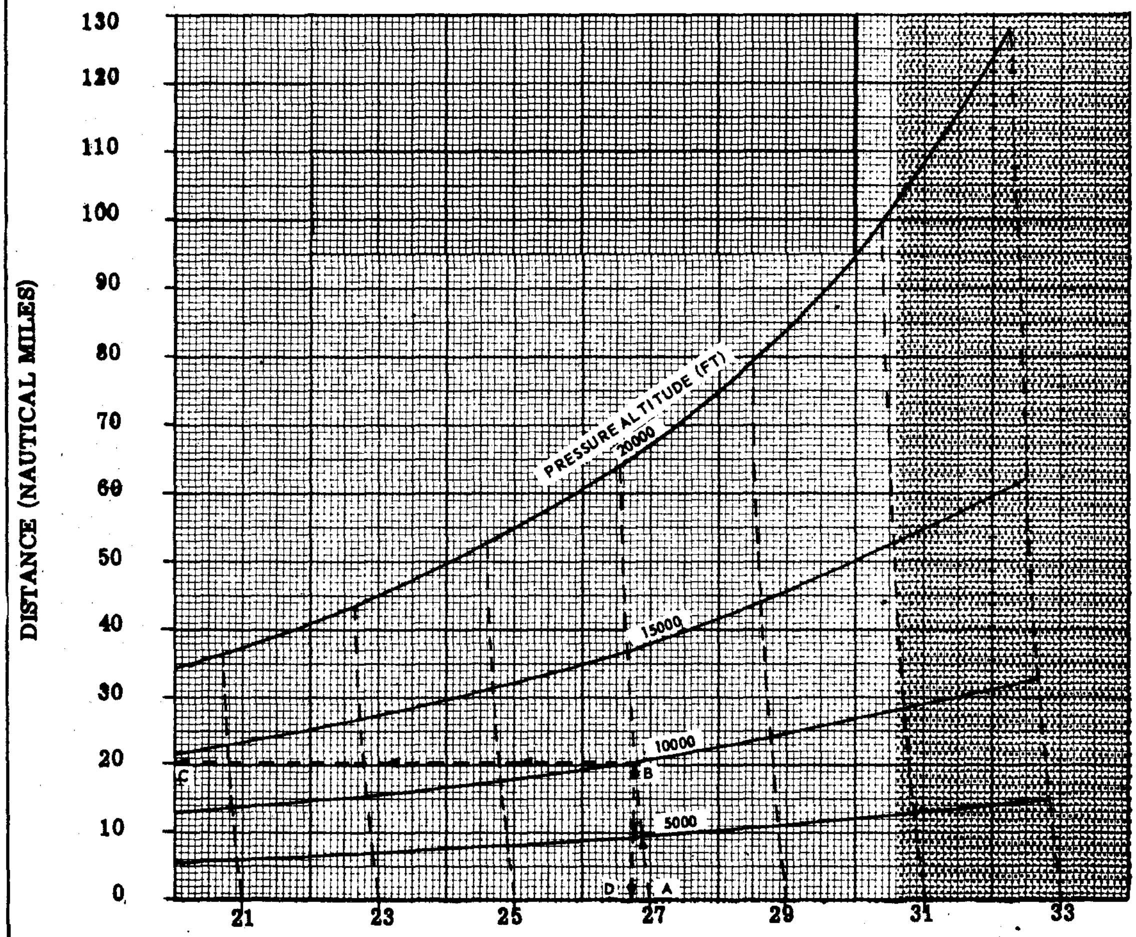
METO POWER TWO ENGINES

LANDING GEAR - UP WING FLAPS - UP COWL FLAPS - TRAIL

⊡ R/C = 100 FT/MIN

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90 AND -92

GROSS WEIGHT (1000 POUNDS)

MODEL(S): C-47
C-117 AND R4D

Figure A4-1. Distance To Climb - Standard Day - METO Power - Two Engines. (Sheet 2 of 2)

TIME TO CLIMB-HOT DAY

METO POWER   TWO ENGINE

☐ R/C = 100 FT/MIN

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

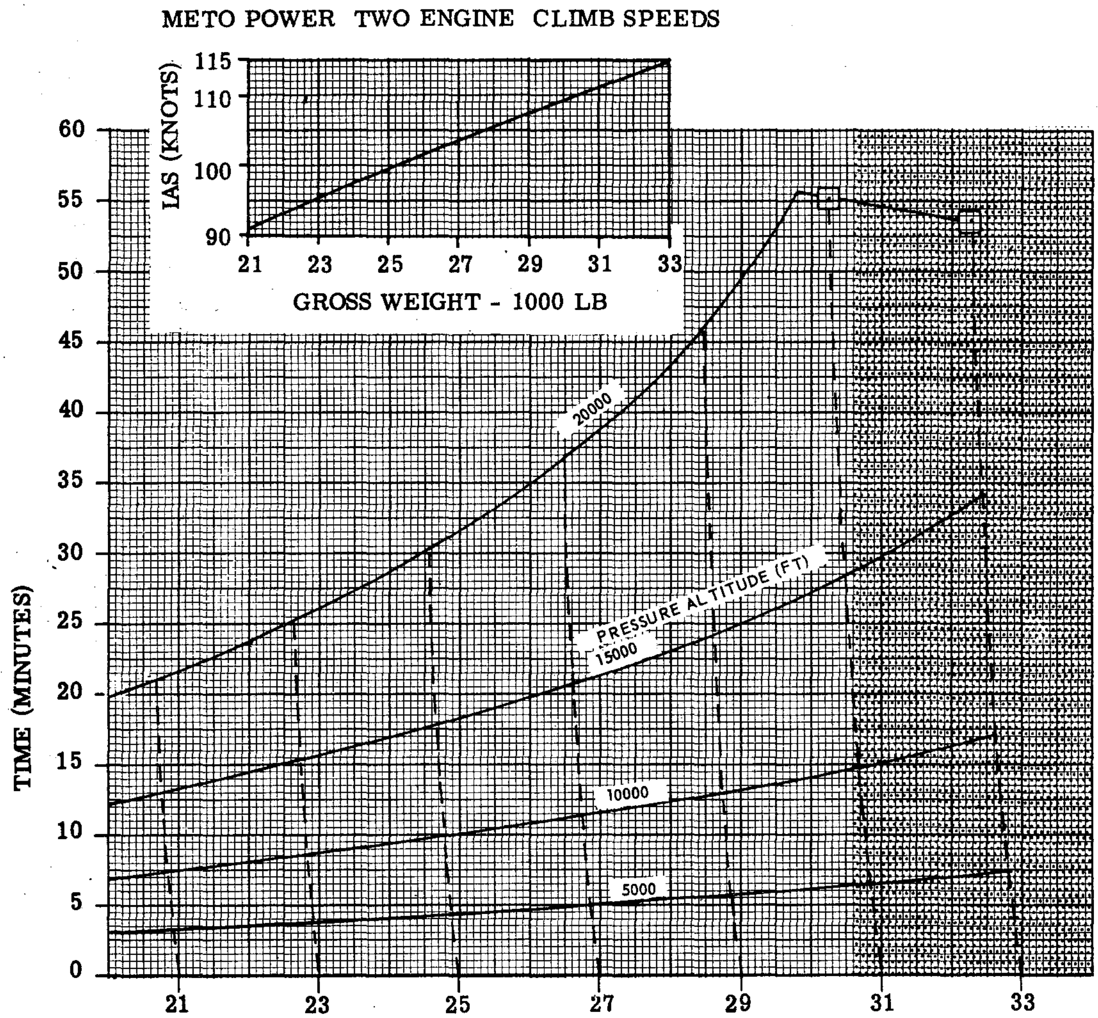


Figure A4-2. Time to Climb - Hot Day - METO Power - Two Engines. (Sheet 1 of 2)

DISTANCE TO CLIMB-HOT DAY

METO POWER TWO ENGINE

⊡ R/C = 100 FT/MIN

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

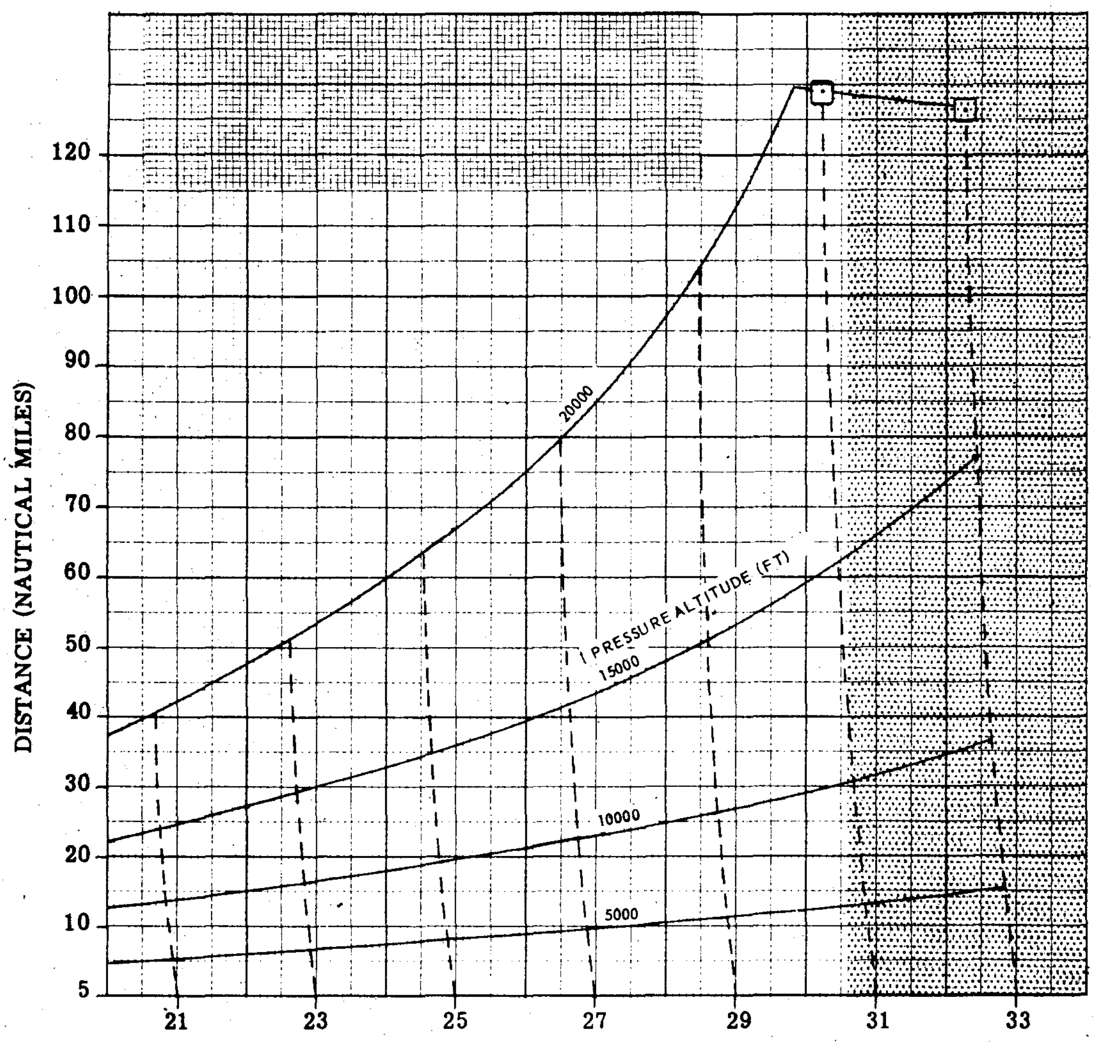


Figure A4-2. Distance To Climb - Hot Day - METO Power - Two Engines. (Sheet 2 of 2)

TIME TO CLIMB-STANDARD DAY

MODEL(S): C-47,
C-117 AND R4D

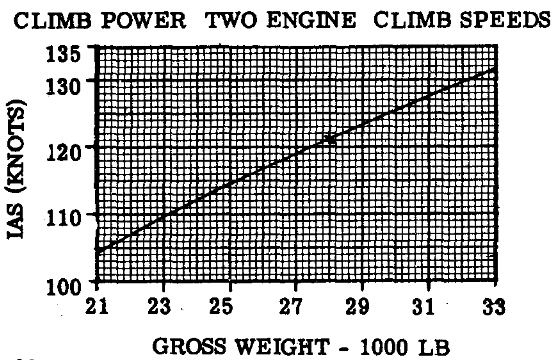
CLIMB POWER TWO ENGINE

□ R/C = 100 FT/MIN

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



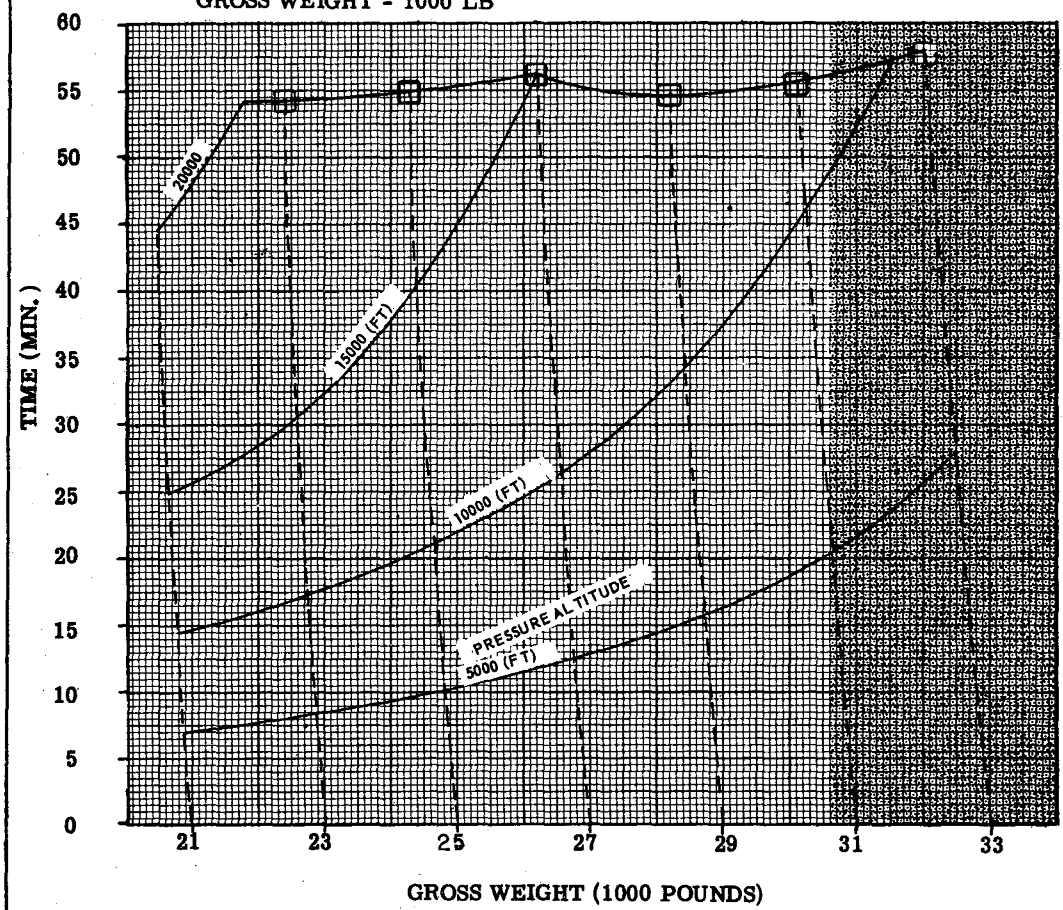


Figure A4-3. Time To Climb - Standard Day - Climb Power - Two Engines. (Sheet 1 of 2)

DISTANCE TO CLIMB-STANDARD DAY

CLIMB POWER TWO ENGINE

⊡ R/C = 100 FT/MIN

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

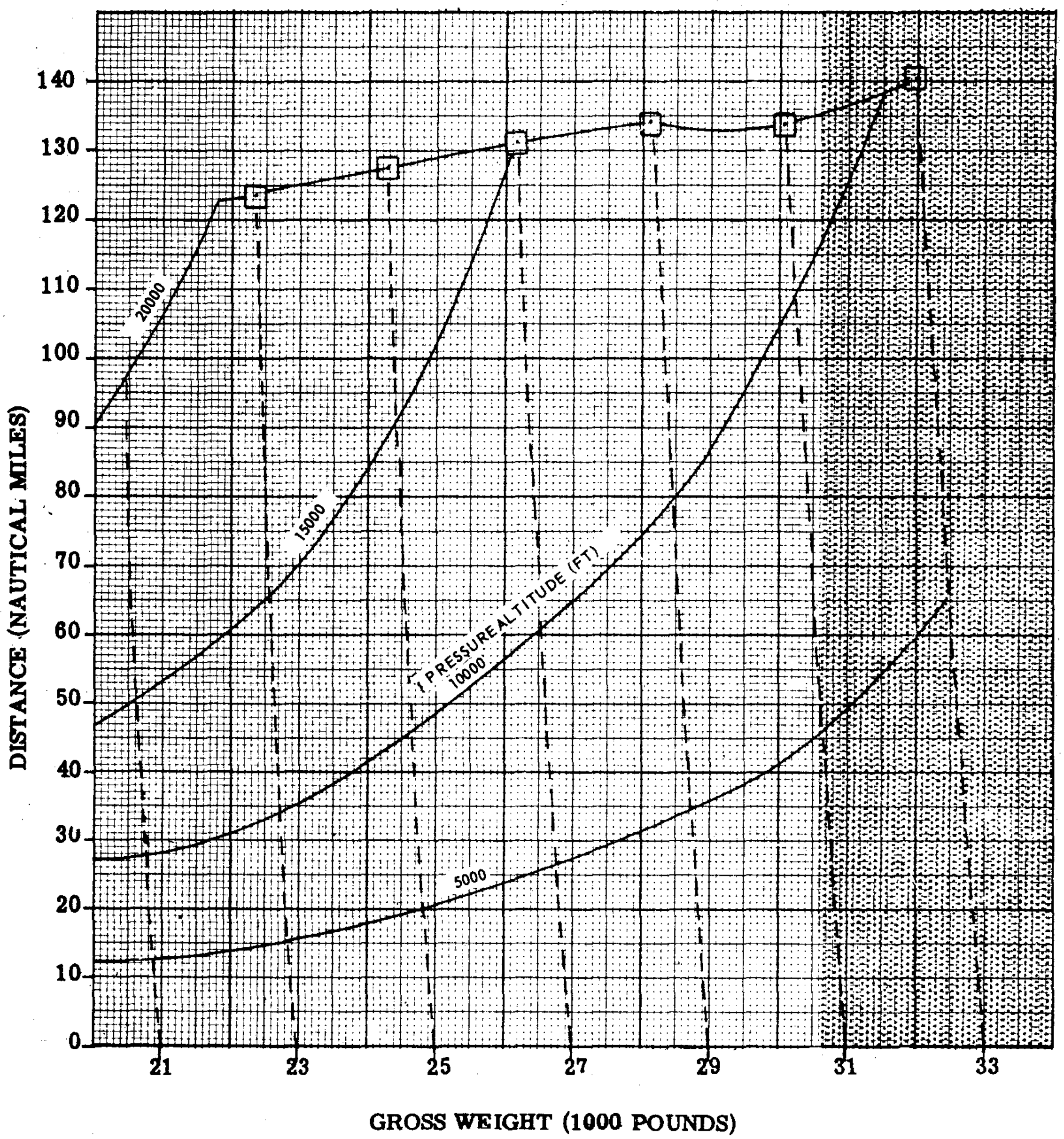


Figure A4-3. Distance To Climb - Standard Day - Climb Power - Two Engines. (Sheet 2 of 2)

TIME TO CLIMB-HOT DAY

CLIMB POWER TWO ENGINE

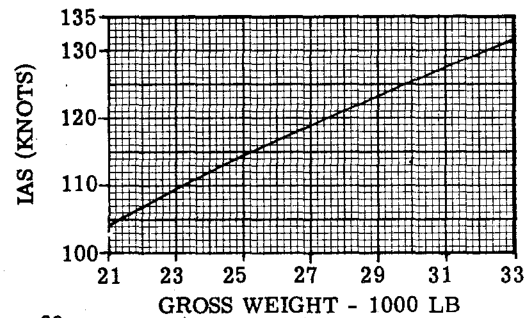
MODEL(S): C-47,
C-117 AND R4D

⊡ R/C = 100 FT/MIN.

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

CLIMB POWER TWO ENGINE CLIMB SPEEDS



FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

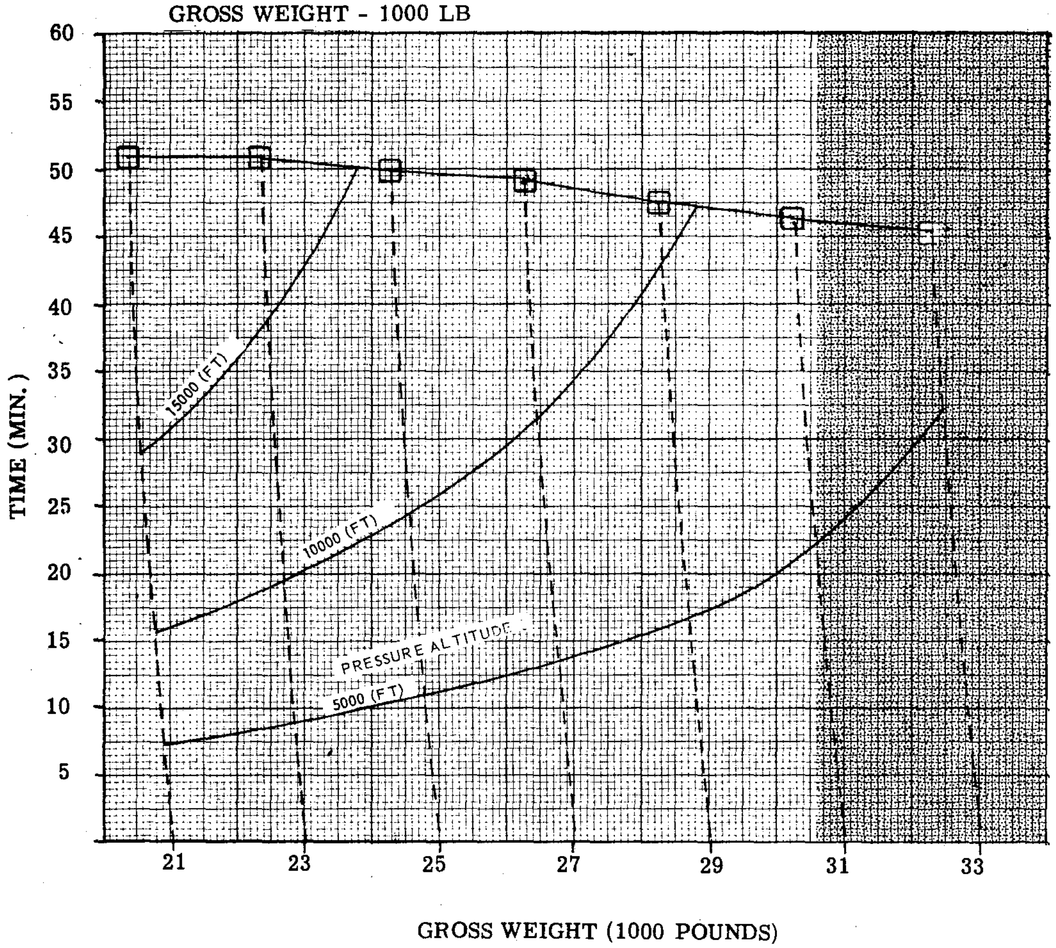


Figure A4-4. Time To Climb - Hot Day - CLIMB Power - Two Engines. (Sheet 1 of 2)

DISTANCE TO CLIMB-HOT DAY

CLIMB POWER TWO ENGINE

[•] R/C = 100 FT/MIN.

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

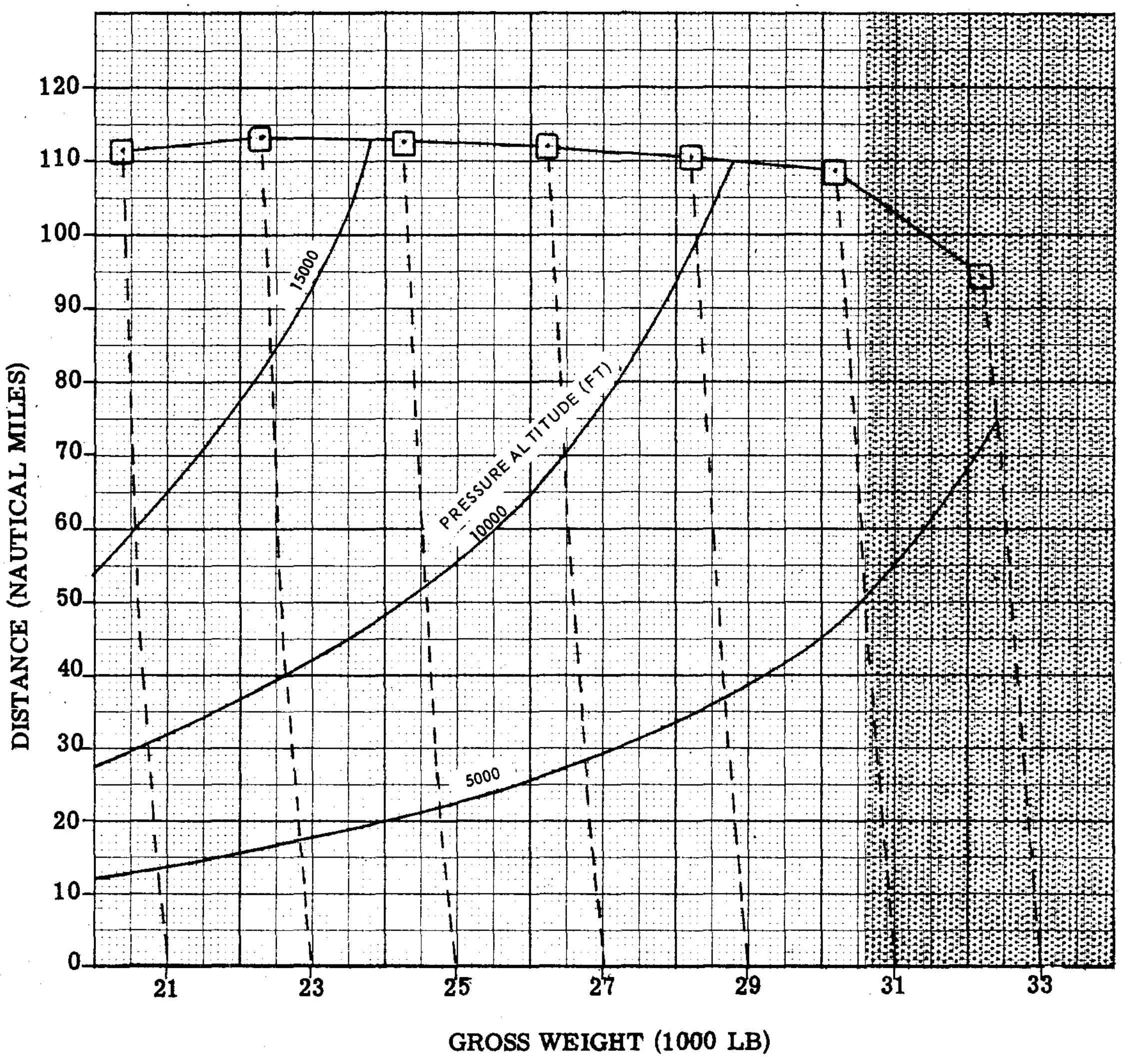


Figure A4-4. Distance To Climb - Hot Day - CLIMB Power - Two Engines. (Sheet 2 of 2)

TIME TO CLIMB-STANDARD DAY

MAX POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

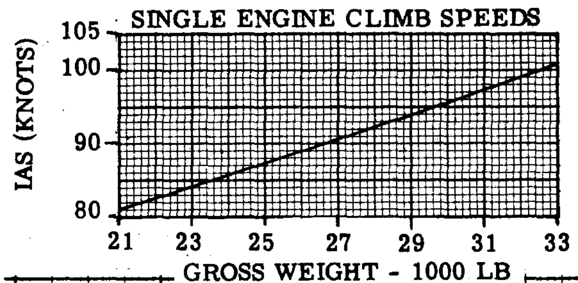
⊡ R/C = 100 FT/MIN.

MODEL(S): C-47
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



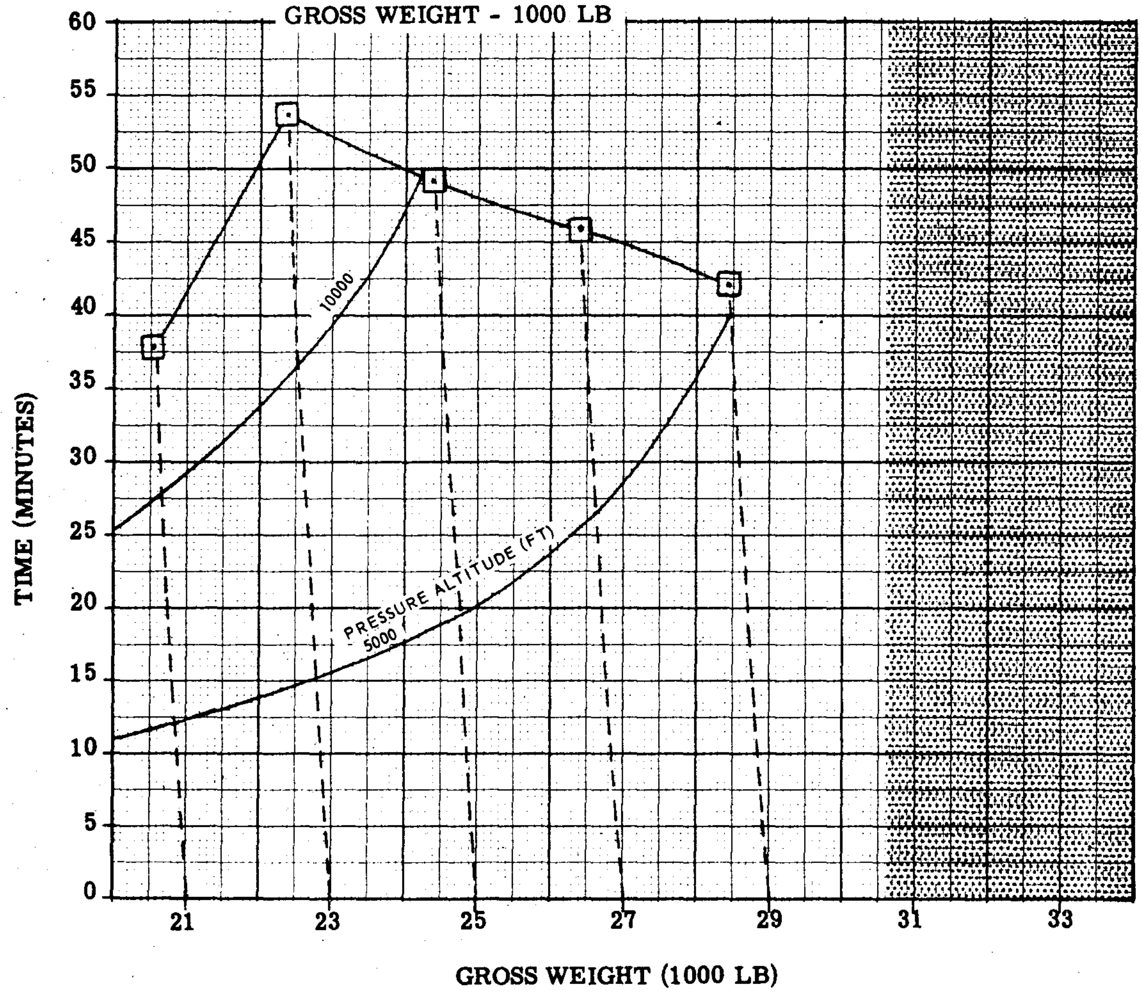


Figure A4-5. Time To Climb - Standard Day - MAX Power - Single Engine. (Sheet 1 of 2)

DISTANCE TO CLIMB-STANDARD DAY

MAX POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

⊡ R/C = 100 FT/MIN.

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

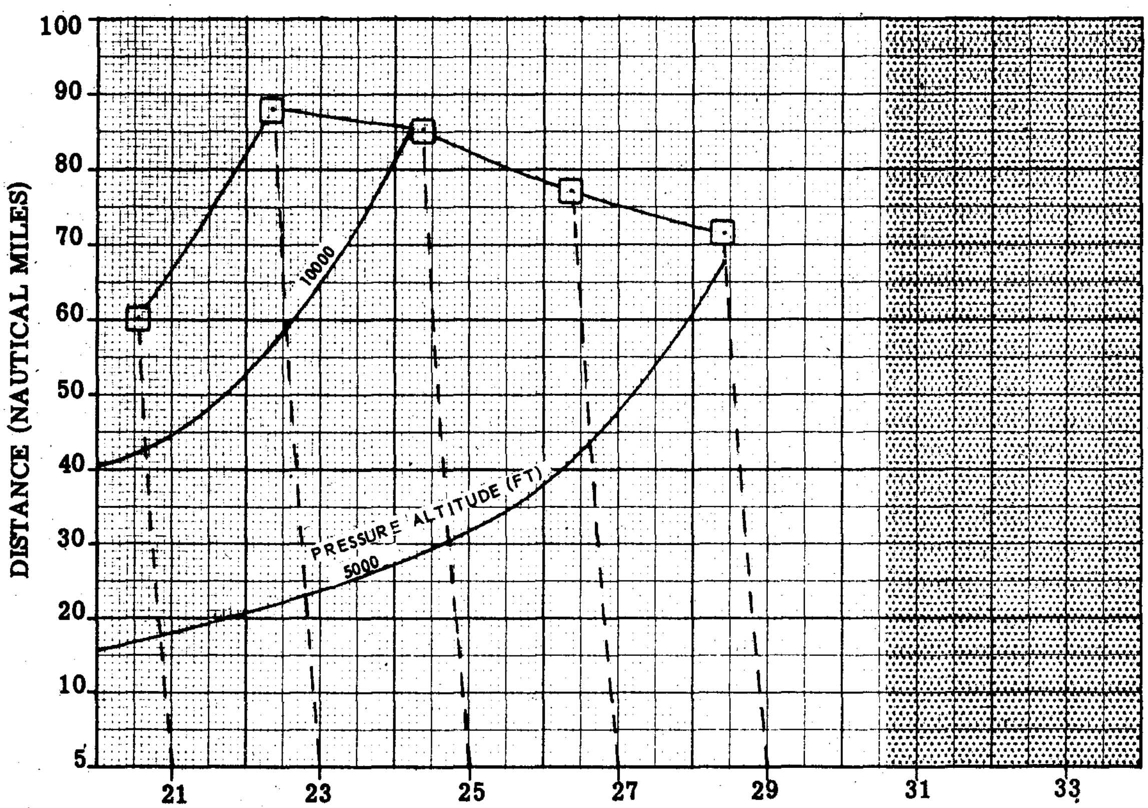


Figure A4-5. Distance To Climb - MAX Power - Single Engine. (Sheet 2 of 2)

TIME TO CLIMB-HOT DAY

MAX POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

⊡ R/C = 100 FT/MIN.

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

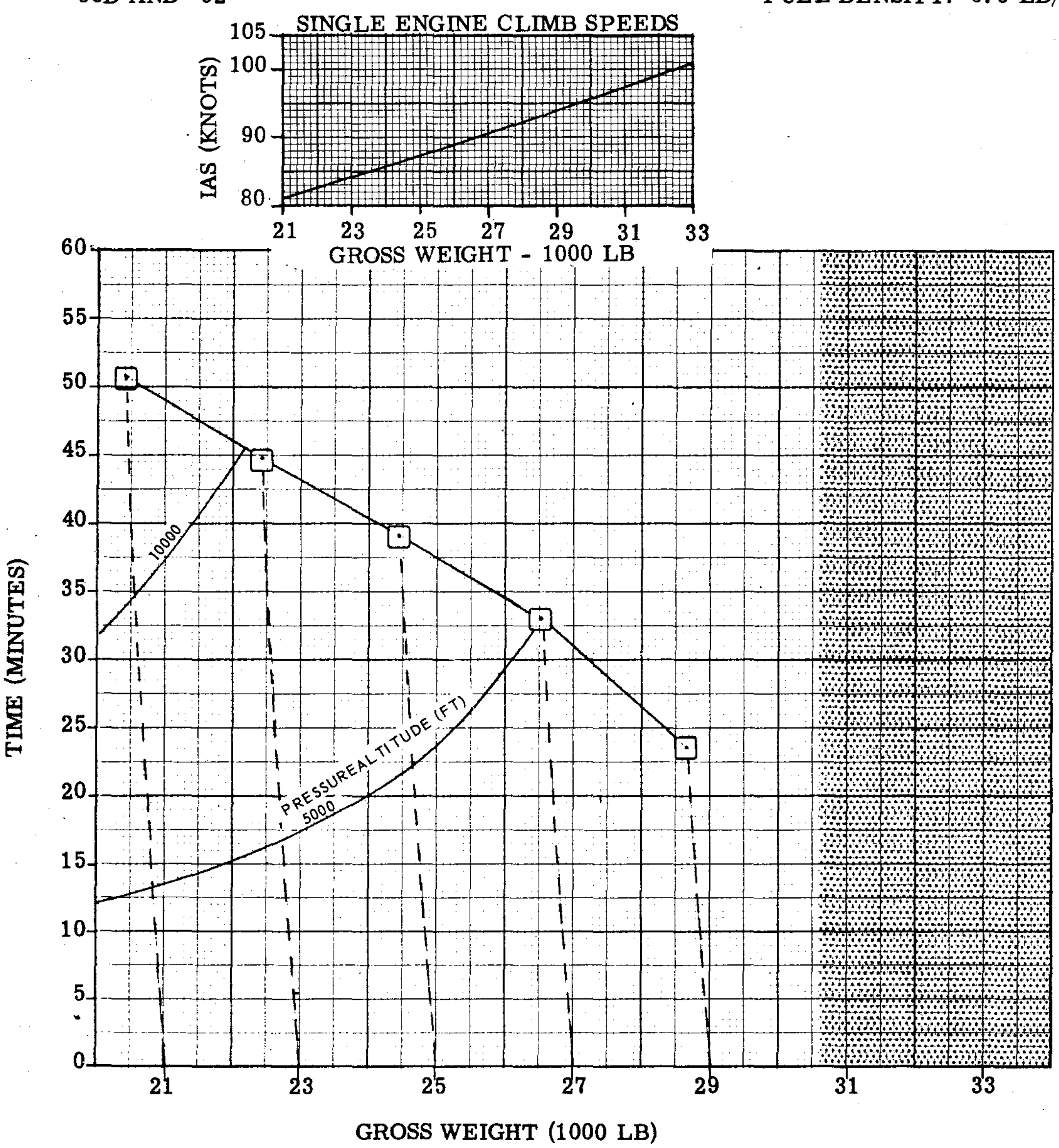


Figure A4-6. Time To Climb - Hot Day - Maximum Power - Single Engine. (Sheet 1 of 2)

DISTANCE TO CLIMB-HOT DAY

MAX POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

⊡ R/C = 100 FT/MIN.

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

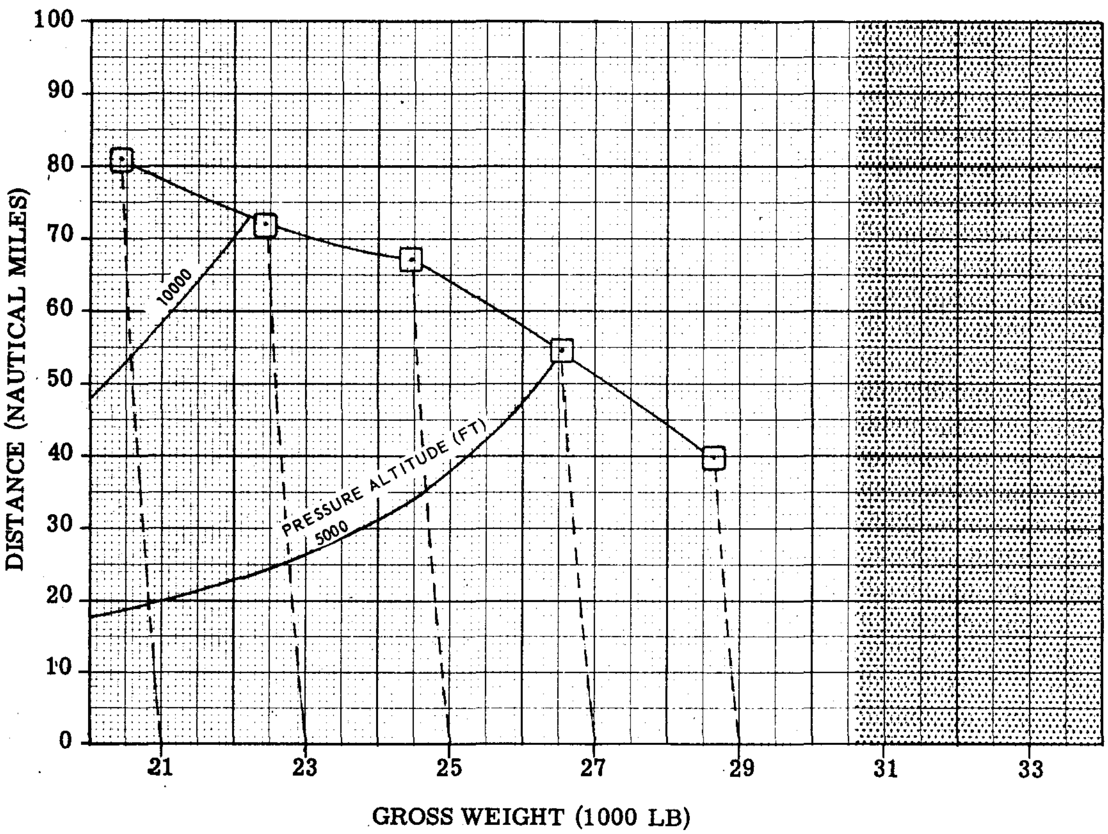


Figure A4-6. Distance To Climb - Hot Day - Maximum Power - Single Engine. (Sheet 2 of 2)

TIME TO CLIMB - STANDARD DAY

METO POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

⊡ R/C = 100 FT/MIN.

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

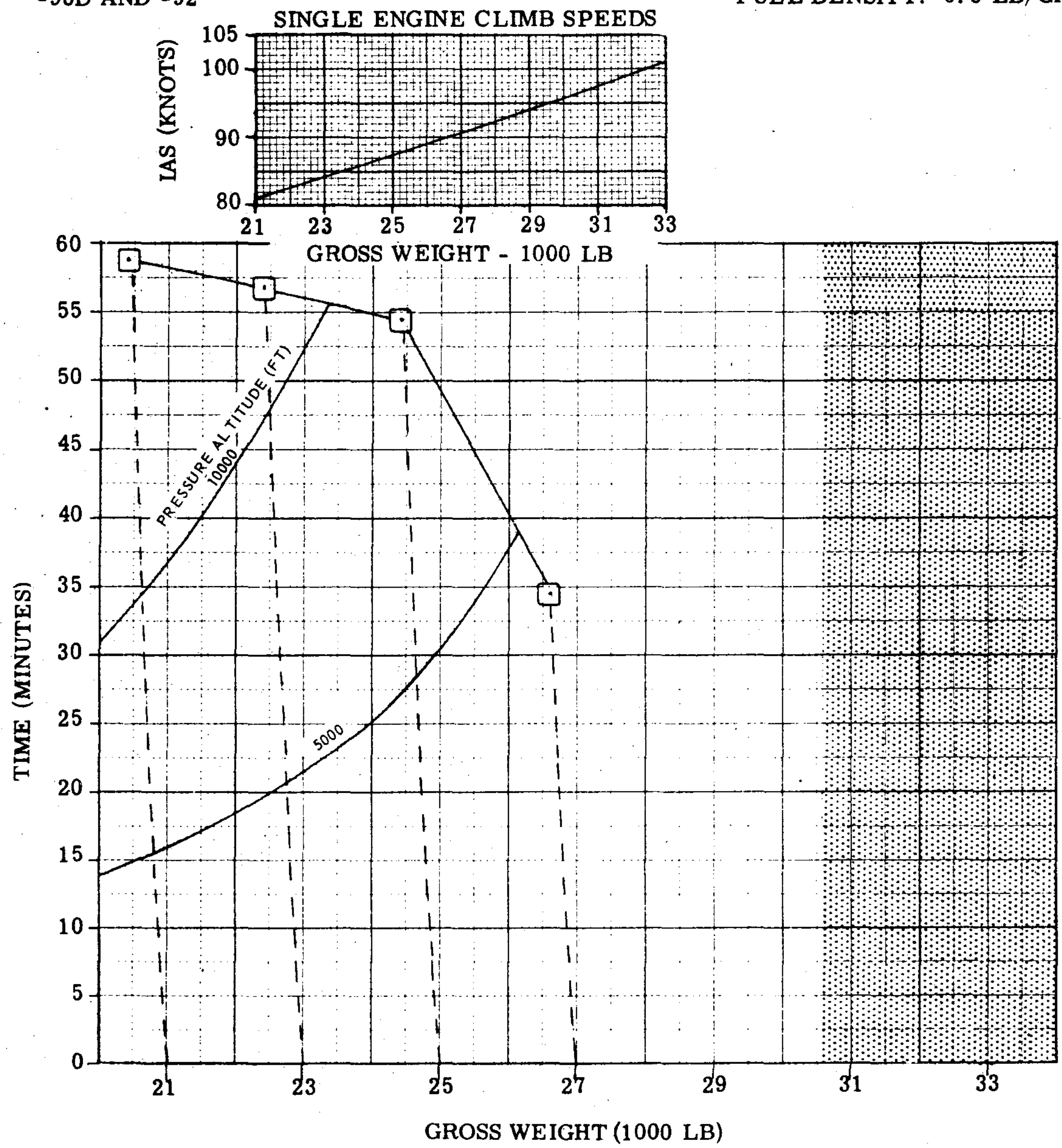


Figure A4-7. Time To Climb - Standard Day - METO Power - Single Engine. (Sheet 1 of 2)

DISTANCE TO CLIMB - STANDARD DAY

METO POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

⊡ R/C = 100 FT/MIN.

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

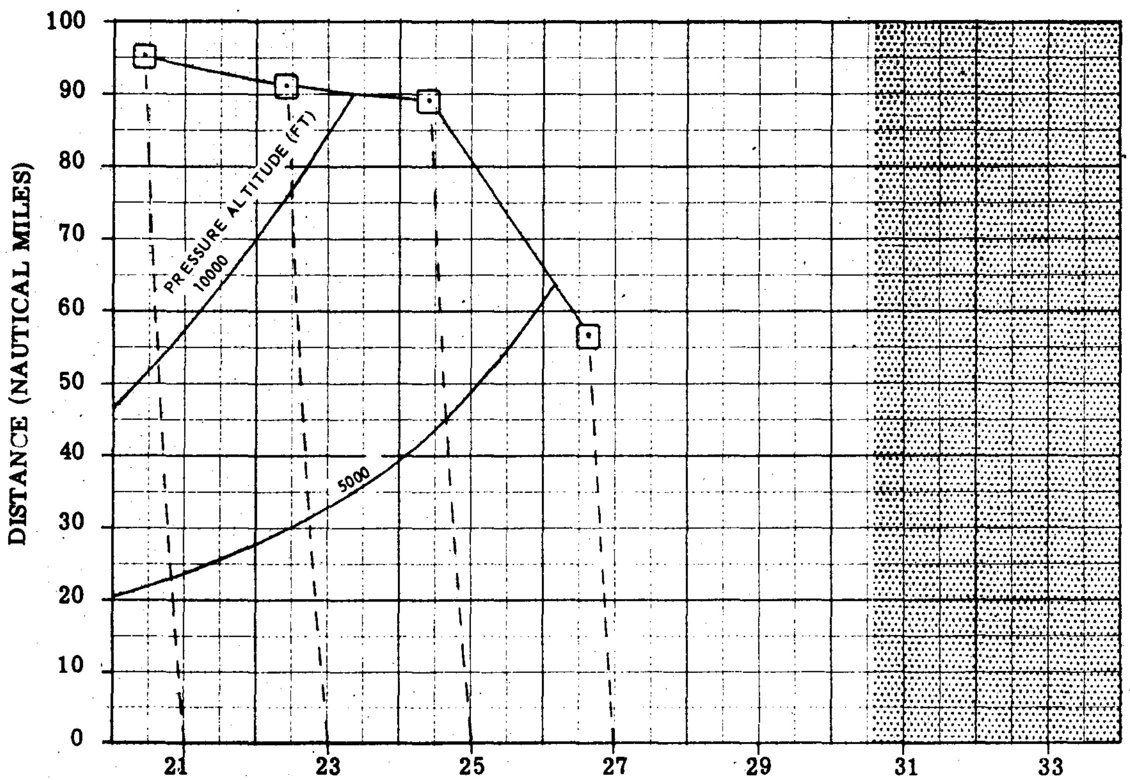


Figure A4-7. Distance to Climb - Standard Day - METO Power - Single Engine (Sheet 2 of 2)

TIME TO CLIMB - HOT DAY

METO POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

⊡ R/C = 100 FT/MIN.

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

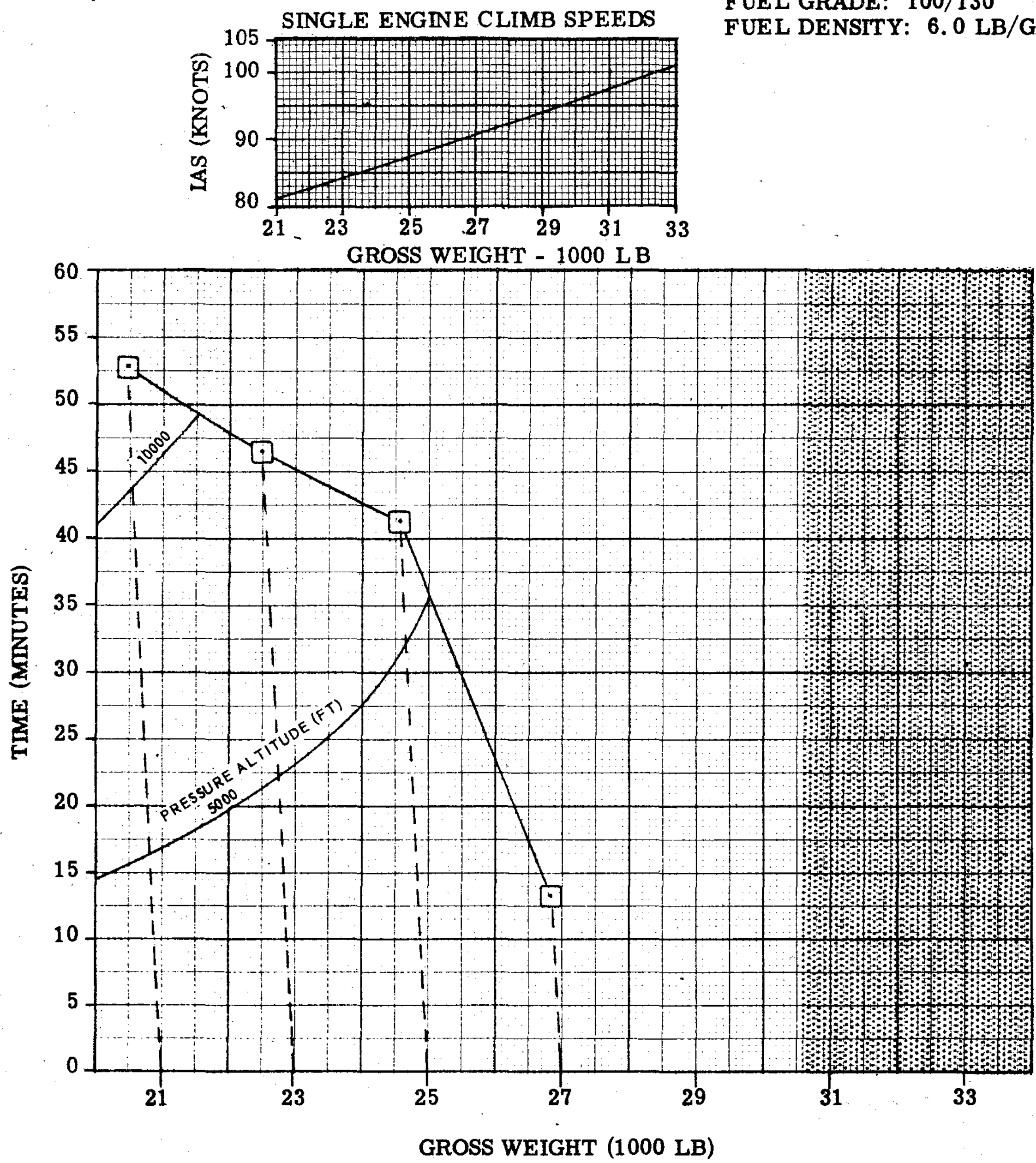


Figure A4-8. Time To Climb - Hot Day - METO Power - Single Engine. (Sheet 1 of 2)

DISTANCE TO CLIMB - HOT DAY

METO POWER SINGLE - ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

⊡ R/C = 100 FT/MIN.

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

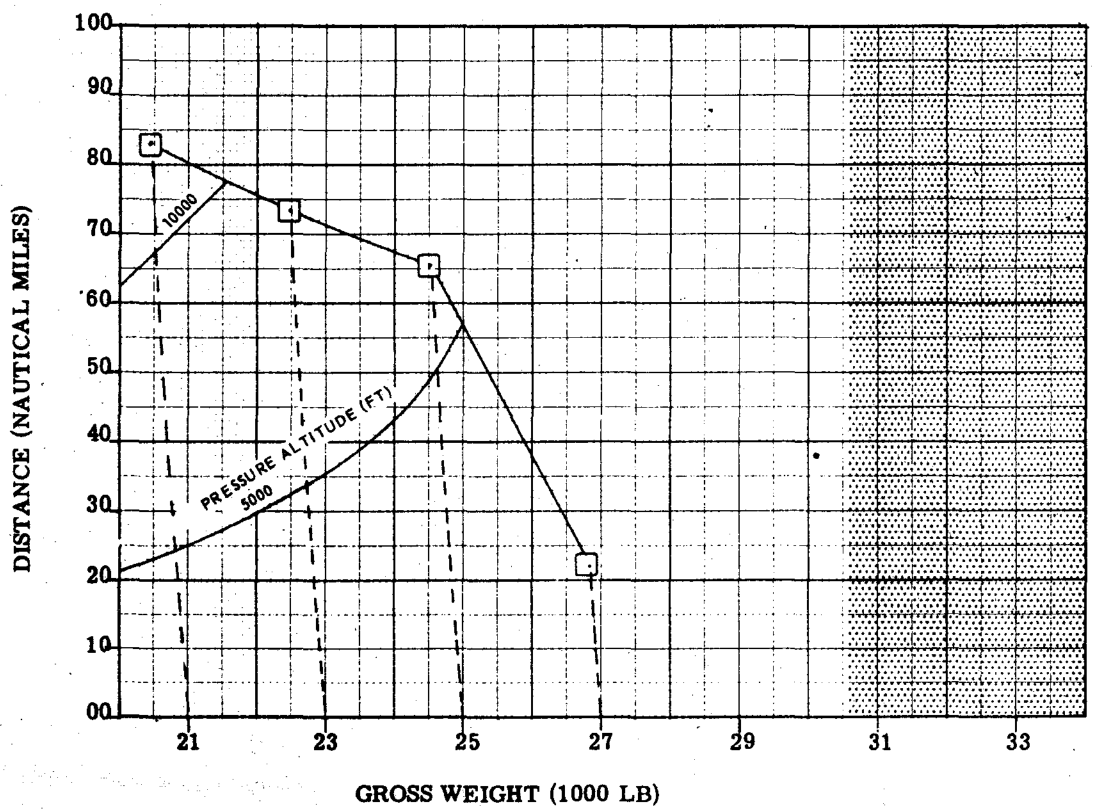


Figure A4-8. Distance To Climb - Hot Day - METO Power - Single Engine. (Sheet 2 of 2)

MODEL(S): C-47,
C-117 AND R4D

RATE OF CLIMB METO POWER

TWO-ENGINE WING FLAPS - UP COWL FLAPS - TRAIL POSITION

2550 RPM

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

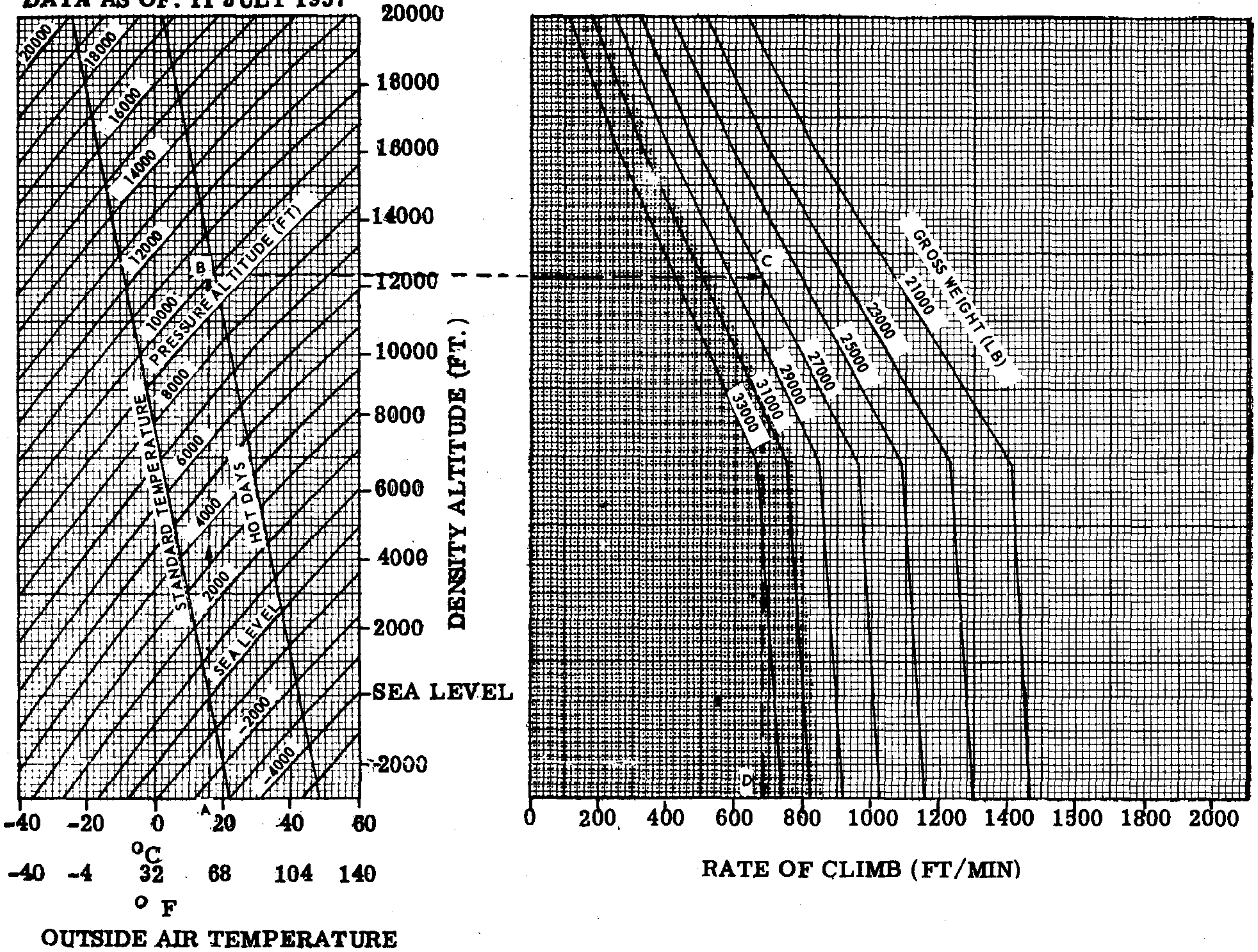


Figure A4-15. Rate of Climb - METO Power - 2550 RPM - Two Engine.

MODEL(S): C-47,
C-117 AND R4D

RATE OF CLIMB CLIMB POWER

TWO ENGINE - 2350 RPM

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

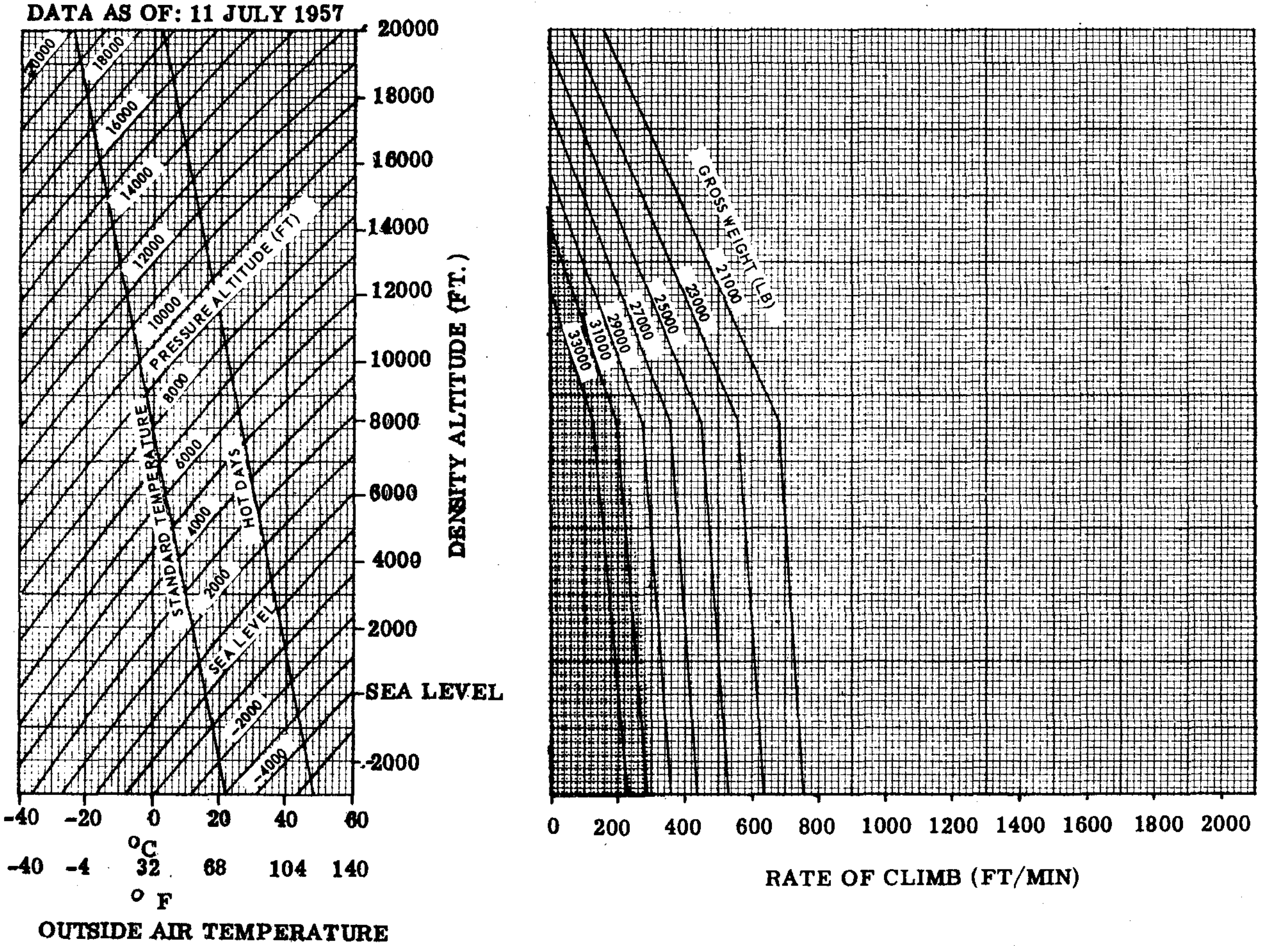


Figure A4-16. Rate of Climb - Climb Power - 2350 RPM - Two Engine.

MODEL(S): C-47,
C-117 AND R4D

RATE OF CLIMB - MAX POWER

SINGLE ENGINE
PROPELLER - FEATHERED ON INOPERATIVE ENGINE
2700 RPM

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

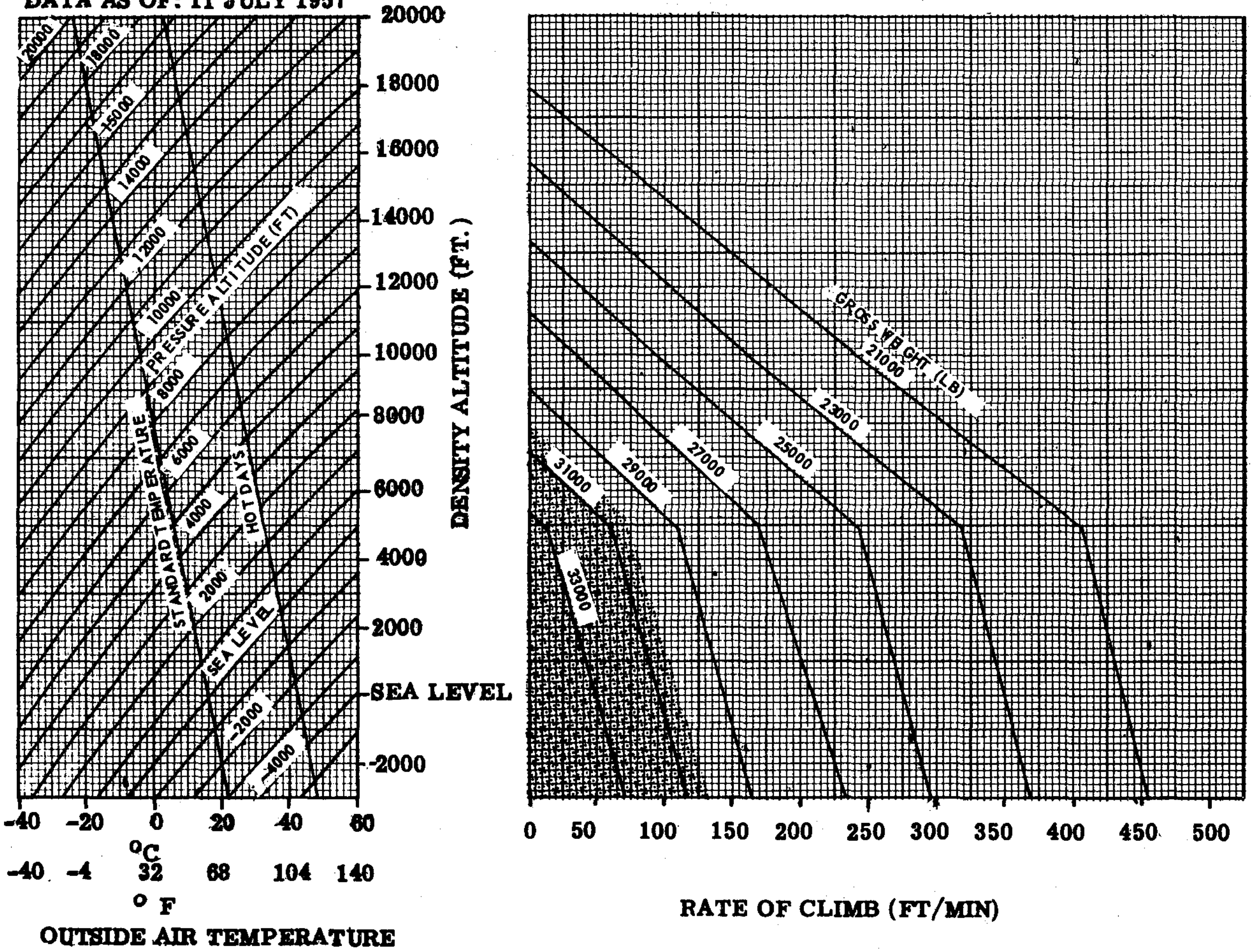


Figure A4-19. Rate of Climb - Maximum Power - 2700 RPM - Single Engine.

MODEL(S): C-47, C-117 AND R4D

RATE OF CLIMB – METO POWER

SINGLE ENGINE PROPELLER - FEATHERED ON INOPERATIVE ENGINE

2550 RPM

WING FLAPS - UP COWL FLAPS - TRAIL POSITION

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

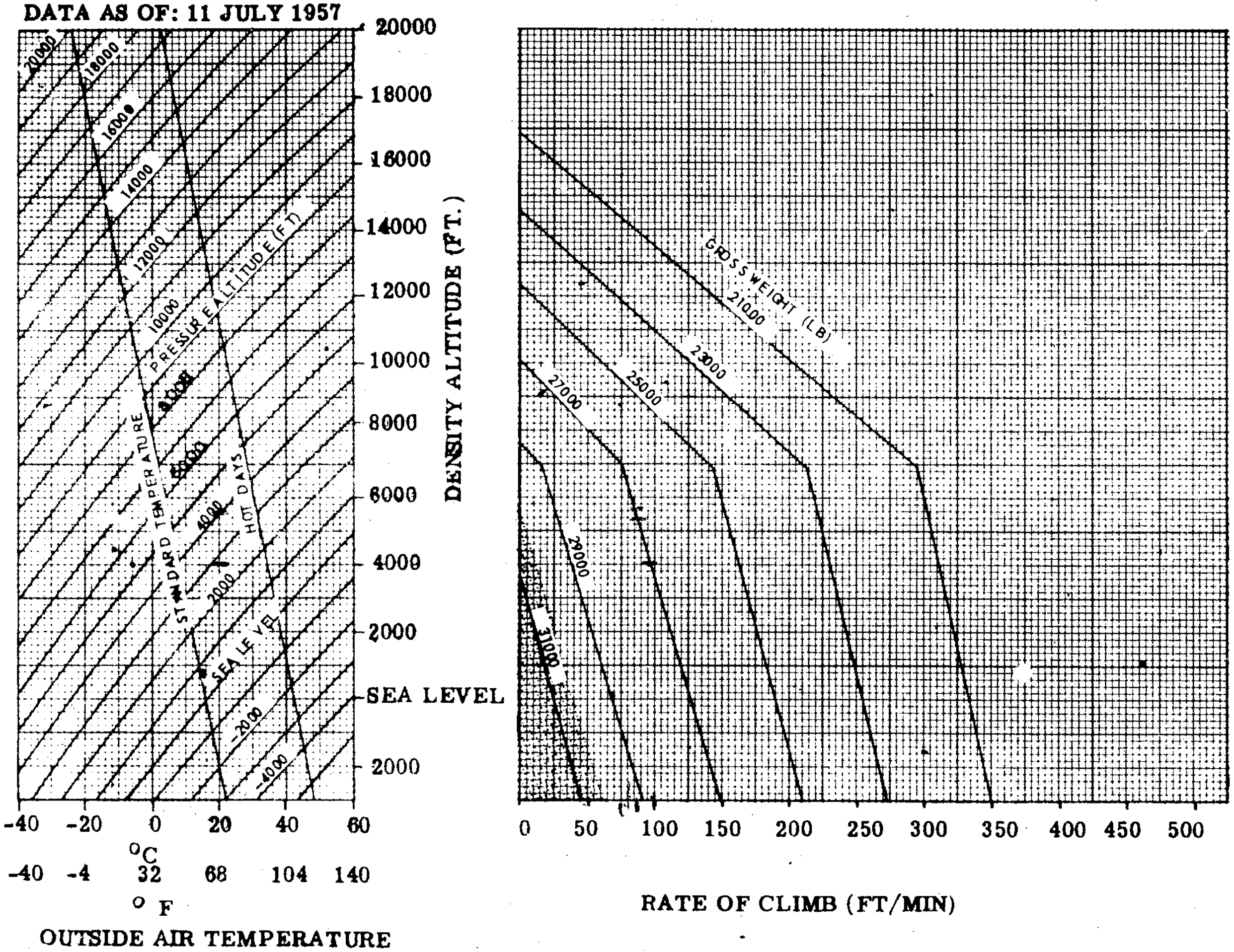


Figure A4-20. Rate of Climb - METO Power - 2550 RPM - Single Engine.

MODEL(S): C-47, C-117 AND R4D

RATE OF CLIMB — CLIMB POWER

SINGLE ENGINE- PROPELLER FEATHERED ON INOPERATIVE ENGINE

2350 RPM

WING FLAPS - UP   COWL FLAPS - TRAIL POSITION

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

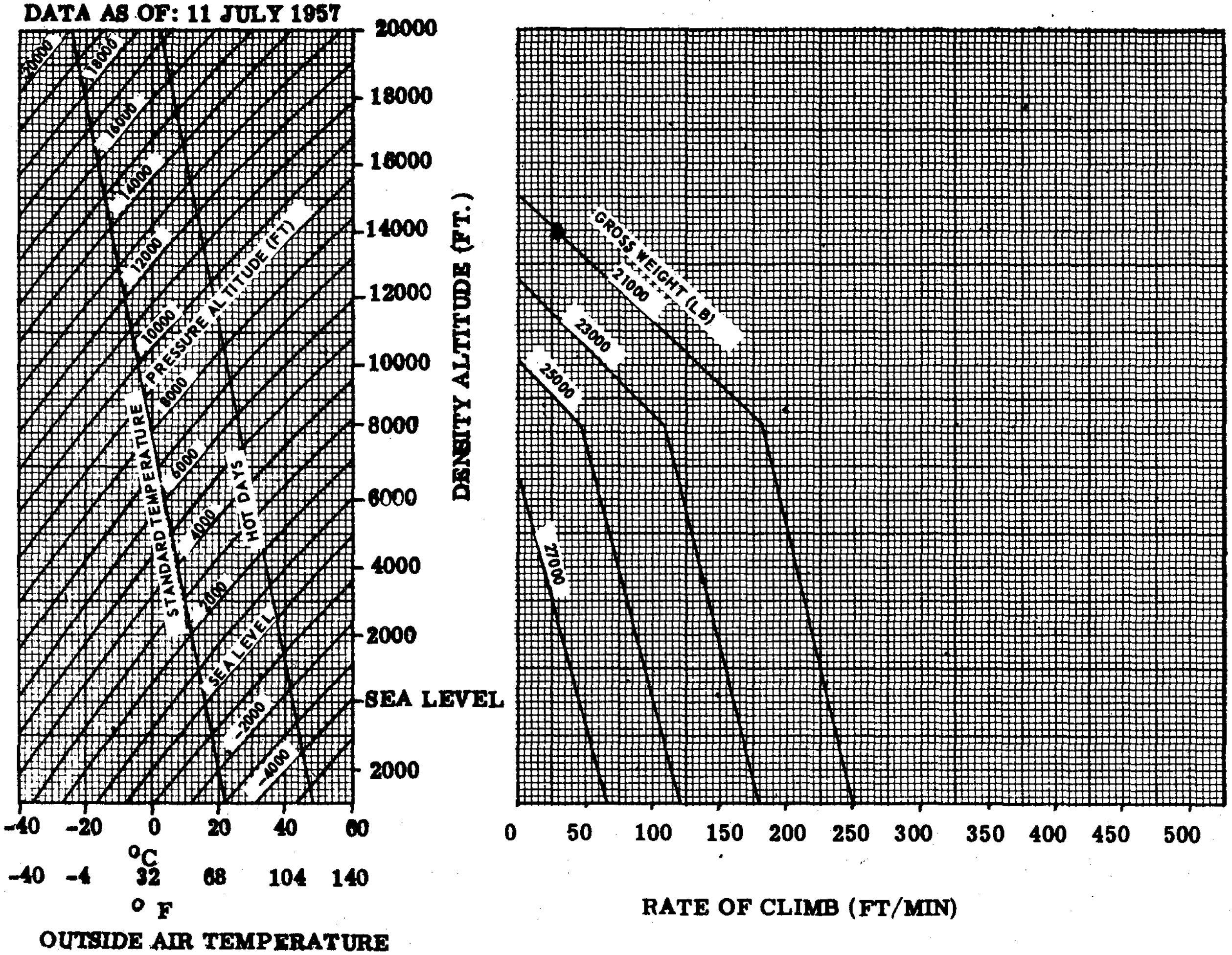


Figure A4-21. Rate of Climb - Climb Power - 2350 RPM - Single Engine.

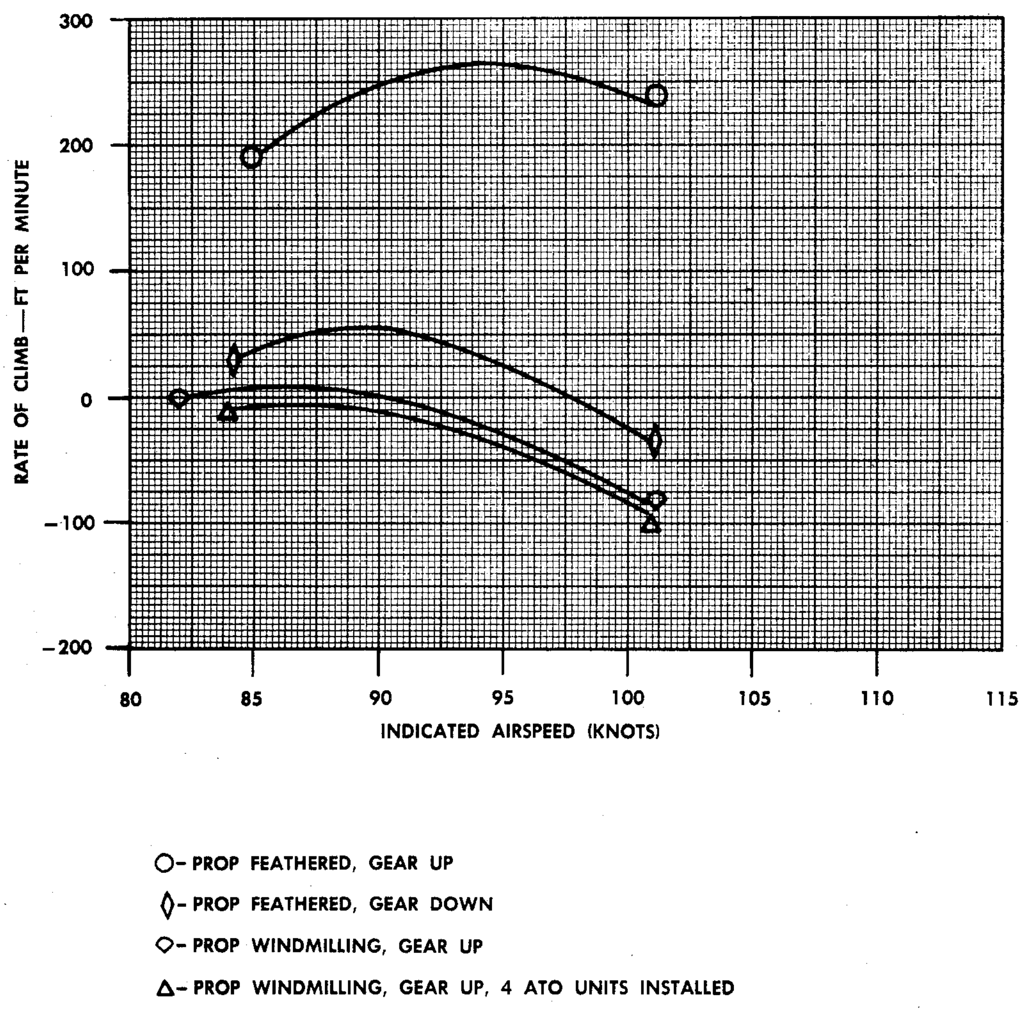
SINGLE-ENGINE SAWTOOTH CLIMB

CONFIGURATION I (CLEAN)
FLAPS UP
COWL FLAPS CLOSED ON INOPERATIVE ENGINE
TAKEOFF POWER AND COWL FLAPS TRAIL
ON OPERATING ENGINE
GROSS WEIGHT — 26,000 LBS

MODEL(S): C-47,
C-117 AND R4D

CONDITIONS
3000 FEET
NACA STANDARD DAY

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957



ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

Figure A4-25. Single Engine Sawtooth Climb.

EMERGENCY CEILING STANDARD DAY

100 FT/MIN RATE OF CLIMB AT METO POWER

CLEAN CONFIGURATION

SAMPLE PROBLEM:
A. GROSS WEIGHT = 27000 POUNDS.
B. TWO ENGINE - WITH SKIS CURVE.
C. PRESSURE ALTITUDE = 22000 FEET.

MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

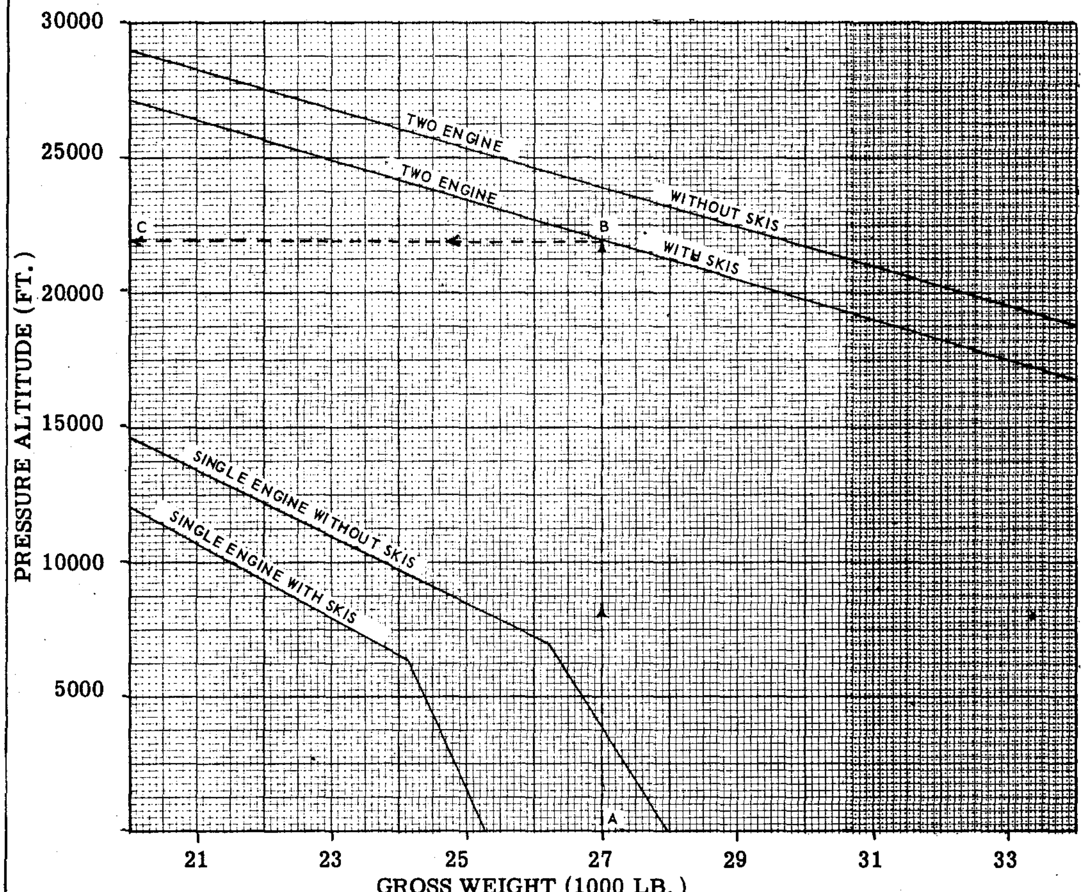


Figure A4-26. Emergency Ceiling - Standard Day.

PART FIVE
RANGE

TABLE OF CONTENTS

LIST OF CHARTS

DISCUSSION OF CHARTS.

The range performance is presented in three types of charts: long range power condition, flight planning for long range cruise condition, and level flight performance. Maximum endurance power conditions charts are also provided.

LEVEL FLIGHT PERFORMANCE

The level flight performance charts (figure A5-1 and A5-2) are used to determine the equivalent and true airspeeds, and the brake horsepower required per engine for level flight performance with and without skis during two engine operation at various combinations of gross weight and density altitude.

Enter the chart at the recommended long range airspeed curve, Point A, and proceed to the known gross weight curve, Point B. From this intersection, proceed horizontally to the known density altitude and read the required brake horsepower per engine for two engine operation, Point C. To determine the correct equivalent airspeed at this setting, proceed from Point B, vertically to the equivalent airspeed scale, Point D. The true airspeed may be determined by projecting a line vertically from Point D to the known density altitude, Point E, and interpolating the true airspeed at this point.

LONG RANGE POWER CONDITIONS

The long range power conditions charts (figure A5-3 through A5-6) are presented with sheet 1 of 2 and 2 of 2 on facing pages. Sheet 1 of 2 shows recommended true airspeed (TAS), brake horsepower, RPM, and manifold pressure. Sheet 2 of 2 shows fuel flow (pounds per hour) and specific range (nautical miles per pound of fuel). Charts are included for two engine and single engine long range operation at various weights in low blower, auto rich and auto lean carburetor settings. Enter each chart at the aircraft's initial cruise gross weight (or any desired intermediate gross weight) and proceed vertically from bottom to top. To gain maximum range efficiency from use of the chart, recompute power settings at least once each hour for the new gross weight (decreased as fuel is consumed). These charts are based on the recommended long range airspeed curve (99 percent maximum range) on the level flight performance charts (figure A5-1 and A5-2). A sample problem is presented on the first chart of this series.

FLIGHT PLANNING CHART FOR LONG RANGE CRUISE CONDITION

The flight planning charts for long range cruise condition (figures A5-7 through A5-13) are used to determine the fuel consumed and the time elapsed for a cruise operation when the required distance to cruise and either the initial or final aircraft cruise gross weight are known. In the event initial and final cruise gross weights are known, both the range and time to cruise may be obtained from the charts.

The charts are constructed for use with two and single-engine power conditions. The vertical scales labeled range and time, are presented only to find the difference in nautical miles (aircraft range) or time in (100 minutes) due to fuel consumption between initial and final cruise gross weights. A sample problem is included on the first chart of this series (figure A5-7).

Enter the chart with the given gross weight (Point A). Draw a line vertically to the time curve (Point B). Extend the line vertically from Point B to the range curve (Point C). Draw a line horizontally from Point C to the range scale (Point D). Subtract mission range from the value shown at Point D and reenter the range scale with this value (Point E). Draw a line horizontally from Point E to intersect the range curve (Point F). From Point F, draw a line vertically to the time curve (Point G) and extend to the gross weight scale (Point H). Subtract the value at Point H from the value at Point A to obtain the fuel required for the mission range. Similarly, time may be found by drawing a horizontal line from the time curve Point B and Point G, to the time scale, Point I and Point J. The difference between the values shown at Point I and Point J is the time corresponding to the mission range.

MAXIMUM ENDURANCE POWER CONDITIONS

The maximum endurance power conditions charts (figures A5-14 and A5-15) present the calibrated airspeed (CAS), brake horsepower, rpm, manifold pressure and fuel flow for maximum endurance conditions at various gross weights for operation with two engines. Where applicable, the charts contain altitude curves which show operation in auto rich or auto lean mixture in low blower.

To determine CAS, power, rpm, manifold pressure, and fuel flow values, enter the chart at the aircraft gross weight and proceed vertically. The desired values may then be read as the vertical line intersects the particular curve. The endurance in hours is obtained by dividing the amount of fuel remaining to be used by the average total fuel flow in pounds per hour occuring between the initial and final gross weights. Where sudden changes occur in the fuel flow curve, the endurance calculation should be separated into parts at the gross weight where the break occurs, and the separate endurance times added together.

LEVEL FLIGHT PERORMANCE
TWO ENGINE

MODEL(S): C-47, C-117 AND R4D

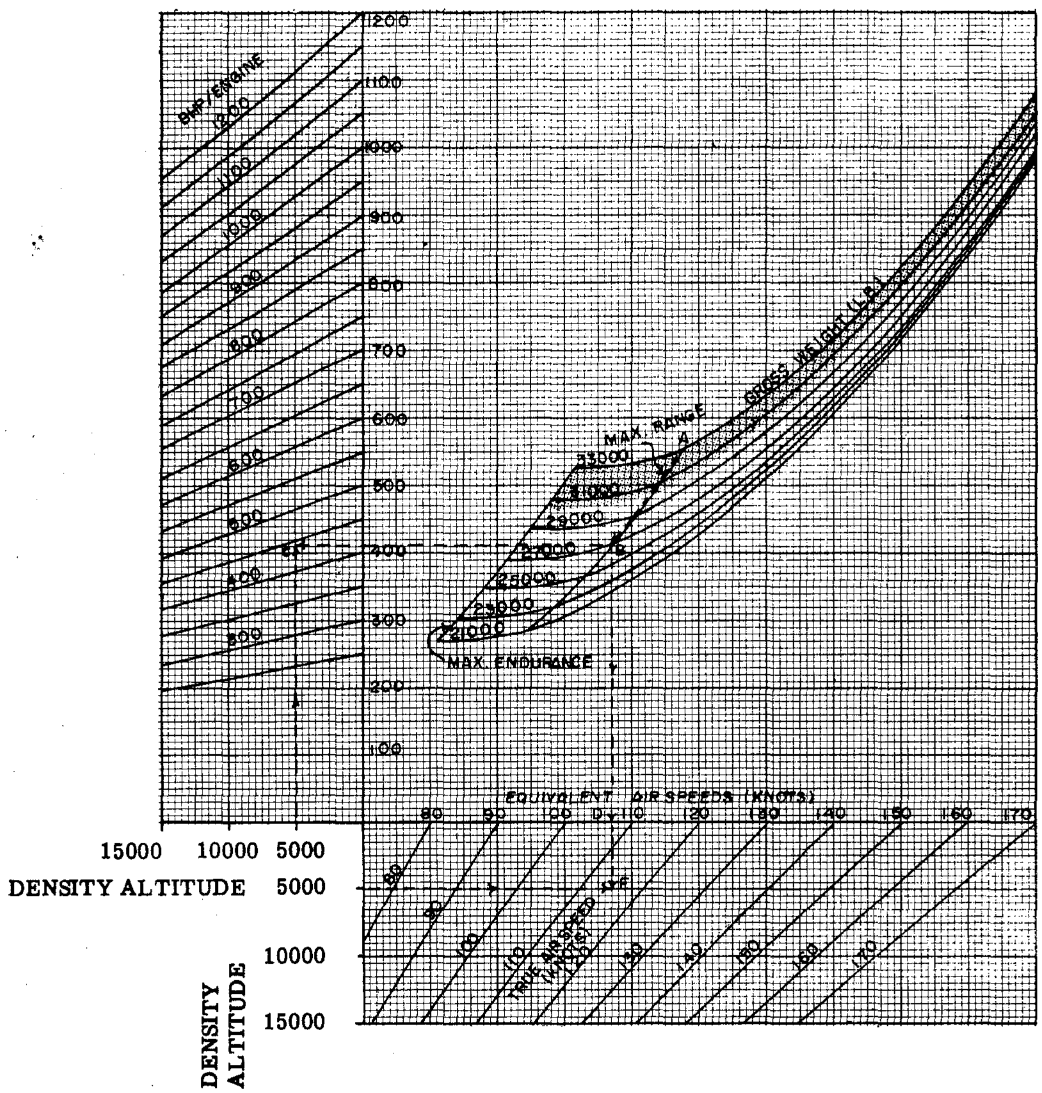
BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY· 6.0 LB/GAI

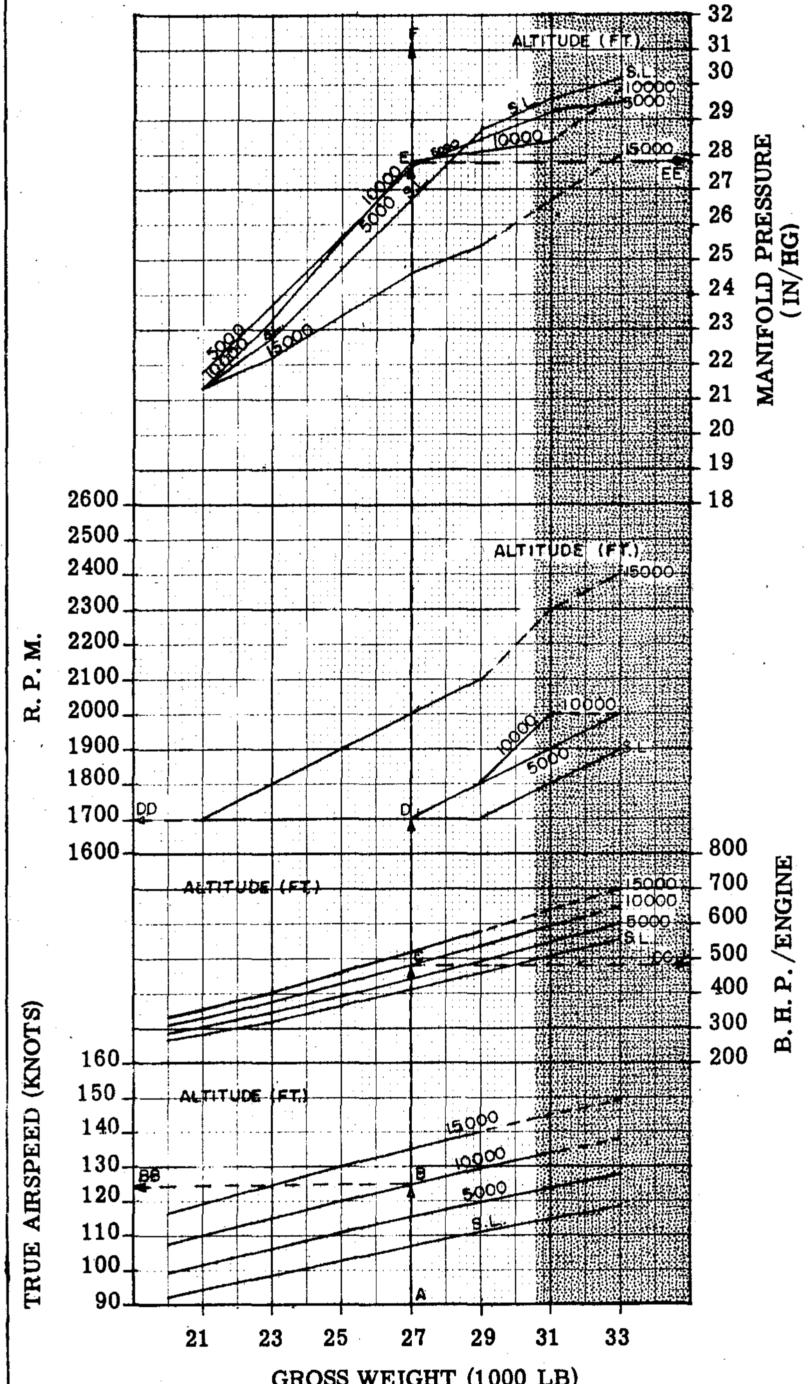
SAMPLE PROBLEM:

A. MAXIMUM RANGE.
B. GROSS WEIGHT = 27000 POUNDS.
C. BRAKE HORSEPOWER PER ENGINE = 440 AT 5000 FEET DENSITY ALTITUDE.
D. EQUIVALENT AIRSPEED = 107 KNOTS.
E. TRUE AIRSPEED = 115 KNOTS AT 5000 FEET DENSITY ALTITUDE.



A5-1. Level Flight Performance – Two Engines.

LONG RANGE POWER CONDITIONS
STANDARD DAY - TWO ENGINES



MODEL(S): C-47; C-117; and R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6 LB/GAL

BASED ON: FLIGHT TEST DATA AS OF: 11 JULY 1957

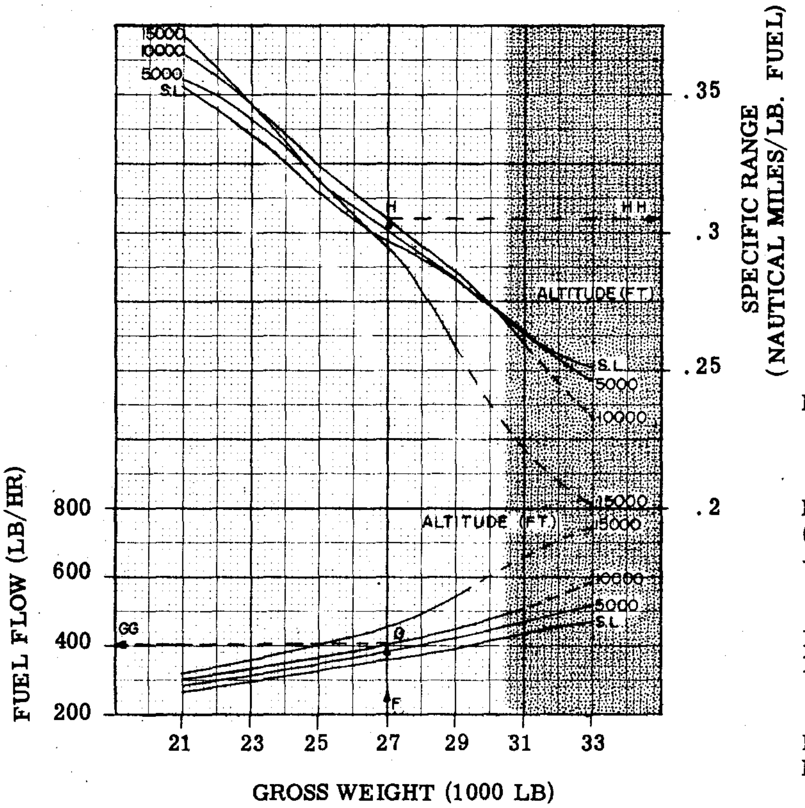
AUTO LEAN ________

AUTO RICH -----------

SAMPLE PROBLEM:
A, F. GROSS WEIGHT - 27000 pounds.
B, C, D, E, G and H. Altitude - 10,000 feet, standard day.
BB. True airspeed - 124.5 knots.
CC. Brake horsepower - 480.
DD. RPM - 1700.
EE. Manifold pressure - 27.5 IN. HG.
GG. Fuel flow - 405 pounds per hour.
HH. Specific range - .305 nautical miles per pound of fuel.

Figure A5-3. Long Range Power Conditions - Standard Day - Two Engines (Sheet 1 of 2)

LONG RANGE POWER CONDITIONS
STANDARD DAY-TWO ENGINES



MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

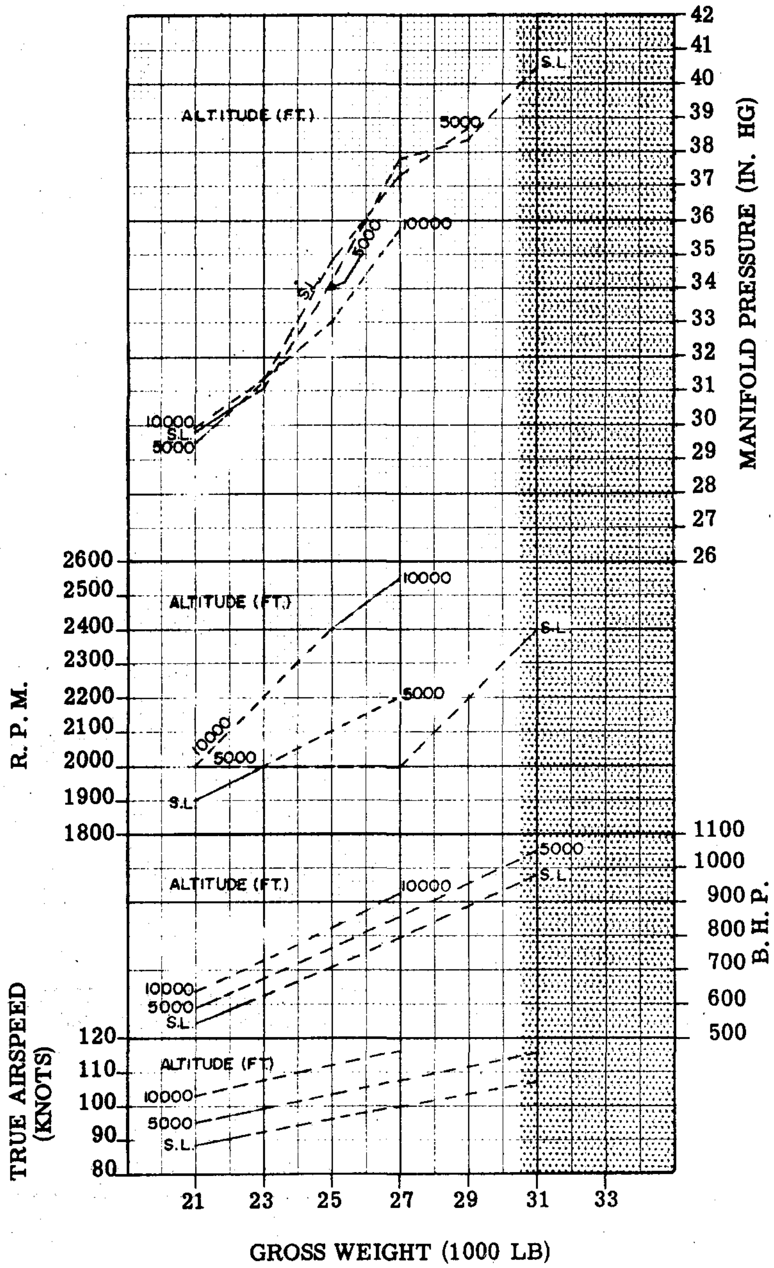
AUTO LEAN ________

AUTO RICH ---------

Figure A5-3. Long Range Power Conditions - Standard Day - Two Engines (Sheet 2 of 2)

LONG RANGE POWER CONDITION - STANDARD DAY - SINGLE ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE



MODEL(S): C-47, C-117 AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLI GHT TEST DATA
DATA AS OF: 11 JULY 1957

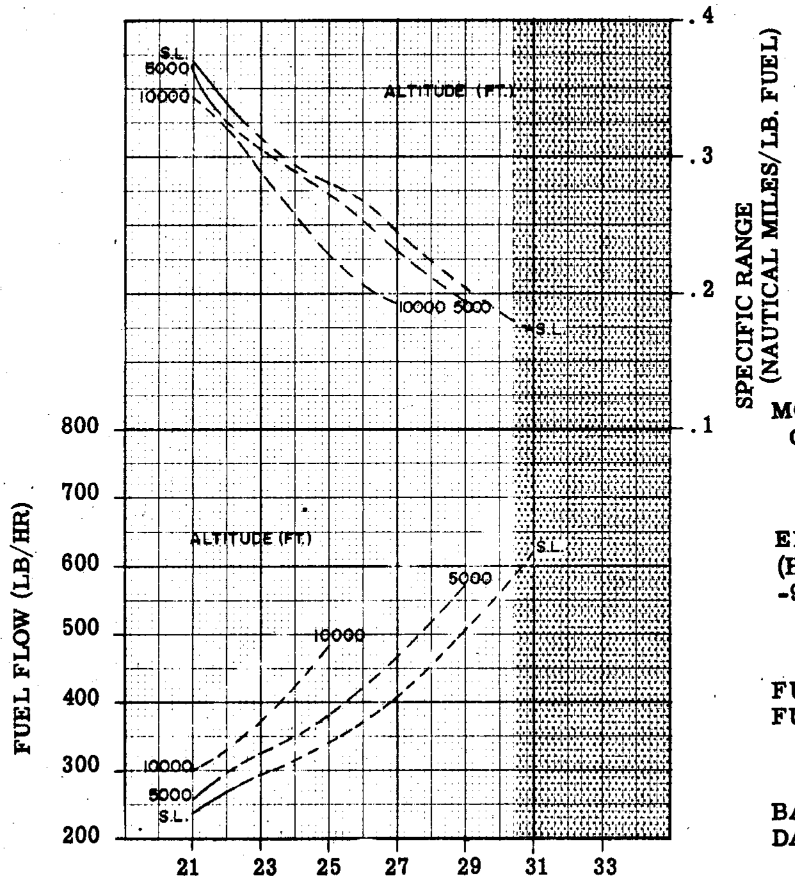
AUTO LEAN _________

AUTO RICH ----------

Figure A5-5. Long Range Power Condition - Standard Day - Single Engine (Sheet 1 of 2)

LONG RANGE POWER CONDITION-STANDARD DAY-SINGLE ENGINE

PROPELLER-FEATHERED ON INOPERATIVE ENGINE



MODEL(S): C-47,
C-117 AND R4D

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

AUTO LEAN ________

AUTO RICH - - - - -

Figure A5-5. Long Range Power Condition - Standard Day - Single Engine (Sheet 2 of 2)

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE SEA LEVEL

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

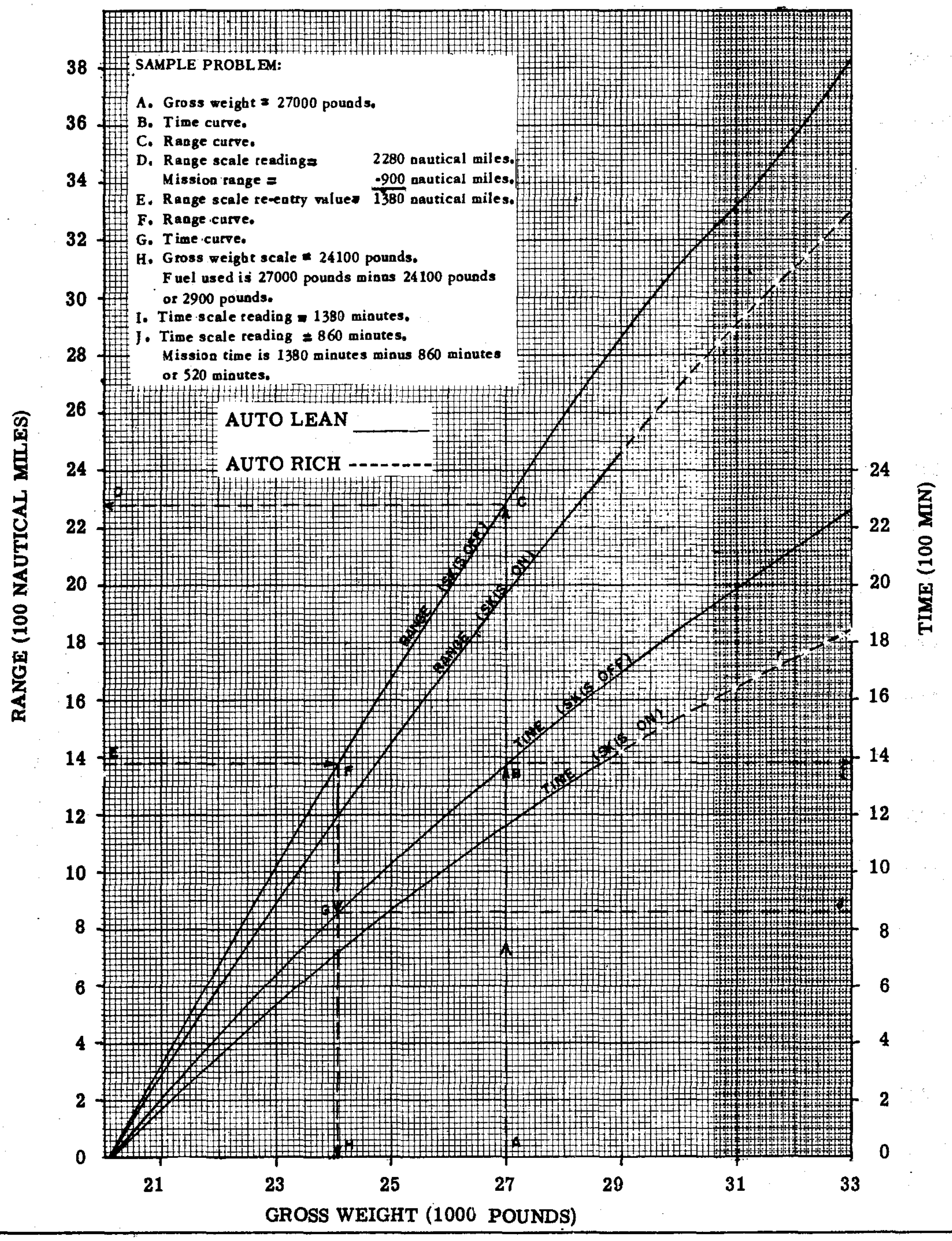


Figure A5-7. Flight Planning for Long Range Cruise Condition - Two Engines - Sea Level.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE 5000 FT. ALTITUDE

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

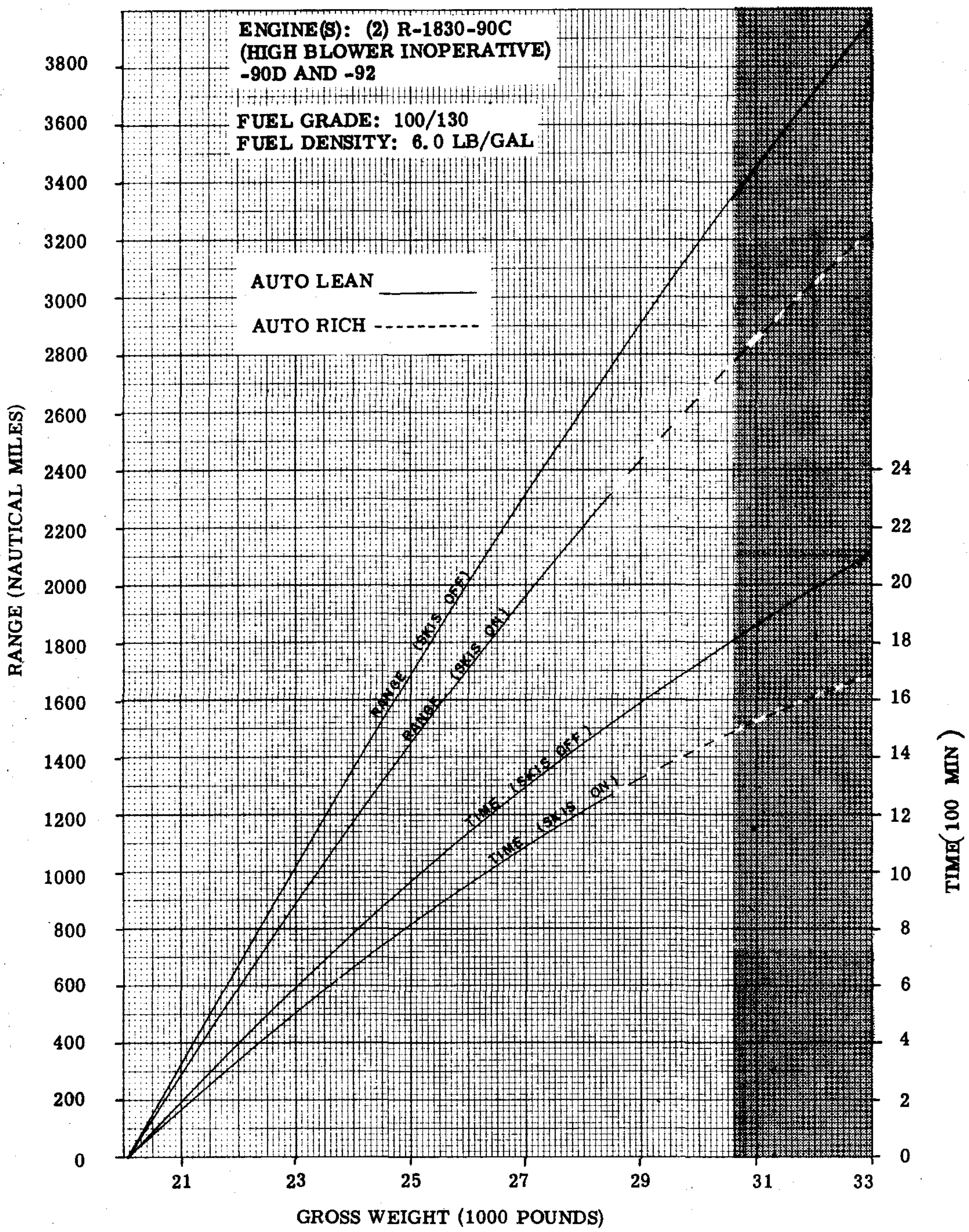


Figure A5-8. Flight Planning for Long Range Cruise Condition - Two Engines - 5000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE
10000 FT. ALTITUDE

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

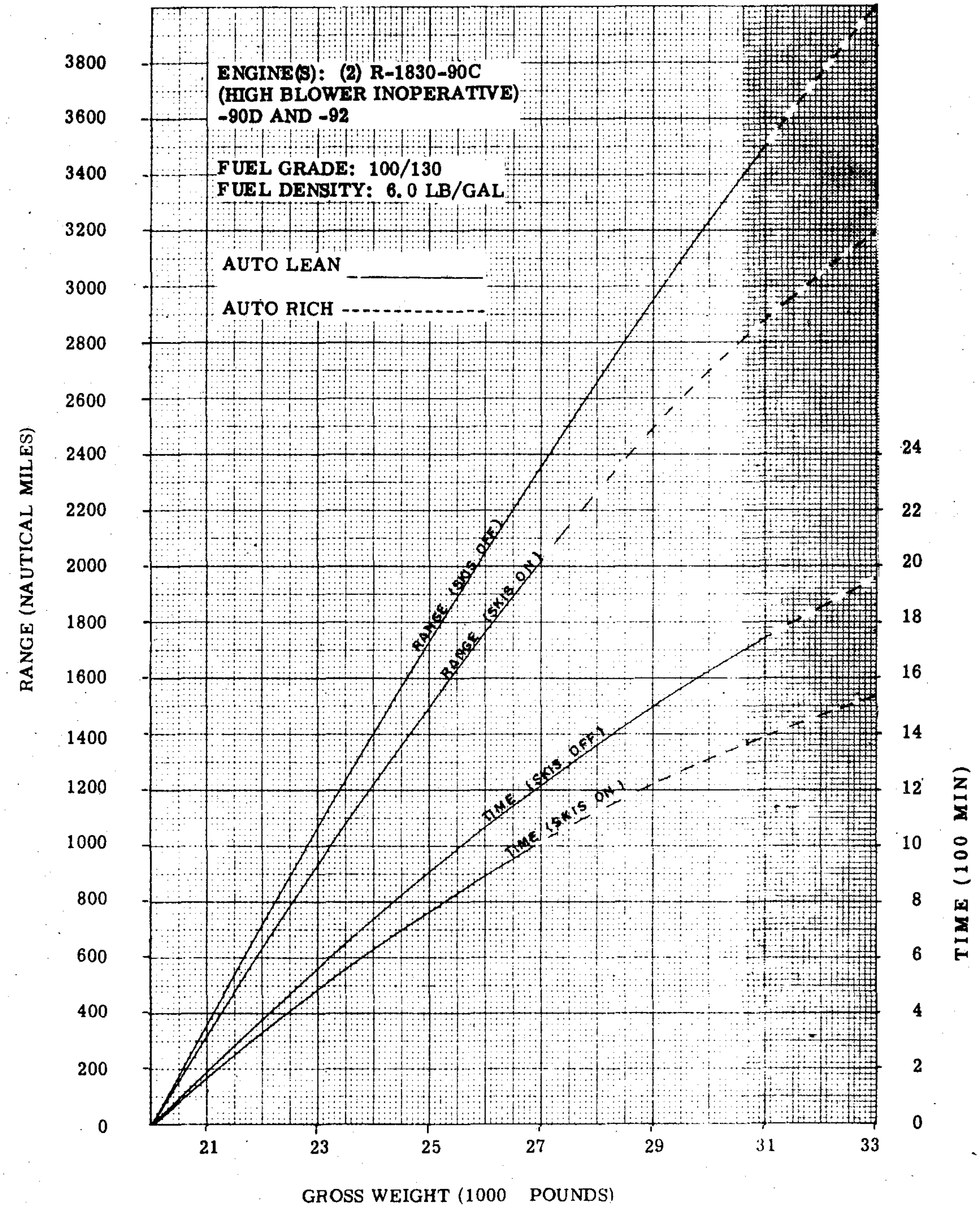


Figure A5-9. Flight Planning for Long Range Cruise Condition - Two Engines - 10000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - TWO ENGINE (15000 FT. ALTITUDE)

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

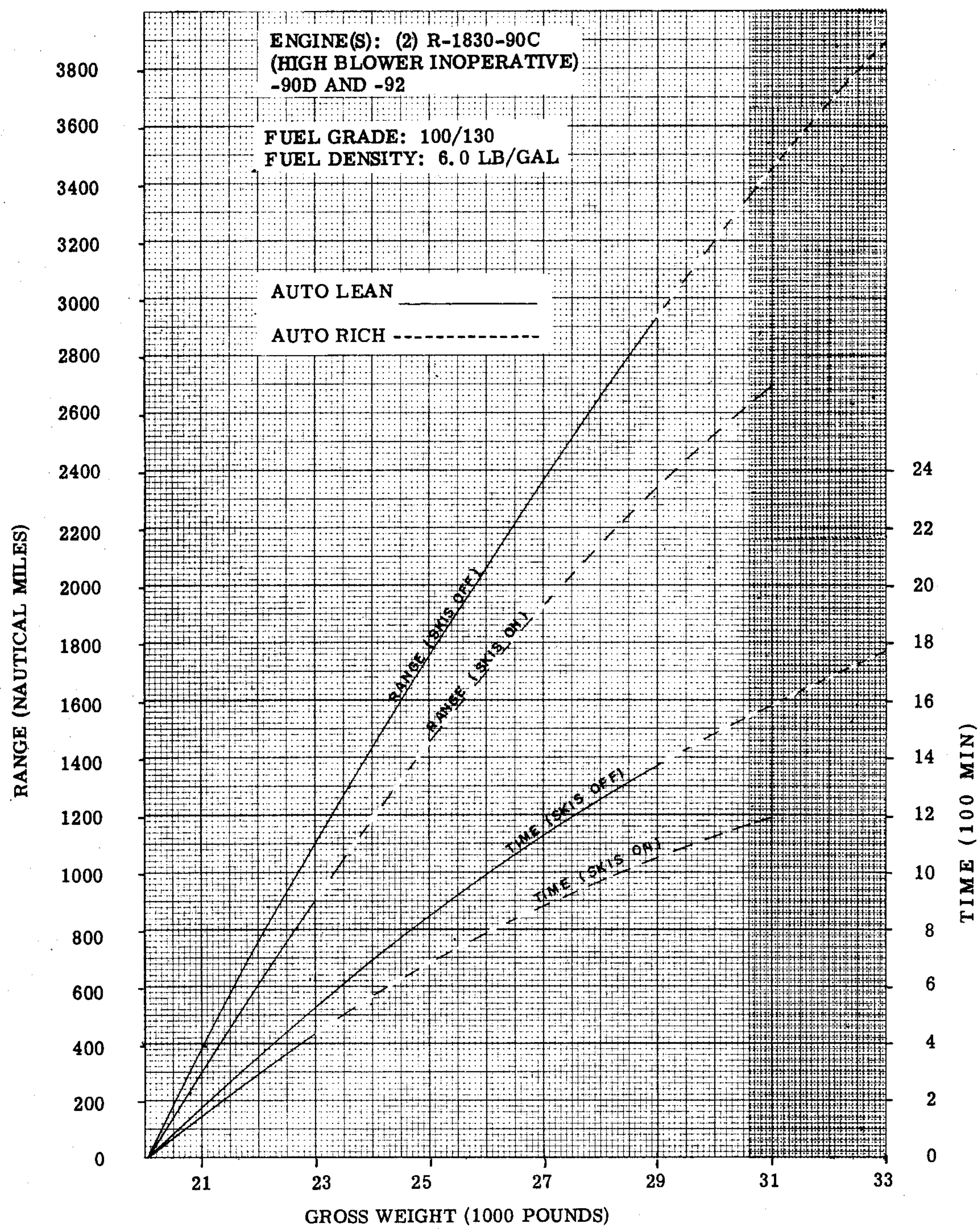


Figure A5-10. Flight Planning for Long Range Cruise Condition - Two Engines - 15000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION
SINGLE-ENGINE SEA LEVEL

PROPELLER: FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

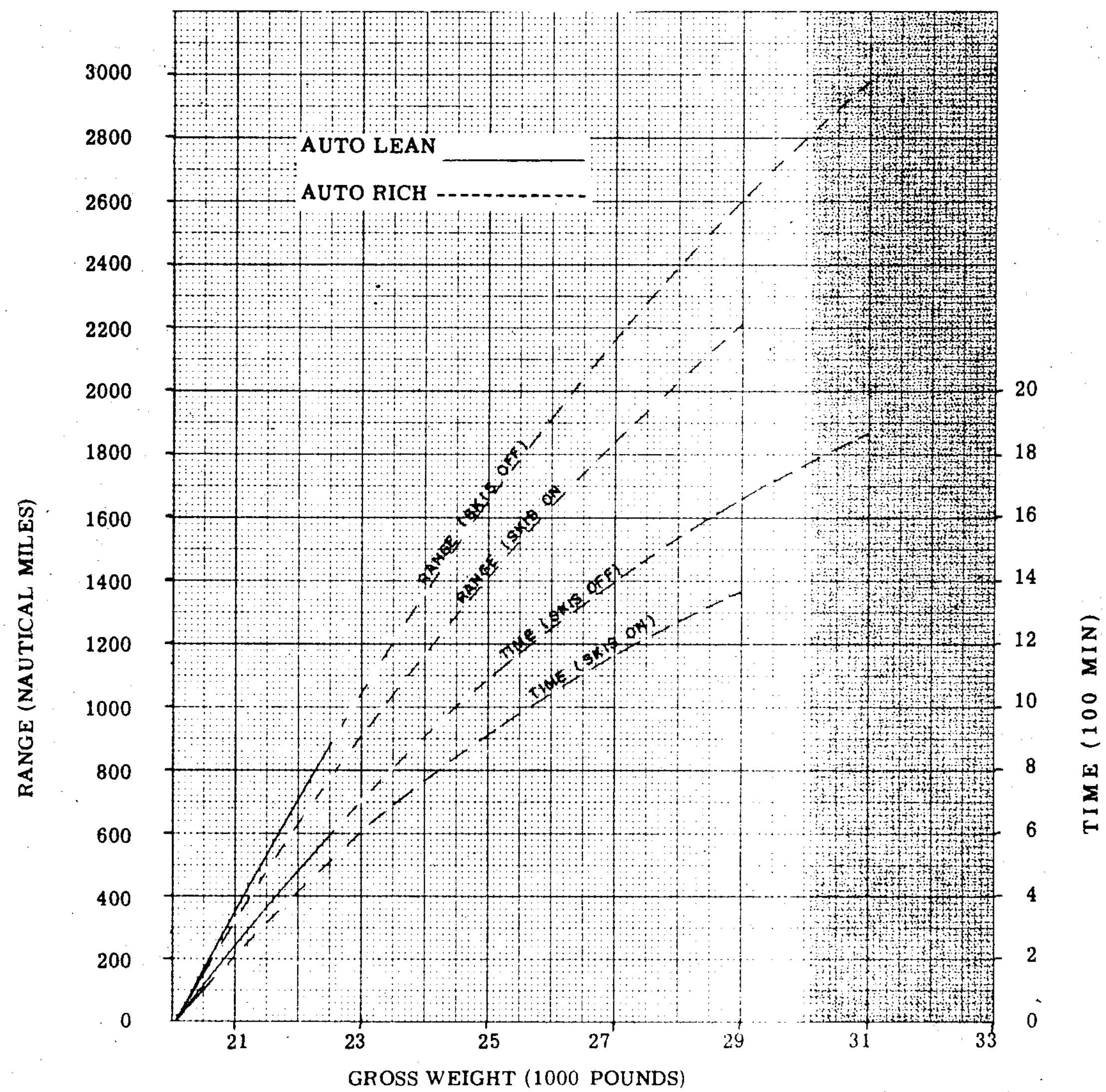


Figure A5-11. Flight Planning for Long Range Cruise Condition - Single Engine - Sea Level.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION
SINGLE ENGINE (5000 FT.)

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

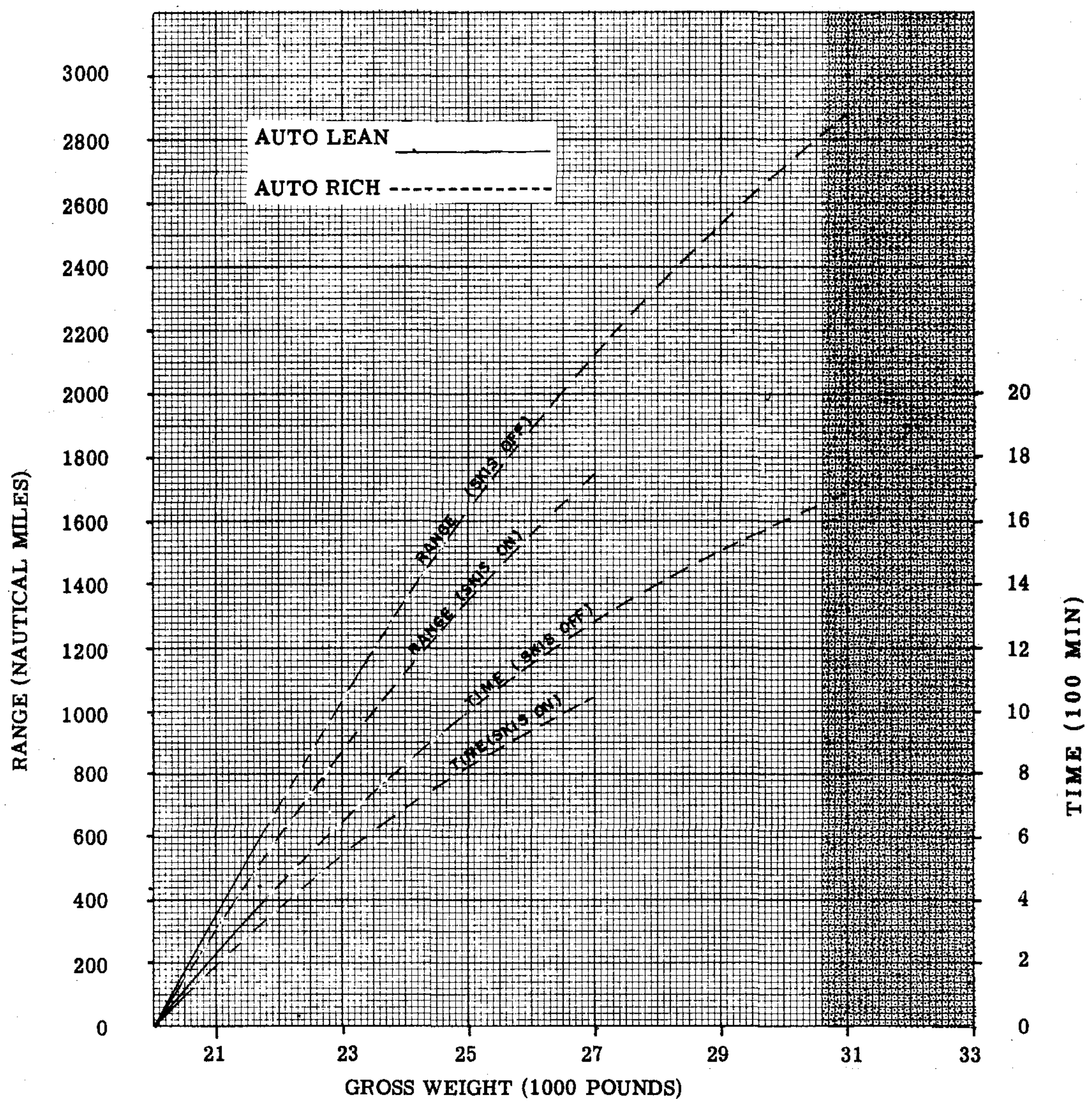


Figure A5-12. Flight Planning for Long Range Cruise Condition - Single Engine - 5000 Ft.

FLIGHT PLANNING FOR LONG RANGE CRUISE CONDITION - SINGLE-ENGINE (10000 FT.)

PROPELLER-FEATHERED ON INOPERATIVE ENGINE

MODEL(S): C-47
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL

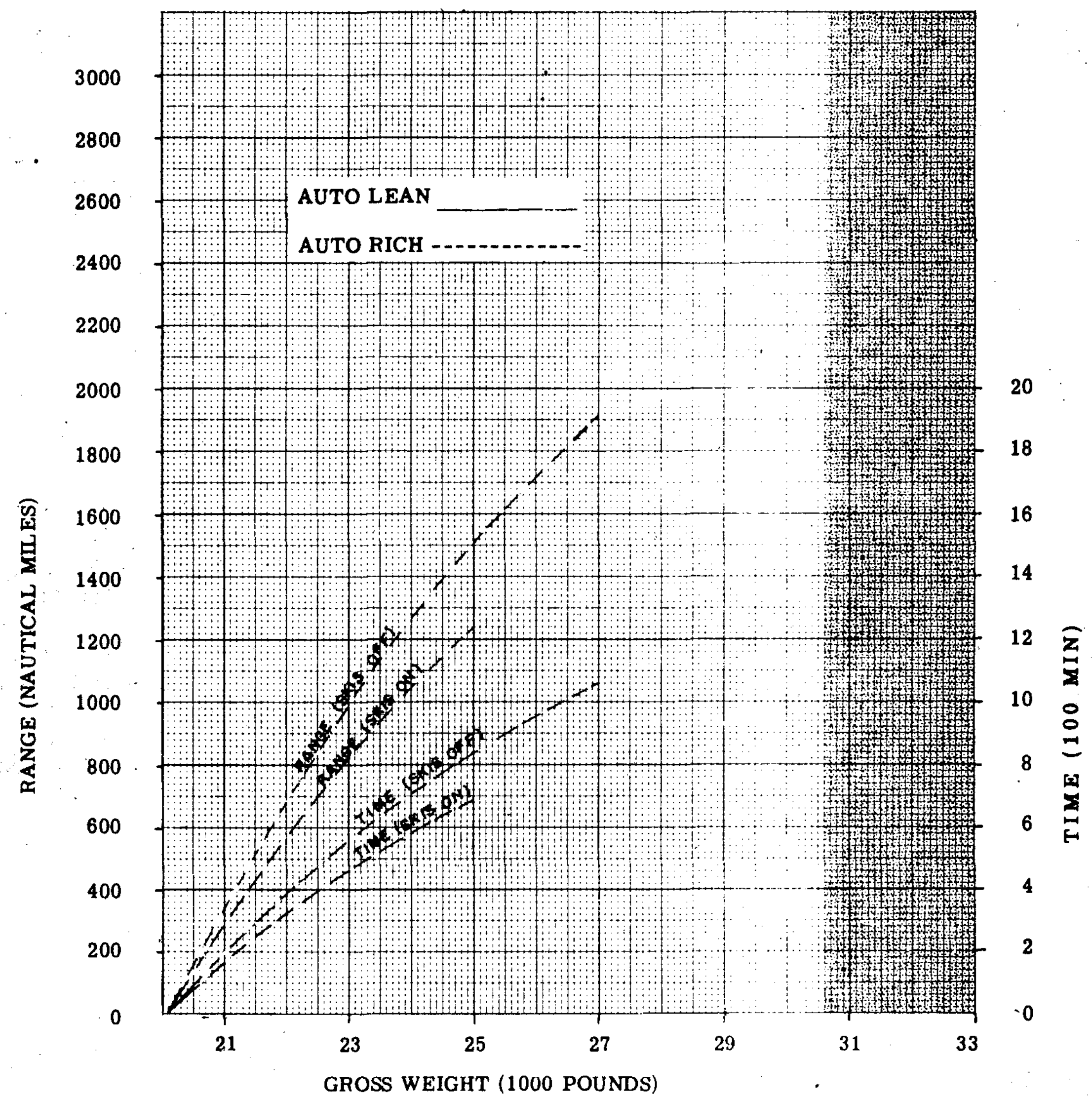


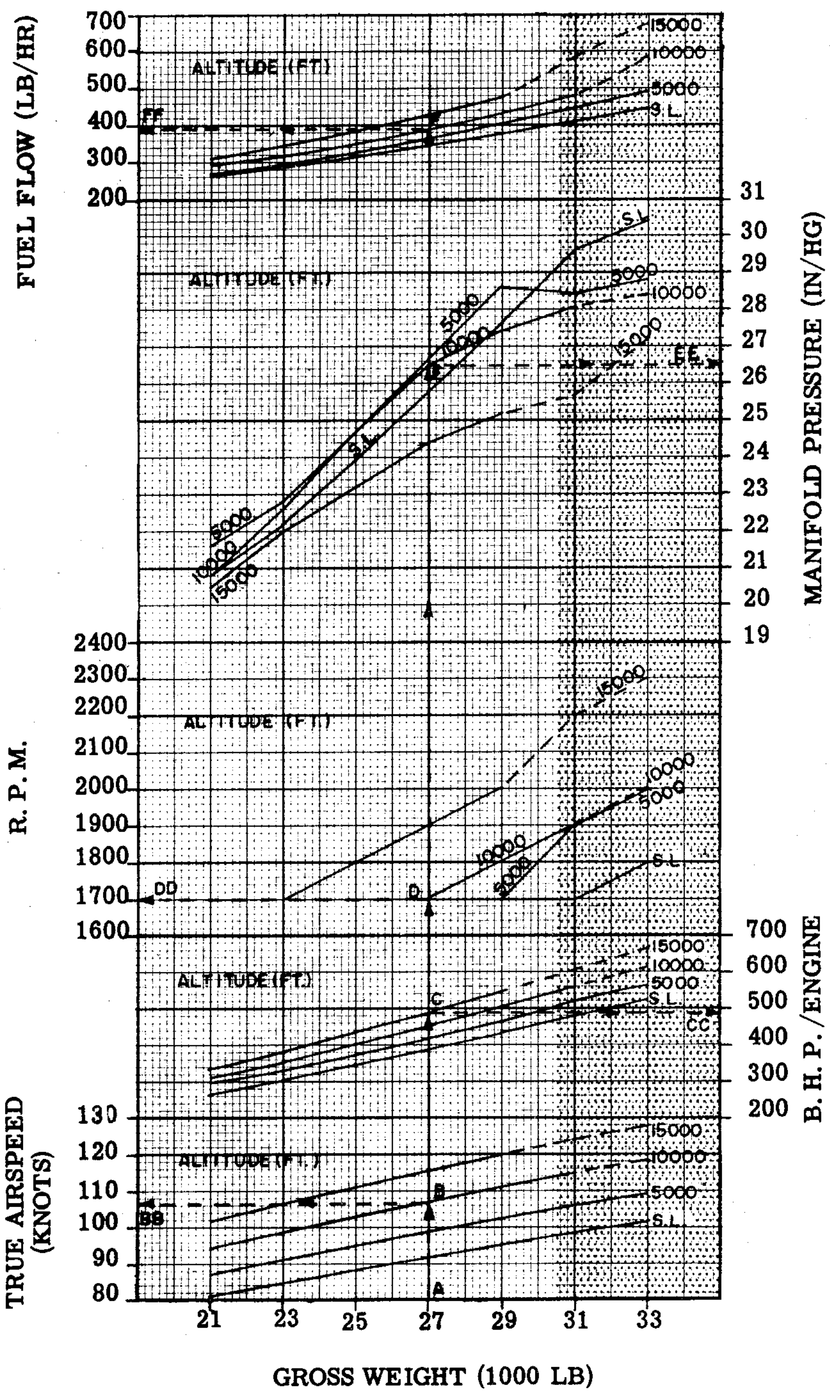
Figure A5-13. Flight Planning for Long Range Cruise Condition - Single Engine - 10000 Ft.

MAXIMUM ENDURANCE POWER CONDITION - TWO-ENGINE
STANDARD DAY

MODEL(S): C-47,
C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

ENGINE(S): R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92
FUEL GRADE: 100/130
FUEL DENSITY: 6.0 LB/GAL



AUTO LEAN ________

AUTO RICH----------

SAMPLE PROBLEM

A. GROSS WEIGHT = 27000 POUNDS.
B, C, D, E AND F = 10,000 FEET ALTITUDE.
BB. TRUE AIRSPEED = 106.5 KNOTS.
CC. BRAKE HORSEPOWER = 450.
DD. RPM = 1700.
EE. MANIFOLD PRESSURE = 26.5.
FF. FUEL FLOW = 390 POUNDS PER HOUR.

Figure A5-14. Maximum Endurance Power Condition - Two Engines.

PART SIX
LANDING

TABLE OF CONTENTS

LIST OF TABLES

DISCUSSION OF CHARTS.

The landing charts are included to enable the pilot to determine the length of the runway necessary to land the aircraft safely under various conditions of wind, temperature, altitude, and runway surface. Since the length of the landing ground run depends to a great extent on the coefficient of friction (μ) numerical values of μ are shown on the landing ground run charts (figures A6-1 through A6-4) corresponding to the most commonly encountered runway surface conditions.

LANDING GROUND RUN

The landing ground run charts (figures A6-1 through A6-4) are used to determine that landing ground run distance for density altitudes (up to 16,000 feet), gross weight, actual wind component, and runway surface condition. The charts are based on the recommended touchdown speed obtained from the characteristic landing speeds chart (figure A6-5). These charts give ground run only; to compute landing distance from a 50-foot height, first determine landing ground run for prevailing runway surface conditions, then add 90 percent of the landing ground run for hard runway surface. The sum of these two distances will give the approximate total landing distance from a 50-foot height.

CHARACTERISTIC LANDING SPEEDS.

The characteristic landing speed chart (figure A6-5) presents recommended touchdown speeds in both knots and MPH indicated airspeed with zero, ¼, ½, and full flaps for various aircraft gross weights. All lines represent the 110 percent power off stall speed for the flap position shown. Enter the chart at the planned landing gross weight and proceed vertically to the appropriate speed curve, then proceed horizontally to the indicated airspeed.

POWER-OFF STALL SPEEDS.

Power-off stall speed charts (figure A6-6 through A6-9) are included for zero, ¼, ½ and full DOWN (45°) flap settings. The power-off stall speeds were determined with the throttles in the CLOSED position. When power is maintained on the engines, the airflow over the wings behind the propellers is increased and therefore increases lift and lower the stalling speed. This effect varies with power setting.

SAMPLE PROBLEM:

GIVEN:

1. Outside Air Temperature = 14°C
2. Pressure Altitude = 2000 feet
3. Gross Weight = 27000 pounds
4. Reported Headwind = 20 knots
5. Runway Surface Condition = Sod
6. Wing Flaps = 45 Degrees

FIND:

1. Landing Groundrun Distance

SOLUTION:

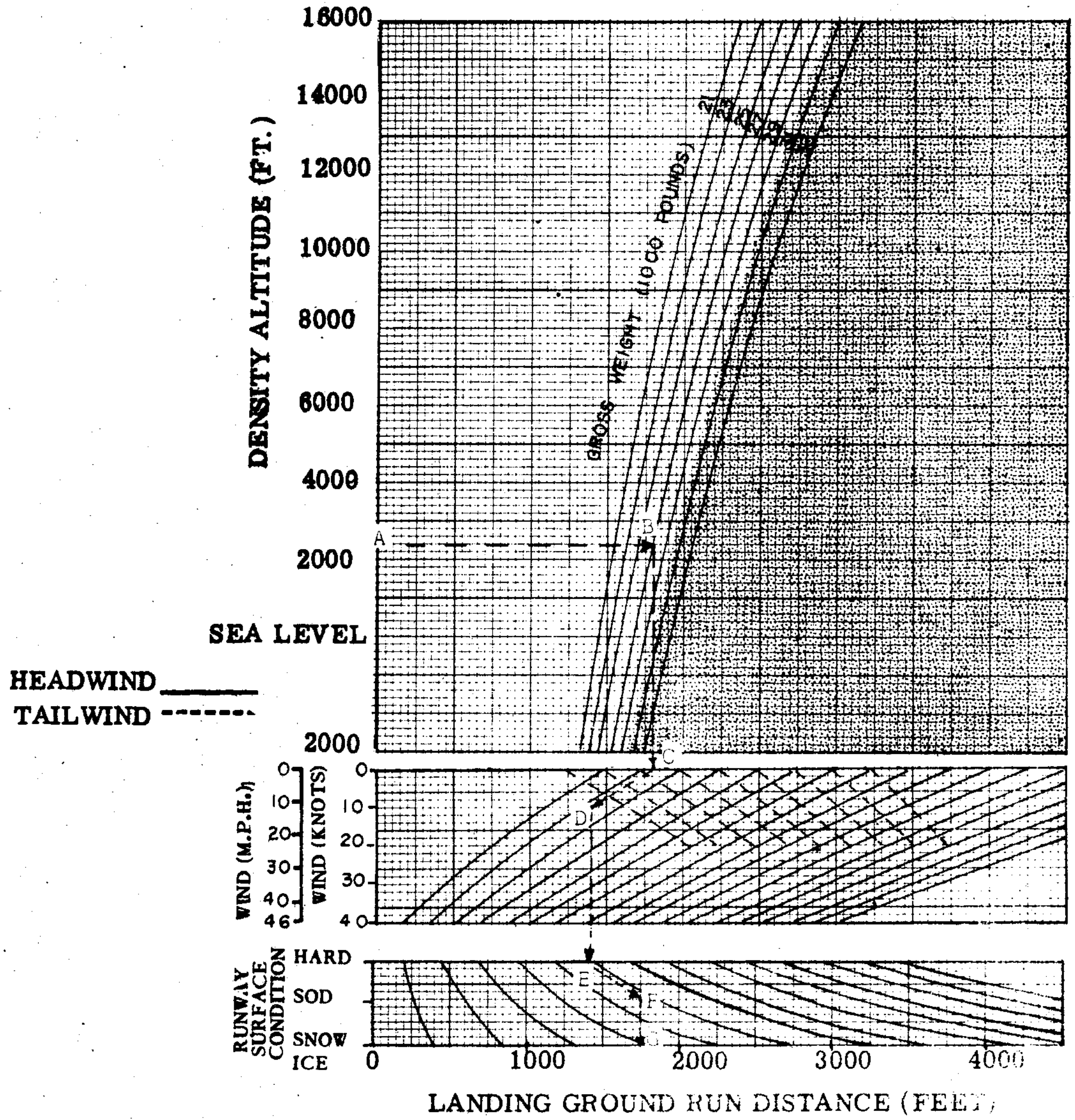
1. From Figure A1-4, determine density altitude = 2300 feet
2. Enter Figure A6-1 with this density altitude (2300 feet, Point A) and proceed horizontally to the desired gross weight (27000 pounds, point B)
3. From this point extend a line down to the base line of the wind correction grid (Point C).
4. Follow the contour line to 50 percent of the reported headwind (10 knots, Point D)
5. From Point D extend a line down to the base line of the Runway Surface Condition Correction grid (Point E).
6. Follow the contour line to runway surface condition (Point F, Sod).
7. From this point extend a line down to the landing Ground Run Distance (Point G) and read Landing Ground Runs Distance of 1750 feet.

LANDING GROUND RUN

TOUCHDOWN AT 1.1Vs
WING FLAPS = 45 DEGREES
IDLE POWER

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D



ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

NOTE:

1. Speed at 50 foot height = 120 percent of stall speed.
2. Speed at touchdown = 110 percent of stall speed.
3. Wing flaps = 45 degrees.
4. This chart is for landing ground run distance only. Air run from a 50 foot height to touchdown is approximately 30 percent of landing ground run on hard surface for 45 degrees flap. Total landing distance from a 50 foot height is the sum of the air run plus the ground run distance for any prevailing runway surface condition.
5. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid, if wind is measured at a source other than runway. This is a recommended procedure which may be revised at the discretion of the pilot, depending upon the source of measurement of the wind data.

Figure A6-1. Landing Ground Run – Touchdown at 1.1V_s – Wing Flaps - 45 Degrees.

LANDING GROUND RUN

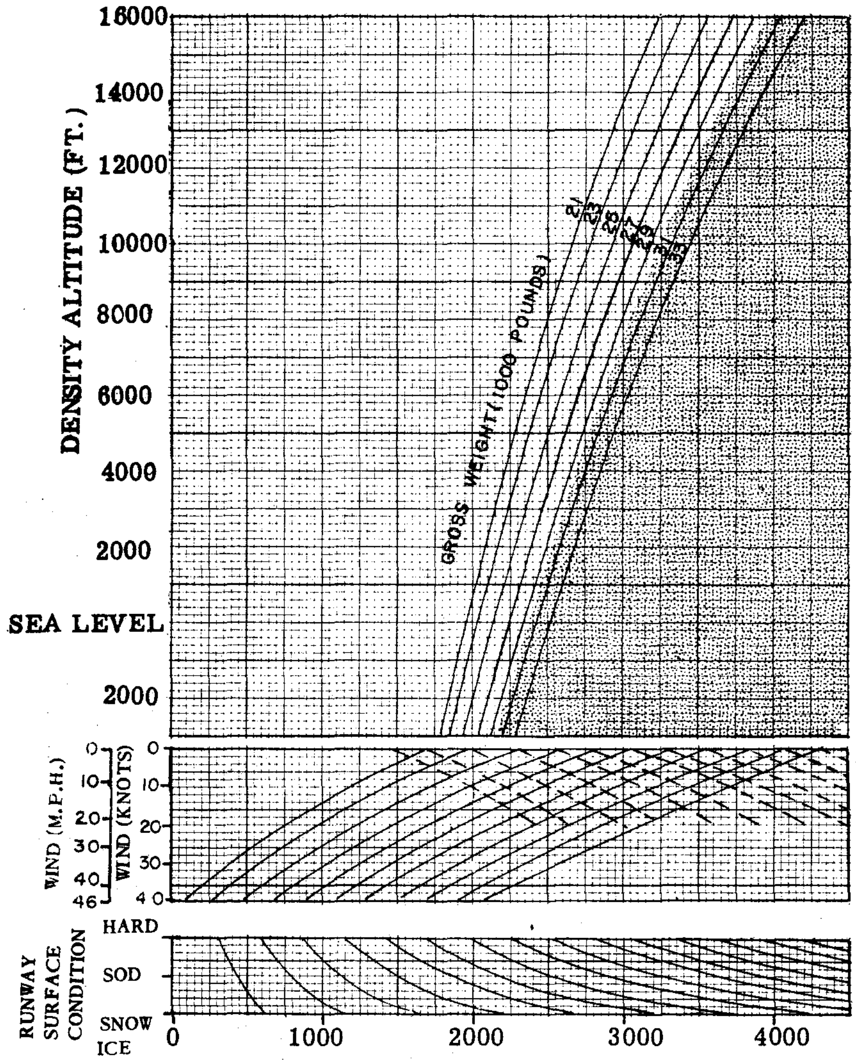
TOUCHDOWN AT 1.1Vs

WING FLAPS = 0 DEGREES

IDLE POWER

BASED ON: FLIGHT TEST DATA
DATA AS OF: 11 JULY 1957

MODEL(S): C-47, C-117 AND R4D



HEADWIND ———

TAILWIND --------

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

NOTE:

1. Speed at 50 feet height 120 percent of stall speed.
2. Speed at touchdown = 110 percent of stall speed.
3. Wing flaps = 0 degrees.
4. This chart is for landing ground run distance only. Air run from a 50 feet height to touchdown is approximately 90 percent of landing ground run on hard surface for 0 degrees flap. Total landing distance from a 50 feet height is the sum of the air run plus the ground run distance for any prevailing runway surface condition.
5. Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the wind correction grid, if wind is measured at a source other than runway. This is a recommended procedure which may be revised at the discretion of the pilot, depending upon the source of measurement of the wind data.

Figure A6-2. Landing Ground Run – Touchdown at 1.1V_s – Wing Flaps - 0 Degrees.

NOTE

The attached charts, Figure 1 and Figure 2 replace the Runway Surface Condition grids on Figure A6-1, page A6-3 and Figure A6-2, page A6-4 respectively.

1. PURPOSE

To provide landing on slippery runway distance factors and to advise flight crews of the new runway conditions reporting system.

2. GENERAL

Explanation of Terms

RCR - Runway condition reading
P - Patchy
WR - Wet runway
SLR - Slush on runway
LSR - Loose snow on runway
PSR - Packed snow on runway
IR - Ice on runway

a. In order to notify pilots of slippery runway conditions at terminal airfield, the following system of reporting has been established:

(1) A teletype sequence will report runway conditions as a series of letters followed by a two digit number. The letter portion is the runway surface condition; the number portion is the runway condition reading (RCR.) The letter "P" may follow this sequence to indicate patchy conditions. A report of SLR 06 P would indicate slush on runway, RCR of 06, and patchy conditions.

(2) Air Traffic Control will report information concerning Runway Surface Condition and RCR in plain language for aircraft enroute and anticipating a landing.

3. INSTRUCTIONS.

a. Determine landing ground run distance for hard runway from the Appendix of the Flight Manual.

b. Use appropriate curve in this Safety Supplement for your planned landing configuration.

c. Enter the unusual runway conditions chart with this landing ground run distance, go right to the reported RCR line and then down to obtain the actual ground run distance.

NOTE

If no RCR is available, use 12 for wet runways and 06 for icy runways.

When using ICAO Reports, use RCR 23 for GOOD; RCR 12 for MEDIUM; RCR 06 for POOR.

MODELS(S): C-47, C-117
AND R4D
BASED ON: ESTIMATED DATA
DATA AS OF: 1 APRIL 1963
ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL

RUNWAY SURFACE	RUNWAY CONDITION READING(RCR)
DRY CONCRETE OR MACADAM	23
DRY TURF	15
WET CONCRETE OR MACADAM	12
SNOW OR WET GRASS	08
ICE	06

TOUCHDOWN AT 1.1V_S
WING FLAPS 0 DEGREES
IDLE POWER

Note: Runway Condition Reading used on landing charts 23.

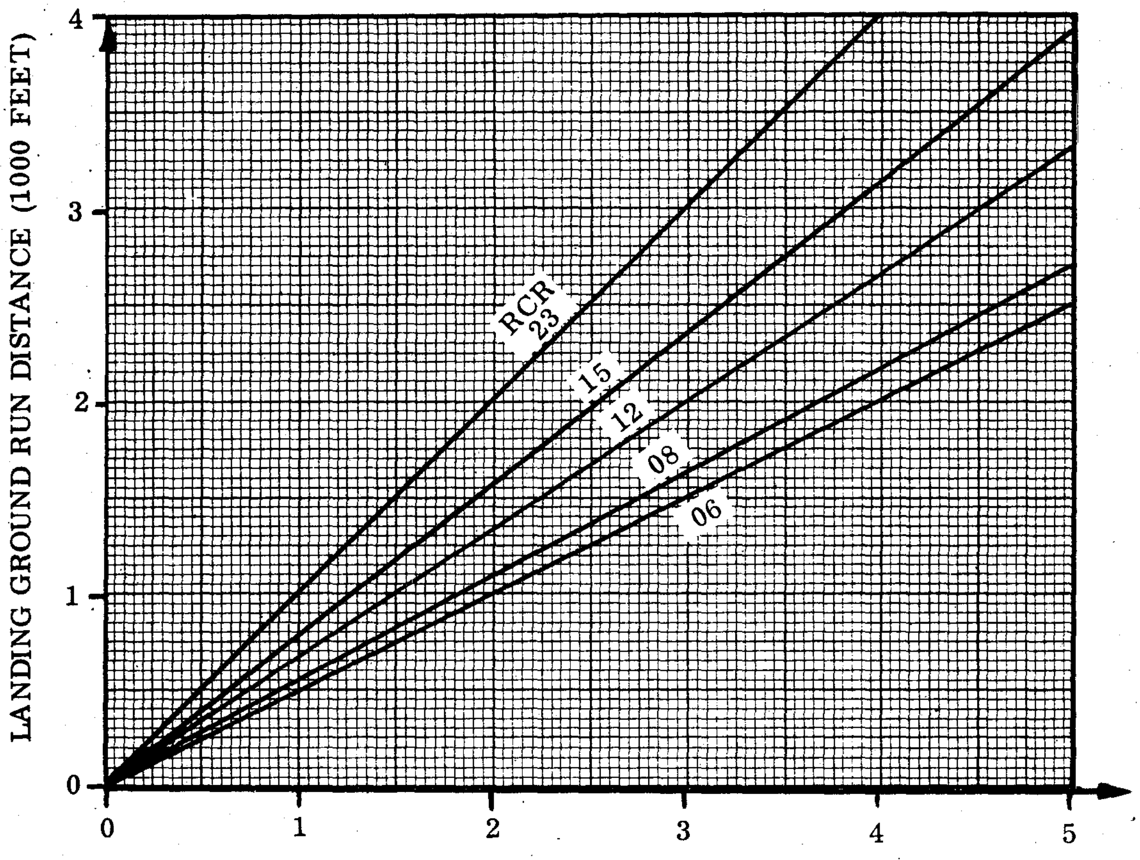


Fig. A6-3

EFFECT OF UNUSUAL RUNWAY CONDITIONS ON LANDING GROUND ROLL

MODELS(S): C-47, C-117 AND R4D
BASED ON: ESTIMATED DATA
DATA AS OF: 1 APRIL 1963
ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) -90D AND -92

RUNWAY SURFACE	RUNWAY CONDITION READING(RCR)
DRY CONCRETE OR MACADAM	23
DRY TURF	15
WET CONCRETE OR MACADAM	12
SNOW OR WET GRASS	08
ICE	06

TOUCHDOWN AT $1.1V_S$
WING FLAPS 45 DEGREES
IDLE POWER

Note: Runway Condition Reading used on landing charts 23.

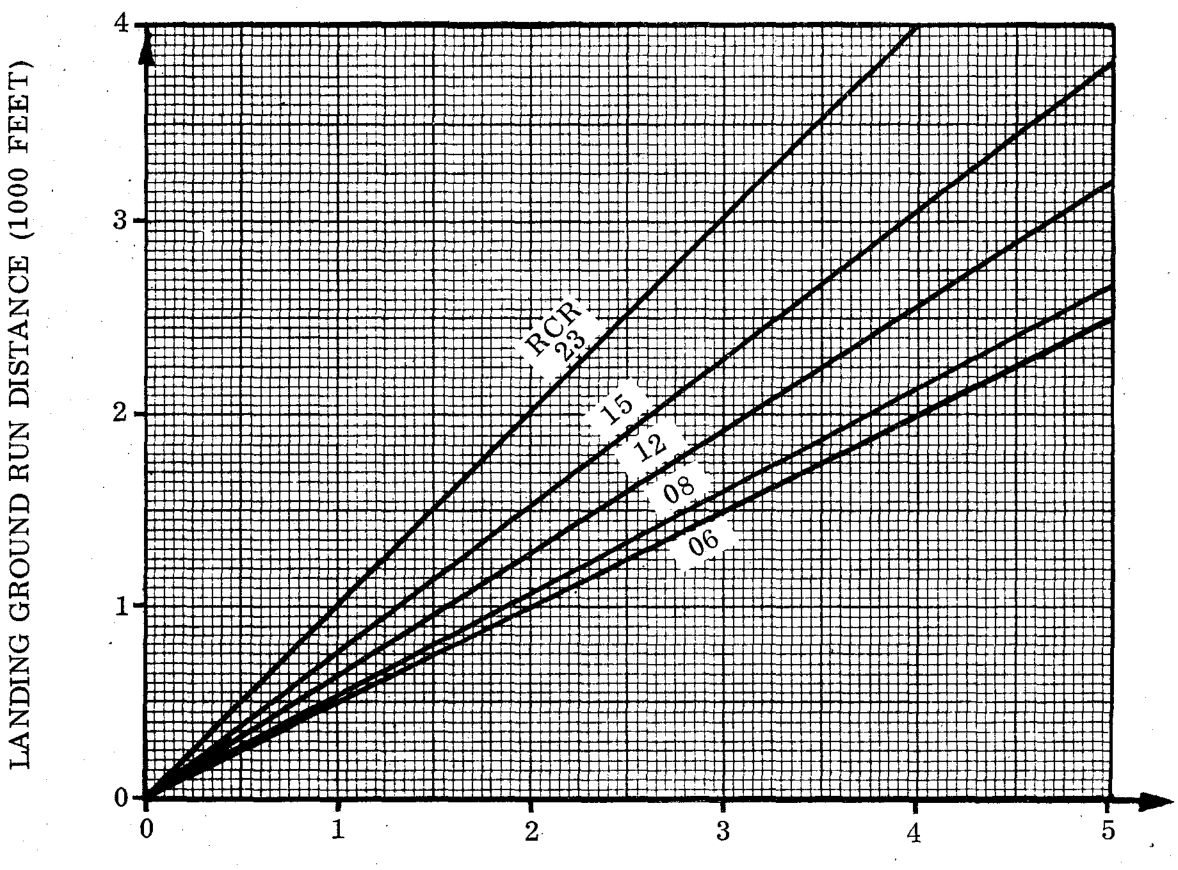


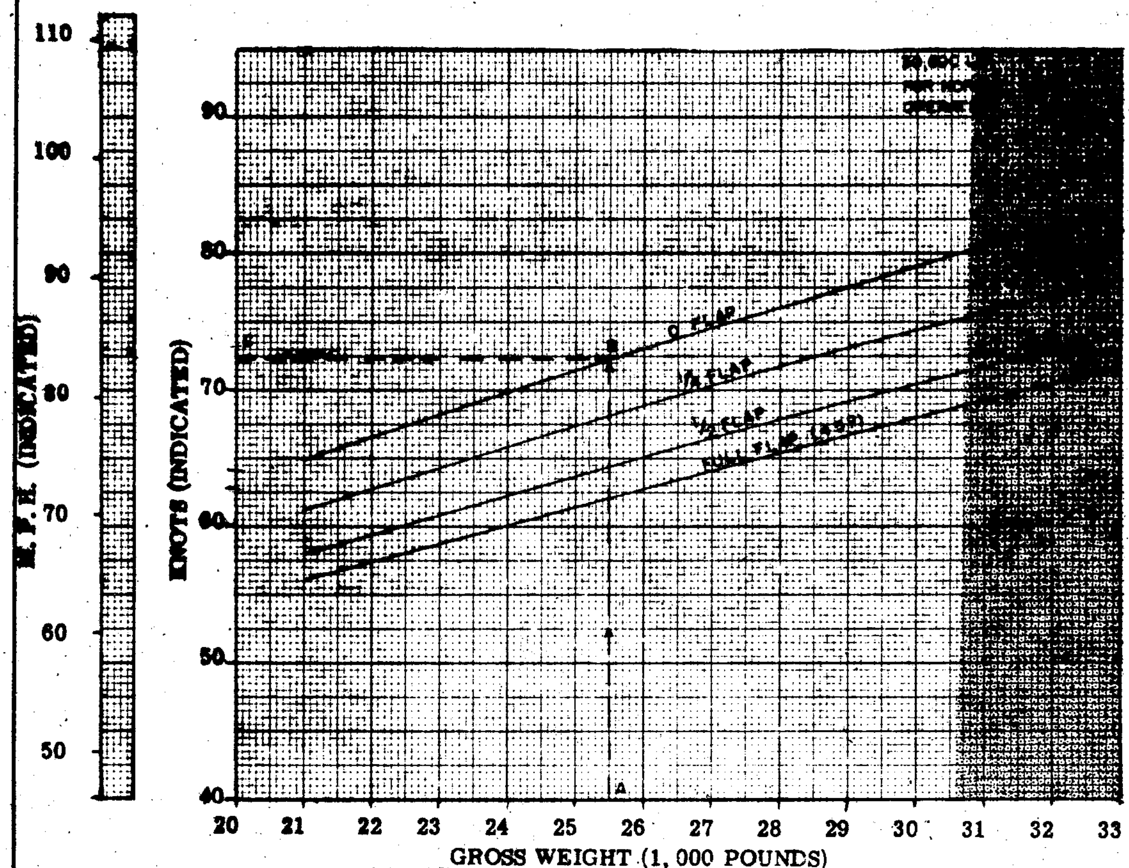
Figure A6-4

CHARACTERISTIC LANDING SPEEDS
TOUCHDOWN AT 1.1Vs

MODELS: C-47, C-117, AND R4D

ENGINE(S): (2) R-1830-90C (HIGH BLOWER INOPERATIVE) - 90D and -92

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949



CONVERSION TABLE

TO GET FROM TOUCHDOWN SPEED 1.1V_s TO:	MULTIPLY BY	
THRESHOLD (1.2V_{stall})	1.09	
FINAL APPROACH (1.3V_{stall})	1.182	
BEFORE TURNING FINAL (1.4V_{stall})	1.272	

NOTE:
1. SPEED OVER A 50 FEET HEIGHT IS 1.2Vs.
2. SPEEDS GIVEN ARE AIRSPEED INDICATOR READINGS.
3. A FIVE KNOT CORRECTION FOR POSITION ERROR HAS BEEN SUBTRACTED.
4. NO INSTRUMENT ERROR IS INCLUDED.

SAMPLE PROBLEM:

GIVEN:
1. GROSS WEIGHT = 25,500 POUNDS (POINT A).
2. WING FLAP SETTING = ZERO (POINT B).

FIND:
1. TOUCHDOWN SPEED = 72.2 KNOTS (POINT C).

Figure A6-5. Characteristic Landing Speeds – Touchdown at 1.1V_s.

POWER OFF STALL SPEEDS 0 FLAPS

MODEL(S): C-47, C-117
AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

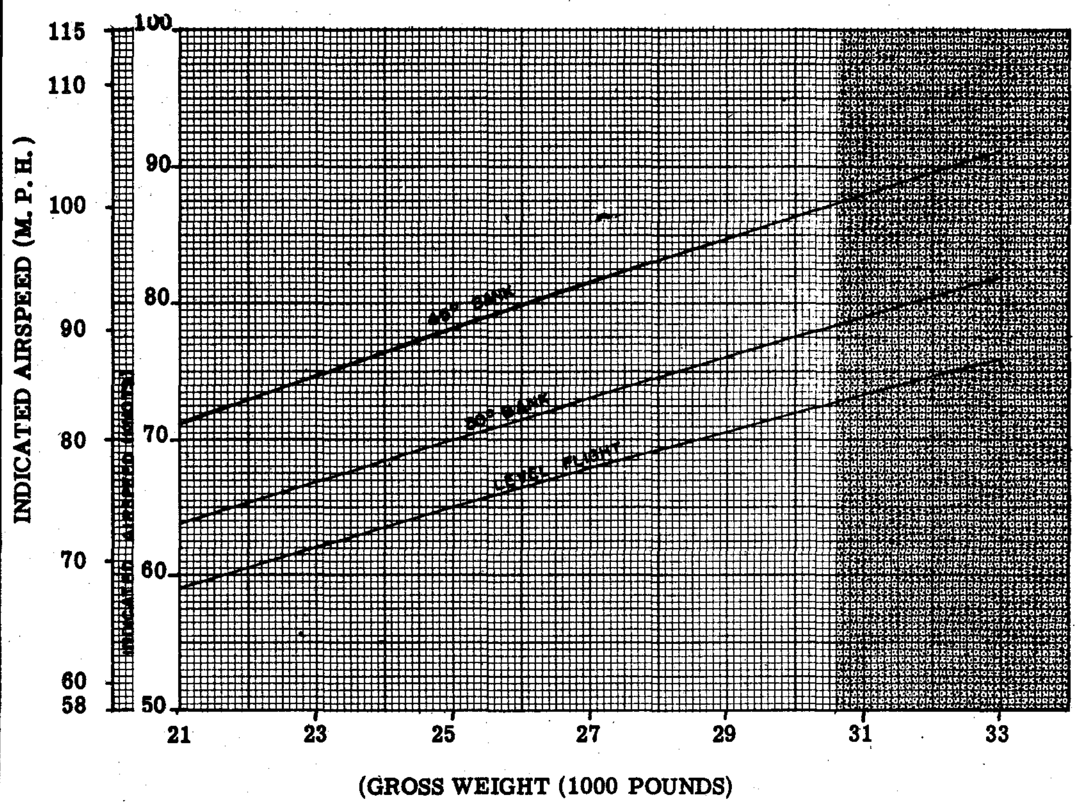


Figure A6-6. Power Off Stall Speeds – 0 Flaps.

POWER OFF STALL SPEEDS
1/4 FLAPS

MODEL(S): C-47, C-117 AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

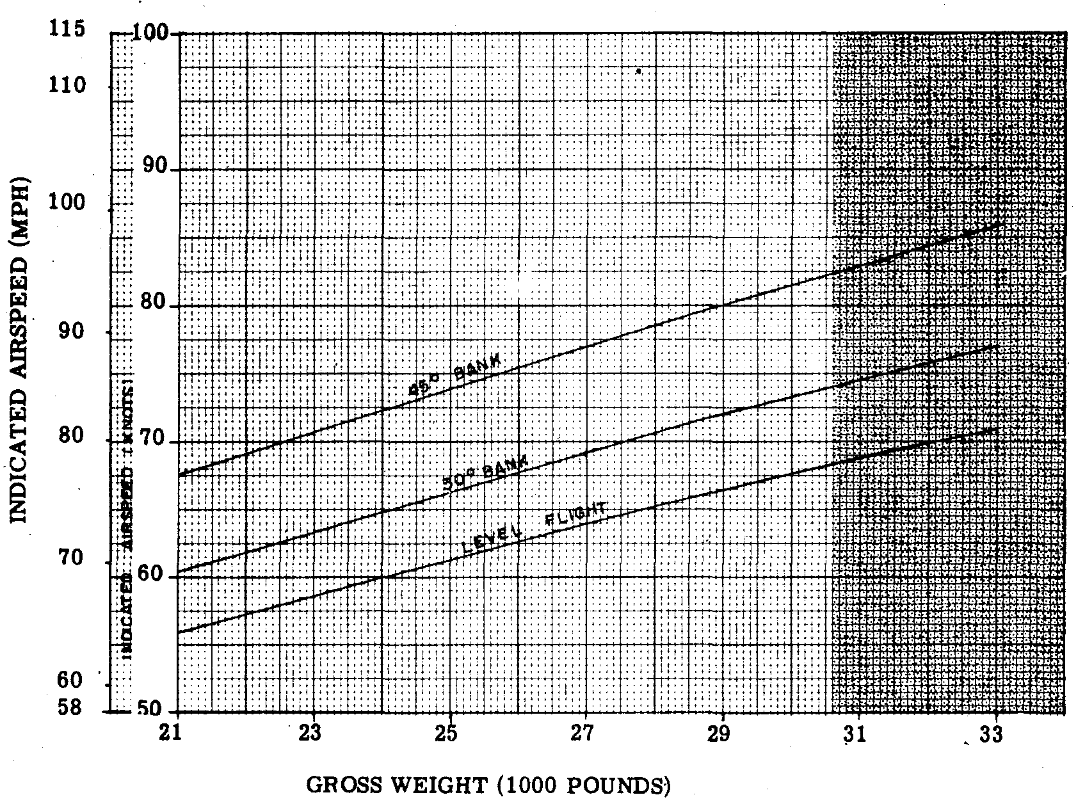


Figure A6-7. Power Off Stall Speeds – ¼ Flaps.

POWER OFF STALL SPEEDS
1/2 FLAPS

MODEL(S): C-47, C-117, AND R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S); (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

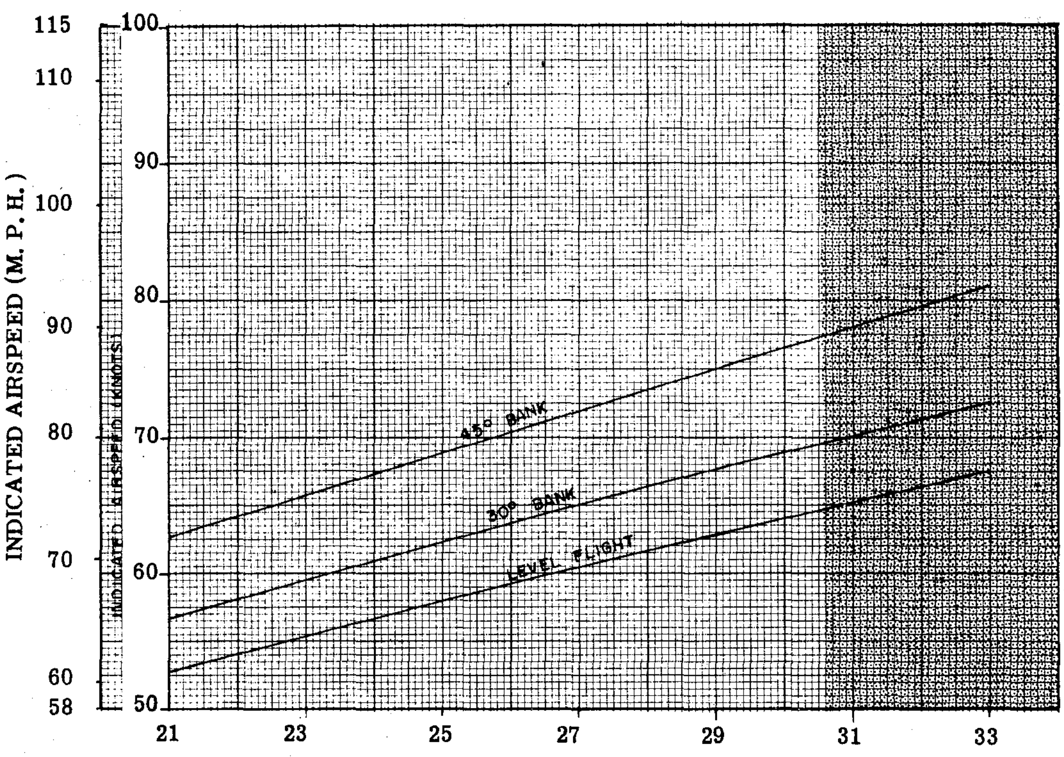


Figure A6-8. Power Off Stall Speeds – ½ Flaps.

POWER OFF STALL SPEEDS
FULL FLAPS

MODEL(S): C-47, C-117, and R4D

BASED ON: FLIGHT TEST DATA
DATA AS OF: 1 DECEMBER 1949

ENGINE(S): (2) R-1830-90C
(HIGH BLOWER INOPERATIVE)
-90D AND -92

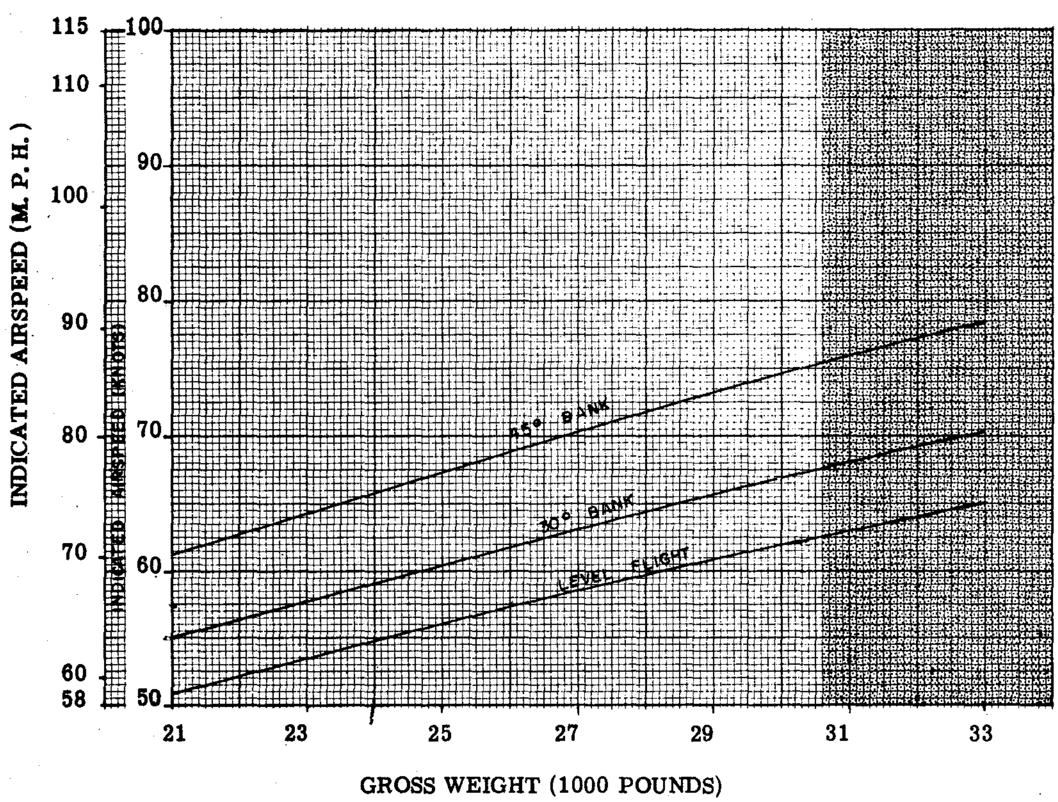


Figure A6-9. Power Off Stall Speeds – Full Flaps.

PART SEVEN
MISSION PLANNING

TABLE OF CONTENTS

TAKE-OFF AND LANDING DATA CARD

A take-off and landing data card is included in T. O. 1C-47-CL-1-1 to provide readily available information for take-off and landing. Prior to each flight, applicable data should be computed and entered on the cards. This information can then be reviewed by the pilot or read aloud by the copilot as a checklist item immediately prior to take-off and landing. A sample is shown on page A7-5.

SOURCES OF INFORMATION

Information for items on the take-off and landing data cards may be found in the following paragraphs.

TAKE-OFF DATA

Refusal Distance---Obtained from the Take-Off Performance--Speed During Ground Run chart (figure A3-9).
Refusal Speed---Obtained from the Take-Off Performance--Refusal Speed chart (figure A3-11).
Take-Off Speed---Obtain from the Take-Off Performance-Characteristic Take-Off Speed chart (figure A3-14).

LANDING IMMEDIATELY AFTER TAKE-OFF DATA

120 Percent Power-Off Stalling Airspeed--Obtained from the Characteristic Landing Speed chart (figure A6-5).
110 Percent Power-Off Stalling Airspeed--Obtained from the Characteristic Landing Speed chart (figure A6-5).
Take-Off Speed---Obtained from the Take-Off Performance--Characteristics Take-Off Speed chart (figure A3-14).

CONDITIONS DATA

Gross Weight (Actual)---Basic aircraft operating weight, plus fuel, cargo, and crew.
Gross Weight Limited by Single-Engine Climb--Obtained from the Take-Off Gross Weight Limited by Single-Engine Climb Performance chart (figure A3-1).
Pressure Altitude---Obtained from weather briefing or tower operator.
Outside Air Temperature---Obtained from aircraft temperature gage.
Dew Point---Obtained from weather briefing.
Specific Humidity---Obtained from weather briefing.
Density Altitude---Obtained from the Density Altitude Chart (figure A1-4).

Runway Length---Obtained from operations or Flight Information Publications (FLIP) charts.
Runway Slope---Obtained from operations or Flight Information Publications (FLIP) charts.
Wind Component---Obtained from weather briefing.

LANDING DATA

Landing Gross Weight---Take-Off weight less fuel consumed.
Wind Component---Obtained from tower operator.
Threshold Airspeed (120) percent of Power-Off Stalling Airspeed)--Obtained from the Characteristic Landing Speeds Chart (figure A6-5).
Touchdown Speed (110 Percent of Power-Off Stalling Airspeed) – Obtained from the Characteristic Landing Speed chart (figure A6-5).
Take-Off Speed---Obtained from the Take-Off Performance--Characteristic Take-Off Speed chart (figure A3-14).

SAMPLE PROBLEM

Sample problems are provided to clarify the use of the performance charts where applied to a typical mission and to emphasize the need for adequate mission planning.

LONG RANGE OPERATION PROBLEM

The following sample problem is a typical search mission for this type aircraft. The mission requires that the aircraft Take-Off - Climb to 10,000 feet density altitude; cruise out for 1 hour at 10,000 feet density altitude then descend to 1000 feet density altitude; search for 4 hours at 1000 feet density altitude; climb to 7000 feet density altitude; then cruise at 7000 feet density altitude and land at the point of departure. All climbs will be made using climb power settings. Both cruises will be made using recommended long range airspeeds and power settings. The 1000 foot search will be made using the recommended maximum endurance airspeeds and power settings. The mission requires that the aircraft return to the base with sufficient fuel to cruise 30 minutes at sea level, plus an additional 10 percent of Take-Off fuel load.

CONDITIONS

TAKE-OFF CONDITIONS

Pressure Altitude-----Sea Level
Outside Air Temperature-----24°C
Specific Humidity-----0.015
Headwind at 50-foot Height-----20 Knots.
Runway Length Available-----4000 Feet
Runway Slope (up hill)-----0.015
Runway Surface Condition-----Hard Surface

TAKE-OFF GROSS WEIGHT

Take-Off gross weight limited by single-engine climb performance (see figure A3-1)---30,600 pounds. Aircraft operating weight, empty, including oil (gross weight less fuel and cargo)-----21,000 pounds.

CRUISE CONDITIONS

Headwind ------None
Temperature at 10,000 feet density altitude ---- –5°C
Temperature at 7000 feet density altitude ---- 1°C
Temperature at 1000 feet pressure altitude ---- 11°C

TAKE-OFF AND ABORT CRITERIA

Take-Off ground run (see figure A3-2)-------- 2050 feet.
Take-Off ground run as corrected by the runway slope correction chart (see figure A3-10) ------- 2250 feet.
Take-Off speed (see figure A3-14)-------- 80 KIAS.
Refusal speed (see figure A3-11) -------- 72 KIAS.
Refusal distance (see figure A3-9) ------- 1820 feet.
Fuel consumed during warmup and take-off (estimated) ------------ 270 pounds.
Distance to clear a 50 foot obstacle ------ (figure A3-2) ----------- 4480 feet.

CLIMB TO 10,000 FEET DENSITY ALTITUDE

Climb to 10,000 feet density altitude will be made at climb power settings. The gross weight at start of climb is 30,330 pounds (30,600 – 270 = 30,330). The time and distance to climb, and the gross weight at end of climb are determined from figure A4-3 as follows:

Time to climb ------ 41.5 minutes.
Distance to climb ------ 97 nautical miles.
Gross weight at end of climb ------ 29,600 pounds.
Fuel consumed during climb is 730 pounds -------- ---(30,330 – 29,600 = 730).
Best climb speed - 126 KIAS

CRUISE AT 10,000 FEET DENSITY ALTITUDE

Cruise at 10,000 feet density altitude and descent to 1000 feet pressure altitude will be made at long range power settings. The gross weight at beginning of cruise is 29,600 pounds. Range during cruise and gross weight at end of cruise for a zero wind condition are determined from figure A5-9 as follows:

Range -------- 120 nautical miles.
Gross weight at end of cruise ----- 29, 150 pounds.
Fuel consumed during cruise is 450 pounds ------ ----(29,600 – 29,150 = 450).
The average airspeed is 120 knots.

The recommended power settings and airspeed during cruise for an initial gross weight of 29,600 pounds are determined from figure A5-3 and are as follows:

True airspeed ------ 130.5 Knots.
Brake horsepower per engine ------ 550.
RPM ---------- 1860.
Manifold pressure ------ 28.2 inches Hg.
Fuel flow ------ 470 pounds per hour.
Nautical miles per pound ------ 0.278.

NOTE

> The long range power condition charts are based on long range cruising operation; therefore, it is essential that conditions of the 99 percent maximum range power conditions curves be followed. Power settings should be changed at least every hour in order that range and time performance on the long range prediction curves be attainable. The fuel flow data will facilitate the determination of the new gross weight at the time of the power change. At the end of one hour cruise at the initial power setting, the gross weight will be 29,150 pounds (29,600 – 450 = 29,150). New power settings can then be read at this new weight.

SEARCH AT 1000 FEET DENSITY ALTITUDE

Search at 1000 feet density altitude with zero degrees wing flaps will be made at the speed and power settings recommended for the maximum endurance. To maintain operation at optimum efficiency, it is necessary to recompute and readjust power settings at least once each hour based on the gross weight change due to fuel consumed. The recommended brake horsepower for the first hour's operation is determined from figure A5-14 as follows:

True airspeed -------------- 96 Knots.
Brake horsepower per engine --------- 445.
Fuel consumed during the first hour of cruise is determined to be 385 pounds per hour from figure A5-14.

Power settings for the first hour of cruise at 445 bhp per engine are determined from figures A5-14 as follows:

Manifold pressure ------ 28 inches Hg
RPM ------ 1700.
Fuel consumed (for two engines) ----- 385 pounds.

At the beginning of the second hour's cruise the gross weight will be 28,765 pounds (29150 – 385 = 28,765). Power settings and fuel consumption for each remaining hour of cruise are computed in the same manner.

After computing power settings and fuel flow for all 4 hours of cruise, the total fuel consumed is determined to be 1495 pounds and the gross weight at end of cruise is 27655 pounds (29150 – 1495 = 27655). Range during cruise is estimated to be 380 nautical miles by multiplying time during cruise by average true airspeed during cruise (4 x 95 = 380).

CLIMB TO 7000 FEET DENSITY ALTITUDE.

Climb to 7000 feet density altitude will be made at climb power settings. The gross weight at start of climb is 27,655 pounds. The time and distance to climb, and the gross weight at end of climb are determined from figure A4-3 as follows:

Time to climb ----- 16.8 minutes.
Distance to climb ------ 37.7 nautical miles.
Gross weight at end of climb ------ 27,280 pounds.
Fuel consumed during climb from 1000 feet to 7000 feet is 375 pounds (27,655 – 27,280 = 375).
Best climb speed - 120 KIAS.

CRUISE AT 7000 FEET DENSITY ALTITUDE

Cruise at 7000 feet density altitude will be made at long range power settings. The gross weight at beginning of cruise is 27,280 pounds. The range to cruise to point of departure is determined to be 179.3 nautical miles. Time during cruise and gross weight at end of cruise for zero wind conditions are determined by interpolation from figures A5-8 and A5-9 and are as follows:

Time -------- 90 minutes.
Gross weight at end of cruise ------ 26,700 pounds.
Fuel consumed during cruise is 580 pounds.

The recommended power settings and airspeed during cruise for an initial gross weight of 27,280 pounds are determined from figure A5-3 and are as follows:

True airspeed ------ 119 Knots.
Brake horsepower --------- 465.
RPM ---------- 1720.
Manifold pressure -------- 27.9 inches Hg.
Fuel flow ---------- 400 pounds per hour.
Nautical miles per pound ---------- 0.299.

NOTE

The long range power condition charts are based on long range cruising operation; therefore, it is essential that conditions of the 99 percent maximum range power conditions curves be followed. Power settings should be changed at least every hour in order that range and time performance on the long range prediction curves be attainable. The fuel flow data will facilitate the determination of the new gross weight at the time of the power change.

RESERVE FUEL AND CARGO

To determine the amount of cargo that can be carried, the reserve fuel load must be computed. The reserve fuel for this sample problem is 10 percent of the total mission fuel plus sufficient fuel to cruise for 30 minutes at sea level. Fuel required to cruise for 30 minutes at sea level, for gross weight at end of cruise at 7000 feet density altitude is determined from figure A5-3 as follows. Fuel flow per engine is determined to be 180 lb/hr. Therefore, fuel required to cruise 30 minutes is 180 pounds. Ten percent of the total mission fuel plus sufficient fuel to cruise for 30 minutes at sea level is 408 pounds. Therefore, the total reserve fuel is 588 pounds (180 + 408 = 588). Fuel load at take-off can now be determined as follows:

Fuel required for mission --- 3900 pounds (30,600 – 26,700 = 3900).
Reserve fuel ------ 588 pounds.
Total fuel load at take-off ------ 4489 pounds.

Operating weight empty plus fuel load at take-off is 25489 pounds (21000 + 4489 = 25489). Therefore, maximum cargo load is 5111 pounds (30600 – 25489 = 5111).

LANDING

IMMEDIATE LANDING

Pressure altitude ------ sea level.
Outside air temperature ------ 24°C.
Headwind at 50-foot wheight ------ 10 knots.
Runway surface condition ------ hard surface.
Landing gross weight ------ take-off gross weight less fuel consumed.
For warm-up and take-off (270 pounds) --- 30600 – 270 = 30330 pounds.
Threshold speed (figure A6-5) ------ 75 knots.
Touchdown speed (figure A6-5) ----- 69 knots.

Landing ground roll distance with full flaps (figure A6-1) ------ 1675 feet.
Two engine go-around best climb speed ≈ 126 KIAS.
Single engine go-around best climb speed ≈ 97 KIAS.

DESTINATION LANDING

Pressure altitude ---- sea level.
Outside air temperature ----- 30°C.
Headwind at 50-foot height ------ 16 knots.
Runway surface condition ------ hard surface.
Landing gross weight ------ 26700 pounds.
Threshold speed (figure A6-5) ------ 69 knots
Touchdown speed (figure A6-5) ------ 64 knots.
Landing ground roll distance with full flaps (figure A6-1) ------ 1400 feet.
Two engine go-around best climb speed ≈ 119 KIAS.
Single engine go-around best climb speed ≈ 97 KIAS.

TAKEOFF AND LANDING DATA CARD

GROSS WEIGHT 30,600 LB.

RUNWAY LENGTH 4,000 FT. SLOPE 0.015 UP HILL.

PRESSURE ALTITUDE SEA LEVEL.

OAT 75 °F 24 °C SPECIFIC HUMIDITY 0.015.

TAKEOFF PERFORMANCE

REFUSAL SPEED 72 KIAS.

REFUSAL DISTANCE 1,820 FT.

TAKEOFF SPEED 80 KIAS. TAKEOFF DISTANCE 2250 FT.

TWO ENGINE CLIMB SPEED 126 KIAS.

SINGLE ENGINE CLIMB SPEED 97 EAS.

IMMEDIATE/DESTINATION LANDING

THRESHOLD SPEED 75/69 KIAS. TOUCHDOWN SPEED 69/64 KIAS.

LANDING DISTANCE 1675/1400 FT.

DESTINATION TWO-ENGINE GO-AROUND SPEED 119 KIAS.

DESTINATION SINGLE-ENGINE GO-AROUND SPEED 91 KIAS.