T.O. 1H-43(H)B-1

FLIGHT MANUAL

USAF SERIES HH-43B HELICOPTER

Commanders are responsible for bringing this publication to the attention of all Air Force personnel cleared for operation of subject aircraft.

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Dates of issue for original and changed pages are:

Original	0	22 Sep 66	Change	3	6 Feb 67
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*C Blank	5	1-19 thru 1-22	0	1-38	1
*Flyleaf-1 thru Flyleaf-2 Added	5	*1-23 thru 1-24	5	*1-38A	5
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*2-8	5				

SAFETY SUPPLEMENT SUMMARY

Safety Supplements are numbered as follows: T.O. 1H-43(H)B-1SS-1, SS-2, etc. The supplements you receive should follow in sequence and if you are missing, one, check the weekly Safety Supplement Index (T.O. 0-1-1-5A) to see whether the supplement was issued and, if so, is still in effect. It may have been replaced or rescinded before you received your copy. If it is still active, see your Publication Distribution Officer and get your copy. It would be noted that a supplement number will never be used more than once.

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NUMBER	DATE	SHORT TITLE	DISIPOSITION
1H-43(H)B-1SS-31	28 Sep 67	Ditching	Section III

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NUMBER	DATE	SHORT TITLE	DISPOSITION
1H-43(H)B-1S-7	11 Apr 67	Cargo Hook Loads	Sect V
1H-43(H)B-1S-8	26 May 67	Intercom, AN/A/C-10A	Sect I
1H-43(H)B-1S-9	15 Dec 67	DSAS Malfunction	Sect III
1H-43(H)B-1S-10	21 May 68	Rotor Brake Limitation	Sect V

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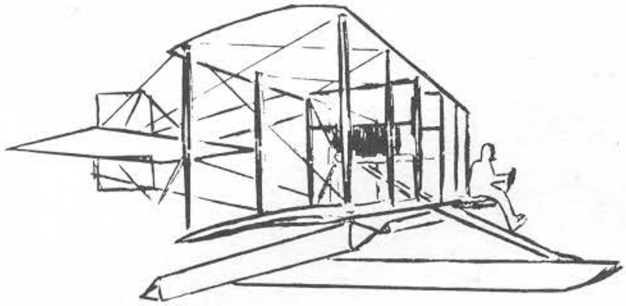

THE LATEST.... ABOUT YOUR AIRCRAFT IS PRINTED IN THIS MANUAL

SCOPE

This manual contains the necessary information for safe and efficient operation of the HH-43B. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided. Instructions in this manual are for a crew inexperienced in the operation of this aircraft. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS

The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from the Flight Manual Manager before any questionable operation is attempted which is not specifically permitted in this manual.

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to T.O. 0-1-1-5A which is issued weekly and devoted solely to the listing of current Flight Manuals, Safety of Flight Supplements, and Checklists. Its frequency of issue and brevity assures an accurate, up-to-date listing of these publications.

STANDARDIZATION AND ARRANGEMENT

Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into eight fairly independent sections to simplify reading it straight through or using it as a reference manual.

SAFETY OF FLIGHT SUPPLEMENTS

Information involving safety will be promptly forwarded to you by Safety of Flight Supplements. Supplements covering loss of life will get to you in 48 hours by TWX, and those concerning serious damage to equipment within 10 days by mail. The title page of the Flight Manual and the title block of each Safety of Flight Supplement should be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements – current supplements must be complied with but there is no point in restricting your operation by complying with a replaced or rescinded supplement.

CHECKLISTS

The Flight Manual contains only amplified checklists. Condensed checklists have been issued as separate technical orders – see the back of the title page for the T.O. number of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety of Flight Supplement affects the condensed checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page incorporating the supplement will be issued. This will keep handwritten entries of Safety of Flight Supplement information in your checklist to a minimum.

HOW TO GET PERSONAL COPIES

Each flight crewmember is entitled to personal copies of the Flight Manual, Safety of Flight Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel — it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Publication Requirements Table (T.O. 0-1-1). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS

Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Binders are also available for carrying your condensed checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4268, -4269, and -4270 for 15, 25, and 40 envelope binders respectively. Check with your supply personnel for assistance in securing these items.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "Warnings", "Cautions", and "Notes" found throughout the manual.

WARNING

Operating procedures, techniques, etc., which will result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

Note

An operating procedure, technique, etc., which is considered essential to emphasize.

YOUR RESPONSIBILITY — TO LET US KNOW

Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through your Command Headquarters to Hq WRAMA, Robins AFB, Georgia, Attn: WRNEO.

The HH-43B Helicopter

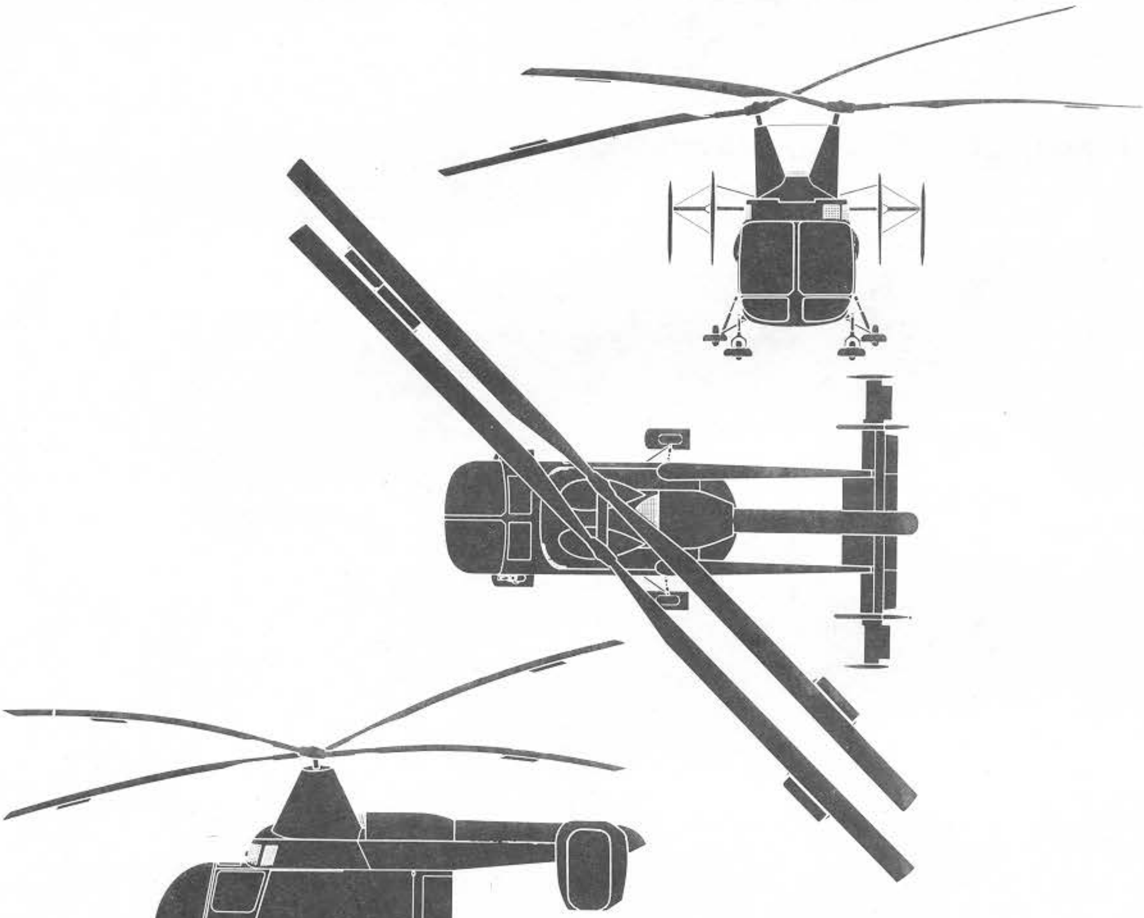

Figure 1—1

SECTION I

DESCRIPTION AND SYSTEMS OPERATION

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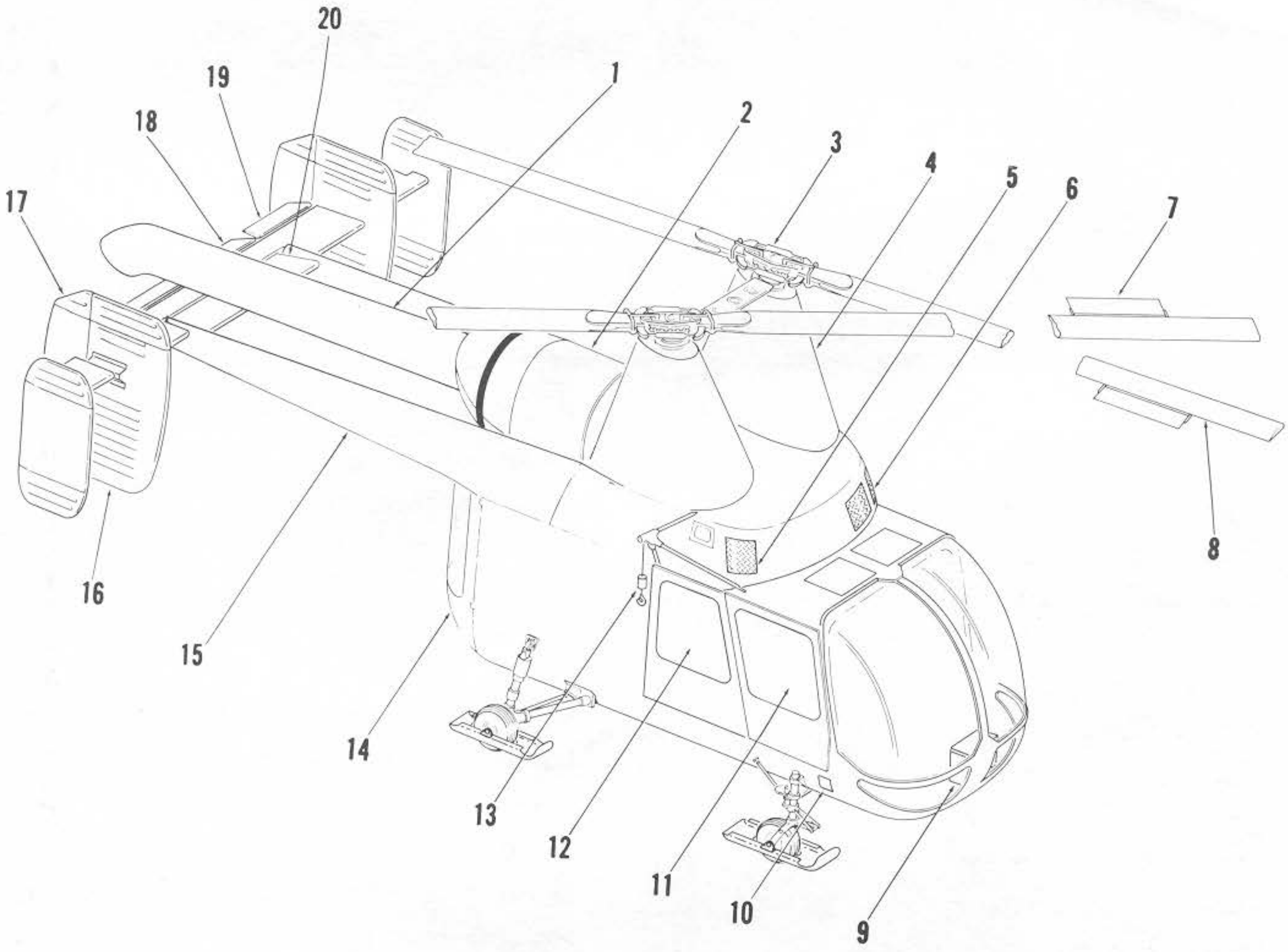
THE HELICOPTER

The U.S. Air Force Series HH-43B helicopter is manufactured by Kaman Aircraft Corporation, Bloomfield, Connecticut. It is a local crash rescue helicopter capable of rapid scramble and flight to a crash or other rescue site. With its auxiliary equipment, the helicopter can be used for aerial pickup of survivors, fire control and suppression, crash entry and survivor removal, and immediate first aid.

SPECIAL FEATURES.

The turbo-shaft engine is mounted above the cabin area between the twin tailbooms. (See figure 1—2.) Two intermeshing, two-blade rotors are mounted on twin pylons forward of and above the engine. Rotors are driven in counterrotation (eggbeater fashion) by the engine. Control of the rotors and, therefore, of the helicopter is obtained through blade flaps mounted on the rotor blades. Aerodynamic action of the flaps changes the pitch (angle of attack) of the rotors in response to the pilot's operation of conventional helicopter flight controls. Most of the energy required to make rotor pitch changes is supplied by the aerodynamic action of the flaps rather than by pilot-applied force. Additional control and stability are provided by the empennage. The empennage consists of horizontal tail surfaces with a fixed horizontal stabilizer, movable horizontal elevator and tabs, and four vertical fins. The fins are attached to the movable elevator. A rudder is attached to each inner vertical fin.

General Arrangement



1. EXHAUST PIPE
2. ENGINE COVER
3. ROTOR HUBS
4. PYLONS
5. OIL COOLER AIR OUTLET
6. OIL COOLER AIR INLET
7. BLADE FLAPS
8. ROTOR BLADES
9. BATTERY
10. EXTERNAL POWER RECEPTACLE
11. COCKPIT
12. CABIN
13. RESCUE HOIST
14. CLAMSHELL DOORS
15. TAILBOOMS
16. VERTICAL FINS
17. RUDDER
18. ELEVATOR STABILIZING TAB
19. ELEVATOR CONTROL TAB
20. HORIZONTAL STABILIZER

Figure 1—2

Compartment Diagram

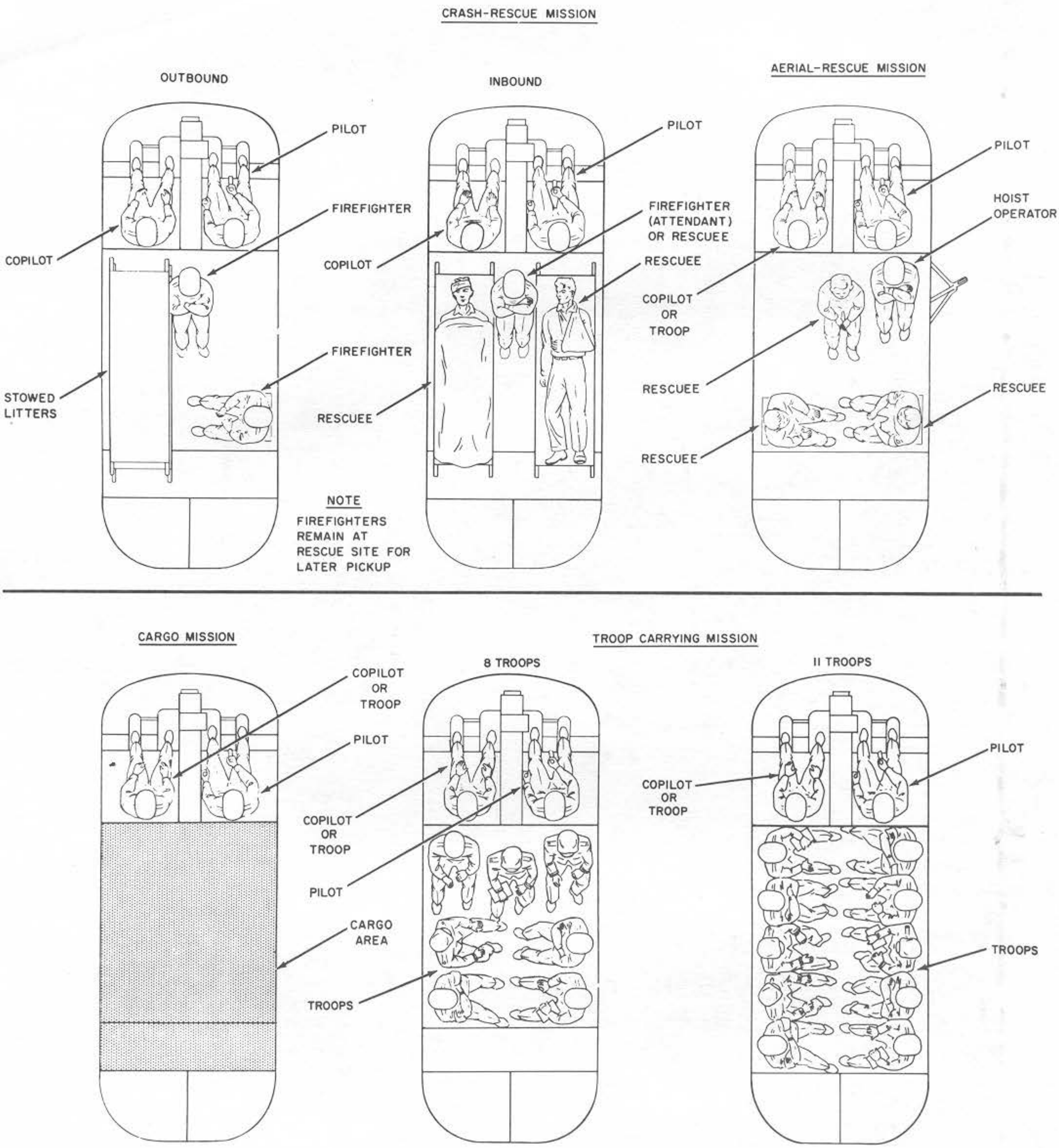
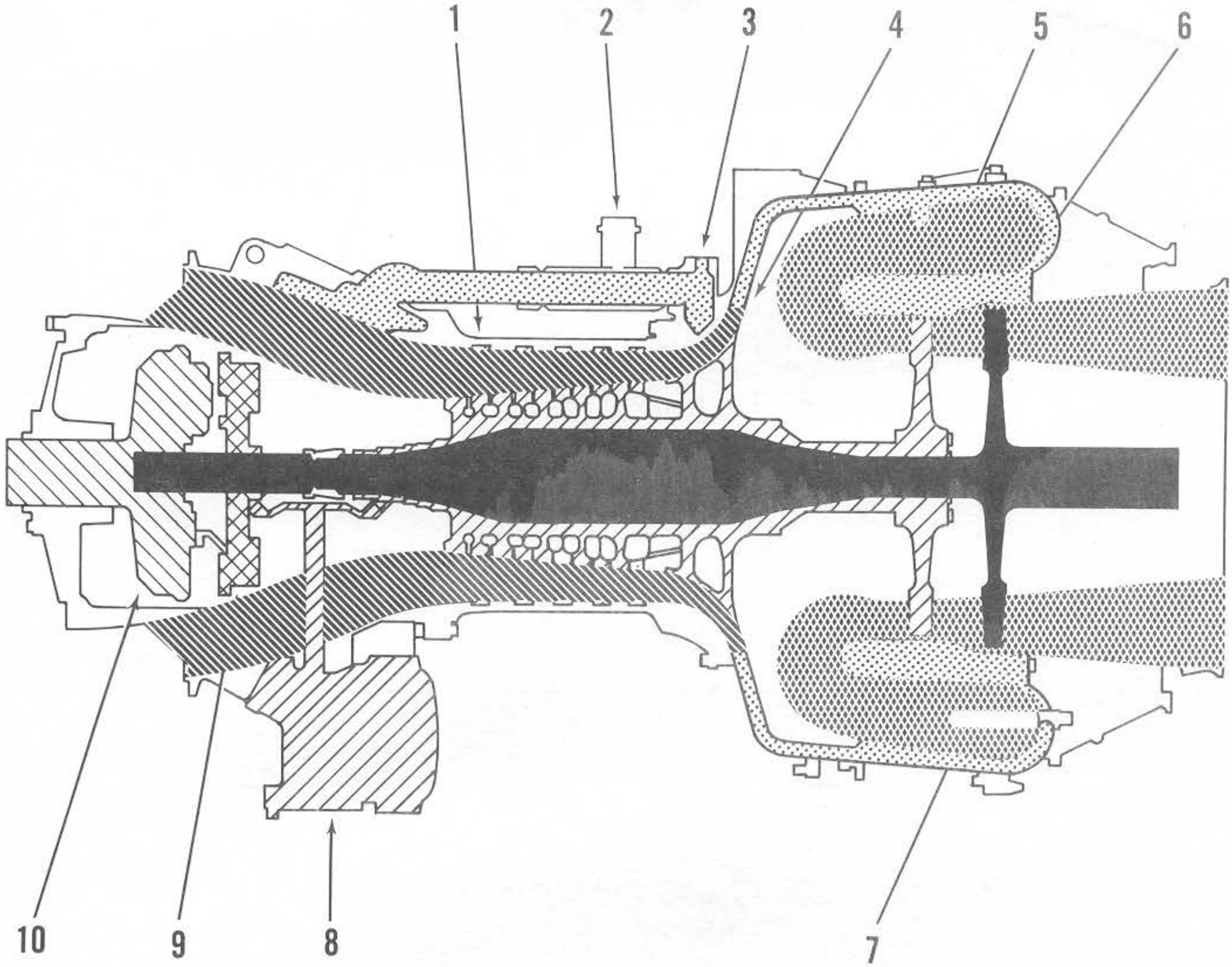


Figure 1—3

Engine



GAS PRODUCER & GAS PRODUCER ACCESSORY DRIVE
POWER TURBINE
REDUCTION GEARING & OUTPUT SHAFT
TORQUE MEASURING DEVICE
INLET AIR
COMPRESSED AIR
COMBUSTIBLE MIXTURE

1. AXIAL COMPRESSOR
2. ANTI-ICING VALVE
3. CABIN HEAT AIR BLEED
4. CENTRIFUGAL COMPRESSOR
5. COMPRESSOR DRIVING TURBINE
6. POWER TURBINE
7. FUEL VAPORIZERS
8. ACCESSORY GEARBOX
9. TORQUEMETER
10. OUTPUT GEARING AND OUTPUT SHAFT

Figure 1—4

CREW AND MISSION PROVISIONS.

Pilot's and copilot's seats and controls are at the right and left sides of the cockpit respectively. All controls and instruments are arranged for convenient operation and observation. For the crash rescue mission an attendant's seat and two litters may be installed in the cabin. (See figure 1–3.) With litters removed the cabin may be used to carry cargo, or as many as seven seats may be installed. A rescue hoist and an external cargo hook are provided.

HELICOPTER DIMENSIONS.

Approximate overall dimensions of the helicopter are as follows:

Length		
fuselage	25 feet	
rotors (operating)	47 feet	
Width		
empennage	15 feet	
main gear (overall)	9 feet	6 inches
main gear (between bear paws)	7 feet	2 inches
auxiliary gear (overall)	7 feet	1 inch
auxiliary gear (between bear paws)	4 feet	11½ inches
rotors (operating)	51 feet	6 inches
Height		
rotor hubs	12 feet	6 inches
rotor tips (in 45-degree position)	17 feet	
rotor tips (blades folded, fore and aft)	13 feet	6 inches
Turning radius	See figure 2-2 for turning radius and all ground clearances.	

HELICOPTER GROSS WEIGHT.

Approximate takeoff gross weight for a typical mission is 7900 pounds (including pilot, crew members and 1000-pound fire suppression kit). Refer to Section V and the Appendix for additional information on gross weight.

ENGINE

The helicopter is powered by a Lycoming T53-L-1B turbo-shaft engine (figure 1–4) installed between the tailbooms, above the cabin. The engine is made up of two main sections: the gas producer and the power turbine. The gas producer section mechanically drives the engine accessory gearbox, and provides hot gas to drive the power turbine. Air enters the engine and is compressed as it passes through a five-stage axial compressor and a centrifugal compressor. The compressed air passes through a diffuser to the combustion chamber, where it is mixed with starting fuel. Combustion is initiated by ignitor plugs. After starting, ignitor plugs and starting fuel are automatically shut off and metered fuel is supplied. Hot expanding gas leaves the combustion chamber and drives the gas producer turbine, which drives the compressors and accessory gearbox. Remaining energy from the expanding gas drives the power turbine, which drives the power output shaft to the transmission through reduction gearing at a speed of approximately ⅓ of the power turbine speed. Compressor discharge air is bled as required by engine anti-icing and the cabin heating and defogging systems. A spring-loaded blow-in door forward of the engine provides engine inlet air in the event the air inlet screen becomes obstructed by foreign object damage or ice.

ENGINE FUEL CONTROL SYSTEM.

The engine fuel control system (figure 1–5) provides automatic control of both engine gas producer speed (N_1) and engine output shaft speed (N_2) under all flight conditions, in response to any setting of the engine controls and flight controls chosen by the pilot. Both N_1 and N_2 are controlled by the fuel control unit, which varies the amount of fuel delivered to the engine fuel nozzles. The fuel control unit automatically prevents power changes from damaging the engine regardless of the rate and sequence in which they are applied. Fuel flow is automatically modified to compensate for changes in the temperature and pressure of the surrounding air. The upper limit of the N_1 range is established by the throttle, and N_2 is established by the engine speed governor switch. N_1 changes as required to maintain N_2 and, therefore, rotor speed at a nearly constant level. The N_1 governor prevents the engine from overspeeding. The fuel control contains a feedback system which provides for stable operation. To maintain constant output shaft speed with changing rotor loads, the N_1 is modified slightly. This is done by a direct mechanical linkage to the collective pitch lever. When operation is switched to emergency, none of the automatic features of the system is operative and all control is maintained by the throttle.

Engine Fuel Control Unit.

The engine fuel control unit (figure 1–5) is a hydro-mechanical device which contains the following basic elements: a two element gear-type main fuel pump, a solenoid controlled changeover valve (which selects either automatic or emergency fuel metering), automatic and emergency fuel metering valves, a stopcock, an N_1 governor, and an N_2 governor. Both speed governors act to position the automatic metering valve. Fuel from the supply system is delivered through the fuel control pump to the changeover valve. In automatic operation, this fuel flows through the automatic metering valve. The amount of fuel delivered to the engine is directly proportional to the opening of the metering valve. Metered fuel flows through the stopcock, which opens when the throttle is moved from CUTOFF to GROUND IDLE. During engine start, a minimum fuel pressure

Engine Fuel Control System

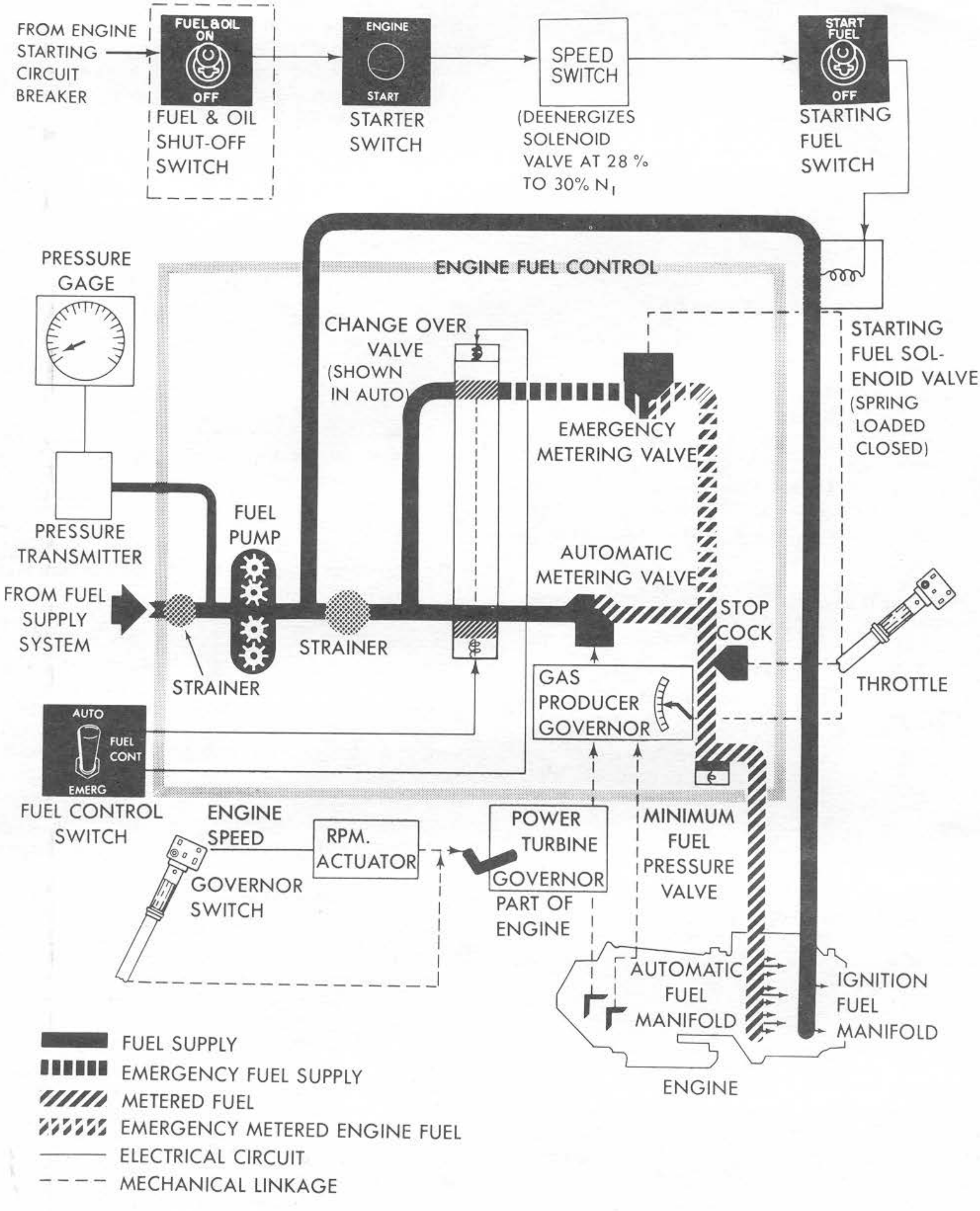


Figure 1—5

valve prevents fuel from flowing to the automatic fuel manifold until the fuel pressure is high enough to insure that the required amount of fuel has been delivered to the ignition manifold. Since the governors automatically prevent the engine from overspeeding, engine starts can be made in any throttle position except CUTOFF. In emergency operation the changeover valve delivers fuel to the emergency metering valve, and the throttle directly controls the flow of fuel to the engine.

ENGINE CONTROLS.

Pilot's Throttle.

The pilot's throttle (labeled POWER CONTROL) (2, figure 1–6), which is a twist grip on the pilot's collective pitch lever, is connected to the N_1 governor by mechanical linkage. Rotating the throttle to the left increases the maximum N_1 and, therefore, engine power. Rotated fully to the right the throttle is in CUTOFF. In this position, the fuel control unit stopcock is closed and no fuel can flow to the engine. Three labeled power settings are provided, GROUND IDLE (GRD IDLE), FLIGHT IDLE (FLT IDLE), and FULL OPEN. In emergency operation the throttle directly controls the position of the emergency fuel metering valve, and provides the only means of controlling engine power output. When the rotor brake is engaged, a locking plunger prevents the throttle from being advanced beyond GROUND IDLE.

Note

- Since starts are normally made with the rotor brake on, most starts will be made in GROUND IDLE.
- To reduce power setting below FLIGHT IDLE, it is necessary to slide throttle upward to clear interlock. This prevents inadvertent reduction of power below FLIGHT IDLE and GROUND IDLE.

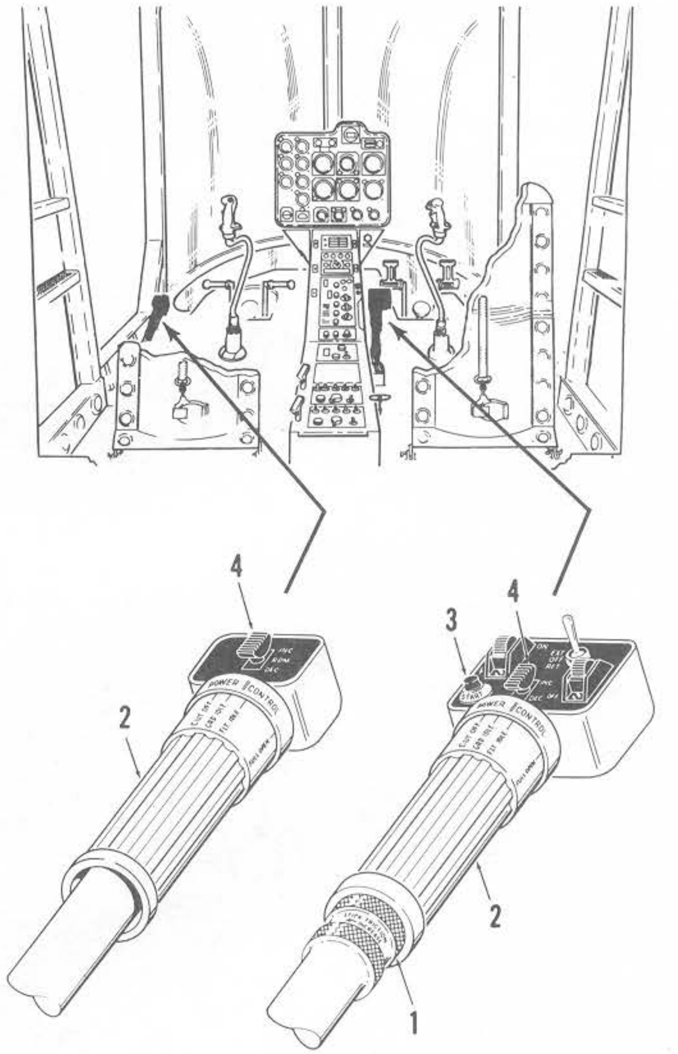
Copilot's Throttle.

The copilot's throttle is on the copilot's collective pitch lever and is connected to the same linkage as the pilot's throttle. The power setting cannot be reduced below FLIGHT IDLE with the copilot's throttle. Otherwise, it is operated in the same manner as the pilot's throttle.

Engine Speed Governor Switch.

An engine speed governor (labeled RPM) switch (4, figure 1–6) is on each collective pitch lever switchbox. The switch has three positions: OFF, INCREASE (INC), DECREASE (DEC), and is spring-loaded to OFF. The switch adjusts N_2 governor settings and, therefore, rotor speed by positioning the rpm actuator. The actuator changes the N_2 governor setting by direct mechanical linkage. Electrical power to operate the actuator is supplied from the essential bus through the engine

Collective Pitch Levers



1. COLLECTIVE FRICTION NUT
2. THROTTLE
3. STARTER SWITCH
4. ENGINE SPEED GOVERNOR SWITCH

Figure 1–6

speed control circuit breaker on the console circuit breaker panel (see figure 1–19).

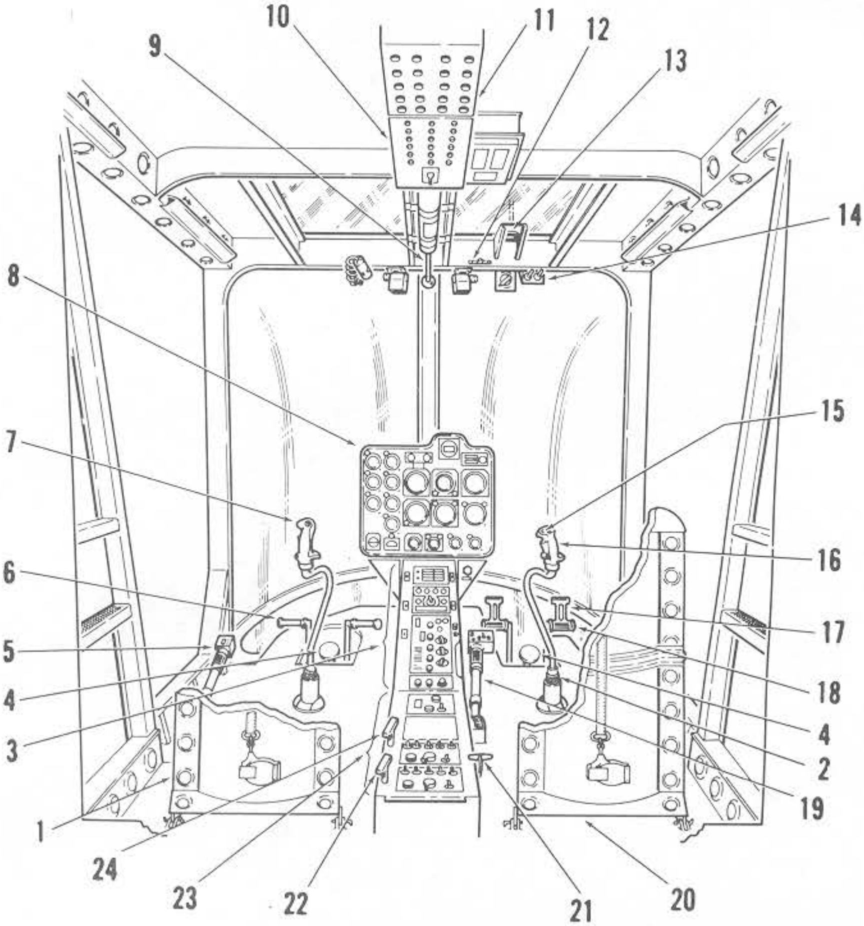
CAUTION

The pilot's engine speed governor switch does not override the copilot's. Since the two switches are connected in parallel, only one should be operated at a time. This will avoid the possibility of introducing opposite electrical signals that could damage the governor actuator circuits.

Fuel Control Switch.

The fuel control (FUEL CONT) switch (7, figure 1–8)

Cockpit



1. COPILOT'S SEAT
2. FRICTION NUT
3. UPPER CONSOLE
4. PEDAL ADJUSTING KNOB
5. COPILOT'S COLLECTIVE PITCH LEVER
6. COPILOT'S DIRECTIONAL PEDALS
7. COPILOT'S CYCLIC STICK GRIP
8. INSTRUMENT PANEL
9. ROTOR BRAKE LEVER
10. CEILING CIRCUIT BREAKER PANEL
11. FUSE PANEL
12. EMERGENCY FLOTATION GEAR HANDLE
13. OUTSIDE AIR THERMOMETER
14. ROTOR TRACK SWITCHES
15. TRIM RELEASE BUTTON
16. PILOT'S CYCLIC STICK GRIP
17. WHEEL BRAKE PEDALS
18. PILOT'S DIRECTIONAL PEDALS
19. PILOT'S COLLECTIVE PITCH LEVER
20. PILOT'S SEAT
21. MANUAL CARGO RELEASE LEVER
22. PARKING BRAKE HANDLE
23. LOWER CONSOLE
24. NOSE WHEEL LOCK HANDLE

Figure 1–7

is a two-position switch on the console. The switch is labeled AUTOMATIC (AUTO) and EMERGENCY (EMER). The switch actuates the solenoid controlled changeover valve in the fuel control unit (figure 1–5). When the switch is in AUTOMATIC, the changeover valve allows fuel to flow to the automatic metering valve only. With the switch in EMERGENCY, all fuel flows to the emergency metering valve. Electrical power to operate the solenoid controlled valve is supplied from the essential bus, through the fuel control circuit breaker on the console circuit breaker panel (figure 1–19). If electrical power fails, the valve will remain locked in the position it was in prior to the power failure.

WARNING

Avoid rapid movements of the collective pitch lever and throttle when the fuel control switch is in EMERGENCY. With the fuel control switch in EMERGENCY, the acceleration – deceleration limiter is not operative and overtemperature protection is not provided. Rapid movements of the throttle or collective pitch lever may cause compressor stall and result in engine failure.

ENGINE SPEEDS.

The term Engine Speed as used in this manual means engine output shaft speed (N_2).
The engine speed governor switch should be set to obtain full decrease during all ground operation, except when functionally checking the governor.

Note

Throughout this manual, procedures are described in terms of rotor speed except where engine speed is of primary importance.

Approximately 250 rpm rotor speed should be used for most powered flight, including partial power approaches. During critical operations, such as high airspeed, hovering at high gross weight, and at higher altitudes, it is desirable to increase rotor speed above 250 rpm. Refer to section VI and Appendix I for a detailed discussion of power management.

If the engine has been shut down for several hours, it is sometimes difficult to obtain maximum N_2. It is a characteristic of the governor that several minutes may be required before fuel flow will stabilize. During this time maximum rpm may be as low as 255 rpm. Maximum speed may be obtained sooner by cycling the governor a number of times through its rpm range. This is done by actuating the engine speed governor switch up and down through a number of cycles, or by hovering the aircraft and pumping the collective pitch lever up and down several times.

ENGINE COOLING.

Engine cooling is accomplished automatically and cannot be controlled by the pilot. The engine is cooled by airflow through internal passages.

ENGINE ANTI-ICING SYSTEM.

The engine is equipped with a non-continuous automatic anti-icing system. The system is controlled electrically and is capable of either manual control by the pilot or automatic selection from an ice detection unit. The anti-icing system is composed of three basic units: the ice detector, the interpreter and the hot air control valve.

Upon inception of icing, the ice detector will transmit an electrical signal to the interpreter, which will open the hot air control valve, permitting hot compressed air to flow from the engine compressor section to the inlet housing. Ice formation in the air inlet is inhibited by hot air passing through internal passages in the 9, 12 and 3 o'clock-position struts and the inlet guide vanes. Circulating hot oil provides protection to the inner housing wall and the 6 o'clock-position strut.

An anti-icing switch on the console electrically controls a caution light which alerts the pilot to the presence of engine ice. A thermo protective switch is incorporated in the circuitry to protect the probe from overheating. Electrical power to operate the system is supplied from the essential bus through two anti-icing circuit breakers (labeled ENG DE-ICE MANUAL, and ENG DE-ICE AUTO) on the console circuit breaker panel (figure 1–19).

Note

At engine shutdown an icing signal will be sensed and the caution light will glow due to the drop in air stream velocity. The thermo protective switch will protect against probe burn-out by deenergizing the probe heater and caution light 14-10 seconds after inception of the icing signal.

Operation In Automatic Mode.

Sensing. The ice detector operates on the principle of differential air pressures. The detector senses ice accumulation through a probe located in the engine air inlet. The probe has a series of six small diameter holes on its front and rear periphery. The air stream inlet velocity which affects the probe creates a differential pressure which causes the diaphragm, located in the detector, to deflect and actuate an electrical snap switch. The anti-icing system is now armed and ready to sense an icing condition.

De-icing. When an icing condition is encountered and the system is armed, ice forms on the probe which causes the pressure differential across the diaphragm to approach zero. As the diaphragm relaxes, the electrical snap switch is restored to its normal position which then energizes a power relay. The power relay lights the caution light and powers the probe heater. As the probe temperature rises above the freezing point the ice on it is shed, restoring the pressure differential across the diaphragm. The system now reverts to its sensitive or armed position. A 5-minute time delay device is used to hold the hot air valve open until icing conditions have ceased. The time delay prevents the continuous opening and closing of the hot air valve every time a new icing signal is sensed by the detector.

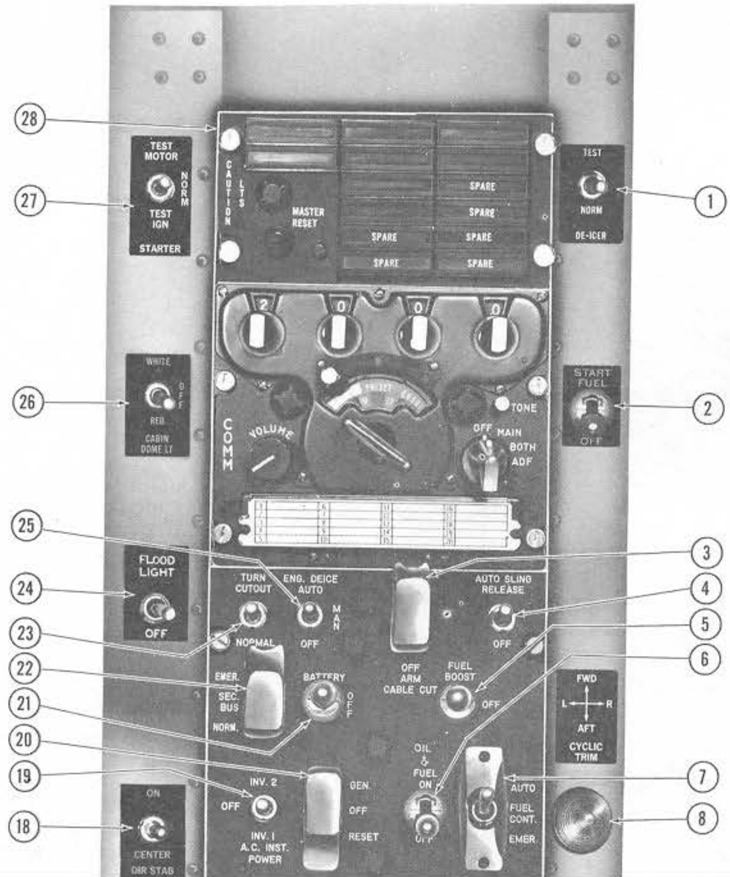
Operation In Manual Mode.

When the pilot places the anti-icing switch in the MANUAL (MAN) position, he merely overrides the automatic mode. When the anti-icing switch is in the MANUAL position, the engine receives continuous anti-icing air until the pilot places the switch in the OFF position.

Engine Anti-icing Switch.

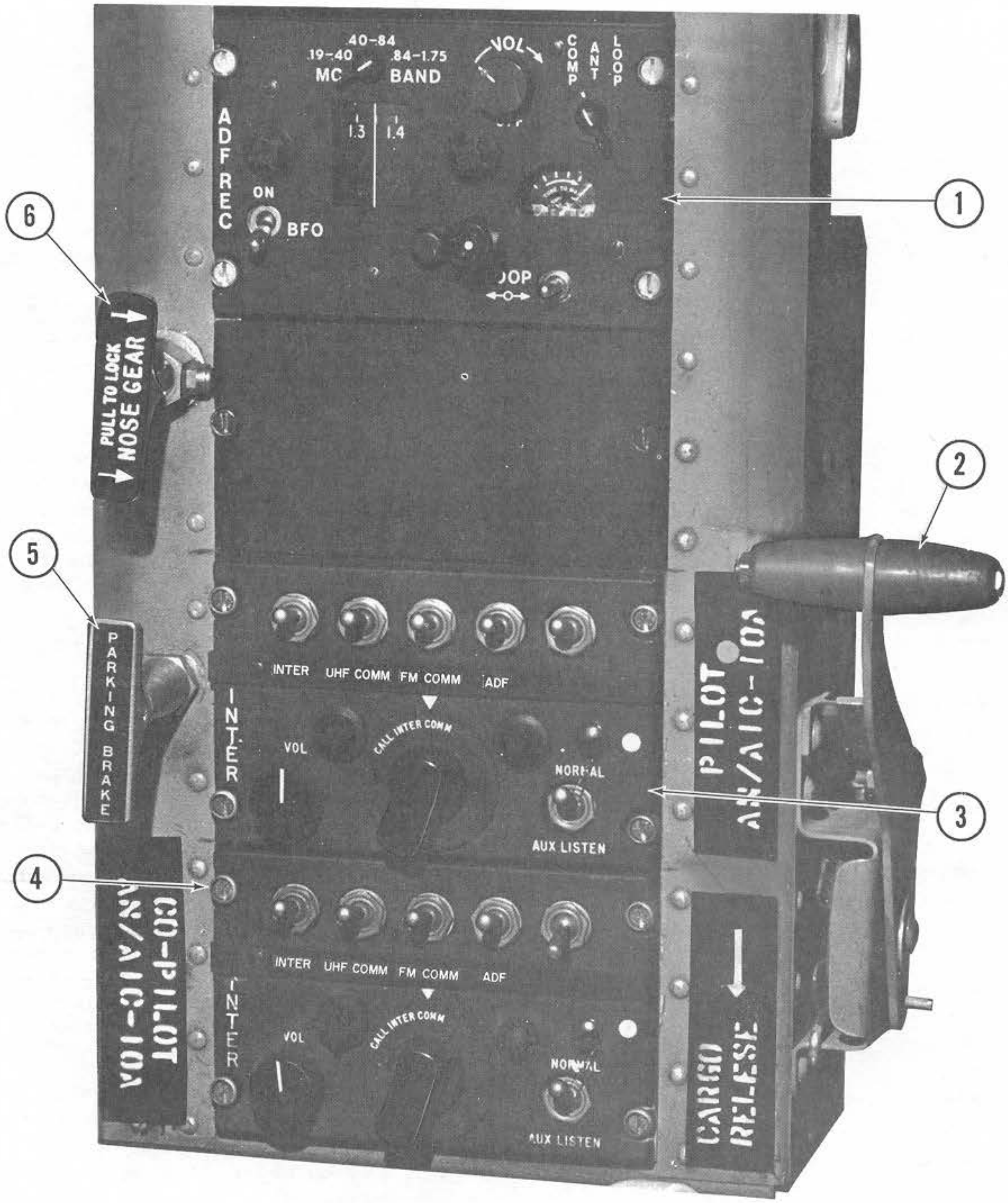
The engine anti-icing switch (labeled ENG DE-ICE; 25, figure 1–8) is a three-position switch on the console. Switch positions are AUTOMATIC (AUTO), MANUAL (MAN), and OFF. In AUTOMATIC, if icing occurs a hot air valve will open automatically, eliminating ice buildup. In MANUAL the valve remains open. In OFF the valve is closed. The valve is spring-loaded to open if electrical power fails.

Upper Console, Typical



1. ENGINE ANTI-ICING SYSTEM TEST SWITCH
2. STARTING FUEL SWITCH
3. CABLE CUTTER ARMING SWITCH
4. AUTOMATIC SLING RELEASE SWITCH
5. FUEL BOOST PUMPS SWITCH
6. FUEL AND OIL SHUTOFF SWITCH
7. FUEL CONTROL SWITCH
8. CYCLIC TRIM SWITCH
9. FLIGHT INSTRUMENT LIGHTS RHEOSTAT
10. ENGINE INSTRUMENT

Lower Console



1. AN/ARN-59 RADIO PANEL
2. CARGO RELEASE LEVER
3. PILOT'S INTERCOM CONTROL PANEL
4. COPILOT'S INTERCOM PANEL
5. PARKING BRAKE HANDLE
6. NOSE WHEEL LOCK HANDLE

Figure 1—9

Engine Ice Caution Light.

The engine ice caution light is on the caution light panel (figure 1–22). When icing is detected the light glows and the words ENGINE ICE appear. The light will flash as ice builds up and is removed. The rate of flashing will indicate approximate severity of icing. Rapid flashing indicates rapid ice accumulation and vice versa.

Note

- The master caution light will not glow when the engine ice caution light is on.
- If the caution light glows continuously for more than 20 seconds, it indicates that the automatic detection system is inoperative. The hot air valve is closed. The engine anti-icing switch should be placed to MANUAL to open the valve.
- The engine ice caution light will be on whenever electrical power is supplied and the engine is not operating.

Engine Anti-Icing System Test Switch.

The engine anti-icing system test switch (labeled DE-ICER; 1, figure 1–8) is on the console. When pressed to TEST (with engine operating), the engine ice caution light should glow to indicate the system is operative. If the light does not glow, the system is inoperative. When the switch is in NORMAL, the caution light will glow when icing is detected.

Functional Check.

To functionally check the system, proceed as follows:

1. Engine – Running.
2. Anti-icing switch – OFF.
3. Cabin heat switch – ON.
4. Defogging lever – ON.
5. Anti-icing switch – MANUAL.
   Velocity of defogging air should decrease noticeably.
6. Anti-icing switch – AUTO.
   Velocity of defogging air should increase noticeably.

ENGINE STARTING SYSTEM.

The engine starting system consists of an electric starting motor, engine ignitor plugs, starting fuel solenoid valve and starting and ignition electrical system. When the starter switch (3, figure 1–6) is pressed, the starting fuel solenoid valve opens, delivering fuel to the ignition fuel manifold. At the same time, the engine ignitor plugs and the starting motor are energized. When N_1 reaches 28-30 percent, a speed switch automatically de-energizes the ignitor plugs, the starting motor and the starting fuel solenoid valve, which closes. All fuel is then delivered to the automatic fuel manifold.

Note

The ignitor plugs will be energized at any gas producer speed as long as the starter switch is initially pressed and held, and is not released after the 28-30 percent cutoff speed is reached.

A switch at the base of the collective pitch lever prevents the system from operating when the throttle is in CUTOFF. Starts may be aborted at any time during the starting cycle by rotating the throttle to CUTOFF.

AF 60-289 AND SUBSEQUENT TCTO-617. In these helicopters electric power from the engine starting circuit breaker (see figure 1–5) is supplied to the engine starting system only when the fuel and oil shutoff switch is ON. The fuel and oil shutoff switch must be ON for all engine operation.

WARNING

AF 60-288 and previous. When the fuel and oil shutoff switch is OFF there may be sufficient fuel remaining in the lines on the engine side of the shutoff valve to permit an engine start and takeoff. However, after a few seconds of operation the engine will stop from lack of fuel. The fuel and oil shutoff switch should be ON for all engine operation.

Starter Switch.

The starter (labeled ENGINE START) switch (3, figure 1–6) is a spring return pushbutton on the pilot's collective pitch lever switchbox. The switch controls a relay that supplies electric power to the starter motor, and a relay that supplies power to the starting fuel solenoid valve and the engine ignitor plugs. The switch and the fuel solenoid valve and ignitor plug relay receive power from the essential bus through the engine starting circuit breaker on the console circuit breaker panel (figure 1–19). Because of the high current requirements of the starter, the starter motor circuit has no circuit breaker and the motor receives its current direct from the essential bus.

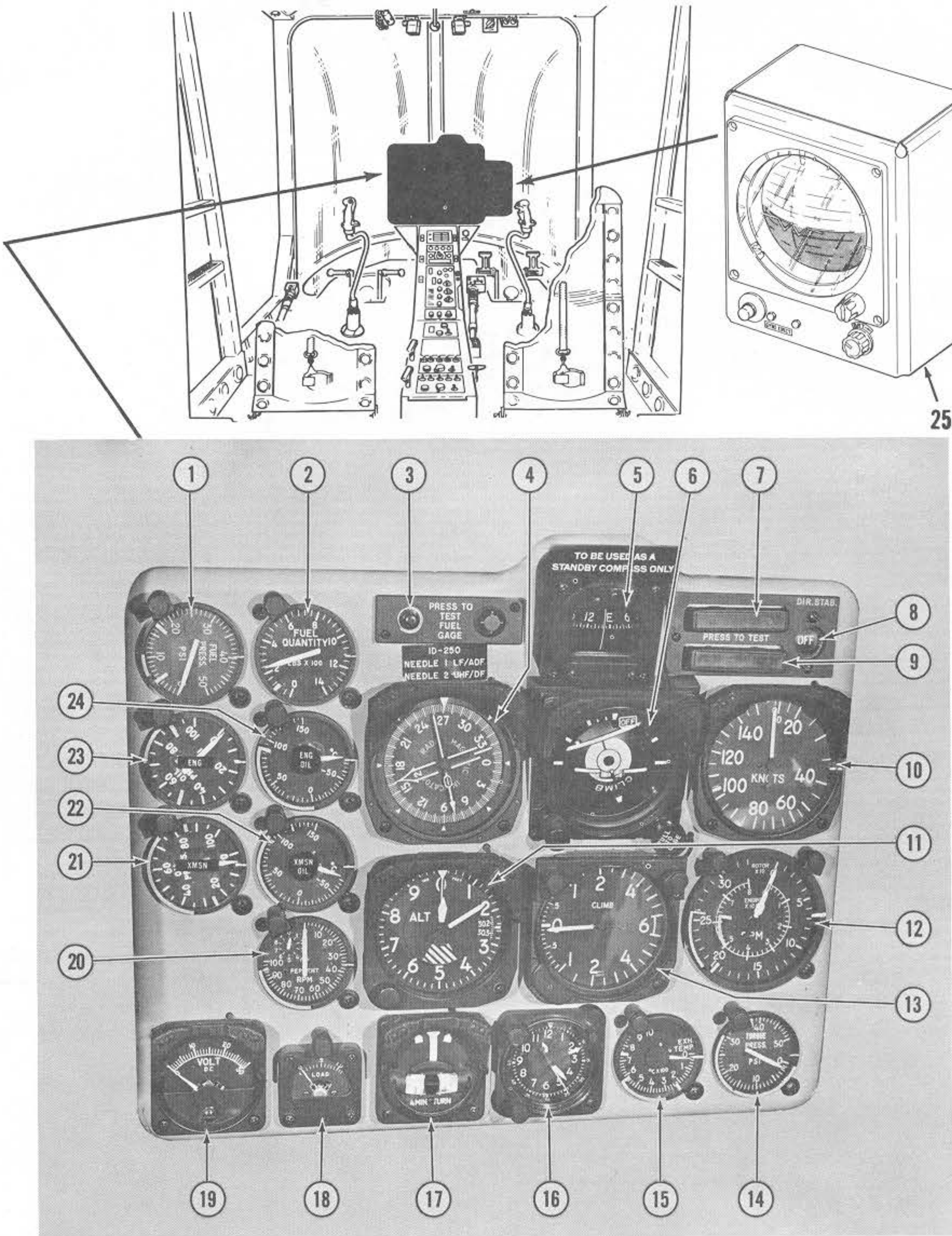
Starting Fuel Switch.

The starting fuel (START FUEL) switch (2, figure 1–8) is on the upper right side of the console. It has two positions: ON (START FUEL) and OFF. Electrically, it is connected between an internal speed switch and the starting fuel solenoid valve, enabling the pilot to shut off the starting fuel in the event of a hot start. Place the switch in the OFF position when it is necessary to avoid a hot start.

Starter and Ignition Test Switch.

The starter and ignition (labeled STARTER) test switch (27, figure 1–8) is on the console at the left of the

Instrument Panel, Typical



1. FUEL BOOST PRESSURE GAGE
2. FUEL QUANTITY GAGE
3. FUEL QUANTITY GAGE TEST BUTTON
4. RADIO MAGNETIC INDICATOR
5. MAGNETIC COMPASS
6. ATTITUDE INDICATOR
7. FIRE WARNING LIGHT
8. DIRECTIONAL STABILITY INDICATOR
9. MASTER CAUTION LIGHT
10. AIRSPEED INDICATOR
11. ALTIMETER
12. DUAL TACHOMETER (N_2)
13. VERTICAL VELOCITY INDICATOR
14. ENGINE TORQUEMETER
15. EXHAUST GAS TEMPERATURE GAGE
16. CLOCK
17. TURN AND SLIP INDICATOR
18. LOADMETER
19. VOLTMETER
20. GAS PRODUCER TACHOMETER (N_1)
21. TRANSMISSION OIL PRESSURE GAGE
22. TRANSMISSION OIL TEMPERATURE GAGE
23. ENGINE OIL PRESSURE GAGE
24. ENGINE OIL TEMPERATURE GAGE
25. ARU-14/A ATTITUDE INDICATOR

Figure 1—10

caution light panel. The switch has three positions: NORMAL (NORM), TEST MOTOR and TEST IGNITION (TEST IGN). The switch is used to test the operation of the starter motor or ignitor plugs and is spring-loaded to NORMAL. With the switch in NORMAL, pressing the starter switch will initiate a complete starting cycle. Placing the switch in TEST MOTOR energizes the starter motor without energizing ignitor plugs or starting fuel. Placing the switch in TEST IGNITION energizes the ignitor plugs only. If the circuit is operating properly, a snapping sound will be heard as the ignitor plugs are energized.

The switch is used by the pilot when exhaust gas temperature rises excessively during stopping of the engine. The switch is then moved to TEST MOTOR, which actuates the starting motor and increases air flow through the engine.

The TEST IGNITION position of the switch is used by maintenance personnel to aid in checking the system.

ENGINE INSTRUMENTS.

Gas Producer Tachometer.

The gas producer tachometer (20, figure 1–10) is on the lower left portion of the instrument panel and indicates gas producer speed (N_1) in percent. The large needle indication is read on a dial calibrated from 0 to 100 percent rpm in 2-percent increments. The small needle indication is read on a dial calibrated from 0 to 10 percent rpm in 1-percent increments. To determine N_1 to the nearest percent read the large needle in tens and add the units indicated by the small needle. Electrical power to operate the instrument is supplied directly by the N_1 tachometer generator, mounted on the engine accessory section. Refer to Section V for details of N_1 tachometer markings and applicable limits.

Dual Tachometer.

A dual tachometer (12, figure 1–10) is at the right side of the instrument panel, and indicates both engine output shaft speed (N_2) and rotor speed in rpm. The short needle indicates engine speed, and the long needle rotor speed. Yellow and black stripes on the center portion of the rotor needles are visible only when the needles split. Electrical power to operate the rotor needle is supplied by the rotor tachometer generator on the transmission. Power for the engine needle is supplied by the power turbine tachometer generator on the engine accessory section. Refer to Section V for dual tachometer marking details and applicable limits.

Engine Torquemeter.

An engine torquemeter (labeled TORQUE) (14, figure 1–10) is at the lower right corner of the instrument panel, and indicates power output in pounds per square inch (psi). The torquemeter is electrically powered from the 26-volt ac bus through the torquemeter pressure (TORQUE MTR PRESS) fuse, on the ceiling fuse panel (figure 1–19). Refer to Section V for torquemeter marking details and torque limits.

Exhaust Gas Temperature Gage.

The exhaust gas temperature (labeled EXH TEMP) gage (15, figure 1–10) is at the lower right side of the instrument panel, and indicates the temperature, in degrees centigrade, of the exhaust gases in the engine tailpipe, aft of the power turbine. The gage is electrically powered by engine thermocouples and is independent of the helicopter's electrical power supply system. Refer to Section V for details of exhaust gas temperature gage markings and temperature limits.

Engine Oil Pressure Gage.

The engine oil pressure (labeled ENG) gage (23, figure 1–10) is on the instrument panel, and indicates pressure of the oil delivered to the engine by the engine oil pump. This pressure is directed to a pressure transmitter which sends an electrical signal to the oil pressure gage. The gage is calibrated in pounds per square inch, each calibration mark representing 5 psi. The gage is electrically powered from the 26 volt ac bus, through the engine oil pressure gage (ENGINE OIL PRESS) fuse on the ceiling fuse panel (figure 1–19). Refer to Section V for engine oil pressure operating limits.

Engine Oil Temperature Gage.

The engine oil temperature (labeled ENG OIL) gage (24, figure 1–10) is on the instrument panel, and indicates the temperature of the oil delivered to the engine by the engine oil pump. A temperature sensing bulb at the pump detects the oil temperature, and the gage indicates this temperature in degrees centigrade. Each gage calibration mark represents 5° C. The gage is electrically powered from the essential bus, through the engine oil temperature (ENGINE OIL TEMP) circuit breaker on the console circuit breaker panel (figure 1–19). Refer to Section V for engine oil temperature operating limits.

Fuel Boost Pressure Gage.

The fuel boost pressure (FUEL PRESS) gage (1, figure 1–10) is at the upper left-hand corner of the instrument panel, and indicates the pressure of the fuel being delivered to the fuel control by the boost pumps. Fuel pressure is indicated in pounds per square inch and the gage is calibrated in 1-psi increments. Fuel from the boost pumps actuates a pressure sensitive transmitter, which sends an electrical signal to the fuel pressure gage. The gage is electrically powered from the 26-volt ac bus through the fuel pressure fuse, located on the ceiling fuse panel (figure 1–19).

Note

Below a pressure altitude of 4500 feet, the engine will continue to operate without the benefit of boost pressure, solely a result of suction developed by the engine driven fuel pump. Above 4500 feet, fuel pressure should be within normal range.

ENGINE FIRE WARNING LIGHT.

The engine fire warning (FIRE) light (7, figure 1–10) is a red light at the upper right corner of the instru-

Engine Oil Supply System

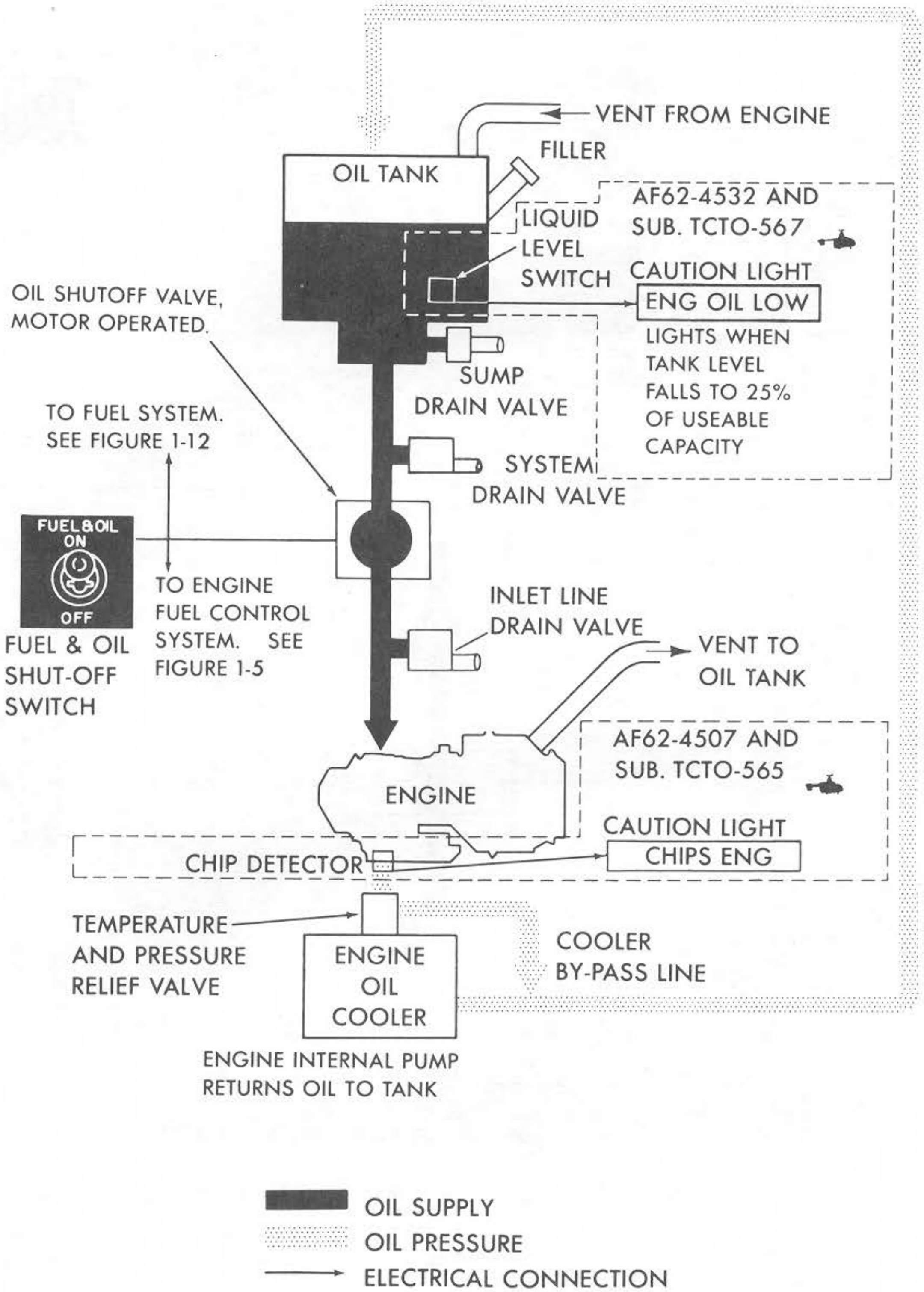


Figure 1—11

Fuel Supply System

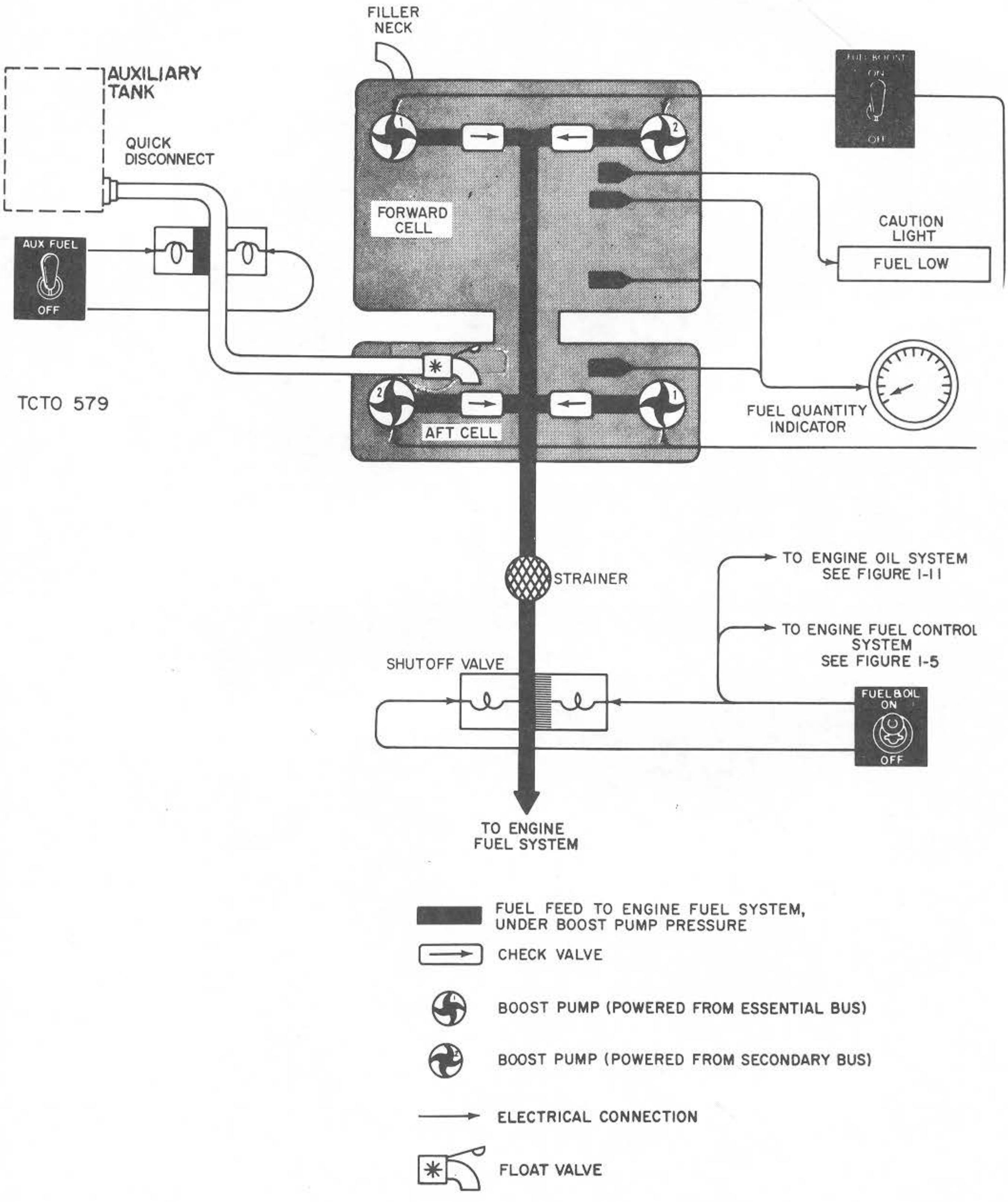


Figure 1—12

ment panel. It is actuated by a heat-sensitive electrical element which encircles the engine. The light will glow and the word FIRE will appear when the temperature in the engine compartment exceeds 400°F (204°C). The light acts as a test bar for the fire warning system. If the system is operating properly, the light will glow when it is pressed. It also may glow momentarily when the inverters are first turned on. Electrical power to operate the light is supplied from the 115 volt ac bus through the fire detector fuse on the ceiling fuse panel (figure 1–19).

ENGINE OIL SUPPLY SYSTEM

The engine oil supply system (figure 1–11) supplies cool, filtered oil to the engine. Oil from the tank is gravity-fed to the engine oil pump, mounted on the engine accessory gearbox. Scavenge oil collected in the accessory gearbox is delivered by the scavenge element of the engine oil pump through the cooler to the tank. A shutoff valve, controlled by the fuel and oil shutoff switch, prevents oil from draining into the accessory gearbox when the engine is shut down. (The fuel and oil shutoff switch is described in the **FUEL SUPPLY SYSTEM** paragraphs of this section.) If electrical power failure occurs, the valve will remain in the position it was in prior to the power failure. The engine oil tank has a usable capacity of 1.8 gallons and 0.8-gallon expansion space. The tank is mounted on the right side of the helicopter above the cabin side door.

The oil cooler is located in the lower pylon above the cockpit ceiling. Operation of the cooler is completely automatic and requires no controls. Cooling air is provided by the oil cooler blower, mounted next to the oil cooler and driven by the transmission. When engine oil temperature is high, a thermostatic valve in the cooler directs all scavenge oil through the cooler radiator. When the oil temperature is low, the valve allows a controlled portion of the scavenge oil to bypass the cooler and flow directly to the engine oil tank.

ENGINE CHIP DETECTOR CAUTION LIGHT, AF 62-4507 AND SUBSEQUENT TCTO-565.

The engine chip detector caution light is located on the caution light panel (figure 1–22). The light is amber and is connected to a magnetic chip detector plug located in the engine sump. An accumulation of metal particles on the magnetic plug will complete an electrical circuit causing the light to glow. The words CHIPS ENG will appear. The light receives electrical power from the essential bus through the caution light circuit breaker on the ceiling circuit breaker panel.

ENGINE OIL LOW CAUTION LIGHT, AF 62-4532 AND SUBSEQUENT TCTO-567.

The engine oil low caution light is located on the caution light panel (figure 1–22). The light is amber and is connected to a liquid level switch in the engine oil tank. The switch will close when oil level in tank falls to 25% of usable capacity, causing the light to glow. The light receives electrical power from the essential bus through the caution light circuit breaker on the ceiling circuit breaker panel.

OIL SPECIFICATION AND GRADE.

Refer to Servicing Diagram (figure 1–49).

FUEL SUPPLY SYSTEM

The fuel supply system (figure 1–12) consists of the fuel tank, boost pumps, filter, fuel shutoff valve and the system controls and indicators. Fuel is delivered by four boost pumps through the fuel filter and fuel shutoff valve to the inlet port of the engine fuel control unit. The fuel supply system is considered to end at the engine fuel control unit inlet. The fuel pressure gage, indicating pressure at this inlet, is described under **ENGINE INSTRUMENTS.** Engine fuel control system controls are described in the **ENGINE FUEL CONTROL SYSTEM** paragraphs of this section.

FUEL TANK.

A rubber fuel tank is located under the cabin floor. The tank consists of two interconnected bladder-type double sump fuel cells, which are not self-sealing. An electrically operated, submerged, self-relieving boost pump is provided in each of the four sumps. Check valves in each of the interconnecting boost pump lines permit fuel discharged by the boost pumps to flow only to the filter, preventing flow back into the sumps. The tank filler neck and cap (figure 1–49) are on the left side of the fuselage. See figure 1–13 for tank capacity and the amount of nonusable fuel.

FUEL QUANTITY GAGE.

A fuel quantity gage (2, figure 1–10) on the instrument panel is calibrated in 40-pound units and indicates the weight of fuel in the tank. The fuel quantity gaging system is a capacitance-type system and includes the gage and three tank units. The rear of the gage case contains an electronic amplifier that positions the needle in response to the capacitance value of the tank units. Since the capacitance value of the tank units is determined by both the level and density of the fuel, the position of the gage needle is determined by weight of the fuel. Electrical power for the system is obtained from the 115 volt ac bus, through the fuel quantity fuse on the fuse panel, and from the essential bus through the fuel quantity gage (FUEL QUANT GAGE) circuit breaker on the console circuit breaker panel (figure 1–19).

FUEL QUANTITY GAGE TEST BUTTON.

A fuel quantity gage test (labeled FUEL GAGE) button (3, figure 1–10) is located at the right of the fuel quantity gage on the instrument panel. When the button is pressed, the capacitance signal from the tank unit is cancelled and the gage needle should rotate counterclockwise toward the zero mark. The needle should rotate at a steady rate, as though fuel were being drained rapidly from the tank. After the needle has traveled a few degrees, the button should be released. The needle should then rotate clockwise at a steady rate, stopping at the original indication.

Fuel Quantity Data

	Pounds	Gallons*
Usable Fuel	1287	198
Nonusable Fuel	13	2

*1 gallon weighs 6.5 lbs on Standard Day

Figure 1–13

FUEL LOW CAUTION LIGHT.

A fuel low caution light is located on the caution light panel (figure 1–22). The light is amber and is electrically powered from the essential bus through the low fuel warning circuit breaker on the console circuit breaker panel (figure 1–19). The light is actuated by a fuel-level sensing unit mounted at a fixed height above the bottom of the forward fuel cell. Operation of the sensing unit is independent of the fuel quantity gaging system. Whenever fuel in the forward cell falls below the level of the sensing unit, the master caution light will glow and the words FUEL FLOW will appear on the caution light panel. The light calls attention to the fact that you are operating with low fuel. You should check the fuel quantity gage to determine actual quantity of fuel remaining in the tank.

CAUTION

When operating with low fuel, uncoordinated flight may cause the remaining fuel to slosh away from the sump, resulting in fuel starvation.

Note

Approximately 120 pounds (18.5 gallons) of fuel and 12 minutes of operation at maximum power remain when the fuel low caution light glows.

FUEL AND OIL SHUTOFF SWITCH.

A fuel and oil shutoff (labeled FUEL or OIL & FUEL) switch (6, figure 1–8) on the console controls both the fuel shutoff valve and the engine oil shutoff valve. In case of electrical power failure, both valves will remain as they were prior to power failure. Moving the switch to ON opens both valves. Moving the switch to OFF closes both valves. Electrical power is supplied to the valves from the essential bus, through the fuel and oil shutoff (FUEL & OIL SHUTOFF VALVE) circuit breaker on the console circuit breaker panel (figure 1–19).

AF 60-289 AND SUBSEQUENT TCTO-617.

In these helicopters the engine cannot be started unless the fuel and oil shutoff switch is ON. Refer to **ENGINE STARTING SYSTEM** paragraphs.

FUEL BOOST PUMPS SWITCH.

The fuel boost pumps (labeled FUEL BOOST) switch (5, figure 1–8) on the console controls four fuel tank boost pumps. When the switch is ON (FUEL BOOST), the pumps operate and deliver fuel to the engine fuel control unit. In the OFF position, pumps are inoperative. Electrical power to operate the left forward and right rear boost pumps is supplied from the essential bus; the right forward and left rear pumps receive electrical power from the secondary bus. Normally, the essential and secondary buses receive generator power. However, in the event of generator failure, the secondary bus will not receive battery power unless the secondary bus switch is placed in EMERGENCY. Refer to **ELECTRIC POWER SUPPLY SYSTEM** paragraphs in this section. Four fuel boost pump circuit breakers are located on the ceiling circuit breaker panel (figure 1–19).

FUEL SPECIFICATION AND GRADE.

Refer to Servicing Diagram (figure 1–49).

FUEL SUPPLY SYSTEM TCTO-579.

In aircraft modified by TCTO-579, the internal fuel cells are self-sealing, and provisions are installed for gravity transfer of fuel into the aft cell from an auxiliary tank located in the cabin. The self-sealing feature of the internal fuel cells reduces internal fuel capacity by about 3 gallons, from 198 gallons to 195 gallons. Fuel transfer from the auxiliary tank is regulated by a float operated valve in the aft cell, which allows fuel to flow when internal fuel is less than 153 gallons (approx.), and stops transfer when internal fuel rises above 153 gallons (approx.). In addition, a solenoid valve in the line can be opened and closed by the auxiliary fuel switch on the pilot's console. The solenoid valve requires electrical power both to open and to close. If power fails, the valve will remain in the last energized position. The valve receives electrical power from the essential bus through the auxiliary fuel (AUX FUEL) circuit breaker on the console circuit breaker panel.

Auxiliary Fuel Switch.

The switch is located on the pilot's console. The switch is labeled AUX FUEL OFF, and controls the electrically operated shutoff valve in the fuel line leading from the auxiliary tank to the main tank. When the switch is placed in the AUX FUEL position, the valve is opened (if the fuel level in the main tank is below 153 gallons) and fuel is permitted to flow by gravity from the auxiliary tank into the main tank. The valve will be closed and fuel flow will be stopped when the fuel level in the main tank reaches 153 gallons, or when the pilot moves the switch to OFF.

TRANSMISSION SYSTEM

The transmission system (figure 1–14) provides controlled application of engine power to the rotors. It consists of the engine-to-transmission drive coupling, the transmission (with an integral freewheeling clutch mechanism), and the rotor brake.

TRANSMISSION.

The transmission (5, figure 1–14) reduces rotor speed to approximately 1/24 of engine output shaft speed and synchronizes the rotors. The transmission drives the dc generator for the helicopter's electric power supply system and the rotor tachometer generator. Since the transmission operates on a fixed gear ratio, no operating controls are needed. Temperature and pressure gages are provided for the transmission lubricating oil system.

ROTOR BRAKE.

A hydraulic rotor brake (6, figure 1–14) is used to stop the rotors from freewheeling during ground operations, such as engine shutdown. The brake is a disc-type friction unit mounted on the transmission housing. The brake makes use of the mechanical advantage of the transmission reduction gearing in stopping the rotors. Application of the brake is controlled by the rotor brake lever which forces hydraulic pressure from a master cylinder, actuating the friction locking mechanism. At the same time, hydraulic pressure is directed to a throttle-locking plunger, which prevents the throttle from being advanced beyond GROUND IDLE when the rotor brake is engaged. The brake has its own oil supply, with the reservoir mounted on the brake at the highest point in the system.

CAUTION

To prevent excessive oil consumption and coking of No. 3 Bearing carbon seal, release of the rotor brake should be initiated as soon as possible after engine start but will not exceed one minute of engine operation.

Rotor Brake Lever.

The rotor brake lever (6, figure 1–15) is in the center of the cockpit ceiling, and is connected directly to the

Transmission System

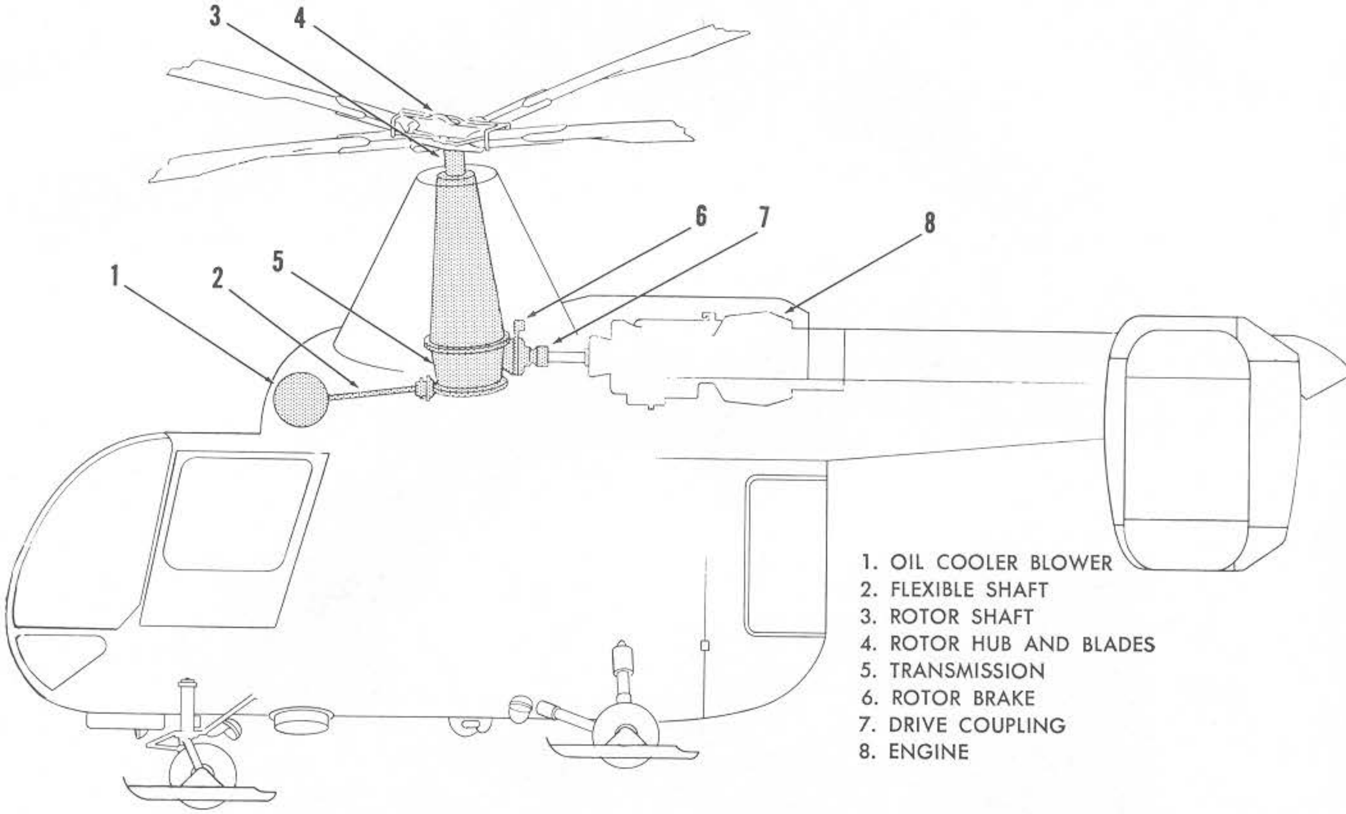


Figure 1–14

master cylinder. The ON position of the brake lever is aft, and OFF is forward. By pulling down and aft on the control lever, the brake may be applied with a controlled amount of pressure. Pulling the lever fully aft locks the brake ON. The brake is released by pulling the lever down and forward.

Rotor Brake Lever Locking Pin.

The rotor brake master cylinder is equipped with a spring-loaded locking pin (7, figure 1–15) which is normally held inoperative by an external spacer positioned under the head of the pin and lockwired in place. If it is desired that the pin be used the lockwire may be cut and the spacer removed. The pin must then be rotated until it moves inward. When the rotor brake lever is pulled fully aft the pin acts as a latch and prevents the lever from being moved forward again until the locking pin is pulled and rotated.

TRANSMISSION OIL SYSTEM

The transmission oil system (figure 1–16) consists of an external tank, a pump and a cooler. The oil tank has a usable capacity of 1.8 gallons, and 0.8 gallon expansion space. (See the servicing diagram, figure 1–49, for specification and grade of oil.) The oil pump, mounted on and driven by the transmission, contains three gear-type pumping elements. One pump element delivers oil under pressure to the transmission. Another element delivers oil under high pressure to the collective limiter and rudder lock hydraulic systems. The third element returns transmission scavenge oil to the oil tank through the oil cooler.

The transmission oil cooler is mounted above the cockpit ceiling. Operation is completely automatic and requires no controls. Cooling air is provided by a blower next to the cooler mounted in the lower pylon, and driven by the transmission. The blower furnishes cooling air for both the transmission and engine oil coolers. When transmission oil temperature is high, a thermostatic valve in the cooler directs all transmission scavenge oil through the cooler radiator. When oil temperature is low, the valve allows a controlled portion of the oil to bypass the cooler and flow directly to the transmission oil tank.

TRANSMISSION OIL PRESSURE GAGE.

A transmission oil pressure (labeled XMSN) gage (21, figure 1–10) is at the left side of the instrument panel, and indicates transmission oil pressure in pounds per

Cockpit Ceiling

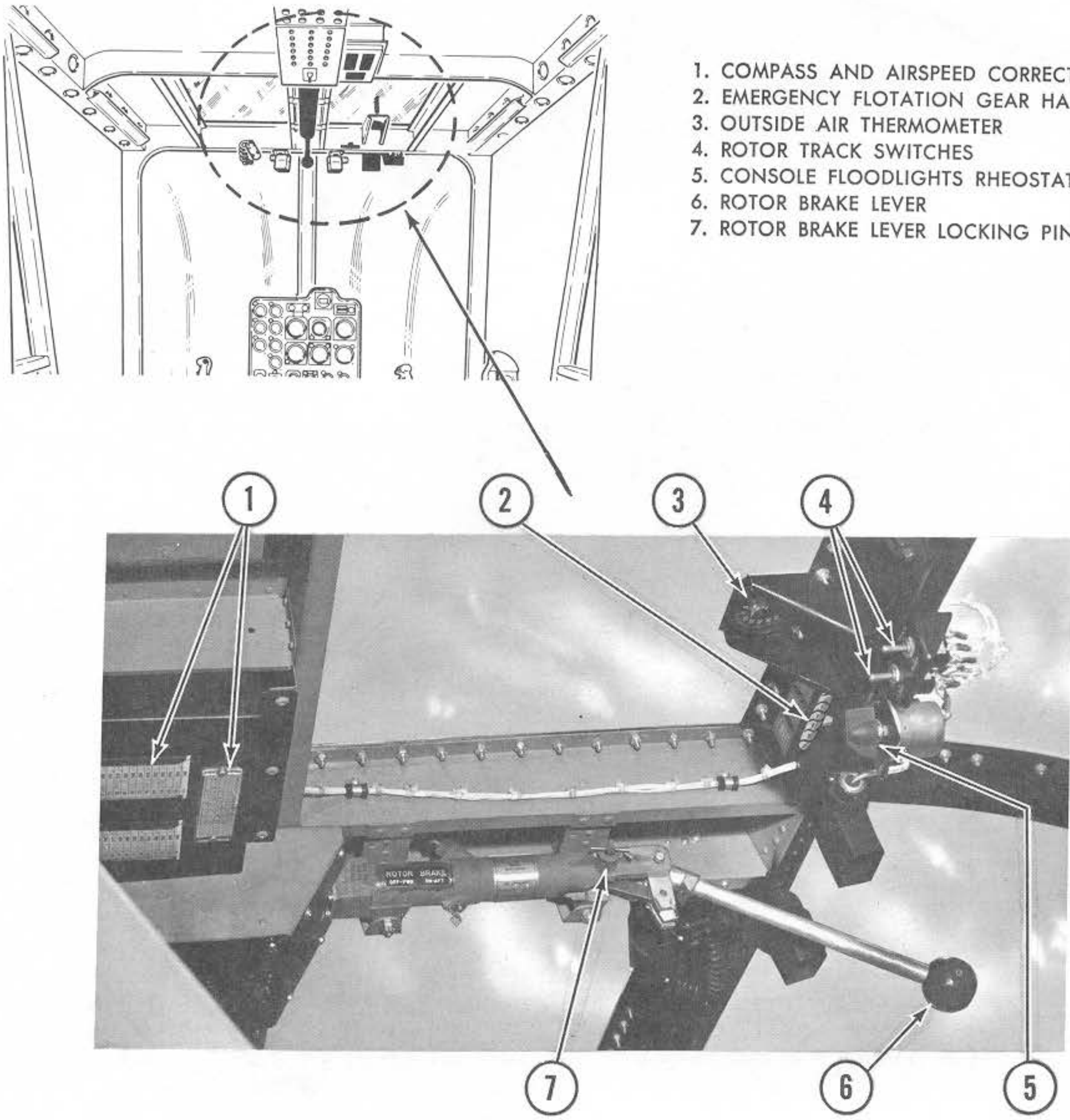


Figure 1—15

square inch. Each calibration mark represents 5 psi. Transmission oil pump discharge pressure is directed to a pressure sensing transmitter, which sends an electrical signal to the gage. The gage is powered from the 26 volt ac bus through the transmission oil pressure gage (XMSN OIL PRESS) fuse on the fuse panel (figure 1—19). Refer to Section V for operating pressures.

TRANSMISSION OIL PRESSURE CAUTION LIGHT.

A transmission oil pressure caution light is on the caution light panel (figure 1—22) at the forward end of the console. The light is amber colored, and is electrically powered from the essential bus, through the transmission oil pressure warning (XMSN OIL PRESS WARN) circuit breaker on the ceiling circuit breaker panel (figure 1—19). The light is controlled by a pressure sensitive switch acted upon by the same pressure that acts upon the transmission oil pressure gage. When transmission oil pressure falls below the minimum, the light glows and the words TRANS OIL PRESS appear. (Refer to Section V.)

TRANSMISSION OIL TEMPERATURE GAGE.

A transmission oil temperature (labeled XMSN OIL) gage (22, figure 1—10) is at the left center of the instrument panel, and indicates transmission oil temperature in degrees centigrade. Each calibration mark represents 5° C. Transmission oil pump discharge temperature is detected by a temperature sensitive bulb which elec-

Transmission Oil System

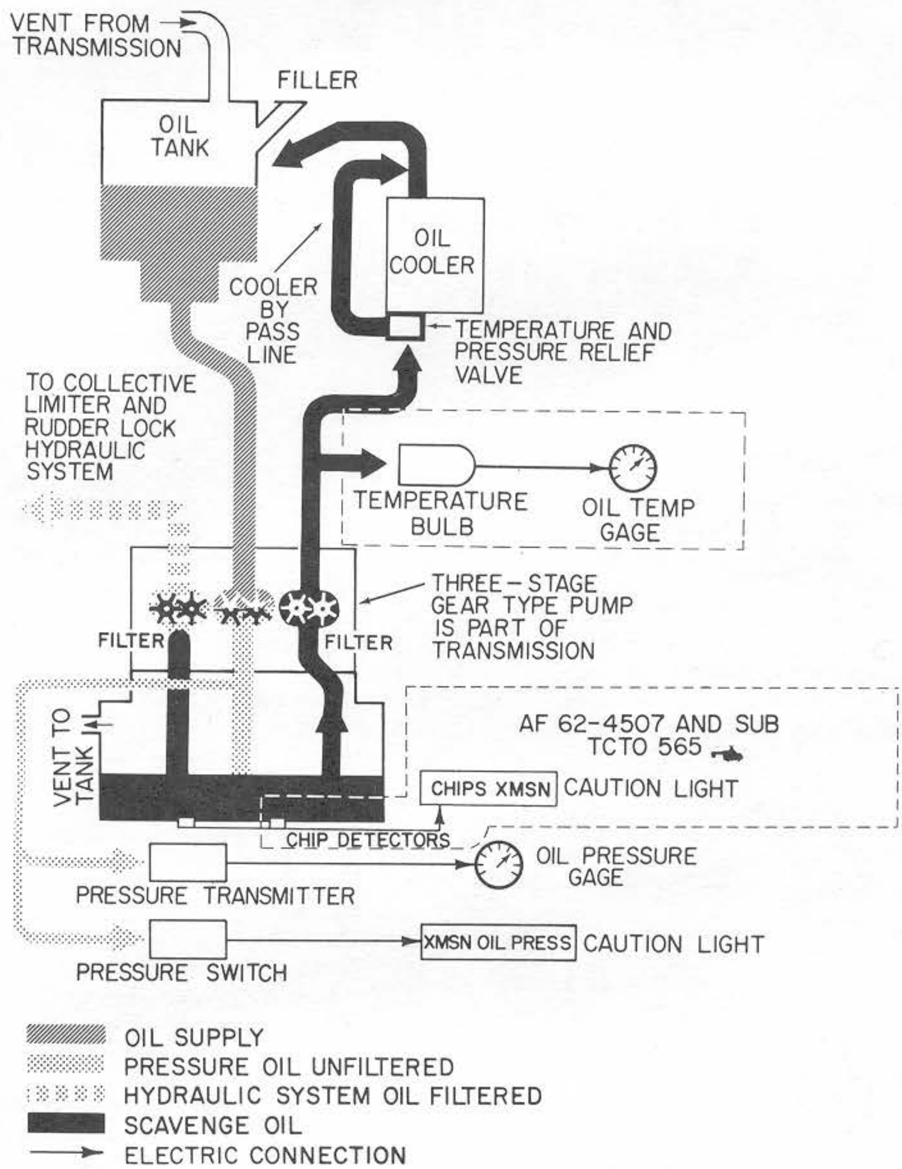
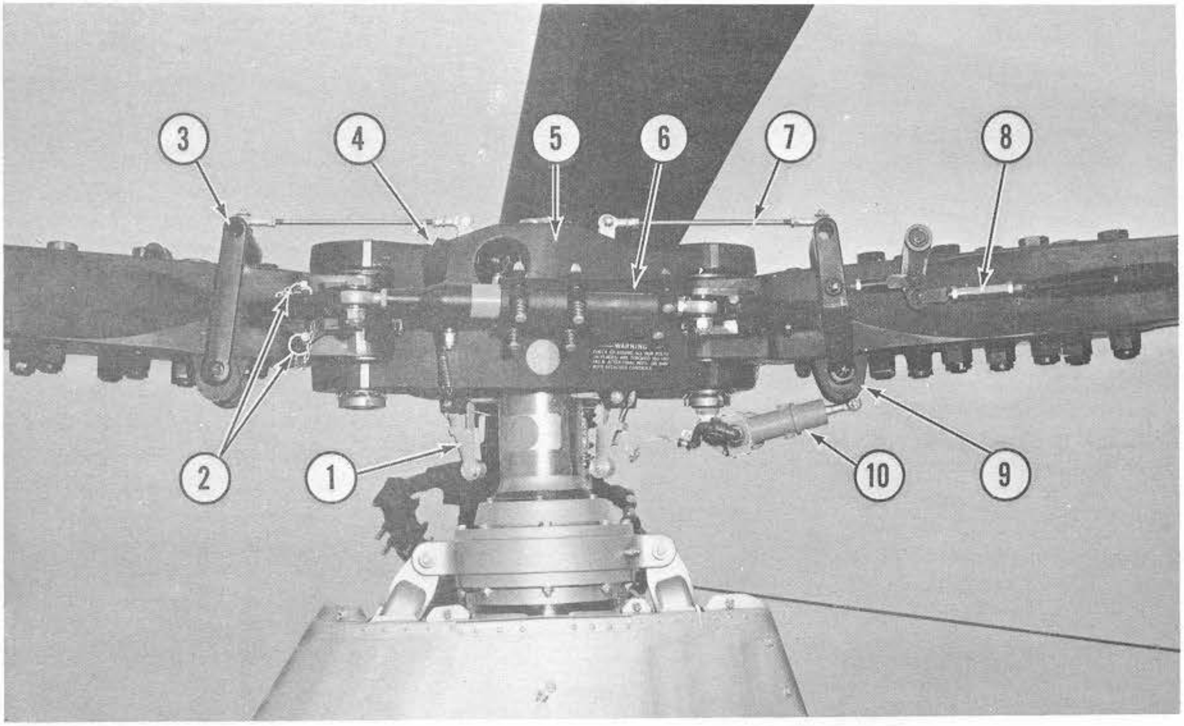


Figure 1—16

trically positions the gage needle. The gage is electrically powered from the essential bus through the transmission oil temperature gage (TRANS OIL TEMP) circuit breaker on the console circuit breaker panel (figure 1—19). Refer to Section V for operating limits.

TRANSMISSION CHIP DETECTOR CAUTION LIGHT, AF 62-4507 AND SUBSEQUENT TCTO-565. The transmission chip detector caution light is located on the caution light panel (figure 1—22). The light is amber and is connected to a magnetic chip detector plug located in the transmission sump. An accumulation of metal particles on the magnetic plug will complete an electrical circuit causing the light to glow. The words CHIPS XMSN will appear. The light receives electrical power from the essential bus through the caution light circuit breaker on the ceiling circuit breaker panel.

Rotors



1. DROOP STOP
2. LEAD STOP LOCKPIN (IN SECURED POSITION)
3. U-CRANK
4. BLADE FOLDING LOCK (IN STOWED POSITION)
5. HUB
6. BLADE DAMPER
7. HUB-TO-BLADE CONTROL ROD
8. TRACKING TURNBUCKLE
9. BLADE GRIP
10. IN-FLIGHT TRACKING ACTUATOR

Figure 1–17

ROTOR SYSTEM

The rotor system consists of two semi-articulated counter rotating rotors. Each rotor has two blades and a hub. Blades are constructed of various kinds of wood, fiberglass, aluminum and stainless steel, with a fabric covering. Each blade is attached to its hub by a vertical lead-lag pin. Rotors are driven by hollow drive shafts extending down through the pylons to the transmission output shafts. Each rotor hub is attached to its drive shaft by a horizontal teeter pin. Droop stops (1, figure 1–17) prevent excessive teetering of blades during blade starts and stops. At rotor speeds of approximately 99 to 104 rpm and higher, droop stops automatically move out by centrifugal force acting on their flyweights. Mechanical friction dampers are installed between the two blades of each rotor to prevent excessive lead-lag oscillation of blades.

ROTOR SYSTEM CONTROL.

Rotor blade pitch changes are accomplished through blade flaps attached to the outboard trailing edges of the blades. Aerodynamic action of the flaps changes blade pitch by twisting the blades. Blades do not pivot at the hub. Blade pitch is controlled by the collective pitch lever, the cyclic stick and the directional pedals, all of which are connected to the flaps by direct mechanical linkage.

ROTOR BLADE FOLDING.

The rotor blades can be folded to reduce width required for storage of the helicopter. In the folded position, all blades are aligned parallel to the longitudinal axis of the helicopter.

CAUTION

The flight controls should not be moved while the rotor blades are folded. Failure to observe this caution can damage the hub-to-blade control rods.

Prior to flight, the blades must be extended.

The lead stops and lag stops should be in flight position and secured with their lockpins (2, figure 1–17). The blade folding locks (4, figure 1–17) should be in the stowed position.

ROTOR TACHOMETER.

Rotor rpm is indicated by the rotor needle of the dual tachometer (12, figure 1–10), described under **ENGINE INSTRUMENTS** in preceding paragraphs of this section.

ELECTRIC POWER SUPPLY SYSTEM

The electric power supply system (figure 1–18) provides 28-volt direct current and 115-volt, 400-cycle, 3-phase alternating current and 26-volt, 400-cycle, 1-phase alternating current to operate the various electric and electronic components of the helicopter. The electric power supply system is considered to end at the buses which supply the circuit breakers and fuses. The circuit breakers and fuses are considered to be a part of the using systems which they serve.

DIRECT CURRENT POWER SUPPLY.

The primary source of 28-volt dc power is the 300-ampere generator. The generator is driven by the transmission and delivers power only when rotor speed is above 89 rpm. An external power receptacle provides for connecting an external source of 28-volt dc power for engine starting or ground testing of electrical equipment. A 34 ampere-hour battery provides 24-volt (full charge) dc power for engine starting when external power is not available, and for operation of essential electric equipment during emergencies resulting from failure of the generator. The dc power is distributed through a dual bus system, consisting of an essential and a secondary bus. When the generator or external power source is supplying dc power, both essential and secondary buses are energized. When the battery alone is supplying dc power, the secondary bus is automatically discontinued from the battery by the secondary bus relay. This conserves battery energy for operation of essential equipment. However, a secondary bus switch is provided to override automatic control so that, when desired, equipment supplied from the secondary bus can be operated with battery power.

Battery.

The fully enclosed battery (9, figure 1–2) is installed in the forward center area of the cockpit. Battery gases are vented overboard through rubber hose vent lines.

Battery Switch. The battery switch (21, figure 1–8) on the console controls the battery relay. The switch has two positions: ON (BATTERY) and OFF. With the switch ON, the battery relay closes and the essential bus is supplied with battery power.

Note

Approximately 18 volts are necessary to energize the relay. When the battery switch is ON, rotors not operating and external power not connected, dc generator and master caution lights should glow. If neither of these lights glows, it is probable that the battery voltage is too low to close the relay. Therefore, if the aircraft is started on external power with the battery under 18 volts, the generator will not charge the battery in flight. Once a landing is made and engine shutdown is completed, a restart may be impossible if external power is not available.

Generator.

The generator charges the battery and supplies power to operate all electric and electronic equipment. The generator voltage regulator automatically controls the generator field current to maintain the desired generator output voltage. The generator reverse current relay automatically opens the circuit from the generator to the essential bus when battery voltage is greater than generator voltage. This prevents discharge of the battery through the generator, with resultant damage to both. The generator field and overvoltage relays protect the generator from excessive loads by automatically disconnecting the generator.

Generator Switch. The generator (GEN) switch (20, figure 1–8) is a guarded switch located on the console. It controls the flow of generator current to the essential bus. The switch has three positions: ON (GEN), OFF, and RESET. The RESET position is spring-loaded so that when the generator switch is pushed to RESET and released, it will automatically return to OFF. When the switch is placed ON, it completes the generator output circuit to the reverse current relay. RESET position is used to attempt to restore generator power to the system if the generator caution light is on. The switch should be held in RESET, momentarily, then moved to ON. If the light goes out, the system has returned to normal. Power to operate the switch is supplied from the essential bus through the generator control circuit breaker on the console circuit breaker panel (figure 1–19).

Generator Caution Light. The generator caution light is amber and is located on the caution light panel (figure 1–22). Power for the light is supplied from the essential bus through the generator caution light circuit breaker on the console circuit breaker panel (figure 1–19). The light is controlled by the reverse current relay. When the relay is open, the light glows and DC GEN will appear indicating that the generator is not supplying current to the bus.

Loadmeter and Voltmeter. The loadmeter (labeled LOAD) and the voltmeter (labeled VOLT) (18 and 19, figure 1–10) are located at the lower left-hand corner of the instrument panel. Since they are connected to the generator side of the reverse current relay they indicate generator output. They are inoperative when power is supplied by the battery or an external source. These meters serve primarily to aid maintenance personnel in trouble shooting. The generator is automatically protected from under-voltage or over-voltage damage. All installed electrical equipment normally can be operated at the same time without exceeding the generator rated output of 300 amps (1.0 load).

Electric Power Supply, Typical

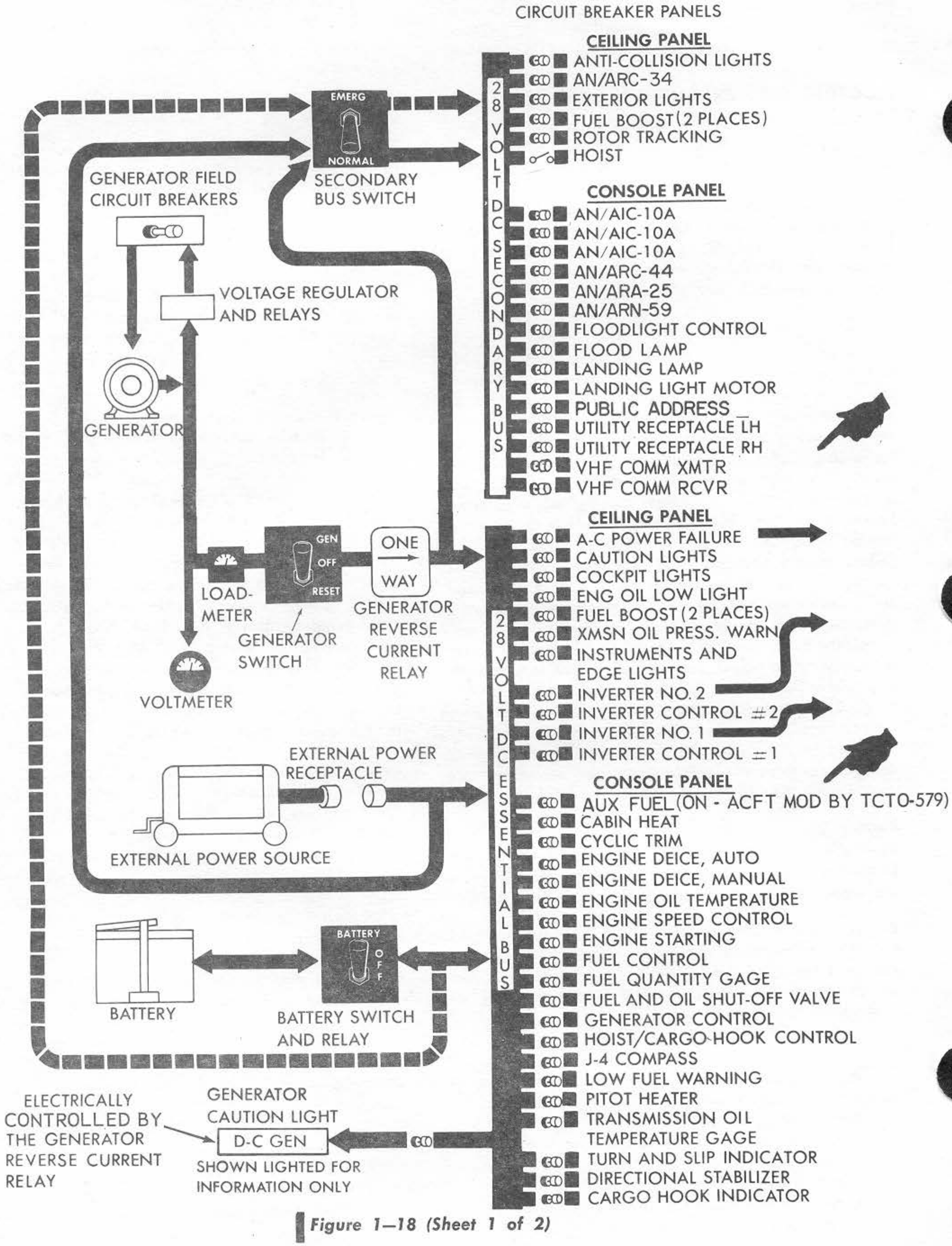


Figure 1–18 (Sheet 1 of 2)

Electric Power Supply

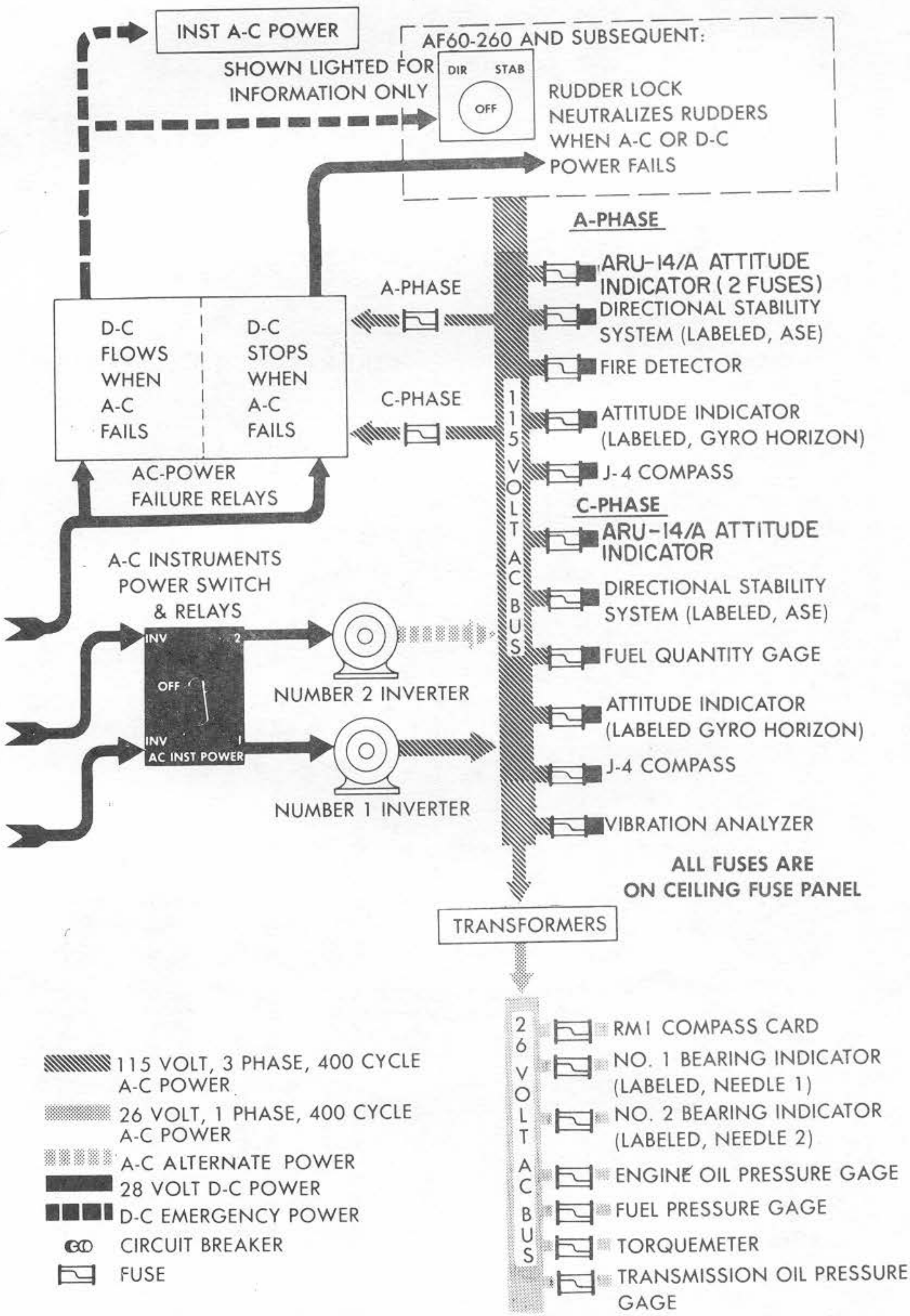
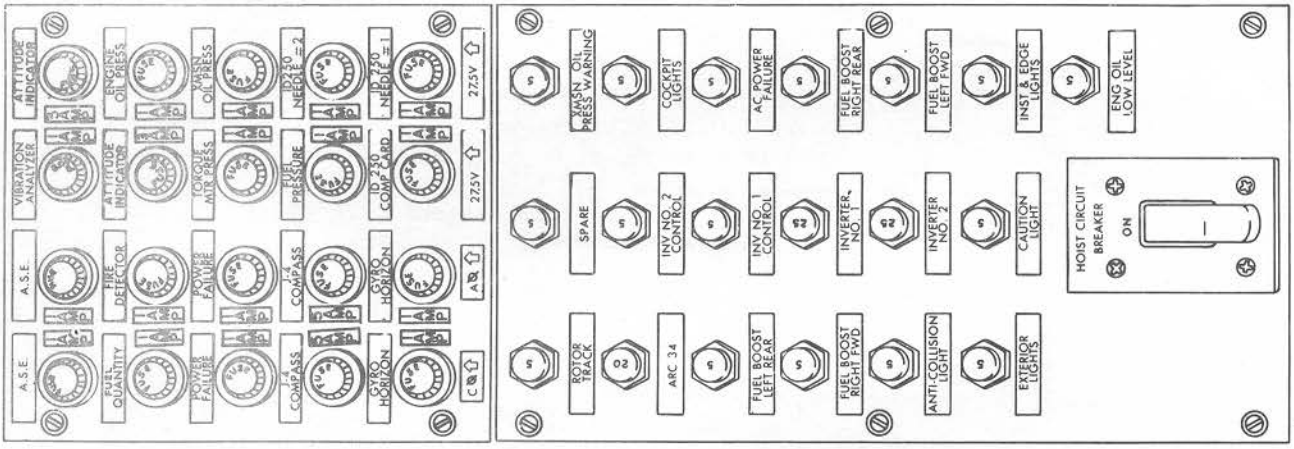


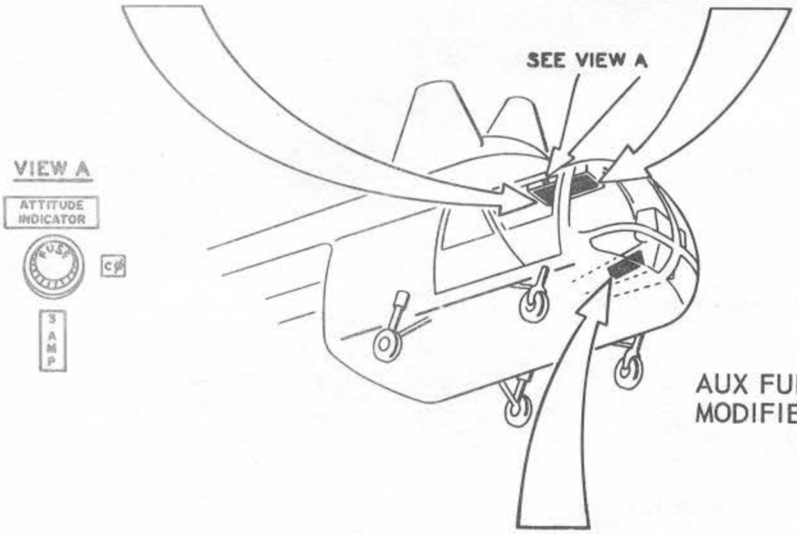
Figure 1—18 (Sheet 2 of 2)

Circuit Breakers and Fuses, Typical



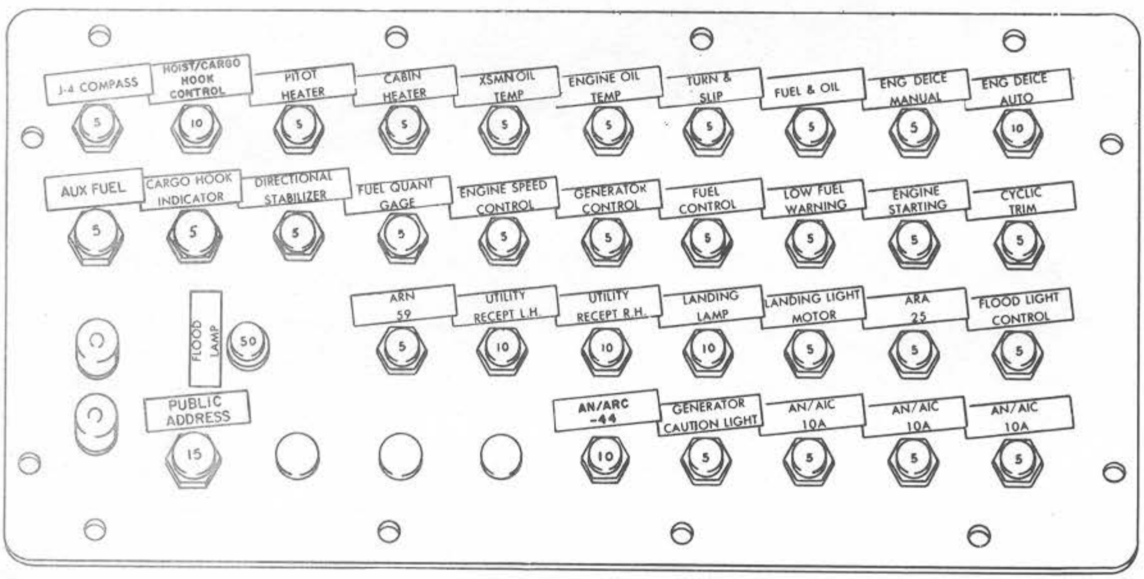
FUSE PANEL

CEILING CIRCUIT BREAKER PANEL



NOTE

AUX FUEL INSTALLED ON AIRCRAFT MODIFIED BY T.O. 1H-43(H)B-579.



CONSOLE CIRCUIT BREAKER PANEL

Figure 1—19

External Power Receptacle.

An external power receptacle (10, figure 1–2) is located inside an access door labeled EXT POWER REC 28 VOLTS DC on the right fuselage exterior, above the forward landing gear. The receptacle provides for connecting an external source of power for ground testing of electrical or electronic equipment and for engine starting.

Secondary Bus Switch.

The secondary bus (SEC BUS) switch (22, figure 1–8) on the console controls the secondary bus relay. It is a guarded switch with two positions: NORMAL (NORM) and EMERGENCY (EMER). With the switch in NORMAL, the relay will be energized whenever generator or external power is supplied to the essential bus. This will close the relay, connecting the secondary bus to the essential bus. With the switch in NORMAL the relay will not close when battery power only is supplied to the essential bus. This prevents operation of equipment supplied by the secondary bus and conserves the battery. With the switch in EMERGENCY the relay closes when power is supplied to the essential bus.

Note

When operating with battery power, turn off all non-essential electrical and electronic equipment to conserve battery energy.

Circuit Breaker Panels.

Both the essential and secondary buses of the dc electric power supply system end at the two circuit breaker panels (figure 1–19). The console circuit breaker panel is located on the right side of the console, and the ceiling circuit breaker panel is located in the center of the cockpit ceiling. The breakers are ON when pressed in, and OFF when out. They automatically pop out when the circuit which they protect becomes overloaded, or they can be pulled out by hand to disconnect their circuits from the bus.

ALTERNATING CURRENT POWER SUPPLY.

Alternating current for operation of various instruments is supplied by inverters (motor-generators) powered from the 28 volt dc power supply. The ac power from the inverters is distributed through the fuse panel on the cockpit ceiling.

Inverters.

Only one of the two inverters installed in the upper left pylon operates at any one time. The second inverter is a spare which is switched on only if the first inverter should fail. Power to operate the inverters is supplied from the essential bus through the inverter (INVERTER NO. 1 and INVERTER NO. 2) circuit breakers on the ceiling circuit breaker panel (figure 1–19). The inverters produce 115-volt, 400-cycle, 3-phase ac power. A portion of the output is reduced by transformers to 26-volt, 400-cycle, 1-phase ac power for operation of the pressure gage instruments and the radio magnetic indicator.

Inverter Switch. The inverter (labeled AC INST POWER) switch (19, figure 1–8) on the console controls both dc input to the inverters and their ac output. The switch has three positions: INVERTER 1 (INV 1), OFF, and INVERTER 2 (INV 2). When the switch is moved to INVERTER 1, dc power is supplied to that inverter, and the inverter output is supplied to the ac buses. Both the input and output of the number 2 inverter remain electrically disconnected. If the number 1 inverter should fail, the instrument ac power caution light will glow, indicating that the switch should be moved to INVERTER 2. This will electrically disconnect the number 1 inverter and connect the number 2 inverter input and output. The switch receives power from the essential bus through the inverter control (INVERTER CONTROL #1 and INVERTER CONTROL #2) circuit breakers on the ceiling circuit breaker panel (figure 1–19).

Instrument AC Power Caution Light. The instrument ac power (INST AC PWR) caution light, on the caution light panel (figure 1–22), will glow whenever the inverter fails to supply power to the ac buses. This will indicate inverter failure and the ac instrument power switch should be placed in the INVERTER 2 position. Power for the light is supplied from the essential dc bus through the ac power failure circuit breaker on the ceiling panel (figure 1–19).

Fuse Panel.

AC power is distributed to the using instruments through the fuse panel (figure 1–19), on the cockpit ceiling. A fuse may be removed for inspection or replacement by unscrewing the circular cap and withdrawing the cap and fuse. Replacement fuses are provided in fuse holders marked SPARE. Each circuit requires a 1-ampere fuse except the two J-4 compass fuses, which require 5-ampere fuses.

HYDRAULIC POWER SUPPLY SYSTEM

Pressurized oil for the operation of the collective limiter and rudder lock hydraulic systems is provided by the transmission oil pump, which is described in the **TRANSMISSION OIL SYSTEM** paragraphs of this section. The collective limiter and the rudder lock are described in the **FLIGHT CONTROL SYSTEM** paragraphs of this section.

LANDING GEAR SYSTEM

The helicopter landing gear consists of four non-retractable wheels, with individual shock struts. The rear wheels are fixed fore-and-aft. The nose wheels have castering mounts that permit unrestricted swivel, and they can be locked fore-and-aft. The nose wheels are equipped with shimmy dampers. Skid assemblies ("bear paws") on each of the four wheels aid in operating from soft ground or snow.

NOSE WHEEL LOCK HANDLE.

A nose wheel lock (labeled NOSE GEAR) handle (24, figure 1–7) is located at the left of the console. It is

Emergency Flotation Gear

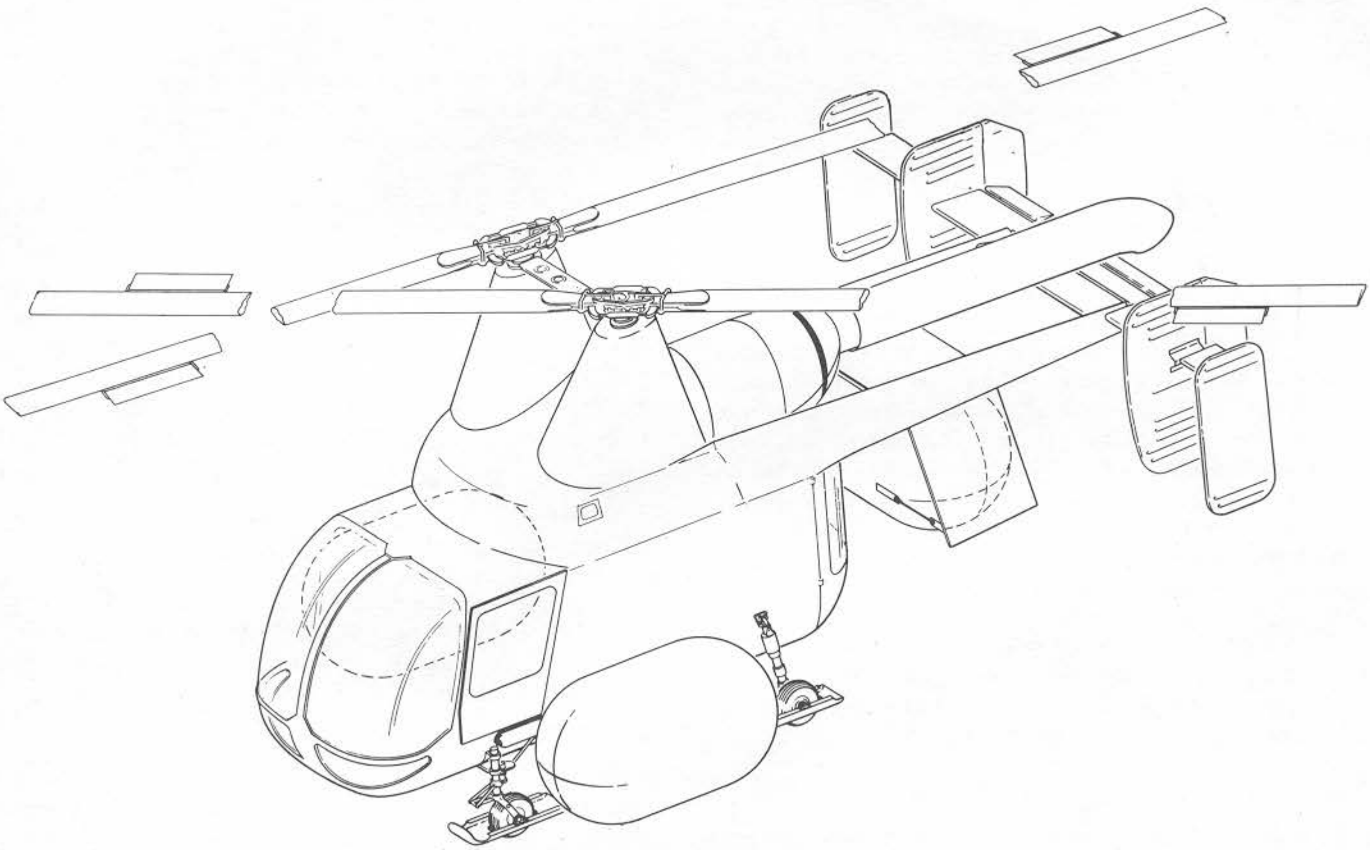


Figure 1—20

connected by mechanical linkage to locking pins in the nose wheel struts. The handle has two positions: LOCKED and UNLOCKED. In LOCKED, the pins hold the nose wheels in alignment with the rear wheels. When the handle is UNLOCKED, the pins are disengaged and nose wheels are free to swivel. Arrows on the handle indicate the direction the handle should be moved to overcome a locking detent before pulling up or pushing down. The position of the handle is as desired by the pilot, however, when operating from rough or sloping terrain, or in crosswinds over 10 knots, it is normally in the locked position.

Note

When helicopter is on the ground, it is necessary to align nose wheels in fore-and-aft position before they can be locked.

WHEEL BRAKE SYSTEM

The two aft wheels of the landing gear are equipped with disc-type hydraulic brakes. These are individually applied by brake pedals at the top of the pilot's directional pedals. Wheel brakes can be locked for parking.

WHEEL BRAKE PEDALS.

Wheel brake pedals (17, figure 1—7) are located at the top of the pilot's directional pedals. Brakes are actuated by hydraulic pressure from the master cylinders, located directly below the brake pedals.

PARKING BRAKE HANDLE.

A parking brake handle (22, figure 1—7) is located at the left of the console. It is connected by mechanical linkage to valves in the wheel brake hydraulic lines. Wheel brakes are applied by toe pressure on the wheel brake pedals. Pressure is maintained while the parking brake handle is pulled up. Hold the parking brake handle until the wheel brake pedals are released. This closes the valves and traps the hydraulic pressure against the wheel brake friction units. Wheel brakes will remain ON, acting as parking brakes until the brake pedals are again applied, automatically releasing the parking brake.

EMERGENCY FLOTATION GEAR

The helicopter contains provisions for installation of emergency flotation gear (figure 1—20). The gear is designed to float the aircraft in the event of an emergency water landing. The gear consists of three inflatable gas bags folded into fairings at each side of the fuselage and between the tail booms. Each bag is individually inflated by an electrically actuated gas generator inflation unit.

When inflated, the bags are cylindrical in shape, and extend fore-and-aft along each side of the helicopter and laterally between the tail booms.

EMERGENCY FLOTATION HANDLE.

The emergency flotation gear handle (12, figure 1–7) is located on the nose bubble frame directly over the console. When the handle is pulled, two cartridge-type bolt cutters are electrically fired which cause the side flotation gear fairings to be released. At the same time, the three gas generator inflation units are electrically actuated and the bags are inflated in approximately 2 seconds. The rear fairing is released by pressure of the inflating bag. An independent source of electrical power for the actuating circuit is supplied from a sealed battery through moisture proof dual circuits. The battery is mounted on the upper cabin roof to the left of the oil cooler blower. It is not connected to the helicopter electric power supply system.

FLIGHT CONTROL SYSTEM

The helicopter is controlled by changing the pitch of the rotors. Pitch changes are accomplished by pilot movement of conventional helicopter flight controls, including collective pitch lever, cyclic stick and directional pedals. The flight controls actuate push-pull rods connected to the blade flaps mounted at the outboard trailing edges of the rotor blades. Aerodynamic action of the flaps twists the blades about their spanwise axes, changing the blade pitch in response to the position of the flight controls. The elevator improves longitudinal stability by compensating for the tendency of the helicopter nose to pitch upward at high forward speeds. The elevator is controlled by tabs that are activated by the collective pitch lever. Additional directional stability is provided by the rudders, positioned by an automatic directional stability system.

COLLECTIVE PITCH LEVER.

The collective pitch lever (figure 1–6) is at the left of the pilot. Pulling up on the lever increases the collective pitch of the rotor blades, developing additional lift. Pushing down on the lever causes the reverse to occur. Up-loads imposed on the collective pitch lever by centrifugal force of the rotor blade control rods are neutralized automatically by the hydraulically controlled collective limiter. During forward flight the collective pitch lever also actuates the trim tab on the elevator. Upward motion of the lever increases the angle of attack of the elevator. The collective pitch lever is also linked to the power turbine governor. An upward motion of the lever increases the power turbine governor speed setting to maintain engine speed as rotor loads are increased.

Collective Pitch Lever Friction Nut.

An adjustable friction nut (1, figure 1–6) is located below the throttle. To increase friction turn nut clockwise.

CYCLIC STICK.

The cyclic stick (figure 1–7) is forward of the pilot. Moving the stick in any direction causes the helicopter to tilt and move in that direction. The cyclic stick grip contains switches for stick trim and for control of auxiliary equipment.

Cyclic Stick Friction Nut.

An adjustable friction nut (2, figure 1–7) is located at the base of the pilot's stick. To increase friction turn nut clockwise.

Cyclic Trim Switch.

The cyclic trim switch (8, figure 1–8), on the console, is spring-loaded to the center OFF position. The switch is labeled FORWARD (FWD), AFT, LEFT (L), and RIGHT (R), and operates electric actuators that adjust the cyclic stick for neutral pressure. The actuators change the spring force of struts that determine the position of the stick. The stick may be moved through its full range in any trim setting, but spring strut resistance increases in proportion to stick displacement. When the cyclic stick is released, the spring struts will return the stick to the original position established by the trim setting. Electric power to operate the actuators is supplied from the essential dc bus, through the cyclic trim circuit breaker on the console circuit breaker panel (figure 1–19).

Trim Release Button.

The trim release (TRIM REL) button (15, figure 1–7) on the pilot's cyclic stick grip permits rapid changes in trim settings. Pressing the button releases the trim actuator clutch and allows free movement of the cyclic stick. When the new stick position has been established and the button is released, the stick will be automatically trimmed in the new position.

CAUTION

Do not press the button if the cyclic stick has been moved through a travel of 5 inches or more from the last trim position. Failure to observe this procedure will damage the trim actuators.

DIRECTIONAL PEDALS.

Directional pedels (6 and 18, figure 1–7) control the heading of the helicopter. Pushing the left pedal causes a left bank and turn; pushing the right pedal causes a right bank and turn. Directional pedal action alone tends to bank the helicopter into the turn. When the right pedal is moved forward, two things happen simultaneously:

1. The collective pitch of the right rotor is decreased, and the pitch of the left rotor is increased, resulting in:
   a. rolling of the aircraft to the right because of changes in lift between the two rotors.
   b. turning of the aircraft to the right because of the unbalanced torque between the rotors.
2. The right rotor is tilted rearward while the left rotor is tilted forward. This furnishes additional turning force to the right.

To retain directional control in autorotation, a reverser and a shifter are included in the control linkages from the directional pedals. The reverser is mechanically actuated by movement of the collective pitch lever to the down position and, in effect, crosses the differential collective controls from the directional pedals. This compensates for the reversal of torque application relative to helicopter heading which is caused by the fact that the rotor blades drive the rotor shafts in autorotation, rather than being driven by them as in power-on flight. The shifter, also actuated mechanically by movement of the collective pitch lever, varies the amount of fore-and-aft differential cyclic control applied to the rotors for a given amount of directional pedal movement, depending on the setting of the collective pitch lever.

Directional Pedals Adjusting Knob.

The pedals adjusting knob (4, figure 1—7) adjusts the position of the pedals to suit the pilot's leg length.

Directional Pedals Friction Nut.

A ground adjustable wing nut for increasing or decreasing friction on the rudder pedals is located forward of and between the pilot's rudder pedals.

DIRECTIONAL STABILITY AUGMENTATION SYSTEM.

The directional stability augmentation system (DSAS) controls the rudders which augment the primary directional control system described under **DIRECTIONAL PEDALS.**

Note

There is no mechanical connection between the directional pedals and the rudders. All inputs to the rudder actuator are electrical.

The system consists of a pedal transducer, a stability control unit, a rudder actuator and a rudder lock. The transducer is linked to the pilot's and copilot's foot pedal linkage and transmits an electrical signal to the stability control unit comparable to any sensed actuation of the pedals. Electric signals from the transducer are summed with signals from the lateral accelerometer; attenuated as a function of airspeed, summed with signals from the yaw rate gyro, and transmitted to the rudder actuator. This resultant signal positions the rudders accordingly by means of a motor driven rudder actuator to produce coordinated flight. The rudders are moved to neutral and locked by the hydraulic rudder lock automatically at airspeeds above 80 knots or if the system is turned off, or in the event of certain malfunctions.

The system also includes a caution light, a directional stability indicator, and a directional stability switch.

Power to operate the system is supplied from the essential bus through the directional stabilizer circuit breaker on the console circuit breaker panel. Additional power for the system is supplied from the 115-volt ac bus through two automatic stabilization equipment (ASE) fuses on the fuse panel (figure 1—19). Loss of dc power to the system will cause the rudders to lock in neutral and the directional stability indicator to read OFF. Loss of ac power or low voltage ac power will cause the system to be inoperative, and the rudders to oscillate or lock in a fully displaced left or right position. Turn the system off to center and lock the rudders.

AF 60-260 and Subsequent. Loss of either ac or dc power will cause the rudders to lock in neutral and the directional stability indicator to read OFF.

Note

AC power, low voltage, can occur without the inverter light illuminating on the caution panel, therefore, when rudder oscillation occurs an inverter malfunction should be suspected.

Directional Stability Switch.

The directional stability (labeled DIR STAB SERVO) switch (18, figure 1—8), on the console, has two positions, ON and CENTER. When the switch is ON, the directional stability augmentation system is operating. When the switch is in CENTER, the rudder lock holds the rudders in a neutral position.

Directional Stability Indicator.

The directional stability (DIR STAB) indicator (8, figure 1—10) is on the upper right corner of the instrument panel. The indicator is marked ON and OFF. The word ON is visible when the directional stability augmentation system is in operation. The word OFF will be visible when the rudder is locked in the neutral position.

Directional Servo Caution Light.

The directional servo (DIRECT SERVO) caution light is on the caution light panel (figure 1—22). If the aircraft attains an airspeed of approximately 85 knots and the directional stability augmentation system has not locked the rudders in a neutral position, the light will come on, indicating a malfunction in the system. The pilot should then move the directional stability switch to the CENTER position.

IN-FLIGHT ROTOR TRACKING SYSTEM.

Description.

The purpose of the in-flight rotor tracking system is to enable the pilot to make rotor track adjustments during maintenance rigging of the helicopter, and during normal flight operation, if required. Adjustment of track is accomplished by electrically operated actuators, connected between the bottom of the lag pin and the U-crank at one blade of each rotor. Each actuator operates an eccentric linkage (tie bar, rockers and bearings) that moves the pivot point of the U-crank inboard or outboard. This increases or decreases the range of the angle of attack of the rotor blade flap. These changes in flap angle raise or lower the tip-path track of that blade. The actuators are controlled by switches located on the upper forward cabin ceiling (4, figure 1—15). Slip ring assemblies, in each pylon, complete the electrical circuits between the switches and the actuators. It is suggested that in-track condition at hover be obtained by normal ground tracking procedures. For forward flight tracking the in-flight tracking controls should be used, after which the in-flight tracking device should be neutralized and properly compensated by normal ground adjustments.

Rotor Track Switches.

The rotor track switches (4, figure 1–15) on the forward ceiling of the cockpit control the in-flight tracking actuators (10, figure 1–17). The left switch controls the actuator for the left rotor and the right switch, the right rotor. Each switch has three positions, UP, OFF, DOWN and is spring-loaded to the OFF position. (The switch positions are not labeled.) Electric power is supplied from the secondary bus through the rotor tracking circuit breaker on the ceiling panel.

Operation.

Visually, follow the tip-path of the right rotor downward and to the right so that the right rotor disc can be seen without interference from the left rotor. If the tip-paths of the two right rotor blades appear as a single line at the edge of the rotor disc, the rotor is in track. No adjustment is required.

However, if the two blades of the rotor appear to describe separate paths, one above the other, the rotor is out of track. To adjust, press up or down on the right rotor track switch. A beeping action, rather than holding the switch steady, is recommended to avoid overshooting, and overheating of the actuator motor. The tip-paths should appear to move vertically toward each other.

Note

If the tip-paths appear to move vertically away from each other, press the switch in the opposite direction. This will reverse the direction of movement and cause the tip-paths to move toward each other.

Release the switch when the tip-paths of the rotor blades appear as a single line.

Repeat the above procedure, but sight to the left to see the tip-paths of the left rotor. Use the left rotor track switch to track the left rotor. It is suggested that the in-flight tracking controls be used only at speeds below 80 knots IAS.

Note

If actuating a rotor track switch causes increased helicopter vibration, actuate the switch to the opposite position to decrease vibration, and visually check that rotor track is being improved.

CAUTION

If during normal operational use of the helicopter (excludes rigging and tracking operations) it is found that maximum available adjustment is not enough to maintain track, an inspection should be made to determine whether some malfunctions exist or whether the tracking actuators require static rigging.

WARNING

If normal procedures fail to correct an out-of-track condition, land the aircraft at the closest safe landing site. This may be an indication of a damaged rotor blade.

EMPENNAGE.

Because of rotor torque, there is a tendency of the pitch attitude of the helicopter to change with power changes. This causes the helicopter to pitch up with the addition of power, and to pitch down when power is reduced. To minimize this tendency, the helicopter is equipped with a movable elevator (7, figure 1–21). The elevator is controlled by two movable elevator control tabs (9, figure 1–21), which are linked to the collective pitch lever. When the collective pitch lever is raised, the tabs move up. With forward airspeed this causes the elevator to move down, lessening the forward pressure required on the cyclic stick to keep the nose down. When the collective pitch lever is lowered, the opposite occurs. A spring, located in the linkage between the tabs and the collective pitch lever, compensates for airspeed changes by allowing the tabs to move toward a streamlined position as airspeed is increased. Stability is provided by a single elevator stabilizing tab (10, figure 1–21) which is linked to the fixed stabilizer (6, figure 1–21). The elevator stabilizing tab moves up in relation to the elevator when the elevator moves up, and moves down in relation to the elevator when the elevator moves down. A bungee strut (4, figure 1–21) is connected between the left tailboom and the leading edge of the elevator to provide static balance. This is necessary due to the pendulum effect of the empennage as a result of the empennage center of gravity being located below the hinge line. In addition, friction dampers prevent oscillation and hunting of the horizontal surfaces at high speed. Four vertical fins are fixed to the elevator, and move with it. The inboard vertical fins are provided with movable rudders which are controlled by the directional stability system.

INSTRUMENTS

Instruments that are a part of a complete system are described in the paragraphs pertaining to that system.

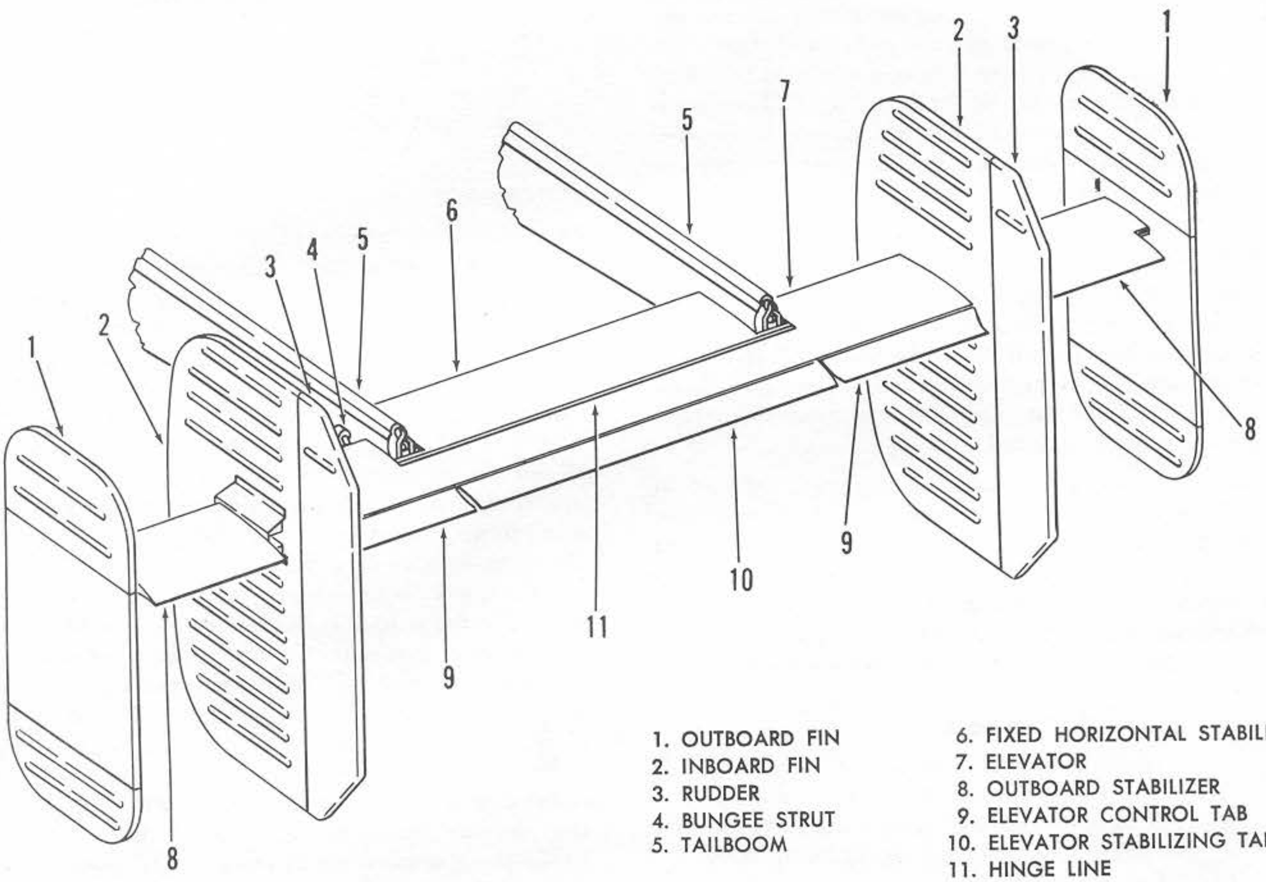
FLIGHT INSTRUMENTS.

Location of the flight instrument group permits ease of scanning and interpretation from either pilot position. The flight instruments are individually lighted; light intensity is controlled by a rheostat-type switch on the main console (9, figure 1–8).

Radio Magnetic Indicator (RMI or ID-250).

The radio magnetic indicator provides gyro stabilized heading information from the J4 compass system. Power for operation of the compass card of the RMI is sup-

Empennage



1. OUTBOARD FIN
2. INBOARD FIN
3. RUDDER
4. BUNGEE STRUT
5. TAILBOOM
6. FIXED HORIZONTAL STABILIZER
7. ELEVATOR
8. OUTBOARD STABILIZER
9. ELEVATOR CONTROL TAB
10. ELEVATOR STABILIZING TAB
11. HINGE LINE

Figure 1—21

plied by the 26-volt ac bus through the compass card fuse on the ceiling fuse panel (figure 1—19). Refer to figure 1—28 for a detailed explanation of this instrument.

J-8 Attitude Indicator.

The J-8 attitude indicator (6, figure 1—10) presents a visual picture of the attitude of the helicopter relative to the surface of the earth. This instrument receives its power from the 115-volt ac bus through two fuses labeled GYRO HORIZON on the ceiling fuse panel (figure 1—19). An OFF flag appears in the upper right corner of the dial face whenever electrical power is not being supplied to the instrument. Caging is accomplished by use of the knob on the lower right of the instrument. A pitch trim knob on the lower left of the instrument permits adjusting of the miniature aircraft reference.

CAUTION

When the battery switch is moved to ON or external power is connected, and the inverter switch is ON, wait 30 seconds and then pull the caging knob. This will prevent unnecessary torque stresses on the instrument mechanism. Pulling the knob operates a gyro centering device which cages the J-8 gyro. Caging is done by smoothly pulling the PULL TO CAGE KNOB and releasing it quickly (so it snaps back) after it reaches the full limit of travel. Press forward slightly to assure proper seating of the knob. This forward pressure is an important step in the caging operation.

ARU-14/A Attitude Indicator, Gyro System (five-inch diameter). TCTO-580.

The ARU-14/A attitude indicator (25, figure 1—10) presents a visual picture of the attitude of the helicopter in relation to the surface. The indicator can be trimmed, according to the pilot's wishes, for various pitch attitudes. Power is supplied to the indicator and its gyro from the 115-volt ac bus through three attitude indicator fuses on the fuse panel. The MD-1 vertical displacement gyro provides pitch and roll information to the ARU-14/A attitude indicator and is remotely located from the attitude indicator.

ARU-14/A Attitude Indicator Pitch Trim Knob. The ARU-14/A attitude indicator pitch trim knob is located at the lower right corner of the indicator. The knob controls, electrically, the vertical position of the horizon bar in the indicator.

ARU-14/A/MD-1 Attitude Indicator Gyro Erection Button. A push button labeled GYRO ERECT is panel mounted at the lower left corner of the ARU-14A attitude indicator. If, because of ambient temperature extremes, the gyro does not reach vertical in the warmup time period, an additional period of high erection rate may be obtained by pushing the gyro erection button until the gyro is vertical. The attitude indicator OFF flag will appear when the gyro erection button is pressed.

WARNING

The gyro erection button should not be used in flight except when the helicopter is known to be level. Ordinarily, the button is used only on the ground.

Turn-and-Slip Indicator.

The turn-and-slip indicator (17, figure 1—10) presents direction and rate-of-turn information (needle) and coordinated flight information (ball). Power for the turn-and-slip indicator is supplied from the essential dc bus through the turn-and-slip circuit breaker on the console circuit breaker panel (figure 1—19).

Pitot-Static System.

The airspeed indicator, the vertical velocity indicator, and the altimeter are dependent upon the pitot-static system for operation. The pitot tube is located on the lower right forward area of the fuselage and is protected from icing by an electrical heating element. A simple tubing system leading from the rear of the instrument panel to ports in the left tailboom provides static venting of these instruments.

Note

The airspeed indicator will be unreliable until stabilized above 30 knots.

Pitot Heater and Switch. The pitot heater is an electrical heating unit which eliminates moisture from the pitot system and prevents pitot tube icing. The heating unit is in the pitot tube, which is mounted externally on the lower right forward area of the fuselage. The pitot heater switch (labeled PITOT HT; 12, figure 1–8) is a two-position switch on the console. Power to operate the heating unit is supplied from the essential bus through the pitot heater circuit breaker on the console circuit breaker panel (figure 1–19). The pitot heater switch should be placed in the PITOT HT position whenever flying through visible moisture.

Magnetic Compass.

The magnetic compass (5, figure 1–10) mounted atop the instrument panel provides directional information in event of failure of the J-4 compass system.

Outside Air Thermometer.

The outside air thermometer (3, figure 1–15) is located on the forward area of the cockpit ceiling. Correction cards (1, figure 1–15) for the magnetic compass and the airspeed indicator are also on the cockpit ceiling.

Note

The outside air thermometer is unreliable when the aircraft is static.

Clock.

The clock (16, figure 1–10) is a manually wound, 8-day, 12-hour type, and is mounted at bottom center of the instrument panel.

CAUTION LIGHT SYSTEM

The caution light system warns of malfunction or unsafe conditions in the helicopter. The system has two main parts: a caution light panel and a master caution light. These receive power from the essential bus through the caution light circuit breaker on the ceiling circuit breaker panel (figure 1–19).

CAUTION LIGHT PANEL.

The caution light (CAUTION LTS) panel (figure 1–22) is at the forward end of the console. The caution lights indicate malfunction or unsafe conditions in the following systems (refer to the systems description for specific conditions indicated by the caution lights):

ENGINE ANTI-ICING SYSTEM
TRANSMISSION OIL SYSTEM
ENGINE OIL SUPPLY SYSTEM
ELECTRIC POWER SUPPLY SYSTEM
FUEL SUPPLY SYSTEM
DIRECTIONAL STABILITY AUGMENTATION SYSTEM.

Caution Light Panel, Typical

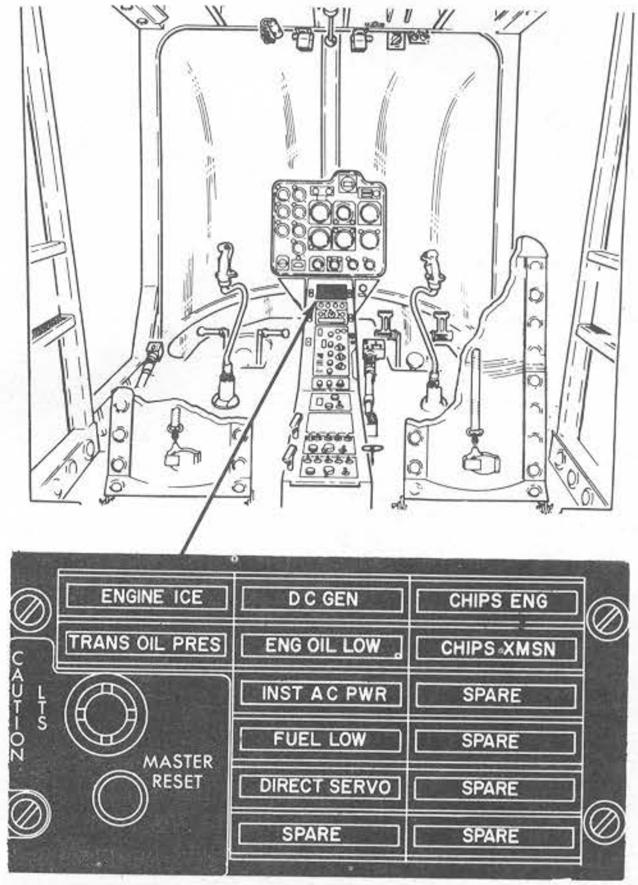


Figure 1–22

Note

If required, light bulbs from the spare modules may be used to replace burned out bulbs in instrument or panel lights.

Caution Light Dimming Switch.

The caution light dimming (labeled CAUTION LTS) switch (14, figure 1–8) on the console has two positions, bright (BRT) and DIM. The solenoid-type switch is spring-loaded to the BRIGHT position. However, if it is moved to DIM when the flight instrument lights rheostat (9, figure 1–8) is ON, its solenoid will hold it in DIM. The switch can be manually moved to BRIGHT, or will automatically return to BRIGHT when the flight instrument lights are turned OFF.

MASTER CAUTION LIGHT.

The master caution light (9, figure 1–10) will glow when any of the caution lights (other than the engine ice light) glow. When the master caution light glows, you should look at the caution light panel to determine the nature of the malfunction. The light is also a test bar for the caution light system. When pressed, the master caution light and all caution lights should glow. All lights should turn off when the bar is released, except the lights which were already on.

MASTER CAUTION LIGHT RESET BUTTON.

The master caution light reset button is located on the caution light panel. (See figure 1–22.) When the button is pressed, the master caution light is deenergized so that it can indicate another malfunction or unsafe condition, if one should occur before the original unsafe condition has been remedied.

NAVIGATION EQUIPMENT

J-4 COMPASS SYSTEM.

Description.

The J-4 compass system is a lightweight, gyro stabilized, remote indicating compass that can be used as a magnetic slaved compass, or as a directional gyro corrected for apparent precession. In magnetic compass operation, signals from the compass transmitter (in the right tailboom), which detects changes in helicopter line of flight, are gyro-stabilized to produce course headings. In directional gyro operation, course headings are provided by comparison of the line of flight with an arbitrary reference heading established by the gyro. During directional gyro operation the system must be corrected for latitude. In either directional gyro or magnetic compass operation, course headings are shown on the rotating compass card of the radio magnetic indicator (2, figure 1–28). Power to operate the equipment is supplied from the essential bus through the circuit breaker (marked J-4 COMPASS) on the console circuit breaker panel, and from the 26-volt ac bus through the compass card fuse (marked ID250 COMP CARD) on the ceiling fuse panel (figure 1–19). System controls are located on the J-4 compass (labeled J-4 COMP) panel (figure 1–23) on the console.

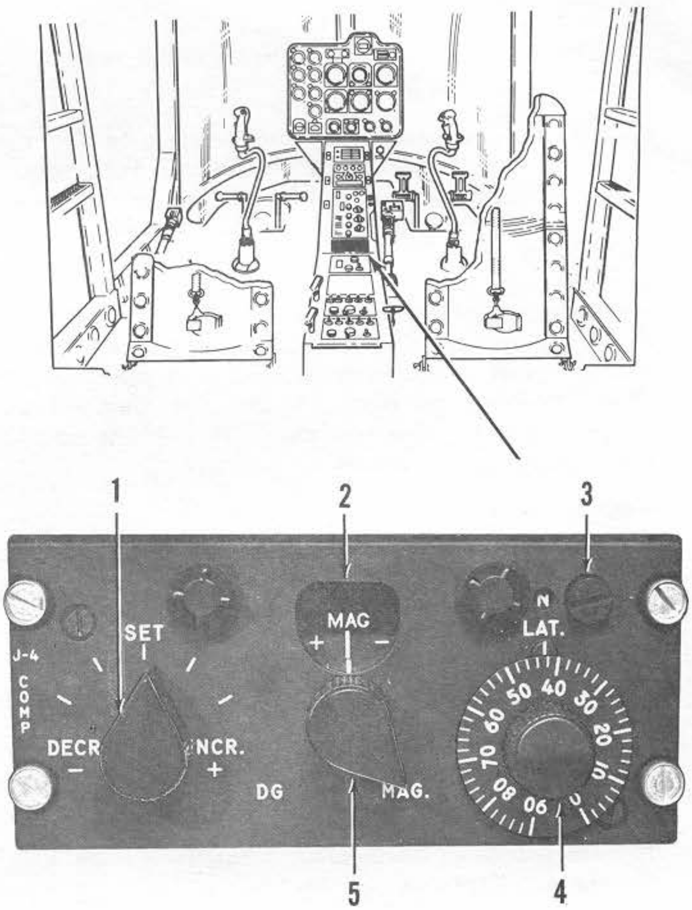
Compass Turn Cutout Switch. A compass turn cutout switch (marked TURN CUTOUT NORMAL; 23, figure 1–8) is at the top of the console switch panel. The switch will be left in the NORMAL position for all operations. However, if inadvertently placed in the TURN CUTOUT position, it should be returned to NORMAL or the system will operate as a directional gyro even though the function switch is in MAGNETIC COMPASS.

Function Switch. The function switch (5, figure 1–23) selects the mode of operation of the compass system, and is a two-position switch marked DIRECTIONAL GYRO (DG) and MAGNETIC COMPASS (MAG). In MAGNETIC COMPASS, the system operates as a magnetic compass with the directional gyro slaved to the remote compass transmitter. In DIRECTIONAL GYRO, the system operates as a directional gyro, manually corrected for local latitude.

Synchronizer Switch. The synchronizer switch (1, figure 1–23), labeled DECREASE-SET-INCREASE, is spring-loaded to SET, and has five positions. With the function switch in MAGNETIC COMPASS, the synchronizer switch manually synchronizes the compass system with the compass transmitter. A synchronizer indicator (2, figure 1–23) above the function switch, shows the amount and direction of correction required. With the function switch in DIRECTIONAL GYRO, the synchronizer indicator is covered with a flag marked DG. Moving the synchronizer switch adjusts the gyro reference heading shown on the rotating compass card of the radio magnetic indicator.

Hemisphere Setting Screw. With the function switch in DIRECTIONAL GYRO, the hemisphere setting screw (3, figure 1–23) selects the proper hemisphere for operations. NORTH (N) is for latitudes north of the equator, and SOUTH (S) for latitudes south of the equator.

J-4 Compass Panel



1. SYNCHRONIZER SWITCH
2. SYNCHRONIZER INDICATOR
3. HEMISPHERE SETTING SCREW
4. LATITUDE KNOB
5. FUNCTION SWITCH

Figure 1–23

Latitude Knob. The latitude knob corrects the system (when in the DG mode of operation only) for apparent precession caused by the earth's rotation. This control knob should be set before takeoff for the correct latitude that will be maintained during flight west to east or east to west. Northerly and southerly directed flights, however, will require gyro drift correction through the latitude correction knob. For this type flight, the latitude knob is set to the present latitude of the aircraft and replaced on new latitudes (usually each 2°) as the flight progresses.

Normal Operation.

To operate the system as a directional gyro, proceed as follows:

1. Allow the equipment to warm up for 2 minutes.
2. Compass turn cutout switch – NORMAL
3. Function switch – DIRECTIONAL GYRO.
4. Hemisphere setting screw – As required.
5. Latitude knob – As required.

Note

For flights expected to cover 2 degrees of latitude, set to mid-latitude. If local latitude changes 2 degrees from original setting, reset to new mid-latitude.

6. Observe course headings on rotating compass card of radio magnetic indicator.

To adjust indicator reference heading, proceed as follows: Synchronizer switch–INCREASE or DECREASE.

Note

INCREASE for clockwise changes; DECREASE for counterclockwise changes. Hold switch until desired heading is shown on the course indicator.

CAUTION

Do not operate synchronizer switch longer than 30 seconds at any one time. Continuous operation may overheat and damage gyro motor.

To operate the system as a magnetic compass, proceed as follows:

1. Function switch–MAGNETIC COMPASS.

   Synchronizer indicator pointer should align with center index within 4 minutes.

Note

If pointer and center index do not align, synchronize as follows: Rotate synchronizer switch to INCREASE or DECREASE until pointer and center index are aligned.

Observe course headings on rotating compass card of radio magnetic indicator.

COMMUNICATION AND RADIO NAVIGATION EQUIPMENT

Figure 1–24 lists equipments installed, and their primary characteristics. Antennas are illustrated in figure 1–25.

INTERCOM, AN/AIC-10A.

Description.

The AN/AIC-10A intercom provides speech communication between crew members, and allows the crew to monitor the radios. On/off switching of intercom and radios is provided through trigger-type microphone switches (1, figure 1–26) on the cyclic sticks and the hoist operator's grip. Squeezing the microphone switch halfway connects the microphone to the intercom. Squeezing the switch all the way connects the microphone to the radios. Power to operate the equipment is supplied from the secondary bus through three circuit breakers (AN/AIC-10A), located on the console circuit breaker panel (figure 1–19).

Intercom control panels (labeled INTER, figure 1–27) are provided for the pilot, copilot and the hoist operator, and one additional crew member (ACM). Headsets and microphones are plugged into cord sets located adjacent to crew stations. The control panel contains the following controls:

Selector Switch. The selector switch (3, figure 1–27) has positions labeled CALL, INTERCOM (INTER), three COMMUNICATION (COMM) positions, and on some aircraft, a fourth position labeled PUBLIC ADDRESS (PA). The selector switch determines different modes of radio transmission. With the switch in INTERCOM, only intercom transmission is possible. With the switch in the COMMUNICATION positions, transmissions are over either intercom or the selected VHF, UHF, or FM radio, depending on the position of the microphone switch. With the switch in the PUBLIC ADDRESS position (labeled PA), transmission is over either intercom or the public address system, depending on the position of the microphone switch. With the switch held in the CALL position, the intercom interrupts all other communications.

Monitor Switches. Monitor switches (1, figure 1–27) at the top of the control panel allow simultaneous monitoring of all communications equipment. These switches are ON when pushed up. The unlabeled switches are not used.

Volume Knob. A volume (VOL) knob (4, figure 1–27) adjusts headset listening level. The maximum obtainable level for any monitored radio equipment depends on the volume control setting of the equipment being monitored.

Emergency Switch. The emergency switch (labeled NORMAL AUX LISTEN; 2, figure 1–27) is used only if the panel amplifier fails. The switch is wired to NORMAL. When the switch is placed in AUXILIARY LISTEN, radio signals are connected directly to the headset.

Hot Mike Switch

A two-position switch (labeled NORM, HOT MIKE, 5 Figure 1–27) allows the hoist operator to select intermittent or continuous speech communication with the pilot. With the switch in normal (NORM) position, it is necessary to squeeze the microphone switch on the hoist operator's grip before speaking. When the switch is moved to HOT MIKE it is only necessary to

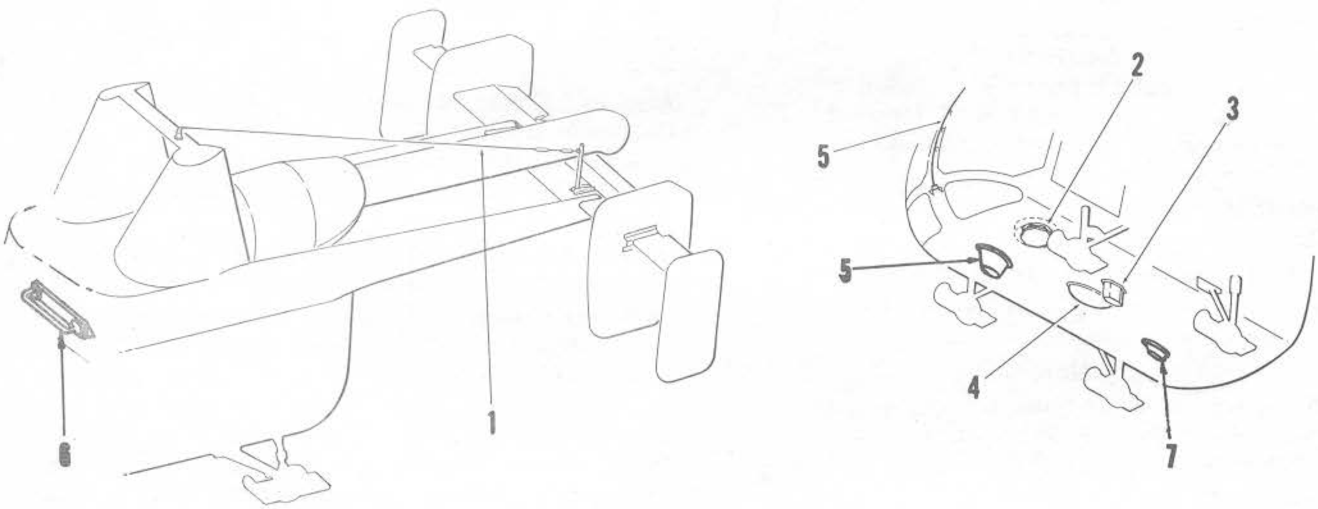
Communication and Radio Navigation Equipment

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROL
INTERCOM	AN/AIC-10A	INTERCOM BETWEEN CREW	PILOT COPILOT HOIST OPERATOR	INTERIOR OF HELICOPTER	AT CREW STATION
UHF COMMUNICATION	AN/ARC-34 OR AN/ARC-133	VOICE COMMUNICATION	PILOT	LINE OF SIGHT	ON CONSOLE
FM COMMUNICATION	AN/ARC-44 OR FM622A*	VOICE COMMUNICATION	PILOT	LINE OF SIGHT	ON CONSOLE
VHF COMMUNICATION	VHF-101 OR AN/ARC-73	VOICE COMMUNICATION	PILOT	DEPENDS ON ALTITUDE	ON CONSOLE
SECURE SPEECH	KY28	VOICE SCRAMBLE	PILOT	—	NOSE CONSOLE
UHF DIRECTION FINDER	AN/ARA-25	AUTOMATIC DIRECTION FINDING	PILOT	LINE OF SIGHT	CONTROLLED THRU AN/ARC-34 PANEL ON CONSOLE
AUTOMATIC DIRECTION FINDER	AN/ARN-59	AUTOMATIC DIRECTION FINDING	PILOT	DEPENDS ON POWER OUTPUT OF GROUND STATION	ON CONSOLE
PUBLIC ADDRESS SYSTEM	NONE	AIR TO GROUND COMMUNICATION	PILOT COPILOT HOIST OPERATOR	3000 FEET	ON CONSOLE

*FM622A RADIO ALSO PROVIDES HOMING FUNCTION

Figure 1—24

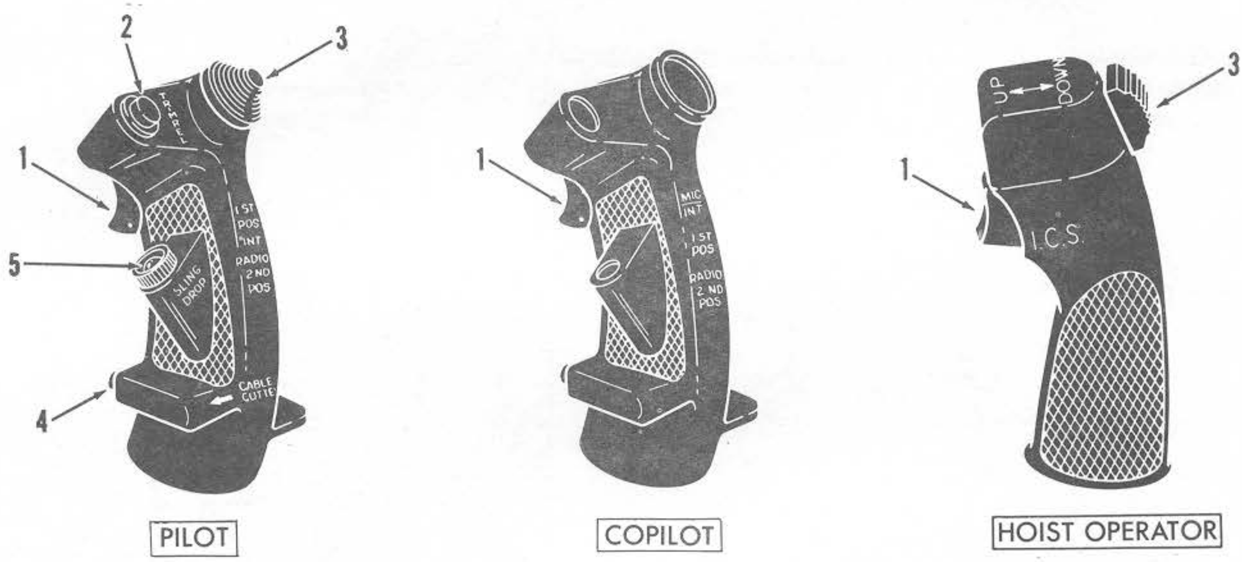
Antennas, Typical



1. AUTOMATIC DIRECTION FINDER SENSE ANTENNA
2. UHF DIRECTION FINDER ANTENNA
3. UHF COMMUNICATIONS ANTENNA
4. AUTOMATIC DIRECTION FINDER LOOP ANTENNA
5. FM COMMUNICATIONS ANTENNA
6. FM HOMING ANTENNA (TCTO 511).
7. IFF ANTENNA (TCTO 510).

Figure 1—25

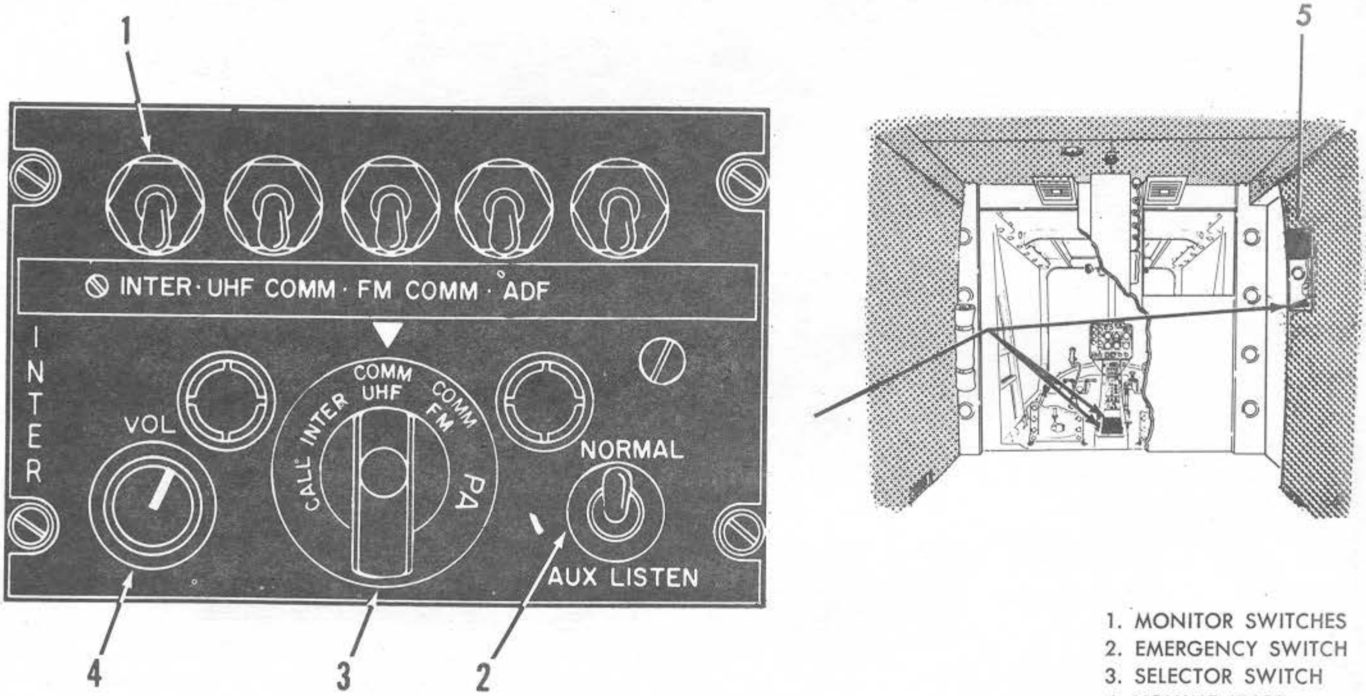
Pilot's, Copilot's, and Hoist Operator's Grips



1. MICROPHONE SWITCH
2. TRIM RELEASE SWITCH
3. HOIST UP-DOWN SWITCH
4. CABLE CUTTER BUTTON
5. SLING DROP BUTTON

Figure 1—26

Intercom Control Panel, Typical



1. MONITOR SWITCHES
2. EMERGENCY SWITCH
3. SELECTOR SWITCH
4. VOLUME KNOB
5. HOT MIKE SWITCH

Figure 1—27

Normal Operation.

1. Selector switch – As desired.

Note

CALL should be used only for emergency communication, or for an initial call, after which communication should be continued on INTERCOM.

2. Monitor switches – As desired.
3. Microphone switch – As required.

Emergency Operation.

In case of amplifier failure, indicated by faulty reception, proceed as follows:

1. Emergency switch – AUXILIARY LISTEN.
2. Monitor switches – As desired.

Note

- It is not possible to transmit in AUXILIARY LISTEN. The equipment that will be heard will be the one at the far left of the monitor switches that are ON. If all monitor switches are OFF, the equipment that will be heard is the one to which the selector is turned.
- If necessary, control panels may be interchanged between intercom stations.

PUBLIC ADDRESS SYSTEM.

TCTO-506.

Description. (See figure 1–27A.)

The public address system enables the helicopter crew to give voice directions to personnel on the ground. The system consists of two loudspeakers mounted on the lower part of the nose bubble, an audio amplifier, and a control panel on the console. The control panel contains an on-off switch and a volume knob. Broadcasting is done through the crew's regular microphones. The on-off switch turns the system on and off, and the volume knob controls the loudspeaker output volume. Before broadcasting, it is necessary that the system be turned on, and that the crewman who wishes to broadcast turns his intercom selector switch (3, figure 1–27) to the PUBLIC ADDRESS position. To assure maximum range and clarity, it is essential to speak slowly and distinctly. Power to operate the system is supplied from the secondary bus through the public address circuit breaker on the console circuit breaker panel.

Normal Operation.

1. On-off switch – ON.
2. Intercom selector switch – PUBLIC ADDRESS.
3. Volume knob – As required.
4. Microphone switch – As needed. (Use second position)

Public Address System

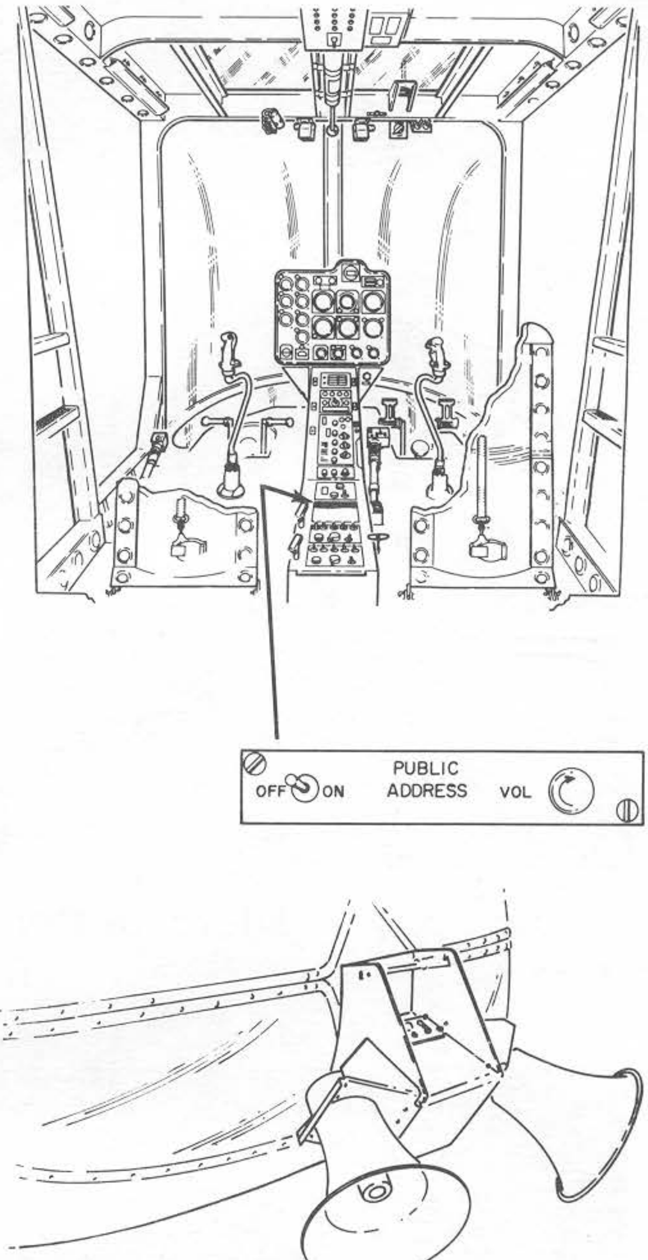


Figure 1–27A

WARNING

Do not operate the public address system on the ground unless personnel in the immediate area (within 50 feet) are wearing protective ear muffs.

speak. Hot mike operation can be interrupted at any time by the pilot, and resumed when the pilot's microphone switch is released.

UHF COMMAND RADIO, AN/ARC-34, WITH AUTOMATIC DIRECTION FINDER, AN/ARA-25.

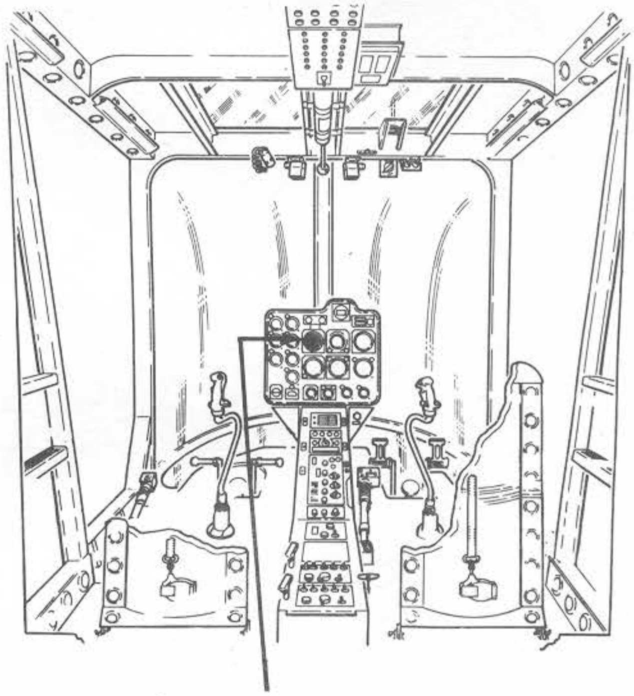
Description.

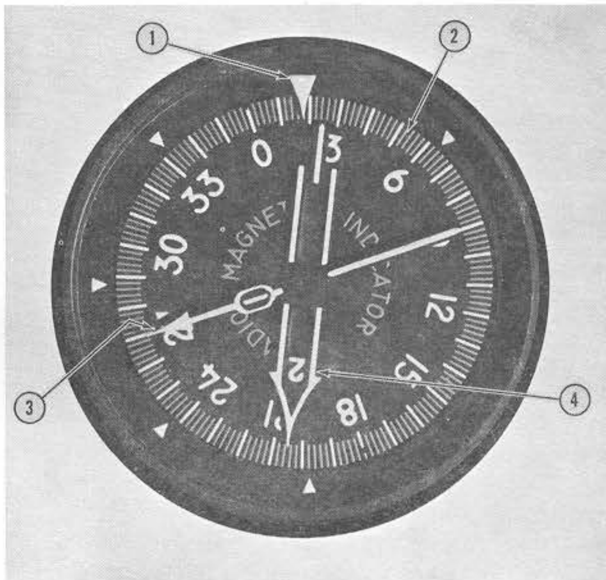
The UHF radio provides voice or code communication, and automatic direction finder (ADF) operation. Any 20 of the 1750 available channels, in the frequency range of 225.0 to 399.9 megacycles, can be preset for selection. Additional channels can be selected manually without disturbing the preset frequencies. GUARD channel can be monitored while using the other channels. The bearing of the station being received by the UHF-ADF is displayed on number two bearing pointer of the radio magnetic indicator (figure 1—28). Power to operate the equipment is supplied from the secondary bus through the ARC-34 circuit breaker on the ceiling circuit breaker panel, and the ARA-25 circuit breaker on the console circuit breaker panel, and from the 26-volt ac bus, through the number two bearing pointer fuse (labeled ID 250 NEEDLE NO. 2) on the fuse panel (figure 1—19). The UHF control panel (labeled COMM, figure 1—29) is on the console, and contains the following controls:

Function Switch. The function switch (labeled OFF-MAIN-BOTH-ADF; 4, figure 1—29) establishes mode of operation. In OFF, the equipment is inoperative. In MAIN, the transmitter, and receiver are operating on the selected channel. In BOTH, the transmitter and receiver are operating on the selected channel, as well as the receiver on the guard channel. The ADF position provides automatic direction finding only on the preset or manually tuned frequency being monitored.

Manual-Preset-Guard Switch. The MANUAL-PRESET-GUARD switch (8, figure 1—29) establishes the method of channel selection. With the switch in MANUAL, the frequency of the tuned channel appears in the windows (1, figure 1—29). When the switch is in PRESET, the channel is selected by the channel selector knob (6, figure 1—29), and appears in the window above the knob. Preset channel frequencies may be recorded on the card (5, figure 1—29). GUARD position selects the guard channel for the main receiver and transmitter.

Radio Magnetic Indicator

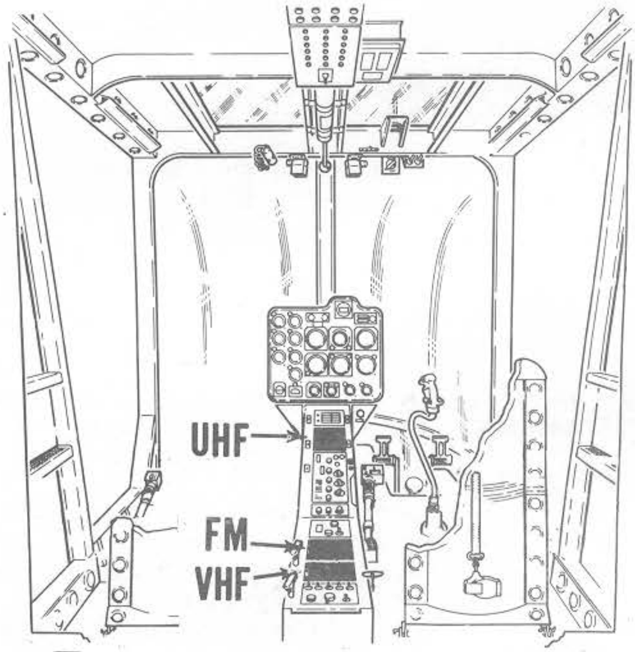




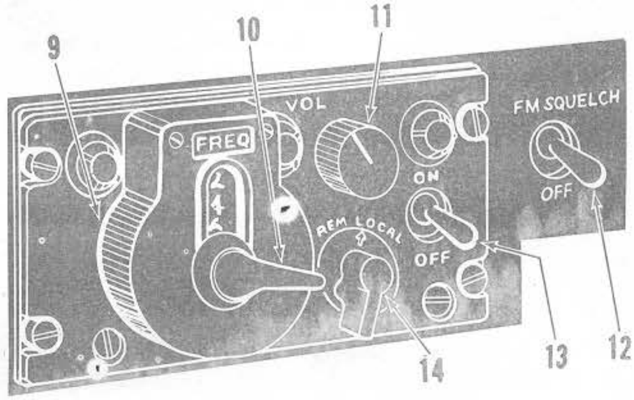
1. FIXED INDEX MARKS. LARGE MARK AT TOP OF INSTRUMENT REPRESENTS FORWARD END OF HELICOPTER FORE-AND-AFT AXIS
2. ROTATING COMPASS CARD CONTROLLED BY THE J-4 MAGNETIC GYRO COMPASS SYSTEM; INDICATES HEADING OF HELICOPTER
3. NUMBER ONE BEARING POINTER INDICATES DIRECTION OF STATION BEING RECEIVED ON AUTOMATIC DIRECTION FINDER (AN/ARN-59).
4. NUMBER TWO BEARING POINTER INDICATES DIRECTION OF STATION BEING RECEIVED ON UHF COMMAND SET WITH SELECTOR AT ADF (AN/ARC-34 WITH AN/ARA-25)

Figure 1—28

Communications Radio Panels, Typical

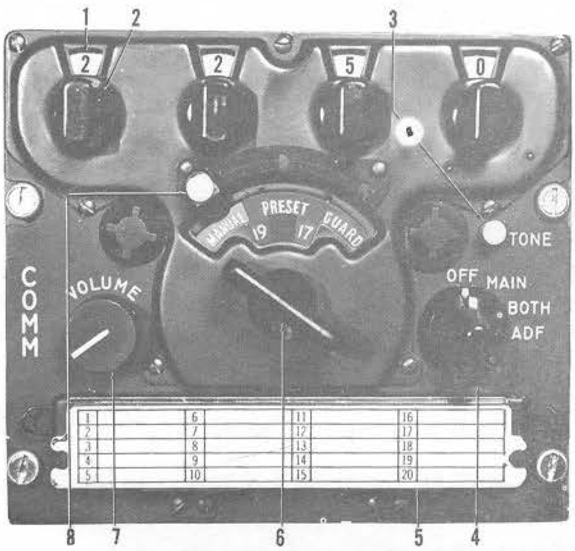


FM



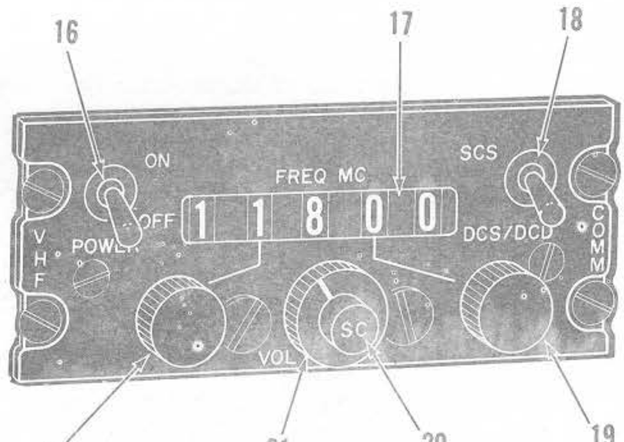
9. WHOLE MEGACYCLE FREQUENCY SELECTOR
10. ONE TENTH MEGACYCLE FREQUENCY SELECTOR LEVER
11. VOLUME CONTROL
12. FM SQUELCH SWITCH
13. POWER ON-OFF SWITCH
14. REMOTE-LOCAL SWITCH

UHF



1. MANUAL FREQUENCY WINDOWS
2. MANUAL FREQUENCY SELECTOR KNOBS
3. TONE BUTTON
4. FUNCTION SWITCH
5. PRESET FREQUENCY RECORD CARD
6. CHANNEL SELECTOR KNOB
7. VOLUME KNOB
8. MANUAL-PRESET-GUARD SWITCH

VHF



15. MEGACYLE DIAL CONTROL
16. POWER ON-OFF SWITCH
17. FREQUENCY MC WINDOW
18. MODE SWITCH
19. 50-KILOCYCLE DIAL CONTROL
20. SQUELCH CONTROL
21. VOLUME CONTROL

Figure 1—29

Receiving and transmitting capabilities for all combinations of these switch positions are as follows:

Position of FUNCTION Switch	Position of MANUAL-PRESET-GUARD Switch	Available Receiving & Transmitting Channels
OFF	Any	All power disconnected.
MAIN or BOTH	GUARD	Receive & transmit guard only.
MAIN	PRESET	Receive & transmit preset channel.
BOTH	PRESET	Receive preset channels and GUARD. Transmit on preset channels only.
MAIN	MANUAL	Receive & transmit manually set channel only.
BOTH	MANUAL	Receive & transmit manually set channel and receive GUARD.
ADF	Any	Receive ADF.

Manual Frequency Selector Knobs. The manual frequency selector knobs (2, figure 1–29) are used to select the manual frequency without disturbing any of the preset frequencies.

Channel Selector Knob. The channel selector knob (6, figure 1–29) selects desired preset channels.

Volume Knob. The volume (VOL) knob (7, figure 1–29) adjusts headset listening level. The knob should be in approximately the 11 o'clock position.

Tone Button. The tone button (3, figure 1–29) acts as a telegraph key, for transmitting code on any channel.

Normal Operation.

1. Function switch – As desired.
2. Intercom COMM UHF monitor switch – ON.

Allow equipment to warm up for 1 minute after the generator caution light goes out. If the caution light has already gone out, allow 1 minute warmup after the radio is turned on.

Note

- For greater accuracy on ADF, it is advisable to request transmitting station to transmit a carrier tone signal.
- For greater accuracy on ADF, fly at low altitudes (500 feet).

CAUTION

If a whirring, clicking noise is heard in the headset, do not operate the radio. This indicates the set is not fully warmed up or has not finished channelizing.

3. Intercom selector switch – COMM UHF.
4. Manual-preset-guard switch – As desired.

NOTE

The ADF will not home on personnel locator beacon signals or other guard transmission unless Manual-Preset-Guard switch is placed in the guard position or 143.0 MC is selected on a preset channel or tuned manually. Only the main receiver provides ADF capability.

5. Channel selector knob – As desired.

Turn selector knob to center the desired channel number in window. Allow about 8 seconds for completion of tuning cycle, or wait until clicking stops.

CAUTION

Severe damage to the equipment can result if this delay is not observed.

6. Manual frequency selector knobs – As desired.
7. Volume Knob – Approximately 11 o'clock position.
8. Microphone switch – As required.

Note

No transmission will be made on GUARD, except for emergency.

FM RADIO SET, AN/ARC-44 (AF60-266, 60-270, AND 62-4541 THRU 62-4543,  TCTO-576).

Description.

The FM radio set provides two-way communications between two or more aircraft or between aircraft and ground stations. The set operates in the frequency range of 24.0 to 51.9 megacycles on any of 280 preset channels. The effective receiving and transmitting range of the set is limited by line of sight to approximately 50 miles. Power for the set is supplied from the non-essential bus through the AN/ARC-44 circuit breaker on the console circuit breaker panel. The set is controlled from the panel (figure 1–29) marked FM, which contains the following controls:

Power ON-OFF Switch. The power switch (13) controls the power supply to the set.

Whole Megacycle Frequency Selector. The whole megacycle frequency selector (9) selects the first two numbers of the receiver and transmitter operating frequency.

One Tenth Megacycle Frequency Selector Lever. The one tenth megacycle frequency selector lever (10) selects the third number of the receiver and transmitter operating frequency.

REM-LOCAL Switch. The remote-local switch (14) is only used in dual installations. In this helicopter always leave the switch in the local position.

Volume Control. The volume control (11) provides control of the receiver audio output.

FM Squelch Switch. The FM squelch switch (12) when placed in the SQUELCH position, squelches the receiver output in your headset, according to a level which is preset on the receiver-transmitter unit. When the switch is placed in the OFF position, the squelching is cut out.

Normal Operation.

1. Intercom selector switch – COMM FM.
2. Intercom COMM FM monitor switch – ON.
3. Squelch switch – OFF.
4. Power ON-OFF switch – ON.

5. Whole megacycle frequency selector – Set.
6. One tenth megacycle frequency selector lever – Set.
7. Remote-Local switch – LOCAL.
8. Volume control – as desired.
9. Microphone switch – as required.

Note

If there is excessive background noise in your headset, place the FM squelch switch in the SQUELCH position. For reception of weak signals, place the FM squelch switch in the OFF position.

VHF COMMUNICATIONS RADIO.

Description.

The VHF (Very High Frequency) radio provides voice communication from aircraft-to-aircraft, or ground, in the frequency range of 116.00 to 151.95 megacycles. Its operation range is 30 miles at 1000 feet, 135 miles at 10,000 feet. The radio-transmitter has 680 crystal-controlled channels available at increments of 50-kilocycles. Power to operate the VHF radio equipment is supplied from the secondary bus, through VHF COMM XMTR and VHF COMM RECEIVER circuit breakers located on the console circuit breaker panel.

The radio control (labeled VHF COMM) (figure 1–29) is mounted on the console panel. The control provides channel switching functions, mode of operation, and power switching for the transmitter. The panel contains the following controls:

Power ON-OFF Switch. The power switch (16, figure 1–29) controls the power supply to the transmitter.

Frequency MC Window. The frequency megacycle dial (17, figure 1–29) indicates the operating frequency.

Megacycle Dial Control. The megacycle dial (15, figure 1–29) also called the course-frequency switch, provides one-megacycle switching steps for the transmitter. Readings are obtained from the first three digits on the frequency window (17, figure 1–29).

50-Kilocycle Dial Control. The kilocycle dial control (19, figure 1–29) also called the fine-frequency switch, provides 50-kilocycle switching steps for the transmitter. Readings are obtained from the last two digits (to the right of the decimal point) on the frequency window (17, figure 1–29).

Mode Switch. The mode-switch (18, figure 1–29) will be placed in SCS (single channel simplex), which allows both stations to transmit and receive on the same frequency. The helicopter is not wired for DCD (double channel duplex).

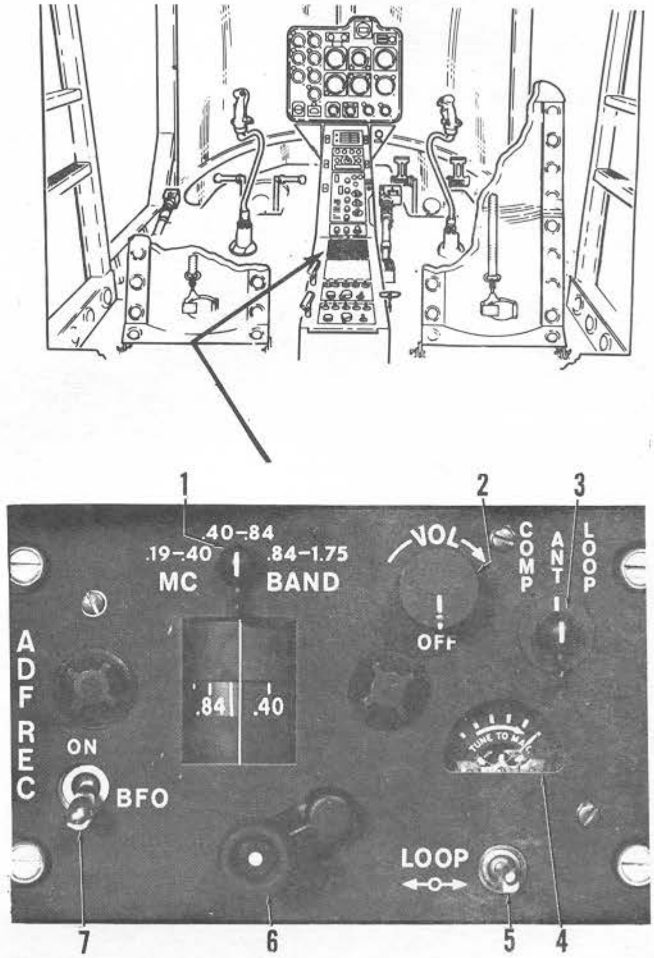
Squelch Control Knob. The squelch control knob (20, figure 1–29) reduces the background noise during operation. The squelch control is operative only over 118.0 megacycles.

Volume Control. The volume control knob, (21, figure 1–29) adjusts the audio level of the receiver.

Normal Operation.

1. Power Switch - ON.
2. Intercom selector switch - COMM VHF.
3. Intercom COMM VHF monitor switch - ON.
4. Mode switch - SCS.

AN/ARN-59 Radio Panel



1. BAND SWITCH
2. OFF-VOLUME KNOB
3. FUNCTION SWITCH
4. TUNING METER
5. LOOP SWITCH
6. TUNING CRANK
7. BEAT FREQUENCY OSCILLATOR

Figure 1–30

5. Tuning knobs - As desired.

6. Volume knob - As desired.

7. Squelch knob - As desired.

8. Microphone switch - As desired.

LF AUTOMATIC DIRECTION FINDER, AN/ARN-59.

Description.

The receiver may be operated within its frequency range of 190 to 1750 kilocycles, as an automatic direction finder (ADF), manual direction finder, or as a low frequency navigation (LF/NAV) receiver. Navigation bearings are provided on any continuous radio signal. The bearing of the transmitting station with respect to the helicopter is shown on number one bearing pointer of the radio magnetic indicator (3, figure 1–28). Power to operate the equipment is supplied from the secondary bus through the ARN-59 circuit breaker on the console circuit breaker panel, and the 26-volt ac bus through the number one bearing pointer fuse (labeled ID 250 NEEDLE NO 1) on the ceiling fuse panel (figure 1–19). The ADF receiver control panel (figure 1–30) is on the console, and contains the following controls:

Off-Volume Knob. The knob (labeled OFF-VOL 2, figure 1–30) turns the equipment on and off, and controls volume of audio signal.

Band Switch. The band switch (labeled MC BAND; 1, figure 1–30) is used to select the frequency band in which equipment will operate. Three bands are available. The band selected is displayed on the frequency dial.

Tuning Crank. The tuning crank (6, figure 1–30) tunes the receiver to the desired frequency, which is displayed on the frequency dial.

Function Switch. The function switch (3, figure 1–30) has three positions, labeled COMPASS (COMP), ANTENNA (ANT), LOOP. In COMPASS position, both loop and sense antennas are connected, and equipment functions as an automatic direction finder. In ANTENNA position, only the sense antenna is connected, and equipment functions as a standard low frequency range receiver. In LOOP position, only the loop antenna is connected and the LOOP switch may be used to rotate the loop antenna for manual direction finding, or to improve reception.

Loop Switch. The loop switch (labeled LOOP; 5, figure 1–30) rotates the loop in either direction regardless of function switch position. The switch is used to position the loop antenna when function switch is in LOOP position. The switch is also used to override an incoming signal momentarily to test signal reliability with function switch in COMP position.

Tuning Meter. With function switch in COMP position, peak deflection of the meter (4, figure 1–30) indicates proper tuning.

Beat Frequency Oscillator Switch. The beat frequency oscillator switch (labeled BFO; 7, figure 1–30) turns the beat frequency oscillator (BFO) on and off. The BFO is used to make CW transmissions audible during low frequency radio range operations, and during loop operation with unmodulated voice, or music modulated signals, to produce a steady single frequency tone. When tuning a CW signal, as the receiver is tuned from one side of the signal to the other, the tone will decrease from a high pitch to zero and then increase again on the other side of zero. When using the BFO, tune to the lower of the two dial readings at which the high pitch tone is obtained.

WARNING

Do not place the BFO switch ON when the function switch is set to COMPASS; this will cause incorrect indications.

Normal Operation.

To operate the equipment, proceed as follows:

1. Off-volume knob – ON.
   Allow equipment to warm up for 30 seconds.
2. ADF monitor switch – ON.
   Switch is located on the intercom panel (figure 1–27).
3. Function switch – ANTENNA.
4. Band switch – As desired.
5. Off-volume knob – Adjust.
   Increase volume until background noise (or station if already tuned in) is heard.
6. Tuning crank – Adjust and identify station.
   Rotate crank until station frequency is aligned with frequency dial hairline. With function switch in ANT/LOOP position tune for maximum audible signal. Switch to COMPASS position and tune for maximum meter deflection.
7. Off-volume knob – As desired.
8. Function switch — As desired.

RADAR IDENTIFICATION SET (IFF) AN/APX-72 (TCTO-510)

Description.

The purpose of the IFF set is to enable you to be identified whenever you are challenged by proper signals from other appropriate radar recognition equipment at land bases, aboard ship, or in other aircraft. The set also enables you to be identified when you are flying among numerous other friendly aircraft. The signals transmitted by the IFF set in response to the challenging signals from the surface stations are received by the surface equipment and displayed visually on the face of a radar scope. The IFF control panel (9, figure 1–30A) is located on the nose console. Electrical power for the IFF equipment is supplied from the secondary bus through the IFF receiver transmitter (IFF R/T unit) circuit breaker on the ceiling panel. Electrical power for all nose console lights is supplied from the essential bus through the IFF INSTRUMENT (INST) LIGHTS circuit breaker on the ceiling panel.

IFF Monitor Switch. The IFF monitor switch (1, figure 1–30B) has two positions, labeled ADF and IFF. The switch is used to select either ADF or IFF audio signals to be heard in the pilot's and copilot's headsets. The IFF monitor switch is in series with the ADF monitor switches (1, figure 1–27) on the pilot's and copilot's intercom panels. The intercom panel ADF switches must be ON for reception of either ADF or IFF audio signals.

Normal and Emergency Operation.

Set IFF panel switches in accordance with current directives.

FM-622A RADIO SET (TCTO-511).

Description.

The FM-622A radio set is capable of operating on 920 communications channels, spaced 50KC, within the tactical frequency modulation (FM) band of 30 to 75.95 MC. The set provides two-way communications between air-to-air and air-to-ground stations. The set is also used in conjunction with the homing indicator (6, figure 1–30A) to enable the pilot to home on FM or CW signals. The indicator provides left-right, over target, and signal strength indications when the set is used in the homing mode. Electrical power for the set is supplied from the secondary bus through the FM-622 circuit breaker on the ceiling panel. The set is controlled from the panel (2, figure 1–30B) marked FM COMM.

Mode Switch. The mode switch (6, figure 1–30B) applies power to the radio set and selects the mode of operation. In the OFF position primary power is removed from the Radio Set. In the T/R (transmit/receive) position power is applied and the radio set operates in normal communications mode. The RETRAN (retransmit) position is not used in this helicopter. In the HOME position power is applied and the radio set and homing indicator operate as a homing facility.

Frequency Selector Knobs. The frequency selector knobs (3, figure 1–30B) are used to control the operating frequency of the set, within its range of 30 to 75.95 MC. The left-hand frequency selector knob selects the tens megacycle frequency; the second selects the units megacycle frequency; the third selects the tenths megacycle frequency, the right-hand control selects the hundredths megacycle frequency. The selected frequency is displayed by the associated frequency digit indicators located directly above the frequency selector knobs.

Squelch Switch. The squelch switch (4, figure 1–30B) is a three-position rotary switch. In the disable (DIS) position the squelch circuits are disabled and the squelch remains open (audio is heard). In the carrier (CARR) position the squelch opens in the presence of any carrier. In the TONE position the squelch opens only on signals containing a 150 CPS tone modulation.

Normal and Emergency Operation.

Set knobs and switches as desired.

KY28 SECURE SPEECH EQUIPMENT (TCTO-512).

Description.

The KY28 secure speech equipment provides scrambled voice communication between the UHF radio or the FM radio and another radio with KY28 equipment. Electrical power is supplied from the essential bus through the KY28 circuit breaker on the ceiling panel. The control panel (1, figure 1–30A) is labeled CIPHONY, and is located on the nose console. The panel contains the following switches (see figure 1–30A):

Power Switch. The power switch (2) turns the equipment ON or OFF.

Delay Switch. The delay switch (8) function is not used in this helicopter. The delay switch must be in the OFF (down) position for the equipment to operate.

Mode Switch. The mode switch (3) has 3 positions, labeled cipher radio 1 (C/RAD 1) PLAIN, and cipher radio 2 (C/RAD 2). Indicator lights show the position of mode switch. With the mode switch in C/RAD 1 FM-622A communications are scrambled. With the mode switch in C/RAD 2 UHF communications are scrambled With the switch in PLAIN all communications are normal.

NOTE

For plain operation of the UHF or FM radio the mode switch must be in PLAIN whether the KY28 power switch is ON or OFF.

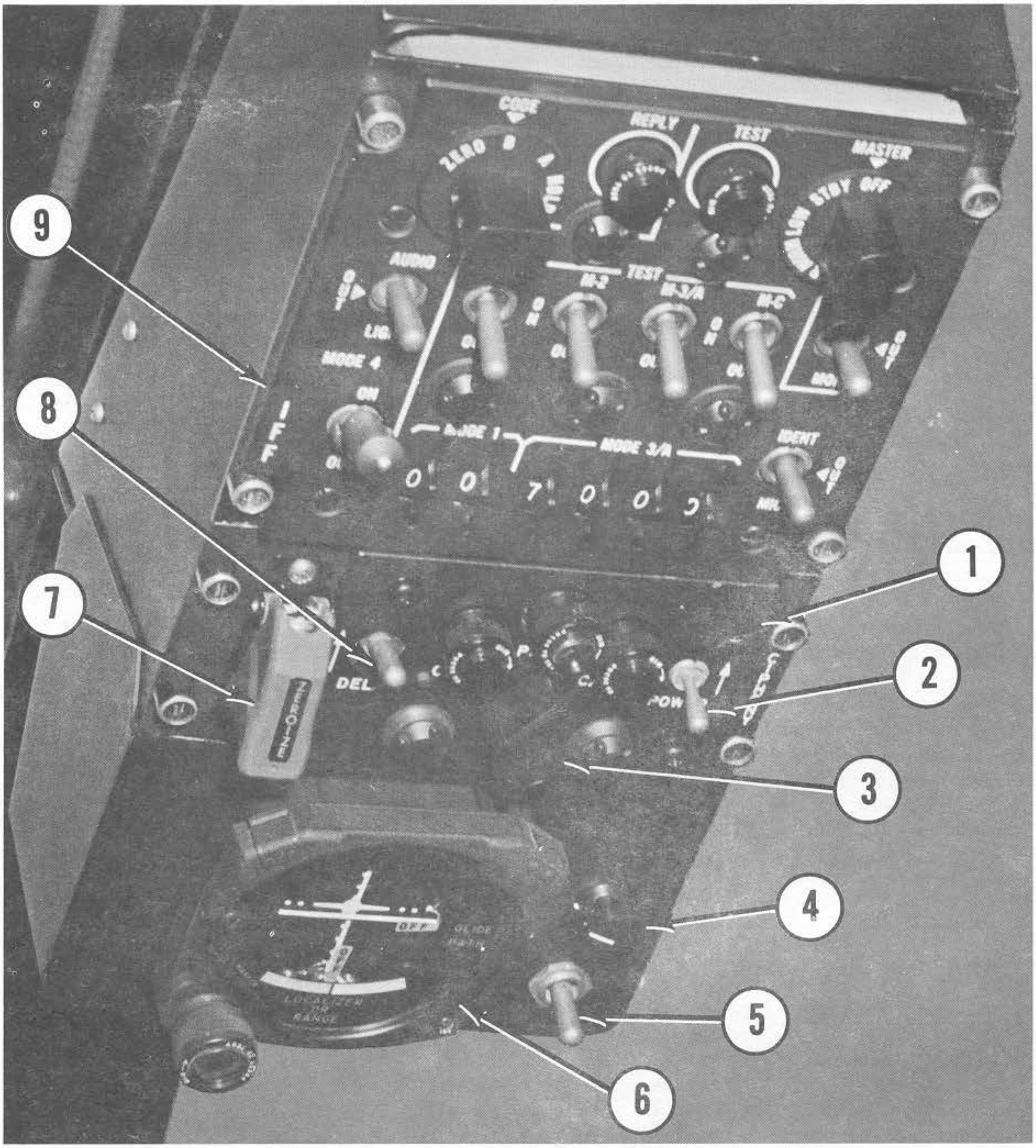
Zeroize Switch. The guarded zeroize switch (7) is used to electrically remove the preset code which makes the KY28 equipment useless until it can be recoded by qualified ground personnel.

Normal Operation.

WARNING

Simultaneous keying of the secure and insecure communications systems is prohibited.

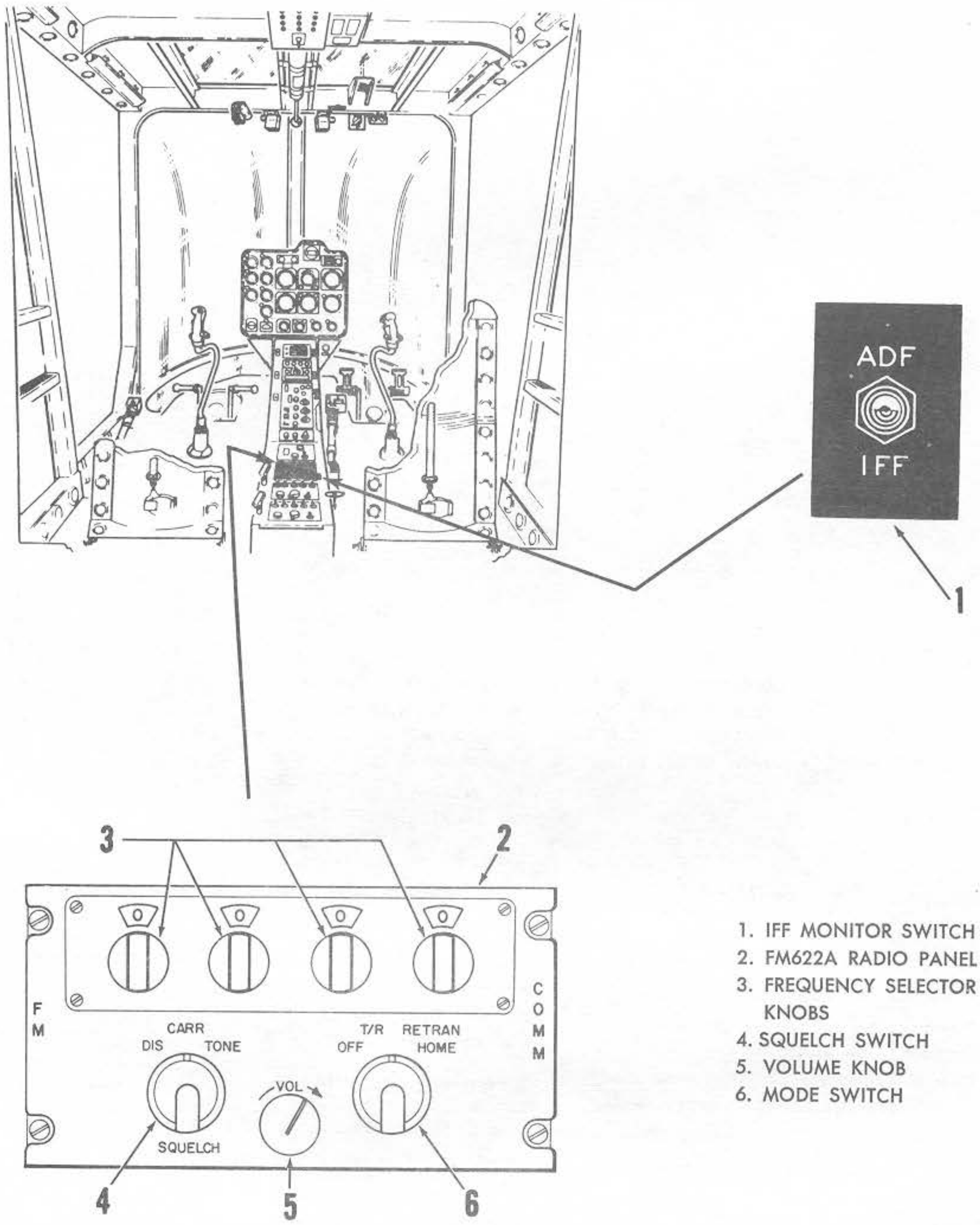
Nose Console, Typical



1. KY28 PANEL
2. KY28 POWER SWITCH
3. KY28 MODE SWITCH
4. NOSE CONSOLE LIGHTS DIMMING KNOB
5. NOSE CONSOLE LIGHTS SWITCH
6. FM622A HOMING INDICATOR
7. KY28 ZEROIZE SWITCH
8. KY28 DELAY SWITCH
9. AN/APX-72 IFF PANEL

Figure 1—30A

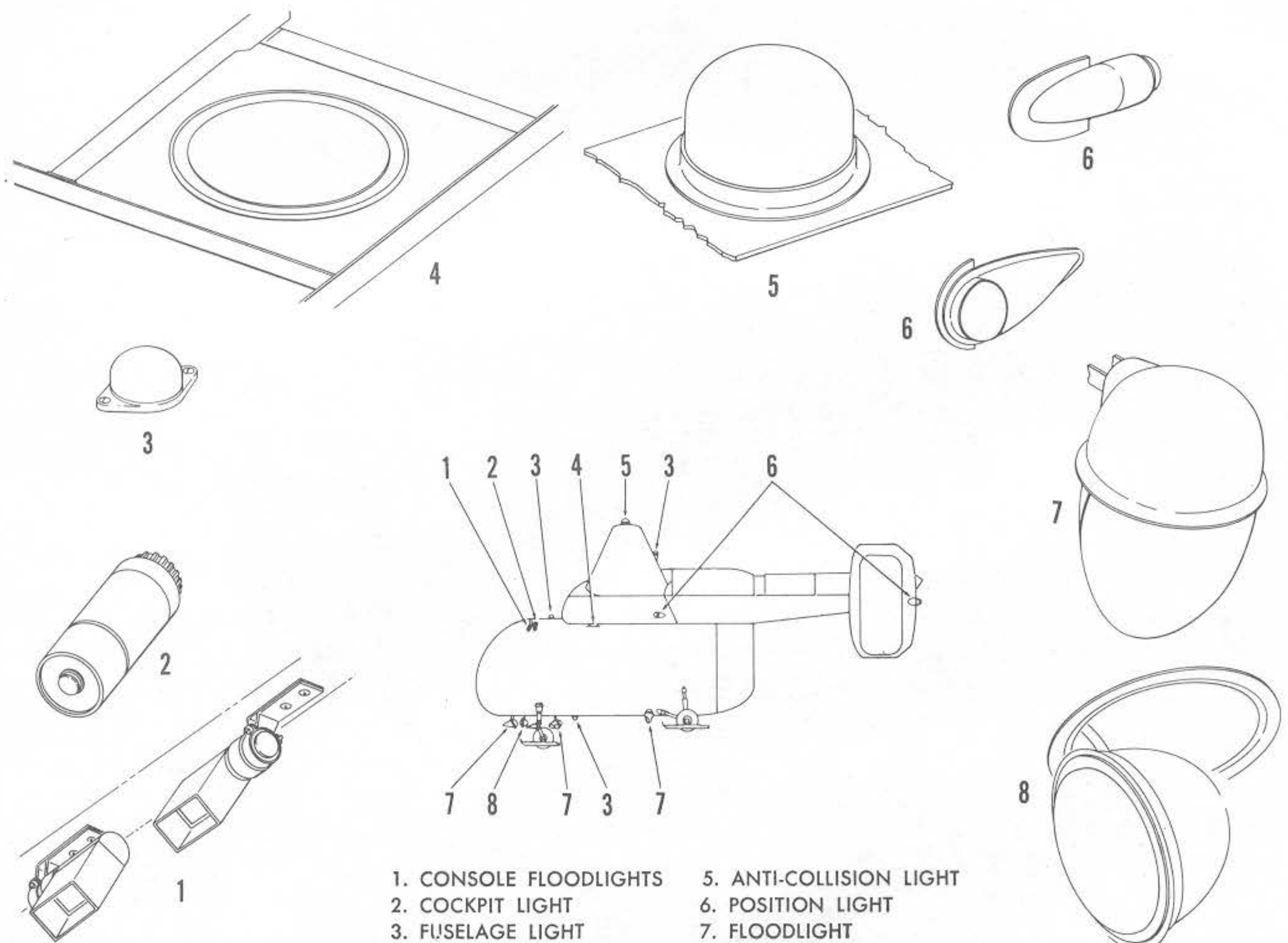
FM622A Radio Panel and IFF Monitor Switch



1. IFF MONITOR SWITCH
2. FM622A RADIO PANEL
3. FREQUENCY SELECTOR KNOBS
4. SQUELCH SWITCH
5. VOLUME KNOB
6. MODE SWITCH

Figure 1–30B

Lighting System



1. CONSOLE FLOODLIGHTS
2. COCKPIT LIGHT
3. FUSELAGE LIGHT
4. CABIN DOME LIGHT
5. ANTI-COLLISION LIGHT
6. POSITION LIGHT
7. FLOODLIGHT
8. LANDING LIGHT

Figure 1—31

To operate the equipment, proceed as follows:

1. Mode switch – PLAIN.
2. UHF and FM radios – Ready in T/R or T/R + G.
3. Mode switch – C/RAD 1 or C/RAD 2.
4. Power switch – ON.
   A pulsating tone should be heard.
5. Microphone switch – Press for about one second. If the pulsating tone disappears the equipment is ready for use. If a steady or pulsating tone is heard the equipment requires maintenance before further use.

NOTE

Steps 1 thru 5 must be repeated each time the KY28 power switch is turned from OFF to ON or electric power has been interrupted.

6. Microphone switch – Press.
   After about 1/2 second a "beep" should be heard, indicating that scrambled communications can be made.

If normal communications ADF, or homing operation is desired move the mode switch to PLAIN or to cipher for the other radio. To turn the equipment off move the power switch to OFF.

Emergency Operation.

Use of the zeroize switch, to make the equipment temporarily useless, shall be in accordance with local directives.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING.

The exterior lighting system consists of navigation and fuselage lights, a landing light, floodlights and an anti-collision light. Switches for the lights are on the console (figure 1—8) or the pilot's collective pitch lever (figure 1—32.)

Navigation Lights and Switches.

Three position lights (6, figure 1–31) are provided as follows: a white tail light is on the left-inboard fin, a red light is forward of the left-hand tailboom, and a green light is forward of the right-hand tailboom. Three white fuselage lights (3, figure 1–31) are mounted on the fuselage, one near the trailing edge of the left pylon, one between the clear panels over the cockpit, and one under the fuselage forward of the cargo hook. Two navigation light switches (labeled NAV LTS) on the console switch panel control all six lights. When the three-position flashing switch (labeled STEADY OFF FLASH; 16 figure 1–8) is in STEADY, position and fuselage lights are illuminated. When the flashing switch is moved to FLASH, position lights illuminate alternately with the white fuselage lights. The other switch is a two-position switch (17, figure 1–8) which controls brilliance, and is labeled DIM and BRIGHT (BRT). Electric power to operate the lights is supplied from the secondary dc bus through a circuit breaker marked EXTERIOR LIGHTS on the ceiling circuit breaker panel (figure 1–19).

Landing Light and Switches.

The retractable landing light (8, figure 1–31) is recessed into the lower forward fuselage, and is controlled by two switches at the top of the collective pitch lever. The landing light motor switch (2, figure 1–32) has three positions, labeled EXTEND (EXT), OFF, and RETRACT (RET). The landing light motor switch is used to extend the light down and forward through an arc of about 80 degrees. The light can be stopped in any intermediate position by placing the switch to OFF. The switch labeled LAND LT ON OFF turns the light on and off. The light will not come on until it has been extended approximately 10 degrees, and will go off automatically if it is retracted to the 10-degree position while it is still on. Power to operate the light is supplied from the secondary bus through the circuit breakers marked LANDING LAMP and LANDING LIGHT MOTOR, on the console circuit breaker panel (figure 1–19).

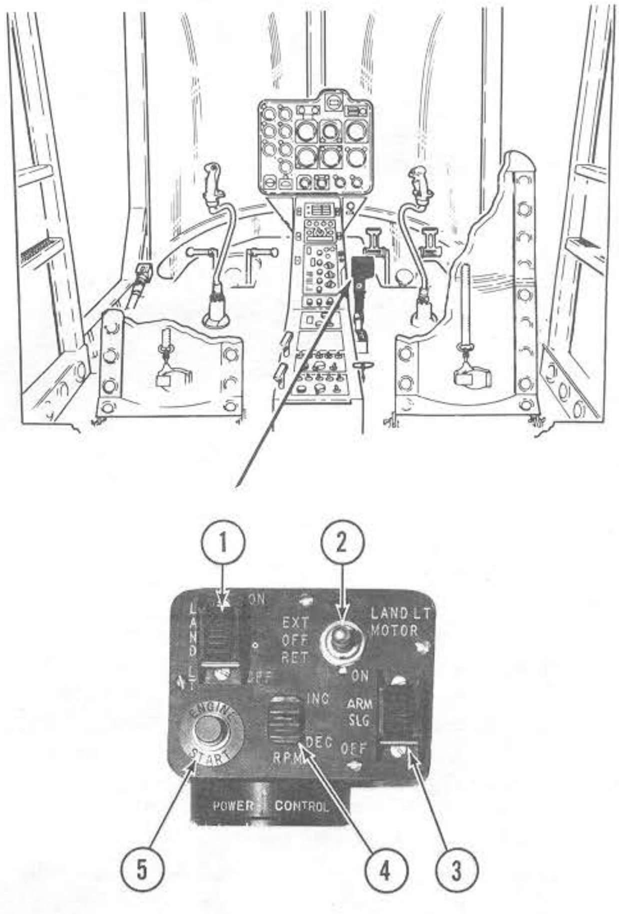
Floodlights and Switch.

Three fixed rescue floodlights (7, figure 1–31) are mounted on the lower fuselage. On/off switching for all three lights is provided by the floodlight switch (labeled FLD LT; 24, figure 1–8). Power to operate the lights is supplied from the secondary bus through the floodlamp and floodlight control circuit breaker panel (figure 1–19).

Anti-collision Light and Switch.

The red, rotating anti-collision light (5, figure 1–31), mounted between the pylons, is turned on and off by the anti-collision light switch (15, figure 1–8) on the console switch panel. Power to operate the light is supplied from the secondary bus through a circuit breaker, labeled ANTI-COLLISION LIGHT, located on the ceiling circuit breaker panel (figure 1–19).

Pilot's Collective Pitch Lever Switch Panel



1. LANDING LIGHT ON/OFF SWITCH
2. LANDING LIGHT MOTOR SWITCH
3. SLING ARMING SWITCH (AFTER TCTO-563) (FLOODLIGHTS SWITCH, BEFORE TCTO-563)
4. ENGINE SPEED GOVERNOR
5. STARTER SWITCH

Figure 1–32

WARNING

The rotating anti-collision light should be turned OFF during flight through heavy fog and clouds that could cause rotating reflections of the light. Such rotating reflections can result in spatial disorientation.

INTERIOR LIGHTING.

The interior lighting consists of the console floodlights, cockpit light, instrument panel lights and a cabin dome light.

Console Floodlights and Rheostat.

Two red console floodlights (1, figure 1—31), positioned directly over the console on the cockpit ceiling, provide illumination of all instruments and console controls. The console floodlights rheostat (5, figure 1—15) is mounted to the right of the floodlights on the cabin ceiling and provides brilliancy control from OFF to BRIGHT (BRT). Power to operate the lights is supplied from the essential bus through the circuit breaker, marked COCKPIT LIGHTS, on the ceiling circuit breaker panel (figure 1—19).

Cockpit Light and Switch.

A type C4 cockpit light (2, figure 1—31), connected to a flexible cord, is mounted in a retaining socket on the ceiling above the copilot's seat. An extra retaining socket is provided on the ceiling above the pilot's seat. The light is detachable and may be moved about to take care of special lighting situations. A rheostat on the light is used to vary the intensity of the light. In addition to this, a push button switch enables the pilot to bypass the rheostat and obtain maximum spotlight brilliance instantaneously. Power to operate the light is supplied from the essential bus through the circuit breaker, marked COCKPIT LIGHTS, on the ceiling circuit breaker panel (figure 1—19).

Instrument Lights and Rheostats.

All instruments and console control labels are illuminated by red edge lights that can be varied from OFF to BRIGHT by rheostats located on the console switch panel. Separate rheostats are provided for flight instruments (9, figure 1—8), engine instruments (10, figure 1—8), and the console (11, figure 1—8). Power to operate the lights is supplied from the essential bus through the instrument and edge light circuit breaker (labeled INST & EDGE LIGHTS) located on the ceiling circuit breaker panel (figure 1—19).

Dome Light and Switch.

The cabin dome light (4, figure 1—31) is mounted on the aft cabin ceiling, and provides white or red illumination of the entire cabin interior. A three-position switch (26, figure 1—8) labeled WHITE-OFF-RED CABIN DOME LIGHT (LT), is located on the console. Power to operate the light is supplied from the essential bus through the cockpit lights circuit breaker on the ceiling circuit breaker panel (figure 1—19).

CARGO HOOK SYSTEM

DESCRIPTION.

A cargo hook (see figures 1—33 and 1—34) mounted externally in the center of the fuselage belly, is used to carry fire suppression equipment or cargo. Equipment to be carried is suspended from the hook by a suitable sling. An external release lever on the hook permits the ground crew to open the hook. The sling can be released automatically by a weight sensing switch or by the pilot's operation of an electrical sling release switch. In case of electrical failure a manual release lever is provided in the cockpit. Electrical power for electrical sling release is supplied from the essential bus through the hoist/cargo hook control circuit breaker on the console circuit breaker panel (figure 1—19). A sheer pin, designed to prevent damage to the helicopter structure, is utilized to attach the cargo hook to the fuselage. Excessive loads will cause the pin to shear, releasing both the cargo and the hook. For automatic release the weight on the hook arm must be at least 35 pounds, but not more than 100 pounds. Refer to Section V for cargo hook load limits.

Sling Arming Switch.

A two-position switch (labeled ARM SLING OFF) is used to arm the cargo hook system. The switch must be ON (ARM SLING) for either automatic or sling drop button electrical release.

On AF64-17557 and subsequent, or after incorporation of TCTO-563, the switch is located on the pilot's collective switch panel (3, figure 1—32). On AF63-9717 and previous the switch is located on the console.

Note

(AF64-17557 and subsequent, TCTO-563) The sling arming switch should be turned OFF as soon as possible after it is evident that the cargo has been released. The hook will cycle rapidly between locked and unlocked, and the amber cargo hook light will glow until the sling arming switch is turned OFF.

Automatic Sling Release Switch.

The automatic sling release (AUTO SLING RELEASE) switch (4, figure 1—8) is located on the console. Placing the switch in the ON (AUTO SLING RELEASE) position, with the sling arming switch ON, will arm the automatic circuit. A weight sensing switch, in the cargo hook, completes the circuit when the weight on the hook is reduced to 35 to 100 pounds.

CAUTION

The cargo hook cannot be locked if automatic sling release switch is ON during cargo hookup.

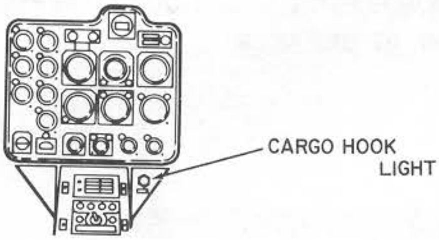
Sling Drop Button.

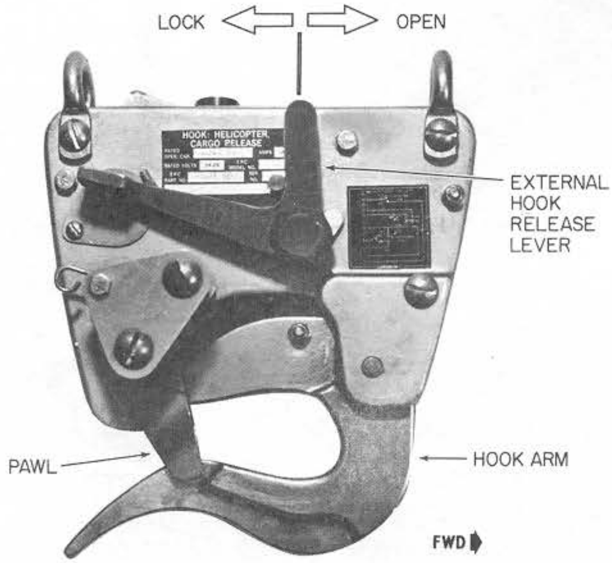
The sling drop button (5, figure 1—26), on the pilot's cyclic stick grip, is used to electrically release the sling. It will release the sling even though the automatic sling release switch is ON.

Manual Cargo Release Lever.

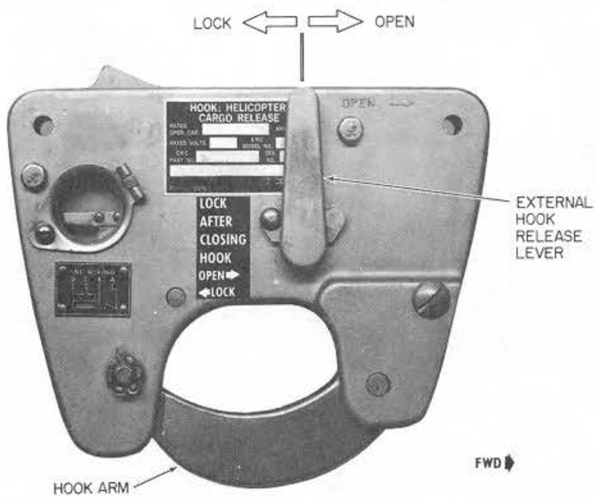
A manual cargo release lever (21, figure 1—7) is located on the right side of the console next to the pilot's seat. When pulled, it mechanically releases the

Cargo Hook and Cargo Hook Light





AF64-17557 and Subsequent, TCTO-563.



AF63-9717 and Previous.

Figure 1—33

sling, regardless of the position of the cargo hook switches.

External Hook Release Lever.

An external hook release lever is located on the right side of the hook (figure 1—33).

AF64-17557 and Subsequent, TCTO-563. When the lever is moved forward to the OPEN position it opens the spring-loaded hook arm for ground crew release of cargo. After the cargo sling has cleared, the hook arm will move upward to the closed position. The hook arm must then be locked by moving the hook release lever to OPEN and then to LOCK.

Note

Moving the hook release lever to OPEN allows the hook arm to enter the latching mechanism so that the arm can be LOCKED.

Cargo is attached with the hook arm closed and locked. As the cargo sling is pushed over the hook, the sling will raise the spring-loaded pawl which will then snap down to keep the sling in the hook.

AF63-9717 and Previous. When the lever is moved forward to the OPEN position, it releases the hook arm for attachment of cargo. After cargo is attached, the hook arm is slammed upward, and latches. It must then be locked by moving the external release lever rearward to the locked position. This forces the latch mechanism in such a direction that the latch will positively lock the hook in the closed position. Observing the position of mechanical parts through the sight window or tugging on the hook after it is closed is not a positive indication that the hook is locked.

Cargo Hook Light.

A cargo hook light (figure 1—33) is located below the lower right corner of the instrument panel. Power to operate the light is supplied from the essential bus through the cargo hook indicator circuit breaker on the console breaker panel (figure 1—19).

Cargo Hook Unlocked Light (AF64-17557 and Subsequent, TCTO-563). The cargo hook unlocked light is amber, and glows when the hook arm is not locked. When the hook is closed and locked the light is off.

Cargo Hook Release Light (AF60-251 thru 63-9717, TCTO-621). The cargo hook release light is green, and glows when the hook is open. When the hook is closed the light is off; however, this does not assure that the hook is locked.

Cargo Hook System

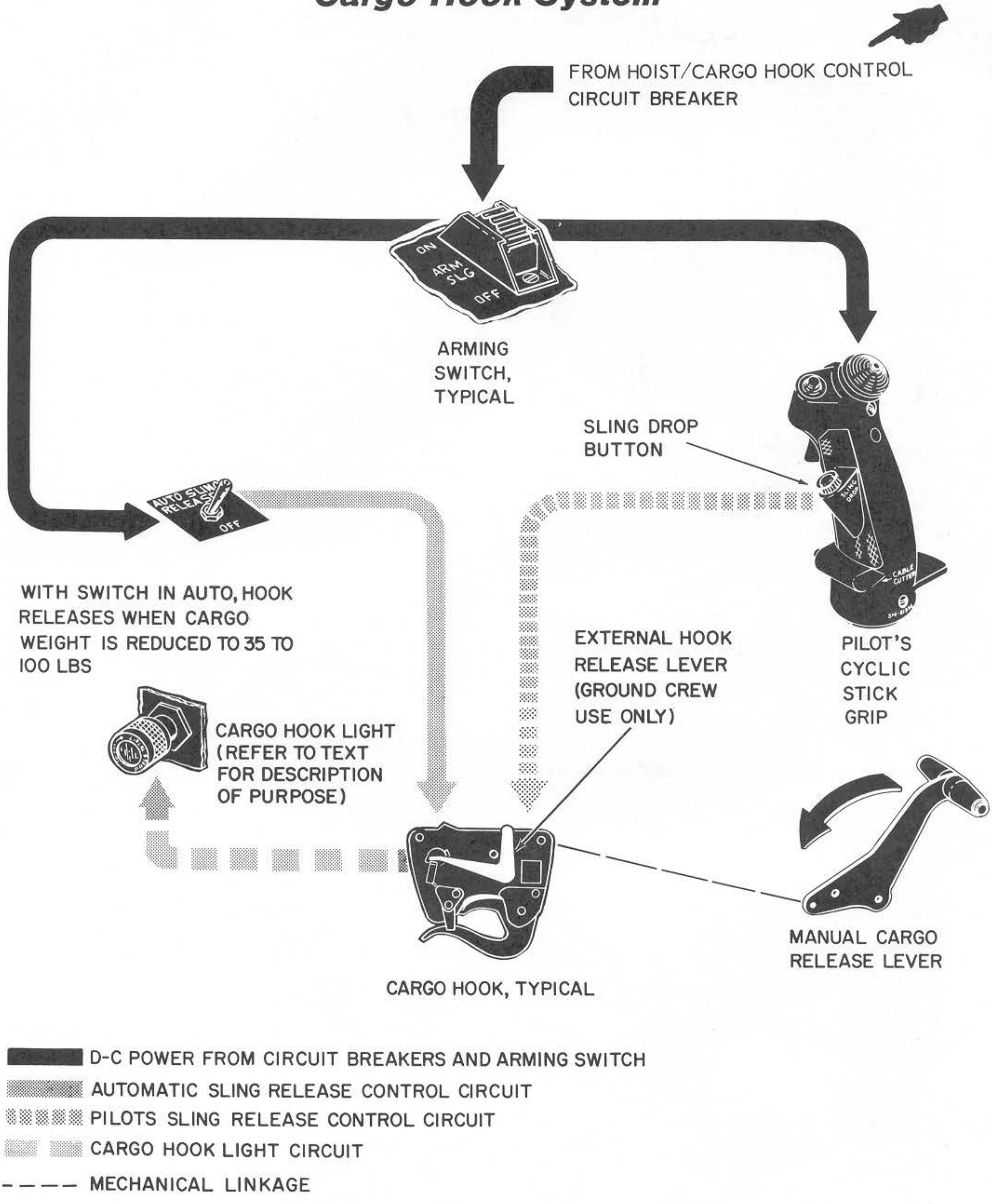


Figure 1–34

NORMAL OPERATION.

To pick up and carry external cargo, proceed as follows: (Refer also to **CARGO HOOK SAFETY**, Section IV).

1. Sling arming switch – ON.
   Hover over the pickup area for attachment of sling by ground crew. (See Section V for limitations on cargo hook loads.) After receiving signal that load has been attached, increase collective pitch until restraint of load is felt. Firmly increase collective pitch until the load is airborne.

WARNING

Avoid abrupt takeoffs as they may shear the shear pin, thus dropping the load, possibly injuring ground personnel, and damaging the load and the hook.

2. Sling arming switch – OFF (at safe altitude). Turn arming switch off to avoid accidentally releasing the sling during flight.

WARNING

- To avoid accidental release of loads in flight, care must be taken to insure that any external cargo is not oscillating excessively before turning the automatic sling release switch ON. For cargo weighing 125 pounds or less do not use the automatic sling release.
- Extreme care must be exercised when carrying low density external cargo to insure that the cargo does not oscillate excessively and inflict structural damage to the airframe or rotor blades. Very low air speeds should be observed. Low density loads have been known to oscillate excessively at airspeeds as low as 20 knots.

CAUTION

- When flying with loads attached to hook do not make uncoordinated turns.
- Avoid high rates of descent when carrying external cargo, as an excessive amount of power may be required to stop the descent. Sufficient power may not be available, or transmission torque limits may be exceeded.
- Avoid excessive oscillation of external cargo during high g conditions.

To release external cargo electrically, proceed as follows:

1. Sling arming switch – ON.
2. Sling drop button – Press and hold.
3. Helicopter – Raise vertically until the cargo sling is separated from the cargo hook.

CAUTION

(AF17557 and subsequent, TCTO 563)
The sling drop button must remain depressed until the cargo sling is clear of the hook. Releasing the sling drop button relocks the cargo hook and makes cargo sling release impossible. Illumination of the cargo hook unlocked light indicates only that the hook is unlocked and not that the cargo sling has dropped clear of the hook.

To release external cargo automatically, proceed as follows:

1. Sling arming switch – ON.
2. Automatic sling release switch – AUTO SLING RELEASE.

   Allow cargo to rest on ground.
3. Helicopter – Raise vertically until the cargo sling is separated from the cargo hook.

CAUTION

(AF59-1593 and previous)
Until a cargo hook release light is incorporated, a visual check following all cargo releases will be made to insure that the cargo has been released.

WARNING

Do not allow the helicopter to move backward. Backward flight without complete separation could result in severe damage.

CAUTION

(AF17557 and subsequent, TCTO 563)
Illumination of the cargo hook unlocked light indicates only that the cargo hook is unlocked and not that the cargo sling has dropped clear of the hook.

4. Automatic sling release switch – OFF.
5. Sling arming switch – OFF.

MANUAL OPERATION.

If sling drop button does not release load, pull the manual cargo release lever.

Rescue Hoist System

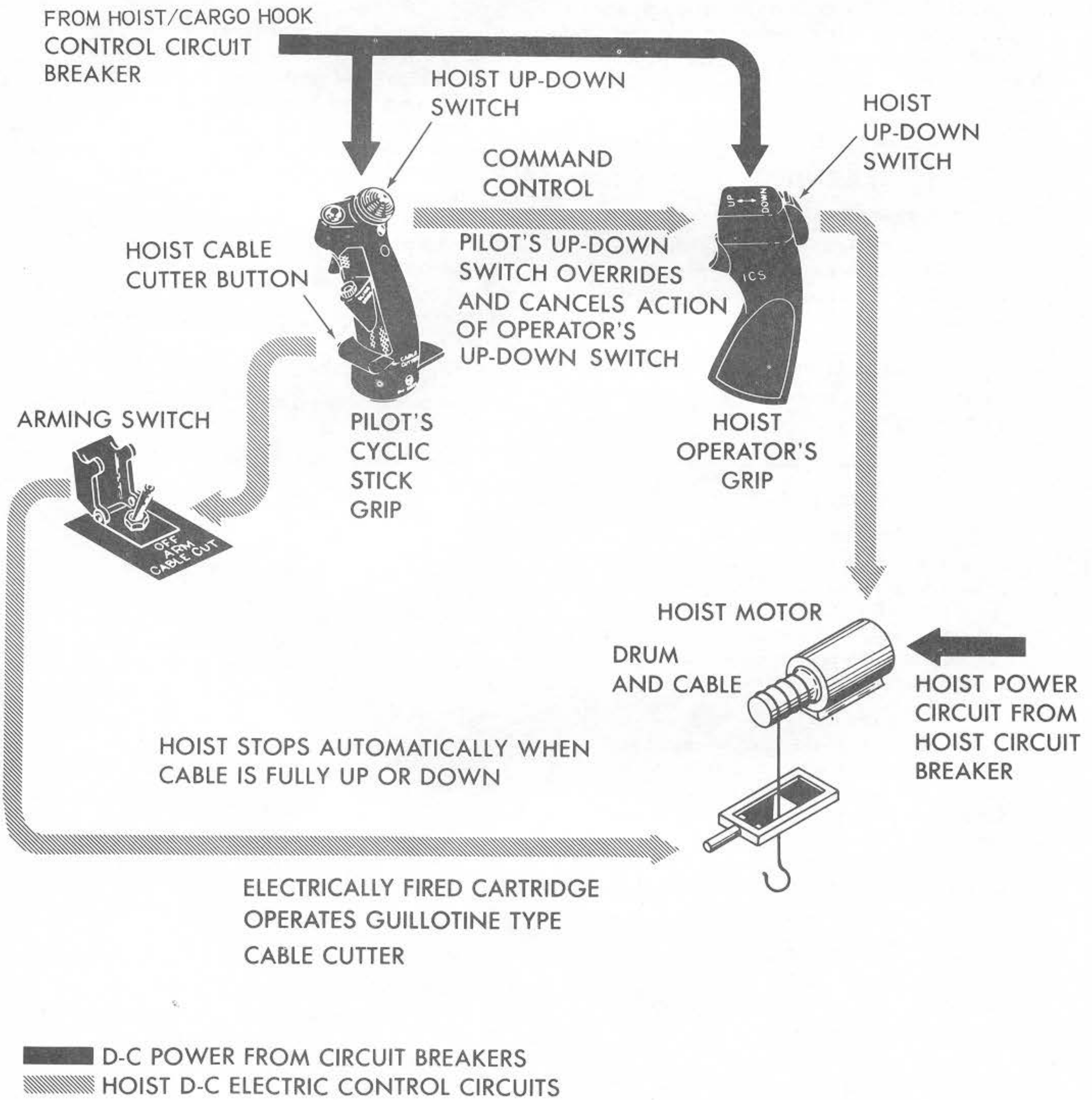


Figure 1—35

RESCUE HOIST SYSTEM

DESCRIPTION.

The rescue hoist (figure 1–35) motor and cable drum are mounted between the pylons. The drum is equipped with 100 feet of cable, which is fed over a pulley mounted on a tripod above the cabin side door. A safety latch hook is attached to the cable by means of a damper which reduces shock loads to the helicopter, and to personnel being rescued. Operation of the hoist is controlled by the pilot or the hoist operator. When the cable is fully up or down, limit switches automatically stop the hoist. An automatic brake will hold the cable in any position at which it is stopped. A pilot-controlled cable cutter is used to cut the cable if it becomes entangled with ground objects and cannot be released in any other way. Power to operate hoist controls is supplied from the essential bus through the hoist control circuit breaker on the console circuit breaker panel. Power for the hoist motor is supplied from the secondary bus through the hoist circuit breaker on the ceiling panel (figure 1–19). Refer to Section V for rescue hoist load limits.

An adjustable safety harness (figure 1–36) is provided for the hoist operator during rescue operations. It consists of a safety belt, shoulder straps and an adjustable anchoring strap with a safety hook attached. Before rescue operations the safety hook is secured to a retaining ring (1, figure 1–36) in the forward center area of the cabin ceiling. Refer to Section IV for hoist operator's duties.

Hoist Up-down Switches.

Hoist UP-DOWN switches (3, figure 1–26) are located on the pilot's cyclic grip, and the hoist operator's grip. Operation of the pilot's switch will override the hoist operator's switch giving the pilot control of the hoist in an emergency.

Cable Cutter Arming Switch.

The cable cutter arming switch (marked ARM CABLE CUT; 3, figure 1–8) is a two-position ON (position not labeled)-OFF switch on the console. Placing the switch to ON completes the circuit between the hoist cable cutter button and the cable cutter. With the cable cutter arming switch ON, to cut the cable, it is only necessary to press the hoist cable cutter button.

Cable Cutter Button.

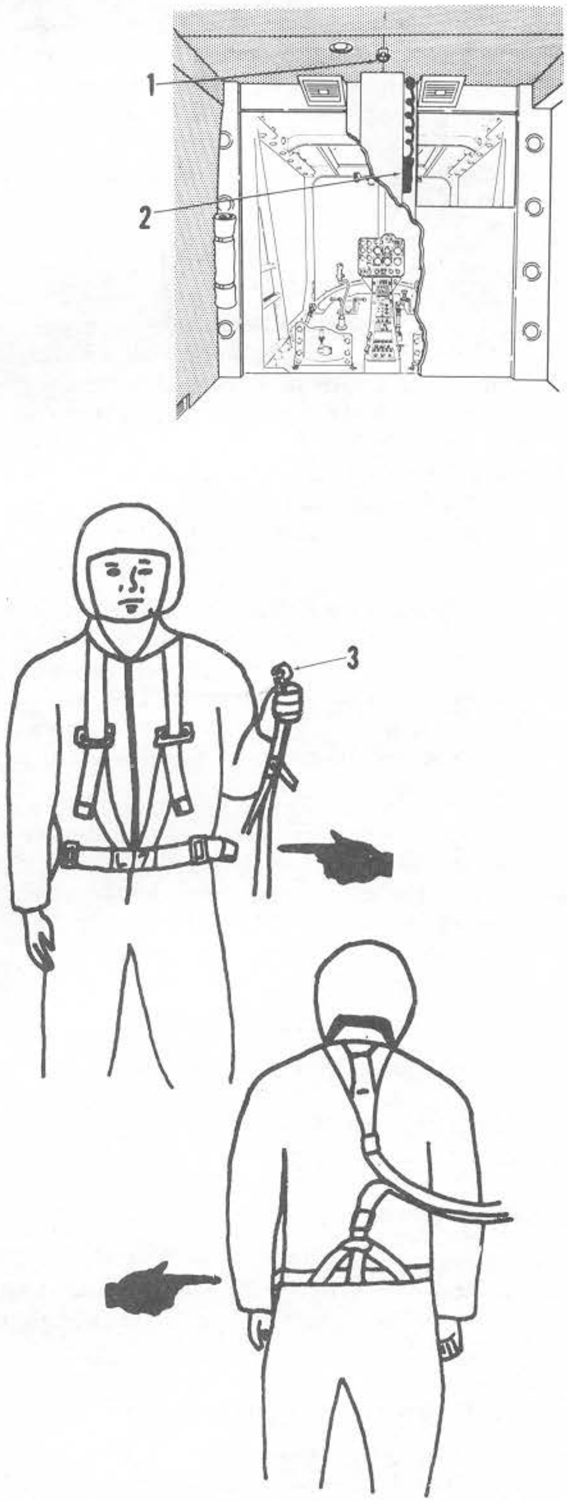
The cable cutter button (4, figure 1–26) is on the pilot's cyclic grip. Pressing the button, when the circuit is armed, electrically fires a cartridge in the cable cutter.

NORMAL OPERATION.

To operate rescue hoist proceed as follows:

1. All non-essential electrical equipment—OFF.
2. Hoist circuit breaker—ON.
3. Cable cutter arming switch—As desired.

Hoist Equipment



1. HOOK RETAINING RING
2. HOIST OPERATOR'S GRIP
3. HOIST OPERATOR'S HARNESS HOOK

Figure 1–36

4. Hoist UP-DOWN switch—Actuate as necessary. Either pilot or hoist operator may actuate.

Note

To reduce the possibility of overheat damage to the hoist motor, do not unnecessarily stop and start the hoist during up or down travel. Whenever possible, allow at least 20 seconds between lowering and raising operations. These restrictions do not apply during actual rescue operations.

WARNING

- When raising the rescue hoist with no load, hand-guide the cable as the cable terminal approaches the UP limit switch, and stop the up motion before the cable terminal enters the UP limit switch actuating rollers. Failure to do this may result in severe whipping of the hook, which causes rapid failure of the cable.
- Under certain conditions the sudden release of high loads or tension from the hoist cable or any improvised use of rope could result in "whiplash" of the rope or cable. This "whiplash" action can cause injury to the flight crew and can cause the rope or cable to enter the rotor system.
- Because it is characteristic of the hoist cable that it will rotate rapidly when the hoist is loaded, rescuees should keep hands away from the cable and the damper assembly. The hoist operator should wear gloves, at all times while handling the hoist cable, to prevent injury.

To turn equipment off, proceed as follows:

1. Cable cutter arming switch—OFF.
2. Hoist circuit breaker—OFF.

EMERGENCY OPERATION

The pilot may operate the rescue hoist UP-DOWN switch as necessary, overriding the hoist operator's switch, and may, if necessary press the cable cutter button to sever the cable.

CARGO CARRYING EQUIPMENT

The cabin floor is equipped with ten cargo tiedown rings. The floor is accessible for loading through the clamshell doors, or the cabin side door (see figure 1–42).

The cargo tiedown rings will withstand loads of 1250 pounds applied vertically and 500 pounds applied parallel to the floor. Both loads may be applied simultaneously.

The cargo floor will support loads up to 300 pounds per square foot, or up to 180 pounds per square inch for point loading.

The cabin step area will support loads up to 200 pounds per square foot, or up to 60 pounds per square inch for point loading.

No loads should be placed in the clamshell door area.

CAUTION

These values are based on a 1g condition. If higher g loads are expected, divide the above values by the total g's anticipated.

WARNING

This information is not intended as weight and balance data or cargo weight limits. Refer to Section V for cargo weight limits, the Technical Manual Basic Weight Checklist and Loading Data, and the Handbook of Weight and Balance.

TROOP CARRYING EQUIPMENT

Removable seat cushions and backrests, with lap-type safety belts and shoulder harnesses, are provided in the cabin area (figure 1–3).

WARNING

- When hauling troops, ballast may be necessary to keep the aircraft center of gravity within limits. Refer to Section V for center of gravity limits, and the Handbook of Weight and Balance for ballast requirements.
- After having delivered a load of troops for which it has been necessary to add ballast, it may be necessary to shift or remove the ballast before taking off.

CASUALTY CARRYING EQUIPMENT

The cabin compartment can be fitted with a two litter and a one seat (for medical attendant) installation. Tiedown fittings and rings are installed in the cabin floor for securing the litters. Seat and litter arrangements are shown in figure 1–3.

CRASH ENTRY KIT

A crash entry kit (figure 1–38) containing equipment for crash entry and survivor removal is carried in a cotton duck hand tool roll which is secured by straps in the cabin.

CRASH RESCUE FIRST AID KIT

A crash rescue first aid kit is mounted in the cabin. (See figure 1–47.)

FIRE SUPPRESSION EQUIPMENT

DESCRIPTION.

The fire suppression equipment (figure 1–39) consists of a fire suppression kit, an insulation blanket, and a trailer. The fire suppression kit is a foam-type extinguisher. The kit can be attached with its sling to the helicopter cargo hook for aerial delivery to the site of a crash fire. A heater in the trailer is used to prevent freezing of the fire suppression kit during airbase

Internal Cargo Area

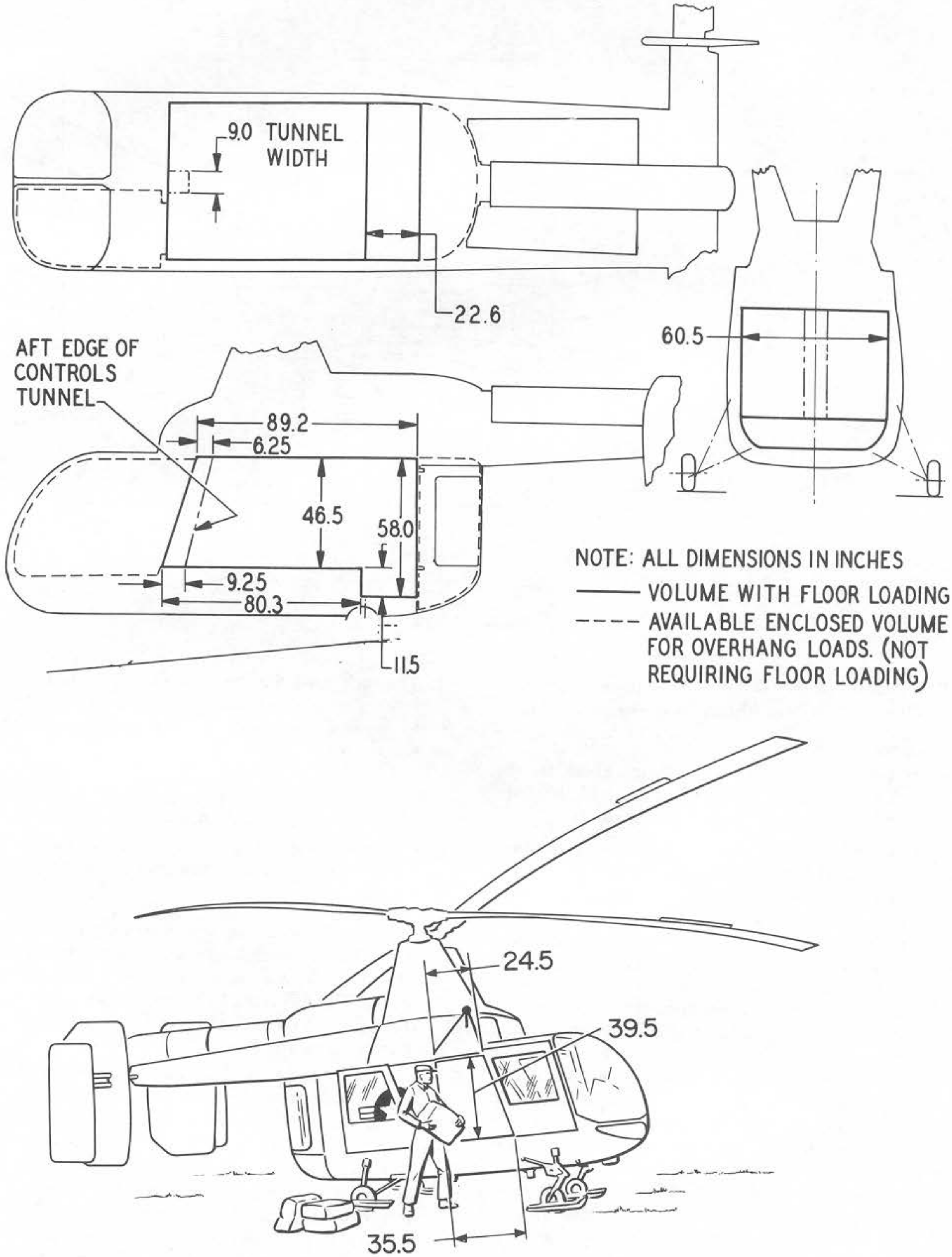


Figure 1—37

Crash Entry Kit

1. HATCHET (FOR CUTTING PLASTIC CANOPIES)
2. SCREWDRIVERS
3. SAFETY PINS
4. V-BLADE KNIFE
5. SAW BLADES
6. KEYHOLE SAW
7. PLIERS
8. CABLE CUTTER
9. METAL SAW
10. CANVAS ROLL FOR CARRYING TOOLS

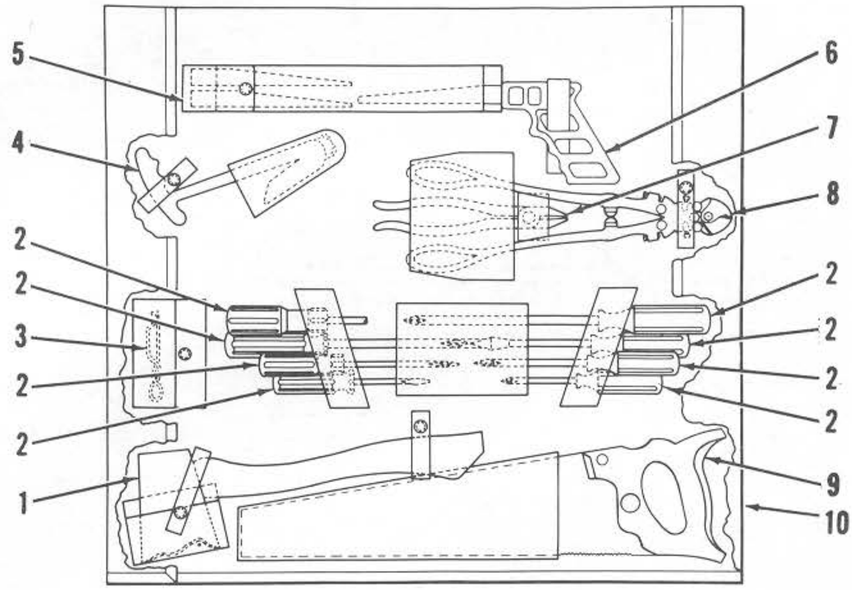


Figure 1–38

standby in cold weather. The insulation blanket is placed on the kit to reduce heat loss in cold weather.

Fire Suppression Kit.

There are two types of kits in operation. These are the soft hose kit (See figure 1–39, sheet 1), and the later design hard hose kit (See figure 1–39, sheet 2).

Both kits include a water tank, foam tank, a pressure tank, and a hose with a foam nozzle. A ball valve, when actuated, releases air from the pressure tank to a pres-ure regulator, which channels the air, at a fixed pressure, into the water and foam tanks. A waterfoam mixture is then forced through the hose to the foam nozzle. Flow from the nozzle is controlled by the foam shutoff valve. When the water-foam mixture strikes the atmosphere, it expands to approximately 8 times its former volume (the 83 gallons of mixture yields about 690 gallons of expanded foam). The discharge of foam can be varied from a narrow to a wide stream by rotating the grip on the nozzle. The discharge will continue for 50 seconds or more, with the foam shutoff valve wide open. The stream will project for 50 feet or less depending on the width of the stream. The desirable pressure tank charging pressure will vary with temperature. Figure 4–1 shows the pressure to which the tank should be charged at various temperatures.

Differences Between the Soft Hose Kit and the Hard Hose Kit.

1. The soft hose kit has a collapsible hose which is stacked in a hose basket attached to the kit when not in use, and which must be completely unstacked before being used.

CAUTION

To avoid rupturing the hose, do not open the ball valve until the hose has been fully extended.

The hard hose kit has a wire-wound, non collapsible hose which is wound on a reel attached to the kit, and which may be used whether partly wound on the reel or not. The reel has a light drag brake which prevents the reel from free wheeling and paying out more hose than is called for.

2. The ball valve control on the soft hose kit is located on the ball valve body, and must not be actuated before all of the hose has been unstacked from the hose basket.

The ball valve control on the hard hose kit is located at opposite end of the kit from the ball valve, and may be actuated before removing all hose from the reel. A push-pull handle near the ball valve acts as a secondary means of actuating the ball valve, and is the primary means of closing the valve after the fire fighting operations are completed.

Fire Suppression Equipment (Soft Hose Kit)

1. SHUTOFF VALVE
2. CHARGING VALVE
3. PRESSURE TANK SUPPORT
4. PRESSURE TANK FRAME
5. PRESSURE TANK TIEDOWN STRAP
6. PRESSURE TANK
7. PRESSURE LINES
8. PRESSURE GAGE
9. FOAM NOZZLE
10. BALL VALVE
11. HOSE TIEDOWN STRAP
12. SPRING CUP
13. FOAM SHUTOFF VALVE
14. PRESSURE REGULATOR
15. WATER FILLER CAP
16. FLUE TEE
17. FOAM TANK RELIEF VALVE
18. SLING ASSEMBLY
19. FOAM FILLER CAP
20. FOAM TANK
21. FOAM TANK PRESSURE LINE
22. HOSE
23. HOSE BASKET
24. TIEDOWN D-RING
25. SHOCK PAD
26. HOLD DOWN ASSEMBLY
27. WATER TANK
28. WATER TANK FRAME
29. SLING D-RING
30. DRAIN COCK
31. FRAME D-RINGS
32. BURNER WELL
33. TREAD PLATE
34. TRAILER TOWBAR
35. CHOCK

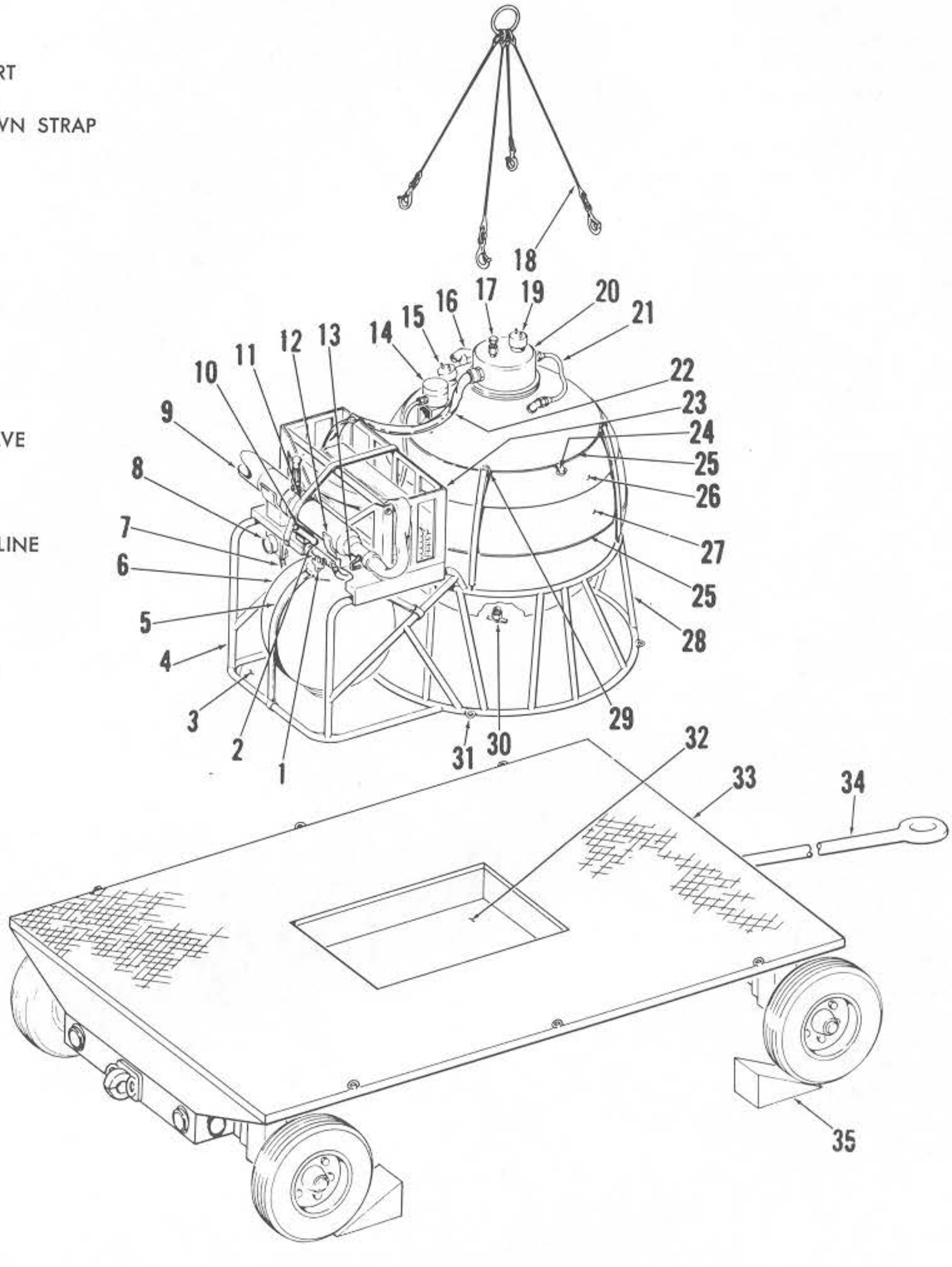


Figure 1–39. (Sheet 1 of 2)

Fire Suppression Equipment (Hard Hose Kit)

1. SLING SPREADER
2. BALL VALVE PUSH-PULL HANDLE
3. WATER TANK
4. FOAM TANK PRESSURE LINE
5. SHOCK PAD
6. HOLD DOWN ASSEMBLY
7. BALL VALVE ACTUATOR HANDLE
8. FOAM NOZZLE
9. SPRING CLIP
10. HOSE
11. HOSE REEL ASSEMBLY
12. FOAM SHUTOFF VALVE
13. SKID BARS
14. TANK TO REEL HOSE
15. BURNER WELL
16. FRAME D-RING
17. TRAILER TOWBAR
18. SLING ASSEMBLY
19. HOSE ROLLERS
20. TIEDOWN D-RING
21. FLUE TEE
22. FAIRING
23. FOAM TANK RELIEF VALVE
24. FOAM TANK
25. FOAM FILLER CAP
26. WATER FILLER CAP
27. FAIRING
28. PRESSURE LINES
29. PRESSURE REGULATOR
30. BALL VALVE
31. PRESSURE GAGE
32. CHARGING VALVE
33. SHUTOFF VALVE
34. PRESSURE TANK
35. PRESSURE TANK TIEDOWN STRAP
36. PRESSURE TANK SUPPORT
37. WATER TANK FRAME
38. DRAIN COCK
39. CHOCK
40. REEL BRAKE
41. TREAD PLATE
42. LADDER BRACKETS
43. VANES

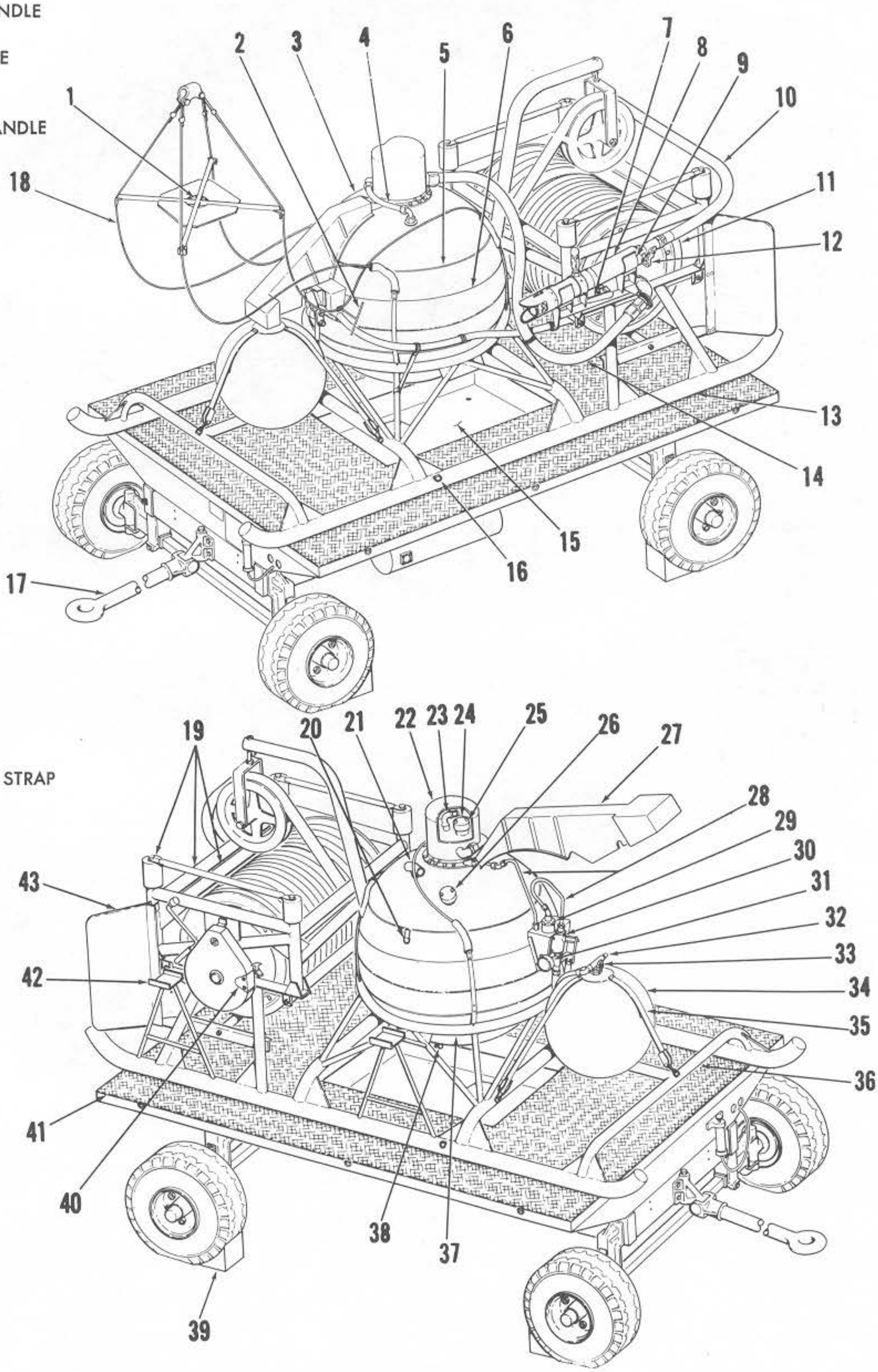


Figure 1–39. (Sheet 2 of 2)

Fire Suppression Kit Hookup Positioner

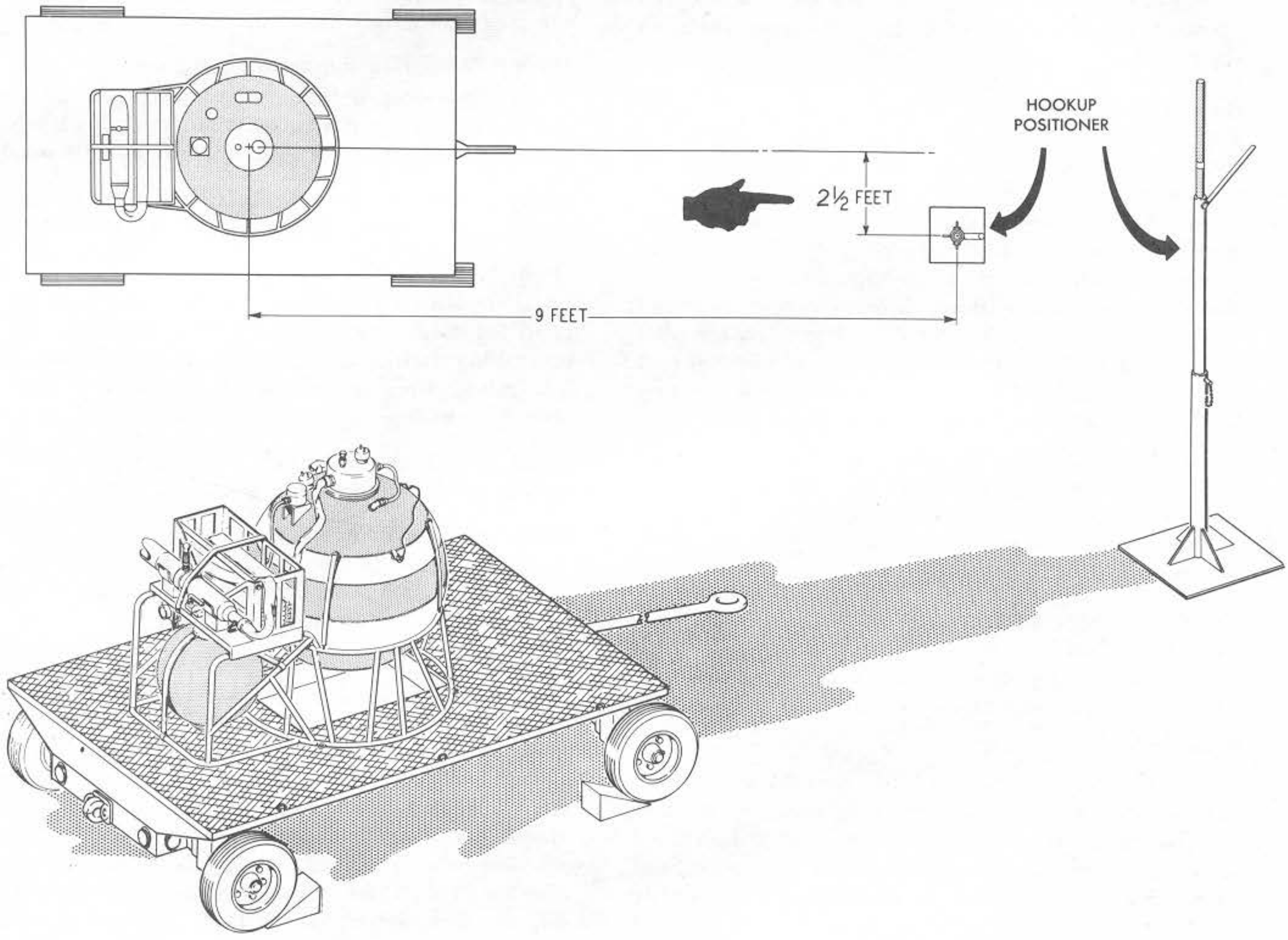


Figure 1—40

3. The supporting structure of the soft hose kit is roughly circular in shape, with the pressure tank and the hose basket both located at one side of the kit.

   The hard hose kit has the pressure tank and the hose reel mounted at opposite ends of the kit, giving it roughly a rectangular shape. The supporting structure rests on two parallel skid bars. There are two fixed vanes at the aft end of the kit which act to streamline the kit, fore and aft, when airborne. The hard hose kit is so balanced that it will fly approximately 10 degrees nose up (full) and 12 degrees nose up (empty) to allow the aft end of the skids to contact the ground first.

CAUTION

The skids are intended to provide improved turnover angle, not for sliding or running take-off and landing.

4. The suspension sling of the hard hose kit is equipped with longer cables to provide greater clearance below the helicopter during hookup.
5. The soft hose kit weighs approximately 1000 pounds (full), and is approximately 5 feet long, 4 feet wide, and 3½ feet high.
6. The hard hose kit weighs approximately 1250 pounds (full), and is approximately 9 feet long, 4½ feet wide, and 4 feet high.

Note

There are other minor differences between the two kits. Refer to the appropriate technical orders for details.

Trailer.

The trailer unit consists of a four-wheel trailer with an attachable gasoline heater, and outside air thermometer. Tiedown straps are provided for securing the fire suppression kit to the trailer during ground transportation. Hot air from the heater burner rises through a tube-like passage in the water tank of the kit, and is exhausted through the flue tee near the top of the kit. The heater is operated in accordance with the instruction plate on the trailer.

Hookup Positioner.

The hookup positioner (see figure 1—40) consists of a slender metal pole mounted on a heavy base. The uppermost portion of the pole is approximately 2 feet of rubber. A white horizontal stripe, approximately 3 inches in width, is located on the upper section of the pole as a reference indicator. A "Y" configuration lateral position indicator extends from below the rubber section of the positioner. The positioner is used to assist the pilot in hovering the helicopter into the proper position over the fire suppression kit so that a ground crewman may hook the kit attaching ring to the external cargo hook.

The pole height for kit pickup from the ground is set at 9½ feet. For kit pickup from the trailer, the pole is set at 11½ feet. The positioner is placed 9 feet forward of the center of the kit and 2½ feet to the right of the kit centerline.

TYPICAL CRASH FIRE RESCUE PROCEDURES.

These procedures are for use in aircraft crash fire suppression and rescue missions, day or night. Special techniques for night missions are indicated where applicable.

Introduction.

This helicopter has the capability of providing rescue coverage for aircraft incidents that result in a crash fire. The helicopter is capable of supplying a directional air blast to assist in controlling flames and smoke and to provide cooling air for the firemen as they operate the fire suppression kit. Litters are provided to evacuate the rescued personnel to medical facilities.

Preflight Planning.

The alert helicopter will be configured for the crash fire mission. Alert crews will have all necessary equipment readily available for immediate scramble.

Fire Suppression Kit Hookup.

After the alert crew has boarded the helicopter and takeoff has been accomplished, the helicopter will hover over the fire suppression kit, using the hookup positioner as a guide. The alert crew chief will hook up the fire suppression kit to the helicopter with the hose basket toward rear of the aircraft, lay the hookup positioner on the ground, and clear the area as rapidly as possible by moving forward and to the right in view of the pilot, and indicate the load is secured by giving the appropriate hand signal.

CAUTION

Considerable static electricity can be accumulated in the helicopter. The hookup man should touch the helicopter with the sling ring before touching any part of the helicopter with his hand so as to discharge this static electricity.

Night Technique. Floodlights should be used, but do not use landing light as it would blind hookup man.

Takeoff With Fire Suppression Kit

When the hookup positioner is removed, the pilot will pick up the kit vertically, ascertain that the kit is attached to the helicopter prior to initiating departure.

Night Technique. Use floodlights and landing light as needed. The landing light should be set for takeoff.

Flight to Crash Fire.

Local conditions will determine the flight path to the crash fire. Radio contact should be maintained with the controlling facility or the cover aircraft at the scene. The pilot will determine wind velocity and best approach route when nearing the scene.

Night Technique. Extra care will be required in evaluating terrain and avoiding obstacles.

Approach To Crash Fire.

On final approach, the sling arming switch will be placed ON, and the automatic sling release switch will be placed in the AUTO position.

Normally, a quartering into-the-wind approach will be executed, with a landing upwind of the fire. (See figure 1—41.) Down-wind approaches to the hover will be avoided when possible. The approach is accomplished in the same basic manner as the normal approach except that the approach is initiated at approximately 60 knots airspeed, with an apparent angle of 20 to 30 degrees. A constant airspeed will be maintained until approximately 150 to 75 feet altitude, depending upon wind conditions. A moderate flare attitude will be assumed to decelerate the aircraft to approximately 30 knots ground speed establishing a hover at the desired release point.

The hover should be established at an altitude which will ensure ground clearance of the kit, with the helicopter in a level attitude.

Night Technique. The copilot should turn all cockpit lights to bright, and monitor the instruments for the pilot.

Lights should be used to avoid obstructions and hazardous terrain.

CAUTION

Floodlights should not be used too soon as they restrict visibility when haze is present. Also there is a tendency to be too fast and too high on night approaches. Selection of fire suppression kit delivery point and landing spot are hampered by glare and shadows. Insure that area is free of obstructions and that fire suppresion kit delivery point and aircraft landing spot are level.

Approach to Crash Fire and Release of Fire Suppression Kit

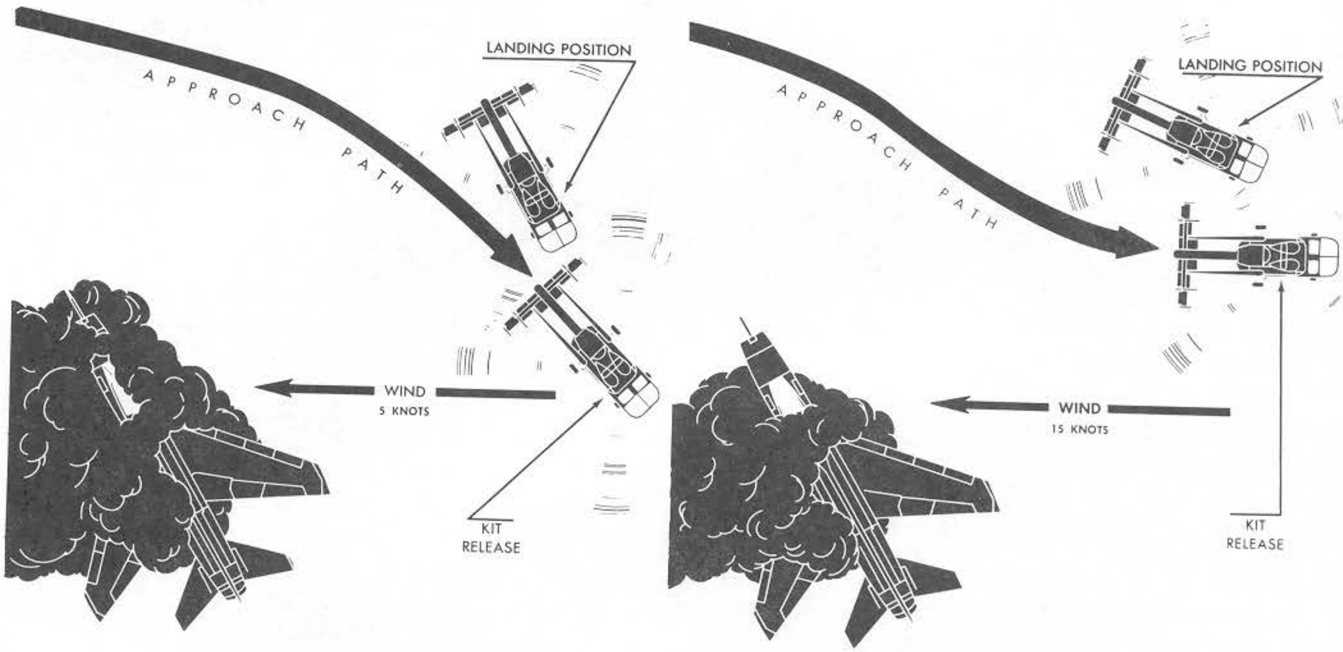


Figure 1—41

Release Of Fire Suppression Kit.

The release of the fire suppression kit will normally be as near to a true upwind position as possible, approximately 75 feet from the fire, with the helicopter heading within 45 degrees of the wind direction. Consider all factors when determining the kit release point. The terrain, if possible, should be level and clear of rocks, stumps or other debris. Consideration must be given to possible ordnance aboard the crashed aircraft and to the probable canopy ejection trajectory.

Note

The first 100 feet of the 150 feet of hose on the hard hose reel is the useful length. The additional 50 feet is reserve for unforeseen circumstances, and provides bulk on the reel to minimize tangling. The kit should be released at a point so that not more than 100 feet of hose will be needed for penetration of the fire.

As the wind velocity increases, the release point should be adjusted accordingly, from the true upwind position to permit landing with a minimum amount of turn after release of the kit. This procedure will minimize the cross wind component during landing, and is considered the fastest method of unloading the firefighter crewmembers. (See figure 1—41.) When over the release point, all horizontal helicopter movement should be stopped. Establish a moderate rate of descent until the automatic release disengages the kit from the helicopter. Descent should be fairly rapid to expedite kit release and also to permit the pilot to feel the kit make ground contact. If the automatic cargo hook release malfunctions or does not immediately release the kit, ascertain that the kit is on the ground and then depress the cargo release button on the cyclic stick. If this fails to release the kit, then operate the manual release lever.

Landing And Unloading Firefighters.

After releasing fire suppression kit, hover backward until nose is clear of kit and then land with kit in front of helicopter. Firefighters will release their safety belts, then depart through and close the right cabin door. After determining that cabin is clear, an immediate takeoff should be accomplished. While firefighters are preparing the kit for use, the rotor downwash will suppress flames and smoke to provide a clearer view of the crash for determining the most advantageous point for starting entry path. Helicopter should be stabilized on the desired entry path as soon as possible to avoid confusing the nozzleman. The nozzleman should approach fire in line with the helicopter and start deploying extinguishing agent. Pilot should observe nozzleman constantly for signals indicating changes in helicopter position necessary to obtain a more desirable rotor downwash, as entry path is established.

CAUTION

After releasing kit, do not hover backward directly toward the fire unless absolutely necessary, or permit tail of the helicopter to penetrate fire perimeter. If landing must be accomplished with kit on either side of helicopter, takeoff must be accomplished immediately after firefighters have cleared the cabin to prevent them from accidentally running under the low side of the rotors.

Preparing And Holding Entry Path.

Pilot. Select position and height that produce the desirable amount of rotor downwash at the point where entry path is to be started. Do not hover in a position over the firefighters which will cause excessive rotor downwash and hamper their effectiveness. Do not permit rotors to extend over the fire perimeter. Keep the nozzleman in view and maintain helicopter in stable position using minimum amount of cyclic control. This will establish a constant rotor downwash. After entry path is established and firefighters are effecting rescue, do not deviate from the entry path. If either side of entry path begins to close in with fire, move helicopter slightly to the side that is not closing in. This moves a stronger rotor downwash upon the closing side, forcing the fire away from center of entry path.

When hovering in winds above 20 knots keep the helicopter headed within 45° of the wind.

Pilot and Copilot Night Technique. The copilot should monitor the instruments for the pilot. The copilot should avoid looking directly at the fire and should watch the ground for drift or altitude changes and warn the pilot as necessary.

The pilot will be unable to read aircraft instruments once he is hovering towards the fire due to the glare and internal reflection.

WARNING

It is imperative that the pilot maintain hover high enough to ensure clearance of the firefighters since he is unable to observe the firefighters until they start penetrating the fire perimeter. After the firefighters are visible, he can adjust the hover as necessary.

Nozzleman. When helicopter has landed, exit immediately. Move forward until clear of the rotor blades, then proceed to the fire suppression kit.

If the soft hose kit is used, release the hose securing strap, grasp the hose nozzle securely, and run toward the fire perimeter in line with the helicopter.

If the hard hose kit is used, pull the ball valve actuator handle out, and then turn it downward only to the detent position; grasp the hose nozzle securely, and run toward the fire perimeter in line with the helicopter. Considerable effort will be needed to unreel and position the hose. The nozzleman should be familiar with the pull effort required and request assistance from the rescueman when needed, because of conditions such as slippery terrain.

CAUTION

Be careful that rotor downwash does not upset your footing.

Use a fan-shaped discharge pattern and lay an arc of foam approximately 8 to 10 feet wide in front of your feet. Rotor downwash will tend to roll this arc into the fire. Fan this arc of foam and advance into the fire to a point approximately 15 feet from the crash. Make certain that entry path is under control.

CAUTION

Do not expend foam in a useless manner. As soon as entry path is under control, shut off nozzle to conserve foam for use if a serious breakdown should occur in the entry path.

NOTE

Shut off nozzle with a smooth gradual motion. Abrupt closing may rupture hose or jam hose reel.

Make every effort to keep hose in the center of the entry path where it will not be exposed to direct flames. During this phase of the operation the pilot should be advised to change his position, as necessary, to obtain a more desirable rotor downwash. Hand signals will be used to motion him up or down, left or right, backward or forward.

Rescueman. When helicopter lands at crash fire scene, exit the helicopter with the crash entry kit, and close the door. Check nozzleman's hood for proper coverage. Proceed foreward until clear of rotor blades, and then to the fire suppression kit.

If the soft hose kit is used, pull out the hose remaining in the hose basket and spread it out to eliminate kinking. Then open the ball valve when the nozzleman arrives at the fire perimeter, and eliminate any kinks that may occur in the hose. Select required equipment from the crash entry kit and proceed into entry path beside the nozzleman.

If the hard hose kit is used, stand by the kit and when the nozzleman is about halfway to the fire turn the ball valve actuator handle all the way down, pressurizing the hose. Remain at the kit until nozzleman reaches perimeter of fire. When nozzleman makes first stop to discharge foam, pull extra hose off reel, so that when nozzleman starts into fire he is relieved of the pull required to unreel. He will merely need to drag slack hose that has been unreeled.

NOTE

Pull ball valve push-pull handle if nozzleman does not get foam when he opens nozzle valve.

Select the required equipment from the crash entry kit and proceed into entry path beside the nozzleman.

Entry And Rescue.

Pilot. Maintain a steady rotor downwash into entry path during crash entry and removal of survivors. Do not terminate this operation until a positive signal is received from the firemen. Landing should then be accomplished at a safe distance from the fire to permit loading of survivors.

Pilot Night Technique. The pilot's visibility will be restricted. The pilot may use the firefighters as a reference as they enter the fire. After the fire has been extinguished, the pilot must use extreme caution during recovery operation. He may be partially blinded by the intense brilliance. After the mission has been completed, the pilot should take adequate time to regain his night vision.

WARNING

The pilot should select a point at the perimeter of the fire where he wishes the firemen to enter. He should not shift his vision to the brilliant part of the blaze, since this would cause him to lose his perspective and aircraft control may become erratic. He may also experience spatial disorientation if he is unable to find a point on which to focus while hovering and could possibly get too near the fire, ground and/or firefighters. At the same time, shifting his attention occasionally will counteract the hypnotic effect of the fire. The copilot will continue to monitor the instruments and should not look directly at the fire; he should continue to check for drift and altitude changes and warn the pilot as necessary.

Nozzleman. After entry path is established and aircrew or passenger compartments of the crashed aircraft are covered with adequate foam, lay down the nozzle and assist rescueman in removing personnel. During this phase it is your responsibility to observe and keep entry path open. If entry path breaks down to a point that it cannot be controlled and the rescue must be terminated, advise the rescueman and signal him to terminate operations.

Rescueman. When entry path is opened, proceed to occupied portion of the crashed aircraft and begin rescue operation. Procedures recommended in applicable firefighting training documents should be used to remove personnel from a crash.

Evacuation of Survivors. After personnel have been evacuated a safe distance from the crash, or after the danger of fire or explosion has been eliminated, firefighters must use extreme care and deliberation in administering first aid and in handling patients due to the danger of critical fracture injuries. When time permits, firefighters should remove their hoods and coats before accomplishing first aid and patient loading operations. After completing any immediate first aid that may be required, survivors will be placed aboard helicopter and flown to the nearest medical facilities.

Aerial Return Of Soft Hose Kit. The trailer and positioner will be set up as indicated in figure 1–40. When approaching the trailer to release the kit, the pilot will establish an altitude so that the kit is approximately one foot above the trailer and positioned in line with the trailer and positioner. A crew member, in a safety harness, in the cabin will go on hot mike and direct the pilot over the trailer. He will advise the pilot to descend when the kit is directly over the trailer. If there is no chance of the kit sliding off, and there is no slack in the cables the pilot will be given the signal to release the kit. After the release, the pilot will back off, land and return the helicopter to an alert configuration or continue with the mission whichever is applicable.

Aerial Return Of Hard Hose Kit. Unless the standard trailer has been modified the hard hose kit will not be returned to the trailer. This trailer modification widens the trailer approximately 3p inches. When operating with an unmodified trailer the kit will be placed on the ground. Additional scramble may either be made with the kit on the ground or the kit may be repositioned on the trailer by ground personnel using a hoist device. If the trailer has been modified the kit may be returned to the trailer in the same manner as outlined in AERIAL RETURN OF SOFT HOSE KIT.

CREW ENVIRONMENT

ENTRANCE DOORS.

The cockpit is entered through sliding doors on each side. The cabin is entered through a sliding door on the right side or through hinged clamshell doors at the rear (figure 1–42).

AF60-291 and Subsequent, TCTO-615.

Provisions are installed for the attachment of a safety strap across the cabin door, and a safety net across the clamshell door. The strap and net may be attached or removed as required.

Side Doors.

The three sliding doors have self-locking knobs near their lower forward corners. Pulling interior or exterior knobs will unlock the doors. Doors automatically lock in any position.

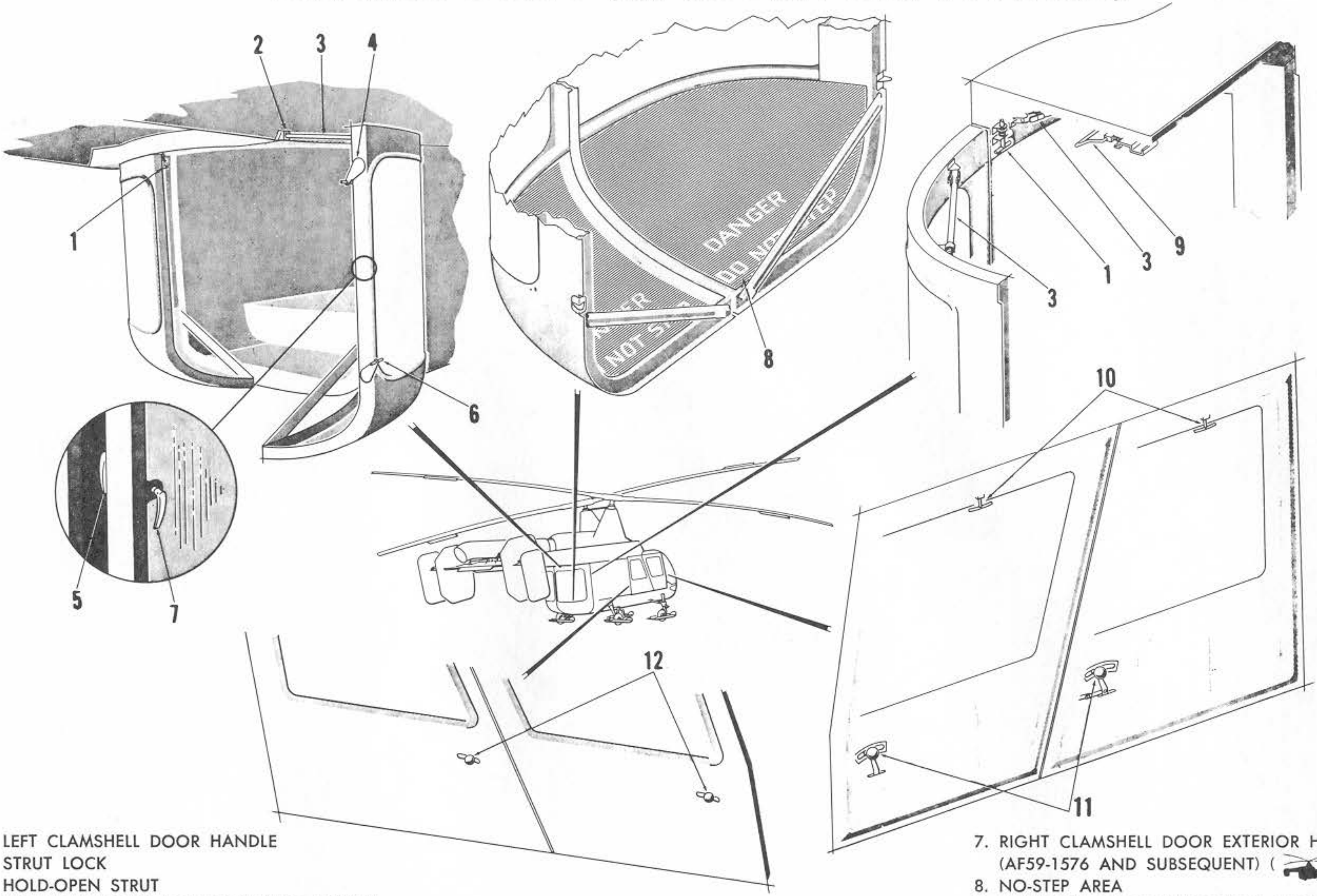
NOTE

The cabin side door locks into the cockpit door. It may be opened and closed independently or with the cockpit door.

Clamshell Doors.

Hinged clamshell doors at the rear of the fuselage provide access to the cabin. The right clamshell door can be opened by the exterior or interior door handle. After the right door has been opened, the left door can be opened by pulling down on its handle. These handles are not self-locking. The clamshell doors can be retained

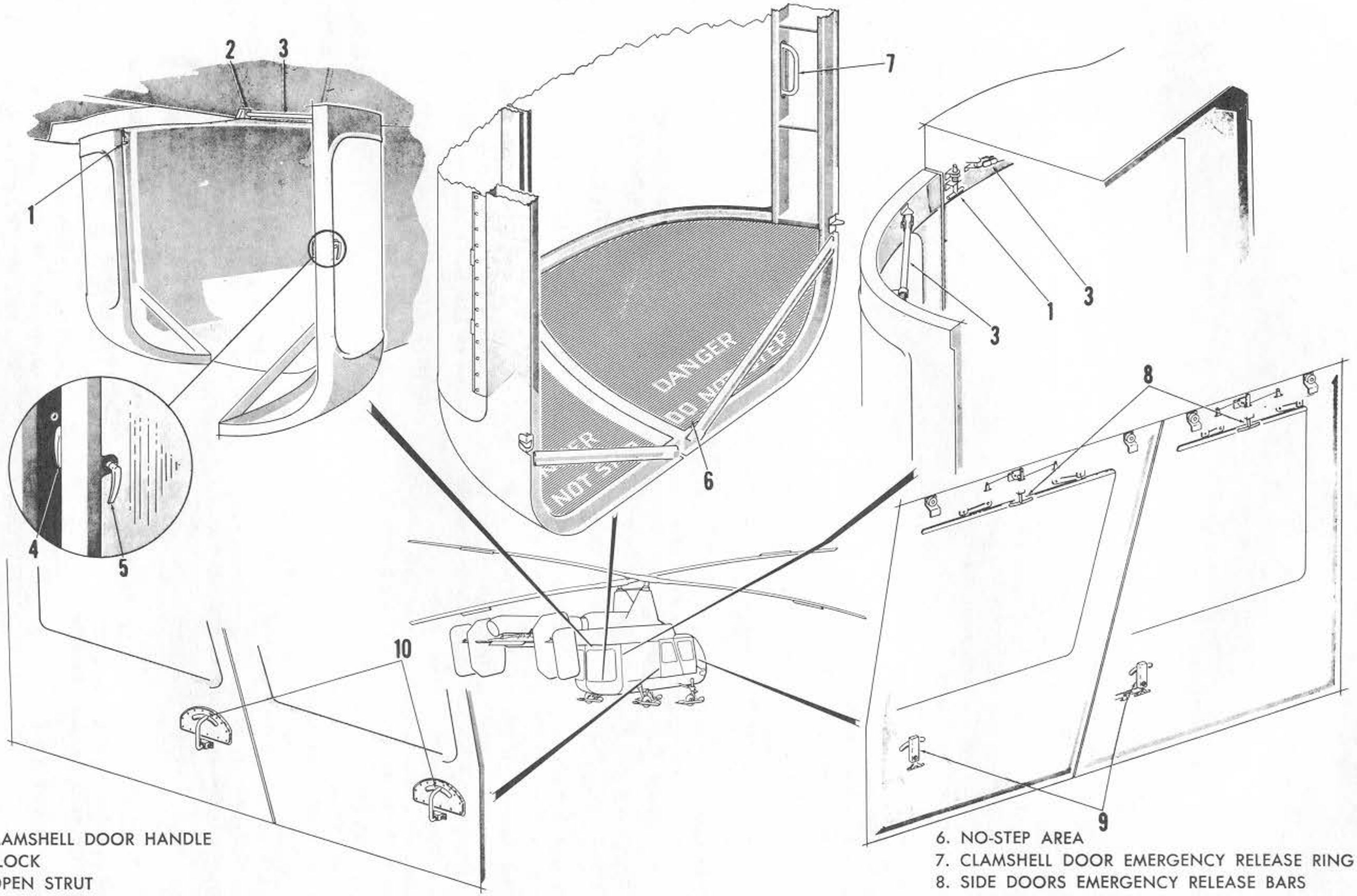
Entrance Doors (AF60-292 and Previous)



1. LEFT CLAMSHELL DOOR HANDLE
2. STRUT LOCK
3. HOLD-OPEN STRUT
4. RIGHT CLAMSHELL DOOR INTERIOR HANDLE (AF59-1575 AND PREVIOUS)
5. RIGHT CLAMSHELL DOOR INTERIOR HANDLE (AF59-1576 AND SUBSEQUENT) (TCTO 506)
6. RIGHT CLAMSHELL DOOR EXTERIOR HANDLE (AF59-1575 AND PREVIOUS)
7. RIGHT CLAMSHELL DOOR EXTERIOR HANDLE (AF59-1576 AND SUBSEQUENT) (TCTO 506)
8. NO-STEP AREA
9. CLAMSHELL DOOR EMERGENCY RELEASE RING
10. SIDE DOORS EMERGENCY RELEASE BARS
11. SIDE DOORS INTERIOR KNOBS
12. SIDE DOORS EXTERIOR KNOBS

Figure 1—42 (Sheet 1 of 2)

Entrance Doors (AF61-2920 and Subsequent TCTO 613)



1. LEFT CLAMSHELL DOOR HANDLE
2. STRUT LOCK
3. HOLD-OPEN STRUT
4. RIGHT CLAMSHELL DOOR INTERIOR HANDLE
5. RIGHT CLAMSHELL DOOR EXTERIOR HANDLE
6. NO-STEP AREA
7. CLAMSHELL DOOR EMERGENCY RELEASE RING
8. SIDE DOORS EMERGENCY RELEASE BARS
9. SIDE DOORS INTERIOR HANDLE
10. SIDE DOORS EXTERIOR HANDLE

Figure 1—42 (Sheet 2 of 2)

in full open position by inserting the struts (3) into the locks (2).

CAUTION

Before opening the right hand clamshell door fully, make sure cabin door is sufficiently forward to prevent interference.

WARNING

If the clamshell doors have been removed from the helicopter, flight is prohibited unless the sound-proofing blanket also has been removed. The danger exists that portions of the blanket may become loose and be blown out of the cabin and into the rotor blades.

Emergency Releases.

AF60-292 and Previous. In an emergency, if a door cannot be opened normally it may be jettisoned by pulling its emergency release (9 or 10, figure 1–42, sheet 1).

CAUTION

Do not jettison doors except to make an immediate emergency exit and when doors cannot be opened normally. Jettisoned doors can cause severe impact damage to other parts of the helicopter.

AF 61-2920 and Subsequent, TCTO-613. These helicopters have kick-out window panels installed and emergency egress depends on the position of the door. For an emergency landing, the door should be fully opened if at all possible. If required for ventilation purposes, the doors should not be open more than about 6 inches. Any intermediate position beyond this prevents use of the kick-out window panels and egress. In case of an emergency where the door cannot be opened, exit can be made by actuating the emergency release (7 or 8, figure 1–42, sheet 2) and simultaneously pushing or kicking out the respective window. After the windows have been kicked out, they will remain connected to the doors by means of restraining cables which are normally concealed around the edges of the windows.

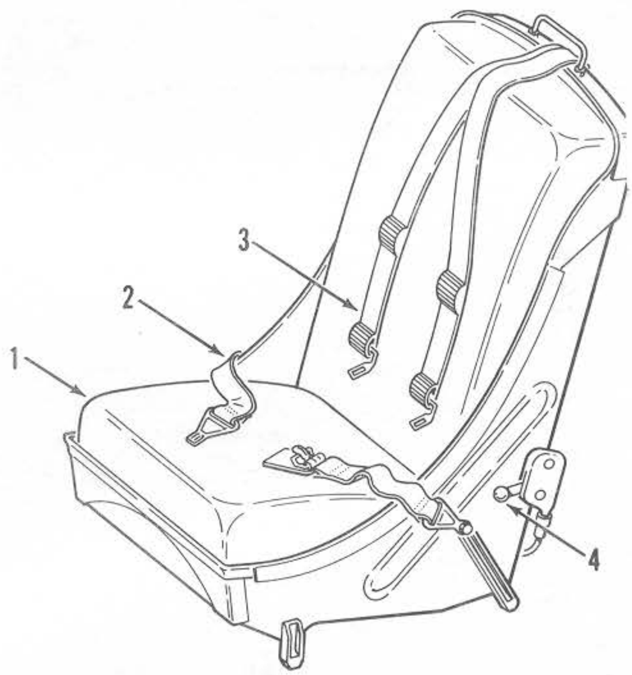
SEATS.

Pilot's and copilot's seats (figure 1–43) are non-adjustable and are equipped with safety belts and omnidirectional inertia reel-type shoulder harnesses.

Shoulder Harness Lock Knob.

A knob, with LOCKED (up) and UNLOCKED (down) positions is mounted on the left side of the seat. The knob actuates a mechanical linkage which locks or unlocks the inertia reel on the seat back. The shoulder harness is retained by the inertia reel cable. When the knob is UNLOCKED, the cable will extend to allow freedom of movement, but will automatically lock when an impact force of 2gs is encountered. When the reel locks this way, it remains locked until the knob is moved to LOCKED, and returned to UNLOCKED.

Pilot's Seat



1. SEAT CUSHION
2. LAP BELT
3. SHOULDER HARNESS
4. SHOULDER HARNESS LOCK KNOB

Figure 1–43

HEATING AND DEFOGGING SYSTEM.

Description.

Hot compressed air for heating and defogging is obtained from the compressor of the engine. This air is released to the distribution system by a solenoid valve. Manually operated valves control heated air flow to nose bubble defogging diffusers, cockpit heating diffusers and cabin heating diffusers. (See figures 1–44 and 1–45.)

WARNING

Deterioration of the oil seals in the vicinity of the number one bearing in the engine can result in oil vapor emission from the engine compressor through the heating system. This can cause the occupants of the cockpit and and cabin to become nauseated. If smoke or oil vapor are detected in the cockpit or cabin, turn off the cabin heat switch, and open sliding doors to eliminate fumes, if necessary.

Heating and Defogging System

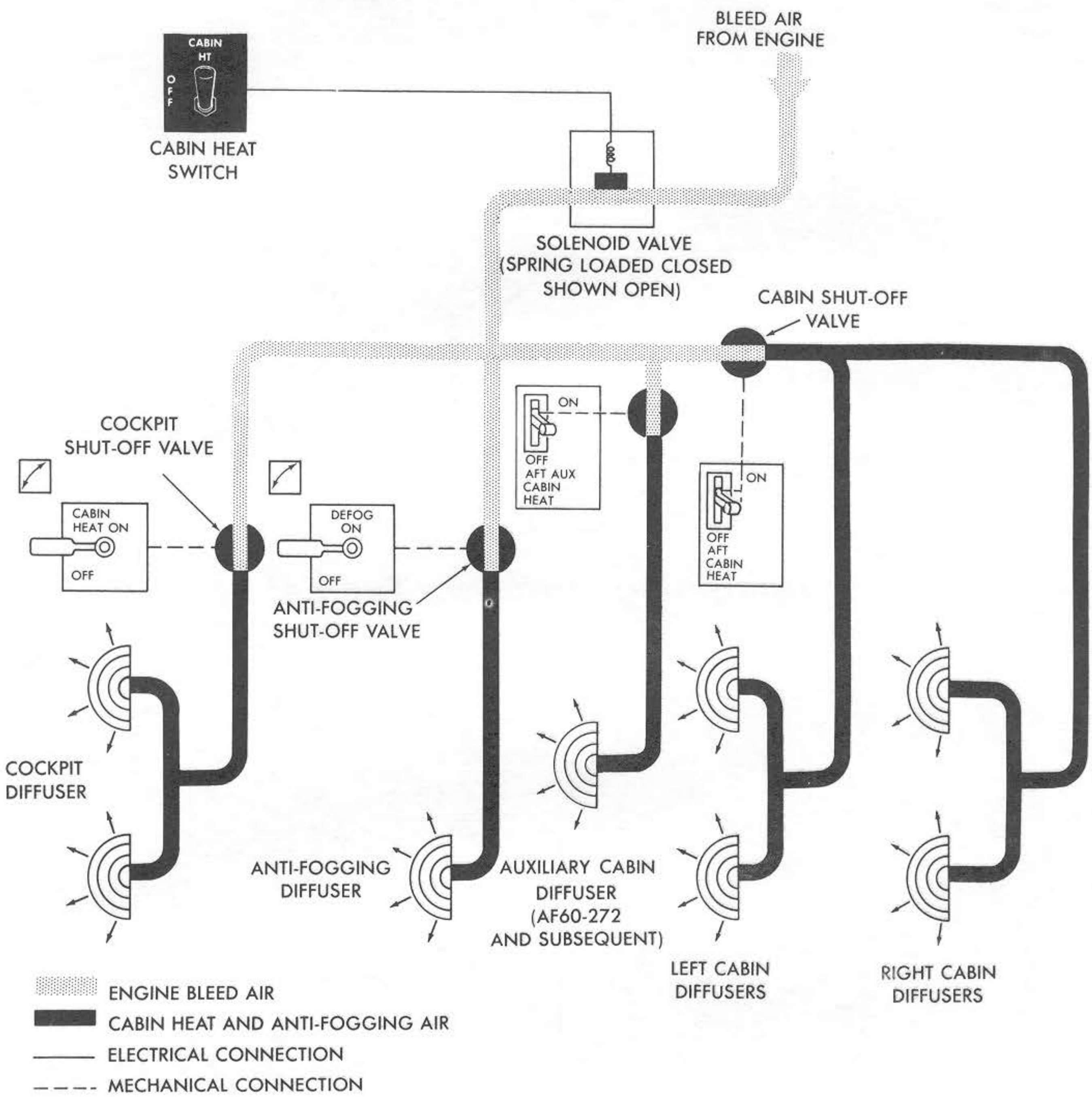


Figure 1—44

Heating and Defogging Controls

1. COCKPIT HEAT LEVER
2. DEFOGGING LEVER
3. AUXILIARY CABIN HEAT LEVER
4. CABIN HEAT LEVER

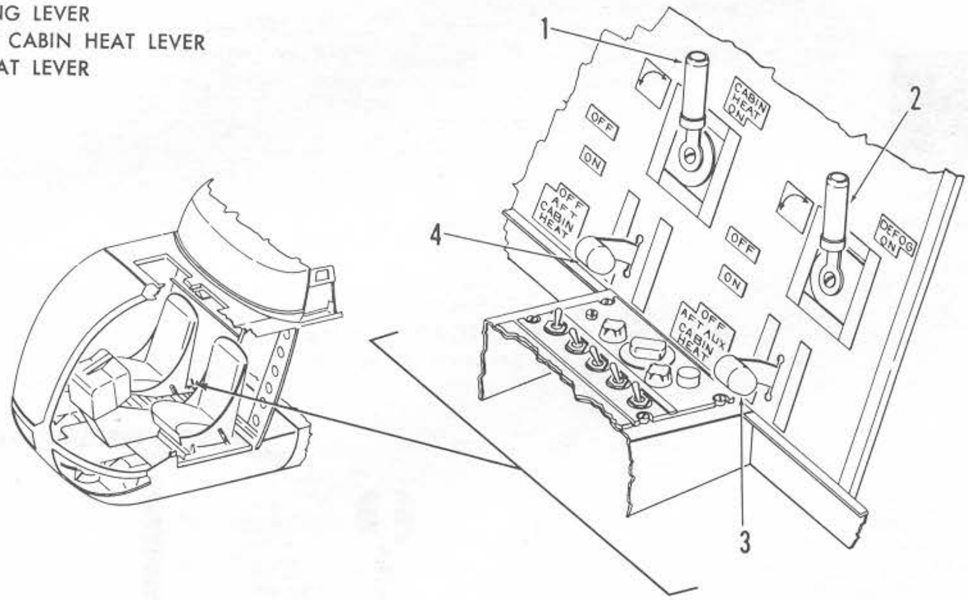


Figure 1—45

Ventilating Diffuser, Typical

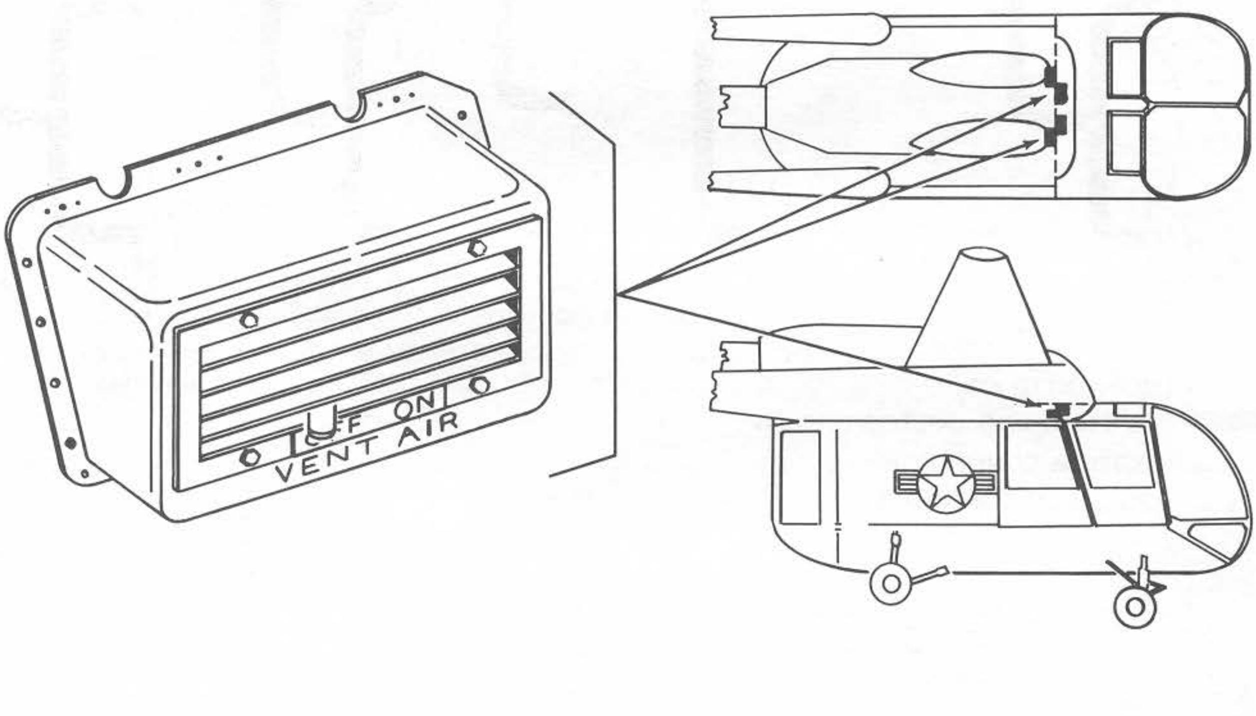


Figure 1—46

Cabin Heat Switch. A two-position cabin heat switch on the console (13, figure 1–8) controls the hot air shutoff solenoid valve above the cabin ceiling. This switch is labeled CABIN HT OFF. In the CABIN HEAT position power is supplied to the solenoid valve, and heated air is released to the distribution system. In the OFF position, power is removed and the spring-loaded valve closes. Electrical power is supplied from the essential bus through the cabin heater circuit breaker on the console circuit breaker panel (figure 1–19).

Cabin Heat Lever. The cabin heat lever (labeled AFT CABIN HEAT ON OFF; figures 1-44 and 1-45) is on the aft wall of the cockpit between the pilots' seats. Lifting the lever to ON mechanically actuates a valve which releases heated air to the cabin diffusers. When the lever is in the OFF position the valve is closed and no air flows.

Auxiliary Cabin Heat Lever (AF60-272 and Subsequent, TCTO-526). The auxiliary cabin heat lever (labeled AFT AUX CABIN HEAT ON OFF; figures 1–44 and 1–45) is on the aft wall of the cockpit between the pilot's seats. Lifting the lever to ON mechanically actuates a valve which releases heated air to an auxiliary cabin diffuser. When the lever is in the OFF position the valve is closed and no air flows.

Cockpit Heat Lever. The cockpit heat lever (labeled CABIN HEAT ON OFF; figures 1–44 and 1–45) is on the aft wall of the cockpit between the pilots' seats. Lifting the lever to ON mechanically actuates a valve which releases heated air to the cockpit diffusers. When the lever is in the OFF position the valve is closed and no air flows.

Defogging Lever. The defogging lever (labeled DEFOG ON OFF; figures 1–44 and 1–45) is on the aft wall of the cockpit between the pilots' seats. Lifting the lever to ON mechanically actuates a valve which releases heated air to the defogging diffusers. When the lever is in the OFF position the valve is closed and no air flows.

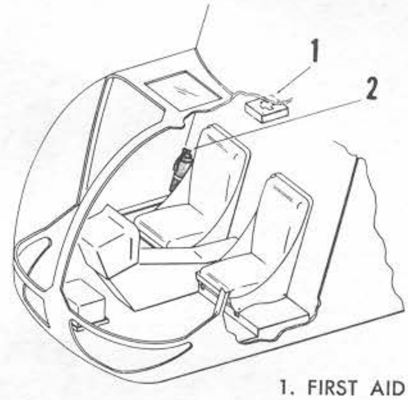
Normal Operation.

1. Cabin heat switch–ON.
2. Defogging lever–As required.
3. Cockpit heat lever–As desired.
4. Cabin heat lever–As desired.

VENTILATING SYSTEM.

The ventilating system supplies a flow of outside air to four overhead diffusers, two in the cockpit and two in the cabin. (See figure 1–46.) Air for the system is supplied by the oil cooler blower and is directed to the diffusers through flexible ducting. Flow of ventilating air may be adjusted mechanically by actuating a lever mounted on the front of each diffuser. Moving the lever to ON opens the diffuser and allows fresh air to flow through. Moving the lever to OFF closes the diffuser and stops the flow of air.

Emergency Equipment



1. FIRST AID KIT
2. FIRE EXTINGUISHER

Figure 1–47

EMERGENCY EQUIPMENT.

The emergency equipment comprises the Type A-20 portable fire extinguisher and the first aid kit. (See figure 1–47 for location.)

WARNING

Prolonged exposure (5 minutes or more) to high concentrations (pronounced irritation of eye and nose) of Bromochloromethane (CB), or its decomposition products, should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

MISCELLANEOUS EQUIPMENT.

Map And Data Cases.

Map and data cases are mounted on the cockpit walls, beside each pilot's feet.

Correction Card Holder.

The card holder, with airspeed correction card and magnetic compass correction card, is mounted on the cockpit ceiling over the pilot's seat.

GROUND SAFETY EQUIPMENT

The ground safety equipment (figure 1–48) is used to prevent damage to the helicopter when it is parked or moored.

WARNING

Ground safety equipment is dangerous in the air and must be removed prior to flight.

Ground Safety Equipment

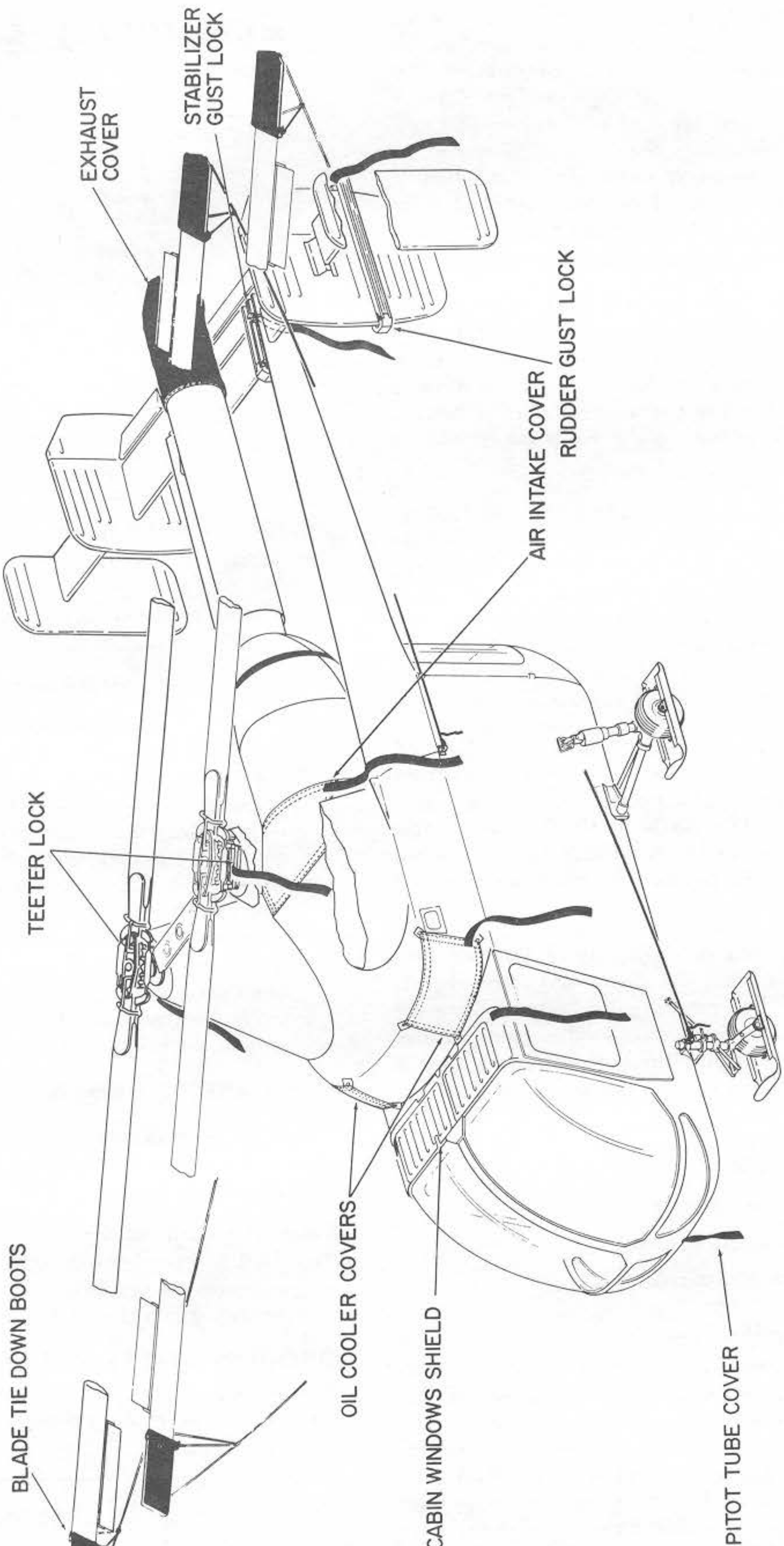
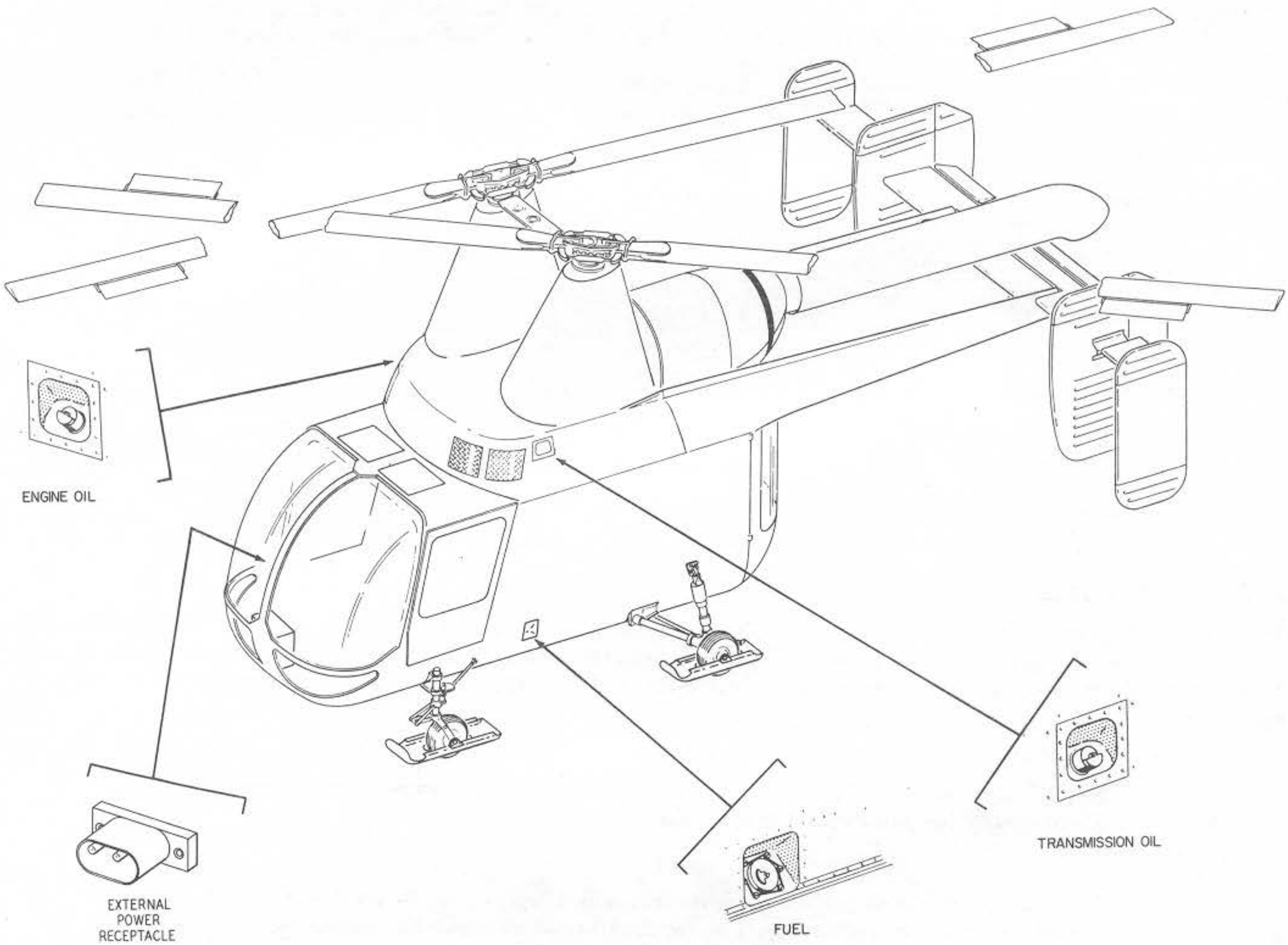


Figure 1—48

Servicing Diagram



1. ENGINE OIL MIL-L-7808 (NATO 0-148)
   *ENGINE OIL MIL-L-23699 (ALTERNATE OIL)
2. TRANSMISSION OIL MIL-L-7808 (NATO 0-148)
   *TRANSMISSION OIL MIL-L-23699 (ALTERNATE OIL)
3. FUEL (SEE SHEETS 2 AND 3)
4. REAR TIRE PRESSURE 160 PSI
5. FRONT TIRE PRESSURE 88 PSI
6. EXTERNAL POWER RECEPTACLE 28 VOLTS DC 800 AMPERES MAXIMUM
7. ROTOR BLADE DEICING FLUID MIL-A-8243 (NATO S-742)
8. REFER TO T.O. 1H-43(H)B-2 FOR ADDITIONAL SERVICING INFORMATION

WARNING

Oil MIL-L-7808 contains toxic additives. Avoid prolonged inhalation of vapors or contact with your skin.

NOTE

Where NATO 0-148 (MIL-L-7808) is specified and is not available, NATO 0-149 may be used or mixed with NATO 0-148 up to 50%. In such a case, when NATO 0-148 becomes available, the oil tank should be drained and filled with NATO 0-148.

NOTE

*Use of MIL-L-23699 oil is limited to temperature above minus 25 degrees Fahrenheit. MIL-L-7808 and MIL-L-23699 are compatible oils and when changing from one to the other it is only necessary to drain the system (flushing not required). When MIL-L-23699 is selected for use, it should be used in both the engine and transmission.

Figure 1—49 (Sheet 1 of 3)

Servicing Diagram

SPECIFICATION FUEL — JP-4 (MIL-J-5624)

The specification fuel for this engine (T-53-L-1B Engine) is JP-4. The following listing gives those military NATO F-40 fuels which are interchangeable with JP-4 Turbine Engine Fuels, Wide Cut Gasoline Type (NATO F-40).

United States	MIL-J-5624E	JP-4
Greece	MIL-J-5624E	JP-4
Netherlands	MIL-J-5624E	JP-4
Portugal	MIL-J-5624E	JP-4
Turkey	MIL-J-5624E	JP-4
Belgium	BA-PT-2	
Canada	3-GP-22d	
France	AIR 3407A	
Germany	VTL-9130-006 Am. 1	
Italy	AM-C-142f	
Norway	D. Eng. R. D. 2486 Iss. 3 Am 2	
United Kingdom	D. Eng. R. D. 2486 Iss. 3 Am 2	
Denmark	D. Eng. R. D. 2486 Iss. 3 Am 2	

ALTERNATE FUELS

When JP-4 is not available, fuels listed in the following tables may be used as alternates. Entries should be made in Form 781 of exact type and duration of use. When 50 hours operating time has been accumulated, the engine will be given a special hot section inspection in accordance with T.O. 1H-43(H)B-6. The groups are listed in order of preference.

NOTE

Manual adjustment of fuel controls may be necessary when using certain alternate or emergency fuels to avoid exceeding RPM & EGT operating limits.

NOTE

When any mixtures of fuels is used, records will reflect the use of the lowest grade, whether alternate or emergency. The required inspections will be determined using the lowest grade fuel.

I. *Commercial Jet Fuels* — ASTM Type B (Jet B). These fuels limit starting to —65°F. (NATO F-40) Specification MIL-J-5624, Grade JP-4. Typical fuels of this type:

Commercial Designation	*Commercial Designation*
Caltex Jet B (Calif Texas Oil Co)	Purejet Type B (The Pure Oil Co)
Cities Service Type B (Cities Serv Oil Co)	ATF-4 (Standard Vacuum Oil Co)
ESSO Turbine Fuel 4 (Humble Oil and Refinery)	Texaco Avjet JP-4 Type B

II. *Commercial Jet Fuels* — ASTM Type A-1 (Jet A-1). These fuels limit starting to —25°F (NATO F-34). Typical fuels of this type:

Arcojet — 1	Purejet Type A-1
American Type A-1	Aeroshell 650
Caltex Jet A-1	Avtur/50
440 Universal Turbine Fuel	Aviation Turbine Fuel Type A

Figure 1—49 (Sheet 2 of 3)

Servicing Diagram

II. *Commercial Jet Fuels — continued*

Chevron Aviation Turbine Fuel No. 1	Aviation Turbine Fuel Type 1
Gulflite Turbine Fuel A	Chevron Turbine Fuel Type 1
ESSO Turbo Fuel 1-A	ATF-1A
Kerosene-Aviation Type	407 Avjet K-58

III. *Commercial Jet Fuels* — ASTM Type A (Jet A). These fuels limit starting to —20°F (NATO F-30). Typical fuels of this type:

Arcojet — A	Phillips Kerosene, Grade TF
American Type A	Purejet A
Caltex Jet A	Richfield Turbine Fuel "A"
Cities Service Type "A"	Sinclair Superjet Fuel
Conoco Jet 50	Aeroshell 640
	Avtur/40
	406 Avjet K-40

IV. All grades of unleaded gasoline conforming to Federal Spec VV-G-109 may be used when other authorized alternates are unavailable.

EMERGENCY FUELS

When specification fuel or alternates are not available, the following fuels may be used in an emergency. Record of exact type and duration will be maintained in AFTO Form 781. Hot section inspection will be required after 6 hours of accumulated operation in accordance with T.O. 1H-43(H)B-6, Section V, System 22.

WARNING

Fuel containing Tricresylphosphate (TCP) additive should not be used.

Type	*NATO Symbol*	*US Military Spec*
JP-5	F-44	MIL-J-5624 Grade JP-5
Avgas 80/87	F-12	MIL-G-5572 Grade 80/87
Avgas 91/96	F-15	MIL-G-5572 Grade 91/96
Avgas 100/130	F-18	MIL-G-5572 Grade 100/130
Avgas 115/145	F-22	MIL-G-5572 Grade 115/145
Automotive Gasoline	—	Federal Spec VV-G-76, VV-G-561A(2), MIL-G-3056

Refer to NATO Interchangeability Tables (T.O. 42B1-1-15) for NATO National Specifications for alternate and emergency fuels if the need requires fuel from NATO countries.

Figure 1—49 (Sheet 3 of 3)

SECTION II

NORMAL PROCEDURES

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PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS.

Refer to Section V for flight restrictions and operating limitations.

FLIGHT PLANNING.

Use the data in the Appendix to determine the required fuel quantity, airspeed, etc., for the mission.

TAKEOFF AND LANDING DATA CARD.

Complete takeoff and landing data card for all flights. Landing data is not required except when landing conditions are more critical than takeoff conditions. Power required will be computed using no wind conditions. Normally, a power reserve of two psi will be maintained. The TOLD card for alert helicopters will be computed using the most critical conditions anticipated during alert period. Instruction for filling out the card are in the appendix.

WEIGHT AND BALANCE.

The gross weight and center of gravity of the helicopter are important factors to be considered in determining the feasibility of any contemplated helicopter operations. The pilot must know the actual gross weight and location of the center of gravity of the helicopter to evaluate the situation. Obtain takeoff and anticipated landing gross weights and balances. Refer to weight and balance limitations contained in Section V. Refer to the Basic Checklist and Loading Data, T.O. 1H-43(H)B-5, and the Handbook of Weight and Balance, T.O. 1-1B-40, for loading data. Check that Form 365F has been completed. In all instances the fuel load, equipment, and personnel should be kept to the minimum required to accomplish the mission.

PREFLIGHT CHECK

Note

The terms "climatic" or "as required" as used in the checklist indicates equipment operation or setting which may be necessary for other than daylight VFR conditions. This includes IFR, night, cold weather, tropic, and desert operation. In practice, the response to climatic steps will be the required switch or control position for prevailing conditions.

BEFORE EXTERIOR INSPECTION.

1. Form 781 — Checked.
2. Battery switch — OFF.
3. Rotor brake lever — OFF.
4. Publications and Charts — Checked.
5. Cabin — Checked.
   a. Crash entry kit — Checked.
   b. Litter Stowage — Checked.
   c. Hoist operator's grip — Stowed.
   d. All other equipment — Secured.
6. Protective covers, teeter locks, pitot cover, and tiedown equipment — Removed.

CAUTION

Personnel removing teeter locks must insure that the droop stops are in. Droop stops that are only partially in may "pop out" momentarily during rotor engagement causing blade damage.

7. Chocks — In place.
8. Crew and Passengers — Briefed.

   The following briefing checklists are to assist the pilot in providing a complete briefing to crew members or passengers prior to flight. Additional items should be added, as necessary.

   Passenger Briefing.

   a. Safety Belt.
   b. Smoking Regulations.
   c. Emergency Landings.
   d. Emergency Exits.
   e. Emergency Equipment (fire extinguishers, first aid kit).
   f. Parachute and Survival Equipment (if applicable).
   g. Adequate clothing for conditions.
   h. Explain Aircraft Characteristics (high noise, vibrations, etc.).

   Crew Briefing.

   a. Type of Mission.
   b. Complete Route Information (maps, flip charts, etc.).
   c. Communications (if applicable).
   d. Weather.
   e. Survival Procedure.

EXTERIOR INSPECTION.

Accomplish exterior inspection as shown in figure 2–1.

CAUTION

Do not use external power current in excess of 800 amperes. This may cause serious pitting and burning of the commutator or brushes of the starter.

Note

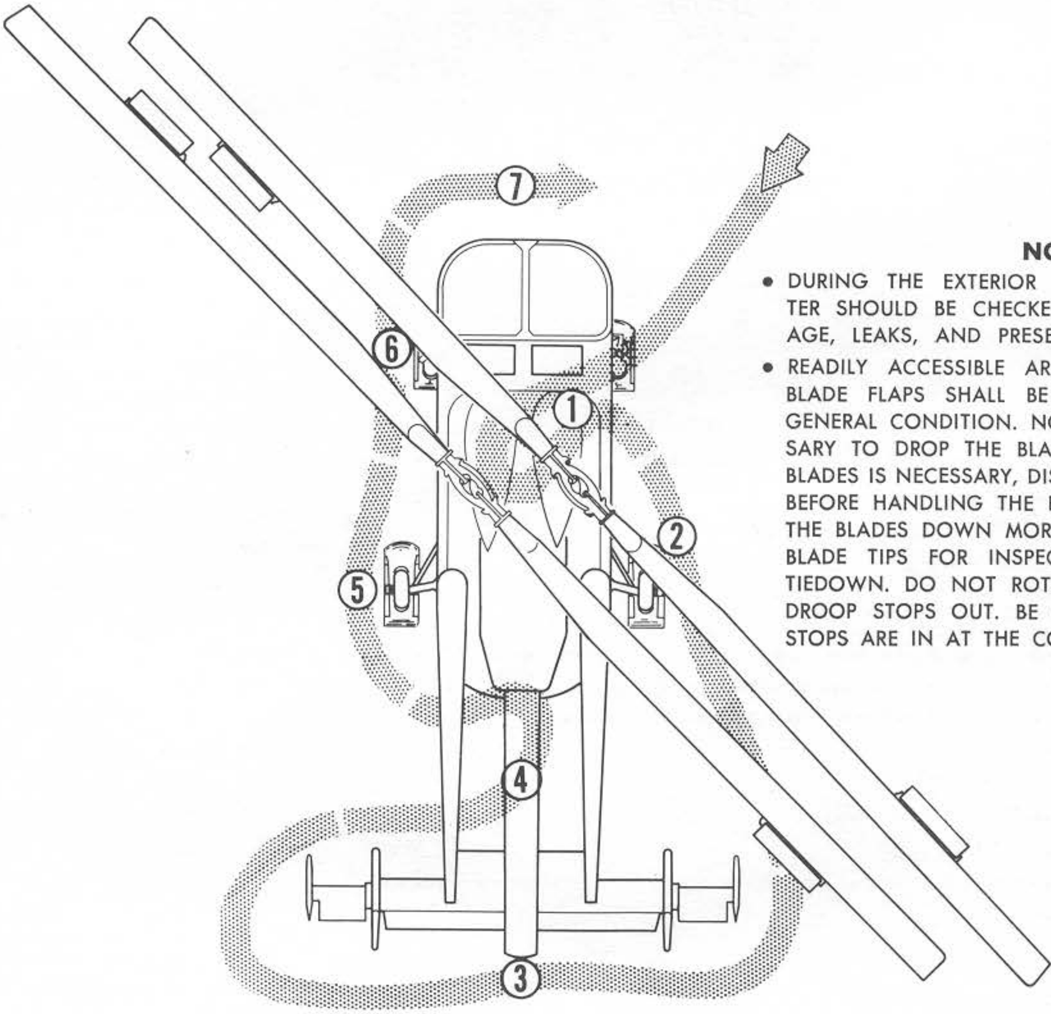
External electrical power should be used to avoid excessive drain on the battery, particularly during cold weather or ground operations. The helicopter battery may be used for engine starting, if desired.

BEFORE STARTING ENGINE

1. Safety belt and shoulder harness — Fastened.
2. Seat and flight control retaining pins — Installed.
3. Flight controls — Checked.

(continued)

Exterior Inspection



NOTE

- DURING THE EXTERIOR INSPECTION, THE HELICOPTER SHOULD BE CHECKED FOR EVIDENCE OF DAMAGE, LEAKS, AND PRESENCE OF FOREIGN MATTER.
- READILY ACCESSIBLE AREAS OF ALL BLADES AND BLADE FLAPS SHALL BE VISUALLY INSPECTED FOR GENERAL CONDITION. NORMALLY, IT IS NOT NECESSARY TO DROP THE BLADES. WHEN DROPPING THE BLADES IS NECESSARY, DISENGAGE THE DROOP STOPS BEFORE HANDLING THE BLADES, AND DO NOT FLEX THE BLADES DOWN MORE THAN 12 INCHES AT THE BLADE TIPS FOR INSPECTION OR 6 INCHES FOR TIEDOWN. DO NOT ROTATE THE BLADES WITH THE DROOP STOPS OUT. BE CERTAIN THAT THE DROOP STOPS ARE IN AT THE COMPLETION OF INSPECTION.

1. TOP OF HELICOPTER AND ROTORS — CHECKED.
   a. LEAD AND LAG STOP LOCKPINS — SECURED.
   b. BLADE FOLDING LOCKS — STOWED.
   c. DROOP STOPS — CHECKED.
   d. CONTROL LINKAGES — SECURED.
   e. TRANSMISSION OIL TANK — CHECKED.
   f. ENGINE OIL TANK — CHECKED.
2. RIGHT SIDE FUSELAGE — CHECKED.
   a. PITOT COVER — REMOVED AND TUBE CHECKED.
   b. AFT LANDING GEAR AND TIRE — CHECKED.
   c. SLIDING DOOR(S) — FREE OPERATION.
   d. FLOTATION GEAR FAIRING — SECURED.
3. TAIL SECTION — CHECKED.
   a. STABILIZER — FREE.
   b. EXHAUST PIPE COVER — REMOVED.
4. AFT SECTION — CHECKED.
   a. EMERGENCY RELEASE HANDLES — LATCHED.
   b. CLAMSHELL DOORS — CLOSED AND LATCHED.
   c. STATIC PORTS — CHECKED.
5. LEFT SIDE FUSELAGE — CHECKED.
   a. AFT LANDING GEAR AND TIRE — CHECKED.
   b. SLIDING DOOR — FREE OPERATION.
   c. FLOTATION GEAR FAIRING — SECURED.
6. FUEL TANK — PROPER SERVICE.
7. FORWARD FUSELAGE — CHECKED.
   a. NOSE GEAR AND TIRES — CHECKED.
8. EXTERNAL POWER UNIT — CONNECTED AND OFF (IF AVAILABLE).

Figure 2–1

a. Directional pedals — Adjust and check for freedom and full travel.
b. Cyclic stick — Check for freedom and full travel, and adjust friction.
c. Collective pitch lever — Adjust friction.

4. Throttle — FULL OPEN, then GROUND IDLE.
5. Sling arming switch — As desired.
6. AN/AIC-10A and AN/ARN-59 radio controls — As desired.
7. Parking brakes — Set.
8. Nose wheel lock handle — As desired.
9. J-4 compass function switch — MAGNETIC COMPASS.
10. Cabin heat switch — Climatic.
11. Pitot heater switch — OFF.
12. External power — On. Signal ground crew to turn power on. (Battery switch — ON if external power is not available.)
13. Lights — Climatic.
    a. Console lights rheostat — As required.
    b. Engine instrument lights rheostat — As required.
    c. Flight instrument lights rheostat — As required.
    d. Dome light switch — As required.
    e. Navigation lights switches — As required.
    f. Landing and floodlight switches — As required.

Note

If a night flight is anticipated, check operation of all exterior lights with the aid of ground crew. Position the landing light forward and turn it off so that it can be used when necessary.

14. Anti-collision light — ON.
15. Directional stability switch — ON.
16. Inverter switch — ON.
    Check both inverters for proper operation. (AC Power caution light out.)
17. Generator switch — ON.
18. Fuel and oil shutoff switch — ON.
19. Fuel control switch — AUTO.
20. Cyclic trim switch — Checked.
21. Fuel boost pumps switch — ON, pressure checked.
22. Secondary bus switch — NORMAL.
23. J-4 compass turn cutout switch — NORMAL.
24. Engine anti-icing switch — AUTO.
25. Cable cutter arming switch — OFF and safetied.
26. Automatic sling release switch — OFF.
27. Starting fuel switch — ON.
28. Communications radio controls —As desired.
29. Auxiliary fuel switch — As desired.
30. Console circuit breakers — Set.
31. Fuel quantity gage test button — Test.
32. Fire warning light — Test.
33. Master caution light — Test and reset.

Note

All panel caution lights should come on.

34. Attitude indicator — Cage.

(continued)

CAUTION

When ac power is supplied to the J-8 attitude indicator, wait 30 seconds and then cage the gyro. This will prevent unnecessary torque stresses on the instrument mechanism.

Note

The gyro is caged by pulling the caging knob at the lower right corner of the attitude indicator. To ensure proper attitude indicator operation, cage the gyro as follows: pull out the knob smoothly to the limit of its travel, release the knob so that it snaps back, and press the knob forward to be sure it is seated.

35. Console floodlights rheostat – Climatic.
36. Rotor brake lever – ON.
37. Hoist circuit breaker – OFF.
38. Ceiling circuit breakers – Set.
39. Fuse covers – Secured.

STARTING ENGINE AND BEFORE TAXIING

Note

Steps 1, 2 and 3 have been inserted to provide for alert procedures continuity. If you are following normal procedures you should skip steps 1, 2 and 3, as they will have been accomplished during **PREFLIGHT CHECK.**

1. Protective covers, teeter locks, pitot cover and tiedown equipment – Removed.

CAUTION

Personnel removing teeter locks must insure the droop stops are in. Droop stops that are only partially in may "pop out" momentarily during rotor engagement causing blade damage.

2. External power – ON (Battery – ON, if external power is not available).
3. Safety belt and shoulder harness – Fastened.
4. Area – Clear and fire guard posted.
5. Engine speed governor switch – DECREASE to minimum.
6. Engine – Start.
   a. Starter switch – Press.

CAUTION

To prevent overheat damage to the starter, limit use of starter to 3 runs ot 40 seconds maximum duration during any 60-minute period. Allow 3 minutes of cooling time between starts.

7. Engine oil pressure gage – Checked.

CAUTION

If oil pressure gage does not move slightly on starting or has not reached 10 psi when N_1 tachometer reads 40 percent, move throttle to CUTOFF.

8. Exhaust gas temperature gage – Checked.

CAUTION

If exhaust temperature during starting rises above 400° C, or if the rate of temperature increase is excessive, place starting fuel switch to OFF. If exhaust temperature exceeds maximum (refer to Section V) during starting, shut down engine by moving throttle to CUTOFF. If necessary, move starter and ignition test switch to TEST MOTOR to clear the engine of excessive heat.

9. Starting fuel switch – ON.
10. External power – OFF and disconnected

CAUTION

All caution lights will go out when the power is switched off at the APU prior to disconnect. The caution lights going out should not be interpreted to mean the APU cord has been disconnected.

(continued)

11. Starting speed switch — Checked.

All caution lights should go out when external power is disconnected. If any remain on, it indicates speed switch failed to open and that starter is acting as an unregulated generator. If necessary, flight may be continued after pulling engine starting circuit breaker; however, switch should be replaced as soon as mission permits. If start was made with battery it will be necessary to flick battery switch off momentarily to check speed switch.

12. Battery — ON. Check master caution light on.

13. Area — Clear.

14. Droop stops — Checked in.

15. Rotor — Engaged.

a. Rotor brake lever — OFF.

b. Throttle — FULL OPEN.

CAUTION

Open the throttle gradually maintaining engine operation within limits.

c. Transmission oil pressure — Checked.

16. Flight controls — Checked.

a. Cyclic stich — Check response. Actuate cyclic stick a slight amount in all directions and check proper response by observing the rotor tip-path plane.

b. Directional pedals — Check response. Actuate directional pedals full travel and check tip path response to insure operational DSAS.

c. DSAS Switch — ON. With directional pedal full travel in either direction, center the DSAS switch and check for rudder lock out. Return DSAS switch to ON position and check for return of rudder to deflected position.

17. Master caution light reset button — Reset.

18. Engine and transmission instruments — Checked.

19. Voltmeter and loadmeter — Checked.

20. Fuel Control Switch — Check operation in Emergency (manual) position.

Note

To be accomplished on the first flight of the day or alert runup.

a. Engine speed governor switch — 250 RPM

b. Collective — Minimum

c. Throttle — Flight Idle

d. Fuel Control Switch — Emergency

e. Throttle — Increase until 250 Rotor RPM is reached.

WARNING

Avoid rapid movements of the collective and throttle when the fuel control switch is in Emergency. With the fuel control switch in Emergency, the acceleration - deceleration limitator is not operative and overtemperature protection is not provided.

f. Throttle – Flight idle, allow N_1 to decrease below 62%.

g. Fuel control switch – Automatic. Check N_1 for a rise to approximately 62%.

Note

While in the emergency fuel position with the throttle in the flight idle position, the N_1 reading should be below 62%. When the fuel control is placed in the automatic position, throttle still at flight idle, the N_1 reading should increase to 62%. If it does not, the fuel control is still in the emergency position.

h. Throttle – Full open

21. Engine speed governor switch — Check for full increase, then full decrease and set as desired.

Note

The purpose of the full increase check in step 19 is to functionally determine limiting action of the fuel control overspeed governor. With engine speed governor switch in full increase, stabilized rotor speed should not exceed approximately 52 rpm above full decrease speed, but may be less at higher density altitudes or temperatures. Operation of the engine and rotors above 260 rpm is permissible only for the purpose of ground checking with full down collective. Red line limits must be observed for all other phases of operation. Refer to MAXIMUM ENGINE AND ROTOR SPEEDS, Section V.

22. Radios and Intercom — Checked.
   a. Obtain taxi and takeoff clearance from tower.
   b. Radio compass — Checked as required. Tune and identify station if available. Check set in ANT, COMP; and LOOP positions. Check the bearing pointer for approximate station bearing.

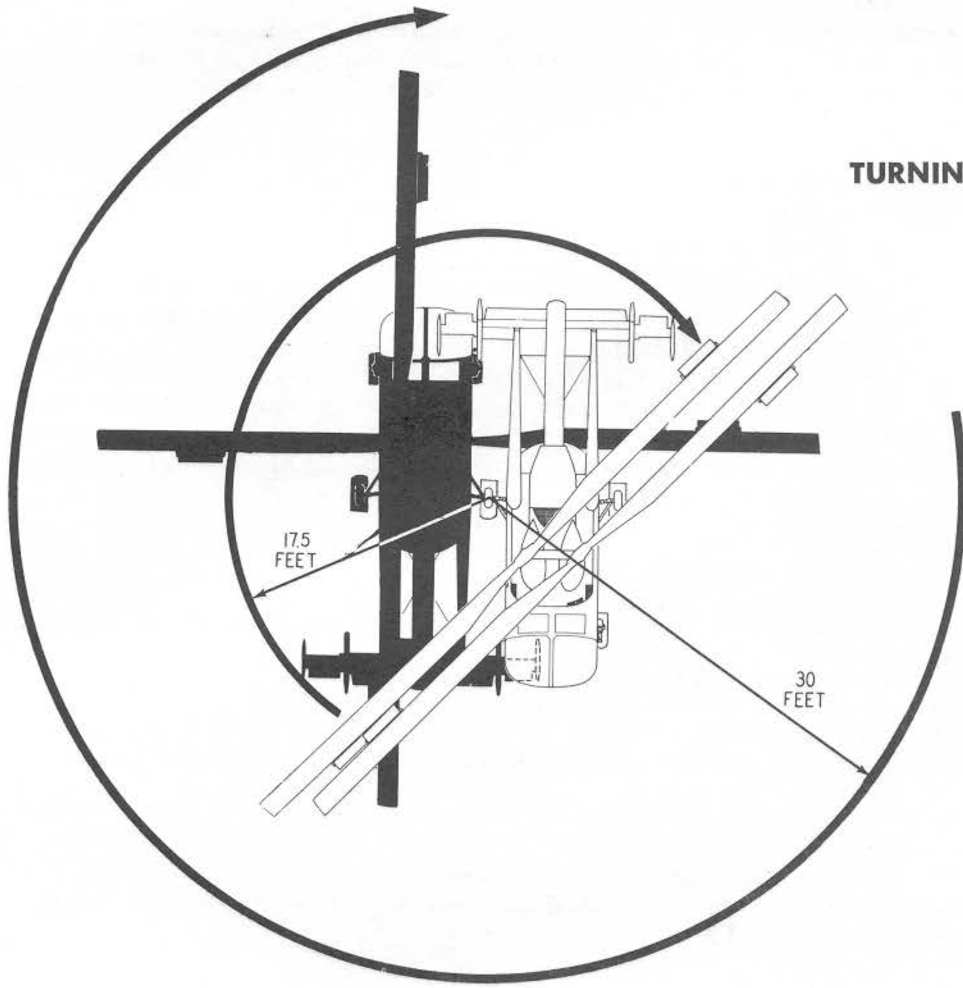
23. Altimeter — Set and checked.

TAXIING AND BEFORE TAKEOFF

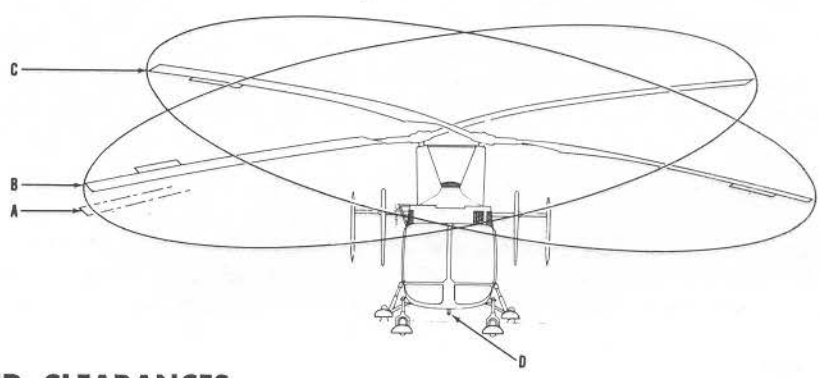
Set engine speed governor switch for full decrease, and raise collective pitch lever to obtain 10 to 15 psi torque. At this power the helicopter has positive rudder control, is stable on the wheels, and can be lifted off the ground should the need arise. More than 15 psi torque may be needed for short periods when on unpaved surfaces.

(continued)

Turning Radius and Ground Clearance



TURNING RADIUS



GROUND CLEARANCES

A. 7 FEET 2 INCHES (AGAINST DROOP STOP)
B. 8 FEET 7 INCHES (NEUTRAL)
C. 17 FEET 2 INCHES (NEUTRAL)
D. CARGO HOOK TO GROUND — APPROXIMATELY 8-9 INCHES

Figure 2—2

CAUTION

Taxiing should not be attempted on rough or questionable terrain, runway barriers, or any other protrusions that might tend to create a safety of flight hazard.

Govern ground speed by fore-and-aft movement of the cyclic stick. When helicopter starts to move, check operation of wheel brakes, then use cyclic stick and brakes as required to control ground speed. Maintain directional control by use of the brakes and the directional pedals. Use lateral cyclic as necessary to assist in turns. Refer to Section V for limitations on ground taxiing.

If necessary to taxi crosswind, apply cyclic stick into the wind, as required by wind velocity. Use caution when taxiing in crosswinds over 10 knots, as directional control may be difficult to maintain.

WARNING

Avoid excessive lateral cyclic application. This causes excessive tilting of rotor disc, and unnecessarily increases disc area exposed to wind. Increased wind force on the disc tends to push the helicopter downwind, the two downwind wheels acting as pivot points. When taxiing with crosswinds over 10 knots, the nose gear should be locked, and ground speed should be reduced. Although the helicopter is capable of much higher ground speeds, it should seldom be necessary to exceed translational lift speeds of approximately 8 to 10 knots.

*1. Area — Cleared.
2. Chocks — Removed.
3. Flight instruments — Checked.
   a. J-4 compass — Compare heading with magnetic compass.
   b. Altimeter — Set to field elevation if known and note error between tower setting and barometric scale reading.
   c. Turn and slip indicator — Check for proper operation.
   d. Clock — Running and set with tower time if available.
   e. Vertical velocity indicator — Zeroed.
   f. Attitude indicator — Miniature aircraft aligned with 90° bank indices.

Note

Do not cage attitude indicator unless it is not aligned with the 90° bank indices, since the horizon bar will indicate a nose down attitude until it precesses back to normal flight position.

   g. Magnetic compass — Bowl full of fluid and card free. Check heading with J-4 compass.
   h. Airspeed indicator — Checked.

*4. Performance instruments — Checked.
5. Pitot heater switch — Climatic.
6. PA system – ON.
7. IFF/SIF – ON/STANDBY (If applicable)
*8. Crew and Passengers – Prepared to takeoff.
*9. Parking brake handle – Released.

Note

When performing a series of takeoffs and engine is not shutdown items marked with an asterisk must be accomplished, however all items are required before initial takeoff.

TAKEOFF

The following procedures will produce the results indicated in the Appendix:

NORMAL TAKEOFF.

The normal takeoff is a takeoff where sufficient power is available to hover with necessary reserve to move out of ground effect into translational lift with no sacrifice of altitude. This takeoff is effective where no restriction exists which requires rapid increase in altitude, and where adequate power reserve will assure rapid acceleration and transition to climb. (See figure 2—3.)

Vertical Takeoff to a Hover.

This takeoff is accomplished by heading aircraft into the wind, setting the desired N_2 rpm and increasing collective as necessary to obtain hover power. Use cyclic and rudder control as necessary to maintain proper heading and attitude. Establish a hover at approximately 5 feet wheel height.

Transition to Forward Flight.

Check instruments for proper operating range and the area clear for takeoff into the wind. Increase power smoothly to that desired for acceleration and climb, using cyclic to move forward. Then make a smooth transition, increasing altitude and airspeed simultaneously until desired climb speed is reached.

Normal Takeoff Procedure

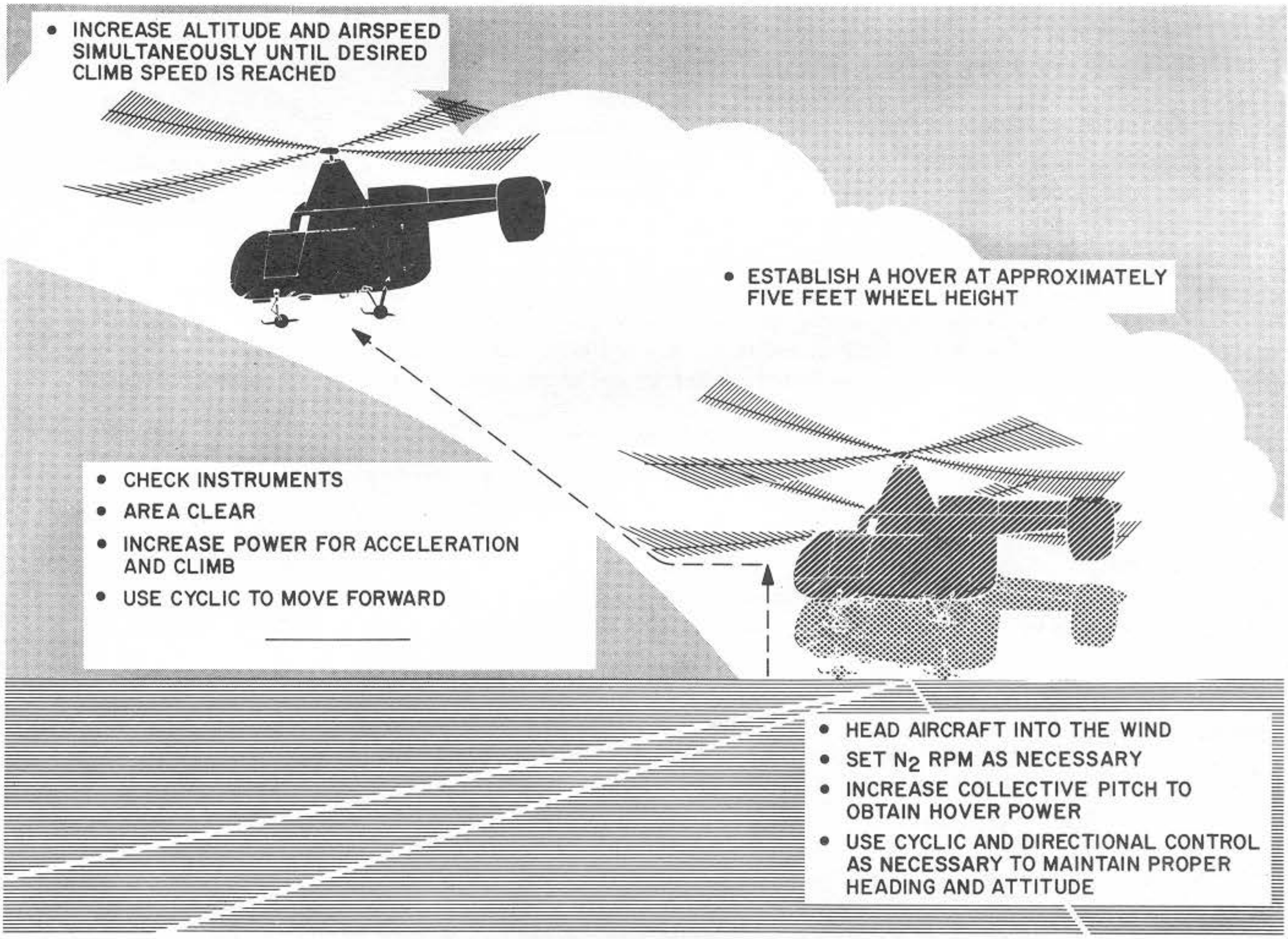


Figure 2—3

MAXIMUM PERFORMANCE TAKEOFF.

There are three types of maximum performance takeoff.

- Marginal Excess Power Takeoff (With or Without Fire Suppression Kit).
- Running Takeoff.
- Maximum Performance Takeoff (Restricted Area).

Marginal Excess Power Takeoff (With or Without Fire Suppression Kit).

A marginal power takeoff is described as a takeoff where maximum power available is approximately 2 psi torque more than that required for hover at 3 feet wheel height or desired ground clearance for cargo. This takeoff is effective where a normal takeoff could otherwise be accomplished except that power reserve is limited. (See figure 2–4.)

In this type of takeoff it is necessary to use ground effect to the maximum. After establishing a hover into the wind and all necessary checks have been made, move forward at a rate that will allow maximum benefit of ground effect (do not over control). As forward movement is started, increase collective to obtain full power. Slowly increase forward speed, attempting to maintain wheel height until translational lift is attained. After the helicopter has passed into translational lift, enough lift will be available for climb; however, do not increase altitude appreciably until best climb speed is reached.

Note

Observe engine performance instruments to preclude exceeding maximum limits. Refer to Section V.

Running Takeoff.

The running takeoff is used when power is insufficient to hover, but is adequate for flight. It can also be used satisfactorily under the marginal power situation when conditions and operating areas are suitable. (See figure 2–5.)

CAUTION

- Surface irregularities may cause excessive helicopter vibration or landing gear damage during the ground run.
- Practice running takeoffs should not be attempted on a rough or questionable terrain, runway barriers, or any other protrusions that might tend to create a safety of flight hazard.

Release wheel brakes, and set nose gear lock as desired, probably locked on rough or sloping terrain, or in crosswinds over 10 knots. Use engine speed governor switch to obtain desired rotor speed (refer to Appendix I). Increase collective pitch and apply forward cyclic as required to start the ground run, and to obtain the desired takeoff speed. Use directional pedals and cyclic as required to maintain heading during the ground run. When desired takeoff speed is reached, move the cyclic stick aft as necessary to become airborne.

Maximum Performance Takeoff (Restricted Area).

This takeoff is required when operating from small areas where obstructions surround the site. It is basic to note that this type of takeoff can usually be accomplished when there is sufficient power to hover out of ground effect. It may be necessary to climb vertically, or near vertically as dictated by surrounding obstacles. (See figure 2–6.) Set rpm, check wind direction and area clear. Increase collective control smoothly to maximum power, simultaneously increasing airspeed to the extent consistent with safely clearing the obstacles, until best climb speed can be attained and climb-out continued. Every effort should be made to minimize operating time in the "Avoid Continuous Operation" area of figure A–8.

CAUTION

- To avoid an overspeed condition, DECREASE engine speed governor switch before decreasing collective pitch while operating with high torque and high rpm.
- Careful application of collective control is required for all marginal power situations to avoid loss of rotor rpm.

Marginal Excess Power Takeoff (With or Without Fire Suppression Kit)

- START CLIMB WHEN BEST CLIMB SPEED IS REACHED

- MOVE FORWARD AT A RATE THAT WILL ALLOW MAXIMUM BENEFIT OF GROUND EFFECT
- AS MOVEMENT IS STARTED INCREASE COLLECTIVE TO OBTAIN FULL POWER
- MAINTAIN HEIGHT
- INCREASE SPEED UNTIL TRANSLATIONAL LIFT IS OBTAINED

- ESTABLISH HOVER INTO THE WIND
- CHECK INSTRUMENTS
- AREA CLEAR

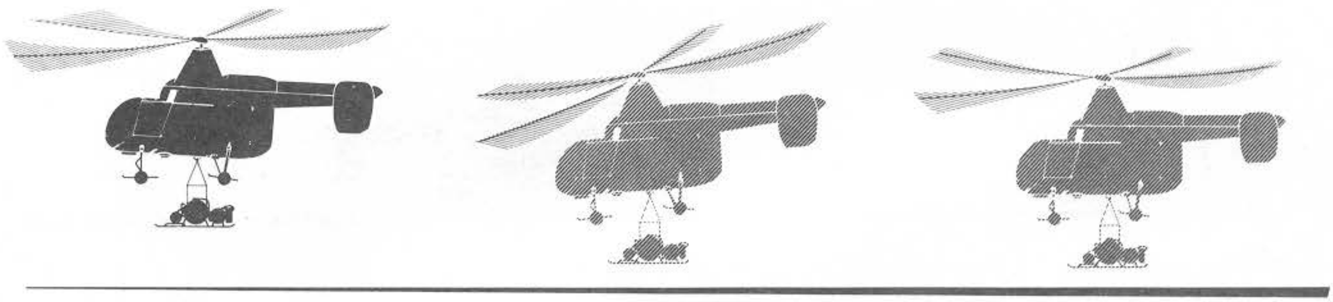


Figure 2—4

Running Takeoff

- WHEN DESIRED TAKEOFF SPEED IS REACHED, MOVE CYCLIC AFT AS NECESSARY TO BECOME AIRBORNE

- INCREASE COLLECTIVE AND APPLY FORWARD CYCLIC AS REQUIRED TO START GROUND RUN
- USE DIRECTIONAL PEDALS AND CYCLIC AS REQUIRED TO MAINTAIN HEADING

- RELEASE WHEEL BRAKES
- SET NOSE GEAR LOCK AS DESIRED
- SET ENGINE SPEED GOVERNOR SWITCH FOR DESIRED N_2 RPM

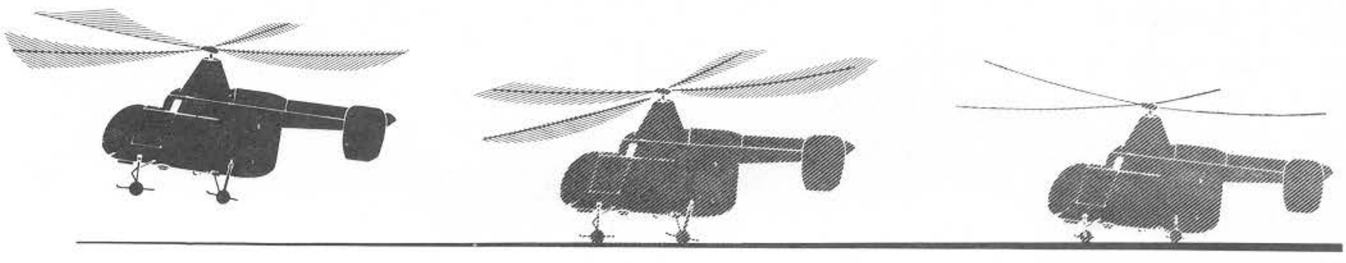


Figure 2—5

Maximum Performance Takeoff (Restricted Area)

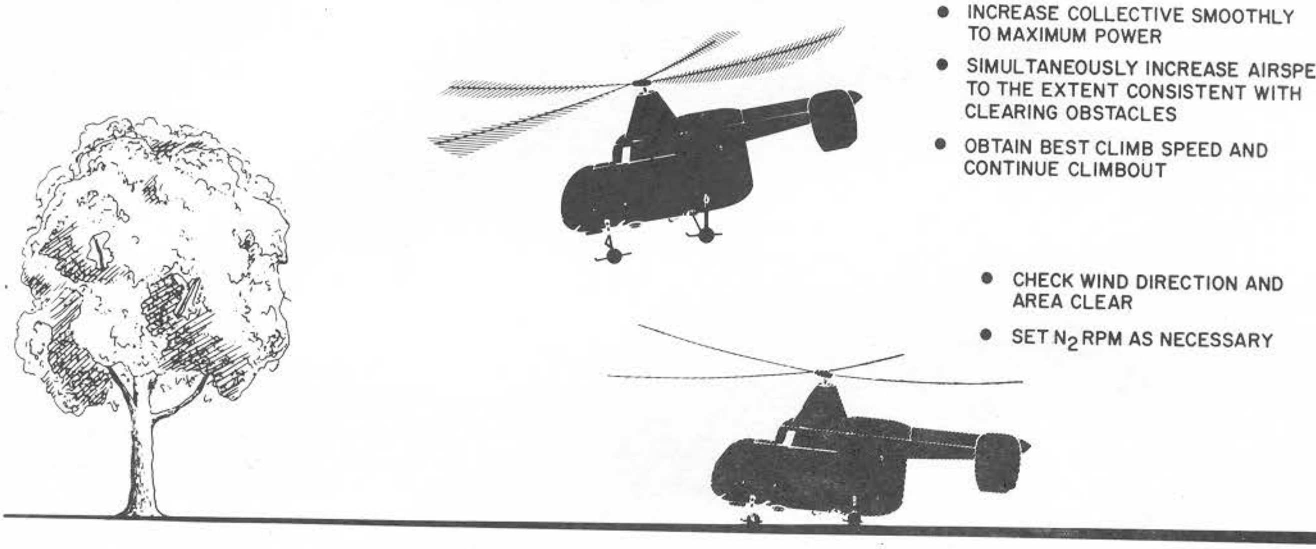


Figure 2–6

AFTER TAKEOFF-CLIMB

For planning, refer to the climb data in the Appendix, and to figure A–8, which indicates safe operating altitudes for various airspeeds.

Reduce to climb power when best speed is obtained.

CRUISE CHECKS

Refer to Appendix and other Sections to monitor cruise, etc.

FLIGHT CHARACTERISTICS

Refer to Section VI.

DESCENT

Descent is accomplished by reducing the collective pitch, while maintaining rpm as desired. Maintain desired heading and airspeed (normally 60 knots IAS) by using cyclic stick and directional pedals.

BEFORE LANDING

1. Crew and passengers – Alerted.
*2. Wheel brakes – As desired.
3. Nose wheel lock handle – As desired. Normally unlocked, unless site is rough or sloping, or crosswinds are over 10 knots.
4. Pitot heater switch – Climatic.
5. Fuel quantity – Checked.
*6. Engine speed governor switch – 250 rpm minimum rotor speed.
7. Sling arming and auto sling release switches – As required.

Note

When performing a series of landings and engine is not shutdown items marked with an asterisk must be accomplished, however all items are required before the initial and final landing.

LANDING SITE EVALUATION.

The versatility of the helicopter permits safe operation from unfamiliar and unprepared operating sites such as open fields, mountain knolls, ridges; and desert, snow and ice areas. Although the helicopter is capable of operating from closely confined areas, the final analysis of the situation and the decision to land or takeoff must be made by the pilot. Prior to operating the helicopter from unprepared areas, the pilot must consider certain basic factors and make on the spot evaluations to determine the existing hazards to flight, and plan his approach, landing, and subsequent takeoff accordingly. On the spot evaluations may be made by making passes into the wind over the intended landing site at various altitudes and airspeeds. The prime factors to be considered are outlined in the following paragraphs.

Approach and Takeoff Obstacles.

Obstacles such as trees, hills, buildings, wires, etc., must be considered prior to attempting operation from unprepared areas. In many instances a crosswind or a downwind approach may be appropriate to avoid hazardous obstacles. The proximity, height, and types of obstacles must be evaluated to allow for the expected aircraft performance, the variable wind factors including gusts and directional changes, and variations in pilot techniques.

Size of Usable Area.

The size of the usable area can be determined by a low speed pass into the wind over the intended landing site. Generally, the landing site should be level and clear, approximately twice the diameter of the rotor disc area. The pilot must consider density altitude, gross weight, personal skill, wind, and obstacles when evaluating the suitability of the landing site.

Wind Direction, Velocity and Consistency.

The effects of winds on takeoffs and landings are very imporatant factors in the operation of the helicopter; however, in planning critical helicopter operation, the winds should not be relied on to accomplish a landing and takeoff from an obstructed area. If the helicopter is riding a gust on the final approach and the gust decreases as the helicopter is aproaching a hover, the helicopter may "fall through" if the wind factors is planned on to execute the landing. This condition would also hold true during the initial phase of takeoff. If an operation is dependent upon wind conditions, all other conditions being marginal, the helicopter should be lightened. Another effect of wind that must be considered is the "lee effect" of the wind over hills, ridges, and obstacles. The down drafts resulting from this condition particularly affect the initial phase of takeoff or the final phase of landing.

Gross Weight.

The gross weight of the helicopter is an important factor to be considered in determining the feasibility of any contemplated helicopter operation. The pilot must know the actual gross weight of the helicopter to adequately evaluate the situation. In all instances the fuel load, equipment, and personnel should be kept to the minimum required to accomplish the mission. Refer to **WEIGHT LIMITATIONS**, Section V, for additional information on gross weight.

Terrain Evaluation.

After the preceding factors have been evaluated and a landing considered practicable, the surface condition must be evaluated. In helicopter operation the presence of shrubs, bushes, stumps, rocks, holes, soft surfaces, etc., is a definite hazard to landing. The elected landing spot must be free of any obstacles that will result in damage to the helicopter. Prior to attempting a landing, the pilot should "drag" the area several times and select the spot in which the helicopter can be landed with adequate fuselage, tail section, and main rotor clearance, and determine the most desirable approach to accomplish an into-the-wind landing and subsequent takeoff.

Rough Terrain.

The helicopter is capable of operating safely from most rough surfaces, provided the pilot uses the proper techniques. In selecting the direction of landing in rough terrain, the pilot must consider wind and surface conditions. When the wind velocity is less than 10 knots, it may be considered secondary in importance. This is not intended to imply that a crosswind landing should be made and certainly not a downwind approach, but is intended to stress the advisability of considering terrain in preference to wind in rough terrain operation.

Rocky Terrain.

Landings on rocky terrain are the most difficult to accomplish in a helicopter, due to the extreme variation in the size and position of the rocks. When a landing is required on an extremely irregular surface, it may be advisable to lower personnel on the hoist or discharge them from a minimum altitude hover position to improve the landing site or to aid in directing the touchdown prior to attempting a landing. The parking brakes should be locked to prevent the helicopter from turning or moving once the landing has been completed. Prior to stopping rotors, the wheels should be chocked to prevent any inadvertent movement of the helicopter when starting. As in other rough terrain landings, pitch should be slowly decreased while maintaining flight rpm until the landing is safely accomplished.

Note

- The pilot should always maintain flight rpm on an unprepared surface until it has been determined that the surface will support the helicopter. This will permit immediate takeoff if the helicopter should start to tip over or sink into the surface.

(continued)

- Prior to any landing, other than emergency landings, the pilot should thoroughly inspect the area for all hazards that may be present. Existing factors affecting the approach, touchdown, and takeoff should be carefully evaluated by the pilot.
- The approach to landing point of touchdown, and the takeoff should be completely planned by the pilot before the first landing attempt.

Expected Helicopter Performance.

The final step in the evaluation of a landing site is the expected helicopter performance during landing and subsequent takeoff. After the size of the area and the effects of obstacles, gross weight, and density altitude have been determined, the performance charts contained in appendix I should be referred to, and the practicability of the contemplated operation determined.

In Flight Power Differential Check.

Due to reduced power availability at altitude, a determination should be made that the power available at the landing altitude is sufficient to permit hovering at the gross weight and atmospheric conditions prevailing at the time of landing. This may be accomplished by an in flight power differential check. This check enables the pilot to determine if performance is adequate to hover, land and takeoff under the prevailing conditions. The check is accomplished by establishing straight and level flight at 40 KIAS, with 260 rotor rpm, out of ground effect, and noting the torque pressure required to maintain this flight condition. When torque has been determined, apply maximum power within the operating limitations of Section V, maintaining attitude and 40 knots (will result in climb if excess power is available), and again note the torque pressure. The difference between the two readings will be the basis for estimating whether or not the helicopter will hover under existing conditions. If climbing torque is greater than level flight torque by 1.5 psi for each 1000 pounds of total gross weight, it will be possible to hover in ground effect (5 foot wheel height), with approximately 3 psi power reserve. This 3 psi power reserve is adequate for transition to and from forward flight and is sufficient to allow for such variables as turbulence, cross slope hovering, pilot proficiency, etc.

Note

- The 1.5 psi torque per 1000 pounds is based on slow, shallow, approach with marginal power and zero wind.
- If external cargo is being landed it will be necessary to hover at a 20 foot wheel height. This will require additional torque of approximately 4 psi.

Note

Do not exceed 260 rotor rpm. During gusty conditions this check can be performed using 250 rotor rpm.

An alternate power differential check procedure is to record during takeoff the torque pressure required to hover at wheel height of 5 feet. After arriving at the landing site, fly low over the intended point of landing, start a climb at 40 knots with maximum power and note the torque pressure. If climbing torque exceeds the earlier obtained hovering torque by 1.5 psi for each 10,000 feet above takeoff site *plus* 3.0 psi, it will be possible to hover in ground effect (5 foot wheel height), with about 3 psi power reserve.

Note

The 1.5 psi torque per 10,000 feet plus 3.0 psi is based on use of a slow, shallow approach with marginal power and zero wind. A decrease in gross weight from takeoff (e.g., fuel consumption) or any wind condition other than zero wind will provide the pilot with a greater safety margin.

APPROACH AND LANDING

The following four approaches and landing are basic maneuvers and it may be necessary to modify or combine elements of each to obtain the desired results during operational conditions.

CAUTION

- Avoid excessive angles of flare, which can cause tail surfaces to contact ground.
- Avoid landing in areas of high grass or other combustible material that may be ignited. If a landing in dry grass or brush is necessary, land into the wind, and if possible, keep rotors turning at minimum rpm. If rotors must be stopped, use normal procedure. Accomplish restart with rotor brake lever OFF.
- After establishing positive ground contact, collective pitch should be placed in full decreased position.

NORMAL APPROACH.

Decrease power as necessary to maintain a constant groundspeed and apparent angle of approach of approximately 30° (figure 2–7). Gradually increase collective pitch to establish a hover.

STEEP APPROACH.

Decrease power as necessary to maintain a constant groundspeed and apparent angle at approach of approximately 45°. Make all major corrections in groundspeed, rate of descent and angle of approach during initial phase of the approach. During the last portion of the approach the rate of descent and forward speed should be decreased to establish a hover at minimum altitude above the ground.

Typical Power-On Landing

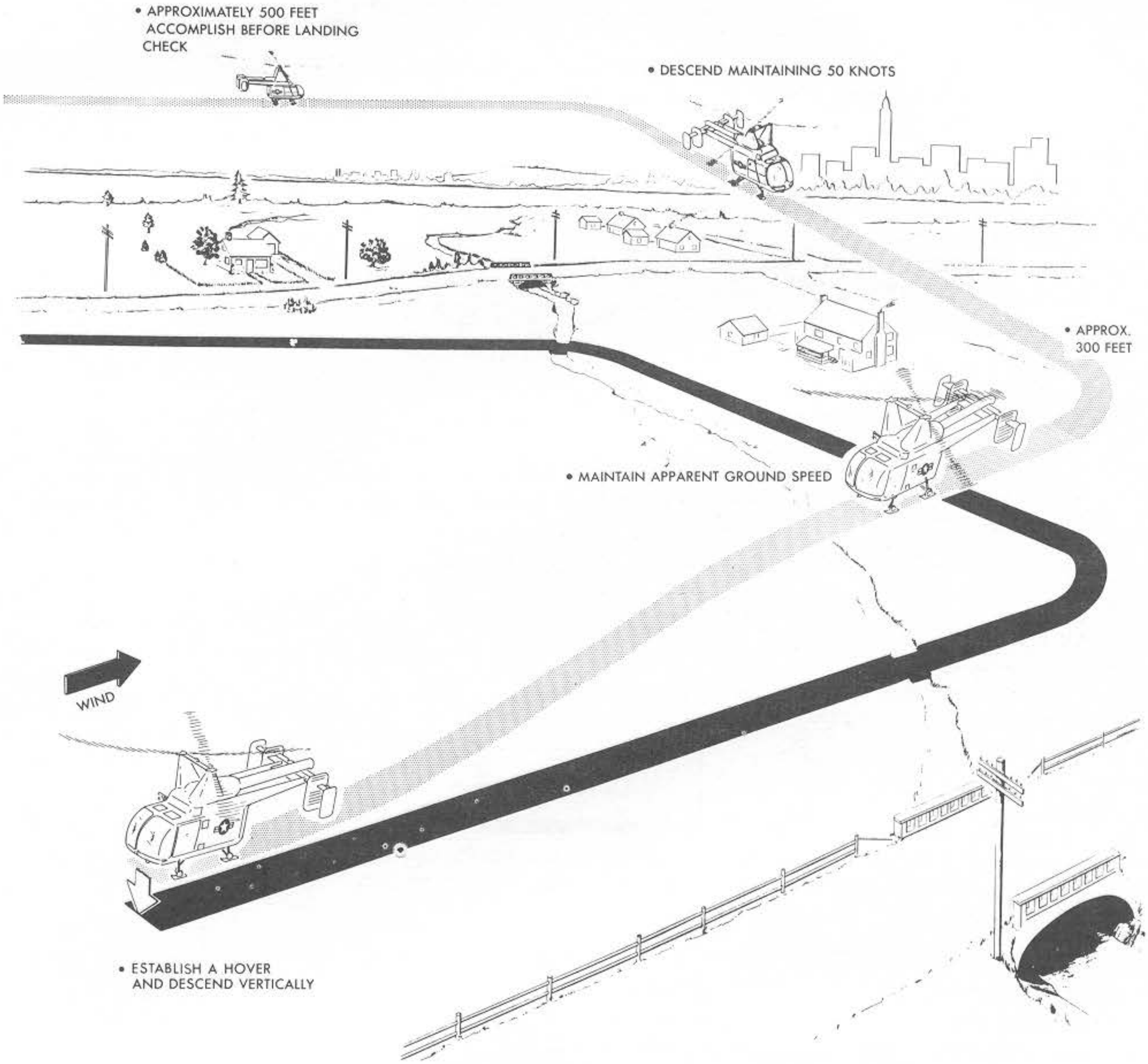


Figure 2–7

SHALLOW APPROACH TO A RUNNING LANDING. Adjust collective pitch as necessary to maintain the desired approach angle (apparent 10 degrees) and dissipate speed gradually throughout the approach so that the landing can be accomplished while maintaining translational lift. During the final phase of the approach, collective pitch should be applied as necessary to cushion the landing. After landing, maintain directional control.

CAUTION

Running landings should not be attempted on a rough or questionable terrain, runway barriers, or any other protrusions that might tend to create a safety of flight hazard.

CROSSWIND LANDING.

Land with cyclic stick and directional pedal application as necessary to maintain heading, and to correct for crosswind drift. Refer to Sections 5 and 6 for limits and flight characteristics.

Note

In crosswinds over 10 knots, nose wheels should be locked for better directional control on ground.

Avoid using excessive lateral cyclic after ground contact is made. This can cause excessive tilting of rotor disc and increase wind force on helicopter.

GO-AROUND

Apply required power, and establish desired airspeed and altitude.

AFTER LANDING

STOPPING ENGINE AND ROTORS.

1. Helicopter — Head into wind.
2. Nose wheel lock handle — As desired.
3. Parking brake — Set.
4. Secondary Bus Switch — Emergency.
5. Engine speed governor switch — DECREASE to minimum.
6. Throttle — FLIGHT IDLE, then GROUND IDLE.
   a. Throttle — FLIGHT IDLE, check gas producer rpm (60-64 percent).
   b. Throttle — GROUND IDLE, check gas producer rpm (42-43 percent).

Note

Allow gas temperature to cool and to stabilize before moving throttle to CUTOFF.

7. Directional stability switch — OFF.
8. All radios — OFF.
9. PA System — OFF.
10. IFF/SIF OFF (IF APPLICABLE)
11. Droop stops — Checked in.

WARNING

Severe damage and injury to personnel can result, especially during windy conditions, if droop stops are not in by approximately 99 rpm.

12. Fuel boost pumps switch — OFF.
    a. Fuel pressure gage — Zero.
13. Throttle — CUTOFF.
14. Rotor brake lever — ON.
    Apply rotor brake after rotor speed drops below 99 rpm.

Note

If excessive rocking is encountered while the rotor is decelerating, release wheel brakes.

15. Anti-collision light — OFF.
16. Inverter switch — OFF.
17. Fuel and oil shutoff switch —OFF.
    Wait until engine has coasted to a complete stop. Listen for any unusual noises during coastdown.

CAUTION

If exhaust gas temperature rises rapidly, place starter and ignition test switch to TEST MOTOR until exhaust gas temperatures starts to fall.

18. Secondary Bus Switch — Normal.
19. Battery switch — OFF.

BEFORE LEAVING THE HELICOPTER

1. All other electric switches — OFF.
2. Chocks — In place.

CAUTION

Make appropriate entries on the Form 781, covering any limits in Section V that have been exceeded during any phase of the flight. Entries must also be made when, in the pilot's judgment, the helicopter has been exposed to unusual or excessive operation, such as hard landings, excessive braking, etc.

ALERT PROCEDURES

The procedures in this manual have been tailored so that maximum use may be made of normal procedures. To provide for operations with the helicopter on alert status, it has been necessary to add **COCKING, SCRAMBLE,** and **UNCOCKING** procedures. In order to obtain the most effective results, it is necessary for air crew members to be thoroughly familiar with the alert procedures in this section.

HELICOPTER ACCEPTANCE CHECK.

When an alert crew assumes alert status, an acceptance check will be accomplished. The acceptance check consists of the following normal procedures:

BEFORE EXTERIOR INSPECTION

Note

When performing the **BEFORE EXTERIOR INSPECTION** in preparation for alert status, protective covers, teeter locks, and tiedown equipment should be removed unless expected weather conditions indicates they will be needed. When protective covers, teeter locks or tiedown equipment is installed, procedures will be established to insure removal prior to engine start.

EXTERIOR INSPECTION

GOING ON IMMEDIATE ALERT.

When the aircrew accepts the helicopter as ready for alert, it should be placed in the area designated for the alert helicopter (hot spot). The helicopter will then be placed in a "cocked" configuration by the aircrew using the **COCKING PROCEDURE.** The helicopter should be headed into the wind. The wind should be checked periodically, and the helicopter turned if necessary to maintain the correct heading in relation to the wind.

COCKING PROCEDURE.

1. Safety belt and shoulder harness — Adjusted.
2. Seat and flight control retaining pins — Installed.
3. Flight controls — Checked.
4. Throttle — FULL OPEN then GROUND IDLE.
5. Sling arming switch — ON.
6. Intercom control panel — Set.
7. Parking brakes — Set.
8. Nose wheel lock handle — As desired.

(continued)

9. Light controls – Climatic.
10. Anti-collision light switch – ON.
11. Directional stability switch – ON.
12. Inverter switch – ON.
13. Generator switch – ON.
14. Fuel and oil shutoff switch – ON.
15. Fuel control switch – AUTO.
16. Fuel boost pumps switch – ON.
17. Secondary bus switch – NORMAL.
18. J-4 compass turn cutout switch – NORMAL.
19. Engine anti-icing switch – AUTO.
20. Cable cutter arming switch – OFF and safetied.
21. Automatic sling release switch – OFF.
22. Starting fuel switch – ON.
23. Communications radio controls – As desired.
24. Console circuit breakers – Set.
25. Console floodlight rheostat – Climatic.
26. Rotor brake – ON.
27. Hoist circuit breaker – OFF.
28. Ceiling circuit breakers – Set.
29. Fuse covers – Secured.
30. Cargo hook – Checked.
    a. Prior to TCTO 563 – Open.
    b. After TCTO 563 – Closed and locked.

SECURITY OF COCKED HELICOPTER.

When the helicopter is cocked, no one will enter it except crew members assigned to that helicopter for alert. The clamshell doors will be closed, and the sliding doors will normally be open except when climatic conditions are unfavorable. A placard with the information "Entry Prohibited – Helicopter Cocked" will be placed near both doors. At any time while the helicopter is cocked and a requirement to perform maintenance exists, the alert pilot will uncock the helicopter using the **UNCOCKING PROCEDURE.** After maintenance has been completed, the helicopter will be reaccepted by the alert pilot using the **HELICOPTER ACCEPTANCE CHECK,** and recocked using the **COCKING PROCEDURE.**

UNCOCKING PROCEDURE.

1. All electric switches – OFF.
2. Throttle – CUTOFF.

SCRAMBLE.

When the order is given, the pilot will use the normal procedures beginning with **STARTING ENGINE AND BEFORE TAXIING.**

ABBREVIATED CHECKLIST

Your normal abbreviated checklist is now contained in T.O. 1H-43(H)B-1CL-1.

SCROLL CHECKLIST

The use of a scroll type checklist is authorized for this aircraft.

SECTION III

EMERGENCY PROCEDURES

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Introduction

TYPES OF PROCEDURE.

Most emergency procedures can be divided into two categories, *critical* and *non-critical,* as follows:

CRITICAL EMERGENCY PROCEDURES.

These steps of procedure must be performed immediately and instinctively without reference to written checklists. These critical steps are displayed in ***BOLDFACE CAPITAL LETTERS*** and should be committed to memory.

NON-CRITICAL EMERGENCY PROCEDURES.

All other steps of procedure can be accomplished while consulting a checklist.

ENGINE FAILURE.

Engine failure requires immediate action if a safe power-off landing is to be accomplished. The varied conditions under which engine failure may occur preclude dictating a standard procedure to be followed. However, a thorough knowledge of helicopter characteristics and emergency procedures will enable you to correctly respond to the emergency. The altitude and airspeed at which engine failure occurs will dictate action to be taken to effect a safe landing. Should engine failure occur at certain airspeed and altitude combinations as depicted in figure A–8, an autorotation may result in a hard landing. Continuous operation within these critical airspeed and altitude combinations should be avoided unless rescue mission requirements dictate otherwise. Because of the equalization of torque between the two rotors, there will be no yawing introduced by sudden engine failure. There is, however, a very pronounced nose down pitching tendency due to loss of nose up torque produced by the lateral inclination of the rotor shafts. The intensity of nose down pitching increases with increased airspeed or power and becomes more critical with forward center of gravity location. The first indication of engine failure will be a noticeable change in load factor and noise level followed by an immediate nose down pitching of the aircraft, coincident with a reduction in exhaust temperature, rotor and gas producer rpm, and tachometer needle split.

WARNING

It is characteristic of this helicopter to automatically nose down when power fails or is cut, and when the collective pitch lever is lowered to establish autorotation and maintain rotor speed within limits. This may be violent if the collective pitch is lowered rapidly, particularly at high power settings or at airspeeds above 60 knots. Immediately following loss of power, aft cyclic should be applied as necessary to arrest nose down pitch rate and to maintain 1g flight. When this application has resulted in control of pitch attitude, and if altitude permits, the collective pitch lever should be lowered at a moderate rate, with simultaneous aft cyclic to compensate for any additional attitude change.

If the nose down pitching is not stopped prior to lowering the collective pitch lever, or if the collective pitch lever is lowered too rapidly, there may be insufficient aft cyclic control to maintain a safe flight attitude. Helicopter pitch attitude must be monitored closely to insure that a positive load factor is maintained at all times.

There is no yawing due to torque as a result of an engine failure. However, engine failures at speeds below 30 knots may result in unpredictable and inconsistent yawing and rolling, especially if a crosswind is present.

Ground Operations

ENGINE FIRE ON STARTING

1. ***ENGINE – SHUT DOWN.***
2. ***FIRE EXTINGUISHER – DISCHARGE AT FIRE.***

NOTE

If it can be determined that the fire is internal, attempt to extinguish it by test motoring.

Takeoff

ENGINE FAILURE DURING TAKEOFF

ENGINE FAILURE WHEN HOVERING BELOW 10 FEET.

The landing can be cushioned somewhat by increasing collective pitch as the helicopter settles to the ground. Do not decrease collective pitch as you normally would in the event of engine failure at higher altitudes. This would only cause the helicopter to settle more rapidly. The sudden loss of power will be accompanied by positive nose down pitching of the aircraft. The helicopter should be held in a level attitude. Regardless of the impact force, damage will be much less if the helicopter lands level.

ENGINE FAILURE AT LOW ALTITUDE.

If engine failure should occur at low altitude and airspeed, an autorotation with no flare may be accomplished. Control of aircraft attitude is the most critical factor in engine failure at low altitudes. Immediate reduction of collective is not necessary and could cause loss of control of pitch attitude. The amount that collective pitch should be decreased is proportional to the altitude and airspeed at the time of engine failure. At an altitude of 10 feet with no airspeed, no attempt to decrease collective pitch should be made. At higher altitudes or with a significant amount of airspeed, if adequate control of pitch attitude can be maintained, collective pitch should be reduced sufficiently to maintain rotor RPM above minimum limits. To avoid tail to ground contact, if a flare is employed it should be completed and landing attitude established at approximately 10 feet above the ground.

NOTE

At low airspeeds, a flare without application of collective pitch will not appreciably alter the flight path or rate of descent of the aircraft.

ENGINE FAILURE DURING HOOKUP OF EXTERNAL LOADS.

This is one of the most critical situations in which to encounter engine failure. Immediate action by the pilot is imperative. If the failure is recognized soon enough, there is sufficient inertia in the rotor system to fly the helicopter clear of the load. Since most of this energy will be expended moving horizontally, there may be insufficient up collective remaining to cushion the landing but damage to the helicopter will be much less if it contacts the ground in a level altitude. One of the cargo release systems should be actuated at the time the engine failure is recognized to release the load or prevent it from being hooked up. The helicopter may be flown forward or backward depending on the position, attitude and direction of movement at the time of engine failure. Under normal circumstances, it is not advisable to move laterally because of the blade height at the side of the helicopter.

Inflight

ENGINE FUEL CONTROL OPERATION

A faulty power turbine governor causes erratic fuel flow. The pilot will first become aware of trouble by feel of the helicopter; if governor becomes unstable, rotor speed will surge and unless corrected may cause a pitching oscillation of the entire helicopter, as well as undesirable altitude changes. The following procedures should be considered immediate corrective measures only. The nature of the failure, mission, altitude, availability of suitable landing site, and pilot proficiency should determine whether or not a precautionary landing should be made.

WARNING

When switching to emergency fuel control there will be some time delay before power is restored. Depending on initial flight conditions and pilot technique, this could result in a substantial altitude loss.

When the fuel control switch is in EMERGENCY, fuel control acceleration and deceleration limiter is not operative, over-temperature protection is not provided, and automatic limitation of gas producer speed is not provided. Rapid movement of throttle or collective pitch lever may cause compressor stall, overtemperature, or structural damage to engine. Excessive opening of the throttle at altitude will cause gas producer overspeed. In EMERGENCY sensitivity of the fuel control increases with altitude.

When using emergency fuel control, avoid any flight condition which may require sudden power changes. Monitor gas producer tachometer and exhaust gas temperature gage to prevent overspeed or overtemperature. Make all power changes slowly, particularly with increasing altitude.

1. ***THROTTLE — FLIGHT IDLE.***
2. ***FUEL CONTROL SWITCH — EMERGENCY.***
3. ***THROTTLE — INCREASE.***
4. ***COLLECTIVE PITCH LEVER — AS NECESSARY.***
5. ***ENGINE PERFORMANCE INSTRUMENTS — MONITOR. OBSERVE LIMITS.***

WARNING

Although sufficient power is available when operating in emergency fuel control to maintain straight and level flight for all approved gross weights, the power available may be less than that available under governed flight. This difference decreases with altitude, and at 8,000 feet (Standard Day), or higher, the same torque is available under both governed and emergency fuel control conditions.

When using emergency fuel control, conduct an in-flight power differential check if feasible. Make any transition requiring increased power gradually and cautiously.

NOTE

When Switchover is accomplished at altitudes below 10,000 feet above sea level, N_1 speed will indicate an appreciable drop to GROUND IDLE. N_1 speed will increase above 10,000 feet.

ENGINE FAILURE DURING FLIGHT

In the event of engine failure during flight, a safe autorotation landing can be accomplished provided the helicopter is being flown at a safe altitude-airspeed combination (refer to figure A–8) and the in-flight altitude is sufficient to permit selection of a suitable landing area. When altitude permits, an air restart should be attempted. If engine fails to start, a normal autorotation landing should be accomplished.

1. ***ESTABLISH AUTOROTATION.***
2. Crew and passengers – Alerted.
3. Shoulder harness – Locked.
4. Engine – Restart if time and altitude permit.
5. Engine – Shut down if engine cannot be restarted.

ENGINE RESTART IN FLIGHT

If the engine has failed it may be possible to restart it in flight. If altitude permits, a restart should be attempted. See figure 3–1 for glide distances.

WARNING

When cause of engine failure is obviously mechanical, DO NOT attempt an engine restart. If a restart is to be attempted, the speed for minimum rate of descent should be established.

1. ***STARTING FUEL – ON.***
2. ***STARTER SWITCH – PRESS AND HOLD. (MONITOR EXHAUST GAS TEMPERATURE GAGE.)***

CAUTION

It is very important to press and hold the starter button until the ignition is assured, since the hold-down feature of the starter circuit does not function above 30% gas producer speed.

If temperature rises above 600°C, or if rate of increase is excessive, move starting fuel switch to OFF. If temperature continues to rise, move throttle to CUTOFF and immediately back to FULL OPEN.

WARNING

During an engine restart at 30-40% N_1, at least 1000 feet of altitude will be lost. The altitude loss will increase the lower the N_1 rpm is before restart is initiated.

If engine fails to start and if time and altitude permit, proceed as follows:

3. ***THROTTLE — FLIGHT IDLE.***
4. ***FUEL AND OIL SHUTOFF SWITCH — CHECK ON.***
5. ***FUEL BOOST PUMPS SWITCH — CHECK ON.***
6. ***STARTING FUEL SWITCH — CHECK ON.***
7. ***FUEL CONTROL SWITCH — EMERGENCY.***
8. ***STARTER SWITCH — PRESS AND HOLD. (MONITOR EXHAUST GAS TEMPERATURE GAGE.)***

WARNING

Loss of altitude will be greater with an emergency fuel restart because of the required careful throttle manipulation at low N_1 rpm. An emergency fuel control restart with 5% N_1 will result in an altitude loss of approximately 2700 feet. Continue autorotation procedure during restart procedure.

ENGINE SHUTDOWN PROCEDURE

1. Throttle – CUTOFF.
2. Fuel and oil shutoff switch – OFF.
3. Auxiliary fuel switch – OFF.
4. Fuel boost pumps switch – OFF.
5. Battery switch – OFF.
6. Rotor brake – ON (accomplish on the ground).

ENGINE FIRE DURING FLIGHT

1. ***HELICOPTER — LAND AS SOON AS POSSIBLE.***
2. ***ENGINE — SHUT DOWN.***
3. ***FIRE EXTINGUISHER — DISCHARGE AT FIRE.***

WARNING

Prolonged exposure (5 minutes or more) to high concentrations (pronounced irritation of eye and nose) of Bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

Autorotation Glide Distance

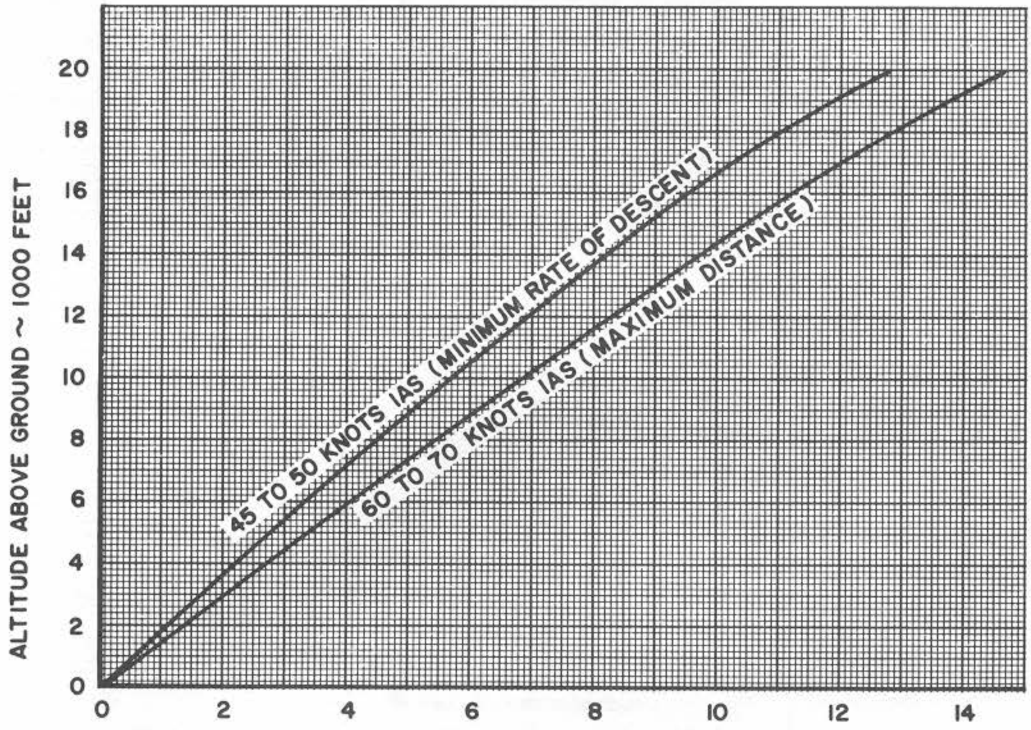

Figure 3—1

BAILOUT

Bailout is only recommended if it is impossible to ditch or make an emergency landing. When the decision has been made to bail out, alert the passengers and crew and open the cockpit and cabin doors. If the doors are stuck, pull the emergency release handles and open the emergency exits. Release your safety belt and make certain that safety belt and shoulder harness are not tangled with your parachute. Bailout, with or following the passengers and crew. Free-fall clear of the helicopter before opening your parachute.

NOTE

Refer to section I for description and operation of the emergency exits.

EMERGENCY DESCENT

A maximum rate of descent may be attained by making coordinated turns while autorotating and while holding the highest possible rotor rpm and airspeed consistent with the pilot's ability to maintain control.

Landing

AUTOROTATION GLIDE DISTANCE

Maximum glide distance is achieved at 60 to 70 knots IAS while minimum rate of descent (about 1400 fpm) is achieved at 45 to 50 knots IAS. Refer to figure 3—1 for corresponding glide distances. The gliding distance shown need not be corrected for gross weight, or rotor speeds above 220 rpm as they have only a slight effect on rate of descent or glide distance. Glide distance is decreased as rotor rpm is lowered below 220 rpm.

LANDING WITH ENGINE INOPERATIVE

TYPICAL AUTOROTATION PROCEDURE.

To enter autorotation following a sudden loss of power, apply immediate aft cyclic control to stop nose down pitching of aircraft, then reduce collective pitch to maintain rotor rpm above minimums. As collective pitch is reduced, additional aft cyclic control will be required to maintain desired pitch attitude. When altitude permits, establish a descent

Typical Autorotation Procedure

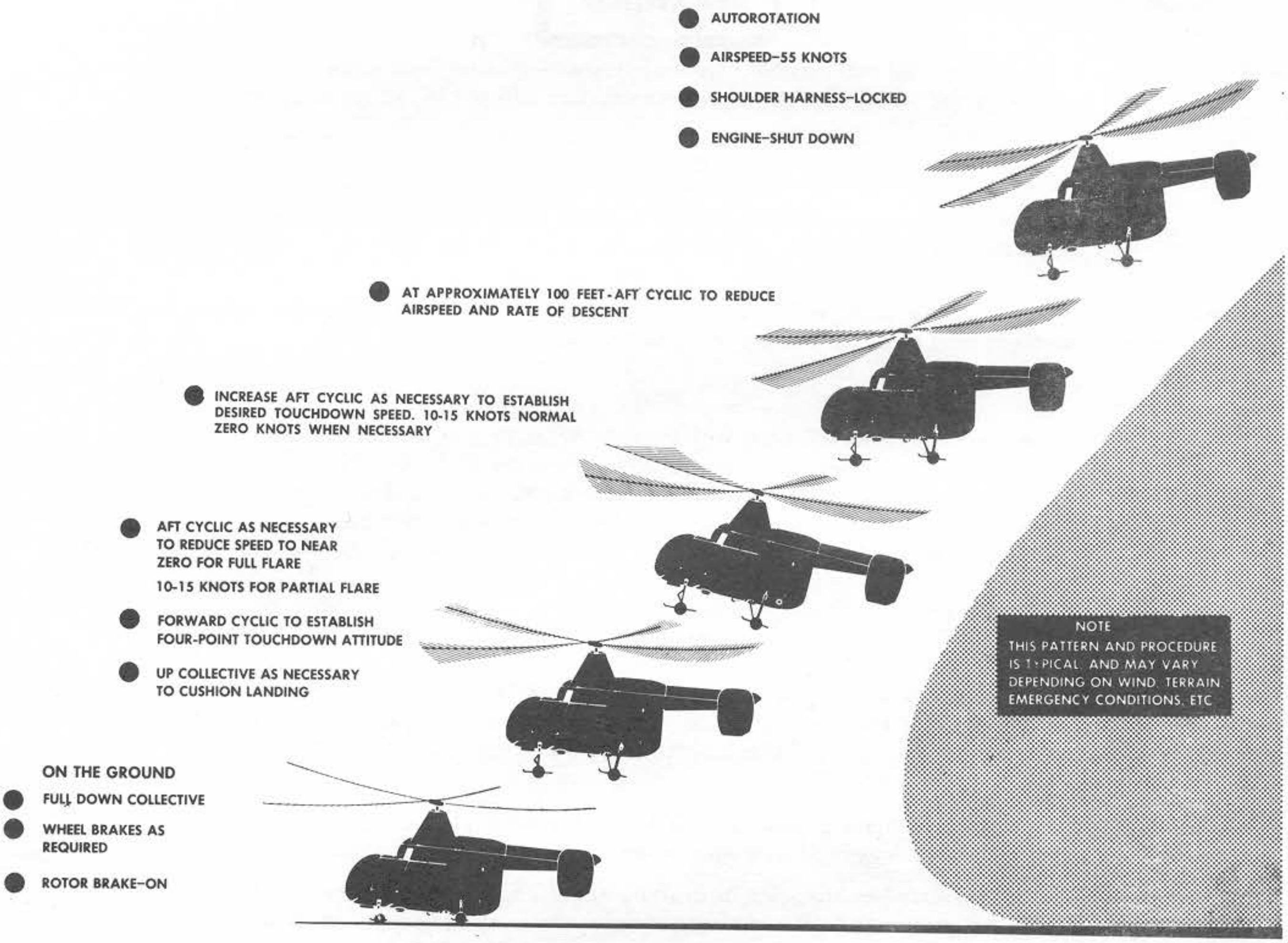

Figure 3–2

airspeed of 55 knots. At approximately 100 feet, start reducing groundspeed by applying aft cyclic control. The groundspeed should be reduced so that the desired landing speed is achieved as the landing attitude is established. To avoid tail to ground contact, flare should be completed and landing attitude established approximately 10 feet above the ground.

ENGINE FAILURE WITH AN EXTERNAL LOAD.

In the event of an engine failure or any other emergency condition requiring an autorotative approach while carrying an external load, the load must be released as soon as practicable.

LANDING PROCEDURE.

Increase collective pitch as necessary to cushion the touchdown. Normal landing airspeed should be approximately 10-15 knots but will vary with terrain and wind conditions. For landings in water, heavily wooded areas, or rough terrain, groundspeed should be reduced to zero, if possible. (See figure 3–2.)

PRACTICE AUTOROTATION

When practicing autorotation, complete "Before Landing Check", then check N_1, N_2, EGT, and airspeed, to insure the engine is running normally and to ascertain expected aircraft performance throughout autorotation.

Practice autorotations should be performed using the procedures described above under **TYPICAL AUTOROTATION PROCEDURE.** Before entering autorotation, move the engine speed governor switch to Increase to obtain 250 to 260 rpm. Entry shall not be made at airspeed above 60 knots or at torque meter pressure readings above 20 PSI. Engine failure is simulated by lowering the collective pitch to minimum and smoothly rotating the throttle to FLIGHT IDLE. When required, control pitch attitude by application of aft cyclic after the collective pitch lever is lowered. Abrupt reduction of throttle and/or collective pitch will be avoided to preclude excessive or violent nose down pitching.

WARNING

During practice autorotation, the 2 aft seats located on both sides of the fuselage and adjacent to the main gear structure will not be occupied.

CAUTION

Practice autorotation landing from a hover is not a recommended normal practice maneuver due to the reduced tolerance for miscalculations.

Practice autorotations should not be attempted on rough or questionable terrain, or on or near runway barriers or any other protrusions that might tend to create a safety of flight hazard.

NOTE

Tachometer needles normally will not split. When making a power recovery from a practice autorotation, move the throttle to the FULL OPEN position and check N_1 for increase before commencing the landing flare. Practice autorotations should not be started under the airspeed and altitude conditions within the areas of figure A–8 labeled "Avoid Continuous Operation."

DITCHING

The helicopter has a capability of landing at very low forward and vertical speeds both in normal flight and in autorotation. With emergency flotation gear installed, ditching can be accomplished with relatively little risk of injury to the crew or structural damage to the helicopter from water impact. Without flotation gear, the helicopter will not float.

The following discussion is based upon general knowledge of the helicopter and past experience with ditching of synchropters, and is presented as a suggested technique rather than a mandatory procedure.

Some of the factors to be considered by the pilot in ditching are altitude, wind velocity and direction, distance from shore, sea state or water condition, air and water temperatures, survival equipment available, helicopter condition, possible time delay in rescue, etc.

NOTE

High wind or sea state may result in rollover, although flotation will not be reduced except by bag rupture.

Bailout of the crew over water is not recommended as long as controlled flight, including autorotation, can be maintained.

USE OF FLOTATION GEAR.

When the emergency flotation gear (figure 1–20) is installed, the helicopter will float at weights in excess of the maximum allowable gross weight (9150 pounds is maximum allowable; 9750 pounds is displacement capacity of gear). Flotation capability with two of the three bags inflated is approximately 6500 pounds. The helicopter will capsize if all bags are not inflated.

CAUTION

Static stability of the helicopter with flotation gear when resting in the water at a gross weight of 6500 pounds is such that the helicopter is statically stable to a 50° roll (list) angle. This critical roll angle decreases with increasing gross weight, and at 9150 pounds gross, the critical angle is 20°. Therefore, the helicopters, when floating at lower gross weights may be expected to be relatively secure against capsizing even in moderately rough seas, but capsizing is probable in any but a clam sea state at gross weights approaching 9150 pounds.

Inflation time for the bags is 2.5 seconds maximum. The entire system, including emergency flotation handle, circuit, and power supply, is sealed to function under water.

CAUTION

If at all possible, bags should be inflated prior to water touchdown. Bags may not fully inflate if bag depth exceeds approximately 6 feet when switch is actuated.

Design leakage rate of the system is such that flotation will normally be maintained for about 24 hours.

Inflight inflation is accomplished with little effect on trim (approximately 2° nosedown at 70 knots). Unsymmetrical inflation results in a small, controllable yaw.

CAUTION

Failure of maintenance personnel to observe proper folding and stowing procedures can cause bags to rupture upon inflation.

If, in conducting a ditching with flotation gear installed, any of the bags should fail to inflate, or rupture upon inflation prior to water contact, the pilot should immediately revert to the procedure for ditching without flotation gear. Although the helicopter will probably float with two bags inflated it will not remain upright. If desired in this case, the crew may elect to remain near the overturned helicopter to increase the probability of survival and early rescue.

Maximum airspeed for bag inflation is 70 knots. Buffeting may occur at higher speeds.

Maximum recommended pressure altitude for bag inflation is 4000 feet. Above this altitude, bag rupture is possible, depending on temperature, airspeed, and variations in individual bags.

For over-water flights normal procedure should be to have all sliding doors fully opened, or fully closed. With the bags inflated the doors cannot be moved.

WARNING

Number six and seven troop seats will not be installed for over water flights. With these seats installed, egress is limited to the aft cabin door, and when flotation gear is installed, egress may not be possible because of the inflated bag.

CAUTION

Recommended speed relative to the water for any ditching is zero. If forward speed exists during touchdown, nose-over may occur. A slightly tail low attitude will reduce the possibility of this occurrence.

PLANNED DITCHING.

In the event of ditching due to anticipated fuel starvation or for any other reason where ditching is imminent but not immediate, much can be done to protect personnel and survival gear by following the planned ditching procedure. Refer to figure 3–3.

WARNING

Following touchdown, the rotors will probably contact the water unless the water is relatively calm and the ditching is symmetrical. Rotor contact while blades are turning slowly may cause some nosedown pitching and possibly result in rotor blade failure. At higher rotor speeds, rotor blade failure should be anticipated. Some damage to the helicopter and flotation gear could result.

Ditching Chart

PLANNED DITCHING WITH OR WITHOUT FLOTATION GEAR

	CREWMEMBER					
	PILOT	COPILOT	FIREMEN	FLT ENGR/ HELI MECH	MEDICAL TECHNICIAN	RESCUE SPECIALIST
1. Sliding Door – Full Open (prior to flotation bag inflation).	P	CP	FF*	FE/HM*	MT*	RS*
2. Radio Calls – Transmit.	P					
a. Crew Altered – (prepare survival gear).	P	CP	FF	FE/HM	MT	RS
b. Distress Message.	P					
3. Personal Equipment – Check.	P	CP	FF	FE/HM	MT	RS
a. Parachute – Unbuckle.	P	CP	FF	FE/HM	MT	RS
b. Life Vest – Check (do not inflate).	P	CP	FF	FE/HM	NT	RS
4. Shoulder Harness – Locked.	P	CP				
5. Flotation Gear – Inflate (if installed)	P					

NOTE

Airspeed must be below 70 knots and pressure altitude below 4000 feet.

	PILOT
6. Helicopter – Hover (if flotation equipment is not installed or malfunctions, or a heavy sea state exists, evacuate crew and proceed 50 yards downwind to complete ditching.)	P
a. Battery and Generator Switches – Off.	P
b. Hover at minimum rotor speed and zero water speed.	P
c. Gradually lower helicopter into water.	P
d. Throttle – CUTOFF.	P
e. Collective Pitch – Increase.	P
f. Rotor Brake – ON.	P
7. Evacuate helicopter (with survival gear) when rotors stop.	P

*When opening right cabin door, pilot's door will be fully opened.

Figure 3–3

IMMEDIATE DITCHING.

If ditching is caused by engine failure, proceed as instructed in the immediate ditching procedure. Refer to figure 3–4.

NOTE

To minimize the hazard of inadvertent or premature water contact, which may result from difficulty in estimating altitude over water, a lower than normal autorotational airspeed is recommended (45 to 50 knots). This will produce a minimum rate of descent, thus giving the pilot a better opportunity to judge height above water, and will reduce the possibility of flying into water or flaring too high. When approaching the water, a tail low attitude is desired, to further reduce hazards associated with inadvertent water contact.

As soon as the pilot has definitely determined that flare altitude is reached, he should complete the autorotation so as to contact the water as close to zero water speed as possible.

Ditching Chart

IMMEDIATE DITCHING WITH OR WITHOUT FLOTATION GEAR

	CREWMEMBER					
	PILOT	COPILOT	FIREMEN	FLT ENGR/ HELI MECH	MEDICAL TECHNICIAN	RESCUE SPECIALIST
1. ESTABLISH AUTOROTATION (45–50 KNOTS INTO THE WIND).	P					
2. SLIDING DOOR – PULL OPEN (PRIOR TO FLOTATION BAG INFLATION).	P	CP	FF*	FE/HM*	MT*	RS*

WARNING

If time does not permit sliding doors to be opened prior to ditching, emergency exits will be used.

3. Radio Calls – Transmit.	P					
a. Crew Alerted (prepare survival gear).	P	CP	FF	FE/HM	MT	RS
b. Distress Message.	P					
4. Personal Equipment – Check.	P	CP	FF	FE/HM	MT	RS
a. Parachute – Unbuckle.	P	CP	FF	FE/HM	MT	RS
b. Life Vest – Check (do not inflate).	P	CP	FF	FE/HM	MT	RS
5. Shoulder Harness – Locked.	P	CP				
6. Flotation Gear - Inflate (if installed).						

NOTE

Airspeed must be below 70 knots and pressure altitude below 4000 feet.

7. Engine – Shutdown.	P					
8. Crew – Alerted and Braced for Ditching.	P	CP	FF	FE/HM	MT	RS
9. Helicopter – Ditch.	P					
a. Collective Pitch – Increase.	P					
b. Rotor Brake On.	P					
10. Evacuate Helicopter (with survival gear when rotors stop).	P	CP	FF	FE/HM	MT	RS

*When opening right cabin door, pilot's door will be fully opened.

Figure 3–4

After contact with the water, maintain a level attitude as long as possible. Increase collective pitch as the helicopter settles and apply the rotor brake. This will reduce rotor inertia and cause a less violent reaction when the blades strike the water. Do not exit the helicopter until the rotors have stopped. If flotation gear is installed and inflated, it may be desirable to remain in or near the helicopter until rescue arrives.

CAUTION

Helicopter should be held symmetrical upon water touchdown. Previous synchropter experience has shown that the possibility of pilot disorientation is thus minimized.

Miscellaneous

ELECTRICAL FIRE

Electrical fire during daylight VFR conditions presents no critical hazard once all electrical power sources are isolated. During night operations the battery must be turned on and the secondary bus switch placed in the emergency position to provide lights for landing in unprepared areas.

SMOKE AND FUME ELIMINATION

Open cockpit and cabin sliding doors for ventilation. Move cabin heat switch to OFF if it is suspected that the fumes may be coming from the cabin heater.

OIL COOLER FAN FAILURE

The design of the oil cooling system is such that ram air can be used for oil cooling when the aircraft is in forward flight. However, if the aircraft is hovering or is in low forward speed, ram air will not be available for cooling. If engine and transmission oil temperature increase rapidly or become excessively high, proceed as follows:

1. Make a precautionary landing if practicable.
2. If conditions are such that a precautionary landing is deemed to be inadvisable:
   a. Increase air speed to permit ram air to stabilize oil temperature below red line limits.
   b. Avoid hovering or low speed flight. Monitor engine and transmission oil pressure gages.
   c. Make a precautionary landing when a safe area as available.

NOTE

The cooling effect of ram air through the coolers will vary with OAT and airspeed. On a 125°F day at 60 knots IAS, ram air alone will keep oil temperatures at approximately red line. Increasing airspeed will lower oil temperatures.

ENGINE OIL LOW CAUTION LIGHT ON, OR ENGINE OIL PRESSURE HIGH OR LOW

Oil system malfunction can cause engine oil starvation, and result in bearing failure and engine seizure. If oil low caution light is on, or pressure becomes excessively high or low, land the aircraft as soon as a safe landing spot is available. If a safe landing spot is not available, reduce power to the minimum amount required to remain airborne and head for the most suitable landing spot. Be prepared for engine failure. The engine may operate for a short time after oil starvation. If rpm drops or if excessive vibration occurs, engine seizure is imminent. Shut down the engine.

ENGINE CHIP DETECTOR CAUTION LIGHT ON

The presence of metallic chips in the engine oil system is an indication of unusual wear. The flight may be continued if necessary to reach a safe landing area, but unnecessary delay in landing should be avoided. Carefully monitor engine oil pressure and temperature. Be prepared for possible engine failure. If a safe landing site is not immediately available, you must evaluate the circumstances and adjust your altitude and airspeed to provide the most favorable situation if further trouble develops. Some of the factors to consider are: time and distance to a safe landing site, weather, terrain, etc.

COLLECTIVE LIMITER FAILURE

Failure of the collective limiter is extremely unlikely. However, if it does occur, as much as 60 pounds of force may be required to hold the collective pitch lever up or down. Failure of the limiter will not cause structural damage, but because of the fatiguing effect of maintaining collective pitch lever settings, you should land as soon as possible. (Rotor rpm can be adjusted to reduce the force. To reduce a downward force on the pitch lever, increase rpm. To reduce an upward force, decrease rpm.) Internal failure of the collective limiter oil valve will require maximum force to hold the collective pitch lever down, with zero force needed to hold it up.

WARNING

Loss of external oil pressure to the collective limiter will require maximum force to hold the collective pitch lever up, with zero force needed to hold it down. In this case you should carefully observe the transmission oil pressure gage. The collective limiter is supplied by the transmission oil pump; and loss of oil to the limiter may be a forewarning of loss of oil to the transmission.

ELECTRICAL POWER FAILURE

DC GENERATOR CAUTION LIGHT ON.

1. Generator switch – RESET, then ON.
2. Generator switch – OFF, if light remains on.
3. Secondary bus switch – As required.

NOTE

Battery power may be supplied to secondary bus by moving secondary bus switch to EMERGENCY.

4. All non-essential electrical equipment – OFF, to conserve battery power.

INSTRUMENT AC POWER CAUTION LIGHT ON.

1. Inverter switch – Switch to alternate inverter.

NOTE

Loss of the 26-volt ac bus will not cause the instrument ac power caution light to glow.

2. Inverter switch – OFF, if light continues to glow.

If light remains on, land as soon as suitable landing site is available, using extreme care not to run out of fuel. The following listed equipment will be inoperative:

Fuel quantity gage.
Fire detector.
J-4 compass.
Attitude indicator.
Radio magnetic indicator.
Transmission oil pressure gage.
Engine oil pressure gage.
Fuel pressure gage.
Torquemeter.
Directional stability system.

TRANSMISSION OIL PRESSURE CAUTION LIGHT ON

1. Transmission oil pressure gage – Check.
   Confirm that pressure is low.
2. Helicopter – Land.
   Initiate a precautionary landing as soon as practicable.

Note

The transmission may operate for a short time even without oil. The flight may be continued if necessary to reach a safe landing area, but unnecessary delay in landing should be avoided.

TRANSMISSION CHIP DETECTOR CAUTION LIGHT ON

The presence of metallic chips in the transmission oil system is an indication of unusual wear. Carefully monitor transmission oil pressure and temperature. The flight may be continued if necessary to reach a safe landing area, but unnecessary delay in landing should be avoided. If a safe landing site is not immediately available, you must evaluate the circumstances and adjust your altitude and airspeed to provide the most favorable situation if further trouble develops. Some of the factors to consider are: time and distance to a safe landing site, weather, terrain, etc.

ENGINE ICE CAUTION LIGHT ON CONTINUOUSLY

Intermittent flashing of the engine ice caution light is normal when flying in icing conditions. However, if the light remains on for more than 20 seconds, it indicates that the automatic anti-icing equipment is inoperative.

1. Engine anti-ice switch – MANUAL.
   In this position, the anti-ice hot air valve will remain open, providing maximum anti-icing of the engine.

ENGINE FIRE LIGHT ON

1. Initiate a precautionary landing, and check for other indications of fire.

2. If a fire exists, refer to procedure under **ENGINE FIRE DURING FLIGHT** in this section.

ROTOR OUT OF TRACK AND CANNOT BE CORRECTED WITH TRACKING SWITCHES

Damage to the rotor blades may result in a sudden severe out-of-track condition. This out-of-track condition can be recognized by observing the rotor blade tip-paths. In addition, vertical vibrations of the entire helicopter at a frequency of 1 vibration per rotor revolution will be felt. The pilot should attempt to reduce vibration by changing the following:

Airspeed

Rotor rpm

Collective Pitch (if descending)

Do not make high bank angle turns. If such a condition appears and cannot be corrected by use of the in-flight tracking switches, land the helicopter at the closest safe landing site. The rotor should be thoroughly inspected for damage which may affect safety of flight.

DROOP STOP STUCK OUT ON ROTOR SHUTDOWN

Severe damage may result, especially during windy conditions, if droop stops are not in at low rpm. If droop stops are not in by approximately 99 rpm increase rotor speed, then repeat shutdown procedure after requesting ground crew to hit droop stops in, if necessary. (Droop stops can be hit in by using a stick of suitable length, or preferably the straw end of a broom.)

If the above procedure does not seat the droop stops, the following procedure should be atttempted:

a. Helicopter – Head into the prevailing wind.

b. Throttle – Ground Idle. Allow rpm to stabilize.

c. Throttle – OFF.

d. Collective pitch lever – Increase slowly to full increase.

e. Directional pedals – Left pedal forward to raise right rotor, and vice versa.

f. Cyclic control – Displace laterally to tilt affected rotor away from opposite rotor hub.

g. Rotor brake – On, all the way.

DSAS FAILURE WITH EXCESSIVE YAW

1. ***COLLECTIVE — INCREASE*** (to level flight or climb power).
2. ***CYCLIC & RUDDERS —*** As required (to regain coordinated flight and established 50-60 KIAS).
3. ***DSAS SWITCH — OFF*** (as soon as possible).
4. Flight may be continued with DSAS OFF as mission dictates.

NOTE

Inverter and DSAS malfunction may occur without visual warning within the cockpit. If severe skidding is encountered immediately after an attempted roll out of a turn, particularly during a partial power descent or in auto-rotation, a DSAS failure should be suspected, and immediate action taken to complete the DSAS FAILURE WITH EXCESSIVE YAW checklist. After coordinated flight has been regained, follow procedures outlined in FLIGHT FOLLOWING DSAS FAILURE (WITHOUT YAW) Section VI.

CAUTION

It is important to maintain coordinated flight since slideslip angles can result in yawing moments that may be difficult to correct if allowed to progress too far; particularly during partial power descent or in autorotation. This condition can be encountered as a result of an uncoordinated turning maneuver or by turbulence while in a descent or in autorotation. The control necessary to regain coordinated FLIGHT is lateral cyclic opposite the direction of bank and rudder in the direction to bring the nose back parallel to the desired ground track. Increasing the collective pitch will speed the recovery to coordinated flight.

DSAS FAILURE WITHOUT YAW

See Section VI.

FOULED HOIST CABLE.

1. **HOIST UP-DOWN SWITCH – DOWN.**

   Immediately lower and keep slack in cable and advise pilot.

2. Cable – attempt to free by manual manipulation. Advise pilot when cable is free.
3. Cable cutter arm switch – On.

WARNING

Do not use hoist motor in attempting to free cable. This could result in snapping cable and "whip lashing" it into the rotor.

4. Cable cutter button – As required.

CONDENSED CHECKLIST

Your emergency condensed checklist is now contained in T.O. 1H-43(H)B-1CL-1.

SECTION IV

CREW DUTIES

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FIREMEN

Firemen (nozzleman and rescueman) will accomplish servicing and preflight inspection of the fire suppression equipment in accordance with the normal procedures. The preflight inspection will be accomplished daily on the alert equipment and again after any maintenance or servicing has been accomplished. Whenever maintenance is required on the equipment, the alert pilot will be notified. The Form 781 will be initiated and maintained to reflect the current status of the fire suppression equipment.

PREPARATION FOR FLIGHT (SOFT HOSE KIT).

1. Form 781 — Checked.
   a. Determine that uncleared discrepancies have no direct effect on the operation of the equipment.
2. Chocks — In place.
   a. Trailer wheels must be chocked to keep trailer from moving during extinguisher hookup.
3. Insulation blanket — Removed.

WARNING

When insulation blanket is removed from fire suppression kit it should be removed from the entire area to prevent blowing into the rotor blades and causing severe damage to the aircraft and injury to personnel.

4. Fire suppression kit tiedown straps — Removed from kit, and secured in a safe place.
5. Trailer towbar — On the ground.
   a. To prevent interference with hookup operations, ascertain that the towbar is on the ground.
6. Pressure tank and lines — Checked.
   a. Check pressure tank for proper service and air pressure within limits. (Refer to figure 4—1.)
   b. Check pressure tank for security, cleanliness and security of fittings, top and bottom.
   c. Check pressure tank tiedown straps for deterioration and security of mounts.

Note

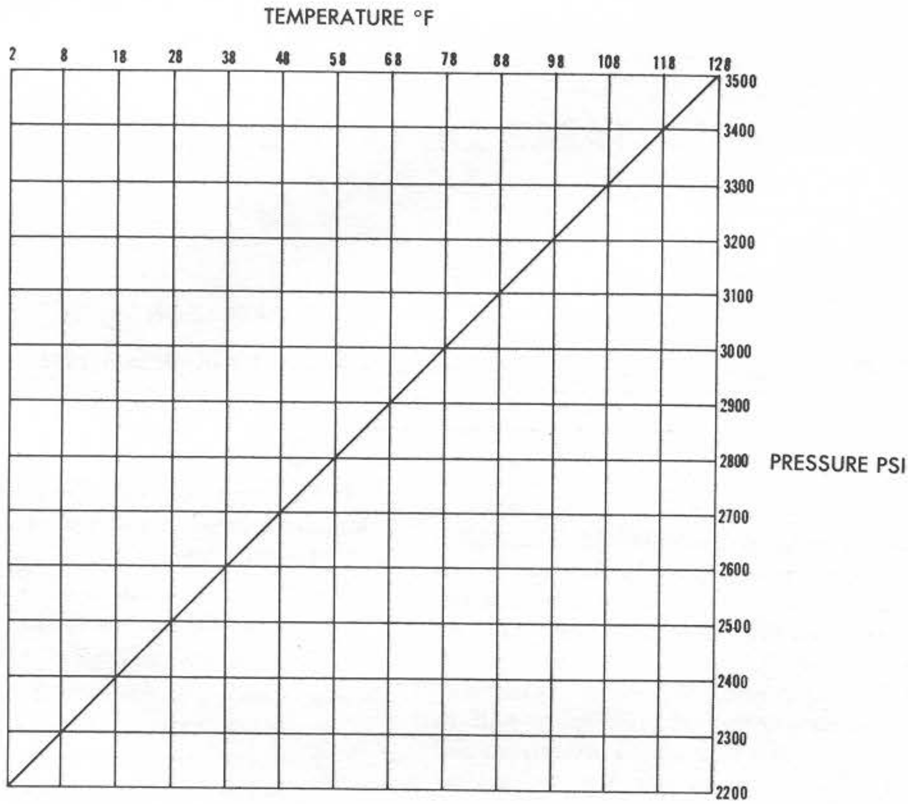
Pressure tank tiedown straps must have slack to allow for expansion of air tank.

   d. Check ball valve and fittings for damage, security and leakage.
   e. Check pressure tank relief valve and fittings for damage, security and leakage.
   f. Check pressure gage for security, cracked or broken glass and defacement.
   g. Check shutoff valve open and flexible hose for cracks, deterioration and loose or leaking fittings.

CAUTION

Valve must be open or kit will not function, and mission will be jeopardized.

Pressure Tank Charging Chart



CAUTION

Observe maximum pressure limits established in applicable technical orders.

Figure 4—1

h. Check charging valve for wear, cracks and evidence of any damage.
i. Check pressure tank frame and support plate for cracks, distortion, corrosion and cleanliness.

7. Hose and hose basket — Checked.
   a. Check foam nozzle for proper operation, loose or missing parts.
   b. Check foam nozzle spring tension clip for cracks, distortion, corrosion, cleanliness and security.
   c. Check hose for cleanliness and loose fittings.

Note

Check the hose next to the foam tank for foam and water by squeezing the hose. Foam and water in the hose is caused by over filling and pressure buildup in the tanks. If foam or water is present, pressure must be relieved, tanks checked and hose flushed out to prevent internal deterioration of the hose.

   d. Check hose for proper connection to foam tank, and proper installation in basket.
   e. Check hose basket for corrosion, cracks, dents and security to frame.
   f. Check hose tiedown strap for fraying and security.

8. Water tank and frame — Checked.
   a. Check water tank for servicing.

CAUTION

Do not add anti-freeze to water as it will prevent proper foaming.

   b. Check water tank filler cap for security.
   c. Check drain cock on bottom of tank for leakage and security.
   d. Check water tank thermometer for proper reading, security and broken or cracked glass.
   e. Check tank for evidence of leakage, corrosion and cleanliness.
   f. Check frame for cracks, distortion, corrosion and cleanliness.
   g. Check frame D-rings for security.
   h. Check top and bottom shock pads for deterioration.
   i. Check tank hold down assembly for cracks, corrosion and security of straps and cable D-rings.
   j. Check flue tee for dents, cracks and security.
   k. Check pressure regulator and bracket for cracks, damage and security.

9. Foam tank — Checked.
   a. Check pressure line for deterioration and security.
   b. Check tank for security to water tank and evidence of leakage.
   c. Check foam tank relief valve for corrosion, damage and security.
   d. Check filler cap for security.

Note

In climatic areas where relatively high temperatures are encountered, it may be necessary to relieve water and foam tank pressures. This can be accomplished by removing and replacing the water and foam caps periodically throughout the day.

10. Sling assembly — Checked.
    a. Check cable for fraying and corrosion.
    b. Check cable clamps and thimbles for proper position and security.
    c. Check ring and hooks for cracks and corrosion.
    d. Check bungee cords for fraying and security (if applicable).
    e. Check sling in proper position for hookup to helicopter.

11. Trailer assembly — Checked.
    a. Check tires for cuts and inflation.
    b. Check tread plates and burner well for cleanliness.
    c. Check fire suppression kit tiedown straps for fraying, deterioration and proper position.

CAUTION

Straps will not be hooked to the alert kit and should be well clear to avoid snagging the frame during hookup operations.

    d. Check heating system for security.
    e. Check heating system for leaks, servicing and proper operation (if applicable).
    f. Check trailer for damage.

12. Insulation blanket — Climatic.
    a. Check for tears, cracks of insulation material, unfastened, loose or broken fasteners, cracked or broken windows.

CAUTION

When installed, check to assure that blanket is securely fastened to fire suppression kit.

PREPARATION FOR FLIGHT (HARD HOSE KIT).

1. Form 781 — Checked.
   a. Determine that uncleared discrepancies have no direct effect on the operation of the equipment.

2. Chocks – In place.
   a. Trailer wheels must be chocked to keep trailer from moving during extinguisher hookup.
3. Ground cover – Removed.
4. Fire suppression kit tiedown straps – Removed from kit, and secured in a safe place.
5. Trailer towbar – On the ground.
   a. To prevent interference with hookup operations, ascertain that the towbar is on the ground.
6. Pressure tank and lines – Checked.
   a. Check pressure tank for proper service and air pressure within limits. (Refer to figure 4–1.)
   b. Check pressure tank for security, cleanliness and security of fittings, top and bottom.
   c. Check pressure tank tiedown straps for deterioration and security of mounts.

Note

Pressure tank tiedown straps must have slack to allow for expansion of air tank.

   d. Check ball valve and fittings for damage, security and leakage.
   e. Check pressure tank relief valve and fittings for damage, security and leakage.
   f. Check pressure gage for security, cracked or broken glass and defacement.
   g. Check shutoff valve open and flexible hose for cracks, deterioration and loose or leaking fittings.

CAUTION

Valve must be open or kit will not function, and mission will be jeopardized.

   h. Check charging valve for wear, cracks and evidence of any damage.
   i. Check pressure tank frame and support plate for cracks, distortion, corrosion and cleanliness.
   j. Check linkage between ball valve and ball valve actuator handle for security and damage. Handle should be horizontal, and in.
   k. Check the ball valve push-pull handle for security and evidence of damage. Handle should be in.
   l. Check the fairing which extends between the pressure tank and water tank for security and damage.
7. Hose and hose reel. – Checked.
   a. Check foam nozzle for proper operation, loose or missing parts, and secure mounting in kit with ball valve actuator handle horizontal and all the way in.
   b. Check foam nozzle spring tension clip for cracks, distortion, corrosion, cleanliness and security.
   c. Check the hose between the tank and the reel for proper connection at both ends.
   d. Check the main hose for cleanliness and proper winding on reel.
   e. Check the hose reel assembly for security and damage.
   f. Check the hose rollers for security and freedom of movement.
   g. Check that reel brake is on and pin is in place.
   h. Check vanes for security and evidence of damage.
8. Water tank and frame – Checked.
   a. Check water tank for servicing.

CAUTION

Do not add anti-freeze to water as it will prevent proper foaming.

   b. Check water tank filler cap for security.
   c. Check drain cock on bottom of tank for leakage and security.
   d. Check tank for evidence of leakage, corrosion and cleanliness.
   e. Check frame for cracks, distortion, corrosion and cleanliness.
   f. Check frame D-rings for security.
   g. Check top and bottom shock pads for deterioration.
   h. Check tank hold down assembly for cracks, corrosion and security of straps and cable D-rings.
   i. Check flue tee for dents, cracks and security.
   j. Check pressure regulator and bracket for cracks, damage and security.
   k. Check ladder brackets for cracks and evidence of damage.
   l. Check skid bars for wear, cracks, and evidence of damage.
9. Foam tank – Checked.
   a. Check pressure line for deterioration and security.
   b. Check tank for security to water tank and evidence of leakage.
   c. Check foam tank relief valve for corrosion, damage and security.
   d. Check filler cap for security.

Note

In climatic areas where relatively high temperatures are encountered, it may be necessary to relieve water and foam tank pressures. This can be accomplished by removing and replacing the water and foam caps periodically throughout the day.

10. Sling assembly – Checked.
    a. Check cable for fraying and corrosion.
    b. Check ring for cracks and corrosion.
    c. Check bungee cords for fraying and security (if applicable).
    d. Check the sling spreader for cracks, bends, dents and damage.
    e. Check sling in proper position for hookup to helicopter.
11. Trailer assembly – Checked.
    a. Check tires for cuts and inflation.
    b. Check tread plates and burner well for cleanliness
    c. Check fire suppression kit tiedown straps for fraying, deterioration and proper position.

CAUTION

Straps will not be hooked to the alert kit and should be well clear to avoid snagging the frame during hookup operations.

    d. Check heating system for security.
    e. Check heating system for leaks, servicing and proper operation (if applicable).
    f. Check trailer for damage.

FIREMAN'S ACCEPTANCE CHECK.

When the firemen assume alert status, or any time maintenance or servicing has been performed on the alert fire suppression equipment, an acceptance inspection will be accomplished on the kit. The acceptance inspection will consist of the normal procedures pertaining to the fire suppression equipment and an inspection of firemen's clothing and rescue equipment.

Normally the alert fireman's acceptance check will be performed concurrently with the alert pilot's acceptance check. After acceptance the firemen will use the cocking check to ready their equipment.

COCKING CHECK.

1. Protective clothing – Checked and positioned for immediate use.
2. Crash entry kit – Checked and secured. Determine that kit is complete and serviceable.
3. Protective helmets – Checked and positioned for immediate use.
4. Crash rescue first aid kit – Checked and secured.
5. Hoist equipment – Checked.
    a. Check hoist hook, hoist cable at hook, hoist frame, pulley, limit switches and insure cable is free from frame.
    b. Check that all necessary equipment and rescue devices are aboard.
    c. Prepare and secure cabin for hoist mission.
    d. Check personal equipment (insure that safety harness and heave gloves are available.)

ALERT CREW CHIEF

The alert crew chief will be responsible for maintaining the alert helicopter and support equipment. Whenever maintenance is required on the alert helicopter, the alert pilot will be notified. The alert crew chief will keep the alert pilot informed of all status changes of the helicopter (to include installation and removal of teeter locks, tiedowns, and other safety of flight items when conditions warrant their use).

PREPARATION FOR FLIGHT.

1. Form 781 – Checked.
    a. Check that maintenance preflight is signed off.
    b. Determine that no discrepancies exist that will compromise mission requirements.

    Check that fuel load is acceptable to alert pilot.
2. Placards – Positioned.
    a. Placards are positioned around hot spot after helicopter is cocked.
3. Helicopter status – Alert.
    a. All required equipment stowed.
    b. Ground equipment positioned to provide minimum delay.
    c. Helicopter headed into wind.
    d. Fire suppression kit positioned for scramble pickup – positioner in place.
    e. All tiedowns and moorings removed.

ALERT CREW CHIEF'S ACCEPTANCE CHECK.

Normally the alert crew chief will perform the preflight inspection prior to the alert pilot's acceptance check. The alert crew chief will ascertain that the required ground equipment is available during the acceptance check and while the helicopter is on alert. Accomplishment of the normal procedure checklist will not be required when the alert crew chief is responsible for the preflight inspection. However, the entire checklist will be checked to ensure that all items are inspected. During the alert pilot's helicopter acceptance check the alert crew chief will assist the pilot in checking the cargo sling release system and the hoist system.

HOIST OPERATION

The success of any hoist operation is directly affected by the degree of crew coordination and proficiency. The responsibility of the hoist operator is to observe all aspects of the operation and keep the pilot completely informed throughout the entire hoisting operation. To provide for a more thorough understanding of hoisting procedures, some typical procedures are outlined in the following paragraphs. Deviations from these procedures may be required during actual missions. Prior to flight the following will be accomplished by the hoist operator:

HOIST OPERATORS CHECKLIST.

a. Check hoist hook, hoist cable at hook hoist frame, pulley, limit switches and insure cable is free from frame.
b. Check that all necessary equipment and rescue devices are aboard.
c. Prepare and secure cabin for hoist mission.
d. Check personal equipment. (Insure that safety harness and heavy gloves are available.)

LAND HOIST OPERATIONS. The following is a typical pattern for a hoist pickup:

a. Wind Determination Phase. Determining wind direction and approximate velocity is very important to successful hoist operations, especially with heavy aircraft gross weights. The wind may be determined from a number of sources such as vegetation in the area, trees, grass, etc., or by use of smoke. If the use of smoke grenade/bomb is elected, the hoist operator will complete the following checklist on downwind advising the pilot as each item is completed:

Smoke Bomb Drop Checklist:

(1) Safety Harness – ON, properly adjusted, and secured to helicopter.
(2) Cabin Interphone control – INTERPHONE.
(3) Gloves – ON.
(4) Door – OPEN.
(5) Smoke Device – Prepared to drop.
(6) Drop Smoke – On Pilot's command drop smoke device away from helicopter. Advise pilot smoke bomb away.

b. The Pattern Phase. Normally a right hand pattern will be flown. This will aid in keeping the rescuee or his location in sight while preparing for the pickup. Pilot will advise the hoist operator when he is on downwind and the type rescue device to use. The hoist operator will acknowledge this call and commence the following downwind checklist (portions not completed for smoke bomb drop) advising pilot as each item is completed.

(1) Safety harness – ON, properly adjusted and secured to helicopter.
(2) Cabin interphone control – INTERPHONE.
(3) Gloves – ON.
(4) Door – OPEN.
(5) Hoist Circuit Breaker – ON (P/CP will respond circuit breaker ON.
(6) Hoist Operational Check.
(a) Pilot will lower the hoist on hoist operator's command.
(b) Hoist operator repositions cable to attach rescue device.
(7) Rescue device – Attached/simulated.
(8) Hot Mike – CHECKED
(9) Hoist operator checklist – Completed ready for pickup.

NOTE

This check will be given for each approach to assure the pilot that the aft cabin is ready for pickup.

The pilot will advise the hoist operator when he is on base leg and final approach, and when survivor is in sight. The hoist operator will acknowledge all calls and inform the pilot when he also has the survivor in sight on final approach. At the pilot's discretion his interphone panel may be set as desired to eliminate radio interference. Normally, no further communication will be required from the hoist operator until he is instructed by the pilot to take over and guide him to the survivor. A slightly steeper than normal approach is desirable in most instances, but the pilot must determine the best approach to be used based on the conditions encountered.

WARNING

Forward flight must not be conducted with the hoist cable partially out unless it is held by the hoist operator. With the cable partially out, it is possible for the cable to wrap around the rear support tube of the hoist tripod. Operation of the hoist in this condition will result in wear of the cable support arm and guides with eventual binding and separation fo the cable.

c. The Recovery Phase. This is the most critical phase of the hoist operation and requires the highest degree of crew coordination for a safe, effective pickup. The pilot will advise the hoist operator when he loses sight of the rescuee and the hoist operator then goes on hot mike and gives directional and range instructions. The verbal instructions must continue throughout the recovery phase and until the hoist operator goes off hot mike. These transmissions must be clear and concise. The following is a sample of what the pilot should hear: On hot mike - survivor in sight 50 feet (distance) ahead - correct right/left - on course survivor straight ahead - survivor 25 feet - on course 15 feet - 10 feet slow - 5, 4, 3, 2 feet - over survivor - stop - hover - move right/left 5 feet - stop - forward 5 feet - stop - hover - hoist going down - air craft descending/rising - hoist halfway down - move right/left 3 feet - stop - hoist on the ground - hover survivor in sling/device - raise helicopter - survivor clear of ground/water - survivor halfway up - hover - survivor at the door. After the hoist pickup is completed the hoist operator will acknowledge the following checklist:

(1) Survivor in and secure, ready for takeoff.
(2) Hoist and cabin secured.
(3) Hoist circuit breaker Off.
(4) Going off hot mike.

NOTE

The hoist operator must be careful not to grip the hoist cable while guiding it down. This can cause a large loop to form which can wrap around the hoist tripod and cause the cable to foul or fail. Prior to hoisting the rescuee, the hoist operator will take up the slack in the cable. He will then notify the pilot that the survivor is ready to be picked up. The pilot will lift the survivor off of the ground by increasing his altitude. After the survivor has cleared the ground, the hoist operator may continue the hoisting operation. The pilot will devote his full attention to maintaining a steady hover utilizing all available references and the hoist operator's instructions. The copilot will monitor the engine instruments, help maintain adequate rotor tip clearance, and remain orientated with the horizon throughout the hoisting operation to assist the pilot should the need arise.

WARNING

The Hoist hook should be permitted to touch ground or water to discharge static electricity prior to personnel pickup.

Under certain conditions the sudden release of heavy loads or tension from the hoist cable or any improvised use of rope could reslut in "whiplash" of the rope or cable. This "whiplash" action can cause injury to the flight crew and can cause the rope or cable to enter the rotor system.

WATER HOIST PROCEDURES. The following is a typical pattern for a hoist pickup.

a. Smoke Placement Phase. The smoke bomb, MK 5 or MK 6, should be used on all overwater hoist recoveries to assist in determining exact wind direction and to act as a visual reference for hovering. The hoist operator will complete the following checklist on downwind advising the pilot as each item is completed.

Smoke Bomb Drop Checklist:

(1) Safety Harness – ON, properly adjusted, and secured to helicopter.
(2) Cabin interphone control – INTERPHONE.
(3) Gloves – ON.
(4) Door – OPEN.
(5) Smoke Device – Prepared to drop
(6) Drop Smoke – When directly over the survivor the hoist operator will drop the smoke bomb on his own command. Advise pilot smoke bomb away.

The pilot will fly over the survivor at 300 feet and 65 knots IAS, as near as possible into the estimated wind. The hoist operator will drop the smoke bomb at his own discretion when directly over the survivor so that the smoke bomb will fall upwind of the target. An indicated airspeed of 65 knots should be maintained during this drop to insure proper placement and ignition of the smoke bomb.

b. The Pattern Phase. After the smoke bomb has been released, the hoist operator will so advise the pilot. The pilot will then continue to fly on the same heading long enough to insure rolling out on the downwind leg at least abeam of the survivor. (approximately 10 seconds depending on the wind velocity.) A right hand pattern should be flown if conditions permit. Pilot will advise the hoist operator when he is on downwind and the type of rescue device to use. The hoist operator will acknowledge this call and commence the following downwind checklist (portion not completed for the smoke bomb drop) advising the pilot as each item is completed.

(1) Safety Harness – ON, properly adjusted and secured to helicopter.
(2) Cabin Interphone control – INTERPHONE.
(3) Gloves – ON.
(4) Door – OPEN.
(5) Hoist Circuit Breaker – ON (P/CP will respond circuit breaker ON.)
(6) Hoist Operational Check.
   a. Pilot will lower the hoist on hoist operator's command.
   b. Hoist operator repositions cable to attach rescue device.
(7) Rescue Device – Attached/simulated.
(8) Hot mike – CHECKED.
(9) Hoist operator checklist – Completed and ready for pickup.

NOTE

This check will be given on downwind for each approach to insure to the pilot that the aft cabin is ready for pickup.

The pilot will advise the hoist operator when he is on base leg, final approach, and when survivor is in sight. The hoist operator will acknowledge all calls and inform the pilot when he also has the survivor in sight on final approach. At the pilot's discretion his interphone panel may be set as desired to eliminate radio interference. Normally, no further communication will be required from the hoist operator until he is instructed by the pilot to take over and guide him to the survivor. The turn to base should allow for a fairly shallow approach to permit establishing a hover about 75 feet downwind of the survivor. At the completion of the approach and while the hover is being established, both the rescue crew commander and copilot will devote full attention to proper altitude, rpm, torque, etc. The pilot will note power required to hover at this time. During the hover the hoist operator will lower the rescue device below the wheels and prepare for hoist pickup.

c. The Recovery Phase. When the pilot is ready to continue with the recovery phase, he will advise the hoist operator to go hot mike and direct the helicopter to the survivor. The hoist operator will give the pilot instructions to keep the helicopter on a straight track to the survivor. The directions will be similar to those described under land hoist procedures. Before the pilot loses sight of the survivor, he should transfer his hover reference to the smoke signal. The hoist operator must continually give clear and concise instructions to the pilot. When the survivor is in the rescue device and ready for hoisting, the hoist operator will take up any slack in the cable and advise pilot to raise helicopter. The pilot will then raise the survivor out of the water with the helicopter. When the hoist operator has the survivor in the cabin and secured, he will notify the pilot. After the hoist pickup is completed the hoist operator will acknowledge the following checklist:

(1) Survivor in and secure, ready for takeoff
(2) Hoist and cabin secured.
(3) Hoist circuit breaker off.
(4) Going off hot mike.

Note

When hoisting over calm or glassy water, smoke grenades and/or dye markers should be utilized for wind and target reference, respectively. It is especially important that the copilot maintain orientation with the horizon under these conditions should the pilot experience vertigo. The success of any hoist operation is directly affected by the degree of crew coordination and training.

INERT VICTIM RECOVERY.

The procedures to be followed in an emergency for the recovery of an unconscious or inert victim from the water or from areas where the helicopter cannot land but may be hovered, will be as follows:

a. If it is determined that the victim is unconscious or unable to enter the rescue device. The pilot will direct one of the crew members to prepare to enter the water and another to act as hoist operator. If a copilot is aboard, he may move to the cabin and perform duties as hoist operator.

b. The crew member performing duties as hoist operator will don the hoist operator's safety harness and assure that the crew member preparing to enter the water has his life preserver inflated and adjusted, has a survival knife, and that the anti-exposure suit, if worn, is properly adjusted. The crew commander will be advised by interphone that preparations are completed in the cabin, that an approach may be made, and that the crew member is ready to be lowered.

c. After the approach, the crew member will enter the rescue device and will be lowered into the water, at which time he will leave the rescue device and secure the survivor for hoisting.

d. The hoist operator will then hoist the survivor, remove him from the rescue device in the cabin and immediately lower the device and retrieve the crew member. The hoist operator will keep the pilot advised as to the progress of the mission. After the helicopter has taken off, the copilot, if aboard, will move to his position in the cockpit or at the discretion of the pilot remain in the cabin to render assistance as necessary.

HOIST SAFETY PROCEDURES.

a. Extreme care should be used when hoisting the stokes litter. If pendulum action and litter rotation are not quickly stopped by the hoist operator, the rotations may increase to unmanageable proportions. The pendulum action may be dampened by moving the cable in the opposite direction of the litter movement. Litter rotation can be stopped if detected early by rotating the hoist cable in a one to two foot diameter circle in the opposite direction of rotation of the litter basket. If the litter rotation cannot be stopped by the hoist operator, the pilot can transition to forward flight to an airspeed between 20 and 40 knots. Rotation should stop in a few hundred yards.

b. When pulling the rescuee in a rescue collar into the helicopter, the easiest method is to turn his back to the helicopter, grasp him around the waist and pull in and up. This procedure will set the rescuee on the door ledge first and will also reduce the possibility of a semi-conscious or injured rescuee fighting the hoist operator. If required, the hoist operator may request the pilot to slack off the hoist cable. This will allow the operator the use of both hands in pulling the rescuee into the helicopter.

c. The rescue device should never be removed from the hoist cable or the rescuee until he is safely inside the helicopter and clear of the door.

d. The hook and cable should be kept in view at all times to prevent the cable from becoming tangled with ground objects. If the time-element requires a rapid pickup, the hoist can be lowered on the approach, but should not be lowered more than 10 feet below the landing gear.

e. If the cable should become tangled with an object on the ground and cannot be freed, it may have to be cut; however, this decision will be made by the pilot in command of the aircraft.

f. When preflighting the hoist, determine that the cable is properly wound and is not frayed or corroded. The cable cutter should be inspected to determine that it is installed.

g. All hoist operations will be conducted at a minimum altitude commensurate with surface conditions. A hover altitude of 15 – 20 feet is considered a realistic altitude.

AERIAL DELIVERY.

In the event a landing cannot be accomplished or the use of the hoist is prohibited, it will be necessary to deliver equipment by free-fall.

a. Equipment dropped in this manner must be suitable protected in a container so that it will have a high shock resistance potential. The approach should be planned so that the delivery of equipment can be accomplished at the lowest air speed and altitude that safe flight will allow. Drops should be made to a target in the vicinity of the ground personnel, close enough to enable easy retrieving.

b. Aerial delivery of equipment will be accomplished in the following manner:

(1) The pilot will evaluate the area, select the target and establish the drop pattern. Communications with ground personnel will be maintained if possible.

(2) A crew member will put on the safety harness and check to see that it is secured and adjusted to permit freedom of movement within one foot of the cargo exit door prior to opening it. The equipment will be arranged so that it can be dispatched readily with a minimum of effort.

Note

Necessary precautions will be taken to preclude bundles from striking the rotor system. Bundles which could develop aerodynamic lift characteristics will not be dropped.

(3) The pilot will keep the crew member informed of the position of the aircraft in the drop pattern and direct the drop with commands "Ready – Drop",

(4) The crew member will immediately inform the the pilot of "bundle away".

(5) Only one bundle will normally be dropped on each approach.

CARGO SLING OPERATIONS.

Hookup to the cargo load is normally accomplished on hand signals from a marshaller and by the hookup man, with the helicopter hovering or approaching the hookup point guided by the hand signals. Two men normally are required for cargo hookups, however, in some instances, it may be necessary for one ground crew man to complete the hookup. In this case, the copilot or crew chief on board the helicopter will take a position in the cabin where he can observe the approach over the cargo and direct the pilot by interphone. During this procedure the safety harness will be worn. Instructions to the pilot will be continuous during the hookup and are essentially the same as those required for hoist operation. Up and down directions will be used in addition to right, left, forward and backward when directing hookup by interphone. The term "cargo hooked" for completion of hookup and "cargo released" when cargo is unhooked will be used to inform the pilot of the cargo condition. Additional information may be used at the discretion of the pilot, such as cargo ground clearance during approach or hover and condition of the cargo in flight. Where no other crew member is available on board the helicopter, the hookup man will direct the pilot by hand signals until the helicopter is properly positioned over the cargo, then complete the hookup. Hookups to the fire suppression kit (refer to Section I for description) will require one man and a hookup positioner. The positioner will be placed as indicated in figure 1–40. There are two settings for the positioner, the highest setting is for hookup with the kit on the trailer and the low setting is for hookup with the kit on the ground. When the hookup is completed, the hookup man will tip the positioner over to indicate to the pilot that the hookup is complete.

In all hookups the hookup man will move forward and to the right, in full view of the pilot and act as marshaller if none is available. The marshaller will indicate by hand signals the condition of the load and direct the pilot to pick up the cargo Upon lift-off, he will give the pilot the proper hand signal to indicate the condition, hooked or unhooked, followed by the clear for takeoff signal or other signal as required. When hookup is directed by interphone, the signals will be accomplished verbally.

When approaching the kit for hookup using the hookup positioner, the pilot will establish his altitude from the positioner and establish a slow approach toward the positioner. If the approach speed is properly established the hookup may be completed and the positioner tipped over by the hookup man before the helicopter's windshield contacts the positioner. After completing the hookup and upon signals from the marshaller, the pilot will lift the load off the ground. At this time, the pilot will check the power required for hover against power available to insure it is adequate for takeoff.

The pilot will takeoff with a smooth application of torque, as required, climbing straight ahead until a safe turn can be made.

WARNING

Use care when flying with cargo sling loads having aerodynamic characteristics, such as aircraft wings and tail sections. The aerodynamic lift capabilities of such loads may cause amplified oscillations which, in turn, may cause the cargo, or loose parts from the cargo, to come in contact with the rotor blades and/or fuselage. Such a load may also react erratically and collide with the helicopter if it becomes necessary to jettison the load in an emergency.

Ground crew members should exercise extreme care not to place themselves between the cargo and the bear paw.

CARGO HOOK SAFETY.

1. Minimum control movements should be maintained while hookup man is under helicopter.

2. To avoid accidental release of loads in flight, care must be taken to insure that any external cargo is not ocsillating excessively before turning the automatic sling release switch ON. For cargo weighing 500 pounds or less do not use the automatic sling release.

3. Marshaller hand signals should be followed closely.

4. The signalman's position will be changed as required to stay in full view of the pilot.

5. Each hand signal must be held until the marshaller is sure that the pilot has seen it.

6. After hookup the hookup man will go forward and right of the flight path until he is clear of the helicopter and in full view of the pilot.

7. Protective helmets, of the type authorized for helicopter crews, and protective goggles will be worn by all marshallers and hookup men during cargo sling operations.

8. All cargo sling loads should be checked or moved slightly before pickup to insure that they are not frozen or otherwise held fast to the surface.

FSK HOOKUP SAFETY PROCEDURES.

In addition to cargo sling safety procedures, the following will be used for FSK hookup:

1. Hold FSK hook ring as shown in Figure 4-2.

2. Ground FSK ring on the helicopter.

CAUTION

Do not touch helicopter until the FSK is grounded to the helicopter.

LITTER LOADS.

Two litters and one medical attendant (Figure 1-3) can be installed in the cargo compartment. If the rotors are turning the helicopter will normally be parked facing the litters, so the pilot can keep the entire operation in view. In the interest of safety, the litter loads should be brought in directly from the front.

LITTER LOADING PROCEDURES.

a. Remove miscellaneous equipment, if installed, remove/foldup seats, and open and secure aft cabin doors.

b. Secure patient to litter if not previously accomplished.

c. Proceed to aft cabin doors and normally load patient with head forward (unless his condition dictates otherwise).

WARNING

Be extremely careful of tailpipe and hot exhaust if engine is running.

d. Secure litters with litter tiedown strap to cargo rings.

e. Install attendant seat.

f. Secure aft cabin doors.

FSK Hookup

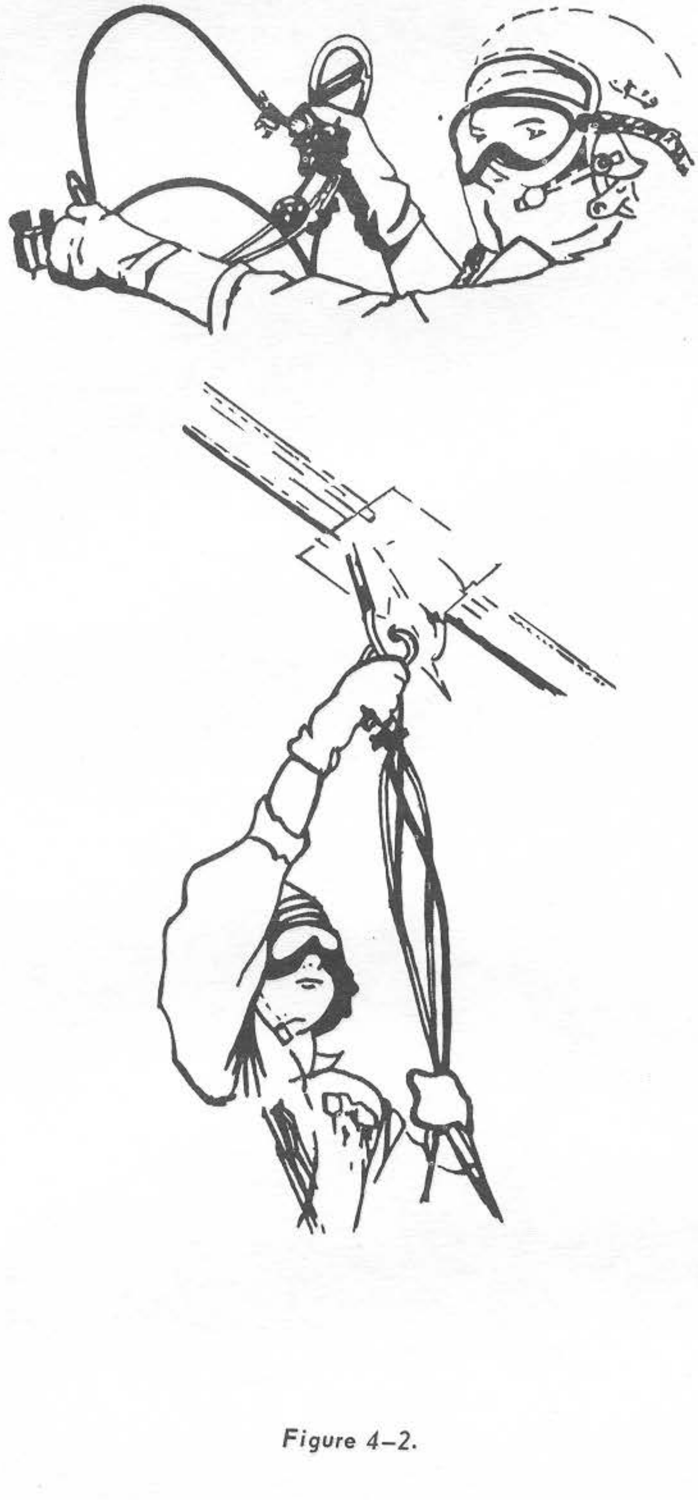


Figure 4–2.

SECTION V

OPERATING LIMITATIONS

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MINIMUM CREW

The pilot is required as a minimum crew for the proper operation of this helicopter. A minimum of two qualified helicopter pilots is required for planned instrument flight. However, additional crew members may be assigned at the discretion of the commander.

INSTRUMENT MARKINGS

The instrument markings are shown in figure 5–1. The limitations indicated are not necessarily repeated in the text. The proper operation of the helicopter will be assured by making certain that the limitations imposed by the instrument markings are not exceeded.

Instrument Markings

FUEL BOOST PRESSURE *

- 5 PSI MINIMUM FOR FLIGHT
- 7 TO 11 PSI DESIRED
- 17 PSI MAXIMUM

ENGINE OIL PRESSURE *

- 50 PSI MINIMUM FOR FLIGHT
- 70 TO 90 PSI DESIRED
- 90 PSI MAXIMUM

TRANSMISSION OIL PRESSURE *

- 25 PSI MINIMUM
- 35 TO 75 PSI DESIRED
- 85 PSI MAXIMUM

FUEL GRADE
JP-4

*THESE INSTRUMENTS ARE POSITIONED SO THAT UNDER NORMAL OPERATING CONDITIONS NEEDLES ARE AT APPOXIMATELY 9:00 O'CLOCK

FUEL GRADE

ALL FUELS LISTED IN SERVICING DIAGRAM

FUEL QUANTITY

- 104 POUNDS MINIMUM FOR SAFE FLIGHT

ENGINE OIL TEMPERATURE*

- 0° TO 90° C. DESIRED
- 90° C. MAXIMUM

TRANSMISSION OIL TEMPERATURE *

- 20° TO 110° DESIRED
- 120° C. MAXIMUM

GAS PRODUCER TACHOMETER

- 65% TO 97% FLIGHT NORMAL RANGE
- 97% MAXIMUM

Figure 5–1 (Sheet 1 of 2)

Instrument Markings

FUEL GRADE

ALL FUELS LISTED
IN SERVICING DIAGRAM

AIRSPEED

- 105 KNOTS MAXIMUM
- 95 to 105 KNOTS OBSERVE MINIMUM ROTOR SPEED LIMITATIONS

DUAL TACHOMETER
ROTOR

- 201 rpm MINIMUM AUTOROTATION
- 211 to 260 rpm CONTINUOUS POWERED FLIGHT
- 260 rpm MAXIMUM

ENGINE

- 5130 rpm MINIMUM FOR POWERED FLIGHT
- 5130 to 6340 rpm CONTINUOUS OPERATION
- 6340 rpm MAXIMUM

TORQUEMETER

- 0 TO 31 PSI NORMAL OPERATING RANGE
- 31 to 37.5 psi LIMITED TO 30 MINUTES DURATION
- 37.5 PSI MAXIMUM LIMITED TO 30 MINUTES DURATION

EXHAUST TEMPERATURE

- 230° C. MINIMUM FOR POWERED FLIGHT
- 230° to 570° C. NORMAL RANGE
- 570° to 595° C. 30 MINUTE TIME LIMIT
- 595° C. MAXIMUM FOR FLIGHT
- 760° C. DURING STARTING, INTERMITTENT TEMPERATURES ARE LIMITED TO A TOTAL OF 5 SECONDS OVER 650° C, WITH NOT MORE THAN 2 SECONDS OVER 760° C.

Figure 5–1 (Sheet 2 of 2)

Maximum Allowable Wind Velocity For Starting and Stopping Rotors

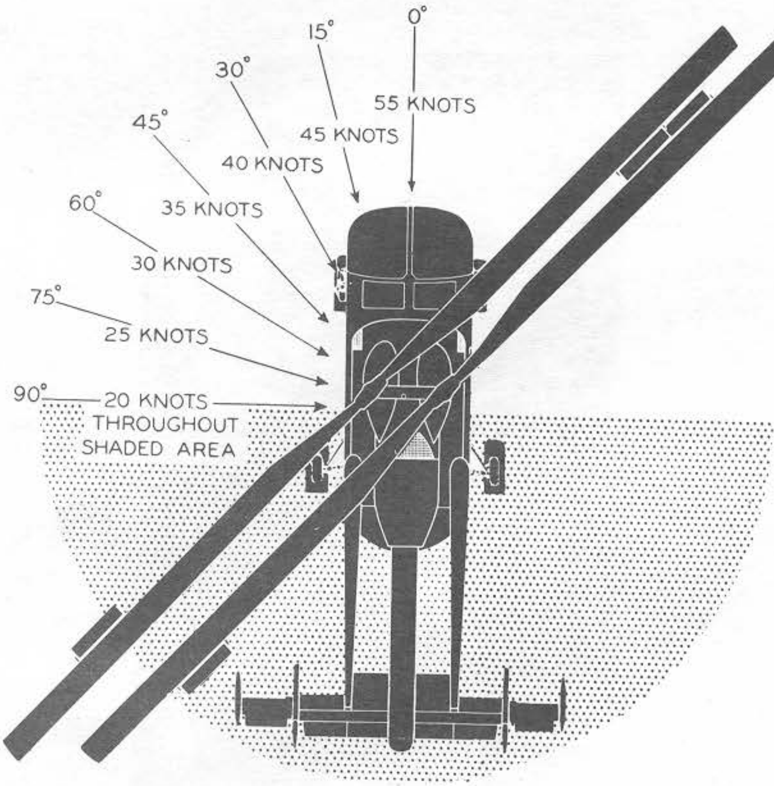

Figure 5–2

MAXIMUM WIND FOR STARTING AND STOPPING ROTORS

The recommended maximum wind velocities for starting and stopping the rotors are shown in figure 5–2. Exceeding these limitations may cause damage to the hubs, the droop stops and the lag stops.

ENGINE AND ROTOR LIMITATIONS

ENGINE STARTING LIMITATIONS.

To prevent overheat damage to the starter, limit use of starter to 3 runs of 40 seconds maximum duration during any 60 minute period. Allow 3 minutes of cooling time between starts.

ROTOR BRAKE LIMITATION.

Rotor brake will be released as soon as possible after engine start but not to exceed one minute of engine operation.

MAXIMUM ENGINE AND ROTOR SPEEDS.

Maximum engine and rotor speeds are 218 rotor rpm, 5250 engine rpm for normal ground operation, and 260 rotor rpm, 6340 engine rpm for flight.

NOTE

Necessary ground rigging and checking may be accomplished at speeds to 273 rotor rpm, 6640 engine rpm.

ENGINE OVERSPEED.

Overspeeding the engine output shaft requires that the following action be taken:

6340 to 6640 rpm	– No action required.
Over 6640 rpm	– Inspection of engine is required. Drive shaft between engine and transmission must be overhauled.

GAS PRODUCER OVERSPEED.

Overspeeding the gas producer requires that the following action be taken:

97% to 100%	– Inspection of engine is required.
over 100%	– Replacement of engine is required.

ROTOR OVERSPEED.

Overspeeding the rotors requires that the following action be taken:

260 to 273 rpm on ground	– No action required.
260 to 265 in flight	– No action required.

265 to 310 rpm in flight or 273 to 310 rpm on ground	– Visual inspection required of rotor blades, hubs and accessible control linkages from azimuth to flaps. Inspection required of azimuth thrust bearing for roughness and/or end play. Inspection required of azimuth bar pivot bearings for roughness.
Over 310 rpm anytime	– Replacement required of transmission, azimuth, control system from azimuth spindles to blades, rotor blades, hubs, teeter pins and lag pins. Replacement of drive shaft required except when overspeed occurs in autorotation.

MINIMUM ROTOR SPEEDS.

Autorotation.

Minimum rotor speed for autorotation is 201 rpm. Lower speeds will cause excessive coning and will result in decreased lift.

Partial Power Flight.

Partial power flight should be made at rotor speeds above 238 rpm. Refer to discussion in engine **PARTIAL POWER FLIGHT LIMITATION,** below.

Airspeed Above 95 Knots.

At airspeeds above 95 knots maintain rotor speed between 255 and 260 rpm. Operation at a combination of relatively high airspeed and lower rotor speeds will shorten blade life.

Powered Flight Above 5,000 Feet.

When operating between 5,000 feet and 10,000 feet density altitude, maintain 250 to 260 rotor rpm. When operating above 10,000 feet density altitude, use 260 rotor rpm.

ENGINE POWER

Engine power output is supplied automatically to meet the demands imposed by the operating conditions at the preselected rpm. This is accomplished by the fuel control unit which senses minor changes in rpm as they occur due to load variations. The fuel flow compensation thus maintains the desired rpm by increasing or decreasing the engine torque to meet the load imposed. The power output capability of the engine can exceed the structural limit of the transmission under certain conditions. Therefore, the markings on the torquemeter (figure 5–1) should be observed to prevent exceeding the maximum allowable power and maximum continuous power torque limitations.

NOTE

97% is a mechanical limitation imposed on all engines. The individual engine "do-not-exceed" speed in percent N_1 is a maximum turbine inlet temperature limit and is based on Sea Level, Standard Day (15°C or 59°F) Conditions. At temperatures below 15°C (59°F) the "do-not-exceed speed can be exceeded assuming the engine has been trimmed in accordance with applicable directives. 97% is a limit for all temperatures and pressure altitudes.

HOT START.

A hot start has occured if, during starting, exhaust gas temperature exceeds 650°C for more than 5 seconds or exceeds 760°C for more than 2 of the 5 seconds. A hot start requires that the hot section of the engine must be inspected.

MINIMUM POWER IN FLIGHT.

Do not reduce throttle setting below FLIGHT IDLE in flight, except for a functional check flight.

With the throttle in GROUND IDLE, engine acceleration to hover power is slow (substantially more than 5 seconds) and may not permit adequate recovery from practice autorotations. Also, experience has shown that there is a possibility of engine cutout if the throttle is reduced to GROUND IDLE while the helicopter is in flight.

The power transmitted in FLIGHT IDLE is low enough to permit full autorotation. However, the needles will not split. This merely indicates that the engine is idling at a synchronous speed.

PARTIAL POWER FLIGHT LIMITATION.

Do not operate in the 5 to 15 psi torquemeter range at rotor speeds less than 238 rpm and at airspeeds less than 60 knots with directional stability system not operating or 40 knots with the directional system on.

The reverser, a part of the directional control system of the aircraft, does not properly locate the reverser dwell zone with low rotor speeds in partial power flight.

MAXIMUM CONTINUOUS POWER.

Maximum continuous power, shown as the upper limit of the green arc on the torquemeter (figure 5–1), is that power at which the transmission can be operated continuously providing the tachometer readings are kept within the operating limits.

MAXIMUM ALLOWABLE POWER.

Maximum allowable power, limited by the helicopter transmission, is indicated by the red line on the torquemeter (figure 5–1). Use of maximum allowable power is limited to 30 minutes.

Under certain altitude conditions the power may also be limited by exhaust gas temperature. Refer to figure 5–1 for exhaust gas temperature limits.

OVERTORQUE.

Overtorquing requires the following action:

37.5 psi to 50.0 psi	– Necessity for transmission removal will depend upon amount of overtorque (psi) and duration (time in minutes). Refer to applicable directives.
Over 48.0 psi	– Inspection of the engine may be required. Refer to applicable directives.
Over 50.0 psi	– Replacement of transmission.

TAXIING LIMITATIONS

Air taxiing will be used whenever possible. During ground taxiing the rotor loads may be greater than during flight, since the helicopter is not free to follow cyclic movement of the rotors. Extended ground taxiing will be avoided, as it may reduce rotor life.

AIRSPEED LIMITATIONS

MINIMUM AIRSPEED.

The airspeed and density altitude combination in the avoid areas of figure A–8 should be avoided during powered flight, if possible. The severity of the nose-down pitching of the helicopter that follows a sudden reduction in power increases with density altitude and is more difficult to control at high density altitudes (above 5,000 feet) due to reduced cyclic control effectiveness. Low airspeed at high density altitude (above 5,000 feet) also reduces directional stability and directional control power to such a degree that excessive yawing may develop during the nose-down pitching, following power loss. This pitching and yawing is most apt to develop at higher absolute altitudes where the pilot's horizontal reference is less well defined.

At airspeeds below 60 knots, observe limits stated in **PARTIAL POWER FLIGHT LIMITATION** paragraph.

MAXIMUM AIRSPEED.

Maximum airspeed is that airspeed which can be achieved in level flight at a torquemeter pressure of 31 psi, but must not exceed 105 knots under any circumstances. Maximum airspeed will vary with changes in density altitude, gross weight, and center of gravity. Exceeding this limit will result in a deterioration of directional stability and may shorten the expected life of the rotor hubs and grips.

When operating at high gross weights and high altitudes, reduce airspeed so that 10% (approximately 1.3 inches from the forward stop measured at the center of the grip) of cyclic control remains.

CAUTION

While performing a functional check flight, the level flight airspeed achieved at a torquemeter pressure of 31 psi may be exceeded for a period no longer than 3 minutes per flight, if necessary to satisfactorily complete the check. No more than five such flights should be made during each rotor blade operating interval. Duration of all such flights should be recorded in rotor blade historical records.

At airspeeds above 95 knots observe limitations stated in **MINIMUM ROTOR SPEEDS** paragraph.

Maximum Airspeed For Practice Autorotation.

No practice autorotation will be attempted from indicated airspeeds in excess of 60 knots. (Exceeding this limit can cause excessive nose-down attitude and loss of control.)

Sideward and Rearward Airspeed.

Sideward and rearward flight shall be limited to a maximum of 20 knots (estimated). These limitations are necessary to assure adequate directional control.

Maximum Airspeed With Soft Hose Fire Suppression Kit Blanket Installed.

To reduce yawing oscillation, airspeed is limited to 55 knots when the fire suppression kit blanket is installed.

Maximum Airspeed With Hard Hose Fire Suppression Kit.

For normal flying, 75-85 knots is the maximum for optimum cruise speed. Should emergency conditions arise whereby flight in excess of 85 knots is required, then fly at maximum forward flight torque in calm air. In turbulent or rough air conditions, caution should be exercised by flying at reduced airspeed commensurate with degree of turbulence encountered. Maintain coordinated flight, especially at high speed, to reduce oscillation of the kit, which feed back to the helicopter.

PROHIBITED MANEUVERS

1. Abrupt movement of the flight controls.
2. Acrobatic flight.

These restrictions are imposed by inherent helicopter structural limitations.

ACCELERATION LIMITATIONS

The maximum permissible acceleration is 2.8g positive or 0.5g negative for gross weights up to 6500 pounds. At higher gross weights, positive acceleration is limited to 2 5g at 7220 pounds gross weight, 2.2 at 8250 pounds gross weight, and 2.0g at 9150 pounds gross weight. In turbulent air, pilot discomfort may be used as a guide to determine the extent of roughness that is acceptable. Refer also to **STRUCTURE LOAD FACTORS** in Section VI.

Maximum Gross Weight for Takeoff, Level Flight and Climb

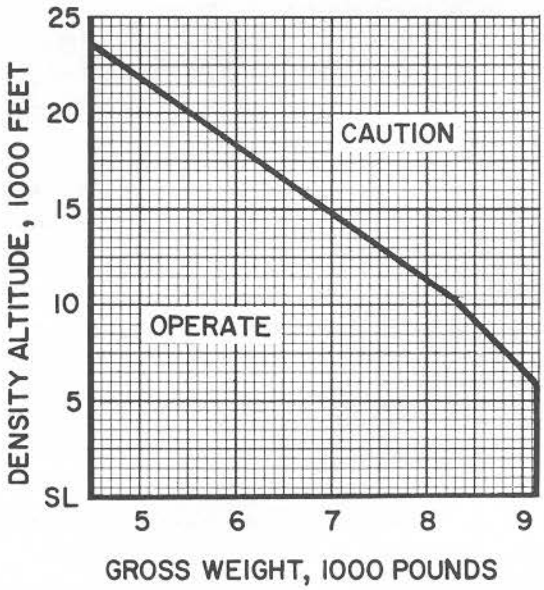

Figure 5—3

Maximum Gross Weight For Landing

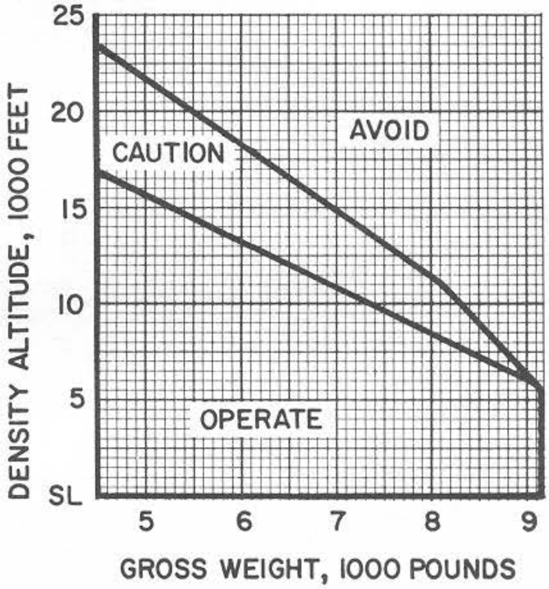

Figure 5—4

HOVERING LIMITATIONS

When hovering in winds above 20 knots (crash fire rescue procedures included), keep the helicopter heading within 45 degrees of the wind. This is necessary to assure adequate directional control.

CENTER OF GRAVITY (CG) LIMITATIONS

To assure adequate control, the helicopter CG shall be within the limits shown below. For information on determining CG location for any load condition, refer to T.O. 1H-43(H)B-5, Basic Weight and Loading Data.

AFT LIMIT.

The CG must not be aft of station 123.0.

FORWARD LIMIT.

The CG must not be forward of station 118.5.

LATERAL LIMIT.

The maximum lateral loading permissible is a 600-pound load on the rescue hoist, pilot in the right seat, and a hoist operator at the door. All other loading should be symmetrical.

WEIGHT LIMITATIONS

MAXIMUM GROSS WEIGHT.

The design gross weight of the helicopter is 6,500 pounds at a flight load factor of 2.8. The maximum overload gross weight is 9,150 pounds at a flight load factor of 2.0. The Maximum Gross Weight for Hovering chart in the Appendix gives detailed information on the maximum gross weights at which the helicopter may be operated under varying conditions of temperature, altitude, wind velocity, and type of takeoff or landing. In addition, other criteria covered in the following paragraphs will also limit maximum weights.

Whenever a helicopter has been operated at weights above 9,150 pounds, a suitable entry should be made in Form 781. Gross weight of the helicopter may be determined by referring to takeoff and landing data card.

TAKEOFF, LEVEL FLIGHT, AND CLIMB GROSS WEIGHT LIMITS.

The maximum recommended gross weight limits for takeoff, level flight, and climb are shown in figure 5—3.

NOTE

The caution area of figure 5—3 represents flight conditions that are not recommended for normal operation in that aircraft performance, stability and control become significantly decreased. Operating personnel will decide whether the degree of risk warrants the use of the helicopter at conditions within the caution area. Refer to the Appendix for determining of rates of climb and service ceiling in this area. Refer to figure 5—4 for detail discussion of landing limitations.

Maximum Sinking Speed On Landing

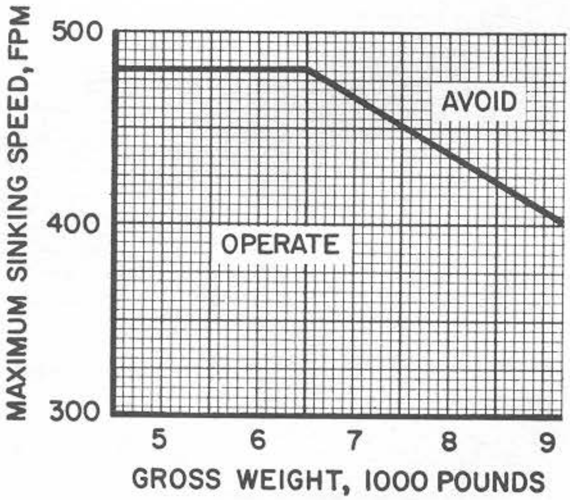

Figure 5–5

LANDING GROSS WEIGHT LIMITATIONS.

The maximum recommended landing gross weight limits are shown in figure 5–4.

NOTE

The avoid area of figure 5–4 represents flight conditions that are not recommended for normal operations in that aircraft performance, stability and control become significantly decreased.

NOTE

The caution area of figure 5–4 represents landing conditions that require a power on maximum performance landing. Maintain 260 rotor rpm during the approach.

CARGO HOOK LOADS.

Avoid high rates of descent when carrying external cargo, as an excessive amount of power may be required to stop the descent. Sufficient power may not be available or transmission torque limits may be exceeded.

Note

When using the automatic release system, the minimum cargo hook loads will not be less than 500 pounds. When using the electrical system without the automatic release portion or the manual release system, there is no minimum cargo load restriction.

AF59-1568 and Previous

Recommended maximum weight for loads attached t the cargo hook is 1000 pounds at acceleration of no over 3.0g, or 3000 pounds at acceleration of not ove 2.0g.

AF59-1569 and Subsequent.

Recommended maximum weight for loads attached to the cargo hook is 1,900 pounds at acceleration of not over 3.0g, or 3,000 pounds at acceleration of not over 1.9g.

NOTE

Loads over 3,000 pounds are not recommended because the cargo hook solenoid is not powerful enough to permit electrical release of the load during an in-flight emergency.

RESCUE HOIST LOADS.

Loads attached to the rescue hoist shall not exceed 600 pounds. Since rescue operations are generally performed at hover, with helicopter movements kept at a minimum to avoid possible injury to personnel being rescued. Acceleration limits have been established for rescue hoist loads.

RESCUE HOIST OPERATION, AF 60-280 AND PREVIOUS

The following limitations apply only to helicopters AF60-280 and previous that have not been modified per TCTO-586. Use of rescue hoist is limited to actual emergency missions. This limitation is necessary to prevent early fatigue of the hoist cable.

When raising the rescue hoist with no load, hand-guide the cable as the cable terminal approaches the UP limit switch, and stop the up motion before the cable terminal enters the UP limit switch actuating rollers. Failure to do this may result in severe whipping of the hook, which causes rapid failure of the cable.

LANDING LIMITATIONS

RATE OF DESCENT LIMITATIONS.

The maximum recommended rate of descent during a power approach and when less than 100 feet above the terrain, is 300 feet per minute. This figure is based on the average time period required for engine acceleration. Since this time period will become greater as the altitude and the outside air temperature increase, the above stated rate of descent should be adjusted as necessary to allow an adequate margin to regain full power from the engine.

SLOPE LANDING.

When it becomes necessary to accomplish a slope landing, it is recommended that the landing be accomplished down-slope. Do not land on slope with an angle greater than 15 degrees from the horizontal.

CAUTION

Care must be exercised when accomplishing a slope landing to make sure that down-slope gravitational settling will not occur.

SINKING SPEED.

AF58-1841 through AF59-1589 (prior to incorporation of TCTO-584). The maximum sinking speed on landing shall be 300 feet per minute. This limit is imposed by the cushioning characteristics of the nose gear struts. Exceeding this limit may damage the struts or the helicopter structure.

AF59-1590 and Subsequent, also AF58-1841 through AF59-1589 after incorporation of TCTO-584. The maximum sinking speed on landing shall be limited to the values shown in figure 5–5. The nose gear struts on these helicopters provide increased cushioning and permit the increased sinking speeds shown.

FLIGHT RESTRICTIONS

CLAMSHELL DOORS REMOVED.

If the clamshell doors have been removed from the helicopter, flight is prohibited unless the sound-proofing blanket also has been removed. The danger exists that portions of the blanket may become loose and be blown out of the cabin and into the rotor disc.

FLIGHT IN RAIN.

Aircraft having thin neoprene (rubber) on the leading edges of the flaps are restricted from flight in rain; if flight in rain is made inadvertently, indicate in Form 781 the time the aircraft has flown in the rain, indicating type and intensity of condition.

DIRECTIONAL STABILITY AUGMENTATION SYSTEM OPERATION

Except for flight test and pilot check-out demonstration flights, all flying shall be done with the directional stability augmentation system operating. If failure of DSAS should occur in flight, flight may be continued; however, maintain airspeed above 50 knots IAS, if possible, and land at the nearest suitable landing area. Refer to Sections III and VI for additional information and procedures.

SECTION VI

FLIGHT CHARACTERISTICS

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GENERAL

The handling qualities of this helicopter are such that the performance of the normal mission can be accomplished. These qualities are maintained and may tend to improve with higher gross weights. This also applies when the fire suppression kit is attached provided the kit is not allowed to swing excessively. Handling qualities are better in climb than in the other modes of flight.

Cyclic forces are high but can be reduced with the console-mounted trim switch and the cyclic-mounted trim release switch. The cyclic-mounted trim centering switch permits reduction in forces on the stick when seeking a new trim position. This switch does not reduce the cyclic force to zero, but is adequate for trimming out forces of larger displacement. The console-mounted 4-way trim switch is used for fine trimming.

Actuation of the cyclic trim release button after the forces have been zeroed by the console trim switch will result in the return of the normal cyclic forces. Lateral cyclic forces are noticeably higher than longitudinal forces and a lateral shake is present at all airspeeds especially high airspeeds. With the cyclic stick at its longitudinal extremes the lateral control force gradient is characterized by the lack of a breakout force. At the forward extreme (high forward speed) there is also a dead-band area (region where displacement does not require application of a force) or a reversal in the slope of the gradient (right lateral force for a left lateral displacement) in the region of the lateral neutral position.

WARNING

At high forward speeds (cyclic stick is at its forward extreme) all trimming of cyclic forces should be done with the *console-mounted trim switch*. In this speed regime a lateral shake (3 to 5 pounds) may be experienced which could cause over-controlling. If the cyclic-mounted trim release switch is employed the cyclic force gradients will not be present to aid in controlling the shake during the time this trim system is reacting.

The directional control pedals do not have a force gradient or centering device, however, a ground adjustable friction device is installed in order that pedals may be positioned for trim flight, and so that a force is required to deflect the pedals. When making pedal inputs some rolling occurs and when lateral cyclic inputs are made some yawing occurs. This produces dihedral effect in flight and appears as a yaw/roll cross coupling; read the discussion under "Flight Control."

This aircraft has a noticeable reaction to power changes. An increase in power produces a nose up trim change and a decrease in power causes a nose down trim change.

WARNING

The power-trim characteristics under normal conditions present no problem. However, under extreme conditions, such as forward cg, high airspeed, or high gross weight, which require higher power settings and extreme control displacements unsafe nose down attitudes can result if the nose down pitch rate is allowed to become excessive. Immediately following loss of power, aft cyclic should be applied as necessary to arrest the nose down pitch rate and maintain 1g flight. When this application has resulted in control of the pitch attitude and if altitude permits, the collective pitch lever should be lowered at a moderate rate with simultaneous aft cyclic to compensate for any additional attitude change. If the nose down pitching is not stopped prior to lowering the collective pitch lever, or if the collective pitch lever is lowered too rapidly, there may be insufficient aft cyclic control to maintain a safe flight attitude. The rate of rotor rpm decrease following an engine failure is low, thus allowing the pilot sufficient time to lower collective to the degree necessary to stay within rotor limits.

The engine power turbine governor controls rotor rpm satisfactorily, particularly, during steady state flying and from 20 to 31 psi torque where most flying takes place. However, transients of 3-5 rpm will be noted as a function of collective transients, such as during lift-off or when changing airspeeds.

TAXI AND GROUND OPERATION

As is normal in all helicopters having a ground taxiing capability, some collective pitch is required for taxiing. In the HH-43, 14-15 psi is normally used. In winds between 5 and 10 knots single pedal braking is required to turn the aircraft. Care must be used to prevent locking one wheel since the power required to taxi and overcome the braking is sufficient to cause the aircraft to become light on the wheels. Use of excessive lateral cyclic should be avoided when taxiing crosswind since this will unnecessarily increase the disc area exposed to the wind and will act as a down wind turning moment.

CAUTION

Air taxiing should be used whenever possible. Avoid ground taxiing in crosswinds above 10 knots, or any winds above 15 knots.

LIFT OFF

As power is increased during lift off to hover, there is an initial requirement for forward cyclic. This forward cyclic requirement is only temporary and cyclic should be returned to neutral as the aircraft becomes airborne.

As collective setting is increased the directional control pedals become effective. (For further explanation see "Flight Controls.")

CAUTION

Due to the low directional control available at low collective settings and low airspeeds, the aircraft should be aligned with the wind prior to applying collective pitch for lift-off when winds are in excess of 10 knots. If winds do not permit ground taxiing, aircraft should be aligned with wind prior to engaging the rotors.

HOVER

Hover characteristics are such that precision hovering can be accomplished with comparative ease in calm winds, however, heading control becomes rather difficult during turbulence and gusty wind conditions. Altitude control during hovering flight is excellent. The helicopter will tend to bank or roll in the direction of rudder input. As a result, to make a flat hover turn, an appropriate amount of opposite lateral cyclic control will be required.

Best directional control in hover is effected by a high collective setting. Therefore, at low gross weights the rotor rpm should be reduced to produce a higher collective position assuring highest positive directional control. However, at high gross weights a maximum rotor rpm can be utilized as the power required will result in a higher collective setting. In general, the handling qualities appear to improve as gross weight is increased for conditions of crosswind hovering. When hovering in crosswinds with a symmetrical load, the helicopter has a "weather vaning" tendency and the directional control will be the limiting factor in maintaining hovering attitude for winds in excess of those limits stated in Section V.

Hovering in a crosswind with a load on the rescue hoist is not difficult; however, a high crosswind from the left may result in interference between the cyclic and the pilot's left leg. With a load on the hoist the aircraft vibration and cyclic shake is noticeably higher with left crosswind than with a right crosswind during hover. It should be noted that for a given hoist load, the interference between the cyclic and the pilot's left leg becomes more critical as gross weight decreases. Hovering in crosswinds should be conducted with a right crosswind whenever it is practical. See Section V for lateral center of gravity limits and maximum cross wind limits.

Note

When hovering in zero wind or directly into the wind, the helicopter should be rigged so that the rudder pedals are within one quarter inch of each other.

CLIMB

The combination of low disk loading and high horse-power-to-weight ratio engine enables the helicopter to perform well during climbing flight. The aircraft accelerates well from a hover to climb speed; however, vibrations increase significantly at translational lift. Overspeeding the rotors or exceeding the transmission torque limit can easily occur during the takeoff acceleration and rotation to climbing flight. Once this climb is established, airspeed and rotor rpm can be easily maintained by monitoring the rpm beep or by using 3-5 rpm less than maximum prior to starting the climb. Flying qualities are very good during climbing flight when compared to level flight and autorotation.

At very high altitudes, the collective pitch lever may reach the full up position. This will normally occur 2,000 to 4,000 feet below the service ceiling (R/C of 100 ft per minute). Once this occurs, the engine speed governor switch may have to be decreased in order to prevent rotor from overspeeding. The altitude at which this occurs decreases as gross weight increases, and is above the altitudes attained during normal operations (e.g., at 6750 pounds, full up collective is reached at about 17,500 feet). If very high altitude operations are contemplated, the helicopter should be re-rigged in accordance with applicable maintenance manuals.

LEVEL FLIGHT

The handling qualities of the HH-43 in level flight are generally normal and are adequate for performing the normal missions. Moderate flight maneuvers can be easily accomplished; however, when abrupt maneuvers are performed the pilot must use a large amount of directional control to maintain coordinated flight. This is especially true when operating at low power settings.

AUTOROTATION

In addition to a low rate of descent, the HH-43 has the excellent characteristic of having a relatively slow power-off landing speed capability. Straight ahead and turning autorotation can be accomplished easily; however, the pilot should be careful to maintain coordinated flight.

During turbulence and when making abrupt rolling-type maneuvers an uncoordinated flight condition can occur. If this condition occurs during a practice autorotation, a power recovery should be immediately initiated unless altitude and control are available to correct the uncoordinated flight condition. In this condition of flight the aircraft will inherently tend to assume a bank angle opposite to the direction of turn. A cross control input must be made to recover (i.e., with a left sideslip the aircraft will be inherently banked to the left; therefore, left pedal and right lateral control must be used, accompanied by aft cycle to restore coordinated flight and the desired attitude).

Autorotative flares accomplished at normal gross weights will not result in a rotor overspeed with full down collective; however, some collective must be applied to maintain rotor rpm limits at the heavier gross weights. As collective is applied to cushion the landing, there is a noticeable decrease in lateral and directional controllability due to decreased rotor rpm. This problem is aggravated when landings are attempted in slight cross-winds.

If autorotation is established with the collective above the dwell zone, the directional control pedals will reverse (i.e., right pedal will result in a left yaw). The dwell zone is the region between approximately 10 to 25 percent up from the full down collective position.

CAUTION

The directional stability in autorotation with DSAS inoperative is such that very large (30 degrees) sideslip angles can occur as a result of light gusts and turbulence. These sideslip angles develop in such a manner that they are not always immediately detectable. Turns should be avoided, if possible.

SIDEWARD AND REARWARD FLIGHT

The sideward flight capability of the helicopter improves as gross weight is increased because of the greater directional control available at higher collective settings. Handling qualities during sideward flight generally improve as gross weight is increased. For symmetrical loading conditions, maximum speed in sideward flight is limited by directional control available. For sideward flight to the left with a load on the rescue hoist, knee-to-cyclic interference can be the factor that limits maximum speed.

Rearward flight speeds are limited by directional control available and the pilot's ability to maintain exact rearward flight.

POWER SETTLING

Under normal flight conditions power settling is non-existent in the HH-43. Power settling requires a "settling in your own rotor wash" or a recirculating of air flow, but due to the syncropters breast stroke rotor wash pattern clean air is being supplied to the rotor at slower airspeeds than other helicopter configurations. When hovering under conditions of high gross weight, high altitudes, and high temperatures it could possibly occur if a rate of descent of 500 fpm or more is allowed to develop.

The pilot's first indication of power settling will be an inability to decrease rate of descent with power and an extreme roughness in the controls while in a vertical descent when out of ground effect. This condition is very difficult to get into but, vertical descent should be avoided at true zero airspeed. Recovery techniques are entering autorotation and transitioning to forward flight. A few knots of airspeed is sufficient to alleviate the power settling. Vertical settling at zero airspeed at high rates of descent should be avoided.

BLADE STALL

Deterioration of control or loss of performance due to blade stall will not occur when the HH-43 is operated within limits of Section V. Due to servo flap control and aerodynamic twisting of the rotor, the blade angle of attack will not increase enough for stall.

GROUND RESONANCE

Ground resonance or mechanical instability does not easily occur in the HH-43 while operating according to Section V, and with proper aircraft servicing.

Rotor interblade dampers, proper strut and tire inflation are most important to provide proper stiffness and damping for the helicopter. Characteristically the possibility of mechanical instability increases as gross weight and rpm increase on the ground. Therefore, when operating at these conditions special emphasis should be placed on aircraft servicing. The worst conditions are when the helicopter is light on the front tires or if they are off the ground. If the tires are soft and the blade dampers are believed to be poor, ground operations should be conducted with the nose gear in contact with the ground.

Test experience has shown that operating under poor servicing and high gross weights, ample time and power are available to lift into a hover if there is any doubt as to ground vibration becoming divergent. At low rotor speeds application of the rotor brake would damp any resonant vibration.

VIBRATION

Vibration in the helicopter in general is lateral or vertical. The predominant frequency in the HH-43 is a lateral 2/rev. Aft cg and high gross weights tend to increase 2/rev vibrations. Condition and servicing of the interblade dampers are important to keep 2/rev at a minimum.

1/rev vibration is in a vertical direction and is rotor induced, generally caused by an out-of-track condition. If 1/rev is felt, the rotor track should be trimmed up by use of the tracking motors. A malfunctioning tracking motor or switch can result in large out-of-track conditions which cause heavy vibration. If this occurs, the pilot can adjust rpm, airspeed, and collective pitch position for minimum vibration. High bank angle turns under these conditions will aggravate the vibration and should be avoided, if possible.

All engine vibrations are of a very high frequency and may feel like a buzz to the pilot. Under normal conditions very little engine frequency is felt although some can be felt on the nose bubble.

STALLS

The helicopter will not stall at slow speeds although a settling tendency will be experienced as it is flown through a zero airspeed condition during a downwind flare. Anticipation with power will be required to avoid the possibility of an inadvertent touchdown. It is recommended that downwind flares be avoided.

DIVING

See Section V for maximum permissible airspeed.

ENGINE POWER CHARACTERISTICS ON RECOVERY FROM PRACTICE AUTOROTATIONS

Recovery to hover power from practice autorotation takes a minimum amount of time if the rotor rpm is set at 250 to 260 rpm prior to entering autorotation, and the throttle is rotated to FULL OPEN before starting the landing flare. Recovery can be accomplished in about 3 seconds engine acceleration time. This procedure offers the closest approach to "needle-split" autorotation without sacrificing power recovery time.

FLIGHT FOLLOWING DSAS FAILURE (WITHOUT YAW)

If failure of DSAS should occur, flight may be continued; move the DSAS switch to the center (OFF) position, maintain coordinated flight, increase the rotor RPM to 250 to 260 RPM and maintain a 50-60 KIAS airspeed. During approach to a landing below 5,000 feet reduce rotor RPM to 250 RPM and make normal approach into the wind. If the approach is to a site above 5,000 feet make a normal approach into the wind but increase rotor RPM to 260 RPM.

These conditions will give the best control and stability provided coordinated flight is maintained.

FLIGHT WITH DSAS INOPERATIVE

Flying with the DSAS inoperative, except for practice autorotations, is authorized. The procedures in **FLIGHT FOLLOWING DSAS FAILURE (WITHOUT YAW)** will be used.

Note

It is important to maintain coordinated flight under these conditions because the directional control available is less than what is normally available. If uncoordinated flight is experienced the control procedures outlined under CAUTION, DSAS FAILURE (with excessive yaw), Section III should be used.

FLIGHT CONTROLS

The aircraft has conventional helicopter flight controls in the cockpit; however, there are several unique features that the pilot should be familiar with in order to fully understand how each affects the flight characteristics.

LONGTUDINAL CONTROL.

Longitudinal control is obtained by simultaneous longitudinal tilting of the rotor disks. Forward motion of the stick causes the disks to tilt forward. This forward tilt of the disks causes a nose down moment.

LATERAL CONTROL.

Lateral control is obtained by simultaneously tilting the rotor disks to the right (right roll) or to the left (left roll). There is a limiting device which prevents one rotor from contacting the hub of the other.

DIRECTIONAL CONTROL.

Directional control is divided into three separate systems which are a function of rudder pedal application. These three systems are differential cyclic, rudder deflection, and differential collective. Differential cyclic and the rudder deflection are the primary turning forces in forward flight. At low airspeeds, the torque reaction caused by differential collective is the primary turning force.

Differential cyclic is the fore and aft tilting of the rotor disks to provide a turning moment on the airframe. As a result of right pedal displacement, the right rotor (the rotor on the inside of the turn) tilts back to provide a braking force of the right side of the aircraft. The left rotor disk tilts forward to produce an accelerating force on the left side of the helicopter. The combined effect of these forces is to turn the aircraft to the right. A left pedal input causes the opposite tilting of the rotor disks (i.e., left rotor disk tilts back and the right one tilts forward). The differential cyclic action that results from a pedal input varies in amount as a function of collective stick position.

The purpose of the directional stability augmentation system (DSAS) is to sense skidding or an uncoordinated turn and to apply corrective rudder action. If pedal inputs are made this information is sent electrically to the DSAS unit which then applies the correct rudder deflection to aid the rotor forces. There is no mechanical linkage between the rudder pedals and the rudders. Because differential cyclic becomes more effective as speed is increased, less rudder deflection is required to produce the required effect. For this reason the DSAS unit applies less and less rudder deflection for a given pedal position as airspeed is increased until the speed of approximately 80 knots IAS is reached at which time the rudders are locked in the neutral position. In case of an electrical failure the DSAS switch should be turned to the off position which will lock the rudder in neutral.

Differential collective is the increasing of the collective of one rotor and decreasing it on the other. The rotor which increases in collective setting for a pedal deflection depends on the location of the collective lever relative to the dwell zone. The dwell zone is located between approximately 10 to 25 percent of the full control throw from the full down collective position. This relationship between collective stick position and the differential collective action is as follows.

COLLECTIVE LEVER ABOVE THE "DWELL ZONE".

With the collective pitch lever in this position the right pedal will cause the left rotor to increase in collective pitch and the right to decrease. The converse is true for left pedal (i.e., left pedal causes an increase in collective on the right rotor and decrease on the left). In powered flight this will cause the aircraft to yaw in the direction of the control input (i.e., right pedal causes a right yaw). In unpowered flight such as autorotation (but not autorotational recovery) if the collective is above the Dwell Zone a directional control reversal will occur (i.e., right pedal causes a left yaw). Differential collective will also cause a rolling moment. This rolling moment will be in the direction of the pedal input (i.e., right pedal causes a right roll) regardless of the collective setting. While hovering over a point if it is desired to turn without rolling, some cross controlling with the lateral cyclic will be required (i.e., for a right pedal input a left lateral cyclic input will be necessary to prevent rolling to the right).

COLLECTIVE PITCH LEVER WITHIN THE "DWELL ZONE".

Within the "dwell zone" the control system does not employ differential collective. A differential cyclic "shifter" is used. It increases directional control by varying the amount of differential cyclic pitch for a given pedal movement as a function of collective pitch lever position.

COLLECTIVE PITCH LEVER BELOW THE "DWELL ZONE".

When the collective is in this position a "reverser" is used. The reverser is required to compensate for the change in the relationship between blade pitch angle and torque in autorotation as compared to power-on flight. It reverses the relationship between directional pedal displacement and the rotor which increases in collective pitch. For a right pedal input the collective is increased on the right rotor thus causing the aircraft to yaw to the right.

STRUCTURE LOAD FACTORS

As a structure is loaded to higher weights, its ability to withstand shocks or additional loads resulting from maneuvers decreases. The amount of shock or additional load that the structure will sustain before failure occurs is the margin of safety. In planning any helicopter mission, cognizance must be taken of the fact that the maximum permissible weight may depend on the margin of safety desired for the various supporting structures (main rotor, fuselage, landing gear, flooring, cargo shackles, etc.). Should the mission require excessive maneuvering or flight through turbulent air, it would be advisable to maintain a larger margin of safety than if smooth, level flight were contemplated, and as pointed out previously, the larger the margin of safety, the lower the maximum permissible weight. It will be noted that as regards to the helicopter, flight load factors are used as an indication of the margin of safety that is available. At any particular moment of operation, the structural margin of safety, for example, will be equal to the difference between the load factor the helicopter is designed for, and the load factor the helicopter is sustaining at that moment due to increases in gross weight, maneuvers, or turbulence. For example, should the helicopter be loaded so that it is capable of making good a load factor of 2.67, and during various phases of the flight, load factors of 1.5, 2.0 and 1.0 are imposed on the helicopter, the margins of safety during these phases would be 1.17, 0.67 and 1.67 load factors, respectively. It is, therefore, of prime importance to anticipate the maximum flight load factors that will be encountered during a mission, in order that the helicopter will be loaded in such a fashion that the load factors it was designed for will never be exceeded during any part of the flight. The helicopter should never be loaded in such a manner that its load factor would be less than 2.0.

SECTION VII

ALL WEATHER OPERATION

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INSTRUMENT FLIGHT PROCEDURES

INTRODUCTION

Procedures included in this section are provided only for conduction instrument flight in limited weather conditions.

The following defines limited weather as applied to this aircraft:

Icing	Flight not permitted under any condition
Precipitation	Flight permitted in light to moderate.
Turbulence	Flight permitted in no more sever than light turbulence.

WARNING

Under no circumstance will instrument flight be attempted when weather conditions are more adverse than those listed above.

A pilot and copilot, both of whom are helicopter instrument qualified, are required as minimum crew. During instrument flight it is necessary to monitor instruments diligently. Corrective control pressures must be applied smoothly and positively. The trim switch should be used to remove undesirable control pressures during stabilized flight conditions.

CAUTION

Avoid flight in hail, icing conditions, and turbulence.

The pilot must keep in mind the fact that the aircraft has a relatively short cruise range. Also, because of relatively low airspeeds, large wind drift corrections are often required to maintain course.

PREFLIGHT AND GROUND CHECKS

Perform the normal preflight inspections, including special checks for night flights. Pay particular attention to proper operation of flight instruments, navigation equipment, external and internal lighting, defrosters, pitot heat, generators, inverters, and the engine ice protection system.

CAUTION

The J-4 compass when operated as a gyro stabilized magnetic compass, may take as long as 4 minutes to synchronize when allowed to synchronize automatically.

On helicopters USAF Serial No. 60-251 and subsequent, and on earlier helicopters modified by TCTO-509, the gyros may require 10 minutes after caging before becoming fully erected. The earlier helicopters not modified by TCTO-509 require approximately 2 minutes.

Note

Prior to performing the instrument takeoff, turn off the anti-collision light to prevent the possibility of reflections from clouds or other weather inducing spatial disorientation.

INSTRUMENT TAKEOFF AND CLIMB

The attitude indicator, heading indicator, and torquemeter, are primary for instrument takeoffs. By use of these instruments, along with the following procedures, ITO's are easily accomplished.

After positioning the helicopter on level or near level surface and into the wind, note heading indicator reading and adjust the miniature aircraft of the attitude indicator so that it appears approximately 2½ bar widths above the horizon bar.

With a steady, smooth motion, apply collective pitch until approximately 30 psi torque is obtained. As the helicopter leaves the ground, position the cyclic pitch so that the miniature aircraft will appear level with the horizon bar of the attitude indicator and maintain directional control with rudder pedals.

The takeoff attitude and power setting should be maintained until vertical velocity reaches approximately 500 fpm, and a constant airspeed between 60 and 70 knots IAS is obtained. Maintain a constant power setting and airspeed until reaching level-off altitude. The miniature aircraft should remain nearly level with the horizon bar during the transition.

WARNING

- The airspeed, vertical velocity and altimeter are unreliable below 30 KIAS because of rotor downwash effect on the pitot static system. During takeoff do not rely on these instruments until the airspeed indicator reads at least 30 KIAS. The time required to reach this airspeed will be approximately 12-14 seconds.
- Do not attempt to hover the helicopter under actual instrument conditions, since inadvertent sideward or rearward flight may result in unexpected ground contact.
- Vertical takeoffs are not compatible with, and are not recommended for instrument flight conditions.

Turns should be made using the attitude indicator to obtain 13 to 15 degrees bank angle which approximates a standard rate turn of 3 degrees per second. Use of approximately 30 psi torque with cyclic pitch set so that the attitude indicates a level pitch attitude will give the recommended climb airspeed and vertical speed. The angle of bank should not exceed 15 degrees. Make all pitch corrections small and gradual.

Level off at the desired altitude by adjusting collective pitch to maintain altitude. As airspeed increases to desired cruising speed adjust cyclic and collective pitch to maintain this speed and altitude.

INSTRUMENT CRUISING FLIGHT

Upon establishing the recommended level cruise, at a speed of 60 to 70 KIAS, the attitude indicator should be set for a nose level indication. All pitch and bank angle corrections should be made using the attitude indicator for reference. Pitch corrections should be small and bank angles should not exceed 20 degrees, with 13- to 15-degree angles the more desirable.

VFR cruise speeds are not recommended for instrument cruise because the directional stability control cuts out at 78 KIAS.

RADIO AND NAVIGATION EQUIPMENT

Operation of the UHF (AN/ARC-34) radio is adequate; however, the helicopter might have to change position to provide reliable communications when buildings and high ground lie between the helicopter and the ground station.

The radio compass (AN/ARN-59) is satisfactory for airway navigation.

If necessary the automatic direction finder (AN/ARA-25) may be used as a navigational aid.

DESCENTS

Enroute descents to traffic altitude can be initiated and maintained without difficulty using the following procedures.

Before commencing the descent, the attitude indicator should be checked and reset for a nose level indication with the helicopter in straight and level flight at the recommended cruise speed. To establish the descent, reduce the torque and set up 400 to 900 feet per minute rate of descent. Maintain recommended cruise airspeed, angle of bank, and pitch attitude. The miniature airplane will remain on the horizon bar during descent.

Note

In general, below 7000 feet altitude a reduction of 1 pound of torque will increase the rate of descent approximately 125 feet per minute.

MAXIMUM (AUTOROTATIVE) DESCENTS

Autorotations are not difficult on instruments. However, due to the higher rate of descents, they are not recommended except for emergencies (loss of engine, etc.). Use the procedures outlined in Section III, with the following exceptions and additions:

Adjust aircraft pitch attitude to give approximately 2 bar width nose high indication. Use 60 KIAS for autorotations. One pilot should fly instruments during descent. The other pilot should scan the outside and take over the controls for the flare and touchdown when visual contact is made with the ground. Autorotation should be made into the last known wind.

HOLDING

Holding presents no handling or control problems using an instrument cruise speed of 60 to 70 KIAS. The VFR maximum endurance airspeeds are not recommended for loitering on instruments. The instrument handling qualities at this speed greatly increase the work load at a time when the pilot is busy monitoring radio communications, and so forth. The decrease in fuel consumption realized from using maximum endurance airspeeds instead of 70 KIAS would be negligible for all practical purposes.

For all pitch and bank corrections utilize the attitude indicator. Do not exceed a one bar width pitch correction for minor altitude changes and limit the angle of bank to 15 degrees.

Anticipate large drift corrections when crosswinds are encountered in the holding pattern.

INSTRUMENT APPROACHES

Instrument approaches are easily flown in this helicopter. Before commencing the approach, set the miniature aircraft on the horizon bar while straight and level at 60 to 70 KIAS. During all phases of the approach, the miniature aircraft of the attitude indicator will be approximately on the horizon bar if the recommended airspeed of 60 to 70 KIAS is maintained.

Use the attitude indicator for all pitch and bank corrections. Do not exceed a one bar width pitch correction for minor altitude changes and limit the angle of bank in turns to 15 degrees.

During the descent phase of an approach, make the rate of descent corrections with cyclic pitch by referring to the attitude indicator.

ADF APPROACHES.

ADF approaches are easily conducted using the procedures outlined in figure 7–1.

RADAR APPROACH.

The helicopter presents a traffic control problem because of its relatively slow speed compared to other air traffic; therefore, the radar operator should be notified that the airspeed will be 60 to 70 KIAS for the entire approach. To reduce the time required to execute a radar approach, request a short pattern with the downwind two to three miles from the runway and a four mile final. Use the procedures outlined in figure 7–2.

Note

A normal radar approach will require 30 to 35 minutes; a short pattern requires 12 to 16 minutes.

MISSED APPROACH.

To conduct a missed approach, apply climb torque and maintain level pitch attitude on the attitude indicator while maintaining 60 to 70 KIAS. This will give normal instrument climb. Follow published missed approach procedures.

ADF Approach

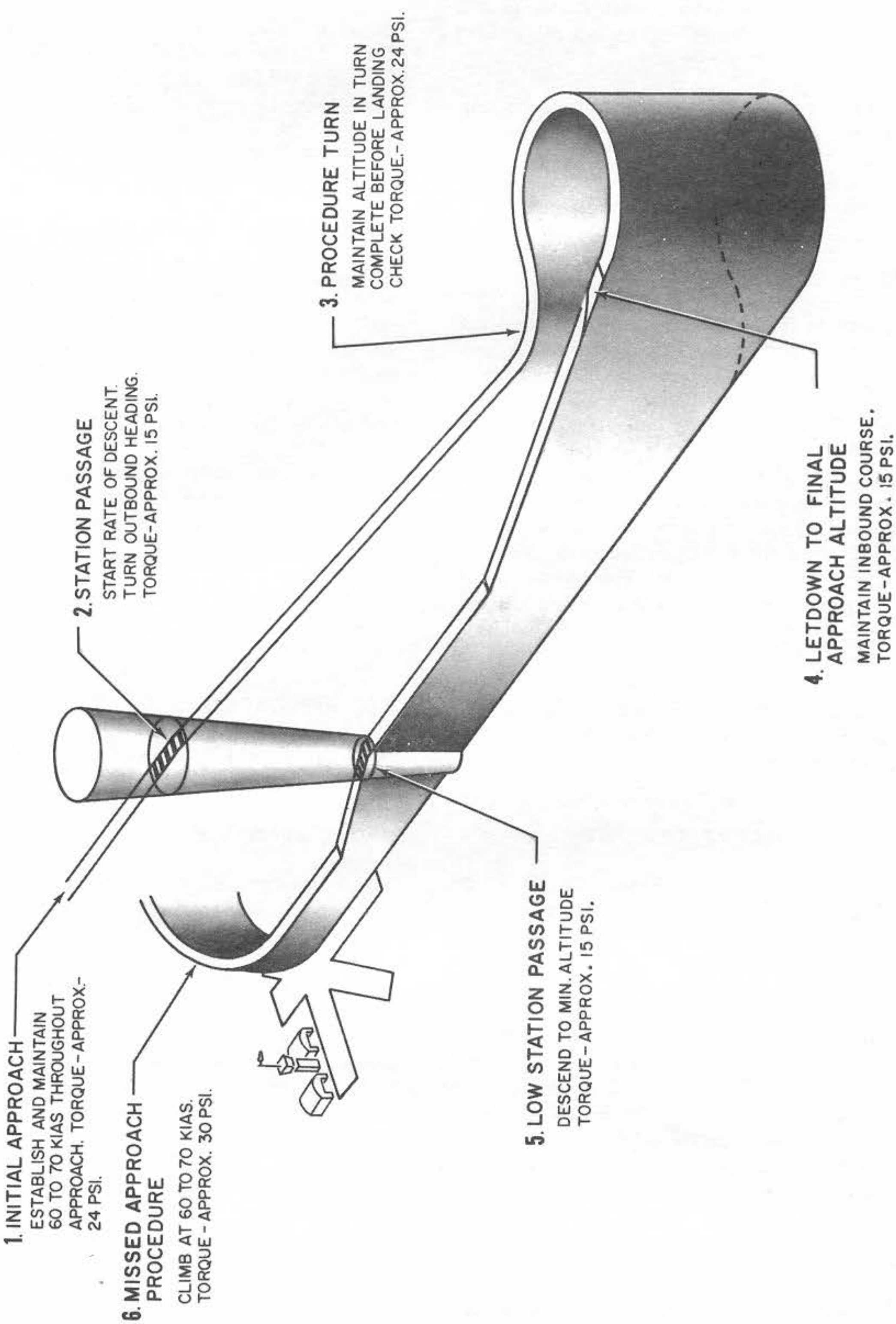

Figure 7–1

Radar Approach

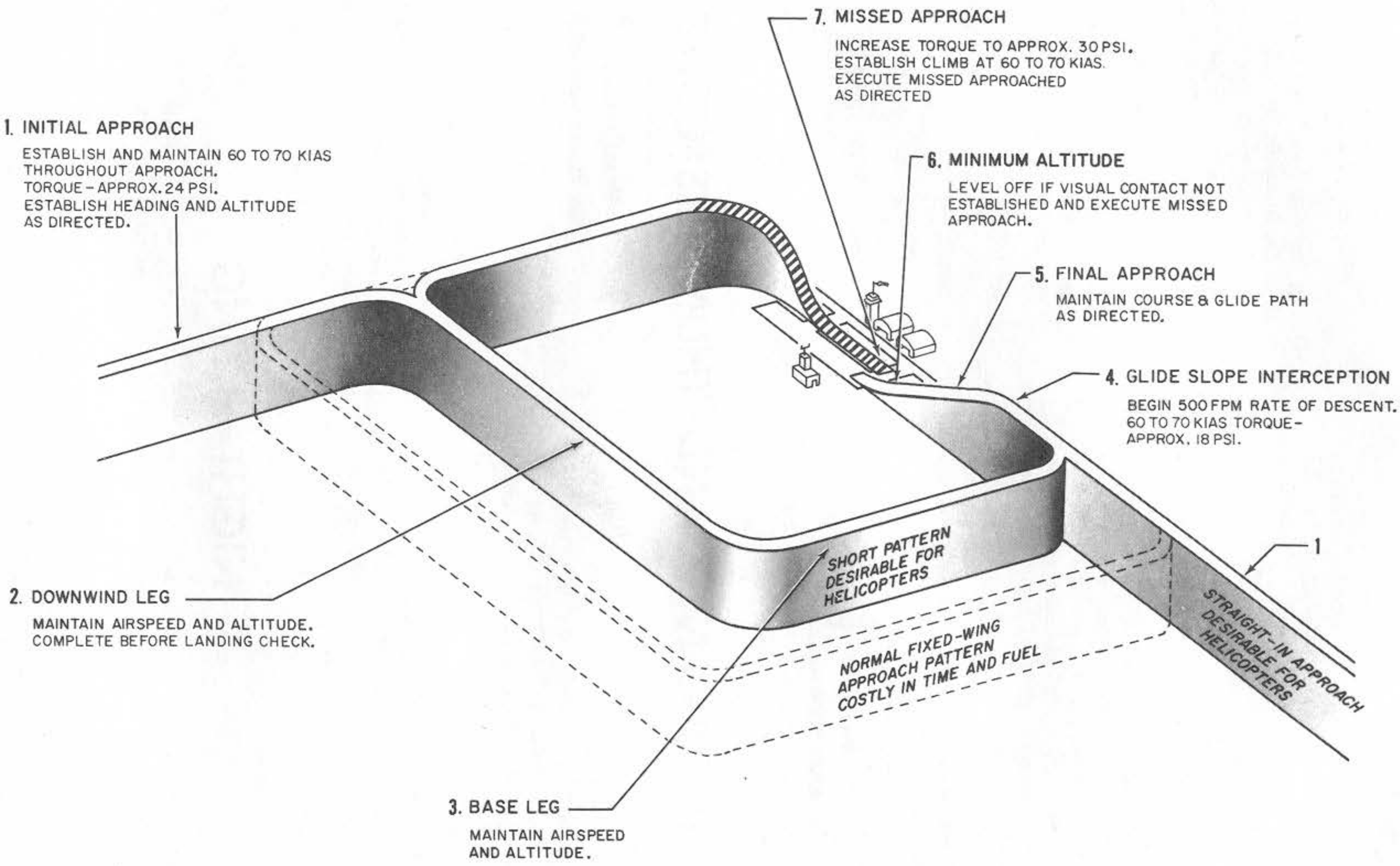

Figure 7—2

ICE AND RAIN

The icing terminology is listed in AWSM 105-39 dated 14 September 1964. These terms are used for reporting icing conditions and all pilots should become familiar with them. The new terms "Trace," "Light," "Moderate," and "Heavy" generally correspond to the old terms "Light," "Moderate," "Heavy," and "Severe." Each pilot must become familiar with the current terminology to assure the existing conditions do not compromise safe flight.

Visibility remains good in light-to-moderate rain. However, when poor visibility is encountered while cruising in rain, it is recommended that the pilot fly by instruments and the copilot attempt to maintain visual reference. Rain has no noticeable effect on handling or performance of the helicopter.

Before entering icing conditions (visible moisture and below freezing temperatures), actuate the pitot heat and windshield defrosters.

WARNING

This aircraft is restricted from flight through known or forecast icing conditions.

CAUTION

During flight in icing conditions, expect one or all of the following to occur:

1. At any temperature below freezing, main blade vibrations can be induced by asymmetrical self-shedding of ice. This is particularly severe at temperatures below 0° F.
2. To maintain airspeed, torque will have to be increased. Power increase up to 20 percent can be expected.
3. Ice forming on servo flaps at 0° F and lower will cause loss of control effectiveness.
4. Droop stops may freeze over.
5. Decrease in rotor speed during autorotations and an increase in rate of descent.
6. Windshield will ice over immediately during freezing rains.

TURBULENCE AND THUNDERSTORMS

TURBULENCE.

The flying qualities of this aircraft are poor in turbulence. If moderate-to-heavy turbulence is unavoidably encountered, do not attempt to maintain a definite altitude. Full attention should be given to maintaining course and a level attitude indication. Set up normal cruise flight conditions.

Pilot's discomfort may be used as a guide to determine the extent of roughness that is acceptable. Decreasing airspeed during cruise conditions may improve handling characteristics of the helicopter. Descents should be made with a low rate of descent and a comfortable airspeed.

WARNING

Do not intentionally encounter turbulent conditions while on instruments.

THUNDERSTORM.

Avoid flights through or near thunderstorms. If thunderstorms are encountered during flight, land as soon as practical and wait for the storm to pass. Violent turbulence and restricted visibility may be encountered in thunderstorms. When lightning is encountered at night, the dome and instrument lights should be turned to full intensity to preclude temporary blindness.

NIGHT FLYING

Night flying presents the same problems as instrument flying plus additional problems introduced by illumination of the instruments and cockpit and exterior reflections.

Note

When operating in the clouds at night, turn navigation lights to steady and anti-collision light off to reduce distracting reflections from the clouds.

Note

For night takeoffs, set the landing light in an intermediate position that gives best reference. This will light the approximate touchdown area following a normal approach.

COLD WEATHER OPERATION

INTRODUCTION

WARNING

In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

Extreme cold causes general adverse effects on aircraft materials. Rubber, plastic and fabric materials stiffen and may crack, craze, or even shatter when loads are applied. Oils congeal and greases stiffen. Dissimilar metals contract differentially. Moisture, usually from condensation or melted ice, freezes in critical areas. Tire, landing gear strut, and accumulator air pressures decrease as the temperature decreases. If hangar space is available, the aircraft should be kept in a heated hangar when outside temperatures drop below 0°F. For cold weather flights use the normal procedures in Section II with the following exceptions or additions:

PREPARATION FOR FLIGHT

EXTERIOR INSPECTION.

1. Check vents for ice stoppage.
   a. Fuel vents.
   b. Transmission breather.
   c. Battery vent.
2. Check that ice and snow is removed from rotor blades and flaps, and all exterior surfaces and openings.

WARNING

Failure to do this can result in dangerous flight conditions due to aerodynamic disturbances and center of gravity changes, as well as the possible ingestion of snow, water, and ice by internal mechanisms and systems. Depending on the weight of snow and ice accumulated on the rotor blades and on, or in, the fuselage, take-off distances and overall performance can be seriously affected. While snow and ice accumulation on the rotor blades would more seriously affect the performance and flight characteristics, the additional weight of snow and ice on, or in, the fuselage would also result in a decrease from expected performance. Do not attempt to chip or scrape ice from fuselage or rotor and flap surfaces.

3. Check that preheat is applied.
   a. Engine.
   b. Transmission.
   c. Cabin.
4. Check that tires and bear paws are not frozen to ground.

INTERIOR INSPECTION.

1. Check that snow accumulations are removed.
2. Flight and engine controls may be difficult to move after the helicopter has been cold soaked. If the controls are not sufficiently free for a safe start and low power warmup, have the affected controls thawed by heating.

BEFORE STARTING ENGINE

An auxiliary power unit should be used when available to ensure a smooth fast engine acceleration to preclude a hot start.

If an auxiliary power unit is not available, keep the battery fully charged and warm prior to starting if possible. This will increase the safety margin for starting in cold weather.

STARTING ENGINE AND BEFORE TAXIING

When outside air temperature is between —17.8° C (0° F) and —31.6° C (—21° F), accomplish the following procedures in addition to those listed in Section II. After starting engine, allow 15 seconds for engine oil pressure to stabilize. Do not advance throttle beyond GROUND IDLE until engine oil pressure is stabilized in desired operating range.

CAUTION

At temperatures below —31.6° C (—25° F), the flow characteristics of the engine oil system cause the torquemeter indications to lag the actual torque output of the engine. By not accounting for this lag, you could overtorque the rotor drive components. Since the torquemeter oil pressure is obtained from engine oil pressure, the torquemeter may be inaccurate if engine oil pressure falls below the gage minimum red line.

Do not advance the throttle beyond FLIGHT IDLE until both engine and transmission oil pressures are stabilized within desired operating ranges.

Note

As a result of the drain on the battery during the start, a high loadmeter reading may be expected while the generator recharges the battery. This high loadmeter reading will decrease rapidly during the first 5 minutes of generator operation, and decrease at a lesser rate for 15 to 20 minutes until a near maximum charged condition of the battery is attained after approximately 30 minutes of operation. The battery condition may be determined at any time by momentarily moving the battery switch to OFF and noting the loadmeter change.

TAKEOFF

Cold weather presents no particular takeoff problem, unless the cold weather is accompanied by snow. The problem of restricted visibilty due to blowing or swirling snow, (from the rotor wash) can be acute, and may require a maximum performance takeoff, or perhaps even an instrument takeoff to get the helicopter safely airborne. If the takeoff area is surrounded by a large expanse of smooth, unbroken snow, there is the danger that the pilot may become disoriented because of the absence of visible ground reference objects. In this case, use any available objects for reference, such as smoke grenades, oil drums, rocks, seat cushions, etc.

LANDING

In normal operations helicopters are often required to land or maneuver in areas other than prepared airfields. In cold weather operations this frequently involves landing and taking off from snow covered terrain. The snow depth is usually less in open areas where there is little or no drift effect. The snow depth is usually greater on the downwind side of ridges and wooded areas. With the bear paw skids attached, safe landings can be made on many different types of surfaces. Whenever possible, the pilot should familiarize himself with the type of terrain under the snow (tundra, brush, marshland, etc.). On all snow landings anticipate the worst conditions; that is, restricted visibility due to loose swirling snow, and an unfirm ice crust under the snow. When loose or powdery snow is expected, make an approach and landing with little or no hover to minimize the effect of the rotor wash on the snow. If possible, have some prominent ground reference objects in view during the approach and landing. If no such objects are available, a smoke grenade, seat cushion, etc., dropped from the helicopter may suffice.

WARNING

Be prepared for a go-around if visual reference is lost.

After contacting the surface, maintain rotor rpm and slowly decrease collective pitch, while slightly rotating the cyclic stick until the aircraft is firmly on the ground. Be ready to take-off immediately if, while decreasing collective pitch, one landing gear should hang up or break through the crust. Do not reduce rotor rpm until it is positively determined that the aircraft will not settle. If posible, have a crew member get out and check the surface before reducing rpm.

BEFORE LEAVING THE HELICOPTER

Perform the following checks in addition to those listed in Section II:

1. Protect the wheels from freezing by placing them on planks or sandbags. If the temperature is —29° C (—20° F) or below and helicopter is to remain static for more than 4 hours, remove the battery and place it in a warm area.
2. Open the cabin doors slightly. This will permit sufficient air circulation to retard frost formation and reduce cracking of transparent areas due to differential contraction.
3. Check that moisture accumulations are drained as soon as possible after engine shutdown.
   a. Fuel cell sumps.
   b. Fuel strainer.
   c. Transmission oil tank sump.
   d. Engine oil tank.
4. Have vents checked for ice stoppage.
   a. Fuel vents.
   b. Transmission breather.

HOT WEATHER OPERATION

There are no restrictions on hot weather operation for this helicopter other than performance limitations resulting from reduced air density. Refer to Appendix I.

Note

To prevent excessive heat buildup in the cockpit and cabin while the aircraft is sitting in the sun, keep the sliding door open slightly, if sand and wind conditions permit.

DESERT OPERATION

While operating in desert areas, procedures do not differ from normal, except that precautions must be observed to protect the aircraft from damage due to blowing sand and dust. Keep taxiing and ground operations to a minimum. When taking off from an area covered with loose sand, use a maximum performance takeoff to get away from blowing or swirling sand as quickly as possible. When landing in such an area, keep hovering to a minimum. Make sure that protective covers are installed immediately after each flight.

HIGH ALTITUDE OPERATION

While operating at high altitudes, procedures do not differ from normal, except operational approaches and landings will be accomplished at maximum rpm. The brakes will be set and the nose wheel locked when required.

As the operating altitude increases, general performance of the helicopter decreases. This shows up in the form of diminished control and power, and slower acceleration. Maximum operating rpm will offset some of the control lost as a result of air density.

When operating at or near maximum computed operating weight with marginal performance conditions, proper technique will improve the helicopter's performance. Smooth, coordinated movements of the controls are essential, and tendencies toward abrupt application or overcontrolling should be avoided.

APPENDIX I

PERFORMANCE DATA

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PURPOSE OF DATA

The charts on the following pages are provided to aid in selecting the power setting and flight conditions that will result in safe and efficient operation of the helicopter. The charts are provided to aid in planning any mission normally performed with the HH-43B helicopter.

SYMBOLS USED IN CHARTS

The following abbreviations are used in this appendix:

C	centigrade
CAS	calibrated airspeed
F	fahrenheit
FT	feet
fpm	feet per minute
IAS	indicated airspeed (corrected as explained below)
KIAS	Knots indicated airspeed (same as IAS)
lb	pound(s)
LB/HR	pounds per hour
MAX	maximum
MIN	minute(s)
N_1	gas producer speed (%)
N_2	rotor speed (rpm)
OAT	outside air temperature
OGE	out of ground effect (for the HH-43B this means hovering approximately 40 feet or higher)
PSI	pounds per square inch
rpm	revolutions per minute
SL	sea level
TAS	true airspeed
$\frac{1}{\sqrt{\sigma}}$	the reciprocal of the square root of the density ratio, at the density altitude (the Greek letter sigma is used to represent the density ratio)

Calibrated Airspeed Correction

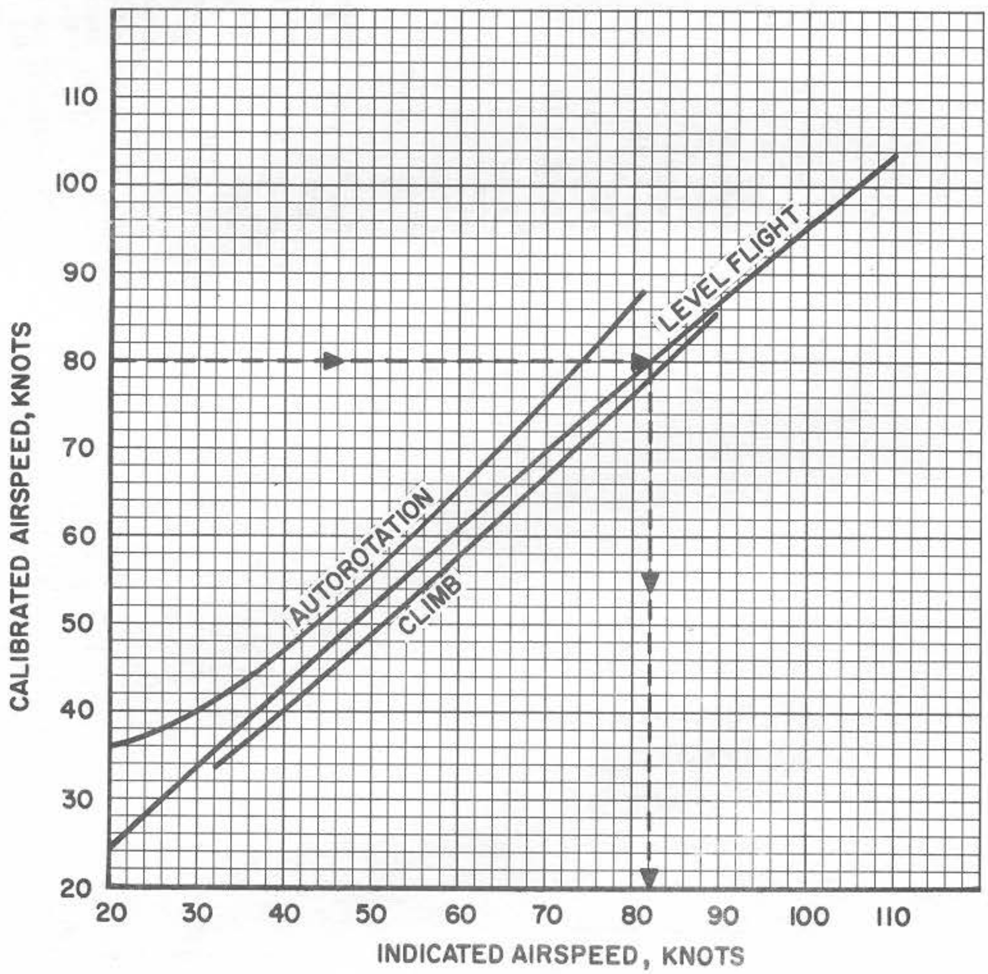


Figure A–1

AIRSPEED CORRECTIONS

AIRSPEED INDICATOR CORRECTION.

The airspeed indicator correction card (1, figure 1–15) is located on the center of the cabin ceiling. The values shown in the card correct for errors in the airspeed indicator, and apply only to the airspeed indicator installed in the same helicopter as the correction card. Add (or subtract, as indicated) the card values to the airspeed indicator reading to obtain indicated airspeed corrected for instrument error. The airspeeds in the charts in this appendix are indicated airspeeds corrected for instrument error (IAS).

CALIBRATED AIRSPEED CORRECTION.

The calibrated airspeed correction chart (figure A–1) provides information for determining CAS from IAS, or vice versa. The chart corrects indicated airspeed for errors imposed by the position of the pitot tube.

COMPRESSIBILITY CORRECTION.

Since the helicopter operates at relatively low airspeeds it is not necessary to correct for compressibility, and such data is omitted from this appendix.

TRUE AIRSPEED CORRECTION.

TAS (true airspeed) is obtained by multiplying CAS by the conversion factor $1\sqrt{\sigma}$, shown in figure A–2, for the density altitude at which the CAS reading is taken.

SAMPLE AIRSPEED CORRECTION PROBLEM.

Find the airspeed indicator instrument reading for an 86.5 knot TAS with the following conditions:
Density altitude = 5200 feet
Airspeed indicator instrument error
(from airspeed indicator correction card) = 1.5 knots

1. To obtain CAS, refer to figure A–2. At a density altitude of 5200 feet, $1\sqrt{\sigma}$ is 1.08. CAS equals TAS divided by $1/\sqrt{\sigma}$, or 86.5/1.08 = 80 knots CAS.
2. To obtain IAS, enter figure A–1 at 80 knots CAS, and read out 82 knots IAS.
3. Add 1.5 knots to 82 knots to arrive at an indicator reading of 83.5 knots.

Density Altitude

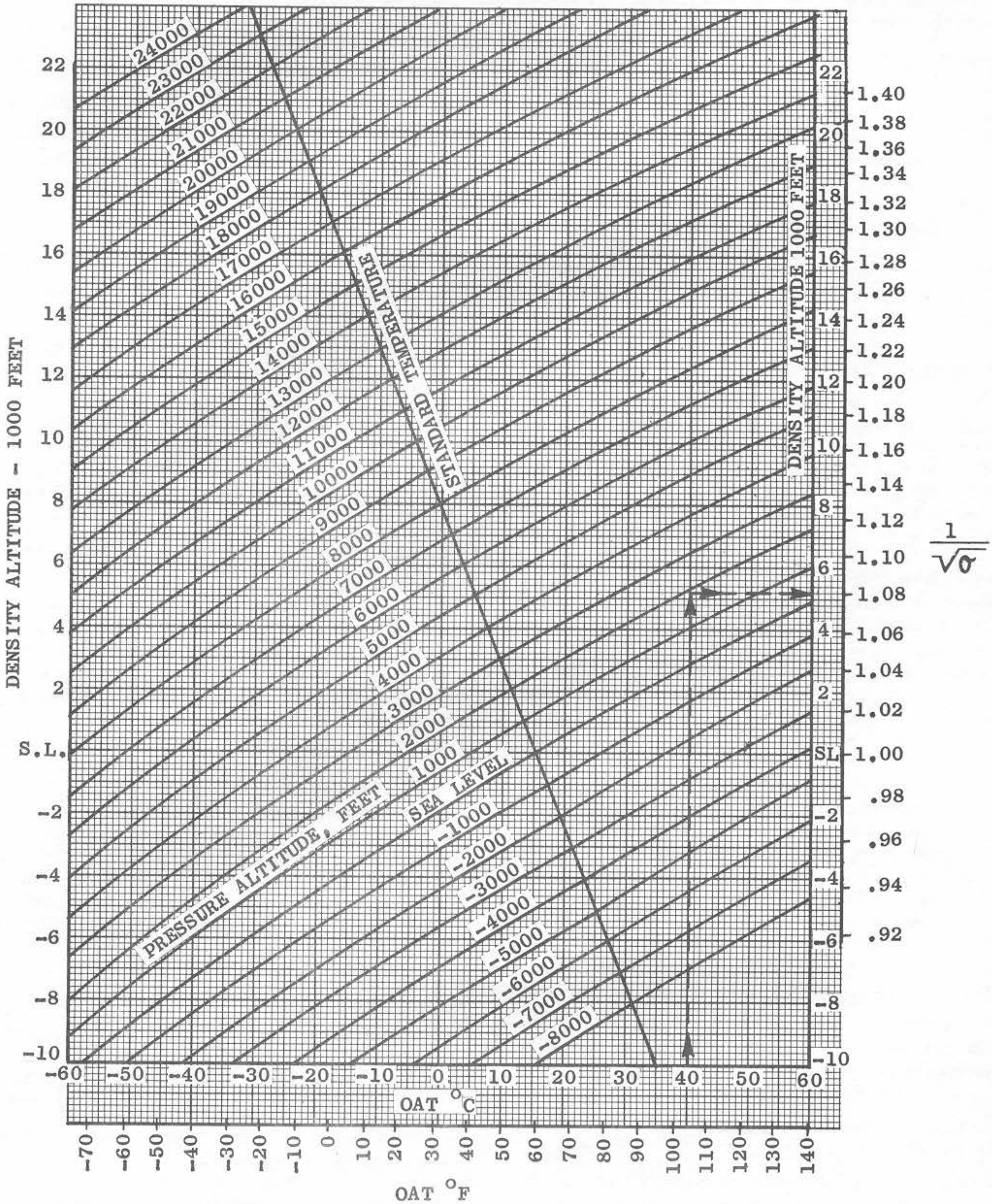


Figure A–2

ALTITUDE DATA

PRESSURE ALTITUDE.

Pressure altitude is the altitude indicated on the altimeter when the barometric scale is set on 29.92.

DENSITY ALTITUDE DATA.

Figure A–2 provides curves for obtaining density altitude information when pressure altitude and temperature are known. To use the chart, enter at the temperature scale and move vertically until the pressure altitude curve is intersected. Then move horizontally to the left or right and read the density altitude, or move horizontally to the right and read the reciprocal of the square root of the density ratio ($1/\sqrt{\sigma}$). The temperatures at the bottom of Figure A–2 are given both in °F and °C. These scales may be used to convert temperature from °F to °C.

FLIGHT CHARTS

The following paragraphs explain the use of the charts in this appendix. All charts are based on the use of 260 rotor rpm, although some provide a correction curve for lower rpm. As a rule, best performance is obtained at 260 rotor rpm when operating under marginal conditions dictated by high OAT, high altitude, or high gross weight.

MAXIMUM POWER AVAILABLE CHART.

Various atmospheric factors, such as OAT and pressure altitude have an effect on the capability of the engine to produce power. Figure A–3 shows the maximum power that an engine can be expected to produce under various atmospheric conditions for an engine trimmed according to T.O. 1H-43(H)B-2, Section III. Power is shown in terms of torquemeter pressure.

Note

The power output capability of the engine can exceed the structural limit of the transmission under certain conditions. Therefore the maximum continuous and maximum allowable torque limitations in Section V should be observed to prevent exceeding the maximum torque limitations.

The following example illustrates the use of figure A–3.

Example:

Find the maximum torquemeter pressure with the following conditions:

OAT	40°C
Pressure Altitude	2,000 feet
Desired Rotor rpm	260 rpm

The chart shows that maximum available power is 29.7 psi. This result is obtained by the following procedure:

1. Enter the charts at 40°C and move vertically to intersect the 2,000 foot pressure altitude line.
2. Move horizontally to intersect the 260 rotor rpm line.
3. Move down vertically to the torquemeter pressure scale and read 29.7 psi.
4. This value of torquemeter pressure of 29.7 psi represents the maximum available power a properly trimmed engine would produce with the above atmospheric conditions.

FUEL FLOW.

The fuel flow chart (figure A–4) shows the fuel flow for a given altitude and power setting. The fuel flow chart can also be used to determine endurance when the power required is known.

Example:

The following example describes the use of figure A–4.

Pressure altitude	4000 feet.
Torquemeter pressure	26.8 psi.

The chart shows that fuel flow will be 517 pounds per hour. This result is obtained by using the following procedure:

1. Enter the chart at the torquemeter pressure of 26.8 psi. Move vertically until the line representing 4000 feet pressure altitude is intersected.
2. Move left to the fuel flow scale and read 517 pounds per hour.

MAXIMUM GROSS WEIGHT FOR HOVERING CHART.

This chart (figure A–5) shows the maximum gross weight for hovering, using maximum available power or maximum allowable torque. The chart includes a provision to adjust helicopter performance for headwind and wheel height. The chart is applicable only for 260 rotor rpm. As a rule, highest maximum hovering gross weights are obtained at 260 rotor rpm.

Under most operating conditions the maximum hovering gross weight is reduced as rotor rpm is reduced below 260 rpm. The reduction depends on whether operating in the maximum power available limited region or maximum allowable torque limited region of figure A–5. These regions are separated by a dotted line. Subtract 100 pounds per 10 rpm reduction when in the maximum power available limited region. Subtract 200 pounds per 10 rpm reduction when in the maximum allowable torque limited region.

Example:

With the following conditions:

Pressure Altitude	4500 feet
OAT	35°C
Wind Velocity	10 knots
Desired Wheel Height	15 feet

The chart shows that 6900 pounds is the maximum gross weight for hovering under the specified conditions. This result is obtained by the following procedure:

1. Enter the chart at 4500 feet pressure altitude and move horizontally to the right to intersect the 35°C OAT curve.

2. Move down vertically until the base line of the wheel height correction curve is intersected. Follow the trend of the correction curve until it intersects the horizontal line representing the 15 foot wheel height.
3. Move down vertically until the base line of the wind correction curve is intersected. Follow the trend of the correction curve until it intersects the horizontal line representing the 10 knot wind velocity line.
4. Move down vertically to the gross weight scale and read 6900 pounds.

POWER REQUIRED TO HOVER CHART.

This chart (figure A–6) is used to determine power required for hovering at desired wheel height and desired rotor rpm. Power required is shown in terms of torquemeter pressure, and can be determined if the gross weight, wind velocity, pressure altitude and OAT are known.

Note

The chart may give torquemeter pressure values which are higher than actual indicated torque if operating at high wind and high wheel height combinations. For example, when out of ground effect, the chart torque will be about 1 psi higher than actual torque for every 10 knots of wind.

Example:

The following example describes the use of figure A–6. Assume the following conditions:

Gross Weight .... 7476 pounds
Wind Velocity .... 10 knots
Density Altitude .... 5200 feet
Desired Wheel Height .... 3 feet
Desired rpm .... 260 rpm

The chart shows that power required with the above conditions is 27.2 psi. This figure is obtained using the following procedure:

1. Enter the chart at 7476 pounds. Follow the trend of the wind velocity correction curve until the vertical line representing 10 knots wind velocity is intersected.
2. Move horizontally until the 3 foot wheel height curve is intersected.
3. Move down vertically until the base line of the rotor rpm plot is intersected. For any rpm other than 260, follow the trend of the correction curve until the horizontal line representing the proper rpm is intersected. In this example, rpm is 260, and the rotor rpm plot base line represents 260 rpm, so no correction for rpm is necessary.
4. Move down vertically until the base line of the density altitude plot is intersected. Follow the trend of the curve until it intersects the horizontal line representing 5200 feet density altitude.
5. Move down vertically to the torquemeter pressure scale and read 27.2 psi.

POWER DETERIORATION CHECK.

This chart (figure A–7) enables the pilot to plot an initial test engine power curve for a new or overhauled engine. At periodic intervals thereafter, test points reflecting current engine power may be plotted and compared with the initial test curve. In this way power deterioration may be detected to provide a basis for referral of the engine to maintenance.

When a new or overhauled engine is installed in the helicopter, proceed as follows (refer to sample chart, figure A–7, sheet 2):

1. Fly the helicopter at 260 rotor rpm, within a speed range of 30 to 60 knots IAS, level or climbing as necessary, at gas producer speeds of 84%, 87%, 90%, 93% and maximum obtainable, and at each gas producer speed, recording torque pressure, OAT, and pressure altitude, as in the following example:

	Point No. 1	*Point No. 2*	*Point No. 3*	*Point No. 4*	*Point No. 5*
N_1	84%	87%	90%	93%	95.7%
TORQUE-PSI	18.2	22.7	27.5	31.4	35.0
OAT	21°C	21°C	20°C	18°C	16°C
PRESSURE ALTITUDE-FT	1500	1500	2000	3000	4000

Note

Gas producer speeds of 84%, 87%, 90%, 93%, and maximum obtainable were selected to provide a sufficient spread to obtain a good curve. If actual gas producer speeds vary slightly from these values, no harm is done, if the exact gas producer speed obtained is accurately plotted.

2. Plot point number three as follows:
    a. Enter chart at 90% gas producer speed and move vertically up to intersect the 20°C OAT line.
    b. Move horizontally right across the chart. Let this be line "A".
    c. Enter the torquemeter pressure plot at 27.5 psi and move vertically up to intersect the 20°C OAT line.
    d. Move horizontally right to intersect the 2000 foot pressure altitude line, and drop vertically down to intersect line "A". This is point number three.
3. Plot the remaining four points in the same manner.
4. Connect the five points with a suitable curve. This is the "initial test curve".
5. Refer to the adjusted torque tabulation at the lower right corner of the chart. From a point on the initial test curve at 20 psi, move horizontally to the left and mark a point at 18.6 psi. From 30 psi on the initial test curve move horizontally to the left and mark a point at 27.9 psi. Proceed in this manner through the rest of the values shown in the adjusted torque tabulation.
6. Connect the newly plotted "reject points" with a suitable curve. This should result in a curve similar to the "initial test curve", and to the left of it. This is the "reject curve".
7. The "reject curve" provides a basis for determining whether engine performance in the future is acceptable or not. At periodic intervals or at any time that significant deterioration is suspected, test points may be plotted. If they fall to the right of the "reject curve", the engine performance is acceptable. If the points fall to the left of the "reject curve", the engine should be referred to maintenance.

Note

These sample curves merely indicate how the chart should be used, and should not be used for any other purpose. Use figure A–7, sheet 1 for plotting actual curves for your engine.

CAUTION

Use extreme care in obtaining and plotting all test points. Errors in the original curve will render the chart useless. Errors in later test points may result in premature maintenance or flying with an engine that should be rejected.

MINIMUM HEIGHT FOR SAFE LANDING AFTER ENGINE FAILURE.

Figure A–8 indicates the altitudes and airspeeds from which a safe landing after an engine failure is difficult to perform at various density altitudes and two gross weights. This area is red. Continuous operation in this area is to be avoided. The green 'OPERATE' areas of figure A–8 indicate the height and airspeed combinations for a safe landing after an engine failure for various density altitudes provided all the limitations of Section V are followed. The yellow 'CAUTION' areas of figure A–8 represent the recommended height and airspeed combinations for takeoff and landing. The data is shown for gross weights of 6,500 and 8,000 pounds. A direct interpolation may be used to determine the airspeed and altitude combination for a safe landing at other gross weights.

The safe area in figure A–8 is presented for density altitudes from sea level to 10,000 feet. The areas on figure A–8 which are shown as white with red bands are either AVOID CONTINUOUS OPERATION or OPERATE, depending on density altitude.

Example: At 6,500 pounds and 4,000 feet density altitude, the minimum wheel height for a safe landing after an engine failure is 275 feet at an indicated airspeed of 15 knots, and 100 feet at an indicated airspeed of 40 knots.

The data shown in figure A–8 is based on the autorotational entry technique described in Section III and a rotor rpm of 260 prior to engine failure. A time delay of two seconds was used after engine failure before the collective pitch was lowered at a moderate rate. Immediate application of aft cyclic is required. Touchdown speeds of 10 to 20 knots true airspeed should be anticipated.

WARNING

Do not enter into any intentional autorotations in any altitude-airspeed combination within the red areas of figure A–8.

WARNING

The minimum heights for safe landing shown figure A–8 will increase if the autorotational entry technique described in Section III is not followed.

Note

Above 5,000 feet density altitude, avoid operation below 30 knots indicated airspeed.

TAKEOFF GROUND RUN CHART.

This chart (figure A–9) shows the minimum takeoff ground run distance for various takeoff speeds, at headwinds up to 30 knots, and 260 rotor rpm.

Ground run distance is not significantly affected by gross weight or power available. Ground run distance is significantly affected by takeoff speed since the time that the aircraft remains on the ground is directly proportional to the takeoff airspeed. The takeoff speeds shown on this chart are at least 3 knots below the climbout airspeed.

Example:

The following example describes the use of figure A–9.

Headwind	10 knots
Chosen climbout airspeed	25 knots

This chart shows that the takeoff ground run with the above conditions will be 130 feet. This is obtained using the following procedure:

1. The climbout airspeed is 3 knots above the takeoff airspeed. For this example, the climbout airspeed is 25 knots. Therefore, takeoff airspeed will be 25 minus 3, or 22 knots.
2. Enter the chart at the takeoff speed of 22 knots. Move vertically until the line representing 10 knots is intersected.
3. Move left to the ground run distance scale and read 130 feet.

TAKEOFF DISTANCE TO CLEAR 50 FOOT OBSTACLE CHARTS.

These charts (figures A–10, A–11, A–12, and A–13) show the total distance necessary to clear an obstacle 50 feet high for various gross weights, altitudes, temperatures, headwinds, climbout speeds, and takeoff techniques.

Figure A–10 is for a takeoff with marginal excess power without the fire suppression kit, starting from a hover at a wheel height of three feet.

Figure A–11 is for a takeoff with marginal excess power with the fire suppression kit, starting from a hover at a wheel height of fifteen feet.

Figure A–12 is for a takeoff starting with a ground run.

Figure A–13 is for a maximum performance takeoff from a restricted area.

The takeoff techniques are described in Section II. Adherence to these techniques will produce the performance contained in these charts. The takeoff performance in figures A–10, A–11, A–12, and A–13 is based on the use of 260 rotor rpm.

Example:

The following example describes the use of figure A–10. Assume the following conditions:

Gross Weight	7476 pounds
OAT	40°C
Pressure Altitude	2000 feet
Headwind	10 knots
Takeoff Technique	Marginal excess power takeoff without FSK
Desired Climbout Speed	30 knots

This chart shows that the total distance required to clear a 50 foot obstacle with the above conditions is 610 feet. This is obtained using the following procedure:

1. The density altitude must be determined first. Refer to figure A–2. For a pressure altitude of 2000 feet and an OAT of 40°C, the density altitude is 5200 feet.
2. Enter the chart at 7476 pounds gross weight and move horiontally to the right until it intersects the 5200 foot density altitude line.
3. Move up vertically to intersect the 40°C line.
4. Move horizontally to the right to the reflector line.
5. Move down vertically until the next base line is intersected. Follow the trend of the correction curve until the horizontal line representing 30 knots climbout airspeed is intersected.
6. Move down vertically to the next base line. Follow the trend of the correction curve until the horizontal line representing 10 knots headwind is intersected.
7. Move down vertically to the distance to clear 50 foot obstacle scale and read 610 feet.

Note

Figures A–10, A–11, and A–12 are used in exactly the same way. The OAT plots are not applicable when power available is greater than 37.5 psi. If this is the case, determine maximum hovering wheel height by either a check flight, or from the power required to hover chart (figure A–6). Then use wheel height lines instead of OAT lines.

MAXIMUM POWER CLIMB.

The climb chart (figure A–14) is used to determine time, distance, fuel used, and vertical velocity for the helicopter to climb from one altitude to another altitude at maximum power. The climb speed at which to achieve the performance shown on the charts varies with gross weight, and is shown (in parenthesis) on each gross weight line at the upper left portion of the chart. An altitude for maximum range plot shows the altitude at which the helicopter will achieve maximum range at a given gross weight.

The following example illustrates the use of figure A–14.

Example:

Find the time to climb, distance, fuel used, and vertical velocity with the following conditions:

Surface pressure altitude	2000 feet
Surface OAT	20°C
Intended cruising pressure altitude	10,000 feet
OAT at intended cruising altitude	4°C
Gross weight	7553 pounds

The chart shows that at 50 knots IAS time to climb will be 8.5 minutes, distance covered during the climb will be 6.9 nautical miles, fuel used during the climb will be 85 pounds, and vertical velocity will vary from 1140 FPM at the surface to 690 FPM just before leveling off at 10,000 feet. This result is obtained using the following procedure:

1. Enter the OAT scale at the surface OAT of 20°C and move horizontally to the right to intersect the 2000 foot pressure altitude line (surface pressure altitude); or the right edge line of the plot, whichever comes first.
2. Move up vertically to intersect the 7553 pound gross weight line. Read best IAS for climb of 50 knots.
3. Move horizontally to the right and read a surface vertical velocity of 1140 FPM.
4. Continue to move to the right to intersect the 2000 foot pressure altitude line (surface pressure altitude). Move down vertically to intersect the time to climb, fuel used, and distance scales.
5. Start back at the beginning once again, this time entering the OAT scale at the OAT for the intended cruising altitude, in this case 4°C. Move horizontally to the right to intersect the 10,000 foot pressure altitude line (intended cruising pressure altitude).
6. Move up vertically to intersect the 7553 pound gross weight line.
7. Move horizontally to the right and read a vertical velocity, just before level-off, of 690 FPM.
8. Continue to move to the right to intersect the 10,000 foot pressure altitude line (intended cruising pressure altitude). Move down vertically to intersect the time to climb, fuel used, and distance scales.
9. On the time to climb scale the first line intersected the scale at 2 minutes. The second line intersected the scale at 10.5 minutes. Subtract 2 from 10.5 for a time to climb of 8.5 minutes.
10. On the fuel used scale, the first line intersected the scale at 20 pounds. The second line intersected the scale at 105 pounds. Subtract 20 from 105 for a fuel quantity of 85 pounds used during the climb.

Note

Figure A–14 does not include the fuel used for warmup and takeoff, which is 22 pounds. This amount must be added to the climb fuel used to determine the total fuel required to reach cruise altitude.

11. On the distance scale the first line intersected the scale at 1.3 nautical miles. The second line intersected the scale at 8.2 nautical miles. Subtract 1.3 from 8.2 for a distance covered during the climb of 6.9 nautical miles.

RANGE CHARTS.

Two charts (figures A–15 and A–16) are provided to show unit range, fuel flow, airspeed and torque information as a function of gross weight and altitude. Unit range may be used to determine range that can be flown with a given quantity of fuel, or conversely, to determine the fuel needed to fly a given distance.

Note

The shaded areas of figures A–15 and A–16 are a reminder of the gross weight – altitude caution area shown in figure 5–3. The shaded area does not impose any limitation on IAS shown in figures A–15 and A–16.

Best Range Chart (figure A–15) presents information for maximum range attainable at 260 rotor rpm. Small improvements in range are possible under certain low altitude and low gross weight conditions as shown below.

Gross Weight	*Density Altitude*	*Best Cruise RPM*	*Increase in Unit Range N. Mi / 100 lbs*
7000 lbs and lower	Below 5000 feet	240	0.6
	5000 to 10,000 feet	250	0.3
	Above 10,000	260	0
8000 lbs	SL	240	0.6
	3000 feet	250	0.3
	6000 feet and up	260	0
9000 lbs	SL and up	260	0

Range at maximum continuous airspeed chart (figure A–16) shows information for cruise at maximum continuous airspeed.

Example:

Since both chart are read in a similar manner, only one example will be provided to illustrate the use of the charts. The following applies to figure A–15. Assume the following:

Gross weight .... 6481 pounds
Pressure altitude .... 10,000 feet
OAT .... 4°C

This chart shows that range will be 19.8 nautical miles per 100 pounds of fuel, and fuel flow will be 460 pounds per hour. In order to accomplish this, IAS will be 79.0 knots, TAS will be 91.0 knots, and torque will be approximately 24.7 psi.

This result is obtained by the following procedure:

1. Enter chart at the bottom, at a gross weight of 6481 pounds.
2. Move vertically to intersect the 10,000 foot pressure altitude line. Let this be point "A". From point "A" move horizontally to the left and read range of 19.8 nautical miles per 100 pounds of fuel.
3. From point "A" move horizontally to the right to intersect the 10,000 pressure altitude line of the fuel flow plot. Drop down and read fuel flow of 460 pounds per hour.

4. Determine density altitude from figure A–2. At a pressure altitude of 10,000 feet and OAT of 4°C, density altitude is 11,000 feet.
5. From point "A" move vertically up to intersect the 11,000 foot density altitude line. Let this be point "B". From point "B" move horizontally to the left to read IAS of 79.0 knots.
6. From point "B" move horizontally right to intersect the 11,000 foot density altitude line of the TAS plot. Drop down and read TAS of 91.0 knots.
7. From point "B" move vertically up to intersect the 11,000 foot density altitude line. Move horizontally left and read approximate torque of 24.7 psi.

ENDURANCE.

The endurance chart (figure A–17) presents endurance, fuel flow, airspeed, and torque information as a function of gross weight, pressure altitude, OAT, and fuel load.

Lowering of fuel flow and corresponding improvement of endurance time is possible by lowering rotor rpm as shown below:

Gross Weight	*Density Altitude*	*Best Cruise RPM*	*Endurance↑ Fuel Flow↓*
Below 7500 lbs	Below 5000 feet	240	8%
	5000 to 10,000 feet	250	4%
	Above 10,000 feet	260	0
7500 lbs to 8500 lbs	SL to 5000 feet	250	4%
	Above 5000 feet	260	0
Above 8500 lbs	All Altitudes	260	0

Note

The shaded area of figure A–17 is a reminder of the gross weight – altitude caution area shown in figure 5–3. The shaded area does not impose any limitation on IAS shown in figure A–17.

Example:

The following example illustrates the use of figure A–17. Assume the following conditions:

Gross weight .... 6,000 pounds
Pressure altitude .... 8,000 feet
OAT .... 27°C
Fuel aboard .... 800 pounds

This chart shows that fuel flow will be 352 pounds per hour and endurance will be 2.3 hours. In order to accomplish this, IAS will be 42 knots, TAS will be 52.5 knots, and torque will be approximately 15.5 psi.

This result is obtained by the following procedure:

1. Enter chart at the bottom, at a gross weight of 6000 pounds.
2. Move vertically to intersect the 8,000 foot pressure altitude line. Let this be point "A". From point "A" move horizontally to the left and read fuel flow of 352 pounds per hour.
3. From point "A" move horizontally to the right to intersect the 800 pound fuel load line. Drop down and read endurance of 2.3 hours.

Note

The dashed fuel load lines are applicable only when auxiliary fuel tanks have been installed.

4. Determine density altitude from figure A–2. At a pressure altitude of 8,000 feet and OAT of 27°C, density altitude is 11,000 feet.
5. From point "A" move vertically up to intersect the 11,000 foot density altitude line. Let this be point "B". From point "B" move horizontally to the left to read IAS of 42 knots.
6. From point "B" move horizontally right to intersect the 11,000 foot density altitude line of the TAS plot. Drop down and read TAS of 52 knots.
7. From point "B" move vertically up to intersect the 11,000 foot density altitude line. Move horizontally left and read approximate torque of 15.5 psi.

INSTRUCTIONS FOR COMPLETING TAKEOFF AND LANDING DATA CARD

The Takeoff and Landing Data Card should be completed by the pilot prior to takeoff and landing. It is accomplished as follows: (refer to MISSION PLANNING for sample cards).

1. Fill in the spaces covering atmospheric conditions as applicable.
2. Write in the basic weight as carried in the aircraft records (T.O. 1-1B-40), the actual oil and equipment weight, and the crew weight. Add these three items to obtain the operating weight.
3. Fill in the actual fuel weight and payload weight. Add these to the operating weight obtained above to determine the gross weight.
4. Enter the desired wheel height and rotor rpm.
5. Enter the maximum gross weight for hovering at the desired wheel height, and 260 rpm. This is obtained from the maximum gross weight for hovering chart (figure A–5).
6. Enter the maximum power available as obtained from the power available chart (figure A–3). Do not list values greater than maximum allowable torque.
7. Enter the power required to hover as obtained from the power required to hover chart (figure A–6).
8. Determine the power reserve by subtracting power required to hover from power available.

Maximum Power Available

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: T.O. 1H-43(H)B-2, SECT. III

ENGINE: T53-L-1B
FUEL GRADE: JP-4

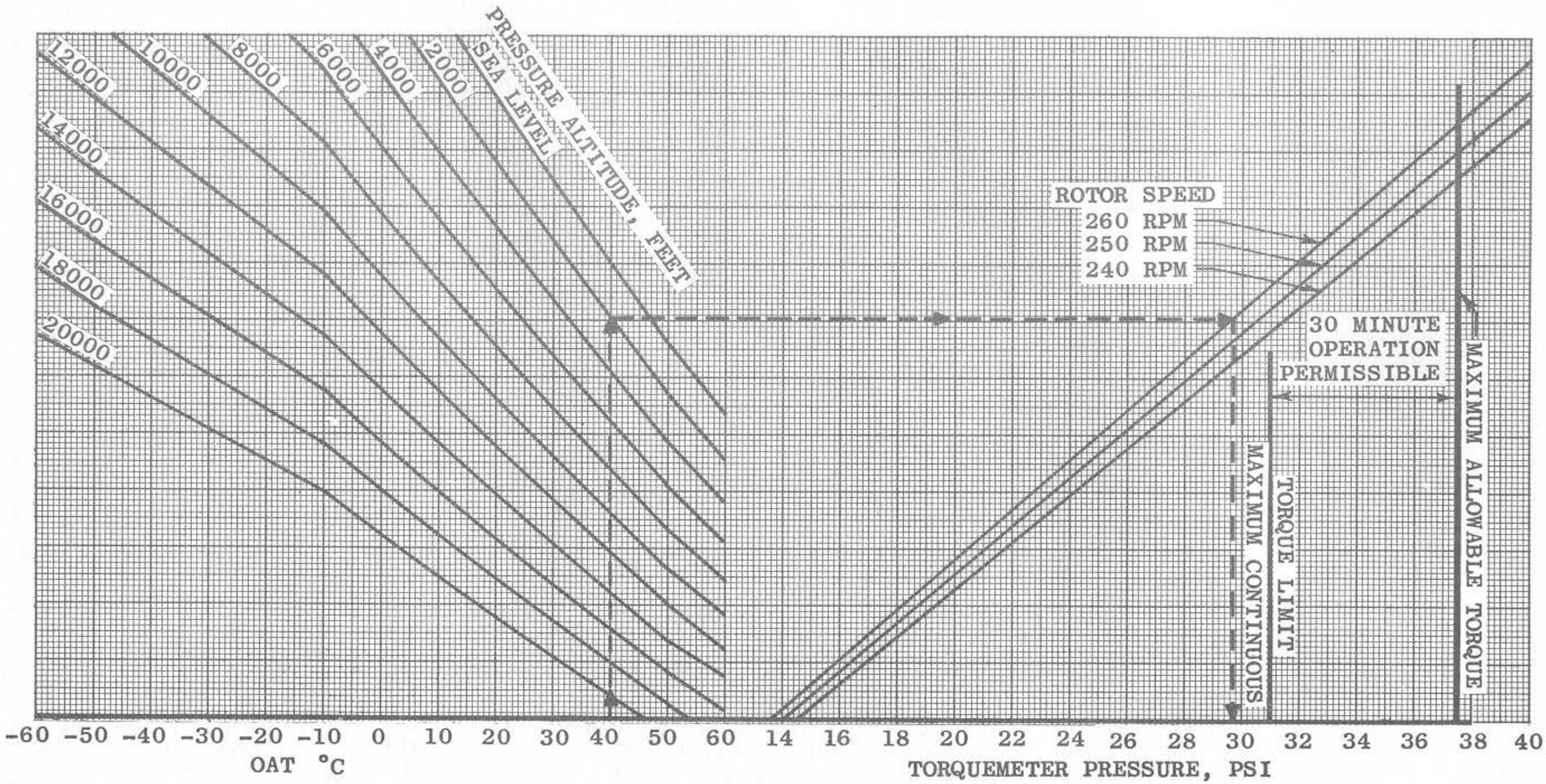


Figure A—3

Fuel Flow

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: ENGINE MODEL SPECIFICATION

ENGINE: T53-L-1B
FUEL GRADE: JP-4

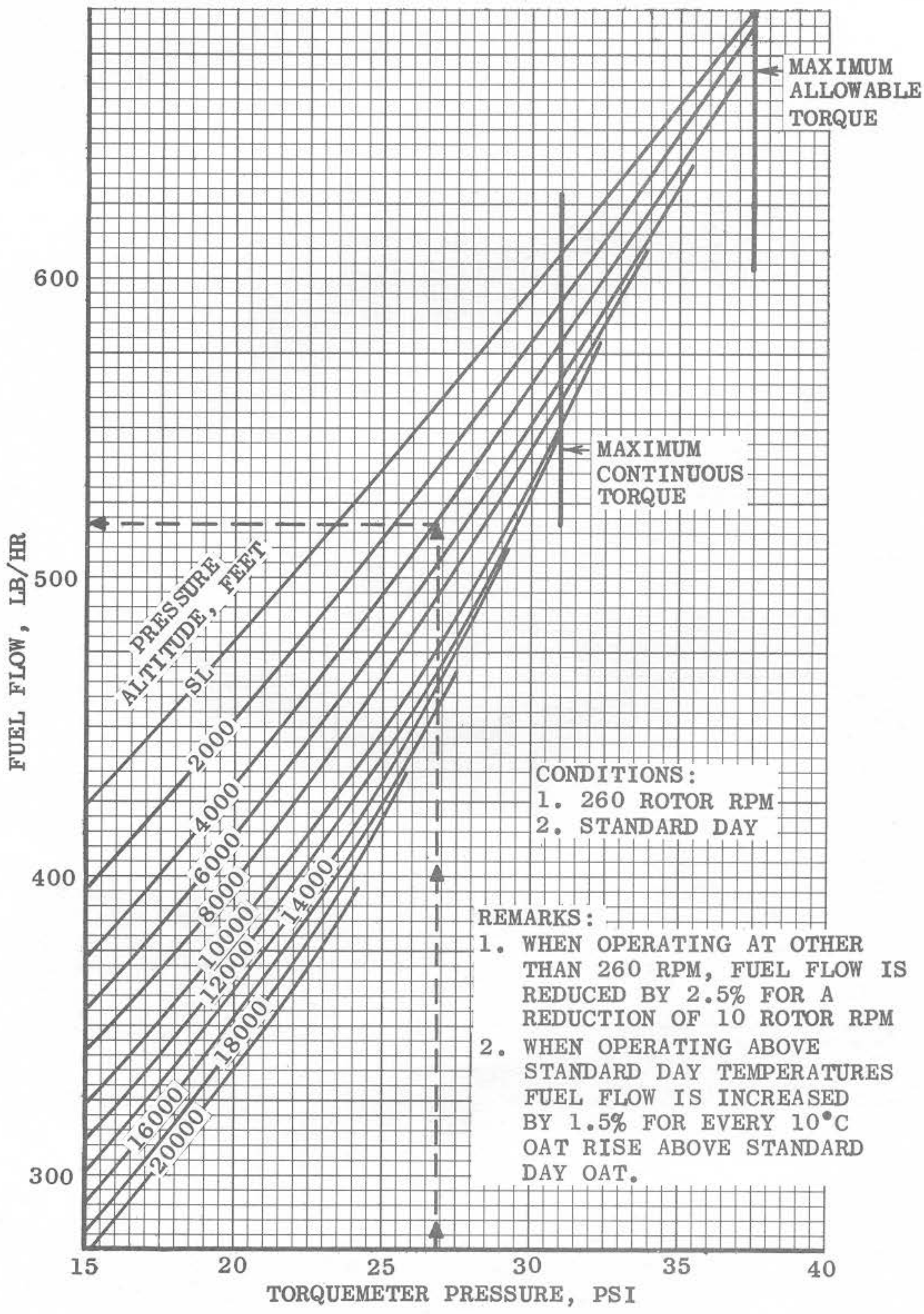


Figure A—4

Maximum Gross Weight for Hovering

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

CONDITIONS
1. 260 ROTOR RPM (FOR LOWER RPM SEE TEXT)
2. MAXIMUM ALLOWABLE TORQUE OR MAXIMUM POWER AVAILABLE

NOTE:
1. THE HEADWIND CORRECTION IS BASED ON HOVERING IN GROUND EFFECT. FOR OUT OF GROUND EFFECT HOVERING THE BENEFIT OF WIND WILL BE GREATER THAN SHOWN. FOR EVERY 10 KNOTS OF HEADWIND ADD AN ADDITIONAL 200 POUNDS WHEN OGE.

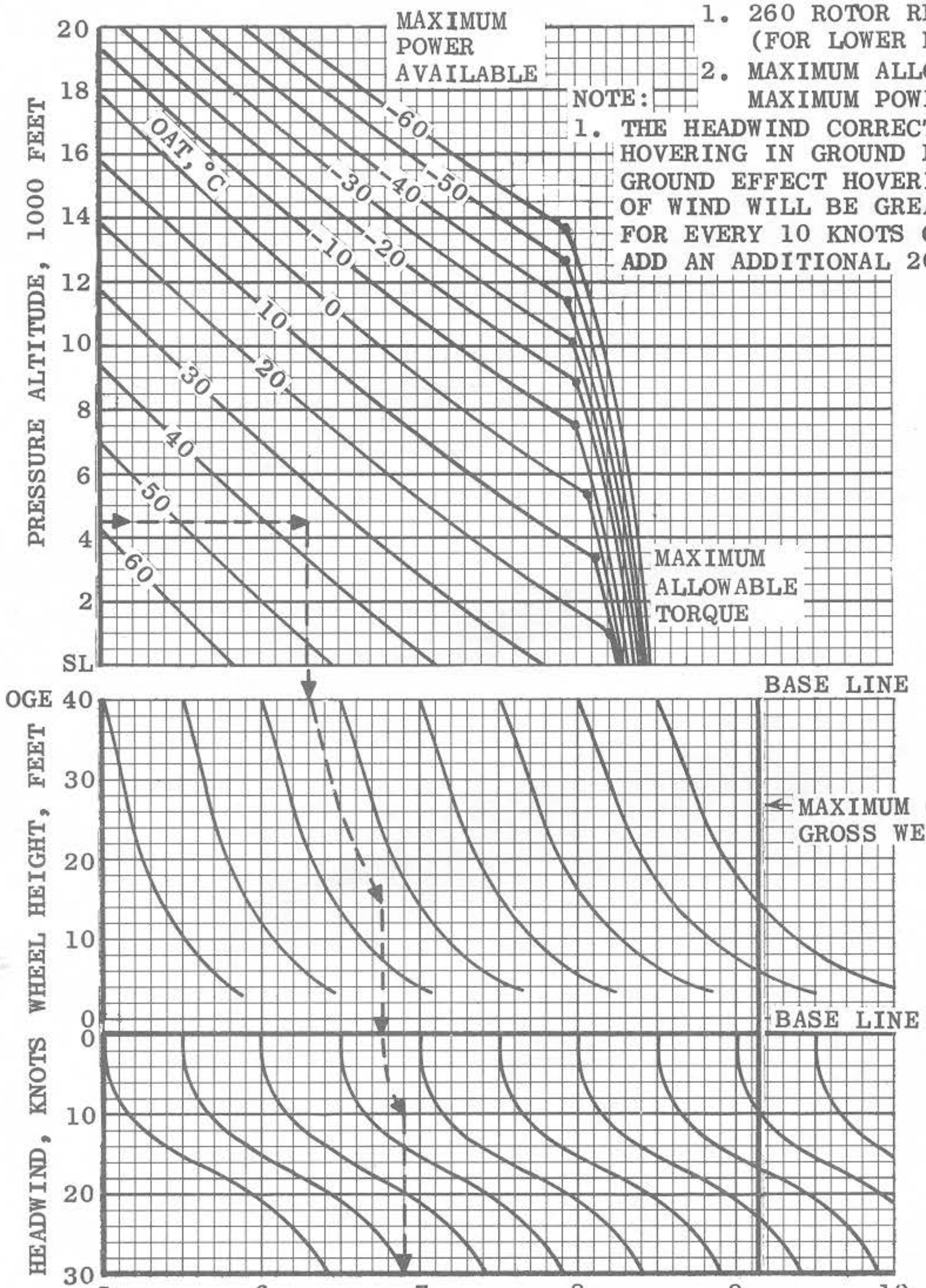


Figure A–5

Power Required To Hover

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

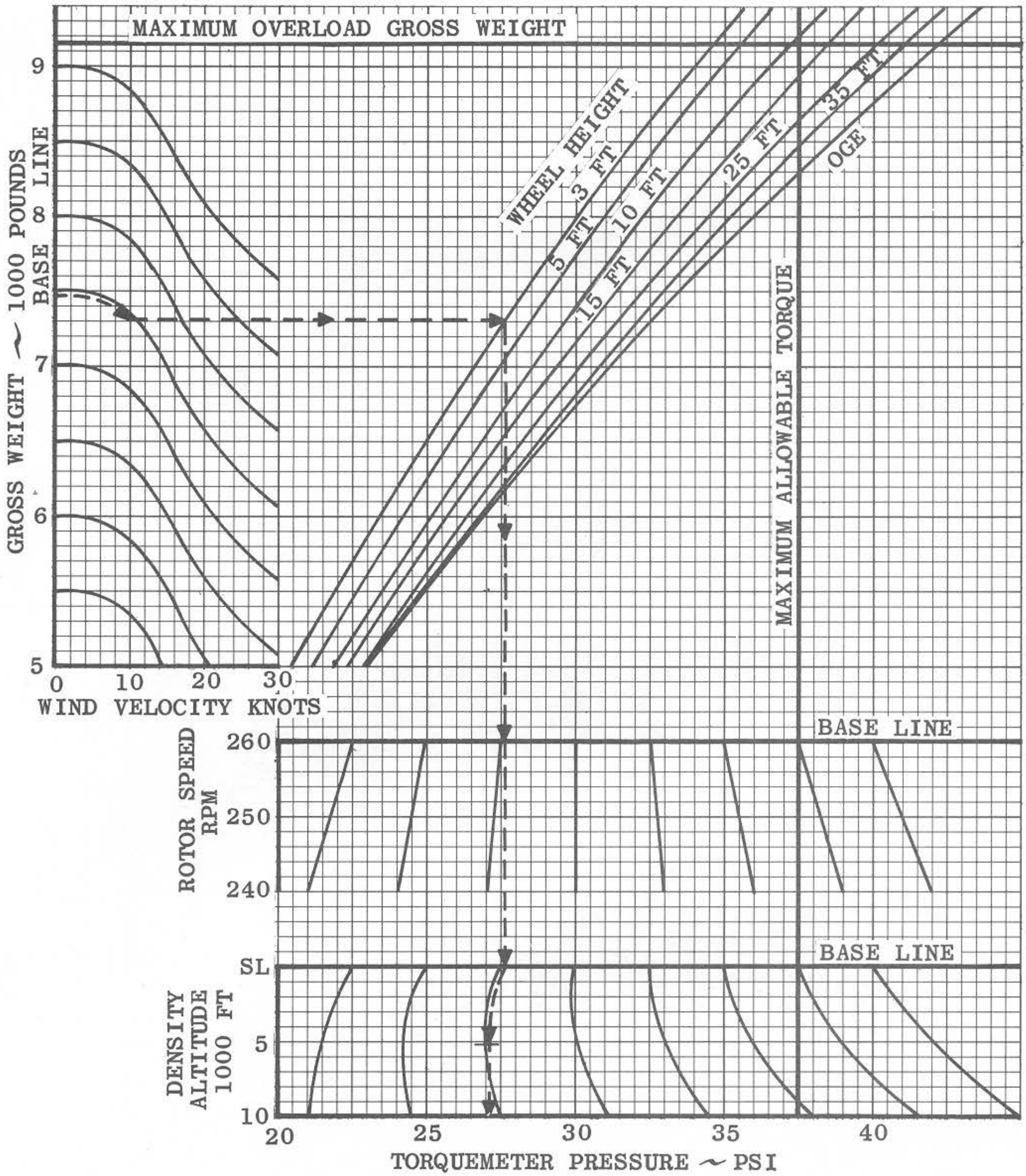
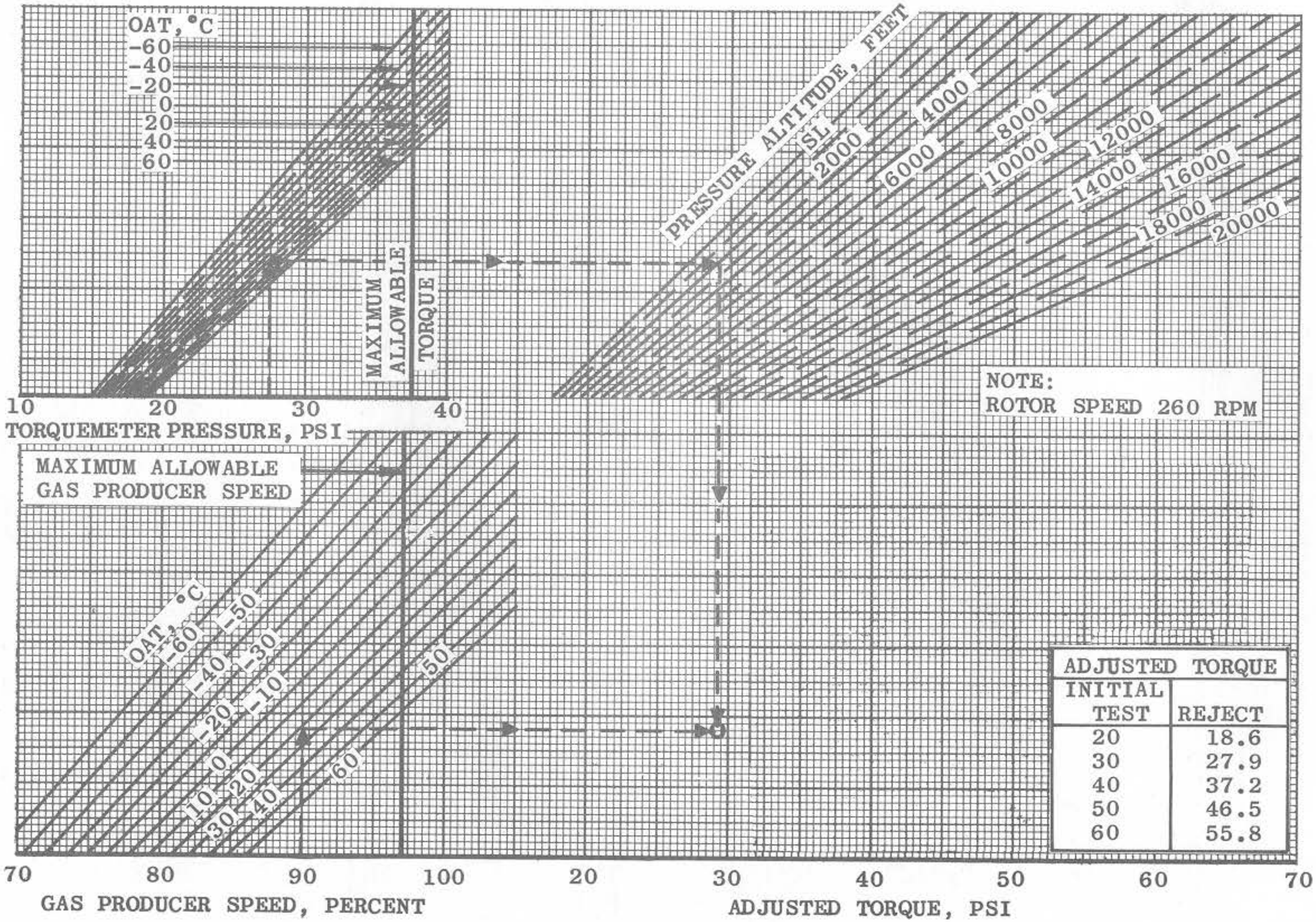


Figure A–6

Power Deterioration Check

MODEL: HH-43B
DATE: 1 FEBRUARY 1966

ENGINE: T53-L-1B
FUEL GRADE: JP-4



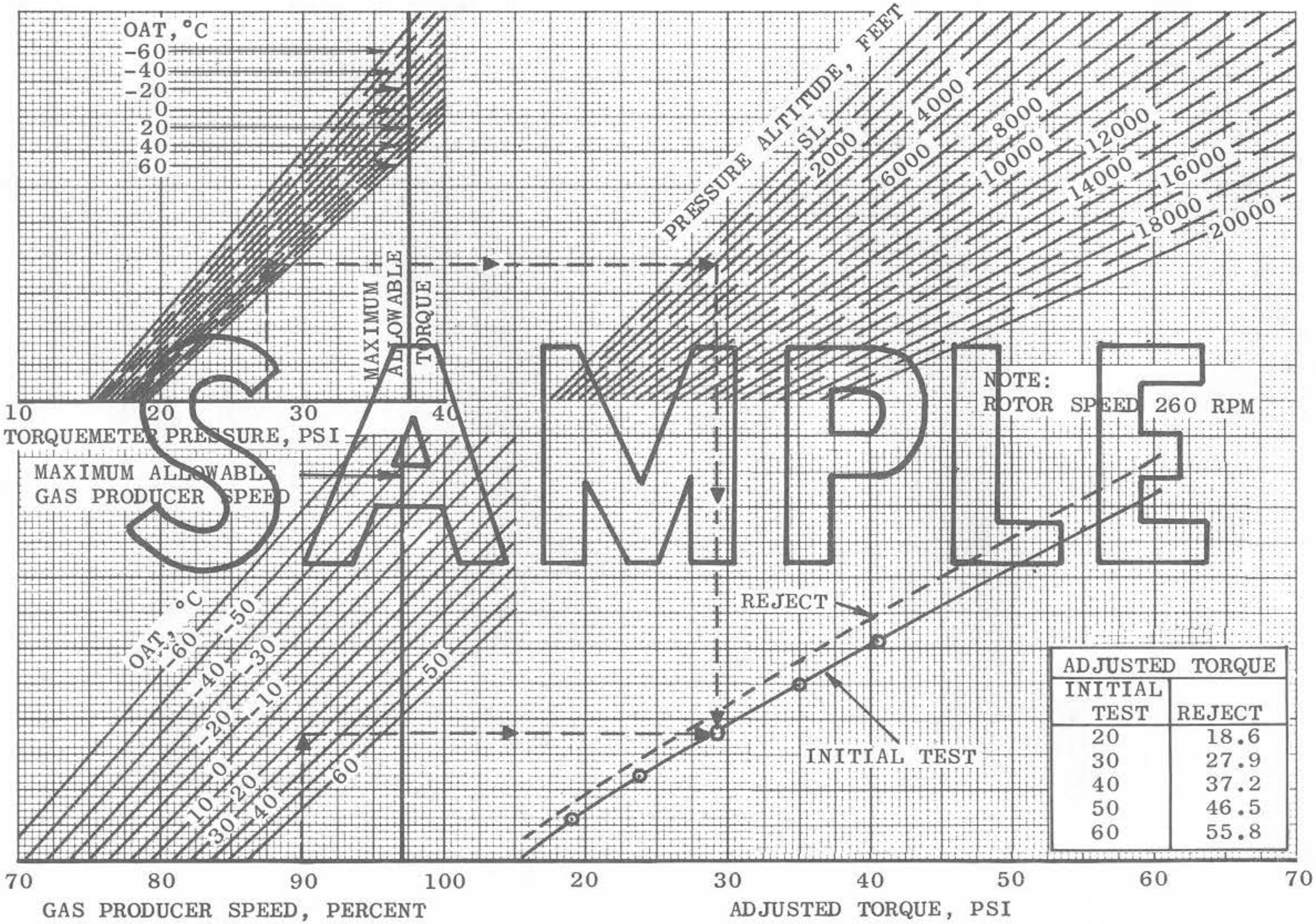
ADJUSTED TORQUE	
INITIAL TEST	REJECT
20	18.6
30	27.9
40	37.2
50	46.5
60	55.8

Figure A–7 (Sheet 1)

Power Deterioration Check

MODEL: HH-43B
DATE: 1 FEBRUARY 1966

ENGINE: T53-L-1B
FUEL GRADE: JP-4



ADJUSTED TORQUE	
INITIAL TEST	REJECT
20	18.6
30	27.9
40	37.2
50	46.5
60	55.8

Figure A–7 (Sheet 2)

Minimum Height for Safe Landing After Engine Failure

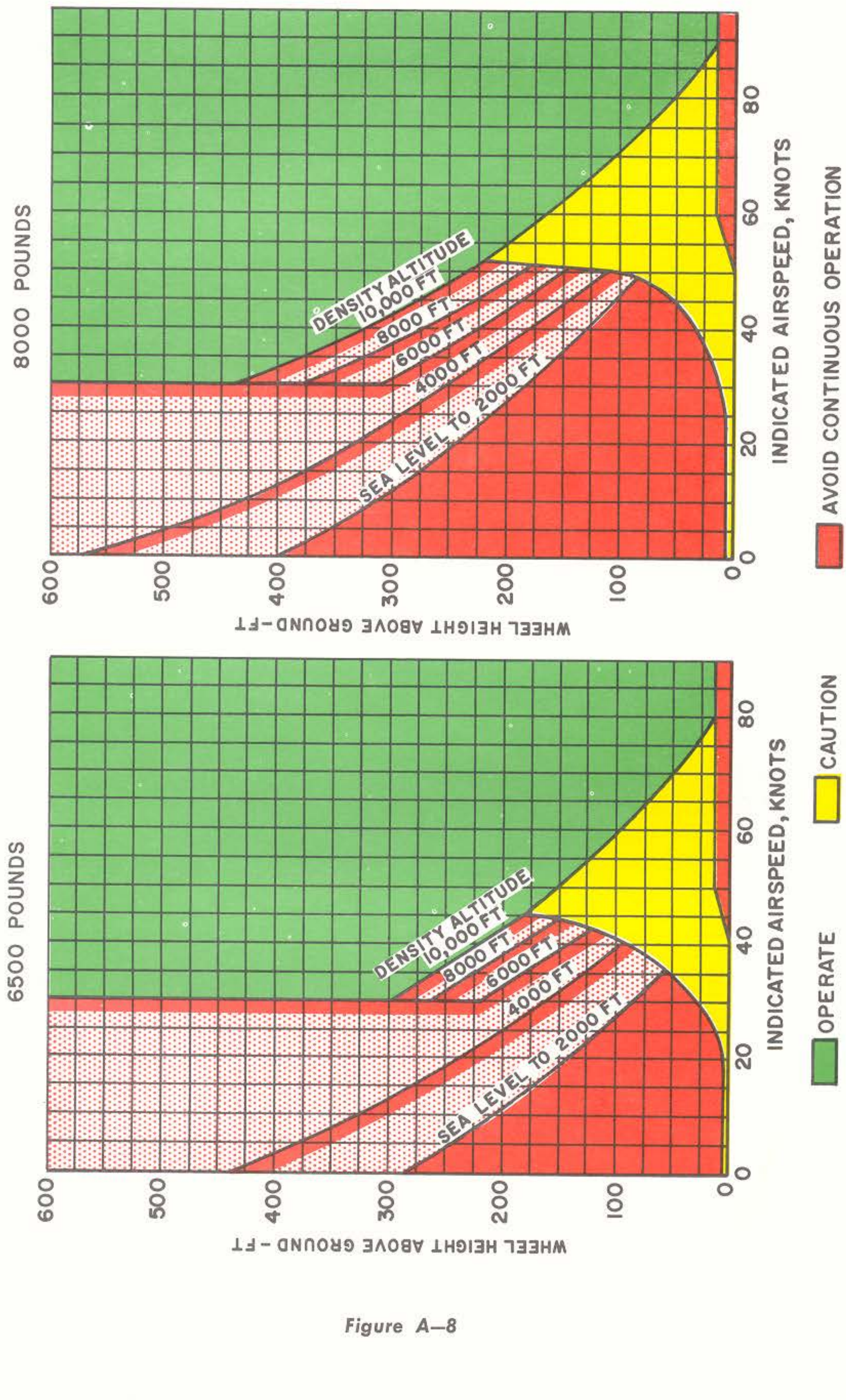


Figure A–8

Takeoff Ground Run

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

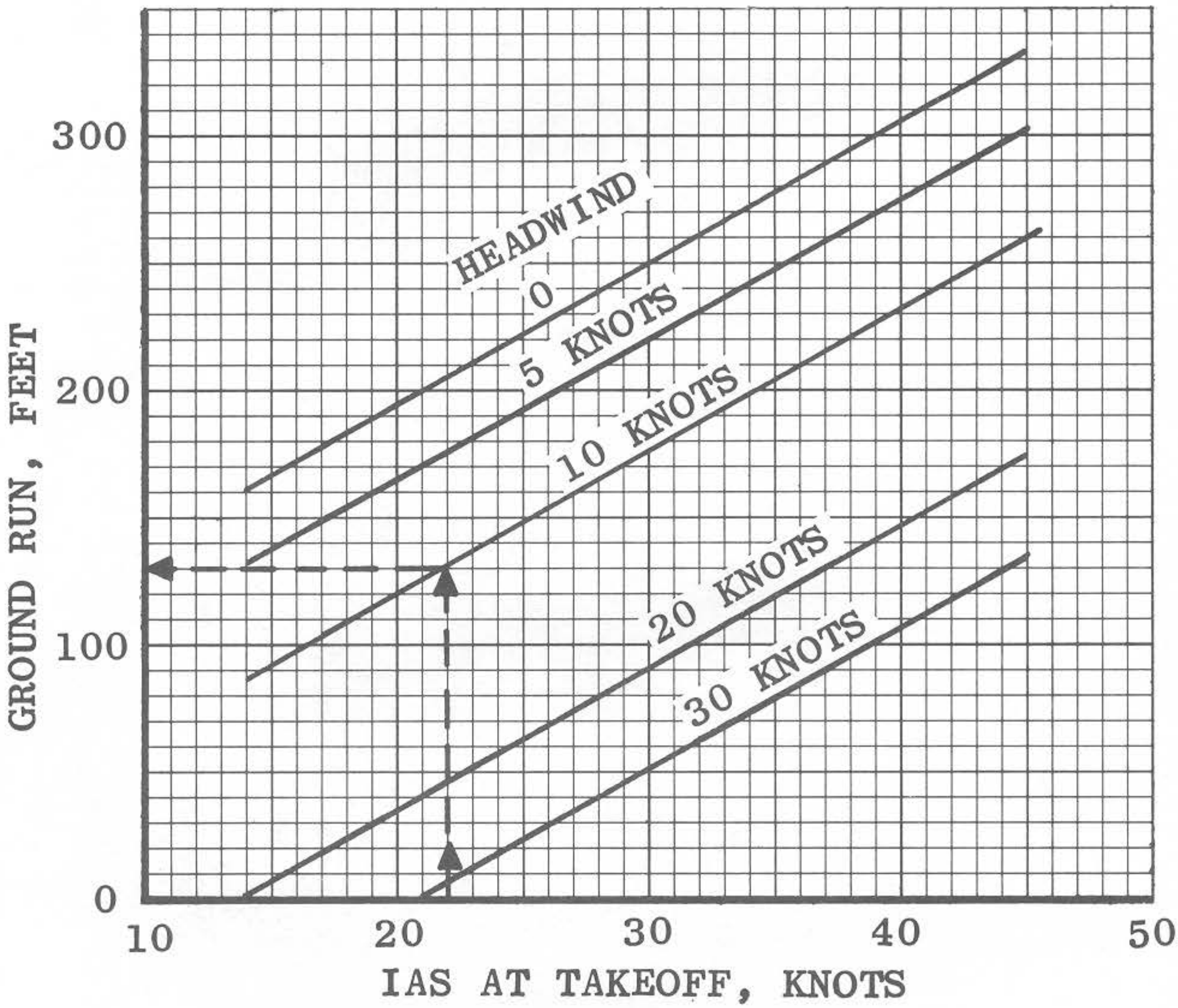


Figure A–9

Takeoff Distance To Clear A 50 Foot Obstacle

MARGINAL EXCESS POWER TAKEOFF WITHOUT FSK

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

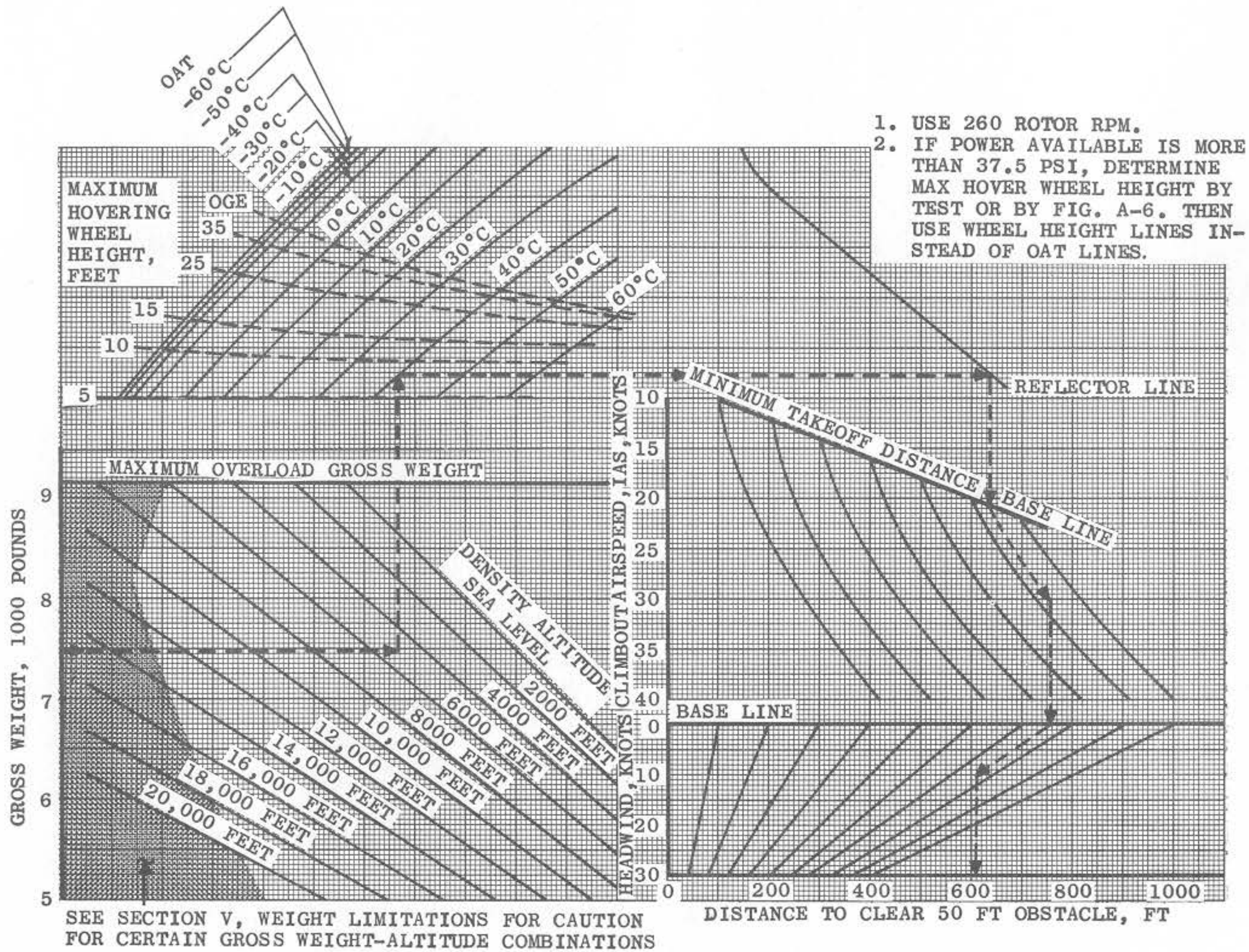


Figure A–10

Takeoff Distance To Clear A 50 Foot Obstacle

MARGINAL EXCESS POWER TAKEOFF WITH FSK

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

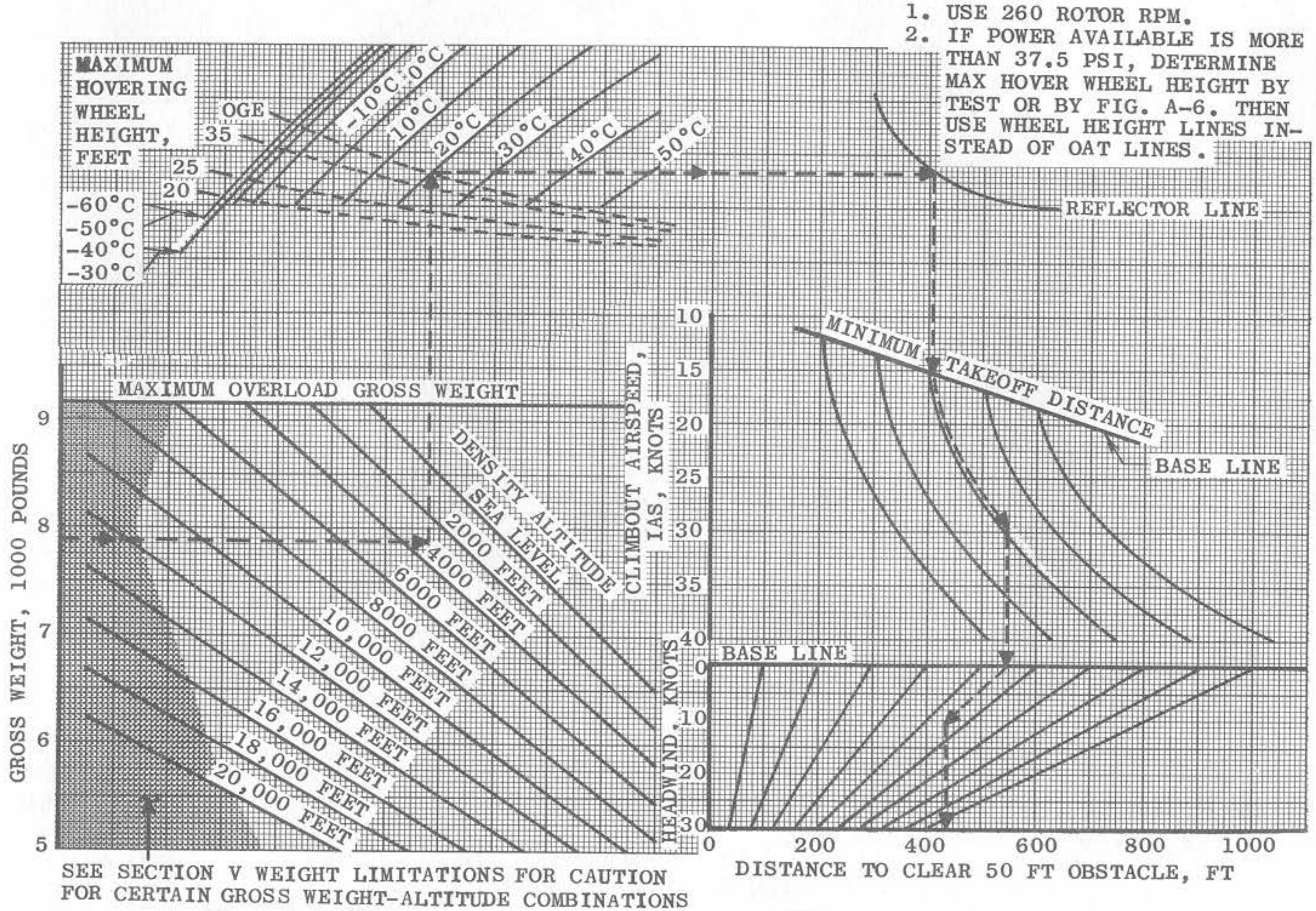


Figure A–11

Takeoff Distance To Clear A 50 Foot Obstacle

RUNNING TAKEOFF

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

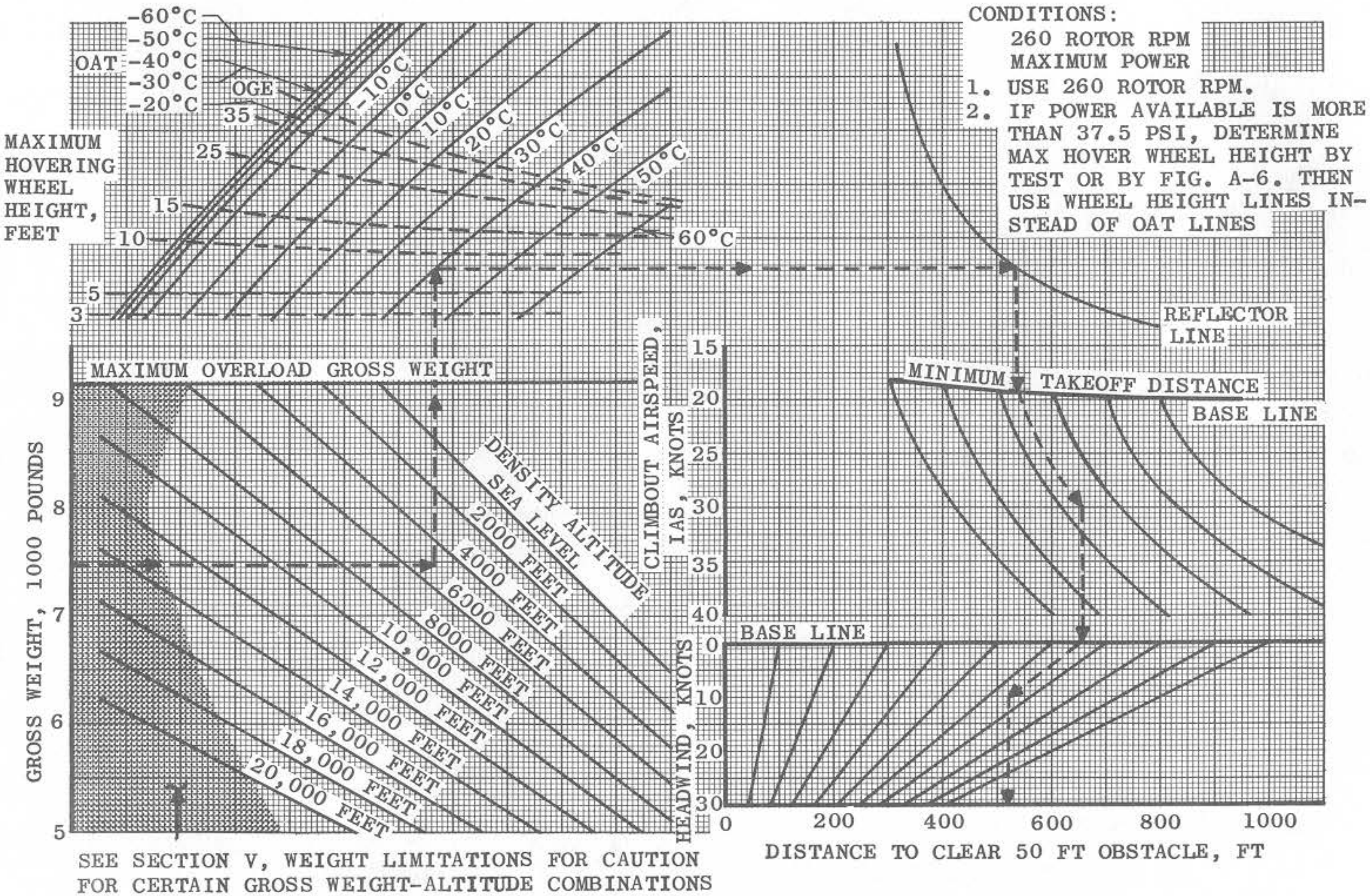


Figure A–12

Takeoff Distance To Clear A 50 Foot Obstacle

MAXIMUM PERFORMANCE TAKEOFF FROM A RESTRICTED AREA

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

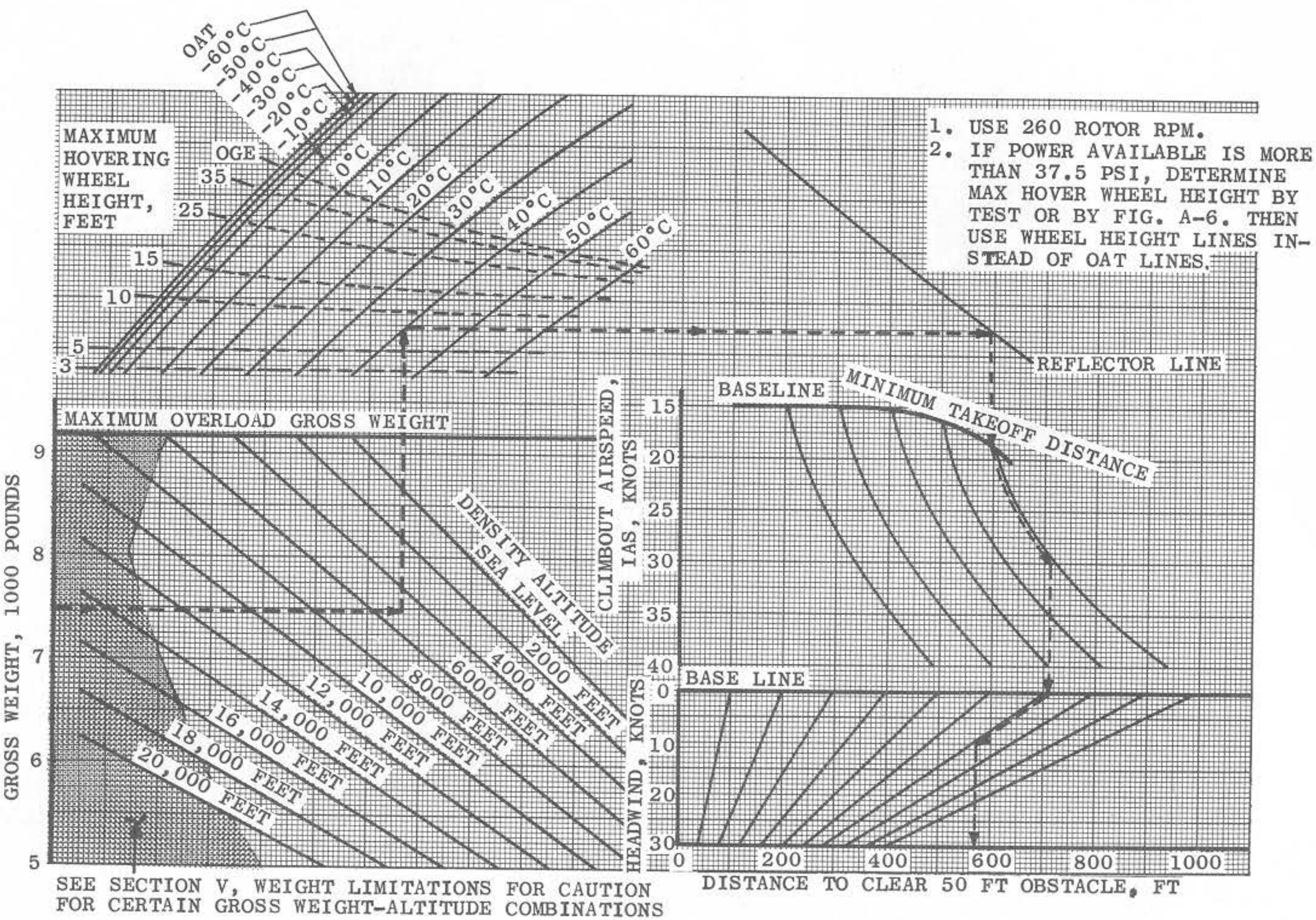


Figure A–13

Maximum Power Climb

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

CONDITIONS:
1. 260 ROTOR RPM
2. MAXIMUM ALLOWABLE TORQUE OR MAXIMUM POWER AVAILABLE

NOTES:
1. WHEN OPERATING WITH THE FIRE SUPPRESSION KIT ATTACHED, RATE OF CLIMB IS REDUCED BY 60 FPM
2. THE FUEL USED DOES NOT INCLUDE ANY ALLOWANCES FOR WARMUP AND TAKEOFF

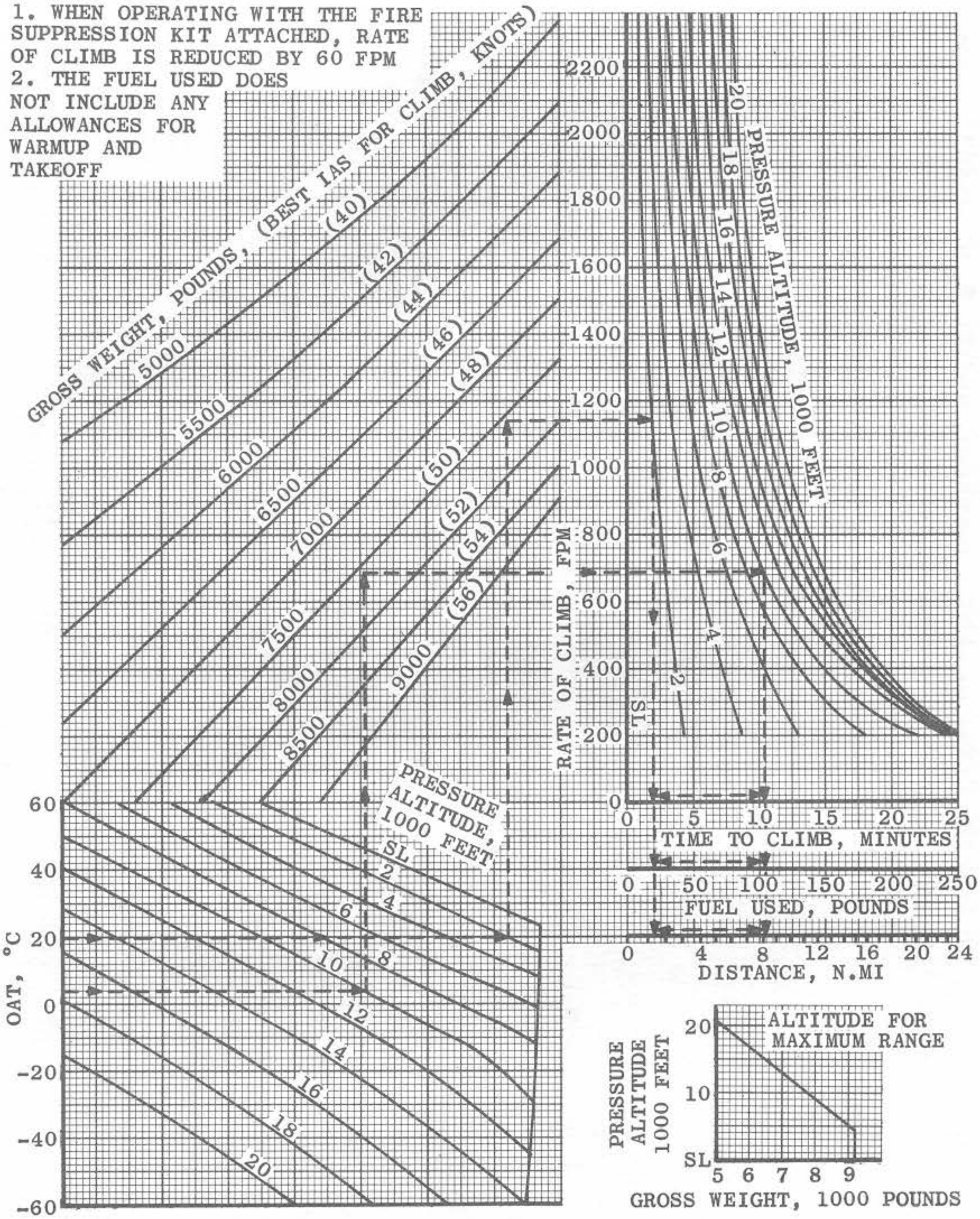


Figure A–14

Best Range

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

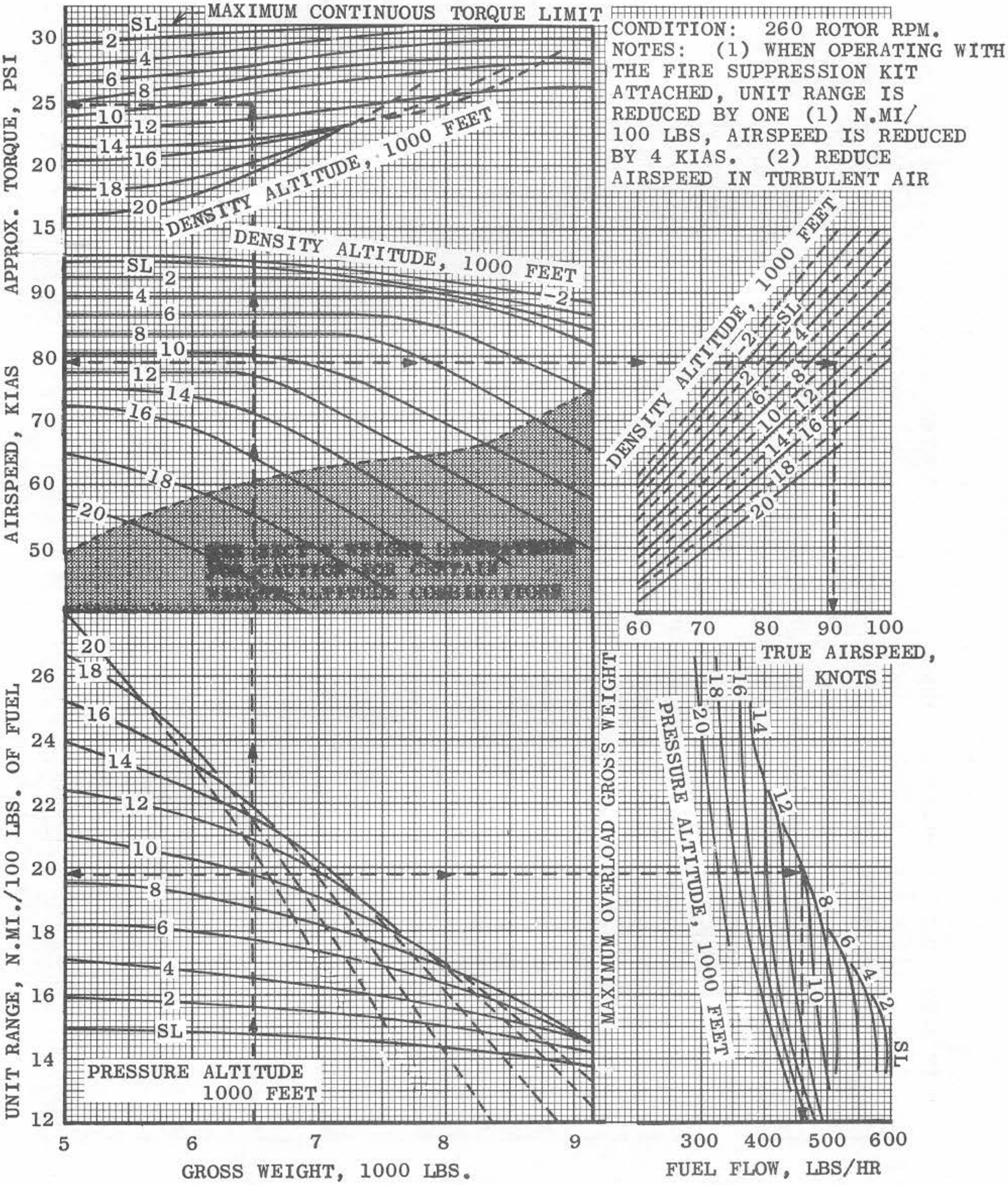


Figure A—15

Range at Maximum Continuous Airspeed

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

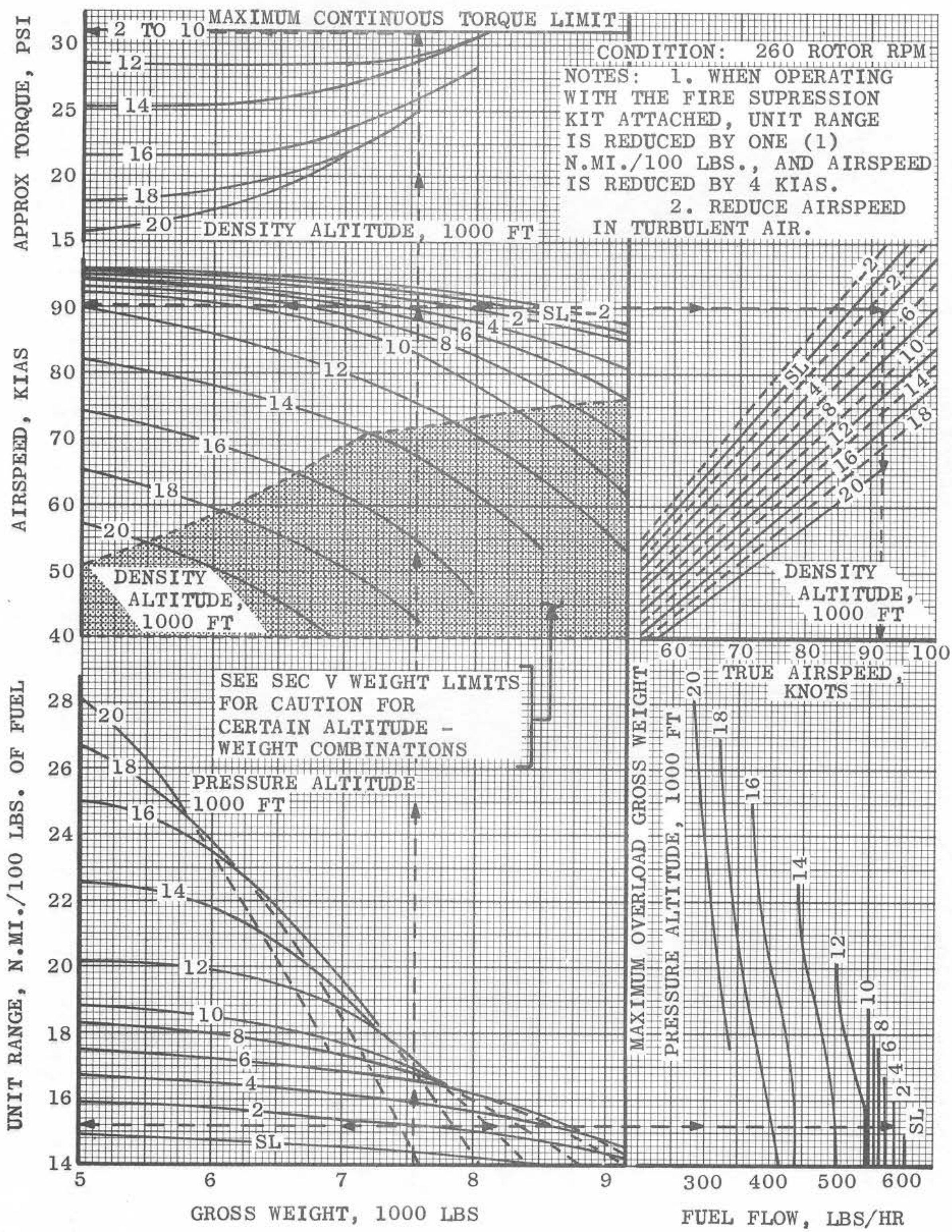


Figure A–16

Endurance

MODEL: HH-43B
DATE: 1 FEBRUARY 1966
DATA BASIS: AFFTC FLIGHT TEST

ENGINE: T53-L-1B
FUEL GRADE: JP-4

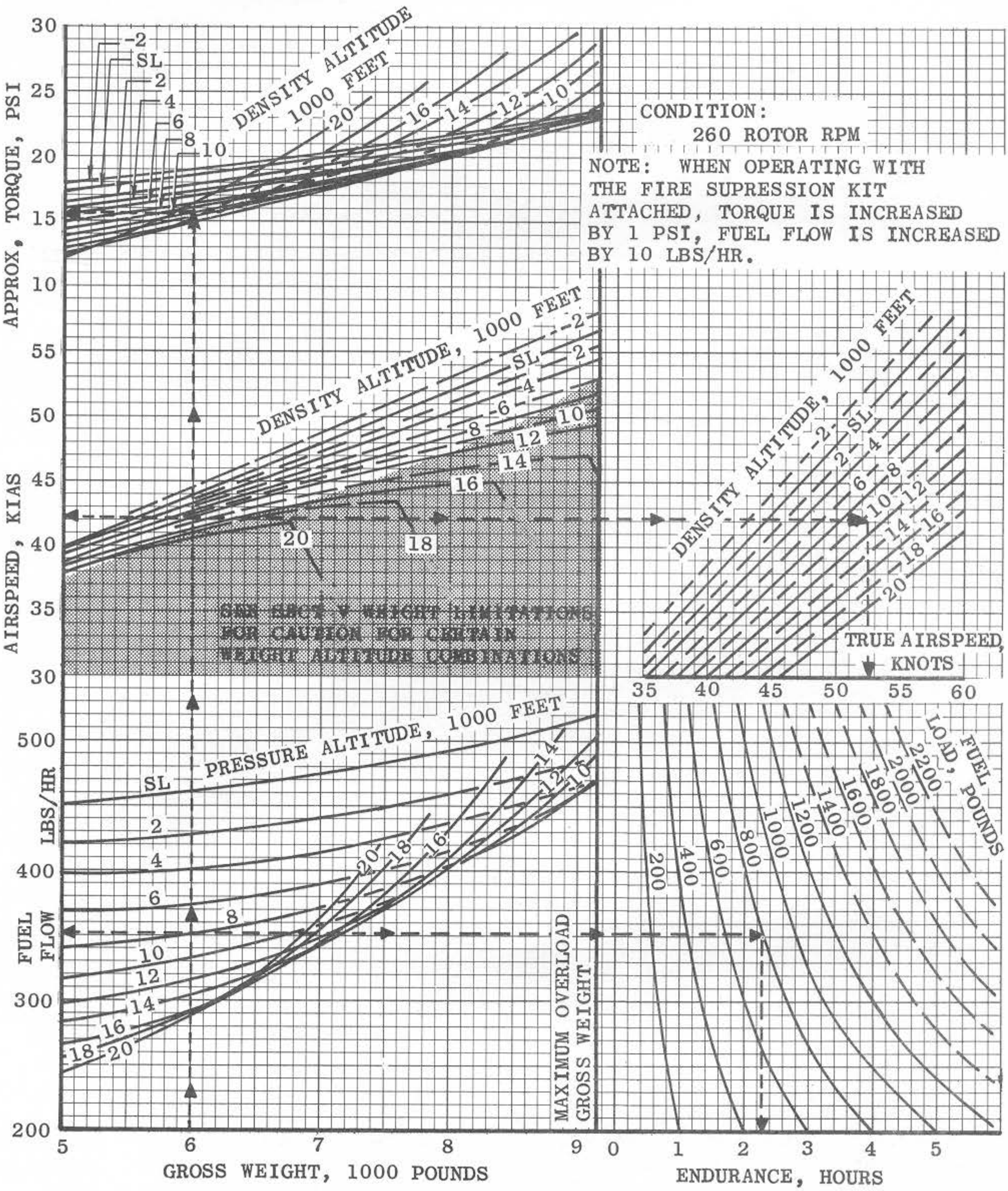


Figure A—17

MISSION PLANNING

This section contains four typical mission plans, illustrating the use of the charts to obtain maximum performance for predetermined conditions.

Note

The following problems are merely exercises in the use of the charts. They are not intended to reflect actual or proposed missions employing this aircraft.

TAKEOFF WITH MARGINAL EXCESS POWER.

This example deals only with the planning of a takeoff with a high OAT.

It is assumed that an aircraft with internal cargo of 1080 pounds is to take off from a site at which the pressure altitude is 2000 feet, OAT is 40°C and wind is 10 knots. The TOLD card should be filled out in accordance with INSTRUCTIONS FOR COMPLETING TAKE-OFF AND LANDING DATA CARD. The following illustrates this procedure (see figure A–18).

List the pressure altitude, OAT and wind at the takeoff site. Read density altitude from figure A–2 and enter on card.

List the weight data. For the sample problem the assumed values result in a gross weight of 7476 pounds.

A check of figure A–5 for these takeoff conditions shows that the maximum gross weight for hovering out of ground effect is 6950 pounds. This is less than the actual gross weight. Therefore, a marginal excess power takeoff may have to be performed.

For marginal excess power takeoffs the lowest possible practicable takeoff wheel height should be chosen so as to have the highest possible excess power. Here a three foot wheel height is chosen. For rotor speed, 260 rpm is chosen because it permits the shortest takeoff distances, improved handling characteristics, and affords the greatest safety in the event of flameout. Enter the chosen wheel height and rotor speed on the TOLD card, and also the MAXIMUM GROSS WEIGHT FOR HOVER, POWER AVAILABLE and POWER REQUIRED, as read from figures A–5 and A–6, respectively. Note that the sample calculations printed on figures A–3 and A–6 coincide with this mission.

Subtract power required to hover from power available to obtain power reserve, or excess power. The resulting value of 2.5 psi indicates that a marginal excess power takeoff as described in Section II be performed. If the power reserve is less than 2 psi, a running takeoff should be used.

This completes the filling out of the TOLD card. If there are no high obstacles along the takeoff path, this is all that is necessary for takeoff planning. The takeoff is performed at best climb speed, as described in Section II, and shown on figure A–15.

For this example it is assumed, however, that there is a 50-foot obstacle about 600 feet from the takeoff site. Figure A–10, TAKEOFF DISTANCE TO CLEAR 50 FT OBSTACLE, for MARGINAL EXCESS POWER TAKEOFF WITHOUT FIRE SUPPRESSION KIT, is used to determine ability to clear this obstacle. A 30 knot climbout airspeed is chosen here, due to the decreased reliability of the airspeed indicator at lower airspeeds. If possible, climbout airspeeds should always be chosen so as not to require flight through the AVOID area of the MINIMUM HEIGHT FOR SAFE LANDING AFTER ENGINE FAILURE chart.

Figure A–10 shows for the assumed conditions a 610-foot distance to clear the 50-foot obstacle. This is greater than the actual distance available, and therefore the charts for the other two possible techniques (figures A–12 and A–13) must be considered. For this set of conditions the results are:

MARGINAL EXCESS POWER TAKEOFF WITHOUT FSK	610 feet	Figure A–10
RUNNING TAKEOFF	520 feet	Figure A–12
MAXIMUM PERFORMANCE TAKEOFF FROM RESTRICTED AREA	570 feet	Figure A–13

The above shows that for the conditions assumed, a running takeoff permits the shortest takeoff distance over a 50-foot obstacle, and could be used here if terrain permits. The length of the corresponding ground run distance may be obtained from Figure A–9. In this example, the takeoff speed of 15 knots is selected, for which the ground run with a 10 knot headwind is 90 feet.

If the terrain is not suitable for a ground run, another way of shortening the takeoff distance is to reduce the climbout speed. It should be noted, however, that at lower airspeeds the AVOID area of the MINIMUM HEIGHT FOR SAFE LANDING AFTER ENGINE FAILURE chart will be penetrated more deeply. Also, the airspeed indicator becomes less reliable, and pilot judgment becomes more critical. If, during takeoff, climbout is attempted inadvertently at speeds too low, the resulting distance will most likely be very much higher than the minimum.

The minimum possible takeoff distance is obtained at the climbout airspeed read opposite the base line where the vertical line from the reflector first intersects it. The following values illustrate the minimum climbout airspeeds for the conditions of the sample mission:

MARGINAL EXCESS POWER TAKEOFF WITHOUT FSK	505 feet at 21 knots IAS
RUNNING TAKEOFF	425 feet at 19 knots IAS
MAXIMUM PERFORMANCE TAKEOFF FROM RESTRICTED AREA	470 feet at 19 knots IAS

The comparison again shows that the running takeoff allows the shortest distance over an obstacle. It is useful to note that the climbout airspeed for the RUNNING TAKEOFF is 4 knots higher than the previously estimated takeoff speed. Approximately four knots is gained while the aircraft is "rotated" into climb attitude.

In general, when the three takeoff techniques are compared at a given climbout airspeed, the running takeoff will allow shortest distances to clear obstacles if the power reserve is less than 5 psi. RUNNING TAKEOFF here will result in about 50-foot shorter distances over a 50-foot obstacle than the maximum performance takeoff. If the power reserve is higher than 5 psi then the MAXIMUM PERFORMANCE TAKEOFF from restricted area will give the shortest possible distance. The technique for MARGINAL EXCESS POWER TAKEOFF, however, results in only about 40 to 80 foot longer ground distances over an obstacle than the technique for MAXIMUM PERFORMANCE TAKEOFF FROM RESTRICTED AREA.

MAXIMUM RANGE MISSION.

Assume that an aircraft with an auxiliary fuel tank installed must be ferried, over level terrain, a distance of 340 nautical miles, without refueling, and that because of unpredictable headwinds, it is desired to obtain maximum range, and land with 10% of initial fuel in reserve. Gross weight and takeoff atmospheric conditions are given on the sample TOLD card (figure A–19).

Note

> In the sample TOLD card, the maximum gross weight for hover includes the 200 pound correction per note on figure A–5. Similarly the power required to hover was reduced by 1 psi as discussed in the text for figure A–6.
>
> Power reserve for hovering OGE shows that sufficient power is available for any type of takeoff. Therefore, takeoff will not be of any further concern in this mission plan.

In choosing a flight profile, many factors must be considered, such as ceiling, availability of oxygen, nature of the terrain, presence of ground fire, etc. In this plan the following four flight profiles are considered and compared:

(a) Cruising at a selected low altitude above the terrain, at 260 rotor rpm. In this case the selected low altitude will be 1000 feet above the terrain.

(b) Same as (a), but at a lower rpm, consistent with gross weight and altitude, in this case 240 rpm.

(c) Cruising at constant pressure altitude consistent with the altitude for maximum range plot (figure A–14), for the initial gross weight. In this case the pressure altitude will be 10,000 feet.

(d) Cruising at stepping altitudes, increasing altitude as gross weight decreases, to approximate the curve on the altitude for maximum range plot in figure A–14.

Profiles (a) (b) and (c) are simple in that the helicopter climbs straight out and cruises at a constant altitude.

The climbing required for profile (d) from 10,000 to 18,000 feet, may be done gradually at close to cruising speed, which produces maximum range, or in steps, which produces nearly maximum range. The altitude for maximum range shown in figure A–14 need only be held within 1600 feet for the desired results. Whether the steps are made on the basis of time intervals or fuel used intervals is a matter of pilot preference. The result in range will be the same as long as the maximum range altitude for the gross weight, at all times, is held within 1600 feet. The fuel flow plot of figure A–15 will be helpful in determining changes in gross weight enroute.

No fuel quantity for descent is included in the profiles because it is assumed that the pilot will commence letdown while enroute, at an appropriate distance from the destination, in which case fuel for descent is included in cruise fuel. However, if for any reason, flight at cruise altitude is continued until over the destination, descent fuel may be calculated at the rate of 5 pounds for each 1000 feet, descending at partial power, at a comfortable rate of descent.

The mission may now be tabulated, as in figure A–20. Data listed on the example TOLD card is not repeated in figure A–20.

The values in the tabulation are obtained directly from the charts, except that the climb fuel for profile (d), between 10,000 and 18,000 feet, has been estimated. The reason for this is that the climb from 10,000 to 18,000 feet is made in steps, at varying gross weights, and it would make the problem unduly cumbersome to calculate the fuel for each of the steps, although this may be done if desired. In this problem, sufficiently accurate results are obtained using the rule of thumb of 10 pounds of fuel per 1000 feet climbed above 10,000 feet. When added to the quantity already determined for the climb up to 10,000 feet, a value of 165 pounds results. Similarly, distance covered during the climb from 10,000 to 18,000 feet was estimated on the basis of 1 nautical mile for every 1000 feet climbed.

The range in all cases was determined from figure A–15 for the average gross weight. Average gross weight for (d) was determined by subtracting from the takeoff gross weight the warmup and takeoff fuel, 1/2 of cruise fuel, climb fuel to 10,000 feet, and 1/2 the fuel used during the stepping climb above 10,000 feet. Corresponding maximum unit range was read from figure A–15.

In less marginal situations, the profile may be based on quicker, more roughly obtained data, but any such shortcuts should be made in a safe, or conservative direction. For example, for smaller fuel loads, a rough and quick range estimate may be obtained by entering figure A–15 with the takeoff gross weight instead of the average gross weight.

The results of the tabulation indicate immediately that profiles (a) and (b) are unsatisfactory for the required mission. When wind is taken into consideration, the logical choice between (c) and (d) will become more apparent, or in case of strong headwinds, perhaps the mission will have to be scrubbed.

Sample TOLD Card, Marginal Excess Power Takeoff

T.O. 1H-43(H)B-1CL-1

TAKEOFF AND LANDING DATA CARD

Data	*Takeoff*	*Landing*
PRESSURE ALTITUDE	2000	______FT
OAT	40	______C
DENSITY ALTITUDE	5200	______FT
WIND	10	______K
BASIC WEIGHT	4682	______LB
OIL, EQUIP., ETC.	27	______LB
CREW	400	______LB
OPERATING WEIGHT	5109	LB
FUEL	1287	______LB
PAYLOAD	1080	______LB
GROSS WEIGHT	7476	LB
DESIRED WHEEL HT	3	______FT
DESIRED ROTOR SPEED	260	______RPM
MAX GROSS WT FOR HOVER (FIG. A—5)	7900	______LB
POWER AVAILABLE (FIG. A—3)	29.7	______PSI
POWER REQUIRED TO HOVER (FIG. A—6)	27.2	______PSI
POWER RESERVE	2.5	______PSI

Figure A—18

Sample TOLD Card, Maximum Range Mission

T.O. 1H-43(H)B-1CL-1

TAKEOFF AND LANDING DATA CARD

Data	*Takeoff*	*Landing*	
PRESSURE ALTITUDE	2000	2000	FT
OAT	20	20	C
DENSITY ALTITUDE	3000	3000	FT
WIND	10	10	K
BASIC WEIGHT	4774	4774	LB
OIL, EQUIP., ETC.	87	87	LB
CREW	430	430	LB
OPERATING WEIGHT	5291	5291	LB
FUEL	2262	226	LB
PAYLOAD	0	0	LB
GROSS WEIGHT	7553	5517	LB
DESIRED WHEEL HT	OGE	OGE	FT
DESIRED ROTOR SPEED	260	260	RPM
MAX GROSS WT FOR HOVER (FIG. A—5)	8240	8240	LB
POWER AVAILABLE (FIG. A—3)	36	36	PSI
POWER REQUIRED TO HOVER (FIG. A—6)	32	23.5	PSI
POWER RESERVE	4.0	12.5	PSI

Figure A—19

Sample Flight Profiles, Range Mission

CONDITION		(a)	(b)	(c)	(d)
Rotor rpm		260	240	260	260
Cruise Pressure Altitude	(ft)	3000	3000	10000	10000 to 18000
OAT, Estimated	(°C)	18	18	4	4 to −12
Density Altitude	(ft)	4000	4000	11000	11000 to 19000
DETERMINE CRUISE FUEL					
Total Fuel at Takeoff		2262	2262	2262	2262
Fuel for Warmup & Takeoff		22	22	22	22
Fuel for Climb (Figure A—14)		27	27	85	165
Fuel Reserve (10% Assumed)		226	226	226	226
Fuel Not Available for Cruise		275	275	333	413
Cruise Fuel		1987	1987	1929	1849
AVERAGE GROSS WEIGHT DETERMINATION					
Takeoff Gross Weight		7553	7553	7553	7553
Warmup & Takeoff Fuel Allowance		−22	−22	−22	−22
Climb Fuel		−27	−27	−85	−125
1/2 Cruise Fuel		−994	−994	−965	−925
Average Gross Weight		6510	6510	6481	6481
Unit Range $\frac{\text{n.mi}}{\text{100 lb}}$ (Figure A—15)		16.1	16.1	19.8	21.8
Unit Range Corrected for 240 rpm, $\frac{\text{n.mi}}{\text{100 lb}}$			16.7		
Air Range, Cruising, n.mi		320	332	362	403
Distance Covered During Climb, n.mi (Figure A—14)		+0.5	+0.5	+7.0	+15.0
Total Air Range, n.mi		320.5	332.5	389.0	418.0

Figure A—20

Sample Data, Rescue Mission

Mission Segment	I Press. Alt (ft)	II OAT (°C)	III G.W. (lb)	IV Fuel	V Fig. No.	VI G.W. (lb)	VII Fuel
Warmup and Takeoff	2000	40	6611	22		6284	22
Climb			6589	85	A–14	6262	74
Cruise	10000	24	6504	220	A–15	6188	219
Descent							
Search	8000	27	6284	90	A–17	5969	88
Descent							
Hover (hoist rescuees)	4500	35	6594	50	A–6 & A–4	6281	50
Climb			6544	58	A–14	6231	52
Cruise	10000	24	6486	227	A–15	6179	226
Descent							
Land	2000	40		535			229

Figure A–21

Let us assume though, that favorable winds make profile (c) the logical choice. Once the mission profile has been chosen, airspeed and approximate torque should be determined for initial, midpoint, and final gross weight. The initial gross weight is the takeoff gross weight, less fuel for warmup, takeoff, and climb. For profile (c) this amounts to 7446 pounds. The midpoint gross weight is the average gross weight, or 6481, as previously determined. The final gross weight is the operating weight plus the payload and reserve fuel, or 5517 pounds. For these values, figure A–15 gives the following airspeeds and approximate torques:

	Initial	*Midpoint*	*Final*
Gross weight, pounds	7446	6481	5517
IAS, knots	72	79	79
Approximate torque, psi	26	24.7	23.7

If the airspeeds listed above are exceeded, the predicted range will be reduced. However, if airspeed is less than that listed, but not more than 15 knots, predicted range will remain unchanged.

RESCUE MISSION.

This example deals with a rescue mission which requires takeoff with less than full fuel in order to have hovering capability at the rescue site.

Assume that an aircraft is required to perform a rescue under high temperature and high altitude conditions at a site estimated to be 50 nautical miles from the base. The rescue site altitude and OAT are estimated at 4500 feet and 35°C. The rescue is to be performed while hovering out of ground effect and with no wind. The weight of two rescuees is estimated at 400 pounds, and estimated hover time to hoist them aboard is 5 minutes. It is necessary to cruise and search as high as possible to avoid ground fire. Cruise altitude is to be 10,000 feet. Search is to be conducted 3500 feet above terrain or at 8000 feet, and is estimated to take 15 minutes.

In determining the aircraft's ability to perform this mission, it is necessary to check that there is sufficient fuel for the required cruise and other contingencies, that the aircraft can take off at its initial gross weight and clear surrounding obstacles, and that hover be possible at the rescue site. The following sample illustrates one way of doing this:

First, divide the mission up into its logical segments, as shown in figure A–21.

Then, list the pressure altitudes for the various segments and obtain or estimate the OAT for each pressure altitude, as in columns I and II of figure A–21.

Next, assuming that the aircraft takes off with full internal fuel, the takeoff weight is determined as outlined on the TOLD card. For this mission, initial gross weight is calculated as follows:

Basic Weight	4682 pounds
Oil, equipment, etc.	27
Crew	+ 615
Operating Weight	5324
Fuel	1287
Payload	0
Gross Weight	6611

The fuel used for each segment is obtained from the performance charts listed in column V. For simplicity, fuel flow for each mission segment is determined at the gross weight at the beginning of the mission segment, rather than at the average gross weight. This introduces only a negligible conservatism if mission segments are short as they are in this example.

The 22 pound warmup and takeoff fuel allowance listed here is equivalent to a 2 minute operation at maximum power. The climb fuel is read from Figure A–14. The distance covered during climb for this example is 6.5 n.mi. The cruise fuel is obtained by reading the unit range from figure A–15, here read as 19.8 n.mi/100 pounds of fuel. The level flight cruise distance is 50 n.mi less the distance covered during climb, or 43.5 n.mi. The cruise fuel then is 220 pounds (43.5 n.mi divided by 19.8 n.mi, per 100 pounds). For simplicity, the descent to lower altitude is assumed to be on-course and therefore included in this distance. The lower fuel consumption during descent introduces only a negligible error.

Search fuel flow is obtained from figure A–16 as 355 lb/hr. For a 15 minute search this results in about 90 lb of fuel used.

Here again descent from search altitude to rescue site was assumed to be included in the search time. Use figure A–6 to determine power required to hover, and figure A–4 to determine corresponding fuel flow. These calculations would result in a fuel flow of about 580 lb/hr or 9.7 lb/minute. For most hover fuel estimations it should be acceptable to approximate hover fuel flow as 10 lb/min due to the generally short hover time. Note that the gross weight for hover was increased by 400 pounds to include the rescuees.

Return climb and cruise fuel is obtained in the same manner as outbound climb and cruise fuel. Fuel remaining after landing is the reserve fuel.

Now, ability to hover at the rescue site is checked using figure A–5. For the conditions at the rescue site the chart shows a maximum gross weight for hovering of 6300 pounds. Column III, however, lists a gross weight of 6594 pounds for hover. Consequently, at least 300 pounds of fuel must be off-loaded. The new initial fuel load is chosen as 960 pounds and the takeoff gross weight then becomes 6284 pounds. Now, new fuel and gross weight values must be calculated as before.

New values for the mission segments are shown in columns VI and VII. The fuel values do not vary much from those of Column IV. The reserve fuel is now 229 pounds.

It should be understood that if the distance to the rescue site turned out to be less than estimated, 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 in column VI, thus exceeding the maximum gross weight for hovering. If this is anticipated, more fuel must be off-loaded before takeoff, or fuel must be burned off before starting the hover.

FIRE SUPPRESSION MISSION.

In this example, it is desired to determine if the aircraft can perform the fire suppression mission at all times of the day without having to off-load fuel.

The helicopter is to take off with the fire suppression kit attached and with pilot and two firefighters on board. The helicopter is required to fly outbound a maximum distance of 15 n. mi to a crash site, deposit the fire suppression kit and two firefighters (1700 pounds), hover near the fire for five minutes to provide rotor downwash while the rescue is being effected, and land. It is then required to take on board two rescuees and a firefighter (600 pounds), fly to a hospital 40 n. mi away, off-load rescuees (400 pounds) and return to base 25 n. mi away.

The base altitude is 2000 feet and the hottest temperature during the day is estimated to be 20°C.

First, ascertain if the helicopter has adequate takeoff capability, and if the fuel load is sufficient. Fill out the TOLD card for takeoff conditions as shown in the sample card (Figure A–22).

Note

> Hover at 15 foot wheel height provides adequate ground clearance for takeoff with the fire suppression kit attached.

The 3.5 psi power reserve calculated indicates that adequate power is available for takeoff. Fill out the TOLD card for landing as shown in Figure A–22. For this example, it was assumed that the highest terrain within a 15 mile radius of the base is 3000 feet. The fuel load listed represents a 128-pound reduction from takeoff fuel load. This is the total of the warmup and takeoff fuel plus 15 n. mi cruise fuel. The power reserve calculated shows that adequate power is available for landing with the fire suppression kit still attached.

For this example, it is assumed that the closest obstacle from the takeoff site is approximately 50 feet high and about 500 feet away. It is in a direction from which a 10-knot steady wind may be anticipated. A normal takeoff is desired with climbout at best climb speed.

The best climb airspeed is given on the MAXIMUM POWER CLIMB Chart, Figure A–14, as about 52 knots IAS. Figure A–11 shows distances for climbout airspeeds up to 40 knots and that, at 40 knots with a 10 knot wind, a 600-foot distance is required to clear a 50-foot obstacle.

Sample TOLD Card, Fire Suppression Mission

T.O. 1H-43(H)B-1CL-1

TAKEOFF AND LANDING DATA CARD

Data	*Takeoff*	*Landing*	
PRESSURE ALTITUDE	2000	3000	FT
OAT	20	18	C
DENSITY ALTITUDE	3000	4000	FT
WIND	10	10	K
BASIC WEIGHT	4682		LB
OIL, EQUIP., ETC.	27		LB
CREW	615		LB
OPERATING WEIGHT	5324	5324	LB
FUEL	1287	1159	LB
PAYLOAD	1300	1300	LB
GROSS WEIGHT	7911	7782	LB
DESIRED WHEEL HT	15	15	FT
DESIRED ROTOR SPEED	260	260	RPM
MAX GROSS WT FOR HOVER (FIG. A—5)	8620	8360	LB
POWER AVAILABLE (FIG. A—3)	35.9	35.2	PSI
POWER REQUIRED TO HOVER (FIG. A—6)	32.4	32.1	PSI
POWER RESERVE	3.5	3.1	PSI

Figure A—22

Sample Data, Fire Suppression Mission

Mission Segment	Gross Initial Weight (Pounds)	Figure Number	Performance	Fuel (Pounds)
Warmup and Takeoff	7911			22
Cruise 15 n.mi. with FSK	7889	A–15	14.2 n.mi/100 lb	106
Land and unload 1700 lb	7783			
Hover for 5 minutes	6083		10 lb/min	50
Land and take on 600 lb	6033			
Takeoff	6633			22
Cruise 40 n.mi	6611	A–16	15.4 n.mi/100 lb	260
Land and off-load 400 lb	6351			
Takeoff	5951			22
Cruise 25 n.mi	5929	A–15	15.8 n.mi/100 lb	158
Land at base				647

Figure A–23

Even more distance is required at higher climbout airspeeds. Because only a 500-foot distance is available in this problem, something must be done to get the aircraft over the obstacle. There are several alternatives:

(a) On Figure A–11, it is observed that the point where the dotted line of the sample problem intersects the 20°C OAT line, out-of-ground effect hover is possible. Therefore, a vertical takeoff may be performed. This, however, would require flight through the AVOID area of the MINIMUM HEIGHT FOR SAFE LANDING AFTER ENGINE FAILURE chart.

(b) The aircraft could fly around the obstacle.

(c) The distance to clear the obstacle can be reduced by reducing climbout airspeed. In this example a 30 knot airspeed is chosen. The corresponding distance is read from Figure A–11 by following the sample problem printed on the chart. The resulting distance is 430 feet, which for this problem is acceptable.

The latter alternative is chosen for this mission.

The adequacy of the full fuel load to perform the mission may be determined as follows: In figure A–23, initial gross weights for each flight segment are listed. These can be determined only after the fuel used for the preceding segment has been determined. The initial gross weight in this example is simply the initial gross weight of the preceding segment less the fuel used or with the weight changes either subtracted or added.

In figure A–23, the climb portions were intentionally omitted in order to simplify the calculations. This should be permissible for flight over terrain with relatively constant elevation, and for missions with more than adequate fuel reserves.

Cruise unit range is read at deck altitude thereby ignoring the possible improvement due to higher altitude. To minimize time to the rescue site the maximum continuous airspeed is to be used. The unit range read from figure A–16 is corrected for the effect of the fire suppression kit drag.

Hovering capability is assured due to the great off-loading of weight, unless the crash site is at a considerably higher elevation. Hover fuel is here estimated by using the rule of thumb for fuel flow of 10 pounds per minute. Flight to the hospital is again to be flown at maximum continuous airspeed. The return flight from the hospital to the base is executed at speed for best range.

The total fuel used for the various mission segments per figure A–23 is 640 pounds, leaving 647 pounds unused at landing for reserve.

In figure A–23 the unit ranges were read from the chart at the initial gross weight for the cruise mission segment.

This is acceptable for short mission segments. For long mission segments use of average gross weight for the segment may show better unit range.

From the preceding mission analysis it is concluded that the aircraft with the fire suppression kit attached is capable of taking off any time during the day with full fuel on board.

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Your Responsibility — To Let Us Know iii

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