part 2
engine data

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION.

The engine data shown in this part are provided to aid the prediction of takeoff, climb and cruise performance and to supply the information necessary for maximum and safe utilization of the engine. The individual charts are described in detail below.

The words "wet" or "dry" describing the power used for takeoff refer to whether or not water injection (ADI fluid) is used.

The engine torquemeters are connected to gauges which are calibrated in terms of BMEP (brake mean effective pressure). If the BMEP and RPM are known it is possible to determine the brake horsepower by the following equation:

$$BHP = (BMEP \times RPM)/283$$

THE EFFECT OF TEMPERATURE ON ENGINE POWER.

The effect of temperature on engine power is accounted for by correction grids on many of the charts. If it is desirable to determine this effect for conditions not shown it may be approximated by the following equations:

$$BHP = BHP_{std}\sqrt{T_{std}/T}$$ For part throttle, constant manifold pressure operation,

$$BHP = BHP_{std}(T_{std}/T)$$ For full throttle operation,

where T and T_{std} are absolute temperature. Absolute temperature is equal to the temperature in degrees Centigrade plus 273. A 10°C temperature increase above standard results in approximately 1.7 percent power loss for part throttle, constant manifold pressure operation, and approximately 3.5 percent power loss for full throttle operation.

THE EFFECT OF HUMIDITY ON ENGINE POWER.

The effect of humidity on engine power is accounted for by correction grids on many of the charts. In addition, a chart labeled "Effect of Humidity on Power Output" *(figure A2-3)* is included to show this effect separately. This chart is discussed under "Discussion of Charts."

THE BMEP DROP METHOD OF SETTING CRUISE MIXTURES.

Considerable experience with the R-2800 engines indicate that the most efficient method of setting cruise mixtures is the BMEP drop method. With this method it is possible to operate the engine much closer to the optimum fuel to air ratio than would result from the use of auto-lean. This, in turn, permits more range for a given amount of fuel.

The BHP-RPM Schedules and BHP-MAP Schedules *(figures A2-16 through A2-19)* and the Power Settings for Cruise Charts (the even numbered figures from A5-28 through A5-50) are based on a given BMEP drop (usually 12 PSI) from best power mixture.

Upon reaching cruise altitude, climb power should be maintained until the indicated airspeed slightly exceeds that anticipated for the particular altitude, gross weight and cruise power to be used. This higher airspeed will afford a cushion so that the airspeed dissipation incurred during trim and power adjustments will not result in an airspeed at the start of cruise less than that anticipated for cruise.

From the charts referenced above for the selected brake horsepower determine the appropriate manifold pressure, RPM, blower ratio and BMEP drop. Cruise power will then be set in this sequence:

1. Set cruise RPM. (Mixture rich)
2. Shift blower, if required.

3. Set cowl flaps to the angle anticipated to yield 190° to 200°C cylinder head temperature when stabilized.

4. Adjust throttle to selected manifold pressure, allowing for any known gage error.

Note

For initial cruise setting after climb, maintain rich mixture setting for 5 minutes to allow stabilization prior to manual adjustment.

5. Manually lean the mixture for each engine individually as follows:

   a. Determine best power mixture by slowly leaning the mixture while carefully observing the BMEP until maximum BMEP is reached. Since the transport carburetor has been specifically designed to facilitate manual leaning, a rise of BMEP should be noted during the initial leaning process, indicating that the mixture is providing the maximum power output for the MAP and RPM setting used. If the initial rise is not observed, but instead an immediate drop of BMEP is noted, the carburetor is at or slightly on the lean side of best power even though the mixture is in the auto-rich position. If the carburetor is lean, return the mixture control to auto-rich and determine best power by applying intermittant prime and observing the BMEP. If a drop in BMEP is noted when using prime, the mixture is at best power. If a rise in BMEP is noted when using prime, the mixture is leaner than best power and should not be leaned beyond the auto-lean position when manually leaning to the prescribed BMEP drop in the following procedure.

   b. When the BMEP is stabilized with the mixture at best power setting (maximum BMEP), manually lean the mixture to the prescribed BMEP drop. Since the BMEP drop setting is based on a constant manifold pressure, it is essential that airspeed and altitude be held constant during this step. A change in airspeed at constant throttle affects ram and therefore manifold pressure and BMEP to the extent that an airspeed change of ten knots can result in as much as a five BMEP change. If loss of manifold pressure is experienced due to loss of ram, reset manifold pressure to original value.

6. Readjust cowl flaps to provide the desired CHT, 190° to 200°C. When stabilized, cross check engine instruments. With equal manifold pressure, RPM, carburetor air and cylinder head temperatures, equal engine airflow is normally obtained. With identical BMEP drop settings, fuel/air ratio and therefore fuel flows will also be equal, regardless of the condition of the ignition system. Any difference in fuel flow under these conditions must be due to instrument inaccuracy, either flowmeter or manifold pressure, or to a mechanical malfunction, such as a stuck valve or broken pushrod, which affects mixture flow. BMEP differences will be due entirely to unequal accessory loads, instrument inaccuracy and/or mechanical discrepancies.

7. Once cruise power has been set and stabilized, the maximum difference in indicated BMEP, after allowing for that due to unequal accessory loading, should not exceed 10 BMEP. If a greater discrepancy is noted, it should be recorded in the log with as complete a description as possible to assist in troubleshooting.

Mixtures adjusted in this manner should remain substantially the same regardless of small throttle adjustments necessary to counteract small changes in airspeed, altitude and/or CAT. Mixtures, however, should be periodically checked during cruise and adjusted as required. Power should be reset after appreciable change in CAT or altitude. If power change is excess of 50 BHP from original power setting, reset mixtures as outlined in step 5. Mixture strength or BMEP drop can be quickly checked by applying prime in varying amounts to determine best power or peak BMEP.

This procedure affords the simplest and quickest adjustment to cruise power since it involves the fewest control movements. Another advantage is that by setting equal airflow (RPM, MAP, CAT and CHT) and fuel/air ratio (BMEP drop) on all engines, any discrepancies are in greater evidence and in-flight troubleshooting is facilitated.

SETTING MANUAL RICH MIXTURES.

When operating in the power ranges where the cruise performance charts require manual rich mixture settings, set the cruise mixture as follows:

1. From the appropriate charts determine manifold pressure, rpm and blower ratio for the selected power.

2. Set RPM, blower ratio (if required), cowl flaps, and manifold pressure as outlined in steps 1 through 4 for manual lean adjustment.

Note

For initial cruise setting after climb maintain rich mixture setting for 5 minutes to allow stabilization prior to manual adjustment.

3. Determine the desired fuel flow from the Minimum Fuel Flow chart *(figure A2-13)*.
4. If fuel flows exceeds chart values manually lean the mixture to charted fuel flow.
5. Readjust cowl flaps to provide the desired CHT, 190° to 200°C. When stabilized cross check engine instruments (see step 6, manual lean adjustment).
6. Check mixture periodically during cruise and adjust as required, particularly after appreciable changes in CAT, power or altitude.

DISCUSSION OF CHARTS.

ENGINE MANIFOLD PRESSURE AND POWER LIMITS CHART.

A chart has been included *(figure A2-1)* tabulating the engine manifold pressure and power limits for take-off, METO and maximum cruise powers. These limits have been established by the engine manufacturer to permit maximum utilization of the engine consistent with a reasonably long engine life. If any of these limits are exceeded, excessive engine wear, and even engine failure, may result.

It will be noted that for several power conditions both a MAP limit and a BMEP limit are shown. In these cases observe whichever limit is reached first. On cold days the BMEP limit will be most restrictive, while on warm days the MAP limit will be most restrictive.

For takeoff power with alternate fuel grade, dry, only a MAP limit need be observed since there is no BMEP limit. For maximum cruise powers there are no MAP limits as such; however, the Power Settings for Cruise charts in Part 5 (the even numbered figures from A5-28 through A5-50) or the BHP-RPM Schedules and BHP-MAP Schedules *(figures A2-16 through A2-19)* list the RPM and MAP required to develop a given brake horsepower at a given altitude and temperature. Each MAP listed is to be considered as the MAP limit for that particular set of conditions. *(See Section D, Engine Overboost Limits.)*

In order to partially offset the loss of power due to humidity the MAP limits for the takeoff powers may be increased by the existing water vapor pressure up to a maximum of 1.5 inches Hg.

WET TAKEOFF BMEP AT VARIOUS CONDITIONS OF TEMPERATURE AND HUMIDITY CHART.

A chart is provided *(figure A2-2)* tabulating the allowable takeoff manifold pressure and the corresponding BMEP for a range of dewpoint temperatures and carburetor air tmeperatures. Although it is based only on sea level with standard fuel grade, wet, it illustrates the use of the increase in MAP by the existing water vapor pressure. It may be noted that even when the MAP is increased by the full amount permitted there is still a loss in power due to humidity. The information supplied by this chart plus the corresponding information for other altitudes and for the other power configurations (standard fuel grade, dry, and alternate fuel grade, wet and dry) may be determined from graphs on figures A2-4 through A2-7.

EFFECT OF HUMIDITY ON POWER OUTPUT CHART.

A chart is provided *(figure A2-3)* to show the effect of humidity on power output. This chart applies only to maximum power (takeoff power) engine settings. It will be noted that the degree of the effect of humidity depends upon whether or not water injection is used. The power loss determined from this chart should not be applied to the predicted power obtained from the Brake Horsepower Available for Takeoff charts *(figure A2-4 through A2-7)* because this humidity correction is built into those charts.

Humidity corrections for climb and cruise powers are not shown because at the higher altitudes the amount of water vapor that the air can hold is much less than at sea level.

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF CHARTS.

Four charts are provided showing the power available for takeoff with standard fuel grade, wet *(figure A2-4)*, standard fuel grade, dry *(figure A2-5)*, alternate fuel grade, wet *(figure A2-6)*, and alternate fuel grade, dry *(figure A2-7)*. The powers determined from these charts are used to determine takeoff performance in Part 3. Results may be read in the form of predicted brake horsepower, predicted BMEP (corresponding to the predicted brake horsepower) or 95% of predicted BMEP. Generally, 95% of predicted BMEP is used to determine takeoff performance.

These charts allow corrections to be made for altitude, carburetor air temperature and humidity. Because the carburetor air temperature is seldom known at the time these charts are used, assume that it is 5 degrees Centigrade above the outside air temperature. To prevent overboosting the engines when the carburetor air temperature is below standard a correction scale, showing the amount by which the MAP limit should be reduced, is included on the applicable charts (the chart for alternate fuel grade, dry, figure A2-7, does not need this correction).

In allowing for the effect of humidity one scale corrects the power downward for the effect of humidity alone. Another scale corrects the power upwards to account for the allowable increase in MAP equal to the existing water vapor pressure up to 1.5 inches Hg. This later correction may only be made when the combination of pressure altitude and carburetor air temperature indicate that takeoff power may be developed with less than full throttle setting.

For takeoff ground run, with full throttle operation, the chart values for BMEP are based on ram available at approximately 70 knots IAS. At the start of the ground run, with no ram air, manifold pressures approximately 1 in. Hg below charted values may be expected. In part throttle operation, when manifold pressures are set at the start of ground run, an overboost of approximately 1 in. Hg MAP may be expected at climbout speeds unless the throttles are adjusted during the ground run.

When planning a takeoff with ADI inoperative on one or more engines, determine the reject BMEP of 95 percent BMEP for both wet and dry power for the given conditions. Compute BMEP for determining takeoff factor, gross weight limited by three-engine climb performance, and emergency climb performance as follows: With ADI inoperative on one engine, take the average of the BMEP for two wet and one dry engine; for example, for given conditions producing a wet BMEP of 240, the dry BMEP will be 211, the average will be (240 + 240 + 211) ÷ 3 = 230 BMEP. Use 230 BMEP for computing performance from the charts. This method allows sufficient margin of safety in the event that engine failure occurs on an engine with ADI operating, leaving only two wet engines. To compute the average BMEP with ADI inoperative on two engines, take the average of one wet and two dry engines. If ADI is inoperative on three engines, compute performance for dry power on all engines.

A different example has been included on each chart to illustrate a range of possible operating conditions.

ENGINE CALIBRATION — LOW BLOWER — BRAKE HORSEPOWER VS MANIFOLD PRESSURE CHART.

This chart *(figure A2-8)* shows the relationship between brake horsepower, manifold pressure and RPM with auto-lean mixture control at sea level on a standard day. From this chart it may easily be determined how a given change in manifold pressure or RPM will affect brake horsepower. Although the actual values on the chart apply only to sea level, standard day, the relative picture remains approximately the same at higher altitudes and other atmospheric conditions. For example, the chart shows that for a given manifold pressure, decreasing the RPM from 1500 to 1400 decreases the power output by 60 brake horsepower. This approximate loss in power will occur regardless of altitude or temperature.

This chart may also be used with the Brake Horsepower vs Altitude chart on the facing page to determine the engine settings required to develop a given power at higher altitudes (see text under Engine Calibration — Low Blower, Brake Horsepower vs Altitude Chart).

ENGINE CALIBRATION — LOW BLOWER — BRAKE HORSEPOWER VS ALTITUDE CHART.

This chart *(figure A2-9)* shows the relationship between brake horsepower, RPM and altitude for low blower operation with standard atmospheric conditions. Each curve is for a single RPM and shows how engine power decreases with increasing altitude when operating at full throttle. The curves for takeoff RPM, wet and dry, and for METO RPM are for auto-rich operation with ram available as noted. The curves for 1400 RPM to 2300 RPM are for auto-lean operation with ram available in level flight at long range cruise speeds.

A line labeled "Limited by Maximum Recommended Cruise BMEP" has been drawn across the auto-lean curves to show the maximum power which may be developed at any given RPM during normal cruise operation. The same line also shows the maximum altitude at which that power may be obtained with that RPM (in lower blower). For example, the chart shows that the maximum cruise power for 2000 RPM is 1100 brake horsepower. Furthermore, the maximum altitude at which 1100 brake horsepower may be obtained with 2000 RPM is 11,600 feet. 1100 brake horsepower may be obtained at lower altitudes by using 2000 RPM and varying degrees of throttle. In order to obtain 1100 brake horsepower at altitudes above 11,600 feet it is necessary to increase the RPM. Once 2300 RPM has been reached, with full throttle, it will be necessary to use high blower to gain more altitude.

The manifold pressures shown on the chart are for full throttle only (with the exception of the sea level values indicated on the takeoff and METO RPM lines). However, manifold pressures for part throttle operation may be determined by use of the guide lines as illustrated in the following example.

Sample Problem.

GIVEN: Cruise altitude = 10,000 feet.
Cruise power = 1240 brake horsepower per engine.

FIND: RPM and manifold pressure.

1. Enter brake horsepower scale at selected power, 1240 BHP.
2. Enter pressure altitude scale at cruise altitude, 10,000 feet.
3. Locate BHP-altitude point.
4. Find intersection of 1240 BHP and the line limited by maximum recommended cruise BMEP. This determines the minimum RPM at which 1240 BHP may be obtained for cruise operation, 2300 RPM.
5. Extend a line parallel to the guide lines from point C to the 2300 RPM line. Read the MAP required to develop 1240 BHP at 10,000 feet with 2300 RPM, 33 inches Hg.
6. As an alternate step to 5, extend a line parallel to the guide lines from point C to the left hand scale. Read the power, 1100 BHP, with which to enter the BHP vs MAP chart *(figure A2-8)* for determining the required MAP.

ENGINE CALIBRATION — HIGH BLOWER — BRAKE HORSEPOWER VS MANIFOLD PRESSURE CHART.

This chart *(figure A2-10)* is similar to the low blower brake horsepower vs manifold pressure chart described above. It differs in that it is based on high blower operation at an altitude of 10,000 feet. It is used in the same manner as described for the low blower chart.

ENGINE CALIBRATION — HIGH BLOWER — BRAKE HORSEPOWER VS ALTITUDE CHART.

This chart *(figure A2-11)* shows data for high blower operation corresponding to the low blower brake horsepower vs altitude chart described above. It differs in that there are no takeoff RPM's shown, and the chart starts at 10,000 feet (to correspond to the facing high blower brake horsepower vs manifold pressure chart) rather than sea level. In other respects the chart may be used in the same manner as described for the low blower chart.

ENGINE CALIBRATION — ALTERNATE FUEL GRADE CHART.

This chart *(figure A2-12)* shows the brake horsepower vs altitude calibration for takeoff RPM, wet and dry, in low blower and for METO RPM in both low blower and high blower with alternate fuel grade. For cruise power calibrations the auto-lean curves on figures A2-8 through A2-11 may be used; however, never exceed the power limited by maximum recommended cruise BMEP for any given RPM.

MINIMUM FUEL FLOW CHART — AUTO RICH OPERATION.

The Minimum Fuel Flow chart *(figure A2-13)* shows the expected fuel flow for auto rich operation in both low blower ratio and high blower ratio. If fuel flows substantially exceed those shown on the chart a loss in power may result. In such a case it is permissible to manually lean the mixture to the fuel flow determined from the chart. In no case should the mixture be leaned to less than the chart fuel flows.

It is important that fuel flow be monitored throughout the climb to ascertain that it is within prescribed limits. The minimum fuel flow limit is not an engine limit at normal climb power. It is, however, a carburetor limit designed to obviate damage which might otherwise result at higher power, where margin between a safe fuel flow and engine detonation is diminishing. At climb power, therefore, it is considered safe to continue operation when the fuel flow is at or 50 pounds per hour below the minimum fuel flow shown on figure A2-13, providing CHT and CAT limits are observed. If the climb fuel flow falls more than 50 pounds per hour below published minimum, power should be reduced by increments of 100 BHP until the fuel flow is not more than 50 pounds per hour below the limit for that particular reduced power. CHT and CAT limits must still be monitored. For a carburetor whose fuel flow is below published minimums, a complete write-up should be made in the log and corrective maintenance accomplished at the next landing.

The chase-around lines on the chart illustrate the example.

Sample Problem.

GIVEN: Engine power = 1300 BHP.
RPM = 2300.

FIND: Minimum fuel flow (low blower).

1. Enter the brake horsepower scale at 1300 BHP and proceed vertically upwards.
2. Enter the left hand scale at 2300 RPM and continue to the right to 1300 BHP.
3. At the intersection of 2300 RPM and 1300 BHP read the minimum fuel flow per engine, 810 pounds per hour.

ESTIMATED FUEL CONSUMPTION FOR CRUISE POWERS CHARTS.

These two charts show the estimated fuel flows for cruise operation in low blower *(figure A2-14)* and high blower *(figure A2-15)* when using the BMEP drop method of cruise control. The charts are based on best economy mixture setting; however, an auxiliary graph is included so that the fuel flow may be determined when operating at any given BMEP drop from best power mixture setting.

Sample Problem:

GIVEN: Engine power = 1150 BHP.

RPM = 2200.

BMEP Drop = 12.

Blower Range = Low blower.

FIND: Estimated fuel consumption.

1. Enter the chart *(figure A2-14)* at 1150 BHP (A).
2. Read vertically to the 2200 RPM curve (B).
3. Read across to find fuel flow of 557 pounds per hour per engine (C).
4. To find fuel flow increment for BMEP drop, enter the auxiliary graph at 12 BMEP (D) and read up to 2200 RPM (E).
5. Read across to find fuel flow increment of 2 pounds per hour (F).
6. Fuel flow for each engine is 557 + 2 = 559 pounds per hour per engine. Total fuel flow for all four engines is 559 × 4 = 2236 pounds per hour.

BHP-RPM SCHEDULE CHARTS.

These two charts show the RPM necessary to develop a given brake horsepower when cruising either in low blower *(figure A2-16)* or high blower *(figure A2-18)*. The charts are based on operating at 12 BMEP drop from best power mixture. Corrections are provided for carburetor air temperature and pressure altitude.

Within a certain range of conditions part throttle operation is indicated on each chart. In such cases the manifold pressure required to develop the given brake horsepower may be determined from the facing BHP-MAP Schedule chart. When full throttle operation is indicated it is not necessary to know the manifold pressure. Correction for ram effect is included in the chart so that no correction for airspeed is required.

It may also be noted that carburetor air temperature only affects RPM when operating at full throttle. For example, figure A2-16 shows that at 6,000 feet pressure altitude the RPM required to develop 1000 BHP is 1855 for any carburetor air temperature from 20°C to minus 60°C. This is because part throttle operation is indicated. However, at 14,000 feet pressure altitude any change in carburetor air temperature affects tbe RPM required to developed 1000 BHP because, for these conditions, full throttle operation is required. The chart shows that an increase in carburetor air temperature increases the RPM required.

Sample Problem:

GIVEN: Carburetor air temperature = −10°C.

Blower operation = Low blower.

Pressure altitude = 10,000 feet.

Desired power = 1050 BHP.

FIND: RPM required to produce 1050 BHP.

1. Enter the low blower chart *(figure A2-16)* at carburetor air temperature of −10°C (A) and read across to pressure altitude of 10,000 feet (C).
2. Read up to desired power of 1050 BHP (C).
3. Read across to find required RPM of 1945 (D). Since power setting is in the part throttle range at this altitude, the manifold pressure for this power setting must be obtained from the BHP-MAP Schedule chart *(figure A2-17)*.

BHP-MAP SCHEDULE CHARTS.

These two charts show the manifold pressure required to develop a given brake horsepower when cruising in either low blower *(figure A2-17)* or high blower *(figure A2-19)*. They are to be used with the RPM's determined from the facing BHP-RPM Schedule charts, and are based on 12 BMEP drop from best power mixture. The corrections shown for carburetor air temperature are applicable only for part throttle operation. Although manifold pressures are also shown for full throttle operation they are approximately correct only for standard atmospheric conditions and are not required for setting up engine powers.

Sample problems are included on both charts to illustrate the method of computing for temperatures below standard *(figure A2-17)* and for temperatures above standard *(figure A2-19)*.

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ENGINE MANIFOLD PRESSURE AND POWER LIMITS

MODEL: C-118A AND VC-118A — **ENGINES: R2800-52W**
DATA AS OF: 2-15-59 — **FUEL GRADE: 115/145**
BASED ON: Estimated data — **ALTERNATE FUEL GRADE: 100/130**

FUEL GRADE: 115/145

Power Condition	*RPM*	*Blower*	*Mixture*	*MAP Limit (In. Hg)*	*BMEP Limit (psi)*	*BHP*
Takeoff (Wet)	2800	Low	Rich	*62.0 at S.L.	253	2500
				*61.5 at 3800 feet	253	2500
Takeoff (Dry)	2800	Low	Rich	*60.0 at S.L.	222	2200
				*58.5 at 5300 feet	222	2200
METO	2600	Low	Rich	51.5 at S.L.	207	1900
				50.0 at 7000 feet	207	1900
METO	2600	High	Rich	50.0 at 10,000 feet	190	1750
				47.5 at 16,000 feet	190	1750
Maximum Cruise	2300	Low	Lean		153	1240
Maximum Cruise	2300	High	Lean		147	1200

FUEL GRADE: 100/130

Power Condition	*RPM*	*Blower*	*Mixture*	*MAP Limit (In. Hg)*	*BMEP Limit (psi)*	*BHP*
Takeoff (Wet)	2800	Low	Rich	*59.5 at S.L.	243	2400
				*58.5 at 5000 feet	243	2400
Takeoff (Dry)	2800	Low	Rich	*53.0 at S.L.		
				*51.0 at 9900 feet		
METO	2600	Low	Rich	49.0 at S.L.	196	1800
				47.0 at 9300 feet	196	1800
METO	2600	High	Rich	47.5 at 10,000 feet	185	1700
				45.5 at 16,000 feet	185	1700
Maximum Cruise	2300	Low	Lean		153	1240
Maximum Cruise	2300	High	Lean		147	1200

Note
1. Observe MAP limit of BMEP limit, whichever is reached first.
2. For maximum cruise MAP see the Power Settings for Cruise charts, Part 5.
Maximum cruise low blower – 155 bmep (except when at 1240 bhp and 2300 rpm – 153 bmep)
Maximum cruise high blower – 150 bmep (except when at 1200 bhp and 2300 rpm – 147 bmep)

* Takeoff MAP may be increased by existing vapor pressure up to 1.5 in. Hg.

Figure A2-1. Engine Manifold Pressure and Power Limits

WET TAKEOFF BMEP AT VARIOUS CONDITIONS OF TEMPERATURE AND HUMIDITY

2800 RPM
SEA LEVEL
ADI ON
NO INSTALLATION EFFECTS

DATA AS OF: 2-15-59
BASED ON: Pratt & Whitney Table, ALT120

Carburetor Air Temperature			°C	10	15	20	25	30	35	40	45
			°F	50	59	68	77	86	95	104	113
**Manifold Pressure (In. Hg)*	*Dewpoint Temperature °C*	*Dewpoint Temperature °F*	*BMEP (psi)*								
62.1	—4	25		253	252	250	248	245	243	241	239
62.2	—1	30		253	252	249	248	245	243	241	239
62.2	2	35		253	251	249	247	244	242	240	238
62.2	4	40		252	250	248	246	244	242	240	237
62.3	7	45		252	250	248	246	243	241	239	237
62.3	10	50		251	249	247	245	243	241	238	236
62.4	13	55			248	246	244	242	240	238	236
62.5	16	60			248	245	244	241	239	237	235
62.6	18	65				244	243	240	238	236	234
62.7	21	70				243	242	239	237	235	233
62.9	24	75					240	238	236	234	231
63.0	27	80					238	236	234	232	230
63.2	29	85						234	232	230	228
63.4	32	90							230	228	226

*62.0 inches plus existing vapor pressure up to 1.5 inches

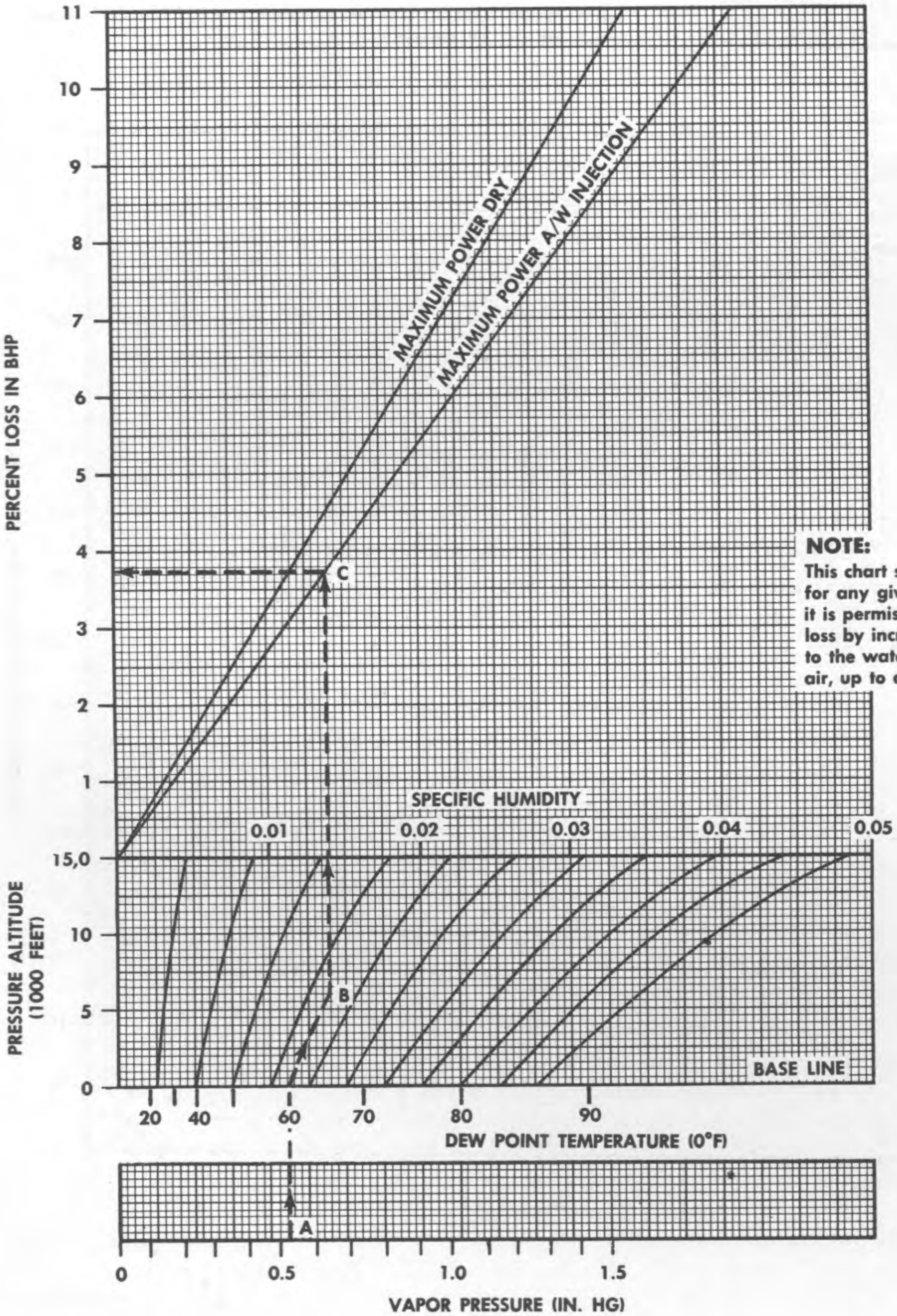
Figure A2-2. Wet Takeoff BMEP at Various Conditions of Temperature and Humidity

EFFECT OF HUMIDITY ON POWER OUTPUT

MODEL: C-118A AND VC-118A
DATA AS OF: 2-15-59
BASED ON: CALCULATED DATA

SAMPLE PROBLEM:
A. Vapor pressure = 0.53 In. Hg (Dew point temperature = 60°F).
B. Pressure altitude = 6000 feet.
C. Effect of humidity on maximum power, wet, is a 3.7% loss in power.

ENGINES: (4) R2800-52W



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 MAP by an amount equal to the water vapor pressure present in the air, up to a limit of 1.5 inches HG.

AA1-542

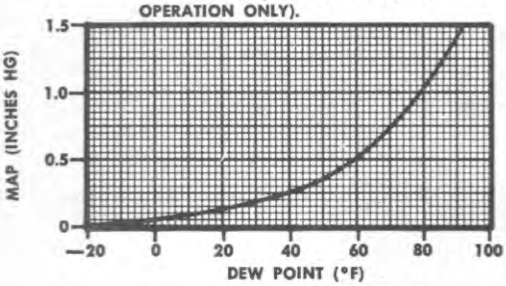
Figure A2-3. Effect of Humidity on Power Output

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — WET

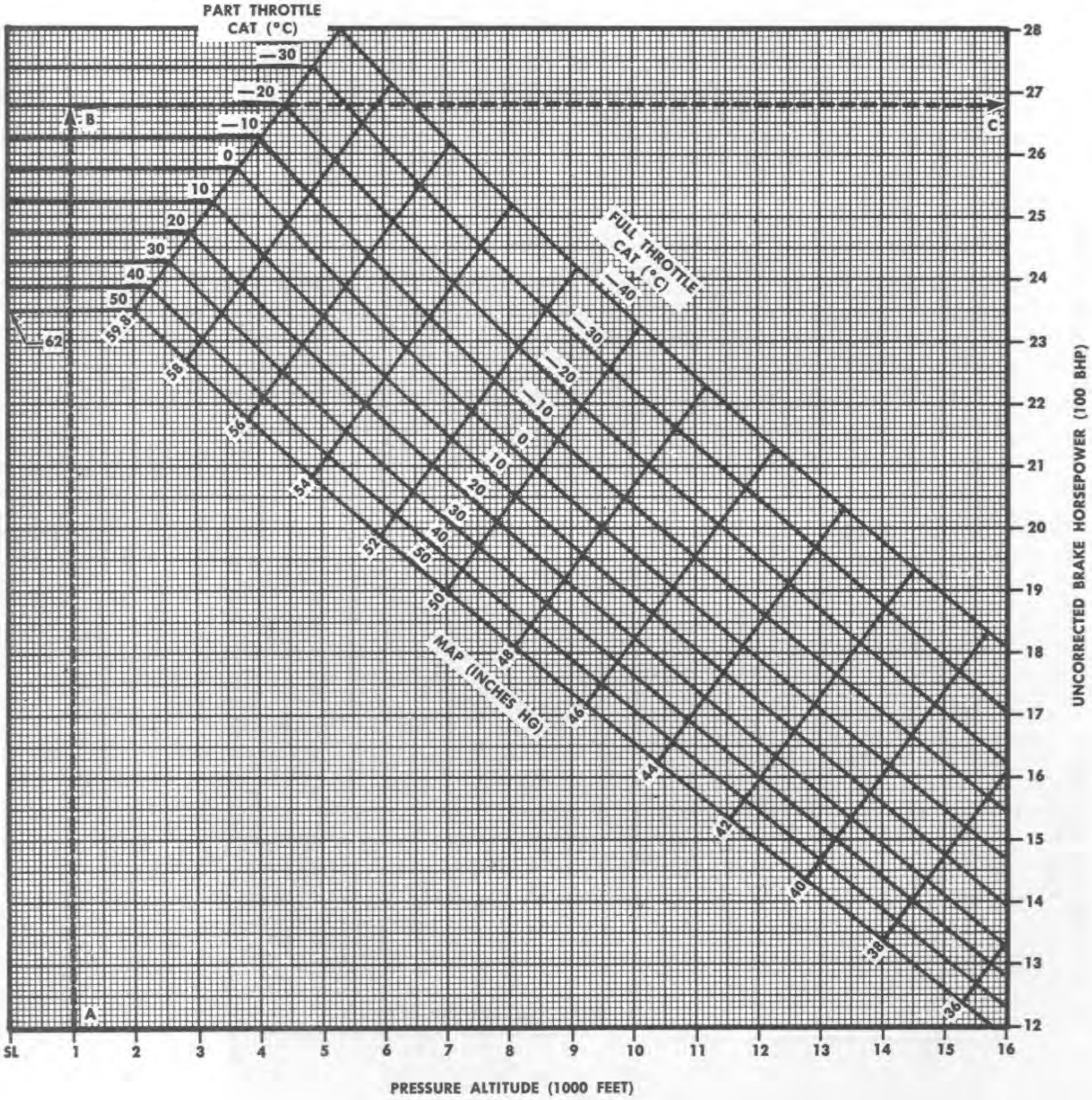
2800 RPM

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145



NOTES:

1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).



AA1-532

Figure A2-4. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Wet (Sheet 1 of 2)

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — WET

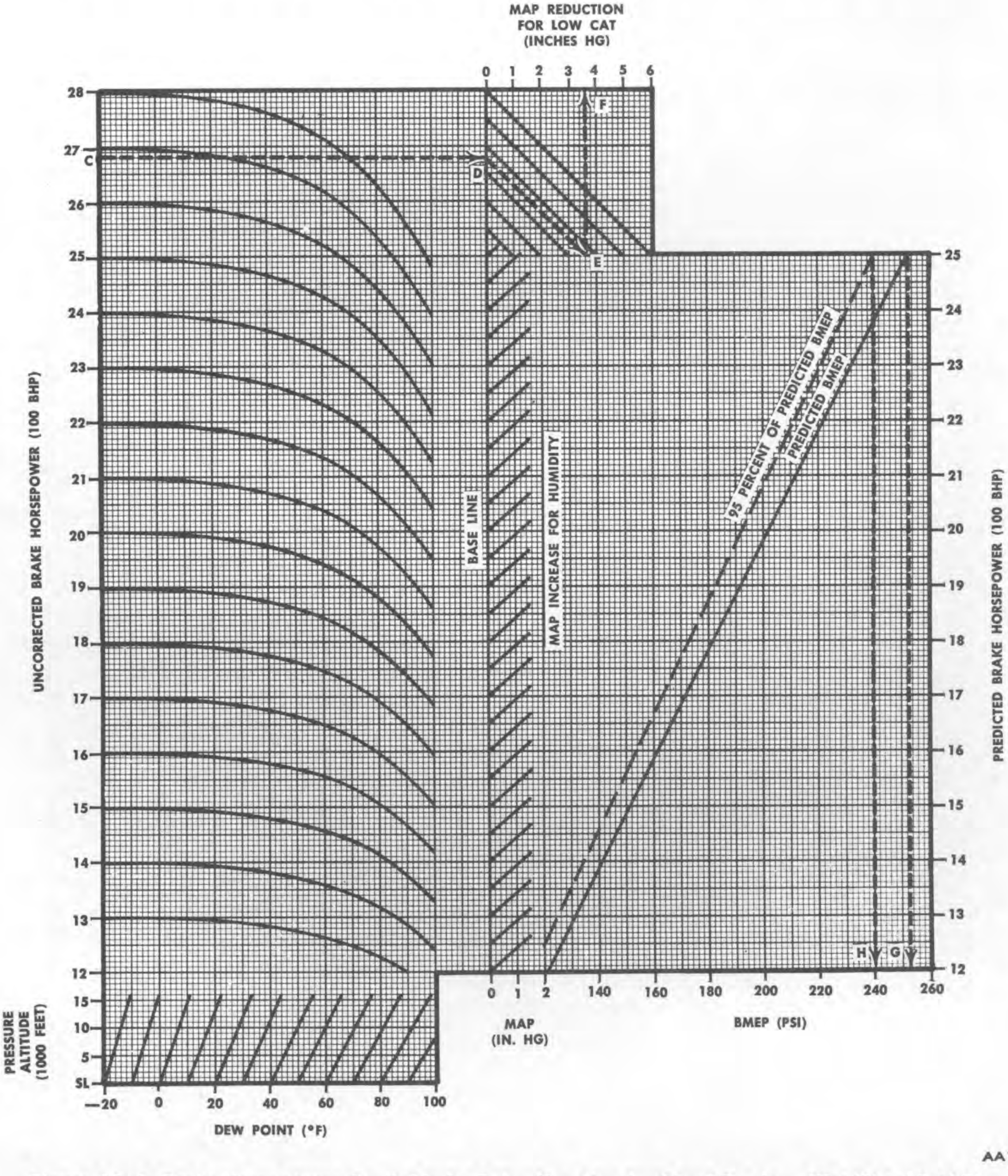
2800 RPM

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145

SAMPLE PROBLEM:

A. Pressure altitude = 1000 feet.
B. CAT = −20°C (5° above OAT of −25°C).
C. Uncorrected brake horsepower = 2680.
D. No correction for humidity because dew point is −20°C.
E. Predicted power per engine = 2500 BHP.
F. Map reduction for low CAT = 3.6 inch. HG. (MAP for takeoff = 62 inch. HG −3.6 inch. HG, or 58.4 inch. HG).
G. Predicted BMEP = 253 PSI.
H. 95 percent predicted BMEP = 240 PSI.



AA1-533

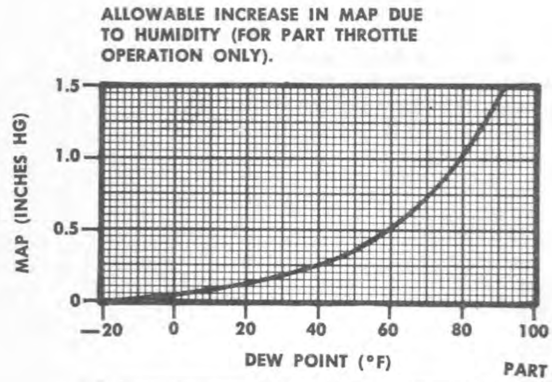
Figure A2-4. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Wet (Sheet 2 of 2)

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — DRY

2800 RPM

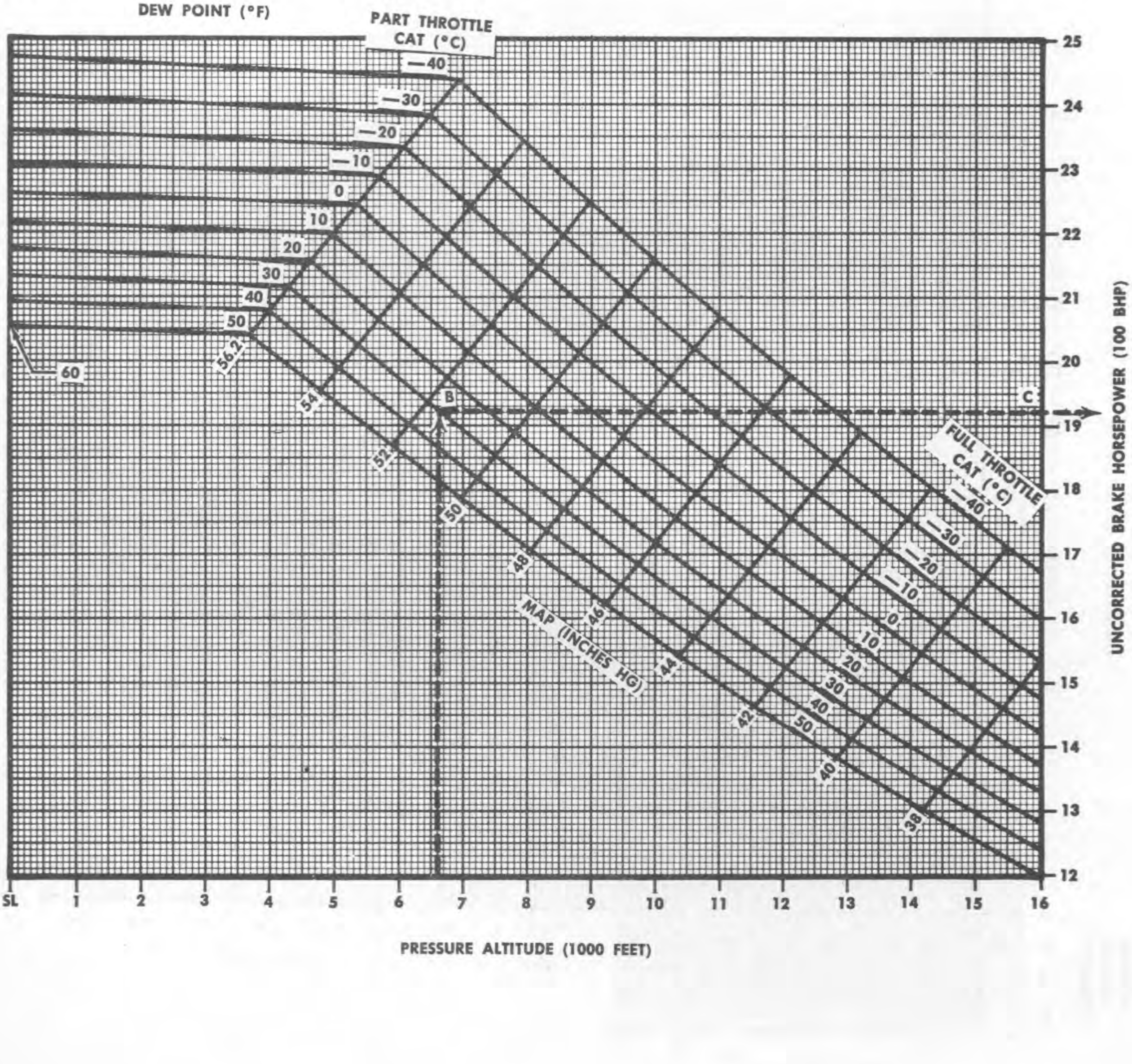
MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145



NOTE:

1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).



AA1-534

Figure A2-5. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Dry (Sheet 1 of 2)

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — STANDARD FUEL GRADE — DRY

2800 RPM

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145

SAMPLE PROBLEM:

A. Pressure altitude = 6600 feet.
B. CAT = 30°C.
C. Uncorrected brake horsepower = 1922 BHP.
D. Dew point = 54°F.
E. Pressure altitude = 6600 feet.
F. Power corrected for humidity.
G. No increase in MAP for humidity because full throttle operation is required (see point B).
H. Predicted power per engine = 1854 BHP.
I. Predicted BMEP = 187.5 PSI.
J. 95 percent of predicted BMEP = 178 PSI

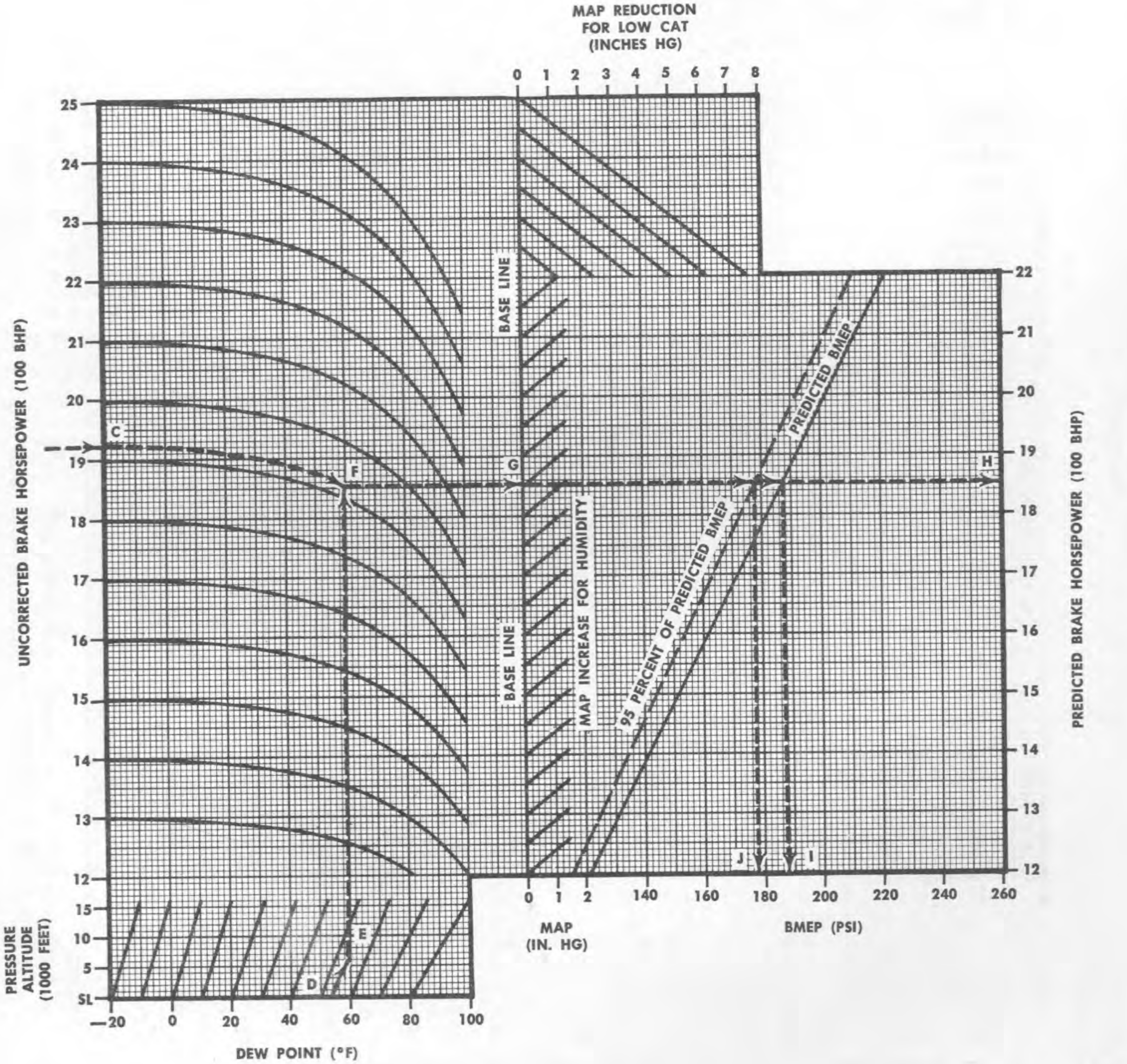


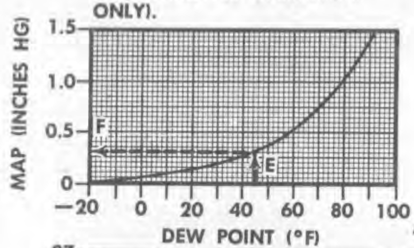
Figure A2-5. Brake Horsepower Available for Takeoff — Standard Fuel Grade — Dry (Sheet 2 of 2)

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON FLIGHT TEST DATA

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — ALTERNATE FUEL GRADE — WET

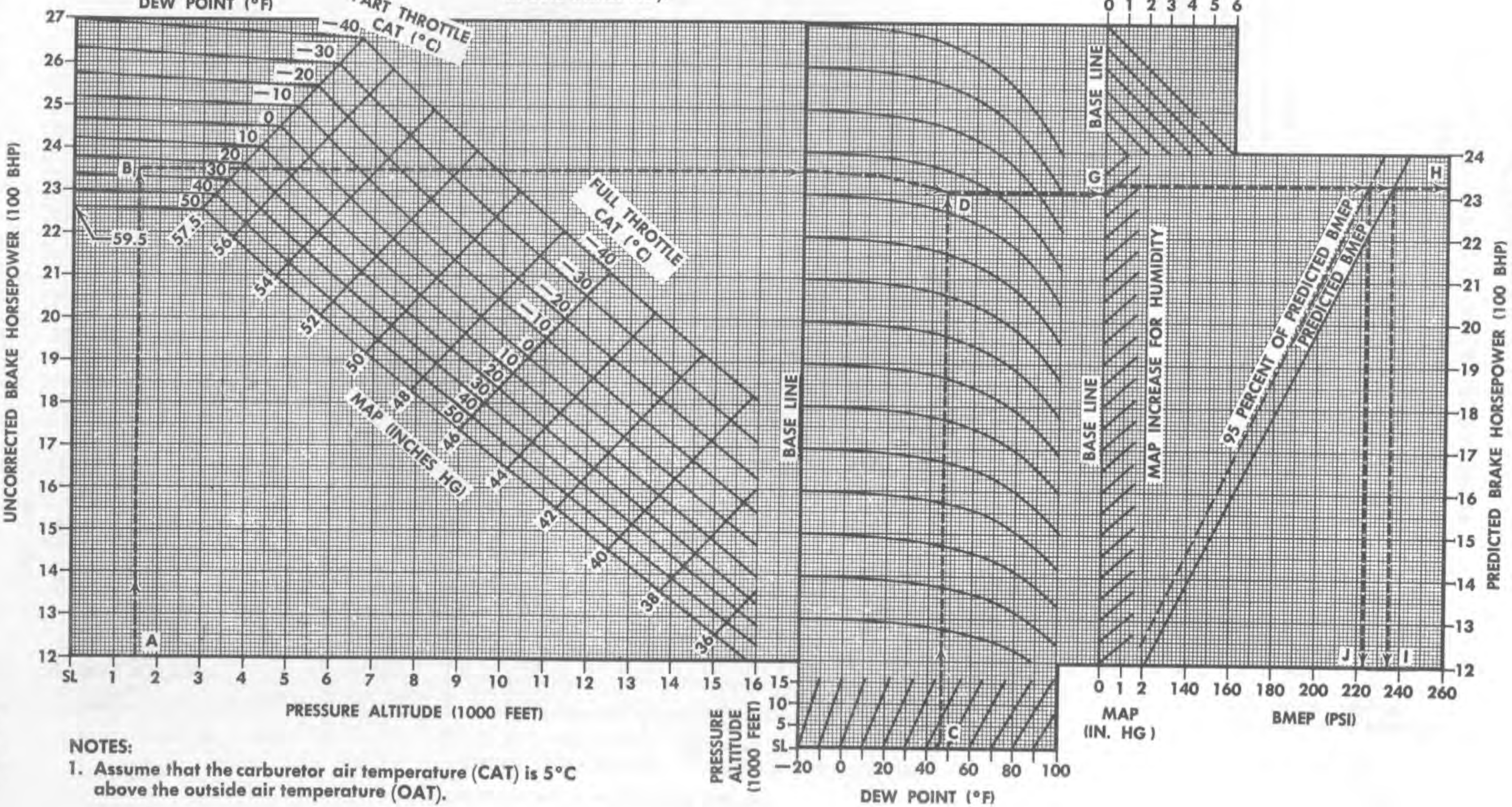
2800 RPM

ENGINES: (4) R2800-52W
FUEL GRADE: 100/130



SAMPLE PROBLEM:

A. Pressure altitude = 1500 feet.
B. CAT = 25°C (5° above OAT of 20°C).
C. Dew point = 45°F at 1500 feet altitude.
D. Power correction for humidity.
E. Enter auxiliary graph at the dew point of 45°F.
F. Read the allowable increase in MAP due to humidity, 0.3 inches of HG (MAP for takeoff will be 59.5 + 0.3 or 59.8 inches HG).
G. Correct power for 0.3 inch HG increase in MAP.
H. Predicted power per engine = 2322 BHP.
I. Predicted BMEP = 234 PSI.
J. 95 percent of predicted BMEP = 222.3 PSI.



NOTES:

1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).

AA1-251

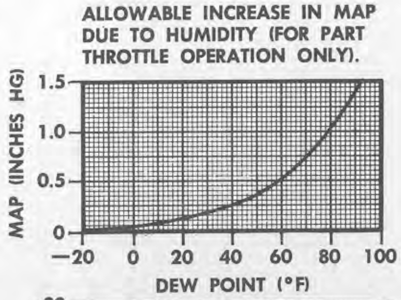
Figure A2-6. Brake Horsepower Available for Takeoff — Alternate Fuel Grade — Wet

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF — ALTERNATE FUEL GRADE — DRY

2800 RPM

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON FLIGHT TEST DATA

ENGINES: (4) R1800-52W
FUEL GRADE: 100/130

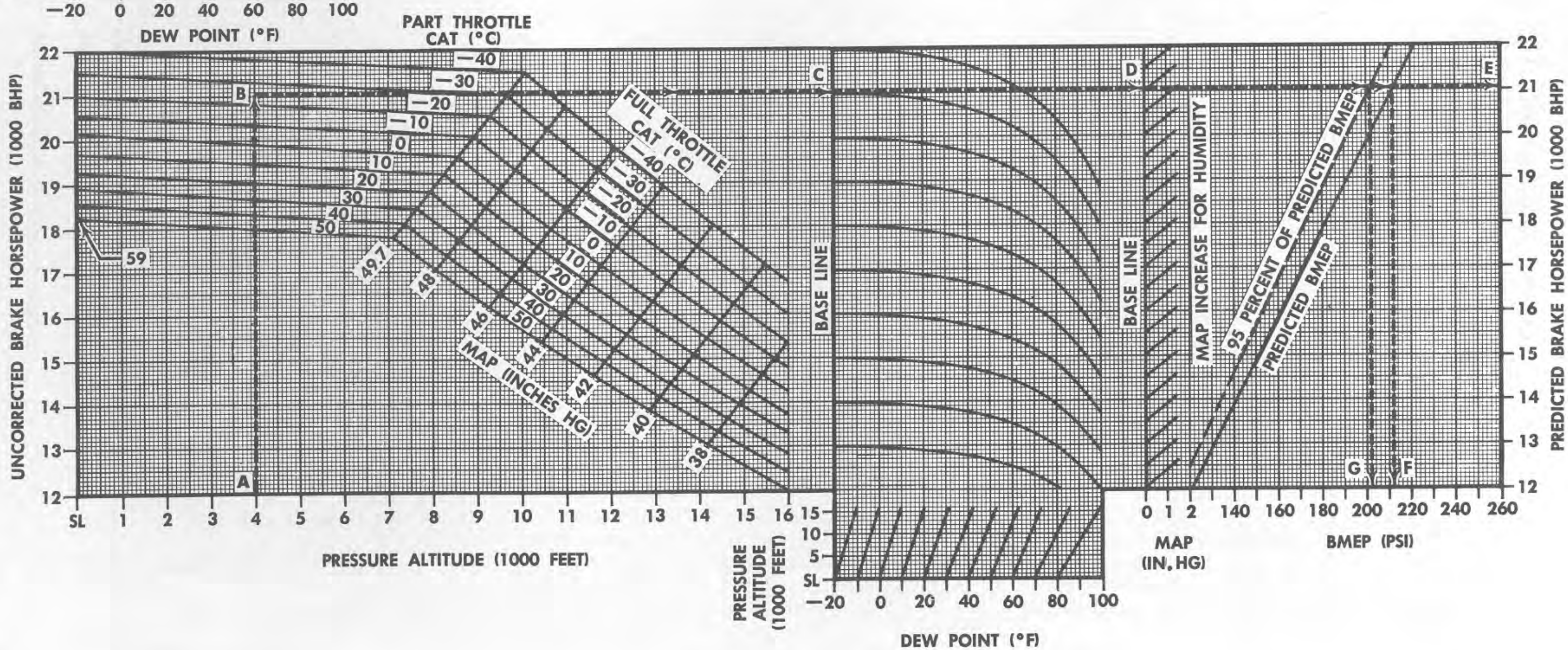


NOTES:

1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).

SAMPLE PROBLEM

A. Pressure altitude = 4000 feet.
B. CAT = −25°C (5°C above OAT of −30°C).
C. There is no correction for humidity because the dew point is less than −20°C.
D. There is no increase in MAP because the dew point is less than −20°.
E. Predicted power per engine = 2105 BHP.
F. Predicted BMEP = 212 PSI.
G. 95 percent of predicted BMEP = 201.5 PSI.



AA1-24B

Figure A2-7. Brake Horsepower Available for Takeoff — Alternate Fuel Grade — Dry

ENGINE CALIBRATION — LOW BLOWER

BRAKE HORSEPOWER Vs MANIFOLD PRESSURE
SEA LEVEL — STANDARD DAY
AUTO — LEAN MIXTURE

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASED ON: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145

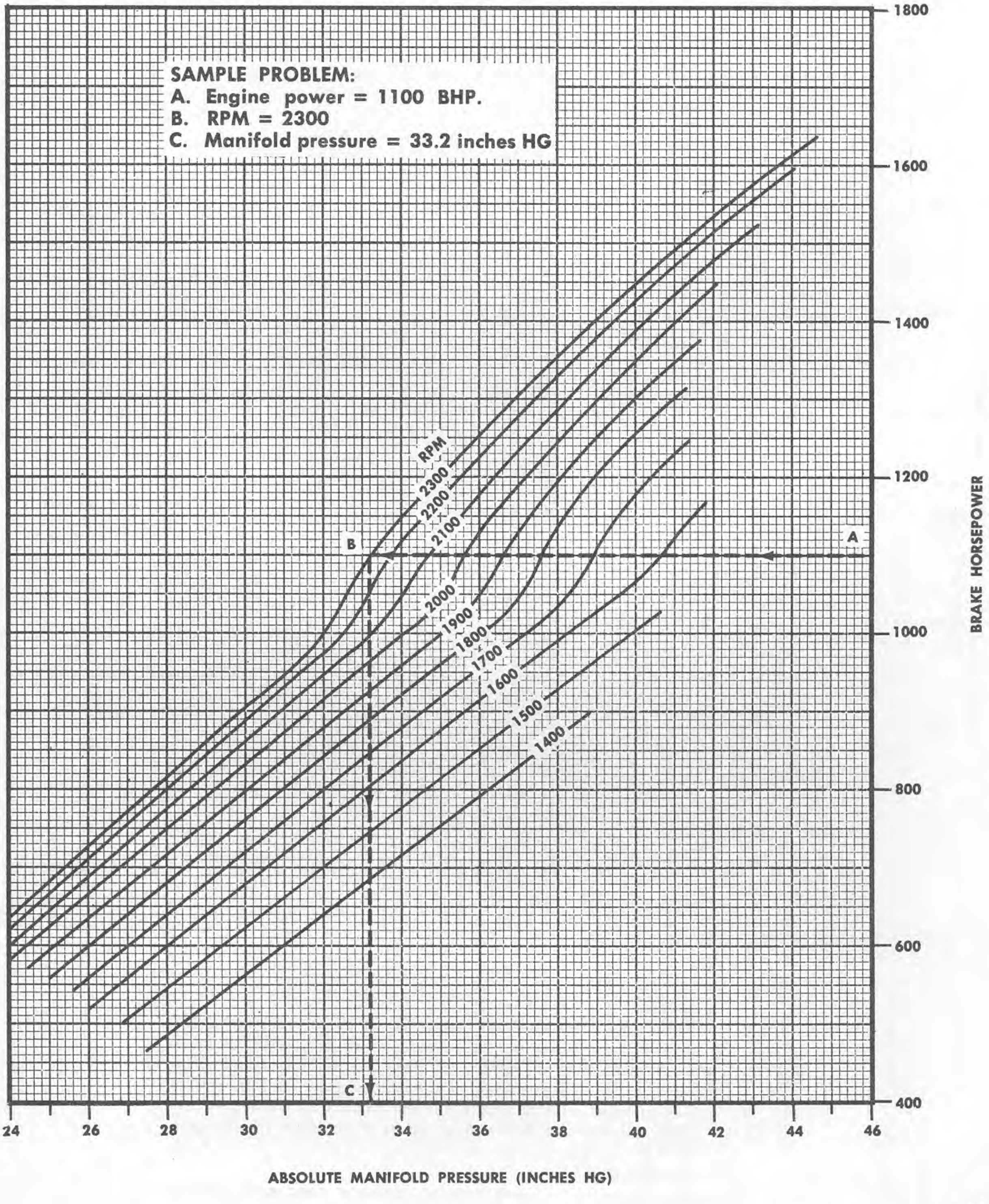
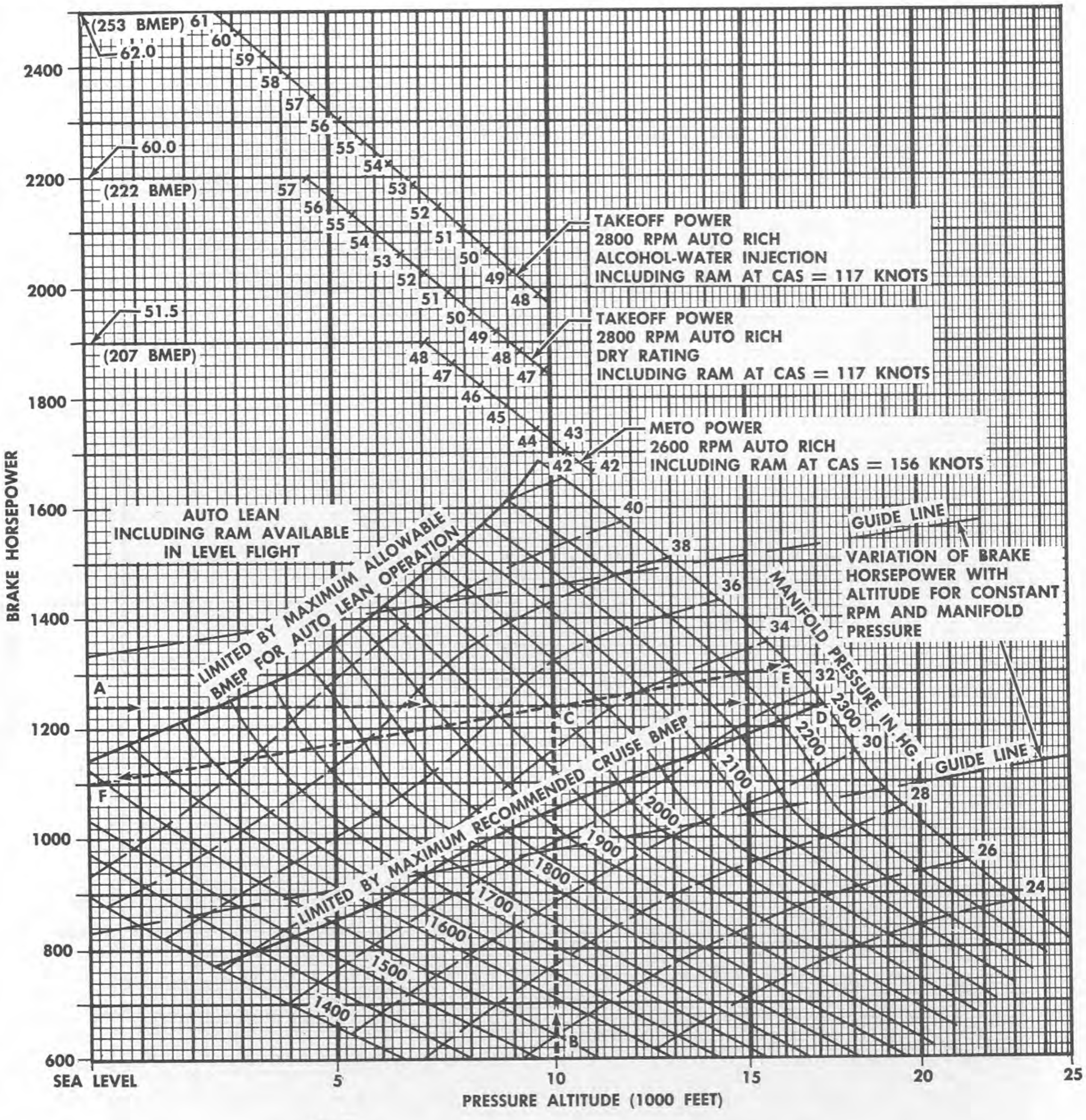


Figure A2-8. Engine Calibration—Low Blower—Brake Horsepower Vs Manifold Pressure

ENGINE CALIBRATION — LOW BLOWER
BRAKE HORSEPOWER Vs ALTITUDE
NACA STANDARD DAY

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145



NOTE:
Values given in this chart are based on flight test engine calibration data where available and on engine calibration curve No. Inst. 16472-1 in Pratt and Whitney Special Operating Instructions No. 01.115 dated April 1951, revised June 15, 1951 (modified to agree with existing flight test results). All values include RAM. All predicted BHP values are available from the Altitude, RPM intersection, back to sea level, at that RPM, by maintaining constant BMEP.

AA1-14

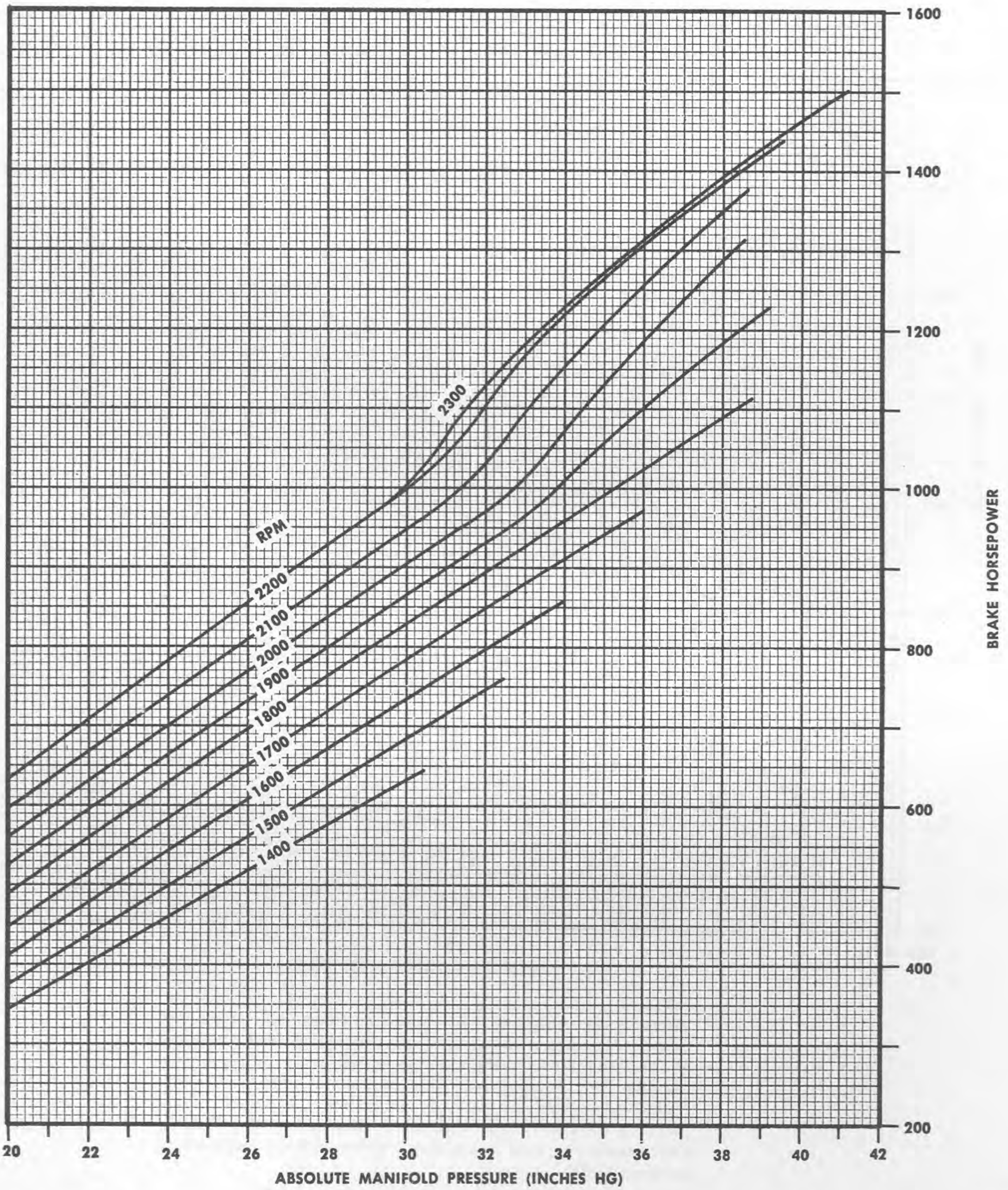
Figure A2-9. Engine Calibration Chart—Low Blower—Brake Horsepower Vs Altitude

ENGINE CALIBRATION — HIGH BLOWER

BRAKE HORSEPOWER VS MANIFOLD PRESSURE
10,000 FEET — STANDARD DAY
AUTO — LEAN MIXTURE

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: CALIBRATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145



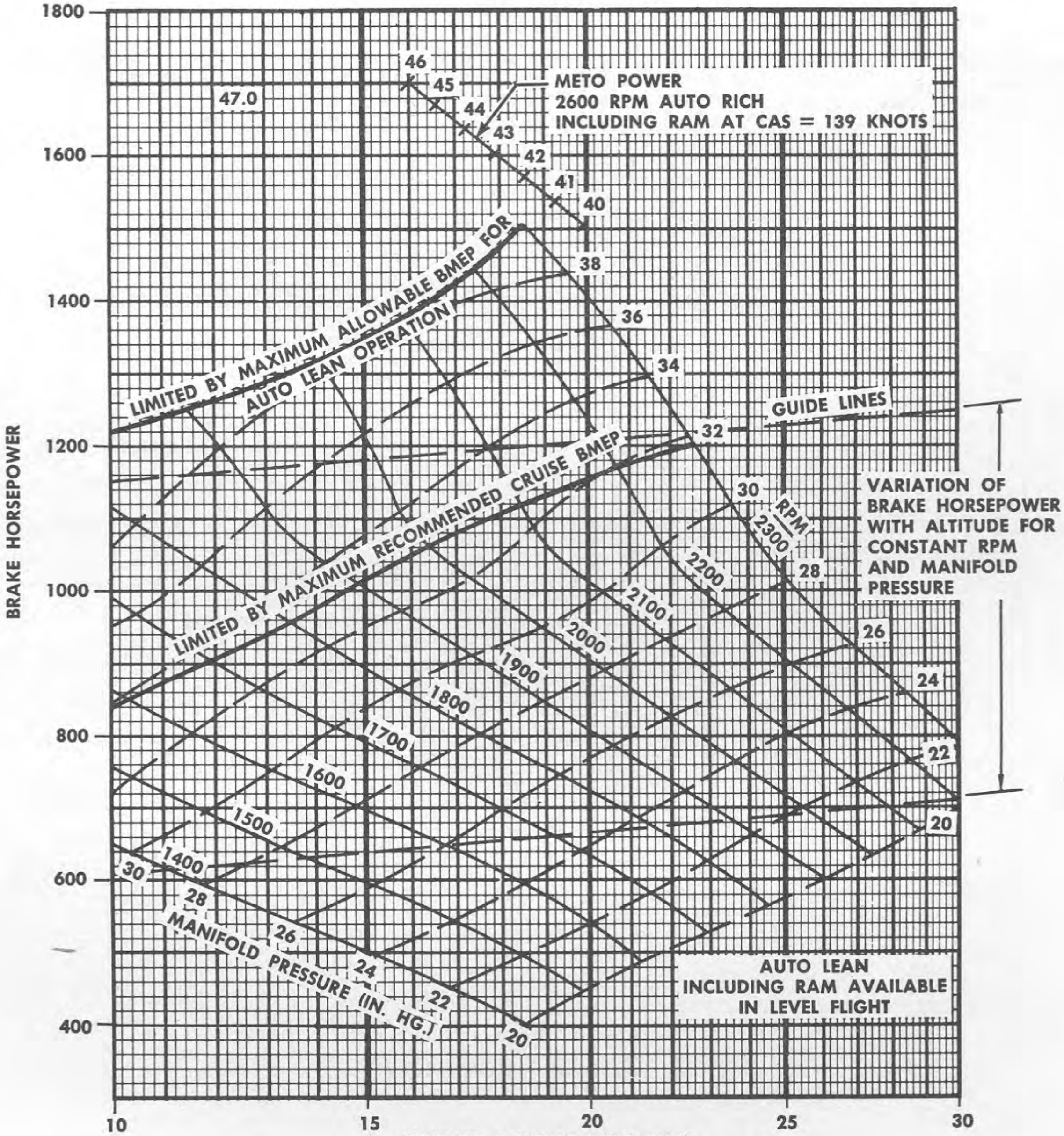
AA1-7

Figure A2-10. Engine Calibration—High Blower—Brake Horsepower Vs Manifold Pressure

ENGINE CALIBRATION — HIGH BLOWER
BRAKE HORSEPOWER VS ALTITUDE
STANDARD DAY

MODEL: C-118A
DATA AS OF: 2-15-59
BASED ON: CALCULATED DATA

ENGINES: R2800-52W
FUEL GRADE: 115/145



NOTES:

1. Values given in this chart are based on flight test engine calibration data where available and on engine calibration curve No. Inst. 16472-3 in Pratt and Whitney Special Operating Instructions No. 01-115 dated April 1951, revised June 15, 1951, (modified to agree with existing flight test results). All values include RAM available at the speeds noted.
2. Do not use high blower if carburetor air temperature exceeds 15°C (approximately 60°F).

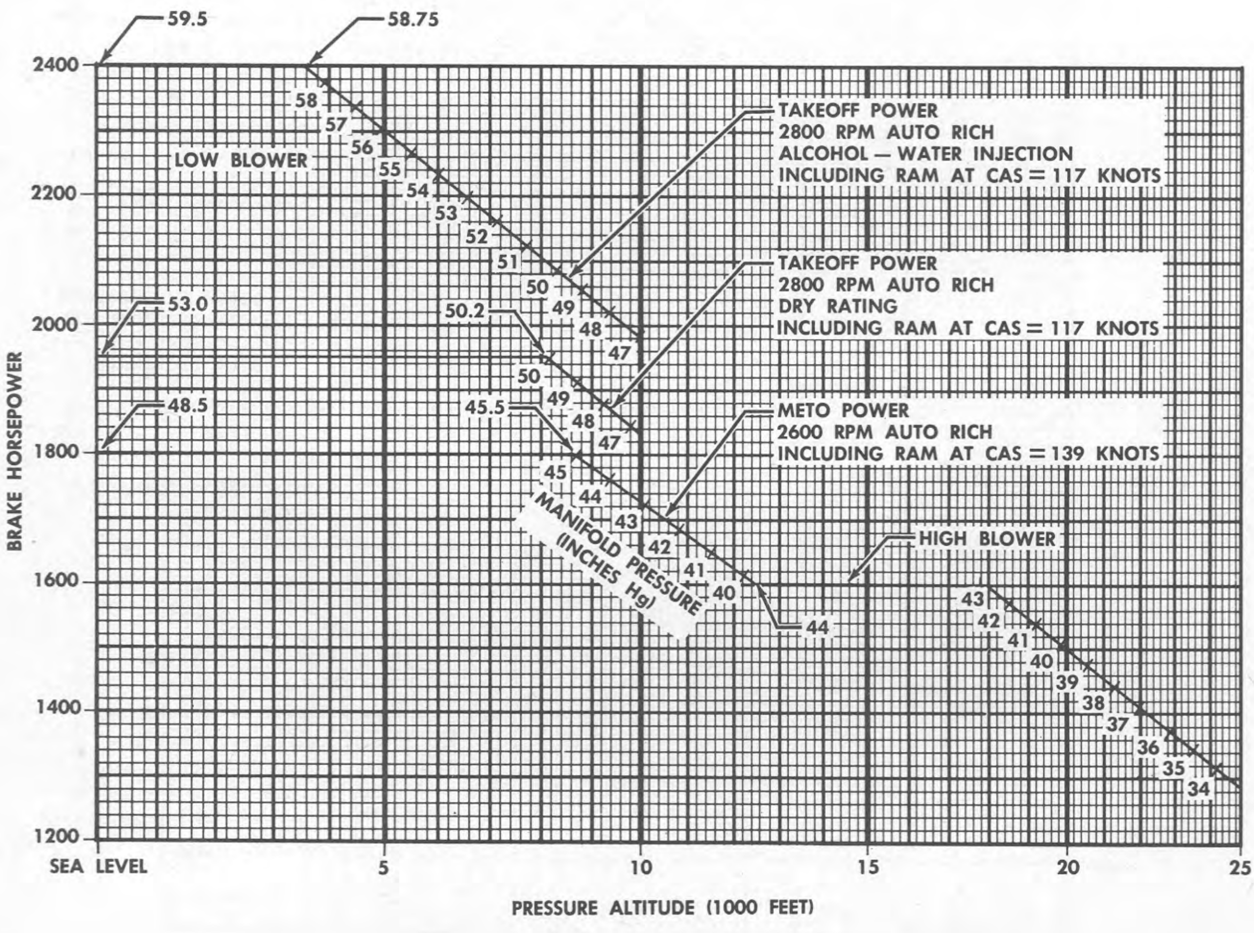
AA1-16

Figure A2-11. Engine Calibration Chart — High Blower — Brake Horsepower Vs Altitude

ENGINE CALIBRATION CURVE — ALTERNATE FUEL GRADE
NACA STANDARD DAY

MODEL: C-118A
DATA AS OF: 2-15-59
DATA BASIS: FLIGHT TEST

ENGINE(S): R2800-52W
FUEL GRADE: 100/130



NOTES:

1. Do not use high blower if carburetor air temperature exceeds 15°C (approximately 60°F).
2. Cruise powers are the same as for 115/145 grade fuel.

CAUTION

Use of this alternate grade fuel for takeoff is not desired for normal operation.

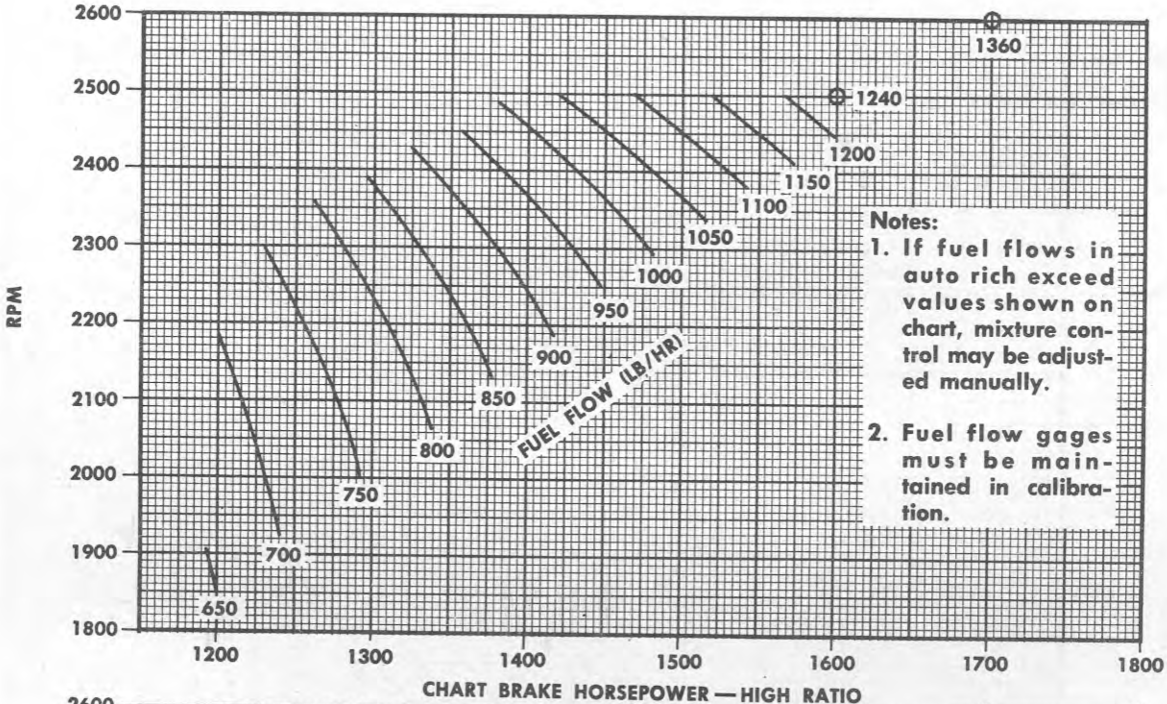
AA1-15

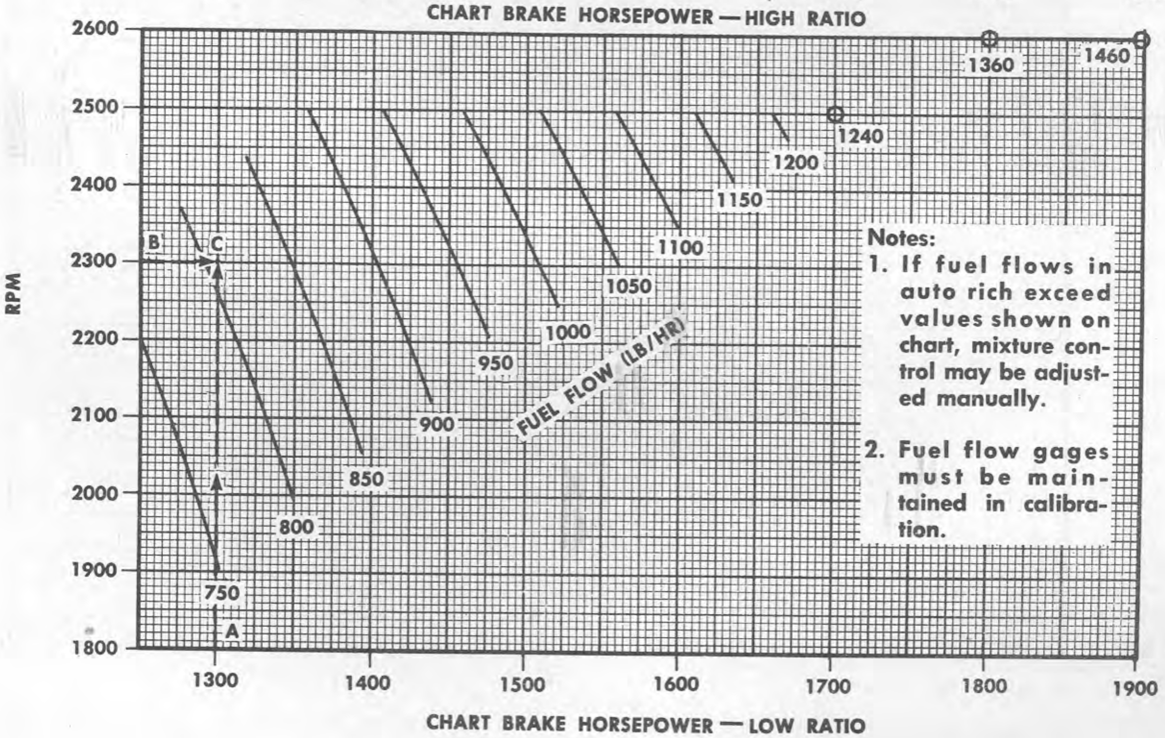
Figure A2-12. Engine Calibration Curve — Alternate Fuel Grade

MINIMUM FUEL FLOW — AUTO RICH OPERATION

MODEL: C-118A
DATA BASIS: P & W SPECIFIC OPERATING INSTRUCTION AS OF 6-15-62

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130





AA1-11

Figure A2-13. Minimum Fuel Flow — Auto Rich Operation

ESTIMATED FUEL CONSUMPTION FOR CRUISE POWERS — LOW BLOWER

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: ESTIMATED

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
Fuel flow increments to be added to fuel flow for best economy, when operating at a given BMEP drop.

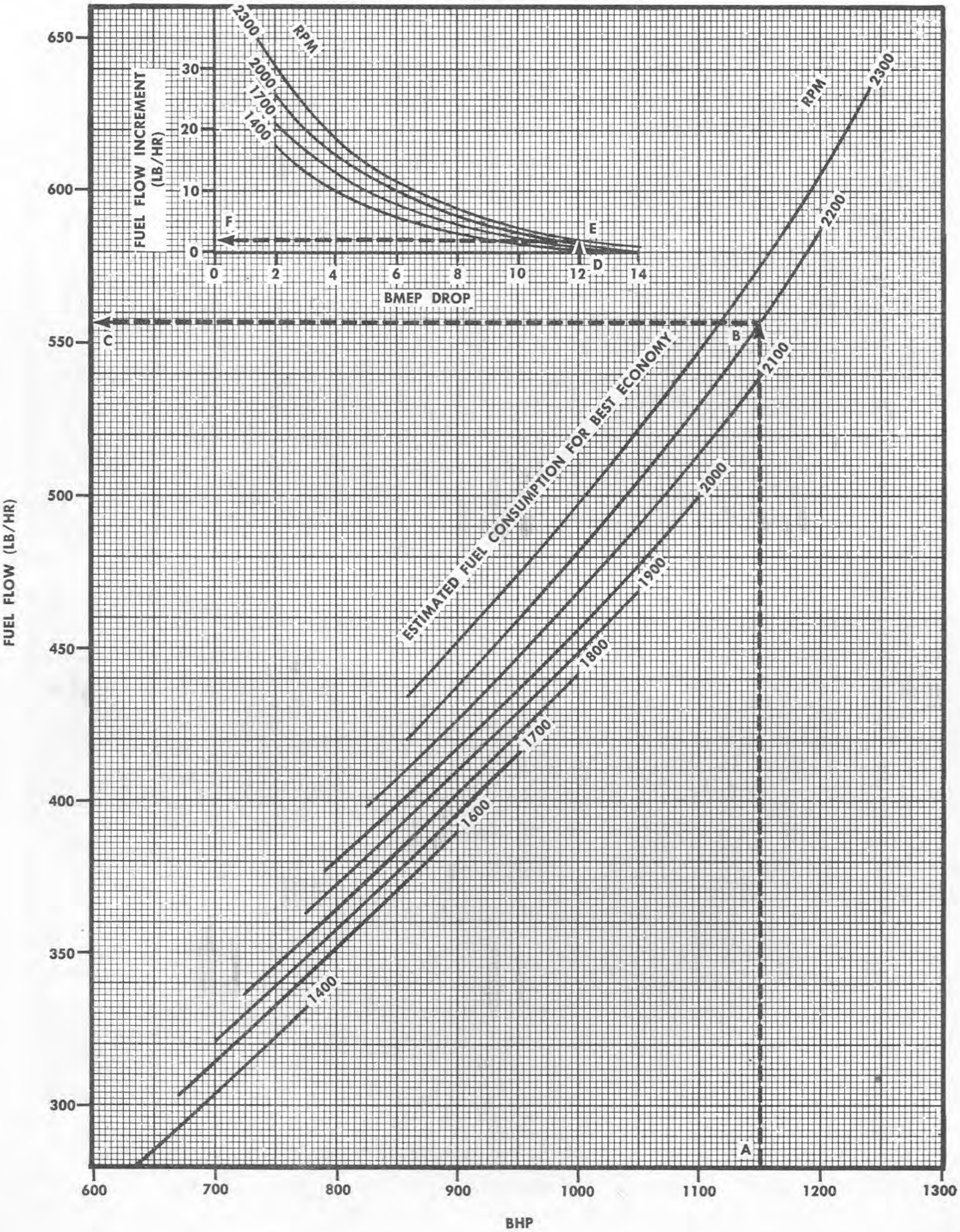


Figure A2-14. Estimated Fuel Consumption for Cruise Powers — Low Blower

ESTIMATED FUEL CONSUMPTION FOR CRUISE POWERS — HIGH BLOWER

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: ESTIMATED

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130

NOTE:
Fuel flow increment to be added to fuel flow for best economy, when operating at a given BMEP drop.

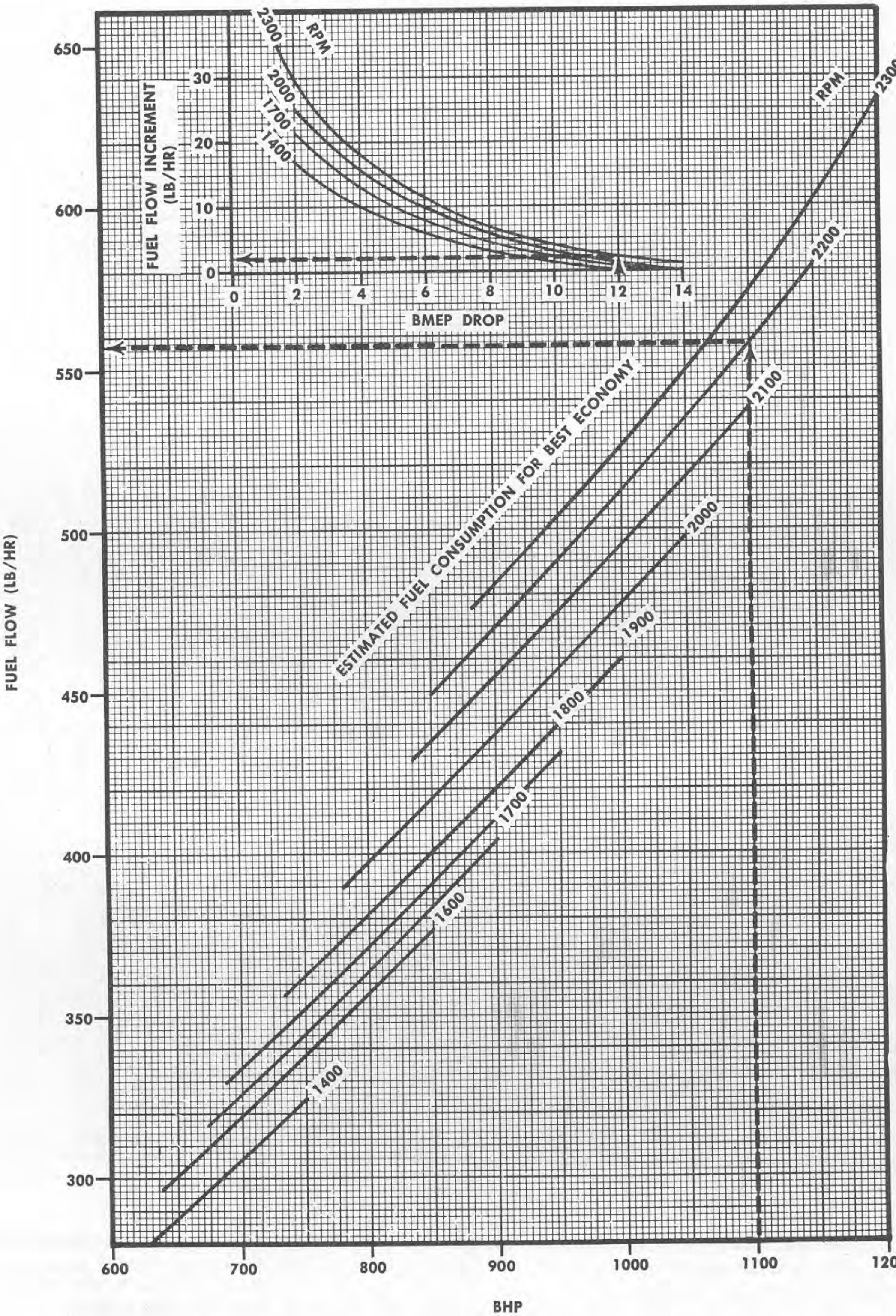
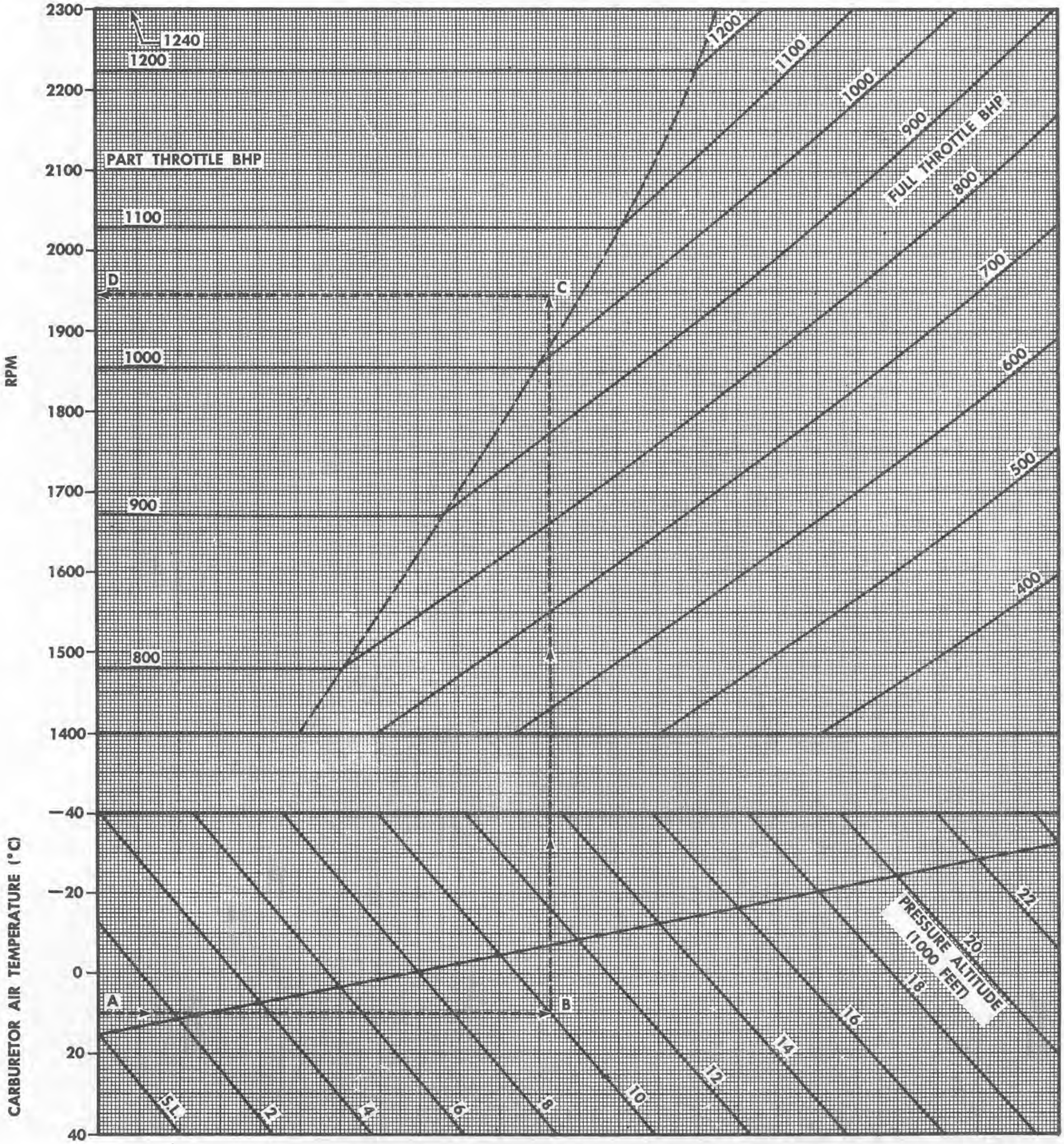


Figure A2-15. Estimated Fuel Consumption for Cruise Powers — High Blower

BHP-RPM SCHEDULE — LOW BLOWER
MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTE:
For part throttle BHP's the manifold pressure must be obtained from the BHP-manifold pressure schedule.

SAMPLE PROBLEM:
A. Carburetor air temperature = 10°C.
B. Pressure altitude = 10,000 feet.
C. Desired power = 1050 BHP.
E. Required RPM = 1945.

AA1-245

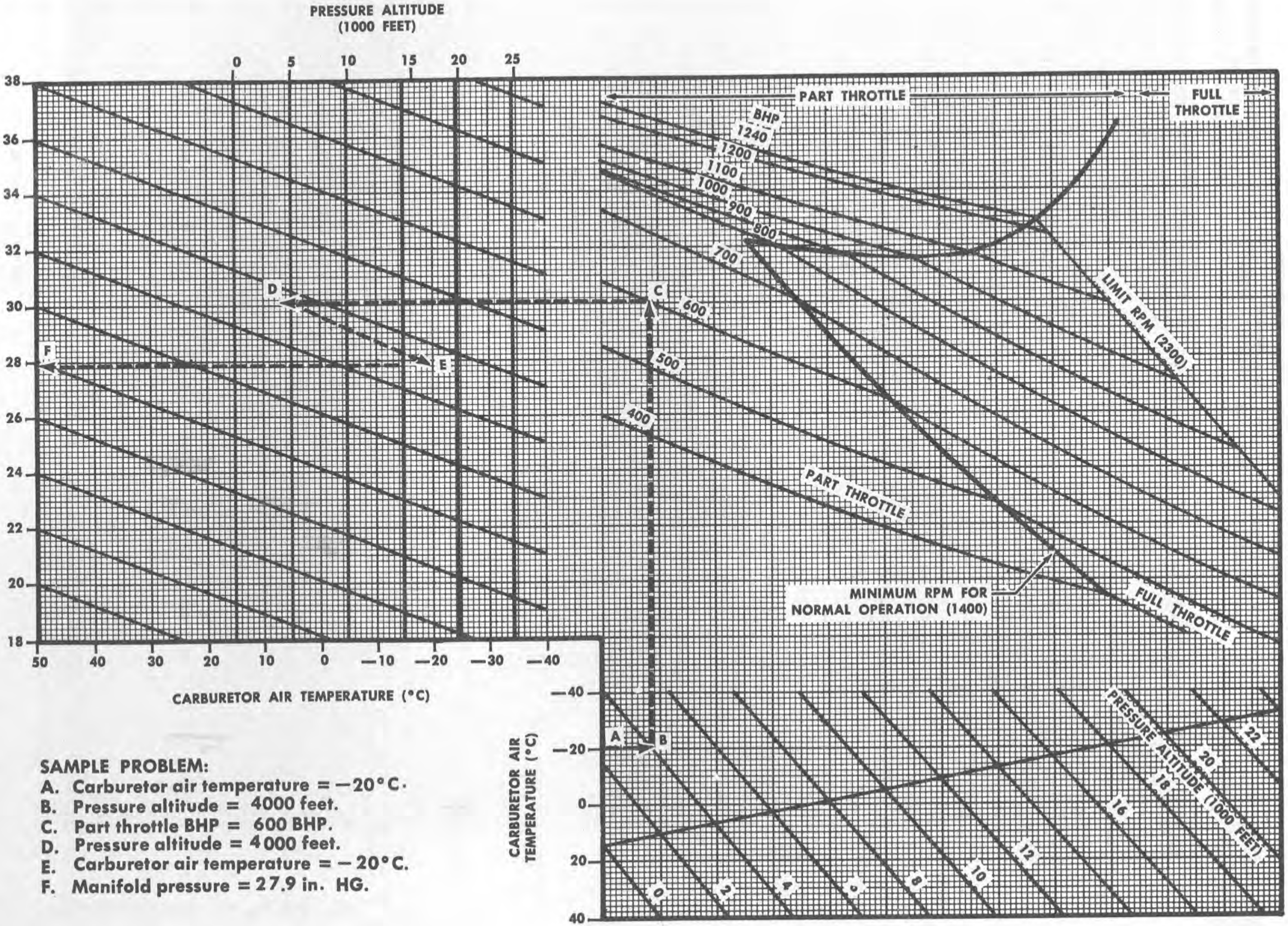
Figure A2-16. BHP — RPM Schedule — Low Blower

BHP-MAP SCHEDULE – LOW BLOWER

MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



SAMPLE PROBLEM:

A. Carburetor air temperature = −20°C.
B. Pressure altitude = 4000 feet.
C. Part throttle BHP = 600 BHP.
D. Pressure altitude = 4000 feet.
E. Carburetor air temperature = −20°C.
F. Manifold pressure = 27.9 in. HG.

AA1-247

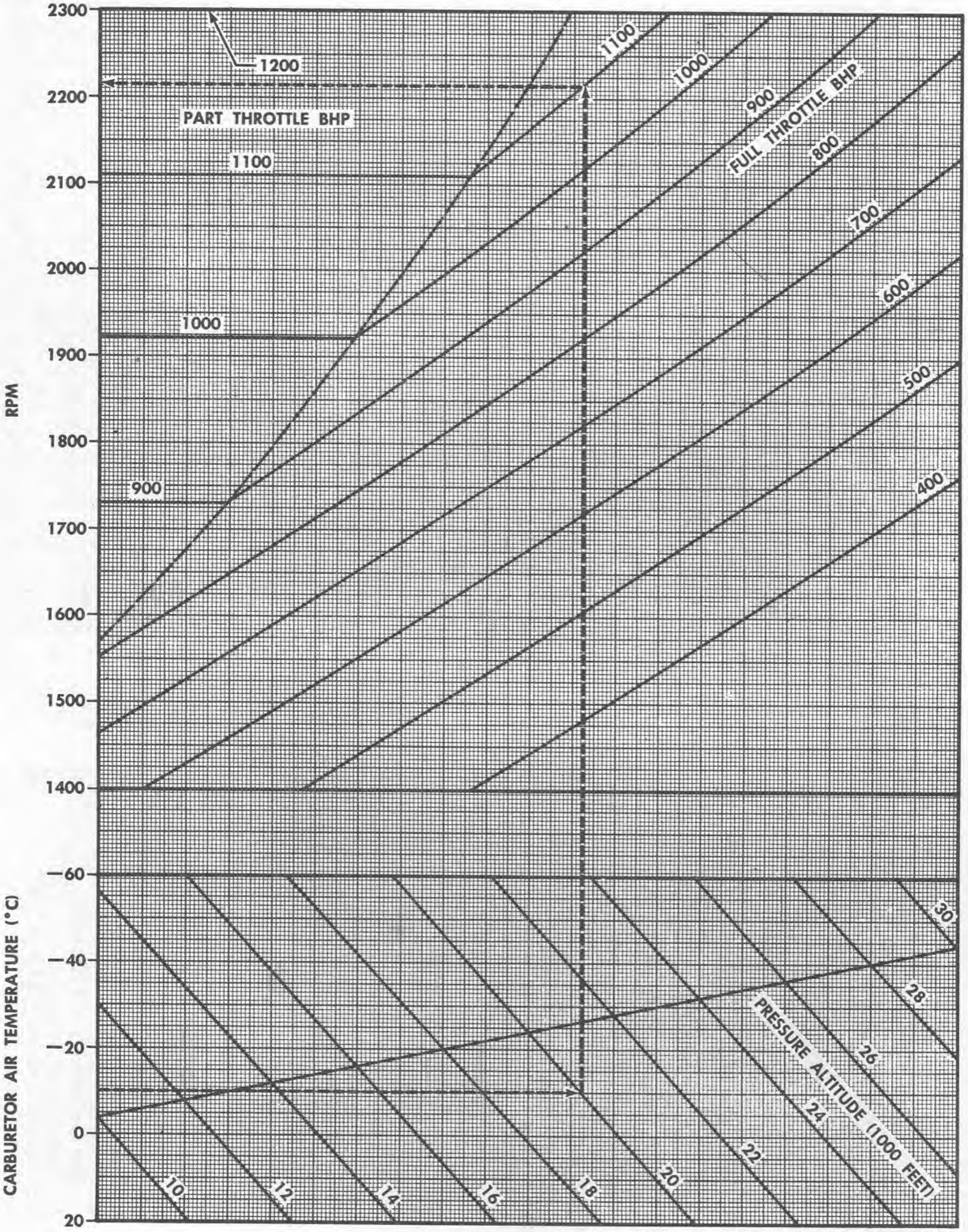
Figure A2-17. BHP – MAP Schedule – Low Blower

MODEL: C-118A
DATA AS OF: 6-15-62
BASED ON: CALCULATED DATA

BHP-RPM SCHEDULE — HIGH BLOWER

MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



NOTE:
For part throttle BHP's the manifold pressure must be obtained from the BHP-manifold pressure schedule.

AA1-244

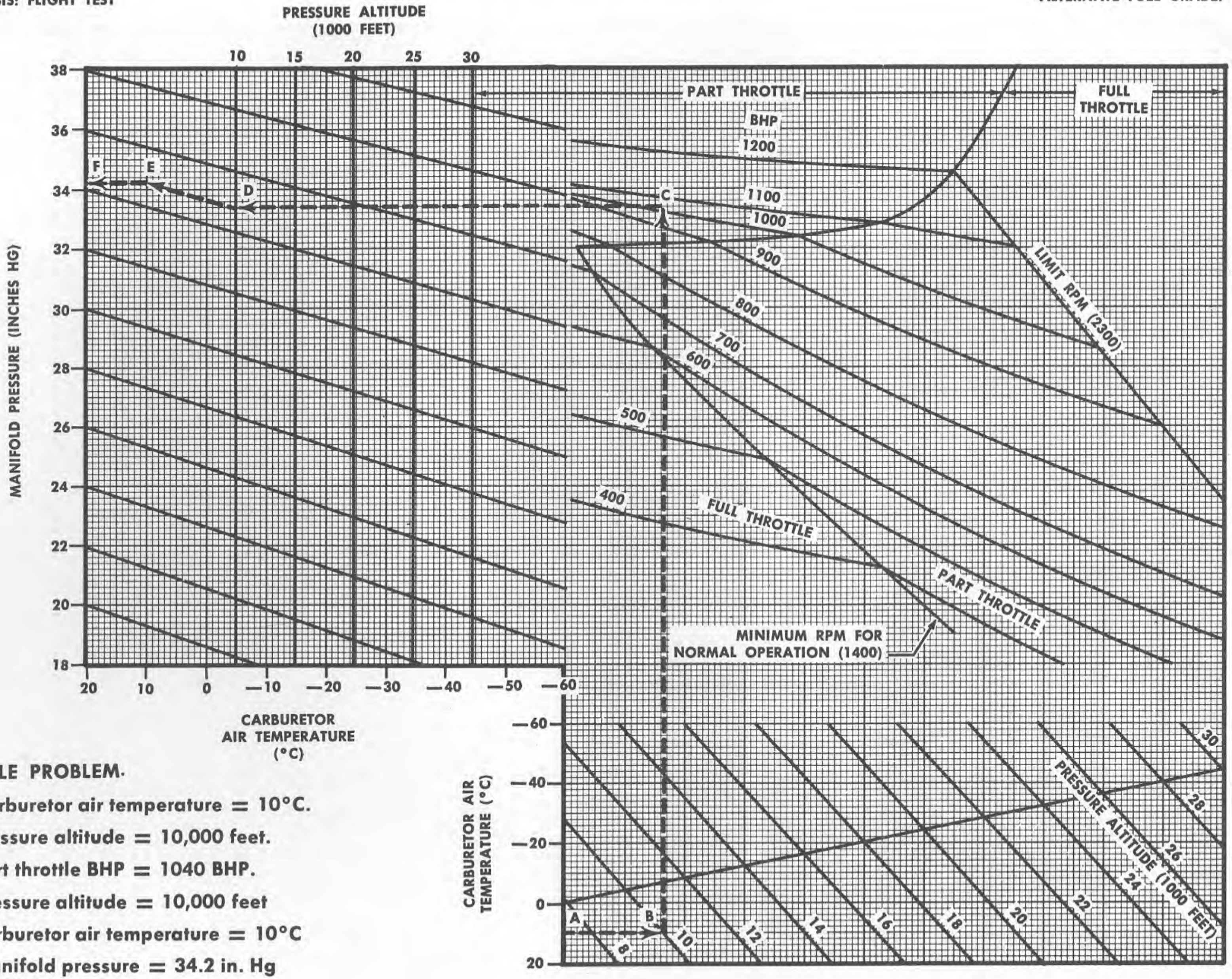
Figure A2-18. BHP — RPM Schedule — High Blower

BHP-MAP SCHEDULE — HIGH BLOWER

MANUAL MIXTURE ADJUSTMENT
12 BMEP DROP FROM BEST POWER MIXTURE

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-52W
FUEL GRADE: 115/145
ALTERNATE FUEL GRADE: 100/130



SAMPLE PROBLEM.

A. Carburetor air temperature = 10°C.
B. Pressure altitude = 10,000 feet.
C. Part throttle BHP = 1040 BHP.
D. Pressure altitude = 10,000 feet
E. Carburetor air temperature = 10°C
F. Manifold pressure = 34.2 in. Hg

AA1-246

Figure A2-19. BHP — MAP Schedule — High Blower