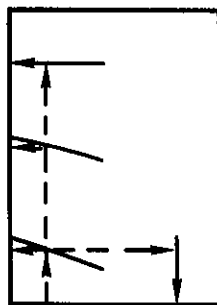


CONDITIONS:

97% NR



CRUISE - SINGLE ENGINE,  
MAXIMUM CONTINUOUS-AIR  
TEMPERATURE WARMER THAN  
+30° C

MODEL  
UH-1N

ENGINE  
T400-CP-400

DATE: 26 JANUARY 1973  
DATA BASIS: FLIGHT TEST  
(AIR FORCE)

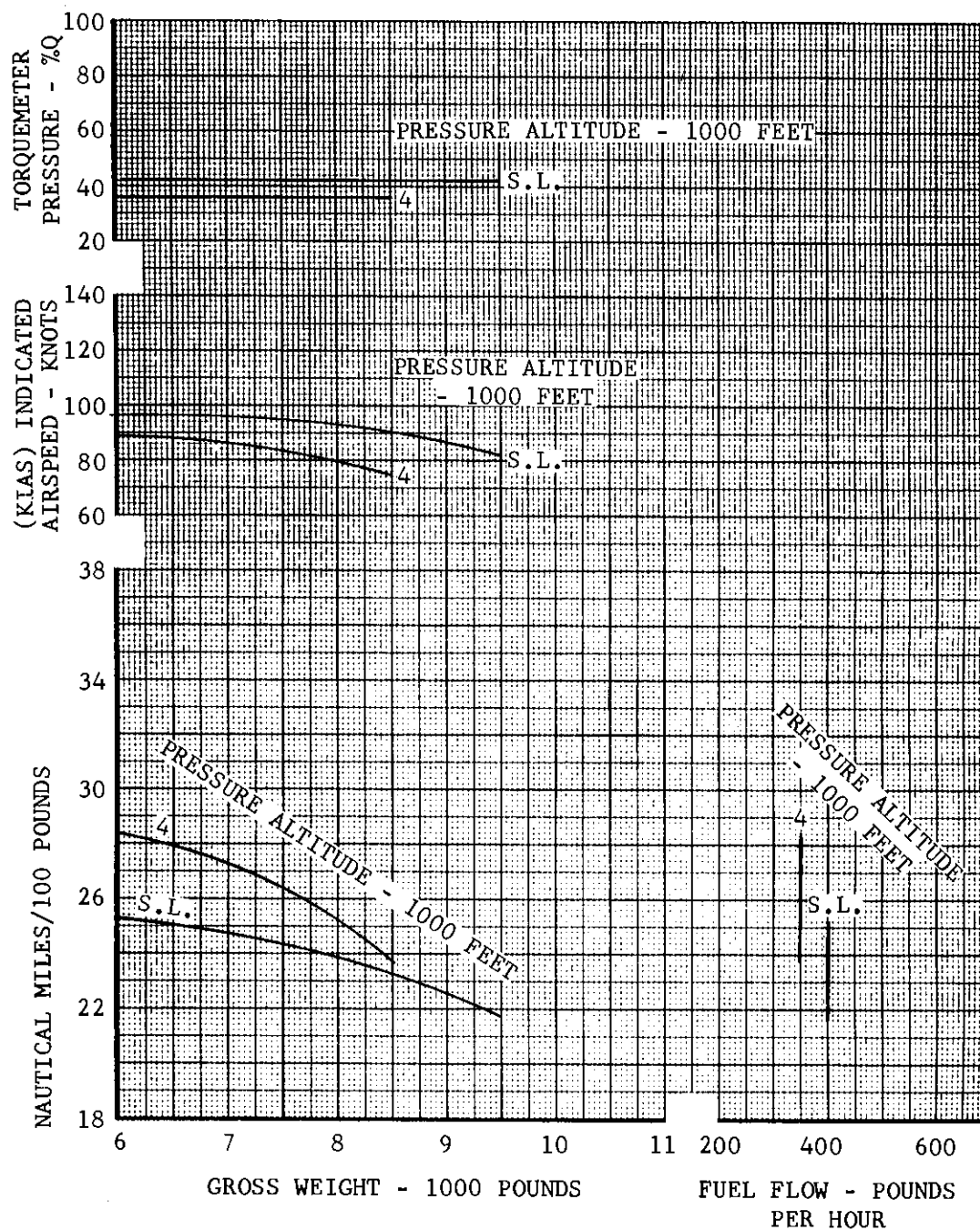


Figure A-35.

CRUISE - SINGLE ENGINE,  
MAXIMUM CONTINUOUS - AIR  
TEMPERATURE BETWEEN  $+10^{\circ}\text{C}$   
AND  $+30^{\circ}\text{C}$

MODEL  
UH-1N

ENGINE  
T400-CP-400

DATE: 26 JANUARY 1973  
DATA BASIS: FLIGHT TEST  
(AIR FORCE)

CONDITIONS:

97% NR

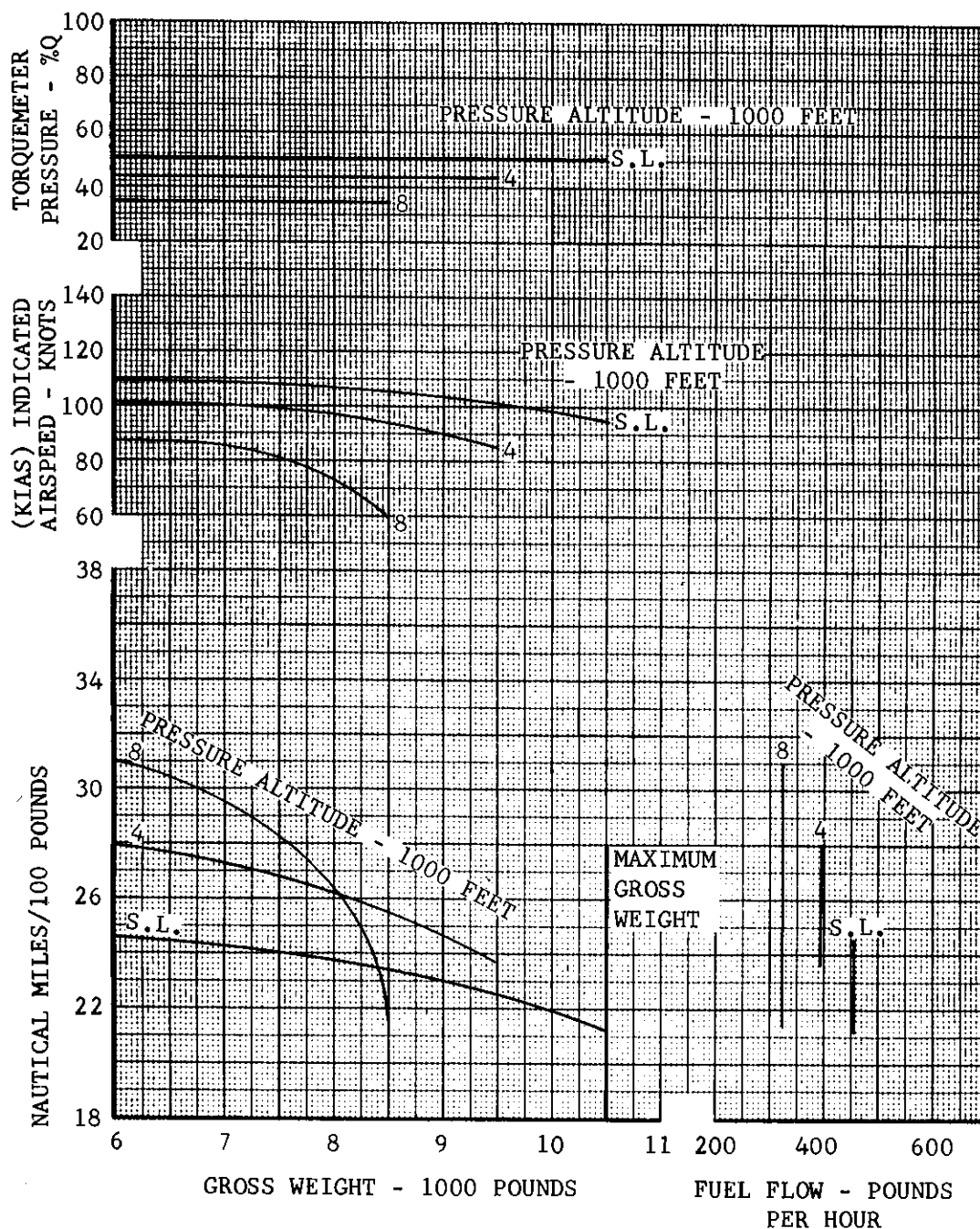
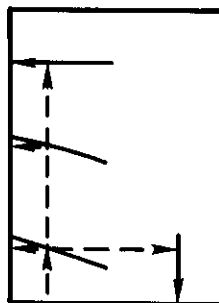
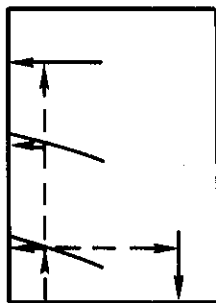


Figure A-36.

CONDITIONS:

97% NR



**CRUISE - SINGLE ENGINE MAXIMUM  
CONTINUOUS - AIR TEMPERATURE  
BETWEEN -10°C AND +10°C**

MODEL  
UH-1N

ENGINE  
T400-CP-400

DATE: 26 JANUARY 1973  
DATA BASIS: FLIGHT TEST  
(AIR FORCE)

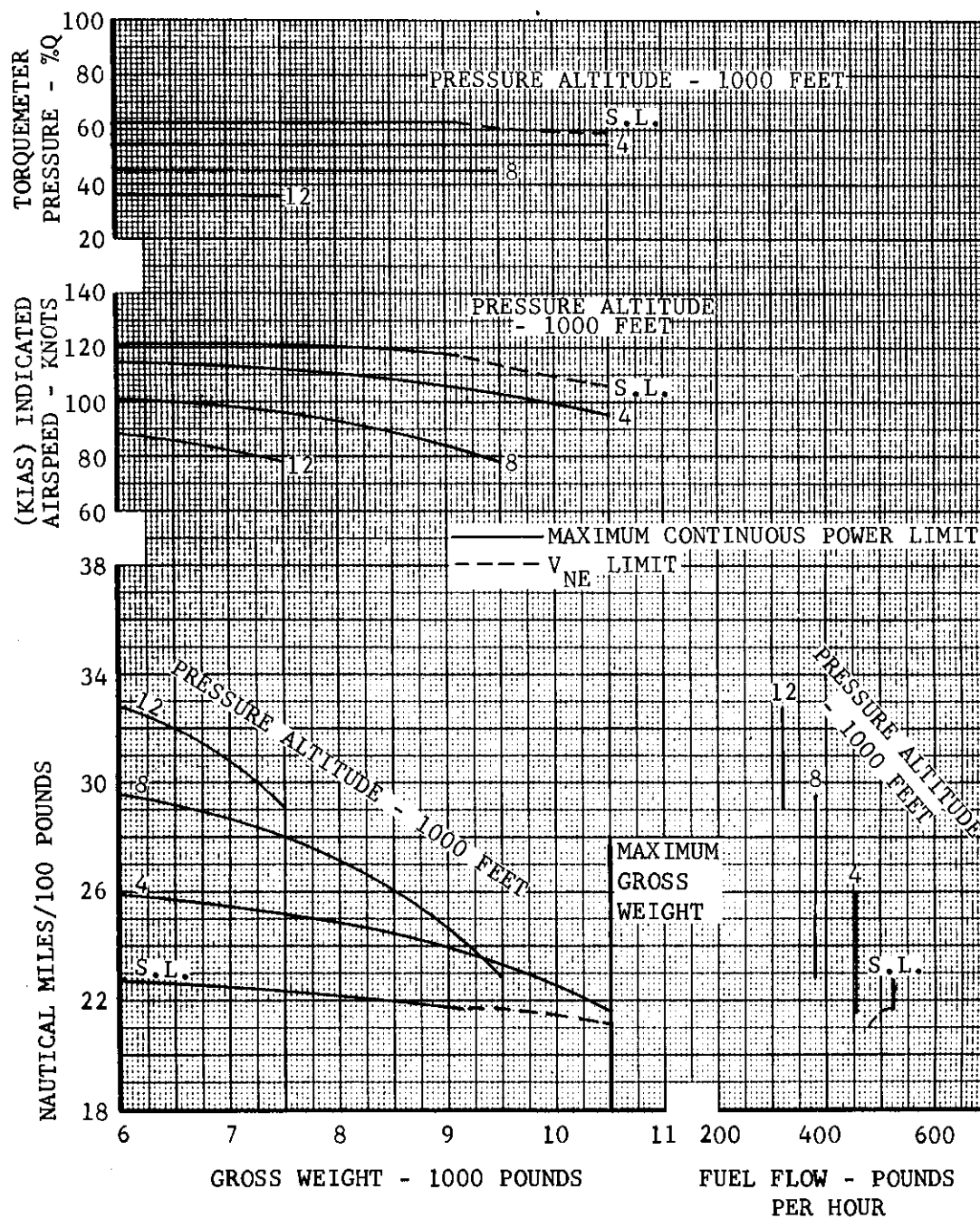


Figure A-37.

CRUISE - SINGLE ENGINE,  
MAXIMUM CONTINUOUS - AIR  
TEMPERATURE BETWEEN  $-30^{\circ}\text{C}$   
AND  $-10^{\circ}\text{C}$

MODEL  
UH-1N

ENGINE  
T400-CP-400

DATE: 26 JANUARY 1973  
DATA BASIS: FLIGHT TEST  
(AIR FORCE)

CONDITIONS:

97% NR

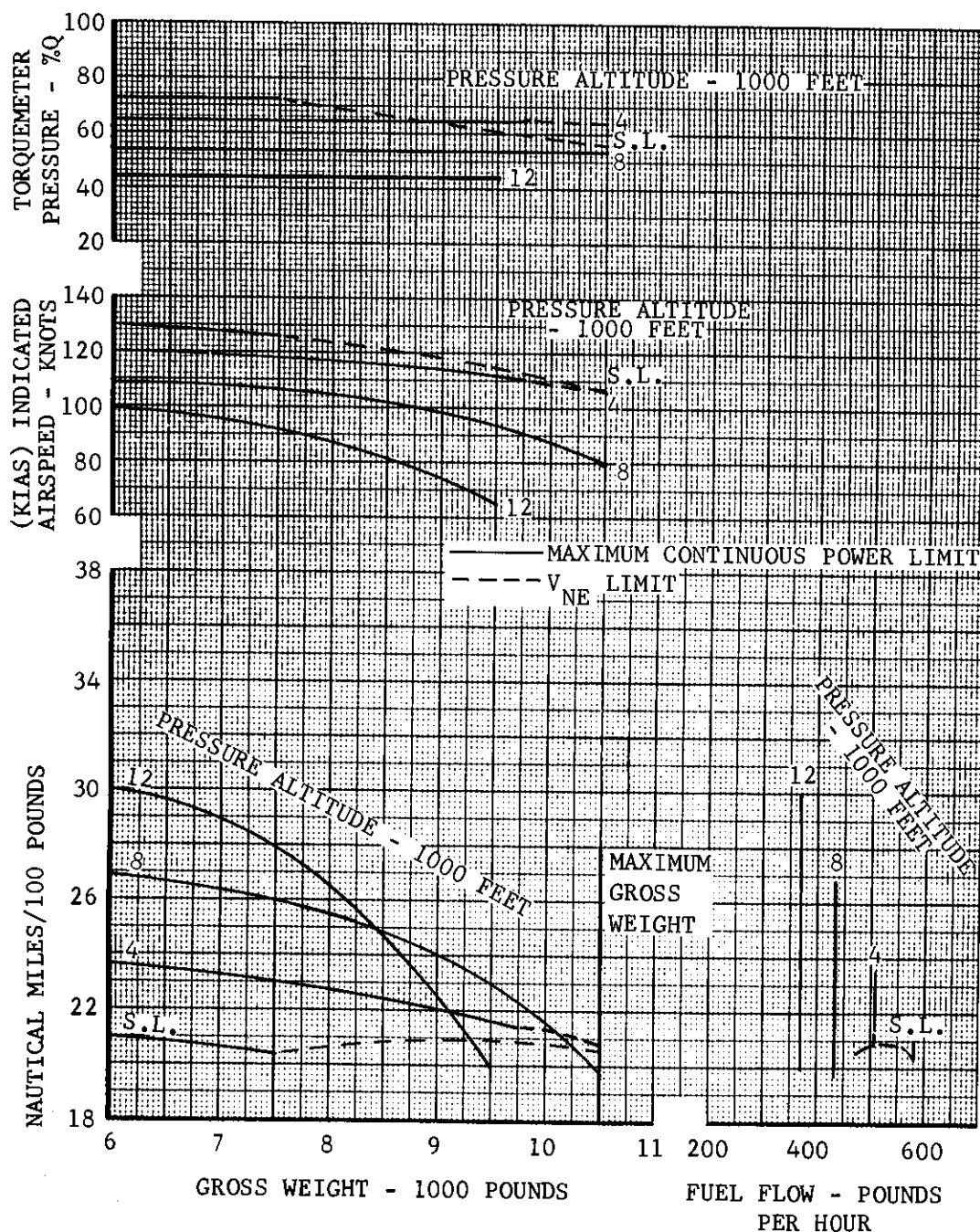
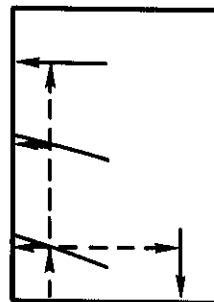
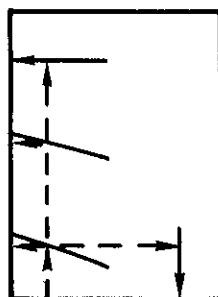


Figure A-38.

CONDITIONS:

97% NR



CRUISE - SINGLE ENGINE,  
MAXIMUM CONTINUOUS -  
AIR TEMPERATURE COLDER THAN  
-30°C

MODEL  
UH-1N

ENGINE  
T400-CP-400

DATE: 26 JANUARY 1973  
DATA BASIS: FLIGHT TEST  
(AIR FORCE)

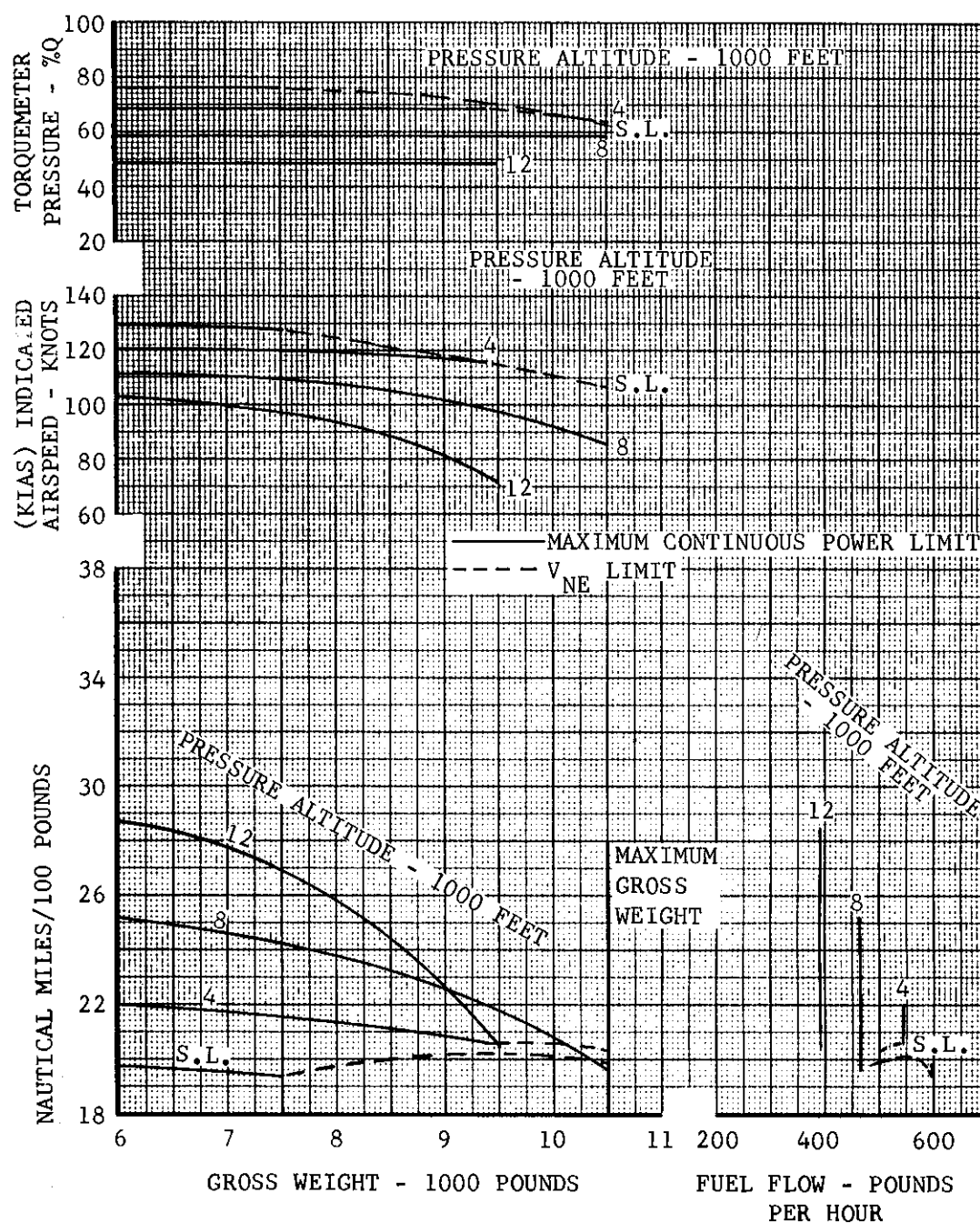


Figure A-39.

**SINGLE ENGINE CAPABILITY -  
MILITARY POWER**

MODEL  
UH-1N

ENGINE  
T400-CP-400

DATE: 26 JANUARY 1973  
DATA BASIS: FLIGHT TEST  
(AIR FORCE)

CONDITIONS:

97% NR

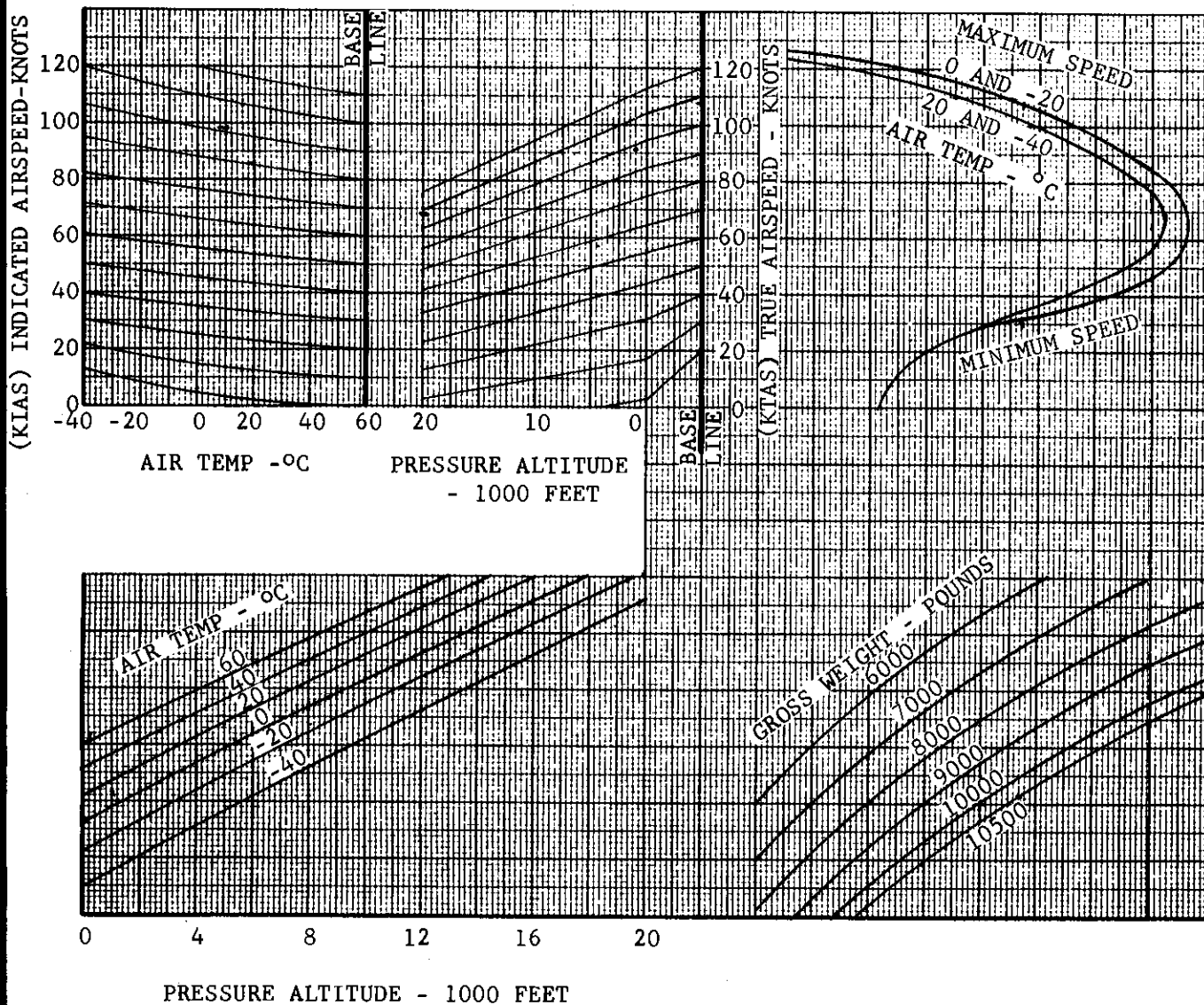
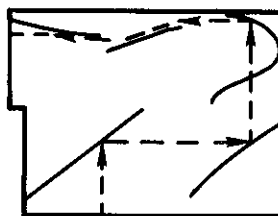


Figure A-40.

| DATA                                                                              | TAKE-OFF | LANDING   |
|-----------------------------------------------------------------------------------|----------|-----------|
| Pressure Altitude                                                                 | _____    | _____ Ft  |
| OAT                                                                               | _____    | _____ °C  |
| Density Altitude (Fig. A-1)                                                       | _____    | _____ Ft  |
| Wind                                                                              | _____    | _____ Kts |
| Gross Weight                                                                      | _____    | _____ Lb  |
| Desired Skid Height                                                               | _____    | _____ Ft  |
| Desired Rotor Speed                                                               | _____    | _____ %   |
| Power Available – Two Engine<br>(Figure A-5)                                      | _____    | _____ %Q  |
| Power Available – Single Engine<br>(Figure A-5)                                   | _____    | _____ %Q  |
| Power Required<br>to Hover (Fig. A-10 & 11)                                       | _____    | _____ %Q  |
| Max. Gross Weight<br>for Hover (Fig. A-9 & 11)                                    | _____    | _____ Lb  |
| Single Engine<br>Max. Gross Wt. to<br>Hover 4 feet Skid Height<br>(Fig. A-9 & 11) | _____    | _____ Lb  |
| Single Engine Take-off<br>Distance (Fig. A-17)                                    | _____    | _____ Ft  |
| Min. Safe Single Engine Speed<br>(Figure A-40)                                    | _____    | _____ Kts |
| Single Engine Service<br>Ceiling (Figure A-24)                                    | _____    | _____ Ft  |
| Max KIAS<br>(Fig. 5-5)                                                            | _____    | _____ Kts |

Figure A-41.

## MISSION PLANNING

The following sample problems are intended primarily to illustrate the selection of suitable performance data charts and the use of the data after obtaining them from the charts. Consequently, fictitious situations are chosen for typical missions to require the use of as many charts as possible and to acquaint the user with the entire scope of information that may be extracted from the charts. Some of the examples also illustrate the use of charts to obtain maximum performance for the predetermined conditions.

Mission weights breakdown for all the four problems is shown in Figure A-42.

### FERRY MISSION

#### PROBLEM

An aircraft is to be ferried with maximum internal fuel over a distance of 225 nautical miles without refueling. The terrain is sea level for the first 100 nautical miles after which it increases to 1000 feet for the next 75 nautical miles and to 2500 feet for the last 50 nautical miles. Enough usable fuel will be carried on each flight to increase the total planned flight time between refueling points by 10 percent or 20 minutes, whichever is greater. Gross weight and takeoff ambient conditions are given on the TOLD card.

#### NOTE

The maximum gross weight to hover out of ground effect at maximum power available is seen as far in excess of the mission takeoff gross weight. Therefore, takeoff will not be of any further concern in this mission plan:

Factors that have to be considered in selecting a flight profile are nature of the terrain, permissible ceiling due to oxygen requirements, headwinds, etc. For this mission, two flight plans are considered.

(a) Cruising at an altitude of 1000 feet above the terrain along the entire flight plan.

(b) Cruising at constant pressure altitude of 10,000 feet (optimum cruise altitude for best range).

The above two flight plans are described in detail in Figure A-43.

#### SOLUTION

For plan (a), fuel used in climb and distance covered during climb are obtained from Figure A-18 for takeoff gross weight and subsequent climbs for gross weights at the end of each cruise phase. Fuel used in the cruise phase is obtained from Figure A-25 for average gross weight. Average gross weight is obtained by subtracting 1/2 of cruise fuel from the gross weight at the beginning of cruise.

For flight plan (b) a pressure altitude of 10,000 feet is chosen because the optimum cruise altitude at takeoff gross weight is well over 10,000 feet and the oxygen requirements do not allow cruise at higher altitudes. Range for both cases is determined from Figure A-25 for average gross weights.

The results of Figure A-43 indicate that profile (a) completes the mission with about the minimum required reserve fuel. This means that in case of strong headwinds, the mission will have to be scrubbed. Profile (b) completes the mission with the required reserve even with a 16-knot headwind along the entire flight path.

|                      |    | Ferry  | Resupply | Rescue | Midpoint Pickup |
|----------------------|----|--------|----------|--------|-----------------|
| *Basic weight        | lb | 5972   | 5972     | 5972   | 5972            |
| Pilot                | lb | 215    | 215      | 215    | 215             |
| Co-pilot             | lb | 215    | -        | 215    | -               |
| Crew chief           | lb | -      | -        | -      | 200             |
| Medic                | lb | -      | -        | 200    | -               |
| Medical equipment    | lb | -      | -        | 50     | -               |
| 9 passengers         | lb | -      | 1800     | -      | -               |
| 9 sets of baggage    | lb | -      | 180      | -      | -               |
| Fuel load            | lb | 1375   | 1375     | 1375   | 533             |
|                      |    | 1320** | 1320**   | 1320** | 533             |
| Takeoff gross weight | lb | 7777   | 9542     | 8027   | 6920            |
|                      |    | 7722** | 9487**   | 7972** |                 |

\*Includes parachutes, copilot seat, cushion, and cargo tie-down rings.

Usable fuel load is 1342 pounds/1284 pounds\*\*

\*\*Aircraft modified by T.O. 1H-1(U)N-587

Figure A-42. Mission Weights Breakdown



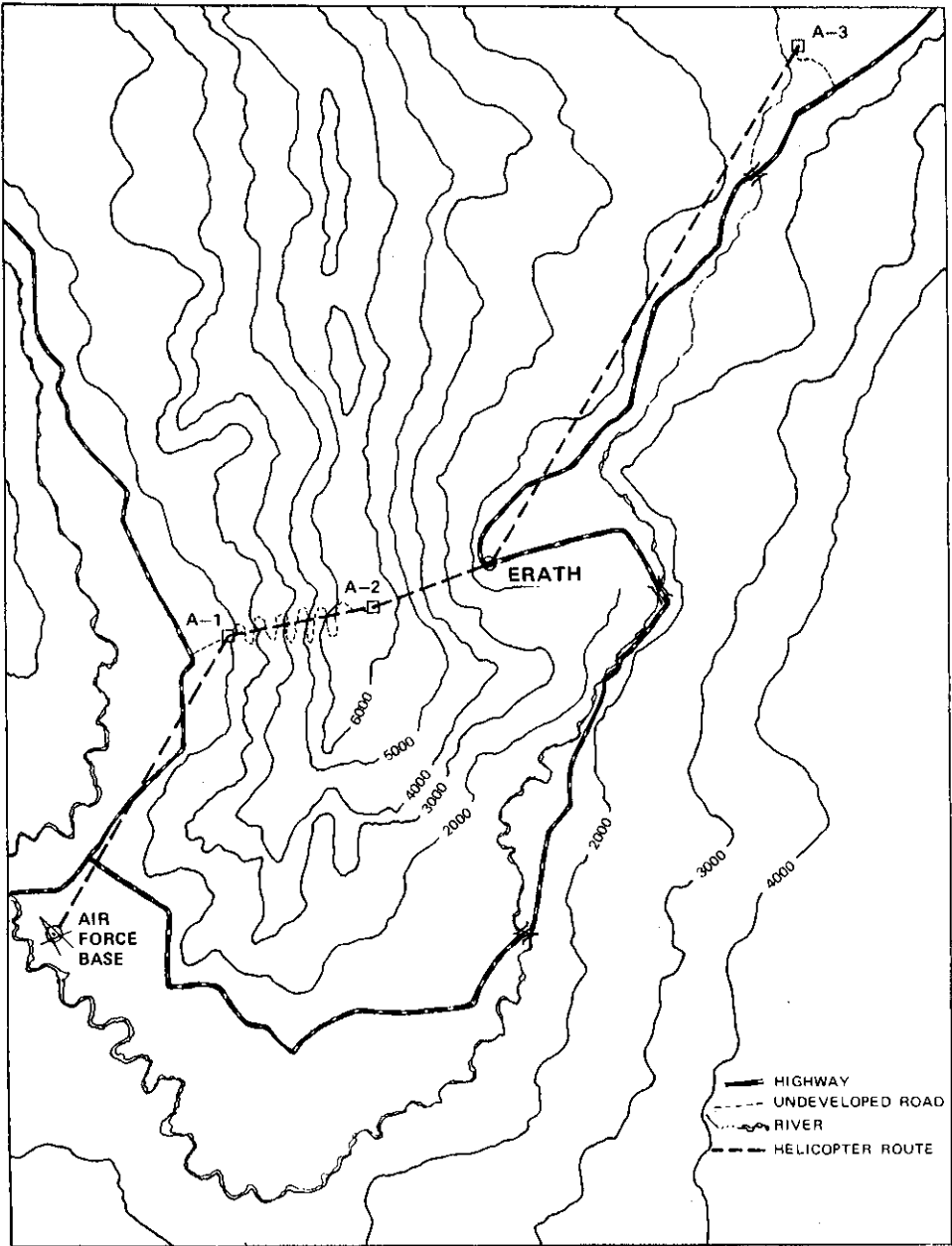
| PROFILES                                    |    |           |           |           |       |
|---------------------------------------------|----|-----------|-----------|-----------|-------|
| Condition                                   |    | a         |           |           | b     |
|                                             |    | 1st Phase | 2nd Phase | 3rd Phase |       |
| Rotor rpm                                   |    | 97%       | 97%       | 97%       | 97%   |
| Cruise pressure altitude                    | ft | 1000      | 2000      | 3500      | 10000 |
| Air temperature -°C                         | °C | 35        | 35        | 35        | 35    |
| <u>Cruise Fuel</u>                          |    |           |           |           |       |
| Total fuel at takeoff (usable)              | lb |           |           |           | 1342  |
| Fuel for warmup and takeoff                 | lb |           |           |           | 26    |
| Fuel for climb (Figure A-18)                | lb | 5         | 6         | 7         | 62    |
| Fuel reserve (10%)                          | lb |           |           |           | 134   |
| Fuel not available for cruise               | lb |           |           |           | 178   |
| Fuel available for cruise                   | lb |           |           |           | 1164  |
| <u>Average Gross Weight</u>                 |    |           |           |           |       |
| Takeoff gross weight                        | lb |           |           |           | 7777  |
| Warmup and takeoff allowance                | lb |           |           |           | -26   |
| Climb fuel                                  | lb | -5        | -6        | -7        | -62   |
| ½ cruise fuel                               | lb | -265      | -190      | -120      | -480  |
| Average gross weight                        | lb | 7481      | 7020      | 6703      | 7209  |
| Nm/lb of fuel                               |    | 0.188     | 0.196     | 0.207     | 0.229 |
| Total fuel used                             | lb | 561       | 947       | 1194      | 959   |
| Range in cruise                             | nm | 99.6      | 74.6      | 49.5      | 219.8 |
| Distance covered during climb (Figure A-18) |    | 0.4       | 0.4       | 0.5       | 5.2   |
| Total air range                             | nm | 100       | 75        | 50        | 225   |
| Headwind                                    | kt | —         | —         | —         | 16    |
| Fuel used to overcome headwind              | lb | —         | —         | —         | 150   |
| Total fuel used including reserve           | lb | 695       | 1081      | 1328      | 1331  |

Figure A-43. Mission Profiles

## Ferry Mission Told Card

| <u>Data</u>                                              | <u>Takeoff</u> | <u>Landing</u> |     |
|----------------------------------------------------------|----------------|----------------|-----|
| Pressure altitude                                        | Sea Level      | 2500           | ft  |
| Air temperature                                          | 35             | 35             | °C  |
| Density altitude                                         | 2300           | 5400           | ft  |
| Wind                                                     | 16             | 16             | kt  |
| Gross weight                                             | 7777           | 6443           | lb  |
| Desired skid height                                      | OGE            | OGE            | ft  |
| Desired rotor speed                                      | 100            | 100            | %   |
| Power required to hover                                  | 65             | 53             | % Q |
| Power available                                          | 100.0          | 100.0          | % Q |
| Maximum gross weight for hover                           | 10500          | 10250          | lb  |
| MAX KIAS                                                 | 127            | 122            | kt  |
| Single engine service ceiling                            | 9300           | 12300          | ft  |
| Safe single engine speed                                 | 8              | 3              | kt  |
| Single engine max gross weight to hover 4 ft skid height | 7700           | 7070           | lb  |

Figure A-44. Takeoff and Landing Data



204947-51

|       | MSL Elevation<br>(ft) | Length of Helipad<br>(ft) | Distances between the sites are: |       |
|-------|-----------------------|---------------------------|----------------------------------|-------|
| Base  | 1000                  | 1000                      | Base to A-1                      | 25 nm |
| A-1   | 2000                  | 200                       | A-1 to A-2                       | 12 nm |
| A-2   | 6500                  | 200                       | A-2 to Erath                     | 10 nm |
| Erath | 2000                  | 4200                      | Erath to A-3                     | 55 nm |
| A-3   | 1500                  | 800                       |                                  |       |

Figure A-45. Terrain Map

## RESUPPLY

A typical resupply mission for the UH-1N involves flying men and/or equipment to remote sites. The map, Figure A-45, shows a typical group of sites in mountainous terrain. The altitude and length of helipad at each site are also included.

### PROBLEM

The mission is flown in straight-line segments as indicated on the map. The helicopter makes its take-off at the base fully loaded and flies to A-1 where three passengers and three sets of baggage are removed (660 pounds). The helicopter then flies to A-2 where three more passengers and three sets of baggage are removed. Ground time at each site is five minutes with engine idling and rotor turning. At A-3 the engine is shut down and three passengers and three sets of baggage are removed. After a two-hour delay the engine is restarted and three passengers and three sets of baggage are loaded. After warmup and takeoff the helicopter is then flown back to A-2 and A-1. Ground time is five minutes and three passengers and three sets of baggage are loaded at each site. The helicopter then returns to base.

### SOLUTION

Two methods for flying this mission will be investigated. The first method is to fly the straight-line segments shown, maintaining 1000-foot clearance over the terrain. The second method involves flying at an optimum cruise altitude (cruise climb).

Figure A-46 shows a breakdown of the resupply mission flown with a terrain clearance of 1000 feet and Figure A-47 shows sample TOLD cards. This method involves the following approximations:

(a) When flying over rising terrain the fuel burned is considered to be the sum of the fuel required to climb the total altitude (Figure A-18) plus fuel required to cruise the given distance (minus distance to climb) at the average altitude and average gross weight. (Figure A-27)

(b) When flying over descending terrain the fuel burned is considered to be that required to cruise the given distance at the average altitude and average gross weight.

(c) Twenty-six pounds of fuel are required to warmup and take off or to idle for five minutes with rotors turning and then takeoff.

Since fuel reserves required for landing at the base are 10% of the initial fuel load (134 pounds) the mission cannot be safely flown using this method. However, the mission may be flown if optimum cruise altitudes are used to obtain maximum fuel economy. Figure A-48 shows the mission breakdown and Figure A-49 shows sample TOLD cards.

Fuel burned in the cruise is computed at the optimum altitude and average gross weight. Cruising altitudes are limited to 10,000 feet due to oxygen requirements.

Cruising at optimum altitudes results in completing the mission with required fuel reserves. It should be noted, however, that the optimum altitude method produces a fuel saving only in segments No. 3 and No. 4. The reason for this being that the optimum altitude method is best suited for longer segments when the climb comprises a relatively small percent of the fuel burned (less than 10 percent). Otherwise the cruising fuel economy is offset by the fuel expended in climbing to the higher altitudes. By referring to Figure A-27, Specific Range, it is seen that the optimum altitude method is more effective when operating at lower gross weights for two reasons. First, less fuel is required to climb at the lower gross weight. Second, higher values of nautical miles per pound may be achieved at lower gross weights. In view of these considerations it would be advantageous to fly the four shorter mission segments (Nos. 1, 2, 5 and 6) using the 1000-foot terrain clearance method while using the optimum altitude method for longer segments (Nos. 3 and 4). Other factors which might affect the choice of methods would be winds aloft, turbulence in mountainous regions, avoidance of instrument flying conditions, etc. In any case, proper combination of the two methods to suit existing conditions will produce a more satisfactory solution to the mission planning problem than will rigid adherence to one method.

## RESCUE MISSION

Five men are to be rescued on a hot day and high altitude at a site estimated to be 50 nautical miles from the base. The base is situated on an altitude of 3500 feet and the terrain where the pilots are located varies between 7000 feet and 10,000 feet. This type of mission is characterized by the ability of the helicopter to search as long as possible at the rescue site and be able to hover out of ground effect (OGE) while performing the rescue operations. In this example, the search is conducted at an altitude of 8500 feet. The search time is estimated to take 30 minutes. The pilots are located at 7500 feet.

### PROBLEM

To determine whether the mission can be successfully completed, it is necessary to check that there is adequate fuel for cruise, search, hover and have enough reserve for any emergencies. It is also important that the helicopter can take off at its initial gross weight and clear surrounding obstacles and be able to hover at the rescue site. The mission is divided into clear segments so that the fuel used for each segment may be readily seen. Figure A-50 shows the mission profile.

### SOLUTION

With full initial fuel and other equipment as outlined in TOLD card (figure A-51), Figure A-9 shows that vertical

takeoff is easily accomplished. Warm-up and takeoff fuel allowance is considered equal to that needed for two-minute operation of the engine at max continuous power and is 26 pounds. Fuel for climb and the distance covered are read from Figure A-18 for the takeoff gross weight. Fuel for cruise is obtained by reading the nautical miles per pound of fuel from Figure A-25 for the average gross weight. Average gross weight is the gross weight at the start of cruise minus one-half of the cruise fuel. Nautical miles per pound of fuel is 0.226 at 10,000 feet (oxygen requirements) and VNE. The cruise distance is the total distance minus the distance covered during climb and is 46.1 nautical miles. Then the cruise fuel is 204 pounds which is obtained by dividing 46.1 nm by 0.226 nm per pound of fuel.

Search is conducted at 8500 feet and search fuel flow is obtained from Figure A-25 as 352 lb/hr. For a 30-minute search this results in 176 pounds of fuel. Descent to 7500 feet is included in the search time.

Power required to hover out of ground effect for a gross weight that includes the weight of the rescuees is obtained from Figure A-10 and the corresponding fuel flow is read from Figure A-8 as 672 lb/hr. Then for 10 minutes, the hover fuel is 112 pounds.

Climb from 7500 feet to 10,000 feet is made at military power and from Figure A-19 the rate of climb is seen to be 1570 ft/min. Return climb and cruise fuel is obtained in the same manner as outbound climb and cruise fuel. Reserve fuel is 10 percent of the initial fuel.

A check is now made on the ability to hover OGE at the rescue site. Figure A-9 shows that hover gross weight at rescue site is 8175 pounds, and the maximum gross weight to hover for the atmospheric conditions is 8150 pounds as shown in Figure A-9. This means that for safe takeoff at least 100 pounds of fuel has to be unloaded before taking off. Then with the new fuel load and takeoff gross weight, the mission fuel weights are calculated as before. These new values are shown in columns VII and VIII of Figure A-50. The reserve fuel is now 103 pounds. It should be noted that if the distance to the rescue site turned out to be less than expected or if the search time was shortened, less fuel would have been burned off and the gross weight at the rescue site would be higher than estimated, thus exceeding the maximum gross weight to hover. If this is anticipated more fuel should be off-loaded before takeoff, or fuel must be burned off before starting the hover.

## MIDPOINT PICKUP (EXTERNAL CARGO) MISSION

### PROBLEM

The mission is to pick up a jeep weighing 3500 pounds from an inaccessible area, located at a distance of 15 nautical miles from the base. For this example, the base is

at sea level and the location of the jeep is at 2000 feet. The ambient conditions are assumed to be 40°C at the base and 35°C at the point of pickup, and it is expected to take 15 minutes of search time to locate the jeep. The clearance at the pickup point is about 400 feet long.

The success of this mission depends primarily on the ability of the helicopter to hover IGE at 15 feet skid height with the jeep and be able to clear a 50-foot obstacle in less than 400 feet. Therefore, the amount of fuel at takeoff should not be excessive. As the mission radius is small, a takeoff fuel load of 500 pounds is assumed as a first approximation.

A check is now made to see whether the fuel on board is adequate. The mission is divided into segments so that fuel for each segment may be readily seen. Figure A-52 shows the mission profile.

### SOLUTION

With the approximate fuel and other equipment as outlined in the TOLD card, Figure A-9 shows that vertical takeoff is easily accomplished from the base. Warm-up and takeoff fuel allowance is considered equal to that needed for two-minute operation of the engine at normal rated power and is 26 pounds. Fuel for the climb and the distance covered are obtained from Figure A-18 for the takeoff gross weight. Cruise fuel is obtained by reading the nautical miles per pound of fuel from Figure A-25 for the average gross weight. The cruise distance is the total distance minus the distance covered during climb. Then the cruise fuel is 13.8 nautical miles divided by 0.206 nautical miles per pound of fuel and is equal to 67 pounds.

Search is conducted at 1000 feet above the terrain at an altitude of 3000 feet. The maximum endurance fuel flow is obtained from Figure A-25 and this results in 102 pounds of fuel used for search. Descent to the pickup point is included in search.

At the point of pickup it is expected to hover for five minutes to prepare for the takeoff. With the jeep, the takeoff gross weight is 10,152 pounds, hover OGE. Therefore, hover at a 15-foot skid height and takeoff distance need not be considerations in this case. If the helicopter cannot hover OGE, then a level acceleration and climb out-type technique has to be used as explained on page A-5. Climb fuel is obtained from Figure A-18 for the takeoff gross weight.

Inbound cruise is conducted at 3000 feet and the fuel flow is 540 pounds per hour for this condition for the average gross weight. Cruise speed is equal to the VNE control limit, which is assumed to be 75 KIAS with the sling load. As seen in Figure A-52, the total fuel used for the entire mission, including a reserve equal to ten percent of the initial fuel, is 423 pounds. The initial fuel was 500 pounds and therefore the mission can be successfully completed.

## GUNSHIP MISSION

### PROBLEM.

The problem is to find the maximum Time Over Target (TOT) that would permit a radius of action of 50 nautical miles. The aircraft has full fuel, cargo doors open, M-93 or M-94 subsystem extended, and LAU-59 or LAU-68 subsystem with 833 pounds of expendable munitions, a crew of two plus two gunners and an engine start gross weight of 9931 pounds. The departure base is at 1000 feet pressure altitude, air temperature of 30°C with a 10 knot wind. The enroute altitude is 4000 feet pressure altitude with a 10 knot headwind outbound and tailwind on the return. The standard lapse rate of 2°C per 1000 feet will be used to obtain flight level temperatures. Combat will be conducted at 2000 feet pressure altitude. No time, fuel or distance allowances will be made for descent. The requirement is to remain at low level for the maximum allowable time, expend all ordnance and return to base with at least 200 pounds of usable fuel remaining. Cruise speeds will be the recommended speeds in the cruise charts or the limit airspeeds, whichever is less. Combat will be conducted at limit airspeed.

### SOLUTION

Maximum TOT will be computed from the fuel remaining after the outbound and inbound cruise legs are calculated and allowances have been made for warmup, takeoff, climbs and reserves. Figure A-54 gives the weight breakdown for this mission. Figure A-55 shows the takeoff and landing data for the mission. Figure A-56 describes the mission profile.

Warmup and takeoff fuel allowance is considered equal to that needed for two minutes operation of the engine at

normal rated power at the takeoff altitude and temperature and is 28 lb. Climb time distance and fuel are obtained from figure A-18. The fuel required to cruise the remaining distance after climb is calculated using Figure A-26 and an estimated average cruise gross weight of 9700 lb. The specific range given by Figure A-26 is decreased to account for the gunship's higher power required by dividing by 1.15, which is equivalent to increasing the fuel flow by 15%. Cruise speed is  $V_{NE}$ -limited to 113 KTAS or 106 KIAS.

The inbound cruise leg is computed by working backwards from the landing weight of 7956 lb, which includes 200 lb of reserve fuel. An estimated average cruise weight of 8100 lb is used with Figure A-26 to calculate the fuel required for return cruise. Specific range is again divided by 1.15 as it was for the outbound leg. Based on the initial outbound climb distance of 1.5 nm, the return climb from the combat altitude to cruise altitude at reduced weight is estimated to be 1 nm, leaving 49 nm for return cruise. This climb distance estimate is confirmed by Figure A-18, which also gives the return climb fuel and time. Return cruise speed is also found to be  $V_{NE}$ -limited at 128 KTAS or 118 KIAS.

Fuel required for both the outbound and inbound legs, with all necessary allowances, is found to be 849 lb, leaving 493 lb for combat. The weight at the end of the outbound cruise leg (9579 lb) and the weight at the beginning of the return climb (8253 lb) are averaged to obtain the average combat weight of 8916 lb. This weight is then used in Figure A-26 to obtain the combat fuel flow at  $V_{NE}$  = 123 KTAS or 119 KIAS. This fuel flow is also increased by 15% and the TOT (39 minutes) is computed from the fuel available.

| Mission Segment                                | Pressure<br>Altitude<br>(ft) | Air<br>Temp<br>(°C) | G W<br>(lb) | Fuel<br>(lb) | Distance<br>Covered<br>(nm) | Figure<br>Number |
|------------------------------------------------|------------------------------|---------------------|-------------|--------------|-----------------------------|------------------|
| No. 1 Warm-up T.O.                             | 1000                         | 0                   | 9542        | 26           |                             |                  |
| Climb                                          |                              | 0                   | 9516        | 11           | .8                          | A-18             |
| Cruise                                         | 2500                         | 0                   | 9439        | 132          | 24.2                        | A-27             |
| Total Base to A-1                              |                              |                     |             | 169          | 25.0                        |                  |
| No. 2 5 Min Idle T.O.<br>(Minus 660 lb)        | 2000                         | 0                   | 8713        | 26           |                             |                  |
| Climb                                          |                              | 0                   | 8687        | 28           | 2.1                         | A-18             |
| Cruise                                         | 5250                         | 0                   | 8634        | 50           | 9.9                         | A-27             |
| Total A-1 to A-2                               |                              |                     |             | 104          | 12.0                        |                  |
| No. 3 5 Min idle T.O.<br>(Minus 660 lb)        | 6500                         | 0                   | 7949        | 26           |                             |                  |
| Cruise                                         | 5250                         | 0                   | 7899        | 49           | 10                          | A-27             |
| Cruise                                         | 2750                         | 0                   | 7730        | 289          | 55                          | A-27             |
| Total A-2 to Erath<br>to A-3                   |                              |                     |             | 364          | 65                          |                  |
| No. 4 Warm-up T.O.                             | 1500                         | 0                   | 7585        | 26           |                             |                  |
| Climb                                          |                              | 0                   | 7559        | 7            | 0.4                         | A-18             |
| Cruise                                         | 2750                         | 0                   | 7409        | 286          | 54.6                        | A-27             |
| Climb                                          |                              | 0                   | 7266        | 20           | 1.4                         | A-18             |
| Cruise                                         | 5250                         | 0                   | 7224        | 44           | 8.6                         | A-27             |
| Total A-3 to Erath<br>to A-2                   |                              |                     |             | 383          | 65                          |                  |
| No. 5 5 Min Idle T.O.<br>(Plus 660 lb)         | 6500                         | 0                   | 7862        | 26           |                             |                  |
| Cruise                                         | 5250                         | 0                   | 7807        | 59           | 12                          | A-27             |
| Total A-2 to A-1                               |                              |                     |             | 85           | 12                          |                  |
| No. 6 5 Min Idle T.O.<br>(Plus 660 lb)         | 2000                         | 0                   | 8437        | 26           |                             |                  |
| Cruise                                         | 2500                         | 0                   | 8344        | 135          | 25                          | A-27             |
| Total A-1 to Base                              |                              |                     | 8276        | 161          | 25                          |                  |
| Fuel burned for mission 1266 lb reserve 76 lb. |                              |                     |             |              |                             |                  |

Figure A-46. Mission Breakdown, 1000 Foot Terrain Clearance

|                                                             | T-01  | LDG <sub>1</sub> | T-02  | LDG <sub>2</sub> | T-03  | LDG <sub>3</sub> |     |
|-------------------------------------------------------------|-------|------------------|-------|------------------|-------|------------------|-----|
| Pressure Altitude                                           | 1000  | 2000             | 2000  | 6500             | 6500  | 1500             | ft  |
| Air Temperature                                             | 0     | 0                | 0     | 0                | 0     | 0                | °C  |
| Density Altitude                                            | -500  | 800              | 800   | 6400             | 6400  | 200              | ft  |
| Wind                                                        | 0     | 0                | 0     | 0                | 0     | 0                | kt  |
| Gross Weight                                                | 9542  | 9373             | 8713  | 8609             | 7949  | 7585             | lb  |
| Desired Skid Height                                         | OGE   | OGE              | OGE   | OGE              | OGE   | OGE              | ft  |
| Desired Rotor Speed                                         | 100   | 100              | 100   | 100              | 100   | 100              | %   |
| Power Required to Hover                                     | 82.0  | 80.6             | 73.0  | 76.7             | 68.5  | 60.8             | % Q |
| Power Available                                             | 100.0 | 100.0            | 100.0 | 100.0            | 100.0 | 100.0            | % Q |
| Maximum Gross Weight to Hover                               | 10500 | 10500            | 10500 | 10120            | 10120 | 10500            | lb  |
| MAX KIAS                                                    | 114   | 116              | 120   | 112              | 115   | 129              | kt  |
| Single Engine Service Ceiling                               | 10850 | 11200            | 12750 | 13000            | 14650 | 15600            | ft  |
| Safe Single Engine Speed                                    | 7     | 8                | 4     | 14               | 9     | 0                | kt  |
| Single Engine Max Gross Weight to Hover 4 Ft Skid Height    | 9700  | 9350             | 9350  | 8000             | 8000  | 9500             | lb  |
| Single Engine Takeoff Distance (Climbout airspeed = 35 KTS) | 620   | 640              | 590   | -                | 620   | 520              | ft  |

Figure A-47. Sample TOLD Card (Sheet 1 of 2)

|                                                               | T-04  | LDG4  | T-05  | LDG5  | T-06  | LDG6  |     |
|---------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-----|
| Pressure Altitude                                             | 1500  | 6500  | 6500  | 2000  | 2000  | 1000  | ft  |
| Air Temperature                                               | 0     | 0     | 0     | 0     | 0     | 0     | °C  |
| Density Altitude                                              | 200   | 6400  | 6400  | 800   | 800   | -500  | ft  |
| Wind                                                          | 0     | 0     | 0     | 0     | 0     | 0     | kt  |
| Gross Weight                                                  | 7585  | 7202  | 7862  | 7777  | 8437  | 8276  | lb  |
| Desired Skid Height                                           | OGE   | OGE   | OGE   | OGE   | OGE   | OGE   | ft  |
| Desired Rotor Speed                                           | 100   | 100   | 100   | 100   | 100   | 100   | %   |
| Power Required to Hover                                       | 60.8  | 59.3  | 67.0  | 62.3  | 69.8  | 67.5  | % Q |
| Power Available                                               | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | % Q |
| Maximum Gross Weight to Hover                                 | 10500 | 10120 | 10120 | 10500 | 10500 | 10500 | lb  |
| MAX KIAS                                                      | 129   | 120   | 117   | 128   | 122   | 123   | kt  |
| Single Engine Service Ceiling                                 | 15600 | 16550 | 14870 | 15100 | 13450 | 13800 | ft  |
| Safe Single Engine Speed                                      | 0     | 1     | 8     | 0     | 3     | 0     | kt  |
| Single Engine Max Gross Weight to Hover 4 Ft Skid Height      | 9500  | 8000  | 8000  | 9350  | 9350  | 9700  | lb  |
| Single Engine Takeoff Distance (Climbout Airspeed = 35 knots) | 520   | 570   | 610   | 530   | 590   | 540   | ft  |

Figure A-47. Sample TOLD Card (Sheet 2 of 2)



| Mission Segment                              | Pressure<br>Altitude<br>(ft) | Air<br>Temp<br>(°C) | G W<br>(lb) | Fuel<br>(lb) | Distance<br>Covered<br>(nm) | Figure<br>Number |
|----------------------------------------------|------------------------------|---------------------|-------------|--------------|-----------------------------|------------------|
| *No. 1 Warm-up and T.O.                      | 1000                         | 0                   | 9542        | 26           |                             |                  |
| Climb                                        |                              | 0                   | 9516        | 11           | .8                          | A-18             |
| Cruise                                       | 2500                         | 0                   | 9439        | 132          | 24.2                        | A-27             |
| Total Base to A-1                            |                              |                     |             | 169          | 25.0                        |                  |
| *No. 2 5 Min Idle and T.O.<br>(Minus 660 lb) | 2000                         | 0                   | 8713        | 26           |                             |                  |
| Climb                                        |                              | 0                   | 8687        | 28           | 2.1                         | A-18             |
| Cruise                                       | 5250                         | 0                   | 8634        | 50           | 9.9                         | A-27             |
| Total A-1 to A-2                             |                              |                     |             | 104          | 12.0                        |                  |
| No. 3 5 Min Idle and T.O.<br>(Minus 660 lb)  | 6500                         | 0                   | 7949        | 26           |                             |                  |
| Climb                                        |                              | 0                   | 7923        | 20           | 1.5                         | A-18             |
| Cruise                                       | 10000                        | 0                   | 7759        | 288          | 63.5                        | A-27             |
| Total A-2 to A-3                             |                              |                     |             | 334          | 65.0                        |                  |
| No. 4 Warm-up and T.O.                       | 1500                         | 0                   | 7615        | 26           |                             |                  |
| Climb                                        |                              | 0                   | 7589        | 45           | 3.1                         | A-18             |
| Cruise                                       | 10000                        | 0                   | 7406        | 276          | 61.9                        | A-27             |
| Total A-3 to A-2                             |                              |                     |             | 347          | 65.0                        |                  |
| *No. 5 5 Min Idle and T.O.<br>(Plus 660 lb)  | 6500                         | 0                   | 7928        | 26           |                             |                  |
| Cruise                                       | 5250                         | 0                   | 7872        | 59           | 12.0                        | A-27             |
| Total A-2 to A-1                             |                              |                     |             | 85           | 12.0                        |                  |
| *No. 6 5 Min Idle and T.O.<br>(Plus 660 lb)  | 2000                         | 0                   | 8503        | 26           |                             |                  |
| Cruise                                       | 2500                         | 0                   | 8410        | 135          | 25.0                        | A-27             |
| Total A-1 to Base                            |                              |                     |             | 161          | 25.0                        |                  |

Fuel burned for mission 1200 lb reserve 142 lb

\* Mission leg is too short to use optimum altitude effectively; therefore, 1000 ft terrain clearance method is used.

Figure A-48. Mission Breakdown, Optimum Altitude

|                                                             | T-01  | LDG <sub>1</sub> | T-02  | LDG <sub>2</sub> | T-03  | LDG <sub>3</sub> |     |
|-------------------------------------------------------------|-------|------------------|-------|------------------|-------|------------------|-----|
| Pressure Altitude                                           | 1000  | 2000             | 2000  | 6500             | 6500  | 1500             | ft  |
| Air Temperature                                             | 0     | 0                | 0     | 0                | 0     | 0                | °C  |
| Density Altitude                                            | -500  | 800              | 800   | 6400             | 6400  | 200              | ft  |
| Wind                                                        | 0     | 0                | 0     | 0                | 0     | 0                | kt  |
| Gross Weight                                                | 9542  | 9373             | 8713  | 8609             | 7949  | 7615             | lb  |
| Desired Skid Height                                         | OGE   | OGE              | OGE   | OGE              | OGE   | OGE              | ft  |
| Desired Rotor Speed                                         | 100   | 100              | 100   | 100              | 100   | 100              | %   |
| Power Required to Hover                                     | 82.0  | 80.6             | 73.0  | 76.7             | 68.5  | 60.9             | % Q |
| Power Available                                             | 100.0 | 100.0            | 100.0 | 100.0            | 100.0 | 100.0            | % Q |
| Maximum Gross Weight to Hover                               | 10500 | 10500            | 10500 | 10120            | 10120 | 10500            | lb  |
| MAX KIAS                                                    | 114   | 116              | 120   | 112              | 115   | 129              | kt  |
| Single Engine Service Ceiling                               | 10850 | 11200            | 12750 | 13000            | 14650 | 15500            | ft  |
| Safe Single Engine Speed                                    | 7     | 8                | 4     | 14               | 9     | 0                | kt  |
| Single Engine Max Gross Weight to Hover 4 Ft Skid Height    | 9700  | 9350             | 9350  | 8000             | 8000  | 9500             | lb  |
| Single Engine takeoff distance (Climbout airspeed = 35 KTS) | 620   | 640              | 590   | -                | 620   | 520              | ft  |

Figure A-49. Sample TOLD Card (Sheet 1 of 2)

|                                                               | T-04  | LDG4  | T-05  | LDG5  | T-06  | LDG6  |     |
|---------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-----|
| Pressure Altitude                                             | 1500  | 6500  | 6500  | 2000  | 2000  | 1000  | ft  |
| Air Temperature                                               | 0     | 0     | 0     | 0     | 0     | 0     | °C  |
| Density Altitude                                              | 200   | 6400  | 6400  | 800   | 800   | -500  | ft  |
| Wind                                                          | 0     | 0     | 0     | 0     | 0     | 0     | kt  |
| Gross Weight                                                  | 7615  | 7268  | 7928  | 7843  | 8503  | 8342  | lb  |
| Desired Skid Height                                           | OGE   | OGE   | OGE   | OGE   | OGE   | OGE   | ft  |
| Desired Rotor Speed                                           | 100   | 100   | 100   | 100   | 100   | 100   | %   |
| Power Required to Hover                                       | 60.9  | 61.0  | 67.5  | 63.4  | 70.8  | 68.7  | % Q |
| Power Available                                               | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | % Q |
| Maximum Gross Weight to Hover                                 | 10500 | 10120 | 10120 | 10500 | 10500 | 10500 | lb  |
| MAX KIAS                                                      | 129   | 120   | 117   | 128   | 122   | 123   | kt  |
| Single Engine Service Ceiling                                 | 15500 | 16400 | 14700 | 14900 | 13250 | 13650 | ft  |
| Safe Single Engine Speed                                      | 0     | 1     | 8     | 0     | 3     | 0     | kt  |
| Single Engine Max Gross Weight to Hover 4 Ft Skid Height      | 9500  | 8000  | 8000  | 9350  | 9350  | 9700  | lb  |
| Single Engine Takeoff Distance. (Climb out airspeed = 35 KTS) | 520   | 570   | 610   | 530   | 590   | 540   | ft  |

Figure A-49. Sample TOLD Card (Sheet 2 of 2)

| I                                               | II                           | III                 | IV          | V            | VI            | VII         | VIII         |
|-------------------------------------------------|------------------------------|---------------------|-------------|--------------|---------------|-------------|--------------|
| Mission Segment                                 | Pressure<br>Altitude<br>(ft) | Air<br>Temp<br>(°C) | G W<br>(lb) | Fuel<br>(lb) | Figure<br>No. | G W<br>(lb) | Fuel<br>(lb) |
| Warm-up & Takeoff                               | 3500                         | 35                  | 7685        | 26           |               | 7585        | 26           |
| Climb                                           |                              |                     | 7659        | 43           | A-18          | 7559        | 40           |
| Cruise                                          | 10000                        | 35                  | 7513*       | 205          | A-25          | 7417*       | 204          |
| Descent<br>Search 30 Min.                       | 8500                         | 35                  | 7321*       | 180          | A-25          | 7227*       | 176          |
| Descent<br>Hover                                | 7500                         | 35                  | 8175*       | 112          | A-10          | 8083*       | 112          |
| Climb                                           |                              |                     | 8119        | 20           | A-18          | 8027        | 19           |
| Cruise                                          | 10000                        | 35                  | 7988*       | 222          | A-25          | 7898*       | 220          |
| Descent<br>Land                                 | 3500                         | 35                  | 7877        |              |               | 7788        | 103          |
| Fuel burned for mission 797 lb. Reserve 103 lb. |                              |                     | * Avg. G W  |              |               |             |              |

Figure A-50. Rescue Mission Profile

## RESCUE MISSION

|                                                          | T-0 <sub>1</sub> | LDG <sub>1</sub> | T-0 <sub>2</sub> | LDG <sub>2</sub> |     |
|----------------------------------------------------------|------------------|------------------|------------------|------------------|-----|
| Pressure Altitude                                        | 3500             | 7500             | 7500             | 3500             | ft  |
| Air Temperature                                          | 35               | 35               | 35               | 35               | °C  |
| Density Altitude                                         | 6600             | 11400            | 11400            | 6600             | ft  |
| Wind                                                     | 0                | 0                | 0                | 0                | kt  |
| Gross Weight                                             | 7585             | 7139             | 8027             | 7788             | lb  |
| Desired Skid Height                                      | OGE              | OGE              | OGE              | OGE              | ft  |
| Desired Rotor Speed                                      | 100              | 100              | 100              | 100              | %   |
| Power Required to Hover                                  | 65.0             | 61.5             | 74.0             | 67.0             | % Q |
| Power Available                                          | 94.5             | 77.0             | 77.0             | 94.5             | % Q |
| Maximum Gross Weight to Hover                            | 9830             | 8150             | 8150             | 9830             | lb  |
| MAX KIAS                                                 | 117              | 106              | 102              | 115              | kt  |
| Single Engine Service Ceiling                            | 9700             | 10700            | 8600             | 9300             | ft  |
| Safe Single Engine Speed                                 | 15               | 22               | 33               | 17               | kt  |
| Single Engine Max Gross Weight to Hover 4 Ft skid height | 6950             | —                | —                | 6950             | lb  |

Figure A-51. Takeoff and Landing Data

| Mission Segment                                           | Pressure Altitude (ft) | Air Temp (°C) | G W (lb) | Fuel (lb) | Distance Covered (nm) | Figure Number |
|-----------------------------------------------------------|------------------------|---------------|----------|-----------|-----------------------|---------------|
| Warm-up and T.O.                                          | SL                     | 40            | 6920     | 26        |                       |               |
| Climb                                                     |                        |               | 6894     | 18        | 1.2                   | A-18          |
| Cruise                                                    | 4000                   | 30            | 6843*    | 67        | 13.8                  | A-25          |
| Descent Search                                            | 3000                   | 33            | 6758*    | 102       |                       | A-25          |
| Descent Hover                                             | 2000                   | 35            | 6680*    | 55        |                       | A-10          |
| Climb (after jeep recovery or plus 3500 lb)               |                        |               | 10152    | 7         | .5                    | A-18          |
| Cruise                                                    | 3000                   | 33            | 10096*   | 108       | 14.5                  | A-25          |
| Descent Land                                              | SL                     | 40            | 10042*   | 117       |                       |               |
| Fuel burned for mission 383 lb. Reserve 117 lb. *Avg. G W |                        |               |          |           |                       |               |

Figure A-52. Midpoint Pickup Mission Profile

|                                                              | T-0 <sub>1</sub> | LDG <sub>1</sub> | T-0 <sub>2</sub> | LDG <sub>2</sub> |     |
|--------------------------------------------------------------|------------------|------------------|------------------|------------------|-----|
| Pressure Altitude                                            | SL               | 2000             | 2000             | SL               | ft  |
| Air Temperature                                              | 40               | 35               | 35               | 40               | °C  |
| Density Altitude                                             | 2900             | 4800             | 4800             | 2900             | ft  |
| Wind                                                         | 0                | 0                | 0                | 0                | kt  |
| Gross Weight                                                 | 6920             | 6652             | 10152            | 10047            | lb  |
| Desired Skid Height                                          | OGE              | OGE              | OGE              | OGE              | ft  |
| Desired Rotor Speed                                          | 100              | 100              | 100              | 100              | %   |
| Power Required to Hover                                      | 55.5             | 54.0             | 94.2             | 91.7             | % Q |
| Power Available                                              | 100.0            | 100.0            | 100.0            | 100.0            | % Q |
| Maximum Gross Weight to Hover                                | 10500            | 10500            | 10500            | 10500            | lb  |
| MAX KIAS                                                     | 130              | 125              | 75               | 75               | kt  |
| Single Engine Service Ceiling                                | 10200            | 11800            | 4100             | 3200             | ft  |
| Safe Single Engine Speed                                     | 4                | 3                | 31               | 30               | kt  |
| Single Engine Max Gross Weight to Hover 4 Ft Skid Height     | 7400             | 7200             | 7200             | 7400             | lb  |
| Single Engine Takeoff Distance. (Climbout airspeed = 35 KTS) | 635              | 620              | —                | —                | ft  |

Figure A-53. Takeoff and Landing Data

| ITEM                                | WEIGHT (POUNDS) |
|-------------------------------------|-----------------|
| *Basic Weight                       | 6863            |
| Pilot                               | 215             |
| Copilot                             | 215             |
| Gunners (2)                         | 430             |
| **Fuel Load                         | 1375            |
| Ordnance                            | 833             |
| Takeoff Gross Weight                | 9931            |
| *Includes parachutes and crew seats |                 |
| **Usable fuel load is 1342 pounds   |                 |

Figure A-54. Gunship Mission Weight Breakdown

| ITEM                                                            | TAKEOFF | LANDING |     |
|-----------------------------------------------------------------|---------|---------|-----|
| Pressure Altitude                                               | 1000    | 1000    | ft  |
| Air Temperature                                                 | 30      | 30      | °C  |
| Density Altitude                                                | 3000    | 3000    | ft  |
| Wind                                                            | 10      | 10      | kts |
| Gross Weight                                                    | 9931    | 7956    | lb  |
| Desired Skid Height                                             | 4       | 4       | ft  |
| Desired Rotor Speed                                             | 100     | 100     | %   |
| Power Required to Hover (4 ft Skid Height)                      | 68      | 50      | %Q  |
| Power Available                                                 | 100     | 100     | %Q  |
| Max Gross Weight to Hover                                       | 10500   | 10500   | lb  |
| Max KIAS (Cruise Alt)                                           | 106     | 118     | kts |
| Single Engine Service Ceiling                                   | 5500    | 9750    | ft  |
| Safe Single Engine Speed                                        | 26      | 4       | kt  |
| Single Engine Max Gross Weight to Hover<br>(4 ft Skid Height)   | 7850    | 7850    | lb  |
| Single Engine Takeoff Distance<br>(Climbout Airspeed = 35 KIAS) | --      | 520     | ft  |

Figure A-55. Takeoff and Landing Data, Gunship Mission

| MISSION<br>SEGMENT       | PRESSURE<br>ALTITUDE<br>(ft) | AIR<br>TEMP<br>(°C) | WIND<br>(kt) | GW<br>(lb) | FUEL<br>(lb) | DIST<br>(nm) | TIME<br>(min) | FIGURE    |
|--------------------------|------------------------------|---------------------|--------------|------------|--------------|--------------|---------------|-----------|
| Warmup<br>and<br>Takeoff | 1000                         | 30                  | 10           | 9931       | 28           |              | 2             | A-6 & A-7 |
| Climb                    | to 4000                      |                     |              | 9903       | 23           | 1.5          | 1.5           | A-18      |
| Cruise                   | 4000                         | 24                  | 10 (HW)      | 9880       | 301          | 48.5         | 28            | A-26      |
| TOT                      | 2000                         | 28                  |              | 9579       | 493          |              | 39            | A-26      |
| Climb                    | to 4000                      |                     |              | 8253       | 13           | 1            | 1             | A-18      |
| Cruise                   | 4000                         | 24                  | 10 (TW)      | 8240       | 284          | 49           | 21            | A-26      |
| Landing                  | 1000                         | 30                  | 10           | 7956       | 200          |              |               |           |

Fuel burned for mission 1142 lb. Reserve 200 lb.

Figure A-56. Gunship Mission Profile



## ALPHABETICAL INDEX

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