APPENDIX I

MODEL HH-52A PERFORMANCE DATA

TABLE OF CONTENTS

PURPOSE OF THE PERFORMANCE CHARTS

The charts presented on the following pages are provided to aid in preflight and inflight planning. Through the use of the charts, the pilot is able to select the best power setting, altitude, and airspeed to be used to obtain optimum performance for the mission being flown. Descriptive explanations are included at the beginning of Appendix I to illustrate the use of the performance charts. Guide lines are shown on the charts to illustrate the path to follow when using the chart.

DENSITY ALTITUDE CHART

Many of the performance charts are based on density altitude to compensate for temperature variations at any altimeter reading. The density altitude chart (figure A-1) provides a means of determining density altitude from a known pressure altitude and outside air temperature. When applicable, a standard day temperature line is shown on the curve as a convenient guide for this frequently referenced condition. The density altitude chart shows the density altitude for standard and nonstandard atmospheric conditions. Density altitude is an expression of the density of the air in terms of height above sea level; hence, the less dense the air, the higher the density altitude. For standard conditions of temperature and pressure, density altitude is the same as pressure altitude. As temperature increases above standard for any altitude the density altitude will also increase to values higher than pressure altitude. Helicopter pilots are vitally concerned with density altitude and its relation to the performance of helicopters. For a given power setting the lift developed by the rotor blades decreases as the density altitude increases. As density altitude increases, useful load must be decreased. Each takeoff and landing must be separately evaluated as density altitude may change considerably in a short period of time.

AIRSPEED CALIBRATION CHART

The airspeed calibration chart (figure A-2) provides a means for converting indicated airspeed (IAS) to calibrated airspeed (CAS) in order to compensate for errors introduced into the airspeed reading as a result of characteristics of the pitot static system. The chart provides correction curves for level flight, descent or autorotation, and climb.

HOVER CEILING CHARTS

The hover ceiling charts (figures A-3 and A-4) provide information to determine the highest pressure altitude at which the helicopter can hover in ground effect at 5-feet wheel clearance and out of ground effect.

TAKEOFF DISTANCE CHART

The takeoff distance chart (figures A-5 and A-6) shows takeoff distances that are required to clear a 50-foot obstacle at various pressure altitudes and temperatures using 100% Q and 100% N_r. Both charts use a climb speed of 45 knots. Helicopter gross weights used are 7500 pounds (figure A-5) and 8300 pounds (figure A-6). This chart does not apply to obstacle takeoffs where straight line climb angle technique is used.

CLIMB CHARTS

Climb charts for maximum continuous power, 96% N_r and 96% torque, (figures A-7 through A-12) are provided. Climb performance is presented for various combinations of gross weights, pressure altitudes and temperature.

AUTOROTATIVE RPM CHART

Correct autorotative N_r can be determined from the autorotative rpm chart (figure A-13). The N_r values are for a steady state autorotation at 55 knots and with collective at full low pitch. The chart presents correct autorotative N_r values at various gross weight and density altitude values.

INDICATED TORQUE VS FUEL FLOW CHART

The torque vs fuel flow chart (figure A-14) provides the means for computing fuel consumption in pounds-per-hour for 96% N_f/N_r and 100% N_f/N_r.

POWER-AVAILABLE CHART

The power-available chart (figure A-15) shows variable atmosphere factors such as temperature and pressure altitude that have an effect on the capability of the engine to produce power. The power-available chart defines power and torque as a function of pressure altitude, temperature, and N_f.

POWER VS SPEED CHARTS

The power vs airspeed charts (figures A-16, A-17, and A-18) show the power required to fly at a given true airspeed (TAS), for various pressure altitudes and aircraft weights.

EMERGENCY SEA STATE CAPABILITIES CHART (figure A-19) AND SEA STATE CAPABILITY VS LATERAL UNBALANCE CHART (figure A-20)

These engineering charts describe the helicopter's sea state capabilities with the rotor stopped.

SPEED VS ALTITUDE CHARTS

The speed vs altitude charts depict the combination of airspeeds and gross weights where level flight can be maintained for a given altitude. Figures A-21 through A-25 are for 96% N_r and figures A-26 through A-30 are for 100% N_r.

ENGINE INPUT HORSEPOWER VS INDICATED TORQUE CHART

This chart (figure A-31) converts engine input shaft horsepower to indicated torque.

POWER CHECK CHART

The power check chart (figure A-32) indicates the power required to hover at a 1-foot wheel clearance, and out of ground effect at various combinations of pressure altitude, outside air temperature, gross weight, and headwind.

RANGE CHARTS

The range charts (figures A-33 through A-35) graphically illustrate the cruise performance of the helicopter. The charts present specific range (nautical miles per pound of fuel), approximate torque required and, if desired, fuel flow in pounds-per-hour. Maximum range and maximum airspeeds are also depicted.

BLADE STALL CHART

The function of the blade stall chart (figure A-36) is to provide a rapid means of determining the speed at which incipient blade stall occurs under various altitude, rotor rpm, gross weight, and angle of bank conditions.

HEIGHT VELOCITY DIAGRAMS

Figure A-37 is a plot of minimum heights required for a safe autorotative landing after a power failure. The plot was established under zero wind conditions, at various CG locations, and throughout a range of airspeeds, altitudes, temperatures, and gross weight. The plot was formulated in both level flight with power required for the selected speed and in a climb using takeoff power (100% Q, 100% N_r). Pilot reaction time was delayed one second following power failure in level flight. Normal pilot reaction time was used after power failure in climbing flight.

SIGNIFICANCE OF DIAGRAM

This curve is established for level flight and climb power conditions. The curve does not apply to steady-state low power of autorotative approach established outside the shaded area of the diagram. Engine failure under low power conditions has less effect on the landing. A dangerous condition does exist however, if the engine should fail during approaches within the shaded area of the curve when using high power, a low rate of descent, and a low airspeed. A high speed roll-on restriction shapes the right-hand portion of the curve. It has been determined that the "nose" portion of the curve, 43 to 47 knots IAS, is more critical with a nose low attitude and/or with a high collective setting. The small identation on the high speed portion of the curve restricts the pilot from obtaining a high speed with low wheel clearance. The required additional altitude allows sufficient altitude and time to rotate the fuselage to a landing attitude and decrease forward airspeed prior to touchdown.

DENSITY ALTITUDE CHART

True airspeed (TAS) is obtained by multiplying CAS by the conversion factor shown in figure A-1, for the density altitude at which the CAS reading is taken.

EXAMPLE PROBLEM

Given

Ambient temperature	40°C
Pressure altitude	2000 Feet
CAS	82 Knots

Determine

Density altitude and true airspeed.

Solution

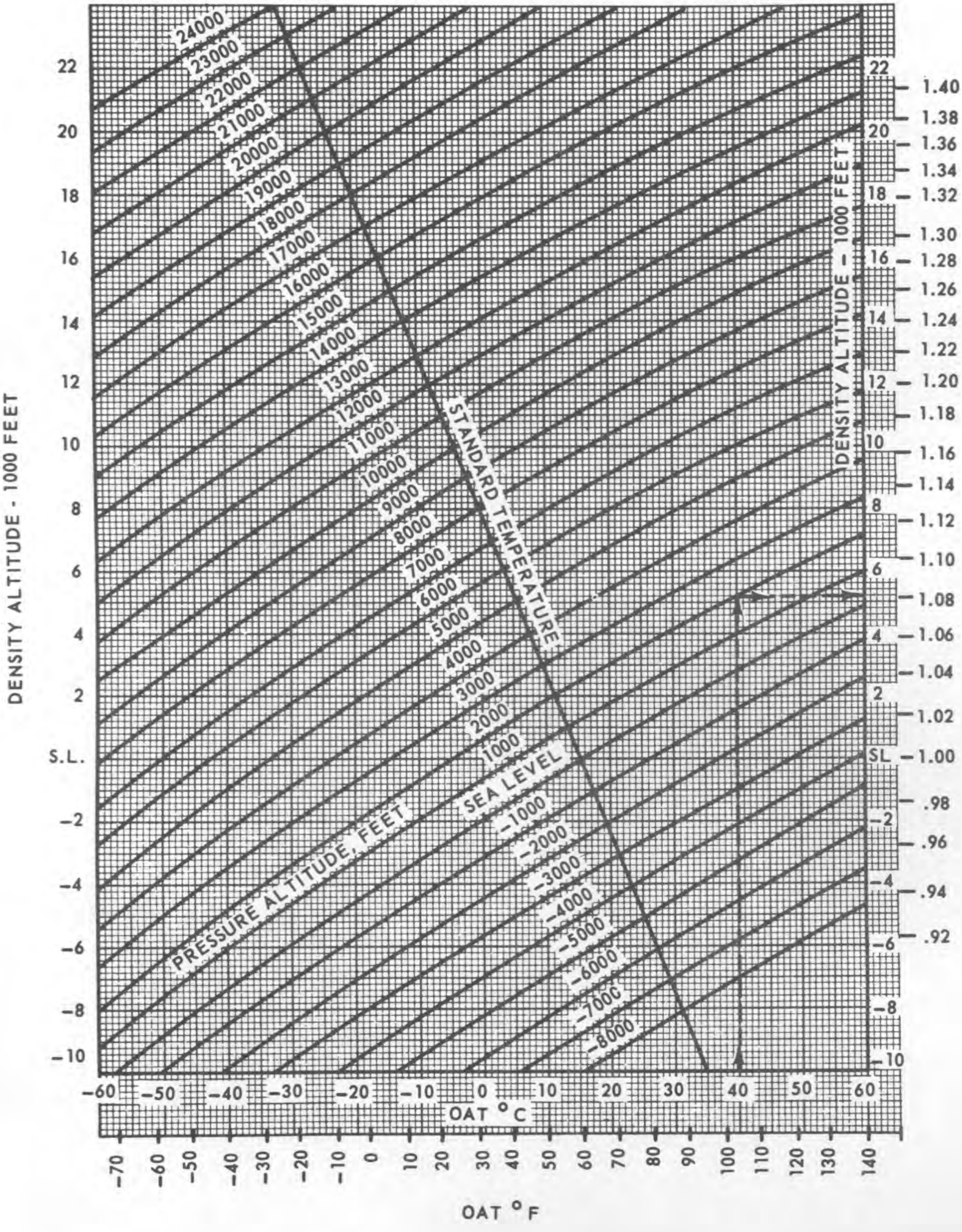
(Refer to figure A-1)

1. Enter chart at 40°C.

2. Move vertically up the 40°C line to intersection of 2000 foot pressure altitude diagonal line.

3. From this intersection move horizontally to the right. Read 5200 feet density altitude and an airspeed correction of 1.08.

4. Determine TAS by multiplying CAS 82 knots × 1.08 = 88.6 knots TAS



$\frac{1}{\sqrt{\sigma}}$

S 55594 (R)

Figure A-1. Density Altitude Chart

AIRSPEED CALIBRATION CHART

EXAMPLE PROBLEM

Given

Indicated airspeed	80 knots
Flight condition	Level Flight

Determine

Calibrated airspeed.

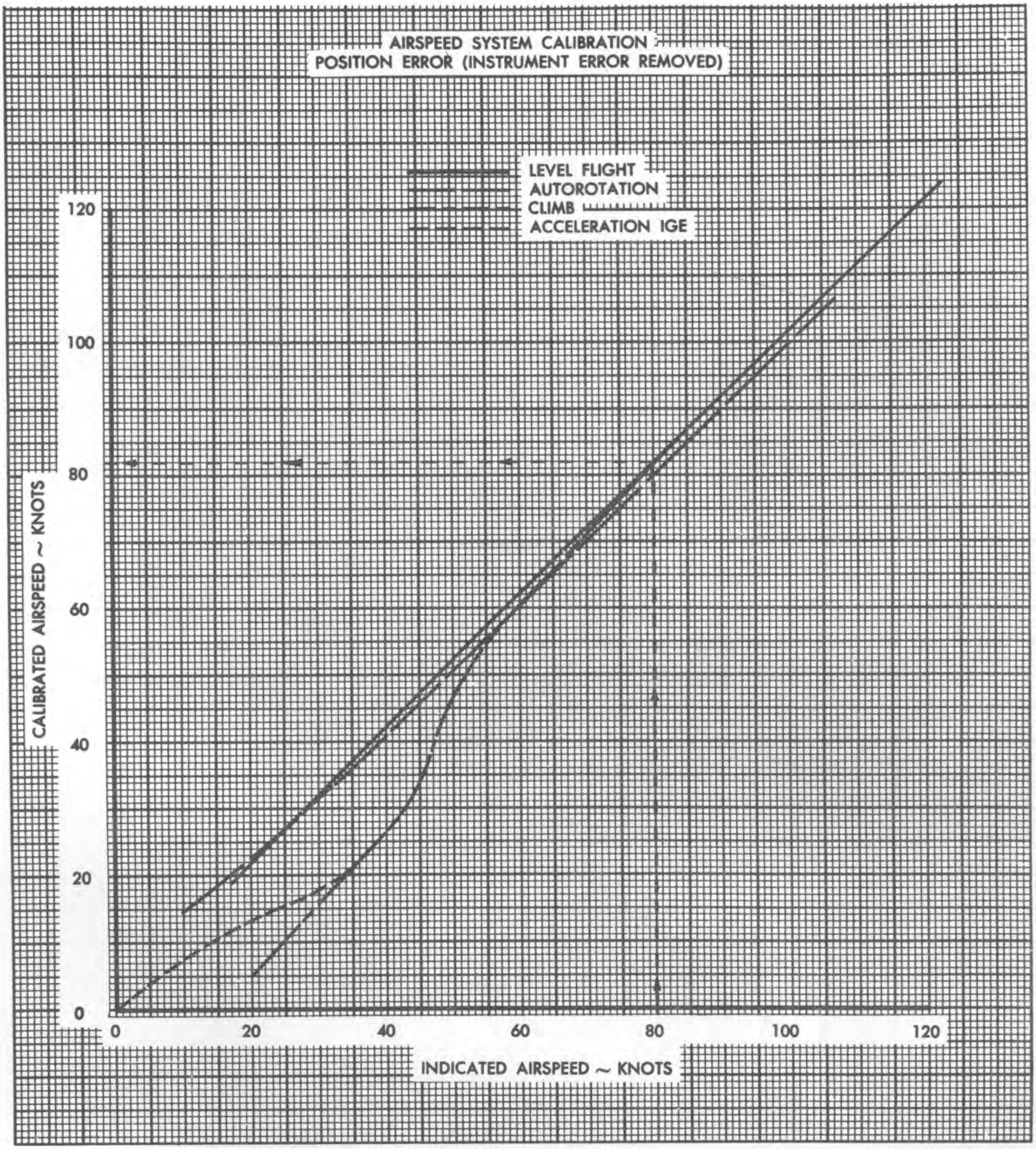
Solution

(Refer to figure A-2)

1. Enter chart at 80 knots indicated airspeed.

2. Move vertically up the 80 knot line to intersection of the level flight curve.

3. From this intersection move horizontally to the calibrated airspeed scale and read 82 knots CAS. To find TAS multiply by airspeed correction factor as shown in figure A-1.



Model: HH-52A
Date: 1960
Data Basis: Flight Test

Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5/6.8 lb/gal.

S 55595 (R)

Figure A-2. Airspeed System Calibration

HOVER CEILING CHART

EXAMPLE PROBLEM

Given

Given weight	8200 pounds
Temperature	Standard +30°C
N_r	100%

Determine

Hover ceiling for 5-foot hover using 5-minute power.

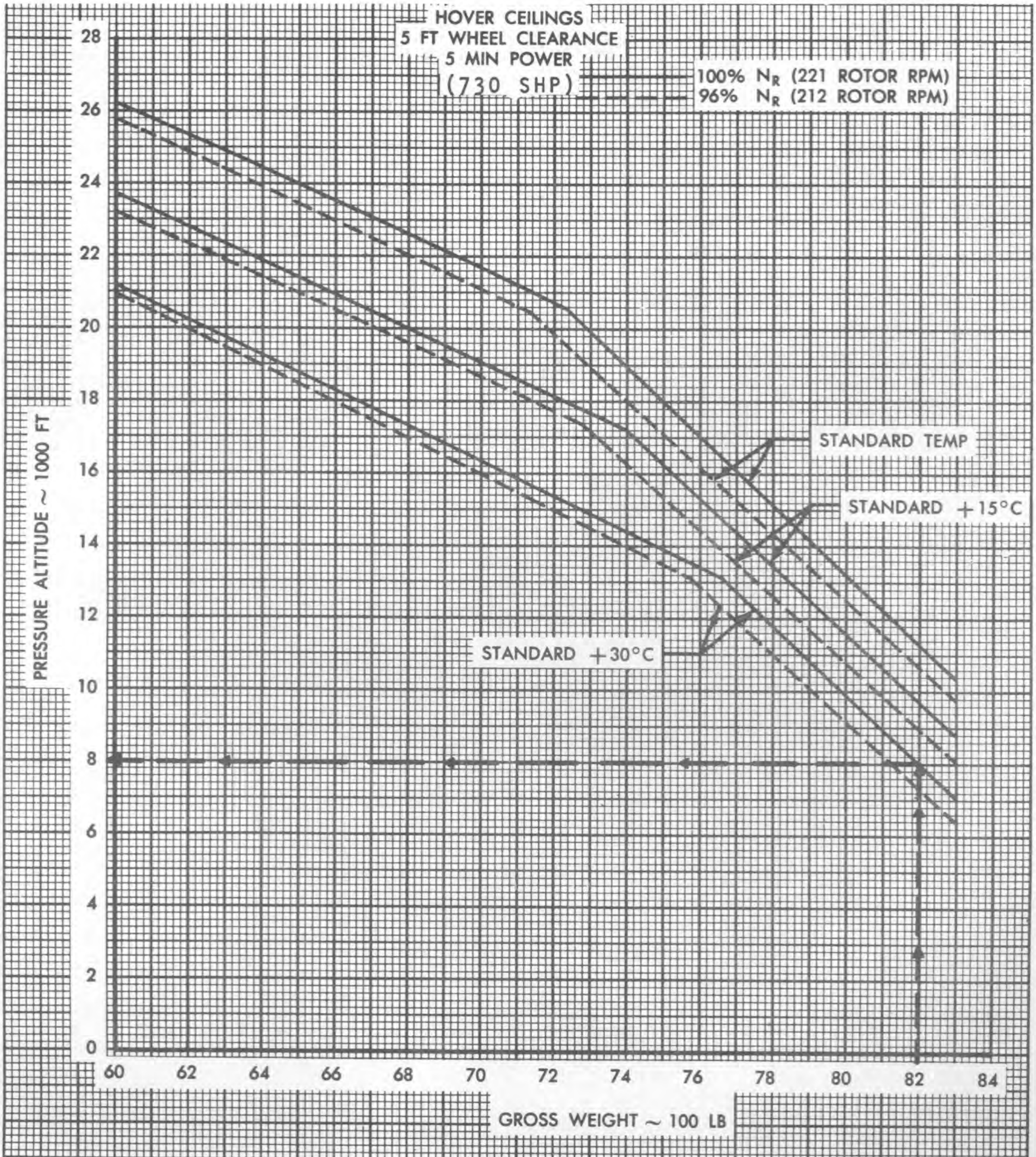
Solution

(Refer to figure A-3)

1. Enter the chart at 8200 pounds.

2. Move vertically up to intersection of the 100% N_r at standard +30°C curve.

3. Move horizontally left to pressure altitude scale and read 8000 feet.



Model: HH-52A | Engine: T58-GE-8B
Date: 1960 | Fuel Grade: JP-4/JP-5
Data Basis: Estimated | Fuel Density: 6.5-6.8 lb/gal.

Disregard 96%Nr Curves. Assume Zero Wind.

S 55596 (R)

Figure A-3. Hover Ceilings IGE

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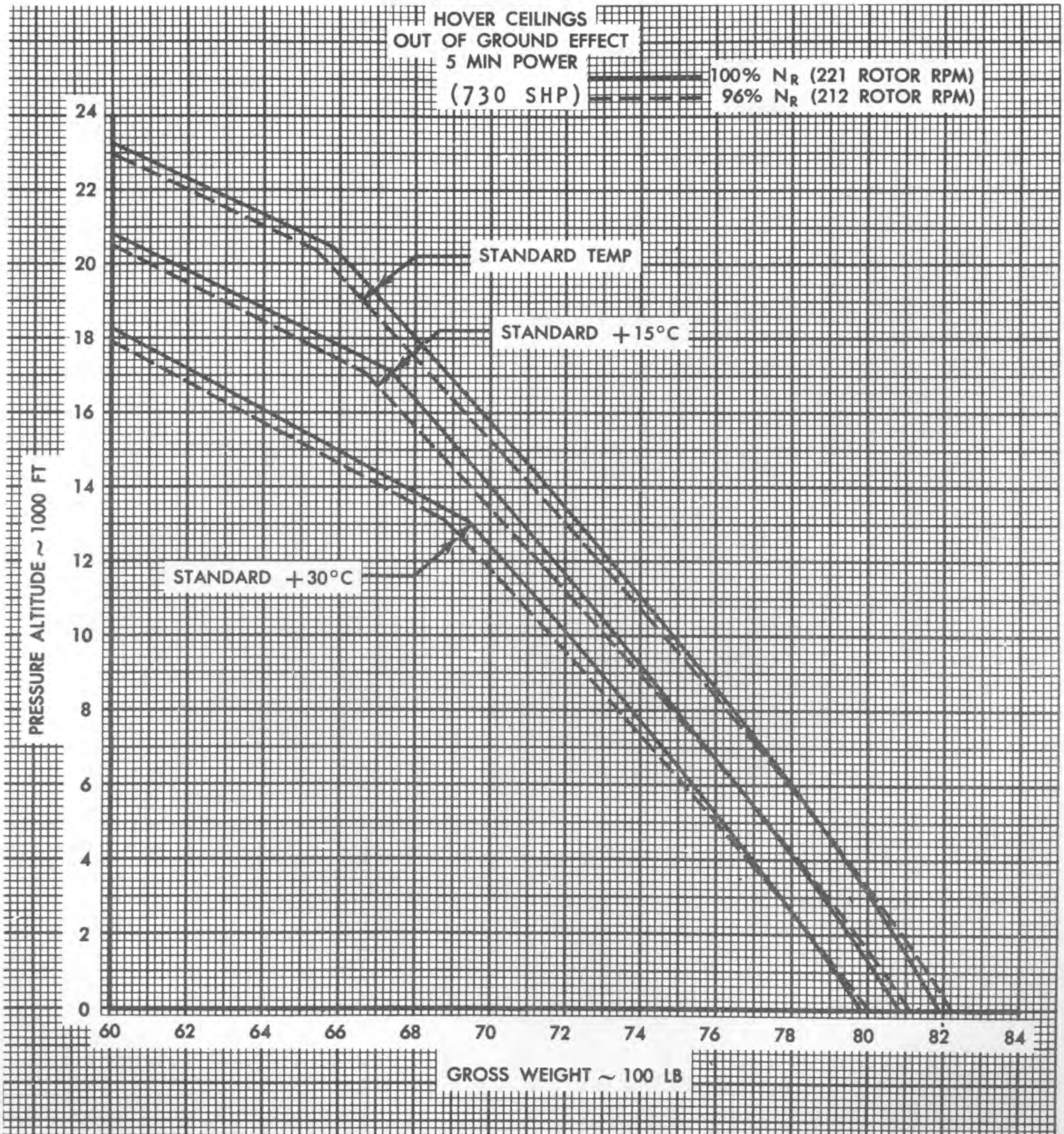


Model: HH-52A
Date: 1960
Data Basis: Estimated
Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

Disregard 96%Nr Curves. Assume Zero Wind.

S 55597 (R)

Figure A-4. Hover Ceiling OGE

TAKEOFF DISTANCE CHART

EXAMPLE PROBLEM

Given

Gross weight	7500 pound
Pressure altitude	2000 feet
Temperature	Standard +15°C

Determine

Takeoff distance required.

Solution

(Refer to figure A-5)

1. Enter chart at pressure altitude of 2000 feet.

2. Move horizontally to the standard +15°C line.

3. Move vertically downward to total takeoff distance scale and read 270 feet.

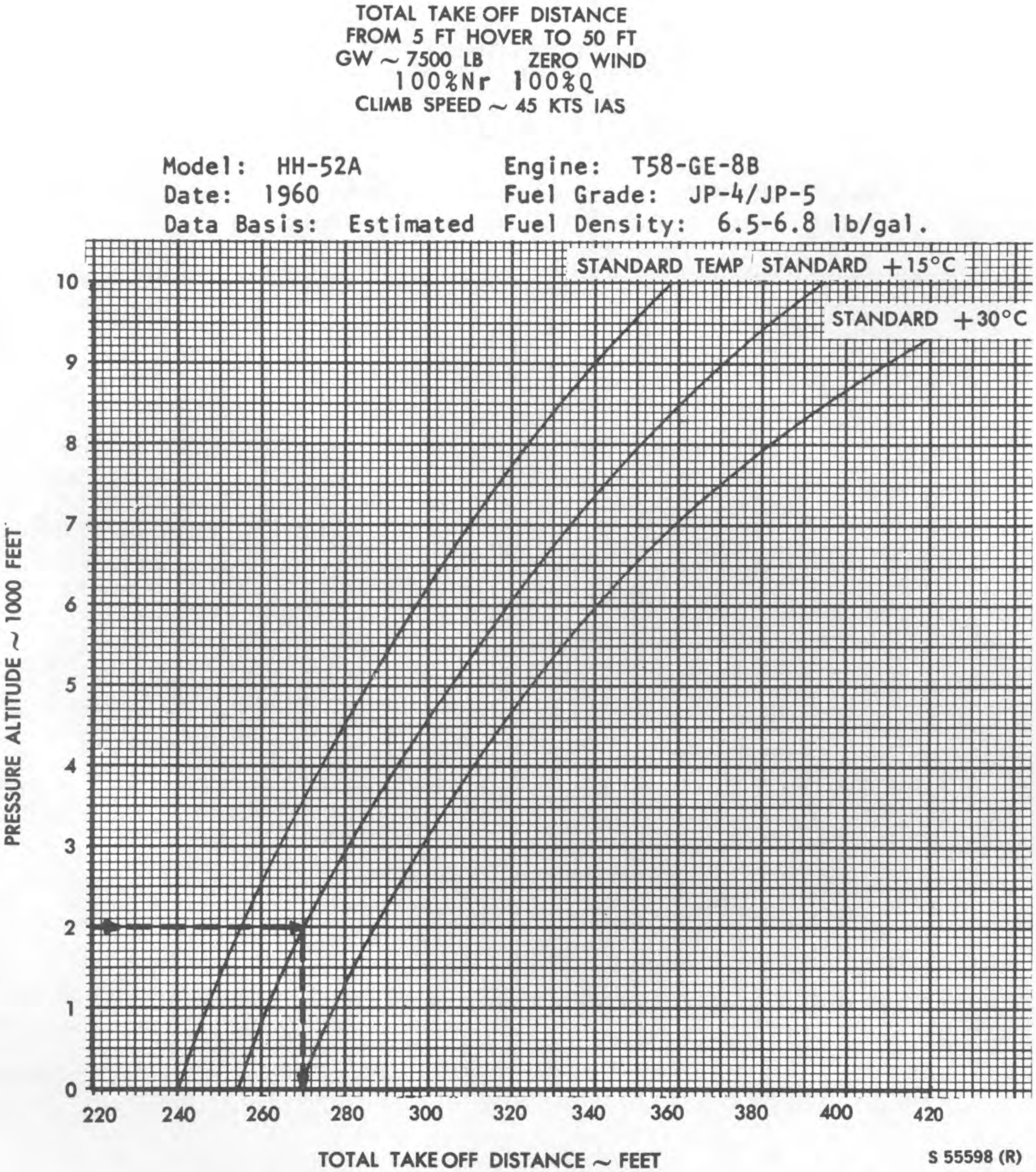


Figure A-5. Takeoff Distance G.W. 7500 Lbs

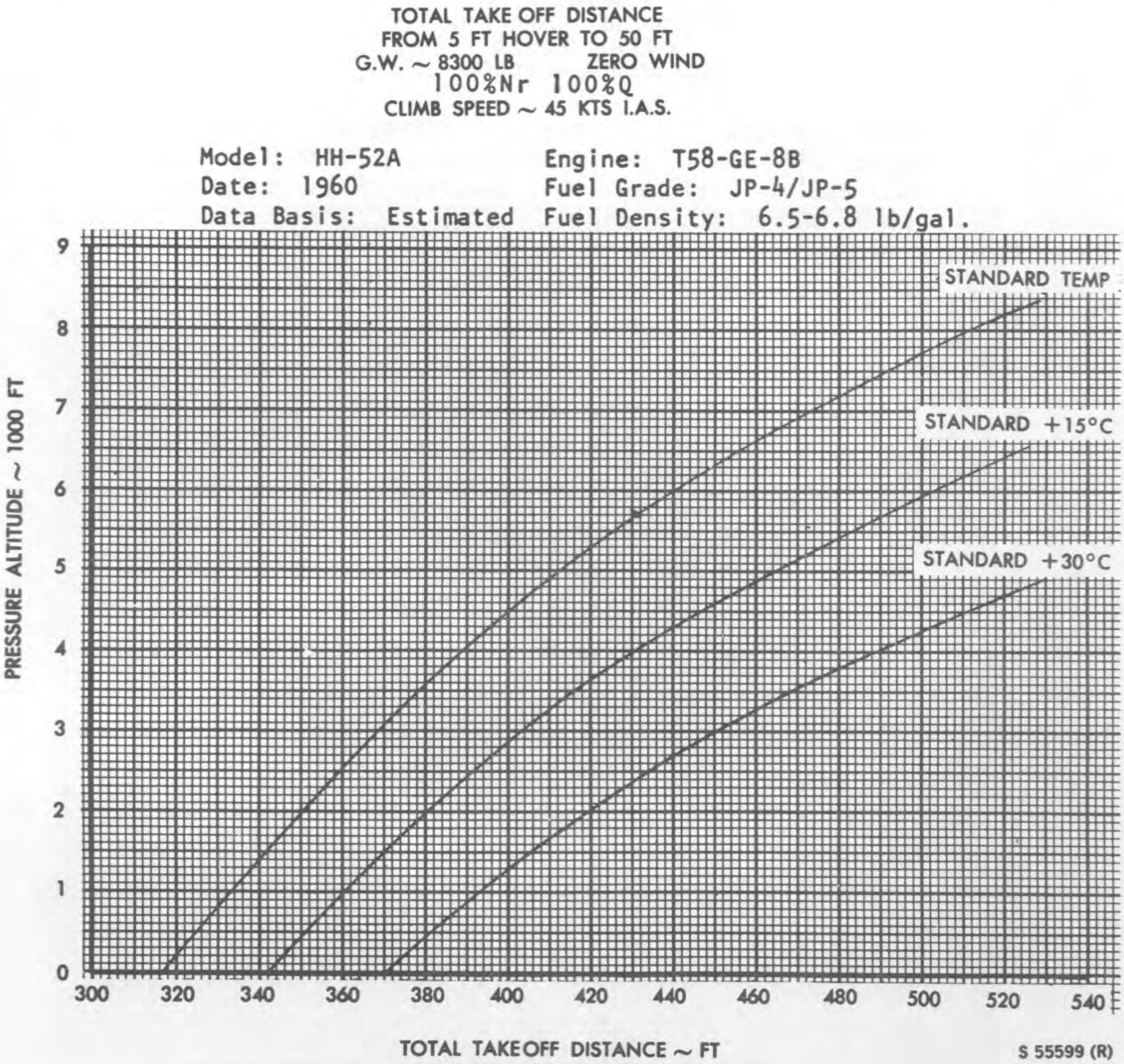
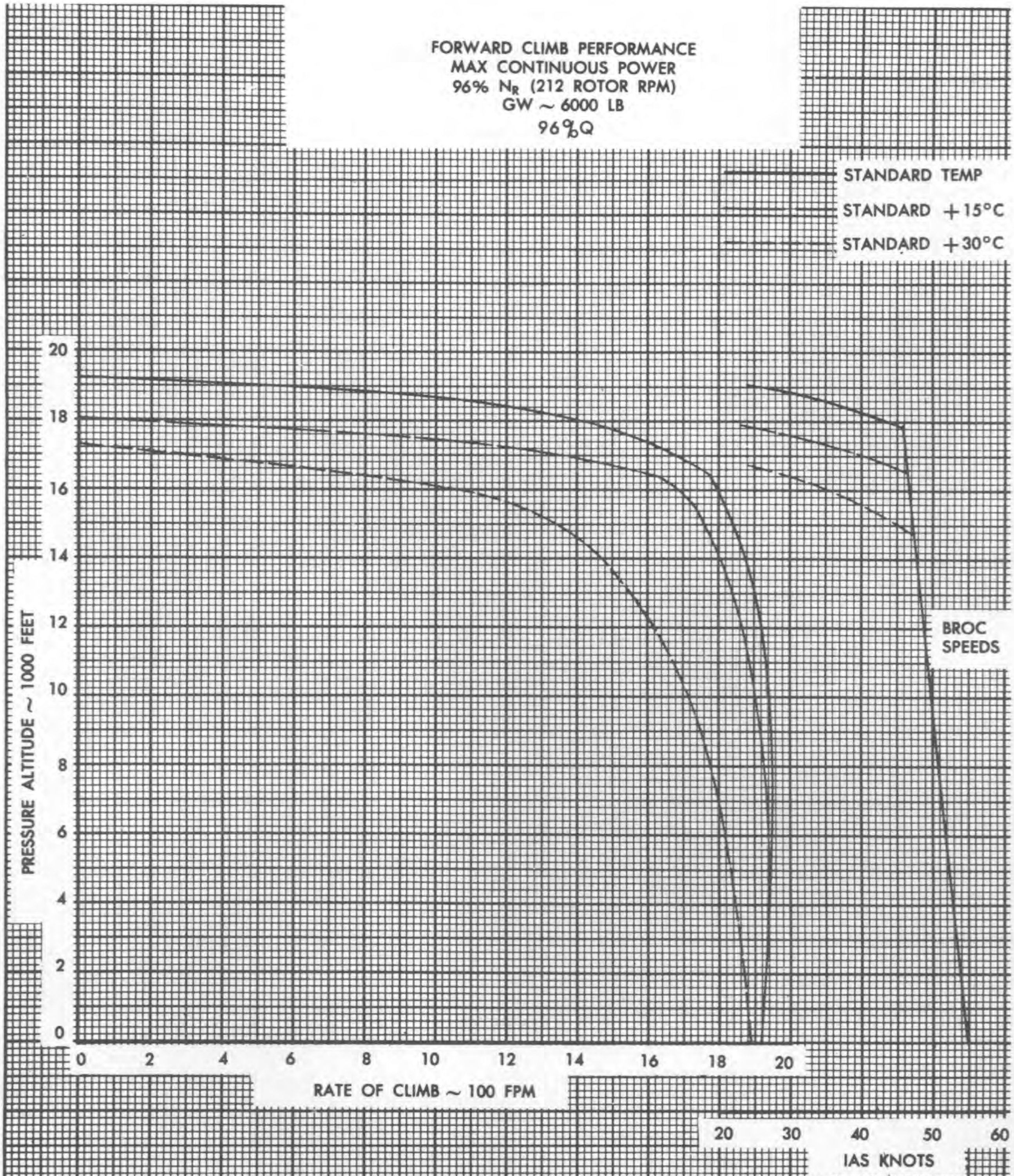


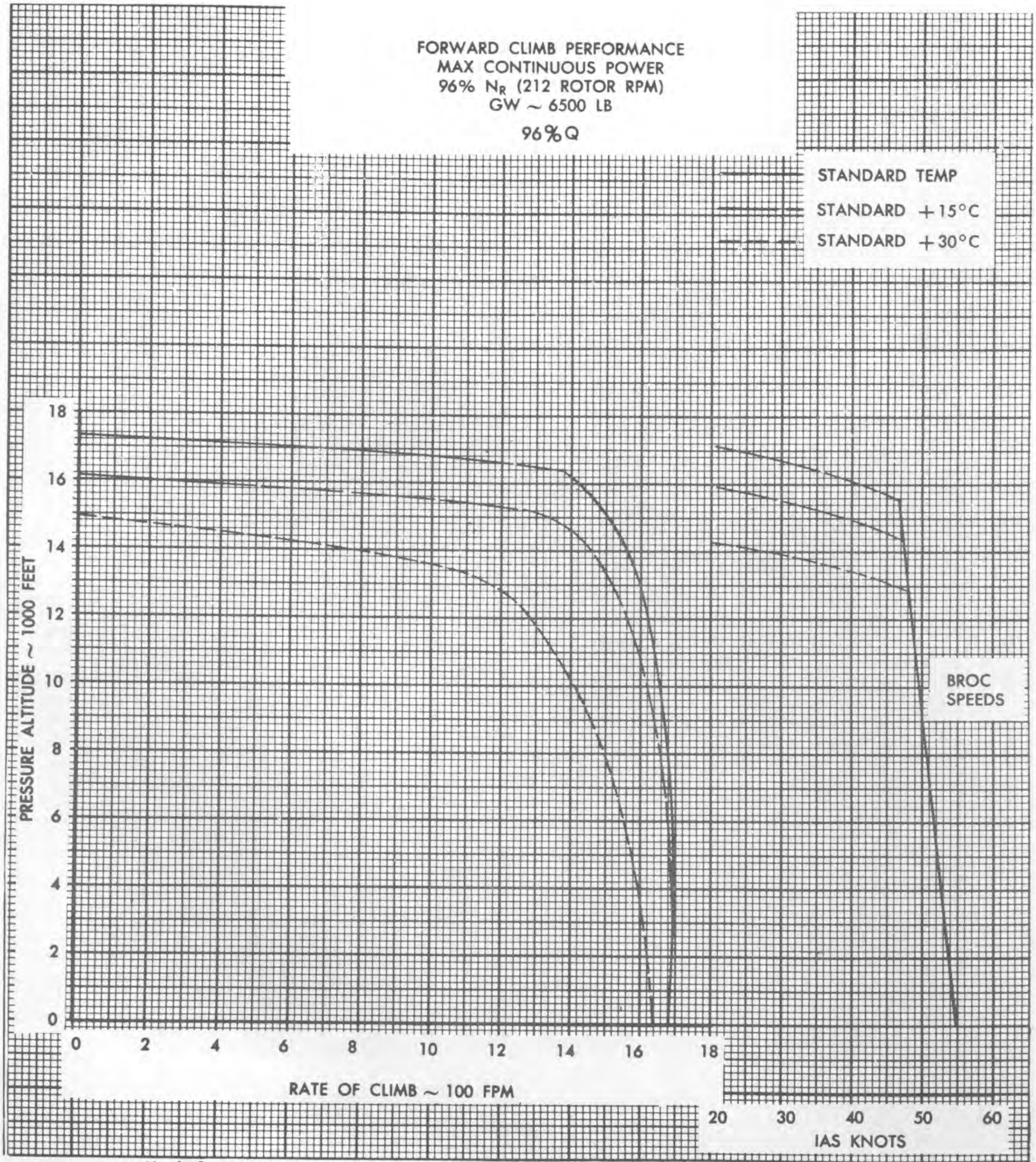
Figure A-6. Takeoff Distance G.W. 8300 Lbs



Model: HH-52A
Date: 1960
Data Basis: Estimated
Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

S 55600 (R)

Figure A-7. Forward Climb Performance G.W. 6000 Lbs

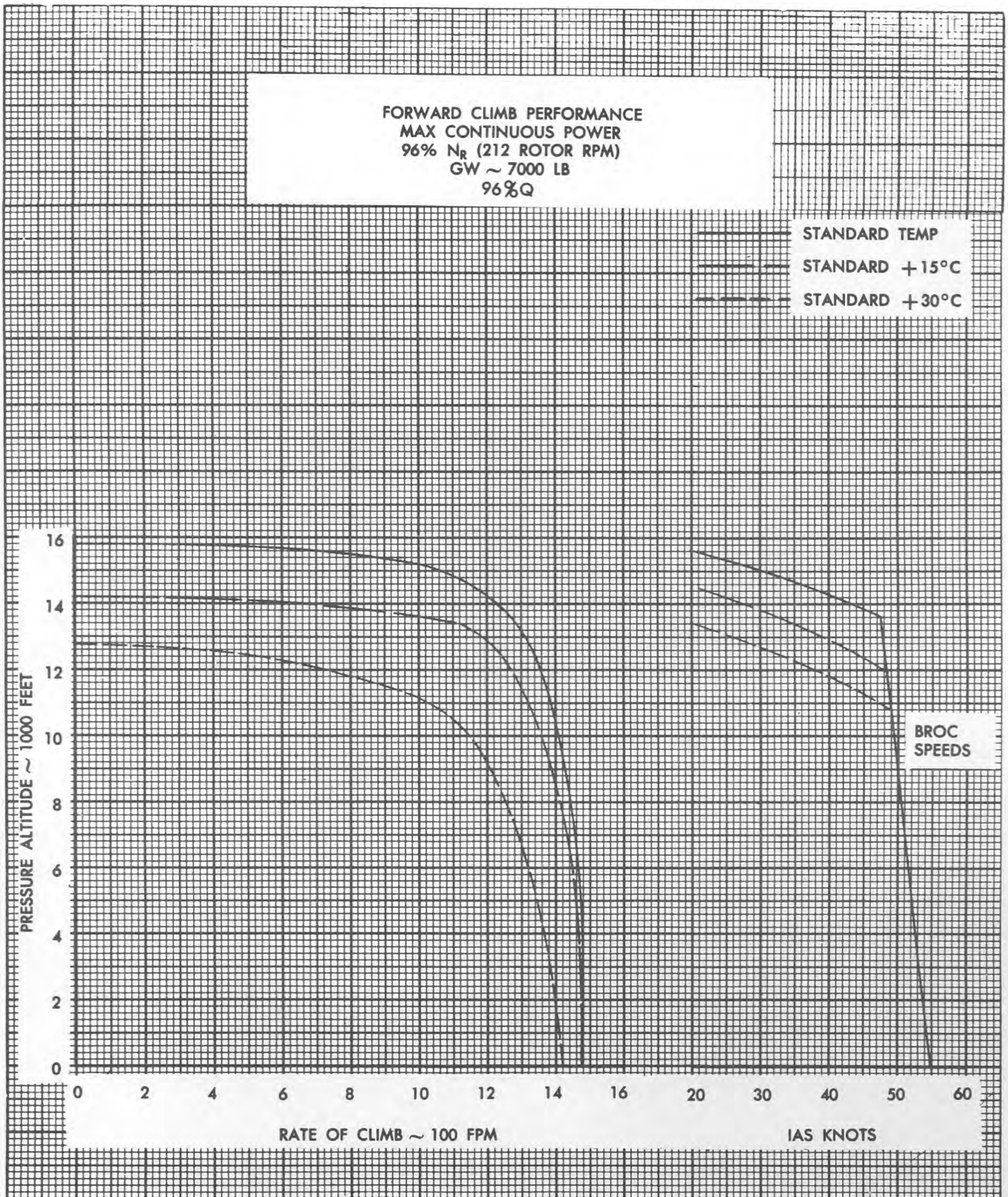


Model: HH-52A
Date: 1960
Data Basis: Estimated

Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

S 55601 (R)

Figure A-8. Forward Climb Performance G.W. 6500 Lbs



Model: HH-52A
Date: 1960
Data Basis: Estimated
Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

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Figure A-9. Forward Climb Performance G.W. 7000 Lbs

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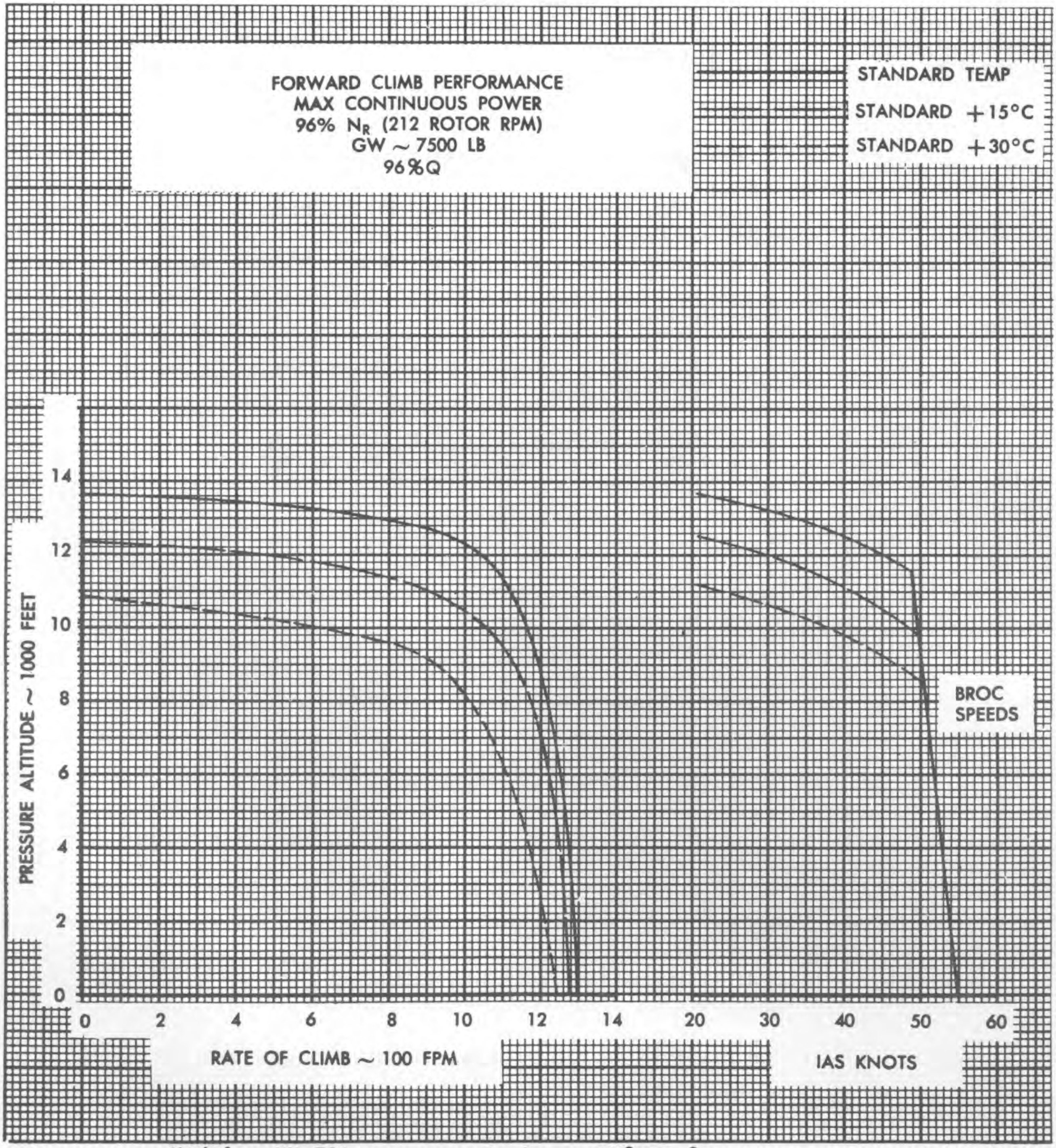


Model: HH-52A Engine: T58-GE-8B
Date: 1960 Fuel Grade: JP-4/JP-5
Data Basis: Estimated Fuel Density: 6.5-6.8 lb/gal.

S 55603 (R)

Figure A-10. Forward Climb Performance G.W. 7500 Lbs

CLIMB CHART

EXAMPLE PROBLEM

Given

Gross weight	8000 pounds
Temperature at 1000 feet pressure altitude	28°C (15°C deviation from Standard Temperature)

Determine

Rate of climb and best rate of climb (BROC) airspeed from 1000 feet to 7000 feet.

Service Ceiling—(HIGHEST ALTITUDE AT WHICH A RATE OF CLIMB OF 100 FEET-PER-MINUTE CAN BE ATTAINED).

Solution

(Refer to figure A-11, Climb Chart for 8000 pounds)

1. Enter chart at pressure altitude of 1000 feet.

2. Move horizontally to standard +15°C line.

3. Move vertically down and read rate of climb 1080 feet per minute at 1000 feet pressure altitude.

4. Follow standard +15°C line to intersection with 7000 foot pressure altitude line.

5. Move vertically down and read rate of climb 980 feet-per-minute at 7000 feet pressure altitude.

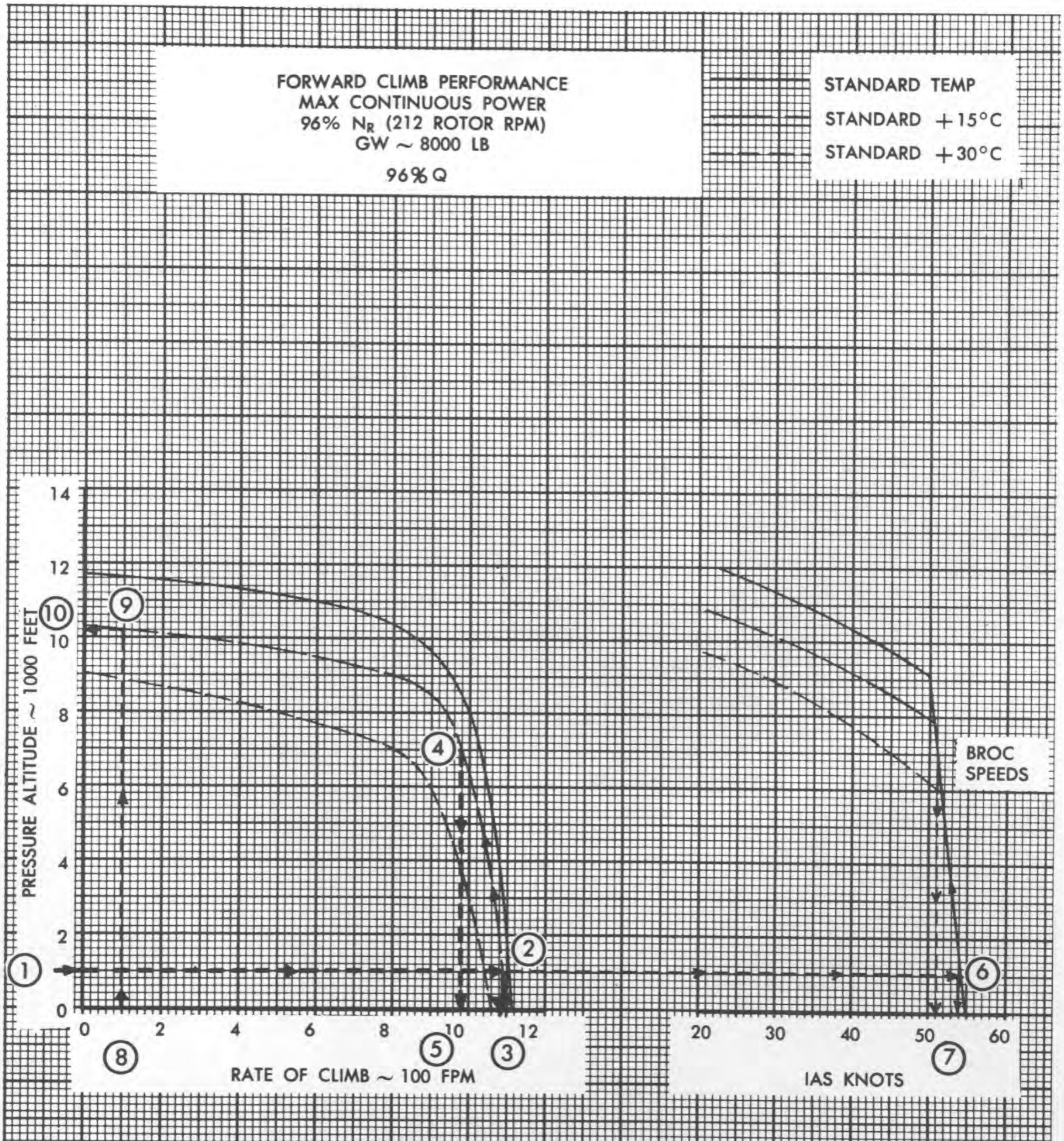
6. Proceed further right on the 1000 feet line to the BROC line.

7. Read BROC airspeed of 54 knots at 1000 feet and 51 knots at 7000 feet.

8. Enter chart on the 100 feet-per-minute rate of climb line.

9. Move vertically to the intersection with the Standard +15°C line.

10. Move horizontally left and read service ceiling 10,200 feet.



Model: HH-52A
Date: 1960
Data Basis: Estimated

Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

S 55604 (R)

Figure A-11. Forward Climb Performance G.W. 8000 Lbs

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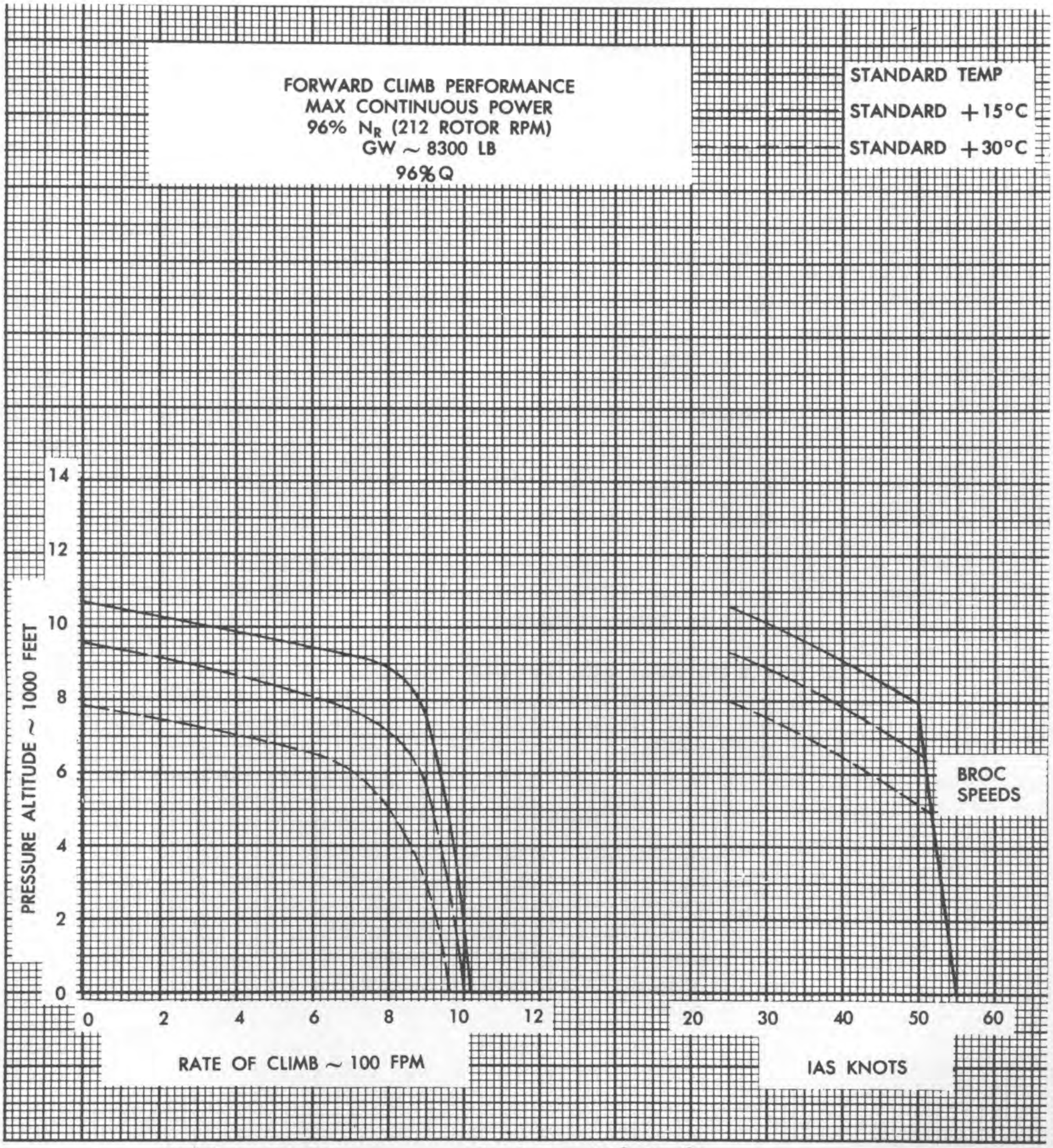


Model: HH-52A
Date: 1960
Data Basis: Estimated
Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

S 55605 (R)

Figure A-12. Forward Climb Performance G.W. 8300 Lbs

AUTOROTATIVE RPM CHART

EXAMPLE PROBLEM

Given

Pressure altitude	1000 feet
OAT	13°C
Gross weight	7500 pounds

Determine

Autorotative rpm.

Solution

1. Using pressure altitude and OAT determine density altitude from density altitude chart (figure A-1) to be 1000 feet.

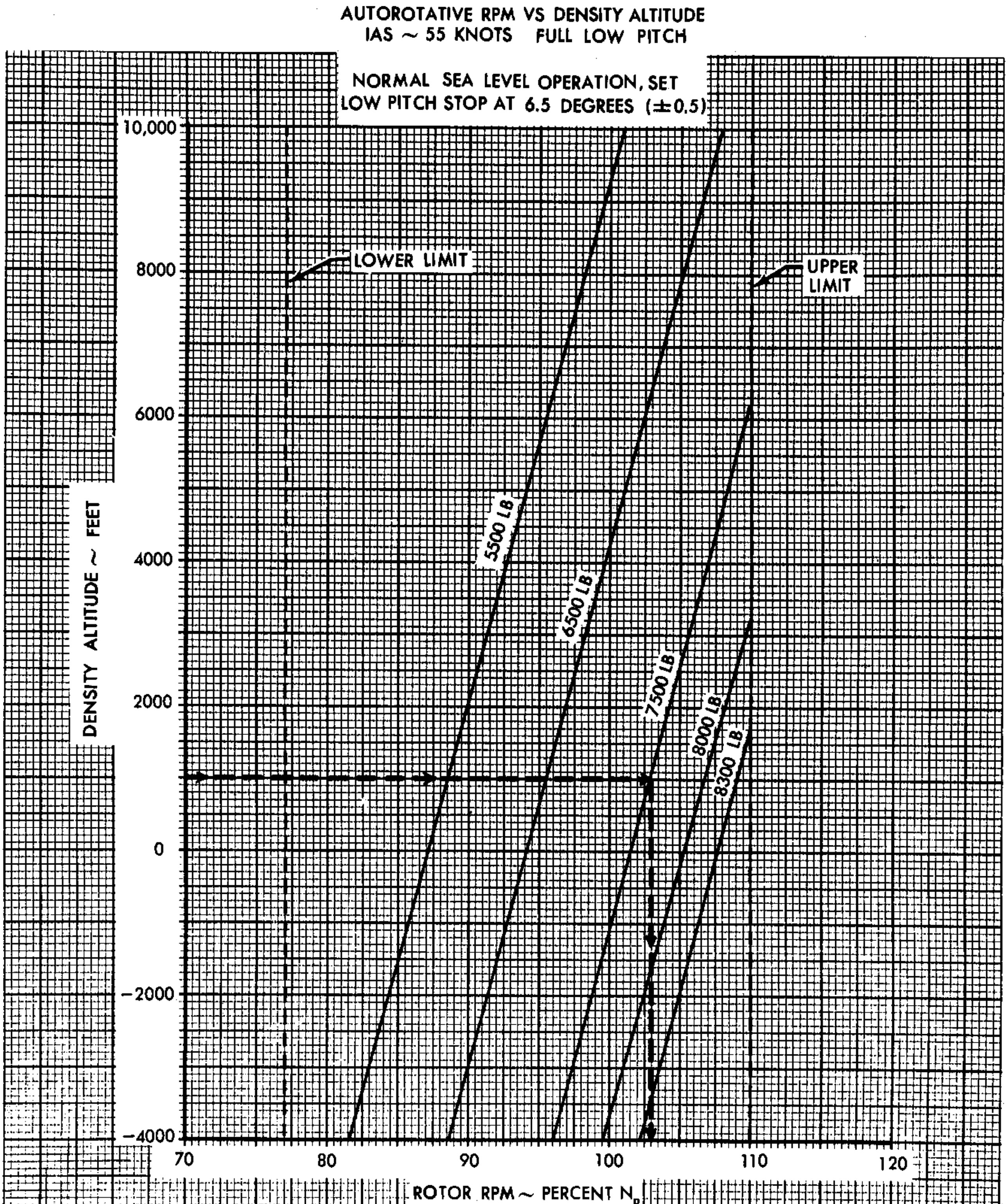
2. Enter autorotative rpm chart at +1000 feet and move horizontally right to the intersection of the 7500 pound gross weight line.

3. Move vertically down to the Nr scale.

4. Read 103% Nr. Correct autorotative Nr should be 103% ±2% Nr.

CAUTION

Autorotation at low gross weights in low density altitude conditions may result in loss of generators. If flight at these low gross weights is required in night or IFR conditions autorotative rpm should be reset. See CGTP 1H-52A-2 for amplifying details.



Model: HH-52A
Date: 1960
Data Basis: Flight Test
Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

S 55606 (R)

Figure A-13. Autorotative RPM VS Density Altitude

FUEL CONSUMPTION VS INDICATED TORQUE CHART

EXAMPLE PROBLEM

Given

Nf/Nr	96%
Torque	70% Q.
Pressure altitude	Sea level

Determine

Fuel flow.

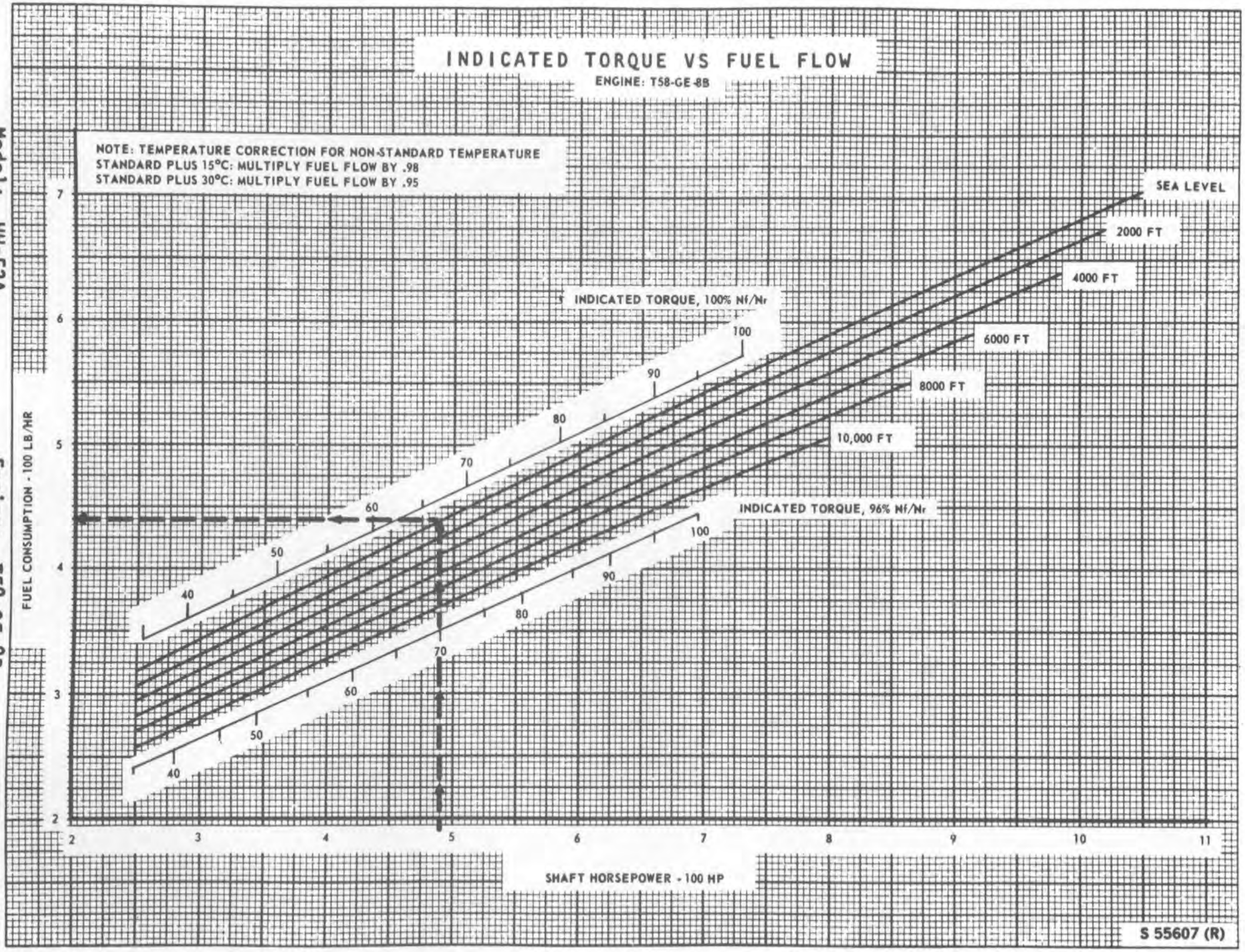
Solution

(Refer to figure A-14)

1. Enter chart on 96% Nf/Nr line at 70% Q.

2. Move vertically up to the intersection of the sea level pressure altitude line.

3. From this intersection move horizontally left to the fuel flow scale and read a fuel flow of 440 pounds-per-hour.



Model: HH-52A
Date: 1963
Data Basis: Eng.Mfr.Spec. (plus 5%)

Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

Figure A-14. Fuel Consumption VS Power and Indicated Torque

POWER AVAILABLE CHART

EXAMPLE PROBLEM

Given

Ambient temperature	45°C
Pressure altitude	7000 feet
Nr	96%

Determine

Torque available at continuous power.

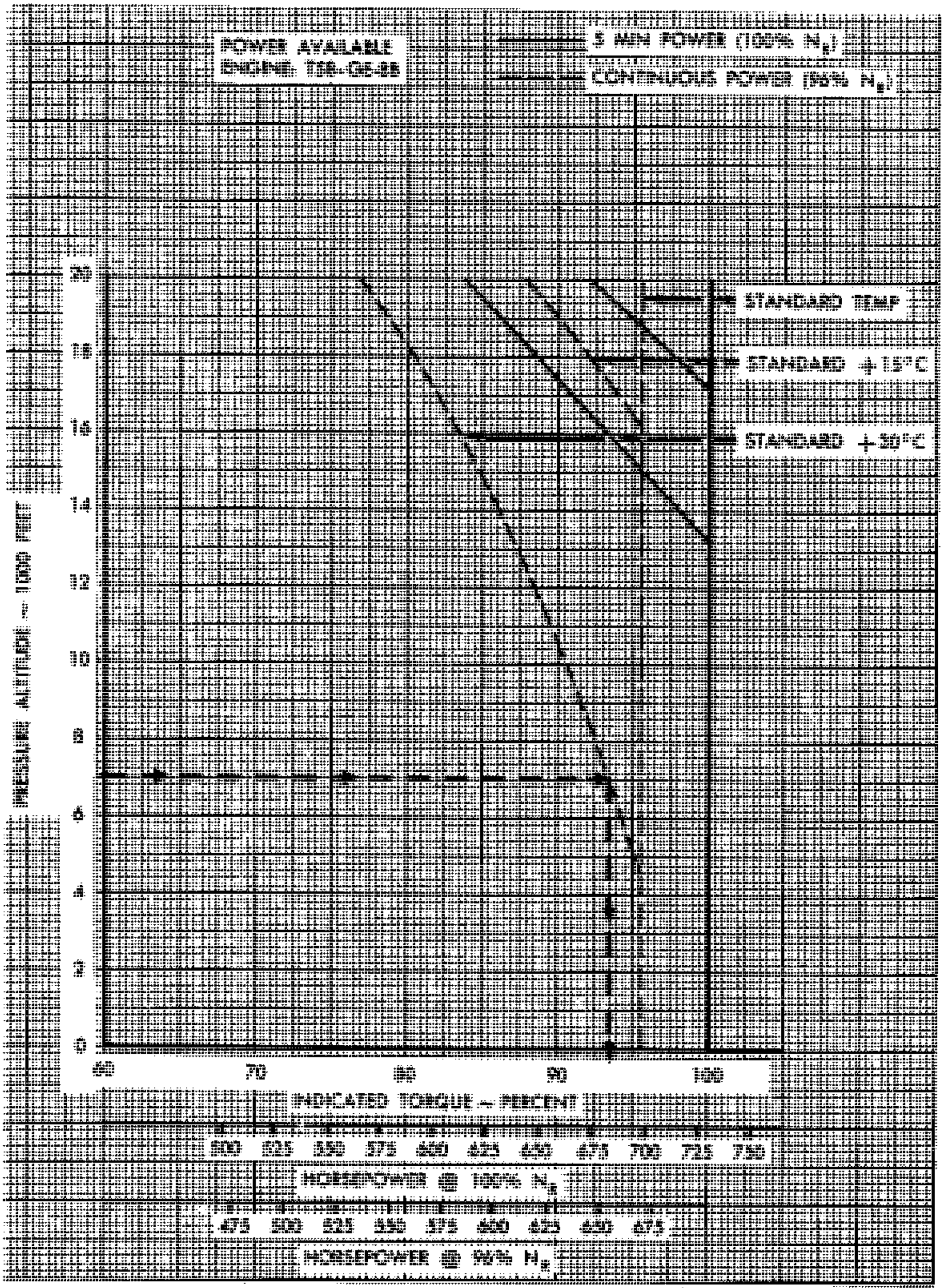
Solution

(Refer to figure A-15)

1. Enter chart at 7000 feet pressure altitude.

2. Move horizontally right to the 45°C (STD +30°C) line for 96% Nr.

3. Move vertically down to the indicated torque scale and read 93.5% Q.



Model: HH-52A
Date: 1963
Data Basis: Eng.Mfr.Spec.
Engine: T58-GE-8B
Fuel Grade: JP-4/JP-5
Fuel Density: 6.5-6.8 lb/gal.

S 55608 (R)

Figure A-15. Power Available

POWER VS SPEED CHART

EXAMPLE PROBLEM

Given

True airspeed	80 knots
Pressure altitude	2000 feet
Gross weight	8000 pounds
Nr	96%

Determine

Power required.

Solution

1. Enter power vs airspeed chart (figure A-16 for 2000 feet PA) at 80 knots (TAS) on the true airspeed scale.

2. Move vertically up to intersection with the 8000-pound gross weight curve.

3. Move horizontally left to the shaft horsepower scale and read 440 shaft horsepower.