TRASANA

TECHNICAL REPORT NO. 3-78

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FLIGHT PROFILE PERFORMANCE HANDBOOK

VOLUME II - UH-60A (BLACKHAWK)

JUNE 1978

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DEPARTMENT OF THE ARMY
US ARMY TRADOC SYSTEMS ANALYSIS ACTIVITY
WHITE SANDS MISSILE RANGE
NEW MEXICO 88002

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VOLUME II - UH-60A (BLACKHAWK)

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JUNE 1978

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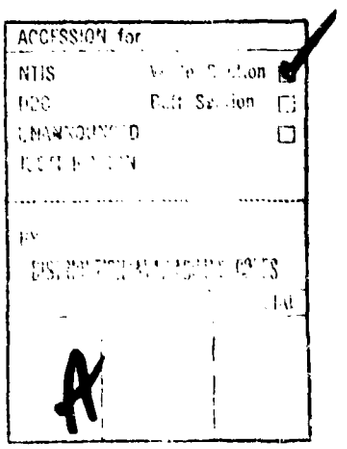

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BLACKHAWK

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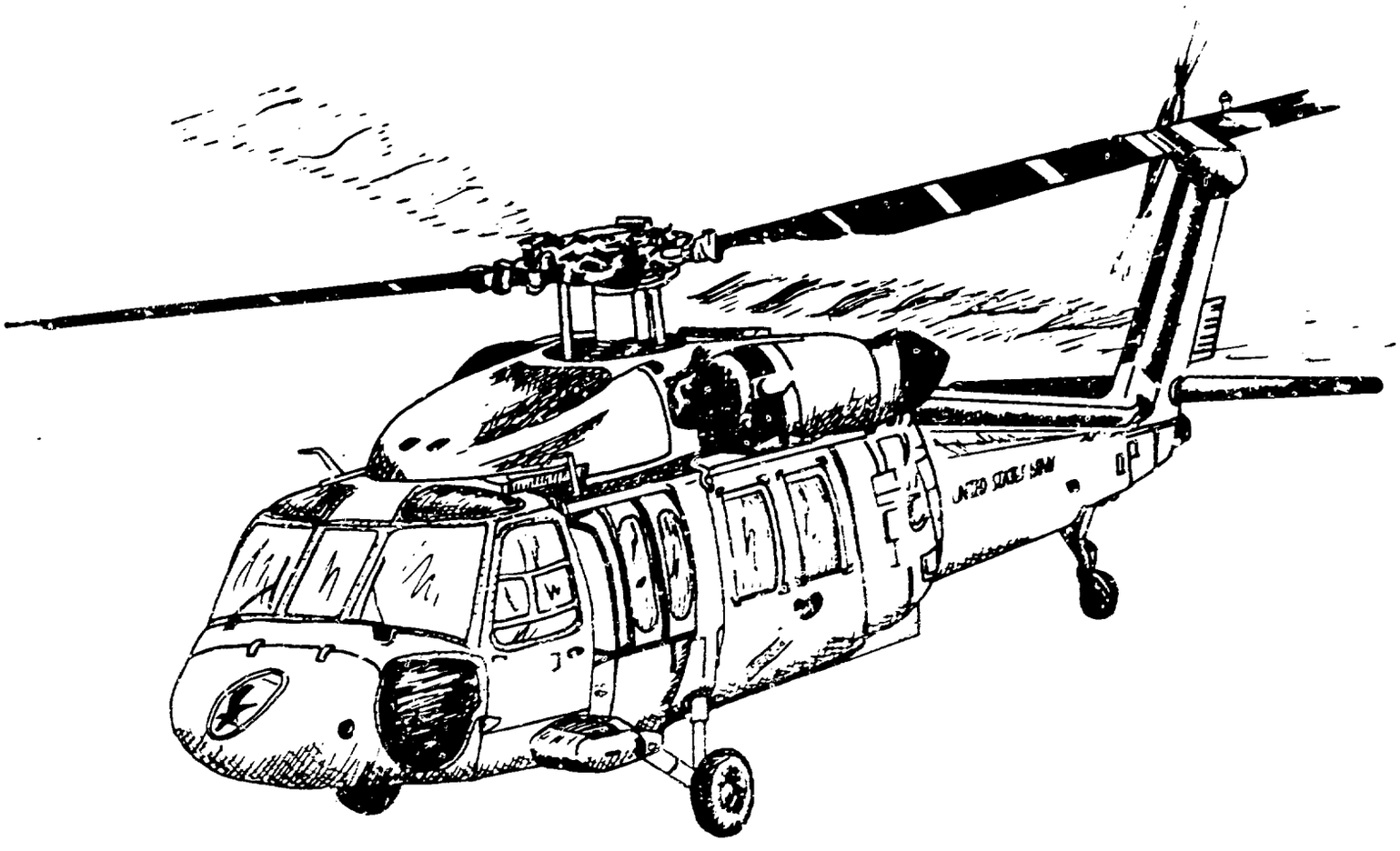


CHAPTER 1

INTRODUCTION

1. PURPOSE

The purpose for preparing this handbook series is fourfold: (a) to validate BLACKHAWK performance data quickly, (b) to reduce the manpower and time to prepare accurate flight profiles, (c) to standardize performance data so that the analysis community can benefit from a single reference in conducting studies and (d) to provide a handbook that can be used for training in the mission profile planning area.

2. BACKGROUND

The BLACKHAWK performance data contained in this Flight Profile Performance Handbook (FPPH) series was originally acquired as a data base for the Aircraft Mission Processing Simulation (AMPS) model. AMPS is a computer program developed by the Aviation Systems Analysis Branch of the US Army TRADOC Systems Analysis Activity (TRASANA) to support Cost and Operational Effectiveness Analyses (COEAs). AMPS generates detailed flight profiles for a wide variety of helicopter missions. The data was provided TRASANA by the Army Aviation Research and Development Command (AVRADCOM) and was the most accurate data available to AVRADCOM at the time of handbook publication. In structuring the data base for AMPS it was noted that the data, when properly organized, could provide a method of doing quick and simple flight profile simulations. This volume presents the BLACKHAWK data and explains how it can be used.

3. OBJECTIVES OF THE HANDBOOK

a. Data Validation. This volume of the handbook contains tables with the precise performance data and format required to develop flight profiles for computer simulations. Using the handbooks as a reference, the individual project manager (PM) will be able to quickly validate or update as required all associated data contained in the different tables. If this procedure is followed by the various PMs, support of Helicopter COEAs and other analyses can be efficiently implemented.

b. Flight Profile Development. Much of the manpower and time spent in preparing flight profiles for supporting aircraft COEAs is dedicated to look-up, correlation and validation of performance data. Once the procedure contained in this handbook is implemented, flight profiles can be easily prepared. What normally took one man 4 to 5 days to prepare can now be prepared in 3 to 4 hours.

c. Standardization of Performance Data. Each of the PMs has been contacted by AVRADCOM to validate the performance data contained in each handbook in this series. Once each handbook is published, the data contained will be kept current as of the publication data. Since the requests for current information are constantly being forwarded to the PMs by analysis groups, this handbook can be a reference and assure a commonality in studies within the community.

d. Training for Planning Missions and Flight Profiles. For training purposes each handbook can stand alone. It is only a matter of following the example provided and applying the proper data to fit the flight profile desired. Although the example shown is simplistic, the methodology may be expanded to apply to any flight profile no matter how complex.

4. OTHER VOLUMES

This handbook is one of a series that covers the helicopters in the US Army inventory. The complete set of handbooks and their subjects are:

Volume I - FPPH Description

Volume II - UH-60A (BLACKHAWK)

Volume III - AH-1G (COBRA)

Volume IV - AH-1S (COBRA)

Volume V - YAH-64 (Advanced Attack Helicopter [AAH])

Volume VI - OH-58C (KIOWA)

Volume VII - CH-47 (CHINOOK)

Volume VIII - CH-54 (TARHE)

Volume IX - UH-1H (HUEY)

5. GENERAL HANDBOOK DESCRIPTION

a. Performance Data. The data contained in these volumes is BLACKHAWK performance data compiled from the results of actual experiments. It is not engineering data and is not intended to serve as a base for future helicopter construction or acquisition. The more mature the helicopter becomes, the less likely there will be a change in the basic performance data.

b. Handbook Organization. This volume is one of a series of volumes as identified in paragraph 4 above. Volume I is a description of the methodology used to develop the tables for each of the other volumes. This volume and all other volumes except Volume I provides a simplified flight profile example in Chapter 2. Chapter 3 provides an explanation of each of the five types of data tables contained in the handbook. The five types of tables deal with: (1) Basic Fuel Flow Data, (2) Delta Fuel Flow for Drag Data, (3) Ground Idle Fuel Flow Data, (4) Gross Weight Limits Data and, (5) Velocity Limits data. Chapter 4 contains the actual tables to be used for developing flight profiles.

CHAPTER 2

FLIGHT PROFILE EXAMPLE

1. GENERAL

This chapter provides an example of how to develop a flight profile, albeit simple, that can be extended to cover any number of stops, loads and distances all depending on helicopter capability and fuel available.

2. DISCUSSION

a. The main question this example of a flight profile will answer is, "Do I have enough fuel to fly the proposed mission?"

b. Suppose a pilot is to fly a simple resupply mission in a UH-60A (BLACKHAWK) helicopter that calls for flying (as shown in illustration 2-1) from point A (the air base), to point B (the pick up area) to point C (the drop off area) and return to A.

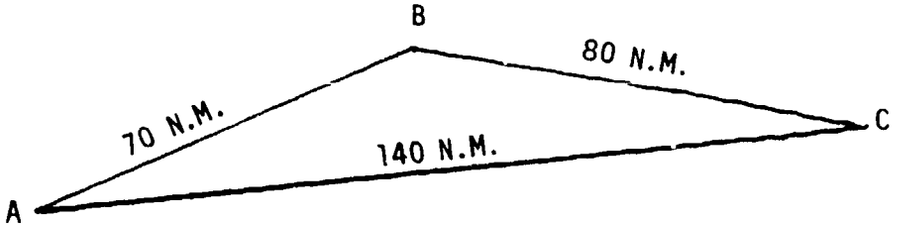


Illustration 2-1

c. The other information given is airspeed (AS) from A to B which is to be 70 knots (kts), from B to C 40 kts, and from C to A 70 kts. The BLACKHAWK helicopter is to be flown, at 4,000 ft for all legs at an ambient temperature of 15°C, and an idle altitude for take off, pick-up and drop off areas (ground level) of 2000 ft*. The mission plan also shows 10 minutes idle at A before take off, 20 minutes idle at B while loading, 20 minutes idle at C while unloading and 10 minutes idle on return to A before shut down. The BLACKHAWK will be flown empty at a gross weight (GW) of 12,000 lbs from A to B and from C to A, while the cargo from B to C will be 6,000 lbs.

**All altitudes are in reference to sea level.*

d. The flight plan is prepared by drawing up a table similar to Table 2-1 below. By filling in the blanks under fuel, it can be determined if the total is too large for the helicopter.

TABLE 2-1

Helicopter: BLACKHAWK

Altitude: 4000 ft flight/2000 ft idle

Temperature: 15°C

LEG	DISTANCE	AS	TIME	GW (lbs)	FUEL
Idle @ A	-	-	10 min	-	
A-B	70 N.M.	70 kts	1 hr	12,000	
Idle @ B	-	-	20 min	-	
B-C	80 N.M.	40 kts	2 hr	18,000	
Idle @ C	-	-	20 min	-	
C-A	140 N.M.	70 kts	2 hr	12,000	
Idle @ A	-	-	10 min	-	

e. First fill in Idle @ A, Idle @ B, Idle @ C and 2nd Idle @ A since they will all come from Table 2-2. In each case the idle is at 2000 ft and a temperature of 15°C. Consulting the ground idle fuel shown in Table 2-2, the value of 509 lbs/hr is at the intersection of 2000 ft and 15°C.

1st Idle @ A = 1/6 X 509 = 85 lbs

Idle @ B = 1/3 X 509 = 170 lbs

Idle @ C = 1/3 X 509 = 170 lbs

2nd Idle @ A = 1/6 X 509 = 85 lbs

TABLE 2-2

GROUND IDLE FUEL FLOW

AIRCRAFT - UH-60A

BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	567	529	491	459	426	395
	-5 C	557	521	484	452	419	388
	15 C	549	509	477	446	414	372
	35 C	549	510	477	443	409	378

ENTRIES ARE AIRCRAFT FUEL FLOW RATES IN LBS/HR

TABLE 2-3

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	647	765	708	631	594	597	634	706	821	1067
14,000	713	891	789	687	639	631	666	735	852	1106
16,000	785	1006	880	753	690	670	703	771	895	1164
18,000	865	1141	987	832	745	718	747	813	946	1252
20,000	951	1297	1111	925	809	774	801	872	1022	1407

Notice the conversion from minutes to hours. These values must be used because fuel flow is in lbs/hr.

f. The fuel flow for the three legs of the mission are calculated next. The heading on Table 2-1 shows a need for the Basic Fuel Flow data chart for the BLACKHAWK helicopter flying at 4000 ft and at 15°C ambient temperature. Table 2-3 contains the necessary information.

(1) Leg A-B is at 70 kts and 12,000 lbs. This is not one of the values given but 60 kts is 594 lb/hr and 80 kts is 597 lb/hr. Interpolation gives the value of 596 lb/hr for a 70 kts airspeed. Since the leg is one hour long:

Leg A-B = 1 X 596 = 596 lbs

(2) Leg B-C is at 40 kts and 18,000 lbs. This value is in the table; 832 lbs/hr. Since the leg is two hours long:

Leg B-C = 2 X 832 = 1664 lbs

(3) Leg C-A is at 70 kts and 12,000 lbs. This fuel flow rate was computed above to be 596 lbs/hr. Since the leg is two hours long:

Leg C-A = 2 X 596 = 1192 lbs.

g. The flight profile can be finished by filling in Table 2-1 as shown in Table 2-4.

TABLE 2-4

Helicopter: BLACKHAWK
Altitude: 4000 ft flight/2000 ft Idle
Temperature: 15°C

LEG	DISTANCE	AS	TIME	GW (lbs)	FUEL
Idle @ A	-	-	10 min	-	85 lbs
A-B	70 N.M.	70 kts	1 hr	12,000	596 lbs
Idle @ B	-	-	20 min	-	170 lbs
B-C	80 N.M.	40 kts	2 hr	18,000	1664 lbs
Idle @ C	-	-	20 min	-	170 lbs
C-A	140 N.M.	70 kts	2 hr	12,000	1192 lbs
Idle @ A	-	-	10 min	-	85 lbs
				Total	3962 lbs

h. Although only two look-up tables were used for this example, each type of table has several conditions that are changed so that a wide band of performance parameters can be addressed. The discussion on each of the five types of tables is contained in Chapter 3. A succinct description of each of these five types of tables is:

(1) Basic Fuel Flow Data: Gives the rate the aircraft uses fuel dependent on the given flight conditions.

(2) Delta Fuel Flow for drag Data: Gives the additional rate of fuel flow to be added to the basic rate for external drag.

(3) Ground Idle Fuel Flow Data: Gives the rate fuel is used when the aircraft is on the ground with its engine running.

(4) Gross Weight Limits Data: A check on whether or not the aircraft has enough lift to take off with a given weight.

(5) Velocity Limits Data gives the optimum (long range) speed and maximum rates of speed.

CHAPTER 3

PERFORMANCE DATA TABLE DESCRIPTIONS

1. GENERAL

This chapter describes each of the five basic type tables used for developing flight profiles. The variables within each type of table are described as well as how the specific data required can be extracted.

2. BASIC FUEL FLOW DATA

a. The basic rate of fuel flow* is determined by five variables:

(1) Type of aircraft

(2) Altitude (Air Pressure)**

(3) Temperature***

(4) Gross Weight****

(5) Flight Mode

b. In each table (see Table 3-1) within the basic type, the first three variables are held constant for the whole table, i.e., (a) Type of Aircraft, (b) Altitude (Air Pressure) above sea level, and (c) Temperature. These variables are stated at the top of each table.

c. There are five rows of fixed gross weights: 12,000 lbs, 14,000 lbs, 16,000 lbs, 18,000 lbs, and 20,000 lbs. The ten columns are fixed flight modes.

(1) The first column is Hover In Ground Effect (HIGE). HIGE is used for hovers at a height of 2 feet or less and a component of forward flight 10 kts or less.

(2) The second column is Hover Out of Ground Effect (HOGE). This is used for hovers at a height of more than 2 feet.

---

*The basic fuel flow data represents a clean drag configuration with all doors closed, no wing stores, and no external sling loads.

**All altitudes or air pressures are feet above sea level.

***For simplicity, all temperatures are considered to be the average temperature in which the helicopter is operating (Degrees Centigrade).

****Total vehicle weight in pounds.

(3) The third column is Nap of the Earth (NOE). This is defined as all flight for variable speeds from 0 to 40 kts and variable altitudes.

(4) The remaining seven columns are for given airspeeds* (in kts) as the flight mode.

d. There are 24 of these basic fuel flow charts. Each chart is for a different combination of Air Pressure (Altitude) and temperature.

e. The Basic Fuel Flow Data is the main table used in simulating a flight profile. For example, assume a pilot's flight path will require 30 minutes of flight at 80 kts airspeed, 4000 ft. altitude, 15°C and a gross weight of 18000 lbs in a UH-60A helicopter. Using Table 3-1 at a gross weight of 18000 lbs and an airspeed of 80 kts, the helicopter will use 718 lbs/hr fuel, i.e., for 30 minutes, 356 lbs of fuel will be used.

f. The gross weights values selected provide the basic range of load carrying capability for the ten flight modes of the BLACKHAWK helicopter. Within the gross weight band shown, linear interpolation** is quite accurate for estimating the fuel flow rates.

g. For example, using Table 3-1, if the helicopter's gross weight was 17,000 lbs and if the flight mode was 60 kts, the fuel flow cannot be found directly. But by interpolating between 60 kts, 16,000 lbs - 690 lbs/hr and 18,000 lbs - 745 lbs/hr, the basic fuel flow rate for 17,000 lbs is 718 lbs/hr. In this example, if the helicopter flies in this mode for 30 minutes, 359 lbs of fuel will be used.

h. As altitude and/or temperature changes occur, different tables are used to look up the aircraft's basic fuel flow rate for each leg of the flight path. Care must be taken that the proper table is used.

i. Appendix A contains a set of functions that will give a good approximation of the basic rate of fuel flow.

3. DELTA FUEL FLOW FOR DRAG DATA

a. The delta fuel flow for drag is also determined by five variables:

(1) Type of Aircraft

(2) Altitude (Air Pressure)

(3) Temperature

(4) Drag Surface (Equivalent Square Footage)

(5) Air Speed

All references to airspeeds are to true airspeeds.

**All references to interpolation are linear interpolations. See FPPH, Volume I, Chapter 3 for a discussion on the accuracy of interpolation.*

TABLE 3-1

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	647	785	708	631	594	597	634	706	821	1067
14,000	713	891	789	687	639	631	666	735	852	1106
16,000	785	1006	880	753	690	670	703	771	895	1164
18,000	865	1141	987	832	745	718	747	813	946	1252
20,000	951	1297	1111	925	809	774	801	872	1022	1407

TABLE 3-2

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	15	36	73	132	223	394
	36	7	22	53	106	192	329	595
	54	10	33	80	161	294	518	995

b. Like the basic fuel flow tables, there are 24 tables for delta fuel flow for drag.

c. There are three fixed rows of equivalent square feet of drag: 25 equivalent sq ft, 36 equivalent sq ft, and 54 equivalent sq ft.

d. The seven columns are for airspeeds in kts of: 40 kts, 60 kts, 80 kts, 100 kts, 120 kts, 140 kts, and 160 kts.

e. When an external load is placed on the helicopter, the amount of fuel consumed per hour increases. The delta fuel flow for drag tables indicate how much extra fuel consumption to add to the basic fuel flow rate.

f. In the example given earlier, a 30 minute flight at 80 kts airspeed, 4000 ft altitude, 15°C and a gross weight of 18,000 lbs was used. Using the basic fuel flow tables, the basic fuel flow rate was 718 lbs/hr. Assuming for this new example that part of the load is external and inducing a 36 equivalent sq ft external drag, the delta fuel flow for drag (Table 3-2) shows 53 lbs/hr should be added to the basic fuel flow rate. Thus the basic fuel flow rate becomes 718 + 53 or 771 lbs per hour and for a half-hour flight, 386 lbs of fuel will be used instead of the 359 lbs figured without an external load.

g. Appendix B contains a function that will give a good approximation of the delta fuel flow for drag.

4. GROUND IDLE FUEL FLOW DATA

a. The ground idle fuel flow rate is determined by only three variables:

(1) Type of Aircraft

(2) Altitude (Air Pressure)

(3) Temperature

b. There is only one ground idle fuel flow table (shown as Table 2-2). The table has four rows of temperatures: -25°C, -5°C, 15°C and 35°C, and six columns of altitudes: Sea Level, 2000 ft, 4000 ft., 6000 ft., 8000 ft., and 10000 ft.

c. The ground idle fuel flow table is used as discussed in the example flight profile in Chapter 2 (Table 2-2). The UH-60A helicopter idling for 20 minutes at 2000 ft. altitude and 15°C, (across the row labeled 15°C and down the column labeled 2000) find the intersection at 509. Thus, the UH-60A uses 509 lbs/hr at these conditions and since it is idling for 20 minutes or 1/3 of an hour, it will use 170 lbs of fuel.

d. If the helicopter had only been 1000 ft. above sea level, the consumption rate would be found by interpolating between the sea level rate of 549 lbs/hr and the 2000 ft. rate of 509 lbs/hr which would be 529 lbs/hr. In 1/3 of an hour 176 lbs of fuel would be used.

e. Appendix C contains a function that will give a good approximation of the ground idle fuel flow.

5. GROSS WEIGHT LIMITS DATA

a. Gross weight limits tables are intended to show whether or not the aircraft can safely take off for four sets of criteria. These criteria are defined in the following paragraphs:

(1) Criteria #1 is based on the helicopter using 100% of Maximum Power for take off and having enough power to lift straight up and above ground effect (See Figure 3-1). Once it is in hovering above ground effect level the helicopter begins forward flight until it acquires, transitional lift and is able to climb at 450 ft/min (a desired standard rate of climb) to the desired altitude. This criteria has some risk since the pilot has no reserve power. It has less risk than Criteria #3 but more than Criteria #2 thus it is considered to be "Middle of the Road" risk.

(2) Criteria #2 (Figure 3-1) is based on the helicopter using 95% of Maximum Power for take off and enough power to immediately begin to climb at a rate of 450 ft/min. This is the least risky criteria since the pilot has power in reserve and is still able to climb at a satisfactory rate.

(3) Criteria #3 (Figure 3-1) has the most risk. Using 100% of Maximum Power the helicopter will only hover in ground effect. Therefore, at an altitude of 2 feet or less, the pilot must begin forward flight and gradually increase airspeed to acquire transitional lift to climb. The reasons for its high risk are readily apparent. First, there is no power in reserve. Second, the pilot must begin forward flight at a very low altitude.

(4) Criteria #4. Structural Gross Weight Limits is the total upper limit of gross weight the helicopter can carry under any take off criteria.

b. Gross Weight Limits are determined by four variables:

(1) Type of Aircraft

(2) Criteria Chosen

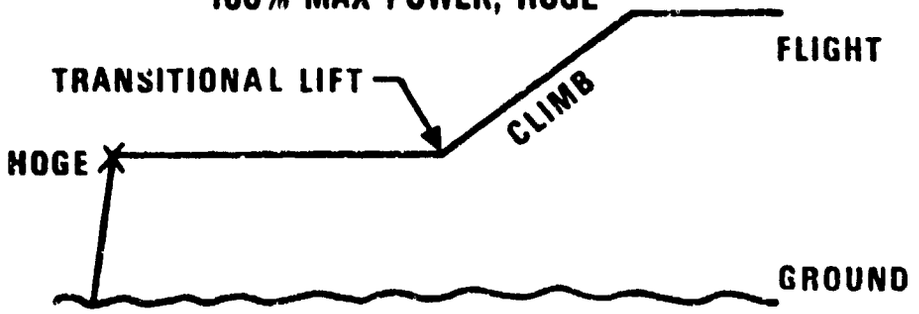
(3) Altitude (Air Pressure)

(4) Temperature

CRITERIA #1

(MIDDLE OF THE ROAD)

100% MAX POWER, HOGE

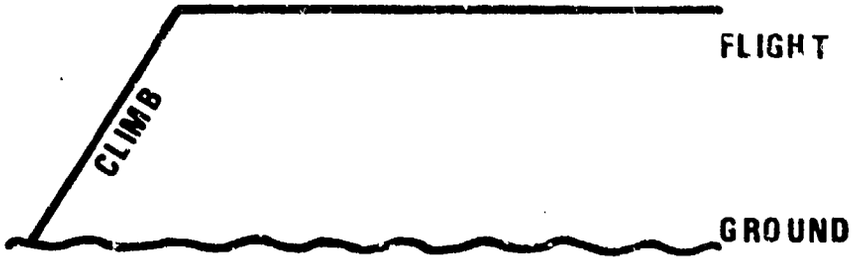


NOTHING TO SPARE.

CRITERIA #2

(LEAST RISKY)

95% OF RATED POWER. VERTICAL RATE OF CLIMB 450 FT/MIN, HOGE

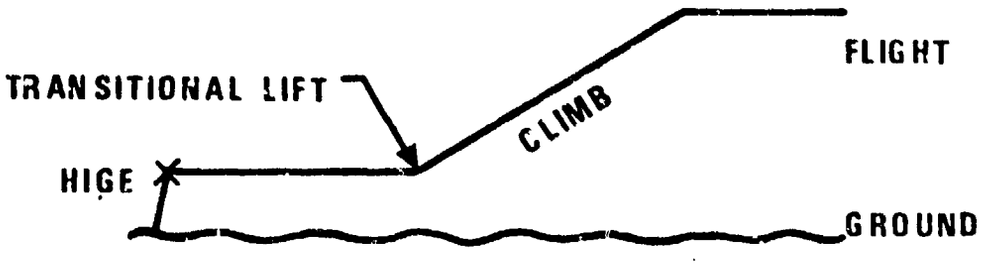


POWER LEFT

CRITERIA #3

(MOST RISKY)

100% MAX POWER, HIGE



NOTHING TO SPARE.

Figure 3-1

c. Additionally, Criteria #1, #2, and #3 differ due to engine power limits or transmission power limits of the aircraft. Thus there are six tables:

(1) Criteria #1 (Due to engine)

(2) Criteria #1 (Due to transmission)

(3) Criteria #2 (Due to engine)

(4) Criteria #2 (Due to transmission)

(5) Criteria #3 (Due to engine)

(6) Criteria #3 (Due to transmission)

d. The structural gross weight limit is a single value for each helicopter and is only dependent on the type helicopter. The BLACKHAWK structural gross weight limit is given as 20,250 lbs and is listed at the bottom of each table. As the name implies, it is simply not safe to expect the UH-60A structure to maneuver normally when the total weight is larger than that value.

e. In simulating inflight profile, the gross weight limits tables are used to check whether the aircraft is going to be too heavy to take off under the given conditions. As an example, assume a BLACKHAWK pilot planned a mission that called for using take off criteria #1 and the take off was to be at 6000 ft., 15°C, and a gross weight of 18,300. Three checks would be required: First, does this gross weight exceed the structural gross weight limit? Second, does it exceed Criteria #1 (due to transmission)? Third, does it exceed Criteria #1 (due to engine)? In the example given, the answer to all three questions is "No", the take off will not exceed aircraft limits. (Tables 3-3 and 3-4)

f. If the assigned gross weight had been 19,000 lbs, it would have exceeded the value given for 6,000 ft. and 15°C at Criteria #1 (Due to engine). (Table 3-3) The mission could not be flown as planned. The plan could be changed, for example to take off at 4000 ft. (which might not be practical) or change to take off Criteria #3 (which is more risky but has higher limits).

g. If the assigned gross weight had been 20,300 lbs., it would have exceeded the structural limits. To perfor the mission the only choices would be to lighten the load or get another type helicopter.

h. Appendix D contains a set of functions that will give a good approximation of the gross weight limits for takeoff.

TABLE 3-3

GROSS WEIGHT LIMITS
(DUE TO ENGINE)
FOR TAKEOFF CRITERIA #1
100% OF MAXIMUM POWER (HOGE)
AIRCRAFT - JH-60A
BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	24815	23085	21453	19922	18479	17126
	-5 C	25019	23337	21717	20175	18710	17265
	15 C	22928	21357	19880	18444	17061	157-1
	35 C	20393	18979	17633	16294	14990	13754

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

TABLE 3-4

GROSS WEIGHT LIMITS
(DUE TO TRANSMISSION)
FOR TAKEOFF CRITERIA #1
100% OF MAXIMUM POWER (HOGE)
AIRCRAFT - UH-60A
BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	22327	21882	21440	20997	20546	20094
	-5 C	21846	21413	20978	20536	20092	19646
	15 C	21417	20988	20553	20116	19677	19236
	35 C	21022	20593	20161	19729	19293	18857

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

6. VELOCITY LIMITS DATA

a. There are various types of data given in these tables but like the gross weight limits tables, they are primarily restraints on what can be expected of a helicopter in planning a mission profile. Velocity limits tables are influenced by five variables:

(1) Type of aircraft

(2) Air pressure (altitude)

(3) Temperature

(4) Gross weight

(5) Condition or limit

b. Items (1) through (4) are self-explanatory. There are five types of information that can be listed under (5):

(1) Long range

(2) Maximum continuous power

(3) Maximum power (due to engine limits)

(4) Transmission limits

(5) V_{ne} (velocity never exceed)

c. For each aircraft, there are 24 Velocity Limits Tables depending on air pressure and temperature combination. Table 3-5 is an example of the content of the Velocity Limits Table.

d. The two columns under Long Range (Table 3-5) give the optimum speed and fuel flow for each set of variables #1 through #4 above. Thus the BLACKHAWK helicopter operating at 2000 ft., temperature 15°C, and having a gross weight of 18,000 lbs will fly a longer distance if the velocity is kept at 138 kts and will use 964 lbs/hr of fuel at that velocity.

e. Maximum continuous power gives the fastest speed at which a helicopter can fly for long periods (30 minutes or more) and the associated fuel flow rate. An example from Table 3-3 would be a BLACKHAWK helicopter at 2000 ft. and 15°C weighing 18,000 lbs could fly 154 kts with a fuel usage of 1174 lbs/hr.

TABLE 3-5

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	140	872	162	1174	175	1403	172	1351
14,000	140	900	160	1174	173	1403	171	1351
16,000	140	935	158	1174	170	1403	168	1351
18,000	138	964	154	1174	166	1403	163	1351
20,000	137	1007	150	1174	161	1403	159	1351

f. Maximum power (engine and transmission limits) show the maximum speeds the aircraft can structurally attain for short periods of time (less than 30 minutes). Thus the BLACKHAWK helicopter at 2000 ft and 15°C weighing 18,000 lbs has an engine that is capable of producing enough power to fly 166 kts but the transmission limits the aircraft to 163 kts. Between these two columns then, the flight cannot exceed 163 kts with a fuel flow rate of 1351 lbs/hr.

g. There is another limiting factor called V_{ne} (velocity never exceed). This velocity limit is determined by helicopter structural considerations. V_{ne}'s for the BLACKHAWK are not included in this edition of the FPPH but will be included in later editions when the data is established.

7. DETAILED FLIGHT PROFILE USING ALL PERFORMANCE DATA TABLES

The example of a Flight Profile in Chapter 2 was intentionally simplified to assure clarity. The description of the various tables in this handbook, however, indicates a more complex set of considerations are normally encountered in developing the flight profile. With the description provided in this chapter, additional information should be included in the flight plan beyond that shown in the example and a suggested format is provided below in Table 3-4.

TABLE 3-6

Helicopter:
Altitude:
Temperature:

LEG	DISTANCE	AS	CHECK VELOCITY LIMIT	TIME	GW (LBS)	DRAG	FUEL

Needed for each take off:
Weight at take off:
Type of take off:
Check transmission limits:
Check engine limits:
Check structural gross weight limit:

CHAPTER 4

BLACKHAWK PERFORMANCE DATA TABLES

GENERAL

The following tables are the major information presented in this handbook. If the procedure for using them is understood, a flight profile for the BLACKHAWK helicopter can be prepared in a matter of a few hours. The performance data contained have been reviewed for accuracy and are corrected to the best of our knowledge. The tables are organized in the following manner:

Tables 4-1 to 4-24	Basic Fuel Flow Data
Tables 4-25 to 4-48	Delta Fuel Flow for Drag Data
Table 4-49	Ground Idle Fuel Flow Data
Tables 4-50 to 4-55	Gross Weight Limits Data
Tables 4-56 to 4-79	Velocity Limits Data

BASIC FUEL FLOW DATA

TABLES

TABLE 4-1

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	660	777	717	657	631	653	723	845	1027	1441
14,000	716	866	784	703	667	683	748	866	1047	1480
16,000	776	965	860	754	707	717	778	892	1080	1535
18,000	843	1075	943	811	753	753	813	925	1127	1610
20,000	915	1192	1034	876	805	793	853	966	1187	1709

TABLE 4-2

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	677	798	734	671	641	656	713	816	968	1296
14,000	734	890	804	718	678	687	739	836	988	1319
16,000	797	994	882	771	720	720	769	863	1017	1361
18,000	866	1104	968	832	768	756	804	897	1058	1423
20,000	941	1227	1064	901	822	799	845	936	1106	1506

TABLE 4-3

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	694	818	751	684	652	662	710	797	930	1214
14,000	753	914	824	733	690	693	736	819	952	1238
16,000	818	1020	904	789	735	726	767	847	984	1276
18,000	889	1133	993	854	785	765	804	883	1025	1331
20,000	967	1262	1096	929	839	811	846	922	1071	1405

TABLE 4-4

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	711	839	768	698	664	670	709	783	896	1140
14,000	771	938	843	749	704	701	736	804	916	1161
16,000	839	1044	926	808	751	735	768	833	943	1194
18,000	912	1163	1020	877	802	776	804	865	985	1246
20,000	992	1297	1127	958	857	824	846	905	1032	1325

TABLE 4-5

BASIC FUEL FLOW*

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	637	758	694	630	601	620	682	794	962	1355
14,000	695	853	765	678	639	651	710	817	988	1401
16,000	759	958	845	732	683	686	742	847	1029	1467
18,000	829	1072	933	795	733	725	780	885	1085	1557
20,000	905	1201	1034	866	788	770	824	929	1153	1677

TABLE 4-6

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	653	779	711	643	611	623	673	766	907	1213
14,000	713	878	785	693	650	654	701	790	932	1244
16,000	779	985	868	750	696	689	734	821	968	1298
18,000	852	1102	959	816	748	729	773	859	1014	1373
20,000	931	1239	1066	893	803	777	817	901	1067	1473

TABLE 4-7

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	669	800	728	656	622	628	670	750	873	1137
14,000	731	901	805	708	663	660	699	774	899	1168
16,000	800	1010	890	769	711	696	733	807	937	1215
18,000	875	1133	987	840	764	739	773	845	982	1281
20,000	957	1275	1099	923	820	790	820	891	1039	1388

TABLE 4-8

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	686	820	745	669	633	635	670	736	840	1067
14,000	750	924	824	724	677	668	699	761	866	1095
16,000	821	1036	913	789	727	705	734	792	902	1139
18,000	898	1165	1015	866	780	751	774	828	943	1203
20,000	983	1310	1132	955	840	803	823	881	1008	1321

TABLE 4-9

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	616	743	674	605	574	589	645	746	903	1276
14,000	676	843	750	656	615	622	675	773	936	1332
16,000	744	954	834	715	662	659	710	808	986	1411
18,000	818	1076	930	783	716	701	752	850	1050	1520
20,000	899	1222	1042	862	773	752	800	901	1125	1669

TABLE 4-10

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	631	764	691	618	584	592	636	721	852	1138
14,000	694	868	770	671	626	625	667	748	882	1180
16,000	765	980	857	733	675	662	704	783	924	1246
18,000	842	1109	958	806	730	707	746	824	974	1336
20,000	925	1260	1076	892	788	760	795	874	1043	1472

TABLE 4-11

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	647	785	708	631	594	597	634	706	821	1067
14,000	713	891	789	687	639	631	666	735	852	1106
16,000	785	1006	880	753	690	670	703	771	895	1164
18,000	865	1141	987	832	745	718	747	813	946	1252
20,000	951	1297	1111	925	809	774	801	872	1022	1407

TABLE 4-12

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHT (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	663	805	725	644	606	604	634	694	790	1001
14,000	731	912	808	704	653	638	666	722	822	1037
16,000	806	1034	905	775	705	680	704	755	860	1090
18,000	888	1173	1016	860	761	730	749	801	915	1187
20,000	977	1333	1147	961	837	792	807	968	992	1338

TABLE 4-13

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	597	732	657	583	549	560	611	703	849	1205
14,000	661	837	737	637	593	595	643	734	892	1272
16,000	732	954	828	701	645	635	682	773	950	1368
18,000	811	1091	934	776	701	683	728	821	1021	1501
20,000	897	1252	1058	865	762	739	781	882	1114	1709

TABLE 4-14

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	612	753	674	595	559	563	603	680	802	1071
14,000	679	861	757	653	605	598	636	711	838	1126
16,000	753	981	851	721	658	639	677	750	886	1205
18,000	835	1125	964	802	714	690	723	795	945	1321
20,000	924	1291	1095	898	781	749	780	860	1040	1516

TABLE 4-15

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	628	773	691	608	570	568	601	666	774	1005
14,000	697	883	776	670	618	604	636	699	812	1053
16,000	774	1010	876	743	671	649	677	738	858	1124
18,000	858	1158	994	831	731	702	727	790	925	1256
20,000	950	1329	1133	936	811	769	792	867	1016	1452

TABLE 4-16

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 ' TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

GR WEI. (LB	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	644	792	707	622	582	574	601	655	746	942
14,000	715	906	797	688	632	612	636	686	781	987
16,000	794	1037	902	766	686	659	678	725	826	1060
18,000	881	1190	1026	861	753	716	731	785	898	1196
20,000	976	1366	1176	986	854	799	807	871	995	1397

TABLE 4-17

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 8000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	580	723	643	563	528	534	580	664	804	1144
14,000	648	834	728	622	575	571	615	699	855	1225
16,000	724	961	827	693	630	615	659	743	921	1341
18,000	808	1115	946	776	689	669	709	799	1004	1517
20,000	901	1293	1085	877	758	730	771	880	1128	1793

TABLE 4-18

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 8000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	596	744	660	576	537	536	573	643	758	1014
14,000	666	857	748	639	587	574	610	678	801	1081
16,000	745	991	853	715	642	621	653	720	853	1178
18,000	831	1150	978	805	704	677	706	778	935	1344
20,000	928	1334	1125	916	788	748	775	861	1049	1608

TABLE 4-19

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HP

PRESSURE: 8000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	611	764	677	590	549	542	572	631	732	950
14,000	684	881	769	657	600	582	610	667	775	1009
16,000	766	1020	879	738	656	632	655	712	830	1110
18,000	855	1184	1010	837	727	693	715	780	916	1289
20,000	954	1373	1173	972	837	783	800	880	1037	1571

TABLE 4-20

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 8000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	627	782	693	604	561	548	572	620	706	891
14,000	702	905	791	676	612	591	610	654	745	946
16,000	786	1048	906	764	672	642	658	704	806	1057
18,000	878	1217	1046	875	760	714	724	781	890	1228
20,000	981	1412	1233	1053	900	831	831	901	1053	1585

TABLE 4-21

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	567	718	632	547	509	510	552	629	765	1091
14,000	639	835	723	611	561	551	591	669	825	1190
16,000	719	979	834	689	618	601	639	719	899	1336
18,000	809	1149	966	784	683	659	696	791	1009	1583
20,000	911	1358	1130	903	771	734	771	895	1158	1902

TABLE 4-22

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	582	738	649	560	519	513	546	610	719	965
14,000	657	860	745	629	572	555	587	649	767	1047
16,000	740	1009	861	714	630	607	635	698	834	1178
18,000	833	1185	1001	817	705	672	698	773	940	1411
20,000	939	1400	1182	964	822	769	790	885	1094	1774

TABLE 4-23

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	598	757	665	574	530	518	546	600	696	903
14,000	675	885	767	649	584	563	587	639	743	978
16,000	761	1039	889	740	647	619	640	697	817	1128
18,000	857	1220	1039	859	741	697	715	765	920	1358
20,000	966	1440	1249	1058	894	826	834	926	1131	1858

TABLE 4-24

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
12,000	613	776	683	589	542	525	546	589	670	846
14,000	693	909	790	670	596	573	588	629	717	925
16,000	781	1066	919	769	670	634	645	694	793	1072
18,000	880	1254	1087	921	792	734	737	798	921	1345
20,000	993	1480	1314	1148	962	876	866	946	1145	1873

DELTA FUEL FLOW FOR DRAG DATA

TABLES

TABLE 4-25

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	6	21	49	101	184	326	650
	36	9	30	71	146	269	489	986
	54	13	45	108	222	417	783	1530

TABLE 4-26

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	150
DRAG IN SQUARE FEET	25	6	19	45	91	167	285	523
	36	8	27	65	133	243	424	809
	54	12	41	99	202	372	673	1318

TABLE 4-27

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	17	42	84	152	256	452
	36	8	25	60	122	221	377	681
	54	11	38	91	185	338	594	1136

TABLE 4-28

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	16	39	77	139	233	394
	36	7	23	56	112	203	342	593
	54	11	35	85	170	310	532	957

TABLE 4-29

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	6	19	46	94	172	305	611
	36	8	28	67	136	251	447	922
	54	12	42	101	208	390	732	1428

TABLE 4-30

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	18	42	85	155	266	488
	36	8	25	61	124	226	396	757
	54	11	38	92	188	347	628	1229

TABLE 4-31

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	16	39	78	142	239	422
	36	7	24	56	114	206	362	636
	54	11	35	85	173	315	555	1063

TABLE 4-32

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	15	34	72	130	218	368
	36	7	22	52	105	189	319	553
	54	10	33	79	159	289	496	894

TABLE 4-33

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	18	43	88	160	285	575
	36	8	26	63	127	234	427	862
	54	12	39	95	194	364	664	1332

TABLE 4-34

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	17	40	80	145	248	457
	36	7	24	57	116	211	370	709
	54	11	36	86	176	324	586	1147

TABLE 4-35

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	15	36	73	132	223	394
	36	7	22	53	106	192	329	595
	54	10	33	80	161	294	518	995

TABLE 4-36

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	14	34	68	121	203	344
	36	6	21	49	98	177	297	517
	54	9	31	74	149	269	463	636

TABLE 4-37

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	17	40	82	149	266	543
	36	7	24	58	119	219	399	807
	54	11	37	88	181	340	640	1293

TABLE 4-38

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	15	37	74	135	232	428
	36	7	22	53	108	197	345	666
	54	10	34	81	164	302	548	1072

TABLE 4-39

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	14	34	68	123	208	369
	36	6	21	49	99	179	307	557
	54	9	31	74	150	274	484	934

TABLE 4-40

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	13	32	63	113	189	322
	36	6	19	46	92	165	277	483
	54	9	29	69	139	251	432	784

TABLE 4-41

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 8000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	5	16	38	76	139	250	514
	36	7	23	55	111	204	375	757
	54	10	34	83	169	317	603	1161

TABLE 4-42

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 8000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	14	35	70	126	217	403
	36	6	21	50	101	183	323	628
	54	9	31	75	153	282	513	1003

TABLE 4-43

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 8000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	13	32	64	115	194	346
	36	6	19	46	93	167	287	524
	54	9	29	70	140	256	453	879

TABLE 4-44

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: 35 C

AIRCRAFT · UH-60A
BLA[illegible]K

DRAG IN SQUARE FEET	AIR SPEED IN KTS						
	40	60	80	100	120	140	160
25	4	12	30	59	104	176	302
36	5	18	43	83	154	259	453
54	8	27	64	130	234	404	737

TABLE 4-45

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	15	35	71	130	236	490
	36	6	21	51	104	191	352	710
	54	10	32	77	157	297	570	1084

TABLE 4-46

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

DRAG IN SQUARE FEET	AIR SPEED IN KTS						
	40	60	80	100	120	140	160
25	4	14	32	65	117	203	381
36	6	20	47	94	171	303	596
54	9	30	71	143	263	481	940

TABLE 4-47

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	13	30	60	107	182	326
	36	6	18	43	86	156	269	495
	54	8	27	65	131	239	425	819

TABLE 4-48

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: 35 C

AIRCRAFT - UH-60A
BLACKHAWK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	25	4	12	28	55	99	165	284
	36	5	17	40	80	143	242	426
	54	8	25	60	121	218	379	696

GROUND IDLE FUEL FLOW DATA

TABLE

TABLE 4-49

GROUND IDLE FUEL FLOW

AIRCRAFT - UH-60A

BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	567	529	491	459	426	395
	-5 C	557	521	484	452	419	388
	15 C	549	509	477	446	414	372
	35 C	549	510	477	443	409	378

ENTRIES ARE AIRCRAFT FUEL FLOW RATES IN LBS/HR

GROSS WEIGHT LIMITS DATA

TABLES

TABLE 4-50

GROSS WEIGHT LIMITS
(DUE TO ENGINE)
FOR TAKEOFF CRITERIA #1
100% OF MAXIMUM POWER (HOGE)
AIRCRAFT - UH-60A
BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	24815	23085	21453	19922	18479	17126
	-5 C	25019	23337	21717	20175	18710	17265
	15 C	22928	21357	19880	18444	17061	15741
	35 C	20393	18979	17633	16294	14990	13754

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

TABLE 4-51

GROSS WEIGHT LIMITS
(DUE TO TRANSMISSION)
FOR TAKEOFF CRITERIA #1
100% OF MAXIMUM POWER (HOGE)
AIRCRAFT - UH-60A
BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	22327	21882	21440	20997	20546	20094
	-5 C	21846	21413	20978	20536	20092	19646
	15 C	21417	20988	20553	20116	19677	19236
	35 C	21022	20593	20161	19729	19293	18857

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

TABLE 4-52

GROSS WEIGHT LIMITS
(DUE TO ENGINE)
FOR TAKEOFF CRITERIA #2
95% OF RATED POWER. VERTICAL RATE OF CLIMB 450 FT/MIN. OGE
AIRCRAFT - UH-60A
BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	23354	21726	20190	18749	17391	16118
	-5 C	23573	21990	20464	19012	17631	16269
	15 C	21596	20117	18727	17374	16070	14827
	35 C	19194	17862	16596	15336	14107	12942

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

TABLE 4-53

GROSS WEIGHT LIMITS

(DUE TO TRANSMISSION)

FOR TAKEOFF CRITERIA #2

TRANSMISSION POWER LIMIT. VERTICAL RATE OF CLIMB 450 FT/MIN. OGE

AIRCRAFT - UH-60A

BLACKHAWK

		PRESSURE ALTIT E (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	21788	21370	20948	20528	20101	19669
	-5 C	21335	20921	20509	20090	19666	19241
	15 C	20925	20519	20106	19689	19271	18849
	35 C	20550	20144	19732	19320	18904	18486

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

TABLE 4-54

GROSS WEIGHT LIMITS
(DUE TO ENGINE)
FOR TAKEOFF CRITERIA #3
100% OF MAXIMUM POWER (HIGE)
AIRCRAFT - UH-60A
BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	32867	0575	28413	26385	24475	22683
	-5 C	33143	30916	28770	26728	24786	22873
	15 C	30374	28292	26336	24434	22601	20854
	35 C	27018	25144	23361	21588	19860	18222

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

TABLE 4-55

GROSS WEIGHT LIMITS
(DUE TO TRANSMISSION)
FOR TAKEOFF CRITERIA #3
100% OF MAXIMUM POWER (HIGE)
AIRCRAFT - UH-60A
BLACKHAWK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	29552	28978	28397	27810	27218	26623
	-5 C	28941	28368	27789	27207	26620	26029
	15 C	28375	27805	27230	26651	26069	25484
	35 C	27849	27282	26711	26137	25560	24981

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 20,250 LBS

VELOCITY LIMITS DATA

TABLES

TABLE 4-56

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: SEA LEVEL TEMPERATURE: -25 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	130	926	167	1629	164	1574	157	1351
14,000	131	957	165	1629	163	1574	156	1351
16,000	132	991	163	1629	161	1574	154	1351
18,000	132	1028	161	1629	159	1574	151	1351
20,000	131	1061	158	1629	156	1574	148	1351

TABLE 4-57

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: SEA LEVEL TEMPERATURE: -5 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	135	927	168	1464	175	1640	163	1357
14,000	136	951	167	1464	174	1640	162	1357
16,000	136	978	164	1464	172	1640	160	1357
18,000	135	1013	162	1464	169	1640	157	1357
20,000	135	1054	159	1464	165	1640	154	1357

TABLE 4-58

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	139	924	162	1263	176	1504	168	1364
14,000	140	952	161	1263	174	1504	167	1364
16,000	140	982	159	1263	172	1504	164	1364
18,000	139	1018	157	1263	169	1504	162	1364
20,000	139	1049	153	1263	164	1504	158	1364

TABLE 4-59

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: SEA LEVEL TEMPERATURE: 35 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	143	921	157	1092	173	1345	175	1371
14,000	143	945	156	1092	172	1345	174	1371
16,000	143	978	153	1092	170	1345	171	1371
18,000	143	1012	150	1092	166	1345	168	1371
20,000	142	1052	145	1092	161	1345	162	1371

TABLE 4-60

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	131	873	166	1514	164	1466	160	1343
14,000	132	906	164	1514	162	1466	158	1343
16,000	132	941	161	1514	160	1466	156	1343
18,000	131	976	159	1514	157	1466	153	1343
20,000	128	1002	155	1514	154	1466	149	1343

TABLE 4-61

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	136	871	167	1360	175	1533	167	1347
14,000	136	895	166	1360	174	1533	165	1347
16,000	135	928	162	1360	170	1533	162	1347
18,000	135	968	159	1360	167	1533	159	1347
20,000	134	1009	156	1360	162	1533	155	1347

TABLE 4-62

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	140	872	162	1179	175	1403	172	1351
14,000	140	900	160	1179	173	1403	171	1351
16,000	140	935	158	1179	170	1403	168	1351
18,000	138	969	154	1179	166	1403	163	1351
20,000	137	1007	150	1179	161	1403	159	1351

TABLE 4-63

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	143	866	156	1014	173	1253	180	1357
14,000	143	894	154	1014	171	1253	178	1357
16,000	143	928	151	1014	168	1253	175	1357
18,000	142	965	147	1014	163	1253	169	1357
20,000	141	1019	141	1014	157	1253	162	1357

TABLE 4-64

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: -5 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	131	825	165	1405	163	1364	162	1340
14,000	132	859	162	1405	161	1364	160	1340
16,000	132	897	160	1405	158	1364	158	1340
18,000	130	929	156	1405	155	1364	154	1340
20,000	127	964	152	1405	151	1364	150	1340

TABLE 4-65

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: -6 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	136	820	167	1263	175	1429	171	1341
14,000	136	847	164	1263	17[illegible]	1429	168	1341
16,000	135	884	161	1263	169	1429	164	1341
18,000	135	926	157	1263	164	1429	160	1341
20,000	133	973	152	1263	159	1429	155	1341

TABLE 4-66

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	140	821	161	1089	175	1309	177	1343
14,000	140	854	159	1089	172	1309	174	1343
16,000	139	887	156	1089	168	1309	170	1343
18,000	137	921	151	1089	162	1309	164	1343
20,000	135	980	145	1089	156	1309	158	1343

TABLE 4-67

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	143	815	155	938	172	1166	185	1346
14,000	143	847	152	938	170	1166	182	1346
16,000	142	882	148	938	165	1166	177	1346
18,000	141	928	142	938	159	1166	169	1346
20,000	141	1003	134	938	152	1166	160	1346

TABLE 4-68

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: -6 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	136	771	166	1171	174	1330	175	1340
14,000	135	804	162	1171	171	1330	171	1340
16,000	135	844	158	1171	166	1330	166	1340
18,000	134	887	154	1171	160	1330	161	1340
20,000	133	956	148	1171	154	1330	155	1340

TABLE 4-69

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	132	790	161	1304	161	1269	166	1340
14,000	132	815	161	1304	160	1269	162	1340
16,000	131	850	158	1304	156	1269	159	1340
18,000	128	882	154	1304	152	1269	155	1340
20,000	126	933	149	1304	147	1269	150	1340

TABLE 4-70

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: 16 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	140	774	160	1009	174	1216	181	1340
14,000	140	809	157	1009	170	1216	178	1340
16,000	138	840	153	1009	165	1216	172	1340
18,000	136	890	147	1009	158	1216	163	1340
20,000	135	972	139	1009	152	1216	156	1340

TABLE 4-71

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: 16 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	143	769	154	864	171	1078	190	1341
14,000	143	803	150	864	167	1078	186	1341
16,000	142	842	144	864	161	1078	178	1341
18,000	141	907	136	864	154	1078	167	1341
20,000	141	1005	118	864	147	1078	158	1341

TABLE 4-72

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: -25 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	132	738	162	1208	161	1179	169	1349
14,000	131	773	159	1208	158	1179	164	1349
16,000	128	801	155	1208	154	1179	160	1349
18,000	126	849	150	1208	149	1179	155	1349
20,000	124	919	144	1208	143	1179	149	1349

TABLE 4-73

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: -2 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	136	728	163	1084	173	1236	178	1343
14,000	135	765	160	1084	168	1236	174	1343
16,000	134	807	156	1084	162	1236	168	1343
18,000	133	863	149	1084	156	1236	160	1343
20,000	132	958	142	1084	149	1236	153	1343

TABLE 4-74

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: 15 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	140	733	159	930	172	1125	186	1341
14,000	139	767	155	930	168	1125	181	1341
16,000	136	805	149	930	161	1125	172	1341
18,000	135	876	141	930	153	1125	162	1341
20,000	134	980	129	930	146	1125	154	1341

TABLE 4-75

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: 16 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	143	728	151	795	169	993	195	1340
14,000	142	763	146	795	163	993	189	1340
16,000	141	815	139	795	156	993	176	1340
18,000	141	901	124	795	149	993	164	1340
20,000	135	1005	0	795	134	993	153	1340

TABLE 4-76

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: -35 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	132	699	161	1116	160	1095	172	1369
14,000	130	734	157	1116	156	1095	167	1369
16,000	127	769	152	1116	151	1095	161	1369
18,000	125	829	146	1116	145	1095	155	1369
20,000	123	930	138	1116	137	1095	148	1369

TABLE 4-77

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: -< C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	135	689	162	999	170	1141	182	1357
14,000	135	730	158	999	165	1141	176	1357
16,000	133	777	152	999	158	1141	168	1357
18,000	132	860	144	999	151	1141	159	1357
20,000	131	974	134	999	142	1141	151	1357

TABLE 4-78

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: 16 C

AIRCRAFT - UH-60A
BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
12,000	140	694	156	854	170	1039	190	1349
14,000	137	726	151	854	163	1039	183	1349
16,000	135	783	144	854	156	1039	170	1349
18,000	135	879	133	854	148	1039	160	1349
20,000	132	1028	108	854	134	1039	149	1349

TABLE 4-79

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: 36 C

AIRCRAFT - UH-60A BLACKHAWK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HP)	VEL (KTS)	F.F. (LBS/HR)
12,000	143	689	148	727	166	911	200	1344
14,000	141	729	141	727	159	911	189	1344
16,000	141	802	128	727	151	911	174	1344
18,000	138	907	0	727	139	911	160	1344
20,000	132	1048	0	727	110	911	149	1344

APPENDIX A

FUNCTIONS FOR CALCULATING BASIC FUEL FLOW

There are four functions that can be used to calculate the basic fuel flow for the UH-60A helicopter. In order to use the functions the following data is needed:

1. Flight Mode
2. Temperature
3. Pressure (altitude)
4. Gross weight

Which of the four functions will be used depends on the flight mode. The first function is for HIGE (Hover In Ground Effect).

$$FF\ (HIGE) = f\ (TEMP,\ ALT,\ GW)$$

The second function is for HOGE (Hover Out of Ground Effect).

$$FF\ (HOGE) = f\ (TEMP,\ ALT,\ GW)$$

The third function is for NOE (Nap of the Earth).

$$FF\ (NOE) = f\ (TEMP,\ ALT,\ GW)$$

The fourth function is for Forward Flight.

$$FF\ (Forward\ Flight) = f\ (AS,\ TEMP,\ ALT,\ GW)$$

The equation for FF (HIGE) is:

$$FF\ (HIGE) = A\ (ALT) + B\ (TEMP) + C\ (GW) + D\ (ALT)(TEMP) + E\ (ALT)\ (GW) + F\ (TEMP)\ (GW) + G\ (ALT)\ TEMP)\ (GW) + K$$

Where ALT is the altitude, TEMP is the temperature and GW is the gross weight and the constants have the following values:

$A = -2.36671245 \times 10^{-2}$ $\qquad$ $E = 1.14598178 \times 10^{-6}$

$B = 1.4961322 \times 10^{-1}$ $\qquad$ $F = 5.[illegible]0408472 \times 10^{-5}$

$C = 3.27971615 \times 10^{-2}$ $\qquad$ $G = 1.72859935 \times 10^{-9}$

$D = -2.76576072 \times 10^{-5}$ $\qquad$ $K = 2.77779198 \times 10^{2}$

The equation for FF (HOGE) is exactly the same form as FF (HIGE). A new set of values for the constants is used. These values are:

$A = -4.22082637 \times 10^{-2}$ $E = 2.85716479 \times 10^{-6}$

$B = -3.34395766 \times 10^{-2}$ $F = 8.61792723 \times 10^{-5}$

$C = 5.21710273 \times 10^{-2}$ $G = 4.73930817 \times 10^{-9}$

$D = -6.18146896 \times 10^{-5}$ $K = 1.62979187 \times 10^{2}$

The equation for FF (NOE) is once again the same as FF (HIGE). The new values for the constants are:

$A = -4.13708738 \times 10^{-2}$ $E = 2.58315822 \times 10^{-6}$

$B = 1.00027338 \times 10^{-1}$ $F = 6.16531179 \times 10^{-5}$

$C = 3.97294145 \times 10^{-2}$ $G = 1.76110437 \times 10^{-8}$

$D = -2.30705413 \times 10^{-4}$ $K = 2.49696922 \times 10^{2}$

For the Forward Flight modes the form of the equation is:

$$FF = A(AS) + B(AS^2) + C(AS^3) + D(TEMP) + E(GW) + F(ALT) + G(AS^3)(TEMP)$$
$$+ H(AS^2)(TEMP) + I(AS)(TEMP) + J(AS^3)(GW) + K(AS^2)(GW)$$
$$+ L(AS)(GW) + M(AS^3)(ALT) + N(AS^2)(ALT) + O(AS)(ALT) + P(TEMP)(GW)$$
$$+ Q(TEMP)(ALT) + R(GW)(ALT) + S(TEMP)(GW)(ALT) + T$$

Where AS is the air speed in kts and the values of the constants are:

$A = -1.75503817 \times 10^{0}$ $K = -3.2272938 \times 10^{-6}$

$B = 2.60824643 \times 10^{1}$ $L = -2.52148136 \times 10^{-4}$

$C = -9.75638628 \times 10^{-4}$ $M = 2.82405971 \times 10^{-8}$

$D = -5.36766827$ $N = -7.29170938 \times 10^{-6}$

$E = 3.93689685 \times 10^{-2}$ $O = 4.6046175 \times 10^{-4}$

$F = -5.07360115 \times 10^{-2}$ $P = 9.07814137 \times 10^{-6}$

$G = 8.74935993 \times 10^{-6}$ $Q = 1.92548687 \times 10^{-5}$

$H = -2.75745546 \times 10^{-3}$ $R = 2.29283282 \times 10^{-6}$

$I = 2.37587094 \times 10^{-1}$ $S = 1.13825678 \times 10^{-9}$

$J = 2.82843517 \times 10^{-8}$ $T = 7.30430611 \times 10^{2}$

These functions allow anyone with a simple calculator to figure the fuel flow of the aircraft and bypass both looking up the values and interpolating for points in between the data points in the tables.

The above equations calculate the basic fuel flow for the BLACKHAWK helicopter with the following accuracies:

FF (HIGE) - 99.51%

FF (HOGE) - 98.99%

FF (NOE) - 98.45%

FF (Forward Flight) - 98.08%

APPENDIX B

FUNCTION FOR CALCULATING DELTA FUEL FLOW FOR DRAG

The function below will calculate the delta fuel flow for drag for the UH-60A helicopter. Recall from the discussion in chapter three that this value is added to the basic fuel flow value whenever drag is increasing the rate of fuel flow.*

In order to use the function the following data is needed:

1. Air Speed (AS)
2. Equivalent Square Footage of Drag (SQ)
3. Temperature (TEMP) in degrees centigrade
4. Altitude (ALT) in feet above sea level

That is:

$$FF\ (Drag) = f(AS, SQ, TEMP, ALT)$$

The equation for FF (Drag) is:

$$FF\ (Drag) = A(AS) + B(AS^2) + C(AS^3) + D(TEMP) + E(SQ) + F(ALT)$$
$$+ G(AS^3)(TEMP) + H(AS^2)(TEM) + I(AS)(TEMP) + J(AS^3)(SQ) + K(AS^2)(SQ)$$
$$+ L(AS)(SQ) + M(AS^3)(ALT) + N(AS^2)(ALT) + O(AS)(ALT) + P(TEMP)(SQ)$$
$$+ Q(TEMP)(ALT) + R(SQ)(ALT) + S(SQ)(ALT)(TEMP) + T$$

Where the constants have the following values:

$A = -1.03805$	$K = -4.74201969 \times 10^{-3}$
$B = 1.52967332 \times 10^{-2}$	$L = 3.49346161 \times 10^{-1}$
$C = -5.13607656 \times 10^{-5}$	$M = -1.98065486 \times 10^{-8}$
$D = 5.11014169$	$N = 3.76338545 \times 10^{-6}$
$E = -6.55957258$	$O = -2.77729705 \times 10^{-4}$
$F = 1.45140886 \times 10^{-2}$	$P = -4.76768687 \times 10^{-2}$
$G = -9.29436328 \times 10^{-6}$	$Q = -1.71242659 \times 10^{-5}$
$H = 2.10173801 \times 10^{-3}$	$R = -2.20640219 \times 10^{-4}$
$I = -1.5564549 \times 10^{-1}$	$S = 1.64278312 \times 10^{-6}$
$J = 2.3078537 \times 10^{-5}$	$T = -2.67658615 \times 10$

There is no delta fuel flow for drag for HIGE, HOGE or NOE flight.

This equation calculates the delta fuel flow for drag value with an accuracy of 99.33%. It should be noted that in some instances the computed value will be negative. If this occurs, zero (Ø) should be used as the value for de'ta fuel flow.

APPENDIX C

FUNCTION FOR CALCULATING GROUND IDLE FUEL FLOW

The function below will calculate the ground idle fuel flow rate for the UH-60A helicopter. In order to use the function the following data is needed:

1. Temperature (TEMP) in degrees centigrade.

2. Altitude (ALT) in feet above sea level.

That is:

$$FF\ (Idle) = f\ (TEMP, ALT)$$

The equation, for FF (Idle) is:

$$FF\ (Idle) = A(TEMP) + B(ALT) + C(TEMP)(ALT) + D(TEMP^2) + E(ALT^2) + F$$

Where the constants have the following values:

$A = -3.47589254 \times 10^{-1}$ $\quad$ $D = 4.68750088 \times 10^{-3}$

$B = -1.84255231 \times 10^{-2}$ $\quad$ $E = 1.36159557 \times 10^{-7}$

$C = 6.42851774 \times 10^{-7}$ $\quad$ $F = 5.53937698 \times 10^{2}$

This equation calculates the ground idle fuel flow rate with an accuracy of 99.85%

APPENDIX D

FUNCTIONS FOR CALCULATING GROSS WEIGHT LIMITS FOR TAKEOFF

The functions given below will calculate the gross weight limits for take off for the UH-60A helicopter. Each of the functions is of the same basic form with the values of the constants changing depending on which take off criteria is being used. In all cases the Structural Gross Weight Limit of the UH-60A helicopter is 20,250 lbs.

In order to use the functions the following data is needed:

1. Temperature (TEMP) in degrees centigrade

2. Altitude (ALT) in feet above sea level

That is:

GW (Limit) = f (TEMP, ALT)

The basic equation for GW (Limit) is:

GW (Limit) = A(TEMP) + B(ALT) + C(TEMP)(ALT) + D

For take off criteria #1 the equation must be used twice, once using the engine limit constants and once using the transmission limit constants. For take off criteria #1 the constants for engine limits are:

$A = -7.53214264 \times 10$ $\quad C = 1.84378553 \times 10^{-3}$

$B = -7.40458168 \times 10^{-1}$ $\quad D = 2.35560115 \times 10^{4}$

For take off criteria #1 the constants for transmission limits are:

$A = -2.17190464 \times 10$ $\quad C = 1.07642722 \times 10^{-4}$

$B = -2.20013201 \times 10^{-1}$ $\quad D = 2.17659282 \times 10^{4}$

For take off criteria #2 two checks must also be made. The constants for engine limits, take off criteria #2 are:

$A = -7.09054737 \times 10$ $\quad C = 1.73[illegible]843 \times 10^{-3}$

$B = -6.97222464 \times 10^{-1}$ $\quad D = 2.21[illegible]247 \times 10^{4}$

For take off criteria #2 the constants for transmission limits are:

$A = -2.0609287 \times 10$ $\quad C = 8.73573872 \times 10^{-5}$

$B = -2.09254643 \times 10^{-1}$ $\quad D = 2.12580105 \times 10^{4}$

Also for take off criteria #3 two checks must be made. The constants for engine limits, take off criteria #3 are:

$A = -9.96414289 \times 10$ $\quad C = 2.43828606 \times 10^{-3}$

$B = -9.80798528 \times 10^{-1}$ $\quad D = 3.12036589 \times 10^{4}$

For take off criteria #3 the constants for transmission limits are:

$A = -2.84426184 \times 10$ $\quad C = 1.02857094 \times 10^{-4}$

$B = -2.50585697 \times 10^{-1}$ $\quad D = 2.88286533 \times 10^{4}$

This equation with the various sets of constants gives results that are 95.13% accurate or better.

APPENDIX E

SHORT DESCRIPTION OF BLACKHAWK DATA SOURCE

DRDAV-EQA(A)
SUBJECT: Short Description of UH-60A BLACKHAWK Performance Data Provided to TRADOC Systems Analysis Activity (TRASANA)

MFR:

1. References:

a. UH-60A Utility Tactical Transport Aircraft System, Prime Item Development Specification, 1 Nov 76.

b. Determination of the Effects of Rotor Blade Compressibility on the Performance of the UH-1F; FTC-TR-65-17.

2. The performance data presented to TRASANA is the result of combining the helicopter power required, engine power available and engine fuel flow characteristics. The UH-60A power required was calculated for the required altitude and temperature combinations from a non-dimensional representation of engine power required (coefficient of power) v.s. gross weight (coefficient of thrust) and true airspeed (advance ratio). The non-dimensional engine power required was extracted from reference a. All performance in ground effect represents a 2 foot wheel height. A temperature dependent correction, based on the method outlined in reference b, was made to the power required to account for compressibility which could not be accounted for in the non-dimensional representation.

3. The T700-GE-700 engine power available (which was used in combination with the power required to find helicopter take off and speed limits), was calculated for the various altitude and temperature combination, by the use of the T700-GE-700 engine specification computer program.

4. The engine fuel flow at a particular altitude and temperature combination was derived from a representative referred fuel flow as a function of referred engine power. The referred fuel flow curve was constructed by use of the T700-GE-700 engine specification computer program which calculated fuel flows at various engine power levels and atmospheric conditions. The fuel flows were then corrected to reflect 5% conservatism. A referred parameter is one which is divided by temperature and pressure ratios in order to represent all atmospheric conditions by one function.

5. The never exceed speeds (V_{ne}) have not been formally established for the production UH-60A and are, therefore, not presented at this time.

/s/ JAMES A. O'MALLEY
JAMES A. O'MALLEY
Aero Engr