

# APPENDIX I

## MODEL HH-3F PERFORMANCE DATA

### TABLE OF CONTENTS

Page	Page
<b>INTRODUCTION .....</b>	<b>A-1</b>
<b>PURPOSE OF PERFORMANCE CHARTS</b>	<b>A-1</b>
<b>COMPRESSIBILITY EFFECTS .....</b>	<b>A-1</b>
<b>ALTITUDE DATA.....</b>	<b>A-2</b>
<b>AIRSPEED CALIBRATION CHART .....</b>	<b>A-2</b>
<b>POWER AVAILABLE CHARTS .....</b>	<b>A-3</b>
<b>INDICATED TORQUE VS FUEL FLOW CHART .....</b>	<b>A-3</b>
<b>AIRSPED EFFECTS ON POWER AVAILABLE AND FUEL FLOW CHART .....</b>	<b>A-4</b>
<b>HOVERING CHART.....</b>	<b>A-4</b>
<b>HEIGHT VELOCITY DIAGRAMS .....</b>	<b>A-6</b>
<b>INTRODUCTION</b>	
<b>PURPOSE OF PERFORMANCE CHARTS</b>	
<b>COMPRESSIBILITY EFFECTS</b>	
<b>TAKEOFF CHARTS.....</b>	<b>A-7</b>
<b>CLIMB CHARTS.....</b>	<b>A-7</b>
<b>SERVICE CEILING CHARTS.....</b>	<b>A-8</b>
<b>CRUISE CHARTS .....</b>	<b>A-9</b>
<b>SINGLE-ENGINE CAPABILITY CHART .....</b>	<b>A-9</b>
<b>BLADE STALL CHART.....</b>	<b>A-10</b>
<b>MAXIMUM AIRSPEED CHART .....</b>	<b>A-10</b>
<b>CENTER OF GRAVITY LIMITATIONS CHART.....</b>	<b>A-11</b>
<b>MAXIMUM SINK RATE ON LANDING CHART.....</b>	<b>A-11</b>
<b>MAXIMUM AUTOROTATIVE GLIDING DISTANCE .....</b>	<b>A-11</b>

This section contains performance data pertinent to HH-3F helicopters with the T58-GE-5 engines. The charts presented in this Appendix are based on the use of JP-4 or JP-5 fuel which has a density of 6.5 lb/gal. and 6.8 lb/gal. respectively. A miniature chase-around is provided at the top of each chart to illustrate the manner of obtaining data from the chart.

### **PURPOSE OF 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.

Rotor compressibility effects have been encountered on this helicopter. This phenomenon is a result of the rotor tip approaching the speed of sound. compressibility causes an abrupt and large increase in drag and a slight decrease in lift when the velocity of some portion of an airfoil approaches the speed of sound. A convenient parameter to measure the degree of compressibility is Mach number, which is the ratio of the airfoil velocity to the local speed of sound. It is important to remember that the speed of sound is dependent on the ambient temperature. Thus, if the resultant rotor tip velocity remains constant (such as constant rotor rpm in hover), changes in the ambient temperature will change the speed of sound and thus change the tip Mach number. A cold day will produce higher tip Mach numbers than a warm day, all other things being equal. Consequently, the ambient temperature affects the degree of compressibility present and therefore also affects the power required. The charts in this Appendix have been corrected for the effects of rotor blade compressibility.

## ALTITUDE DATA

### PRESSURE ALTITUDE

Pressure altitude is the altitude indicated on the altimeter when the barometric scale is set on 29.92. It is the height above the theoretical plane at which the air pressure is equal to 29.92 inches of mercury.

### DENSITY ALTITUDE

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.

### DENSITY ALTITUDE CHART

The density altitude chart (figure A-1) provides a means of determining density altitude from a known pressure altitude and OAT. Along the right side of the chart, the reciprocal square root of the density ratio is given to provide a means of computing true airspeed at any altitude from CAS. Figure A-1 also provides a means to convert Fahrenheit temperatures to Celsius temperatures or vice versa.

#### Example Problem for Use of Density Altitude Chart

Given:

OAT 20°C

Pressure altitude 2000 feet

Determine:

Density altitude

Solution: (figure A-1.)

1. Enter chart at 20°C.

2. Move up to 2000 foot pressure altitude line, then move horizontally to the left to the density altitude scale and read 3000 feet.

## AIRSPED CALIBRATION CHART

An airspeed calibration chart (figure A-2) is provided to supply the correction required to determine calibrated airspeed (CAS). Indicated airspeed (IAS), as read from the instrument and corrected for instrument error, plus or minus installation correction, equals calibrated airspeed (CAS). Because of the speed range through which the helicopter operates, compressibility corrections to airspeed are negligible and were intentionally omitted.

#### EXAMPLE PROBLEM FOR USE OF AIRSPEED CALIBRATION CHART

Given:

AIRSPED 60 KIAS

Flight condition Climb and acceleration takeoff

Determine:

Calibrated airspeed

Solution: (figure A-2.)

1. Enter chart at 60 KIAS.

2. Move up to the takeoff line, then move horizontally to the left to the calibrated airspeed scale and read 45 knots.

#### True Airspeed Correction

True airspeed (TAS) is obtained by multiplying CAS by the conversion factor  $\sqrt{\frac{T}{29}}$  shown in figure A-1, for the density altitude at which the CAS reading is taken.

Given:

OAT 20°C

Pressure altitude 2000 feet

Determine:

CAS and TAS.

Solution: (figures A-1 and A-2.)

1. Enter the density altitude chart (figure A-1) at 20°C and move up to intersect the 2000-foot pressure altitude line.

2. From this intersection, move horizontally to the right and read  $\sqrt{\sigma}$  equal to 1.045.
3. Enter the airspeed calibration chart (figure A-2) at 60 KIAS and move up to intersect the takeoff line.
4. From this intersection, move horizontally to the left and read a CAS of 45 knots.
5. Multiply CAS  $\times \sqrt{\sigma}$  to obtain TAS, or 45 KCAS  $\times 1.045 = 47$  KTAS.

## POWER AVAILABLE CHARTS

Various atmospheric conditions, such as OAT and pressure altitude, have an effect on the capability of the engine to produce power. Data for power available at three power settings is shown: maximum power available (figure A-3); military power available (figure A-4); and maximum continuous power available (figure A-5). OAT and pressure altitude effects on power available are shown on the charts. Also shown on the charts is a wheel height correction for engine exhaust recirculation effects that exist while hovering in a dead calm wind condition. Figures A-3, A-4, and A-5 provide power available data that is the maximum power output expected of a properly tuned specification T58-GE-5 engine operating at 721°C Ts for figure A-3; 696°C Ts for figure A-4; and 660°C Ts for figure A-5. The performance of the charts in this Appendix are based on the power output shown in figures A-3, A-4, and A-5. No allowance for engine deterioration below a specification engine is contained in the charts.

### CAUTION

The power output capability of the engine can exceed the structural limit of the transmission under certain conditions. Therefore, the power limitations in Section V should be observed to prevent exceeding the power limitations imposed by the transmissions. These limitations are also shown on the charts.

### NOTE

Engines received from jet engine base maintenance facility may be 3% below maximum power available chart value. New or newly overhauled engines should meet maximum power available values during initial installation check. Maximum power available charts do not reflect engine operation with anti-icing on.

### NOTE

If the power available is being computed in forward flight, OGE, reduce OAT by 2.5°C and adjust pressure altitude by the amount indicated when the selected factors are applied to figure A-7 Airspeed Effects on Power Available and Fuel Flow Charts.

## EXAMPLE PROBLEM FOR USE OF POWER AVAILABLE CHARTS

The power available charts are illustrated in the same manner; therefore, figure A-3, Maximum Power Available - 5-Minute Limit-One Engine, is used to illustrate the example problem.

Given:

OAT	20°C
Wind	0 Knots
Wheel height	30 feet
Pressure altitude	2000 feet
N <sub>r</sub>	103%N <sub>r</sub>

Determine

Torque available at maximum power.

Solution: (figure A-3.)

1. Enter chart at 20°C OAT.
2. Move horizontally and follow the guideline to a point that intersects the 30-foot wheel height line, then continue to move horizontally to 2000 feet pressure altitude.
3. From this intersection, move vertically downward to the 103% N<sub>r</sub> line.
4. From this point, move horizontally to the indicated torque scale and read 99%Q.

## INDICATED TORQUE VS FUEL FLOW CHART

The indicated torque vs fuel flow chart (figure A-6) provides the means for computing fuel consumption for a selected altitude and power rating. To find the fuel flow in pounds-per-hour for one engine, enter the chart at the indicated torque on the bottom scale and

proceed vertically to the proper altitude line. From this point of intersection move horizontally left to the scale and read the fuel flow in pounds-per-hour.

#### NOTE

If fuel flow is being computed in forward flight, OGE, apply the indicated torque to a pressure altitude that has been adjusted by the factors computed from figure A-7, Airspeed Effects on Power Available and Fuel Flow Chart. If the fuel flow is being computed at zero airspeed no pressure altitude adjustment is necessary.

#### EXAMPLE PROBLEM FOR USE OF TORQUE VS FUEL FLOW CHART

Given:

Torque	99%Q
Pressure altitude	2000 feet
Airspeed	0 Knots

Determine:

Fuel flow per engine.

Solution: (figure A-6.)

1. Enter chart at 99%Q.
2. Move vertically up to the intersection of the 2000-foot altitude curve.
3. From this intersection, move horizontally to the fuel flow curve and read a fuel flow of 790 pounds-per-hour per engine.

#### AIRSPED EFFECTS ON POWER AVAILABLE AND FUEL FLOW CHART

The airspeed effects on power available and fuel flow chart (figure A-7) graphically illustrates the effects of airspeed on power available and fuel flow, with the FOD shield on or off, at selected pressure altitudes and outside air temperatures. The chart presents the pressure altitude adjustment to be added or subtracted algebraically from the selected pressure altitude when being applied to the power available and fuel flow charts. Further, when applying the adjusted pressure altitude to the power available charts it will also be necessary to reduce the selected OAT by  $2.5^{\circ}\text{C}$  to

compensate for the difference in engine inlet temperature rise between OGE hover and forward flight.

#### EXAMPLE PROBLEM FOR USE OF AIRSPEED EFFECTS ON POWER AVAILABLE AND FUEL FLOW CHART

Given:

Indicated airspeed	60 KIAS
OAT	$20^{\circ}\text{C}$
Selected pressure altitude	2000 feet
FOD shield	ON

Determine:

Pressure altitude adjustment necessary to apply to power available and fuel flow charts.

Solution: (figure A-7.)

1. Enter the chart at 60 KIAS.
2. Follow the guideline to the baseline of the OAT scale, then continue to follow the guideline to a point that intersects the  $20^{\circ}\text{C}$  OAT line.
3. From this intersection, move vertically upward to the pressure altitude baseline, then follow the guideline to a point that intersects the 2000-foot pressure altitude line.
4. From this point, move vertically to a point that intersects the shield on line.
5. From this point, move horizontally to the left to the pressure altitude adjuster scale and read plus 175 feet.

#### HOVERING CHARTS

The hovering charts (figures A-8, A-9, A-10, and A-11) provide a means of computing the maximum gross weight and indicated torque required to hover at all wheel heights in ground effect, out of ground effect, and the effect of headwinds.

#### MAXIMUM GROSS WEIGHT FOR HOVERING - ZERO WIND - TWO ENGINES

The maximum gross weight for hovering - zero wind - two-engines chart (figure A-8) provides a means of computing the maximum gross weight at which the

helicopter can be hovered in ground effect and out of ground effect. The gross weight is based on zero wind with various combinations of pressure altitude, OAT, rotor speed, and wheel height.

#### **Example Problem for Use of Maximum Gross Weight for Hovering Chart**

Given:

Pressure altitude	2000 feet
OAT	20°C
Rotor speed	103%Nr
Wheel height	30 feet

Determine:

Maximum gross weight for hovering at maximum power and 30-foot wheel height.

Solution: (figure A-8.)

1. Enter chart at 2000 feet pressure altitude.
2. Move horizontally to intersect the 20° C OAT line.
3. From this intersection, move downward through the rotor speed grid to the wheel height baseline. If the rotor speed had been other than that established for a baseline, movement would have been to the rotor speed baseline, the influence line followed to the appropriate rotor speed, then downward to the wheel height baseline.
4. From the wheel height baseline, follow the influence line to intersect the 30-foot wheel height line, then down to the gross weight scale and read 19,750 pounds.

#### **TORQUE REQUIRED TO HOVER - ZERO WIND - TWO ENGINES**

The torque required to hover zero wind - two engines chart (figure A-9), provides a means of computing the torque required to hover in ground effect and out of ground effect. The torque requirement indication is based on zero wind with various combinations of gross weight, density, altitude, rotor speed, tip Mach number, and wheel height.

#### **Example Problem for Use of Torque Required to Hover Chart**

Given:

Gross weight	20,000 pounds
Density altitude	sea level
Rotor speed	103%Nr
Air temperature	-10°C
Wheel height	20 feet

Determine:

Torque required to hover.

Solution: (figure A-9.)

1. Enter chart at 103% Nr, move upward to intersect the -10°C OAT line and read .632 tip MACH number. Retain this value.
2. Reenter the chart at 20,000 pounds gross weight and move horizontally to the right to intersect the sea level density altitude line.
3. From this intersection, move downward to the baseline of the compressibility influence lines, then follow the influence line to a .632 tip MACH number.
4. From this intersection, move downward to the rotor speed baseline, then downward to the wheel height baseline.
5. From the baseline, follow the influence line to the 20-foot wheel height line, then move downward to the torque scale and read 98%Q.

#### **HEADWIND INFLUENCE ON MAXIMUM GROSS WEIGHT FOR HOVERING**

The headwind influence on maximum gross weight for hovering chart (figure A-10), provides a means of computing the headwind influence on the maximum gross weight that can be hovered at various wheel heights.

#### **Example Problem for Use of Headwind Influence on Maximum Gross Weight for Hovering Chart**

Given:

Gross weight	19,750 pounds
--------------	---------------

Headwind	10 knots
Wheel height	30 feet
Determine:	

Influence of 10-knot headwind on maximum gross weight to hover at 30-foot wheel clearance.

Solution: (figure A-10.)

1. Enter chart at the 30-foot wheel clearance graph where the 19,750-pound gross weight line intersects the baseline.
2. From this intersection, follow the influence line to intersect the 10-knot headwind line.
3. From this intersection, move downward to the gross weight scale and read 20,950 pounds.

#### **HEADWIND INFLUENCE ON TORQUE REQUIRED TO HOVER**

The headwind influence on torque required to hover chart (figure A-11), provides a means of computing the headwind influence on the torque required to hover at various wheel heights.

#### **Example Problem for Use of Headwind Influence on Torque Required to Hover Chart**

Given:

Torque	100%
Headwind	10 knots
Wheel height	30 feet
Determine:	

Influence of 10 knot headwind on torque required to hover at 30-foot wheel height.

Solution: (figure A-11.)

1. Enter the chart at 30-foot wheel clearance graph where the 100% torque line intersects the baseline.
2. From this intersection, follow the influence line to intersect the 10 knot headwind line.
3. From this intersection, move downward to the torque scale and read 95% torque.

#### **HEIGHT VELOCITY DIAGRAMS**

Figures A-12 and A-13 are plots of minimum heights versus speed for a safe single engine or autorotative landing following failure of one or two engines. The single engine height velocity curve is based upon test points flown in low wind conditions at a mid CG and 17,000 and 19,500 pounds gross weight. The points obtained at the knee of the curve (low speed, low altitude) were simulated single-engine failure from a takeoff condition and others from level flight. The single-engine height-velocity capabilities of the helicopter, in the low speed range (0 to 24 knots), are a function of power remaining in the operating engine and the weight of the helicopter. The height-velocity capabilities in the high speed range (24 knots to  $V_{max}$ ) are less affected by power remaining and weight. The low speed portion of the H-V curve can be adjusted as a function of weight, temperature, and altitude. This is done by sliding the whole low speed portion of the H-V curve to the right until the part furthest to the right meets the computed airspeed. The height velocity diagram is meant to depict the capabilities of the helicopter, as flown by an average pilot over a paved runway, with zero wind. Under operational conditions, the altitude airspeed combination for a safe autorotative landing is dependent upon many variables such as pilot capabilities, density altitude, helicopter gross weight, proximity of suitable landing area, and wind direction and velocity in relation to flight path. This does not preclude any operation in the shaded areas under emergency or pressing operational requirements, as a controlled landing can usually be accomplished and minimum damage, if any, will occur to the helicopter.

#### **EXAMPLE PROBLEM FOR USE OF HEIGHT VELOCITY DIAGRAM - ONE ENGINE FAILURE CHART**

Given:

Gross weight	20,500 pounds
Pressure altitude	2000 feet
OAT	20°C

Determine:

Height velocity curve speed.

Solution:

1. Enter bottom of chart at 20,500 pounds gross weight and move vertically to intersect the 2000-foot pressure altitude line.
2. From this intersection, move horizontally to the right to intersect the 20°C OAT line.
3. From this intersection, move downward to the airspeed scale and read 30 KIAS.
4. Apply the 30 KIAS to the top portion of the chart to determine the avoid area.

## **TAKEOFF CHARTS**

The takeoff charts (figures A-14 through A-19), each for a particular type takeoff, provide the takeoff distance required to clear a 50-foot obstacle at various combinations of gross weight, excess power margin, climb speed, and headwinds. The excess power margin is an index of the difference between the maximum power available at the 50-foot obstacle and the power required to hover at a 3-foot wheel height. (The numerical values on the charts are not percent Q.) This power margin is automatically compensated for on charts that do not have an additional excess power margin block on the right-hand side of the chart. However, when the additional excess power margin block is on the right-hand side of the chart, and operations are conducted within that region, excess power noted in the left-hand excess power margin grid is reduced by the amount indicated in the upper right-hand block, and the takeoff distance computed from that point. As all the takeoff charts are used in a similar manner, figure A-15, Distance to Clear a 50-Foot Obstacle - Climb and Acceleration Takeoff - Two Engines, is used for the example problem.

### **EXAMPLE PROBLEM FOR USE OF TAKEOFF CHARTS**

Given:

Gross weight	20,500 pounds
Pressure altitude	2000 feet
OAT	20°C
Climb out airspeed	60 KIAS
Headwinds	10 Knots

Determine:

Takeoff distance to clear a 50-foot obstacle.

Solution: (figure A-15.)

1. Apply the 60 KIAS to figure A-2, Airspeed Calibration, to determine CAS so that true airspeed can be computed. Enter chart at 60 KIAS, move up to intersect the takeoff line, then move left to the CAS grid and read 45 knots CAS.
2. Refer to figure A-1, Density Altitude, to compute the true airspeed conversion factor. Enter the chart at 20°C OAT, move up to intersect the 2000-foot pressure altitude line, then move horizontally to the right to read a conversion factor of 1.045. Multiplying 45 knots CAS X 1.045 = 47 KTAS. (Retain this value.)
3. Enter chart at 20,500 pounds gross weight.
4. Move horizontally to intersect the 2000-foot pressure altitude line.
5. From this intersection, move upward to intersect the 20°C OAT line in the excess power margin grid.
6. From this intersection, move horizontally to the right to intersect the all other conditions deflector line, then move down to the climb out airspeed baseline.
7. From the climb out airspeed baseline, follow the influence line to intersect the 47 KTAS line, then move down to the headwind baseline.
8. From the headwind baseline, follow the influence line to the 10-knot headwind line, then move down to the takeoff distance scale and read 480 feet.

## **CLIMB CHARTS**

The climb charts (figures A-20 through A-25) provide a means of computing the time to climb, the horizontal distance covered, the fuel consumed, and the rate-of-climb for various gross weights. These values are computed by applying the gross weights to various conditions of pressure altitude and temperature. The fuel used does not include the fuel used for warmup and takeoff (approximately 25 pounds for each engine). Also included is a climb speed schedule, based on a decrease of approximately one knot indicated airspeed for every thousand feet increase in altitude, to provide the climb speed for various pressure altitudes. A temperature scale is also provided to relate the OAT at various pressure altitudes. The temperature scale is either based on a warm day (0° to 40°C) or a cold day (-40° to 0°C), for each series of charts. Figures A-20

(warm day) and A-21 (cold day) provide climb data for two-engine operation at military power. Figures A-22 and A-23 provide data at comparable conditions for one-engine operation. Figures A-24 and A-25 provide climb data at comparable temperature conditions for two-engine operation at maximum continuous power.

#### NOTE

If OAT is 0°C, use the warm day charts.  
If OAT is colder than -40°C, use values determined at -40°C.

#### NOTE

Best climb performance is obtained at a constant 75 KTAS. The speed schedules on the climb charts provide appropriate indicated airspeeds to maintain best climb performance.

#### EXAMPLE PROBLEM FOR USE OF CLIMB CHARTS

Given:

Gross weight	20,500 pounds
Temperature (cruise)	18°C
Pressure altitude (cruise)	3000 feet
Temperature (takeoff)	20°C
Pressure altitude (takeoff)	2000 feet

Determine:

Rate-of-climb speed, rate-of-climb, time-to-climb, fuel consumed, and horizontal distance covered to climb from 2000 feet to 3000 feet pressure altitude at military power.

Solution: (Refer to figure A-20.) Since takeoff is from above sea level, it will be necessary to determine climb data from sea level to 2000 feet pressure altitude and from sea level to 3000 feet pressure altitude. The difference between the data necessary to climb to both altitudes will then be the data necessary to climb from 2000 feet pressure altitude to 3000 feet pressure altitude.

1. Enter the chart at 20,500 pounds gross weight.
2. From the intersection of the 20,500 pound gross weight line and the 3000-foot pressure altitude lines in the time, distance, fuel, and rate-of-climb grids, proceed horizontally to the left to the OAT baseline.

Follow the influence line in each grid to the 18°C OAT line then proceed horizontally to the left to note the following values:

Time-to-climb	2.4 minutes
Distance covered	3.3 nautical miles
Fuel consumed	63 pounds
Rate-of-climb	1050 feet per minute

3. Repeat the procedures outlined in step 3, using the 2000-foot pressure altitude lines and 20°C OAT. However, as 20°C OAT is the temperature baseline, trace through the temperature grid to determine climb data and note the following values:

Time-to-climb	1.7 minutes
Distance covered	2.0 nautical miles
Fuel consumed	42 pounds
Rate-of-climb	1150 feet per minute

4. Subtract the climb data factors to determine climb data to climb from 2000 feet to 3000 feet pressure altitude as follows:

$$\text{Time to climb } (2.4 - 1.7) = .7 \text{ minute}$$

$$\text{Distance covered } (3.3 - 2.0) = 1.3 \text{ nautical mile}$$

$$\text{Fuel consumed } (63 - 42) = 21 \text{ pounds}$$

5. Enter the climb speed schedule at 2000 and 3000 feet pressure altitude and note the climb speeds. When related to the rate-of-climb data, note that the initial rate-of-climb of 1150 fpm at 72 KIAS decreases to 1050 fpm at 71 KIAS.

#### SERVICE CEILING CHARTS

The service ceiling charts (figures A-26 and A-27) show the highest altitude at which a rate-of-climb of 100 feet per minute can be attained at a specific gross weight and temperature. Figure A-26 reflects the service ceiling for two-engine operation at maximum continuous power, and figure A-27 reflects the service ceiling for one-engine operation at military power. Since the service ceiling is affected by gross weight, it can be raised by reducing the gross weight.

## EXAMPLE PROBLEM FOR USE OF SERVICE CEILING CHARTS

Given:

Gross weight 20,500 pounds

Temperature 10°C

Determine:

Service ceiling.

Solution: (figure A-26.)

1. Enter chart at 20,500 pounds gross weight.
2. Move vertically to intersect the 10°C OAT line.
3. From this intersection, move horizontally to the left and read 9500 feet.

## CRUISE CHARTS

The cruise charts (figures A-28 through A-33) provide the means of computing cruise performance at various outside air temperatures. Cruise performance is computed by referencing the appropriate cruise chart for the operating outside air temperature and flight condition, then applying a gross weight to pressure altitude and true airspeed parameters to determine specific fuel consumption and fuel flow. The charts also contain a service ceiling line, optimum cruise altitude line, recommended cruise speed baseline, and a maximum endurance line. Maximum endurance is computed by decreasing true airspeed from the recommended cruise speed baseline.

## EXAMPLE PROBLEM FOR USE OF CRUISE CHARTS

Given:

Gross weight 20,474 pounds

Pressure altitude 3000 feet

OAT 18°C

Determine:

Recommended airspeed and fuel flow and unit range.

Solution: (figure A-29.)

1. Enter the chart on sheet 1 at 20,475 pounds gross weight and move vertically to intersect the 3000-foot pressure altitude line.

2. From this intersection, move horizontally to the right to the recommended cruise speed baseline then down to the true airspeed scale and read 123 KTAS.

3. Continue to move down to the airspeed baseline then follow the influence lines to a point that intersects the 3000-foot pressure altitude line.

4. From this intersection, move down to the airspeed scale and read 116 KIAS.

5. From the intersection at the recommended cruise speed baseline, move horizontally to the right to the transfer scale and read 5.1.

6. Enter the transfer scale on sheet 2 at 5.1 and move horizontally to the right to intersect the 3000-foot pressure altitude line.

7. From this intersection, move down to the unit range scale and note a unit range of .101 NM/lb of fuel.

8. Continue to move down to intersect the true airspeed line, then move horizontally to the left and note a fuel flow of 1220 lbs/hr.

9. Determine fuel required for cruise by dividing the distance by the unit range.

## SINGLE ENGINE CAPABILITY CHART

The single engine capability chart (figure A-34) illustrates the gross weight capability to maintain level flight at 70 KIAS for various pressure altitudes and temperatures with one engine at military power. The chart also portrays the indicated torque and fuel flows associated with military power for the various pressure altitudes and temperatures. If conditions of gross weight, pressure altitude, and temperature do not permit level flight at 70 KIAS, a rate of descent grid is provided for estimating rate of descent for actual flight conditions.

## EXAMPLE PROBLEM FOR USE OF SINGLE ENGINE CAPABILITY CHART

Given:

Temperature 18°C

Pressure altitude 3000 feet

Gross weight 20,475 pounds

Determine:

Gross weight capability to maintain level flight at 70 KIAS and associated torque and fuel flow values. If capability does not exist for given gross weight, determine the resulting rate of descent.

Solution: (figure A-34.)

1. Enter the chart at 18°C OAT.
2. Move vertically to the 3000 foot pressure altitude line in the indicated torque grid.
3. From the intersection of the 18°C OAT line and the 3000-foot pressure altitude line in the gross weight, fuel flow, and indicated torque grids, move horizontally to the left and note the following values:

Gross weight 18,800 pounds

Fuel flow 740 pounds per hour

Torque 91%

4. As the aircraft gross weight is 20,475 pounds, and the gross weight capability to maintain level flight is 18,800 pounds, it is necessary to determine the resulting rate-of-descent in the following manner:

5. From the intersection of the 18°C OAT and 3000-foot pressure altitude lines in the gross weight grid, move horizontally to the right to the rate-of-descent baseline.

6. From the baseline, follow the influence line up to the 20,475-pound gross weight line then move downward to the rate-of-descent scale and read 220 feet per minute. This indicates a rate of descent will be realized at a gross weight of 20,475 pounds until the helicopter descends to a pressure altitude where level flight can be maintained at 70 KIAS.

## BLADE STALL CHART

The function of the blade stall chart (figure A-35) is to provide a means of determining the speed at which blade stall occurs under various altitude, rotor rpm, gross weight, and angle of bank conditions.

## EXAMPLE PROBLEM FOR USE OF BLADE STALL CHART

Given:

Pressure altitude 3000 feet

Temperature 18°C

Rotor speed 100%Nr

Gross weight 20,475 pounds

Angle of bank 20°

The indicated airspeed at which blade stall will occur.

Solution: (figure A-35.)

1. Enter the chart at 3000 feet pressure altitude.
2. Move horizontally to the right to intersect the 18°C OAT line.
3. From this intersection, move downward to the rotor speed baseline then follow the influence line to intersect the 100% rotor speed line.
4. From this intersection, move downward to the gross weight baseline then follow the influence line to intersect the 20,475 pound gross weight line.
5. From this intersection, move downward to the angle of bank baseline, then follow the influence line to intersect the 20° angle of bank line.
6. From this intersection, move downward to the airspeed scale and read 108 KIAS.

## MAXIMUM AIRSPEED CHART

The maximum airspeed chart (figure A-36) provides a variation of maximum KIAS with density altitude, gross weight, and rotor speed.

## EXAMPLE PROBLEM FOR USE OF MAXIMUM AIRSPEED CHART

Given:

Density altitude 4000 feet

Gross weight 20,475 pounds

Nr 100%

Determine:

KIAS.

Solution:

1. Enter the chart at 4000 feet density altitude.
2. Move horizontally to the right to intersect the 20,475 pound gross weight line.
3. From this intersection, move downward to the rotor speed baseline, follow the influence line to 100% Nr line, then move downward to read 113 KIAS.

### **CENTER OF GRAVITY LIMITATIONS CHART**

The center of gravity limitations chart (figure A-37) shows the recommended center of gravity limits and the maximum weight that can be accommodated at these stations.

#### **EXAMPLE PROBLEM FOR USE OF CENTER OF GRAVITY LIMITATIONS CHART**

Given:

Gross weight 20,500 pounds

Center of gravity Sta. 259.0

Determine:

If cargo is within the recommended CG limits.

Solution:

1. Enter left side of chart at 20,500 pounds.
2. Move horizontally to the right to intersect the 259 station line and note that intersection is within the recommended center of gravity limits.

### **MAXIMUM SINK RATE ON LANDING CHART**

The maximum sink rate on landing chart (figure A-38) provides the maximum sink rate in fpm the helicopter

can withstand at various gross weights. To find the maximum sink rate for 20,500 pounds enter the base of the chart with this weight, read up to the limiting curve, then left, and read 433 fpm.

### **MAXIMUM AUTOROTATIVE GLIDING DISTANCE**

The maximum autorotative gliding distance chart (figure A-39) gives the gliding distance for two specific KIAS and sink rates.

#### **EXAMPLE PROBLEM FOR USE OF MAXIMUM AUTOROTATIVE GLIDING DISTANCE CHART**

Given:

Rotor rpm 212

Rotor speed 104%Nr

Altitude 750 feet

Determine:

Gliding distance

Solution:

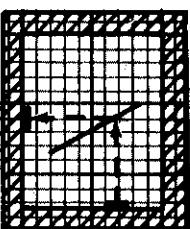
1. Enter chart at 750 feet altitude.

2. Move horizontally to the right to intersect the 70 KIAS and 1900 fpm sink rate curve.

3. From this intersection, move downward and read 0.46 nautical miles.

4. From the intersection noted in step 2, move horizontally to the right to intersect the 110 KIAS and 2300 fpm sink rate curve.

5. From this intersection, move downward and read 0.6 nautical miles gliding distance.



## DENSITY ALTITUDE

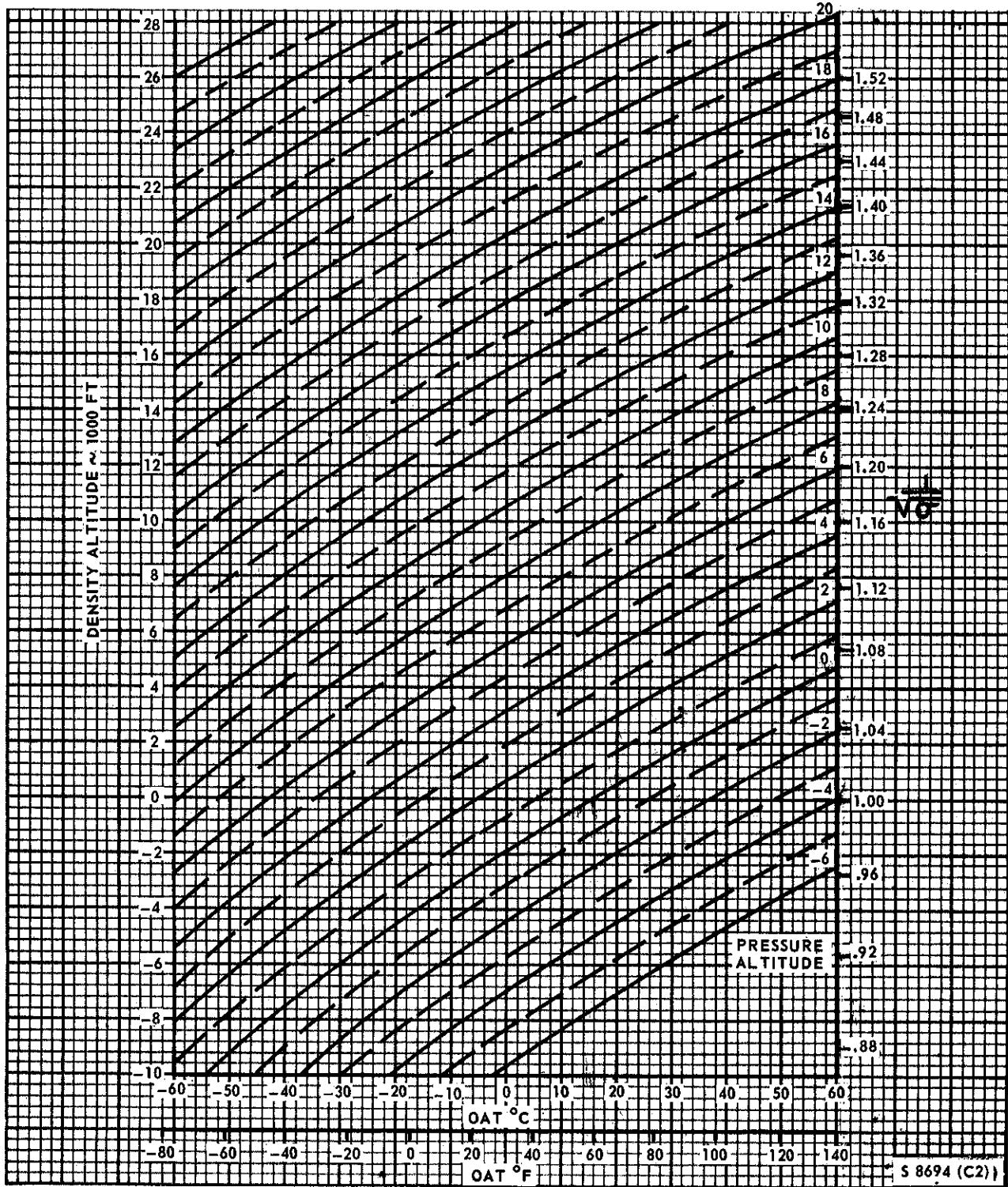


Figure A-1. Density Altitude

CONDITIONS:  
LANDING GEAR UP  
EXCEPT FOR  
TAKEOFF

## AIRSPEED CALIBRATION

DATE: 15 APRIL 1971  
DATA BASIS: FLIGHT TEST (AIR FORCE)

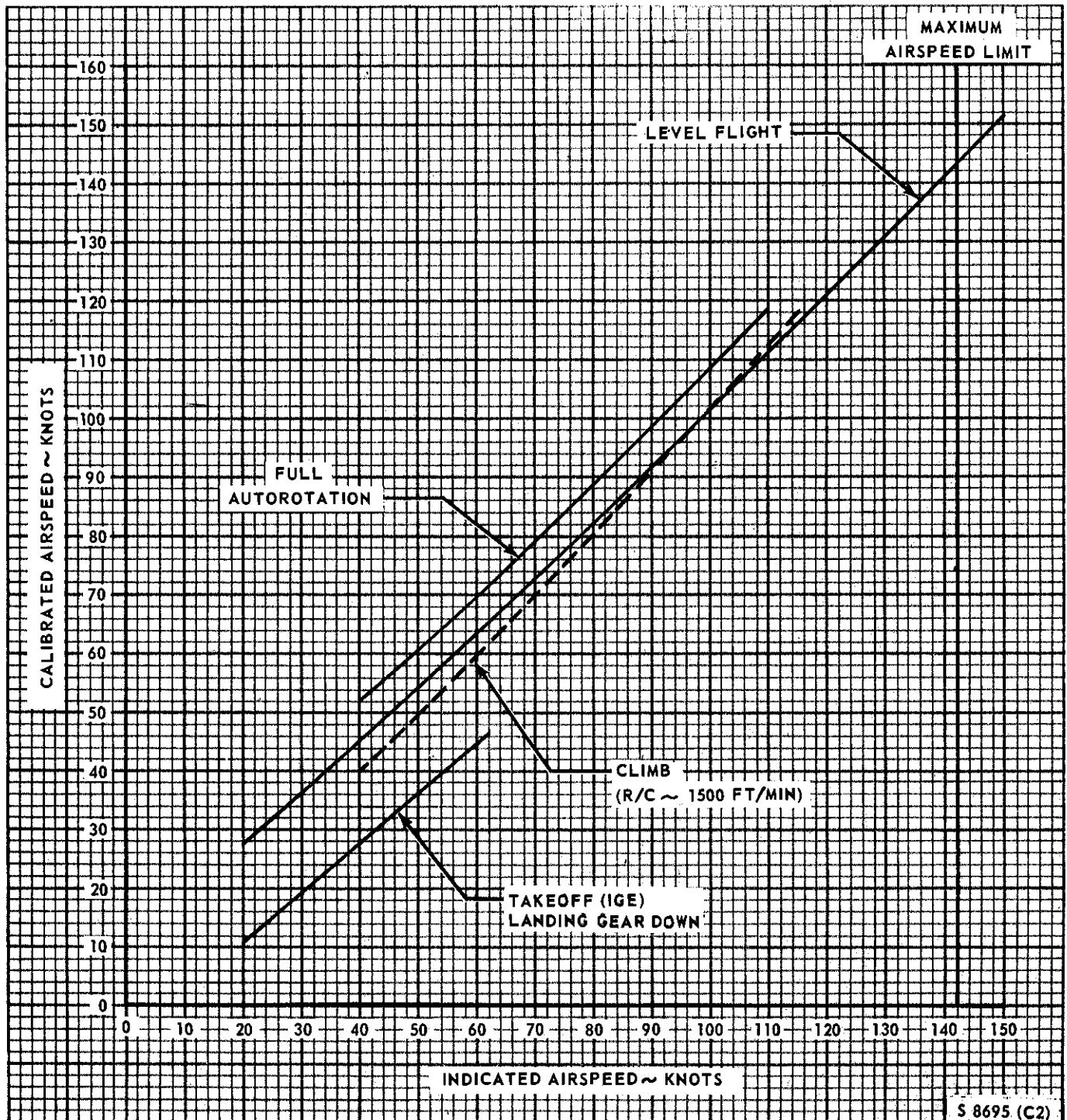
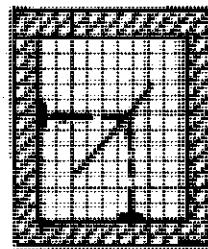
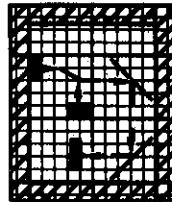


Figure A-2. Airspeed Calibration

S 8695 (C2)

CONDITIONS:  
HOVER ZERO WIND  
ZERO AIRSPEED  
FOD SHIELD ON OR OFF  
MAXIMUM POWER



**MAXIMUM POWER  
AVAILABLE**  
ONE ENGINE  
MODEL HH-3F      ENGINE T58-GE-5

DATE: 15 APRIL 1971

DATA BASIS: ENG MFG SPEC E1096-A

NO WIND TO 3 KNOTS

WITH WIND

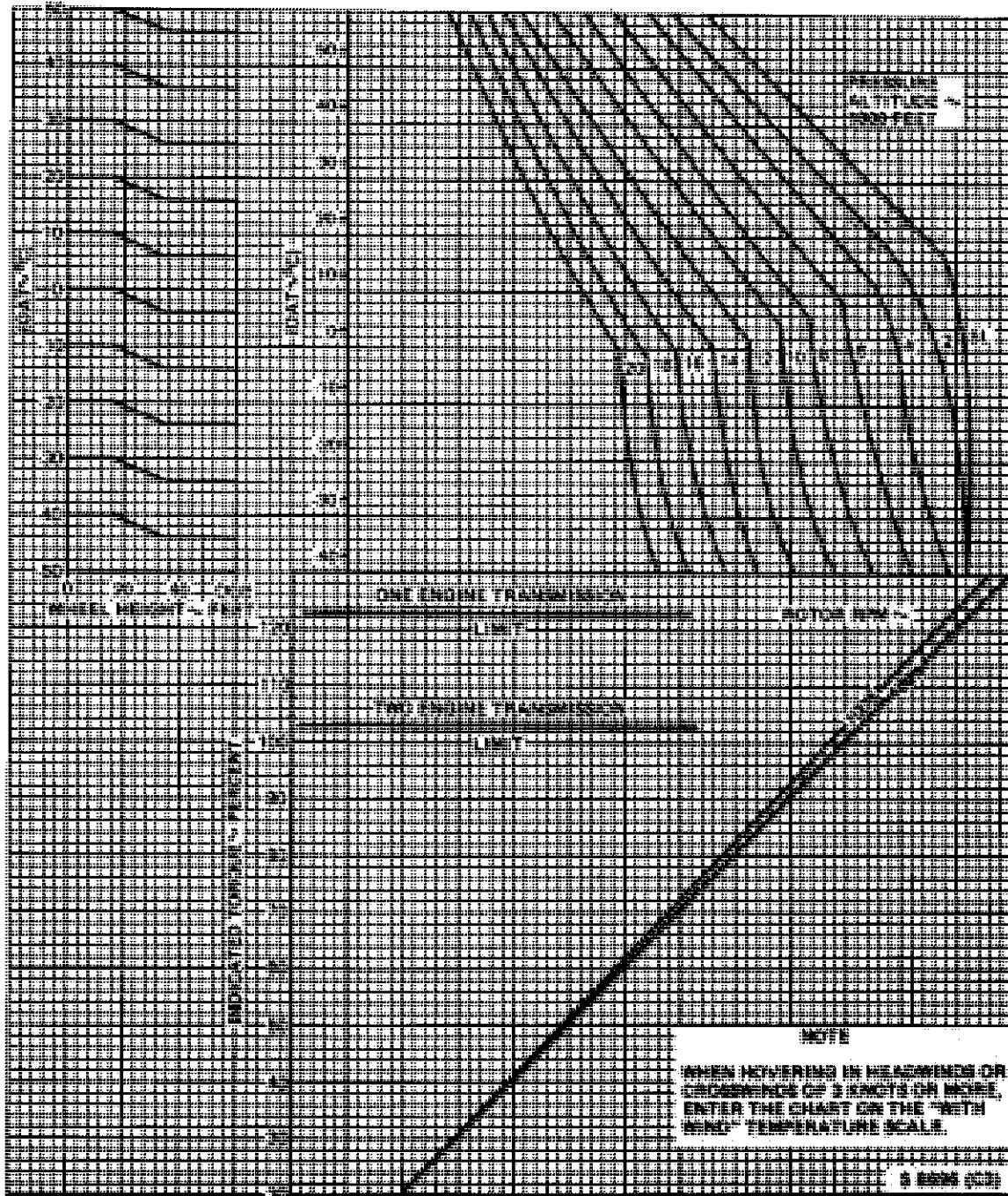


Figure A-3. Maximum Power Available - 5 Minute Limit - One Engine

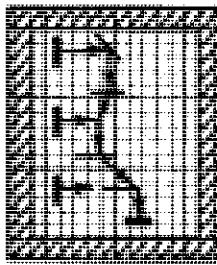
CONDITIONS:  
MAXIMUM POWER  
ZERO AIRSPEED  
FOD SHIELD ON OR OFF

**MAXIMUM GROSS  
WEIGHT FOR HOVERING**

TWO ENGINES

MODEL  
HH-3F

ENGINE  
T58-GE-5



DATE: 15 APRIL 1971

DATA BASIS: FLIGHT TEST (AIR FORCE)

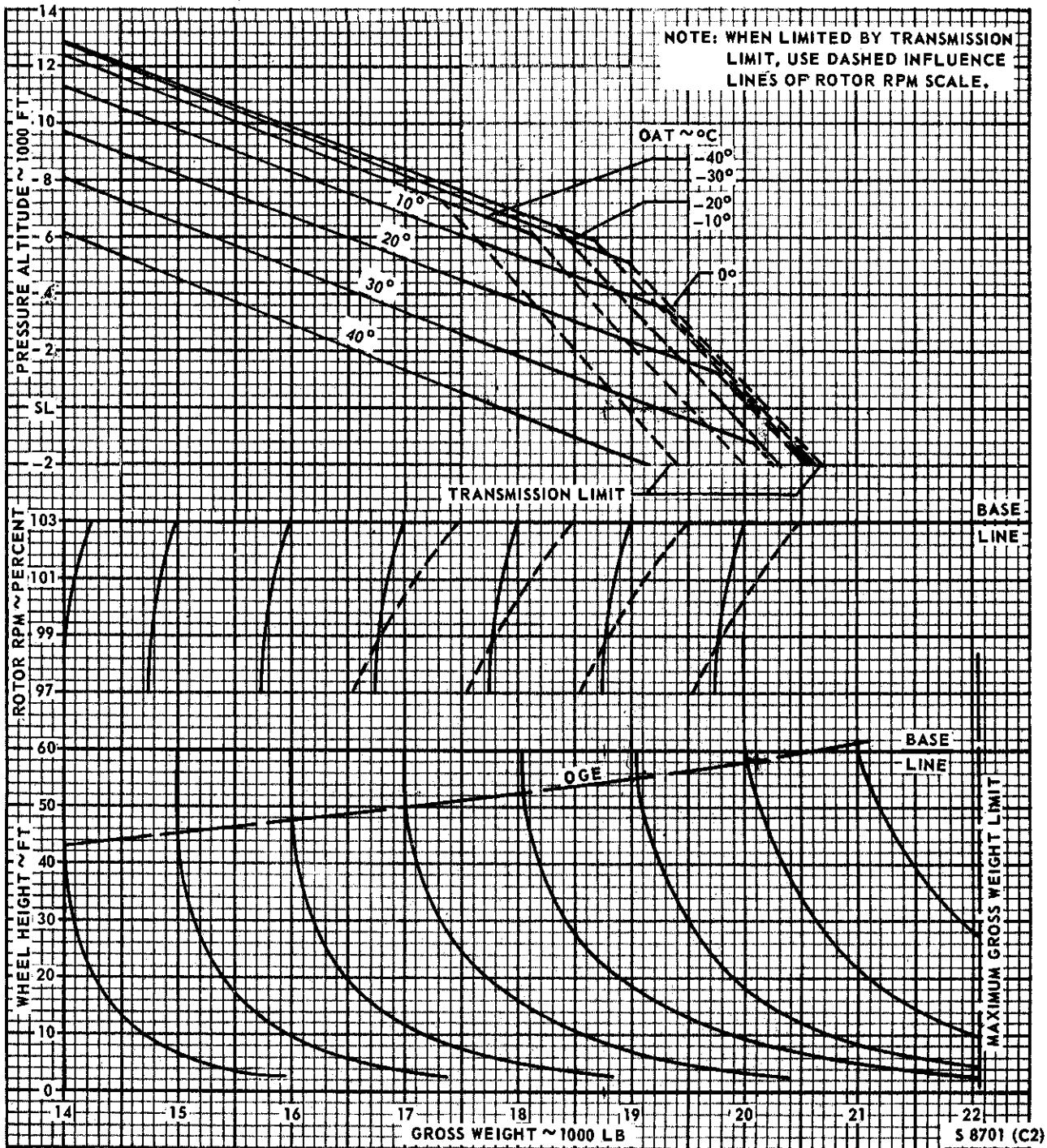
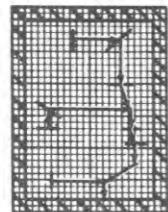


Figure A-8. Maximum Gross Weight for Hovering - Zero Wind - Two Engines

CONDITIONS:  
HOVER, ZERO AIRSPEED,  
FOD SHIELD ON OR OFF

DATE: 15 APRIL 1971  
DATA BASIS: FLIGHT TEST



### TORQUE REQUIRED TO HOVER

TWO ENGINES

MODEL:  
HH-3F

ENGINE:  
T58-GE-5

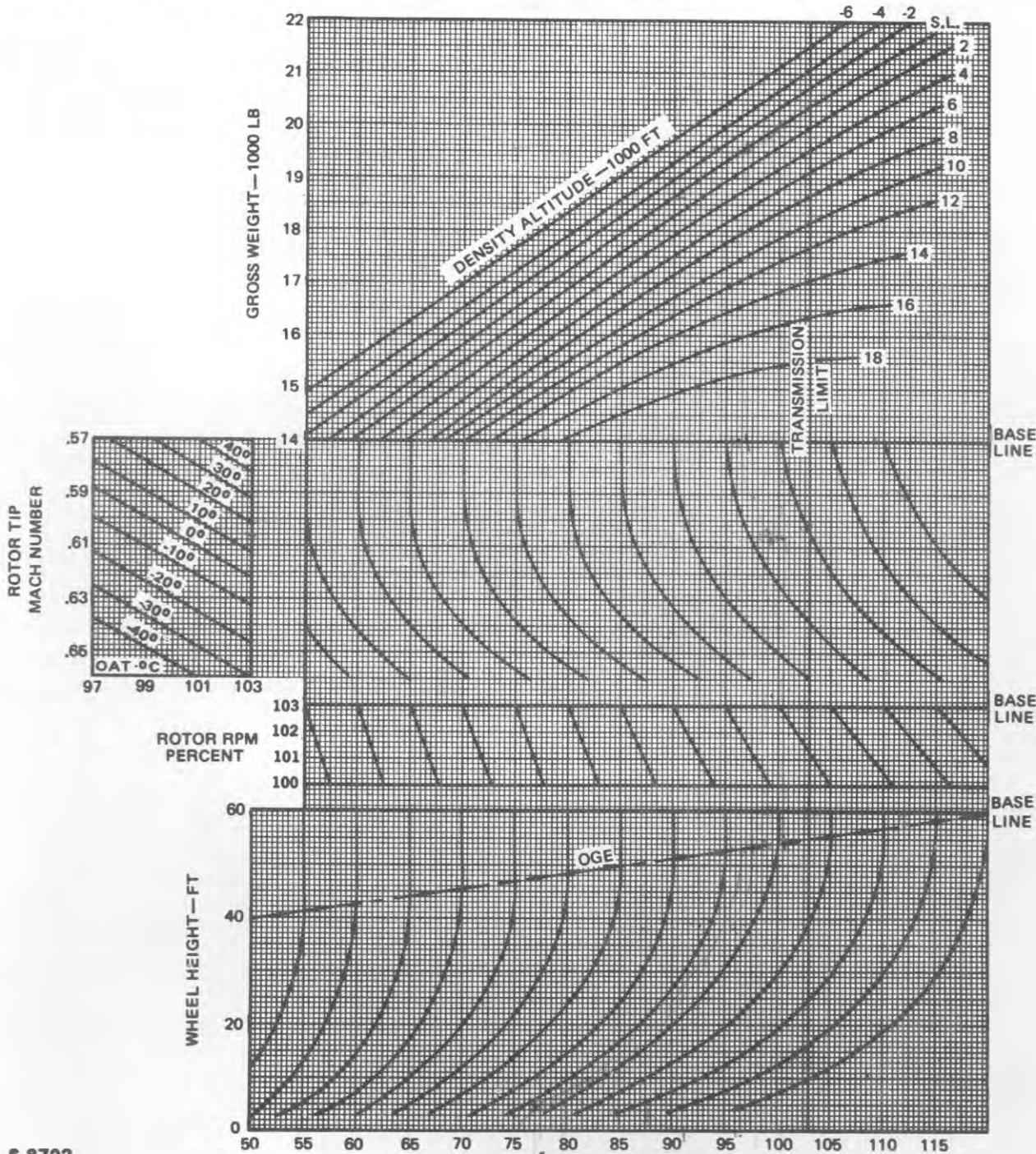


Figure A-9. Torque Required to Hover - Zero Wind - Two Engines

# HEADWIND INFLUENCE ON MAXIMUM GROSS WEIGHT FOR HOVERING

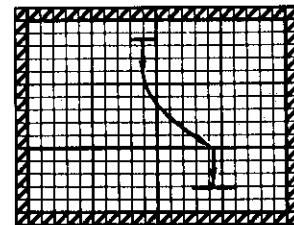
TWO ENGINES

MODEL

HH-3F

ENGINE

T58-GE-5



DATE: 1 JULY 1974

DATA BASIS: ESTIMATED

NOTE: WEIGHT CORRECTION FOR  
HEADWINDS LESS THAN  
3 KNOTS IS NEGLIGIBLE

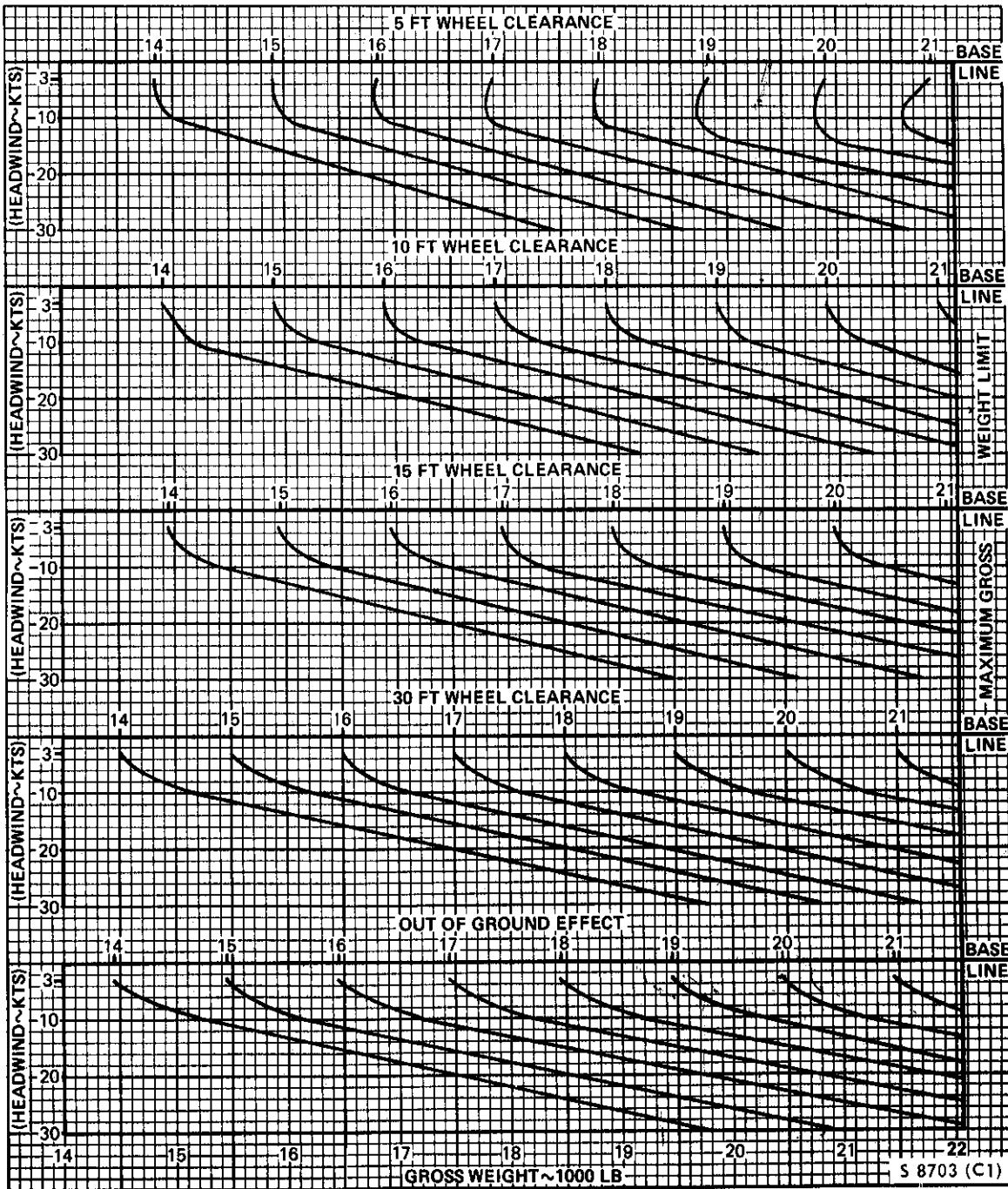
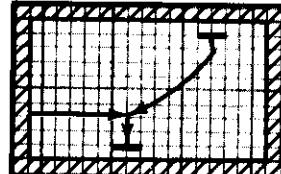


Figure A-10. Headwind Influence on Maximum Gross Weight for Hovering

CONDITIONS:  
HOVER WITH WINDHEADWIND INFLUENCE ON TORQUE  
REQUIRED FOR HOVERING

MODEL	TWO ENGINES	ENGINE
HH-3F		T58-GE-5

DATE: 15 APRIL 1971

DATA BASIS: ESTIMATED

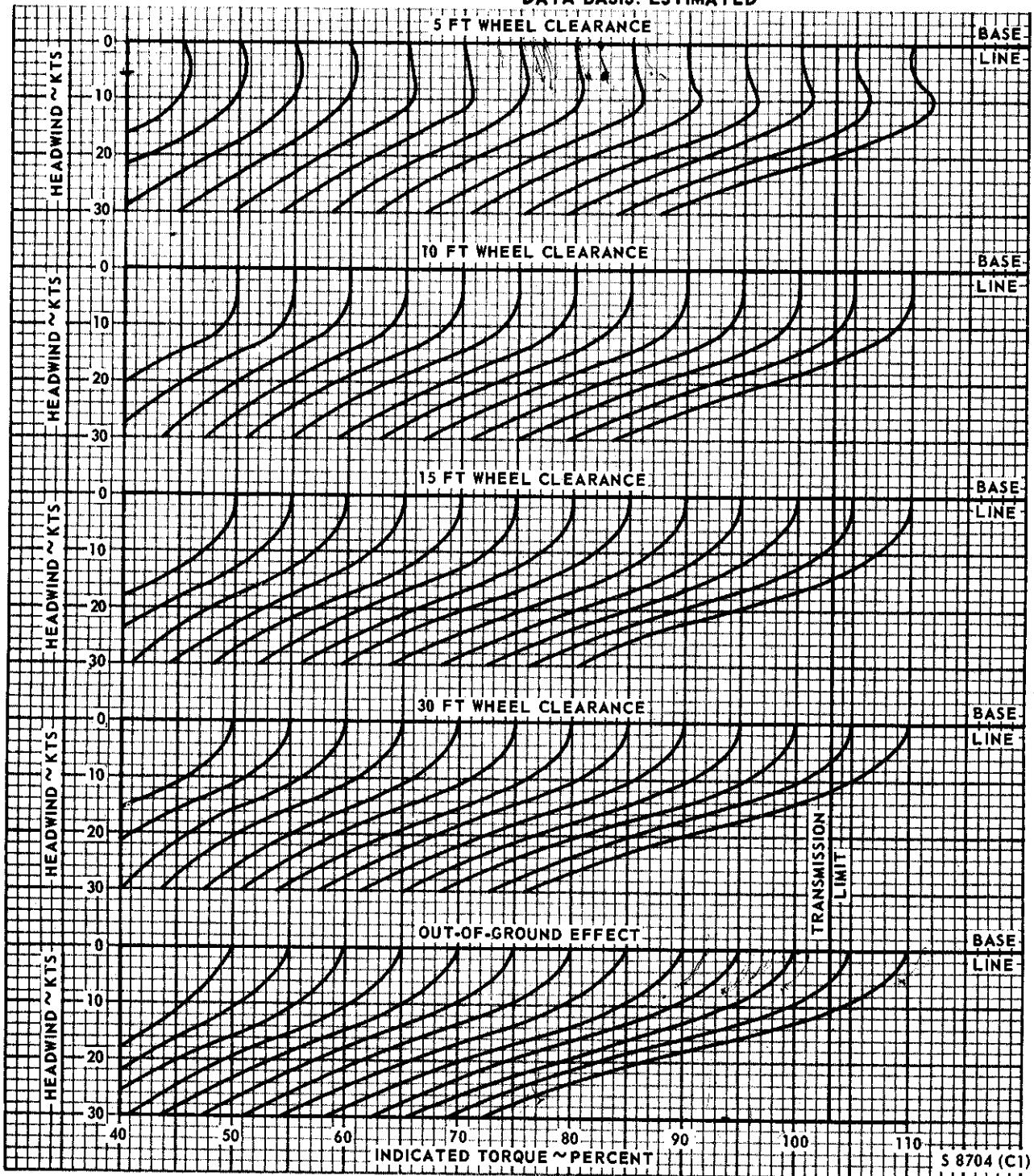


Figure A-11. Headwind Influence on Torque Required to Hover

Enter ↑

CONDITIONS  
103% N<sub>r</sub>  
MILITARY POWER  
WARM UP AND TAKE OFF  
FUEL NOT INCLUDED  
ZERO WIND  
FOD SHIELD ON OR OFF

## CLIMB

TWO ENGINES  
WARM DAY

MODEL  
HH-3F

ENGINE  
T58-GE-5

DATE: 15 APRIL 1971

DATA BASIS: FLIGHT TEST (AIR FORCE)

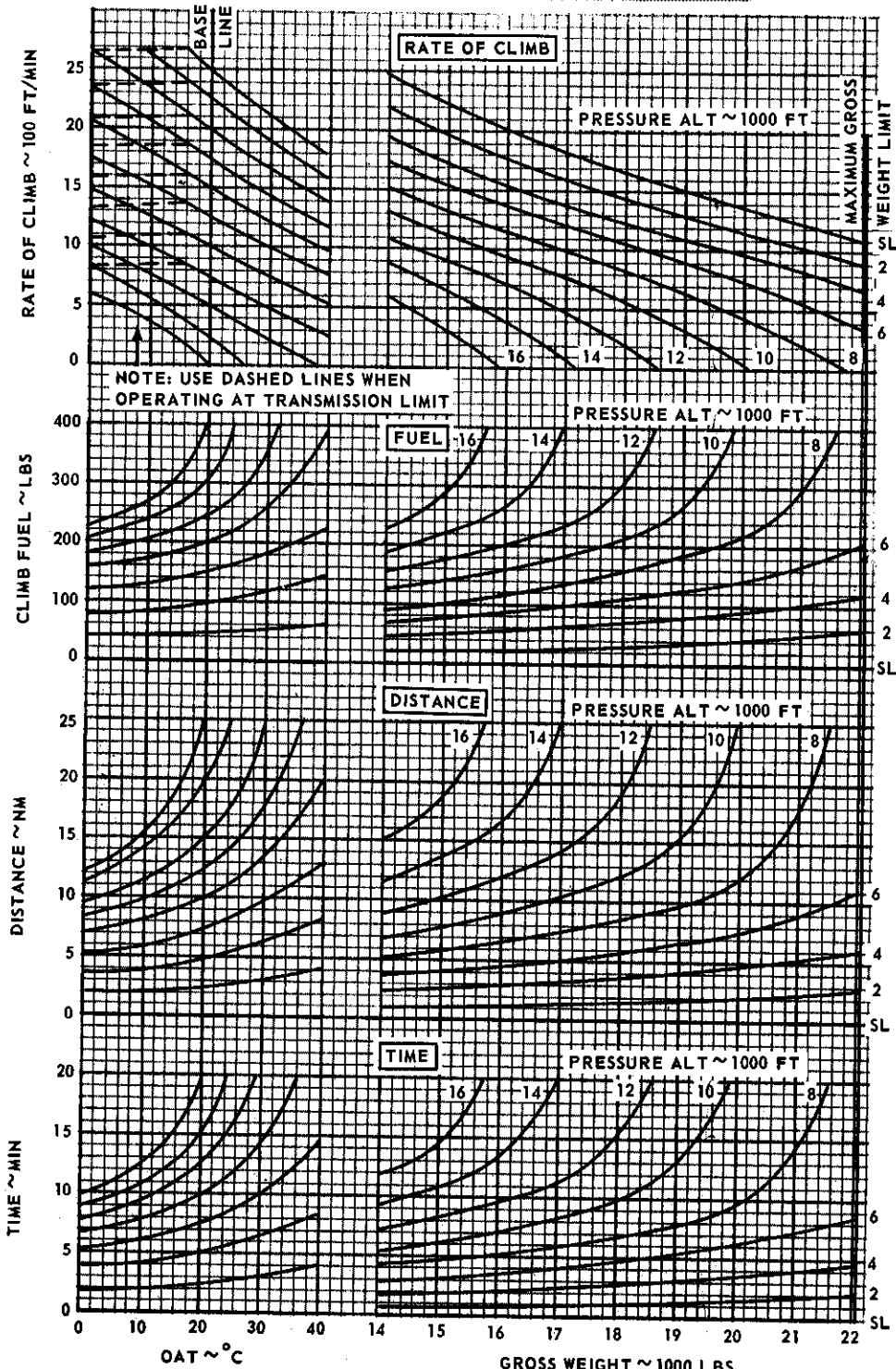
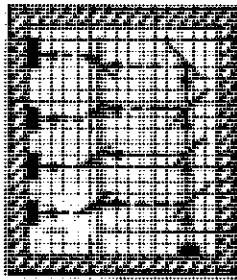
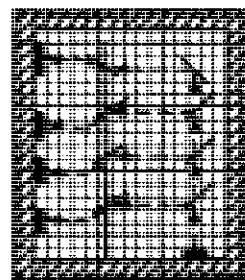


Figure A-20. Climb - Military Power (0° to 40°C OAT) - Two Engines

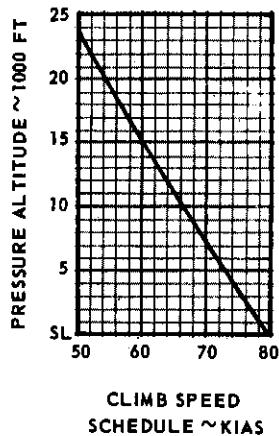
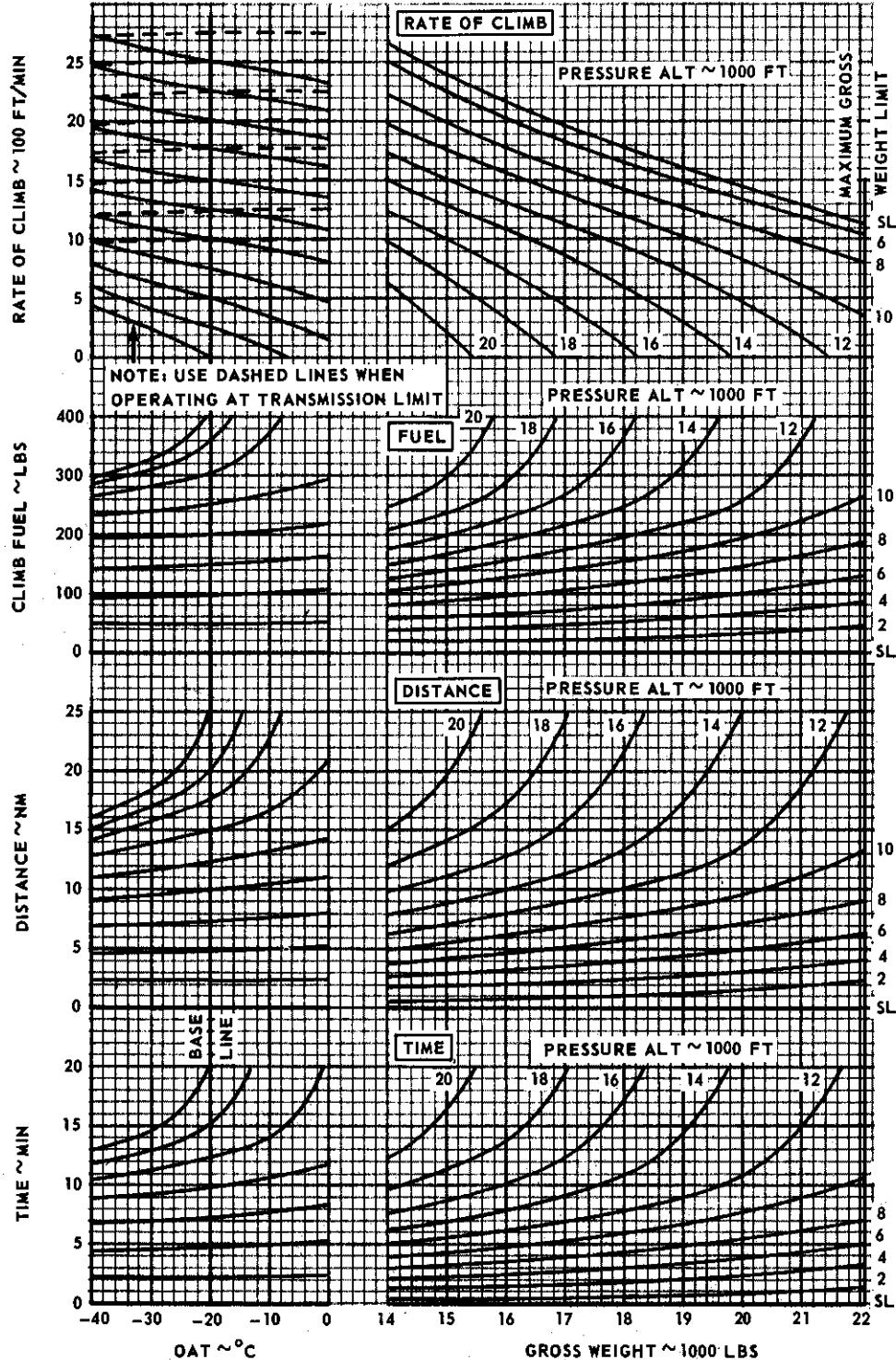
S 8714 (C2)

**CONDITIONS:**  
103% N,  
**MILITARY POWER**  
**WARM UP AND TAKE OFF**  
**FUEL NOT INCLUDED**  
**ZERO WIND**  
**FOD SHIELD ON OR OFF**



**CLIMB  
TWO ENGINES  
COLD DAY**

DATE: 15 APRIL 1971  
DATA BASIS: FLIGHT TEST (AIR FORCE)



**Figure A-21. Climb - Military Power (-40° to 0°C OAT) - Two Engines**

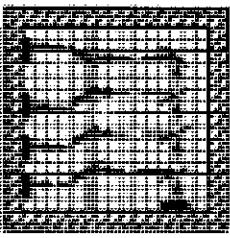
**CLIMB  
ONE ENGINE  
WARM DAY**

**MODEL  
HH-3F**

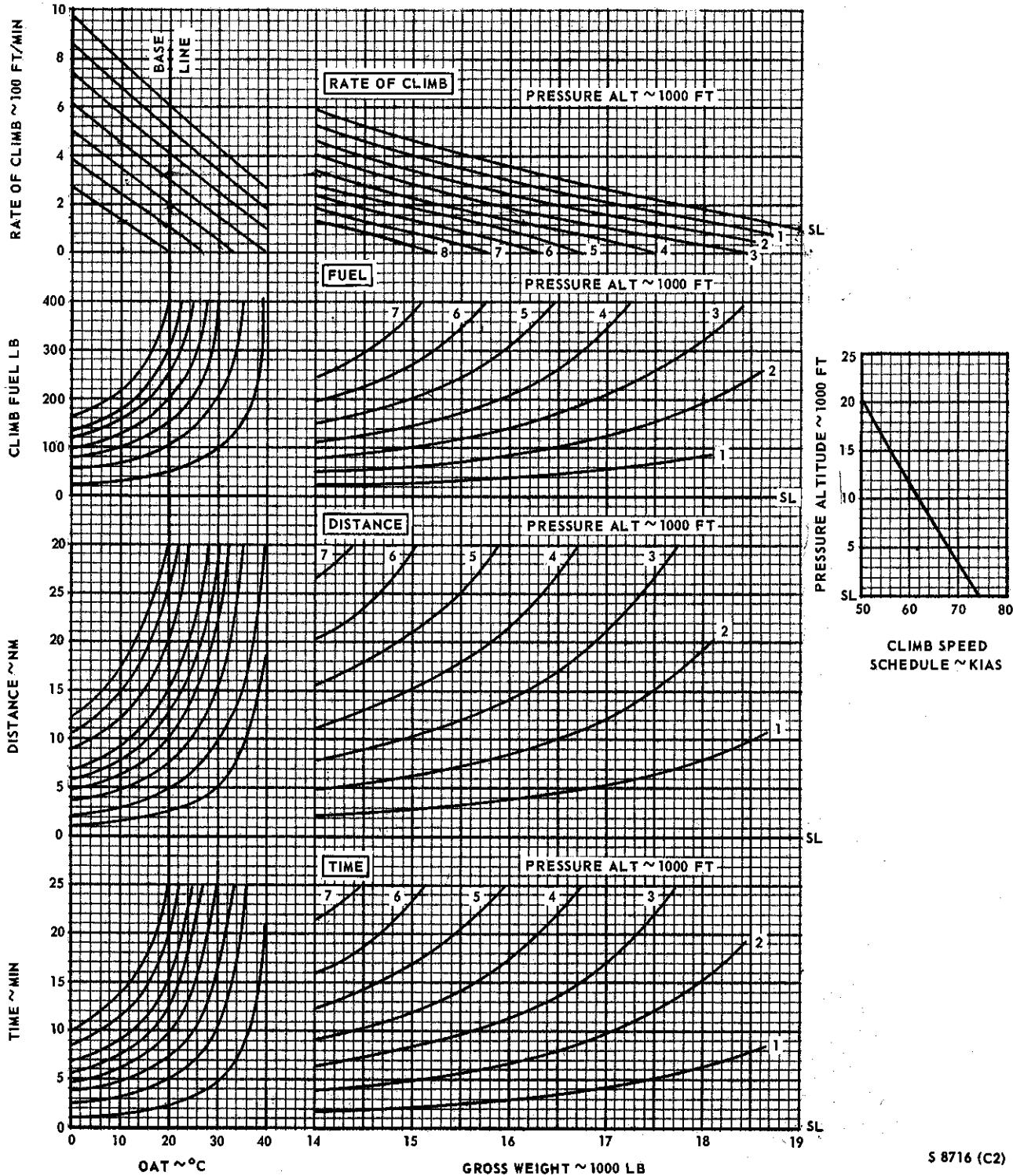
**ENGINE**  
**T58-GE-5**

DATE: 15 APRIL 1971

#### **DATA BASIS: FLIGHT TEST (AIR FORCE)**



**CONDITIONS:**  
103% N,  
**MILITARY POWER**  
**WARM UP AND TAKE OFF**  
**FUEL NOT INCLUDED**  
**ZERO WIND**  
**FOD SHIELD ON OR OFF**



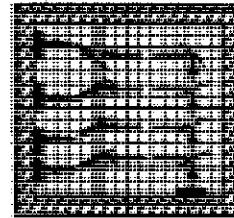
S 8716 (C2)

**Figure A-22. Climb - Military Power (0° to 40°C OAT) - One Engine**

**T.O. 1H-3(H)P-1**

**CONDITIONS:**

103% N<sub>T</sub>  
**MILITARY POWER**  
WARM UP AND TAKE OFF  
FUEL NOT INCLUDED  
ZERO WIND  
FOD SHIELD ON OR OFF



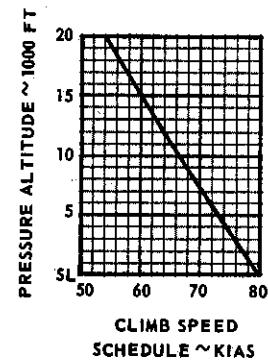
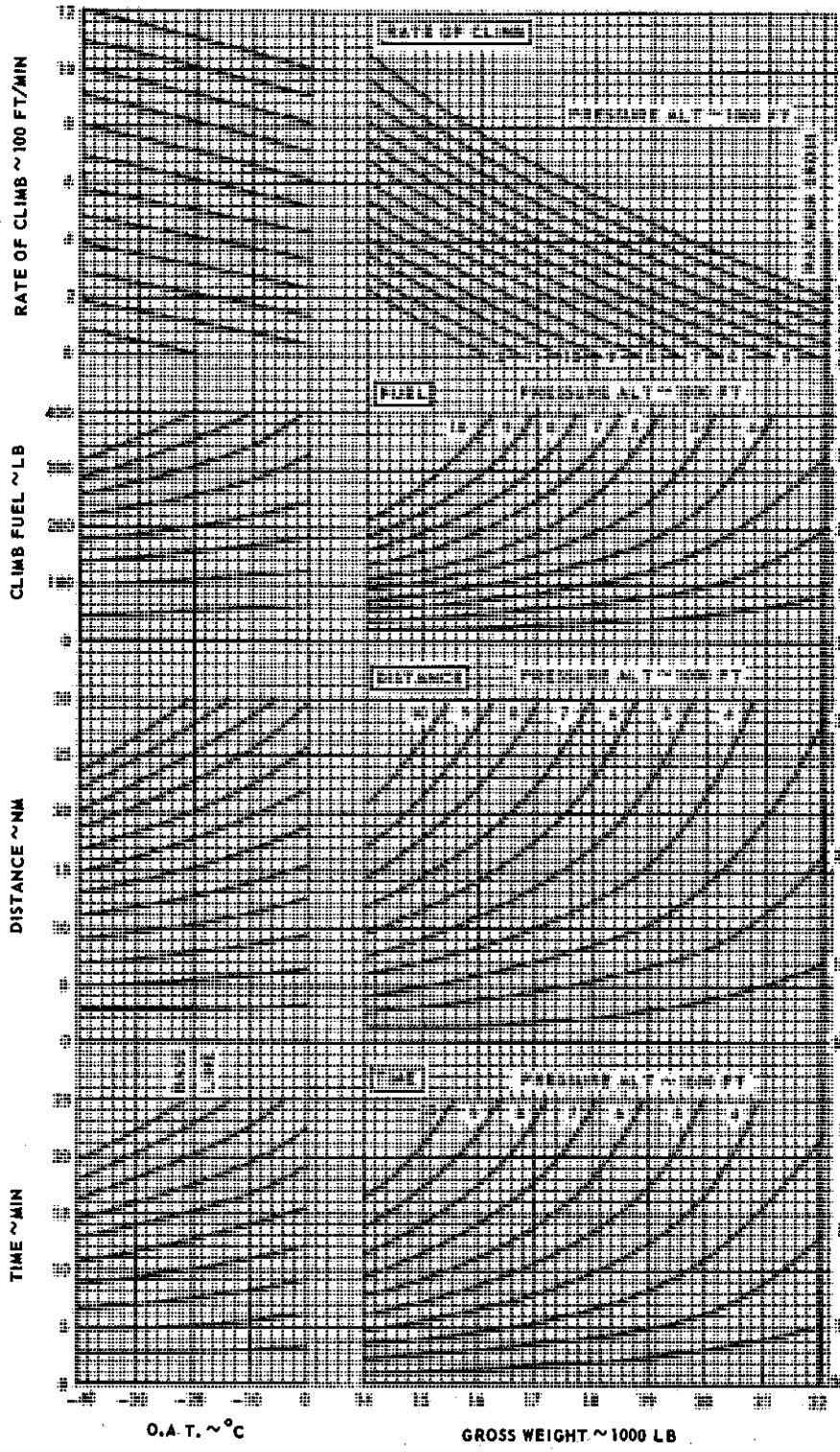
**CLIMB**  
**ONE ENGINE**  
**COLD DAY**

**MODEL**  
**HH-3F**

**ENGINE**  
**T58-GE-5**

**DATE: 15 APRIL 1971**

**DATA BASIS: FLIGHT TEST (AIR FORCE)**



S 8717 (C2)

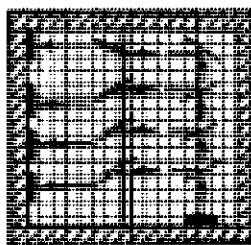
**Figure A-23. Climb - Military Power (-40° to 0°C OAT) - One Engine**

## CLIMB

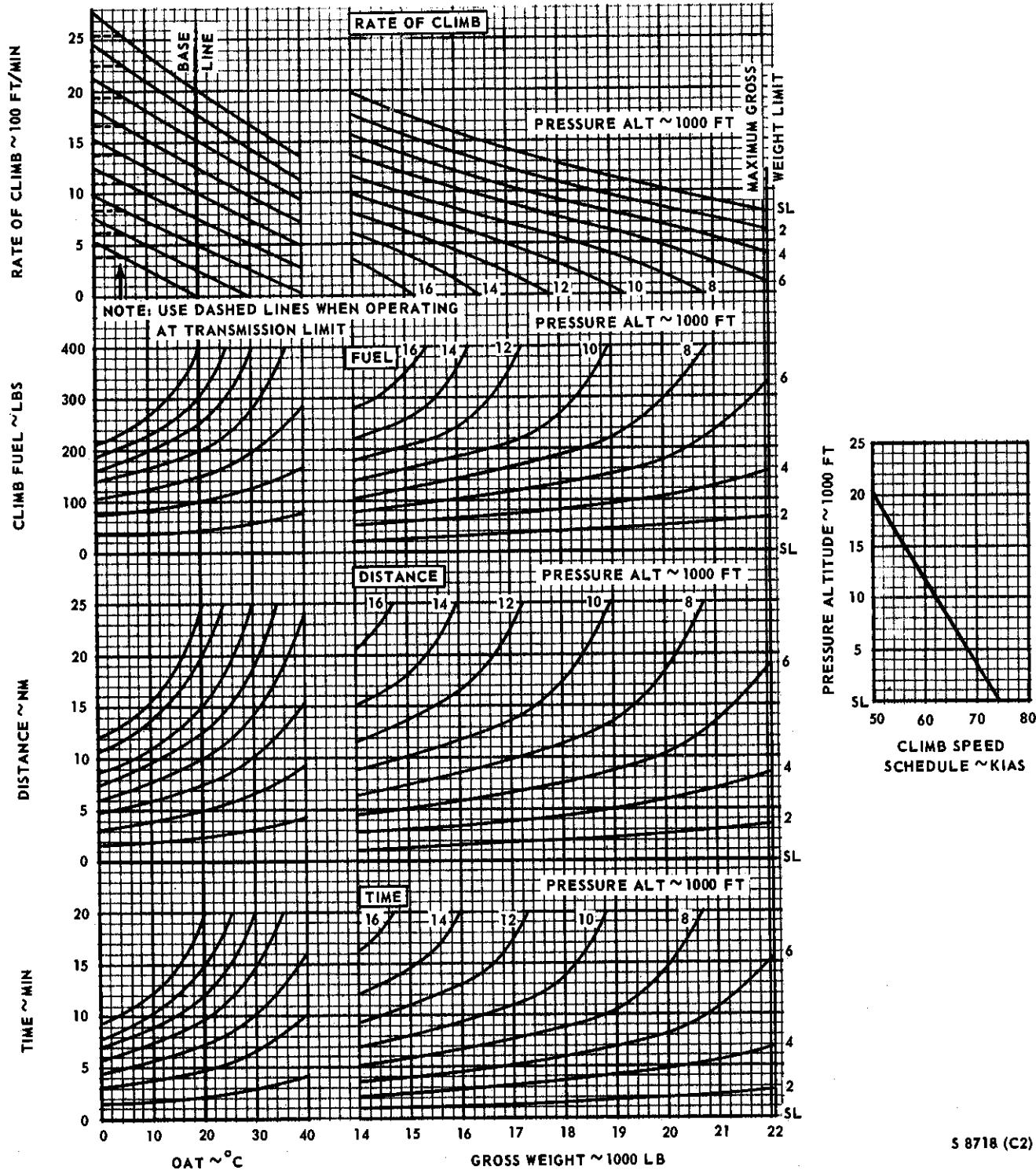
TWO ENGINES  
WARM DAYMODEL  
HH-3FENGINE  
T58-GE-5

DATE: 15 APRIL 1971

DATA BASIS: FLIGHT TEST (AIR FORCE)



CONDITIONS:  
 103% N,  
 MAXIMUM CONTINUOUS POWER  
 WARM UP AND TAKE OFF  
 FUEL NOT INCLUDED  
 ZERO WIND  
 FOD SHIELD ON OR OFF  
 TRANSMISSION LIMIT IS  
 30 MIN AT 103% Q



S 8718 (C2)

Figure A-24. Climb - Maximum Continuous Power (0° to 40°C OAT) - Two Engines

## CONDITIONS

103% N<sub>r</sub>

MAXIMUM CONTINUOUS POWER

WARM UP AND TAKE OFF

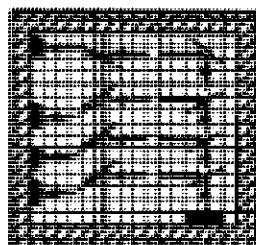
FUEL NOT INCLUDED

ZERO WIND

FOD SHIELD ON OR OFF

TRANSMISSION LIMIT IS

30 MIN AT 103% Q



CLIMB

TWO ENGINES  
COLD DAYMODEL  
HH-3FENGINE  
T58-GE-5

DATE: 15 APRIL 1971

DATA BASIS: FLIGHT TEST (AIR FORCE)

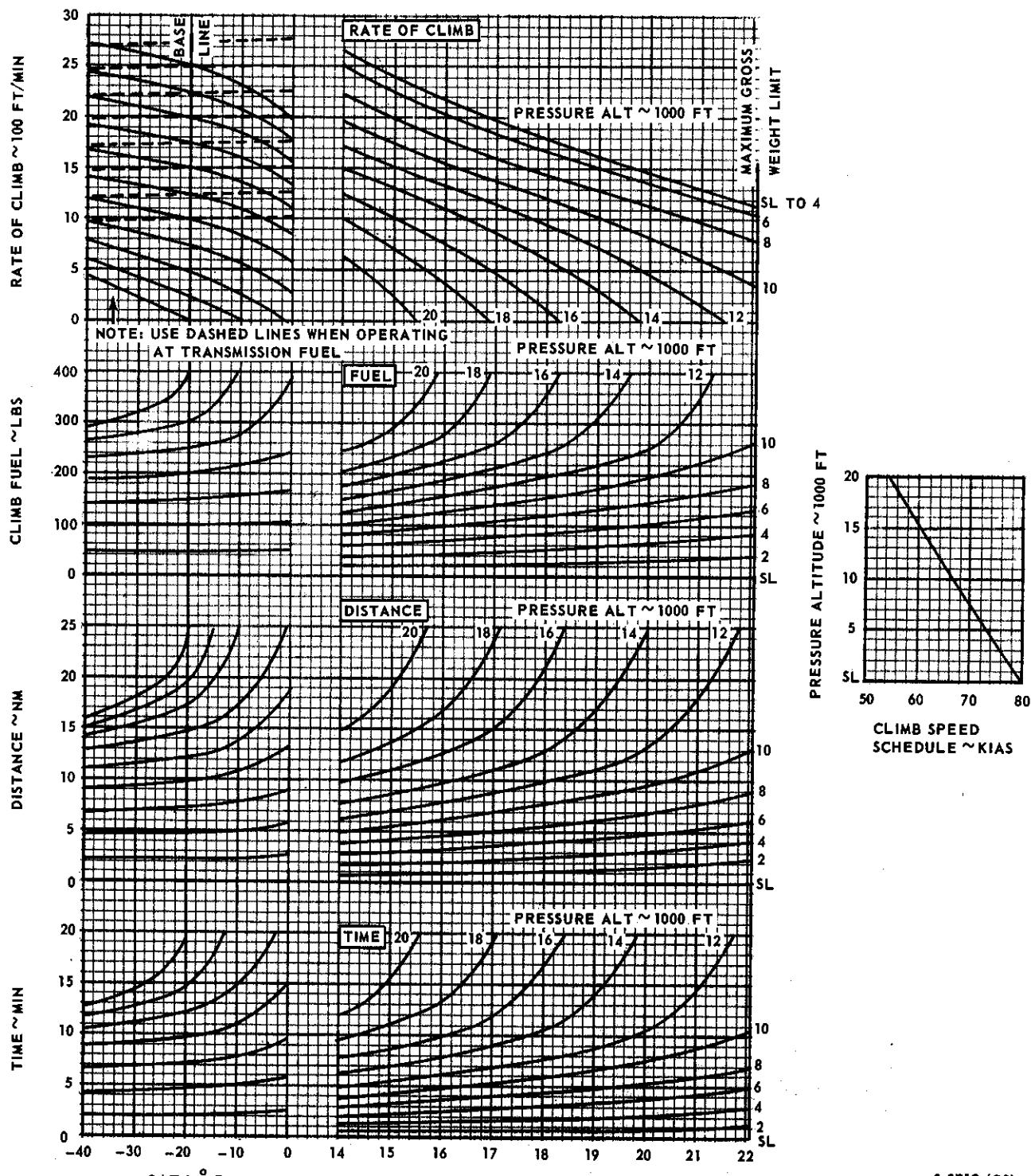
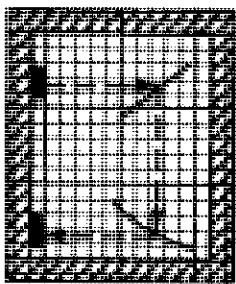


Figure A-25. Climb - Maximum Continuous Power (-40° to 0°C OAT) - Two Engines

S 8719 (C2)

CONDITIONS:  
103%  $N_r$ ,  
ZERO WIND  
FOD SHIELD ON OR OFF



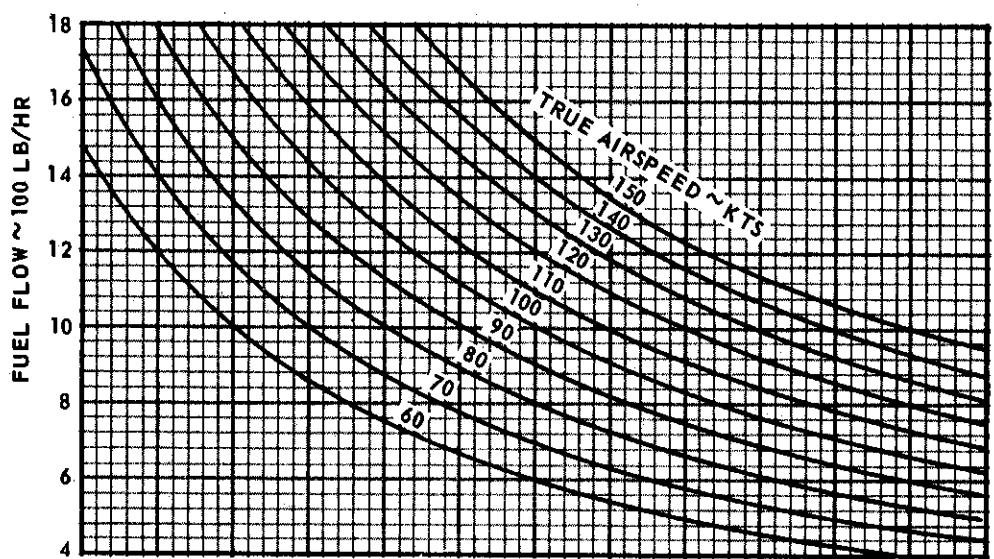
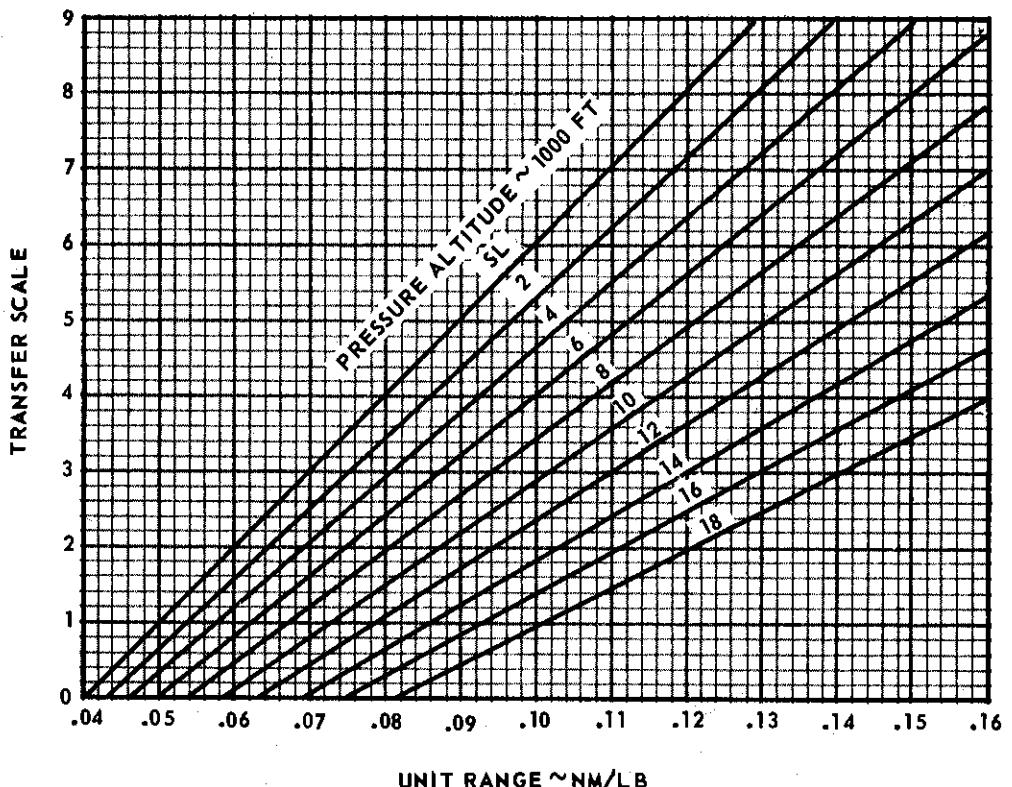
## CRUISE

OAT BETWEEN  $-40^{\circ}\text{C}$  AND  $20^{\circ}\text{C}$   
ONE ENGINE

MODEL  
HH-3F

ENGINE  
T58-GE-5

DATE: 15 APRIL 1971  
DATA BASIS: FLIGHT TEST (AIR FORCE)



S 23152.2 (C2)

Figure A-33. Cruise ( $-40^{\circ}$  to  $20^{\circ}$  OAT) - One Engine (Sheet 2 of 2)

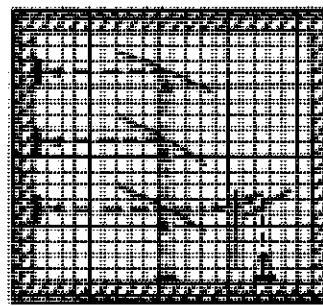
## SINGLE ENGINE CAPABILITY

ONE ENGINE

MODEL  
HH-3FENGINE  
T58-GE-5

DATE: 15 APRIL 1971

DATA BASIS: FLIGHT TEST (AIR FORCE)



CONDITIONS:  
70 KTS IAS  
MILITARY POWER  
103% NR  
FOD SHIELD  
ON OR OFF  
LANDING GEAR UP

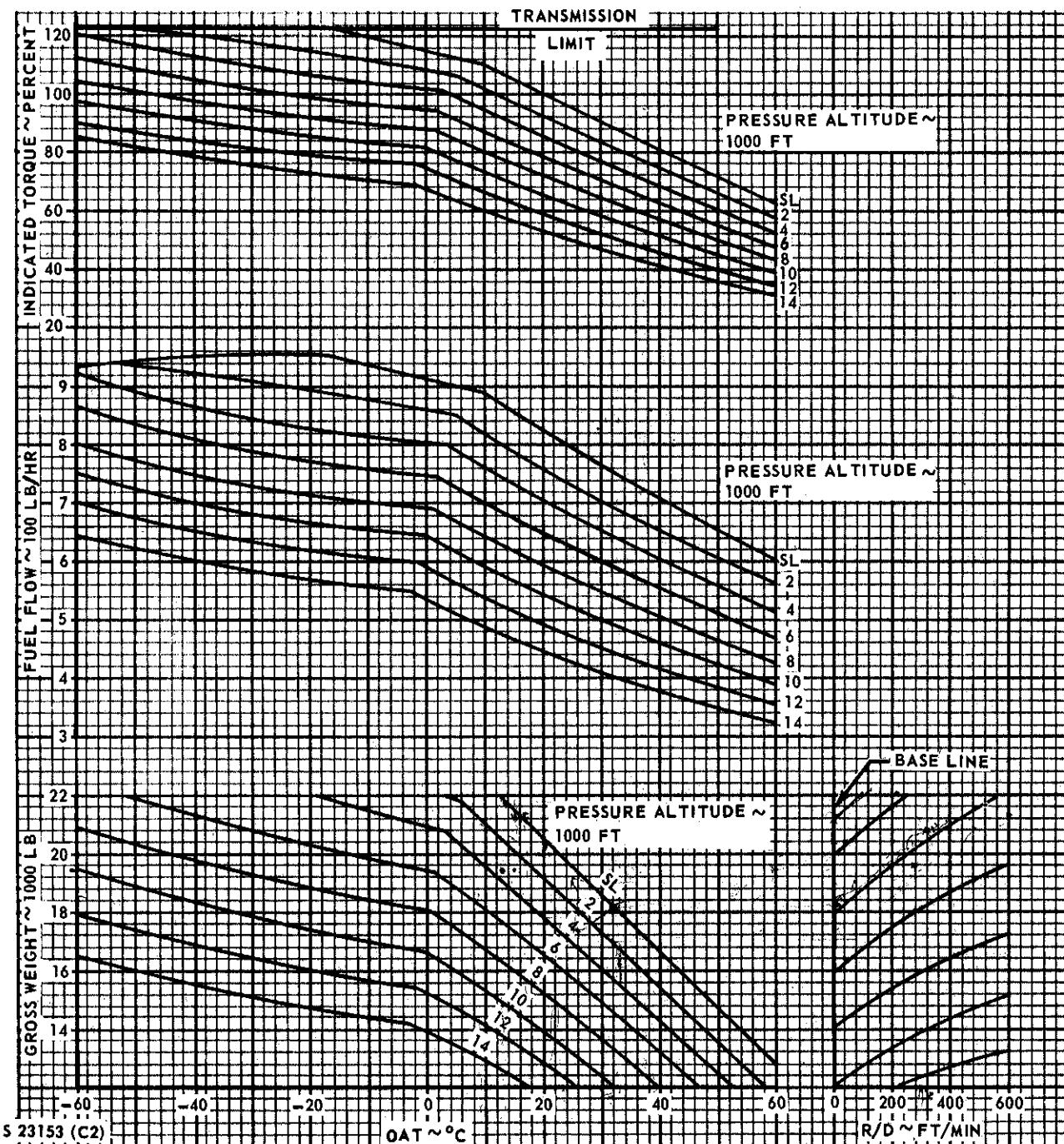
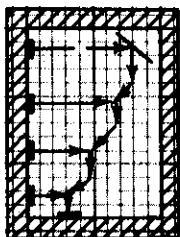


Figure A-34. Single Engine Capability - Military Power - One Engine



## BLADE STALL

## MODEL

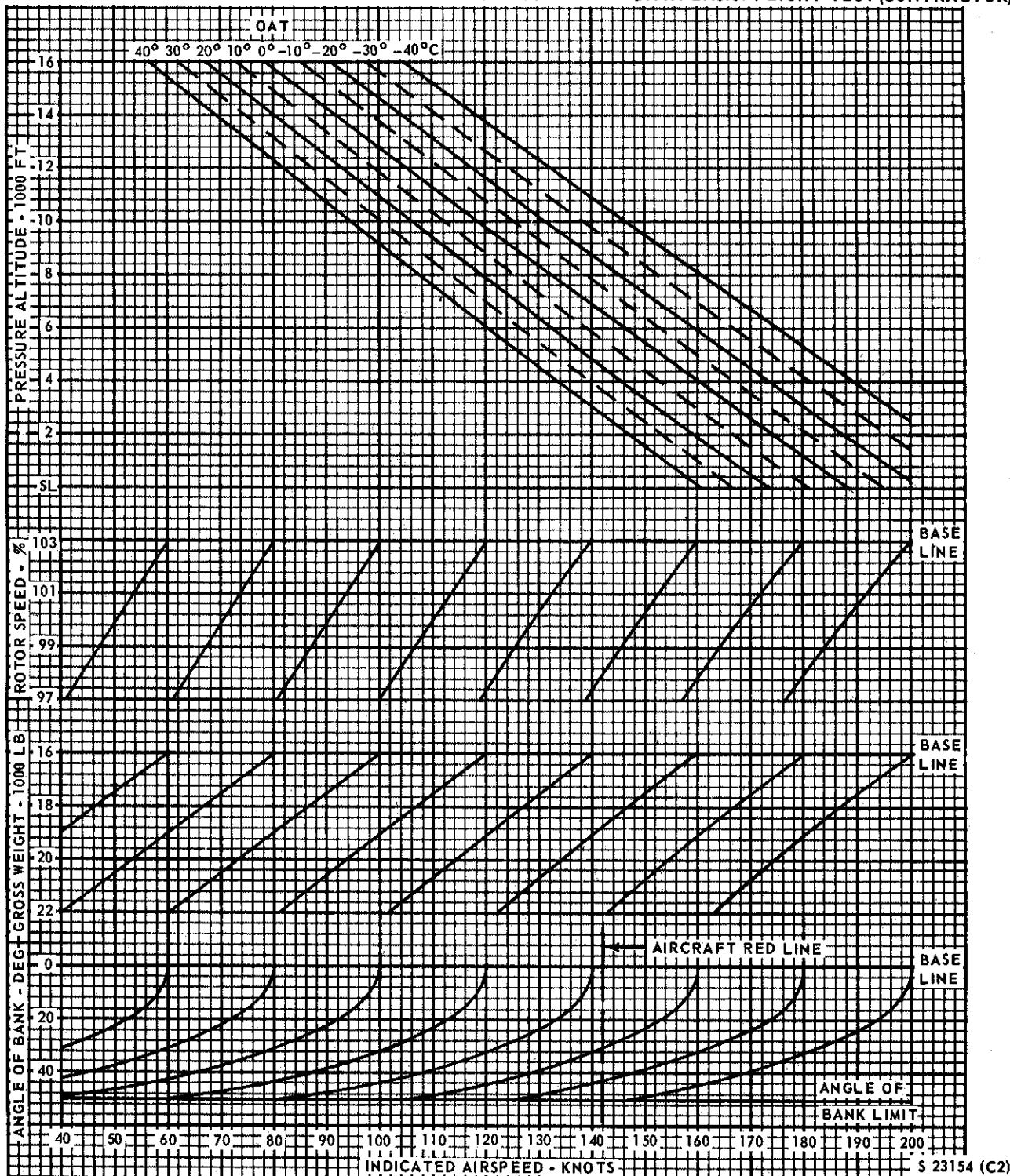
## ENGINE

HH-3F

T58-GE-5

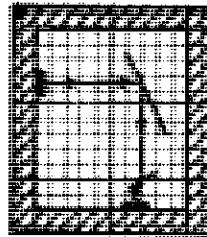
DATE: 15 APRIL 1964

**DATA BASIS: FLIGHT TEST (CONTRACTOR)**



**Figure A-35. Blade Stall**

## MAXIMUM AIRSPEED

MODEL  
HH-3FENGINE  
T58-GE-5

DATE: 1 DECEMBER 1967

DATA BASIS: ESTIMATED

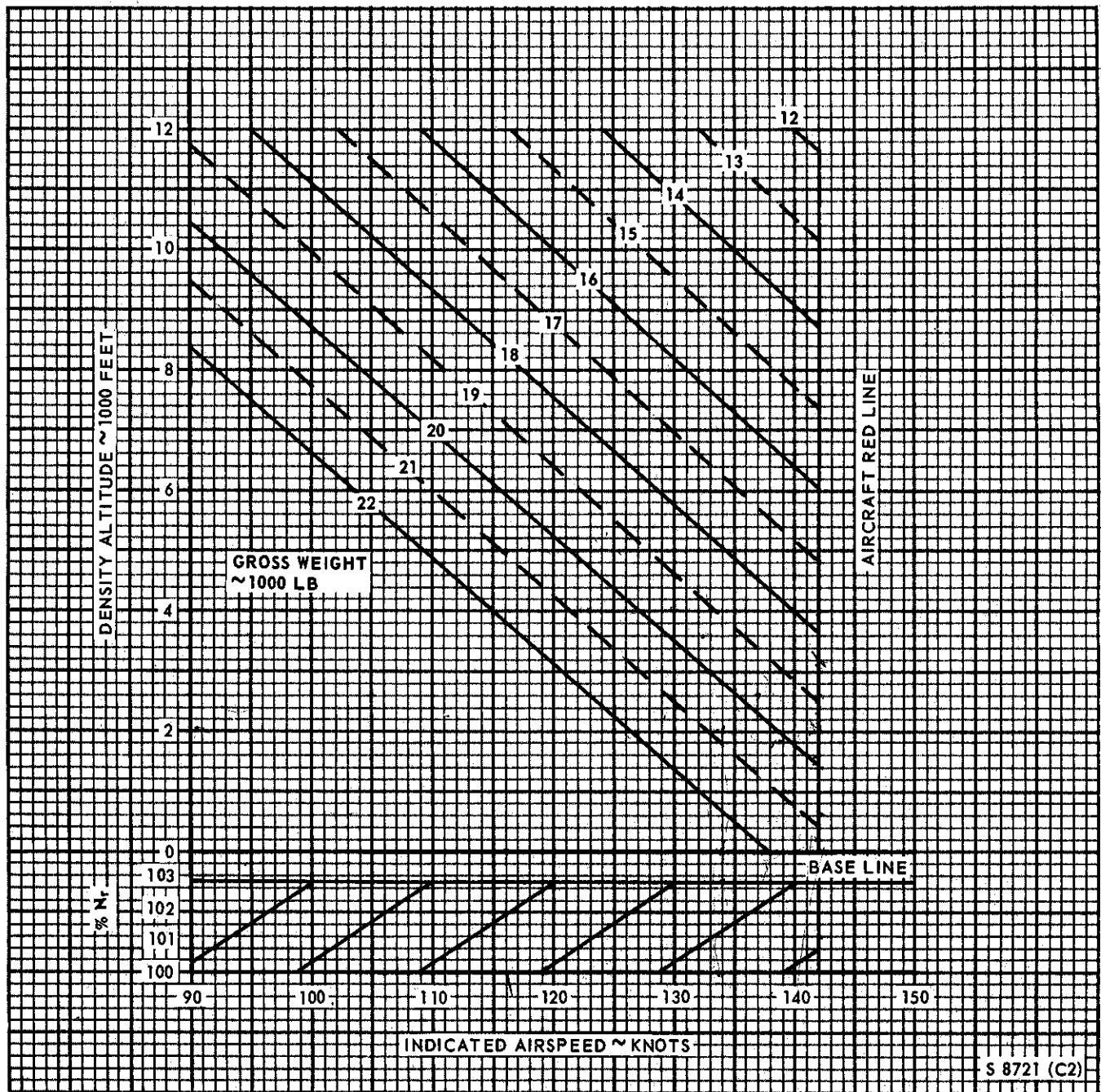
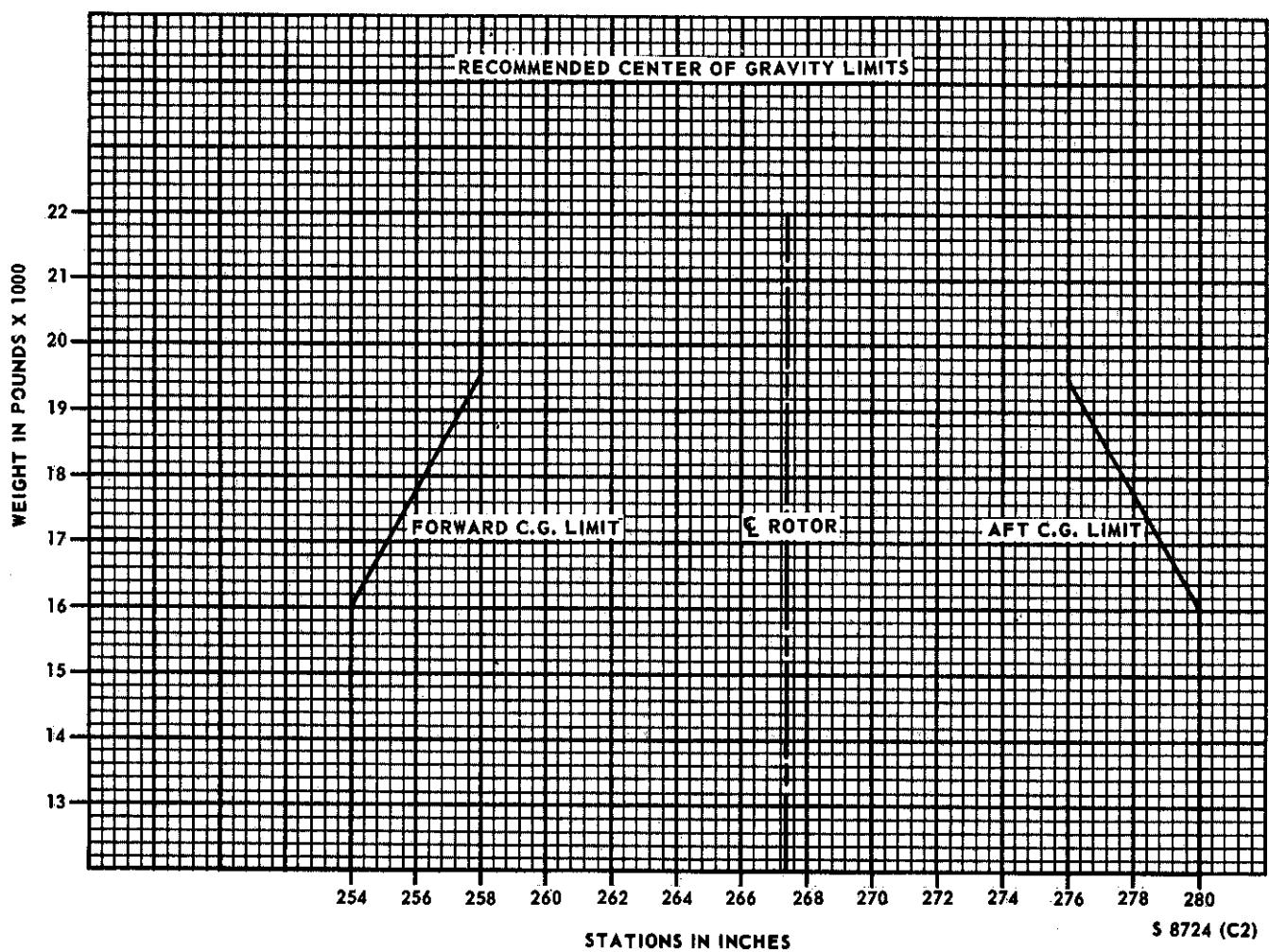
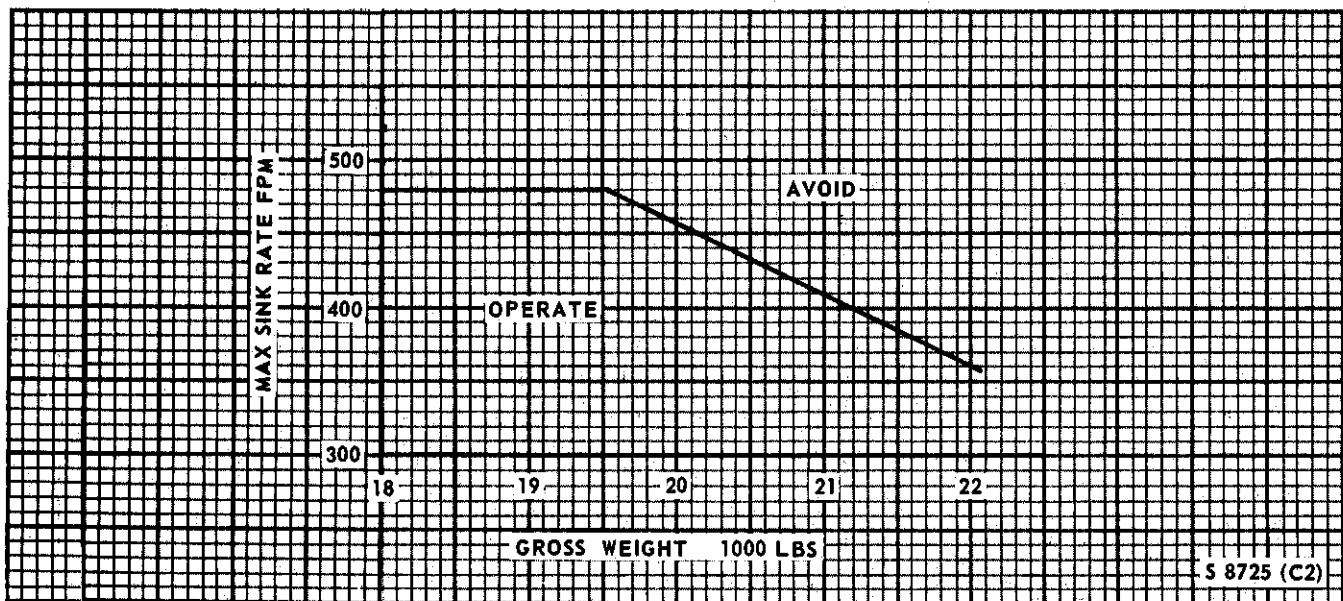
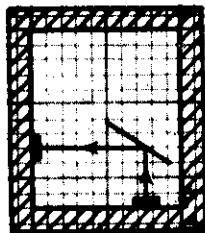
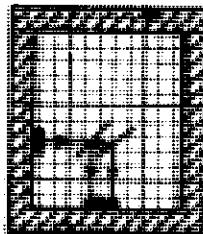


Figure A-36. Maximum Airspeed

**CENTER OF GRAVITY  
LIMITATIONS****Figure A-37. Center of Gravity Limitations Chart**

**MAXIMUM SINK RATE  
ON LANDING****Figure A-38. Maximum Sink Rate on Landing Chart**

CONDITIONS:  
212 ROTOR RPM  
104% ROTOR SPEED



## MAXIMUM AUTOROTATIVE GLIDING DISTANCE

MODEL  
HH-3F

ENGINE  
T58-GE-5

DATE: 1 DECEMBER 1967  
DATA BASIS: ESTIMATED

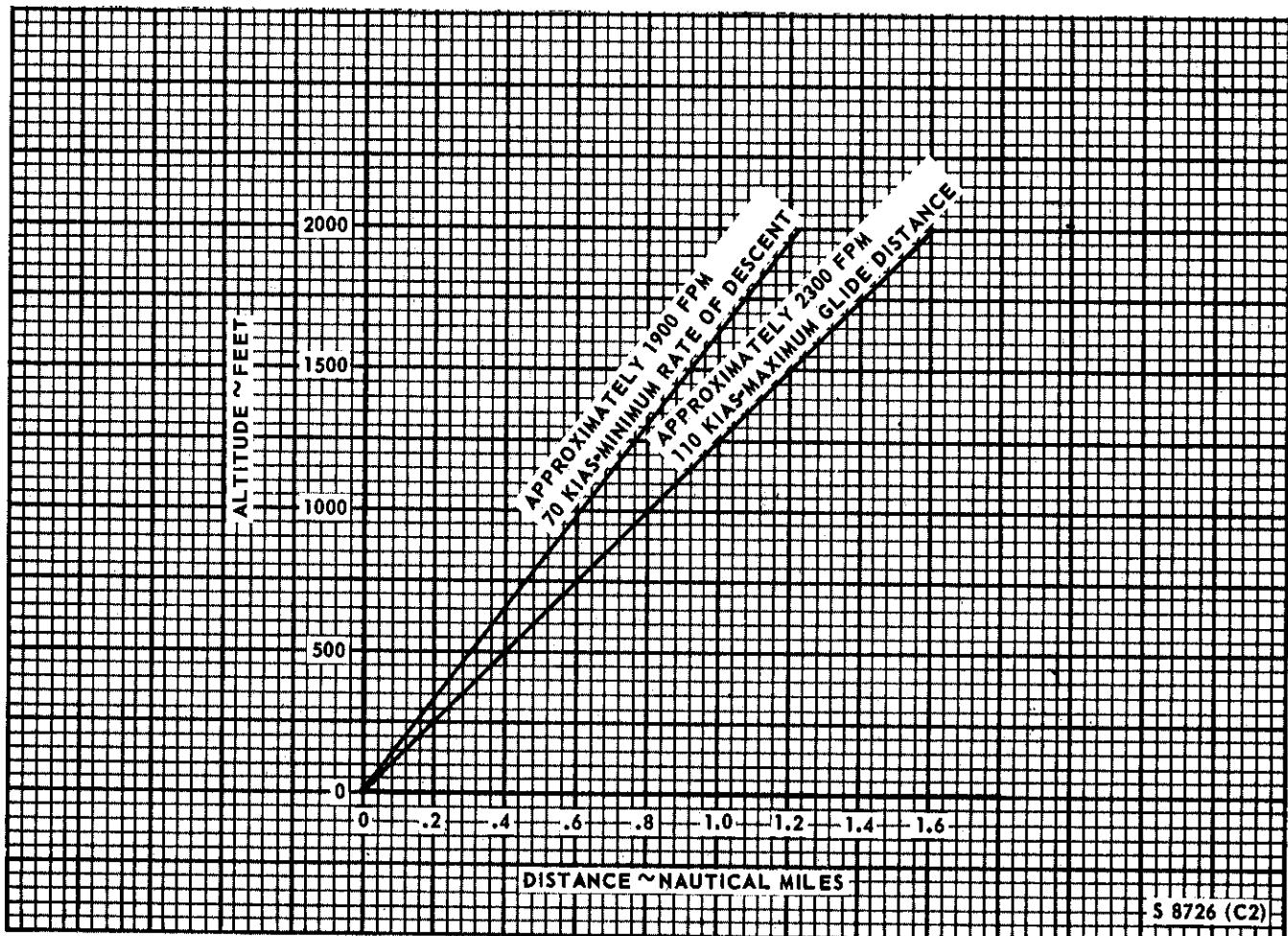


Figure A-39. Maximum Autorotative Gliding Distance

## TAKEOFF AND LANDING DATA CARD HH-3F

HELO NO. \_\_\_\_\_

DATE \_\_\_\_\_

MISSION \_\_\_\_\_

DATA

TAKEOFF/LANDING

FIELD ELEVATION \_\_\_\_\_ FT

PRESSURE ALTITUDE \_\_\_\_\_ FT

FREE-AIR TEMP \_\_\_\_\_ C

WIND \_\_\_\_\_ KT

DENSITY ALTITUDE \_\_\_\_\_ (Figure A-1) FT

OPERATING WT \_\_\_\_\_ LB

EXTRA CREW/EQUIP \_\_\_\_\_ LB

FUEL \_\_\_\_\_ LB

MISSION GROSS WT \_\_\_\_\_ LB

POWER AVAILABLE SE/DE \_\_\_\_\_ %Q

POWER REQ HIGE SFT \_\_\_\_\_ (Figures A-9, A-11) %Q

POWER RESERVE \_\_\_\_\_ %Q

MAX GROSS WT HOGE \_\_\_\_\_ (Figures A-8, A-10) LB

POWER REQ HOGE  
MISSION GROSS WT \_\_\_\_\_ (Figures A-9, A-11) %Q

SINGLE - ENGINE CLIMB \_\_\_\_\_ (Figures A-22, A-23, and A-34) FPM

MAX AIRSPEED MISSION GWT \_\_\_\_\_ (Figure A-36) KT

## FUEL LOG

TIME						
FA						
FM						
AA						
AM						
TOT						

DESTINATION	1	LAT	LONG	VAR
	2			
	3			
	4			

SRCH TYPE \_\_\_\_\_

IP \_\_\_\_\_

CSE \_\_\_\_\_ LG 1 \_\_\_\_\_ LG 2 \_\_\_\_\_

ETA ON SCENE \_\_\_\_\_

ESTIMATED TIME TO COMPLETE SRCH \_\_\_\_\_

ON SCENE ENDURANCE \_\_\_\_\_

ON SCENE WX: \_\_\_\_\_

S 8728 (C2)

Figure A-40. Takeoff and Landing Data Card

## ALPHABETICAL INDEX

<b>Subject</b>	<b>Page</b>	<b>Subject</b>	<b>Page</b>
Abbreviated Checklist.....	2-22	Attitude Indicator AN/AYN-2.....	4-91
Acceleration Limits.....	5-9	F 4-92	
AC Electrical Systems Schematic Diagram.....	FO-6	Automatic Flight Control (AFCS) and Coupler Systems.....	1-33
AC Utility Receptical.....	4-30	Automatic Flight Control System (AFCS).....	1-33
ADAPTS (Air Deliverable Anti-Pollution Transfer System).....	2-52,4-25	Autorotative Landings - Land.....	3-10
ADAPTS Equipment.....	F 2-53	Autorotative Landings - Water.....	3-11
ADAPTS Handling Equipment.....	F 2-55	Autotransformer Failure.....	3-27
ADF/VOR and TACAN Approaches	F 2-54	Auxiliary Equipment.....	1-46
ADF, VOR Approach (Normal and Single Engine).....	9-3	Auxiliary Flotation Collars.....	4-14
ADF/VOR TACAN Approaches.....	F 9-4	Auxiliary Flotation Equipment.....	F 4-14
AFCS Equipment.....	9-3	Auxiliary Power Unit.....	4-11
AFCS Malfunctions.....	FO-11	F 4-12	
After Landing Checklist.....	3-18	Avionicsman Duties.....	8-2
After Takeoff Checklist.....	2-24	Axe, Crash.....	3-35
AIMS/IFF Transponder AN/APX-72.....	2-21		
Airspeed Calibration Chart.....	4-49	<b>B</b>	
Airspeed Effects on Power Available and Fuel Flow Chart.....	F 4-50	Bailout.....	3-32
Airspeed Limitations.....	A-2	Battery Overtemperature.....	3-27
AN/ASN-50 OFF/Gyro Fast Erect Panel.....	F A-13	Battery Thermal Runway.....	3-27
Alternating Current Power Supply System.	A-4	Beacon, Underwater Acoustic.....	4-32
Altimeter AAU-24/A.....	F A-18	Before Landing.....	2-22
Altimeter-Encoder AAU-21/A or AAU-32/A	5-9	Before Starting Engines.....	2-2
Anchor.....	F 5-9	Before Takeoff.....	2-16
Anchor, Sea.....	1-37	Before Taxi.....	2-13
Antennas and Avionics.....	F 1-37	Bilge Pump.....	4-33
Anti-Icing Systems.....	1-24	F 4-34	
APU Accumulator Hand Pump.....	1-36	Blade Stall.....	6-2
APU Compartment Fire.....	F 1-37	Blade Stall Chart.....	A-10
APU Control Panel.....	1-35	F A-53	
APU Fire Extinguishing System.....	F 1-35	Boost Pump Failure.....	3-22
Ash Trays.....	4-31	Brake System.....	1-42
Attitude and Heading Reference System	F 2-14	Briefings.....	2-2
	FO-11		
	4-3	<b>C</b>	
	F 4-14	Cabin.....	F 4-6
	3-30	Cabin Equipment.....	4-15
	4-12	Cargo Door.....	4-22
	F 4-12	Cargo Loading Data.....	F 4-35
	1-45	Cargo Loading Stations.....	4-15
	4-30	Cargo Sling, External.....	4-25
	F 1-37	Cargo Sling Operations.....	2-43
	4-3	Cargo Sling System, Low Response.....	F 4-27
	3-30	Caution - Advisory Lights Test Switch.....	1-39
	4-12	Caution - Advisory Panel.....	1-38
	F 4-12	Center of Gravity Limitations.....	5-9
	1-45	A-11	
	4-30	F A-55	
	F 1-37	Channel Monitor Panel.....	1-34
		Checklist Responses.....	2-2
		Checklists.....	2-2,4-28

<b>Subject</b>	<b>Page</b>	<b>Subject</b>	<b>Page</b>
Circuit Breaker Panels.....	FO-8	Dual Engine Failure.....	3-10
Climb Charts.....	A-8	Dual Engine Failure While Hovering.....	3-10
Clocks.....	1-35		
Cockpit Arrangement.....	F 1-43		
Cockpit Canopy Shades.....	4-30		
Cockpit Control Panels, Lower .....	FO-9		
Cold Hangup.....	3-2,7-2		
Cold Weather Procedures .....	9-11	E	
Collective Bounce (Collective Resonance)...	6-4	Electrical Fire.....	3-31
Collective Pitch Lever Grip.....	F 1-8	Electrical Power Supply System.....	1-24
Combustion Chamber.....	1-5	Electrical Power Supply System .....	
Communication and Associated Electronic Equipment.....	4-38	Malfunctions.....	3-23
Compressibility Effect.....	A-2		
Compressor, Engine.....	1-4	Electrical System, AC .....	FO-6
Compressor Stalls, Engine .....	3-4,7-2	Electrical System, DC .....	FO-7
Converter Failure .....	3-26	Electronic Equipment .....	F 4-39
Coordination of Flight Controls.....	6-4	Emergency Entrances and Exits.....	1-45,3-34
Coupled Hover Procedures .....	2-41		
Coupler System.....	1-33	FO-10	
Course Indicator AN/AYN-2 .....	F 4-95	Emergency Equipment .....	3-35
	4-93		
Crew Briefing Guide.....	F 4-96	FO-10	
Crew Coordination .....	8-2	Emergency Fuel Control Levers .....	1-7
Crew Duties .....	8-3	Emergency Water Landing Procedure .....	3-32
Crew Seats.....	8-1	Engine Air Inlet and IGV Anti-Icing Systems.....	4-4
Crewman's Safety Harness .....	1-45	Engine and APU Compartment Fire Detection Systems.....	1-42
Crosswind Landing.....	4-29	Engine Compartment Fire .....	3-30
Crosswind Takeoffs.....	2-24	Engine Compartment Fire Extinguishing Systems.....	1-44
Cruise.....	2-19	Engine Control System .....	7-1
Cruise Charts.....	2-21	Engine Controls .....	F 1-7
Cyclic Stick Grip .....	A-9	Engine Cutaway View .....	F 1-3
	F 1-30	Engine Failure, Dual .....	3-10
		Engine Fuel Control System Operation .....	7-4
		Engine Fuel System .....	1-5
			F 1-6
		Engine Instruments .....	1-11
Damper Malfunction, Main Rotor .....	3-15	Engine, Main Gear Box, and APU Installation .....	F 1-4
Danger Area .....	F 2-10	Engine Malfunctions .....	3-3
Density Altitude Chart.....	A-2	Engine Malfunctions During Start .....	3-2
Desert Procedures .....	F A-12	Engine Malfunctions Resulting In Apparent Loss of Power .....	3-4
Dimensions.....	9-15	Engine Oil Pressure Failure .....	3-3
Direct Current Power Supply System.....	1-2	Engine Oil System .....	1-16
DC Electrical System Schematic Diagram .....	1-26		
DC Utility Receptical .....	FO-7	F 1-16	
Direction Finder Group AN/ARA-25 (UHF/VHF/ADF) System.....	4-30	Engine Post Shutdown Fire .....	3-31
Doppler Controls AN/APN-175(V)-1 .....	4-51	Engine Restart During Flight .....	3-6
Doppler Radar AN/APN-175(V)-1 .....	F 4-62	Engine Shutdown Procedures .....	3-2
Droop, Nf .....	4-61	Engine Speed Trim Malfunction .....	3-4
	7-2	Engine Speed Trim Switches .....	1-7
		Engine Start With APU Inoperative .....	2-56

<b>Subject</b>	<b>Page</b>	<b>Subject</b>	<b>Page</b>	
Engine Starting .....	7-4	Fuel Low Level Caution Lights.....	1-23	
Engine Starting Procedures.....	2-9	Fuel Low Pressure Caution Lights.....	1-22	
Engine Starting System.....	F 1-9	Fuel Quantity Data .....	F 1-21	
Engine Starting, Warm-Up, and Ground Tests, Hot Weather .....	9-15	Fuel Quantity Gages and Test Switches .....	1-22	
Engines.....	1-2,7-1	Fuel Shutoff Valve Switches .....	1-22	
Equipment Limitations .....	5-10	Fuel Supply System.....	1-18	
Exterior Inspection.....	2-2	Fuel Supply System Malfunctions.....	3-22	
Exterior Lights.....	F 2-3	Fuel System.....	7-6	
External Cargo Sling .....	4-7	Fuel System Operation, Table .....	F 7-7	
External Power.....	4-25	Fuel System Management.....	7-6	
	1-27	Fuel System Schematic Diagram.....	FO-5	
		Fuel Tanks.....	1-19	
		Fuel Transfer.....	1-23	
		Fuselage Fire.....	3-31	
<b>F</b>				
Failure of the Nf Flex Shaft .....	3-6	<b>G</b>		
Fire.....	3-30	Gas Generator Speed (Ng).....	1-5,5-6	
Fire Detection Systems .....	1-42	Gas Generator Turbine .....	1-5	
Fire Extinguishers, Portable.....	3-35	General Arrangement and Dimension Diagram.....	FO-1	
Fire Extinguishing Systems.....	1-44	Generator Failure.....	3-23	
First Aid Kit .....	3-35	Glide Slope Receiver GSA-8A-1 .....	4-54	
Flameout.....	3-6	Glossary of Terms and Abbreviations .....	iii	
Flight Control Hydraulic Servo System Failure .....	3-16	Go-Around .....	2-24	
Flight Control Hydraulic Systems.....	1-31	Go-Around Diagram .....	F 2-25	
Flight Control Servo Unit Malfunction .....	F 1-32	Ground Clearances (Normal and Kneeled) .....	F 1-41	
Flight Control Hydraulic Servo System Failure .....	3-16	Ground Roll .....	6-5	
Flight Control Servos .....	6-3	Gyro System Malfunctions.....	3-20	
Flight Control System .....	1-27	<b>H</b>		
Flight Controls .....	6-3	Heating and Ventilating Diffusers .....	4-3	
Flight Director AN/AYN-2 .....	4-89	Heater Blower Switch.....	4-3	
Flight Mechanic Duties .....	8-1	Heater Switch .....	4-1	
Flight With External Loads.....	6-6	Heating System.....	4-1	
Flotation System, Auxiliary .....	4-13	F 4-2		
Formation Flight.....	2-42	Height Velocity Diagrams .....	A-6	
Free Air Temperature Gage.....	1-35	F A-23		
Free Power Turbine Speed (Nf).....	1-5	F A-24		
Fuel Boost Pump Failure.....	3-22	Helicopter, The .....	1-1	
Fuel Boost Pumps .....	1-19	Helicopter Vibration.....	6-4	
Fuel Control Scheduling.....	7-1	HF/COMM Radio Set AN/ARC-94.....	4-48	
Fuel Control System Malfunction .....	3-5	F 4-48		
Fuel Crossfeed Valve Switch .....	1-22	HF/COMM Control Advisory Light.....	F 4-48	
Fuel Dump Procedures .....	3-23	HF/COMM Switch Panel.....	F 4-48	
Fuel Dump System .....	1-23	High Speed (Power Turbine) Shaft Failure .....	3-5	
Fuel Filter Bypass Caution Lights.....	1-23	Hot Cup Receptacle.....	4-30	
Fuel, Fuel Control and Divider Settings Vs Type Start to Expect Chart (Initial Starts Only).....	7-6			

<b>Subject</b>	<b>Page</b>	<b>Subject</b>	<b>Page</b>
Hot Refueling Operations.....	2-58	Landing Gear Actuating System .....	1-39
Hot Starts.....	3-2	Landing Gear Alternate Extension System.....	1-42
Hot Weather Procedures .....	9-15	Landing Gear Control Panel .....	F 1-42
Hover Indicator .....	4-62	Landing Gear Emergencies.....	3-28
	F 4-63	Landing Gear Hydraulic System.....	F 1-40
Hovering.....	2-19	Landing Gear Limitations.....	5-10
Hovering Charts.....	A-5	Landing Gear System.....	1-39
	I	Level Flight Characteristics .....	6-1
IBIS Indicator.....	F 1-13	LF Automatic Direction Finders Set (LF/ ADF) (AN/ARN-89A) .....	4-56
IBIS Pressure Warning .....	3-15		F 4-56
Ice Shield, Engine Inlet .....	4-28	Lighting Equipment .....	4-5
Icing, Inflight.....	9-10	Lighting System .....	F 4-8
ICS Coordination .....	8-3	Lights, Exterior.....	4-7
Ignition System.....	1-10	Lights, Interior.....	4-5
ILS Approach (Normal and Single Engine).....	F 9-3	Load Adjuster .....	4-34
Inflight Flow Chart .....	FO-13		F 4-35
Inflight Icing.....	9-10	Load Adjuster Instructions .....	4-37
Instrument Flight Procedures.....	9-1	Load Adjuster Operation .....	4-36
Instrument Panel.....	FO-4	LORAN A Control and Indicator Panel .....	F 4-65
Instrument Range Markings.....	5-1	LORAN A Receiver AN/APN-180 .....	4-64
Instruments.....	1-35	Loss of Engine Oil.....	3-3
Intercommunication System (ICS) AN/ AIC-18 .....	4-38	Low Frequency Vibrations .....	6-4
Interior Arrangement Diagram .....	FO-2	Low Fuel Pressure Caution Lights .....	1-22
Interior Inspection.....	2-2	Low Hover Spray Patterns .....	F 2-28
Interior Lights.....	4-5	Lube Pump Shaft Failure .....	3-3
Intermediate and Tail Gear Box Caution			
Lights Illumination of.....	3-13		
Intermediate and Tail Gear Box Oil			
Systems.....	1-18	M	
Intermediate Gear Box.....	1-15	Magnetic Compass .....	1-35
	J	Main Gear Box .....	1-15
Jump Seat .....	1-46	Main Gear Box Failure Imminent .....	3-12
	K	Main Gear Box Malfunction .....	3-11
Keyboard Selection Relationships Display		Main Landing Gear .....	1-39
Function.....	F 4-90	Main Rotor Damper Malfunction .....	3-15
	L	Main Rotor Flight Control System .....	1-29
Ladder, Cargo Door.....	4-30	Main Rotor System .....	1-12
Landing.....	F 2-24	Main Transmission with Auxiliary Sump .....	F 1-17
Landing, No Hover .....	2-24	Maneuvers .....	5-9
Landing In Trees.....	3-11	Map Case .....	4-29
		Map Display Cover .....	F 4-79
		Marker Beacon Receiver MKA-23A .....	4-54
		Master Caution Light .....	1-38
		Maximum Airspeed Chart .....	A-11
		Maximum Airspeed Table .....	F 5-8
		Maximum Autorotative Gliding	
		Distance .....	3-11,A-11
			F A-57
		Maximum Glide .....	3-11

<b>Subject</b>	<b>Page</b>	<b>Subject</b>	<b>Page</b>
Maximum Performance Take-Off (Restricted Area) .....	2-18	Practice Dual Engine Failure During Flight (Autorotation) .....	2-60
F Maximum Sink Rate on Landing Chart.....	2-20	Practice Emergency Fuel Control Lever Operations.....	2-60
A-11			
F Miscellaneous Equipment.....	A-56	Practice Dual Engine Failure During Flight.....	2-60
4-28		Practice Emergency Procedures.....	2-60
Mountain Flying.....	2-47	Practice Single-Engine Landings.....	2-60
		Practice Tail Rotor Control Linkage Failures.....	2-60
		Precision Approach to a Coupled Hover (PATCH).....	9-3
		F 9-8	
N Navaid Auxiliary Controls for VOR, ILS, TACAN, and ADF .....	4-53	Preflight Check.....	2-2
Navigation Computer Outline .....		Preparation for Flight.....	2-1
AN/AYN-1 .....	F 4-73	Pressure Defueling System .....	1-24
Navigation Computer Set AN/AYN-1.....	4-71	Pressure Refueling System.....	1-23
Navigation Radios and Sensors.....	F 4-72		
Nf Flex Shaft, Failure of .....	4-51		
Ng Tachometer Failure.....	3-6		
NIGHTSUN Searchlight Operation.....	3-4		
NIGHTSUN Searchlight.....	2-49		
No Hover Landing .....	F 4-9		
No Hover Takeoff .....	2-24	R	
	2-18		
Normal Approach .....	F 2-19	Radar Altimeter AN/APN-171(V).....	4-57
Normal Crew Assignments .....	2-22	F 4-58	
Normal Landing .....	8-1	Radar Approach (Normal and Single Engine).....	F 9-7
Nose Landing Gear.....	F 2-23	Radar Set AN/APN-195 .....	4-59
	1-39	F 4-59	
O		Radio Autotransformer Failure.....	3-26
Oil Supply Systems.....	1-16	Raft, Life.....	3-35
Overhead Switch and Lighting Panel .....	FO-3	Ramp Actuating Systems .....	F 4-20
		Ramp Control Panels .....	F 4-21
		Ramp Actuating System .....	F 4-20
		Ramp Control Panels .....	F 4-21
P		Ramp System .....	4-18
Parachute and Life Jacket Stowage.....	3-35	Ramp Uplock Release Levers .....	F 4-22
Passenger Briefing Guide.....	8-2	Range Markings .....	F 5-2
Performance Data .....	A-1	Rear View Mirrors .....	4-30
Pilot's Compartment Curtain.....	4-30	F 4-32	
Pitot Heaters.....	4-5	Relief Tubes .....	4-30
Pitot-Static System .....	1-35	Rescue Hoist .....	4-23
Power Available Charts .....	A-3	Rescue Hoist Controls .....	F 4-24
Power Available Check .....	7-2	Rescue Platform .....	4-31
Power Deterioration, Salt Water .....	2-27	Rescue Platform and Rear View Mirrors .....	F 4-32
Power Limitations .....	5-6	Rotor Blade Damage .....	3-16
F 5-7		Rotor Brake .....	1-14
Power Settling .....	6-3	F 1-14	
Power Turbine .....	1-5		
Power Turbine Inlet Temperature (T <sub>5</sub> ) .....	5-7		
Power Turbine Speed (N <sub>f</sub> ) Limits.....	5-6		
		Rotor Brake Caution Light, Illumination of .....	3-16

<b>Subject</b>	<b>Page</b>	<b>Subject</b>	<b>Page</b>
Rotor Engagement Chart.....	F 2-12	Stick Trim System Malfunctions.....	3-19
Rotor Engagement With APU Inoperative.....	2-57	Stowage Bag .....	4-28
Rotor Limitations.....	5-8	Supervisory Panel Malfunction .....	3-25
Rotor Systems .....	1-12		
Rough Area Operations.....	2-45		
Running Landing .....	2-24		
Running Takeoff.....	2-19		
	F 2-21		
		T	
		TACAN Approach (Normal and Single Engine).....	F 9-5
		TACAN Radio Set AN/ARN-52(V) (Tactical Air Navigation).....	4-54
		TACAN AN/ARN-52(V).....	F 4-55
		Tail Gear Box .....	1-16
		Tail Rotor.....	1-3
		Tail Rotor Control Linkage Failure.....	3-14
		Tail Rotor Control Linkage Failure, Practice.....	
		Tail Rotor Drive System Failure in Flight.....	2-60
		Tail Rotor Drive System Failure While Hovering.....	3-13
		Tail Rotor Flight Control System .....	1-30
		Tail Rotor Takeoff Freewheeling Failure .....	3-12
		Takeoff.....	2-17
		Takeoff Charts .....	A-7
		Taxiing .....	2-16
		Taxiing Instructions, Cold Weather .....	9-13
		Tie-Down Rings.....	4-30
		Tie Down Devices.....	4-18
		Tie Down Fittings.....	4-18
	F A-52		F 4-19
Service Ceiling Charts.....	A-9	Tip Sock Stowage.....	4-32
Servicing Diagram.....	F 1-20	Topping Check .....	7-3
Servo Hydraulic Pressure Failure.....	3-18	Topping Governor .....	7-1
Servo Unit Malfunction.....	3-16	Torquemeter(Q).....	5-7
Shipboard Helicopter Operations.....	2-60	Torquemeter System Malfunctions.....	3-12
Signal Light.....	4-30	Torquemeter Instrument Power Supply Failure .....	
Single Engine Capability Chart.....	A-9	Towing of Helicopter on Water.....	3-34
	F A-52	Traffic Pattern .....	2-22
Single Engine Failures.....	3-7	Transition to Forward Flight.....	2-21
Single Engine Failure During Takeoff.....	3-8	Transmission Limitations.....	5-8
Single Engine Failure While Hovering At a High Altitude.....	3-8	Transmission Oil Systems.....	1-16
Single Engine Failure While Hovering At Low Altitude.....	3-8	Transmission System .....	1-15
Single Engine Flight and Landings.....	3-8		F 1-15
Single Engine Landing - Land.....	3-9	Turbulence and Thunderstorms.....	9-11
Single Engine Landing - Water.....	3-9	Turning Radius and Ground Clearance.....	F 2-14
Single Engine Water Take-Off .....	3-9	Ts System Malfunction .....	3-4
Slope Limitations.....	5-10		
Smoke and Fume Elimination.....	3-31		
Spare Lamps.....	4-32		
Speed Selector Linkage Failure.....	3-7		
Speed Selectors (Engine Speed Selector Levers).....	1-6		
Stalls.....	6-2		
Starter System.....	1-8		

U	
UHF/COMM Radio Set AN/ARC-51A .....	4-44
Under Water Accoustic Beacon .....	F 4-44
Utility Hydraulic Pressure Indicator .....	4-32
Utility Hydraulic Pressure Loss .....	1-27
Utility Hydraulic Supply System .....	3-28
Utility Receptacles, AC and DC.....	1-27
	F 1-28
	F 4-29
	F 4-31
V	
Ventilating System .....	4-3
Vertical Landing.....	2-24
Vertical Takeoff.....	2-18
Vertical Takeoff to a Hover .....	F 2-18
Vertical Velocity Indicator.....	1-35
VHF/COMM Radio Set AN/ARC-84 .....	4-47
	F 4-47
VHF-FM/COMM Radio Set AN/ARC-160 .....	4-45
VHF/NAV Radio Set AN/ARN-87(V).....	F 4-46
VHF Navigation Receiver Failure.....	4-52
Vibrations .....	F 4-52
VOR/TACAN Airway Navigation.....	3-29
	6-4
	9-2
	W
Water Clearance.....	F 2-29
Water Container .....	4-32
Water Operations .....	2-27
Weight Limitations.....	5-9
Wind Effect in a Confined Area .....	F 2-19
Wind Effect on Ridgeline Approach .....	F 2-18
Wind Flow in Valley or Canyon .....	F 2-50
Wind Flow in Over and Around Peaks.....	F 2-15
Wind Flow Over Gorge or Canyon.....	F 2-48
Wind - Sea State Table .....	F 2-30
Windshield Anti-Icing System .....	4-5
Windshield Washer.....	4-33
Windshield Wiper System .....	4-33