Section 4

PERFORMANCE

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Section 4

PERFORMANCE

4-1. INTRODUCTION

The performance data presented herein are derived from the engine manufacturer's specification power for the engine less installation losses. These data are applicable to the basic helicopter without any optional equipment that would appreciably affect lift, drag, or power available.

4-2. POWER ASSURANCE CHECK

Power Assurance Check charts (Figure 4-1) are provided to determine if the engines can produce installed specification power.

A power assurance check should be performed daily. Additional checks should be made if unusual operating conditions or indications arise. The hover check is performed prior to takeoff, and the in-flight check is provided for periodic in-flight monitoring of engine performance. Either power assurance check method may be selected at the discretion of the pilot. It is the pilot's responsibility to accomplish the procedure safely, considering passenger load, terrain being overflown, and the qualifications of persons on board to assist in watching for other air traffic and to record power check data.

If either engine does not meet the requirements of the hover or the in-flight power assurance check, published performance may not be achievable. The cause of engine power loss, or excessive ITT or N1 should be determined as soon as practical. Refer to Engine Maintenance Manual.

4-3. DENSITY ALTITUDE

A Density Altitude chart (Figure 4-2) is provided to aid in calculation of performance and limitations. 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. The chart expresses density altitude as a function of pressure altitude and temperature.

The chart also includes the inverse of the square root of the density ratio \( \frac{1}{\varpi} \), which is used to calculate KTAS by the relation:

\[ \text{KTAS} = \text{KCAS} \times \frac{1}{\varpi} \]

EXAMPLE:

If the ambient temperature is -15°C and the pressure altitude is 6000 feet, find the density altitude, \( \frac{1}{\varpi} \), and true airspeed for 100 KCAS.

Solution:

a. Enter the bottom of the chart at -15°C.

b. Move vertically upward to the 6000 foot pressure altitude line.

c. From this point, move horizontally to the left and read a density altitude of 4000 feet and move horizontally to the right and read \( \frac{1}{\varpi} \) equals 1.06.
4-4. HEIGHT-VELOCITY ENVELOPE

Refer to Section 1.

4-5. HOVER CEILING

4-5-A. HOVER CEILING — IGE

Adequate cyclic and directional control is available at the gross weights allowed by the Hover Ceiling IGE charts in relative winds from any direction, up to the speeds shown in Figure 1-3. Improved control margins will be realized by avoiding winds in the critical relative wind azimuth areas (Figure 4-3).

The Hover Ceiling IGE charts (Figure 4-4) provide the maximum allowable gross weights for hovering IGE at all pressure altitude and outside air temperature conditions with heater on or off. Conversely, the hover ceiling altitude can be determined for any given gross weight.

4-5-B. HOVER CEILING — OGE

The Hover Ceiling OGE charts (Figure 4-5) provide maximum allowable gross weights for hovering OGE at all pressure altitude and outside air temperature conditions with heater on or off.

CAUTION

OGE HOVER OPERATION MAY RESULT IN VIOLATION OF HEIGHT-VELOCITY LIMITATIONS.

Some of the OGE hover ceiling charts are divided into two areas as follows:

AREA A (white area) as shown on the hover ceiling charts presents hover performance for which satisfactory cyclic and directional control have been demonstrated in relative winds from any direction, up to the speeds shown in Figure 1-3. Improved control margins will be achieved by avoiding winds in the critical relative wind azimuth areas (Figure 4-3).

AREA B (yellow area) as shown on hover ceiling charts presents additional hover performance, which can be achieved in calm winds or winds outside the critical relative wind azimuth area.

NOTE

Tail rotor or cyclic control margin may preclude operation in AREA B of the hover ceiling charts when the relative wind is in the respective critical wind azimuth area.

4-6. TAKEOFF DISTANCE

The Takeoff Distance charts (Figure 4-6) provide takeoff distances required to clear a 50-foot (15-m) obstacle in a zero wind condition, using a takeoff flight path, which will avoid the critical areas of the Height-Velocity Diagram (Section 1). Takeoff is initiated from a hover at 4 feet (1.2 m) skid height with climbout speed of 45 knots.

NOTE

Downwind takeoffs are not recommended because the published takeoff distance performance cannot be achieved.

4-7. CLIMB AND DESCENT

4-7-A. TWIN ENGINE RATE OF CLimb

The Twin Engine Rate of Climb charts (Figure 4-7) provide the rates of climb that can be obtained at all outside air temperatures/pressure altitudes/gross weight combinations with heater on or off at maximum continuous power and takeoff power.
4-7-B. SINGLE ENGINE RATE OF CLIMB

The Single Engine Rate of Climb charts (Figure 4-8) provide the rates of climb that can be obtained at all outside air temperatures/pressure altitudes/gross weight combinations with heater off at maximum continuous power and 30 minute OEI power.

NOTE

Published single engine performance is intended for emergency use only when one engine becomes inoperative due to an actual malfunction. Routine operation in 2 1/2 or 30 minute OEI range can affect engine service life.

4-8. AIRSPEED CALIBRATION

The Airspeed Calibration chart (Figure 4-9) provides calibrated airspeeds for all indicated airspeeds during level flight, climb, and autorotation.

4-9. LANDING DISTANCE

The Single Engine Landing Distance chart (Figure 4-10) provides the landing distances required to clear a 50-foot (15-m) obstacle for all outside air temperatures, pressure altitudes, and gross weights. Landing distances are based on an approach that remains clear of the critical areas of the Height-Velocity Diagram during a zero wind condition. The approach is initiated at 45 KIAS and 500 feet per minute rate of descent.
HEATER/ECU — OFF.
THROTTLES:
TEST ENGINE — FULL OPEN, FRICTIONED.
OTHER ENGINE — FLIGHT IDLE.
N11 RPM — 97%.
COLLECTIVE PITCH — INCREASE UNTIL LIGHT ON SKIDS OR HOVERING. DO NOT EXCEED 810° ITT OR 100.8% NI RPM.

STABILIZE POWER ONE MINUTE. THEN RECORD PRESSURE ALTITUDE, OAT, ENGINE TORQUE, ITT, AND NI RPM.
ENTER CHART AT INDICATED ENGINE TORQUE. MOVE UP TO INTERSECT PRESSURE ALTITUDE. PROCEED TO THE RIGHT TO INTERSECT OUTSIDE AIR TEMPERATURE, THEN MOVE UP TO READ VALUES FOR MAXIMUM ALLOWABLE ITT AND NI RPM.

IF INDICATED ITT OR NI RPM EXCEEDS MAX ALLOWABLE, REPEAT CHECK, STABILIZING POWER FOUR MINUTES.
REPEAT CHECK USING OTHER ENGINE.
IF EITHER ENGINE EXCEEDS ALLOWABLE ITT OR NI RPM AFTER STABILIZING FOUR MINUTES, PUBLISHED PERFORMANCE MAY NOT BE ACHIEVABLE. CAUSE SHOULD BE DETERMINED AS SOON AS PRACTICAL.

Figure 4-1. Power Assurance Check (Sheet 1 of 4)
ESTABLISH LEVEL FLIGHT ABOVE 1000 FEET AGL.

AIRSPEED — 100 KIAS (OR VNE, IF LESS).

HEATER/ECU — OFF.

THROTTLES:
TEST ENGINE — FULL OPEN, FRICTIONED

OTHER ENGINE — DECREASE SLOWLY UNTIL TEST ENGINE TORQUE IS WITHIN TEST RANGE. DO NOT EXCEED 810°C ITT OR 100.8% N1 RPM.

N1 RPM — 97%.

STABILIZE POWER ONE MINUTE IN LEVEL FLIGHT, THEN RECORD PRESSURE ALTITUDE, OAT, ENGINE TORQUE, ITT, AND N1 RPM.

ENTER CHART AT INDICATED ENGINE TORQUE, MOVE UP TO INTERSECT PRESSURE ALTITUDE, PROCEED TO THE RIGHT TO INTERSECT OUTSIDE AIR TEMPERATURE, THEN MOVE UP TO READ VALUES FOR MAXIMUM ALLOWABLE ITT AND N1 RPM.

IF INDICATED ITT OR N1 RPM EXCEEDS MAX ALLOWABLE, REPEAT CHECK, STABILIZING POWER FOUR MINUTES.

REPEAT CHECK USING OTHER ENGINE.

IF EITHER ENGINE EXCEEDS ALLOWABLE ITT OR N1 RPM AFTER STABILIZING FOUR MINUTES, PUBLISHED PERFORMANCE MAY NOT BE ACHIEVABLE. CAUSE SHOULD BE DETERMINED AS SOON AS PRACTICAL.

Figure 4-1. Power Assurance Check (Sheet 2 of 4)
HEATER/ECU — OFF.
THROTTLES: TEST ENGINE — FULL OPEN, FRICTIONED. OTHER ENGINE — FLIGHT IDLE.
N1 RPM — 97%.
COLLECTIVE PITCH — INCREASE UNTIL LIGHT ON SKIDS OR HOVERING. DO NOT EXCEED 810° ITT OR 101.8% N1 RPM.

STALLIZE POWER ONE MINUTE, THEN RECORD PRESSURE ALTITUDE, OAT, ENGINE TORQUE, ITT, AND N1 RPM.

ENTER CHART AT INDICATED ENGINE TORQUE, MOVE UP TO INTERSECT PRESSURE ALTITUDE, PROCEED TO THE RIGHT TO INTERSECT OUTSIDE AIR TEMPERATURE, THEN MOVE UP TO READ VALUES FOR MAXIMUM ALLOWABLE ITT AND N1 RPM.

IF INDICATED ITT OR N1 RPM EXCEEDS MAX ALLOWABLE, REPEAT CHECK, STABILIZING POWER FOUR MINUTES.

REPEAT CHECK USING OTHER ENGINE.

IF EITHER ENGINE EXCEEDS ALLOWABLE ITT OR N1 RPM AFTER STABILIZING FOUR MINUTES, PUBLISHED PERFORMANCE MAY NOT BE ACHIEVABLE, CAUSE SHOULD BE DETERMINED AS SOON AS PRACTICAL.

Figure 4-1. Power Assurance Check (Sheet 3 of 4)
ESTABLISH LEVEL FLIGHT ABOVE 1000 FEET AGL.
AIRSPEED — 100 KIAS (OR VNE, IF LESS).
HEATER/ECU — OFF.
THROTTLES:
TEST ENGINE — FULL OPEN, FRICTIONED.
OTHER ENGINE — DECREASE SLOWLY UNTIL TEST ENGINE TORQUE IS WITHIN TEST RANGE. DO NOT EXCEED 810°C ITT OR 101.8% NI RPM.

N1 RPM — 97%.
STABILIZE POWER ONE MINUTE IN LEVEL FLIGHT, THEN RECORD PRESSURE ALTITUDE, QAT, ENGINE TORQUE, ITT, AND NI RPM.
ENTER CHART AT INDICATED ENGINE TORQUE, MOVE UP TO INTERSECT PRESSURE ALTITUDE, PROCEED TO THE RIGHT TO INTERSECT OUTSIDE AIR TEMPERATURE, THEN MOVE UP TO READ VALUES FOR MAXIMUM ALLOWABLE ITT AND NI RPM.

IF INDICATED ITT OR NI RPM EXCEEDS MAX ALLOWABLE, REPEAT CHECK, STABILIZING POWER FOUR MINUTES.
REPEAT CHECK USING OTHER ENGINE.
IF EITHER ENGINE EXCEEDS ALLOWABLE ITT OR NI RPM AFTER STABILIZING FOUR MINUTES, PUBLISHED PERFORMANCE MAY NOT BE ACHIEVABLE. CAUSE SHOULD BE DETERMINED AS SOON AS PRACTICAL.

Figure 4-1. Power Assurance Check (Sheet 4 of 4)
Figure 4-2. Density Altitude
Figure 4-3. Critical Relative Wind Azimuths
Figure 4-4. Hover Ceiling IGE (Sheet 1 of 2)
Figure 4-4. Hover Ceiling IGE (Sheet 2 of 2)
FAA APPROVED  

HOVER CEILING  
OUT OF GROUND EFFECT  

TAKEOFF POWER  
ENGINE RPM 100%  
GENERATOR 150 AMPS (EA.)  

SKID HEIGHT 60 FT.  
HEATER OFF  
0 TO 52°C  

CAUTION: OGE HOVER OPERATION MAY RESULT IN VIOLATION OF H-V LIMITATIONS.  

Figure 4-5. Hover Ceiling OGE (Sheet 1 of 8)
Figure 4-5. Hover Ceiling OGE (Sheet 2 of 8)
Figure 4-5. Hover Ceiling OGE (Sheet 3 of 8)
Figure 4-5. Hover Ceiling OGE (Sheet 4 of 8)
Figure 4-5. Hover Ceiling OGE (Sheet 5 of 8)
HOVER CEILING
OUT OF GROUND EFFECT

MAXIMUM CONTINUOUS POWER
ENGINE RPM 100%
GENERATOR 150 AMPS (EA.)

SKID HEIGHT 60 FT.
HEATER OFF
-40 TO 0°C

CAUTION: OGE HOVER OPERATION MAY RESULT IN VIOLATION OF H-V LIMITATIONS.

Figure 4-5. Hover Ceiling OGE (Sheet 6 of 8)
Figure 4-5. Hover Ceiling OGE (Sheet 7 of 8)
Figure 4-5. Hover Ceiling OGE (Sheet 8 of 8)
Figure 4-6. Takeoff Distance (Sheet 1 of 2)
TAKEOFF DISTANCE
OVER 15 METER OBSTACLE

HOVER POWER = 15% TORQUE
ENGINE RPM 100%
GENERATOR 150 AMPS (EA)
INITIATED FROM 1.2 meter SKID HEIGHT
V_{T[ofa]} = 40 KIAS
HEATER ON OR OFF

MIN OAT → MAX OAT

PRESSURE ALTITUDE (m)

4267 meter DEN. ALT. LIMIT

MAXIMUM GROSS WEIGHT FOR TAKEOFF

OAT °C

-60 -40 20 0 20 40 60

TAKEOFF DISTANCE \( m \)

100 200 300 400

METRIC

Figure 4-6. Takeoff Distance (Sheet 2 of 2)
TWIN ENGINE RATE OF CLimb

TAKEOFF POWER
ENGINE RPM 100%
GENERATOR 150 AMPS (EA.)

WITH ALL DOORS OPEN OR REMOVED:
1. CLIMB SPEED IS 60 KIAS
2. RATE OF CLIMB WILL DECREASE 275 FT/MIN

Figure 4-7. Twin Engine Rate of Climb (Sheet 1 of 4)
TWIN ENGINE RATE OF CLimb

Twin Engine Rate of Climb (Sheet 2 of 4)

Figure 4-7.
Figure 4-7. Twin Engine Rate of Climb (Sheet 3 of 4)
TWIN ENGINE RATE OF CLimb

MAXIMUM CONTINUOUS POWER
ENGINE RPM 100%
GENERATOR 150 AMPS (EA.)

WITH ALL DOORS OPEN OR REMOVED:
1. CLIMB SPEED IS 60 KIAS
2. RATE OF CLIMB WILL DECREASE 275 FT/Min

Figure 4-7. Twin Engine Rate of Climb (Sheet 4 of 4)
SINGLE ENGINE RATE OF CLIMB

30 MINUTE POWER
ENGINE RPM 97%
GENERATOR 150 AMPS

70 KIAS
HEATER OFF

WITH ALL DOORS OPEN OR REMOVED:
1. CLIMB SPEED IS 60 KIAS
2. RATE OF CLIMB WILL DECREASE 275 FT/MIN

Figure 4-8. Single Engine Rate of Climb (Sheet 1 of 2)
SINGLE ENGINE RATE OF CLimb

CONTINUOUS POWER
ENGINE RPM 97%
GENERATOR 150 AMPS

WITH ALL DOORS OPEN OR REMOVED:
1. CLIMB SPEED IS 60 KIAS
2. RATE OF CLIMB WILL DECREASE 275 FT/ MIN

Figure 4-8. Single Engine Rate of Climb (Sheet 2 of 2)
PILOT & COPILOT AIRSPEED SYSTEM CALIBRATION

CLimb, LEVEL FLIGHT, AUTORotation

Figure 4-9. Airspeed Calibration
Figure 4-10. Single Engine Landing Distance