Chapter 5

Operating Limits and Restrictions

Section I. GENERAL

5-1. Purpose This chapter identifies or refers to all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. General The operating limitations set forth in this chapter are the direct results of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the helicopter.

5-3. Exceeding Operational Limits Anytime an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required.

5-4. Minimum Crew Requirements The minimum crew required to fly the helicopter is one pilot whose station is in the right seat. Additional crewmembers as required will be added at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

Section II. SYSTEM LIMITS

5-5. Instrument Markings (Fig 5-1)

a. Instrument Marking Color Codes. Operating limits and ranges color markings which appear on the dial faces of engine, flight, and utility system instruments are illustrated with the following symbols:

R=Red, G=Green, Y=Yellow,

RED markings on the dial faces of these instruments indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings on instruments indicate the safe or normal range of operation. The YELLOW markings on instruments indicate the range when special attention should be given to the operation covered by the instrument.

b. Instrument Glass Alignment Marks. Limitation markings consist of strips of semitransparent color tape which adhere to the glass outside of an indicator dial. Each tape strip aligns to increment marks on the dial face so correct operating limits are portrayed. The pilot should occasionally verify alignment of the glass to the dial face. For this purpose, all instruments that have range markings have short, vertical white alignment marks extending from the dial glass onto the fixed base of the indicator. These slippage marks appear as a single vertical line when limitation markings on the glass properly align with reading increments on the dial face. However, the slippage marks appear as separate radial lines when a dial glass has rotated.

5-6. Rotor Limitations.

a. Refer to figure 5-1.

b. Restrict rotor speed to 319 to 324 RPM (6500 to 6600 Engine RPM) during cruise flight.

Section III. POWER LIMITS

5-7. Engine Limitations

a. Refer to figure 5-1.

b. Maximum starter energize time is 40 seconds with a three-minute cooling time between start attempts with three attempts in any one hour.

c. Health Indicator Test. When a difference between a recorded EGT and the baseline EGT is plus or minus 20°C, make an entry on DA Form 2408-13; ±30°C or greater make an entry on DA Form 2408-13 and do not fly the aircraft.

Section IV. LOADING LIMITS

5-8. Center of Gravity Limitations

a. Center of gravity limits for the helicopter to which this manual applies and instructions for computation of the center of gravity are contained in chapter 6.

b. Do not carry external loads if the cg is aft of station 142 prior to lifting external load.

c. When flying at an aft cg (station 140 to 144) terminate an approach at a minimum of five-foot hover prior to landing to prevent striking the tail on the ground. Practice touchdown autorotations shall not be attempted with the cg aft of 140 because termination at 5 feet is not possible.

5-9. Weight Limitations

a. Maximum Gross Weight. The maximum gross weight for the helicopter is 9500 pounds. The maximum gross weights for varying conditions of temperature, altitude, wind velocity, and skid height are shown in chapter 7.

b. Maximum Gross Weight for Towing. The maximum gross weight for towing is 9500 pounds.

c. Cargo Hook Weight Limitations. Maximum allowable weight for the cargo hook is 4000 pounds.

d. Weight Distribution Limitations. Cargo distribution over the cargo floor area shall not exceed 100 pounds per square foot. For information pertaining to weight distribution, refer to chapter 6.

e. Mine Disperser Jettisoning Limits. Except in an emergency, the mine dispersing subsystem M56 shall not be jettisoned above 60 KIAS with roof mounted pitot tube or 50 KIAS with nose mounted pitot tube.

5-10. Turbulance Limitations

a. Intentional flight into severe or extreme turbulance.

b. Intentional flight into moderate turbulance is not recommended when the report or forecast is based on aircraft above 12,500 pounds gross weight.

c. Intentional flight into thunder storms are prohibited.

Section V. AIRSPEED LIMITS

5-11. Airspeed Limitations

a. Refer to figure 5-2 for forward airspeed limits.

b. Sideward flight limits are 30 knots.

c. Rearward flight limit is 30 knots.

d. The helicopter can be flown up to VNE with the cabin doors locked in either the closed position or the fully open position. Flight above 50 KIAS with the cabin doors in the unlocked position is prohibited.

e. The helicopter can be flown up to an IAS of 50 knots with one door open and one door closed. This will allow .for missions such as rappeling, paradrop, and use of rescue hoist. If a door comes open, speed should be reduced to 50 KIAS or below the door secured. Crewmembers should ensure that they are fastened to the helicopter by seat belts or other safety devices while securing the cabin doors inflight.

f. Flight above 60 KIAS with roof mounted pitot tube or 50 KIAS with nose mounted pitot tube with one M56 mine disperser installed and the other disperser subsystem removed is prohibited.

Section VI. MANEUVERING LIMITS

5-12. Prohibited Maneuvers

a. Abrupt inputs of flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

b. No aerobatic maneuvers permitted. Aerobatic flight is defined to be any intentional maneuver involving an abrupt change in the aircraft's attitude, an abnormal attitude pitch angle greater than ±30° or roll angles greater than 60°, or abnormal acceleration not necessary for normal flight.

c. Intentional flight below *+0.5G is prohibited. Refer to low G maneuvers, paragraph 8-53.*

d. The speed for any and all maneuvers shall not exceed the level flight velocities as stated on the airspeed operating limits chart (fig 5-2).

Section VII. ENVIRONMENTAL RESTRICTIONS

5-13. Environmental Restrictions

a. This helicopter is qualified for flight under instrument meteorological conditions.

b. Intentional flight into known moderate icing condition is prohibited.

c. Wind Limitation.

(1) Maximum cross wind for hover is 30 knots.

(2) Maximum tail wind for hover is 30 knots.

*d. Wind Limitation for Starting.*Helicopter can be started in a maximum wind velocity of 30 knots or a maximum gust spread of 15 knots. Gust spreads are not normally reported. To obtain spread, compare minimum and maximum wind velocity.

Section VIII. HEIGHT VELOCITY

5-14. Height Velocity The Height Velocity diagram (fig 9-3) is based on an extrapolation of test data. The chart is applicable for all gross weights up to and including 9500 pounds.

Section IX. INTERNAL RESCUE HOIST (BREEZE ONLY)

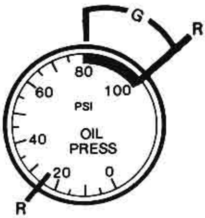
5-15. Hoist Restrictions Rescue hoist (breeze hoist only) is totally restricted from any live rescues, non-critical training and demonstrations. Dummy load pickups over uninhabited areas are authorized for training.

Section X. OTHER LIMITATIONS

5-16. Towing The helicopter should not be towed for 25 minutes after the battery and inverter switches have been turned off to prevent damage to attitude and directional gyros. If the helicopter must be towed prior to the 25 minute limit, the battery and inverter switches shall be turned on. Wait five minutes after the switches are on before moving the helicopter.

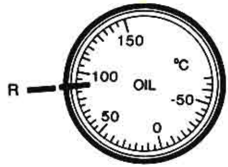
COLOR MARKING CODES

R - Red
G - Green



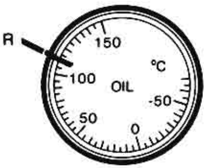
ENGINE OIL PRESSURE

R ■ 25 PSI Minimum—Engine Idle
G ■ 80 to 100 PSI Continuous
R ■ 100 PSI Maximum



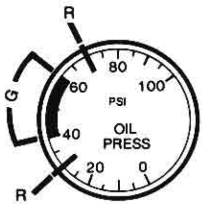
ENGINE OIL TEMPERATURE

R ■ 93°C Maximum Below 30°C FAT
100°C Maximum At 30°C FAT and Above
(Write Up Required Anytime 93°C Exceeded.)



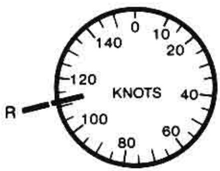
TRANSMISSION OIL TEMPERATURE

R ■ 110°C Maximum



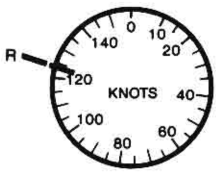
TRANSMISSION OIL PRESSURE

R ■ 30 PSI Minimum
G ■ 40 to 60 PSI Continuous
R ■ 70 PSI Maximum



AIRSPEED
NOSE MOUNTED PITOT TUBE

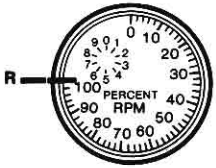
R ■ 112 Knots Maximum
Refer to Figure 5-2, Airspeed Operating Limits for Additional Limitations.



AIRSPEED
ROOF MOUNTED PITOT TUBE

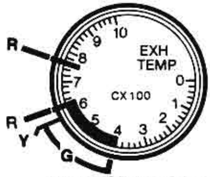
R ■ 124 Knots Maximum
Refer to Figure 5-2, Airspeed Operating Limits for Additional Limitations.

Figure 5-1. Instrument Markings (Sheet 1 of 3)



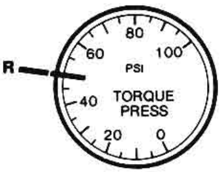
GAS PRODUCER TACHOMETER (N1)

R 101.5 Percent Maximum



EXHAUST TEMPERATURE

G 400°C to 610°C Continuous
Y 610°C to 625°C 30 Minutes
R 625°C Maximum 30 Minutes
625°C to 675°C 10 Second Limit for Starting and Acceleration
675°C to 760°C 5 Second Limit for Starting and Acceleration
R 760°C Maximum



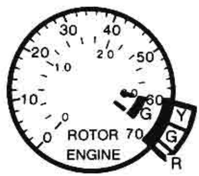
TORQUE PRESSURE

Meter is marked with the maximum torque limit for each engine as reflected by the individual engine Data Plate Torque. Refer to Torque Available Chart, Chapter 7.

NOTE

Line at 50 PSI shown on dial face is for illustration only. Actual location will vary.

R



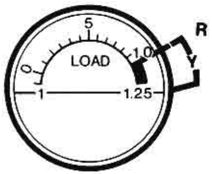
ROTOR TACHOMETER

G 294 to 324 Continuous
R 339 RPM Maximum

ENGINE TACHOMETER (N2)

Y 6000 to 6400 RPM Transient
G 6400 to 6600 RPM Continuous
R 6700 RPM Maximum Continuous above 15 PSI Torque
6900 RPM Maximum Continuous at 15 PSI Torque or Less
6900 RPM Maximum Transient (3 second) above 15 PSI Torque
R 6900 RPM Maximum

Figure 5-1. Instrument Markings (Sheet 2 of 3)



LOADMETER MAIN GENERATOR

Y ■ 1.0 to 1.25 Transient

STANDBY GENERATOR

R ■ 1.0 Maximum

FUEL PRESSURE

G ■ 5 to 35 PSI Continuous

Figure 5-1. Instrument Markings (Sheet 3 of 3)

AIRSPEED OPERATING LIMITS

EXAMPLE

WANTED

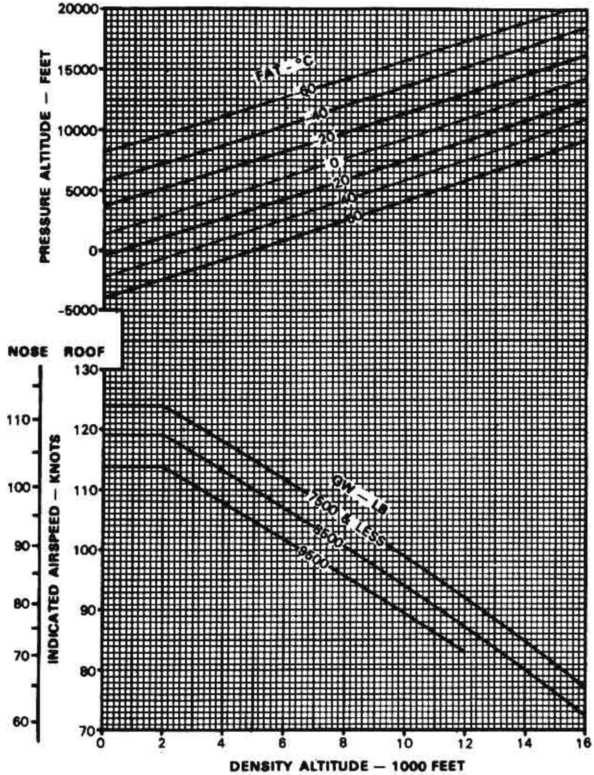
INDICATED AIRSPEED
AND DENSITY ALTITUDE

KNOWN

GROSS WEIGHT = 8500 LB
PRESSURE ALTITUDE = 7500 FEET
FAT = -20°C
ROOF MOUNTED SYSTEM

METHOD

ENTER PRESSURE ALTITUDE
MOVE RIGHT TO FAT
MOVE DOWN TO GROSS WEIGHT
MOVE LEFT, READ INDICATED
AIRSPEED = 110 KNOTS
REENTER PRESSURE ALTITUDE
MOVE RIGHT TO FAT
MOVE DOWN, READ DENSITY
ALTITUDE = 5000 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 5-2. Airspeed operating limits chart

Chapter 6

Weight/Balance and Loading

Section I. GENERAL

6-1. General Chapter 6 contains sufficient instructions and data so that an aviator knowing the basic weight and moment of the helicopter can compute any combination of weight and balance.

6-2. Classification of Helicopter. Army UH-1H/V helicopters are in class 2. Additional directives governing weight and balance of class 2 aircraft forms and records are contained in AR 95-16, TM 55-1500-342-23 and DA PAM 738-751.

6-3. Helicopter Station Diagram Figure 6-1 show the helicopter reference datum lines, fuselage stations, butt lines, water lines and jack pad locations. The primary purposes of the figure is to aid personnel in the computation of helicopter weight/balance and loading.

Section II. WEIGHT AND BALANCE

6-4. Loading Charts

a. Information. The loading data contained in this chapter is intended to provide information necessary to work a loading problem for the helicopters to which this manual is applicable.

b. Use. From the figures contained in this chapter, weight and moment are obtained for all variable load items and are added to the current basic weight and moment (DD Form 365-3) to obtain the gross weight and moment.

(1) The gross weight and moment are checked on DD Form 365-3 to determine the approximate center of gravity (cg).

(2) The effect on cg by the expenditures in flight of such items as fuel, ammunition, etc., may be checked by subtracting the weights and moments of such items from the takeoff weight and moments and checking the new weight and moment on the CG limits Chart.

6-5. DD Form 365-1—Basic Weight Checklist. The form is initially prepared by the manufacturer before the helicopter is delivered. The form is a tabulation of equipment that is, or may be, installed and for which provision for fixed stowage has been made in a definite location. The form gives the weight, arm, and moment/100 of individual items for use in correcting the basic weight and moment on DD Form 365-3 as changes are made in this equipment.

6-6. DD Form 365-3—Basic Weight and Balance Records The form is initially prepared by the manufacturer at time of delivery of the helicopter. The form is a continuous history of the basic weight and moment resulting from structural and equipment changes. At all times the last entry is considered current weight and balance status of the basic helicopter.

6-7. DD Form 365-4—Weight and Balance Clearance Form F

a. General. The form is a summary of actual disposition of the load in the helicopter. It records the balance status of the helicopter, step-by-step. It serves as a worksheet on which to record weight and balance calculations, and any corrections that must be made to ensure that the helicopter will be within weight and cg limits.

b. Form Preparation. Specific instructions for filling out the form are given in TM 55-1500-342-23. Figure 6-3 shows the results of the instructions.

NOTE

Allowable gross weight for take off and landing is 9500 pounds.

Section III. FUEL/OIL

6-8. Fuel Refer to figure 6-2.

6-9. Oil For weight and balance purposes, engine oil is a part of basic weight.

Section IV. PERSONNEL

6-10. Personnel Compartment and Litter Provisions

a. The personnel compartment provides seating for eleven combat equipped troops (fig 6-3). Seat belts are provided for restraint.

b. Provisions and hardware are provided for up to six patients. Refer to figure 6-3.

6-11. Personnel Loading and Unloading When helicopter is operated at critical gross weights, the exact weight of each individual occupant plus equipment should be used. If weighing facilities are not available, or if the tactical situation dictates otherwise, loads shall be computed as follows:

a. Combat equipped soldiers: 240 pounds per individual.

b. Combat equipped paratroopers: 260 pounds per individual.

c. Crew and passengers with no equipment: compute weight according to each individual's estimate.

d. Litter Weight and Balance Data. Refer to figure 6-3. Litter loads shall be computed at 265 pounds (litter and patient's weight combined).

6-12. Personnel Moments Refer to figure 6-3.

Section V. MISSION EQUIPMENT

6-13. Weight and Balance Loading Data

a. System Weight and Balance Data. Refer to figure 6-6.

b. Hoist Loading Data. Use Hoist Loading Limitations charts for hoist in forward right or forward left positions only (figs 6-4 and 6-5).

WARNING

Longitudinal or lateral cg limits may not permit maximum hoist loading capability. The lesser of the two loads derived from lateral and longitudinal charts shall be used.

NOTE

If additional internal load is carried during hoisting operations this load should be positioned on opposite side from hoist.

c. Positions Hoist May Occupy in Cabin. Refer to figure 6-7 .

Section VI. CARGO LOADING

6-14. Cargo Loading The large cargo doors, open loading area and low floor level preclude the need for special loading aids. Through loading may be accomplished by securing cargo doors in the fully open position. Cargo tiedown fittings (figs 6-8 and 6-9) are located on the cabin floor for securing cargo to prevent cargo shift during flight.

6-15. Preparation of General Cargo

a. The loading crew shall assemble the cargo and baggage to be transported. At time of assembly and prior to loading, the loading crew shall compile data covering weight, dimensions, center of gravity location and contact areas for each item.

b. Heavier packages to be loaded shall be loaded first and placed in the aft section against the bulkhead for cg range purposes.

c. Calculation of the allowable load and loading distribution shall be accomplished by determining the final cg location and remain within the allowable limits for safe operating conditions.

6-16. Cargo Center of Gravity Planning

a. Planning. The items to be transported should be assembled for loading after the weight and dimensions have been recorded.

(1) Loading time will be gained if the packages are positioned as they are to be located in the helicopter.

(2) To assist in determining the locations of the various items, the individual weights and total weight must be known.

(3) When these factors are known the cargo loading charts (fig 6-10 and 6-11 can be used as a guide to determine the helicopter station at which the package cg shall be located and the moment for each item.

(4) The information presented on the loading chart will not be affected by fuel quantity, as full to empty fuel load as been considered during data computation.

(5) Final analysis of helicopter cg location for loading shall be computed from the data presented in this chapter.

b. Computation of Cargo Center of Gravity.

(1) The loading data in this chapter will provide information to work a loading problem. From the loading charts, weight and moment/100 are obtained for all variable load items and are added mathematically to the current basic weight and moment/100 obtained from chart C to arrive at the gross weight and moment.

(2) The cg of the loaded helicopter is represented by a moment figure in the center of gravity table. If the helicopter is loaded within the forward and aft cg limits, the figure will fall numerically between the limiting moments.

(3) The effect on the cg of the usable inflight items of fuel may be checked by subtracting the weights and moments of such items from the takeoff gross weight and moment and checking the landing weight new moment with the cg limits chart.

(4) This check will be made to determine whether or not the cg will remain within limtis during the entire flight.

6-17. Loading Procedures The helicopter requires no special loading preparation.

a. The loading procedure consists of placing the heaviest items to be loaded as far aft as possible. Such placement locates the cargo nearer the helicopter cg and allows maximum cargo load to be transported, as well as maintaining the helicopter within the safe operating cg limits for flight.

b. The mission to be performed should be known to determine the weight and moment of cargo, troop transport, or litter patients to be carried on the return trip.

c. If troops or litter patients are to be carried, troop seats and litter racks shall be loaded aboard and stowed.

d. High density cargo distributed over floor area shall not exceed 100 pounds per square foot.

6-18. Loading and Unloading of Other Than General Cargo

WARNING

Before transporting nuclear weapons, the pilot shall be familiar with AR 95-27, AR 50-4 and AR 50-5.

The helicopter is capable of transporting nuclear weapons, if required.

6-19. Tiedown Devices Refer to figures 6-8 and 6-9.

Section VII. CENTER OF GRAVITY LIMITS

6-20. Center of Gravity Limits Refer to figure 6-2 for longitudinal limits. The lateral C.G. limits are 5 inches (5 inches to the right and left of the helicopter centerline). The lateral C.G. limits will not be exceeded if external store loadings are symmetrical, the hoist loading limits (fig 6-4) are observed, and a reasonable effort is made to evenly distribute internal loads from left to right.

HELICOPTER DIAGRAM

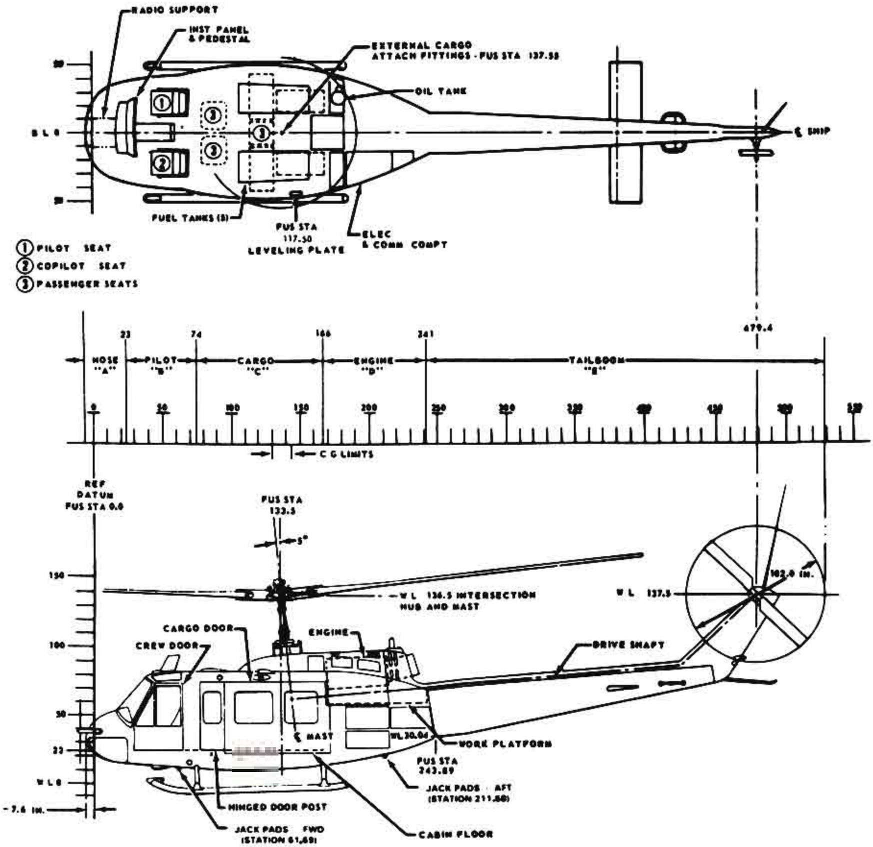


Figure 6-1. Helicopter Station Diagram

FUEL LOADING

FUEL MOMENT

CRASHWORTHY SYSTEM TANKS

EXAMPLE

WANTED

WEIGHT AND MOMENT FOR A GIVEN QUANTITY OF USABLE FUEL IN CRASHWORTHY FUEL SYSTEM.

KNOWN

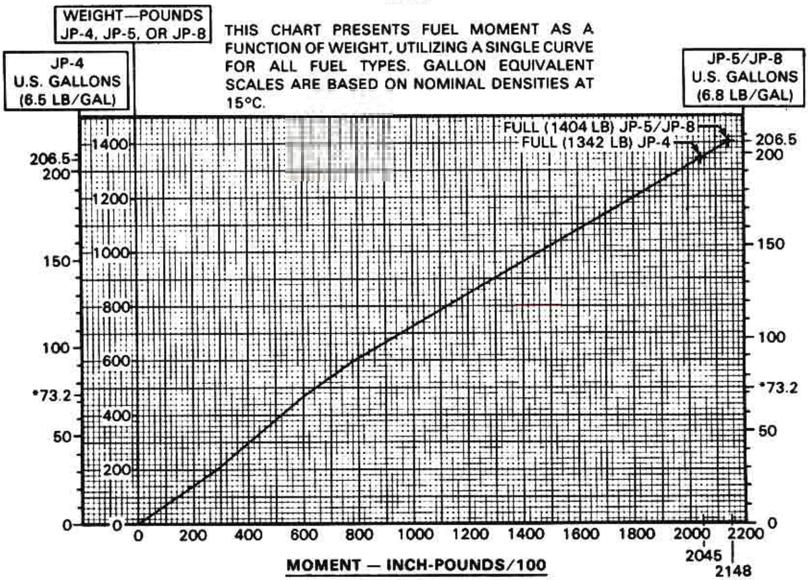
U.S. GALLONS OF JP-4 FUEL.

METHOD

ENTER AT GALLONS ON JP-4 SCALE. MOVE RIGHT TO READ WEIGHT CONTINUE RIGHT TO INTERSECT DIAGONAL LINE, THEN PROJECT DOWN TO READ MOMENT/100 SCALE.

NOTE

THIS CHART PRESENTS FUEL MOMENT AS A FUNCTION OF WEIGHT, UTILIZING A SINGLE CURVE FOR ALL FUEL TYPES. GALLON EQUIVALENT SCALES ARE BASED ON NOMINAL DENSITIES AT 15°C.



*MOST FORWARD FUEL CG AT 73.2 GALLONS

Figure 6-2. Fuel Loading (Sheet 1 of 2)

FUEL LOADING

FUEL MOMENT

AUXILIARY FUEL
300 GALLONS INTERNAL
(F.S. 151.0)

EXAMPLE

WANTED
WEIGHT AND MOMENT FOR A GIVEN QUANTITY OF FUEL IN AUXILIARY FUEL TANKS.

KNOWN
300 U.S. GALLONS OF JP-4 FUEL (IN AUXILIARY TANKS ONLY).

METHOD
ENTER AT GALLONS ON JP-4 SCALE.
MOVE RIGHT TO READ WEIGHT.
CONTINUE RIGHT TO INTERSECT DIAGONAL LINE, THEN PROJECT DOWN TO READ MOMENT/100 SCALE.

NOTE

THIS CHART PRESENTS FUEL MOMENT AS A FUNCTION OF WEIGHT, UTILIZING A SINGLE CURVE FOR ALL FUEL TYPES. GALLON EQUIVALENT SCALES ARE BASED ON NOMINAL DENSITIES AT 15°C.

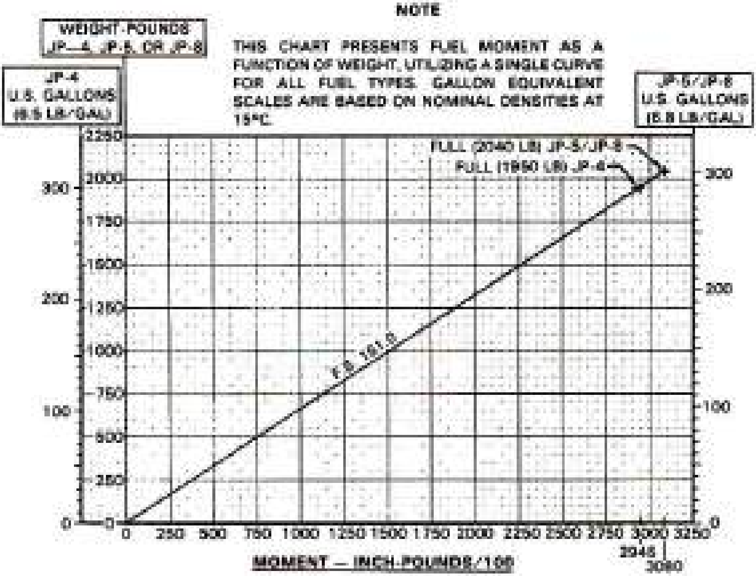


Figure 6-2. Fuel Loading (Sheet 2 of 2)

PERSONNEL LOADING CHART

MOMENT FOR PERSONNEL

EXAMPLE

WANTED

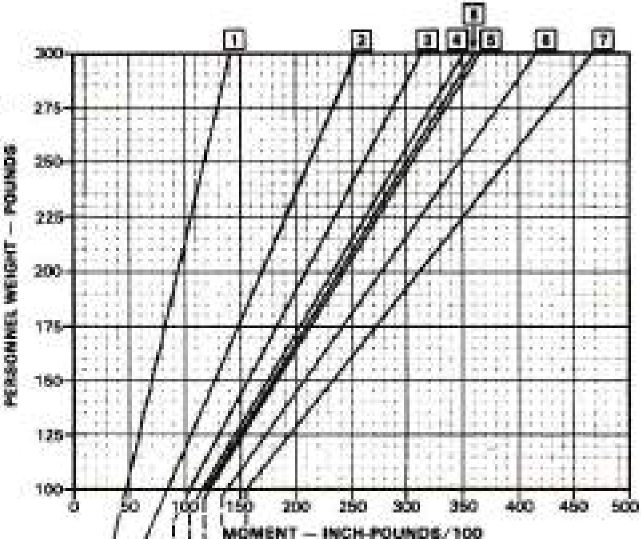
PERSONNEL MOMENT FOR A GIVEN WEIGHT AND LOCATION

KNOWN

PERSONNEL WEIGHT OF 200 POUNDS AT F.S.117.0 (Row 4)

METHOD

MOVE RIGHT FROM 200 LBS TO THE LINE CONNECTING WITH SEAT ROW 4. PROJECT DOWN TO READ 234 ON THE MOMENT/100 SCALE.



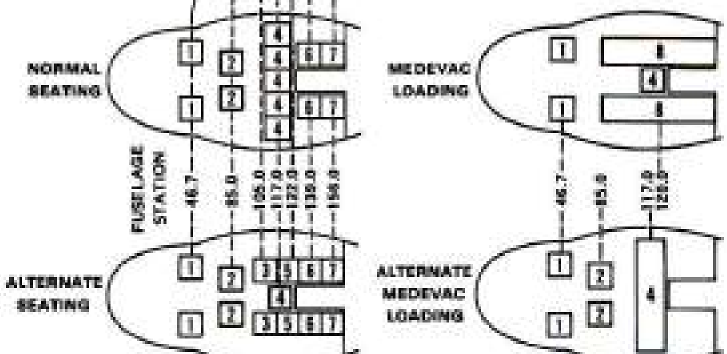


Figure 6-3. Personnel Loading

HOIST LOADING LIMITATIONS DUE TO LATERAL C .G. LIMITS

HOIST IN FORWARD RIGHT POSITION

EXAMPLE

WANTED

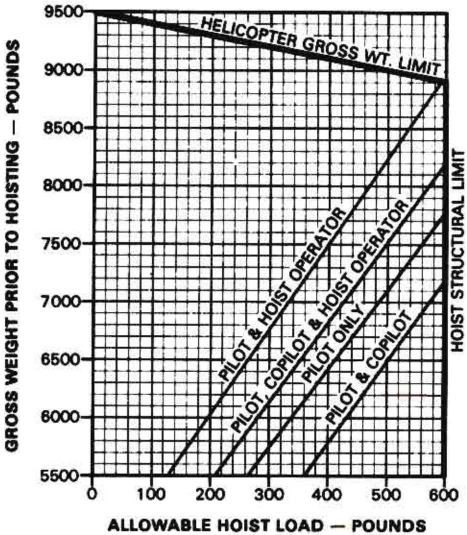
MAXIMUM ALLOWABLE
HOIST LOAD

KNOWN

GROSS WEIGHT 8600 LBS
LONGITUDINAL C. G. 133.5,
CREW — PILOT & HOIST OPERATOR.

METHOD

ENTER GROSS WEIGHT
MOVE RIGHT TO INTERSECT
PILOT & HOIST OPERATOR CURVE.
MOVE DOWN TO READ
ALLOWABLE HOIST LOAD 550 LBS



NOTE

THE LESSER OF THE TWO WEIGHTS DERIVED FROM LATERAL AND LONGITUDINAL CHARTS SHALL BE USED (EXAMPLE 335 POUNDS).

GROSS WEIGHT TO BE THE LIGHTEST WEIGHT OF THE HELICOPTER DURING HOISTING OPERATIONS, BUT NOT INCLUDING THE WEIGHT OF THE HOIST LOAD. FUEL BURNED PRIOR TO HOISTING OPERATION MUST BE DEDUCTED FROM TAKEOFF GROSS WEIGHT BEFORE COMPUTING ALLOWABLE HOIST LOAD.

Figure 6-4. Hoist Loading Limitations (Lateral CG)

HOIST LOADING LIMITATIONS DUE TO LONGITUDINAL C .G. LIMITS

HOIST IN FORWARD RIGHT OR FORWARD LEFT POSITION

EXAMPLE

WANTED

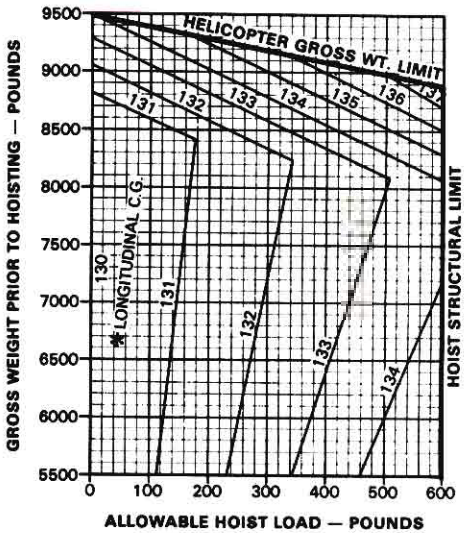
MAXIMUM ALLOWABLE
HOIST LOAD

KNOWN

GROSS WEIGHT 8600 LBS
LONGITUDINAL C.G. 133.5
PRIOR TO HOISTING.

METHOD

ENTER GROSS WT.
MOVE RIGHT TO C.G.
MOVE DOWN TO READ
ALLOWABLE HOIST LOAD 335 LBS



*GROSS WEIGHT AND C.G.
DO NOT INCLUDE HOIST LOAD

Figure 6-5. Hoist Loading Limitations (Longitudinal CG)

100,000 BTU HEATER

WINTERIZATION KIT

ITEM	WEIGHT	ARM	MOMENT/ 100
Complete Heater Instl. (205-706-001)	73.2	197.0	144.2
Winterization Kit (Muff Heater)	61.0	212.0	129.3

AFT BATTERY INSTALLATION

ITEM	WEIGHT	ARM	MOMENT/ 100
Battery (Fwd)	80.0	5.0	4.0
Battery (Aft)	80.0	233.0	186.4
Aft Battery Provisions (205-1682-1)	15.0	224.8	33.8

300 GALLON INTERNAL AUXILIARY FUEL TANK

ITEM	WEIGHT	ARM	MOMENT/ 100
Tank, LH, Non-Crashworthy	50.8	151.3	76.9
Tank, RH, Non-Crashworthy	50.8	151.3	76.9
Tank, LH, Crashworthy	(*)	151.3	(**)
Tank, RH, Crashworthy	(*)	151.3	(**)

*Tank weight varies; use weight stamped on tank (use fuel loading chart for fuel weight).
**Depends on tank weight.

RESCUE HOIST (BREEZE)

ITEM	WEIGHT	ARM	MOMENT/ 100
Hoist—Forward Position (Arm Inside)	151.3	87.3	132.1
Hoist—Aft Position (Arm Inside)	151.3	125.1	189.3

Figure 6-6. System Weight and Balance Data Sheet (Sheet 1 of 3)

RESCUE HOIST (HIGH PERFORMANCE)

ITEM	WEIGHT	ARM	MOMENT/100
Hoist—Forward RH Position (Arm Stowed Forward)	174.0	80.0	139.2
Hoist—Forward RH Position (Arm Stowed Aft)	174.0	84.0	146.2
Hoist—Forward LH Position (Arm Stowed Forward)	174.0	82.0	142.7
Hoist—Forward LH Position (Arm Stowed Aft)	174.0	84.0	146.2
Hoist—Aft Position (Arm Stowed Forward)	174.0	129.0	224.5
Hoist—Aft Position (Arm Stowed Aft)	174.0	133.0	231.4

GLASS WINDSHIELD INSTALLATION

ITEM	WEIGHT	ARM	MOMENT/100
Glass Windshield—Pilot/Copilot (Both)	30.0	27.0	8.1
Glass Windshield—Pilot Only or Copilot Only	15.0	27.0	4.1

M-23 DOOR MOUNTED M-60

ITEM	WEIGHT	ARM	MOMENT/100
Armament Subsystem W/O Ammunition	128.0	142.6	182.5
Ammunition 7.62 MM (1300 Rounds)	78.0	142.6	111.2
Total Armament Subsystem W/Ammunition (1300 Rounds)	206.0	142.6	293.8
Ammunition Box (2 each) W/Cover Assembly	8.5	142.6	12.1
Machine Guns W/Ejection Control Bags (2 each) and Chute Assembly (2 each)	66.5	142.0	94.4
Mount Assembly (2 each) W/Hardware	53.0	142.6	75.6

EXTERNAL STORES SUPPORT

ITEM	WEIGHT	ARM	MOMENT/100
Stores Rack			
Cross Beam Assys.	29.5	142.5	42.1
Fwd. Beam Assys.	11.5	129.0	14.8
Aft Beam Assys.	11.9	155.1	18.4
Fwd. Sway Brace Assys.	1.1	135.3	1.5
Aft Sway Brace Assys.	1.2	149.7	1.9
Hardware	3.1	142.9	4.4
Total Aft Stores Instl.	58.3	142.5	83.1

Figure 6-6. System Weight and Balance Data Sheet (Sheet 2 of 3)

Stores Rack (205-706-013-11)			
Cross Beam Assys.	31.1	73.9	23.0
Fwd. Beam Assys.	11.7	63.0	....
Aft Beam Assys.	13.6	84.5	11.5
Fwd. Sway Brace Assys.	1.9	68.4	1.3
Aft Sway Brace Assys.	1.5	79.7	1.2
Hardware	3.2	74.0	2.4
Total Fwd. Stores Instl.	63.0	74.2	46.8

M52 SMOKE GENERATOR SUBSYSTEM

ITEM	WEIGHT	ARM	MOMENT/ 100
A Kit	16.7	161.67	27.0
B Kit	39.64	120.08	47.6
	−20.62	122.21	−25.2
C Kit Without Oil in Tank	117.5	127.57	149.9
C Kit With Oil in Tank (50 Gal)	492.5	121.81	599.9

MULTIARMAMENT STRUCTURAL SUPPORT KIT

ITEM	WEIGHT	ARM	MOMENT/ 100
A Kit (Roof Hardpoints)	5.83	146.71	8.6
B Kit	205.87	141.87	292.1

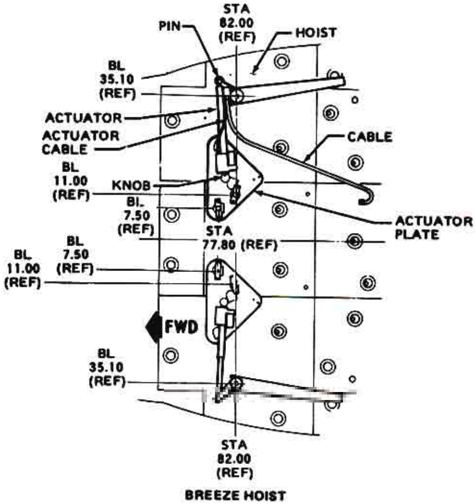
M56 MINE DISPENSER (SUN-13D/A)

ITEM	WEIGHT	ARM	MOMENT/ 100
Each Dispenser Empty, Without Pallet	117	145.83	170.6
Each Dispenser with Canisters Only	188	145.83	274.2
Each Dispenser—Loaded as Flown	640	143.79	920.3

AUXILIARY SUPPRESSOR KIT, EXHAUST SUPPRESSOR

ITEM	WEIGHT	ARM	MOMENT/ 100
A Kit	4.0	228.0	9.1
B Kit	47	230.2	108.2

Figure 6-6. System Weight and Balance Data Sheet (Sheet 3 of 3)



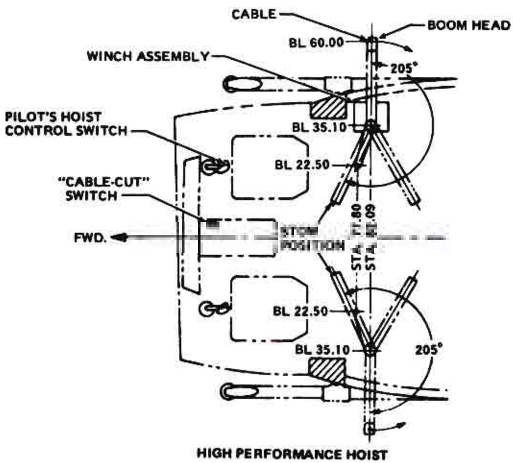
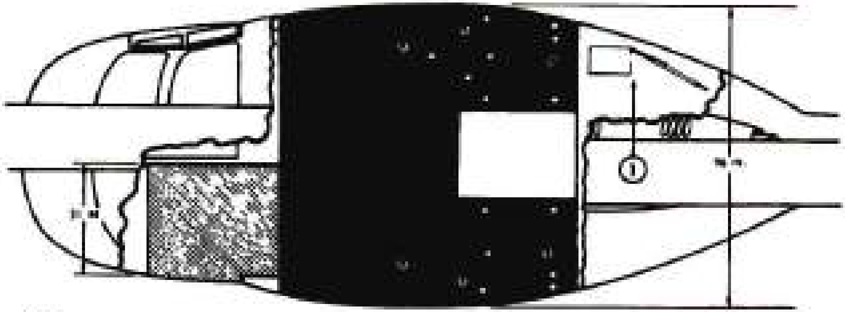


Figure 6-7. Hoist Installation Positions



CODE

1. Tie-down Fittings
2. Stanchion Fittings
3. Cargo Area, Maximum Loading Dimensions
4. Optional Loading Area, Left Seat Removed
5. Interior Clearance Above Maximum Package at Centerline of Cabin

(1) Mirror stowage

NOTES:

1. Floor tie-down fittings, strength 1250 pounds vertical, 500 pounds horizontal load per fitting. Each aft bulkhead tiedown fitting is capable of the following loads: 1250 lbs, parallel to the bulkhead, 2195 lbs at a 45° angle.
2. Bulkhead tie-down fittings are good for 2500 pounds ultimate per fitting perpendicular to the bulkhead.
3. Tie-down fittings on the side of the beams are good for 1250 pounds ultimate per fitting perpendicular to the beams.
4. Two fittings at station 128.0 are good for 1650 pounds ultimate per fitting perpendicular to bulkhead.

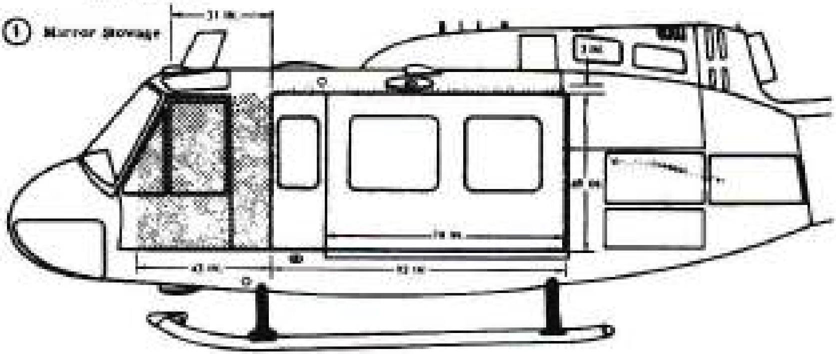


Figure 6-8. Cargo Compartment

CARGO TIE DOWN FITTING DATA

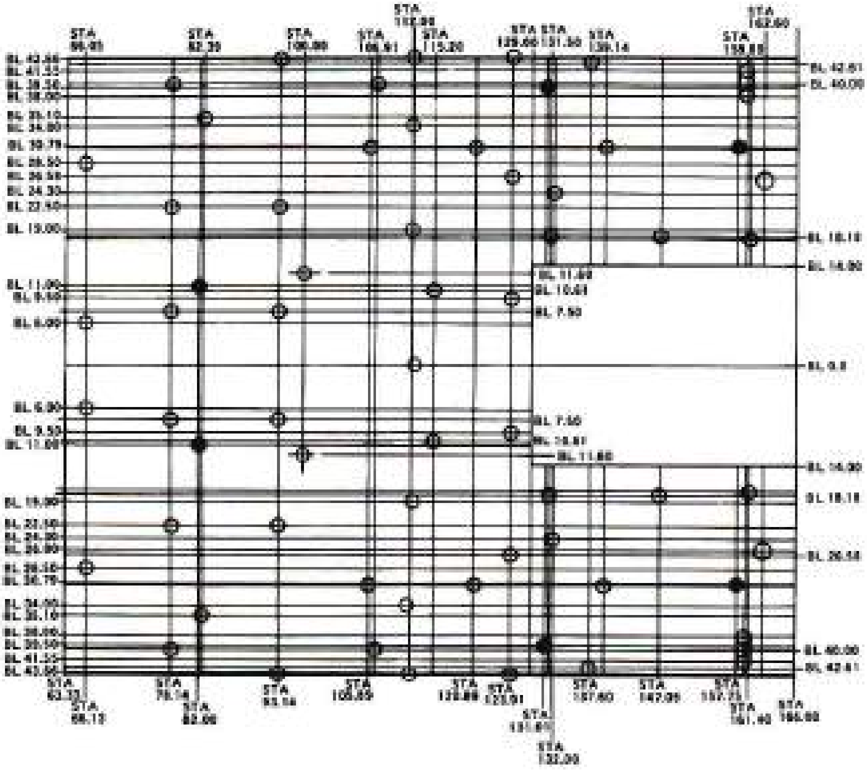


Figure 6-9. Cargo Tiedown Fitting Data

INTERNAL CARGO WEIGHT AND MOMENT

EXAMPLE

WANTED

CARGO MOMENT FOR A GIVEN CARGO WEIGHT AND FUSELAGE STATION

KNOWN

CARGO WEIGHT 1000 LBS
LOCATION FS105

METHOD

ENTER INTERNAL CARGO WEIGHT
MOVE RIGHT TO FS105
MOVE DOWN TO BASE-LINE AND READ 1050 INCH POUNDS/100

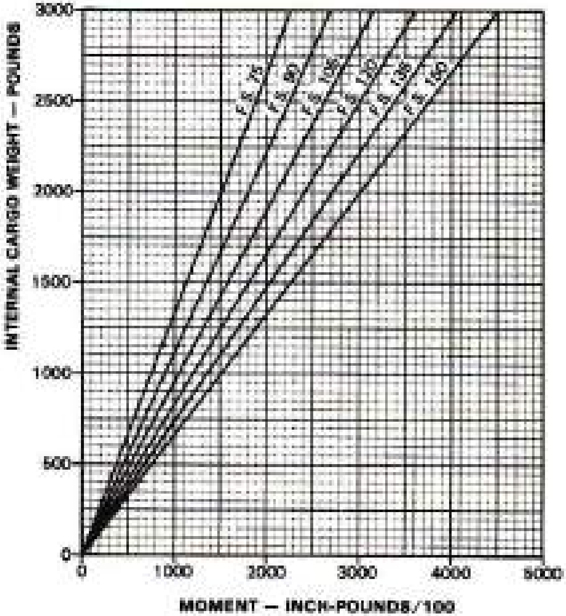


Figure 6-10. Internal Cargo Weight and Moment

EXTERNAL CARGO WEIGHT AND MOMENT

F.S. 137.55

EXAMPLE

WANTED

CARGO MOMENT/100 FOR A GIVEN CARGO WEIGHT.

KNOWN

CARGO WEIGHT 3000 LBS

METHOD

ENTER EXTERNAL CARGO WEIGHT MOVE RIGHT TO DIAGONAL LINE MOVE DOWN TO BASELINE AND READ 4127 ON MOMENT/100 SCALE.

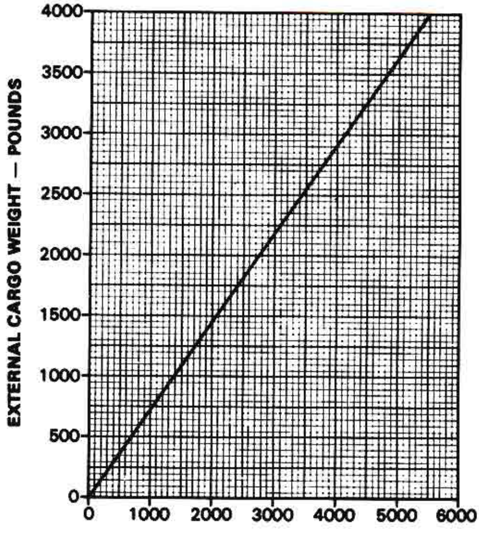


Figure 6-11. External Cargo Weight and Moment

CENTER OF GRAVITY LIMITS

C.G. LIMITS

EXAMPLE

WANTED

DETERMINE CENTER OF GRAVITY FOR KNOWN WEIGHT AND MOMENT.

KNOWN

GROSS WEIGHT EQUALS 8460 POUNDS, MOMENT/100 EQUALS 11,900 INCH-POUNDS

METHOD

MOVE RIGHT FROM 8460 POUNDS TO A POINT APPROXIMATELY 1/2 OF THE DISTANCE BETWEEN 11,800 AND 12,000 INCH-POUND DIAGONAL LINES. FROM THIS POINT PROJECT DOWN TO READ 140.6 ON THE CENTER OF GRAVITY SCALE (FUSELAGE STATION IN INCHES).

NOTE

WHEN CG IS WITHIN SHADED AREA AFT OF STATION 140.0, APPROACHES SHOULD BE TERMINATED TO A 5-FOOT HOVER FOR ADEQUATE TAIL ROTOR CLEARANCE.

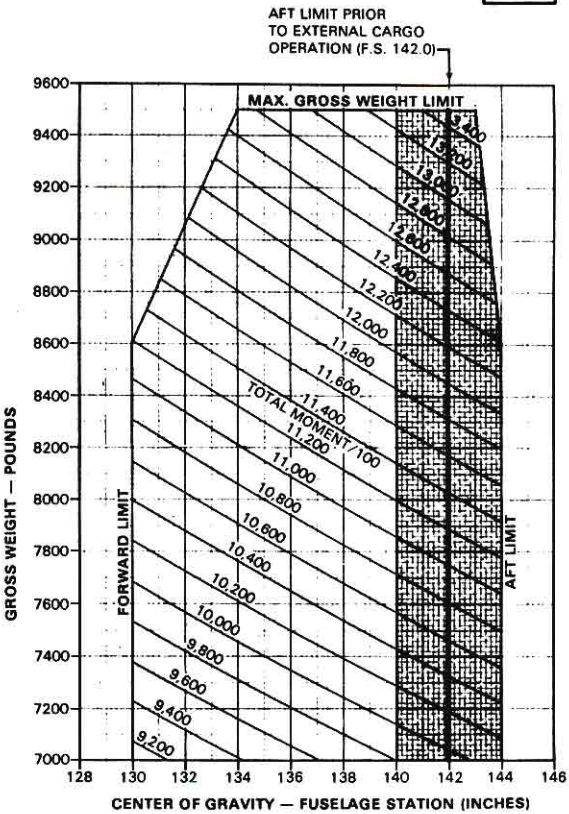


Figure 6-12. Center of Gravity Limits (Sheet 1 of 2)

CENTER OF GRAVITY LIMITS

C.G. LIMITS

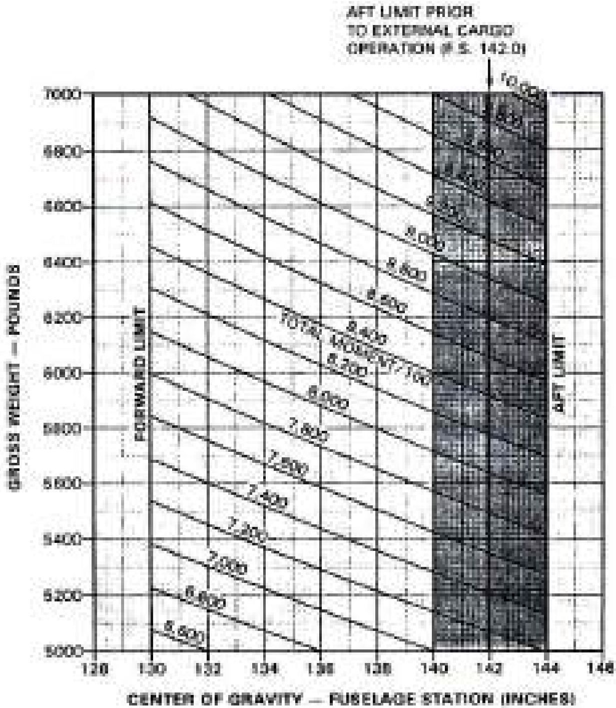


Figure 6-12. Center of Gravity Limits (Sheet 2 of 2)

Chapter 7

Performance Data

Section I. INTRODUCTION

7-1. Purpose The purpose of this chapter is to provide performance data. Regular use of this information will enable you to receive maximum safe utilization from the helicopter. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons:

a. Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.

b. Situations requiring maximum performance will be more readily recognized.

c. Familiarity with the data will allow performance to be computed more easily and quickly.

d. Experience will be gained in accurately estimating the effects of variables for which data are not presented.

NOTE

The information provided in this chapter is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used inflight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-2. Chapter 7 Index The following index contains a list of the sections and their titles, the figure numbers, subjects of each performance data chart contained in this chapter.

INDEX

Altitude Sea Level to 2000 Ft
18, 4000 Ft to 6000 Ft
19, 8000 Ft to 10000 Ft
20, 12000 Ft 14000 Ft
21, FAT =45°C, Pressure
Altitude Sea Level to 2000 Ft
22, 4000 Ft to 6000 Ft
23, 8000 Ft to 10000 Ft
24, 12000 Ft to 14000 Ft

VI Drag
Figure 7-7. Drag Chart
Sheet 1, Drag (Authorized Configurations) Chart
Sheet 2, Drag Chart

VII Climb-Descent
Figure 7-8. Climb-Descent Chart

VIII Fuel Flow
Figure 7-9. Fuel Flow
Sheet 1, Idle Fuel Flow Chart
Sheet 2, Fuel Flow vs. Torque

7-3. General The data presented covers the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgment and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text. Where practical, data are presented at conservative conditions. However NO GENERAL CONSERVATISM HAS BEEN APPLIED. All performance data presented are within the applicable limits of the helicopter.

7-4. Limits Applicable limits are shown on the charts. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13 so proper maintenance action can be taken.

7-5. Use of Charts

a. *Chart Explanation*. The first page of each section describes the chart(s) and explains its uses.

b. *Shading*. Shaded areas on charts indicate precautionary or time limited operation.

c. *Reading the Charts*. The primary use of each chart is given in an example to help you follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, reflect down at right angles to the third variable, reflects left at right angles to the fourth variable, reflect down, etc. until the final variable is read out at the final scale.

NOTE

An example of an auxiliary use of the charts referenced above is as follows: Although the hover chart is primarily arranged to find torque required to hover, by entering torque available as required, maximum skid height for hover can also be found. In general, any single variable can be found if all others are known. Also, the tradeoffs between two variables can be found. For example, at a given pressure altitude, you can find the maximum gross weight capability as free air temperature changes.

d. *Dashed Line Data*. Data beyond conditions for which tests were conducted are shown as dashed lines.

7-6. Data Basis The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date are also given. The data provided generally is based on one of four categories:

a. *Flight Test Data*. Data obtained by flight test of the aircraft by experienced flight test personnel at precise conditions using sensitive calibrated instruments.

b. *Derived From Flight Test*. Flight test data obtained on a similar rather than the same aircraft and series. Generally small corrections will have been made.

c. *Calculated Data*. Data based on tests, but not on flight test of the complete aircraft.

d. *Estimated Data*. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-7. Specific Conditions The data presented are accurate only for specific conditions listed under the title of each chart. Variables for which data are not presented, but which may affect that phase of performance, are discussed in the text. Where data are available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-8. General Conditions In addition to the specific conditions, the following general conditions are applicable to the performance data.

a. Rigging. All airframe and engine controls are assumed to be rigged within allowable tolerances.

b. Pilot Technique. Normal pilot technique is assumed. Control movements should be smooth and continuous.

c. Helicopter Variation. Variation in performance between individual helicopters are known to exist; however, they are considered to be small and cannot be individually accounted for.

d. Instrument Variation. The data shown in the performance charts do not account for instrument inaccuracies or malfunctions.

7-9. Performance Discrepancies Regular use of this chapter will allow you to monitor instruments and other helicopter systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data are not provided, thereby increasing the accuracy of performance predictions.

7-10. Definitions of Abbreviations

a. Unless otherwise indicated abbreviations and symbols used in this manual conform to those established in Military Standard MIL-STD-12, which is periodically revised to reflect current changes in abbreviations usage.

b. Capitalization and punctuation of abbreviations varies, depending upon the context in which they are used. In general, lower case abbreviations are used in text material, whereas abbreviations used in charts and illustrations appears in full capital letters. Periods do not usually follow abbreviations; however, periods are used with abbreviations that could be mistaken for whole words if the period were omitted.

7-11. Temperature Conversion The temperature conversion chart figure 7-1 is arranged so that degrees celsius can be converted quickly and easily by reading celsius and looking directly across the charts for fahrenheit equivalence and vice versa.

Section II. TORQUE AVAILABLE

7-12. Description The torque available charts show the effects of altitude and temperature on engine torque.

7-13. Chart Differences Both pressure altitude and FAT affect engine power production. Figure 7-2 shows power available data at 30 minute power ratings in terms of the allowable torque as recorded by the torquemeter (psi). Note that the power output capability of the T53-L-13 engine can exceed the transmission structural limit (50 psi calibrated) under certain conditions.

a. Figure 7-2 is applicable for maximum power, 30 minute operation at 324 rotor/6600 engine rpm.

b. If the hot metal plus plume tailpipe is installed on the aircraft, subtract 1 psi from the torque values obtained from figure 7-2.

7-14. Use of Chart The primary use of the chart is illustrated by the examples. In general, to determine the maximum power available, it is necessary to know the pressure altitude and temperature. The calibration factor (Data Plate Torque), obtained from the engine data plate or from the engine acceptance records, is the indicated torque pressure at 1125 ft-lbs actual output shaft torque, and is used to correct the error of individual engine torque indicating system.

NOTE

Torque available values determined are not limits. Any torque which can be achieved, without exceeding engine, transmission, or other limits, may be used.

7-15. Conditions Chart (fig 7-2) is based upon speeds of 324 rotor/6600 engine rpm grade J-4 fuel. The use of aviation gasoline will not influence engine power. All torque availables are presented for bleed air heater and deice off. Decrease power available 1.4 psi for heater on and 2.1 psi for deice on; decrease torque available 3.5 psi if both bleed air heater and deice are operating.

Section III. HOVER

7-16. Description The hover charts (fig 7-3, sheets 1 and 2) shows the hover ceiling and the torque required to hover respectively at various pressure altitudes, ambient temperatures, gross weights, and skid heights. Maximum skid height for hover can also be obtained by using the torque available from figure 7-2.

7-17. Use of Chart The primary use of the hover charts is illustrated by the charts examples. In general, to determine the hover ceiling or the torque required to hover, it is necessary to know the pressure altitude, temperature, gross weight and the desired skid height. In addition to its primary use, the hover chart (sheet 2) can also be used to determine the predicted maximum hover height, which is needed for use of the takeoff chart (fig 7-5).

7-18. Control Margin

a. Sheet 1 of the control margin charts (fig 7-4) shows the maximum right crosswind which one can achieve and still maintain directional control as a function of pressure altitude, temperature, and gross weight. Sheet 2 of the control margin chart (fig 7-4) shows the combinations of relative wind velocity and azimuth which may result in marginal directional or longitudinal control.

b. Use of the control margin charts is illustrated by the example on sheet 1. Ten percent pedal margin (full right to full left) is considered adequate for directional control when hovering. The shaded area on sheet 1 indicates conditions where the directional control margin may be less than ten percent in zero wind hover. The shaded area on sheet 2 labeled DIRECTIONAL indicates conditions where the directional control margin may be less than ten percent for crosswind components in excess of those determined from sheet 1. The shaded area on sheet 2 labeled LONGITUDINAL indicates wind conditions where longitudinal control may be less than 10 percent. These charts are based on control margin only.

7-19. Conditions

a. The hover charts are based upon calm wind conditions, a level ground surface, and the use of 324 rotor rpm.

b. The control margin charts are based on test of in-ground effect (IGE) translation flight over a level surface at 324 rotor rpm. Use of these charts is to determine if adequate control margin will be available for IGE and OGE hover in winds or low speed translation.

Section IV. TAKEOFF

7-20. Description The takeoff chart (fig 7-5) shows the distances to clear various obstacle heights, based upon several hover height capabilities. The upper chart grid presents data for climbout at a constant INDICATED airspeed. The two lower grids present data for climbouts at various TRUE airspeeds. Figure 7-5, sheet 1, is based upon level acceleration technique, sheet 2 is based upon a climb and acceleration from a 3 foot skid height and sheet 3 is based upon a level acceleration from a 15 foot skid height.

NOTE

The hover heights shown on the chart are only a measure of the aircraft's climb capability and do not imply that a higher than normal hover height should be used during the actual takeoff.

7-21. Use of Charts The primary use of these charts is illustrated by the charts examples. The main consideration for takeoff performance is the hovering skid height capability, which includes the effects of pressure altitude, free air temperature, gross weight, and torque. Hover height capability is determined by use of the hover chart, figure 7-3. A hover check can be made to verify the hover capability. If winds are present, the hover check may disclose that the helicopter can actually hover at a greater skid height than the calculated value, since the hover chart is based upon calm wind conditions.

7-22. Conditions

a. Wind. The takeoff chart is based upon calm wind conditions. Since surface wind velocity and direction cannot be accurately predicted, all takeoff planning should be based upon calm wind conditions. Takeoff into any prevailing wind will improve the takeoff performance.

WARNING

A tailwind during takeoff and climbout will increase the obstacle clearance distance and could prevent a successful takeoff.

b. Power Settings. All takeoff performance data are based upon the torque used in determining the hover capabilities in figure 7-3.

Section V. CRUISE

7-23. Description The cruise charts (fig 7-6, sheets 1 through 24) show the torque pressure and engine rpm required for level flight at various pressure altitudes, airspeeds, gross weights and fuel flows.

NOTE

The cruise charts are basically arranged by FAT groupings. Figure 7-6, sheets 1 through 24, are based upon operation with clean configuration. Each chart has a dashed line that represents a ten square foot equivalent flat plate drag area. This allows quick determination of Delta PSI for other than clean configurations.

7-24. Use of Charts

CAUTION

Cruise flight is restricted to 319 to 324 Rotor RPM (6500 to 6600 Engine RPM.). Cruise at 324 Rotor/6600 Engine RPM is recommended. The cruise chart data for true airspeeds above 40 KTAS is based on 314 Rotor/6400 Engine RPM. Until the cruise charts are revised performance planning shall be accomplished using the procedures and torque corrections from Table 7-1.

The primary use of the charts is illustrated by the examples provided in figure 7-6. The first step for chart use is to select the proper chart, based upon the planned drags configuration, pressure altitude and anticipated free air temperature; refer to chapter 7 index (para 7-2). Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and FAT, or the next higher altitude and FAT. If greater accuracy is required, interpolation between altitudes and/or temperatures will be required. You may enter the charts on any side: TAS, IAS, torque pressure, or fuel flow, and then move vertically or horizontally to the gross weight, then to the other three parameters. Maximum performance conditions are determined by entering the chart where the maximum range or maximum endurance and rate of climb lines intersect the appropriate gross weight; then read airspeed, fuel flow and PSI torque pressure. For conservatism, use the gross weight at the beginning of cruise flight. For greater accuracy on long flights it is preferable to determine cruise information for several flight segments in order to allow for decreasing fuel weights (reduced gross weight). Estimated performance data is presented for hover (KTAS=0) in figure 7-6, however, the hover performance data presented in figure 7-3 is more accurate and should be used in planning critical hover performance. The following parameters contained in each chart are further explaned as follows:

a. Airspeed. True and indicated airspeeds are presented at opposite sides of each chart. On any chart, indicated airspeed can be directly converted to true airspeed (or vice versa) by reading directly across the chart without regard for other chart information. Maximum permissible airspeed (VNE) limits appear on some charts. If no line appears, VNE is above the limits of the chart.

b. Torque Pressure (PSI). Since pressure altitude and temperature are fixed for each chart, torque pressures vary according to gross weight, airspeed and bleed air on or off. See paragraph 7-15 for effect of bleed air heater and deice.

NOTE

Torque available values determined are not limits. Any torque which can be achieved, without exceeding engine, transmission, or other limits, may be used.

c. Fuel Flow. Fuel flow scales are provided opposite the torque pressure scales. On any chart, torque pressure may be converted directly to fuel flow without regard for other chart information. All fuel flows are presented for bleed air heater and deice off. Add two percent fuel flow (about 14 lb/hr) for heater on and increase fuel flow three percent (approximately 21 lb/hr) for deice on. If both are operating, add five percent fuel flow (about 35 lb/hr) to chart values.

d. Maximum Range. The maximum range lines indicate the combinations of weight and airspeed that will produce the greatest flight range per gallon of fuel under zero wind conditions. When a maximum range condition does not appear on a chart it is because the maximum range speed is beyond the maximum permissible speed (VNE); in such cases, use VNE cruising speed to obtain maximum range.

e. Maximum Endurance and Rate of Climb. The maximum endurance and rate of climb lines indicate the airspeed for minimum torque pressure required to maintain level flight for each gross weight, FAT and pressure altitude. Since minimum torque pressure will provide minimum fuel flow, maximum flight endurance will be obtained at the airpeeds indicated.

7-25. Conditions The cruise charts are based upon operations at 324 rotor/6600 engine rpm below 40 KTAS and 314 rotor/6400 engine rpm for true airspeeds above 40 knots.

Section VI. DRAG

7-26. Description The drag chart (fig 7-7, sheet 1 of 2) shows the authorized configuration or the equivalent flat plate drag area changes for additional aircraft modifications. There is no increase in drag with cargo doors fully open. The upper left portion of figure 7-7, sheet 2 of 2, presents drag areas of typical external loads as a function of the load frontal area. The balance of the charts shows the additional torque required in level flight due to the increase in drag caused by external loads, aircraft modifications or authorized configurations.

7-27. Use of Chart The primary use of the chart is illustrated by the example. To determine the change in torque it is necessary to know the drag area change, the true airspeed, the pressure altitude and the free air temperature. Enter at the known drag area change, move right to TAS, move down to pressure altitude, move left to FAT, then move down and read change in torque. In addition, by entering the chart in the opposite direction, drag area change may be found from a known torque change. This chart is used to adjust cruise charts for appropriate torque and fuel flow due to equivalent flat plate drag area change (ΔF). For frontal areas exceeding values shown on figure 7-7 (sheet 2 of 2) use a smaller value and multiply, e.g. 36 sq. ft.=9 sq. ft.x4.

7-28. Conditions The drag chart is based upon 314 rotor/6400 engine rpm.

Section VII. CLIMB-DESCENT

7-29. Description

The climb descent chart fig 7-8, shows the change in torque (above or below torque required for level flight under the same gross weight and atmospheric conditions) to obtain a given rate of climb or descent.

7-30. Use of Chart

Climb-Descent. The primary uses of the chart are illustrated by the chart examples.

a. The torque change obtained from the grid scale must be added to the torque required for level flight (for climb)—or subtracted from the torque required for level fight (for descent)—obtained from the appropriate cruise chart in order to obtain a total climb or descent torque.

b. By entering the bottom of the grid with a known torque change, moving upward to the gross weight, and left to the corresponding rate of climb or descent may also be obtained.

7-31. Conditions

Climb-Descent. The climb-descent chart is based on the use of constant rotor or engine rpm. The rate of climb (descent) presented is for steady state conditions and rpm bleed could increase (decrease) the rate of climb (descent) shown.

Section VIII. FUEL FLOW

7-32. Description

a. The fuel flow chart (fig 7-9) shows the fuel flow at engine idle and 324 rotor/6600 engine rpm with flat pitch.

b. Fuel flow vs torque, shows fuel flow in pound-per-hour versus torquemeter psi for pressure altitudes from sea level to 14000 feet and for 0°C free air temperature.

7-33. Use of Chart

a. The primary use of the idle fuel flow chart is illustrated by the example. To determine the idle fuel flow, it is necessary to know the idle condition, pressure altitude, and free air temperature. Enter at the pressure altitude, move right to FAT in appropriate grid, then move down and read fuel flow on the scale corresponding to the condition. Refer to the cruise charts to obtain fuel flow for cruise power conditions.

b. Fuel flow will increase about two percent with the bleed air heater on and three percent with deice on. When both systems are on, increase fuel flow five percent. Also a range or endurance penalty should be accounted for when working cruise chart data. A fairly accurate rule-of-thumb to correct fuel flow for temperatures other than 0°C FAT is to increase (decrease) fuel flow 1 percent for each 10°C increase (decrease) in FAT.

7-34. Conditions

These charts are based upon the use of JP-4 fuel. The change in fuel flow when using other jet fuels is insignificant.

Table 7-1 Torque Correction (Sheet 1 of 4)

To determine cruise performance data for 324 Rotor/6600 Engine RPM at speeds above 40 KTAS, follow the instructions in paragraph 7-24 except:

a. Add appropriate torque correction from this table to the calibrated torque required values determined from the intersection of the airspeed and gross weight lines on the upper (6400 Engine RPM) portion of the cruise chart.

b. Determine fuel flow corresponding to the corrected torque required from the lower (6600 Engine RPM) portion of the cruise chart.

c. Determine continuous torque available (CONT TRQ AVAIL) and 30 minute torque available (30 MIN TRQ AVAIL) from the lower (6600 Engine RPM) portion of the cruise chart.

EXAMPLE

WANTED

Speed for Maximum Range
Calibrate Torque Required and Fuel Flow at Maximum Range

KNOWN

324 Rotor/6600 Engine RPM
Clean Configuration
FAT = -30°C
Pressure Altitude = 8000 feet
Gross Weight = 8500 pounds
Roof Mounted System

METHOD

Locate (-30°C FAT, 8000 Feet) Chart (figure 7-6 Sheet 3 of 24)
Find Intersection of 8500 LB Gr Wt Line With the Max Range Line
To Read Speed for Maximum Range:
Move Right, Read TAS = 105.3 Knot
Move Left, Read IAS = 102.3
To Read Calibrated Torque Required @ 314 Rotor/6400 Engine RPM
Move Down, Read Torque = 41.2 PSI
To Correct Torque Required for 6600 Engine RPM
From Table for Sheet 3 (8000 Ft -30°C) @ 8500 lb Gross Weight
For 90 KTAS, Torque Correction = 3.5 PSI
For 110 KTAS, Torque Correction = 5.7 PSI
Interpolate for 105.3 KTAS Torque Correction = 5.2 PSI
Corrected Torque Required = 41.2 PSI + 5.2 PSI = 46.4 PSI
To Determine Fuel Flow
Enter Figure 7-6, Sheet 3 of 24 At 46.4 PSI Torque:
Move Down Read Fuel Flow = 614 Lb/Hr

TABLE 7-1 TORQUE CORRECTION (Sheet 2 of 4)

		TORQUE CORRECTION - PSI							
(-30°C FAT)		SHEET 1		SHEET 2		SHEET 3		SHEET 4	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	NA	NA	2.4	2.2	2.1	1.9	1.8
	70	NA	NA	NA	2.8	2.6	2.4	2.2	2.2
	90	NA	NA	NA	3.5	3.4	3.2	3.0	2.9
	110	NA	NA	NA	5.9	5.5	5.2	4.9	4.5
6500	50	3.0	2.8	2.6	2.4	2.2	2.2	2.1	1.9
	70	3.3	3.2	3.1	2.9	2.6	2.5	2.4	2.3
	90	4.3	4.1	3.9	3.7	3.5	3.4	2.9	2.9
	110	7.3	6.9	6.4	6.1	5.6	5.3	4.5	4.6
7500	50	3.1	2.9	2.6	2.5	2.3	2.3	1.7	1.4
	70	3.5	3.3	3.0	3.0	2.8	2.7	2.2	2.2
	90	4.5	4.3	4.1	3.9	3.4	3.3	2.9	2.7
	110	7.4	7.0	6.5	6.2	5.3	5.3	4.7	4.7
8500	50	3.0	2.9	2.7	2.6	2.3	1.8	1.1	0.8
	70	3.5	3.4	3.3	3.1	2.8	2.6	1.8	1.1
	90	4.6	4.4	4.0	3.7	3.5	3.2	1.9	0.8
	110	7.5	7.1	6.4	6.0	5.7	5.5	2.6	0.6
9500	50	3.1	3.0	2.9	2.1	1.7	1.1	0.1	-1.8
	70	3.8	3.5	3.4	2.8	2.8	1.9	-0.6	-2.3
	90	4.9	4.2	4.2	3.5	3.5	2.0	-2.4	-1.5
	110	7.7	6.6	6.7	6.0	5.9	2.5	-4.8	1.4
[-15°C FAT]		SHEET 5		SHEET 6		SHEET 7		SHEET 8	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	NA	1.3	1.2	1.1	1.0	1.0	1.0
	70	NA	NA	1.9	1.7	1.7	1.5	1.5	1.3
	90	NA	NA	2.6	2.5	2.3	2.2	2.1	1.9
	110	NA	NA	3.0	2.9	2.6	2.4	2.3	2.0
6500	50	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.5
	70	2.2	2.1	1.9	1.7	1.7	1.6	1.5	1.3
	90	3.0	2.9	2.7	2.5	2.4	2.2	2.1	1.8
	110	3.5	3.3	3.1	2.8	2.7	2.3	2.2	1.8
7500	50	1.6	1.4	1.3	1.3	1.2	0.7	0.7	0.3
	70	2.2	2.0	2.0	1.9	1.8	1.6	1.6	0.6
	90	3.2	2.9	2.8	2.6	2.4	2.1	2.0	0.9
	110	3.6	3.3	3.2	2.7	2.5	2.2	2.1	-0.5
8500	50	1.6	1.5	1.4	1.1	0.7	0.5	0.5	-0.9
	70	2.3	2.2	2.1	1.9	1.7	1.2	0.8	-1.4
	90	3.3	3.1	2.8	2.6	2.2	1.6	1.3	-3.2
	110	3.6	3.3	2.8	2.7	2.3	0.8	-0.2	-7.5
9500	50	1.6	1.4	0.8	0.9	0.4	-0.1	-0.8	-7.5
	70	2.3	2.3	2.0	2.0	0.8	-0.2	-1.2	-6.6
	90	3.2	3.1	2.6	2.6	1.2	-0.8	-2.9	-6.8
	110	3.2	3.1	2.7	2.7	-0.7	-3.8	-7.2	-6.9

TABLE 7-1 TORQUE CORRECTION (Sheet 1 of 4)

		TORQUE CORRECTION - PSI							
[0°C FAT]		SHEET 9		SHEET 10		SHEET 11		SHEET 12	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	NA	1.1	1.1	1.0	0.9	0.9	0.8
	70	NA	NA	1.2	1.1	1.1	1.0	0.9	0.8
	90	NA	NA	1.4	1.3	1.2	1.1	1.1	1.0
	110	NA	NA	2.5	2.3	2.1	2.0	1.9	1.6
6500	50	1.4	1.3	1.1	1.2	1.1	0.9	0.7	0.6
	70	1.4	1.3	1.2	1.2	1.1	0.9	0.8	0.8
	90	1.6	1.5	1.4	1.4	1.2	1.2	0.9	0.9
	110	2.9	2.7	2.5	2.4	2.1	2.0	1.8	1.6
7500	50	1.3	1.3	1.2	1.1	0.9	0.7	0.4	0.4
	70	1.4	1.4	1.3	1.1	1.0	0.8	0.2	0.0
	90	1.6	1.6	1.4	1.3	1.2	0.9	0.3	0.0
	110	3.0	2.7	2.5	2.3	2.1	1.9	0.5	-0.1
8500	50	1.4	1.3	1.1	0.7	0.7	0.4	-0.5	-3.0
	70	1.5	1.3	1.2	0.9	0.8	0.1	-1.5	-3.8
	90	1.7	1.5	1.5	1.0	0.8	0.1	-3.8	-5.9
	110	3.0	2.5	2.5	2.1	1.8	0.0	-4.9	-8.8
9500	50	1.3	1.0	0.8	0.5	0.4	-0.8	-6.9	NA
	70	1.4	1.2	1.1	0.3	0.0	-2.0	-7.3	NA
	90	1.6	1.3	1.2	0.3	-0.3	-5.3	-8.5	NA
	110	2.8	2.6	2.4	0.4	-0.4	-6.3	-15.4	NA
(15°C FAT)		SHEET 13		SHEET 14		SHEET 15		SHEET 16	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	0.7	0.7	0.6	0.6	0.7	0.6	0.5
	70	NA	0.9	0.9	0.8	0.7	0.7	0.6	0.5
	90	NA	1.0	1.1	0.9	0.9	0.8	0.8	0.7
	110	NA	0.9	0.9	0.9	0.8	0.8	0.8	0.8
6500	50	0.8	0.7	0.7	0.8	0.7	0.6	0.4	0.2
	70	1.0	1.0	0.9	0.9	0.6	0.5	0.4	0.1
	90	1.2	1.1	1.0	0.9	0.9	0.8	0.6	0.3
	110	1.1	1.0	1.0	0.9	0.8	0.8	0.6	-0.3
7500	50	0.9	0.9	0.8	0.7	0.4	0.4	0.1	-1.0
	70	1.1	1.0	0.7	0.7	0.5	0.2	-0.2	-1.7
	90	1.2	1.1	1.0	1.0	0.6	0.5	-0.1	-4.2
	110	1.1	1.0	0.9	1.1	0.7	0.1	-1.2	-6.7
8500	50	0.9	0.8	0.6	0.5	0.0	-0.5	-1.3	-7.3
	70	0.9	0.8	0.6	0.5	-0.3	-0.9	-2.0	-7.1
	90	1.1	1.2	0.8	0.8	-0.1	-2.0	-5.0	-7.9
	110	1.0	1.1	0.8	0.8	-1.5	-4.0	-8.2	-19.6
9500	50	0.8	0.6	0.4	0.0	-1.4	-4.9	NA	NA
	70	0.7	0.6	0.2	-0.2	-2.2	-5.2	NA	NA
	90	1.2	0.8	0.4	0.0	-5.4	-7.3	NA	NA
	110	1.2	0.9	-0.2	-1.5	-8.7	-15.2	NA	NA

TABLE 7-1 TORQUE CORRECTION (Sheet 4 of 4)

		TORQUE CORRECTION - PSI							
[30°C FAT]		SHEET 17		SHEET 18		SHEET 19		SHEET 20	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.3
	70	0.8	0.7	0.7	0.6	0.6	0.5	0.3	0.3
	90	0.5	0.5	0.4	0.3	0.3	0.2	0.3	0.1
	110	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.6
6500	50	0.6	0.6	0.7	0.5	0.5	0.3	0.4	0.0
	70	0.7	0.7	0.6	0.5	0.4	0.4	0.3	-0.2
	90	0.6	0.4	0.3	0.3	0.4	0.1	0.1	-0.6
	110	1.0	0.9	0.8	0.8	1.0	0.6	0.5	-0.9
7500	50	0.9	0.7	0.6	0.3	0.4	-0.1	-0.6	-1.6
	70	0.8	0.5	0.5	0.4	0.3	-0.3	-0.9	-2.0
	90	0.3	0.3	0.4	0.1	0.2	-0.7	-2.7	-5.1
	110	0.9	1.0	1.0	0.8	0.7	-1.1	-2.8	-7.4
8500	50	0.7	0.6	0.5	0.1	0.0	-1.6	-6.3	NA
	70	0.5	0.4	0.4	0.0	-0.1	-2.1	-6.0	NA
	90	0.4	0.3	0.2	-0.4	-0.7	-5.7	-7.9	NA
	110	1.2	1.0	0.7	-0.6	-1.1	-8.0	-16.3	NA
9500	50	0.5	0.5	-0.1	-1.0	-2.2	-8.3	NA	NA
	70	0.4	0.5	-0.3	-1.3	-2.7	-7.7	NA	NA
	90	0.1	0.2	-0.8	-3.9	-6.6	-9.3	NA	NA
	110	0.8	0.8	-1.3	-5.4	-9.7	-21.5	NA	NA
[45°C FAT]		SHEET 21		SHEET 22		SHEET 23		SHEET 24	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	0.5	0.5	0.5	0.6	0.5	0.4	0.3	0.2
	70	0.4	0.5	0.4	0.3	0.3	0.1	0.2	0.1
	90	0.5	0.5	0.3	0.2	0.2	0.3	0.3	0.1
	110	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.0
6500	50	0.6	0.6	0.5	0.4	0.3	0.2	-0.1	-0.3
	70	0.5	0.4	0.3	0.2	0.2	0.1	-0.3	-0.6
	90	0.3	0.2	0.2	0.4	0.3	0.1	-0.4	-1.3
	110	0.3	0.4	0.4	0.4	0.3	0.0	-1.1	-2.5
7500	50	0.6	0.4	0.4	0.3	0.0	-0.1	-1.5	-5.9
	70	0.3	0.2	0.3	0.2	-0.2	-0.2	-2.1	-5.7
	90	0.3	0.4	0.4	0.1	-0.4	-0.6	-5.0	-6.9
	110	0.4	0.5	0.3	0.0	-0.9	-1.5	-7.9	-34.7
8500	50	0.5	0.3	0.2	-0.2	-1.4	-3.6	7.2	NA
	70	0.3	0.2	0.1	-0.3	-1.9	-3.9	8.0	NA
	90	0.5	0.1	0.0	-0.8	-4.4	-6.4	11.0	NA
	110	0.6	0.0	-0.3	-1.8	-7.2	-11.7	NA	NA
9500	50	0.4	-0.1	-0.4	-1.9	-7.7	NA	NA	NA
	70	0.2	-0.4	-0.6	-2.6	-7.5	NA	NA	NA
	90	0.3	-0.7	-1.4	-6.3	-8.8	NA	NA	NA
	110	0.1	-1.6	-2.8	-10.0	-18.8	NA	NA	NA

TEMPERATURE CONVERSION CHART

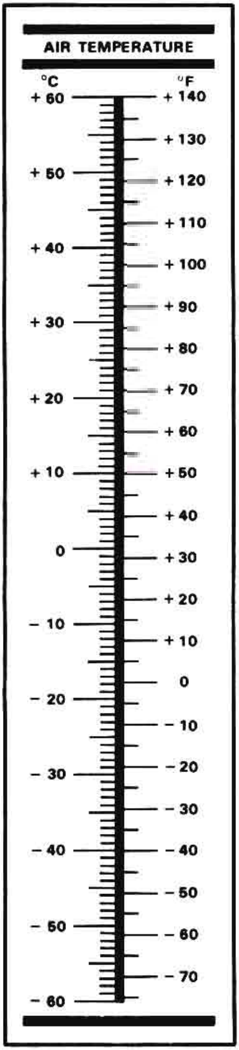


Figure 7-1. Temperature Conversion Chart

MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION)

ANTI-ICE OFF BLEED AIR HEATER OFF

324 ROTOR/6600 ENGINE RPM

EXAMPLE

WANTED

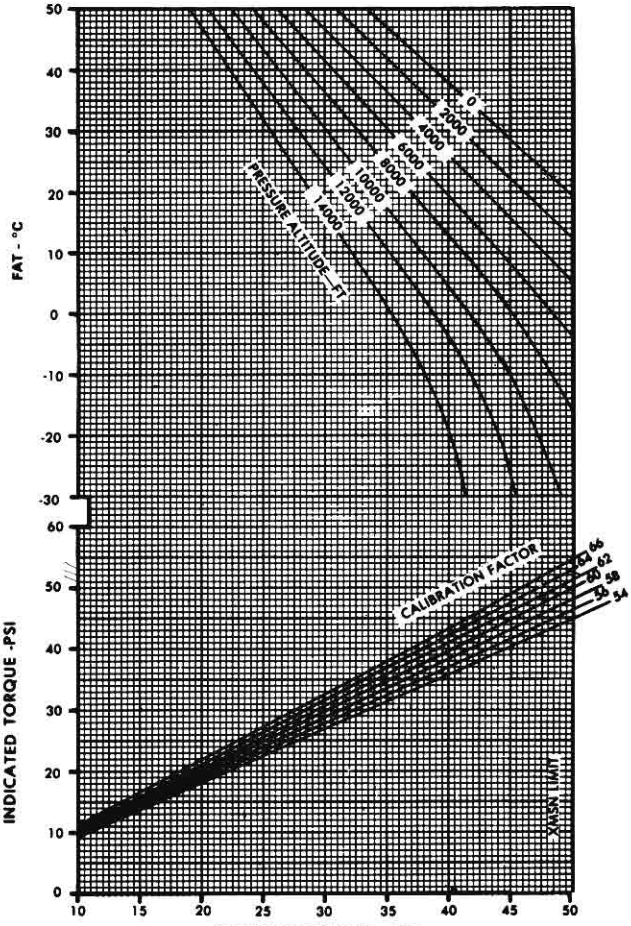
INDICATED TORQUE
CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 10,000 FT.
OAT = 15°C
CALIBRATION FACTOR = 66.0

METHOD

ENTER FAT
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO CALIBRATION FACTOR
MOVE LEFT, READ INDICATED TORQUE = 39 PSI
FOR CALIBRATED TORQUE CONTINUE DOWN THRU CALIBRATION FACTOR, READ CALIBRATED TORQUE = 36.0 PSI



DATA BASIS: CALCULATED FROM T53-L-13B ENGINE PROGRAM 19.28.25.03 CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST, ASTA 66-04, NOVEMBER 1970. AND LOSS DUE TO PARTICLE SEPARATOR

Figure 7-2. Maximum Torque Available (30 Minute Operation) Chart

HOVER POWER REQUIRED

LEVEL SURFACE CALM WIND
324 ROTOR/6600 ENGINE RPM

EXAMPLE

WANTED

TORQUE REQUIRED TO HOVER

KNOWN

PRESSURE ALTITUDE = 2000 FEET
FAT = -40°C
GROSS WEIGHT = 8500 LB
DESIRED SKID HEIGHT = 2 FEET

METHOD

ENTER PRESSURE ALTITUDE
MOVE RIGHT TO FAT
MOVE DOWN TO GROSS WEIGHT
MOVE LEFT TO SKID HEIGHT
MOVE DOWN, READ CALIBRATED TORQUE = 31.5 PSI
FROM THE TABLE FOR FAT = -40°C AND 31.5 PSI TORQUE
DETERMINE TORQUE CORRECTION OF 2.2 PSI

TORQUE REQUIRED TO HOVER IS 31.5 +2.2 = 33.7 PSI

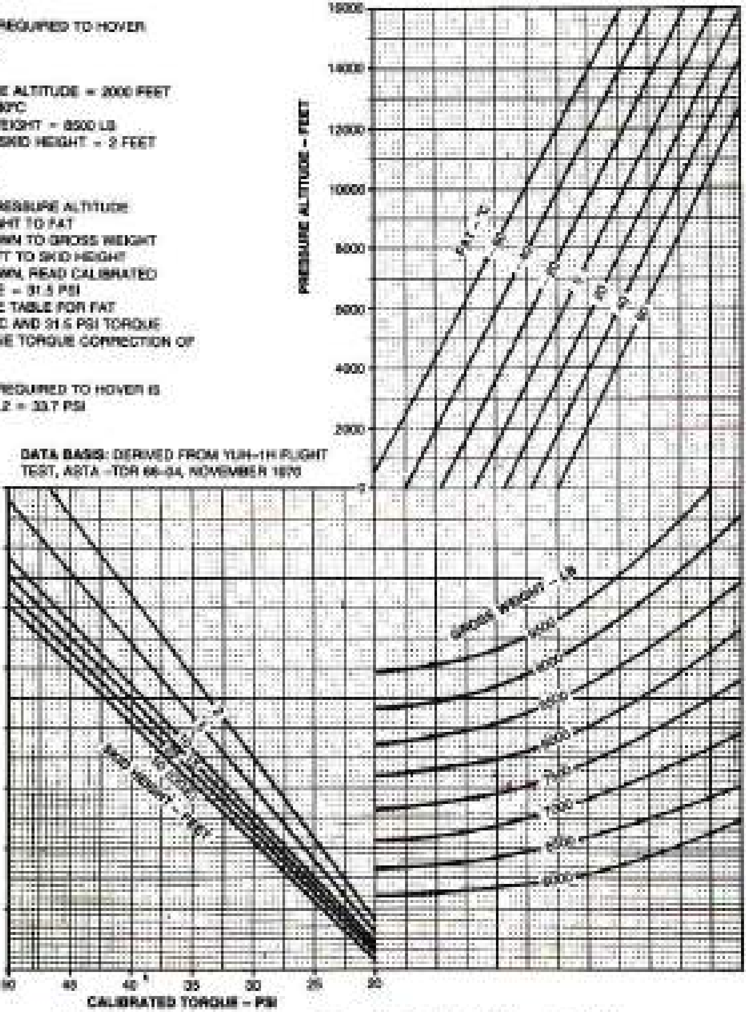


Figure 7-3. Hover (Power Required) Chart (Sheet 1 of 2)

HOVER CEILING

MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION)
324 ROTOR/6600 ENGINE RPM

EXAMPLE

WANTED

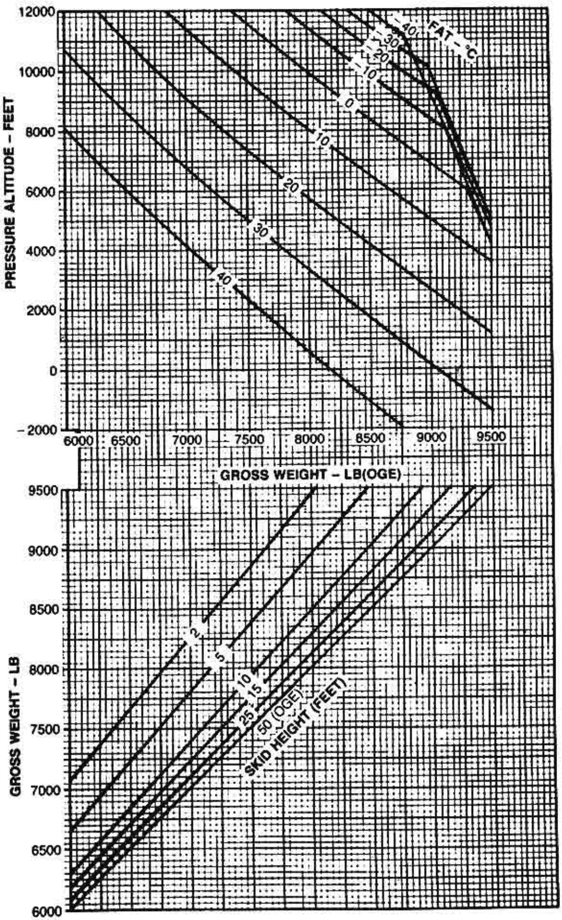
GROSS WEIGHT TO HOVER

KNOWN

PRESSURE ALTITUDE = 10600 FEET
FAT = 10°C
SKID HEIGHT = 2 FEET

METHOD

ENTER PRESSURE ALTITUDE
MOVE RIGHT TO FAT
MOVE DOWN TO SKID HEIGHT
MOVE LEFT, READ GROSS WEIGHT
TO HOVER = 8500 POUNDS



CORRECTION TABLE:

NOTE:
WHEN OPERATING BELOW 20°C
INCREASE TORQUE REQ'D BY:

PSI / FAT	20	30	40	50
0°C	.2	.3	.4	.5
-20°C	.4	.6	.8	1.0
-40°C	1.4	2.1	2.8	3.5
-50°C	2.4	3.6	4.8	6.0
-60°C	4.0	6.0	8.0	10.0

DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04 NOVEMBER 1970

Figure 7-3. Hover (Ceiling) Chart (Sheet 2 of 2)

EXAMPLE

WANTED

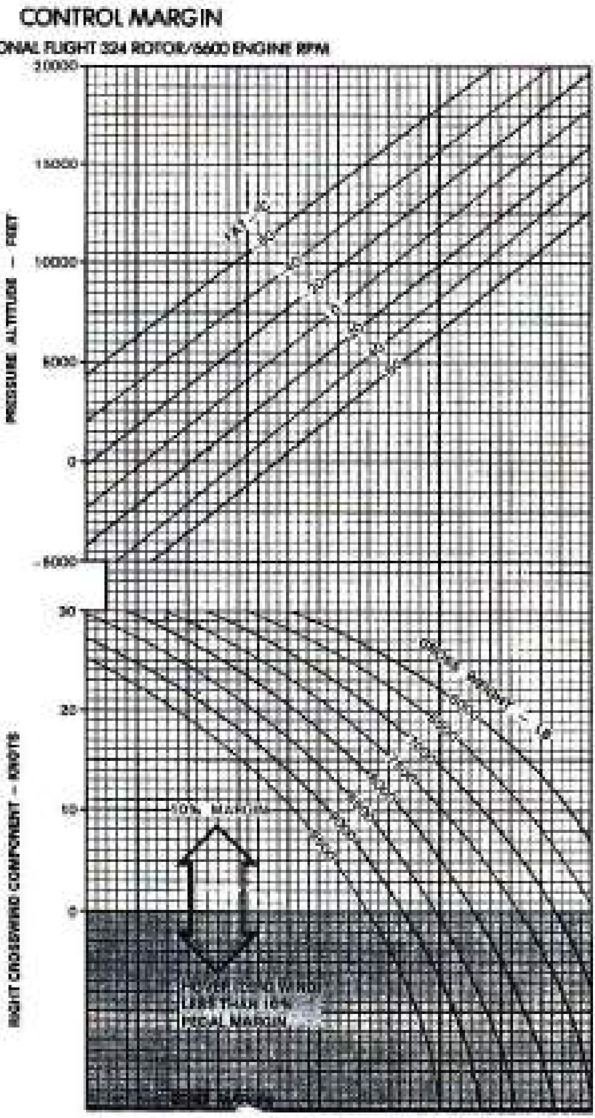
MAXIMUM RIGHT CROSSWIND COMPONENT WITH 10% SAFE PEDAL MARGIN

KNOWN

PRESSURE ALTITUDE = 5000 FEET
FAT = 0°C
GROSS WEIGHT = 8500 POUNDS

METHOD

ENTER PRESSURE ALTITUDE
MOVE RIGHT TO FAT
MOVE DOWN TO KNOWN GROSS WEIGHT
MOVE LEFT AND READ 18.8
RIGHT CROSSWIND COMPONENT
REFER TO SHEET 2. SAFE PEDAL MARGIN MAY BE LESS THAN 10% FOR CROSSWIND COMPONENTS GREATER THAN 18.8 KNOTS IN THE SHADED AREA LABELED DIRECTIONAL.



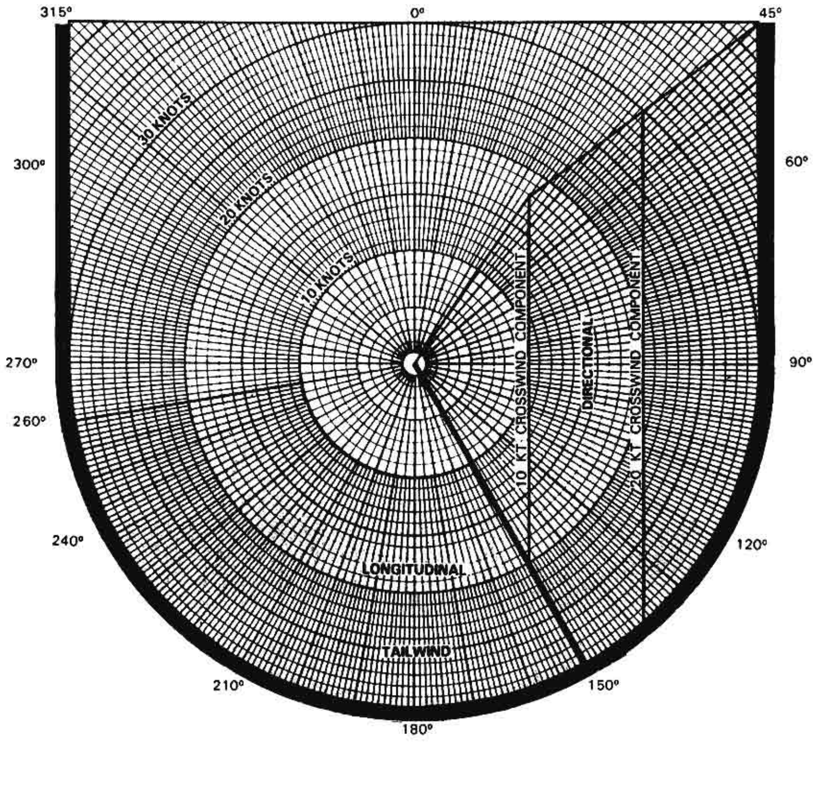
DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 7-4. Control margin (Sheet 1 of 2)

CONTROL MARGIN

TRANSLATIONAL FLIGHT 324 ROTOR/6600 ENGINE RPM

CONDITIONS WHERE THE CONTROL MARGIN MAY BE LESS THAN 10% ARE SHOWN IN SHADED AREA



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 68-37, JUNE 1969

Figure 7-4. Control margin (Sheet 2 of 2)

TAKEOFF

LEVEL ACCELERATION, 3 FT SKID HEIGHT
324 ROTOR/6600 ENGINE RPM MAXIMUM TORQUE AVAILABLE
CALM WIND LEVEL SURFACE ALL CONFIGURATIONS

EXAMPLE A

WANTED

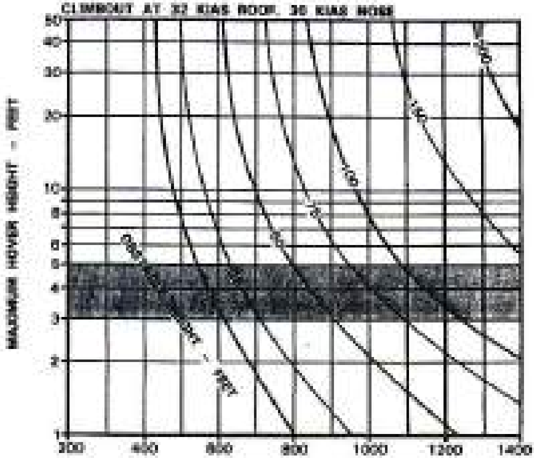
DISTANCE TO CLEAR OBSTACLE

KNOWN

MAXIMUM HOVER HEIGHT = 10 FEET
OBSTACLE HEIGHT = 50 FEET

METHOD

ENTER MAX HOVER HEIGHT
MOVE RIGHT TO OBSTACLE HEIGHT
MOVE DOWN, READ DISTANCE
TO CLEAR OBSTACLE = 700 FEET



EXAMPLE B

WANTED

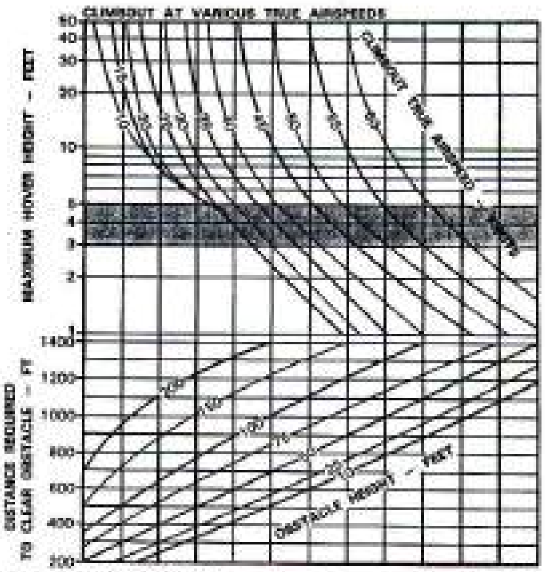
DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 8 FEET
OBSTACLE HEIGHT = 50 FEET
CLIMBOUT AIRSPEED = 40 KNOTS

METHOD

ENTER MAX HOVER HEIGHT
MOVE RIGHT TO CLIMBOUT TRUE AIRSPEED
MOVE DOWN TO OBSTACLE HEIGHT
MOVE LEFT READ DISTANCE
TO CLEAR OBSTACLE = 830 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST FTC-TDR 64-27, NOVEMBER 1964

Figure 7-5. Takeoff chart (Sheet 1 of 3)

TAKEOFF

CLIMB AND ACCELERATION, 3 FT SKID HEIGHT
324 ROTOR/6600 ENGINE RPM   MAXIMUM TORQUE AVAILABLE
CALM WIND LEVEL SURFACE   ALL CONFIGURATIONS

EXAMPLE A

WANTED

DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 17 FEET
OBSTACLE HEIGHT = 120 FEET

METHOD

ENTER MAX HOVER HEIGHT
MOVE RIGHT TO OBSTACLE HEIGHT
MOVE DOWN, READ DISTANCE
TO CLEAR OBSTACLE = 1420 FEET

EXAMPLE B

WANTED

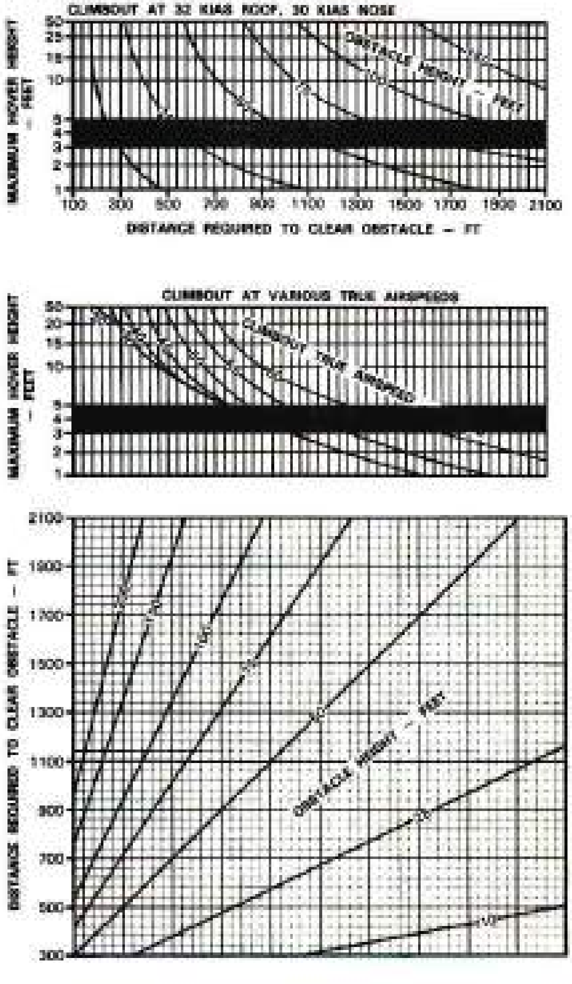
DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 17 FEET
OBSTACLE HEIGHT = 120 FEET
CLIMBOUT AIRSPEED = 50 KTAS

METHOD

ENTER MAX HOVER HEIGHT
MORE RIGHT TO AIRSPEED
MOVE DOWN TO OBSTACLE HEIGHT
MOVE LEFT, READ DISTANCE
TO CLEAR OBSTACLE = 1610 FEET



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-5. Takeoff Chart (Sheet 2 of 3)

TAKEOFF

LEVEL ACCELERATION, 15 FT SKID HEIGHT
324 ROTOR/6600 ENGINE RPM MAXIMUM TORQUE AVAILABLE
CALM WIND LEVEL SURFACE ALL CONFIGURATIONS

EXAMPLE A

WANTED

DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 17 FEET
OBSTACLE HEIGHT = 120 FEET

METHOD

ENTER MAX HOVER HEIGHT
MOVE RIGHT TO OBSTACLE HEIGHT
MOVE DOWN, READ DISTANCE
TO CLEAR OBSTACLE = 1125 FEET

EXAMPLE B

WANTED

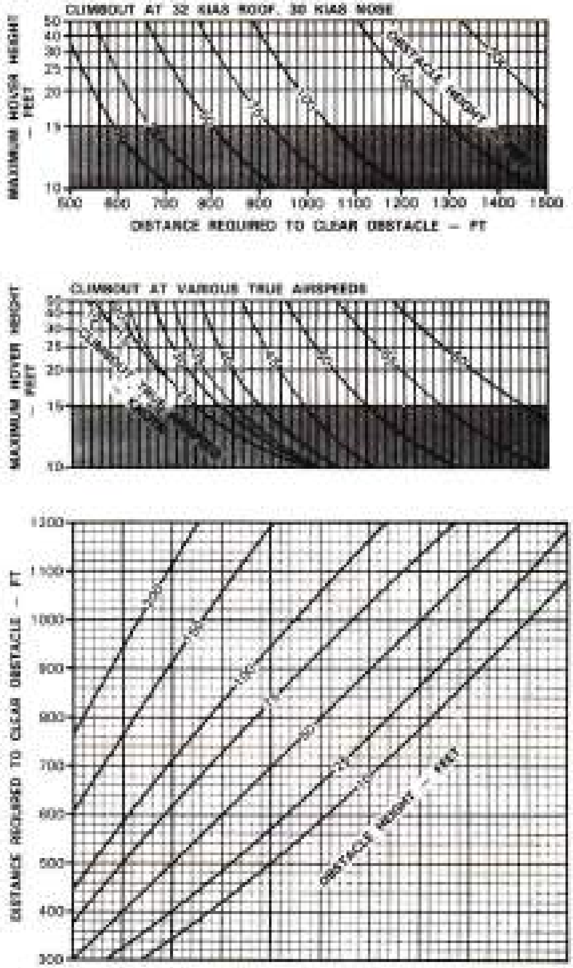
DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 17 FEET
OBSTACLE HEIGHT = 120 FEET
CLIMBOUT AIRSPEED = 40 KTAS

METHOD

ENTER MAX HOVER HEIGHT
MOVE RIGHT TO CLIMBOUT
TRUE AIRSPEED
MOVE DOWN TO OBSTACLE HEIGHT
MOVE LEFT, READ DISTANCE
TO CLEAR OBSTACLE = 1000 FEET



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-5. Takeoff Chart (Sheet 3 of 3)

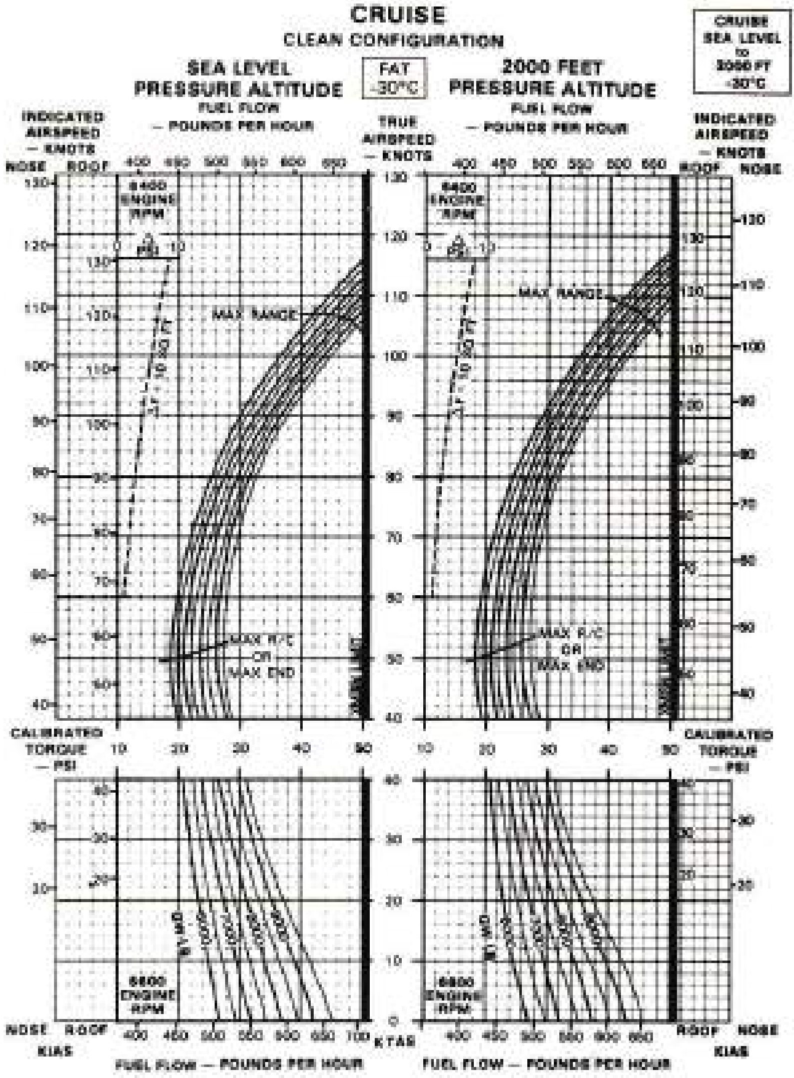


Figure 7-6. Cruise Chart (Sheet 1 of 24)

EXAMPLE

WANTED

CALIBRATED TORQUE REQUIRED FOR LEVEL FLIGHT, FUEL FLOW, INDICATED AIRSPEED

KNOWN

CLEAN CONFIGURATION
GROSS WEIGHT = 9000 LB
PRESSURE ALTITUDE = 5000 FEET
FAT = −30 °C
DESIRED TRUE AIRSPEED = 100 KNOTS ROOF MOUNTED SYSTEM

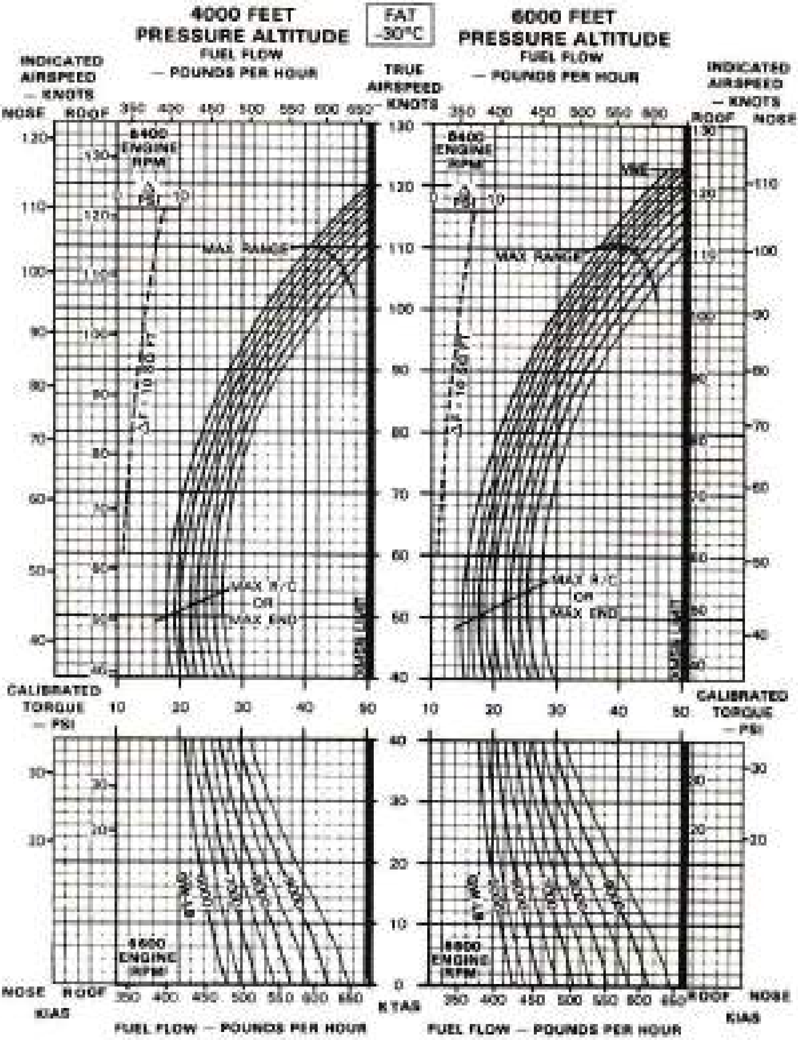
METHOD (INTERPOLATE)

ENTER TRUE AIRSPEED
READ CALIBRATED TORQUE, FUEL FLOW, AND IAS ON EACH ADJACENT ALTITUDE AND/OR FAT, THEN INTERPOLATE BETWEEN ALTITUDE AND/OR FAT.

ALTITUDE, FEET	4000 FT	6000 FEET	5000 FEET
FAT, C	−30	−30	−30
CALIBRATED TORQUE, PSI	41.2	40.2	40.7
FUEL FLOW, LB/HR	582	558	570
IAS, KNOTS	104.5	100.7	102.6

CRUISE

CLEAN CONFIGURATION



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (2 of 24)

EXAMPLE

WANTED

SPEED FOR MAXIMUM RANGE
CALIBRATE TORQUE REQUIRED AND FUEL FLOW AT MAXIMUM RANGE
SPEED FOR MAXIMUM ENDURANCE

KNOWN

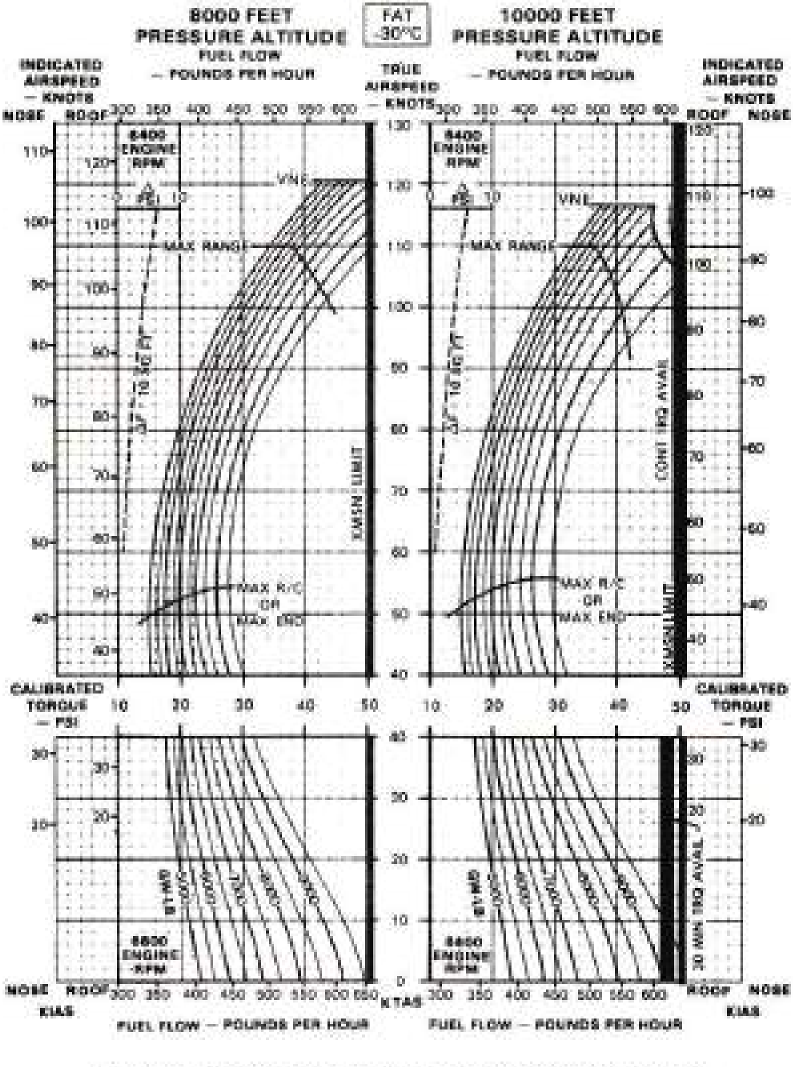
CLEAN CONFIGURATION, FAT = -30°C
PRESSURE ALTITUDE = 8000 FEET,
AND GROSS WEIGHT = 8500 POUNDS
ROOF MOUNTED SYSTEM

METHOD

LOCATE (-30°C FAT, 8000 FEET) CHART
FIND INTERSECTION OF 8500 GROSS WEIGHT LINE
WITH THE MAXIMUM RANGE LINE
TO READ SPEED FOR MAXIMUM RANGE:
MOVE RIGHT, READ TAS = 105.3 KNOT AND MOVE LEFT,
READ IAS = 102.3
TO READ FUEL FLOW REQUIRED:
MOVE UP, READ FUEL FLOW = 554 LB/HR
TO READ CALIBRATED TORQUE REQUIRED:
MOVE DOWN, READ TORQUE = 41.2 PSI
FIND INTERSECTION OF 8500 LB GROSS WEIGHT LINE
WITH THE MAXIMUM ENDURANCE LINE
TO READ SPEED FOR MAXIMUM ENDURANCE
MOVE RIGHT, READ TAS = 53.9 KNOTS AND MOVE LEFT,
READ IAS = 50.5 KNOTS

CRUISE

CLEAN CONFIGURATION



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 3 of 24)

EXAMPLE

WANTED

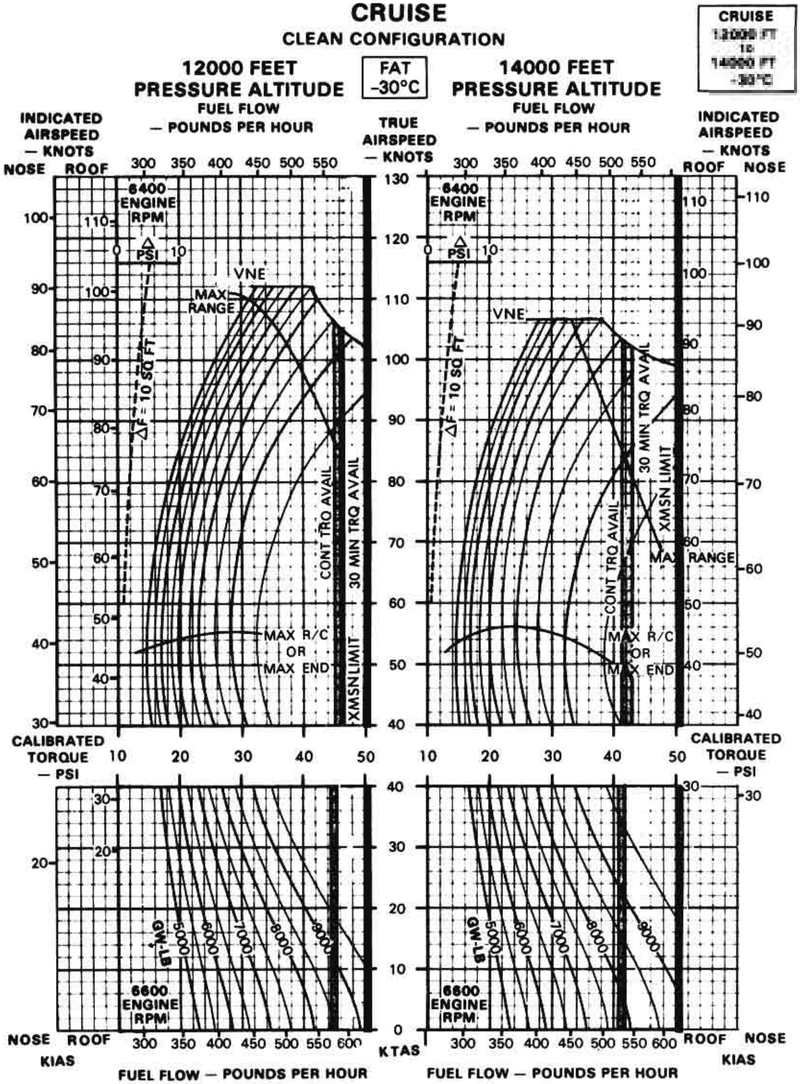
ADDITIONAL CALIBRATED TORQUE REQUIRED AND FUEL FLOW FOR EXTERNAL DRAG CONFIGURATION

KNOWN

DF FOR EXTERNAL DRAG CONFIGURATION (FROM FIGURE 7-7, EXAMPLE B) = 4 SQUARE FEET
GROSS WEIGHT = 8000 POUNDS
FAT = -30°C
PRESSURE ALTITUDE = 12000 FEET
TRUE AIRSPEED = 105 KNOTS

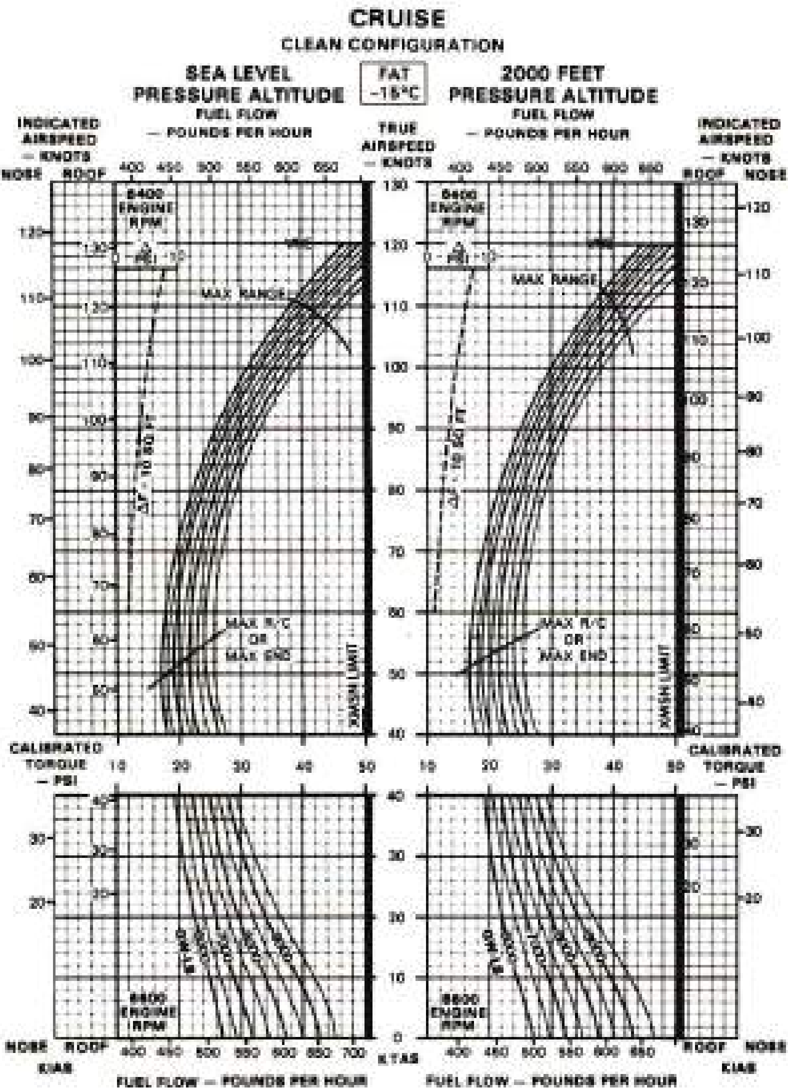
METHOD

ENTER TRUE AIRSPEED AT 105 KNOTS AND MOVE LEFT TO 8000 POUND GROSS WEIGHT LINE. MOVE UP TO FUEL FLOW SCALE AND READ 510 LB/HR. MOVE DOWN TO CALIBRATED TORQUE SCALE AND READ 39.0 PSI. MOVE LEFT (AT 105 KNOTS) TO 10 SQ FEET DF LINE. MIOVE UP AND READ 4.0 DPSI. DIVIDE 4 SQ FEET BY 10 SQ FEET = 40%. 40% OF 4.0 DPSI = 1.6 DPSI. ADD 1.6 AND 39.0 = 40.6 PSI. MOVE UP FROM TORQUE SCALE AT THIS POINT TO FUEL FLOW SCALE AND READ 537 LB/HR.



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 4 of 24)

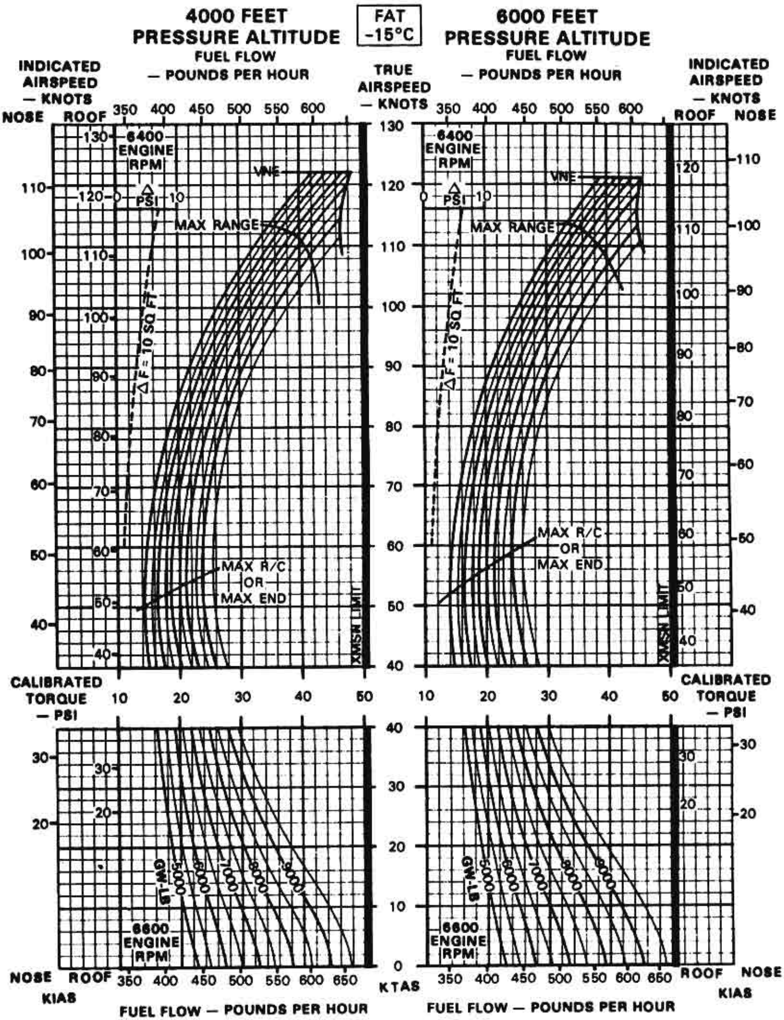


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 5 of 24)

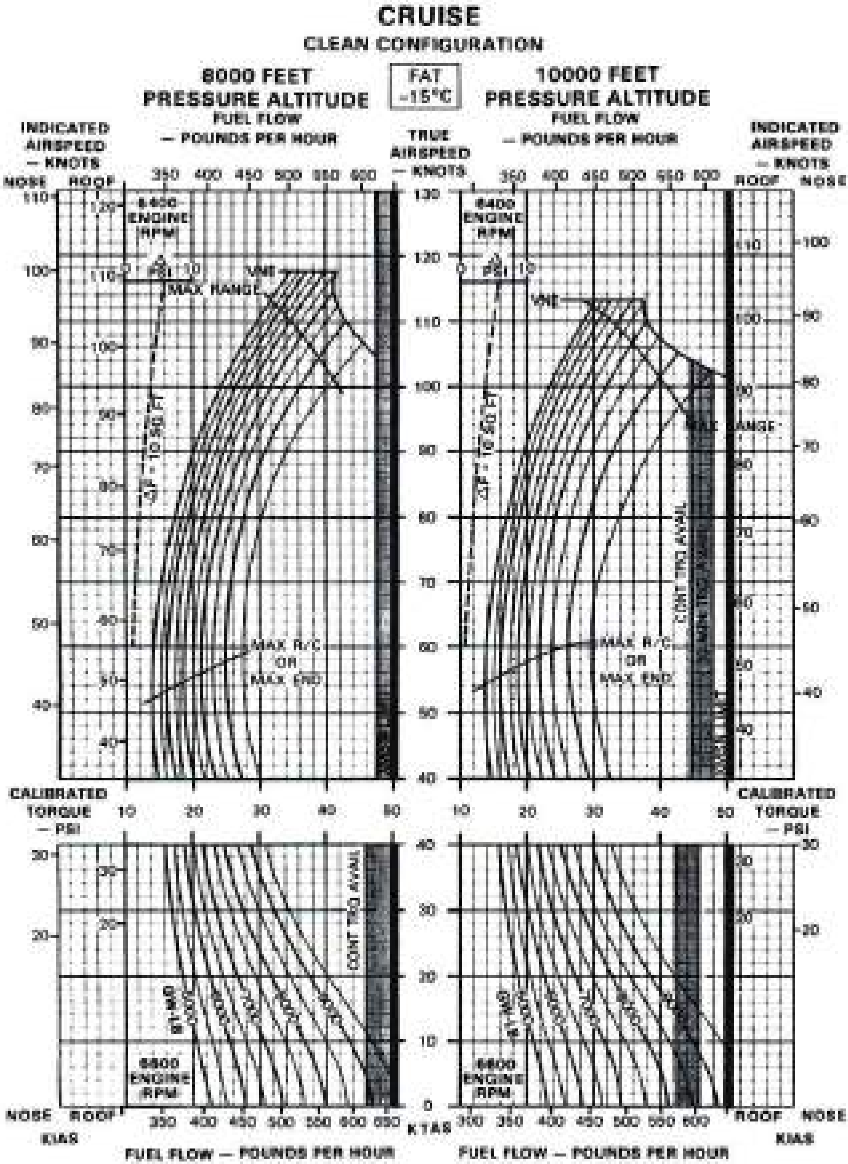
CRUISE

CLEAN CONFIGURATION



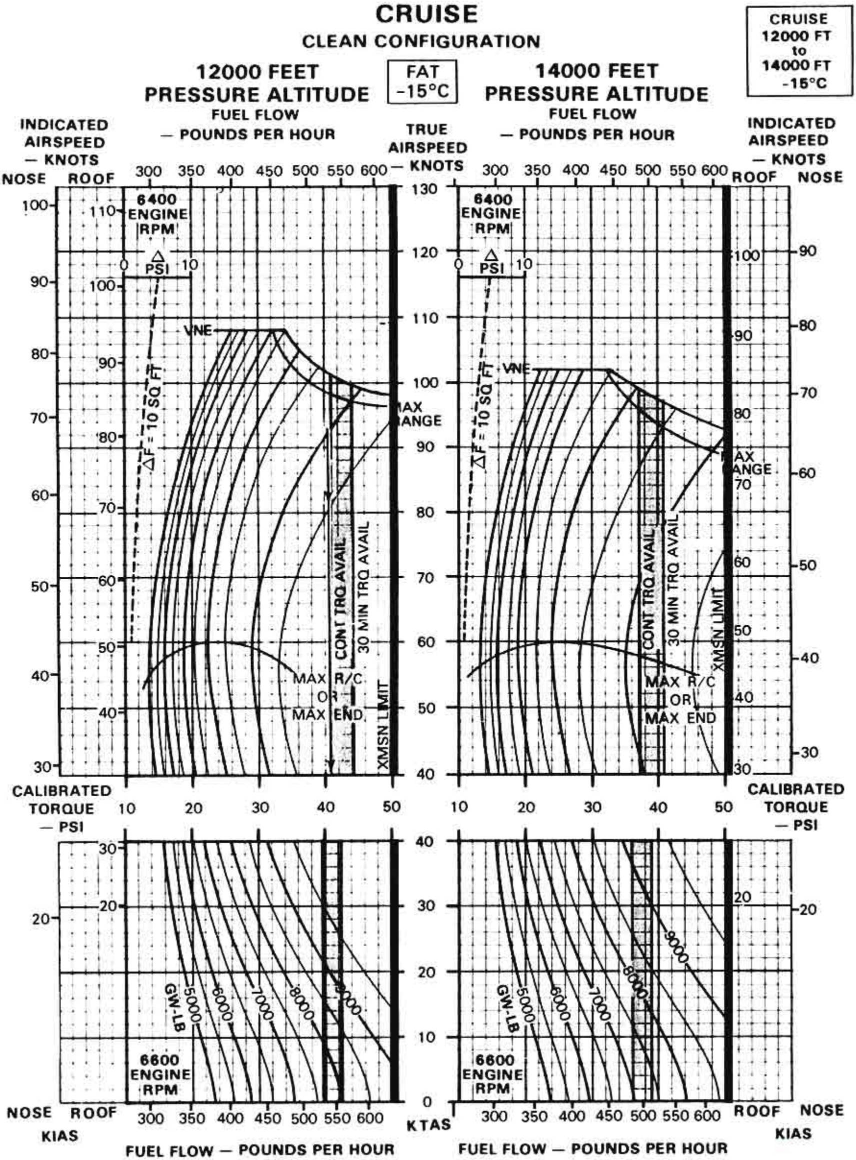
DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 6 of 24)



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 7 of 24)

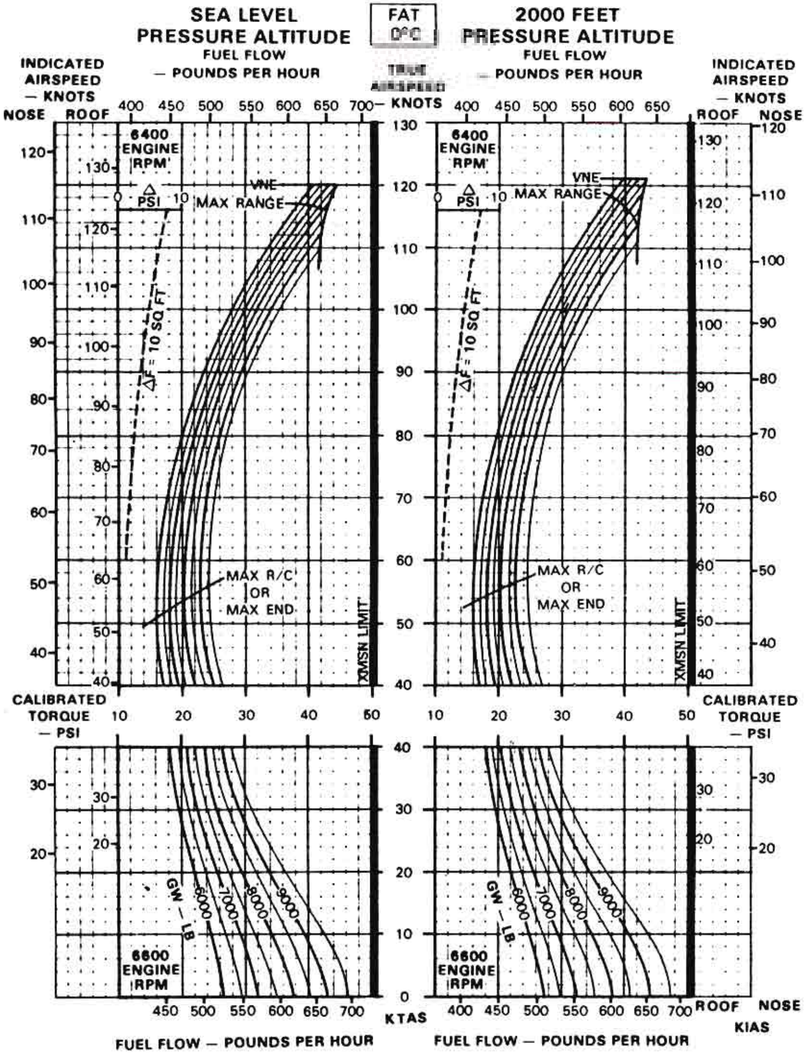


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 8 of 24)

CRUISE

CLEAN CONFIGURATION

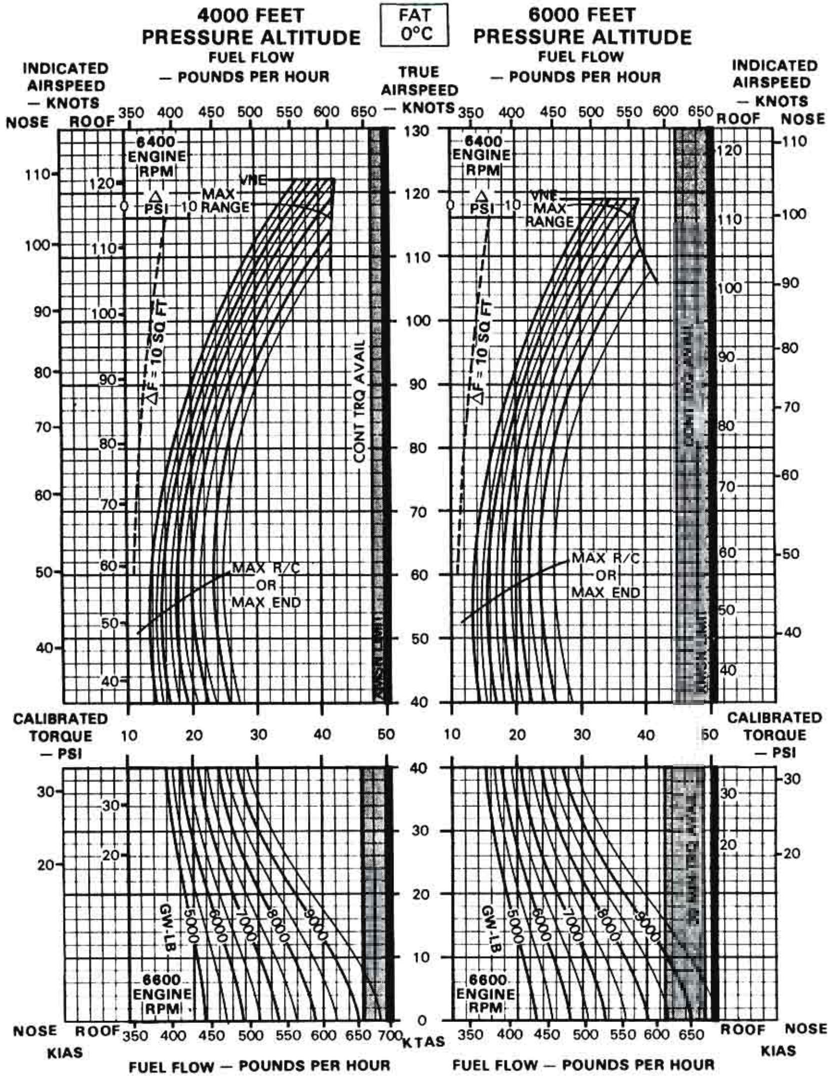


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 9 of 24)

CRUISE

CLEAN CONFIGURATION

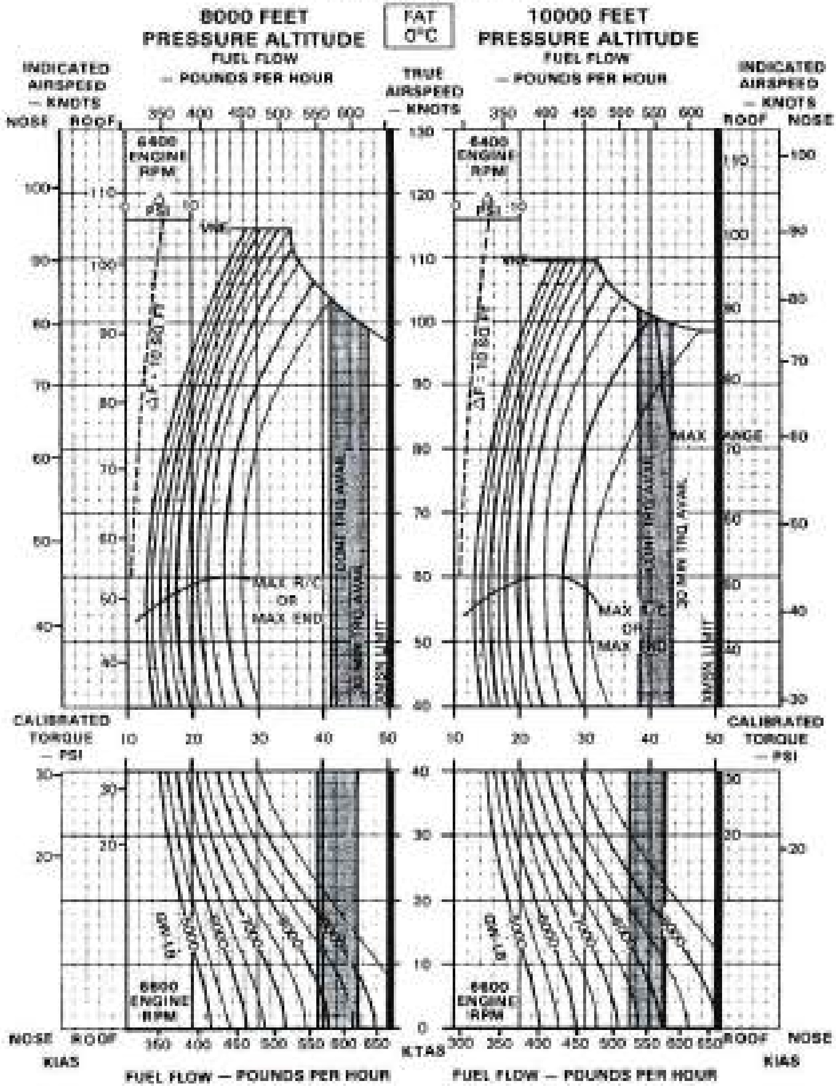


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 10 of 24)

CRUISE

CLEAN CONFIGURATION

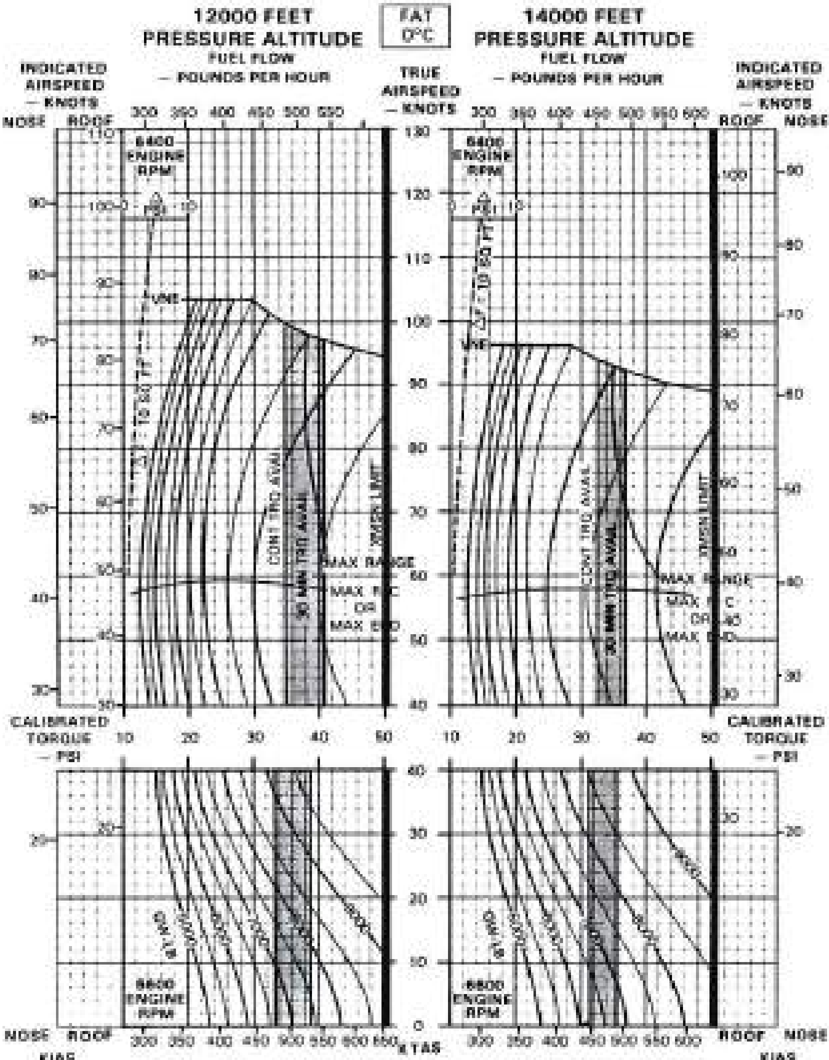


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 11 of 24)

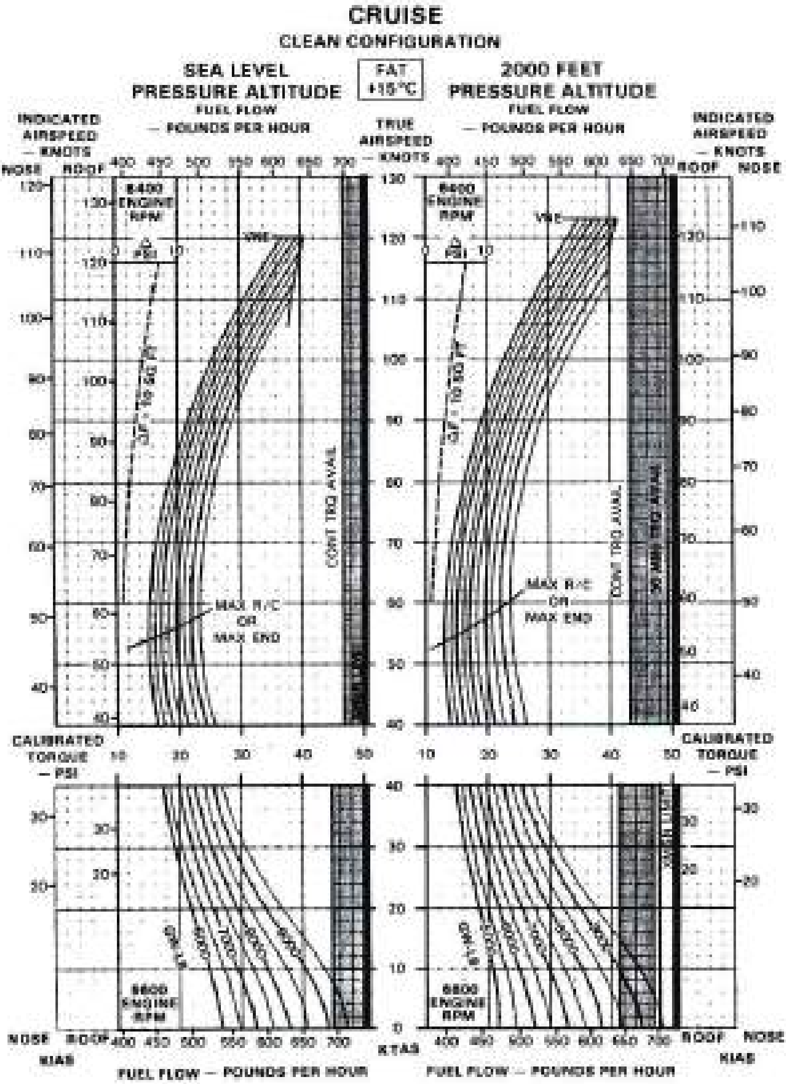
CRUISE

CLEAN CONFIGURATION



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 12 of 24)

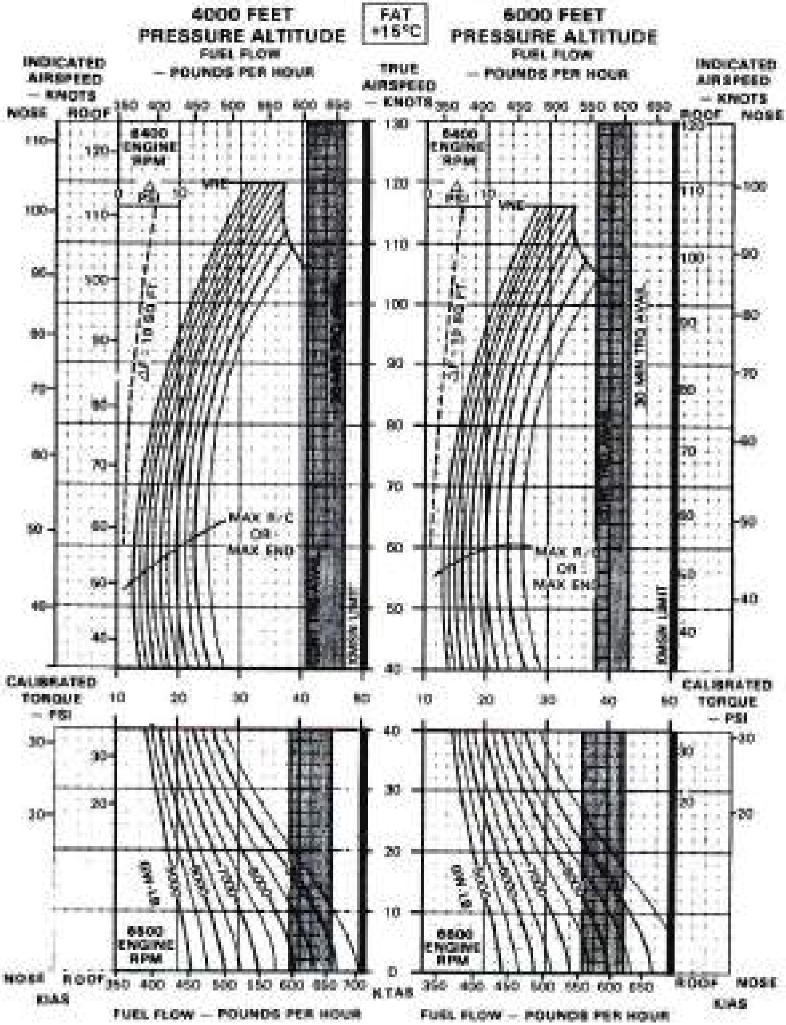


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 13 of 24)

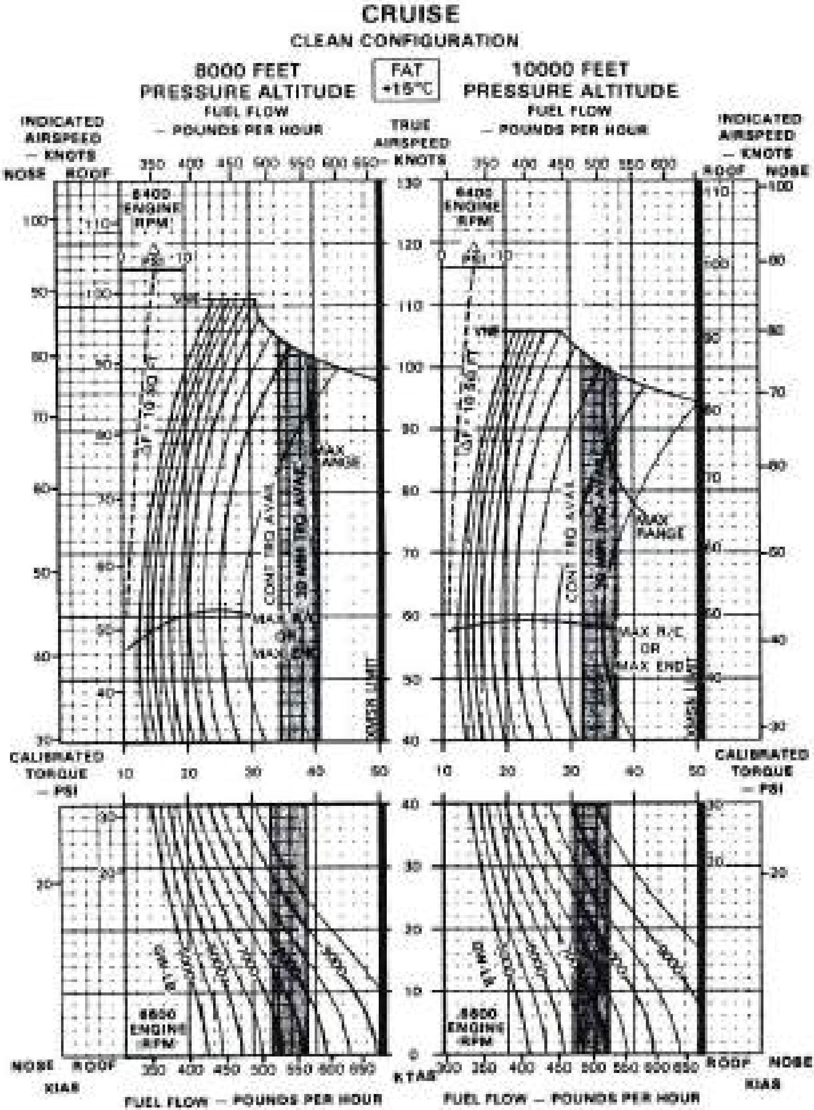
CRUISE

CLEAN CONFIGURATION



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 14 of 24)

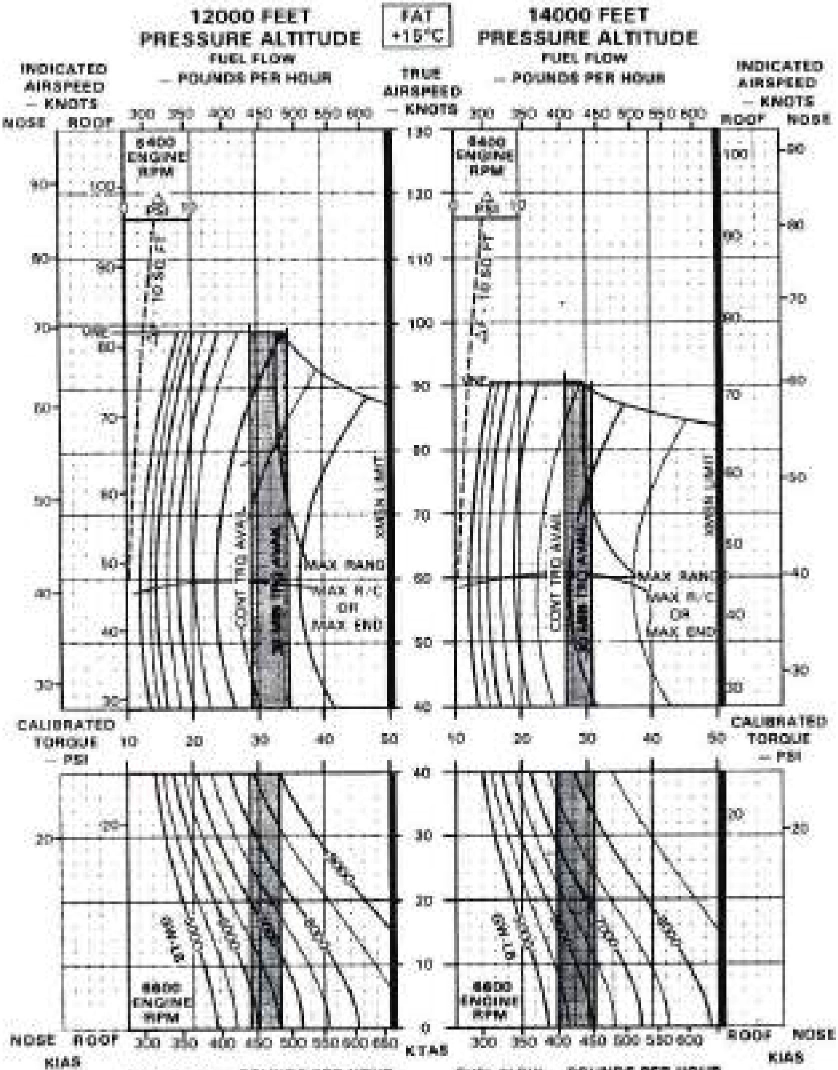


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 16 of 24)

CRUISE

CLEAN CONFIGURATION



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 16 of 24)

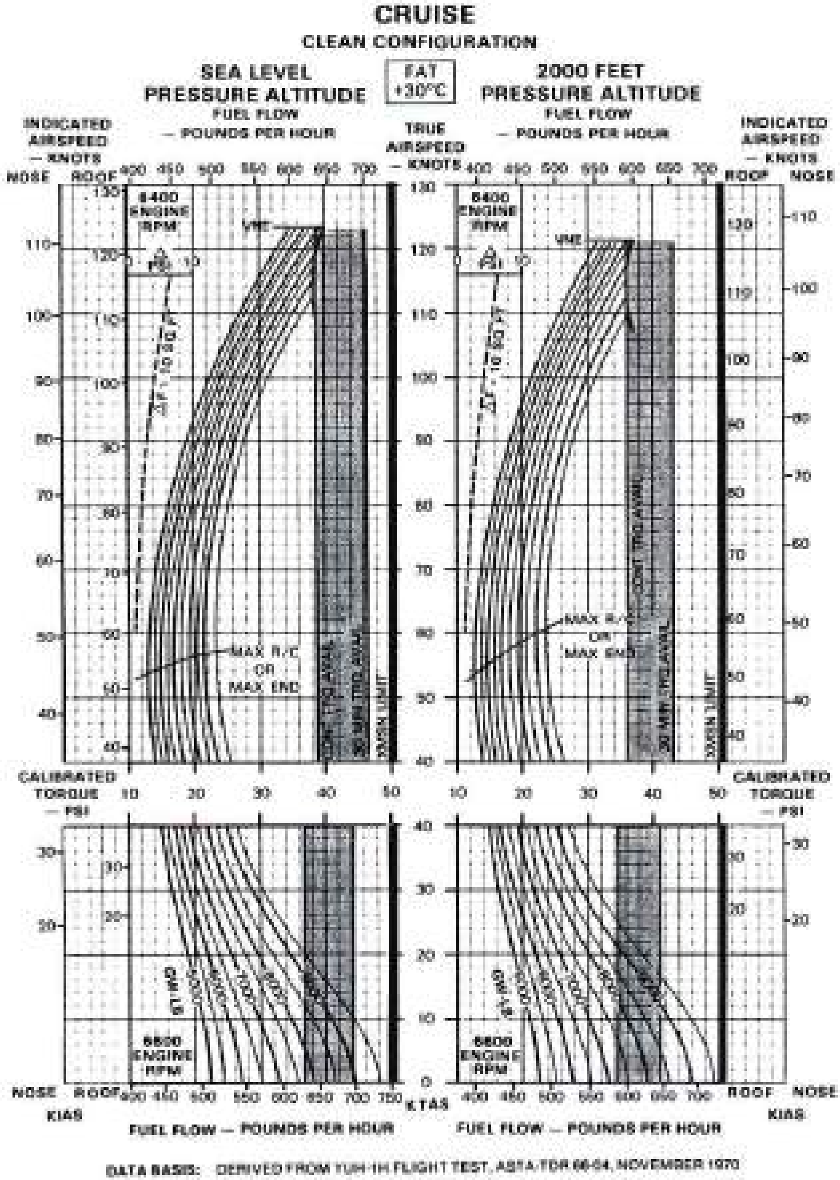
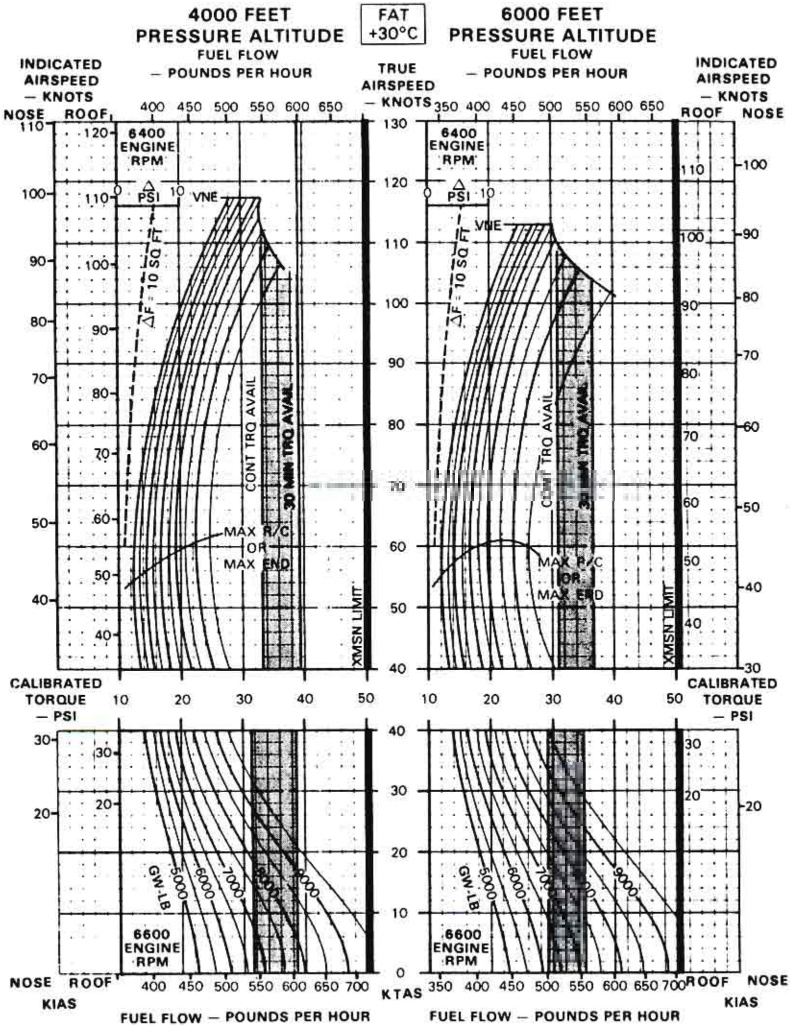


Figure 7-6. Cruise chart (Sheet 17 of 24)

CRUISE

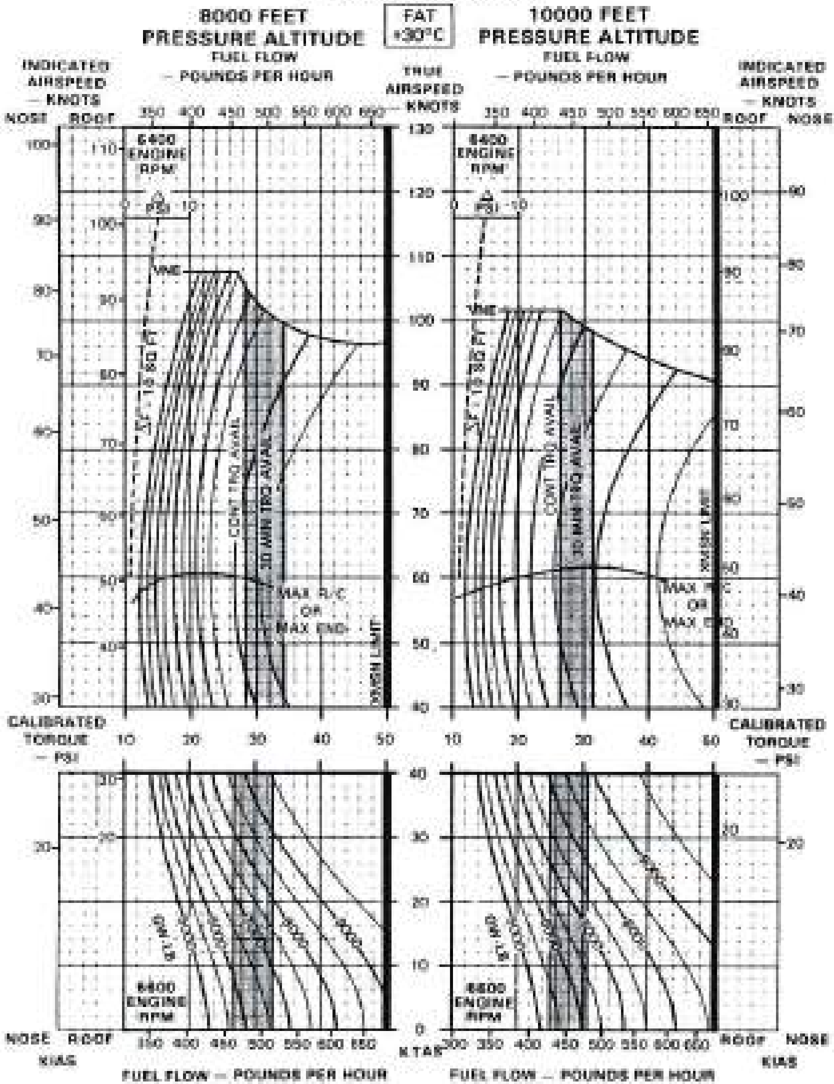
CLEAN CONFIGURATION



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 18 of 24)

CRUISE

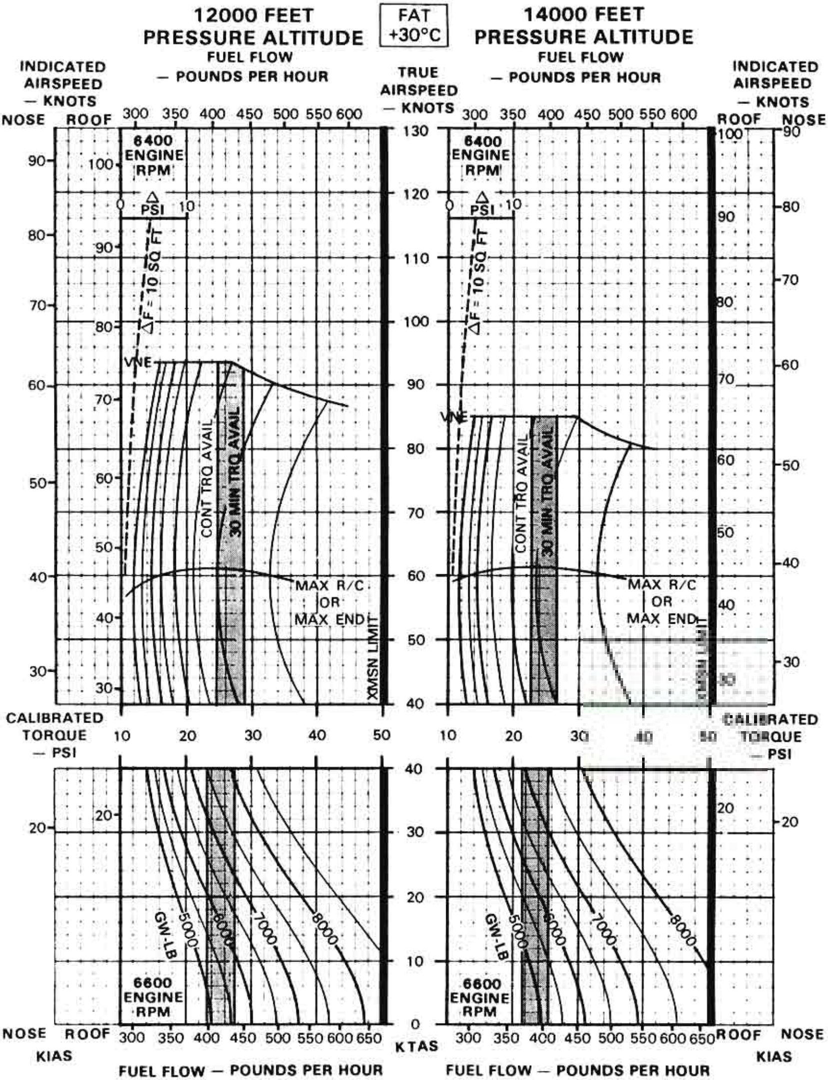


DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 19 of 24)

CRUISE

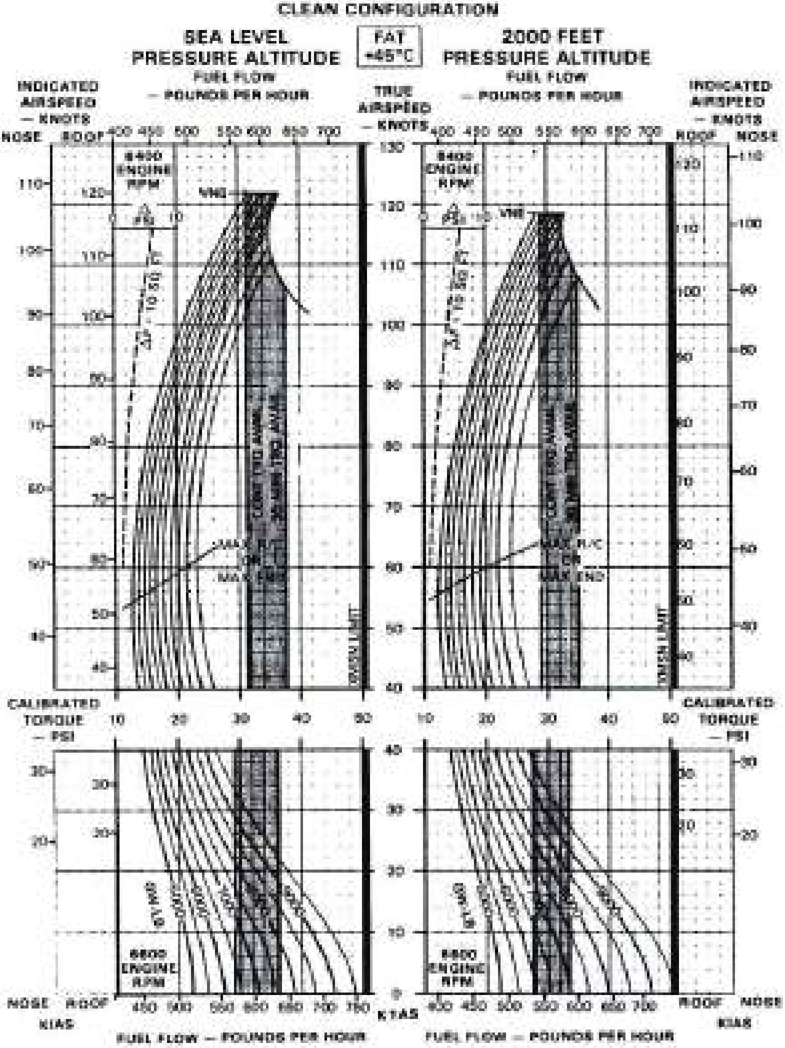
CLEAN CONFIGURATION



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

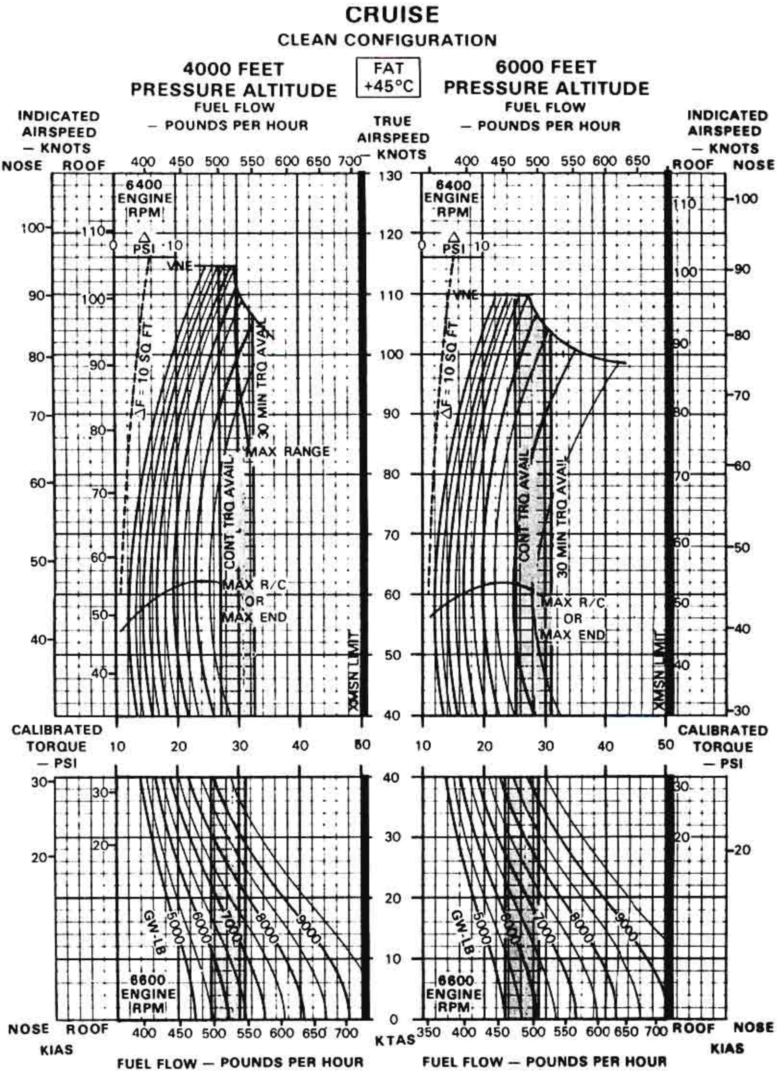
Figure 7-6. Cruise chart (Sheet 20 of 24)

CRUISE



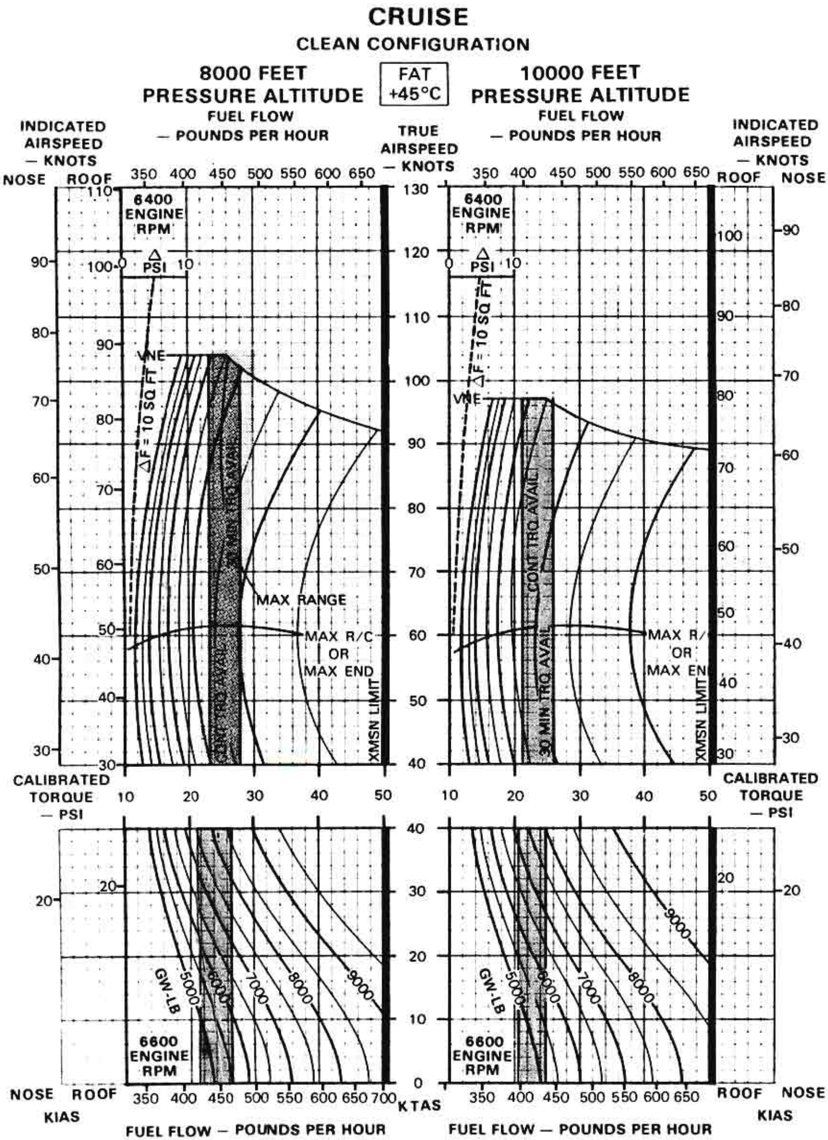
DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR-66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 21 of 24)



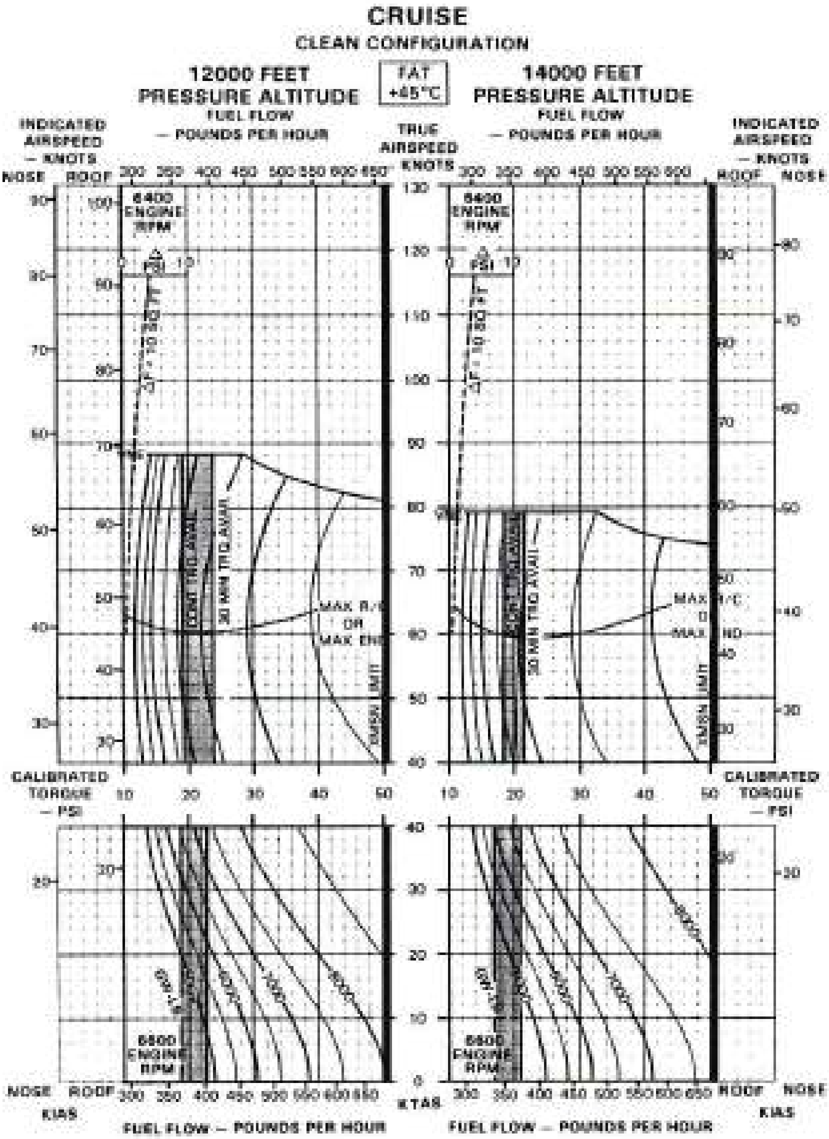
DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise Chart (Sheet 22 of 24)



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 23 of 24)



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Cruise chart (Sheet 24 of 24)

DRAG

ΔF—SQ FT			
0	CLEAN CONFIGURATION (BASE LINE)		
6		CARGO MIRROR	
11	M-23		M-23
12	M-59		M-59
15	M-56		M-56

EXAMPLE A

WANTED

CHANGE IN TORQUE REQUIRED DUE TO EQUIVALENT FLAT PLATE DRAG AREA CHANGE (ΔF) FROM CLEAN (BASELINE) CONFIGURATION TO AN M-56 SUBSYSTEM CONFIGURATION

ΔF DRAG AREA CHANGE = 15 SQ FT
TRUE AIRSPEED = 120 KNOTS
PRESSURE ALTITUDE = SEA LEVEL
FAT = 0°C

METHOD

ENTER DRAG AREA CHANGE
MOVE RIGHT TO TRUE AIRSPEED
MOVE DOWN TO PRESSURE ALTITUDE
MOVE LEFT TO FREE AIR TEMPERATURE
MOVE DOWN, READ CHANGE IN TORQUE = 12.2 PSI

EXAMPLE B

WANTED

INCREASE IN DRAG AREA DUE TO EXTERNAL CARGO

KNOWN

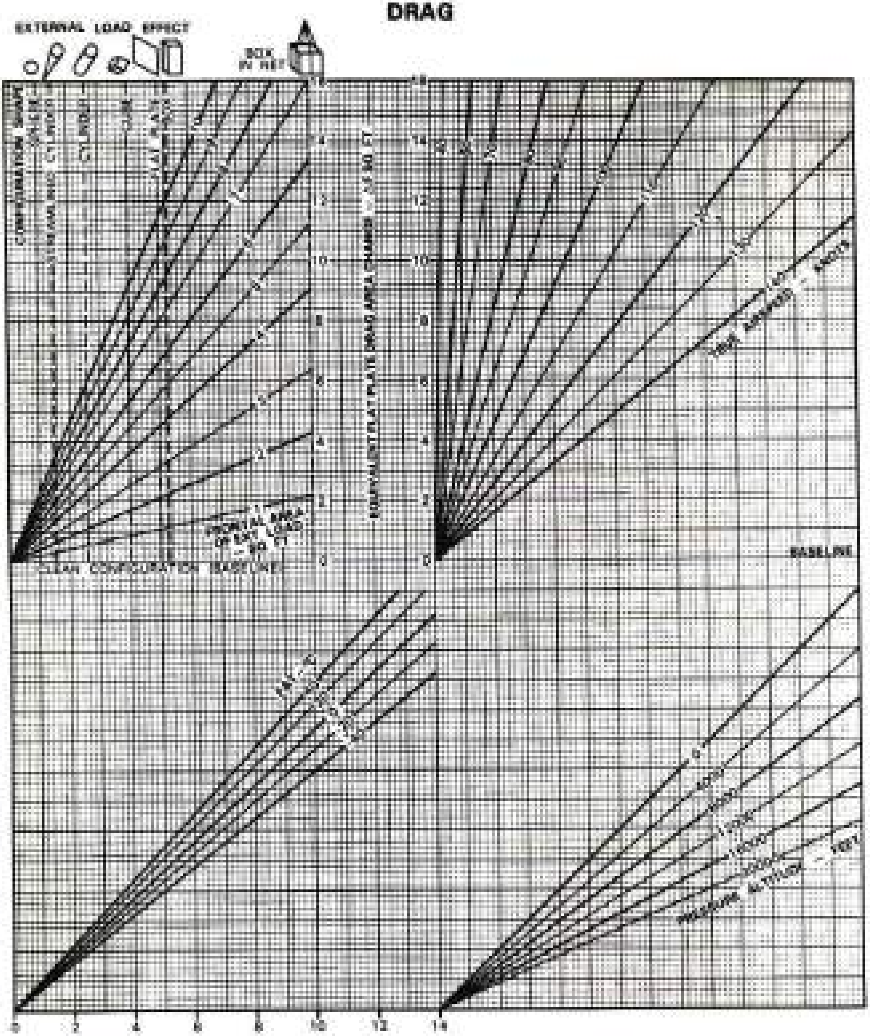
SHAPE OF EXTERNAL LOAD = CYLINDER
FRONTAL AREA OF EXTERNAL LOAD = 6.8 SQ FT

METHOD

ENTER CHART AT SYMBOL FOR CYLINDER
MOVE DOWN TO 6.8 SQ FT
MOVE RIGHT AND READ INCREASED DRAG AREA = 4.0 SQ FT

Figure 7-7. Drag Chart (Sheet 1 of 2)

DRAG



DATA BASIS: CALCULATED DATA

Figure 7-7. Drag Chart (Sheet 2 of 2)

CLIMB—DESCENT

314 ROTOR/6400 ENGINE RPM

EXAMPLE

WANTED

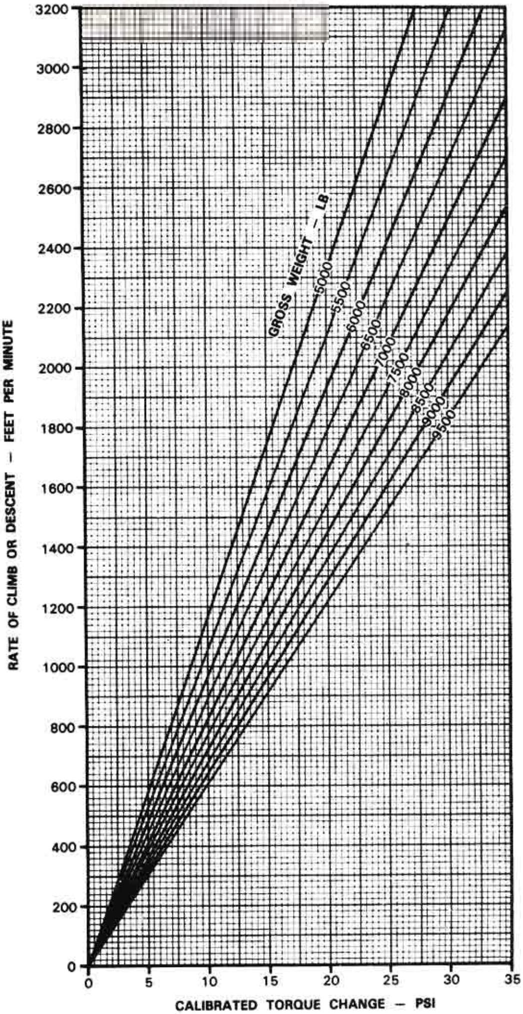
CALIBRATED TORQUE CHANGE
FOR DESIRED R/C OR R/D

KNOWN

GROSS WEIGHT = 6000 LB
DESIRED R/C = 1200 FT/MIN

METHOD

ENTER R/C
MOVE RIGHT TO GROSS WEIGHT
MOVE DOWN, READ CALIBRATED
TORQUE CHANGE = 12.5 PSI



DATA BASIS: DERIVED FROM FLIGHT TEST FTC-TDR 62-21, DECEMBER 1962, AND CALCULATED DATA.

Figure 7-8. Climb-Descent Chart

FUEL FLOW

JP-4 FUEL

EXAMPLE B

WANTED

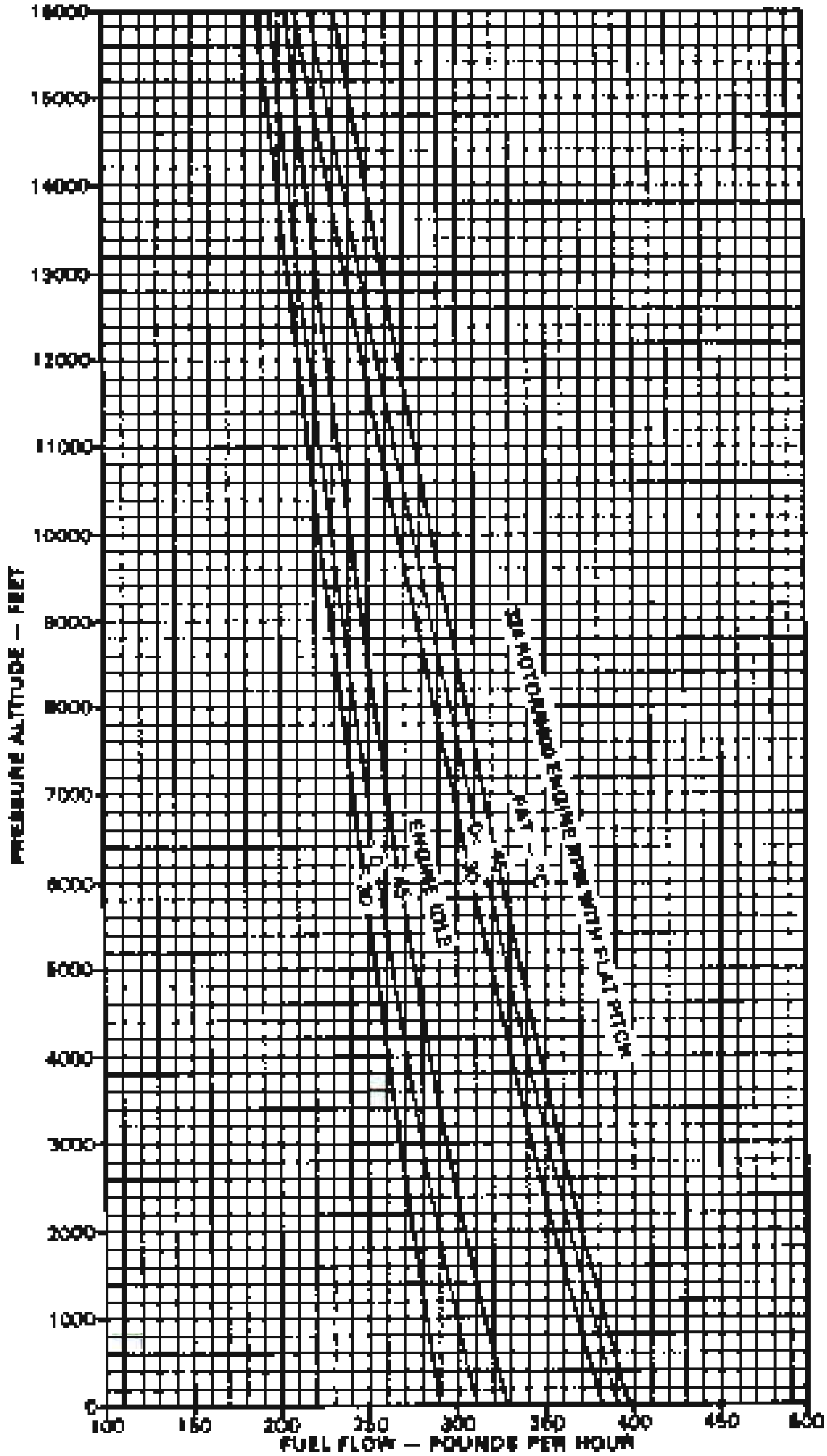
FUEL FLOW AT ENGINE IDLE AND AT 324 ROTOR/6600 ENGINE RPM WITH FLAT PITCH

KNOWN

PRESSURE ALTITUDE - 11000 FEET.
FAT = 0°

METHOD

ENTER PRESSURE ALTITUDE
MOVE RIGHT TO (ENGINE IDLE) FAT
MOVE DOWN, READ ENGINE IDLE
FUEL FLOW = 223 LB/HR
REENTER PRESSURE ALTITUDE
MOVE RIGHT TO (FLAT PITCH) FAT
MOVE DOWN, READ FLAT PITCH
FUEL FLOW = 286 LB/HR



DATA BASIS: CALCULATED FROM MODEL SPEC 104.33, SEPTEMBER 1964, CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST FTC-TDR 64-27 NOVEMBER 1964

Figure 7-9. Idle Fuel Flow Chart

ALL DATA ON PAGE 7-52 INCLUDING FIGURE 7-9 (SHEET 2) DELETED.

Chapter 8
Normal Procedures

Section I. MISSION PLANNING

8–1. Mission Planning Mission planning begins when the mission is assigned and extends to the preflight check of the helicopter. It includes, but is not limited to checks of operating limits and restrictions; weight balance and loading; performance; publication; flight plan and crew and passenger briefings. The pilot in command shall ensure compliance with the contents of this manual that are applicable to the mission.

8–2. Operating Limits and Restrictions The minimum, maximum, normal and cautionary operational ranges represent careful aerodynamic and structural calculation, substantiated by flight test data. These limitations shall be adhered to during all phases of the mission. Refer to chapter 5, OPERATING LIMITS AND RESTRICTIONS, for detailed information.

8–3. Weight Balance and Loading The helicopter shall be loaded, cargo and passengers secured, and weight and balance verified in accordance with chapter 6, WEIGHT, BALANCE AND LOADING. This helicopter requires a weight and balance clearance, in accordance with AR 95–16. The helicopter weight and center–of–gravity conditions shall be within the limits prescribed in Chaper 5, OPERATING LIMITS AND RESTRICTIONS.

8–4. Performance Refer to chapter 7, PERFORMANCE DATA, to determine the capability of the helicopter for the entire mission. Consideration shall be given to changes in performance resulting from variation in loads, temperatures, and pressure altitudes. Record the data on the Performance Planning Card for use in completing the flight plan and for reference throughout the mission.

8–5. Crew and Passenger Briefings A crew briefing shall be conducted to ensure a thorough understanding of individual and team responsibilies. The briefing should include, but not be limited to, copilot, crew chief, mission equipment operator, and ground crew responsibilites and the coordination necessary to complete the mission in the most efficient manner. A review of visual signals is desirable when ground guides do not have direct voice communications link with the crew.

Section II. CREW DUTIES

8–6. Crew Duties

a. *Responsibilities*. The minimum crew required to fly the helicopter is a pilot. Additional crewmembers, as required, may be added at the discretion of the commander. The manner in which each crewmember performs his related duties is the responsibility of the pilot in command.

b. *Pilot*. The pilot in command is responsible for all aspects of mission planning, preflight, and operation of the helicopter. He will assign duties and functions to all other crewmembers as required. Prior to or during preflight the pilot will brief the crew on the mission, performance data, monitoring of instruments, communications, emergency procedures, taxi, and load operations.

c. *Copilot (when assigned)*. The copilot must be familiar with the pilots duties and the duties of the other crew positions. The copilot will assist the pilot as directed.

d. *Crew Chief (when assigned)*. The crew chief will perform all duties as assigned by the pilot.

e. *Passenger Briefing*. The following is a guide that should be used in accomplishing required passenger briefings. Items that do not pertain to a specific mission may be omitted.

(1) Crew Introduction.

(2) Equipment.

(a) Personal to include ID tags.

(b) Professional.

(c) Survival.

(3) Flight Data.

(a) Route.

(b) Altitude.

(c) Time enroute.

(d) Weather.

(4) Normal Procedures.

(a) Entry and exit of helicopter.

(b) Seating.

(c) Seat belts.

(d) Movement in helicopter.

(e) Internal communications.

(f) Security of equipment.

(g) Smoking.

(h) Oxygen.

(i) Refueling.

(j) Weapons.

(k) Protective masks.

(l) Parachutes.

(m) Ear protection.

(n) ALSE

(5) Emergency Procedures.

(a) Emergency exits.

(b) Emergency equipment.

(c) Emergency landing/ditching procedures.

8-7. Danger Areas Refer to figure 8-1.

Section III. OPERATING PROCEDURES AND MANEUVERS

8-8. Operating Procedures and Maneuvers This section deals with normal procedures, and includes all steps necessary to ensure safe and efficient operating of the helicopter from the time a preflight begins until the flight is completed and the helicopter is parked and secured. Unique feel, characteristics and reaction of the helicopter during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described including precautions to be observed. Your flying experience is recognized; therefore, basic flight principles are avoided. Only the duties of the minimum crew necessary for the actual operation of the helicopter are included.

8-9. Additional Crew Additional crew duties are covered as necessary in section II, CREW DUTIES. Mission equipment checks are contained in chapter 4, MISSION EQUIPMENT. Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in section V, FLIGHT CHARACTERISTICS, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions, such as desert and cold weather operations, supplement normal procedures checks in this section and are covered in section VI, ADVERSE ENVIRONMENTAL CONDITIONS.

8-10. Checklist Normal procedures are given primarily in checklist form, and amplified as necessary in accompanying paragraph form, when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operators Checklist, TM 55-1520-210-CL. To provide for easier cross-referencing, the procedural steps in CL are numbered to coincide with the corresponding numbered steps in this manual.

8-11. Checks The checklist includes items for day, night, and instrument flight with annotative indicators immediately preceding the check to which they are pertinent; N for night operation only; I for instrument operations only; and O to indicate a requirement if the equipment is installed. The symbol star ★ indicates that a detailed procedure for the step is located in the performance section of the condensed checklist. When a helicopter is flown on a mission requiring intermediate stops it is not necessary to perform all of the normal checks. The steps that are essential for safe helicopter operations on intermediate stops are designated as "thru-flight" checks. An asterisk indicates that performance of steps is mandatory for all "thru-flights". The asterisk applies only to checks performed prior to takeoff.

WARNING

Do not preflight until armament systems are safe.

8-12. Before Exterior Checks

*1. Covers, locking devices, tiedowns, and cables—Removed, except aft main rotor tiedown.

2. Publications—Check DA Forms 2408-12, -13, -14, and -18; DD Form 1896; DD Form 365F; locally required forms and publications, and availability of Operators Manual (-10), and Checklist (-CL).

3. AC circuit breakers—IN.

4. BAT switch—ON. Check battery voltage. A minimum of 24 volts should be indicated on the DC voltmeter for a battery start.

5. Lights—On. Check landing, search, anti-collision, position, interior lights and NVG lighting as required for condition and operation as required; position landing and searchlights as desired; then off.

*6. Fuel—Check quantity. Caps secure.

7. Fuel sample—Check for contamination before first flight of the day. If the fuel sumps, and filter have not been drained by maintenance personnel, drain a sample as follows:

a. Sumps—Drain sample and check.

b. MAIN FUEL switch—ON.

c. Filter—Drain sample and check.

O *d.* Auxiliary fuel tanks—Drain sample and check.

e. MAIN FUEL switch—OFF.

O 8. Cargo hook—Check as required, if use is anticipated, refer to Chapter 4, MISSION EQUIPMENT, for checks of the system.

9. BAT switch—OFF.

8-13. Exterior Check (Fig 8-2)

8-14. Area 1

*1. Main rotor blade—Check condition.

2. Fuselage—Check as follows:

a. Cabin top-Check windshields, wipers, FAT probe, WSPS, for condition.

b. Radio compartment—Check security of all equipment. Check battery if installed. Secure door.

c. Antennas—Check condition and security.

O *d.* Pitot tube—Check security and unobstructed.

e. Cabin lower area-Check condition of windshield, antennas, WSPS and fuselage. Check for loose objects inside which might jam controls.

O *f.* Cargo suspension mirror—Check security and cover installed. Uncover and adjust if cargo operations are anticipated.

8-15. Area 2

1. Fuselage—Check as follows:

O *a.* Static port—Check unobstructed.

b. Copilot seat, seat belt and shoulder harness—Check condition and security; secure belt and harness if seat is not used during flight.

c. Copilot door—Check condition and security.

d. Cabin doors—Check condition and security.

e. Landing gear—Check condition and security; ground handling wheels removed.

f. Radio and electrical compartments—Check condition, circuit breakers in and components secure. Secure access doors.

O *g.* Armament systems—Check weapon(s) safe. Check condition and security. Refer to Chapter 4, MISSION EQUIPMENT, for checks of the system.

2. Engine compartment—Check fluid lines and connections for condition and security. Check general condition. Cowling secure.

8-16. Area 3

1. Tailboom—Check as follows:

a. Skin—Check condition.

b. Driveshaft cover—Check secure.

c. Synchronized elevator—Check condition and security.

d. Antennas—Check condition and security.

e. Tail skid—Check condition and security.

*2. Main rotor blade—Check condition, rotate in normal direction 90 degrees to fuselage, tiedown removed.

*3. Tail rotor—Check condition and free movement on flapping axis. The tail rotor blades should be checked as the main rotor blade is rotated. Visually check all components for security.

8-17. Area 4

*1. Tail rotor gearboxes (90 and 42 degrees)—Check general condition, oil levels, filler caps secure.

2. Tailboom—Check as follows;

a. Skin—Check condition.

b. Antennas—Check condition and security.

c. Synchronized elevator—Check condition and security.

3. Engine exhaust/smoke generator—Check condition. Refer to chapter 4 MISSION EQUIPMENT, for systems check.

4. Oil cooling fan and heater compartments—Check condition of fan, flight control and cables, tail rotor servo for leaks and security and battery if installed; check for installation of structural support; check tailboom attachment bolts; check heater for condition and security if installed; check area clear of obstructions; secure doors.

8-18. Area 5

*1. Engine compartment—Check fluid lines and connections for condition and security. Check fluid levels and general condition; cowling secure.

*2. Hydraulic fluid sight gage—Check.

*3. Fuselage—Check as follows:

O **a.* Armament systems—Check weapon(s) safe. Check condition and security. Refer to Chapter 4, MISSION EQUIPMENT, for systems check.

b. Cabin doors—Check condition and security.

c. Landing gear—Check condition and security; ground handling wheels removed.

O *d.* Static port—Check unobstructed.

e. Pilot door—Check condition and security.

f. Pilot seat, seat belt and shoulder harness—Check condition and security.

O *g.* Fire extinguisher—Check secure.

8-19. Area 6

*1. Main rotor system—Check condition and security; check level of fluid in dampers, blade grips, and pillow blocks.

2. Transmission area—Check as follows:

a. Transmission and hydraulic filler caps—Secure.

b. Main driveshaft—Check condition and security.

c. Engine air intake—Check unobstructed.

d. Engine and transmission cowling—Check condition and security.

e. Antennas—Check condition and security.

O *f.* Pitot static tube—Check security and unobstructed.

8-20. Interior Check—Cabin

*1. Transmission oil level—Check.

*2. Cabin area—Check as follows:

O *a.* Cargo—Check as required for proper loading and security.

b. Loose equipment—Stow rotor blade, tiedown, pitot tube cover, tailpipe cover and other equipment.

O *c.* Mission equipment—Check condition and security. Refer to Chapter 4, MISSION EQUIPMENT, for equipment checks.

d. Passenger seats and belts—Check condition and security.

e. First aid kits—Check secure.

O *f.* Fire extinguisher—Check secure.

*3. Crew and passenger briefing—Complete as required.

8-21. Before Starting Engine

1. Overhead switches and circuit breakers—Set as follows:

O *a.* Smoke generator operating switch—Check condition and security. Refer to chapter 4, MISSION EQUIPMENT, for systems check.

b. DC circuit breakers—In, except for armament and special equipment.

O *c.* DOME LT switch—As required.

d. PITOT HTR switch—OFF.

**e.* EXT LTS switches—Set as follows:

(1) ANTI COLL switch—ON.

(2) POSITION lights switches—As required: STEADY or FLASH for night; OFF for day.

f. MISC switches—Set as follows:

(1) CARGO REL switch—OFF.

(2) WIPERS switch—OFF.

g. CABIN HEATING switches—OFF.

h. INST LTG switches—As required.

i. AC POWER switches—Set as follows:

(1) PHASE switch—AC.

(2) INVTR switch—OFF.

j. DC POWER switches—Set as follows:

(1) MAIN GEN switch—ON and cover down.

(2) VM selector—ESS BUS.

(3) NON-ESS BUS switch—As required.

(4) STARTER GEN switch—START.

*(5) BAT switch—ON.

*2. Ground power unit—Connect for GPU start.

O 3. Smoke gage—Check.

4. FIRE warning indicator light—Test.

5. Press to test caution/warning lights—Check as required.

6. Systems instruments—Check engine and transmission systems for static indications, slippage marks, and ranges.

7. Center pedestal switches—Set as follows:

a. Avionics equipment—Off; set as desired.

b. External stores jettison handle—Check safetied.

O *c.* DISP CONTROL panel—Check ARM/STBY/SAFE switch is SAFE; check that JETTISON switch is down and covered.

d. GOV switch—AUTO.

e. DE-ICE switch—OFF.

**f.* FUEL switches—Set as follows:

(1) MAIN FUEL switch—ON.

O (2) START FUEL switch—ON.

(3) All other switches—OFF.

g. CAUTION panel lights—TEST and RESET.

h. HYD CONT switch—ON.

i. FORCE TRIM switch—ON.

j. CHIP DET switch—BOTH.

8. Flight controls—Check freedom of movement through full travel: center cyclic and pedals; collective pitch full down.

9. Altimeters—Set to field elevation.

*8-22. Starting Engine

1. Fireguard—Posted if avaliable.

2. Rotor blades—Check clear and untied.

3. Ignition key lock switch—On.

4. Throttle—Set for start. Position the throttle as near as possible (on decrease side) to the engine idle stop.

5. Engine—Start as follows:

a. Start switch—Press and hold; start time. Note DC voltmeter indication. Battery starts can be made when voltages less than 24 volts are indicated, provided the voltage is not below 14 volts when cranking through 10 percent N1 speed.

b. Main rotor—Check that the main rotor is turning as N1 reaches 15 percent. If the rotor is not turning, abort the start.

O *c.* START FUEL switch—OFF at 40 percent N1.

d. Start switch—Release at 40 percent N1 or after 40 seconds, whichever occurs first. Refer to chapter 5 for starter limitations.

e. Throttle—Slowly advance past the engine idle stop to the engine idle position. Manually check the engine idle stop by attempting to close the throttle.

f. N1—68 to 72 percent. Hold a very slight pressure against the engine idle stop during the check. A slight rise in N1 may be anticipated after releasing pressure on throttle.

NOTE

The copilot attitude indicator should be caged and held momentarily as inverter power is applied.

6. INVTR switch—MAIN ON.

7. Engine and transmission oil pressures—Check

8. GPU—Disconnect.

8-23. Engine Runup

*1. Avionics—On. Check as required.

*2. STARTER GEN switch—STBY GEN.

*3. Systems—Check as follows:

a. FUEL.

b. Engine.

c. Transmission.

d. Electrical.

(1) AC—112 to 118 volts.

(2) DC—27 volts at 26°C and above. 28 volts from 0°C to 26°C. 28.5 volts below 0°C.

*4. RPM—6600. As throttle is increased, the low rpm audio and warning light should be off at 6100 to 6300 rpm.

5. Fuel control—Check as required (for helicopters without modified fuel control) before first flight of the day as follows:

a. GOV RPM INCR/DECR switch—DECR to 6000 rpm.

b. Collective pitch—Increase slowly until the helicopter is light on the skids. Do not exceed 94 percent N1 or torque limit.

c. RPM—Check for the following:

(1) If rpm remains at 6000 (no bleed-off) or if bleed-off occurs but returns to 6000 within 4 seconds, the fuel control is acceptable.

(2) If rpm bleed-off occurs but does not return to 6000, the fuel control is not acceptable and the helicopter shall not be flown. An entry on DA Form 2408-13 is required.

d. Collective pitch—Decrease to full down.

e. GOV RPM INCR/DECR switch—Increase to 6600 rpm.

6. Health Indicator Tests (HIT) check—Perform as required on first flight of the day. Refer to HIT EGT log in helicopter log book.

8-24. Takeoff to Hover Refer to FM 1-203, Fundamentals of Flight.

8-25. Hovering Turns Refer to FM 1-203, Fundamentals of Flight.

8-26. Sideward and rearward hovering Flight Refer to FM 1-203, Fundamentals of Flight.

8-27. Hover/Taxi Refer to FM 1-203, Fundamentals of Flight.

8-28. Hover/Taxi Check Perform the following checks at a hover:

*1. Engine and transmission instruments—Check.

2. Flight instruments—Check as required.

a. VSI and altimeter—Check for indication of climb and descent.

b. Slip indicator—Check ball free in race.

c. Turn needle, heading indicator, and magnetic compass—Check for turn indication left and right.

d. Attitude indicator—Check for indication of nose high and low and banks left and right.

e. Airspeed indictor—Check airspeed.

*3. Power check as required. The power check is performed by comparing the indicated torque required to hover with the predicted values from performance charts .

8-29. Landing From a Hover Refer to FM 1-203, Fundamentals of Flight.

***8-30. Before Takeoff** Immediately prior to takeoff, the following checks shall be accomplished.

1. RPM—6600.

2. Systems—Check engine, transmission, electrical and fuel systems indications.

3. Avionics—As required.

4. Crew, passengers, and mission equipment—Check.

8-31. Takeoff

Caution

During take-off and at any time the helicopter skids are close to the ground, negative pitch attitudes (nose low) of 10° or more can result in ground contact of the WSPS lower cutter tip. Forward c.g., high gross weight, high density altitude, transitional lift settling, and a tail wind increases the probability of ground contact.

8-32. Normal Refer to FM 1-203, Fundamentals of Flight.

8-33. Maximum Performance A takeoff that demands maximum peformance from the helicopter is necessary because of various combinations of heavy helicopter loads, limited power and restricted performance due to high density altitudes, barriers that must be cleared and other terrain features. The decision to use either of the following takeoff techniques must be based on an evaluation of the conditions and helicopter performance. The copilot (when available) can assist the pilot in maintaining proper rpm by calling out rpm and torque as power changes are made, thereby allowing the pilot more attention outside the cockpit.

a. Coordinated Climb. Align the helicopter with the desired takeoff course at a stabilized hover of approximately three feet (skid height). Apply forward cyclic pressure smoothly and gradually while simultaneously increasing collective pitch to begin a coordinated acceleration and climb. Adjust pedal pressure as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding helicopter limits) as the helicopter attitude is established that will permit safe obstacle clearance. The climbout is continued at that attitude and power setting until the obstacle is cleared. After the obstacle is cleared, adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. This technique is desirable when OGE hover capability exists. Takeoff may be made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

b. Level—Acceleration. Align the helicopter with the desired takeoff course at a stabilized hover of approximately three feet (skid height). Apply forward cyclic pressure smoothly and gradually while simultaneously increasing collective pitch to begin an acceleration at approximately 3 to 5 feet skid height. Adjust pedal pressure as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding helicopter limits) prior to accelerating through effective translational lift. Additional forward cyclic pressure will be necessary to allow for level acceleration to the desired climb airspeed. Approximately five knots prior to reaching the desired climb airspeed, gradually release forward cyclic pressure and allow the helicopter to begin a constant airspeed climb to clear the obstacle. Care must be taken not to decrease airspeed during the climbout since this may result in the helicopter descending. After the obstacle is cleared adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. Takeoff may be made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

c. Power Application.

During takeoffs where maximum engine performance is demanded and the maximum torque limit cannot be reached it will be necessary to press the GOV INCR switch (increase "beep") to prevent drooping the engine rpm below 6600. As the GOV INCR switch is pressed, collective pitch must be increased simultaneously to prevent engine overspeed. As the takeoff is completed and power requirements are reduced, a coordinated reduction is collective pitch and GOV DECR (decrease "beep") are required to maintain 6600 rpm. The copilot (when available) can assist the pilot in maintaining proper rpm by calling out rpm and torque as power changes are made, thereby allowing the pilot more attention outside the cockpit.

d. Comparison of Techniques. Refer to chapter 7, Performance Data, for a comparison of takeoff distances. Where the two techniques yield the same distance over a fifty-foot obstacle, the coordinated climb technique will give a shorter distance over lower obstacles and the level acceleration technique will give a shorter distance over obstacles higher than fifty feet. The two techniques give approximately the same distance over a fifty-foot obstacle when the helicopter can barely hover OGE. As hover capability is decreased the level acceleration technique gives increasingly shorter distances than the coordinated climb technique. In addition to the distance comparison, the main advantages of the level acceleration technique are: (1) it requires less or no time in the avoid area of the height velocity diagram; (2) performance is more repeatable since reference to attitude which changes with loading and airspeed is not required; (3) at the higher climbout airspeeds (30 knots or greater), reliable indicated airspeeds are available for accurate airspeed reference from the beginning of the climbout, therefore minimizing the possibility of descent. The main advantage of the coordinated climb technique is that the climb angle is established early in the takeoff and more distance and time are available to abort the takeoff if the obstacle cannot be cleared. Additionally, large attitude changes are not required to establish climb airspeed.

8-34. Slingload The slingload takeoff requiring the maximum performance (when OGE hover is not possible) is similar to the level acceleration technique except the takeoff is begun and the acceleration made above 15 feet. Obstacle heights include the additional height necessary for a 15-foot sling load.

8-35. Climb After takeoff, select the airspeed necessary to clear obstacles. When obstacles are cleared, adjust the airspeed as desired at or above the maximum rate of climb airspeed. Refer to chapter 7 for recommended airspeeds.

8-36. Cruise When the desired cruise altitude is reached, adjust power as necessary to maintain the required airspeed. Refer to chapter 7 for recommended airspeeds, power settings, and fuel flow.

8-37. Descent Adjust power and attitude as necessary to attain and maintain the desired speed and rate during descent. Refer to chapter 7 for power requirements at selected airspeeds and rates of descent. All checks of mission equipment that must be made in preparation for landing should be accomplished during descent.

8-38. Before Landing Prior to landing the following checks shall be accomplished:

1. RPM-6600.

2. Crew, passengers, and mission equipment—Check.

8-39. Landing

a. Approach. Refer to the Height Velocity Diagram. Figure 9-3, for avoid area during the approach.

b. Run-on Landing. A run-on landing is used during emergency conditions of hydraulic power failure and some flight control malfunctions. The approach is shallow and flown at an airspeed that provides safe helicopter control. Airspeed is maintained as for a normal approach except that touchdown is made at an airspeed above effective translational lift. After ground contact is made, slowly decrease collective pitch to minimize forward speed. If braking action is necessary, the collective pitch may be lowered as required for quicker stopping.

c. Landing from a Hover. Refer to FM 1-203, Fundamentals of Flight.

8-40. Engine Shutdown

Caution

If throttle is inadvertently rolled to the OFF position, do not attempt to roll it back on.

1. Throttle—Engine idle for two minutes.

2. FORCE TRIM switch—ON.

NOTE

Steps 3 through 8 are to be completed after the last flight of the day if the system operation was not verified during the mission.

3. PITOT HTR—Check. Place the PITOT HTR switch in the ON position. Note loadmeter increase—then OFF.

4. INVTR switch—OFF. Check for INST INVERTER caution light illumination. Switch to SPARE check caution light OFF.

5. AC voltmeter—Check 112 to 118 volts.

6. MAIN GEN switch—OFF. Check DC voltmeter for 26 volts at 26°C and above 27 volts from 0°C to plus 26°C; and 27.5 volts below 0°C. The DC GENERATOR caution light should illuminate and the standby generator loadmeter should indicate a load.

7. NON-ESS BUS—Check as required. If equipment powered by the nonessential bus is installed, accomplish the following:

a. VM switch—NON-ESS BUS.

b. NON-ESS BUS switch—MANUAL ON. Check DC voltmeter for the same DC volts as in step 7 above.

c. VM switch—ESS BUS.

8. MAIN GEN switch—ON and guard closed. The DC GENERATOR caution light should be out and the main generator loadmeter should indicate a load.

9. STARTER GEN switch—START.

10. Throttle—Off.

11. Center Pedestal switches—Off.

a. FUEL.

b. Avionics.

12. Overhead switches—Off.

a. INVTR.

b. PITOT HTR.

c. EXT LTS.

d. MISC.

e. CABIN HEATING.

f. INST LTG.

g. BAT.

13. Ignition keylock switch—Remove key as required.

8-41. Before Leaving The Helicopter

1. Walk-around—complete, checking for damage, fluid leaks and levels.

2. Mission equipment—Secure.

3. Complete DA Forms 2408-12 and -13. An entry in DA Form 2408-13 is required if any of the following conditions were experienced:

a. Flown in a loose grass environment.

b. Operated within 10 miles of saltwater.

c. Exposed to radioactivity.

d. Operated in rain, ice, or snow.

e. Operated within 200 miles of volcanic area.

4. Secure helicopter.

Section IV. INSTRUMENT FLIGHT

8-42. Instrument Flight—General This helicopter is qualified for operation in instrument meteorological conditions. Flight handling qualities, stability characteristics, and range are the same during instrument flight as for visual flight. Navigation and communication equipment are adequate for instrument flight. Refer to FM 1-240, Instrument Flying and Navigation for Army Aviators.

Section V. FLIGHT CHARACTERISTICS

8-43. Flight Characteristics

8-44. Operating Characteristics The flight characteristics of this helicopter in general are similar to other single rotor helicopters.

8-45. Mast Bumping

WARNING

Abrupt inputs of flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

Mast bumping (flapping-stop contact) is the main yoke contacting the mast. It may occur during slope landings, rotor startup/coastdown, or when the flight envelope is exceeded. If mast bumping is encountered in flight, land as soon as possible. Because of mission requirements, it may be necessary to rapidly lower the nose of the helicopter with cyclic input or make a rapid collective reduction. At moderate to high airspeeds it becomes increasingly easy to approach less than +0.5G by abrupt forward cyclic inputs. Variance, in such things as sideslip, airspeed, gross weight, density altitude, center of gravity and rotor speed, may increase main rotor flapping and increase the probability of mast bumping. Rotor flapping is a normal part of maneuvering and excessive flapping can occur at greater than one G flight; but, flapping becomes more excessive for any given maneuver at progressively lower load factors.

a. If bumping occurs during a slope landing, reposition the cyclic to stop the bumping and re-establish a hover.

b. If bumping occurs during startup or shutdown, move cyclic to minimize or eliminate bumping.

c. As collective pitch is reduced after engine failure or loss of tail rotor thrust, cyclic must be positioned to maintain positive "G" forces during autorotation. Touchdown should be accomplished prior to excessive rotor rpm decay.

8-45.1. Hub Spring Contact

a. With the addition of the Hub Spring the likelihood that mast bumping will occur is reduced. A 2 per rev. vibration will be noticed when the hub spring makes contact with the plate assembly on the hub. With the hub spring modification, contact is made at rotor flapping angles greater than 4 degrees and becomes more pronounced as the angle increases. Without the Hub Spring, contact is made at 11 degrees (contact between yolk and mast, i.e., mast bumping).

b. Due to the difference in contact limitations (4 degrees compared to 11 degrees) it is likely that this vibration (2 per rev.) will be felt while flying within the flight envelope. Gusting winds, landings with slope angles, greater than 4 degrees and hoisting operations are several situations that increase main rotor flapping angles, thus increasing the possibility of hub spring contact. While the hub spring will not prohibit mast bumping, it will aid in controlling rotor flapping angles, and provide an extra margin of safety. Installation of the hub spring does not change in any way the approved flight envelope. Should hub spring contact occur during normal operations, no special inspections or maintenance actions are required. Anytime operating limitations or the flight envelope is exceeded and hub spring contact is encountered, a mast bump inspection will be performed.

8-46. Collective Bounce Collective bounce is a pilot induced vertical oscillation of the collective control system when an absolute friction (either pilot applied or control rigged) is less than seven pounds. It may be encountered in any flight condition by a rapid buildup of vertical bounce at approximately three cycles per second. The severity of the oscillation is such that effective control of the helicopter may become difficult to maintain. The pilot should apply and maintain adequate collective friction in all flight conditions.

8-47. Blade Stall Refer to FM 1-203, Fundamentals of Flight.

8-48. Settling with Power Refer to FM 1-203, Fundamentals of Flight.

8-49. Maneuvering Flight Action and response of the controls during maneuvering flight are normal at all times when the helicopter is operated within the limitations set forth in this manual.

8-50. Hovering Capabilities Refer to chapter 7.

8-51. Flight With External Loads The airspeed with external cargo is limited by controllability.

8-52. Types of Vibration

a. The source of vibrations of various frequencies are the rotating and moving components on the helicopter; other components vibrate in response to an existing vibration.

b. Rotor vibrations felt during in-flight or ground operations are divided in general frequencies as follows:

(1) Extreme low frequency—Less than one per revolution (pylon rock).

(2) Low frequency—One or two per revolution.

(3) Medium frequency—Generally, four, five, or six per revolution.

(4) High frequency—Tail rotor frequency or higher.

c. Most vibrations are always present at low magnitudes. The main problem is deciding when a vibration level has reached the point of being excessive.

d. Extreme low, and most medium frequency vibrations are caused by the rotor or dynamic controls. Various malfunctions in stationary components can affect the absorption or damping of the existing vibrations and increase the overall level.

e. A number of vibrations are present which are considered a normal characteristic. Two per revolution is the most prominent of these, with four or six per revolution the next most prominent. There is always a small amount of high-frequency vibration present that may be detectable. Experience is necessary to learn the normal vibration levels. Sometimes the mistake is made of concentrating on feeling one specific vibration and concluding that the level is higher than normal.

8-53. Low G Maneuvers

WARNING

Intentional flight below +0.5G is prohibited.

WARNING

Abrupt inputs of flight controls cause excessive main rotor flapping, which may result in mast bumping and must be avoided.

a. Because of mission requirements, it may be necessary to rapidly lower the nose of the helicopter. At moderate to high airspeeds, it becomes increasingly easier to approach zero or negative load factors by abrupt forward cyclic inputs. The helicopter may exhibit a tendency to roll to the right simultaneously with the forward cyclic input.

b. Such things as sideslip, weight and location of external stores and airspeed will affect the severity of the right roll. Variances in gross weight, longitudinal cg, and rotor rpm may affect the roll characteristics. The right roll occurs throughout the normal operating airspeed range and becomes more violent at progressively lower load factors. When it is necessary to rapidly lower the nose of the helicopter, it is essential that the pilot monitor changes in roll attitude as the cyclic is moved forward.

c. If the flight envelope is inadvertently exceeded, causing a low ''G'' condition and right roll, move cyclic aft to return rotor to positive thrust condition, then roll level, continuing flight if mast bumping has not occurred.

8-54. Rollover Characteristics Refer to FM 1-203, Fundamentals of Flight.

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Section VI. ADVERSE ENVIRONMENTAL CONDITIONS

8-55. General This section provides information relative to operation under adverse environmental conditions (snow, ice and rain, turbulent air, extreme cold and hot weather, desert operations, mountainous and altitude operation) at maximum gross weight. Section II check list provides for operational requirements of this section.

Caution

Extreme care should be exercised under adverse environmental conditions when using NVG. Such conditions induce backscatter and could significantly decrease or destroy the effectiveness of NVG to the extent of creating unsafe flight conditions. Use of NVG should be discontinued under such conditions and assure that the NVG searchlight and/or landing light and NVG position lights are extinguished.

8-56. Cold Weather Operations Operation of the helicopter in cold weather or an arctic environment presents no unusual problems if the operators are aware of those changes that do take place and conditions that may exist because of the lower temperatures and freezing moisture.

a. Inspection. The pilot must be more thorough in the preflight check when temperatures have been at or below 0°C (32°F). Water and snow may have entered many parts during operations or in periods when the helicopter was parked unsheltered. This moisture often remains to form ice which will immobilize moving parts or damage structure by expansion and will occasionally foul electric circuitry. Protective covers afford protection against rain, freezing rain, sleet, and snow when installed on a dry helicopter prior to the precipitation. Since it is not practicable to completely cover an unsheltered helicopter, those parts not protected by covers and those adjacent to cover overlap and joints require closer attention, especially after blowing snow or freezing rain. Remove accumulation of snow and ice prior to flight. Failure to do so can result in hazardous flight, due to aerodynamic and center of gravity disturbances as well as the introduction of snow, water and ice into internal moving parts and electrical systems. The pilot should be particularly attentive to the main and tail rotor systems and their exposed control linkages.

Caution

At temperatures of -35°C (-31°F) and lower, the grease in the spherical couplings of the main transmission driveshaft may congeal to a point that the couplings cannot operate properly.

b. Transmission. Check for proper operation by turning the main rotor opposite to the direction of rotation while observer watches the driveshaft to see there is no tendency for the transmission to ''wobble'' while the driveshaft is turning. If found frozen, apply heat (do not use open flame, avoid overheating boot) to thaw the spherical couplings before attempting to start engine.

c. Checks.

(1) Before exterior check 0°C (32°F) and lower. Perform check as specified in Section III.

(2) Exterior check 0°C (32°F) to -54°C (-65°F). Perform the following checks. Check that all surfaces and controls are free of ice and snow. Contraction of the fluids in the helicopter system at exteme low temperatures causes indication of low levels. A check made just after the previous shutdown and carried forward to the walk around check is satisfactory if no leaks are in evidence. Filling when the system is cold-soaked will reveal an over-full condition immediately after flight, with the possibility of forced leaks at seals.

(a) Main rotor—Check free of ice, frost, and snow.

(b) Main driveshaft—Check for freedom of movement.

(c) Engine air inlet and screens—Remove all loose snow that could be pulled into and block the engine intake during starting.

(d) Oil cooling fan compartment—Check oil cooling fan blades for ice.

(3) Interior check—All flights 0°C (32°F) to -54°C (-65°F). Perform check as specified in section III.

(4) Engine starting check 0°C (32°F) to -54°C (-65°F). Determine that the compressor rotor turns freely. As the engine cools to an ambient temperature below 0°C (32°F) after engine shutdown condensed moisture may freeze engine seals. Ducting hot air from an external source through the air inlet housing will free a frozen rotor. Perform check as

outlined in section II. If temperature is -44°C (-47°F) or below the pilot must be particularly careful to monitor engine and transmission instruments for high oil pressure. During cold weather starting the engine oil pressure gage will indicate maximum (100 psi). The engine should be warmed up at engine idle until the engine oil pressure indication is below 100 psi. The time required for warmup is entirely dependent on the starting temperature of the engine and lubrication system.

(5) Engine runup check. Perform the check as outlined in section II.

WARNING

Control system checks should be performed with extreme caution when helicopter is parked on snow and ice. There is reduction in ground friction holding the helicopter stationary, controls are sensitive and response is immediate.

d. Engine Starting Without External Power Supply. If a battery start must be attempted when the helicopter and battery have been cold-soaked, preheat the engine and battery if equipment is available and time permits. Preheating will result in a faster starter cranking speed which tends to reduce the hot start hazard by assisting the engine to reach a self-sustaining speed (40 percent N1) in the least possible time. Electrical load may be reduced by leaving inverter lights and other electrical equipment off during start.

8-57. Before Leaving the Helicopter Open vents to permit free circulation of air. Install protective covers as required.

8-58. Snow Refer to FM 1-202, Environmental Flight.

8-59. Desert and Hot Weather Operations Refer to FM 1-202, Environmental Flight.

8-60. Turbulence and Thunderstorms

8-61. Turbulence

a. In turbulence, check that all occupants are seated with seat belts and harnesses tightened.

b. Helicopter controllability is the primary consideration; therefore, if control becomes marginal, exit the turbulence as soon as possible.

c. To minimize the effects of turbulence encountered in flight the helicopter should be flown at an airspeed corresponding to minimum torque required; maximum endurance airspeed. There will be a corresponding increase in control movements at the reduced airspeed.

8-62. Thunderstorms

a. To minimize the effects of thunderstorms encountered in flight perform the following:

(1) Adjust torque to maintain maximum endurance airspeed.

(2) Check that all occupants are seated with seat belts and harnesses tightened.

(3) PITOT HTR switch—ON.

(4) Avionics—Reduce volume on any equipment affected by static.

(5) Interior lights—Adjust to full bright at night to minimize blinding effect of lightning.

b. In The Storm.

(1) Maintain a level attitude and constant power setting. Airspeed fluctuations should be expected and disregarded.

(2) Maintain original heading, turning only when necessary.

(3) The altimeter is unreliable due to differential barometric pressures within the storm. An indicated gain or loss of several hundred feet is not uncommon and should be allowed for in determining minimum safe altitude.

8-63. Lightning Strikes

a. Although the possiblity of a lightning strike is remote, with increasing use of all-weather capabilities the helicopter could inadvertently be exposed to lightning damage. Therefore static tests have been conducted to detemine lightning strike effects on rotors.

b. Simulated lightning tests indicate that lightning strikes may damage helicopter rotors. The degree of damage will depend on the magnitude of the charge and the point of contact. Catastrophic structural failure is not anticipated. However, lightning damage to hub bearings, blade aft section, trim tabs, and blade tips was demonstrated. Also, adhesive bond separations occurred between the blade spar and aft section between the spar and leading edge abrasion strip. Some portions of blade aft sections deformed to the extent that partial or complete separation of the damaged section could be expected. Such damage can aerodynamically produce severe structural vibration and serious control problems which, if prolonged, could endanger the helicopter and crew.

WARNING

Avoid flight in or near thunderstorms especially in areas of observed or anticipated lightning discharges.

c. If lightning damage occurs, indications such as control problems or vibration changes, especially abnormal noise may or may not be evident.

NOTE

Abnormal operating noises almost always accompany rotor damage, but loudness or pitch are not valid indications of the degree of damage sustained.

d. If lightning strike occurs or is suspected, the following precautions are recommended to minimize further risk.

(1) Reduce airspeed as much as practical to maintain safe flight.

(2) Avoid abrupt control inputs.

8-64. Ice and Rain

a. In heavy rain, a properly adjusted wiper can be expected to clear the windshield adequately throughout the entire speed range. However, when poor visibility is encountered while cruising in rain, it is recommended that the pilot fly by reference to the flight instruments and the copilot attempt to maintain visual reference. Rain has no noticeable effect on handling or performance of the helicopter. Maintenance personnel are required to perform a special inspection after the helicopter has been operated in rain.

NOTE

If the windshield wiper does not start in LOW or MED position, turn the control to HIGH. After the wiper starts, the control may be set at the desired position.

b. Continuous flight in light icing conditions is not recommended because the ice shedding induces rotor blade vibrations, adding greatly to the pilots work load. If icing conditions are encountered during flight every effort should be made to vacate the icing environment.

Caution

When operating at outside air temperatures of 40°F (5°C) or below, icing of the engine air inlet screens can be expected. Ice accumulation on inlet screens can be detected by illumination of the ENGINE INLET AIR caution light. Continued accumulation of ice will result in partial or complete power loss. It should be noted that illumination of the ENGINE INLET AIR caution light indicates blockage at the inlet screen only and does not reveal icing conditions in the particle separator or on the FOD screen. To preclude the possibility of icing, it is recommended that the right and left engine air inlet filters be removed from the cowling when it is anticipated that the helicopter will be flown under atmospheric conditions conductive to icing. (Do not remove the top filter.)

c. If icing conditions become unavoidable the pilot should actuate the pitot heat, windshield defroster and de-icer switches.

d. Flight tests in closely controlled icing conditions have indicated that the pilot can expect one or all of the following to occur:

(1) Obscured forward field of view due to ice accumulation on the windscreens and chin bubbles. If the windshield defrosters fail to keep the windshield clear of ice, the side windows may be used for visual reference during landing.

(2) One-per-rotor-revolution vibrations ranging from mild to severe caused by asymmetrical ice shedding from the main rotor system. The severity of the vibration will depend upon the temperatures and the amount of ice accumulation on the blades when the ice shed occurs. Flight test experience has shown that the possiblity of an asymmetric ice shed occurring increases as the outside air temperature decreases.

(3) An increase in torque required to maintain a constant airspeed and altitude due to ice accumulation on the rotor system.

(4) Possible degradation of the ability to maintain autorotational rotor speed within operating limits.

e. Severe vibrations may occur as a result of main rotor asymmetrical ice shedding. If icing conditions are encountered while in flight, land as soon as practical. All ice should be removed from the rotor system before attempting further flight.

f. Control activity cannot be depended upon to remove ice from the main rotor system. Vigorous control movements should not be made in an attempt to reduce low frequency vibrations caused by asymmetrical shedding of ice from the main rotor blades. These movements may induce a more asymmetrical shedding of ice, further aggravating helicopter vibration levels.

g. If a 5 psi (or greater) torque pressure increases is required above the cruise torque setting used prior to entering icing conditions it may not be possible to maintain autorotational rotor speed within operational limits, should an engine failure occur.

h. Ice shed from the rotor blades and/or other rotating components presents a hazard to personnel during landing and shutdown. Ground personnel should remain well clear of the helicopter during landing and shutdown, and passengers and crewmembers should not exit the helicopter until the rotor has stopped turning.

8-65. High or Gusty Wind

a. High or gusty wind operations require no special procedures or techniques while in flight however, special parking precautions are necessary to ensure that the main rotor blades do not flex downward contacting the tail rotor driveshaft during rotor coast down.

b. To reduce the possibility of main rotor/tailboom contact during engine shutdown, land the helicopter on an upwind heading. During engine shutdown, displace cyclic into the wind, adding cyclic as necessary as rotor rpm decreases.

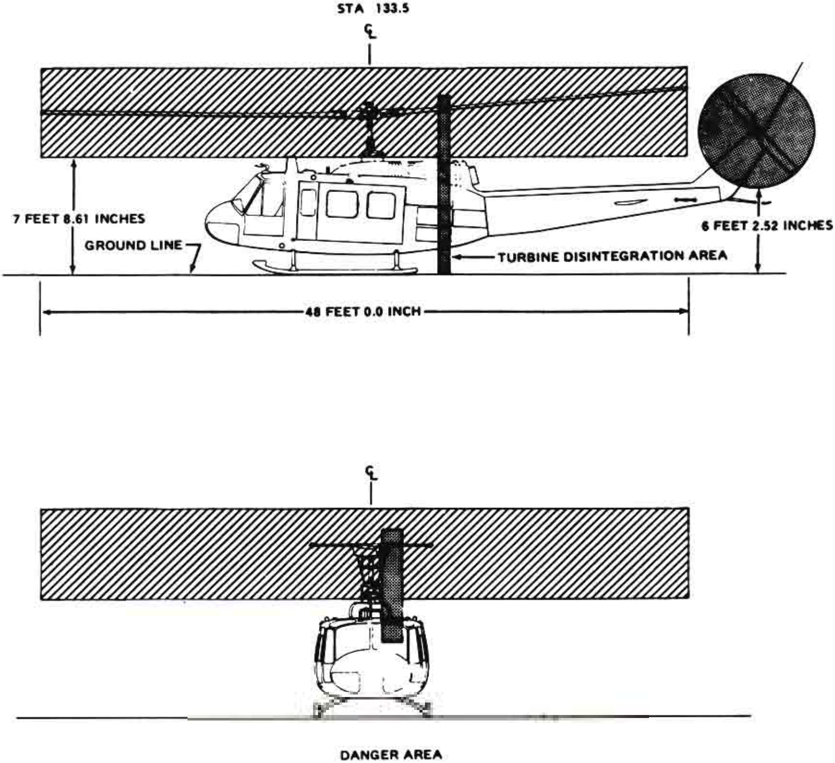


Figure 8-1. Danger Area

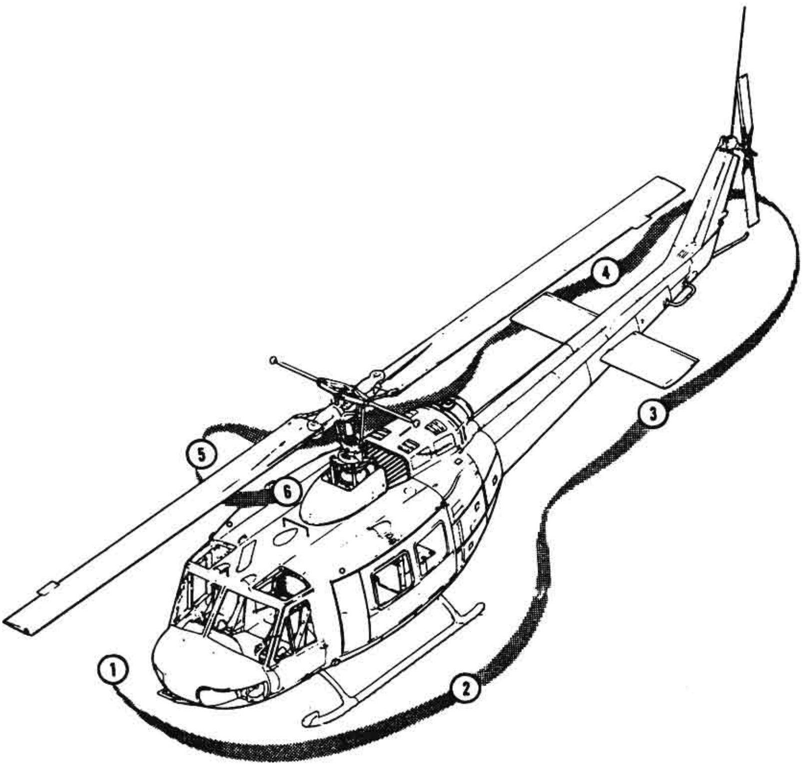


Figure 8-2. Exterior Check Diagram

Chapter 9

Emergency Procedures

Section I. HELICOPTER SYSTEMS

9-1. Helicopter Systems. This section describes the helicopter systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency operation of mission equipment is contained in this chapter insofar as its use affects safety of flight. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist TM 55-1520-210-CL.

9-2. Immediate Action Emergency Steps. Those steps that must be performed immediately in an emergency situation are underlined. These steps must be performed without reference to the checklist. When the situation permits, non-underlined steps will be accomplished with use of the checklist.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is aircraft control. All procedures are subordinate to this requirement.

9-3. Definition Of Emergency Terms. For the purpose of standardization the following definitions shall apply:

a. The term LAND AS SOON AS POSSIBLE is defined as executing a landing to the nearest suitable landing area without delay. The primary consideration is to assure the survival of occupants.

b. The term LAND AS SOON AS PRACTICABLE is defined as executing a landing to a suitable airfield, heliport, or other landing area as the situation dictates.

c. The term AUTOROTATE is defined as adjusting the flight controls as necessary to establish an autorotational descent. See figure 9-2, FM 1-203, Fundamentals of Flight.

1. Collective adjust as required to maintain rotor rpm.

2. Pedals adjust as required.

3. Throttle adjust as required.

4. Airspeed adjust as required.

d. The term EMER SHUTDOWN is defined as engine stoppage without delay.

1. Throttle—Off.

2. FUEL switches—OFF.

3. BAT switch—OFF.

e. The term EMER GOV OPNS is defined as manual control of the engine RPM with the GOV AUTO/EMER switch in the EMER position. Because automatic acceleration, deceleration, and overspeed control are not provided with the GOV switch in the EMER position, throttle and collective coordinated control movements must be smooth to prevent compressor stall, overspeed, overtemperature, or engine failure.

1. GOV switch—EMER.

2. Throttle-Adjust as necessary to control RPM.

3. Land as soon as possible.

9-4. Emergency Exits. Emergency exits are shown in figure 3-1. Emergency exit release handles are yellow and black striped.

a. *Cockpit Doors.*

(1) Pull handle.

(2) Push door out.

b. *Cabin Door Windows.*

(1) Pull handle.

(2) Lift window inward.

9-5. Emergency Equipment

WARNING

Toxic fumes of the extinguishing agent may cause injury, and liquid agent may cause frost bite or low-temperature burns.

Refer to figure 9-1 for fire extinguisher and first aid kit locations.

9-6. Minimum Rate of Descent. See figure 9-2

9-7. Maximum Glide Distance. See figure 9-2

9-8. Engine

9-9. Engine Malfunction-Partial or Complete Power Loss

a. The indications of an engine malfunction, either a partial or a complete power loss are left yaw, drop in engine rpm, drop in rotor rpm, low rpm audio alarm, illumination of the rpm warning light, change in engine noise.

b. Flight characteristics:

(1)—Control response with an engine inoperable is similar to a descent with power.

(2)—Airspeed above the minimum rate of descent values (figures 9-2) will result in greater rates of descent and should only be used as necessary to extend glide distance.

(3)—Airspeeds below minimum rate of descent airspeeds will increase rate of descent and decrease glide distance.

(4)—Should the engine malfunction during a left bank maneuver, right cyclic input to level the aircraft must be made simultaneously with collective pitch adjustment. If the collective pitch is decreased without a corresponding right cyclic input, the helicopter will pitch down and the roll rate will increase rapidly, resulting in a significant loss of altitude.

WARNING

Do not close the throttle. Do not respond to the rpm audio and/or warning light illumination without first confirming engine malfunction by one or more of the other indications. Normal indications signify the engine is functioning properly and that there is a tachometer generator failure or an open circuit to the warning system, rather than an actual engine malfunction.

c. Partial power condition:

Under partial power conditions, the engine may operate relatively smoothly at reduced power or it may operate erratically with intermittent surges of power. In instances where a power loss is experienced without accompanying power surging, the helicopter may sometimes be flown at reduced power to a favorable landing area. Under these conditions, the pilot should always be prepared for a complete power loss. In the event a partial power condition is accompanied by erratic engine operation or power surging, and flight is to be continued, the GOV switch may be moved to the EMER position and throttle adjusted in an attempt to correct the surging condition. If flight is not possible, close the throttle completely and complete an autorotational landing.

d. Complete power loss:

(1) Under a complete power loss condition, delay in recognition of the malfunction, improper technique or excessive maneuvering to reach a suitable landing area reduces the probability of a safe autorotational landing. Flight conducted within the caution area of the height-velocity chart (fig 9-3) exposes the helicopter to a high probability of damage despite the best efforts of the pilot.

(2) From conditions of low airspeed and low altitude, the deceleration capability is limited, and caution should be used to avoid striking the ground with the tail rotor. Initial collective reduction will vary after an engine malfunction dependent upon the altitude and airspeed at the time of the occurrence. For example, collective pitch must not be decreased when an engine failure occurs at a hover in ground effect; whereas, during cruise flight conditions, altitude and airspeed are sufficient for a significant reduction in collective pitch, thereby, allowing rotor rpm to be maintained in the safe operating range during autorotational descent. At high gross weights, the rotor may tend to overspeed and require collective pitch application to maintain the rpm below the upper limit. Collective pitch should never be applied to reduce rpm below normal limits for extending glide distance because of the reduction in rpm available for use during autorotational landing.

NOTE

If time permits, during the autorotative descent, transmit a "May Day" call, set transponder to emergency, jettison external stores, and lock shoulder harness.

9-10. Deleted

9-11. Engine Malfunction—Hover

Autorotate.

9-12. Engine Malfunction—Low Altitude/Low Airspeed or Cruise

1. Autorotate.

2. EMER GOV OPNS

9-13. Engine Restart—During Flight After an engine failure in flight, resulting from a malfunction of fuel control unit, an engine start may be attempted. Because the exact cause of engine failure cannot be determined in flight, the decision to attempt the start will depend on the altitude and time available, rate of descent, potential landing areas, and crew assistance available. Under ideal conditions approximately one minute is required to regain powered flight from time the attempt start is begun. If the decision is made to attempt an in-flight start:

1. Throttle—Off.

2. STARTER GEN switch—START.

3. FUEL switches—ON.

4. GOV switch—EMER.

5. Attempt start.

a. Starter switch—Press.

b. Throttle—Open slowly to 6400 to 6600 rpm as N1 passes through 8 percent. Control rate of throttle application as necessary to prevent exceeding EGT limits.

c. Starter switch—Release as N1 passes through 40 percent. After the engine is started and powered flight is reestablished, continue with manual control. Turn the START FUEL switch OFF and return the STARTER GEN switch to STANDBY.

6. Land as soon as possible.

9-14. Droop Compensator Failure Droop compensator failure will be indicated when engine rpm is no longer controlled by application of collective pitch. The engine will tend to overspeed as collective pitch is decreased and will underspeed as collective pitch is increased. If the droop compensator fails, make minimum collective movements and execute a shallow approach to the landing area. If unable to maintain the operating rpm within limits:

EMER GOV OPNS

9-15. Engine Compressor Stall Engine compressor stall (surge) is characterized by a sharp rumble or loud sharp reports, severe engine vibration and a rapid rise in exhaust gas temperature (EGT) depending on the severity of the surge. Maneuvers requiring rapid or maximum power applications should be avoided. Should this occur:

1. Collective—Reduce.

2. DE-ICE and BLEED AIR switches—OFF.

3. Land as soon as possible.

9-16. Inlet Guide Vane Actuator Failure-Closed or Open

a. Closed. If the guide vanes fail in the closed position, a maximum of 20 to 25 psi of torque will be available although N1 may indicate normal. Power applications above 20 to 25 psi will result in deterioration of N2 and rotor rpm while increasing N1. Placing the GOV switch in the EMER position will not provide any increase power capability and increases the possibility of an N1 overspeed and an engine overtemperature. Should a failure occur, accomplish an approach and landing to the ground with torque not exceeding the maximum available. If possible, a running landing is recommended.

b. Open. If the inlet guide vanes fail in the open position during normal flight, it is likely that no indications will be evidenced. In this situation, increased acceleration times will be experienced. As power applications are made from increasingly lower N1 settings, acceleration times will correspondingly increase.

9-17. Engine Overspeed Engine overspeed will be indicated by a right yaw, rapid increase in both rotor and engine rpm, rpm warning light illuminated, and an increase in engine noise. An engine overspeed may be caused by a malfunctioning N2 governor or fuel control. Although the initial indications of high N2 rpm and rotor rpm are the same in each case, actions that must be taken to control rpm are distinctly different. If the N2 governor malfunctions, throttle reduction will result in a corresponding decrease in N2 rpm. In the event of a fuel control malfunction, throttle reduction will have no effect on N2 rpm. If an overspeed is experienced:

1. Collective—Increase to load the rotor in an attempt to maintain rpm below the maximum operating limit.

2. Throttle—Reduce until normal operating rpm is attained. Continue with manual throttle control.

If reduction of throttle does not reduce rpm as required:

3. EMER GOV OPNS

9-18. Transmissions, and Drive Systems

9-19. Transmission Oil—Hot or Low Pressure. If the transmission oil temperature XMSN OIL HOT caution light illuminates, limits on the transmission oil temperature gage are exceeded; XMSN OIL PRESS caution light illuminates, or limits on the transmission oil pressure gage are exceeded (low or high)—

1. Land as soon as possible.

2. EMER SHUTDOWN— After landing.

WARNING

Engine power must be maintained throughout the approach and landing to aid in preventing seizure of gears in the transmission.

Should transmission oil pressure drop to zero psi, a valid cross reference cannot be made with the oil temperature indicators. The oil temperature gage and transmission oil hot warning lights are dependent on fluid for valid indications.

9-20. Tail Rotor Malfunctions. Because the many different malfunctions that can occur, it is not possible to provide a solution for every emergency. The success in coping with the emergency depends on quick analysis of the condition.

9-21. Complete Loss of Tail Rotor Thrust. This situation involves a break in the drive system, such as a severed driveshaft, wherein the tail rotor stops turning or tail rotor controls fail with zero thrust.

a. Indications.

(1) Pedal input has no effect on helicopter trim.

(2) Nose of the helicopter turns to the right (left sideslip).

(3) Roll of fuselage along with the horizontal axis.

(4) Nose down tucking will also be present.

WARNING

At airspeeds below 30 to 40 knots, the sideslip may become uncontrollable, and the helicopter will begin to revolve on the vertical axis.

b. Procedures.

(1) If safe landing area is not immediately available and powered flight is possible, continue flight to a suitable landing area at above minimum rate of descent airspeed. Degree of roll and sideslip may be varied by varying throttle and/or collective.

(2) When landing area is reached, AUTOROTATE using an airspeed above minimum rate of descent airspeed.

(3) If landing area is suitable, touchdown above effective translational lift utilizing throttle as necessary to maintain directional control.

(4) If run-on landing is not possible, start to decelerate at about 75 feet altitude so that forward groundspeed is at a minimum when the helicopter reaches 10 to 20 feet; execute the touchdown with a rapid collective pull just prior to touchdown in a level attitude with minimum groundspeed.

9-22. Fixed Pitch Settings. This is a malfunction involving a loss of control resulting in a fixed-pitch

*U.S. Government Printing Office: 1989-654-061/83137

setting. Whether the nose of the helicopter yaws left or right is dependent upon the amount of pedal applied at the time of the malfunction. Regardless of pedal setting at the time of malfunction, a varying amount of tail rotor thrust will be delivered at all times during flight.

a. Reduced power (low torque).

(1) Indications: The nose of the helicopter will turn right when power is applied.

(2) Procedure: Reduced power situations:

(a) If helicopter control can be maintained in powered flight, the best solution is to maintain control with power and accomplish a run-on landing as soon as practicable.

(b) If helicopter control cannot be maintained, close the throttle immediately and accomplish an autorotational landing.

b. Increased power (high torque).

(1) Indications: The nose of the helicopter will turn left when power is reduced.

(2) Procedure.

(a) Less than hover power. Maintain control with power and accomplish a run-on landing with greater than normal speed and land as soon as practicable.

(b) Greater than hover power.

1. Maintain control with power and airspeed between 40 and 70 knots.

2. If needed, reduce rpm (not below 6000) to control sideslip.

3. Continue powered flight to a suitable landing area where a run-on landing can be accomplished.

4. On final, reduce rpm to 6000 and accomplish a run-on landing.

c. Hover.

(1) Indication. Helicopter heading cannot be controlled with pedals.

(2) Procedure. Simultaneously reduce throttle and increase collective pitch to land the helicopter.

9-23. Loss of Tail Rotor Components. The gravity of this situation is dependent upon the amount of weight lost. Any loss of this nature will result in a forward center of gravity shift, requiring aft cyclic control correction.

a. Indications:

(1) Varying degrees of right yaw depending on power applied and airspeed at time of failure.

(2) Forward CG shift.

b. Procedure:

(1) Enter autorotative descent (power off).

(2) Maintain airspeed above minimum rate of descent airspeed.

(3) If run-on landing is possible, complete autorotation with a touchdown airspeed of between 15 and 25 knots.

(4) If run-on landing is not possible, start to decelerate from about 75 feet altitude, so that forward groundspeed is at a minimum when the helicopter reaches 10 to 20 feet; execute the touchdown with a rapid collective pull just prior to touchdown in a level attitude with minimum ground roll.

9-24. Loss of Tail Rotor Effectiveness. This is a situation involving a loss of effective tail rotor thrust without a break in the drive system. The condition is most likely to occur at a hover as a result of two or more of the following:

a. Out-of-ground effect hover.

b. High pressure altitude/high temperature.

c. Adverse wind conditions.

d. Engine/rotor rpm below 6600/324.

e. Improperly rigged tail rotor.

(1) Indications: The first indication of this condition will be a slow starting right turn of the nose of the helicopter which cannot be stopped with full left pedal application. This turn rate will gradually increase until it becomes uncontrollable or, depending upon conditions, the aircraft aligns itself with the wind.

(2) Procedures. Lower collective to regain control and allow the aircraft to touchdown with little if any forward movement.

9-25. Main Driveshaft Failure. A failure of the main driveshaft will be indicated by a left yaw (this is caused by the drop in torque applied to the main rotor), increase in engine rpm, decrease in rotor rpm, low rpm audio alarm (unmodified system), and illumination of the rpm warning light. This condition will result in complete loss of power to the rotor and a possible engine overspeed. If a failure occurs:

1. Autorotate.

2. Throttle—Off.

9-26. Clutch Fails to Disengage A clutch failing to disengage in flight will be indicated by the rotor rpm decaying with engine rpm as the throttle is reduced to the engine idle position when entering autorotational descent. This condition results in total loss of autorotational capability. If a failure occurs, do the following:

1. Throttle—On.

2. Land as soon as possible.

9-27. Clutch Fails to Re-engage During recovery from autorotational descent clutch malfunction may occur and will be indicated by a reverse needle split (engine rpm higher than rotor rpm):

1. Autorotate.

2. Throttle—Off.

9-28. Collective Bounce If collective bounce occurs.

1. Relax pressure on collective. (Do not "stiff arm" the collective.)

2. Make a significant collective application either up or down.

3. Increase collective friction.

9-29. Fire The safety of helicopter occupants is the primary consideration when a fire occurs; therefore, it is imperative that every effort be made by the flight crew to put the fire out. On the ground it is essential that the engine be shut down, crew and passengers evacuated and fire fighting begun immediately. If time permits, a "May Day" radio call should be made before the electrical power is OFF to expedite assistance from fire fighting equipment and personnel. If the helicopter is airborne when a fire occurs, the most important single action that can be taken by the pilot is to land the helicopter. Consideration must be given to jettison external stores prior to landing.

9-30. Fire-Engine Start The following procedure is applicable during engine starting if EGT limits are exceeded, or if it becomes apparent that they will be exceeded. Flames emitting from the tailpipe are acceptable if the EGT limits are not exceeded.

1. Start switch—Press. The starter switch must be held until EGT is in the normal operating range.

2. Throttle—Off. The throttle must be closed immediately as the starter switch is pressed.

3. FUEL switches—OFF.

9-31. Fire-Ground

EMER SHUTDOWN

9-32. Fire-Flight If the fire light illuminates and/or fire is observed during flight, prevailing circumstances (such as VFR, IMC, night, altitude, and landing areas available), must be considered in order to determine whether to execute a power-on, or a power-off landing.

a. *Power-On.*

1. Land as soon as possible.

2. EMER SHUTDOWN after landing.

b. *Power-Off.*

1. Autorotate.

2. EMER SHUTDOWN.

9-33. Electrical Fire-Flight Prior to shutting off all electrical power, the pilot must consider the equipment that is essential to a particular flight environment that will be encountered, e.g., flight instruments, and fuel boost pumps. In the event of electrical fire or suspected electrical fire in flight:

1. BAT, STBY, and MAIN GEN switches—OFF

2. Land as soon as possible.

If landing cannot be made soon as possible and flight must be continued, the defective circuits may be identified and isolated as follows:

3. Circuit breakers—Out. As each of the following steps is accomplished, check for indications of the source of the fire.

4. MAIN GEN switch-ON.

5. STARTER GEN switch—STBY GEN.

6. BAT switch-ON.

7. Circuit breakers—In one at a time in the priority required, GEN BUS RESET first. When malfunctioning circuit is identified, pull the applicable circuit breaker out.

9-34. Overheated Battery.

WARNING

Do not open battery compartment or attempt to disconnect or remove overheated battery. Battery fluid will cause burns and overheated battery will cause thermal burns and may explode.

If an overheated battery is suspected or detected:

1. BAT switch—OFF.

2. Land as soon as possible. If condition is corrected, flight may be resumed with battery switch off.

3. EMER SHUTDOWN.

9-35. Smoke and Fume Elimination. Smoke and/or toxic fumes entering the cockpit and cabin can be exhausted as follows:

Doors, windows, and vents—Open.

Caution

Do not jettison doors in flight.

9-36. Hydraulic

WARNING

During actual or simulated hydraulic failure, do not pull or push circuit breakers or move the HYD CONT switch during takeoff, nap of the earth flying, approach and landing or while the aircraft is not in level flight. This prevents any possibility of a surge in hydraulic pressure and the resulting loss of control.

9-37. Hydraulic Power Failure. Hydraulic power failure will be evident when the force required for control movement increases; a moderate feedback in the controls when moved is felt, and the HYD PRESSURE caution light illuminates. Control movements will result in normal helicopter response in every respect. In the event of hydraulic power failure:

1. Airspeed—Adjust as necessary to attain the most comfortable level of control movements.

2. HYD CONT circuit breaker—Out.

If hydraulic power is not restored:

3. HYD CONT circuit breaker—In.

4. HYD CONT switch—OFF.

5. Land as soon as practicable at an area that will permit a run-on landing with power. Maintain airspeed at or above effective translational lift until touchdown.

9-38. Control Stiffness. A failure within the hydraulic irreversible valve may cause stiffness in the flight controls to the extent that controls are extremely hard to move. Should control stiffness occur:

1. HYD CONT switch—OFF then ON.

Check for restoration of normal flight control movements.

Repeat as necessary.

If control response is not restored:

2. HYD CONT switch—Off if normal operation is not restored.

3. Land as soon as practicable at an area that will permit a run-on landing with power. Maintain airspeed at or above effective translational lift until touchdown.

9-39. Cyclic Hardover. Cyclic hardover is any erratic movement of the cyclic stick not induced by turbulence or by crew input. During a hydraulics OFF check on the ground, in the event of an irreversible valve failure (hardover), the cyclic stick will move either left rear, right rear, left forward, or right forward, depending on which irreversible fails. In flight with hydraulics ON when a hardover occurs, the cyclic will move left rear, right rear, left forward, or right forward. In flight, with hydraulics OFF (when a hardover occurs), the cyclic will tend to move either right rear or left rear. The cyclic moves toward the rear quadrants due to the main rotor exerting extension forces on the hydraulic servos. A failure in either mode may render the helicopter uncontrollable unless the following corrective action is taken:

1. HYD CONT switch—Select opposite position.

2. Land as soon as practicable at an area that will permit a run-on landing with power. Maintain airspeed at or above effective translational lift at touchdown.

9-40. Fuel System

9-41. Fuel Boost Caution Light Illuminated

a. One Boost Pump. If the fuel pressure gage indicates a drop in pressure and/or one FUEL BOOST caution light illuminates:

Land as soon as practicable.

b. Two Boost Pumps. If the fuel pressure gage indicates zero pressure and/or both FUEL BOOST caution lights illuminate, proceed as follows:

1. FUEL switch – Check ON.

2. Decend to a pressure altitude of 4600 feet or less if possible.

3. Land as soon as practicable.

No attempt should be made to troubleshoot the system while in flight.

9-42. Electrical System

9-43. Main Generator Malfunction A malfunction of the main generator will be indicated by zero indication on the Main Generator Loadmeter and DC GENERATOR caution light illumination. An attempt may be made to put the generator back on line as follows:

1. GEN and BUS RESET circuit breaker—In.

2. MAIN GEN switch—RESET then ON. Do not hold the switch in the RESET POSITION. If the main generator is not restored or if it goes off again:

3. MAIN GEN switch—OFF.

NOTE

Check that the standby generator loadmeter is indicating a load. Flight may be continued using the standby generator.

9-44. Landing and Ditching

9-45. Landing in Trees A landing in trees should be made when no other landing area is available. Select a landing area containing the least number of trees of minimum height. Decelerate to a zero ground speed at tree-top level and descend into the trees vertically, applying collective pitch as necessary for minimum rate of descent. Prior to the main rotor blades entering the trees, apply all of the remaining collective pitch.

9-46. Ditching—Power on If it becomes necessary to ditch the helicopter, accomplish an approach to an approximate 3-foot hover above the water and proceed as follows:

1. Cockpit doors—Jettison at a hover.

2. Cabin doors—Open.

3. Crew (except pilot) and passengers—Exit.

4. Hover a safe distance away from personnel.

5. Throttle—Off and autorotate. Apply full collective pitch prior to the main rotor blades entering the water. Maintain a level attitude as the helicopter sinks and until it begins to roll, then apply cyclic in direction of the roll.

6. Pilot—Exit when the main rotor is stopped.

9-47. Ditching-Power Off If ditching is imminent, accomplish engine malfunction emergency procedures. Decelerate to zero forward speed as the helicopter nears the water. Apply all of the collective pitch as the helicopter enters the water. Maintain a level attitude as the helicopter sinks and until it begins to roll, then apply cyclic in the direction of the roll. Exit when the main rotor is stopped.

1. Cockpit and cabin doors—Jettison.

2. Exit when main rotor has stopped.

9-48. Flight Control/Main Rotor System Malfunctions

a. Failure of components within the flight control system may be indicated through varying degrees of feedback, binding, resistance, or sloppiness. These conditions should not be mistaken for hydraulic power failure.

b. Imminent failure of main rotor components may be indicated by a sudden increase in main rotor vibration and/or unusual noise. Severe changes in lift characteristics and/or balance condition can occur due to blade strikes, skin separation, shift or loss of balance weights or other material. Malfunctions may result in severe main rotor flapping. In the even of a main rotor system malfunction, proceed as follows:

WARNING

Danger exists that the main rotor system could collapse or separate from the aircraft after landing. A decision must be made whether occupant egress occurs before or after the rotor has stopped.

1. Land as soon as possible.

2. EMER SHUTDOWN.

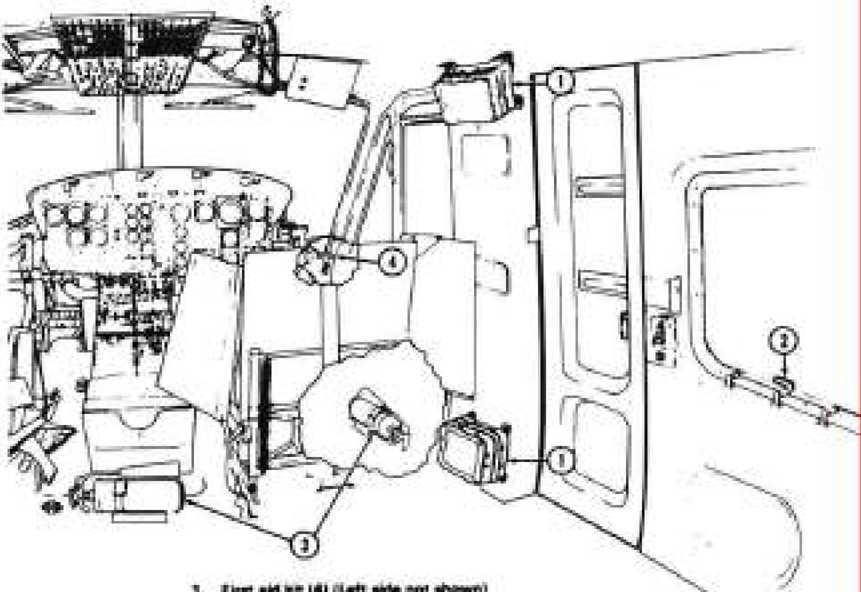
9-49. Mast Bumping

If mast bumping occurs:

1. Reduce severity of maneuver.
2. Land as soon as possible.

Table 9-1 Emergency Procedures for Caution Segments

Light	Corrective Action
MASTER CAUTION	Check the CAUTION panel for the condition. If master caution only (no segment light), land as soon as possible.
AUX FUEL LOW	INT AUX FUEL transfer switches-OFF.
DC GENERATOR	Check GEN AND BUS RESET circuit breaker in MAIN GEN switch RESET then ON. Switch to STBY GEN.
INST INVERTER	Switch to other inverter.
EXTERNAL POWER	Close door.
XMSN OIL PRESS	Land as soon as possible.
XMSN OIL HOT	Land as soon as possible.
ENGINE INLET AIR	Land as soon as practicable.
CHIP DETECTOR	Land as soon as possible.
LEFT FUEL BOOST	Land as soon as practicable.
RIGHT FUEL BOOST	Land as soon as practicable.
20 MINUTE FUEL	Information/System Status
IFF	Information/System Status
ENGINE OIL PRESS	Land as soon as possible.
ENGINE CHIP DET	Land as soon as possible.
GOV EMER	Information/System Status
ENGINE ICE DET	Land as soon as possible.
ENGINE FUEL PUMP	Land as soon as possible.
ENGINE ICING	Land as soon as possible.
FUEL FILTER	Land as soon as practicable.
HYD PRESSURE	Land as soon as practicable.
SPARE	Land as soon as possible.



1. First aid kit (4) (Left side not shown)
2. Cabin door window emergency release handle (Left side not shown)
3. Fire extinguisher (1)
4. Crew door jettison handle (Left side not shown)

Figure 9-1. Emergency Exits and Equipment

AUTOROTATIONAL GLIDE CHARACTERISTICS

POWER OFF

EXAMPLE

WANTED

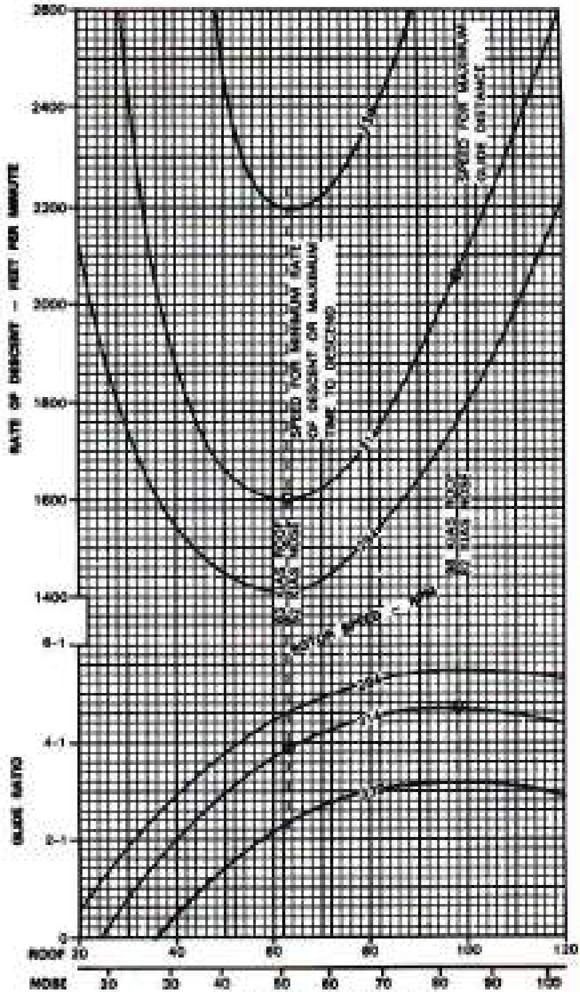
GLIDE RATIO AND RATE OF DESCENT

KNOWN

AIRSPEED = 80 KIAS ROOF
ROTOR RPM = 314

METHOD

ENTER INDICATED AIRSPEED
MOVE UP TO 314 ROTOR RPM LINE
MOVE LEFT, READ GLIDE RATIO.
CONTINUE UP 80 KIAS TO 314 ROTOR
RPM LINE ON UPPER GRAPH. MOVE
LEFT, READ RATE OF DESCENT.



TED DATA

Figure 9-2. Autorotational Glide Characteristics Chart

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HEIGHT VELOCITY DIAGRAM

324 ROTOR RPM

EXAMPLE A

WANTED

INDICATED AIRSPEED

KNOWN

GROSS WEIGHT = 8700 LB
SKID HEIGHT ABOVE GROUND = 370 FEET
ROOF MOUNTED SYSTEM

METHOD

ENTER SKID HEIGHT HERE
MOVE RIGHT TO GROSS WEIGHT
MOVE DOWN, READ INDICATED
AIRSPEED = 18 KNOTS

EXAMPLE B

WANTED

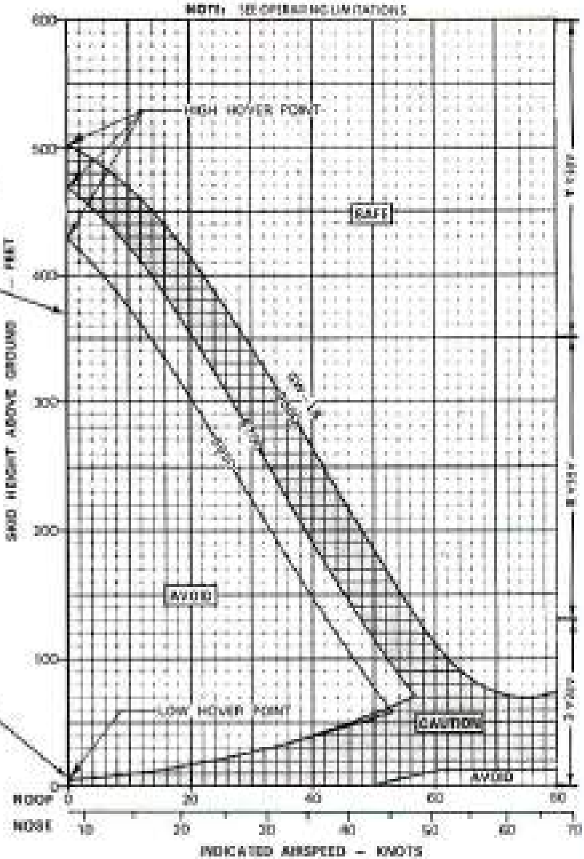
MINIMUM INDICATED AIRSPEED
FOR CLIMBOUT TO AVOID
HEIGHT VELOCITY RESTRICTIONS

KNOWN

GROSS WEIGHT = 8700 LB
LOW HOVER POINT = 4 FEET
SKID HEIGHT ABOVE GROUND
ROOF MOUNTED SYSTEM

METHOD

ENTER SKID HEIGHT HERE
(AT LOW HOVER POINT)
MOVE RIGHT ALONG THE
GROSS WEIGHT LINE
TO THE FASTEST AIRSPEED
MOVE DOWN, READ INDICATED
AIRSPEED = 36.5 KNOTS



DATA BASIS: DERIVED FROM FLIGHT TEST FTC-TDR 67-27, NOVEMBER 1964

Figure 9-3. Height Velocity Diagram

Appendix A
References

AR 50-4
Safety Studies and Reviews of Nuclear Weapon Systems

AR 50-5
Nuclear Surety

AR 70-50
Designating and Naming Military Aircraft, Rockets, and Guided Missiles

AR 95-1
Army Aviation General Provisions and Flight Regulations

AR 95-16
Weight and Balance—Army Aircraft

AR 95-27
Operational Procedures for Aircraft Carrying Dangerous Materials

AR 385-40
Accident Reporting and Records

TB 55-9150-200-24
Engine and Transmission Oils, Fuels and Additives for Army Aircraft

TB MED 501
Noise and Conservation of Hearing

TM 9-1005-224-10
Operators Manual for M60, 7.62-MM Machine Gun (NSN 1005-00-605-7710)

TM 9-1005-224-12
Operator and Organizational Maintenance Manual Including Repair Parts and Special Tool Lists: Machine Gun 7.62-MM M60, and Mount, Tripod, Machine Gun M122

TM 9-1345-201-12
Operators and Organizational Maintenance Manual: Mine Dispersing Subsystem, Aircraft: M56 and M132

TM 11-5810-262-OP
Loading Procedures

TM 55-1500-342-23
Army Aviation Maintenance Engineering Manual—Weight and Balance

TM 55-1500-334-25
Conversion of Aircraft to Fire Resistant Hydraulic Fluid

TM 55-1520-210-CL
Operators and Crewmembers Checklist—UH-1H/V Helicopters

TM 57-220
Technical Training of Parachutists

TM 750-244-1-5
Procedures for the Destruction of Aircraft and Associated Equipment to Prevent Enemy Use

DA Pam 738-751
Functional Users Manual for the Army Maintenance Management System-Aviation (TAMMS-A)

DOD FLIP
DOD Flight Information Publication (Enroute)

FM-1-202
Environmental Flight

FM-1-203
Fundamentals of Flight

FM-1-204
Night Flight Techniques and Procedures

FM-1-240
Instrument Flying and Navigation for Army Aviators

FM 10-68
Aircraft Refueling

FM 10-1101
Petroleum Handling Equipment and Operation

AC
Alternating Current

ADF
Automatic Direction Finder

AGL
Above Ground Level

AI
Attack Imminent

ALT
Alternator

ALT
Altitude/Altimeter

ALTM
Altimeter

AM
Amplitude Modulation

AMP
Ampere

ANT
Antenna

ATTD
Attitude

AUTO
Automatic

AUX
Auxiliary

AVGAS
Aviation Gasoline

BAT
Battery

BDHI
Bearing Distance Heading Indicator

BFO
Beat Frequency Oscillator

BL
Butt Line

BRIL
Brilliance

BRT
Bright

C
Celsius

CARR
Carrier

CAS
Calibrated Airspeed

CCW
Counter Clockwise

CDI
Course Deviation Indicator

CG
Center of Gravity

CL
Centerline

CMPS
Compass

CNVTR
Converter

COLL
Collision

COMM
Communication

COMPT
Compartment

CONT
Control

CONT
Continuous

CONV
Converter

CW
Clockwise

DC
Direct Current

DCP
Dispenser Control Panel

DF
Direction Finding

DECR
Decrease

DELTA Δ
Incremental Change

DET
Detector

DG
Directional Gyro

DIS
Disable

DISP
Dispense

DSCRM
Discriminator

ECM
Electronic Countermeasures

EGT
Exhaust Gas Temperature

ELEC
Electrical

EMER
Emergency

END
Endurance

ENG
Engine

ESS
Essential

EXH
Exhaust

EXT
Extend

EXT
Exterior

F
Fahrenheit

FAT
Free Air Temperature

FITG
Fitting

FM
Frequency Modulation

FOD
Foreign Object Damage

FPS
Feet Per Second

FREQ
Frequency

FS
Fuselage Station

FT
Foot

FT/MIN
Feet Per Minute

FUS
Fuselage

FWD
Forward

ΔF
Increment of Equivalent Flat Plate Drag Area

G
Gravity

G
Guard

GAL
Gallon

GD
Guard

GEN
Generator

GND
Ground

GOV
Governor

GPU
Ground Power Unit

GRWT
Gross Weight

GW
Gross Weight

HDG
Heading

HF
High Frequency

HIT
Health Indicator Test

HTR
Heater

HYD
Hydraulic

IAS
Indicated Airspeed

ICS
Interphone Control Station

IDENT
Identification

IFF
Identification Friend or Foe

IGE
In Ground Effect

IN
Inch

INCR
Increase

IND
Indication/Indicator

INHG
Inches of Mercury

INOP
Inoperative

INST
Instrument

INT
Internal

INT
Interphone

INV
Inverter

INVTR
Inverter

IR
Infrared

IRT
Indicator Receiver Transmitter

ISA
International Standard Atmosphere

KCAS
Knots Calibrated Airspeed

kHz
Kilohertz

KIAS
Knots Indicated Airspeed

km
Kilometer

KTAS
Knots True Airspeed

KN
Knots

kva
Kilovolt-Ampere

kw
Kilowatt

L
Left

LB
Pounds

LDG
Landing

LH
Left Hand

LSB
Lower Sideband

LT
Lights

LTG
Lighting

LTS
Lights

MAG
Magnetic

MAN
Manual

MAX
Maximum

MED
Medium

MHF
Medium-High Frequency

MHz
Megahertz

MIC
Microphone

MIN
Minimum

MIN
Minute

MISC
Miscellaneous

mm
Millimeter

MON
Monitor

MWO
Modification Work Order

NAV
Navigation

NET
Network

NO
Number

NM
Nautical Mile

NON-ESS
Non-Essential

NON-SEC
Non-Secure

NORM
Normal

NVG
Night Vision Goggles

N1
Gas Turbine Speed

N2
Power Turbine Speed

OGE
Out of Ground Effect

PED
Pedestal

PLT
Pilot

PRESS
Pressure

PRGM
Program

PSI
Pounds Per Square Inch

PVT
Private

PWR
Power

QTY
Quantity

% Q
Percent Torque

R
Right

RCVR
Receiver

R/C
Rate of Climb

R/D
Rate of Descent

RDR
Radar

RDS
Rounds

REL
Release

REM
Remote

RETR
Retract

RETRAN
Retransmission

RF
Radio Frequency

RH
Right Hand

RI
Remote Height Indicator

RPM
Revolutions Per Minute

SAM
Surface to Air Missile

SEC
Secondary

SEC
Secure

SEL
Select

SENS
Sensitivity

SL
Searchlight

SOL
Solenoid

SQ
Squelch

SSB
Single Sideband

STA
Station

STBY
Standby

SQ FT
Square Feet

TAS
True Airspeed

TEMP
Temperature

TGT
Turbine Gas Temperature

T/R
Transmit-Receive

TRANS
Transfer

TRANS
Transformer

TRANS
Transmitter

TRQ
Torque

UHF
Ultra-High Frequency

USB
Upper Sideband

VAC
Volts, Alternating Current

VDC
Volts, Direct Current

VHF
Very high Frequency

VM
Volt Meter

VOL
Volume

VOR
Visual Omni Range

VNE
Velocity, Never Exceed (Airspeed Limitation)

WL
Water line

WPN
Weapon

XCVR
Transceiver

XMIT
Transmit

XMTR
Transmitter

XMSN
Transmission

APPENDIX C
TABULAR PERFORMANCE DATA

[illegible]

MAXIMUM TORQUE AVAILABLE — 30 MINUTE LIMIT

ANTI-ICE OFF BLEED AIR HEATER OFF

324 ROTOR/6600 ENGINE RPM

This index is organized alphabetically by paragraph number topics.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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6	2-1 a			In line 6 of paragraph 2-1a the manual states the engine has 6 Cylinders. The engine on my set only has 4 Cylinders. Change the manual to show L Cylinders.
81		4-3		Callout 16 on figure 4-3 is pointing at a bolt. In key to figure 4-3, item 16 is called a shim - Please correct one or the other.
125	line 20			I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket bit it doesn't fit. Supply says I got what I ordered, so the NSN is wrong. Please give me a good NSN

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