Lt. Ed Powell

NAVAIR 01-260HCB-1

NATOPS

Flight Manual

NAVY MODEL

UH-2C
HELICOPTER

THIS PUBLICATION SUPERSEDES NAVAIR 01-260HCB-1
DATED 15 MARCH 1968

5592

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS
AND UNDER THE DIRECTION OF THE COMMANDER,
NAVAL AIR SYSTEMS COMMAND

AIRCRAFT 1
INDOCT 2
NORMAL PROCD 3
FLIGHT PROCD 4
EMER PROCD 5
ALL-WTHR OPERATION 6
COMM PROCD 7
WEAPONS SYSTEMS 8
FLT CREW COORD 9
NATOPS EVAL 10
PERFORM DATA 11
APPENDIX
INDEX

NAVAIR 01-260HCB-1

NATOPS

Flight Manual

NAVY MODEL

UH-2C

HELICOPTER

AIRCRAFT 1
INDOCT 2
NORMAL PROCD 3
FLIGHT PROCD 4
EMER PROCD 5
ALL-WTHR OPERATION 6
COMM PROCD 7
WEAPONS SYSTEMS 8
FLT CREW COORD 9
NATOPS EVAL 10
PERFORM DATA 11
APPENDIX
INDEX

THIS PUBLICATION SUPERSEDES NAVAIR 01-260HCB-1
DATED 15 MARCH 1968

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS
AND UNDER THE DIRECTION OF THE COMMANDER,
NAVAL AIR SYSTEMS COMMAND

REPRINT

15 September 1969

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current change is indicated by a vertical line in the outer margins of the page.

CURRENT FLIGHT CREW CHECKLISTS

NAVAIR 01-260HCB-1B 15 SEPTEMBER 1969
NAVAIR 01-260HCB-1C 15 SEPTEMBER 1969

* The asterisk indicates pages changed, added or deleted by the current change.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS: NAVAIR

USAF ACTIVITIES—In accordance with Technical Order No. 00-5-2.

NAVY ACTIVITIES—Use DD FORM 1348 and submit in accordance with the instructions contained in NAVSUP PUBLICATION 437—Military Standard Requisitioning and Issue Procedures.

For information on other available material and details of distribution refer to NAVSUP PUBLICATION 2002, SECTION VIII, PART C and NAVAIR 00-500A.

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C.-20350

1 May 1969

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach towards improving combat readiness and achieving a substantial reduction in the aircraft accident rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative but rather, to aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end Type/Fleet/Air Group/Air Wing/Squadron Commanders and subordinates are obligated and authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3510.9 series, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and may be carried in Naval Aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

Thomas F. Connolly

THOMAS F. CONNOLLY
Vice Admiral, USN
Deputy Chief of Naval Operations (Air)

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

[illegible] May 196[illegible]

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft accident rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative but rather, to aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end Type, Fleet, Air Group/Air Wing, Squadron Commanders and subordinates are obligated and authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3510.9 series, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and may be carried in Naval Aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

THOMAS F. CONNOLLY
Vice Admiral, USN
Deputy Chief of Naval Operations (Air)

INTERIM CHANGE SUMMARY

The following Interim Changes have been canceled or previously incorporated in this manual:

CHANGE NUMBER(S)	REMARKS/PURPOSE

The following Interim Changes have been incorporated in this Change/Revision:

CHANGE NUMBER	ORIGINATOR AND REFERENCE	REMARKS/PURPOSE
1	NASYSCOM	Hovering Over Salt Water
2	CNO	Severe One-Per-Rev
3	NASYSCOM	Transient Overtorque
4	CNO	Emergency Throttle Check
5	NASYSCOM	Emergency RPM Control
6	NASYSCOM	One Eng Water Takeoff
7	NASYSCOM	Blade Track Check
8	CNO	Night/IFR Equipment

Interim Changes outstanding - to be maintained by custodian of this manual:

CHANGE NUMBER AND DATE	ORIGINATOR AND REFERENCE	PAGES AFFECTED	REMARKS/PURPOSE

NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV FORM 3500/22 (5-69) 0107-722-2002

DATE

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (originator)	Unit
TO (Model Manager)	Unit

Complete Name of Manual/Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph

Recommendation (be specific)

☐ CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title

Address of Unit or Command

TO BE FILLED IN BY MODEL MANAGER *(Return to Originator)*

FROM	DATE
TO	

REFERENCE
(a) Your Change Recommendation Dated ____________

☐ Your change recommendation dated ________ is acknowledged. It will be held for action of the review conference planned for ____________ to be held at ____________

☐ Your change recommendation is reclassified URGENT and forwarded for approval to ____________ ____________ by my DTG ____________.

/S/ ____________ MODEL MANAGER, ____________ AIRCRAFT

Sample Change Recommendation Form

TABLE OF CONTENTS

Section		Page
I	AIRCRAFT	1-1
II	INDOCTRINATION	2-1
III	NORMAL PROCEDURES	3-1
IV	FLIGHT PROCEDURES	4-1
V	EMERGENCY PROCEDURES	5-1
VI	ALL WEATHER OPERATION	6-1
VII	COMMUNICATIONS PROCEDURES	7-1
VIII	WEAPONS SYSTEM	8-1
IX	FLIGHT CREW COORDINATION	9-1
X	NATOPS EVALUATION	10-1
XI	PERFORMANCE DATA	11-1
A	LIST OF REFERENCES	A-1
	ALPHABETICAL INDEX	X-1

FOREWORD

SCOPE

The NATOPS Flight Manual is issued by the authority of the Chief of Naval Operations and under the direction of the Commander, Naval Air Systems Command in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) Program. It provides the best available operating instructions for most circumstances, but no manual is a substitute for sound judgment. Emergencies, adverse weather, or terrain may require modification of the procedures contained herein. Read this manual from cover to cover. It's your responsibility to have a complete knowledge of its contents.

HOW TO GET COPIES

Automatic Distribution

To receive future changes and revisions to this manual automatically, a unit must be established on the automatic distribution list maintained by the Naval Air Technical Services Facility (NATSF). To become established on the list of change distribution requirements, a unit must submit NAVWEPS Form 5605/2 to NATSF, 700 Robbins Ave., Philadelphia, Pa. 19111, listing this manual and all other NAVAIR publications required. For additional instructions refer to BUWEPSINST 5605.4 series and NAVSUP Publication 2002.

Additional Copies

Additional copies of this manual and changes thereto may be procured by submitting a DD Form 1348 to NPFC Philadelphia in accordance with the instructions contained in NAVSUP PUBLICATION 437 – Military Standard Requisitioning and Issue Procedures. For information on other available material and details of distribution refer to NAVSUP PUBLICATION 2002, SECTION VIII, PART C and NAVAIR 00-500A.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, a review conference will be held periodically as necessary.

YOUR RESPONSIBILITY

NATOPS Flight Manuals are kept current through an active manual change program. If you find anything you don't like about the manual, if you have information you'd like to pass along to others, or if you find an error in this manual, submit a change recommendation to the Model Manager at once.

CHANGE RECOMMENDATIONS

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with OPNAVINST 3510.9 (series). Change recommendations of an URGENT nature (safety of flight, etc.,) should be submitted directly to the NATOPS Advisory Group Member in the Chain of Command by priority message.

Submit routine change recommendations to the Model Manager on OPNAV Form 3500-22.

Address routine changes to:

COMMANDING OFFICER, HELICOPTER
COMBAT SUPPORT SQUADRON FIVE
NAVAL AIR STATION
IMPERIAL BEACH, CALIFORNIA 92032

NATOPS FLIGHT MANUAL INTERIM CHANGES (FMIC'S)

FMIC'S are changes or corrections to the NATOPS Flight Manuals promulgated by CNO or NAVAIRSYSCOM. FMIC'S may be received by the individual custodian as a printed page or pages, or by the commands as a naval message.

INTERIM CHANGE SUMMARY

The interim change summary in each manual is provided for the purpose of maintaining a complete record of all interim changes issued to the manual. Each time the manual is changed or revised, the interim change summary will be updated to indicate disposition and/or incorporation of previously issued interim changes. When a regular change is received, the interim change summary should be checked to ascertain that all outstanding interim changes have been either incorporated or cancelled; those not incorporated should be re-entered and noted as applicable.

CHANGE SYMBOLS

Revised text is indicated by a black vertical line in either margin of the page, like the one printed next to this paragraph. The change symbol shows where there has been a change. The change might be material added or information restated.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "WARNINGS", "CAUTIONS", and "NOTES" found throughout the manual.

WARNING

Operating procedures, practices, etc., which may result in injury or death, if not carefully followed.

CAUTION

Operating procedures, practices, etc., which, if not strictly observed, may damage equipment.

Note

An operating procedure, condition, etc., which is essential to emphasize.

WORDING

The concept of word usage and intended meaning which has been adhered to in preparing this Manual is as follows:

"Shall" has been used only when application of a procedure is mandatory.

"Should" has been used only when application of a procedure is recommended.

"May" and "need not" have been used only when application of a procedure is optional.

"Will" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

The Helicopter

Figure 1—1

SECTION I

THE AIRCRAFT

TABLE OF CONTENTS

PART 1—GENERAL DESCRIPTION

The Helicopter 1-2

PART 2—SYSTEMS

Engines 1-6
Engine Oil System 1-16
Transmission System 1-18
Rotor System 1-20
Flight Control System 1-22
Automatic Stabilization Equipment (ASE) 1-23
Blade Tracking System 1-29
Hydraulic Power Supply System 1-31
Landing Gear System 1-33
Rescue Hoist System 1-34
Rescue Boom (Fishpole) System 1-37
Windshield Wiper System 1-37
Windshield Washer System 1-38
Brake System 1-38
Fuel Supply System 1-38
Single-Point Pressure Fueling System 1-45
Electrical Power Supply System 1-48A
Communications and Radio-Navigation Equipment 1-54
Navigation Equipment 1-68
Lighting Equipment 1-78
Caution Light System 1-82
Instruments 1-82
Entrance Doors 1-84
Pilots' Seats 1-84
Passenger Carrying Equipment 1-85
Casualty Carrying Equipment 1-85
Internal Cargo Carrying Equipment 1-85
Cargo Hook System 1-85
Emergency Floatation Gear 1-88
Emergency Equipment 1-88
Heating, Ventilating, and Defogging System 1-88
Pilots' Suit Ventilating System 1-89
Rotor Deicing System 1-89
Windshield Anti-Icing System 1-90
Pitot Heater and Switch 1-91
Miscellaneous Equipment 1-91

PART 3—AIRCRAFT SERVICING

Mooring Requirements 1-92
Aircraft Fueling and Servicing 1-92

PART 4—OPERATING LIMITATONS

Operating Limitations 1-98

PART 1 GENERAL DESCRIPTION

THE HELICOPTER

The helicopter has a single main rotor, an anti-torque tail rotor and is powered by two turboshaft engines. The helicopter was primarily designed for plane guard and search and rescue. It may also be used for such missions as observation, reconnaissance, and transportation of internal and external cargo. The helicopter is capable of instrument flight. It is manufactured by Kaman Aircraft.

SPECIAL FEATURES.

The engines are mounted above the cabin aft of the cockpit. The four bladed main rotor is driven through the combining and main gearboxes which are mounted between the engines.

Cyclic and collective pitch control is obtained through blade flaps mounted on the main rotor blades (see figures 1–1 and 1–3). Aerodynamic action of the flaps changes the pitch (angle of attack) of the main rotor blades in response to the pilot's operation of the controls. The major portion of the energy required to accomplish rotor pitch changes is supplied by the aerodynamic action of the blade flaps rather than by pilot applied force. For this reason, control forces are light. An inflight blade tracking system automatically adjusts the tip path of the main rotor blades. The aircraft is equipped with automatic stabilization equipment. The aircraft has retractable main landing gear and a full swivel non-retractable tail wheel.

CREW AND MISSION PROVISIONS.

(See figure 1–4.)

The pilot's seat is at the right side of the cockpit. The copilot's seat and dual flight controls are at the left. Directly behind the pilot's and copilot's seats is the bulkhead separating the cockpit and cabin.

The cabin can be used to carry additional crew, passengers, litter patients, or cargo. The aircraft is equipped with a hydraulic rescue hoist and an externally mounted cargo hook.

HELICOPTER DIMENSIONS.

Approximate overall dimensions are as follows (see figure 1–2):

LENGTH

Minimum (with main and tail rotor blades, and nose doors, folded back)	38 ft 4 in.
Same as above but with nose doors closed	40 ft 6 in.
Operating configuration	52 ft 6 in.
Wheelbase	24 ft

WIDTH

Across main landing gear	11 ft 7 in.
Rotor disc	44 ft

HEIGHT

Main rotor hub	13 ft 7 in.
Tail rotor tip (maximum)	15 ft 5 in.
Main rotor minimum ground clearance	8 ft 4 in.
Tail rotor minimum ground clearance	6 ft 4 in.

Helicopter Dimensions

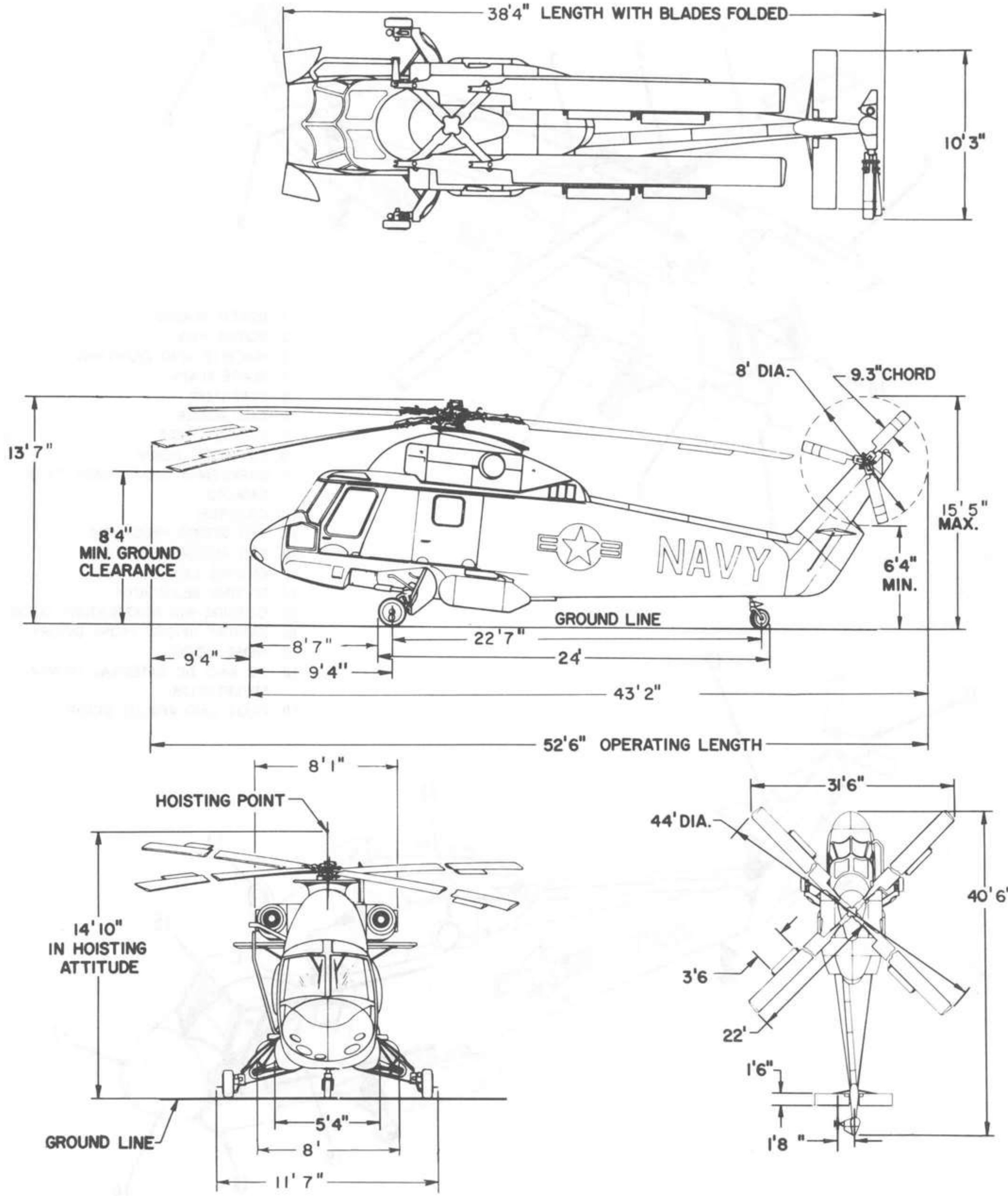
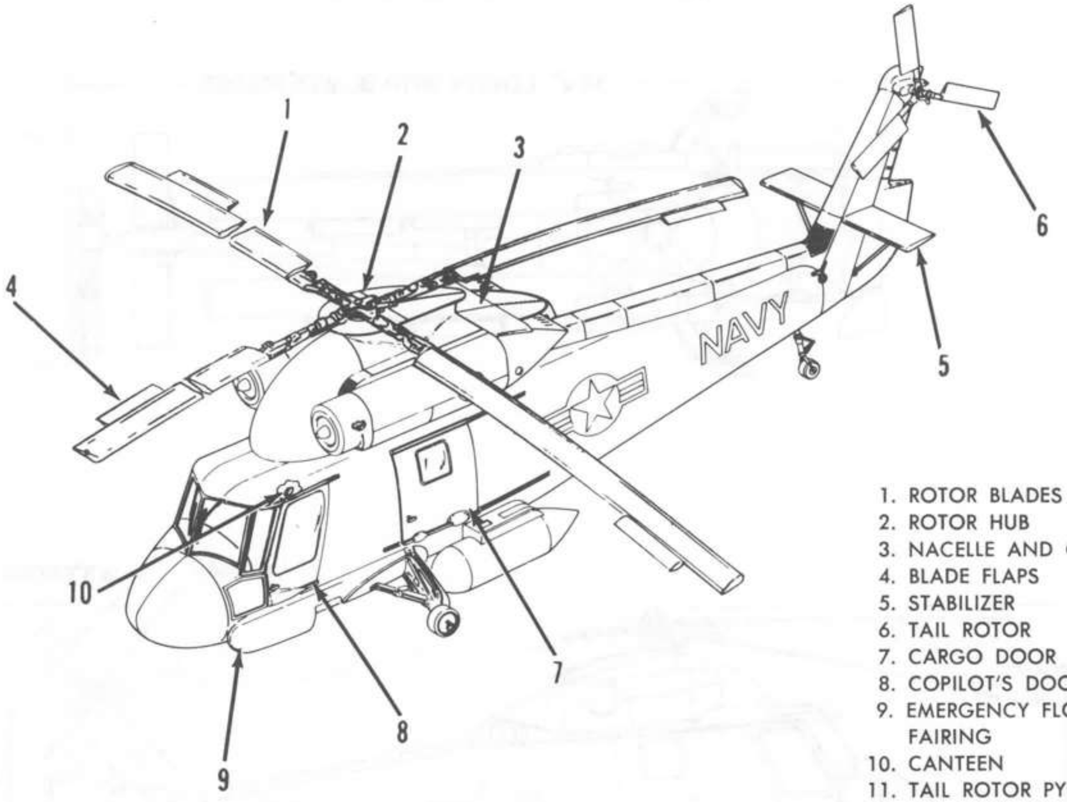


Figure 1—2

General Arrangement



1. ROTOR BLADES
2. ROTOR HUB
3. NACELLE AND COWLING
4. BLADE FLAPS
5. STABILIZER
6. TAIL ROTOR
7. CARGO DOOR
8. COPILOT'S DOOR
9. EMERGENCY FLOATATION GEAR FAIRING
10. CANTEEN
11. TAIL ROTOR PYLON TIP
12. TAIL ROTOR PYLON
13. ENGINE EXHAUST DUCT
14. ENGINE BELLMOUTH
15. OUTSIDE AIR TEMPERATURE GAGE
16. BATTERY (INSIDE NOSE DOORS)
17. NOSE DOORS
18. AC AND DC EXTERNAL POWER RECEPTACLES
19. PILOT AND RESCUE DOOR

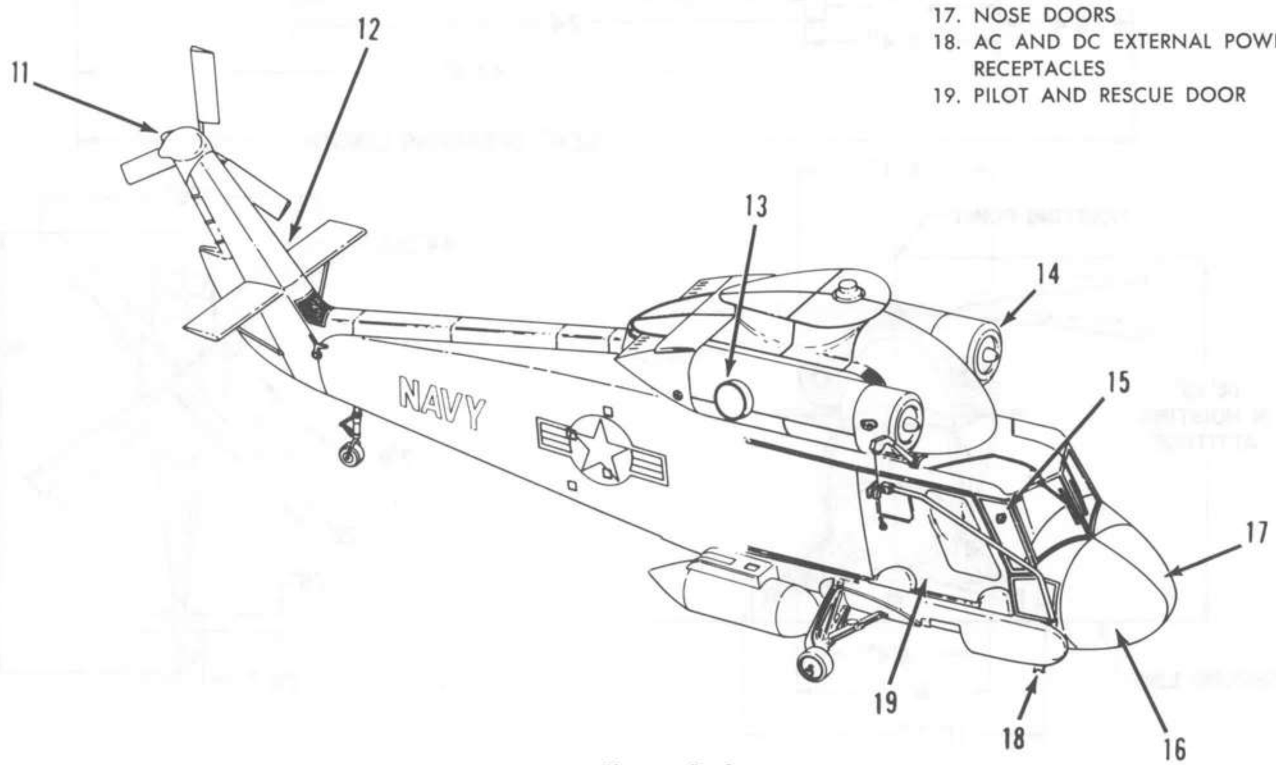


Figure 1—3

Compartment Diagram

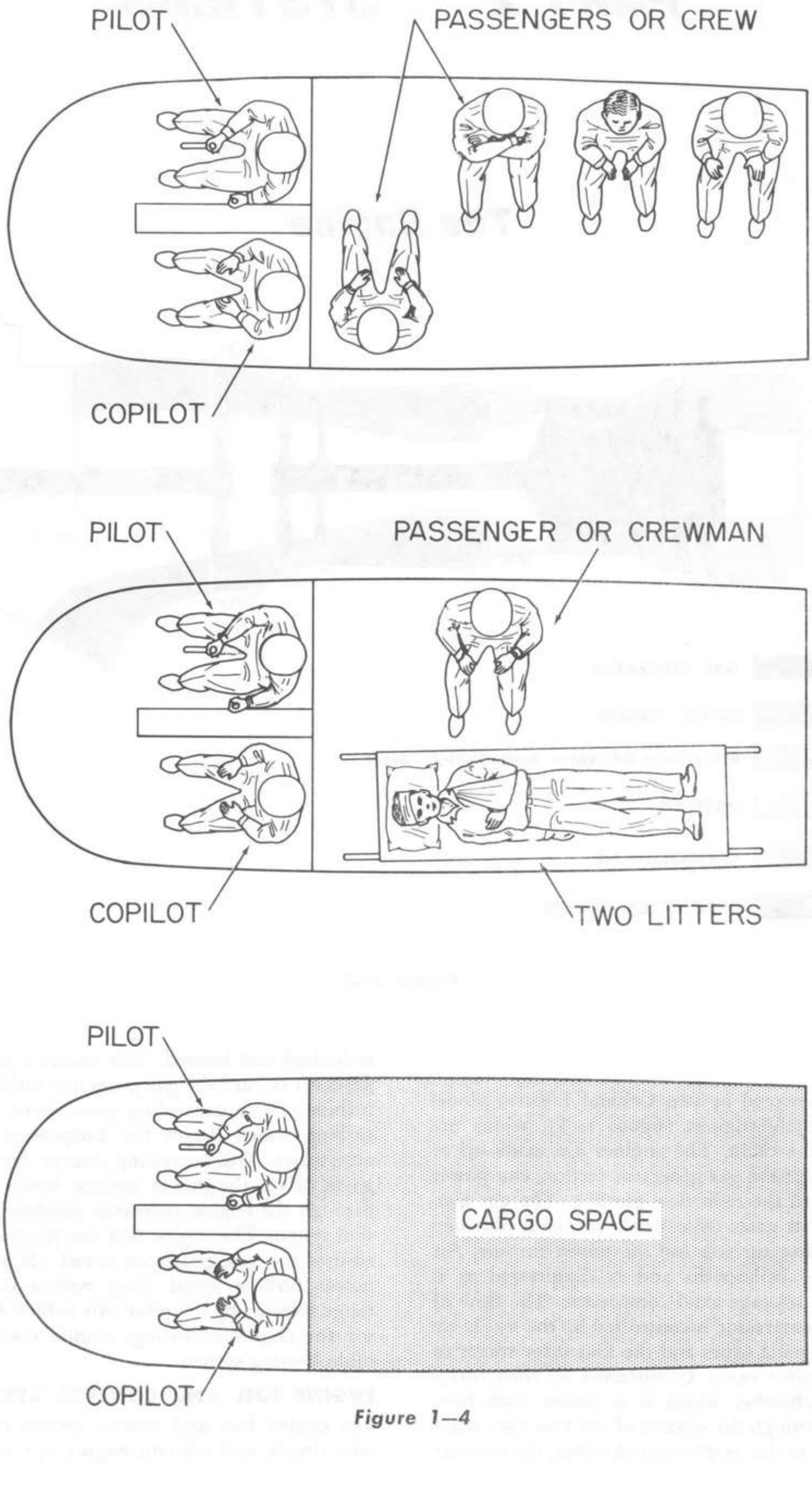


Figure 1—4

PART 2 SYSTEMS

The Engine

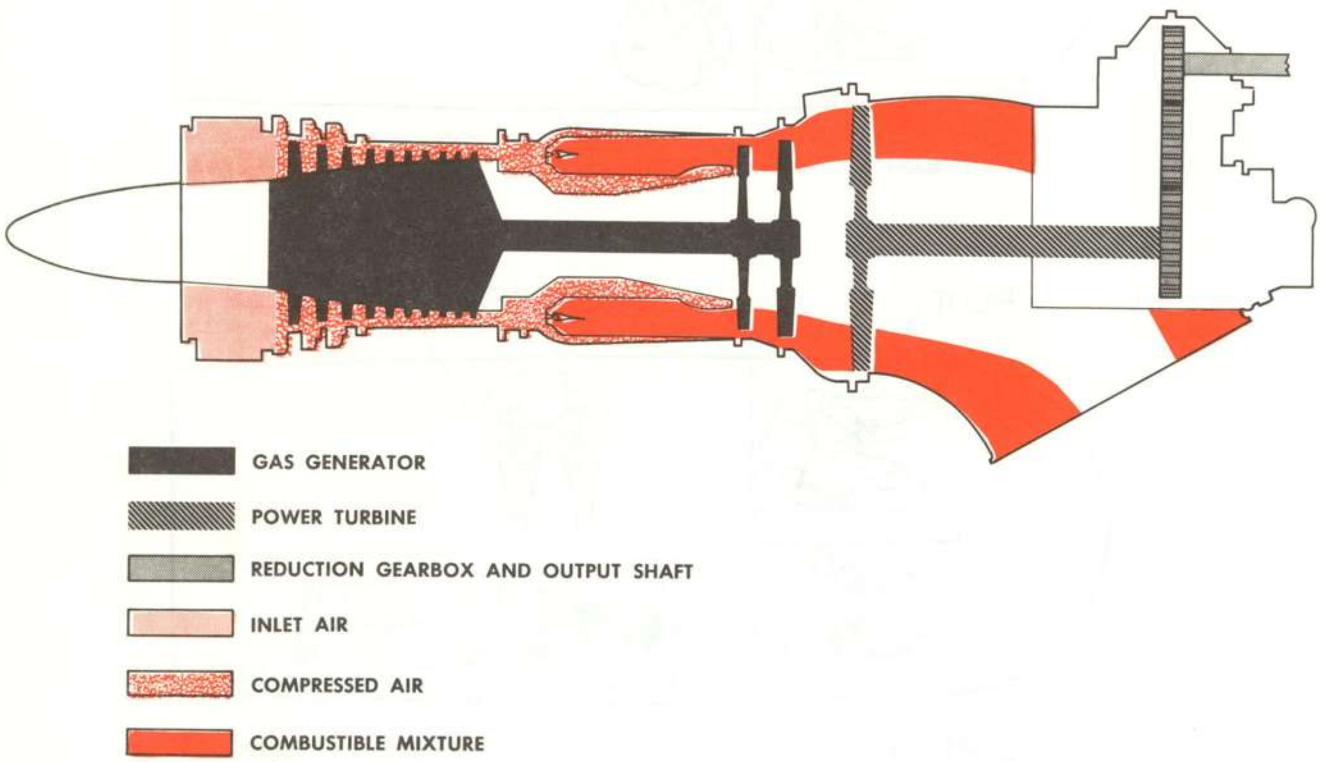


Figure 1—5

ENGINES

The aircraft is powered by two General Electric Model T58-GE-8 turboshaft engines (figure 1—5), which are mounted above the cabin. The engines are made up of three main sections: the gas generator section, the power turbine section and the reduction gearbox. The gas generator produces hot gases from which power is obtained by the gas generator turbine and the power turbine. Air enters the engine bellmouths and is compressed as it passes through a 10-stage axial compressor. The flow of air through the compressor is controlled by the single set of variable inlet guide vanes and the first three stages of the compressor stator vanes. Compressed air then enters the combustion chamber where it is mixed with fuel, which is added through the nozzles of the two fuel manifolds. While still in the combustion chamber, the mixture is ignited and burned. This causes a rapid expansion of gases aft toward the gas generator turbine and the power turbine. These expanding gases drive the gas generator turbine which drives the compressor and the engine accessories. The remaining energy from the expanding gases drives the power turbine which drives the rotors through the engine reduction gearbox and the transmission system. The engine fuel control system automatically adjusts the gas generator speed (N_g) to maintain the power turbine speed (N_t) within the governed rpm range selected by the pilot. Air is bled from the compressor for engine anti-icing, engine cooling, and for the cabin heating system.

ENGINE FUEL AND CONTROL SYSTEM.

The engine fuel and control system (figure 1—6) permits simple and efficient engine operation by means of

Engine Fuel and Control System

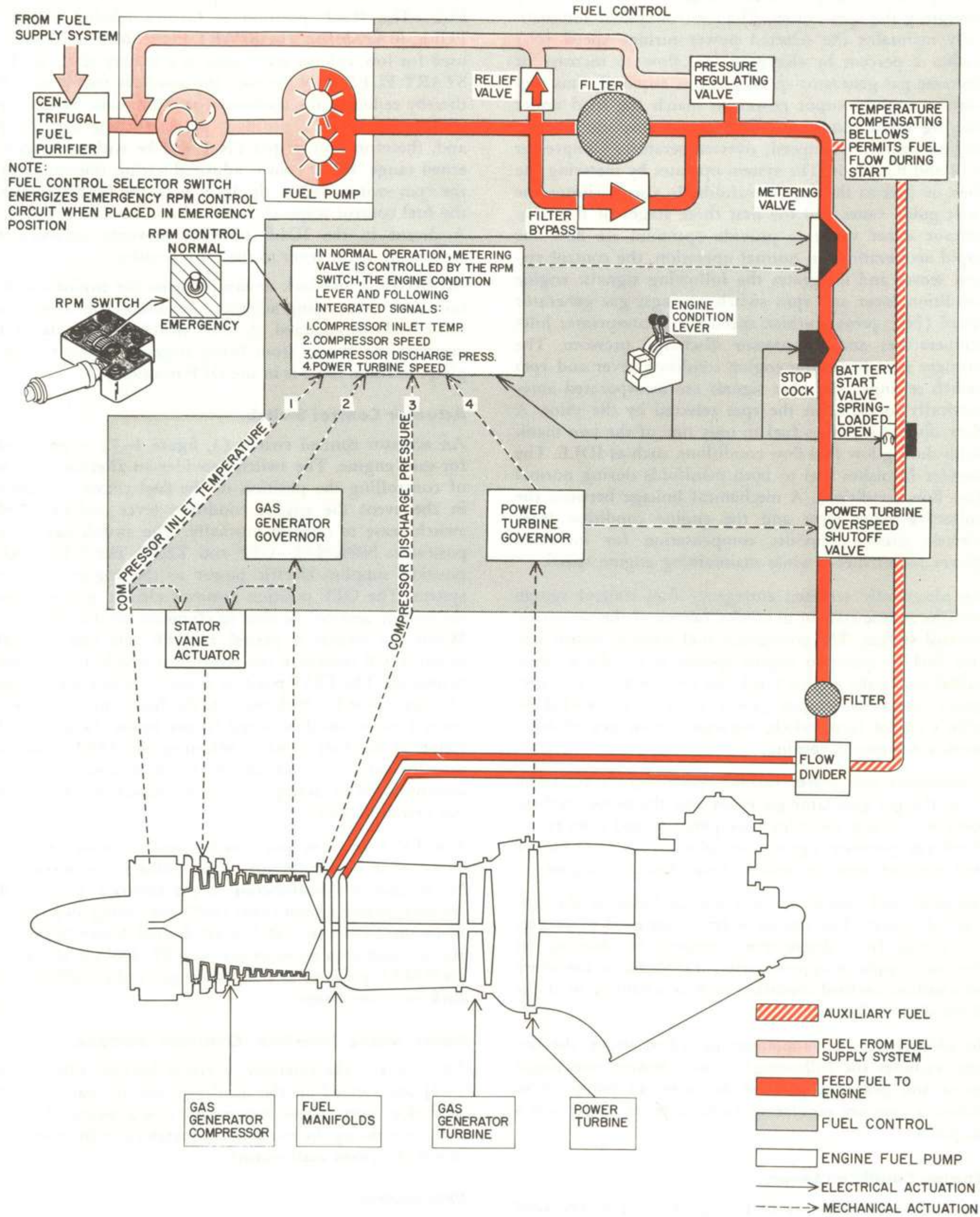


Figure 1–6

two controls for each engine, the engine condition lever and the rpm switch. With the engine condition lever in FLY position, the pilot selects engine output speed by operating the rpm switch. The control system automatically maintains the selected power turbine speed (N_f) within 2 percent by changing fuel flow to increase or decrease gas generator speed (N_g) as required, thus regulating engine output power to match the load under varying flight conditions. The system also protects the engine against overspeed, overtemperature, compressor stall and flame-out. The system operates by metering the flow of fuel to the fuel manifolds. It also positions the inlet guide vanes and the first three stages of the compressor stator vanes to provide optimum air flow for rapid acceleration. In normal operation, the control system senses and integrates the following signals: engine condition lever and rpm switch settings; gas generator speed (N_g); power turbine speed (N_f); compressor inlet temperature; and compressor discharge pressure. The primary signals are the engine condition lever and rpm switch settings. All other signals are incorporated automatically to maintain the rpm selected by the pilot. A flow divider provides fuel to only one of the two manifolds during low fuel flow conditions, such as IDLE. The divider furnishes fuel to both manifolds during normal fuel flow conditions. A mechanical linkage between the collective pitch lever and the engine condition lever electric circuits provides compensation for increased power requirements while maintaining engine speed.

An electrically actuated emergency fuel control system permits engine control in case of failure of the automatic control system. The emergency fuel control system meters fuel to maintain engine speeds at or above those called for by the engine condition lever setting. In emergency operation, engine power (N_g) is controlled by pilot's use of rpm switch, without advantages of automatic rotor rpm governing.

Compressor and power turbine speed signals are taken from the gas generator governor and the power turbine governor. Compressor inlet temperature and compressor discharge pressure signals are taken from temperature and pressure sensitive bellows located on the engine.

An overspeed shutoff valve is also included in the fuel control system. The shutoff valve is designed to protect the engine from destructive overspeed by shutting off the fuel supply at approximately 123% N_f in the event of a sudden no-load condition such as would occur if the drive shaft failed.

In addition to the components described above, the system includes the following: a two element centrifugal boost and gear-type positive displacement pump, three filters, a pressure regulating valve, a relief valve, and a stopcock.

Engine Condition Lever.

An engine condition lever (1, figure 1–7) is provided for each engine. The lever is mounted in a quadrant on the center console. Electrical signals from the lever are amplified and used to position a rotary fuel control actuator on the fuel control input shaft. The engine condition lever has three detented positions: OFF, IDLE and FLY. The IDLE position is further labeled START FUEL, MAX-MIN. The START FUEL MIN position is used for low voltage starts such as a battery start. In the START FUEL MIN position the auxiliary fuel is cut off thereby reducing the tendency for a hot start. When the lever is in the FLY position, power turbine rpm (N_f) and, therefore, rotor rpm (N_r) will be within the governed range. Rotor rpm is adjusted within this range by the rpm switch. When the lever is in the OFF position, the fuel control stopcock is closed and no fuel can flow. A detent in the IDLE position prevents inadvertent movement of the lever to the OFF position.

An electrical interlock device prevents the engine condition lever from being advanced beyond IDLE when the rotor brake is engaged. A limit switch in the quadrant prevents the starter from being engaged unless the engine condition lever is in the OFF position.

Actuator Control Switch.

An actuator control switch (3, figure 1–7) is provided for each engine. The switch provides an alternate means of controlling the position of the fuel control actuator in the event the engine condition lever and/or RPM switch cease to operate normally. The switch has three positions: NORMAL, OFF and TEST. The NORMAL position supplies electric power to the engine throttle system. The OFF position removes electric power from the system, and can be used to eliminate erratic behavior. When the switch is placed to OFF, the fuel control actuator will remain in the position at which it was when turned off. The TEST position is used to check the setting of a limit switch which restricts the fuel control actuator from a maximum downward failure below the governed range of the fuel control. Selecting the TEST position actually causes a maximum down signal, and the test is accomplished by noting the N_f that results after placing the switch in TEST.

The TEST position can also be used to reduce rpm in event of a maximum up signal calling for maximum N_f/N_r due to a malfunction in the electrical portion of the fuel control system (near 106% depending on power). Place the switch in TEST until desired lower N_f/N_r is reached and then move switch to OFF. Do not return to NORMAL position as this would place the malfunction back into the system.

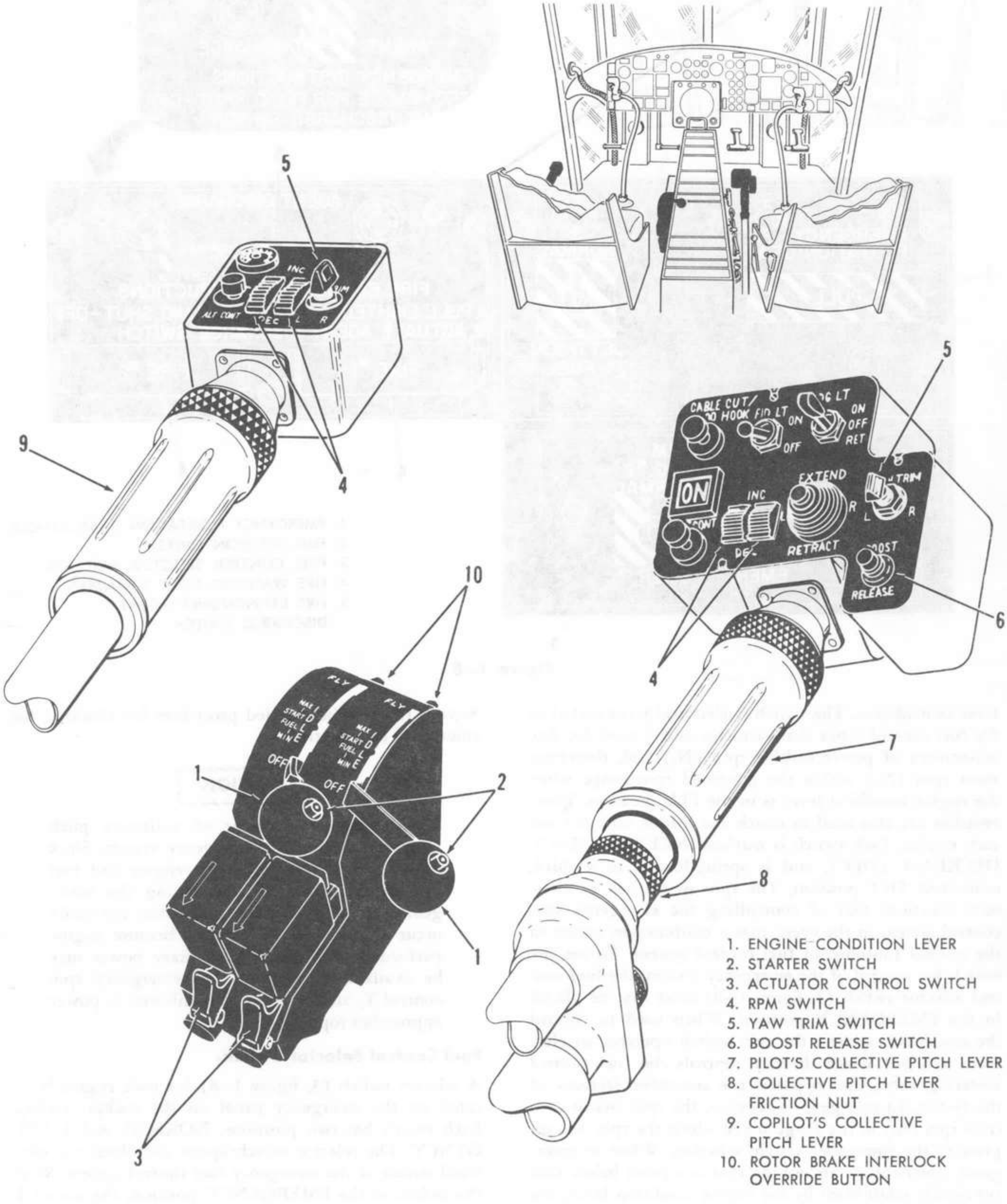
Rotor Brake Interlock Override Buttons.

Two rotor brake interlock override buttons (10, figure 1–7) are located on the quadrant, one for each engine condition lever. These buttons provide a means of manually overriding the rotor brake interlock in the event of interlock system malfunction.

RPM Switch.

An rpm switch (4, figure 1–7) for each engine is provided on both the pilot's and copilot's collective pitch

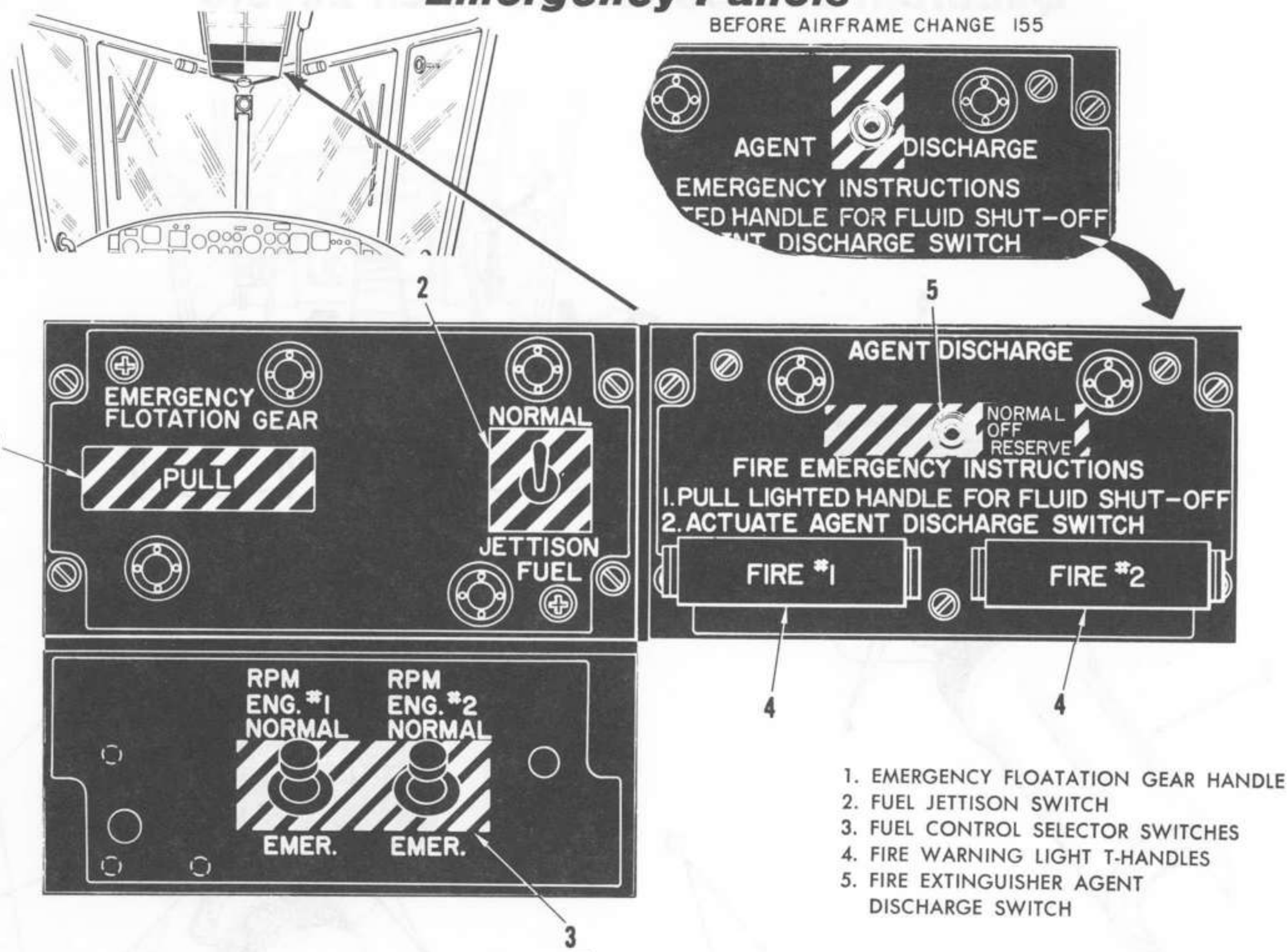
Quadrant and Collective Pitch Levers



1. ENGINE CONDITION LEVER
2. STARTER SWITCH
3. ACTUATOR CONTROL SWITCH
4. RPM SWITCH
5. YAW TRIM SWITCH
6. BOOST RELEASE SWITCH
7. PILOT'S COLLECTIVE PITCH LEVER
8. COLLECTIVE PITCH LEVER FRICTION NUT
9. COPILOT'S COLLECTIVE PITCH LEVER
10. ROTOR BRAKE INTERLOCK OVERRIDE BUTTON

Figure 1–7

Emergency Panels



1. EMERGENCY FLOATATION GEAR HANDLE
2. FUEL JETTISON SWITCH
3. FUEL CONTROL SELECTOR SWITCHES
4. FIRE WARNING LIGHT T-HANDLES
5. FIRE EXTINGUISHER AGENT DISCHARGE SWITCH

Figure 1—8

lever switchboxes. The switch is electrically connected to the fuel control input shaft actuator and is used for fine adjustment of power turbine rpm (N_f) and, therefore, rotor rpm (N_r) within the governed rpm range when the engine condition lever is in the FLY position. These switches are also used to match the torque output from each engine. Each switch is marked INCREASE (INC), DECREASE (DEC), and is spring-loaded to a third, unmarked, OFF position. The rpm switch has an alternate function; that of controlling the emergency fuel control system in the event that a malfunction occurs in the normal (automatic) fuel control system. To use the switch for control of the emergency system, the fuel control selector switch (3, figure 1—8) must first be placed in the EMERGENCY position. When used to control the emergency system, the rpm switch operates an electrical actuator which directly controls the fuel control metering valve, and bypasses the automatic features of the system. In emergency operation, the rpm switch controls rpm only in the range above which the rpm was set prior to the emergency system selection. When in emergency operation, to reduce the rpm to a point below that previously established by the engine condition lever, the engine condition lever must first be retarded. Refer to Section III, for the detailed procedure for checking the emergency rpm control.

CAUTION

> Avoid abrupt movement of collective pitch lever when using the emergency system. Since the automatic features of the engine and fuel control are bypassed when using the emergency system, overspeeding of rotors can easily occur as collective is lowered. Because engine performance in excess of military power may be available through use of emergency rpm control T_5 and N_g must be monitored as power approaches topping.

Fuel Control Selector Switch.

A selector switch (3, figure 1—8) for each engine is located on the emergency panel on the cockpit ceiling. Each switch has two positions, NORMAL and EMERGENCY. The selector switch opens and closes the electrical circuit of the emergency fuel control system. With the switch in the EMERGENCY position, the circuit is closed and the emergency fuel control is operative through the rpm switch. During all normal flight operations, the fuel control selector switch shall be in the NORMAL position. When the selector switch is placed in NORMAL, the electrical actuator in the emergency fuel control system runs to full decrease.

TURBINE ANTI-ICE SWITCH.

The turbine anti-ice switch (1, figure 1–10) is located on the heat and miscellaneous (HEAT & MISC) panel on the cockpit ceiling. The switch has two positions: TURBINE ANTI-ICE and OFF. When moved to the TURBINE ANTI-ICE position, a solenoid air valve on each engine is opened, permitting hot air from the compressor to flow through passages in the front part of the engine. This provides anti-icing air for the front struts, the bulletnose, the inlet guide vanes, and the engine bellmouth. Turbine anti-icing may be checked, while on the ground with the engine condition lever in IDLE, by moving the switch to TURBINE ANTI-ICE and observing the gas generator tachometer. N_g should decrease approximately one-half percent. The solenoid valve is spring-loaded to the open position and, therefore, would open in the event of electrical power failure. The solenoid draws electrical power from the 28-volt primary bus through the TURBINE ANTI-ICE circuit breaker. Refer to Section VI for information on flight in icing conditions.

Note

The turbine anti-icing air shall be used as a preventive measure, not a corrective one. Move the switch to TURBINE ANTI-ICE whenever icing conditions are anticipated, but in any case whenever the outside air temperature is 10° C or below.

ENGINE COOLING.

Compressed air, bled from various stages of the gas generator compressor, is directed to engine parts that require cooling during operation. It is directed away from the compressor by external hoses and internal passages. Engine cooling is automatic and is not directly controlled by the pilot.

ENGINE STARTER AND IGNITION SYSTEM.

The starting and ignition system for each engine consists of an electrical starter motor, two ignitor plugs, a sealed ignitor unit, and a starting and ignition electrical control system. In each system, the sealed ignitor unit contains a radio interference suppressor and the necessary electrical components to transform 28 volts dc into the required high voltage output for energizing the ignitor plugs. The starter and ignition system is energized and de-energized by means of the starter switch. A limit switch, connected to the engine condition lever prevents the system from being energized unless the lever is in the OFF position. Also the fuel pumps switch must be ON. Complete operation of each system is also dependent upon the starter and ignition system test switch being in the NORMAL (NORM) position. The starter motor during a normal start, accelerates the gas generator from zero percent to 23 percent (N_g) at which point light-off occurs. During starting, fuel flow is controlled by the position of the engine condition lever. Electrical power for the ignition system and control of the starter motor is supplied from the 28-volt dc primary bus through the STARTER CONTROL circuit breaker. Because of the high current requirements of the starter motor, there is no circuit breaker in the starting motor circuit. Each starting motor is supplied current directly from the dc primary bus. The engines are normally started using an external dc power supply but can be started by an adequately charged battery. The engines cannot be started with converted ac power because the 28 vdc converter output is not connected to the starter.

Starter Switches.

Each engine starter switch (2, figure 1–7) is located on the engine condition lever. The switch controls a relay that supplies electrical power to the starter motor and a relay that supplies electrical power to the engine ignitor plugs. Pressing the switch causes the starter and ignition system to be energized, and releasing the switch causes the system to be de-energized. A limit switch connected to the engine condition lever prevents the system from being energized unless the engine condition lever is in the OFF position. Complete operation of the system is also dependent upon the starter and ignition system test switch being in the NORMAL (NORM) position, and the fuel pumps switch in the ON position. The starter switch is also used to activate the auxiliary power circuit to the fuel control actuator in the event of complete failure of the helicopter electrical system.

Starter and Ignition System Test Switch.

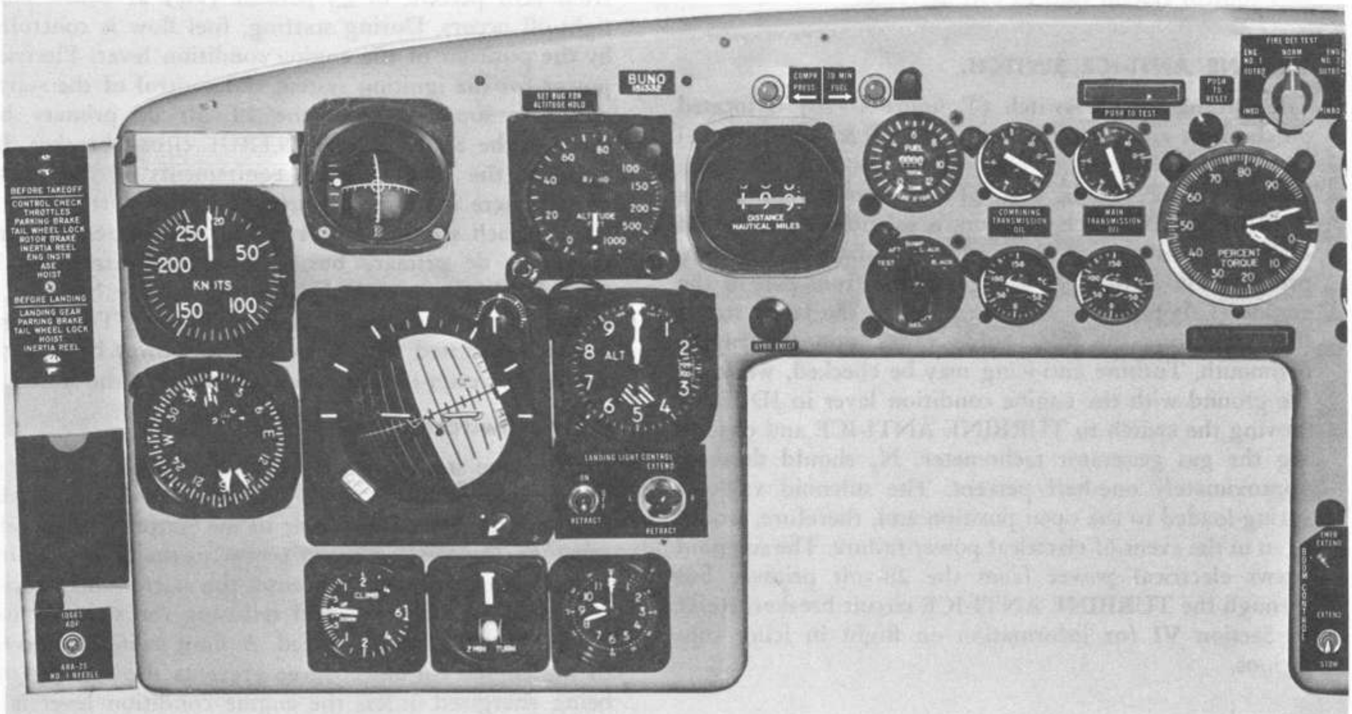
The starter and ignition system test switch (5, figure 1–11) is located on the starting (STARTING) panel on the cockpit ceiling. The switch is used to test the operation of the starter motor and ignitor plugs. The switch has three positions and is spring-loaded to the NORMAL (NORM) position. With the switch in the NORMAL position, pressing the starter button will cause both the starter motor and the ignitor plugs to be energized. With the switch in the STARTER position pressing the starter button will energize only the starter motor. The fact that the circuit is operating properly is indicated by the sound of the starter motor turning over. With the switch in the IGNITION (IGN) position pressing the starter button will energize only the ignitor plugs. The fact that the circuit is operating properly will be indicated by a snapping sound as the ignitor plugs are energized.

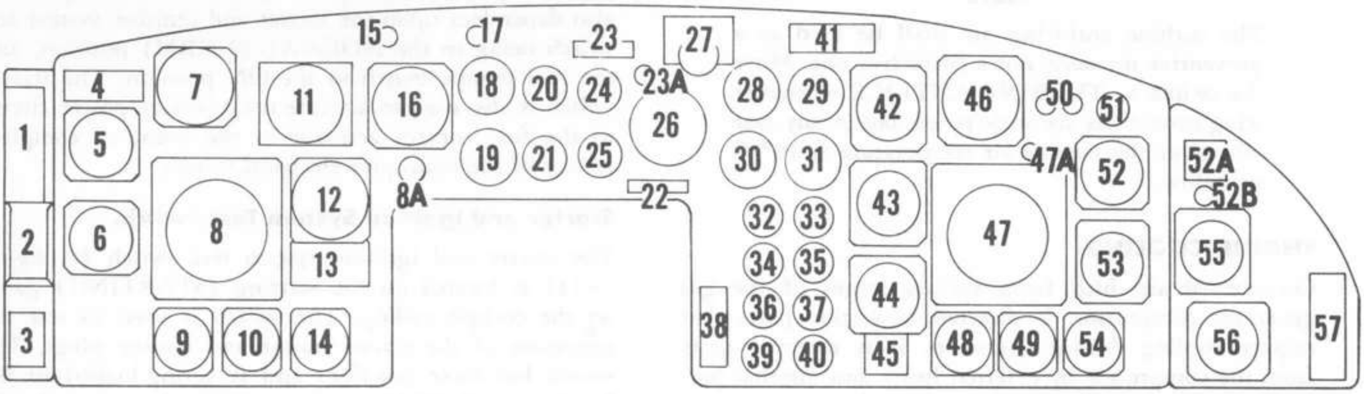
ENGINE INSTRUMENTS.

Gas Generator Tachometer.

A gas generator tachometer (28 or 29, figure 1–9) for each engine is located in the right center portion of the

Instrument Panel





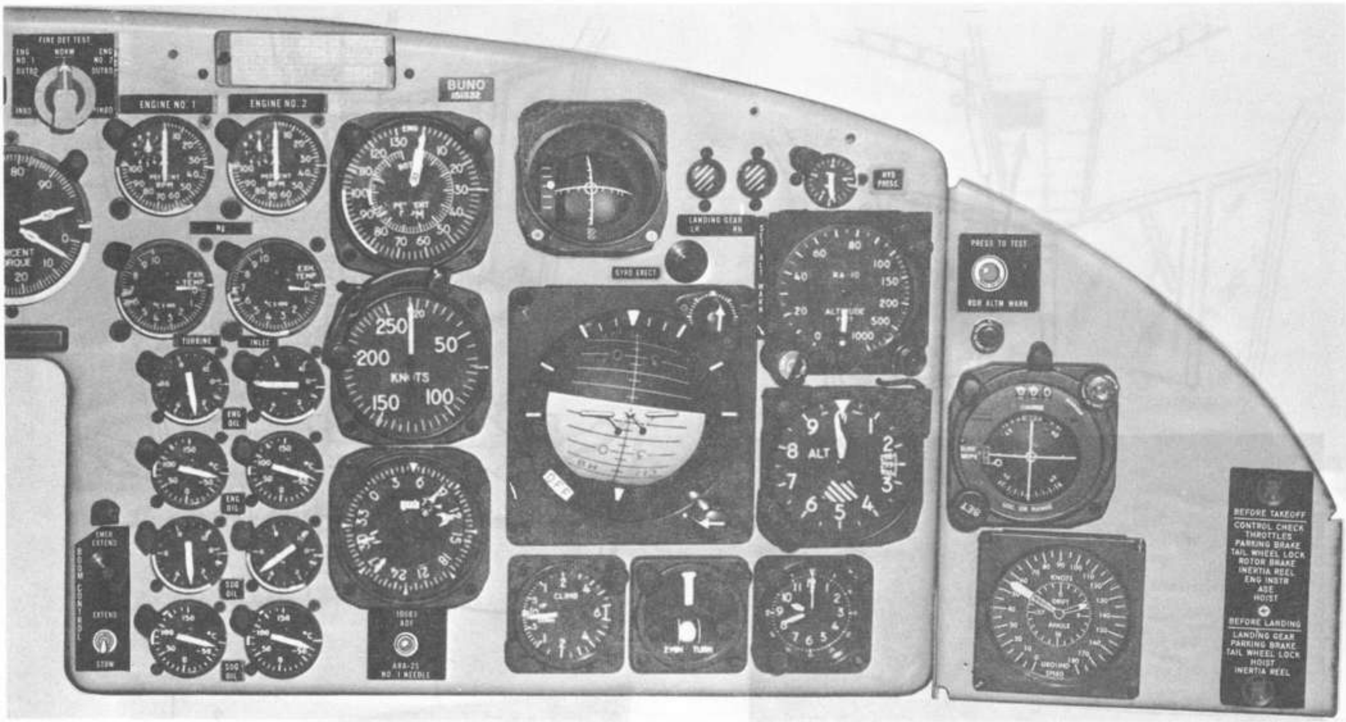
1. COPILOT'S CHECKLIST
2. COPILOT'S COMPASS CORRECTION CARD
3. COPILOT'S NEEDLE NO. 1 SWITCH
4. COPILOT'S AIRSPEED CORRECTION CARD
5. COPILOT'S AIRSPEED INDICATOR
6. COPILOT'S RADIO MAGNETIC INDICATOR, OR BEARING DISTANCE HEADING INDICATOR
7. COPILOT'S DIRECTION VELOCITY INDICATOR
8. COPILOT'S REMOTE ATTITUDE INDICATOR

8A. COPILOT'S GYRO ERECT BUTTON

9. COPILOT'S VERTICAL VELOCITY INDICATOR
10. COPILOT'S TURN AND SLIP INDICATOR
11. COPILOT'S RADAR ALTIMETER
12. COPILOT'S BAROMETRIC ALTIMETER
13. LANDING LIGHT SWITCHES
14. COPILOT'S CLOCK
15. COMPRESSOR PRESSURE LIGHT
16. RANGE INDICATOR
17. 30-MINUTE FUEL LIGHT
18. FUEL QUANTITY GAGE
19. FUEL QUANTITY GAGE SELECTOR SWITCH
20. COMBINING GEARBOX OIL PRESSURE GAGE

Figure 1—9 (Sheet 1)

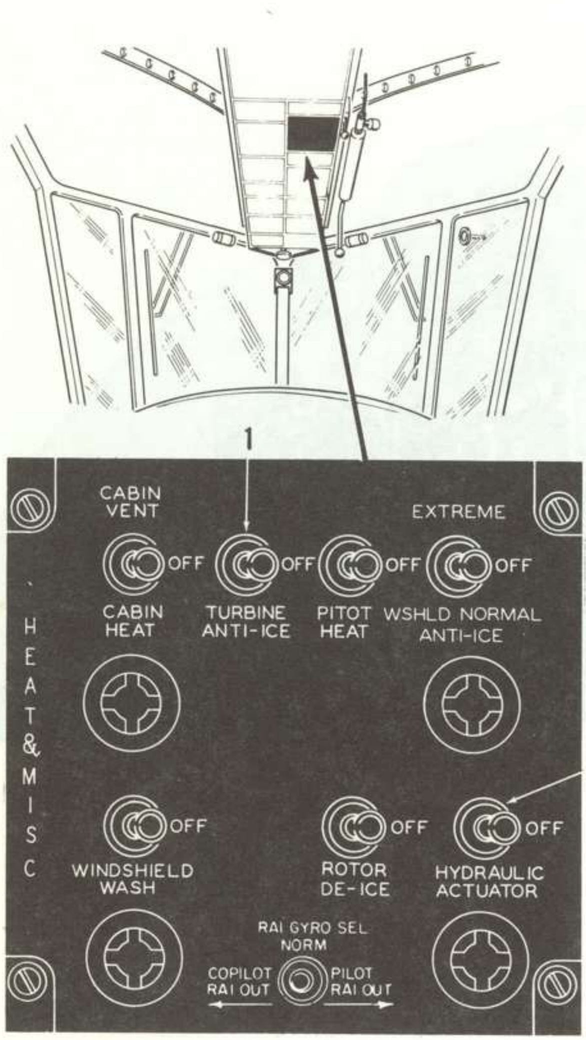
Instrument Panel



21. COMBINING GEARBOX OIL TEMPERATURE GAGE
22. FIRE WARNING LIGHT
23. MASTER CAUTION LIGHT
23A. MASTER CAUTION LIGHT RESET BUTTON
24. MAIN GEARBOX OIL PRESSURE GAGE
25. MAIN GEARBOX OIL TEMPERATURE GAGE
26. DUAL TORQUEMETER
27. FIRE DETECTOR TEST SWITCH
28. NO. 1 ENGINE GAS GENERATOR TACHOMETER
29. NO. 2 ENGINE GAS GENERATOR TACHOMETER
30. NO. 1 ENGINE TURBINE INLET TEMPERATURE GAGE
31. NO. 2 ENGINE TURBINE INLET TEMPERATURE GAGE
32. NO. 1 ENGINE OIL PRESSURE GAGE
33. NO. 2 ENGINE OIL PRESSURE GAGE
34. NO. 1 ENGINE OIL TEMPERATURE GAGE
35. NO. 2 ENGINE OIL TEMPERATURE GAGE
36. NO. 1 SPEED DECREASER GEARBOX OIL PRESSURE GAGE
37. NO. 2 SPEED DECREASER GEARBOX OIL PRESSURE GAGE
38. FISHPOLE CONTROL PANEL
39. NO. 1 SPEED DECREASER GEARBOX OIL TEMPERATURE GAGE
40. NO. 2 SPEED DECREASER GEARBOX OIL TEMPERATURE GAGE
41. PILOT'S AIRSPEED CORRECTION CARD
42. TRIPLE TACHOMETER
43. PILOT'S AIRSPEED INDICATOR
44. PILOT'S RADIO MAGNETIC INDICATOR, OR BEARING DISTANCE HEADING INDICATOR
45. PILOT'S NEEDLE NO. 1 SWITCH
46. PILOT'S DIRECTION VELOCITY INDICATOR
47. PILOT'S REMOTE ATTITUDE INDICATOR
47A. PILOT'S GYRO ERECT BUTTON
48. PILOT'S VERTICAL VELOCITY INDICATOR
49. PILOT'S TURN AND SLIP INDICATOR
50. LANDING GEAR POSITION INDICATORS
51. HYDRAULIC PRESSURE GAGE
52. PILOT'S RADAR ALTIMETER
52A. RAWS TEST SWITCH
52B. RAWS LIGHT
53. PILOT'S BAROMETRIC ALTIMETER
54. PILOT'S CLOCK
55. COURSE INDICATOR
56. GROUNDSPEED DRIFT ANGLE INDICATOR
57. PILOT'S CHECKLIST

Figure 1–9 (Sheet 2)

Turbine Anti-Ice Switch

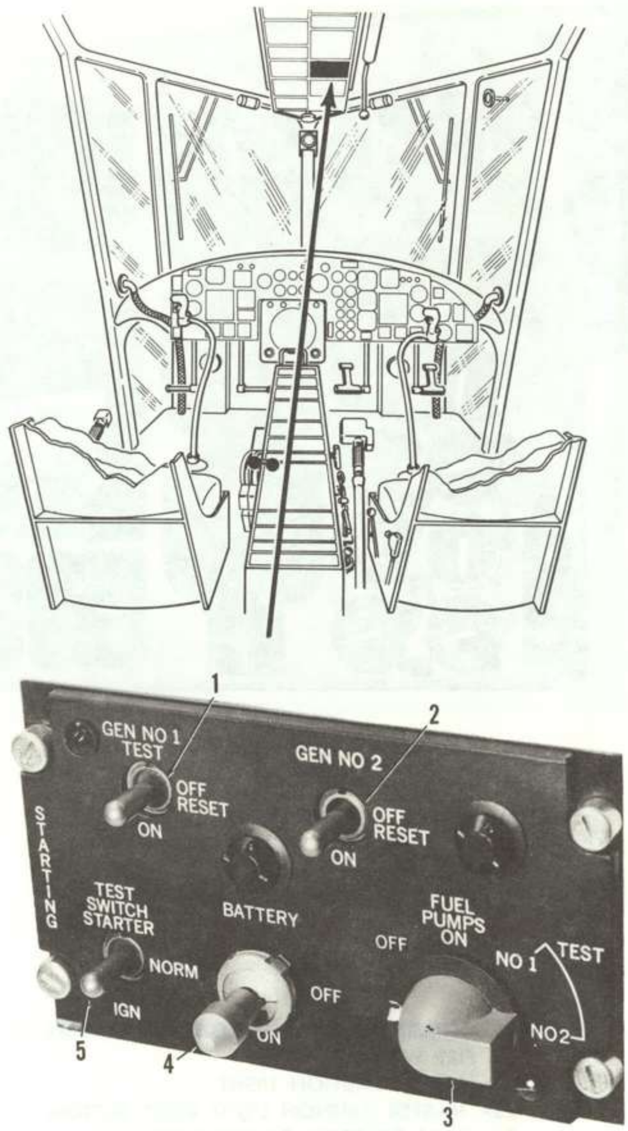


1. TURBINE ANTI-ICE SWITCH
2. HYDRAULIC ACTUATOR SWITCH

Figure 1–10

instrument panel, and indicates gas generator rpm (N_g) in percent. There are two needles on the face of the instrument. The large needle indicates on a dial calibrated from 0 to 100 percent rpm in 2-percent increments. The small needle indicates on a dial calibrated from 0 to 10 percent rpm in 1-percent increments. To determine gas generator rpm (N_g) within 1 percent, read the large needle indication in tens, and add to this reading the units indicated by the small needle. Electrical power to operate the instrument is not provided by the aircraft electrical power supply system, but is supplied directly from the gas generator tachometer generator mounted on the engine lubrication pump. (Refer to part 4 of this section for details of gas generator tachometer markings and operating limitations.)

Starting Panel



1. GENERATOR NO. 1 SWITCH
2. GENERATOR NO. 2 SWITCH
3. FUEL PUMPS SWITCH
4. BATTERY SWITCH
5. STARTER AND IGNITION SYSTEM TEST SWITCH

Figure 1–11

Triple Tachometer.

The triple tachometer (42, figure 1–9) is located in the right center portion of the instrument panel. The instrument indicates power turbine rpm (N_f) of each engine and rotor rpm (N_r) in percent. The three needles indicate rpm on a single dial calibrated from 0 to 130 percent in increments of 2 percent. Electrical power to operate the rotor needle is supplied by the rotor tachometer generator, located on the transmission. Electrical power for the operation of each engine needle is supplied by the power turbine tachometer generator, located on each fuel control. (Refer to part 4 of this section for details of the triple tachometer markings and operating limitations.)

Rotor Overspeed Recorder.

The rotor overspeed recorder (when installed) is mounted below the pilot's pedal adjustment knob. If rotor speed reaches 113% a yellow rectangle will appear in the left window of the recorder. If rotor speed reaches 123% a yellow rectangle will appear in the right window. The recorder is installed to aid maintenance personnel in evaluating the need for component replacement, in the event of rotor speeds higher than the 110% calibration of the triple tachometer. Power for the recorder is provided from the 28-volt dc primary bus through the rotor overspeed recorder (ROTOR OSPD) circuit breaker. Rotor speed signals are provided from the rotor tachometer generator.

Torquemeter.

The dual torquemeter (26, figure 1–9) is located on the instrument panel, and indicates power output shaft torque in % for each engine. The indication is obtained by means of a torque measuring device in each engine speed decreaser gearbox. The torque measuring device consists of two helical gears which tend to move apart as the torque is increased, causing pressure to build up in a small hydraulic chamber. The resulting pressure is directed to a pressure sensing transmitter, which sends an electrical signal to the indicator.

Turbine Inlet Temperature Gage.

A turbine inlet temperature gage (30 or 31, figure 1–9) for each engine is located in the right center section of the instrument panel, and indicates the temperature (T_5) of the gases entering the power turbine in degrees centigrade. The turbine inlet temperature (T_5) is sensed by the thermocouples that project into the hot gas stream in the passage between the gas generator turbine and the power turbine. Since the gage is electrically powered by thermocouples, it is independent of the aircraft electrical power supply system. (Refer to part 4 of this section for details of the turbine inlet temperature gage markings and operating limits.)

Engine Oil Pressure Gage.

An engine oil pressure gage (32 or 33, figure 1–9) for each engine is located in the lower center section of the instrument panel and indicates, in pounds per-square-inch, the pressure of the oil delivered to the engine lubrication system by the engine oil pump. The pressure is detected by a pressure-sensing transmitter which sends an electrical signal to the gage. The gage receives electrical power from the 26-volt ac inverter bus through the engine oil pressure (ENG OIL PRESS) circuit breaker. (Refer to part 4 of this section for details of the gage marking and operating limits.)

Engine Oil Temperature Gage.

An engine oil temperature gage (34 or 35, figure 1–9 for each engine is located in the center section of th instrument panel and indicates, in degrees centigrad the temperature of the oil returning to the tank fror the engine lubrication system. The gage receives its sig nal from a temperature-sensing bulb located in the oi line. The gage receives electrical power from the 28-vol dc primary bus through the engine oil temperatur (ENG OIL TEMP) circuit breaker. (Refer to part 4 o this section for the gage markings and operating limits.)

Speed Decreaser Gear Oil Pressure Gage.

A speed decreaser gear oil pressure gage (36 or 37, fig ure 1–9) for each engine is located in the center sectio of the instrument panel and indicates, in pounds per square-inch, the pressure of the oil delivered to th speed decreaser gearbox by the speed decreaser gearbo oil pump. The pressure is detected by a pressure-sensin transmitter which sends an electrical signal to the gage Electrical power for the instrument is supplied from th 26-volt ac inverter bus through the speed decreaser gea oil pressure (SDG OIL PRESS) circuit breaker. (Refe to part 4 of this section for the gage markings and op erating limits.)

Speed Decreaser Gear Oil Temperature Gage.

A speed decreaser gear oil temperature gage (39 or 40 figure 1–9) for each engine is located in the cente section of the instrument panel and indicates, in degree centigrade, the temperature of the scavenge oil leavin the speed decreaser gearbox. The gage receives its signal from a temperature-sensing bulb located in the oil line. Electrical power for the gage is supplied from the 28-volt dc primary bus through the speed decreaser gear-box oil temperature (SDG GEAR OIL TEMP) circuit breaker. (Refer to part 4 of this section for gage markings and operating limits.)

Fire Warning System and Test Switch.

The fire warning lights are located in the two T-handles (4, figure 1–8) located on the emergency panel on the forward cockpit ceiling. The lights are connected to photoelectric sensors located on each engine. The light will glow and the words FIRE #1 or FIRE #2 will appear if a fire breaks out in the engine compartment. The master fire warning light (22, figure 1–9) will light whenever a T-handle glows. A test switch (27, figure 1–9) for the system is located on the instrument panel. The switch has five positions, marked ENG No. 1 OUTBD, INBD; ENG No. 2 OUTBD, INBD; and NORM. When the switch is moved to any of the test positions, continuity only in that part of the system is checked, and if the system is functioning properly, the T-handle for that engine will light up. The switch should be in the NORMAL position during flight. Electrical power for the system is supplied from the 28-volt dc primary bus through the No. 1 and No. 2 engine fire detector (NO. 1 ENG FIRE DET, and NO. 2 ENG FIRE DET) circuit breakers. The fire warning system senses visible infrared radiation (Flame) and will trigger the fire warning system above a predetermined intensity. The fire warning system will not TEST in bright sunlight with cowlings removed.

Note

The fire warning light may come on in the full sunlight of the late afternoon or early morning with the engine exhaust ducts towards the sun. A change of heading by a few degrees, either left or right, should make the light go out unless a true fire exists.

FIRE EXTINGUISHING SYSTEM.

A fire extinguishing system is installed for each engine compartment. Each system consists of a spherical container charged with an extinguishing agent (bromotrifluromethane, CF_3BR) under high pressure, lines leading from the sphere to the engine compartment, an electrical squib, and a control switch. The system is controlled from the emergency panel. When either of the T-handles (4, figure 1–8) on the panel is pulled, the firewall shutoff valves for that engine are closed and the fire extinguishing agent discharge switch for that engine is armed. When the agent discharge switch is moved forward, the squib is electrically actuated, firing a slug which ruptures a disc in the sphere, releasing the agent, which flows under pressure through the lines, into the engine compartment at two places. Each spherical container has a pressure gage for determining proper charge. The systems receive electrical power from the 28-volt dc primary bus through the number one engine fire extinguisher (NO. 1 ENG FIRE EXT) and number two engine fire extinguisher (NO. 2 ENG FIRE EXT) circuit breakers. After AFC 155 the fire extinguishing system has cross feed plumbing so that, if necessary, both agent containers can be directed to either engine. After a T-handle has been pulled, the agent discharge switch is moved aft to NORMAL to discharge the agent container for that engine. If required, the agent discharge switch is moved forward to RESERVE to discharge the second container through the cross feed plumbing.

ENGINE OIL SYSTEM

The engine oil system (figure 1–12) supplies oil for lubrication of each engine and the speed decreaser gearbox. The system for each engine includes one oil tank, two lube scavenge pumps, and two oil coolers. Oil is fed by gravity to both pumps. The lube section of the engine pump delivers pressure oil, through a filter, to the various parts of the engine requiring lubrication. The scavenge section of the engine pump returns the scavenge oil, through the engine oil cooler, to the tank. The lube section of the speed decreaser gearbox pump delivers pressure oil through a filter, to the speed decreaser gearbox. The scavenge section of the speed decreaser gearbox pump then pumps the scavenge oil through the speed decreaser gearbox oil cooler, and back to the tank. The T-handles on the emergency panel labeled FIRE, control the engine oil firewall shutoff valves. Each valve will close when the T-handle for that engine is pulled, thus preventing oil from the tank from flowing to the engine side of the firewall. The purpose of the fire T-handle is to cut off all fluid at the firewall in the event of a fire in the engine compartment. There is no firewall shutoff valve in the speed decreaser gearbox lines because all oil flow in that system is external to the engine compartment. The oil tanks have a usable capacity of 5 gallons with a 20% expansion space. The tanks are located behind the engines. The engine pumps are mounted on the forward part of the engine, and the speed decreaser gearbox pumps are mounted at the rear of the speed decreaser gearboxes. The tanks are gravity filled through filler necks on the tanks. See the servicing diagram, figure 1–62, for specification and grade of oil.

OIL COOLERS.

The engine oil cooler is an oil-to-fuel heat exchanger with an associated oil bypass valve. The flow of oil through the cooler depends on the oil temperature. At lower temperatures, the pressure differential across the cooler causes most of the oil to flow through the bypass valve. At higher temperatures the lower viscosity reduces the pressure differential causing the bypass valve to close, and all of the oil flows through the cooler. The engine oil cooler is mounted on the forward part of the engine.

The speed decreaser oil cooler is located in the engine compartment aft of the combining gearbox. Cooling air is furnished by the oil cooler blower mounted in front of the oil cooler.

When the oil temperature is low, the valve causes a controlled portion of the oil to bypass the cooler and to flow directly to the tank. When the temperature of the oil rises, a thermal valve in the cooler causes the oil to flow through the cooler. The oil cooler blower provides cooling air for both the speed decreaser gearbox and transmission oil coolers.

ENGINE OIL PRESSURE CAUTION LIGHTS.

The engine oil pressure caution lights are located on the caution light panel (figure 1–56). The lights are controlled by a pressure-sensitive switch which is controlled by the same pressure that controls the engine oil pressure gage. When the engine oil pressure falls to the minimum (refer to part 4 of this section), the light will glow. The lights are labeled NO. 1 ENG OIL PRESS and NO. 2 ENG OIL PRESS. The lights receive electrical power from the 28-volt dc primary bus through the engine oil pressure light (ENG OIL PRESS LT) circuit breaker on the fuse and circuit breaker panel.

SPEED DECREASER GEAR OIL PRESSURE CAUTION LIGHTS.

The speed decreaser gear oil pressure caution lights are located on the caution light panel (figure 1–56). The lights are controlled by a pressure-sensitive switch which

Engine and Speed Decreaser Gear Oil System

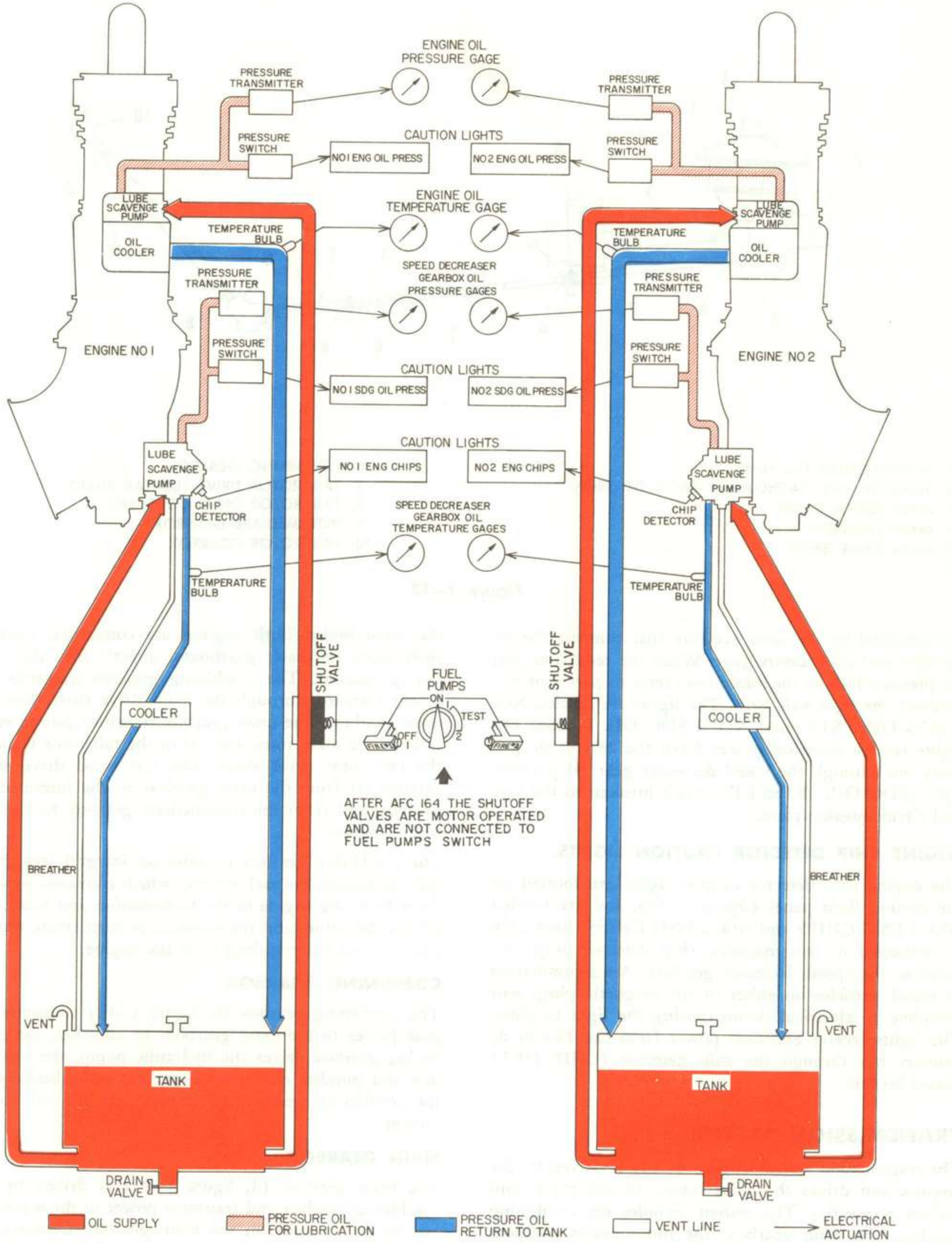
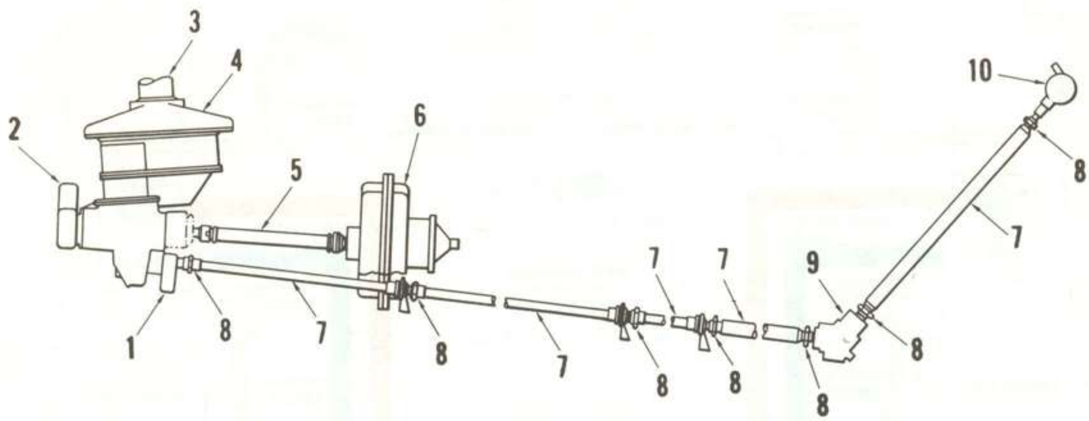


Figure 1—12

Transmission System



1. TRANSMISSION OIL PUMP
2. RESOLVER AND TACHOMETER DRIVE GEARBOX
3. MAIN ROTOR SHAFT
4. MAIN GEARBOX
5. MAIN DRIVE SHAFT
6. COMBINING GEARBOX
7. TAIL ROTOR DRIVE TUBULAR SHAFT
8. TAIL ROTOR DRIVE COUPLING
9. INTERMEDIATE GEARBOX
10. TAIL ROTOR GEARBOX

Figure 1—13

is controlled by the same pressure that controls the reduction gear oil pressure gage. When the reduction gear oil pressure falls to the minimum (refer to part 4 of this section) the light will glow. The lights are labeled NO. 1 SDG OIL PRESS and NO. 2 SDG OIL PRESS. The lights receive electrical power from the 28-volt dc primary bus through the speed decreaser gear oil pressure light (SDG OIL PRESS LT) circuit breaker on the fuse and circuit breaker panel.

ENGINE CHIP DETECTOR CAUTION LIGHTS.

The engine chip detector caution lights are located on the caution light panel (figure 1—56), and are labeled NO. 1 ENG CHIPS and NO. 2 ENG CHIPS. Each light is connected to two magnetic chip detector plugs, located in the speed decreaser gearbox. An accumulation of metal particles on either of the magnetic plugs will complete an electrical circuit causing the light to glow. The lights receive electrical power from the 28-volt dc primary bus through the chip detector (CHIP DET) circuit breaker.

TRANSMISSION SYSTEM

The transmission system (figure 1—13) is driven by the engines and drives the main rotor, the tail rotor, and certain accessories. The system includes the combining gearbox, the main gearbox, the intermediate gearbox, the tail rotor gearbox, the transmission oil system, and the rotor brake. Both engines are connected, through their speed decreaser gearboxes, directly into the combining gearbox. The combining gearbox transmits the power forward, through the main drive shaft, into the main gearbox. The main gearbox transmits power vertically to the main rotor and aft to the tail rotor through the tail rotor drive shaft. The tail rotor drive shaft extends aft from the main gearbox to the intermediate gearbox and from the intermediate gearbox to the tail rotor gearbox.

The combining gearbox contains an integral freewheeling mechanism for each engine, which transmits positive drive from the engine to the transmission and rotor, but allows the rotors and transmission to turn freely during autorotation without drag from the engine.

COMBINING GEARBOX

The combining gearbox (6, figure 1—13) transmits engine power to the main gearbox. In addition, the combining gearbox drives the hydraulic pump, the number one and number two generators, the rotor brake disc, the combining gearbox oil pump, and the oil cooler blower.

MAIN GEARBOX.

The main gearbox (4, figure 1—13) is driven by the combining gearbox and transmits power to the main and tail rotors. In addition the main gearbox transfers lift forces from the main rotor to the aircraft structure. The main gearbox also drives the rotor tachometer generator, the inflight tracking resolver drive assembly, and the main gearbox oil pump.

INTERMEDIATE GEARBOX.

The intermediate gearbox (9, figure 1–13) is driven by the tail rotor drive shaft from the main gearbox and transmits power upward through the tail rotor shaft to the tail rotor gearbox. The intermediate gearbox is lubricated by a self-contained system. A sight gage in the side of the box permits a visual check of the oil level.

TAIL ROTOR GEARBOX.

The tail rotor gearbox (10, figure 1–13) is driven by the main gearbox through the tail rotor drive shaft and intermediate gearbox. The tail rotor gearbox drives the tail rotor through the tail rotor shaft. The tail rotor gearbox is lubricated by a self-contained system. A sight gage in the side of the box permits a visual check of the oil level.

TRANSMISSION OIL SYSTEM.

The transmission oil system (figure 1–15) supplies oil for the lubrication of the main and combining gearboxes. Lube-scavenge pumps attached to and driven by each gearbox draw oil from a common tank and deliver it under pressure to each gearbox. The scavenge sections of the pumps then return it to the tank. An oil cooler is located in the return line of the combining gearbox. The tank has a usable capacity of 5 gallons and provides 37% expansion space. See servicing diagram (figure 1–62) for specification and grade of oil.

Transmission Oil Cooler.

The transmission oil cooler is located at the rear of the nacelle. Cooling air is furnished by the oil cooler blower mounted forward of the coolers. The blower supplies cooling air for both the transmission oil cooler and the two speed decreaser gearbox oil coolers, and is driven through a shaft by the combining gearbox. When the oil temperature is low, a thermal valve in the cooler causes a controlled portion of the oil to bypass the coolers and to flow directly to the tank. When the oil temperature rises, the valve causes the oil from the combining gearbox to flow through the cooler.

Transmission System Oil Pressure Gages.

Two oil pressure gages (20 and 24, figure 1–9) are located near the center of the instrument panel. One gage indicates oil pressure in the main gearbox and the other indicates oil pressure in the combining gearbox. Both read pressure in pounds per-square-inch. The instruments receive electrical signals from pressure transmitters which sense oil pressure at the two oil pump outlets. The gages receive electrical power from the 26-volt ac inverter bus through the transmission oil pressure (XMSN OIL PRESS) and combining gearbox oil pressure (COMB BOX OIL PRESS) circuit breakers.

Transmission System Oil Pressure Caution Lights.

Two transmission system oil pressure caution lights are located on the caution light panel (figure 1–56). The lights are amber and are controlled by pressure-sensitive switches located in each gearbox oil system. When the gearbox oil pressure falls below the minimum (refer to part 4 of this section), the light will glow and the words TRANS OIL PRESS or COMB BOX OIL PRESS will appear. The lights receive electrical power from the 28-volt dc primary bus through the transmission oil pressure light (XMSN OIL PRESS LT) and the combining gearbox oil pressure light (COMB BOX OIL PRESS LT) circuit breakers.

Transmission System Oil Temperature Gages.

Two oil temperature gages (21 and 25, figure 1–9) are located near the center of the instrument panel. One gage indicates oil temperature in the main gearbox and the other indicates oil temperature in the combining gearbox. Both read temperature in degrees centigrade. The instruments receive electrical signals from temperature bulbs located in the scavenge outlets of the two pumps. The gages receive electrical power from the 28-volt dc primary bus through the transmission oil temperature (XMSN OIL TEMP) and combining gearbox oil temperature (COMB BOX OIL TEMP) circuit breakers.

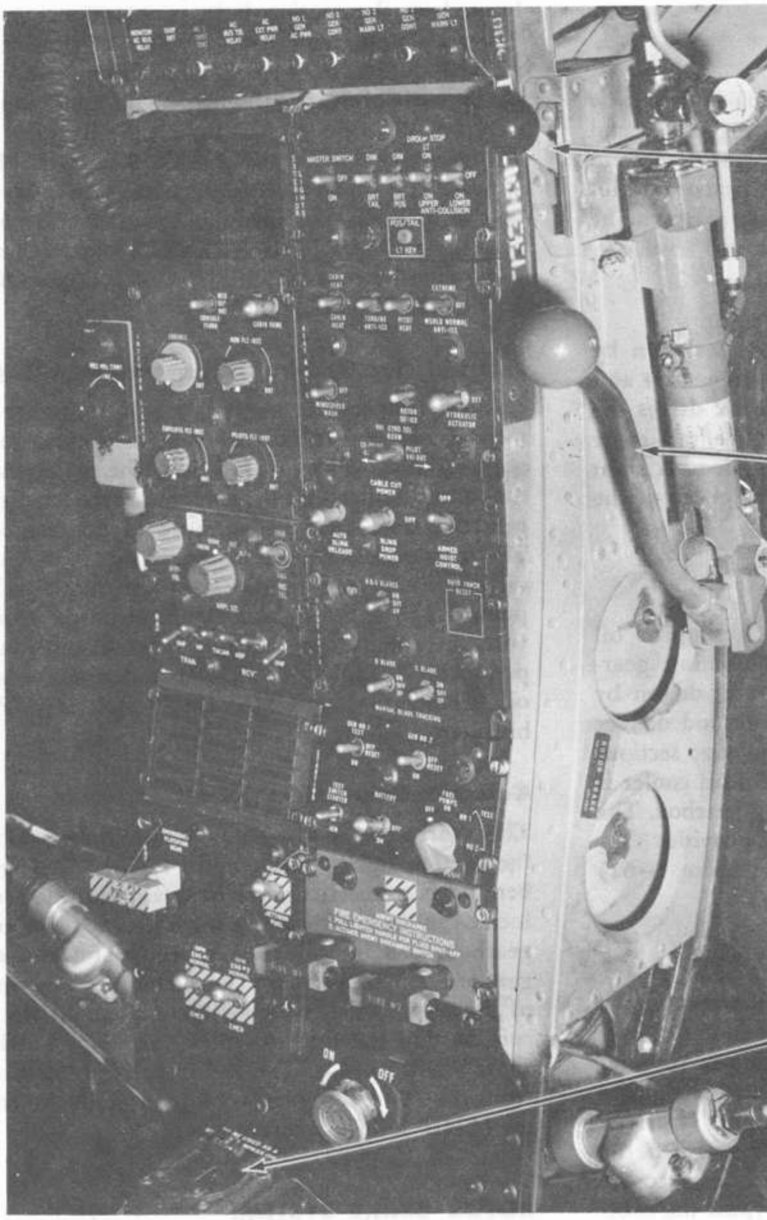
Gearbox Chip Detector Caution Light.

The gearbox chip detector caution light is located on the caution light panel (figure 1–56). The light is amber and is connected to six magnetic chip detector plugs, located in the sumps of the main gearbox, the combining gearbox, the intermediate gearbox and the tail rotor gearbox. An accumulation of metal particles on any one of the six magnetic plugs will complete an electrical circuit causing the light to glow. The words GEARBOX CHIPS will appear. The light receives electrical power from the 28-volt dc primary bus through the chip detector (CHIP DET) circuit breaker.

ROTOR BRAKE SYSTEM.

The rotor brake is a single-disc mechanical friction unit mounted on the combining gearbox. The brake acts on the combining gearbox output shaft. Application of the brake is controlled by the rotor brake lever, which applies fluid from the master cylinder, actuating the friction braking mechanism. At the same time, an electrical inter-lock mechanism prevents the engine condition lever from being advanced to the FLY position. When the brake is released the engine condition lever may be advanced as desired. The system is supplied hydraulic fluid from the main hydraulic reservoir mounted on the transmission support. When the brake is engaged, a holding pressure of approximately 275 psi is maintained in the system by an air-charged accumulator. A pressure gage mounted on the rotor brake master cylinder indicates pressure applied to the rotor brake.

Cockpit Ceiling



1. TAIL WHEEL LEVER
2. ROTOR BRAKE LEVER
3. STANDBY COMPASS

Figure 1–14

Rotor Brake Lever.

The rotor brake lever (2, figure 1–14) is located in the center of the cabin ceiling and is connected directly to the master cylinder. The brake may be applied with a controlled amount of pressure by pulling down and aft on the lever. The brake may be locked by pulling the handle all the way back. The brake is released by moving the lever down and forward.

CAUTION

Tailwheel should be locked to prevent ground looping if rotor brake is applied too rapidly.

ROTOR SYSTEM

The rotor system includes the main rotor and the tail rotor. Both the main rotor and the tail rotor are driven by the engines through the transmission system.

MAIN ROTOR.

The main rotor is composed of the rotor hub, four blade retention assemblies, and four blades. The blades are attached to the blade retention assemblies which are connected to the hub by means of flapping hinges and lead-lag hinges. The rotor hub is bolted to the transmission rotor shaft. All lift from the main rotor is transferred to the transmission through the transmission

Transmission Oil System

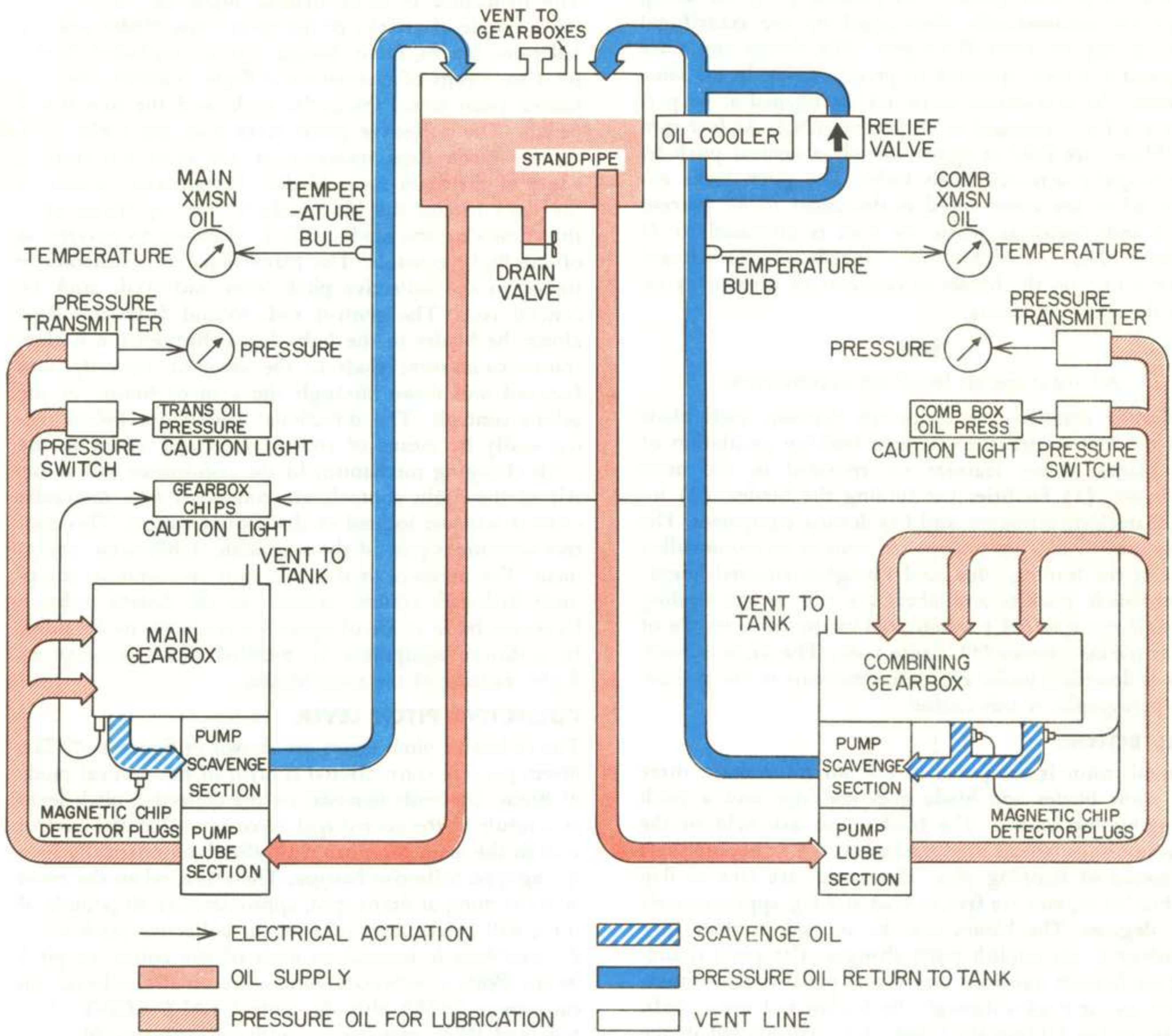


Figure 1–15

rotor shaft, and from the transmission to the aircraft structure at the transmission mounts. Droop stops limit the downward angling of the blades, and anti-coning stops prevent the blades from flapping upward. The droop stops and anti-coning stops prevent flapping of the blades only when the rotor is at rest or turning slowly. At a rotor speed of 64 percent (N_r) the droop stops are automatically disengaged by the centrifugal force acting on their flyweights. The droop stops are engaged at a rotor speed of 53 percent (N_r). In the same manner, the anti-coning stops are disengaged at 46 percent (N_r) and engaged at 38 percent (N_r). At low rpm the blades are held in approximately a neutral pitch by centrifugally actuated pitch locks. The pitch locks engage when the rotor speed is decreased to 43 percent (N_r) and disengage when the rpm is increased to 45 percent (N_r). At higher rotor speeds, the centrifugal force acting on the blades is sufficient to prevent excessive drooping or coning.

Note

All rotor speeds listed are approximate.

Hydraulic dampers are connected between each blade and the hub to prevent excessive lead-lag oscillation of the blades. Other features incorporated in the main rotor are: (1) facilities for folding the blades, (2) in-flight tracking actuators, and (3) deicing equipment. The main rotor blades are constructed with an aluminum alloy spar at the leading edge, and fiberglass covered honeycomb blade pockets and fiberglass ribs at the trailing edge. Rotor rpm (N_r) is indicated by the rotor needle of the triple tachometer (42, figure 1—9). The triple tachometer is described under engine instruments in the preceding paragraphs of this section.

TAIL ROTOR.

The tail rotor is composed of the tail rotor shaft, three tail rotor blades and blade grip housings and a pitch changing mechanism. The blade roots are held in the grip housings, which are attached to the tail rotor shaft by means of flapping pins. The blades are free to flap within limits, and are free to lead and lag approximately 1½ degrees. The blades may be rotated in their grip housings to accomplish pitch changes. The pitch changing mechanism transmits directional pedal control movements to the blades through the hollow tail rotor shaft. Facilities for folding the blades are incorporated in the tail rotor. The tail rotor blades are constructed with an aluminum alloy spar at the leading edge. The trailing edge is constructed of aluminum honeycomb covered with sheet aluminum.

ROTOR SYSTEM CONTROL.

The pitch of the main rotor blades is changed by means of the blade servo flaps, which are attached at the outboard trailing edge of each blade. Aerodynamic action of the flaps changes blade pitch by causing the blades and the outer portions of the blade retention assemblies to rotate. The inner portions of the blade retention assemblies do not rotate. The servo flaps are controlled by the collective pitch lever and the cyclic stick which are connected to the servo flaps by mechanical linkages. The pitch of the tail rotor blades is controlled by the directional pedals, which are connected by mechanical linkage to the tail rotor pitch changing mechanism.

FLIGHT CONTROL SYSTEM

The helicopter is controlled in flight by varying the pitch (angle of attack) of the main rotor blades and the tail rotor blades. Pitch changes are accomplished by the pilot by means of conventional flight controls: the collective pitch lever, the cyclic stick, and the directional pedals. The collective pitch lever and the cyclic stick actuate blade flaps mounted at the outboard trailing edges of the main rotor blades. Aerodynamic action of the flaps rotates the blades about their spanwise axes, thus changing the blade pitch in response to movement of the flight controls. The blade flaps are mechanically linked to the collective pitch lever and cyclic stick by control rods. The control rods extend from the flaps along the blades to the hub, down through the hollow transmission rotor shaft to the azimuth assembly, and forward and down through the control tunnel to the pilot's controls. The directional pedals are linked mechanically by means of control rods and cables to the pitch changing mechanism in the anti-torque tail rotor. All of the flight controls are connected to a hydraulic control actuator located in the control tunnel. This control actuator is part of the automatic stabilization equipment. The presence of the automatic stabilization equipment hydraulic control actuator in the system makes a hydraulic boost mode of operation available to the pilot. In addition, equipment is installed which permits in-flight tracking of the rotor blades.

COLLECTIVE PITCH LEVER.

The collective pitch levers are shown in figure 1—7. The levers provide conventional control of the vertical mode of flight. Up-loads imposed on the collective pitch lever as a result of the centrifugal force acting on the control rods in the main rotor are neutralized automatically by a spring-type collective bungee. Therefore, when the rotor is not turning at flight rpm, approximately 30 pounds of force will be required to raise the collective pitch lever. A switchbox is located on each of the collective pitch levers. Both switchboxes contain automatic stabilization equipment (ASE) altitude control (ALT CONT) buttons and RPM switches. In addition, the switchbox on the pilot's collective pitch lever contains the boost release button, and switches for control of the floodlight, landing light, and the cargo hook. (These switches are described elsewhere in this section. Refer to index.)

Collective Pitch Lever Friction Nut.

The collective pitch lever friction nut (8, figure 1—7) is located on the collective pitch lever below the grip. The desired amount of friction on the lever can be obtained by turning the nut to the left for increase, and to the right for decrease. The friction nut, when turned, rotates a rheostat through a mechanical gear train. The rheostat varies the electrical power applied to an electromagnetic brake which provides the friction on the lever.

Cyclic Stick Grips

1. COPILOT'S CYCLIC STICK GRIP
2. PILOT'S CYCLIC STICK GRIP
3. CYCLIC STICK TRIM SWITCH

Figure 1—16

This circuit receives electrical power from the 28-volt dc primary bus through the collective friction (COLL FRICTION) circuit breaker. Due to the fact that this is an electrical device, it should be noted that in the event of total electrical power failure, the friction nut would be inoperative, and friction would be off.

CYCLIC STICK.

The cyclic sticks (figure 1—16) provide conventional lateral and longitudinal control of the helicopter. The cyclic stick grip contains a cyclic stick trim switch and several switches for the control of auxiliary equipment.

Cyclic Stick Trim Switch.

The cyclic stick trim switches (3, figure 1—16) operate electrical actuators which change the spring force of struts which determine the hands-off position of the cyclic stick. Using the trim switch, the cyclic stick can be adjusted for neutral pressure and can be released for hands-off flying. The cyclic stick trim switch receives electrical power from the 115-volt ac primary bus through the automatic stabilization equipment (ASE) fuses.

A two-speed cyclic trim feature is incorporated. A slow rate of trim is obtained by depressing the trim switch in the desired direction without applying stick pressure. To obtain a faster rate of cyclic trim, apply stick pressure and depress the trim switch in the desired direction.

DIRECTIONAL PEDALS.

The directional pedals provide control of the heading of the aircraft by varying the pitch of the anti-torque tail rotor blades. When the hydraulic boost is operating and the ASE has warmed up, control forces on the pedals are automatically trimmed out when the heading is constant, or when the rate of turn is less than approximately 3 degrees per second. When the hydraulic boost and/or ASE are not operating, pedal force can be trimmed out by use of yaw trim switch. Toe brake pedals are mounted at the top of the pilot's directional pedals (refer to the BRAKE SYSTEM paragraph in this section).

Directional Pedals Positioning Knob.

The directional pedals positioning knob enables the directional pedals to be adjusted to the pilot's leg length.

Yaw Trim Switch.

The yaw trim switch (5, figure 1—7) operates an electrical actuator which changes the spring force on a strut which determines the feet-off position of the directional pedals. The switch receives electrical power from the 115-volt ac primary bus through the automatic stabilization equipment (ASE) fuses. The yaw trim switch operates in various ways, depending on whether the hydraulic boost and the ASE are in operation.

With the ASE disengaged, and the hydraulic boost off, the switch operates strictly as a motorized pedal trim switch.

See **Yaw Trim Switch When Under ASE Control.**

AUTOMATIC STABILIZATION EQUIPMENT (ASE)

DESCRIPTION.

The ASE is designed to automatically maintain the helicopter in any airspeed, roll attitude, and on any heading established by the pilot. In addition, the equipment, when called upon, will maintain altitude, or groundspeed, or both. While the ASE is engaged, the pilot may maneuver the aircraft in any manner within its maneuvering capability. Upon completion of the maneuvers, the ASE will stabilize the aircraft in any airspeed, roll attitude, and heading for which it is trimmed. The equipment will operate efficiently throughout the altitude and speed range of the helicopter, including hovering. In turbulent air, the ASE will restore the aircraft to its preset attitude and heading with not more than one overshoot. The ASE may be engaged or disengaged at any time during level flight without objectionable disturbance, and the helicopter may be precisely trimmed while under ASE control. Heading signals come from the MA-1 compass. (See figure 1—17 for a block diagram of the equipment.) Airspeed signals come from the airspeed transducer. Altitude signals come from either the radar altimeter or the barometric altimeter, depending on which the pilot selects. Groundspeed and altitude

ASE Block Diagram

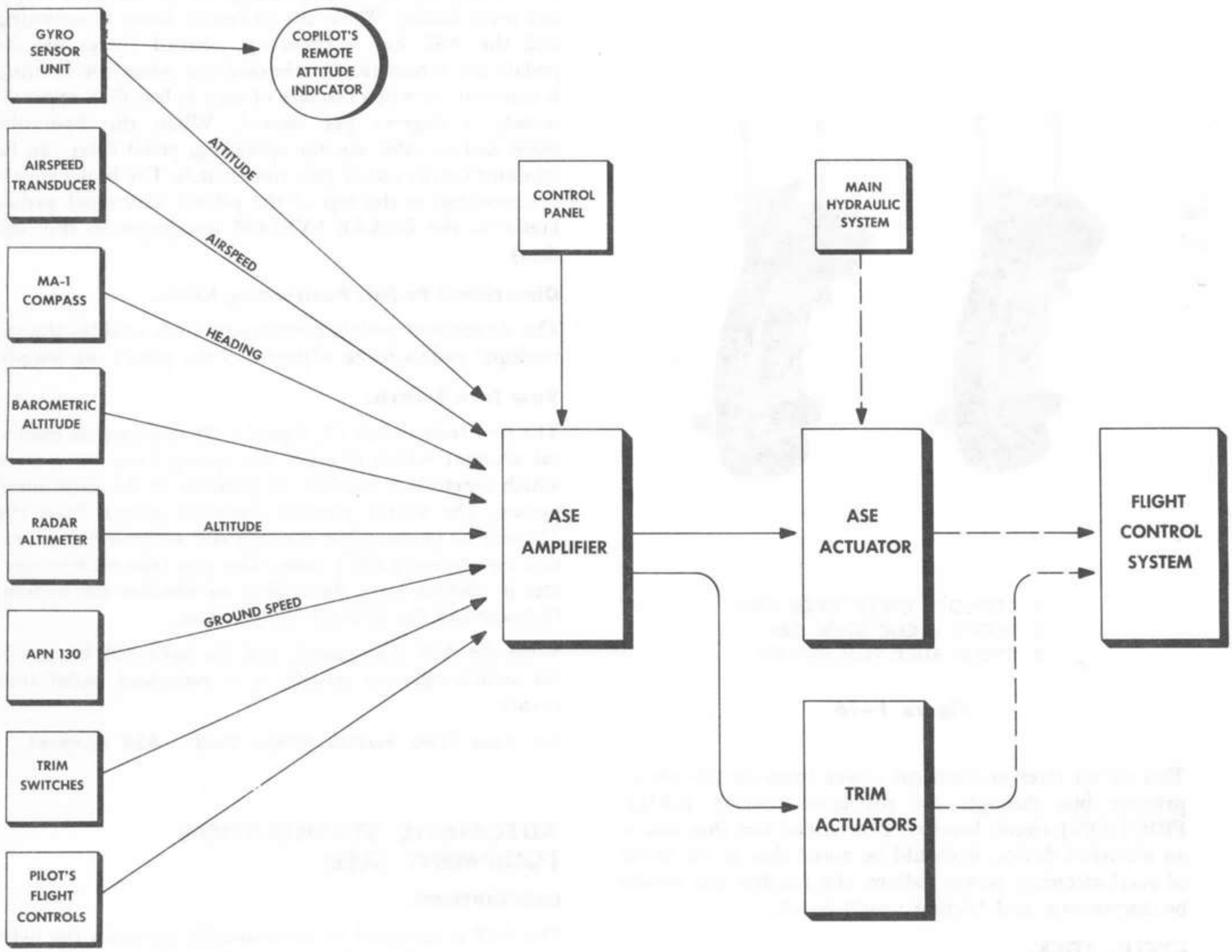


Figure 1—17

rate of change signals are received from the APN-130 radar system. Attitude information is provided by the ASE gyro sensor unit, which also controls the copilot's remote attitude indicator. The pilot may, at any time, override the ASE, using the primary flight controls or the trim switches. All input signals are fed into the ASE amplifier. The amplifier sums, amplifies, and synchronizes the various signals into an integrated command signal. This signal is fed to the ASE hydraulic actuator which responds with a mechanical output to the rotor system. The system receives electrical power from the 115/200-volt ac primary bus through one ASE circuit breaker, or three ASE fuses; from the 26-volt ac primary bus through one ASE fuse; from the 28-volt dc primary bus through the ASE circuit breaker and the hydraulic actuator fuse. All fuses and circuit breakers are located on the fuse and circuit breaker panel (see figure 1—31). Hydraulic power comes from the main hydraulic system (see figure 1—21). The ASE control panel (figure 1—18) is located on the console. Other ASE controls are located on the pilot's collective pitch lever and cyclic stick (see figure 1—18). Refer to **SYSTEMS CHECKS,** Section III for the ASE ground check procedure.

Hydraulic Actuator Switch.

The hydraulic actuator switch (2, figure 1—10) is located on the heat and miscellaneous panel on the cockpit ceiling. The switch turns the ASE hydraulic actuator on when moved to the ON (HYDRAULIC ACTUATOR) position and off when moved to the OFF position. The hydraulic actuator may be turned off by means of the boost release button. In this case, the hydraulic actuator switch will not go to the OFF position. To turn the actuator on again, the hydraulic actuator switch must be moved to OFF and back to ON. The hydraulic actuator receives hydraulic power from the main hydraulic system (figure 1—21), and supplies power to actuate the flight control system as directed by the ASE. The switch must be on before the ASE may be engaged. The actuator may also be used independently of the ASE as a hydraulic booster for the flight controls.

Boost Release Button.

The boost release button (10, figure 1—18) is located on the pilot's collective pitch lever switchbox. The button is provided to enable the pilot to disengage the hydraulic actuator without removing his hand from the collective pitch lever. The button cannot be used to engage the actuator. The actuator may be engaged only by use of the hydraulic actuator switch.

ASE Engage Switch.

The ASE engage switch (1, figure 1—18) activates the basic ASE when moved to the ENGAGED position, and places the entire system in a standby condition when moved to the STANDBY position. With the ASE engage switch in the ENGAGE position, the aircraft will be stabilized on the existing heading and on the airspeed and roll attitude for which the aircraft is trimmed. The pilot may, at any time while the system is engaged, change the airspeed, attitude, or heading using the normal flight controls or the appropriate trim switches. When the controls are released, the aircraft will once again be stabilized on the existing heading and on the airspeed and roll attitude for which the aircraft is trimmed. If the pitch and roll trim has not been changed, the aircraft will return to its originally stabilized attitude.

Note

When the cyclic stick is displaced longitudinally without the use of trim, it will not return to its original position immediately, but will overshoot and then return slowly. This is due to the trim follow-up feature, and the time to return to trim will be a function of trim actuator speed and the length of time the stick is displaced from trim.

The ASE engage switch will not stay in the ENGAGE position unless power is available, the system has warmed up for 3 minutes, and the hydraulic actuator switch (2, figure 1—10) is ON. The power flag on the copilot's remote attitude indicator will disappear at the completion of warmup, indicating that the ASE can be engaged. The flag will reappear in the event of any ASE electrical power malfunction. The switch will move to the STANDBY position when the hydraulic actuator switch is turned off or when the ASE disengage button (7, figure 1—18) is depressed.

Yaw Damper. With ASE engaged yaw damping is provided when the aircraft is flying at an airspeed of 50 knots or less, feet on or off the pedals, if the turn rate of the helicopter is less than 3 degrees per second. Above 50 knots the damper is operative, feet on or off pedals, regardless of the turn rate provided the collective pitch lever is greater than 10 percent from full down. The collective pitch lever position will generally be greater than 10 percent from full down except during autorotations.

Yaw Trim Switch When Under ASE Control.

With the ASE engaged, the switch operates as follows:

1. When the rate-of-turn is less than 3 degrees per second and feet are off the pedals, the switch functions as a heading adjust switch which changes the aircraft's heading at the rate of 4 degrees per second as long as the switch is depressed.
2. When the rate-of-turn is less than 3 degrees per second and feet are on the pedals, the switch is inoperative, and the control force applied to the pedals is automatically trimmed out.
3. When the rate-of-turn is greater than 3 degrees per second, or when the coordinated turn button is depressed, the switch operates as a motorized pedal trim switch.

With the ASE disengaged and the hydraulic boost on, the switch operates as follows:

1. When the rate-of-turn is less than 3 degrees per second and a control force is applied to the pedals, the switch is inoperative and the control force is automatically trimmed out.
2. In all other cases the switch operates as a motorized pedal trim switch.

Coordinated Turn Button.

When the coordinated turn button (8, figure 1—18) is pressed, the heading hold signal to the ASE from the MA-1 compass is disconnected. While pressing the coordinated turn button, the pilot may make coordinated turns using only the cyclic stick. It is not necessary to apply directional pedals in the direction of the turn. The ASE automatically applies approximately the correct amount of directional pedal.

Directional Pedal Switches.

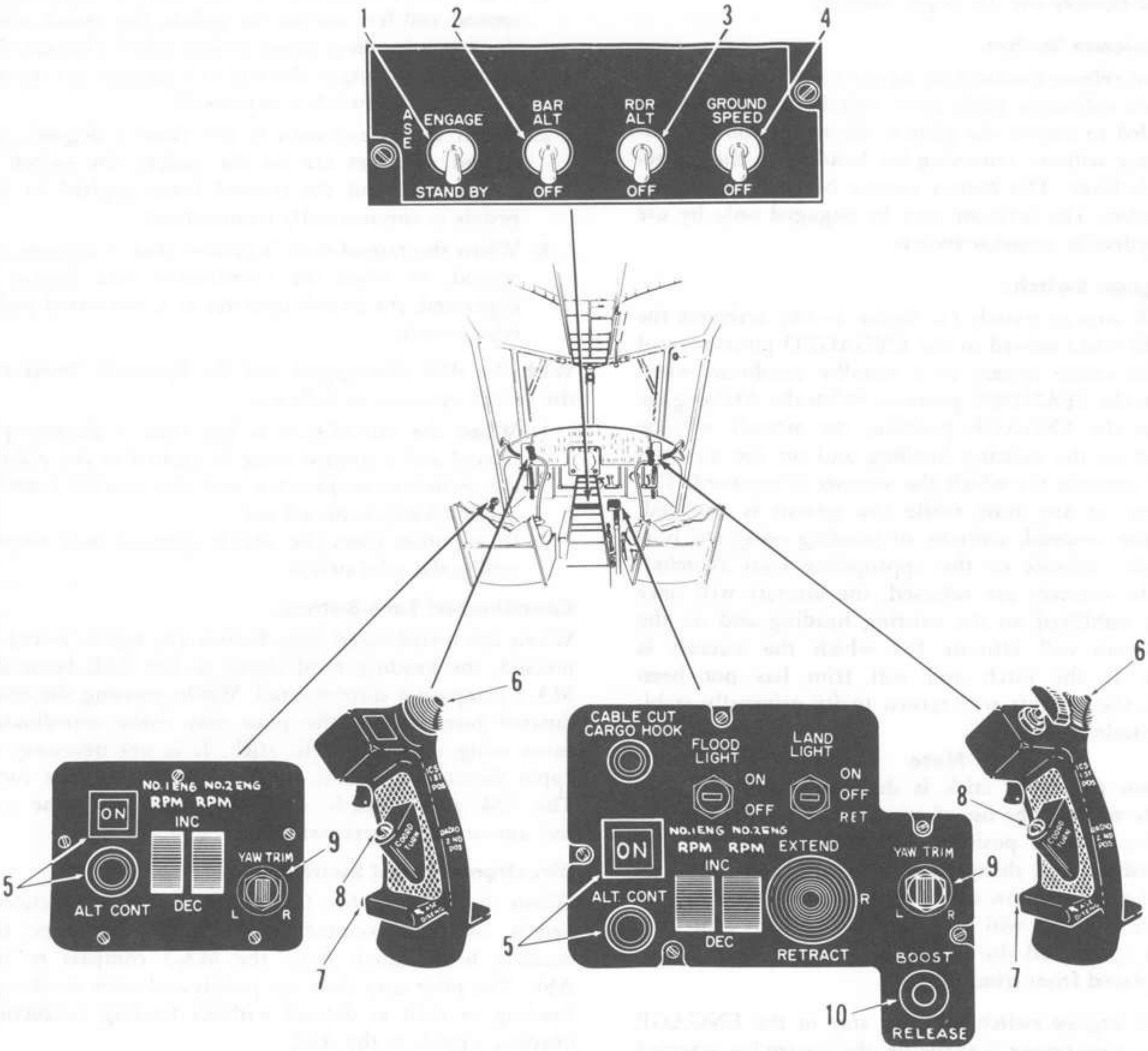
When the pilot applies foot pressure to the directional pedals, switches mounted on the pedals disconnect the heading hold signals from the MA-1 compass to the ASE. The pilot may then use pedals and stick to change heading or turn as desired without feeding conflicting heading signals to the ASE.

When flying with ASE or boost on, and the pilot is holding heading, or turning at a rate less than approximately 3 degrees per second, the control forces on the directional pedals are automatically trimmed out.

Barometric Altitude Switch.

The barometric altitude switch (2, figure 1—18), connects and disconnects signals from the barometric altimeter to the ASE. The ASE engage switch must be in ENGAGE before the barometric altitude switch will stay in the BAR ALT position. When the switch is moved to BAR ALT, and the altitude control button is depressed momentarily, the ASE will, in addition to holding airspeed and heading, maintain the established barometric altitude of the helicopter by controlling the collective pitch. The pilot may, at any time while under

ASE Controls



1. ASE ENGAGE SWITCH
2. BAROMETRIC ALTITUDE SWITCH
3. RADAR ALTITUDE SWITCH
4. GROUNDSPEED SWITCH
5. ALTITUDE CONTROL BUTTON AND ANNUNCIATOR
6. CYCLIC STICK TRIM SWITCH
7. ASE DISENGAGE BUTTON
8. COORDINATED TURN BUTTON
9. YAW TRIM SWITCH
10. BOOST RELEASE BUTTON

Figure 1—18

barometric altitude control, change altitude by applying force to the collective pitch lever. The ASE will maintain the new altitude when the pilot releases the collective pitch lever.

In order to provide stability and smoothness at cruising speed, the sensitivity of the barometric altitude mode is low. As a result, when making rapid airspeed transitions it will be necessary to make manual adjustments of the collective pitch lever to maintain altitude.

The collective pitch lever friction lock does not interfere with operation of the system. The lock is automatically released when altitude control is engaged. The barometric altitude switch will move to OFF when the ASE engage switch is turned to STANDBY, or when the ASE disengage button is depressed.

The BAR ALT mode utilizes a sensitive-pressure transducer, connected to the static vent system, for altitude measurement. The BAR ALT performance is degraded when aircraft speed and altitude are so low that rotor wash strikes the ground below aircraft. In addition, the BAR ALT mode may allow altitude excursions of 25 feet or more during maneuvers or in gusty air. Therefore, it is recommended that BAR ALT be used only at altitudes above 50 feet and only at airspeeds below 120 knots. When flying in turbulent air, the BAR ALT mode may cause disconcerting movement of collective pitch lever. To eliminate this unwanted condition, reduce airspeed or disengage BAR ALT.

CAUTION

In heavy turbulence, the collective response to BAR ALT inputs can exceed torque limitations.

Radar Altitude (RAD ALT) Switch.

The radar altitude (RAD ALT) switch (3, figure 1–18) connects and disconnects signals from the radar altimeter to the ASE. The ASE switch must be in the engaged position, the BAR ALT switch must be engaged, and the radar altimeter must be reliable before the radar altitude switch will stay in the RAD ALT position. When the switch is moved to RAD ALT and the altitude control button is depressed momentarily, the ASE will, in addition to holding attitude and heading, seek and maintain the altitude set by the altitude index on the copilot's radar altitude height indicator, by controlling collective pitch. Smooth changes in altitude can be made on the RAD ALT mode by adjustment of the copilot's limit-on knob while RAD ALT is engaged. The rate of climb or descent, when seeking the preindexed altitude, will vary with the difference between indexed and actual altitude. Slow rates of descent or climb are accomplished by keeping the difference between indexed altitude and actual altitude 100 feet or less. Since the electrical output sensitivity of the APN-117 decreases with increasing altitude, the accuracy of the ASE RAD ALT mode also decreases as altitude is increased. The severe decrease of altimeter electrical sensitivity above 200 feet establishes this altitude as the maximum recommended altitude for accurate use of the RAD ALT mode.

WARNING

The RAD ALT mode requires a vertical velocity signal from the APN-130 to provide damping of altitude excursions and to prevent overshooting the set altitude, following a change in the altitude index setting. Do not use ASE RAD ALT mode when APN-130 is not operating.

When the RAD ALT mode is used to make a descent from say 200 feet to 30 feet, the pilot should monitor the vertical velocity dot of the direction velocity indicator. In the event that the doppler signal return is poor and the ball does not move down, indicating a descent, either the pilot should monitor the collective stick and aid the automatic control in bringing in power prior to reaching the set altitude, or RAD ALT should be disengaged and the descent made manually. RAD ALT may then be re-engaged at the lower altitude, providing the effect of rotor wash on the water produces a good doppler signal return. In forward flight at low altitude with RAD ALT engaged, it will be found that at speeds up to 80 knots the altitude is held above the set altitude. This is because of a false rate of descent signal from the APN-130 caused by the combination of forward speed and antenna angle at speeds up to 80 knots. At higher speeds the APN-130 will indicate a false climb, causing the aircraft to fly below the set altitude; therefore, it is recommended that the RAD ALT mode be used only at speeds below 80 knots. It should be repeated that it is essential to have good doppler return for an accurate RAD ALT mode. The condition of sea state and APN-130 equipment performance should cause the pilot to carefully monitor the performance of the RAD ALT mode when used for the first time during a flight. Refer to Section III for further information on the use of RAD ALT mode made during instrument flight.

The RAD ALT switch will automatically move to OFF when the ASE ENGAGE switch is turned to STANDBY or when the ASE DISENGAGE button is depressed. If the altimeter signal is lost and the radar altimeter indicates unreliable (pointer behind mask), the existing altitude will be maintained by barometric altitude control.

Altitude Control Button and Annunciator.

The altitude control button (5, figure 1–18) is operated in connection with two switches on the ASE control panel, the barometric altitude switch and the radar altitude switch. After either the barometric altitude switch or the radar altitude switch has been turned on, before the altitude control circuits become energized, the altitude control button must be depressed momentarily.

Altitude control may be disengaged by depressing the altitude control button a second time, or by moving the altitude switch on the ASE control panel to the OFF position. The altitude control annunciator (5, figure 1–18) will read ON when altitude control is engaged, and will be blank when altitude control is disengaged.

Groundspeed Switch.

The groundspeed switch (4, figure 1–18), when in the GROUNDSPEED position, feeds APN-130 groundspeed signals into the ASE. The ASE engage switch must be in ENGAGE before the groundspeed switch will stay in the GROUNDSPEED position. When the switch is moved to the GROUNDSPEED position, the ASE will maintain the groundspeed for which the aircraft is trimmed by controlling the aircraft's pitch and roll. The ASE will maintain groundspeed along the longitudinal axis, the lateral axis, or a combination of the two. The pilot may, at any time while under groundspeed control, change the aircraft's groundspeed using the normal flight controls. When the controls are released, the ASE will maintain the newly trimmed groundspeed or, if the original trim has not been disturbed, will return the aircraft to the original groundspeed. The groundspeed switch will move to OFF when the ASE engage switch is turned to STANDBY or when the ASE disengage button is depressed.

CAUTION

> Loss of APN-130 signal reliability can cause groundspeed control to put in excessive cyclic corrections. This control input may be severe at high speeds. Unless APN-130 reliability is insured by conditions of terrain and altitude, use groundspeed control only at airspeeds below 70 knots.

ASE Disengage Button.

The ASE disengage (ASE DISENG) button (7, figure 1–18) when depressed, disengages the entire ASE system and places it in a disengaged (standby) status.

NORMAL OPERATION.

To Engage ASE.

1. MA-1 compass mode – As desired.
2. Helicopter heading – As desired.
3. Helicopter attitude – Trimmed straight and level.
4. Hydraulic actuator switch – HYDRAULIC ACTUATOR.
5. ASE engage switch – ENGAGE.

   Pilot may now release cyclic stick and directional pedals.

Trimming The Helicopter With ASE Engaged.

The aircraft is trimmed for balanced flight by lateral actuation of the cyclic trim switch. For example, if the ball is out to the left, trim it back to the center using right cyclic trim. Directional trim is accomplished automatically by the ASE. Remember that the yaw trim switch with ASE engaged is not used for trimming, but is used for small heading changes. The fore-and-aft cyclic trim switch should not be used when the aircraft is on the ground and ASE is on. The ASE will sense the trim input as a command to change attitude or speed. When no attitude or speed change results, the ASE will utilize full fore-and-aft trim capability, attempting to satisfy this command.

Note

> Because of the above characteristics, the ASE shall not be engaged during ground taxiing.

To Change Stabilized Heading.

1. Helicopter heading – As desired.
   a. Use foot pressure on directional pedals, or –
   b. Use yaw trim switch, or –
   c. Press coordinated turn button and turn, using cyclic stick.

To Change Stabilized Attitude.

1. Cyclic trim switch – As necessary.

   Permanent attitude or speed changes are made by means of the cyclic trim switch. If the attitude or speed of the aircraft is changed by means of stick force, and it is then desired to trim out the force and remain at the new attitude or speed, this may be done by trimming out the force with the cyclic trim switch. The attitude or speed of the aircraft will not change while the force is being trimmed out. The maximum roll angle at which the ASE will laterally stabilize the aircraft is 13 degrees in a trimmed bank, or 90 degrees in a bank resulting from applied lateral stick force. Beyond this, the pilot must manually stabilize the aircraft roll angle.

To Maneuver With ASE Engaged.

1. Flight controls – As necessary.

   With ASE engaged, any temporary attitude change or maneuver is accomplished by applying force to the cyclic stick. However, a slight overshoot will be experienced and the return to trim from the overshoot will be at trim actuator speed. Use of trim switch at this time to return to original trim is not required. The resulting attitude or speed change will be proportional to the force applied to the stick. Speed and attitude will return to the original trimmed conditions after the maneuvering force is removed from the stick. In order to avoid excessive sensitivity of the aircraft to stick movement, the ASE response is less sensitive to small displacements of the stick from the trimmed position than it is to large displacements.

Note

Boost or ASE disengagement when a maneuvering control force is being applied to the cyclic stick may cause a more noticeable stick kick or aircraft attitude change than experienced when boost is disengaged in a trimmed condition. Controls shall be monitored closely during maneuvers.

To Disengage ASE.

1. Helicopter attitude – Trimmed straight and level.
2. ASE disengage button – Press and release.

To Engage Barometric Altitude Control.

1. ASE – Engaged.
2. Barometric altitude switch – BAR ALT.
3. Helicopter altitude – As desired.
4. Altitude control button – Press and release. Pilot may now release collective pitch lever.

To Change Stabilized Barometric Altitude.

1. Collective pitch lever – As necessary.

   When altitude control is engaged, it is possible to climb or descend by applying force to the collective pitch lever. The rate of climb or descent will be proportional to the force applied. Large altitude changes are most conveniently made by disengaging altitude control, flying the aircraft to the desired altitude and then re-engaging altitude control.

To Disengage Barometric Altitude Control.

1. Altitude control button – Press and release.

To Engage Radar Altitude Control.

1. AN/APN-130 radar – ON.
2. Radar altimeter – ON and reliable.
3. ASE – Engaged.
4. Barometric altitude switch – BAR ALT.
5. Radar altitude switch – RAD ALT.
6. Helicopter – Altitude below 200 feet, airspeed below 80 knots.
7. Pilot's limit-on knob – Set for desired warning light altitude.
8. Copilot's limit-on knob – Set for desired altitude.
9. Altitude control button – Press and release. Pilot may now release collective pitch lever.

   For hovering with ASE, radar altitude control is recommended. Barometric altitude control may be used, but for hovering and at low speeds, radar altitude control is steadier. Therefore, for best altitude stability in a hover or at low speeds, use radar altitude control, make sure that APN-130 is operating, and keep the aircraft as level as possible.

To Change Stabilized Radar Altitude.

1. Copilot's limit-on knob – Set for new altitude.

   Large altitude changes are most conveniently made by disengaging altitude control, flying the aircraft to the desired altitude, and then re-engaging altitude control.

To Disengage Radar Altitude Control.

1. Altitude control button – Press and release. Or place RAD ALT switch OFF.

To Engage Groundspeed Control.

1. AN/APN-130 radar – ON. Set terrain and hover switches as desired.
2. ASE – Engaged.
3. Helicopter groundspeed – Trimmed as desired below 70 knots.
4. Groundspeed switch – GROUNDSPEED. Pilot may now release the controls.

To Change Stabilized Groundspeed.

1. Helicopter groundspeed – As desired.

   Use cyclic trim as necessary.

To Disengage Groundspeed Control.

1. Groundspeed switch – OFF.

To Disengage All ASE Control.

1. ASE disengage button – Press and release.
2. ASE engage switch – STANDBY.

EMERGENCY DISENGAGEMENT.

The ASE may be disengaged by any of the following steps:

1. Boost release switch – Press.
2. Hydraulic actuator switch – OFF.

BLADE TRACKING SYSTEM

DESCRIPTION.

Two types of out-of-track can occur in the rotor system. One blade can be out-of-track with respect to its 180-degree counterpart, or two opposing blades can be out-of-track with respect to their two 90-degree counterparts. In the first case a vertical vibration with a frequency of one cycle-per-rotor revolution (approximately $4\frac{1}{2}$ cycles per second, commonly referred to as one-per-rev) will occur and more than one blade tip path may be visible to the pilot. In the second case no noticeable vibration will occur, but more than one blade tip path will be visible.

The blade tracking system continually detects and corrects the one-per-rev type of out-of-track condition whenever it occurs. A vibration-sensing device, located in the left cabin bulkhead forward of the cargo door, senses vertical vibrations and produces proportional electrical signals which are amplified and sent to a resolver, mounted on the main gearbox. The function of the resolver is first, to detect those signals which signify a one-per-rev out-of-track condition and second, to determine which blade needs to be adjusted. A rotating part in the resolver rotates at exactly the same rpm as the rotor. The resolver is, therefore, only able to recognize those signals which are produced by a one-per-rev out-of-track condition. Because the resolver is synchronized with the rotor, the position of the resolver at the time of the strongest signal reveals which blade is out-of-track. The resolver then sends an electrical signal to a phase-detecting device which determines whether the blade must be adjusted up or down. A final signal is then transmitted to one of two blade tracking actuators mounted on the rotor hub. The actuators adjust the blade flaps to raise or lower the track of the blades. During normal operation only the C and D blades (see figure 1—19) are adjusted, being raised or lowered as necessary to place them in track with their 180-degree opposites. An airspeed switch starts the system operating when the airspeed reaches approximately 50 knots, and stops it when the airspeed is decreased to approximately 25 knots. Switches on the landing gear prevent the system from operating when the aircraft is on the ground. Two guard circuits are included to de-energize the system if out-of-track vibrations exceed G forces and cannot be corrected automatically. Primary guard will de-energize the system immediately if vibrations exceed 0.15 Gs. Secondary guard will open the circuit to the tracking actuators if vibrations exceed 0.04 Gs, and will remain open for approximately 5 seconds. If vibrations are not reduced in this time, the secondary guard will cause primary guard to de-energize the system. The system receives electrical power from the 26-volt ac inverter bus and from the 28-volt dc primary bus.

Blade Track Annunciator.

The blade track annunciator (5, figure 1—20) is located on the blade track panel and is electrically connected to the airspeed switch and the landing gear switches. The annunciator indicates ON when the system cuts in as a result of the aircraft leaving the ground and accelerating to an airspeed above 50 knots. The annunciator indicates OFF when the system cuts off due to the airspeed decreasing below 25 knots, or when the aircraft is landed.

Automatic Blade Track Caution Light.

The automatic blade track caution light is located on the caution light panel (figure 1—56). The light is amber and is controlled by the guard circuit in the blade tracking system. If the guard circuit de-energizes the blade tracking system, the caution light will glow and the words AUTO BLADE TRACK will appear. The automatic blade track caution light will go out when the auto track reset button is pressed, and will remain out as long as the blades remain in track. If the system becomes de-energized again, the light will glow again. The light receives electrical power from the 28-volt dc primary bus through the blade tracking (BLADE TRACKING) circuit breaker.

Rotor Blade Identification

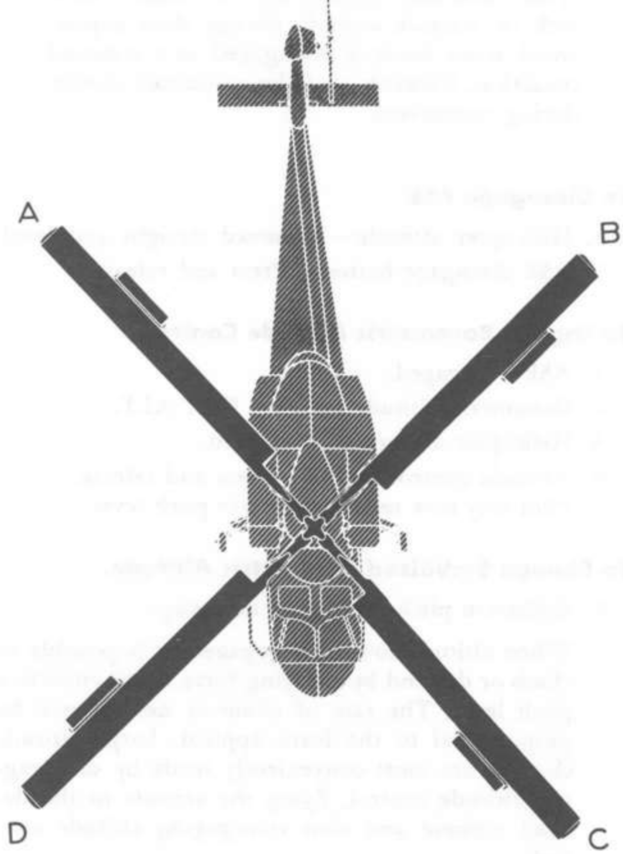


Figure 1—19

Auto Track Reset Button.

The auto track reset button (labeled AUTO TRACK RESET; 2, figure 1—20) is located on the blade tracking panel. The button is used to reset the guard circuit and restore the system to automatic operation after the guard circuit has de-energized the system; or as a momentary switch, to bypass the airspeed switch when it is desired to track the blades before the airspeed switch has energized the system.

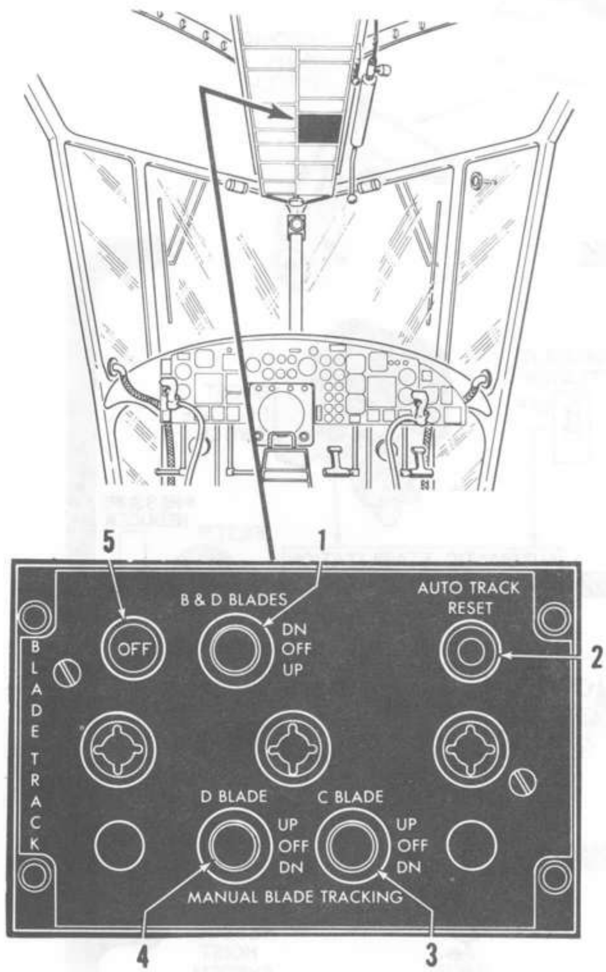
CAUTION

At airspeeds above 60 knots, discretion must be used in pressing auto track button. By bypassing the guard circuit, a malfunctioning system can further cause excessive out-of-track condition.

D Blade and C Blade Switches.

The D blade and C blade switches (4 and 3, figure 1—20) provide individual control of the tracks of the D and C blades during manual operation of the system.

Blade Track Panel



1. DIFFERENTIAL CONE SWITCH
2. AUTO TRACK RESET BUTTON
3. C BLADE SWITCH
4. D BLADE SWITCH
5. BLADE TRACK ANNUNCIATOR

Figure 1—20

The switches have 3 positions labeled UP, OFF, and DOWN. The switches are spring-loaded to the OFF position. Moving either switch to UP or DOWN results in a corresponding change in the track of the selected blade.

Differential Cone Switch.

The differential cone switch (1, figure 1—20) has three positions labeled UP, OFF, and DOWN and is spring-loaded to the OFF position. It is used to correct an out-of-track condition caused by a difference in the tracks of the two pairs of blades. This condition may be remedied by adjusting the B and D blades up or down, as necessary, to bring the tracks together. The differential cone switch, when moved to the UP or DOWN position, raises or lowers the track of the B and D pair of blades. The differential cone switch provides the only means of correcting this type of out-of-track condition.

Note

The A blade is a master blade and is not adjustable in flight.

NORMAL OPERATION.

The automatic mode of operation is the normal mode of operation. No pilot action is necessary.

MANUAL OPERATION.

Refer to Section V.

USE OF THE DIFFERENTIAL SWITCH.

Refer to Section V.

HYDRAULIC POWER SUPPLY SYSTEM

The hydraulic system reservoir (figure 1—21) contains 1.7 gallons. It supplies fluid under pressure to the landing gear system, the automatic stabilization equipment (ASE) control actuator, the rescue hoist system, the rescue boom (fishpole) system, and the windshield wiper system. The system includes a reservoir, a transmission driven hydraulic pump, a pressure relief valve, a pressure switch, a hydraulic pressure gage, and two filters. Fluid is fed by gravity from the reservoir to the pump. The pump delivers fluid, under a pressure of 1500 psi, through a filter and directly to the five systems requiring hydraulic power. The pressure relief valve has a cracking pressure of 1750 psi. Any fluid passing through the relief valve is returned to the reservoir. External pressure and return line fittings are provided for the purpose of ground checking the system. See the servicing diagram (figure 1—62) for hydraulic fluid grade and specification. Refer elsewhere in Section I for information on the rescue hoist system, the rescue boom system, the windshield wiper system, the landing gear system, and the automatic stabilization equipment control actuator.

HYDRAULIC PUMP.

The hydraulic pump is mounted on and driven by the combining gearbox. The pump is a piston type, variable displacement, designed to deliver 1500 psi.

HYDRAULIC PRESSURE GAGE.

The hydraulic pressure gage (51, figure 1—9) is located on the right side of the instrument panel. The gage indicates, in pounds per-square-inch, the hydraulic pressure available to the systems connected to the hydraulic power supply system. The gage receives its signal from a pressure-sensitive transmitter located in the hydraulic line. Electrical power is supplied to the gage from the 26-volt ac inverter bus through the hydraulic pressure gage (HYD OIL PRESS) fuse.

Hydraulic Power Supply

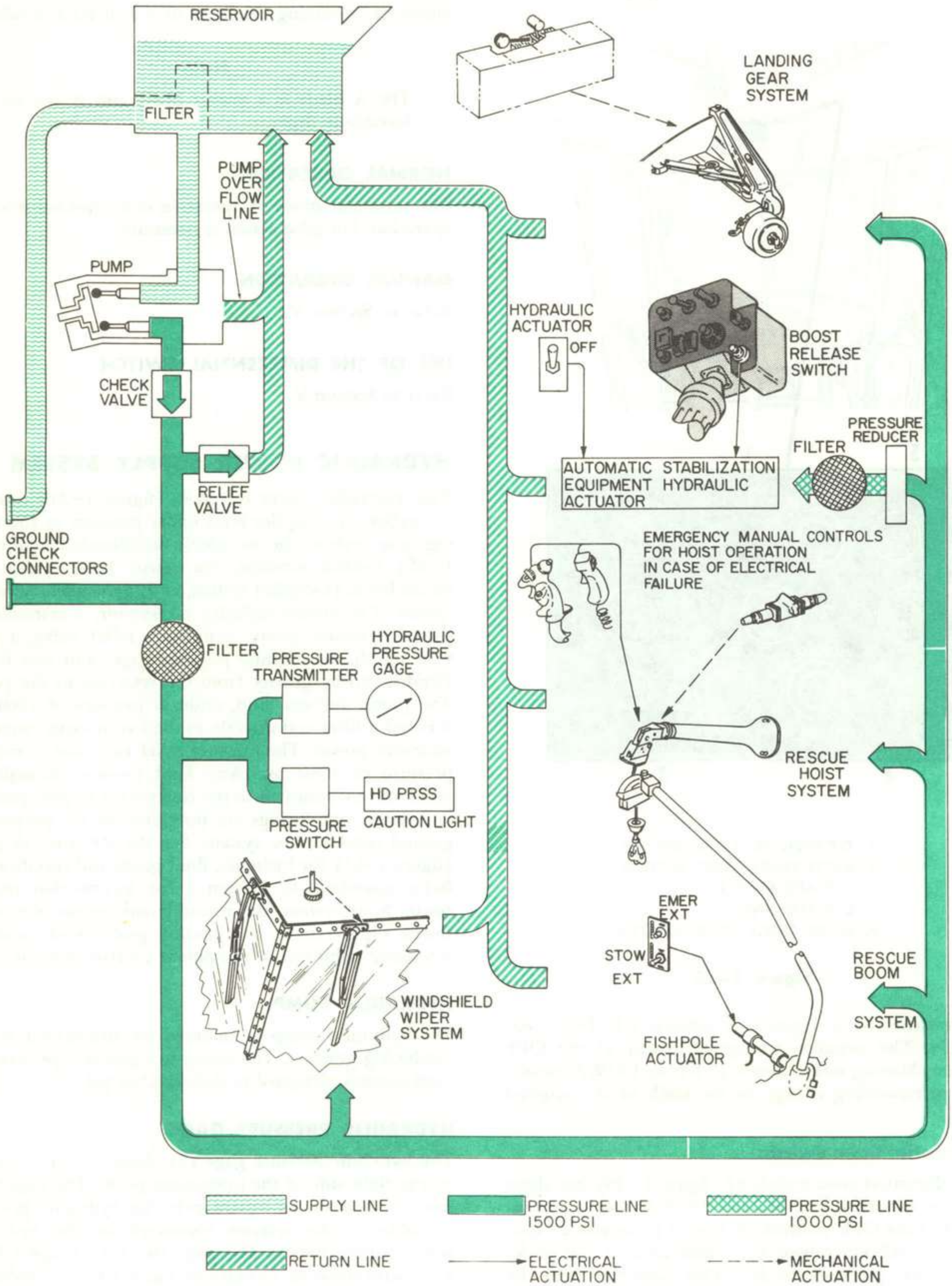


Figure 1—21

HYDRAULIC PRESSURE CAUTION LIGHT.

The hydraulic pressure caution light is located on the caution light panel (figure 1–56). The light is amber and is controlled by a pressure-sensitive switch located in the hydraulic line, after the filter. In the event that the pressure falls below 800 psi, the light will glow and the words HYD PRESS will appear. The light is supplied electrical power from the 28-volt dc primary bus through the hydraulic pressure light (HYD PRESS LT) circuit breaker.

LANDING GEAR SYSTEM

The aircraft is equipped with two main gear and a tail wheel, all equipped with individual shock struts. The main gear is retracted and extended hydraulically. The tail wheel is not retractable. The main gear retracts forward and inboard into the fairings at each side of the fuselage. Two fairings, one attached to each of the main landing gear, partially cover the openings in the wheel wells when the gear is retracted, and remain open when the gear is extended. The tail wheel can be swiveled through 360 degrees and can be locked in the fore-and-aft position. In normal operation the main gear can be retracted or extended in less than 3 seconds. An emergency means of lowering the gear is also provided. Ground safety pins (see figure 1–65) are provided for manual installation in each of the main gear.

LANDING GEAR LEVER.

The landing gear lever (1, figure 1–27) is mounted on the right side of the console. The lever is connected mechanically to a hydraulic landing gear control valve and to the landing gear up-lock device. When the lever is placed in the down or horizontal position, the up-lock device is released and the valve is actuated, permitting hydraulic pressure from the main hydraulic system to act on the landing gear actuators, forcing the gear out and down to the extended position where they are mechanically locked. When the lever is placed in the up or vertical position, the opposite happens; the gear is unlocked, retracted, and mechanically latched in the retracted position. The translucent plastic wheel-shaped knob on the lever contains a red light. Limit switches in the landing gear are arranged so that the light will glow whenever the position of the landing gear is not the same as the position of the lever, or whenever the landing gear is in an unlocked condition. The light draws electrical power from the 28-volt dc primary bus through the landing gear light (LDG GEAR LT) circuit breaker. A spring-loaded lock prevents the landing gear lever from being raised while the weight of the helicopter is on the wheels. When the weight of the aircraft is off the wheels, the lock is released electrically by means of a solenoid. The solenoid receives electrical power from the 28-volt dc primary bus through the landing gear (LDG GEAR) circuit breaker.

LANDING GEAR POSITION INDICATORS.

The landing gear position indicators (50, figure 1–9) are located on the instrument panel. They are designed to show three landing gear conditions: gear up, gear unsafe, and gear down. The gear unsafe position is indicated by a barber pole design when the gear is on the way up or on the way down, and when the helicopter is on the ground with power off. The indicators receive power from the 28-volt dc primary bus through the landing gear light circuit breaker. The indicators are actuated by microswitches located on the landing gear struts. The switches are activated by movement of the gear in its upward or downward travel. When the gear is down and locked, the indicators will simulate an extended landing gear. In the gear unsafe position, the indicators will show a black and white crosshatching or barber pole design. When the gear is up and locked, the indicator will register UP.

RADAR ALTIMETER WARNING SET TONE AND FLASHING LIGHT.

If the landing gear is up when the helicopter descends through a preset high altitude index, a red warning light (52B, figure 1–9) on the instrument panel will flash for about 3 seconds, and a repetitive tone will sound in the pilots' headsets, for about 3 seconds. If the aircraft descends further, gear up, through the low altitude index as set by the pilot's radar altitude limit-on knob, the repetitive tone will start, and will continue as long as the helicopter remains below the low altitude index with the gear up. (For additional information refer to RADAR ALTIMETER WARNING SET paragraphs in this section.)

Note

> Below the low altitude index level, the flashing light will come on, whether the landing gear is up or down.

DOWNLOCK OVERRIDE BUTTON.

The downlock override button (2, figure 1–27) is located next to the landing gear lever. The button is marked DNLOCK OVRIDE. A spring-loaded lock prevents the landing gear lever from being raised while the weight of the helicopter is on the wheels. When the weight of the aircraft is off the wheels, the lock is released electrically by means of a solenoid. If this solenoid were to fail, the spring-loaded lock may be overridden by pressing the downlock override button.

LANDING GEAR EMERGENCY HANDLE.

The landing gear emergency handle (3, figure 1–27) is mounted on the right side of the console, aft of the landing gear lever. The landing gear emergency handle is mechanically connected to the landing gear up-lock device and to an emergency landing gear hydraulic valve. When the handle is pushed down, the up-lock device is released and the emergency hydraulic valve is actuated to permit any fluid trapped in the actuator to pass into the return line. The landing gear is then extended to the down and locked position by means of gravity, spring tension, and the aircraft slipstream. Extension time by this method is approximately 3 seconds. If landing gear emergency handle is not all the way up, hydraulic pressure may be permitted to bypass the system precluding normal operation.

Note

Once the landing gear emergency handle is pushed down the landing gear cannot be raised until the emergency handle is reset by maintenance personnel.

TAIL WHEEL LOCK LEVER.

The tail wheel lock lever (1, figure 1–14) is located in the cabin ceiling. The lever is connected by means of a cable to a spring-loaded locking pin in the tail wheel assembly. When the lever is moved out of the detent forward to a vertical position, the spring presses the pin downward. When the tailwheel is aligned fore-and-aft, the pin drops into a hole in the swivel portion of the gear, locking it in the fore-and-aft position. When the lever is moved aft, the pin is withdrawn and the tail wheel is free to swivel. The tailwheel should be locked for all rotor engagements, takeoffs, landings, and rotor disengagements.

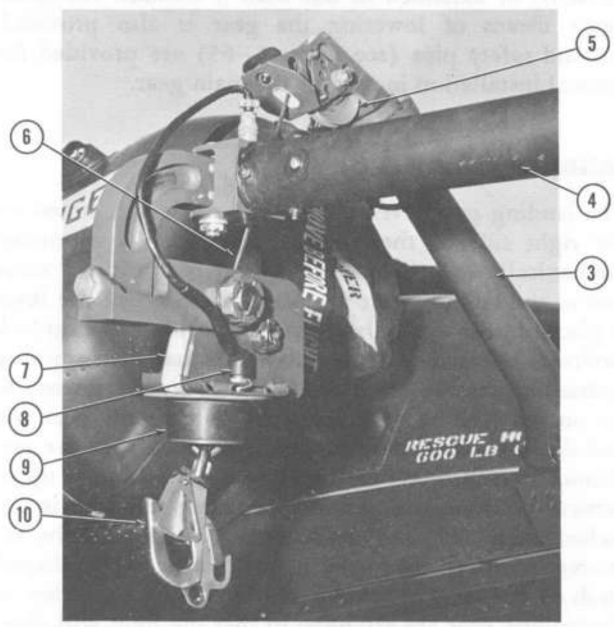
RESCUE HOIST SYSTEM

DESCRIPTION.

A hydraulically powered hoist is mounted on the roof (figure 1–22). The cable extends from the hoist unit over a pulley at the end of a fixed arm which protrudes over the rescue door. The hoist contains 100 feet of cable which is wound on a drum within the hoist, and a full swivel hook with a safety latch attached to the cable. The hoist cable speed is 100 feet-per-minute up or down with an automatic spring-loaded brake which prevents the cable from unwinding in the event of hydraulic failure. Hydraulic power to operate the hoist is supplied by the main hydraulic system through an electrically operated valve equipped with a manual override feature. Thus the hoist may be operated either by electrical switches or manually by pressing the buttons on the valve. An electrically actuated cartridge-type cable cutter is located on the level wind mechanism. Electrical power for the system is provided from the 28-volt dc primary bus through the HOIST CONTROL circuit breaker, and the hoist power switch located overhead (figure 1–23).

After AFC 160 Part I a hoist containing 200 feet of cable, or a pre-AFC 160 hoist with 100 feet of cable can be installed. Aircraft with this modification can be identified by the bubble fairing on the right side of the forward nacelle door. The length of the hoist cable installed should be verified by checking with maintenance personnel.

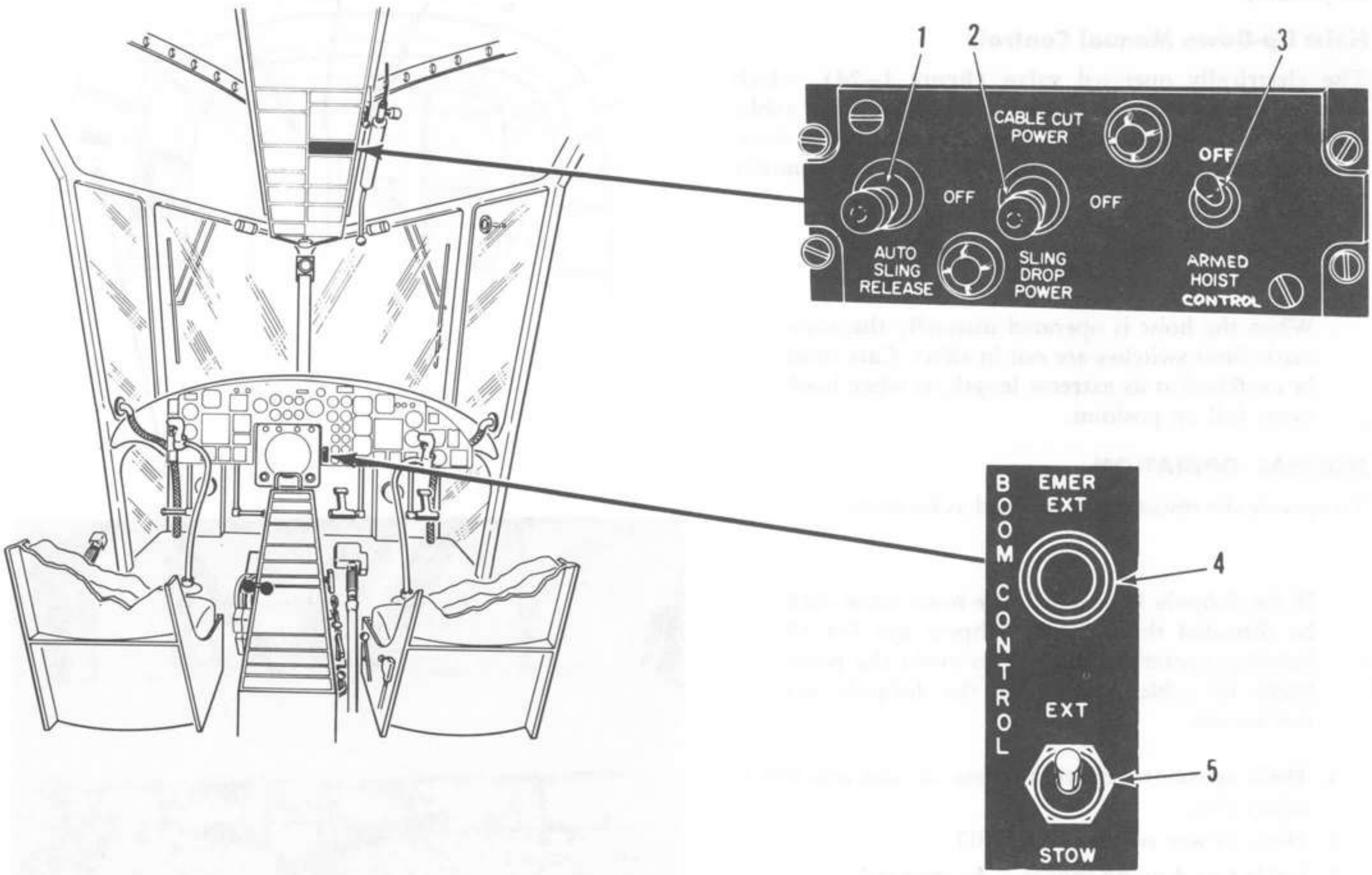
Rescue Hoist and Fishpole



1. FISHPOLE SOCKET
2. FISHPOLE (LOWER END)
3. HOIST ARM
4. FISHPOLE (UPPER END)
5. HOIST ARM PULLEY
6. HOIST CABLE
7. FISHPOLE EYE
8. LIMIT SWITCH
9. BUMPER
10. HOIST HOOK

Figure 1–22

Hoist, Fishpole, and Hook Panels



1. AUTOMATIC SLING RELEASE SWITCH
2. CABLE CUT ARMING SWITCH
3. HOIST POWER SWITCH
4. FISHPOLE EMERGENCY EXTEND BUTTON
5. FISHPOLE SWITCH

Figure 1—23

Hoist Power Switch.

The hoist power switch (HOIST CONTROL, OFF, ARMED; 3, figure 1—23) provides power to the entire hoist/fishpole circuit and enables the pilot to disable the complete hoist system by placing the switch to OFF.

Rescue Hoist Up-Down Switches.

Rescue hoist up-down switches (2, figure 1—34) are located on the pilot's cyclic stick grip, and on the hoist operator's grip. When the hoist power switch is ARMED, the up-down switches control electrical power to solenoids in the hoist control valve. When either switch is moved to the up position, the up solenoid is energized, actuating a valve to cause hydraulic fluid to flow through the hoist motor, retracting the hoist cable. When either switch is moved to the down position, the down solenoid in the valve is energized, causing the opposite reaction. The switches are both spring-loaded to the center, or OFF, position. The electrical circuits are so arranged that the pilot's switch will override the hoist operator's switch. Up- and down-limit switches stop the hoist at both extremities of travel.

Cable Cut Arming Switch.

The cable cut arming switch (2, figure 1—23) serves two systems. When the switch is moved to the CABLE CUT POWER position, the cable cutter circuit is armed, and when the drop button (see following paragraph) is pressed, the cable cutter cartridge is fired, severing the cable.

Drop Button.

The drop (CABLE CUT-CARGO HOOK) button (4, figure 1—54) is located on the pilot's collective pitch lever switchbox. The drop button serves two systems. Pressing the button with the arming switch in the CABLE CUT POWER position will complete the cable cutter circuit, firing the cable cutter cartridge. With the arming switch in the OFF position, the drop button is inoperative.

Hoist Up-Down Manual Controls

The electrically operated valve (figure 1–24), which controls the up and down movement of the hoist cable, is located in the starboard bulkhead, aft of the rescue door. If electrical failure occurs, the valve can be manually operated.

CAUTION

When the hoist is operated manually the automatic limit switches are not in effect. Care must be exercised at its extreme length, as when hook nears full up position.

NORMAL OPERATION.

To operate the rescue hoist, proceed as follows:

Note

If the fishpole is installed, the hoist cable shall be threaded through the fishpole eye for all hoisting operations. This is to avoid the possibility of cable fouling in the fishpole eye mechanism.

1. Hoist operator – Safety harness on, and attached to safety ring.
2. Hoist Power switch – ARMED.
3. Cable Cut Arming switch – As required.
4. Fishpole switch – As desired.
5. Hoist up-down switch – As necessary to retrieve the rescuee. After rescuee is safely in cabin and disconnected from the hoist hook, hoist up-down switch – UP. Raise hoist hook until limit switch has been actuated.
6. Hoist Power switch – After fishpole is unthreaded, OFF.
7. Cable Cut Arming switch – OFF.

WARNING

- To avoid static electricity shock to rescuee allow hoist cable to first contact ground or water out of reach of rescuee. Then move cable within rescuee's reach, while maintaining cable contact with ground or water.
- It is possible for rescue seat rings or horse collar rings to slip from the hook during rescue operations if they are not set properly in the hook. When hauling in, use care to determine that rings are set properly in hook.

Hoist Manual Controls

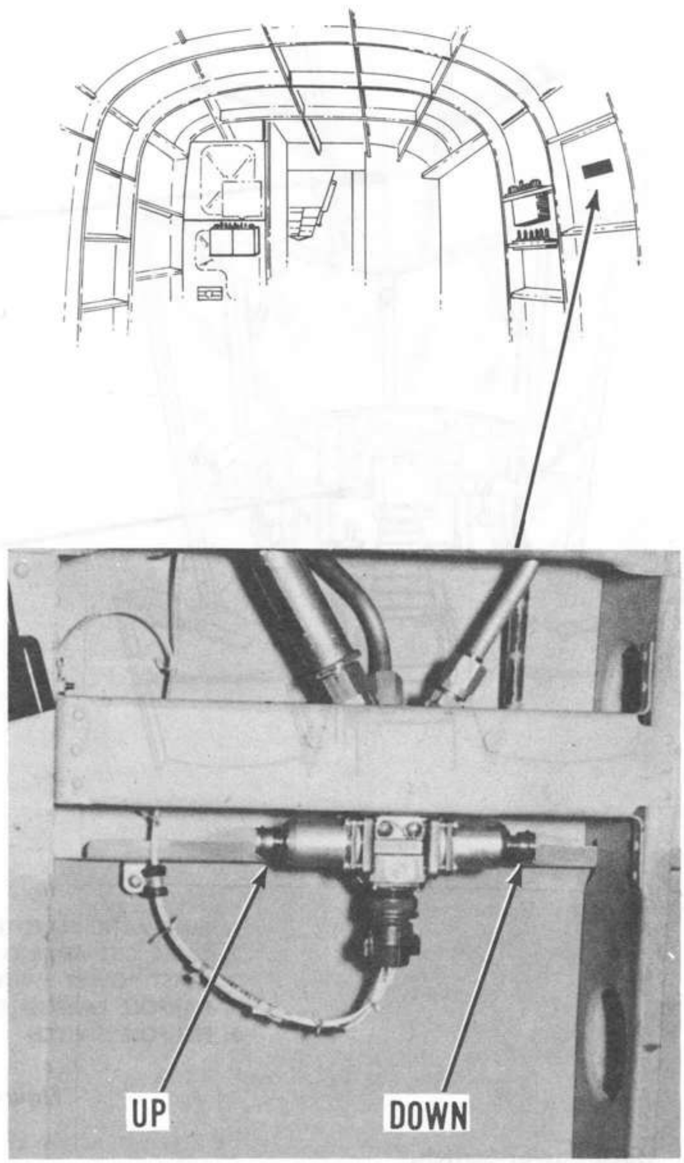


Figure 1–24

EMERGENCY OPERATION.

If the hoist electrical switches are inoperative, use hoist up-down manual controls as required.

If, during hoisting operations, the cable becomes entangled with ground objects and cannot be freed, the cable can be cut by the hoist operator, using the manual shears or snippers that are usually carried when hoisting operations are anticipated. If the hoist operator cannot free or cut the cable, the pilot can cut the cable by moving the arming switch to CABLE CUT POWER, and pressing the drop button. Cable cutter may be inoperative if it becomes necessary to use the emergency levers.

The cartridge cable cutter severs the cable close to the drum. Any cable remaining on the drum will not pay out properly and will foul the hoist, preventing further use until cable is replaced by the ground crew.

However, if hoist operator can cut cable as low as possible, and sufficient cable is on drum, it will be possible to use the quick splice device, usually carried on hoisting missions, and hoisting can be continued.

RESCUE BOOM (FISHPOLE) SYSTEM

DESCRIPTION.

UH-2C Helicopters are equipped with an eight-foot curved rescue boom referred to as the "fishpole," which is mounted in a socket on the right side of the fuselage just aft of the nose door hinge-line. The rescue hoist cable is threaded through an eye and pulley at the upper end of the fishpole by the crewman either in flight or on the ground. The fishpole is extended and stowed hydraulically by an actuator which rotates the fishpole socket. When the fishpole is in the stowed position, the eye is directly under the rescue hoist, suspending the hoist hook over the rescue door. When the fishpole is extended, it swings forward about 90 degrees, suspending the hoist cable 8 feet outboard of the fuselage and placing the pickup point within the pilot's range of vision. Starting with the hoist fully up and the boom control switch in the EXT position, the fishpole will automatically extend as the hoist hook is lowered. When fully extended, the fishpole will be hydraulically held in that position while the hoist hook is lowered for a pickup. When the hoist hook is raised the fishpole will stay in the extended position until the hook bumps against the limit switch on the fishpole eye.

When hoisting two people, the weight may be sufficient to overcome the hydraulic extension actuator thereby forcing the fishpole boom partially inboard from its full extend position before limit switch actuation. The system incurs no damage by this overriding action. When the limit switch is compressed, the extend circuit is deactivated, the hydraulic extend actuator is neutralized, and the fishpole is returned to the STOW position by hoist cable retraction. When the fishpole reaches the fully stowed position, another limit switch will be tripped, stopping retraction of the hoist and fishpole. The fishpole switch will automatically return to STOW and the fishpole will be hydraulically locked in the stowed position. The hoist hook can then be lowered to bring a rescuee fully into the cabin. Electrical power for the fishpole circuits is provided from the 28-volt dc primary bus through the RESCUE BOOM circuit breaker and hoist power switch. Hydraulic power is supplied from the helicopter hydraulic power supply.

When picking up the rescuee, some cyclic control will be required to counteract the center of gravity offset produced by the weight on the extended fishpole. In order to maintain maximum control, it is important that the helicopter be headed into the wind during pickups, and that the cyclic control force be trimmed out as the aircraft takes on the weight of the rescuee. This is particularly important when using ASE. To minimize the initial upsetting moment as the weight is picked up, it is recommended that the rescuee be lifted by an increase in collective pitch rather than by reeling in the hoist cable.

Boom Control (Fishpole).

The BOOM CONTROL (fishpole) panel is located on the instrument panel and contains (a) the fishpole EXT-STOW switch and (b) the fishpole emergency extend EMER EXT button. When the fishpole switch is placed in the EXT position and the fishpole is stowed with hoist hook fully up, a magnetic holding coil will keep the switch in that position. The fishpole will then swing outboard when hoist cable is lowered. When hoist cable is raised, the hoist hook will contact the fishpole eye and pull the fishpole upward toward its stowed position. The fishpole switch will automatically return to the STOW position when the hoist is fully up. The fishpole may be retracted at any time by manually placing the switch to STOW. The fishpole switch will not be effective in the EXT position unless the hoist hook has been fully retracted with fishpole stowed except as described in the following paragraph.

The fishpole emergency extend button (4, figure 1–23) is used to latch the fishpole switch in the EXT position even though hoist cable has already been extended.

WARNING

Do not actuate the emergency extend button if slack cable is in cabin or is fouled. Occupants can be seriously injured if slack cable is in the aft cabin and the unloaded fishpole whips outboard when extended.

When the fishpole emergency extend button is pressed and the fishpole switch is moved to the EXT position, the fishpole will rapidly extend. This button provides the only means of extending the fishpole after the hoist hook has been lowered.

WINDSHIELD WIPER SYSTEM

The windshield wipers are hydraulically operated. The speed of the wipers is variable, and when the system is turned off, the wipers are held by hydraulic pressure in the parked position. The wipers are turned on and off and their speed is controlled by the speed control knob on the forward cockpit ceiling. A control unit alternately directs hydraulic fluid under pressure from the inboard to the outboard side of the two window units which convert hydraulic power into the pendulum-like action of the wipers. Each control unit has a double acting bypass valve which permits hydraulic fluid to continue flowing even when the movement of the wipers is limited. This means that if one wiper is restricted, the other will continue to swing with a full sweep. Hydraulic power for the system is supplied from the main hydraulic system (figure 1–21).

WINDSHIELD WASHER SYSTEM

The windshield washer system has two nozzles connected by tubes to a fluid reservoir located under the cockpit floor. Fluid is forced onto the windshield by compressed air which is piped into the reservoir from both engine compressor sections. The windshield washer system is turned ON (WINDSHIELD WASH) and OFF by a 2-position switch on the heat and miscellaneous panel (5, figure 1–61). When the switch is moved to WINDSHIELD WASH, a solenoid valve is energized permitting fluid to flow from the bottom of the reservoir to the nozzles. When the switch is moved to the OFF position, the solenoid is deenergized, the valve closes, and flow stops. Power to operate the solenoid valve is supplied from the 28-volt dc monitor bus through the WINDSHIELD WASHER fuse on the fuse and circuit breaker panel (figure 1–31).

NORMAL OPERATION.

To operate the system proceed as follows:

1. Windshield washer switch – WINDSHIELD WASH.
2. Windshield wiper speed control knob – ON. Leave on until the windshield is clean.
3. Windshield washer switch – OFF.
4. Windshield wiper speed control knob – OFF.

BRAKE SYSTEM

The main wheels are equipped with disc-type hydraulic brakes. The brakes are actuated by the toe brake pedals mounted at the top of the pilot's directional pedals. The brakes can be locked for parking. Each brake has an independent hydraulic system consisting of a master cylinder and reservoir, attached to each brake pedal, and a hydraulic line leading through the parking brake valve to the brake unit on each wheel.

BRAKE PEDALS.

The brake pedals enable the pilot, by means of toe pressure on the pedals, to apply either or both brakes as desired.

PARKING BRAKE HANDLE.

The parking brake handle (4, figure 1–27) is located at the right side of the console. The handle is connected by mechanical linkage to valves in the wheel brake hydraulic lines. To engage the parking brake, apply and hold pressure on the toe brake pedals, pull up on the parking brake handle, and release the pressure on the toe brake pedals. To release the parking brake, apply pressure on the toe brake pedals and release. This will automatically disengage the parking brake.

FUEL SUPPLY SYSTEM

Fuel is carried internally in two bladder-type tanks, the sump tank and the aft tank, and externally in the droppable left and right auxiliary tanks. Each of the two internal tanks is composed of two interconnected cells. During operation of the system (figure 1–26), fuel is transferred from the auxiliary tanks to the sump tank and when the auxiliary tanks are empty, from the aft tank to the sump tank. From the sump tank, the fuel is pumped through filters to the engine fuel pumps and fuel controls. Transfer of fuel from the auxiliary tanks is accomplished by means of air pressure from the compressor. Pressure in the auxiliary tanks forces the fuel through the lines and into the sump tank; check valves in the lines prevent recirculation of the fuel. Air pressure in the auxiliary tanks is controlled by a pressure switch which starts and stops the compressor to maintain a pressure of 14-16 psi. When all of the fuel from both auxiliary tanks has been transferred, low level switches turn off the compressor. Fuel is transferred from the vented aft tank by two ac transfer pumps.

Since the transfer pressure from the aft tank is lower than that of the auxiliary tanks, transfer from the aft tank does not normally begin until the auxiliary tanks are empty. The transfer pumps run continuously, however, so the fuel in the aft tank is merely recirculated through relief orifices until the auxiliary tanks are empty. When all of the usable fuel in the aft tank has been transferred, low level switches turn off the transfer pumps to prevent them from running while dry. The fuel feed from the vented sump tank to the engine fuel pumps and fuel controls is supplied by the ac sump pump. In the event of failure of the sump pump, a pressure switch closes the circuit to start the dc emergency pump which then takes over the function of the sump pump and continues supplying fuel to the engines. Check valves in the aft and sump tanks prevent recirculation of fuel.

A manual diverter valve is located in the aft fuselage. It enables fuel to be drawn from the aft tanks and the sump tanks at a central point in the system, bypassing the normal flow path through the sump tanks in the event of failure of the electrical system, the sump tank pumps, the transfer pumps, or a combination thereof.

(See the servicing diagram, figure 1–62, for fuel grade and specification, and the fuel quantity data table, for tank capacities.) The system is designed for single-point pressure-fueling and defueling.

FUEL QUANTITY DATA.

	No. of Tanks	Approximate Usable Fuel in Level Flight	Fully Serviced
Sump Tank	1	99 Gallons 643 Pounds (JP-4) 673 Pounds (JP-5)	100 Gallons 650 Pounds (JP-4) 680 Pounds (JP-5)
Aft Tank	1	175 Gallons 1137 Pounds (JP-4) 1190 Pounds (JP-5)	176 Gallons 1144 Pounds (JP-4) 1197 Pounds (JP-5)
Auxiliary Tanks	2	59 Gallons (EA) 383 Pounds (JP-4) 401 Pounds (JP-5)	60 Gallons (EA) 390 Pounds (JP-4) 408 Pounds (JP-5)
Total Usable Fuel (without auxiliary tanks)			274 Gallons 1780 Pounds (JP-4) 1863 Pounds (JP-5)
Total Usable Fuel (with auxiliary tanks)			392 Gallons 2546 Pounds (JP-4) 2665 Pounds (JP-5)

Note:

- To convert gallons of JP-4 fuel to pounds multiply gallons by 6.5 (Standard Day Only).
- To convert gallons of JP-5 fuel to pounds multiply gallons by 6.8 (Standard Day Only).
- Quantities shown are for gravity filling. When pressure fueling is used total quantity will be 50 to 200 pounds less, depending primarily on OAT and Helicopter Attitude.

FUEL PUMPS SWITCH.

The fuel pumps switch (3, figure 1–11), located on the starting (STARTING) panel, has four positions:

OFF position.

A safety button prevents inadvertent movement of the switch to OFF. When the safety button is pressed in, and the switch is moved to the OFF position, the sump pump, the emergency pump, and both transfer pumps are turned off and the firewall fuel shutoff valves are closed.

Note

Prior to AFC 164 the firewall oil shutoff valves are also controlled by the fuel pumps switch.

ON position.

When the switch is moved to the ON position and ac power is available, the sump pump and both transfer pumps will come on. In addition, the firewall fuel shutoff valves will open and will stay open for all positions of the fuel pumps switch except OFF, provided that the fire warning light T-handles are in the NORMAL position.

No. 1 TEST (Transfer Pump Number 1 Test) Position.

When the switch is moved to the No. 1 TEST position, all components remain as they are when the switch is in the ON position, except that transfer pump number 2 is turned off. If the outlet pressure of transfer pnpm number 1 is below the established minimum for at least 5 seconds the fuel transfer caution light will come on. The switch is spring-loaded to return to the ON position. Neither TEST position of the switch affects the fuel feed to the engine.

No. 2 TEST (Transfer Pump Number 2 Test) Position.

When the switch is moved to the No. 2 TEST position, all components remain as they are when the switch is in the ON position except that transfer pump number 1 is turned off. If the outlet pressure of transfer pump number 2 is below the established minimum for at least 5 seconds the fuel transfer caution light will come on. The switch is spring-loaded to return to the ON position. Neither TEST position of the switch affects the fuel feed to the engine.

FUEL TANKS.

The internal tanks are located beneath the cabin floor. The auxiliary tanks are mounted externally on bomb shackles, one on each side of the lower fuselage. The auxiliary tanks have automatic vents which open when the landing gear is lowered so that the tanks will not be pressurized for landings. The auxiliary tanks can be jettisoned in an emergency. In addition to the single point refueling facilities, gravity fillers are installed in each of the four tanks, to provide an alternate refueling method.

Auxiliary Fuel Tank Jettison Handle.

The auxiliary fuel tank jettison handle (6, figure 1–27) is located on the forward right side of the console. The handle is connected by means of flexible cable to the bomb shackles which support the auxiliary fuel tanks. When the handle is pulled, the flexible cable trips the bomb shackle release mechanism and the tanks drop from the aircraft.

TRANSFER PUMPS.

Two ac transfer pumps are located in the bottom of the aft tank. Both pumps run continuously, provided that ac power is available; that the fuel pump selector switch is in the ON position; that fuel is in the aft tank; and that pressure is not building up in the sump tank. In the event of failure or malfunction of either pump, one pump is capable of complete fuel transfer. Pump discharge pressure is 10 psi. The pumps can be tested for proper operation by means of the fuel pumps switch. The pumps receive 3-phase electrical power from the 115-volt ac primary bus through the pump number one (PUMP NO. 1) and pump number two (PUMP NO. 2) circuit breakers (or through 3 pump number one and 3 pump number two fuses).

FUEL TRANSFER CAUTION LIGHT.

The fuel transfer caution light is located on the caution light panel (figure 1–56). The light is amber and is controlled by a pressure-sensitive switch located in a common pressure line between the two transfer pumps. If both transfer pumps stop and there is still fuel in the aft tank, the pressure will drop, the light will glow, and the words FUEL TRANSFER will appear. If the light comes on it may be that the transfer pumps have automatically turned off as a result of a temporary pressure buildup in the sump tank. If this is the case, the pumps will start again and the light will go out when the pressure is relieved due to fuel consumption from the sump tank. If the light comes on and does not go out after 2 minutes, the indication is that the transfer pumps have failed. The light will not come on when all fuel has been transferred from the aft tank. Electrical power for the light is supplied from the 28-volt dc primary bus through the transfer pump pressure light (TRNF PUMP PRESS LT) circuit breaker.

SUMP PUMP AND EMERGENCY PUMP.

The ac sump pump and the dc emergency pump are located in the bottom of the sump tank. Either pump is capable of sufficient fuel delivery to sustain the aircraft at maximum performance. The sump pump will run whenever ac power is available and the fuel pumps switch is in the ON position. The emergency pump will run whenever dc power is available, the fuel pumps switch is ON and the sump pump is not developing sufficient pressure. The sump pump receives 3-phase electrical power from the 115-volt ac primary bus through the sump pump (SUMP PUMP) circuit breaker (or 3 sump pump fuses). The emergency pump receives electrical power from the 28-volt dc primary bus through the emergency fuel pump (EMER FUEL PUMP) circuit breaker.

EMERGENCY PUMP CAUTION LIGHT.

The emergency pump caution light is located on the caution light panel (figure 1–56). The light is amber and is controlled by a pressure-sensitive switch located in the fuel line leading from the sump pump. In the event of failure of the sump pump, the drop in pressure will activate the pressure switch which, in turn, will close the circuit causing the light to glow and the words EMERGENCY PUMP to appear. The same pressure switch, when activated, will close another circuit causing the emergency pump to run. Electrical power for the emergency pump caution light is provided from the 28-volt dc primary bus through the emergency pump light (EMER PUMP LT) circuit breaker.

FUEL BOOST CAUTION LIGHT.

The fuel boost caution light is located on the caution light panel (figure 1–56). The light is amber and is controlled by a pressure-sensitive switch located in the fuel feed line to the engine fuel pump and fuel control. If the fuel pressure from the sump tank is below limits, the light will glow and the words FUEL BOOST will appear. The fuel boost caution light is supplied electrical power from the 28-volt dc primary bus through the boost pressure light (BOOST PRESS LT) circuit breaker.

COMPRESSOR.

The air compressor, located in fuselage behind the cabin, supplies the air pressure required for transfer of fuel from the auxiliary fuel tanks. The compressor will run whenever there is fuel in either auxiliary tank, ac power is available, the landing gear is up, the sump tank is not full, and pressure is called for by a pressure switch located in the line leading from the compressor to the auxiliary tanks. Electrical power for the operation of the compressor is supplied from the 115-volt ac primary bus through the three air compressor (AIR COMPR) fuses. The compressor will not run after the auxiliary tanks are empty.

COMPRESSOR PRESSURE CAUTION LIGHT.

The Compressor Pressure Light is located on the instrument panel (15, figure 1–9). The light is amber and is controlled by a pressure sensitive switch in the line leading from the compressor to the aux tanks. It is supplied electrical power from the 28-volt dc primary bus through the compressor pressure light (COMPR PRESS LT) circuit breaker. The light is wired through the landing gear handle and may come on under two different conditions: (1) If the landing gear handle is up when the light comes on, the air pressure is too low. (The light will not come on when the aux tanks go dry.) (2) If the landing gear handle is down and the light comes on, the pressure is too high, indicating the aux tanks did not vent.

WARNING

If aux tanks do not vent, ground crew personnel shall be notified before fueling the aircraft.

Note

When the landing gear is raised after takeoff, the compressor pressure caution light will come on and will remain on until the compressor has developed sufficient pressure in the system to transfer fuel. The time required to pressurize the tanks will vary from about 5 minutes for full tanks to about 20 minutes for empty tanks.

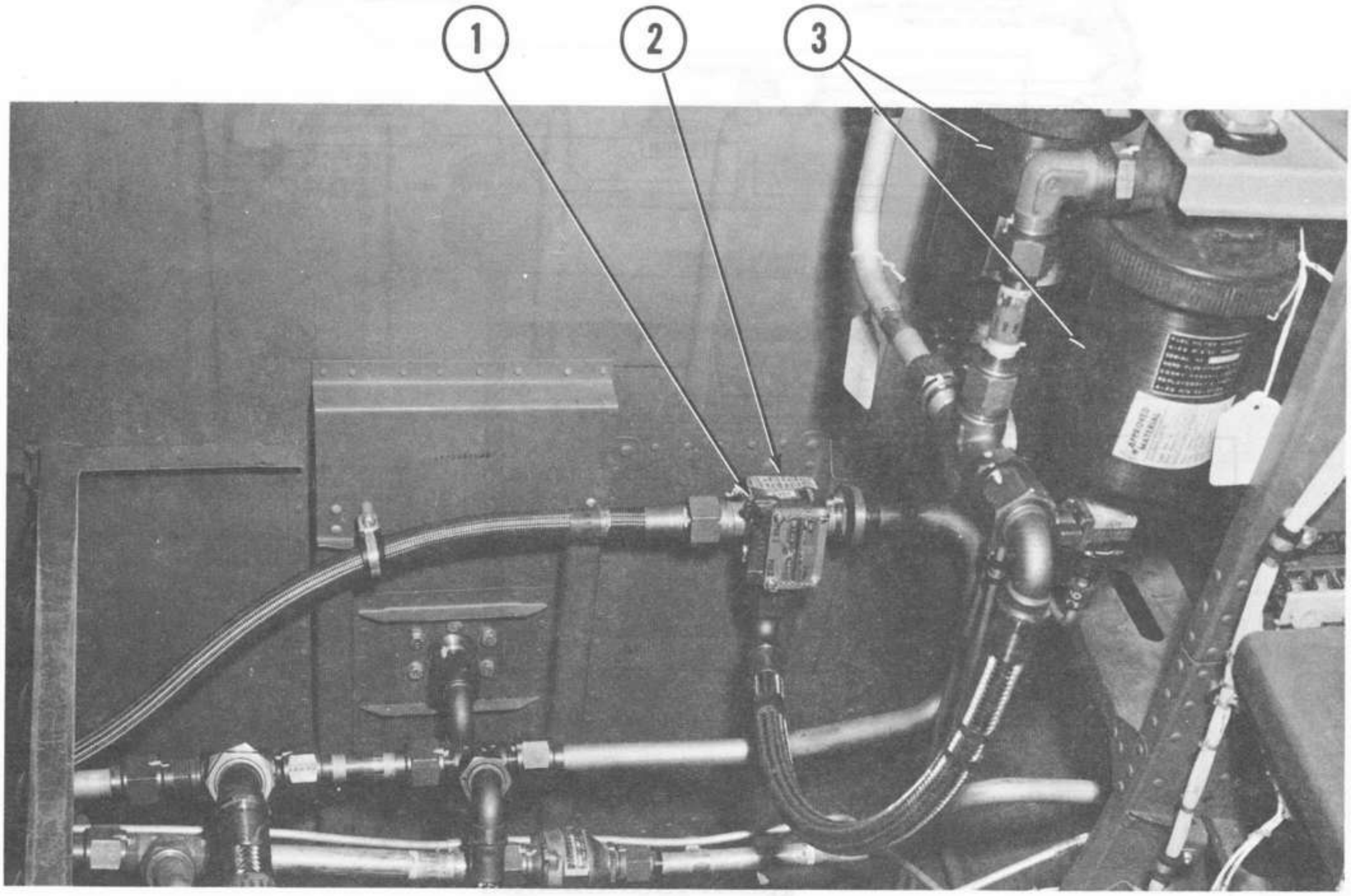
MANUAL DIVERTER VALVE.

A manual diverter valve (figure 1–25) is located in the fuselage behind the cabin. This valve must be actuated by hand to select an alternate fuel flow path from fuel tanks to the engine (figure 1–26). The diverter valve enables each engine fuel pump to draw fuel from all internal tanks in case of failure in the electrical system, sump pumps, transfer pump, or any combination thereof.

WARNING

All external fuel stores must be jettisoned prior to actuating the emergency fuel feed diverter valve. This prevents air from entering the engine fuel feed lines during emergency suction feed causing possible engine flameout.

Manual Diverter Valve



1. MANUAL DIVERTER VALVE HANDLE
2. MANUAL DIVERTER VALVE
3. FUEL FILTERS

Figure 1—25

The diverter valve method of fuel flow utilizes the inter-tank pressure fueling lines and bypasses the boost pumps. Allowable valve tolerances within the entire fuel system prohibits a predictable sequence of tank exhaustion.

Note

With manual diverter valve supplying engine fuel, flight above 8000 feet will be made only when the aft tank contains fuel and at least one transfer pump is operating.

WARNING

Do not switch from diverter mode back to normal fuel flow unless the sump tank contains fuel.

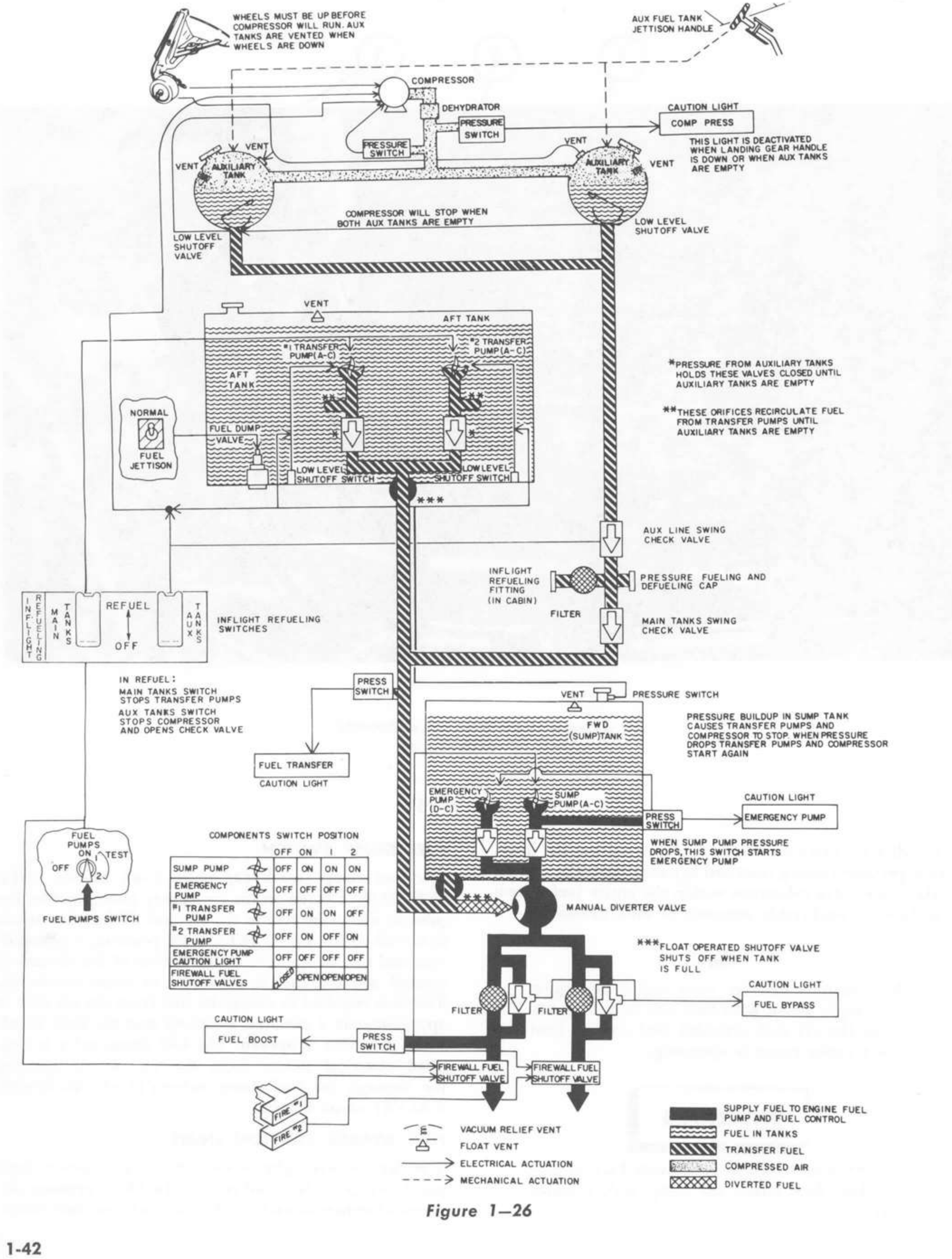
FUEL DUMP SWITCH.

The fuel dump switch (2, figure 1—8) labeled FUEL JETTISON, located on the emergency panel, enables the pilot to dump the fuel in the aft tank. When the switch is moved to the FUEL JETTISON position, a solenoid-operated fuel dump valve in the bottom of the aft tank is opened and the fuel is permitted to drain overboard. The time required to dump the fuel from the aft tank is approximately 2 minutes, assuming that the tank is full when the valve is opened. The fuel dump valve is supplied electrical power from the 28-volt dc primary bus through the fuel dump valve (FUEL JETTISON VALVE) circuit breaker.

FUEL BYPASS CAUTION LIGHT.

The fuel bypass light is located on the caution light panel (figure 1—56), and is controlled by a pressure differential switch in each of the two airframe fuel filters.

Fuel Supply System

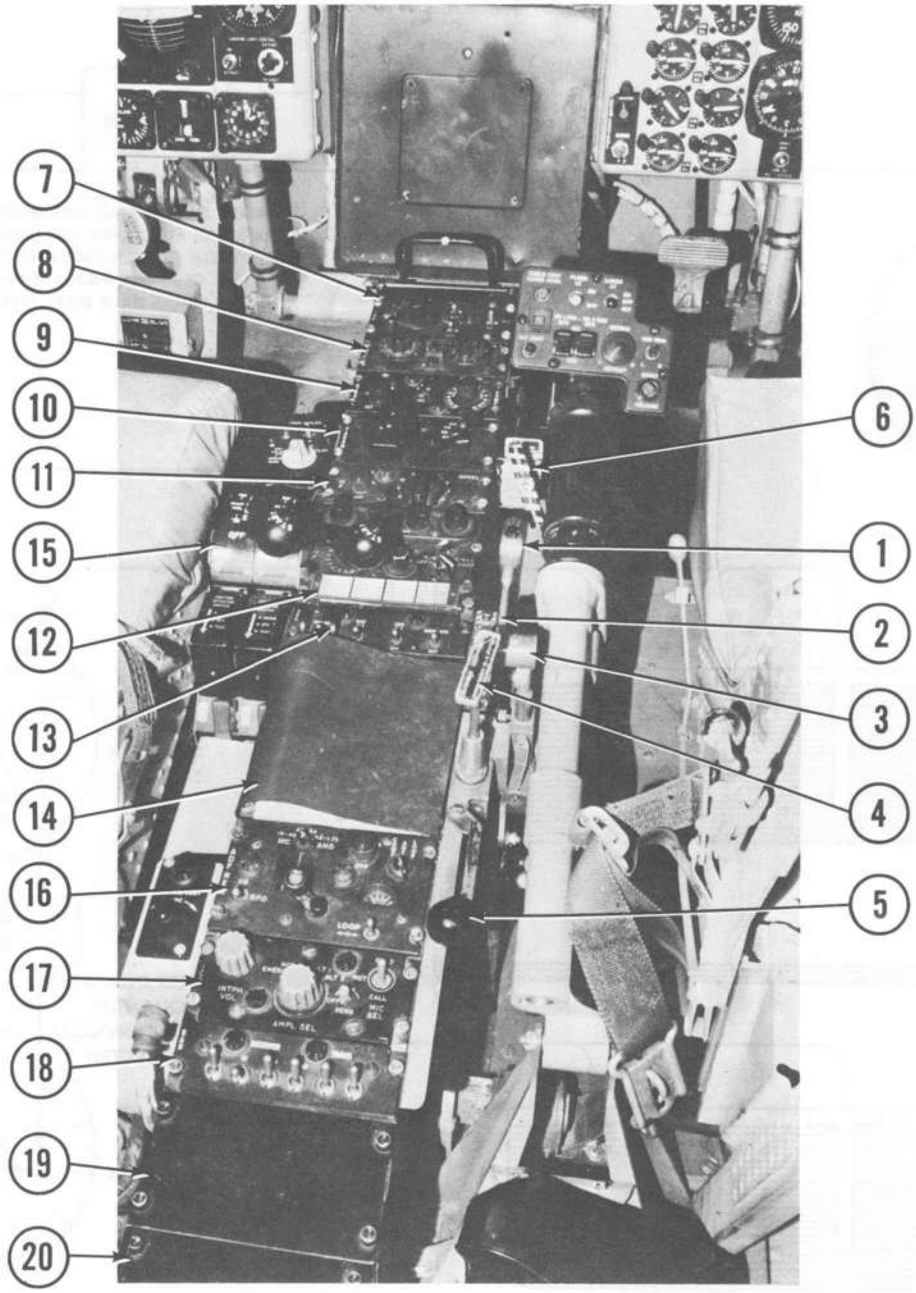


COMPONENTS SWITCH POSITION

	OFF	ON	1	2
SUMP PUMP	OFF	ON	ON	ON
EMERGENCY PUMP	OFF	OFF	OFF	OFF
#1 TRANSFER PUMP	OFF	ON	ON	OFF
#2 TRANSFER PUMP	OFF	ON	OFF	ON
EMERGENCY PUMP CAUTION LIGHT	OFF	OFF	OFF	OFF
FIREWALL FUEL SHUTOFF VALVES	CLOSED	OPEN	OPEN	OPEN

Figure 1—26

Console, Typical



1. LANDING GEAR LEVER
2. DOWNLOCK OVERRIDE BUTTON
3. LANDING GEAR EMERGENCY HANDLE
4. PARKING BRAKE HANDLE
5. CARGO HOOK EMERGENCY RELEASE HANDLE
6. AUXILIARY FUEL TANK JETTISON HANDLE
7. SIF PANEL
8. IFF PANEL
9. MA-1 COMPASS/PANEL
10. TACAN PANEL
11. AN/ARC-39 HF RADIO PANEL
12. AN/ARC-52 UHF RADIO PANEL
13. ASE PANEL
14. AN/ASA-13A COMPUTER PANEL (IF INSTALLED)
15. QUADRANT
16. AN/ARN-59 RADIO PANEL
17. AN/AIC-14 INTERCOM PANEL
18. RADIO SELECTOR PANEL
19. AN/APN-130 RADAR GROUNDSPEED PANEL (IF INSTALLED)
20. KY28 PANEL (IF INSTALLED)

Figure 1—27

Fuel Quantity Gage System

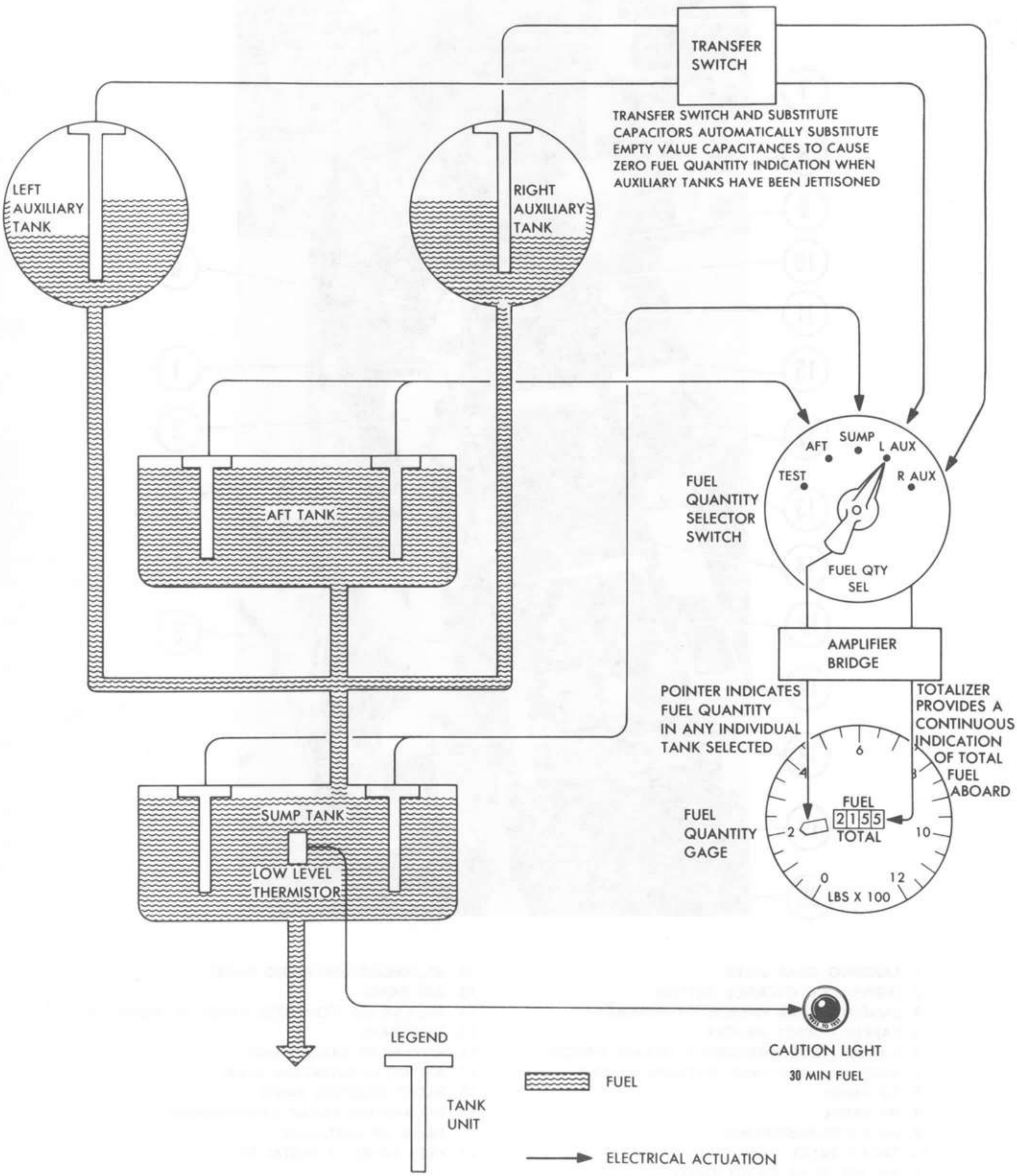


Figure 1—28

When a filter has become contamniated to the extent that fuel flow through the filter is restricted, the pressure differential switch will cause the light to glow, indicating an impending bypass. The light receives electrical power from the 28-volt dc primary bus through the filter bypass light (FILTER BYPASS LT) circuit breaker.

FUEL QUANTITY GAGE SYSTEM.

The capacitance-type fuel quantity gage system (see figure 1–28) is composed of a fuel quantity gage, a selector switch, an amplifier bridge, six tank units and an independent low level warning system. The capacitance values of the tank units are determined by the level of the fuel in the tanks and by the density of the fuel itself. Signals from the tank units are delivered to an electronic amplifier bridge, located beneath the cockpit floor. The amplifier bridge responds to these signals by sending a proportional voltage to the indicator, where the quantity of the fuel in the tanks is indicated in pounds. In the event that the auxiliary fuel tanks are jettisoned, a transfer switch automatically substitutes capacitances into the system which provide a zero gage indication for the auxiliary tanks. Electrical power for the system is provided from the 115-volt ac inverter bus and from the 28-volt dc primary bus through the two fuel gage (FUEL GAGE) circuit breakers.

Fuel Quantity Gage.

The fuel quantity gage (26, figure 1–9) is located on the left center portion of the instrument panel. The face of the gage contains a pointer which indicates, in pounds, the quantity of the fuel in any one of the four tanks selected by the selector switch. In addition, a totalizer located in the center of the instrument dial indicates at all times the total fuel aboard. Each mark on the dial represents 50 pounds of fuel.

Note

When using the manual diverter valve, an erroneous fuel quantity indication will occur if the sump tank becomes empty. Capacitance change on the sump tank gage unit causes an abrupt increase in the fuel totalizer reading.

Fuel Quantity Selector Switch.

The selector switch (19, figure 1–9) is located on the left center portion of the instrument panel under the fuel quantity gage. The switch has five positions, one for each of the four fuel tanks, and a TEST position. When turned to any one of the four tank positions, the pointer on the face of the fuel quantity gage will indicate the quantity of the fuel in that tank. The TEST position on the switch provides a means of checking the gage for proper operation. When the switch is moved to the TEST position, both the pointer and the totalizer should move toward zero. When the switch is moved back to its original position, the gage should return to its original indication. The switch is spring-loaded to return to the SUMP position when it is released. When switching to any specific tank for a reading, the switch should be held in that position for a few seconds to allow pointer to steady down before taking a reading.

30 Minute Fuel Caution Light.

The 30 Minute fuel caution light (17, figure 1–9) is located on the instrument panel. The light is amber and is controlled by a low level sensing element (thermistor) located at a fixed height in the sump tank. When the fuel level falls below the sensing unit, the 30 minute fuel caution light will glow. Because the amount of flight time remaining is dependent on the flight conditions, 30 minutes is only an approximate figure. The light serves to call your attention to the fact that you are operating with low fuel and that you should check the fuel quantity gage to determine the actual quantity of fuel in the tank. The caution light draws electrical power from the 28-volt dc primary bus through the low fuel light (LOW FUEL LT) circuit breaker.

SINGLE-POINT PRESSURE FUELING SYSTEM

DESCRIPTION.

All tanks may be pressure-filled through the single-point pressure fueling adapter (see figure 1–62). Fueling pressure must not exceed 55 psi. Although the following information is not normally the concern of the aircraft flight crew, it is included to provide rudimentary knowledge of the system if strange field operations require pressure refueling. During pressure fueling, the fuel level in each tank is controlled by a pilot valve actuated shut-off valve which shuts off the fuel flow when the tank is full. For reliability there is a primary and a secondary pilot valve in each main tank. The pilot valves can be checked for proper operation by the two 2-position switches on the fuel precheck panel. During fueling operations, the primary pilot valves can be checked by holding all the precheck panel switches in the primary position. If the valves are operating properly, the fuel flow will stop within 20 seconds. The secondary pilot valves can be checked the same way. When the door to the fuel precheck valve is open, a switch is actuated which opens vent valves in the auxiliary tanks and closes the circuit to the main and auxiliary tank line check valve switches in the precheck panel. The sump and aft tanks are vented by float-type vent valves. When fueling, as each tank becomes full, the pilot valve closes the shutoff valve and flow into that tank will stop. When all flow has stopped, the tanks are full. When the pre-check panel door is closed, the auxiliary tank vent valves are closed and the solenoid operated check valve in the line is returned to its original status. The fuel precheck switches may also be used for selective pressure refueling by simply actuating either the primary or secondary valves in those tanks which are not to be filled. For defueling, the same system is used. (Defueling is covered in the Manual of Maintenance Instructions, NAVAIR 01-260HCA-2-4 Series.) Electrical power for operation of the valves and switches comes directly from the battery bus. The battery switch need not be ON for operation of the system.

In-Flight Pressure Fueling Equipment.

See figure 1–28A.

Both the internal and auxiliary tanks may be refilled in flight from a properly equipped fuel supply on the surface. The inflight fueling provisions consist of a refuel nipple fitting (3), connecting plumbing (4) between the nipple fitting and the pressure fueling adapter (6), a filter (5), main and auxiliary tanks inflight refueling switches (1 and 2).

The main tanks inflight refueling switch has two positions, marked REFUEL and OFF. This is for control of fuel to the aft tank only. When the switch is moved to the REFUEL position, the transfer pumps in the aft tank stop running, thus allowing fuel to flow into the aft tank. There is no control over the forward tank, and fuel will flow in as long as the fueling line is connected and the line is pressurized. A surge will be felt in the line as the tank reaches its capacity and is shut off by the normal refueling valve. When the fuel level drops due to engine demands, the valve will again open and start the cycle over again.

The auxiliary tanks inflight refueling switch has two positions, marked REFUEL and OFF. When the switch is moved to the REFUEL position, the air compressor is stopped and the auxiliary tank lines are positioned to allow new fuel to flow into the tanks. As the main and auxiliary tanks become full, fuel flow to the tanks is automatically stopped. Fuel flow can be stopped before the tanks are full by turning off the inflight refueling switches, or by signalling the surface station to stop pumping.

PRESSURE FUELING.

For pressure fueling of static helicopter, on deck or ashore:

1. Fuel precheck panel door – OPEN.
2. Fuel vehicle – Grounded to the aircraft.
3. Pressure fueling nozzle – Grounded to the aircraft.
4. Pressure fuel and defuel cap – REMOVED.
5. Pressure fueling nozzle – Connected. Start pumping fuel.
6. Auxiliary tank line check valve switch – CLOSED.
7. Main tank fuel precheck switches – PRIMARY. Fuel flow should stop, indicating correct operation of primary pilot valves.
8. Main tank fuel precheck switches – SECONDARY.

   Fuel flow should stop, indicating correct operation of secondary pilot valves.

CAUTION

If both the primary and secondary valves in any one tank do not operate correctly, stop fueling operations to avoid rupturing fuel tanks. Pilot valves must be repaired before continuing pressure fueling. However, to continue the mission, tanks may still be filled by gravity through the filler necks.

9. Auxiliary and main tank line check valve switches – OPEN. Continue fueling. When fuel flow has stopped:
10. Pressure fueling nozzle – Disconnected after fuel flow has stopped.
11. Pressure fuel and defuel cap – Replaced.
12. All grounding wires – Removed.
13. Fuel precheck panel door – Closed.

PRESSURE FUELING – HELICOPTER IN FLIGHT.

1. Lower hoist cable for pickup of refueling rig.
2. Raise the attached refueling rig to about 3 feet from the hoist.
3. Connect the grounding wire.
4. Connect the refueling hose to the fitting added to the starboard side of the passenger compartment.
5. Check the emergency breakaway handle for correct attachment. Note that if it should become necessary to execute an emergency breakaway, the saddle fitting and a short length of hose will remain attached to the aircraft.
6. Signal ship to pressurize hose. Turn inflight refueling switches to refuel. Fuel flow rate will vary with delivery pressure and will stop automatically when the selected tanks are full.
7. Signal the ship to shut off the fuel before you exceed maximum gross weight for the existing conditions. This requires careful planning and extremely close watch of N_g, T_5, and rotor RPM by the pilot not flying the aircraft.
8. Turn inflight fueling switches to OFF and disconnect the fuel nozzle.
9. Note that the special filter "fuses" in the aft fuselage must be inspected after each flight involving an inflight refueling.

PRESSURE FUELING – ENGINES AND ROTORS OPERATING, HELICOPTER ON DECK.

This procedure utilizes items from both the inflight and static pressure fueling procedures, modified to permit "hot" refueling on deck. It is essential that the pilot coordinate the assistance of the aircrewman and the fueling detail on deck. All personnel must adhere to all safety precautions given for normal pressure fueling.

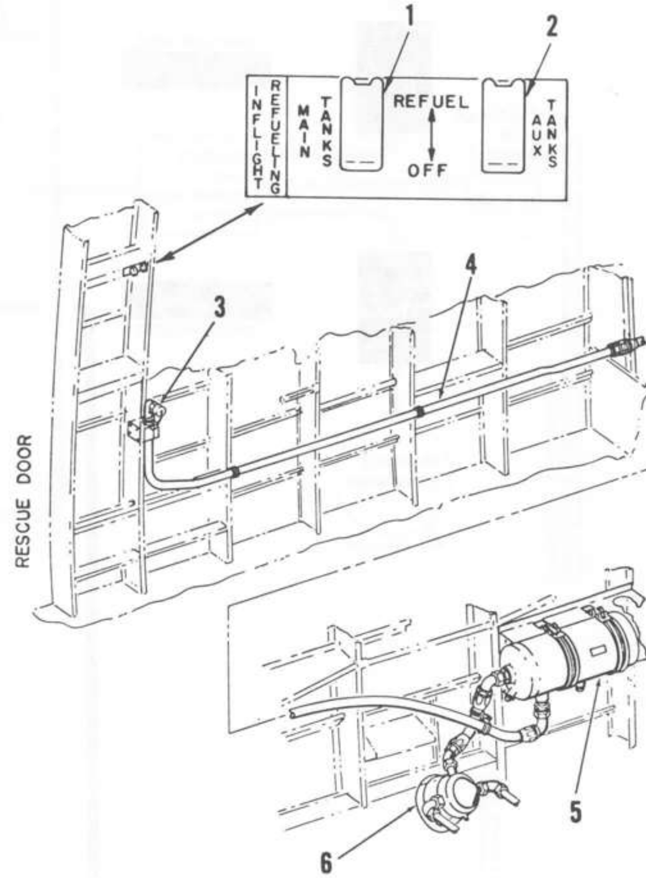
1. Once the helicopter is in position the pilot shall switch OFF the ASE and lock the collective with friction.
2. The pilot must maintain UHF radio contact with the control tower during the fueling operation to report any emergency.
3. Secure all electrical and electronic equipment not necessary for the fueling operation, and disarm all weapons.
4. Pilot direct aircrewman to place inflight refueling switches to REFUEL position. Aircrewman acknowledges.
5. Fueling detail must be familiar with, and adhere to following procedure:
   a. Fuel precheck panel door – OPEN.
   b. Fuel vehicle (ashore only) – Grounded to the aircraft.
   c. Pressure fueling nozzle – Grounded to the aircraft.
   d. Pressure fuel and defuel cap – REMOVED.
   e. Pressure fueling nozzle – Connected. Begin pumping fuel on pilot's signal.
   f. Main tank fuel precheck switches – PRIMARY. Fuel flow should stop, indicating correct operation of primary pilot valves.
   g. Main tank fuel precheck switches – SECONDARY. Fuel flow should stop, indicating correct operation of secondary pilot valves.

CAUTION

If both the primary and secondary valves in any one tank do not operate correctly, temporarily stop fueling, and advise pilot to monitor fuel gauge and signal when to cease fueling to avoid the possibility of rupturing fuel tanks.

   h. Pressure fueling nozzle – Disconnected after fuel flow has stopped or on signal from pilot.
   i. Pressure fuel and defuel cap – Replaced.
   j. All grounding wires – Removed.
   k. Fuel precheck panel door – Closed.
   l. Signal pilot that fueling is completed.
6. Pilot direct aircrewman to place inflight refueling switches to OFF position. Aircrewman acknowledges.
7. Pilot check fuel transfer caution light OFF.

Inflight Pressure Fueling Equipment



1. MAIN TANKS INFLIGHT REFUELING SWITCH
2. AUXILIARY TANKS INFLIGHT REFUELING SWITCH
3. REFUEL NIPPLE FITTING
4. CONNECTING PLUMBING
5. FILTER (FUSES)
6. PRESSURE FUELING ADAPTER

Figure 1-28A

Note

Fuel transfer light will be off while fuel is being pumped into aircraft. Fuel transfer light should come on approximately 5 seconds after ceasing fueling operation. When inflight fueling switches are turned off, fuel transfer light should go off indicating proper transfer pump operation.

Electrical Power Supply Functional Flow Diagram

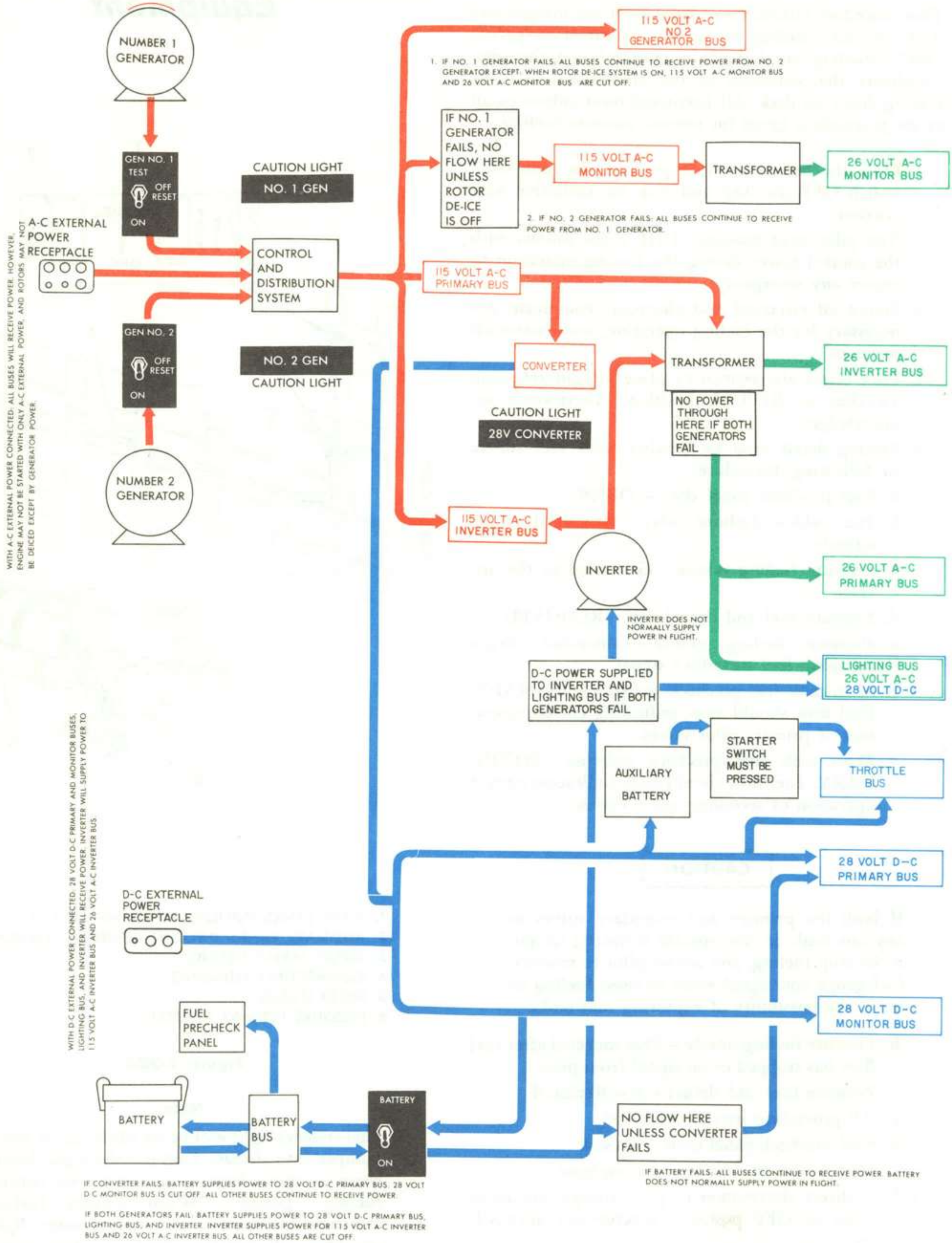


Figure 1—29

ELECTRICAL POWER SUPPLY SYSTEM

The electrical power supply system (figures 1—29 and 1—30) provides 115/200-volt, 400-cycle, 3-phase ac power, 26-volt, 400-cycle, single-phase ac power and 28-volt dc power to operate the various electrical and electronic components of the helicopter. The electrical power supply system is considered to end at the distribution busses in the circuit breaker and fuse panel (figure 1—31). The circuit breakers and fuses are considered to be a part of the using systems which they serve. There are four sources of electrical power: the number one generator, the number two generator, the main battery, and the auxiliary battery. In addition, external power receptacles are provided for both ac and dc power.

Power from these sources is distributed through a multi-bus system. The principal source of electrical power for the aircraft is the number one (ac) generator, supplying power directly to the 115/200-volt ac primary, monitor, and inverter busses and the 28-volt converter. Both the primary and monitor busses, in turn, supply power to two transformers. One of the transformers supplies power to the 26-volt ac inverter and primary busses and the lighting bus and the other supplies power to the 26-volt ac monitor bus. The 28-volt converter converts the ac to dc and supplies power to the 28-volt dc primary and monitor busses and charges the battery. A second source of power is the number two generator which, under normal conditions, supplies power to the 115/200-volt ac number two generator bus. In the event of failure of the number one generator, the number two generator will automatically take over and supply power to the system in the same manner as did the number one generator, with one exception: power to the 115/200-volt ac monitor bus and the 26-volt ac monitor bus will be cut off if the rotor deicing system is used. In the event of failure of only the number two generator, the number one generator will supply power to the entire system. If both generators fail, power will be supplied automatically from the main battery to the 28-volt dc primary bus, to the lighting bus and to the inverter. The inverter will then change the dc to ac and supply the necessary power to the 115/200-volt ac inverter bus and to the 26-volt ac inverter bus. In this situation, power to all other ac busses will be cut off. The changeovers are accomplished automatically by means of automatic transfer relays and power failure relays. Any undervoltage, overvoltage or underfrequency condition in the generator output will cause the automatic changeover to occur. The auxiliary battery will provide power to the throttle bus whenever the starter switch is pressed.

Note

In the interest of brevity, the 115/200-volt ac busses will hereafter be referred to as 115-volt busses.

Electrical Power Supply Distribution

28-VOLT DC PRIMARY BUS

AC BUS TIE RELAY
AC EXTERNAL POWER RELAY
ADF RECEIVER
AIR COMPRESSOR
ANTI-COLLISION LIGHT (AFC 114)
ANTI-COLLISION LIGHT MOTOR (AFC 114)
ASE
BLADE TRACKING
BOOST PRESSURE LIGHT
CARGO HOOK INDICATOR
CHIP DETECTOR
COLLECTIVE FRICTION
COMB BOX OIL PRESSURE LIGHT
COMB BOX OIL TEMP GAGE
COMPRESSOR PRESSURE LIGHT
CONVERTER
CONVERTER WARNING LIGHT
COPILOT'S TURN INDICATOR
DC UTILITY RECEPTACLE (ON CABIN CEILING)
EMERGENCY FUEL FEED
EMERGENCY FUEL PUMP
EMERGENCY PUMP LIGHT
ENGINE EMERGENCY RPM CONTROL
ENGINE RPM CONTROL
FILTER BYPASS LIGHT
FLOODLIGHT CONTROL
FLOATATION GEAR
FUEL GAGE
FUEL JETTISON VALVE
FUEL-OIL SHUTOFF
FUEL TRANSFER PUMP PRESSURE LIGHT
GROUNDSPEED/DRIFT ANGLE INDICATOR
HF COMMUNICATIONS
HOIST CONTROL
HYDRAULIC ACTUATOR (F)
HYDRAULIC PRESSURE LIGHT
ICS (F)
IFF SIF
INVERTER CONTROL
JULIET 28 (AFC 152)
LANDING GEAR
LANDING GEAR LIGHT
LANDING LIGHT
LOUD HAILER
LOW FUEL LIGHT
MASTER CAUTION LIGHT
MONITOR AC BUS RELAY
NO. 1 ENGINE FIRE DETECTOR
NO. 2 ENGINE FIRE DETECTOR
NO. 1 ENGINE FIRE EXTINGUISHER
NO. 2 ENGINE FIRE EXTINGUISHER
NO. 1 ENGINE OIL PRESSURE LIGHT
NO. 2 ENGINE OIL PRESSURE LIGHT
NO. 1 ENGINE OIL TEMP GAGE
NO. 2 ENGINE OIL TEMP GAGE
NO. 1 ENGINE STARTER CONTROL
NO. 2 ENGINE STARTER CONTROL
NO. 1 GEN AC POWER
NO. 1 GEN CONTROL
NO. 1 GEN WARN LIGHT
NO. 2 GEN CONTROL
NO. 2 GEN WARN LIGHT
NO. 1 SDG OIL PRESSURE LIGHT
NO. 2 SDG OIL PRESSURE LIGHT
NO. 1 SDG OIL TEMP GAGE
NO. 2 SDG OIL TEMP GAGE
PILOT'S TURN INDICATOR
PILOT'S VERTICAL GYRO
PUMP NO. 1
PUMP NO. 2
RADAR ALTIMETER
RAWS DC
RESCUE BOOM (FISHPOLE)
ROTOR BLADE DEICE
ROTOR OVERSPEED INDICATOR
SUMP PUMP
TRANSMISSION OIL PRESSURE LIGHT
TRANSMISSION OIL TEMP GAGE
TURBINE ANTI-ICE
UHF COMMUNICATIONS
UHF DF

28-VOLT DC MONITOR BUS

ANTI-COLLISION LIGHT MOTOR (PRIOR AFC 114)
AN/ALQ-98(AFC 157)
ASA-13A
CABIN HEAT VALVE (F)
DOPPLER MEMORY
NAV RECEIVER(ARN-21 OR-52)
WINDSHIELD HEAT (F)
WINDSHIELD WASHER (F)

BATTERY BUS

BATTERY RELAY
JULIET 28 (AFC 152) (UNDER PILOT'S SEAT)

THROTTLE BUS

NO. 1 THROTTLE (NO. 1 ENGINE CONDITION LEVER)
NO. 2 THROTTLE (NO. 2 ENGINE CONDITION LEVER)

26-VOLT AC PRIMARY BUS

ADF RECEIVER (F)
ASE (F)
COMPASS
NAV RECEIVER(ARN-21)
NAV RECEIVER(F)(ARN-52)
PILOT'S VERTICAL GYRO
PRIMARY 26V SENSE RELAY
UHF DF (F)

LIGHTING BUS 26-VOLT AC OR 28-VOLT DC

CABIN DOME LIGHT
COCKPIT FLOODLIGHTS
HOIST FLOODLIGHTS
INSTRUMENT LIGHTS
LANDING LIGHT
PITOT HEAT
POSITION LIGHT

26-VOLT AC MONITOR BUS

ANTI-COLLISION LIGHT (PRIOR AFC 114)
NOSE FLOODLIGHT

26-VOLT AC INVERTER BUS

BLADE TRACKING
COMB BOX OIL PRESSURE GAGE
HYDRAULIC PRESSURE GAGE (F)
NO. 1 ENGINE OIL PRESSURE GAGE
NO. 2 ENGINE OIL PRESSURE GAGE
NO. 1 SDG OIL PRESSURE GAGE
NO. 2 SDG OIL PRESSURE GAGE
NO. 1 ENGINE TORQUE PRESSURE
NO. 2 ENGINE TORQUE PRESSURE
POWER FACTOR CORRECTION(F)
TRANSMISSION OIL PRESSURE

115/200-VOLT AC MONITOR BUS

AN/ALQ-98(AFC 157)
ASA-13A (F)
CABIN HEAT FAN (F3)
COPILOT SUIT VENT FAN
GROUNDSPEED RADAR (3)
NAV RECEIVER(2)(ARN-21)
NAV RECEIVER(F)(ARN-52)
PILOT'S SUIT VENT FAN
WINDSHIELD HEAT (2)
26-VOLT TRANSFORMER

115/200-VOLT AC PRIMARY BUS

AIR COMPRESSOR (F3)
ASE (F3)
CONVERTER
GYRO COMPASS
IFF SIF
PILOT'S RAI (3)
PUMP NO. 1 (F3)
PUMP NO. 2 (F3)
RADAR ALTIMETER
RAWS CO
SUMP PUMP (F3)
3-VOLT LIGHTING (F)
5-VOLT LIGHTING (F)
5-VOLT LIGHTING TRANSFORMER (F)
26-VOLT TRANSFORMER (F)

115/200-VOLT AC NO. 2 GENERATOR BUS

GENERATOR FAN (3)
ROTOR BLADE DEICE (3)

115/200-VOLT AC INVERTER BUS

FUEL GAGE

(F) INDICATES FUSE— ALL OTHERS ARE CIRCUIT BREAKERS

(3) INDICATES NUMBER OF CIRCUIT BREAKERS OR FUSES ON BUS WITH SAME NAME

Figure 1—30

Fuse and Circuit Breaker Panels, Typical

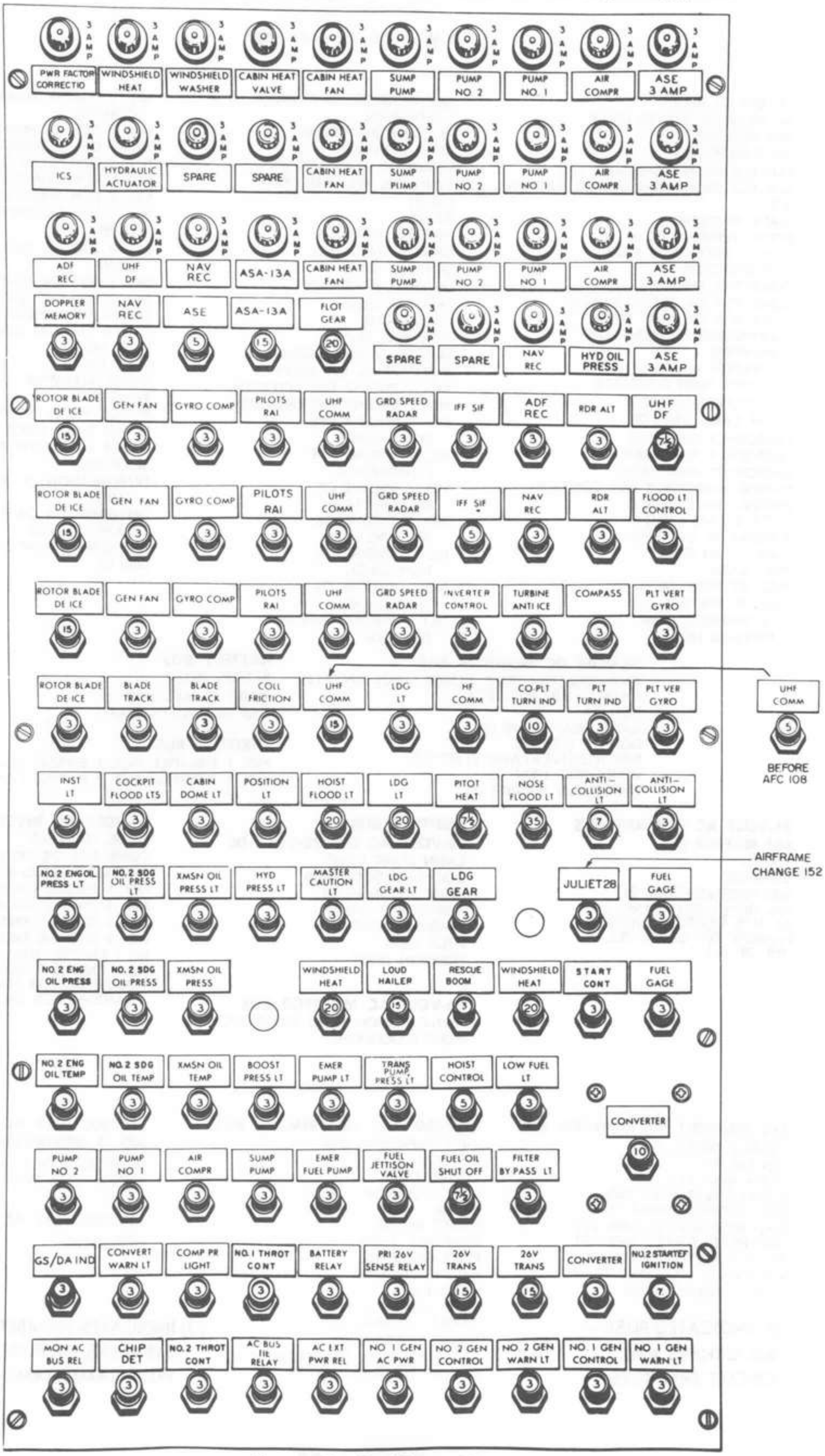


Figure 1—31 (Sheet 1)

Fuse and Circuit Breaker Panels, Typical

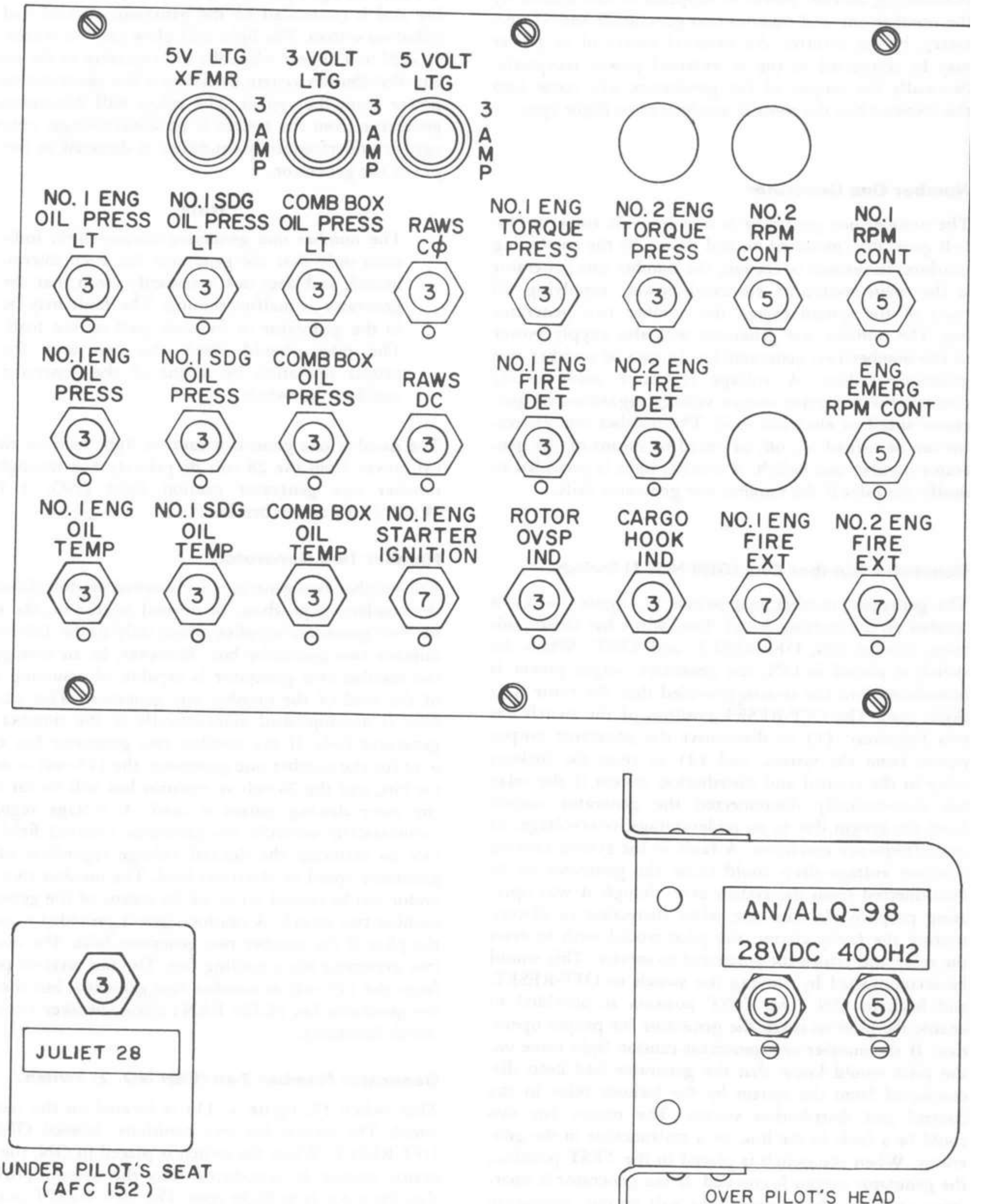


Figure 1–31 (Sheet 2)

ALTERNATING CURRENT POWER SUPPLY SYSTEM.

Alternating current power is supplied to the system by the number one and number two generators and, if necessary, by the inverter. An external source of ac power may be connected at the ac external power receptacle. Normally the output of the generators will come into the system when the rotor is accelerated to flight rpm.

Number One Generator.

The number one generator is a 20-kilovolt ampere, 115-volt generator, mounted on and driven by the combining gearbox. In normal operation, the number one generator is the main source of electrical power, supplying all parts of the system except the number two generator bus. The number one generator will also supply power to the number two generator bus in case of number two generator failure. A voltage regulator automatically controls the generator output voltage regardless of generator speed or electrical load. The number one generator can be turned on, off, or tested by means of the generator number one switch. A caution light is provided to notify the pilot if the number one generator fails.

Generator Number One (GEN NO. 1) Switch.

The generator number one switch (1, figure 1—11) is located on the starting panel. The switch has three positions, labeled ON, OFF-RESET, and TEST. When the switch is placed in ON, the generator output power is introduced into the system provided that the rotor is at flight rpm. The OFF-RESET position of the switch has two functions: (1) to disconnect the generator output power from the system, and (2) to reset the lockout relay in the control and distribution system if the relay has automatically disconnected the generator output from the system due to an undervoltage, overvoltage, or underfrequency condition. A fault in the system causing a severe voltage drop could cause the generator to be disconnected from the system even though it was operating properly. In this case, after correcting or disconnecting the faulty circuit, the pilot would wish to reset the relay and return the generator to service. This would be accomplished by moving the switch to OFF-RESET, and back to ON. The TEST position is provided to enable the pilot to check the generator for proper operation. If the number one generator caution light came on, the pilot would know that the generator had been disconnected from the system by the lockout relay in the control and distribution system. The reason for this could be a fault in the line, or a malfunction in the generator. When the switch is placed in the TEST position, the generator output is checked. If the generator is operating properly, the caution light will go out, indicating to the pilot that the fault is in the line. If the generator is malfunctioning, the caution light will remain lighted when the switch is moved to the TEST position.

Number One Generator Caution Light.

The number one generator caution light is located on the caution light panel (figure 1—56). The light is amber and is controlled by the generator control and distribution system. The light will glow and the words NO. 1 GEN will appear when the lockout relay in the control and distribution system disconnects the generator output power from the system. The relays will disconnect the generator from the system if an undervoltage, overvoltage, or underfrequency condition is detected in the output of the generator.

Note

The number one generator caution light indicates only that the generator has been disconnected, and does not necessarily mean that the generator is malfunctioning. The fault may be in the generator or in some part of the load. The pilot should check the generator for proper operation by means of the generator number one switch.

The number one generator caution light receives electrical power from the 28-volt dc primary bus through the number one generator caution light (NO. 1 GEN WARN LT) circuit breaker.

Number Two Generator.

The number two generator is mounted on and driven by the combining gearbox. In normal operation, the number two generator supplies power only to the 115-volt ac number two generator bus. However, in an emergency, the number two generator is capable of assuming most of the load of the number one generator. This changeover is accomplished automatically if the number one generator fails. If the number two generator has taken over for the number one generator, the 115-volt ac monitor bus, and the 26-volt ac monitor bus will be cut off if the rotor deicing system is used. A voltage regulator automatically controls the generator internal field current to maintain the desired voltage regardless of the generator speed or electrical load. The number two generator can be turned on or off by means of the generator number two switch. A caution light is provided to notify the pilot if the number two generator fails. The number two generator has a cooling fan. The fan receives power from the 115-volt ac number two generator bus through the generator fan (GEN FAN) circuit breaker (or three circuit breakers).

Generator Number Two (GEN NO. 2) Switch.

This switch (2, figure 1—11) is located on the starting panel. The switch has two positions, labeled ON and OFF-RESET. When the switch is placed in ON, the generator output is introduced into the system provided that the rotor is at flight rpm. The OFF-RESET position of the switch has two functions: (1) to disconnect the generator output power from the system, and (2) to reset the lockout relay in the control and distribution system if the relay has automatically disconnected the generator output from the system due to an undervoltage, overvoltage, or underfrequency condition. A fault in the system causing a severe voltage drop could cause the generator to be disconnected from the system even though it was operating properly. In this case, after correcting or disconnecting the faulty circuit, the pilot would wish to reset the relay and return the generator to service. This would be accomplished by moving the switch to OFF-RESET, and back to ON.

Number Two Generator Caution Light.

The number two generator caution light is located on the caution light panel (figure 1–56). The light is amber and is controlled by the generator control and distribution system. The light will glow, and the words NO. 2 GEN will appear when the lockout relay in the control and distribution system disconnects the generator output power from the system. The relay will disconnect the generator from the system if an undervoltage, overvoltage, or underfrequency condition is detected in the output of the generator.

Note

The number two generator caution light indicates only that the generator has been disconnected, and does not necessarily mean that the generator is malfunctioning. The fault may be in the generator or in some part of the load. If the fault is located somewhere other than in the generator, the generator may be returned to service by means of the generator number two switch after the fault has been corrected or disconnected.

The number two generator caution light receives electrical power from the 28-volt dc primary bus through the number two generator caution light (NO. 2 GEN WARN LT) circuit breaker.

Transformers.

Two transformers are included in the system. The transformers supply power to those systems or components requiring 26-volt ac single-phase power. One transformer supplies power for the 26-volt ac inverter and primary busses, and the lighting bus. This transformer receives power from the 115-volt ac primary bus through one of the two 26-volt transformer (26V TRANS) circuit breakers. The other transformer supplies power for the 26-volt ac monitor bus. This transformer receives power from the 115-volt ac monitor bus through one of the two 26-volt transformers (26V TRANS) circuit breakers.

Inverter.

The inverter supplies ac power during start-up for those instruments requiring ac power, and provides a source of emergency ac power if both generators fail. In normal operation of the system, the inverter is not operative. The ac power failure sense relays constantly monitor the ac power output of the generators. If the ac power from both generators stops, the relay will direct power from the battery to the inverter. The inverter will then produce ac power which is supplied to the 115-volt ac inverter bus, and via a transformer, to the 26-volt ac inverter bus. The inverter draws 28-volt dc power from the battery.

Alternating Current External Power Receptacle.

An ac external power receptacle (18, figure 1–3) is located on the lower right side of the fuselage. When the external ac power supply is connected, the generators are disconnected and power is supplied to those portions of the system which are normally supplied by the number one generator. However, if the generator switches are in the ON position when the rotor accelerates to flight rpm, and the generators are developing normal output voltage and frequency, the automatic transfer relays will disconnect the external power from the system and reconnect the generators. A dc external power receptacle is also provided on the aircraft.

DIRECT CURRENT POWER SUPPLY.

Direct current power is supplied to the system by the converter during normal operations, and by the battery if the converter becomes inoperative. An external source of dc power may also be connected at the dc external power receptacle.

Converter.

The converter receives ac power from the generators and changes it into dc power which is supplied to the 28-volt dc primary bus and the 28-volt dc monitor bus. The converter also supplies the necessary power to charge the battery. During normal operation the converter is the only source of dc power. If the converter fails, the 28-volt dc primary bus will receive power from the battery, and the 28-volt dc monitor bus will receive no power. The converter receives power from the 115-volt ac primary bus through the CONVERTER circuit breaker. A caution light on the caution light panel will notify the pilot if the converter becomes inoperative. If a dc external power supply is plugged in, the converter will be inoperative.

Converter Caution Light.

The converter caution light is located on the caution light panel (figure 1–56). If the converter becomes inoperative, the light will glow and the words 28V CONVERTER will appear. The light receives power from the 28-volt dc primary bus through the converter caution light (CONVERT WARN LT) circuit breaker.

Battery.

The battery (16, figure 1–3) is located on the right side under the forward cockpit floor. The battery is fully enclosed within its case, and battery gases are vented overboard by means of a vent tube. The battery supplies power at all times to the battery bus, regardless of the position of the battery switch. The battery serves as a standby source of emergency power. In flight, the battery would only be called upon to supply power if both generators or the converter failed. If both generators failed, the battery would automatically supply power to the 28-volt dc primary bus, the lighting bus, and the inverter. The remainder of the system would be without power. If only the converter failed, the battery would supply power only to the 28-volt dc primary bus. In this condition, the 28-volt monitor bus would be without power and the remainder of the system would be supplied power by the generators.

Note

> The battery is supplying power when both generator lights come on or when the converter caution light comes on. Since the battery is the only source of dc power, reduce the load by shutting down all unnecessary dc operated equipment. Of particular importance is minimum use of floodlights and landing lights, and HF ARC-39 communications. The duration of battery power under these circumstances varies greatly depending on many factors, such as battery age, charge state, and OAT.

Battery Switch.

The battery switch (4, figure 1–11) is located on the starting panel and controls the battery relay. The switch has two positions: ON and OFF. When the switch is moved to the ON position, the battery is connected to the system and will deliver power if no generator power or external power is available. The battery will be charged if generator power or external power is available. When the switch is moved to the OFF position, the battery will be disconnected from the system and only the battery bus will receive power.

Auxiliary Battery.

The auxiliary battery is mounted on the roof, inside the forward part of the nacelle. It provides power to the auxiliary throttle bus whenever the starter switch is pressed. This provides full voltage to the electric fuel control circuits, even though starter-drain may lower the voltage in other circuits of the helicopter. In the event of helicopter electric power failure, the auxiliary battery will supply power to the fuel control system whenever the starter switch is pressed.

Direct Current External Power Receptacle.

A dc external power receptacle (18, figure 1–3) is located on the lower right side of the fuselage. When an external dc power supply is connected, power is supplied to those portions of the system which are normally supplied by the converter. An external dc power supply is desirable for engine starting. An external ac power receptacle is also provided.

DC Utility Receptacle.

Equipment such as an aldis lamp may be connected to the dc utility receptacle (3, figure 1–35) located on the cabin ceiling. Power is supplied from the 28-volt dc primary bus through the fuse adjacent to the receptacle.

COMMUNICATIONS AND RADIO NAVIGATION EQUIPMENT

The seven communications systems installed in the helicopter provide intercommunication between crew members, two-way voice radio communication, and radio reception of navigation information. (Navigation systems that do not require radio signals are described under the navigation equipment paragraphs of this section.) Figure 1–32 lists the communication system installed and their primary characteristics. Antennas are shown in figure 1–33.

Note

> Since the communications systems are not peculiar to this helicopter, but are widely used on many Navy aircraft and are fully covered in existing publications, description of these systems is brief.

HEADSET AND MICROPHONE CONNECTORS.

Flexible cord sets are provided at each crew station for connecting the pilot's, copilot's, and hoist operator's headsets and microphones to the communications systems.

MICROPHONE SWITCHES.

Trigger-type switches on the backs of the pilots' cyclic sticks and the hoist operator's grip (1, figure 1–34) provide ON-OFF switching of their respective microphones. Squeezing one of the switches to the detent position closes the microphone circuits to the intercom only; squeezing the switch to the limit of its travel closes the microphone to the radios and loud hailer.

RADIO SELECTOR PANELS.

These panels (2, figure 1–35) enable the pilot, copilot, hoist operator, and second crewman to independently select the radio reception systems to be connected to their headsets. Any or all of the receiver signals can be heard at one time, plus the intercom signals. The pilot's and copilot's microphone signals can be directed to either the UHF transmitter or the HF transmitter or both.

RADIO VOLUME CONTROLS.

A volume control (1, figure 1–35) located at each of the four crew stations controls the volume of all selected incoming radio signals at that station.

Communications and Radio Navigation Equipment

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROL
INTERCOMMUNICATION	AN/AIC-14	INTERCOM BETWEEN CREW & SELECTION OF HEADSET AND MICROPHONE SIGNALS	PILOT	INTERIOR OF HELICOPTER	SEE FIGURE 1—36
LOUD HAILER	LOUD HAILER	AIR-TO-GROUND VOICE AMPLIFICATION	PILOT	100 FEET	CONSOLE
UHF COMMUNICATION	AN/ARC-52X	VOICE COMMUNICATION	PILOT	LINE OF SIGHT	CONSOLE
UHF ENCODING	KY28	SECURE SPEECH	PILOT	—	CONSOLE
UHF DIRECTION FINDER	AN/ARA-25	AUTOMATIC DIRECTION FINDING (DF)	PILOT	LINE OF SIGHT	CONTROLLED THROUGH AN/ARC-52X
HF COMMUNICATION	AN/ARC-39	VOICE COMMUNICATION	PILOT	DEPENDS ON FREQUENCY	CONSOLE
DIRECTION FINDER	AN/ARN-59	AUTOMATIC DIRECTION FINDING (ADF)	PILOT	DEPENDS ON FREQUENCY	CONSOLE
UHF NAVIGATION (TACAN)	AN/ARN-21 OR AN/ARN-52	INDICATES BEARING & DISTANCE TO STATION	PILOT	195 MILES OR 300 MILES	CONSOLE
IFF & SIF	AN/APX-6B AN/APA-89	IDENTIFICATION	PILOT	—	CONSOLE

Figure 1—32

INTERCOMMUNICATION SYSTEM, AN/AIC-14.

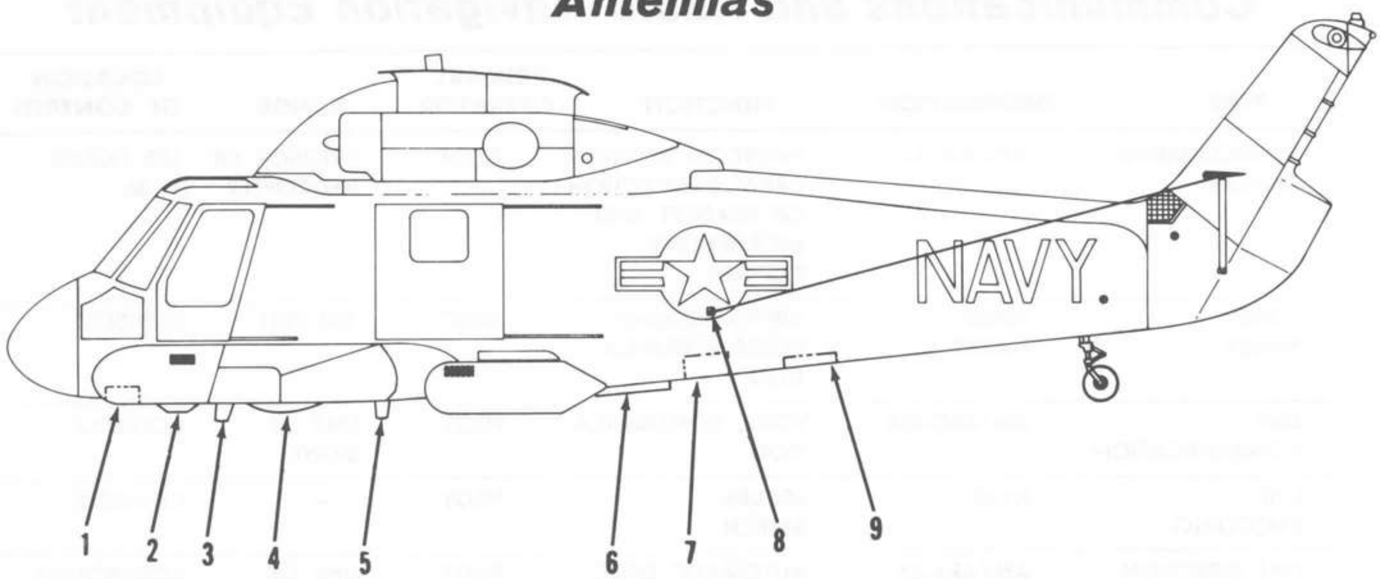
Description.

The intercommunication system provides communication facilities between the pilot, copilot and hoist operator. The equipment is controlled from the pilot's ICS panel on the console, the copilot's ICS panel on the cockpit ceiling, and the two crewmen's ICS panels in the cabin. Power to operate the equipment is supplied from the 28-volt dc primary bus through the ICS fuse on the fuse and circuit breaker panel (figure 1—31).

ICS Panels.

The ICS panels (figure 1—36) each contain two separate transistorized amplifiers for ICS and RADIO signals amplification. The amplifier selector knob (AMPL SEL) controls the amplifier functions. In the NORM position both amplifiers function. In the ALT 1 and ALT 2 positions, either amplifier will perform the function of both. In the EMERG position, the intercom is inoperative and radio signals bypass the ICS panel, going directly to the headset. The microphone selector (MIC SEL) switch has HOT and COLD positions (the CALL position is not used in this installation). In the COLD position it is necessary to squeeze the microphone switch before speaking, but in the HOT position it is merely necessary to speak.

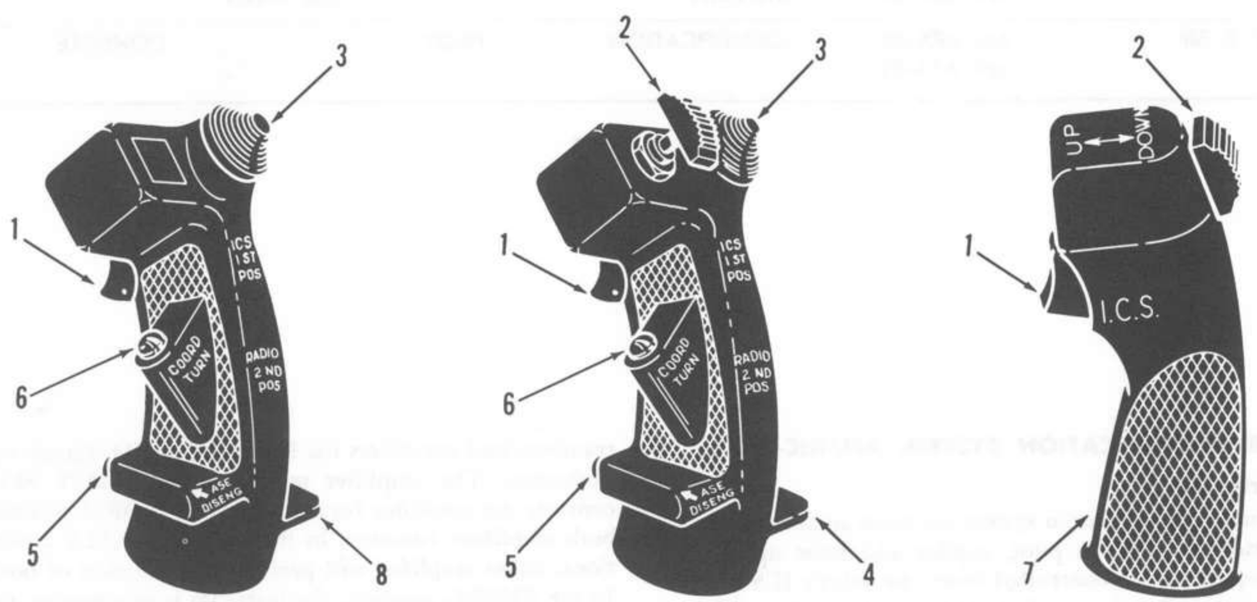
Antennas



1. UHF-DF, AN/ARA-25
2. UHF COMMUNICATIONS, AN/ARC-52X
3. TACAN, AN/ARN-21 OR AN/ARN-52
4. ADF, AN/ARN-59 (LOOP)
5. IFF, AN/APX-6B
6. ADF, AN/ARN-59 (SENSE)
7. RADAR GROUNDSPEED, AN/APN-130
8. HF COMMUNICATIONS, AN/ARC-39
9. RADAR ALTIMETER, AN/APN-117

Figure 1—33

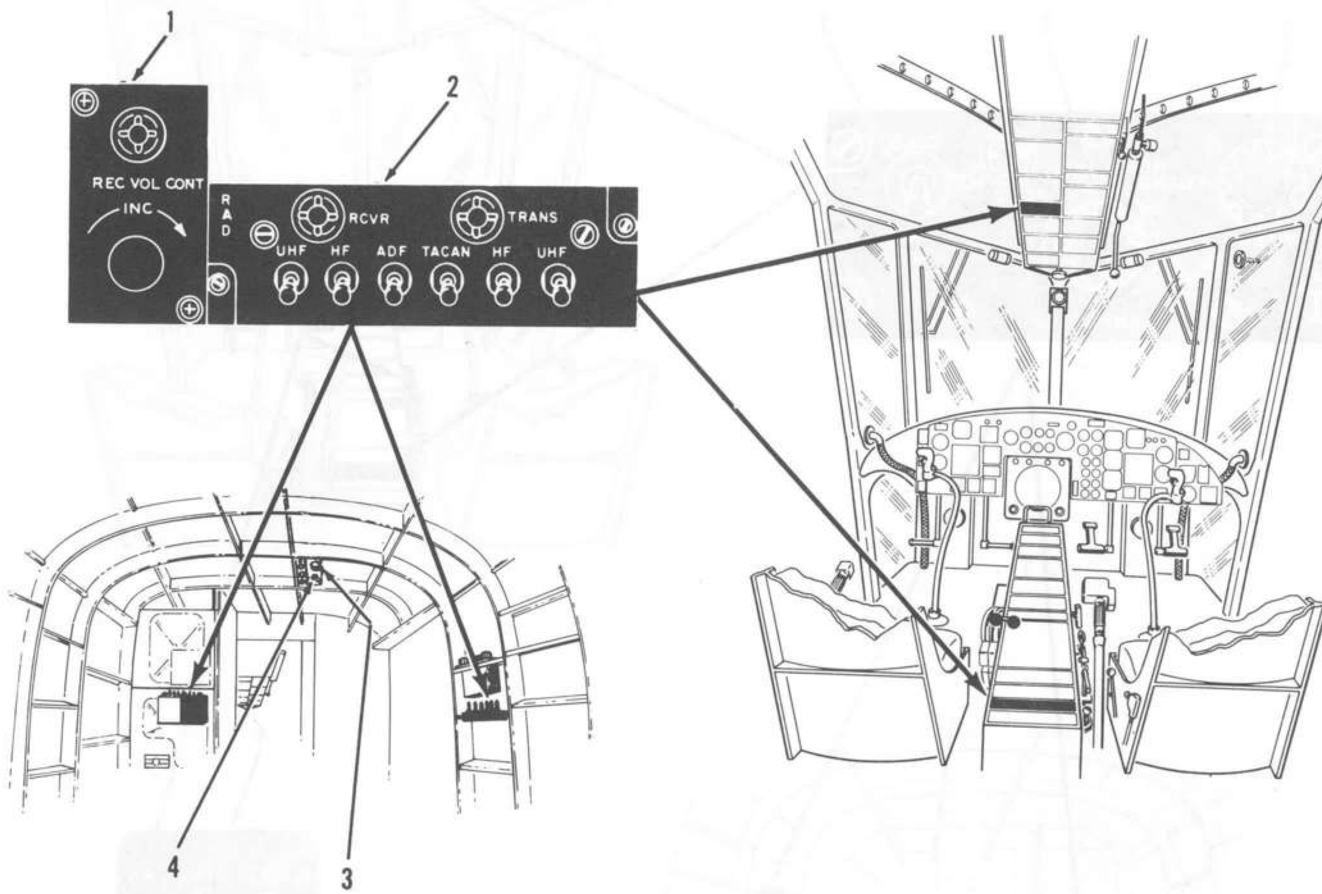
Copilot's, Pilot's and Hoist Operator's Grips



1. MICROPHONE SWITCH
2. HOIST (UP-DOWN) SWITCH
3. CYCLIC STICK TRIM SWITCH
4. PILOT'S GRIP
5. ASE DISENGAGE BUTTON
6. ASE COORDINATED TURN BUTTON
7. HOIST OPERATOR'S GRIP
8. COPILOT'S GRIP

Figure 1—34

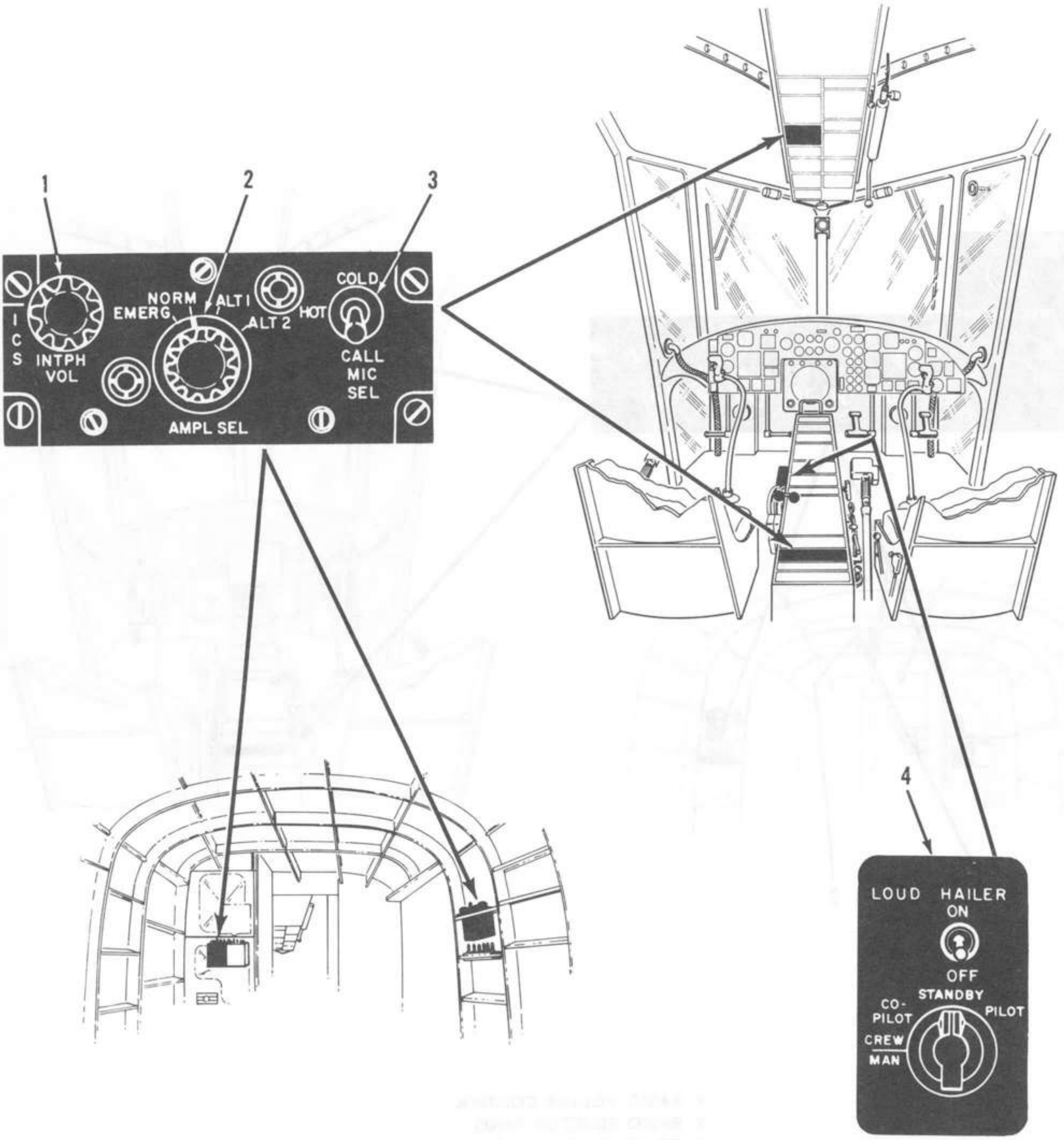
Radio Selector Panels



1. RADIO VOLUME CONTROL
2. RADIO SELECTOR PANEL
3. DC UTILITY RECEPTACLE
4. DC UTILITY RECEPTACLE FUSE

Figure 1—35

Intercom and Loud Hailer Panels



1. ICS VOLUME KNOB
2. ICS AMPLIFIER SELECTOR SWITCH
3. ICS MICROPHONE SELECTOR SWITCH
4. LOUD HAILER CONTROL PANEL

Figure 1—36

Some ICS panels are equipped with a voice operated transmission control, labeled VOX SENS. This feature is used when operating with the microphone selector switch in the HOT position. When operating with a hot microphone, the operator can talk to other intercom stations without pressing the microphone switch for each transmission. This, however, leaves the amplifier on the line at all times and, as a result, aircraft noises, operator breathing, etc., are transmitted continuously. The VOX SENS control eliminates this problem. When operating with a hot microphone, set the VOX SENS knob to the full counterclockwise position, and then slowly rotate it clockwise until background noise disappears but not so far that your voice doesn't still actuate it. Thus all undesirable background noise is eliminated, but hot mike operation is retained. The VOX SENS control works in the same manner as a squelch control. Varying the VOX SENS varies the amplitude of audio necessary to actuate the intercom. No stick keying is necessary. This feature is only on intercom function, and will not key radio transmissions.

Note

The VOX SENS control causes low sensitivity when the microphone selector switch is in the COLD position. Therefore, VOX SENS should be OFF (fully counterclockwise) when the switch is in the COLD position.

Normal Operation.

1. Amplifier selector knob – NORMAL.
2. Microphone selector switch – COLD or HOT.
3. Volume – As desired.

Emergency Operation.

During operation, if either ICS or radio reception becomes faulty, move the amplifier selector switch from NORMAL to ALTERNATE 1 and adjust the volume control as necessary. If the trouble is not corrected, move the switch to ALTERNATE 2 and adjust the volume as necessary. If the trouble persists, move the switch to EMERGENCY.

Note

When the amplifier selector switch is in the EMERGENCY position, the interphone is inoperative. The selected radio receiver signals are fed directly to the headset and selected radio transmitters are connected directly to the microphone.

LOUD HAILER SYSTEM.

Description.

The loud hailer system enables the helicopter crew to give voice directions to personnel on the ground, or in surface vessels. The system consists of two loudspeakers in the nose doors, an audio amplifier, and a control panel. The control panel (4, figure 1–36) contains an on-off switch, and a knob for selecting voice signals from one crew member. Voice signals are obtained from the crew's regular microphones. When the loud hailer system is installed, the hoist operator's grip is modified so that squeezing the microphone switch to the first position connects his microphone to the ICS only; squeezing the switch to the limit of its travel closes the microphone circuits to the ICS and the loud hailer if the selector knob is in the CREWMAN position. (The second crewman's ICS station cannot be used with the loud hailer system.) If the selector knob is in the PILOT or the CO-PILOT position, the selected pilot's microphone will be connected to the ICS and the loud hailer when his microphone switch is in the RADIO position. Power for the equipment is supplied from the 28-volt dc primary bus through the LOUD HAILER circuit breaker on the fuse and circuit breaker panel.

Normal Operation.

1. On-Off switch – ON.
2. Loud hailer knob – As desired.
3. Selected crew member's ICS panel –
   a. Amplifier switch – NORMAL.
   b. Microphone switch – COLD.
4. Microphone switch – As needed.

UHF COMMUNICATIONS SYSTEM, AN/ARC-52X WITH DIRECTION FINDER GROUP, AN/ARA-25A.

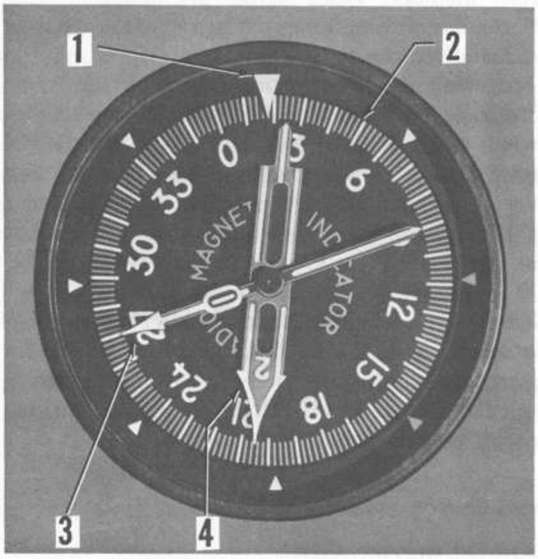
Note

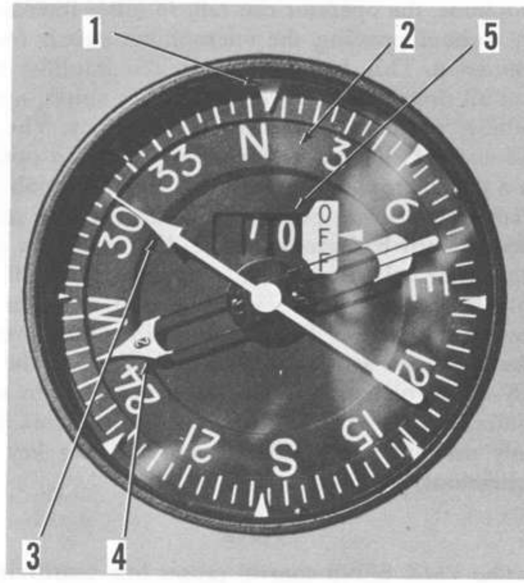
Early UH-2C aircraft will be delivered from the factory with AN/ARC-52 radio. (AN/ARC-52X radio will be incorporated in those aircraft later, by Navy retrofit of AFC 108.) The following paragraphs apply to both radios except that the AN/ARC-52 receives electrical power from the 115-volt ac primary bus as well as the 28-volt dc primary bus. Therefore, the AN/ARC-52 cannot be operated when the generators are not on the line and ac external power is not connected.

Description.

The AN/ARC-52X radio provides 1750 channels for 2-way voice or code communication in the frequency range of 225.0 to 399.9 megacycles. Any 18 of the available channels can be preset for automatic selection, and additional channels can be selected manually without disturbing the preset channels. A fixed guard channel at 243.0 megacycles can be monitored at the same time any of the other channels are being received.

Direction Indicators





1. FIXED INDEX MARKS: LARGE MARK AT TOP OF INSTRUMENT REPRESENTS FORWARD END OF HELICOPTER
2. ROTATING COMPASS CARD: CONTROLLED BY MA-1 COMPASS SYSTEM: INDICATES HEADING OF HELICOPTER
3. NEEDLE NO. 1: INDICATES BEARING OF STATION BEING RECEIVED ON LF/ADF OR UHF/DF, DEPENDING ON POSITION OF NEEDLE NO. 1 SELECTOR SWITCH
4. NEEDLE NO. 2: INDICATES BEARING OF STATION BEING RECEIVED ON TACAN
5. ODOMETER

Figure 1—37

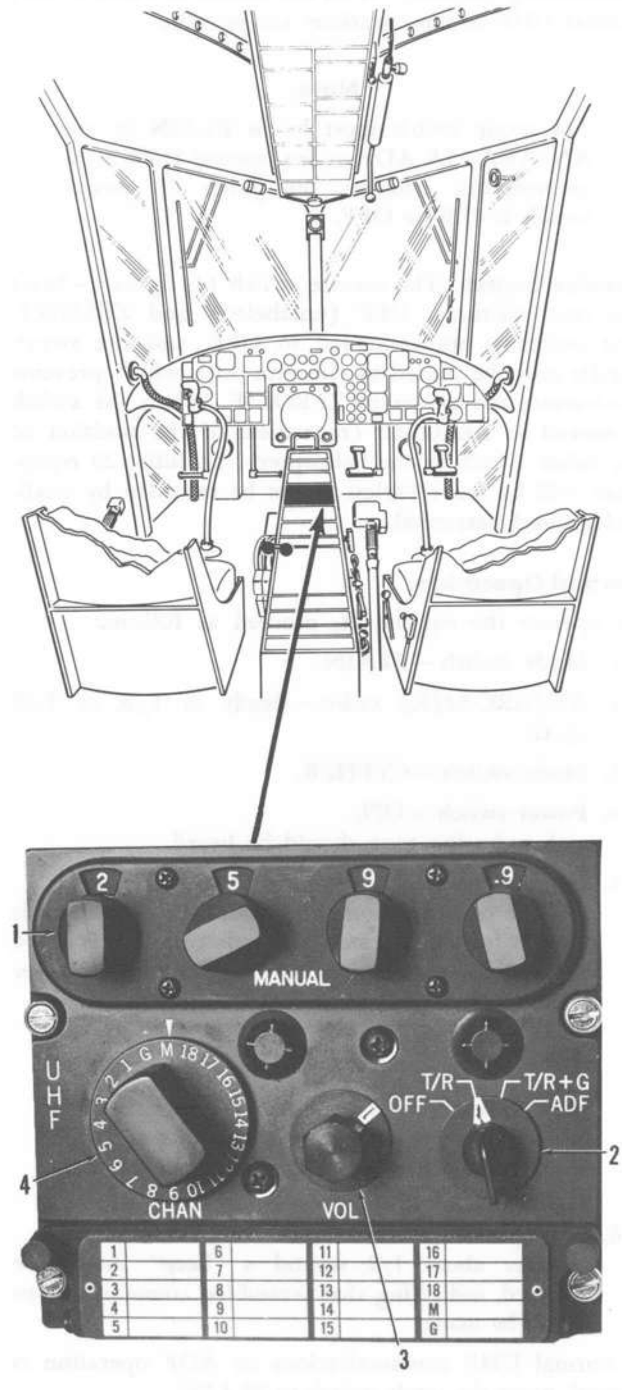
Power to operate the set is supplied from the 28-volt dc primary bus through the UHF communications (UHF COMM) circuit breaker on the fuse and circuit breaker panel (figure 1—31). When used as a direction finder (DF), the bearing of the station being received is displayed on needle 1 of the radio magnetic indicator (figure 1—37), when the needle No. 1 selector switch (3 or 45, figure 1—9) is in the UHF DF position. Power to operate the direction finder equipment is supplied from the 28-volt dc primary bus through the UHF direction finder (UHF DF) circuit breaker. The control panel for the system is located on the console (see figure 1—38). The control panel is labeled UHF, and contains the following controls.

Function Switch and Channel Selector Knob. The function switch (2, figure 1—38) is labeled OFF, T/R, T/R+G, ADF. The function switch establishes the mode of operation of the system. The channel selector knob (CHAN) establishes the method of frequency selection. Receiving and transmitting capabilities for all combinations of these switch positions are as follows:

Position of Function Switch	*Position of Channel Selector Knob*	*Available Receiving and Transmitting Frequencies*
OFF	ANY	All power disconnected
T/R	1 through 18	Receive and transmit preset channel frequencies (1 through 18 only)
T/R	MANUAL (M)	Receive and transmit on any of 1750 manually selected channels
T/R	GUARD (G)	Receive and transmit fixed guard frequency only
T/R+G	1 through 18 or MANUAL (M)	Receive and transmit on selected frequencies and receive on guard frequency
ADF	ANY	Receive AN/ARA-25 and transmit on selected frequencies

Preset channel frequencies may be recorded on a white card mounted on the presetting mechanism access door.

AN/ARC-52X UHF Radio Panel



1. MANUAL FREQUENCY SELECTOR KNOB
2. FUNCTION SWITCH
3. VOLUME CONTROL
4. CHANNEL SELECTOR KNOB

Figure 1–38

Manual Frequency Selector Knobs. When the chan nel selector knob is in MANUAL, the tuned frequenc appears in the four small windows above the four man ual frequency selector knobs (1, figure 1–38) which ar used to select the tuned frequency.

Volume Control. The volume control (3, figure 1–38) is marked VOL, and adjusts headset listening level.

Normal Operation.

Note

To operate the UHF radio normally the Juliet 28 (when installed) mode switch must be in PLAIN, whether the Juliet 28 power switch is ON or OFF.

To operate the equipment, proceed as follows:

1. Function switch – As desired.
   Allow equipment to warm up for a minimum of 1 minute.
2. UHF receiver switch – ON.
   Switch is located on the RAD panel (figure 1–35)
3. UHF transmitter switch – ON.
   Switch is located on the RAD panel (figure 1–35)
4. Channel selector knob – As desired.
5. Volume knob – Fully clockwise.
6. Radio volume control – As desired.
   The radio volume control knob is located next t RAD panel (figure 1–35).

To turn the equipment off, proceed as follows:

1. Function switch – OFF.

CAUTION

To conserve the battery and to minimize any deleterious effects of low voltage on the set, keep operation of the radio to a minimum when the generators are not on the line and no external power is connected.

Emergency Operation.

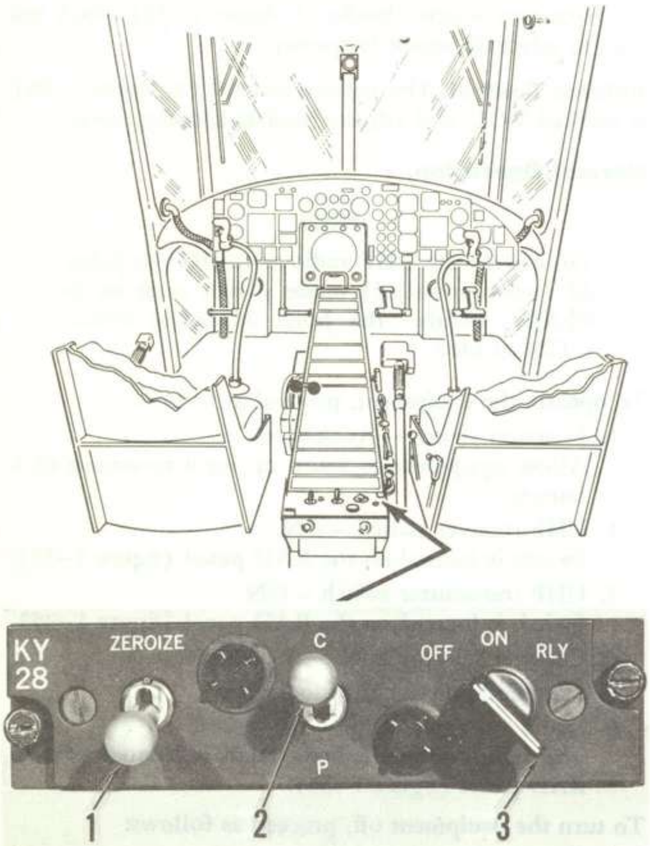
During operation, if radio reception becomes faulty du to failure of the AN/AIC-14 amplifier, move the ampli fier selector switch (2, figure 1–36) from NORMAL t ALTERNATE 1 and adjust the volume control as neces sary. If the trouble is not corrected, move the switch t ALTERNATE 2 and adjust the volume as necessary. I the trouble persists, move the switch to EMERGENCY

JULIET 28 UHF COMMUNICATIONS ENCODING EQUIPMENT (AFC 152).

Description.

The Juliet 28 equipment provides scrambled voice com munication between the UHF radio and another radi with like equipment. Power to scramble transmissio and unscramble reception is supplied from the 28-vol dc primary bus through the JULIET 28 circuit breake on the fuse and circuit breaker panel (figure 1–31)

Juliet 28 Control Panel



1. ZEROIZE SWITCH
2. MODE SWITCH
3. POWER SWITCH

Figure 1—38A

Power to zeroize (electrically remove the preset code and make the equipment ineffective) is supplied from the battery bus through the JULIET 28 circuit breaker mounted on the canted bulkhead, under the pilot's seat. The control panel (see figure 1—38A) is labeled KY28, and is located on the console. The panel contains the following switches:

Power Switch. The power switch (3, figure 1—38A) turns the equipment ON or OFF. The RLY (relay) position of the switch is not used in the UH-2C installation. The power switch does not supply the zeroize circuits of the equipment.

Mode Switch. The mode switch (2, figure 1—38A) has two positions, CYPHER (labeled C) and PLAIN (labeled P). The switch handle must be pulled to clear the lock which prevents inadvertent use of the switch. With the switch in CYPHER, UHF voice transmissions are scrambled, and reception from like equipment is unscrambled. Also, when the switch is in CYPHER, plain (normal) reception can be heard from stations transmitting normally. With the switch in PLAIN, only normal UHF communications are possible.

Note

The mode switch must be in PLAIN to use AN/ARA-25A ADF or for normal UHF communications, whether the Juliet 28 power switch is ON or OFF.

Zeroize Switch. The zeroize switch (1, figure 1—38A) has two positions, OFF (unlabeled) and ZEROIZE. The switch is spring-loaded to OFF, and the switch handle must be pulled to clear the lock which prevents inadvertent movement to ZEROIZE. When the switch is moved to ZEROIZE (regardless of the position of any other switch in the helicopter) the Juliet 28 equipment will be made useless it can be recorded by qualified ground personnel.

Normal Operation.

To operate the equipment, proceed as follows:

1. Mode switch – PLAIN.
2. AN/ARC-52(X) radio – Ready in T/R or T/R + G.
3. Mode switch – CYPHER.
4. Power switch – ON.
   A pulsating tone should be heard.
5. Microphone switch – Press for about 1 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 Juliet 28 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 UHF communications or ADF operation is desired, move the mode switch to PLAIN.

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.

HF COMMUNICATIONS SYSTEM, AN/ARC-39.

Description.

This equipment will transmit and receive amplitude-modulated voice signals on any of 12 preset crystal controlled channels within the frequency range of 2.0 to 9.1 megacycles. Channels 1 through 6 are allocated to a low band (2.0 to 4.27 megacycles) and channels 7 through 12 are allocated to a high band (4.27 to 9.1 megacycles). Any frequency within a given band may be assigned to any channel allocated to that band. Electrical power to operate the equipment is supplied from the 28-volt dc primary bus through the HF communications (HF COMM) circuit breaker (figure 1–31).

The control panel is located on the console (see figure 1–39). The control panel is labeled HF, and contains the following controls:

Volume-Off Knob. The volume-off knob (1, figure 1–39) is marked VOL OFF, and is used to turn the system on and off, and to adjust the headset listening level.

Channel Selector Switch. The channel selector switch (2, figure 1–39), is marked CHANNEL, and is used to select any of the 12 preset crystal controlled channels. The channel selector switch handle contains a snap-action lever, for the convenience of the technician when he is adjusting the equipment. The lever must be pushed down for normal operation of the equipment. If the lever is pulled up, channel selection control is transferred to a channel selector switch on the receiver-transmitter, and the channel selector switch on the HF control panel will have no effect.

Normal Operation.

To operate the equipment, proceed as follows:

1. Volume-off – ON.
   Allow equipment to warm up for a minimum of 1 minute.
2. HF receiver switch – ON.
   Switch is located on the RAD panel (figure 1–35).
3. HF transmitter switch – ON.
   Switch is located on the RAD panel (figure 1–35).
4. Channel selector switch – As desired.
5. Volume-off knob – Fully clockwise.
6. Radio volume control – As desired.

   The radio volume control knob is located next to the RAD panel (figure 1–35).

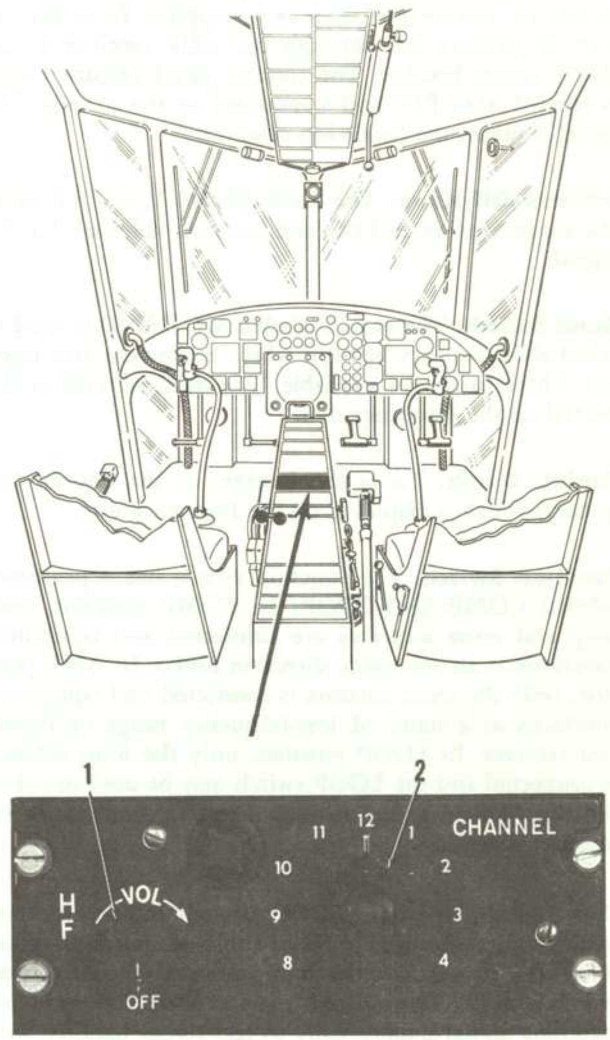
To turn the equipment off, proceed as follows:

1. Volume-off knob – OFF.

Emergency Operation.

During operation, if radio reception becomes faulty due to failure to the amplifier in the ICS system, move the amplifier selector switch (2, figure 1–36) from NORMAL to ALTERNATE 1 and adjust the volume control as necessary. If the trouble is not corrected, move the switch to ALTERNATE 2 and adjust the volume as necessary. If the trouble persists, move the switch to EMERGENCY.

AN/ARC-39 HF Radio Panel



1. VOLUME KNOB
2. CHANNEL SELECTOR SWITCH

Figure 1–39

AUTOMATIC DIRECTION FINDER RECEIVER AN/ARN-59.

Description.

The receiver may be operated within its frequency rang of 190 to 1750 kc as ADF (automatic direction finder equipment, as a low frequency navigation (LF/NAV receiver, or for manual direction finding (MDF) proc dures. Navigation bearings are provided on any contin ous radio signal. The bearing of the transmitting statio with respect to the helicopter, is shown on needle 1 the radio magnetic indicator (figure 1–37) when th needle No. 1 selector switch (3 or 45, figure 1–9) is in the LF/ADF position. Needle 1 of the radio magnetic indicator is electrically powered from the 26-volt ac primary bus through the ADF receiver (ADF REC) fuse, and power to operate the receiver is supplied from the 28-volt dc primary bus through the ADF receiver (ADF REC) circuit breaker. The control panel (figure 1–40) is labeled ADF REC and is mounted on the console. The panel contains the following controls:

Volume-Off Knob. The knob labeled VOL-OFF turns the equipment on and off, and controls volume of audio signal.

Band Switch. The switch labeled MC BAND 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. Tunes the receiver to the desired frequency, which is displayed on the frequency dial.

Function Switch. The function switch has 3 positions, labeled COMP-ANT-LOOP. In COMP position, both loop and sense antennas are connected and equipment functions as an automatic direction finder. In ANT position, only the sense antenna is connected and equipment functions as a standard low-frequency range or broadcast 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.

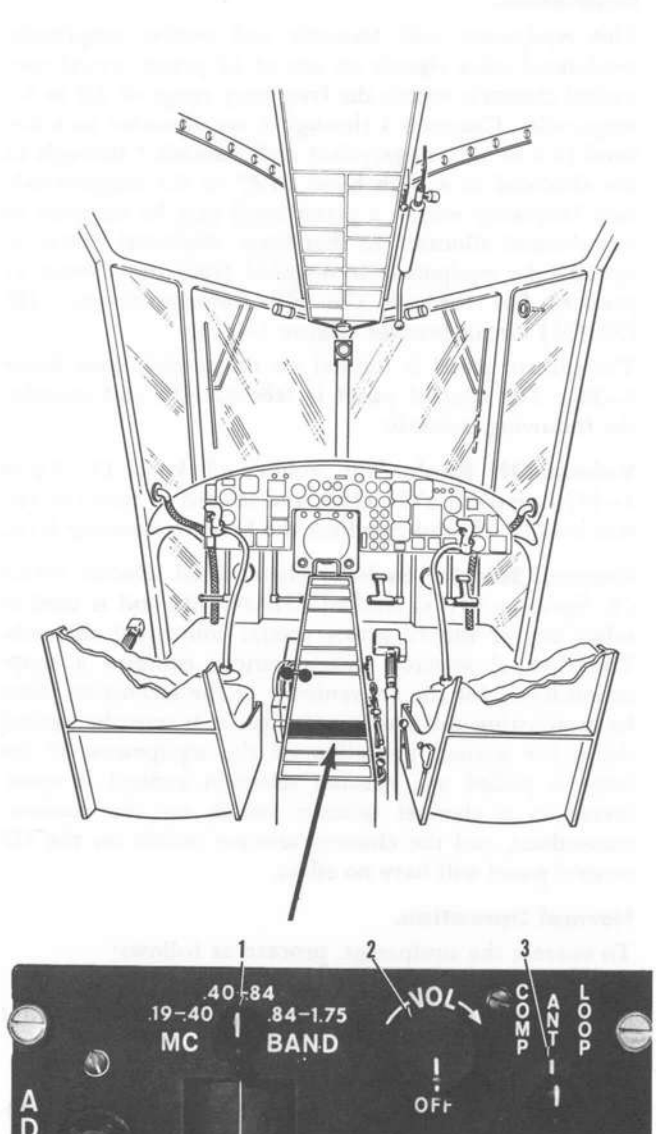
Test Switch. The test (LOOP) switch rotates the loop in either direction regardless of function switch position. It is used to position the loop antenna when function switch is in LOOP position. It is also used to override an incoming signal momentarily to test signal liability with function switch in COMP position.

Tuning Meter. With function switch in COMP position, peak deflection indicates proper tuning.

Beat Frequency Oscillator Switch. This switch turns the beat frequency oscillator (BFO) on and off.

BFO Operation. 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 signal 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. Do not place the BFO switch ON when the function switch is set to COMP. This will cause incorrect indications.

AN/ARN-59 Radio Panel



1. BAND SWITCH
2. VOLUME — OFF KNOB
3. FUNCTION SWITCH
4. TUNING METER
5. TEST SWITCH
6. TUNING CRANK
7. BFO SWITCH

Figure 1–40

Normal Operation.

To operate the equipment, proceed as follows:

1. Volume-off knob – ON.
   Allow equipment to warm up for 30 seconds.
2. ADF receiver switch – ON.
   Switch is located on the RAD panel (figure 1–35).
3. Function switch – ANT.
4. Band switch – As desired.
5. Volume-off knob – Adjust.
   Increase volume until background noise (or station if already tuned in) is heard.
6. Tuning crank – Adjust.
   Rotate crank until station frequency is aligned with frequency dial hairline; then tune for maximum tuning meter deflection by slowly rotating the tuning crank in the vicinity of the desired frequency.
7. Volume-off knob – Fully clockwise.
   Identify the station.
8. Function switch – Compass.

To turn the equipment off proceed as follows:

1. Volume-off knob – OFF.

Emergency Operation.

During operation, if radio reception becomes faulty due to failure of the amplifier in the ICS system, move the amplifier selector switch (2, figure 1–36) from NORMAL to ALTERNATE 1 and adjust the volume control as necessary. If the trouble is not corrected, move the switch to ALTERNATE 2 and adjust the volume as necessary. If the trouble persists, move the switch to EMERGENCY.

TACAN, AN/ARN-52 (or AN/ARN-21).

Description.

This set provides bearing and distance indications to any selected TACAN or VORTAC surface navigation beacon located within a line-of-sight distance up to 300 nautical miles for the ARN-52 (195 nautical miles for ARN-21). In addition, the ARN-52 and the ARN-21D will provide separation distance information from another properly tuned airborne ARN-52 or ARN-21D TACAN (the ARN-21A does not have this air-to-air capability, and may be identified by the lack of the A/A position on the TACAN panel).

The bearing from the aircraft to the beacon is indicated in degrees by needle No. 2 of the bearing, distance, heading indicator (or the radio magnetic indicator) shown in figure 1–37.

Note

> The needle No. 2 is slaved to the MA-1 compass and indicates the magnetic bearing, not the true bearing of the TACAN beacon. Insure that the BDHI (or RMI) compass card is synchronized and operating properly.

Range Indicator

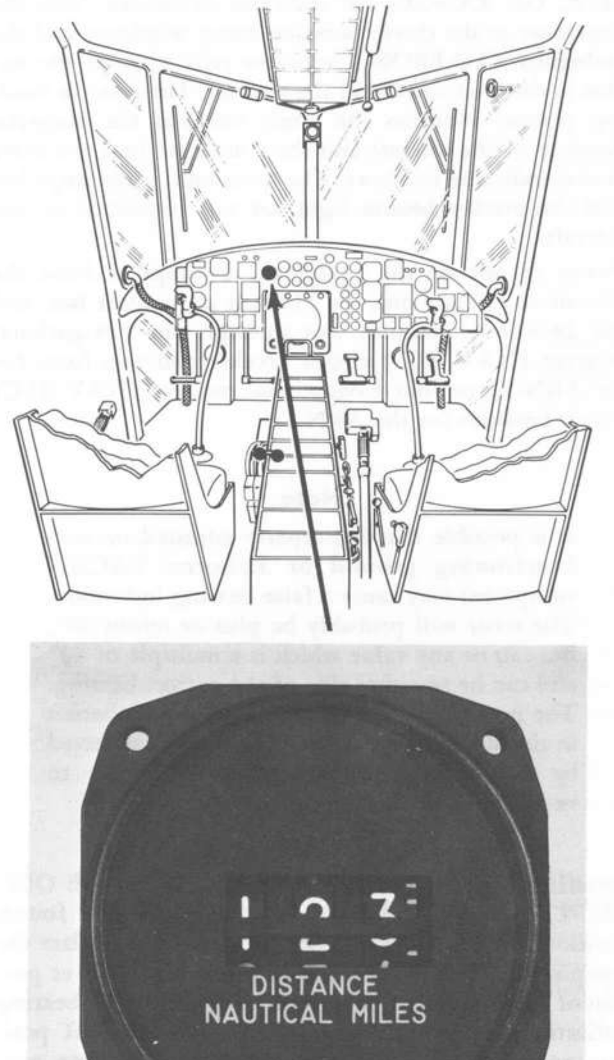


Figure 1—41

The distance to the beacon (and distance to another properly equipped aircraft in the case of the ARN-52) is shown on the odometer portion of the bearing, distance, heading indicator (figure 1–37) for the ARN-52, and on the range indicator (figure 1–41) for the ARN-21. Distance is determined by the elapsed time of round trip travel of radio pulse signals between the helicopter and the beacon. When the system is computing the distance, the numbers on the instrument will be covered by a horizontal red bar. When the correct distance is indicated, the bar will disappear.

A course indicator (figure 1—42) is provided to aid the pilot in flying a specified course to the beacon. The course to be flown is indicated in the three course indicator windows at the top of the instrument which are controlled by a knob labeled SET. The course deviation (LOC OR RANGE) bar indicates deviations from the course set in the three course indicator windows, and the ambiguity (TO-FROM) indicator tells whether the station is ahead of or behind the aircraft. The relative heading pointer indicates the angle between the magnetic heading of the aircraft and the course set into the three course indicator windows. The horizontal glide slope bar and the marker beacon light are not connected in this aircraft.

Power to operate the equipment is supplied from the 26-volt ac primary bus, the 115-volt ac monitor bus, and the 28-volt dc monitor bus through one navigational receiver (NAV REC) circuit breaker and two fuses for the ARN-52, or four navigational receiver (NAV REC) circuit breakers for the ARN-21.

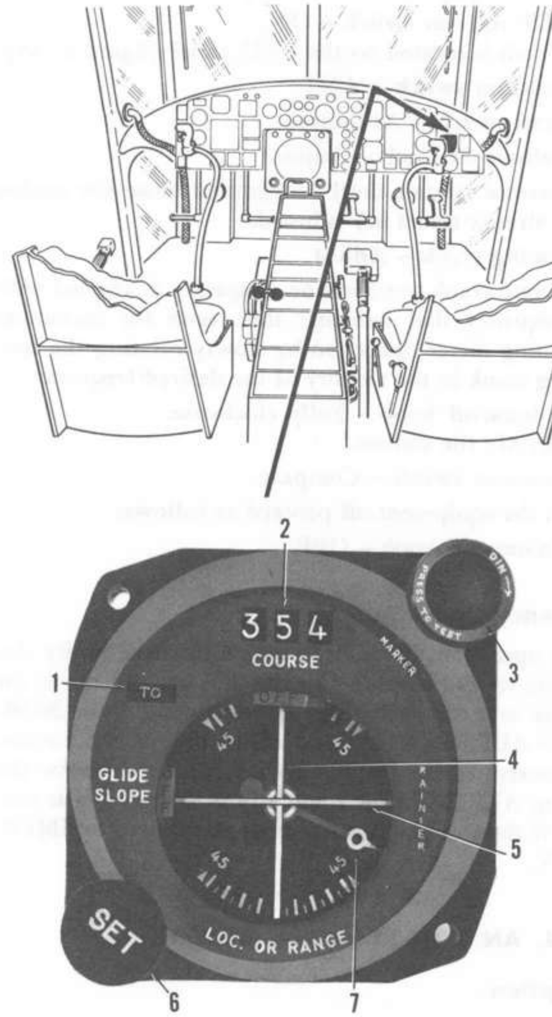
Note

> It is possible that improperly adjusted or malfunctioning ground or airborne TACAN equipment may cause a false bearing indication. The error will probably be plus or minus 40°, but can be any value which is a multiple of 40° and can be to either side of the correct bearing. The possibility of a false indication is inherent in the TACAN system and can only be detected by the use of other navigation equipment to verify TACAN bearing information.

Function Switch. The function switch is marked: OFF-REC-T/R; and the ARN-52 has, in addition, a fourth position labeled A/A. The OFF position deenergizes the equipment. The REC position energizes the receiver portion of the equipment, thus permitting display of bearing indications while maintaining radio silence. T/R position energizes both the transmitter and receiver portions, thereby allowing both distance and bearing information to be displayed. The A/A position provides for air-to-air operation. Air-to-air operation requires a cooperating aircraft within 300 nautical miles of the first aircraft, and specific pairing of channels. The air-to-air link is established when the function selector switches in both aircraft are set to A/A and the channel selectors are set 63 channels apart (i.e., channels 1 and 64, channels 2 and 65, etc.). The range indicators should lock on and display the distance to the cooperating aircraft. Although one aircraft may reply to as many as five other aircraft, it will only display distance to the first aircraft to which its ranging circuits lock on. Bearing information is not provided in the air-to-air mode.

Channel Selector. The channel selector (CHAN) consists of two coaxially mounted rotary switches actuated by two coaxial knobs. The dials of the knobs are arranged to indicate directly the selected channel number.

Course Indicator

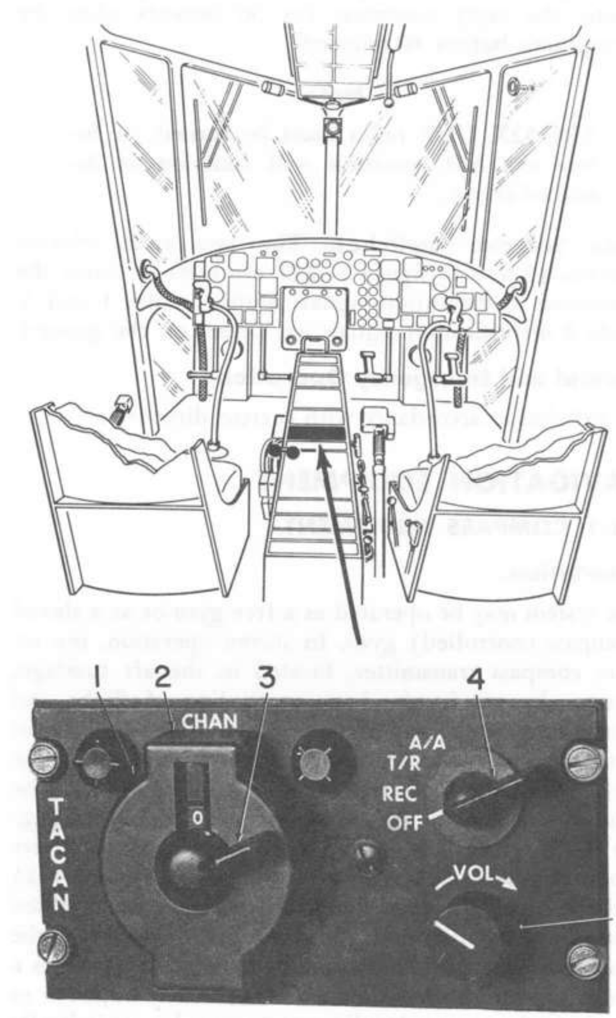


1. AMBIGUITY (TO-FROM) INDICATOR
2. COURSE INDICATOR
3. MARKER BEACON LIGHT (NOT USED)
4. COURSE DEVIATION BAR
5. GLIDE SLOPE BAR (NOT USED)
6. COURSE INDICATOR SET KNOB
7. RELATIVE HEADING POINTER

Figure 1—42

The outer knob actuates a rotary switch having 13 positions from "blank" at the extreme counterclockwise position to 12 at the extreme clockwise position. The inner knob actuates a 10-position rotary switch marked 0 to 9, with the numbers increasing as the knob is rotated clockwise. Combinations of dial settings allow for indications from 0 to 129, reading from top to bottom. The equipment, however, operates only on channels 1 through 126.

TACAN Panel



1. OUTER KNOB
2. CHANNEL SELECTOR
3. INNER KNOB
4. FUNCTION SWITCH
5. VOLUME KNOB

Figure 1—43

Volume Knob. The volume knob adjusts the volume of the audio identification signal received from the beacon. The signal, audible in the pilot's headphones, consists of a two or three letter and digit tone signal in International Morse Code which identifies the surface beacon to which the equipment has been tuned.

Normal Operation.

To operate the equipment, proceed as follows:

1. Function switch – As desired.
   Set switch to REC or T/R or A/A.
2. TACAN receiver switch – ON.
   Switch is located on the RAD panel (figure 1–35).
3. Channel selector – As desired.

CAUTION

Do not change AN/ARN-52 channels with function switch in A/A, to avoid damage to equipment.

4. Volume knob – As desired.

Note

If AFC 92 has been incorporated, turn volume knob fully clockwise. Crew members may adjust volume at their individual stations.

5. Identify the beacon.

To turn the equipment off, proceed as follows:

1. Function switch – OFF.

Emergency Operation.

1. Defective operation of the distance measuring equipment may cause erroneous indications. If this occurs, bearing information may still be obtained by switching from T/R to REC.
2. During operation, if radio reception becomes faulty due to failure of an amplifier in the ICS system, move the amplifier selector switch (2, figure 1–36) from NORMAL to ALTERNATE 1 and adjust the volume control as necessary. If the trouble is not corrected, move the switch to ALTERNATE 2 and adjust the volume as necessary. If the trouble persists, move the switch to EMERGENCY.

RADAR IDENTIFICATION SET (IFF) AN/APX-6B, AND CODER GROUP (SIF) AN/APA-89.

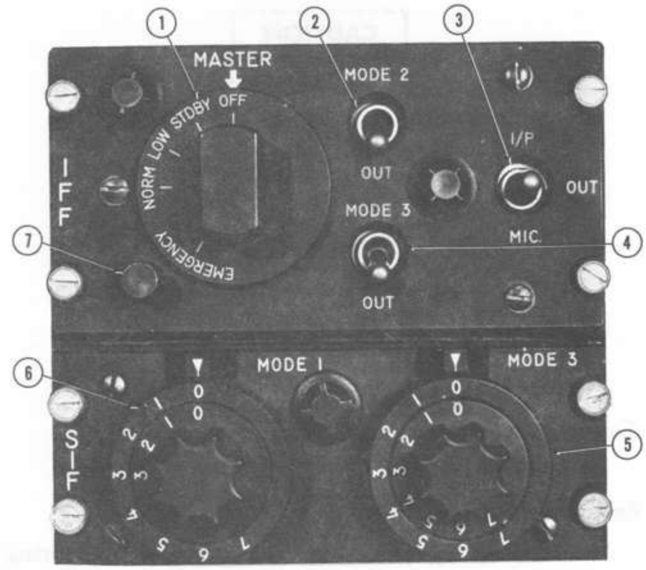
Description.

The basic 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 set responds with three basic identification signals, referred to as modes 1, 2, and 3. The equipment transmits only when it is challenged, or interrogated, and the response is only in the modes in which the challenge is received.

The SIF codes group is an attachment to the IFF set, which provides a means of making numerous separate and distinct identification displays within each of the three basic IFF modes.

The equipment receives power from the 28-volt dc and the 115-volt ac primary buses through the two IFF-SIF circuit breakers.

IFF and SIF Panels



1. MASTER CONTROL SWITCH
2. MODE 2 SWITCH
3. I/P-OUT-MIC SWITCH
4. MODE 3 SWITCH
5. MODE 3 CODE SELECTOR SWITCH
6. MODE 1 CODE SELECTOR SWITCH
7. EMERGENCY STOP RELEASE BUTTON

Figure 1—44

The control panels for the equipment are shown in figure 1—44, and contain the following controls:

Master Control Switch. The switch (1, figure 1—44) has five positions, labeled OFF, STANDBY, LOW, NORMAL, and EMERGENCY. When the switch is in the OFF position, the equipment is inoperative. When the switch is in the STANDBY position, the power is on, but the equipment is not responding to interrogations. When the switch is in the LOW or NORMAL position, the equipment is on and responding, with low or normal power, whichever is selected. When the switch is in the EMERGENCY position, the set responds to mode 1 interrogations with a special emergency signal on mode 1.

Mode Switches. The two mode switches (2 and 4, figure 1—44), labeled MODE 2, OUT and MODE 3, OUT, turn modes 2 and 3 on when placed in the MODE position, and OFF when placed in the OUT position. Mode 1 is in operation whenever the master control switch is in the LOW, NORMAL, or EMERGENCY positions.

I/P-OUT-MIC Switch. When this switch (3, figure 1—44) is held in the I/P position, the set replies to mode 1 challenges with a double mode 1 identification. This occurs when the switch is held in the I/P position, and continues for 30 seconds after it is released. When the switch is in the MIC position, the same response is given, but only when the microphone button is depressed. As before, the reply continues for 30 seconds after the microphone button is released.

Note

ARC-52X UHF radio must be turned on before the MIC position will function as described above.

Code Selector Switches. The two code selector switches (5 and 6, figure 1—44) are used to select the distinctive identification signals within modes 1 and 3. Mode 2 identification signals are preset on the ground.

Normal and Emergency Operation.

Set switches in accordance with current directives.

NAVIGATION EQUIPMENT

MA-1 COMPASS EQUIPMENT.

Description.

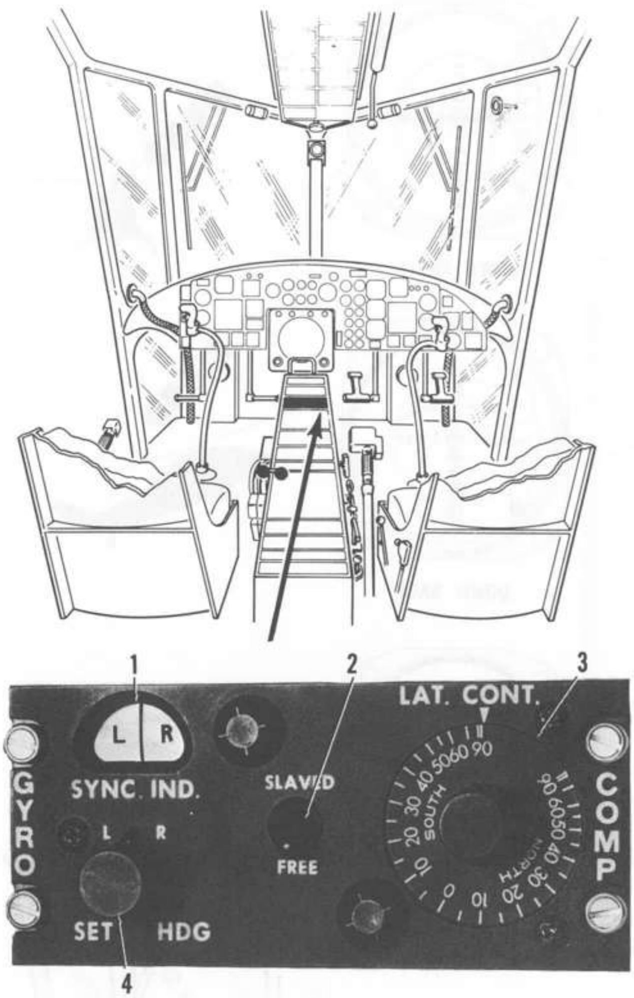
The system may be operated as a free gyro or as a slaved (compass controlled) gyro. In slaved operation, the remote compass transmitter, located in the aft fuselage, detects changes in the helicopter's line of flight and transmits these changes to an amplifier. The amplifier, in turn, transmits corresponding correction signals to the gyro, which produces the heading information for the rotating dials on the two radio magnetic indicators (figure 1—37), the AN/ASA-13A navigational computer group (figure 1—49), the course indicator (figure 1—42) and the ASE. The amplifier and gyro are located in the nose door compartment. In free gyro operation, the compass transmitter is disconnected from the gyro. As a result, the indicator dials must be manually adjusted to the desired starting heading and must be periodically adjusted to compensate for gyro drift. The amplifier receives power from the 115-volt ac primary bus through the gyro compass (GYRO COMP) circuit breaker (or three circuit breakers). The rotating dials on the radio magnetic indicators receive electrical power from the 26-volt ac primary bus through the compass ID-250 (COMPASS ID-250) circuit breaker.

The system is controlled from a panel (see figure 1—45) located on the console and contains the following controls:

Slaved-Free Switch. The slaved-free switch (2, figure 1—45) is a two-position switch marked SLAVED FREE. This switch determines whether the system will operate as a slaved (compass controlled) directional gyro, or as a free directional gyro.

Set Heading Knob. The set heading knob (4, figure 1—45) is a three-position momentary switch marked LEFT (L) and RIGHT (R). The switch is spring-loaded to a center, unmarked, off position. When the system is operated in the slaved mode, the set heading knob is

MA-1 Compass Panel



1. SYNCHRONIZING INDICATOR
2. SLAVED — FREE SWITCH
3. LATITUDE CONTROL DIAL
4. HEADING SET KNOB

Figure 1—45

used to synchronize the gyro and the radio magnetic indicator (2, figure 1—37) with the compass transmitter. When the system is operated as a free directional gyro, the set heading knob is used to adjust the radio magnetic indicator to agree with the actual heading of the aircraft.

Synchronizing Indicator. When the system is operating in the slaved mode, and the gyro is either synchronized with the compass transmitter or 180 degrees out of synchronization, the small pointer in the synchronizing indicator (1, figure 1—45) will be centered. Check your standby compass to determine whether you are synchronized or 180 degrees out. The synchronizing indicator is inoperative when the system is operating as a free directional gyro.

Latitude Control Dial. The latitude control dial (3, figure 1—45) is used, during free directional gyro operation, to compensate for apparent gyro drift due to the rotation of the earth. The latitude control dial is not used when operating in the slaved mode.

Normal Operation.

To operate the system as a slaved (compass controlled) directional gyro, set the switches on the compass control panel (figure 1—45) as follows:

1. Slaved-free switch — SLAVED.
2. Set heading knob — As required.
   Rotate the knob to the L (left) or R (right) position, and hold until the indicator dial has rotated to the approximate magnetic heading. Release the knob and allow the indicator dial to slave-in with the exact magnetic heading of the aircraft. The system is slaved-in when the synchronizing indicator (SYNC IND) arrow is in the center of the window. The arrow will oscillate slightly in the slaved mode of operation. This indicates proper operation of the system and is a normal condition. The synchronizing indicator is operative only during slaved operation.

To operate the system as a free directional gyro, set the switches on the compass control panel as follows:

1. Slaved-free switch — FREE.
2. Set heading knob — As required.
   Rotate the knob to the L (left) or R (right) position, and hold until the indicator dial has rotated to the desired heading.
3. Latitude control dial — Adjust.
   Rotate the knob to the degree of latitude in which the helicopter is flying to compensate for gyro drift due to the earth's rotation.

Note

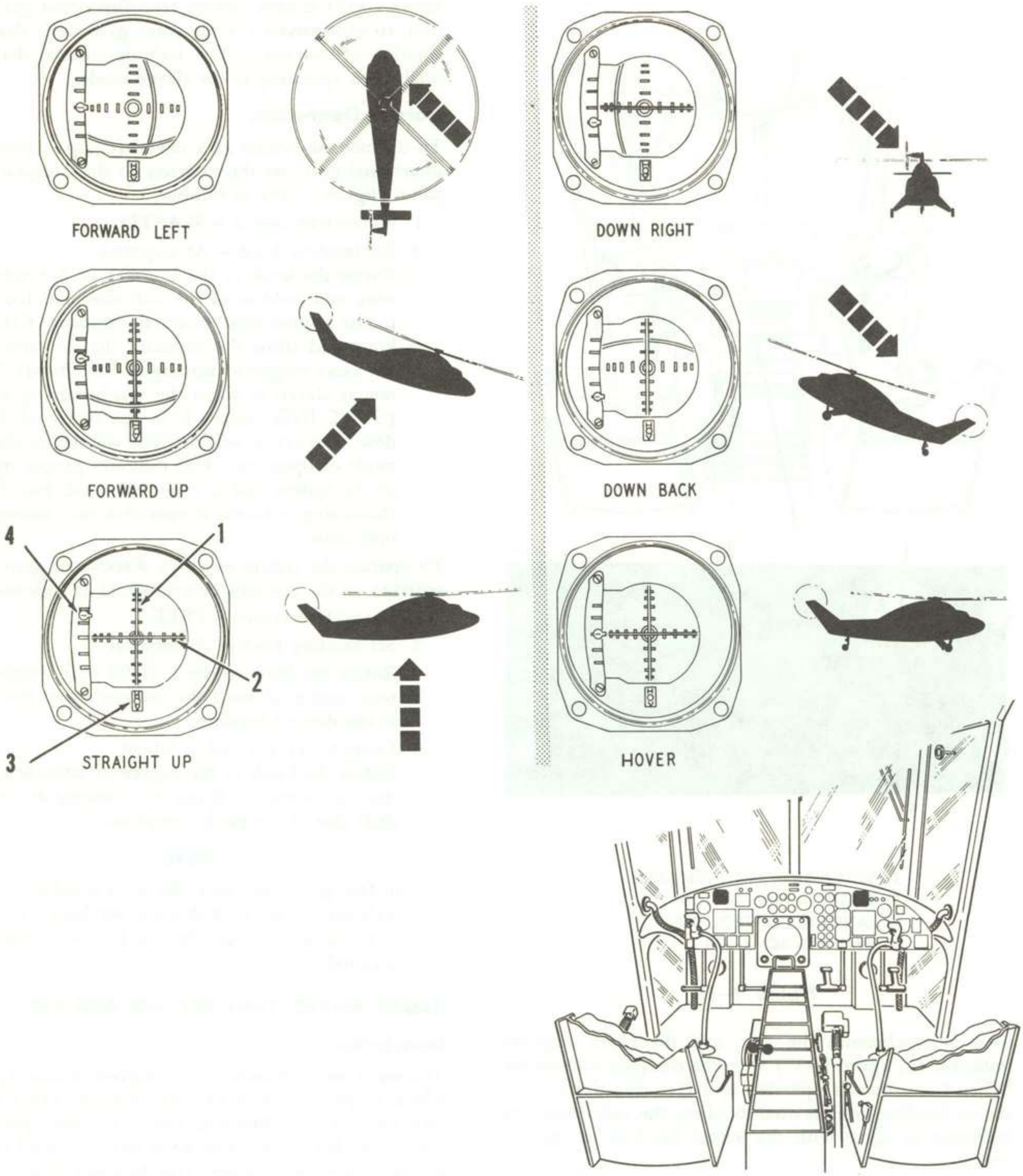
In free gyro operation, the gyro is subject to a drift rate of up to 4 degrees per hour. Therefore, the gyro should be checked and reset as required.

RADAR NAVIGATION SET, AN/APN-130.

Description.

The set is an all-weather groundspeed indicating system which employs continuous-wave doppler radar to indicate the aircraft's heading speed, vertical speed, drift speed and drift angle. The set is self-contained and does not require wind estimates, true airspeed data, or special inputs from ground stations. Outputs from the system are used by the automatic stabilization equipment (ASE) and the AN/ASA-13A navigational computer group (both described elsewhere in this section), as well as by the direction velocity indicator (figure 1—46) and the groundspeed drift-angle indicator (figure 1—47). The set includes the following components: a power supply,

Direction Velocity Indicator



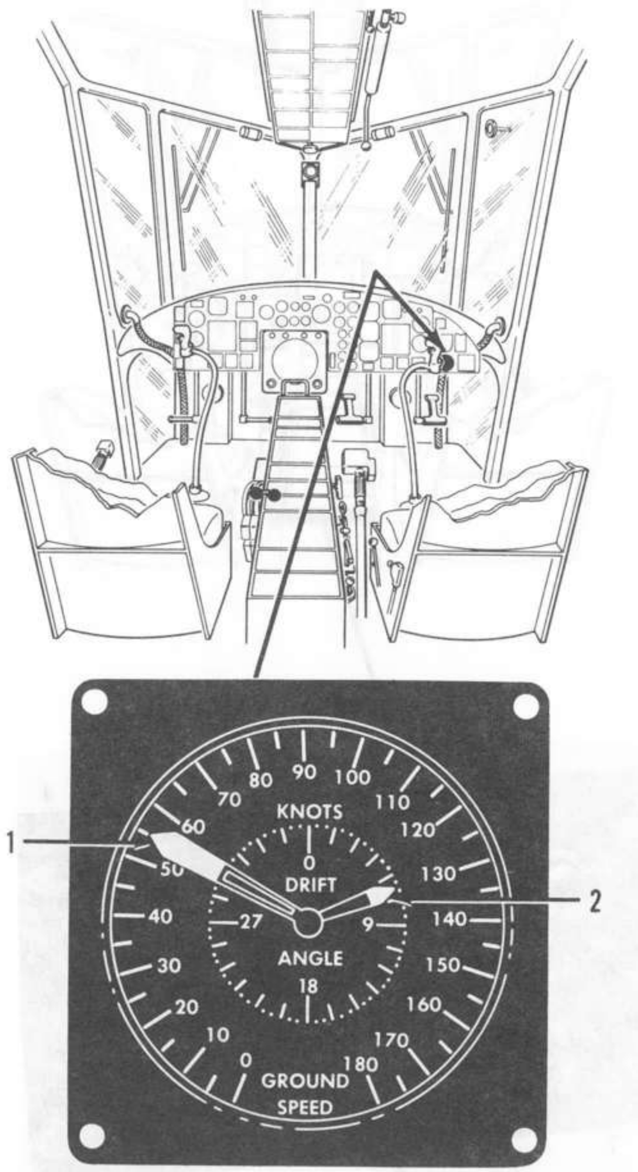
1. DRIFT NEEDLE
2. HEADING NEEDLE
3. HOVER FLAG
4. VERTICAL VELOCITY DOT

Note

TO ESTABLISH AND MAINTAIN HOVER, CYCLIC CORRECTIONS ARE MADE TOWARD NEEDLES (AS IN TACAN OR OMNI).

Figure 1—46

Groundspeed Drift-Angle Indicator



1. GROUNDSPEED POINTER
2. DRIFT ANGLE POINTER

Figure 1—47

a receiver-transmitter, an electron tube liquid cooler, a signal data converter, a control panel (figure 1—48) and two instruments, the direction velocity indicator and the groundspeed drift-angle indicator. The radar receiver-transmitter transmits four narrow beams of electromagnetic energy toward the earth. Energy reflected back from the earth is continuously and directly compared with the transmitted energy producing signals proportional to the doppler frequency shifts resulting from the motion of the aircraft. The doppler signals are then amplified and fed to the signal data converter, which counts the frequency and provides output signals for the ASE, the AN/ASA-13A, and the two indicators on the instrument panel. The system receives electrical power from the 115-volt ac monitor bus through the groundspeed radar (GRD SPEED RADAR) circuit breaker (or 3 circuit breakers). The indicators and control panel switches are as follows:

Direction Velocity Indicator (DVI). The face of the direction velocity indicator (DVI, figure 1—46) contains a vertical velocity dot, a drift needle, a heading needle, and a hover flag. The dot indicates vertical velocity of the aircraft, moving down when the aircraft is descending, and up when the aircraft is ascending, each increment on the scale representing a rate of change of 500 feet per minute. The drift needle indicates left and right velocity, moving left when the aircraft is moving right, and moving right when the aircraft is moving left. The heading needle indicates forward and rearward velocity, moving down when the aircraft is moving forward, and moving up when the aircraft is moving aft. The drift and heading needle scales are graduated in increments of 10 knots, except for the small circle at the center of the indicator, which indicates a velocity of 5 knots. The hover flag indicates HOV when in normal operation and shows a barber pole (yellow and red stripes) and the word OFF when the doppler signal is unreliable.

Groundspeed Drift-Angle Indicator. The face of the groundspeed drift-angle indicator contains two pointers. The long pointer (1, figure 1—47) indicates the speed of the aircraft on its ground track. The short pointer (2, figure 1—47) indicates the drift-angle of the aircraft.

Power-Off Switch. The power-off switch (5, figure 1—48), is marked POWER OFF, and energizes and de-energizes the complete system.

Note

The ASE RAD ALT switch should be in the OFF position prior to switching the POWER OFF switch to the OFF position. The radar altitude hold feature of the ASE uses a damping input from the AN/APN-130 to prevent vertical oscillations of the aircraft.

Land-Sea Switch. The two-position land-sea switch (6, figure 1—48) is marked LAND SEA, and compensates for the difference in radar reflection characteristics of water and land surfaces.

Transmit-Standby Switch. The two-position transmit-standby (XMTG STBY) switch (7, figure 1–48) controls the high voltage required by the transmitter. Assuming that the power-off switch is in the POWER position, the transmitter will transmit when the transmit-standby switch is in the TRANSMIT position, and will be silent when the switch is in the STANDBY position.

Note

The ASE RAD ALT switch should be in the OFF position prior to switching the XMTG-STBY switch to the STBY position. The radar altitude hold feature of the ASE uses a damping input from the AN/APN-130 to prevent vertical oscillations of the aircraft.

Test-Operate Switch. The two-position, spring-loaded, test-operate (TEST OPR) switch (2, figure 1–48) is used for testing the system. When the switch is moved to the TEST position, a known test signal will be fed into the system. If everything is operating correctly, the test signal will cause the two needles and the dot on the direction velocity indicator to move to predetermined positions. (Refer to **SYSTEMS CHECKS** in Section III.) Before testing the system, the transmit-standby switch must be in the STANDBY position. During normal operation of the system, the switch will be in the OPERATE position.

Note

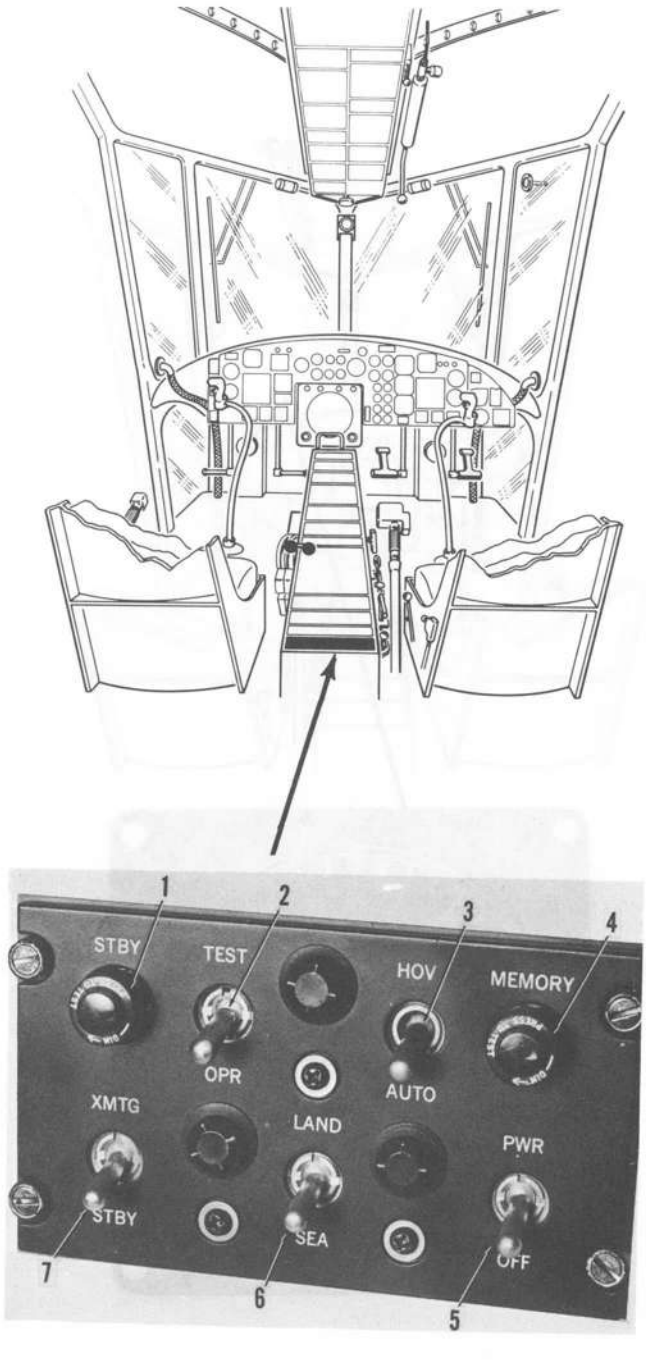
The TEST position should be used with ASE RAD ALT and GROUNDSPEED switches OFF only to preclude feeding false signals to the ASE. The normal use of the TEST position is for ground checking the system prior to flight.

Hover-Auto Switch. The two-position hover-auto (HOV-AUTO) switch (3, figure 1–48) is placed in the HOVER or AUTO position, depending on the nature of the flight. For normal operations, both high speed and hovering flight, the switch should be left in the AUTO position.

Standby Light. The standby (STBY) light (1, figure 1–48) is amber. The light glows when the transmitter is off or inoperative.

Memory Light. The memory (MEMORY) light (4, figure 1–48) is amber. The light glows whenever the doppler signal is unreliable or inoperative, and indicates that the AN/ASA-13A navigational computer group is operating on the memory of the last reliable signals. The hover flag on the direction velocity indicator will show a yellow and red barber pole and read OFF when the memory light is on.

AN/APN-130 Radar Groundspeed Panel



1. STANDBY LIGHT
2. TEST—OPERATE SWITCH
3. HOVER—AUTOMATIC SWITCH
4. MEMORY LIGHT
5. POWER—OFF SWITCH
6. LAND—SEA SWITCH
7. TRANSMIT—STANDBY SWITCH

Figure 1—48

Normal Operation.

To operate the system proceed as follows:

1. Transmit-standby switch – STANDBY.
2. Power-off switch – Power.
3. Wait 5 minutes for equipment to warm up.
4. Test-operate switch – Move to TEST, check for correct indications, and return to OPERATE.
5. Land-sea switch – To agree with surface.
6. Hover-auto switch – AUTO.
7. Transmit-standby switch – TRANSMIT.

Emergency Operation.

1. If, while operating with the hover-auto switch in AUTO, the direction velocity indicator displays erroneous information above 20 knots, but appears to be correct below 20 knots, place the hover-auto switch in the HOVER position and continue to operate.

Note

When operating with the hover-auto switch in the HOVER position, the system accuracy may be reduced at high altitudes or over smooth sea conditions.

2. If, while operating with the hover-auto switch in AUTO, the direction-velocity indicator displays erroneous information below 20 knots and correct information above 20 knots, move the hover-auto switch to HOVER when flying below 20 knots and back to AUTO when flying above 20 knots. Continue operation in this manner.

NAVIGATIONAL COMPUTER GROUP, AN/ASA-13A WITH TACTICAL DISPLAY PLOTTING BOARD, PT-429/A.

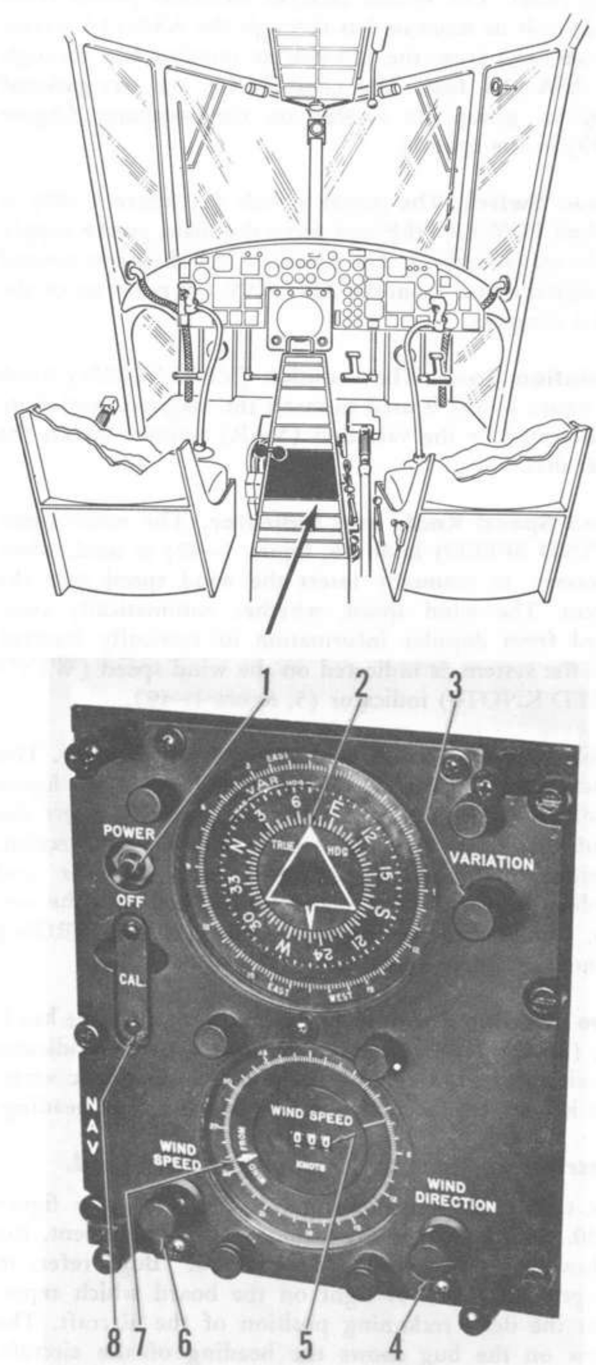
Description, Navigational Computer Group.

The navigational computer group receives information from the AN/APN-130 groundspeed indicating equipment, the MA-1 compass and an airspeed transmitter. This information is used by the computer to determine the direction and velocity of the wind, and the heading, track, and groundspeed of the aircraft. The computer then supplies signals to the tactical display plotting board which continually displays the heading and position of the aircraft.

Note

Due to a characteristic yaw of the aircraft at airspeeds below 120 knots, the indicated wind direction and velocity will be inaccurate at those airspeeds. This does not adversely affect the position of the aircraft as displayed on the tactical display plotting board, no matter what the airspeed. At airspeeds of 120 knots or above, the displayed wind information will be accurate.

AN/ASA-13A Computer Panel



1. POWER SWITCH
2. TRUE HEADING POINTER
3. VARIATION KNOB
4. WIND DIRECTION KNOB
5. WIND SPEED INDICATOR
6. WIND SPEED KNOB
7. WIND – FROM POINTER
8. MAINTENANCE ACCESS PLATE

Figure 1–49

The navigational computer group includes an electronic amplifier and the computer located in the console. The tactical display plotting board is located on the instrument panel. The system receives electrical power from the 28-volt dc monitor bus through the ASA-13A circuit breaker, and from the 115-volt ac monitor bus through the ASA-13A fuse. The controls for the navigational computer group are located on the computer (figure 1–49) in the console.

Power Switch. The power switch (1, figure 1–49) is marked POWER OFF and turns the main power supply to the set on and off. The power switch does not control the signal inputs from the AN/APN-130 radar set or the MA-1 compass.

Variation Knob. The variation (VARIATION) knob (3, figure 1–49) is used to insert the magnetic variation, as indicated by the variation (VAR) pointer within the outer dial.

Wind Speed Knob and Indicator. The wind speed (WIND SPEED) knob (6, figure 1–49) is used, when necessary, to manually insert the wind speed into the system. The wind speed, whether automatically computed from doppler information or manually inserted into the system, is indicated on the wind speed (WIND SPEED KNOTS) indicator (5, figure 1–49).

Wind Direction Knob and Wind From Pointer. The wind direction (WIND DIRECTION) knob (4, figure 1–49) is used, when necessary, to manually insert the wind direction into the system. The wind direction, whether automatically computed from doppler and heading information or manually inserted into the system, is indicated by the wind from (WIND FROM) pointer (7, figure 1–49).

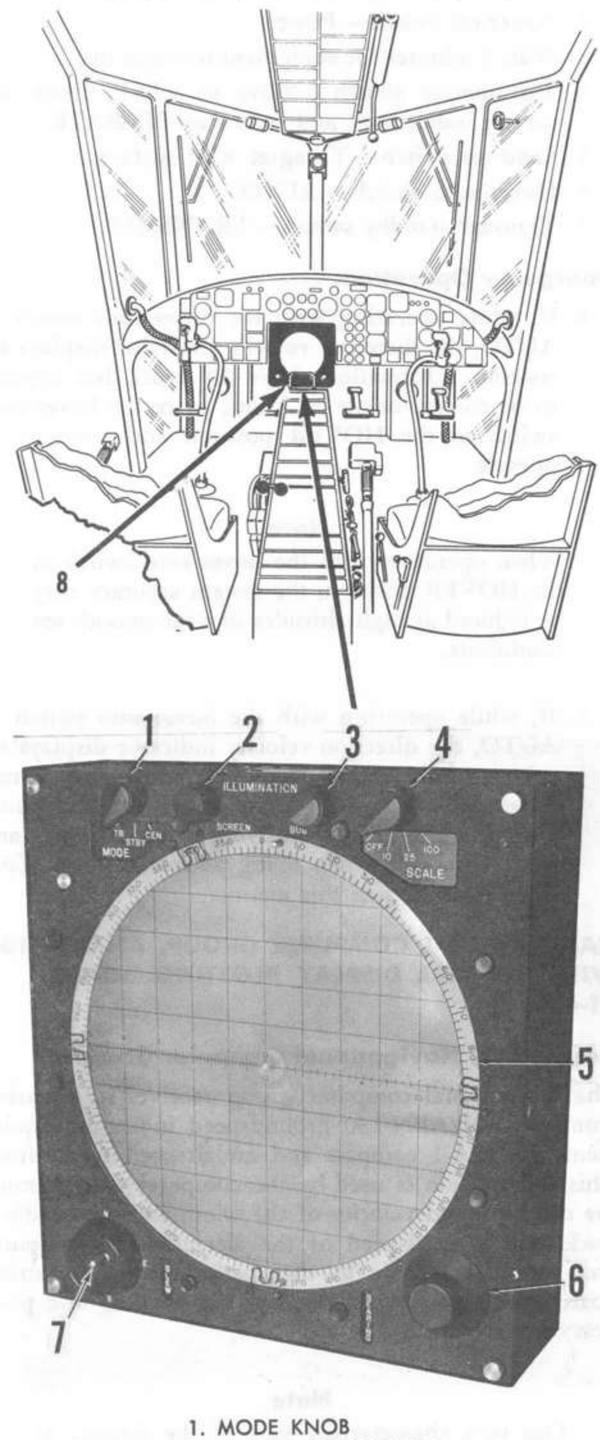
True Heading Pointer. The large triangular true heading (TRUE HDG) pointer (2, figure 1–49) indicates the aircraft's heading. When the correct magnetic variation is inserted, the indicated heading is a true heading.

Description, Tactical Display Plotting Board.

The tactical display plotting board is shown in figure 1–50. Before further discussion of this equipment, the following terms should be understood: "Bug" refers to the projected spot of light on the board which represents the dead reckoning position of the aircraft. The arrow on the bug shows the heading of the aircraft. "Track" refers to the motion of the bug across the board when simulating the motion of the aircraft. "Slew" refers to the positioning of the bug on the board by use of the appropriate switch. The following controls are located on the plotting board:

Mode Knob. The mode knob (1, figure 1–50) is marked TRACK (TR), STANDBY (STBY) and CENTER (CEN). The knob is used to start and stop the motion of the bug. When the knob is moved to the TRACK position, the bug will immediately begin to

Tactical Display Plotting Board, PT-429/A



1. MODE KNOB
2. SCREEN LIGHT KNOB
3. BUG LIGHT KNOB
4. SCALE KNOB
5. SCREEN
6. BEARING KNOB
7. SLEW SWITCH
8. HANDLE

Figure 1–50

track the aircraft motion. When the knob is moved to the STANDBY position, the bug will stop tracking and hold its position. When the knob is moved to the CENTER position, the bug will be slewed automatically toward the center of the board. The knob is spring-loaded to return to the STANDBY position from the CENTER position.

Slew Switch. The slew switch (7, figure 1–50) is marked SLEW NESW. The slew switch is used to position the bug on the board. The switch is connected to the bug motor circuits so that control of the bug motion can be exercised in the North-South and East-West directions, separately or in combination, by moving the switch in the desired direction. The slew switch overrides the mode switch.

CAUTION

Do not attempt to slew the bug beyond the perimeter of the screen. Damage to the slew mechanism may result.

Scale Knob. The scale knob (4, figure 1–50) is marked SCALE, OFF, 10, 25, 100. The knob is used to select any of three different operating ranges. The three ranges, 10, 25, and 100, each correspond to the diameter of the screen in nautical miles. There are 10 grid divisions on the screen. Therefore, when the scale knob is at 10, the diameter of the screen represents 10 nautical miles, and each grid division represents 1 nautical mile. When the knob is at 25, the diameter of the screen represents 25 nautical miles, and each grid division represents 2.5 nautical miles. When the knob is at 100, the diameter of the screen represents 100 nautical miles and each grid division represents 10 nautical miles.

Bearing Knob. The bearing knob (BEARING) (6, figure 1–50) is used to rotate the screen through 360 degrees in either direction.

Screen Light Knob. The screen light (SCREEN) knob (2, figure 1–50) adjusts the intensity of the screen lighting.

Bug Light Knob. The bug light (BUG) knob (3, figure 1–50) adjusts the brightness of the bug.

Handle. The handle (8, figure 1–50) is pushed forward or pulled aft to position the board vertically, or at an angle, for ease of viewing.

Normal Operation.

To operate the equipment, proceed in the following manner:

1. MA-1 compass – ON.
   Use desired mode, preferably slaved.
2. AN/APN-130 – ON.
   Use desired mode.
3. Computer power switch – POWER.
4. Allow equipment to warm up for a minimum of 30 minutes.
5. Variation knob – Set for magnetic variation.
6. Wind speed knob – As desired.
   Leave as is, or if radar groundspeed equipment is in MEMORY mode or inoperative, set for correct wind speed.
7. Wind direction knob – As desired.
   Leave as is, or if radar groundspeed equipment is in MEMORY mode or inoperative, set for correct wind direction.
8. Mode knob – STANDBY.
9. Scale knob – Set to desired scale.
10. Bearing knob – Set screen as desired.
11. Slew switch – As required.
    Move as necessary to slew bug to desired starting position on screen.
12. Mode knob – TRACK.

CAUTION

Do not allow the bug to track beyond the perimeter of the board. Damage to the tracking mechanism may result.

13. Screen lighting knob – As desired.
14. Bug lighting knob – As desired.

Emergency Operation.

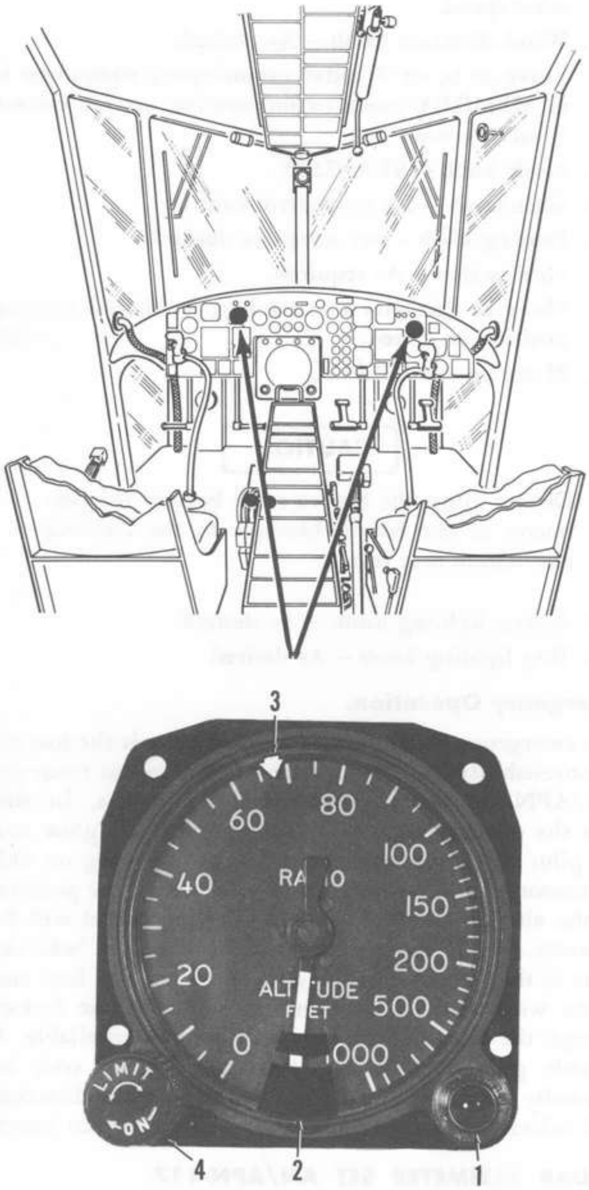
The emergency condition which could arise is the loss of, or unreliability of, the doppler signal received from the AN/APN-130 radar groundspeed equipment. In this case the memory light (4, figure 1–48) will glow and the pilot will know that the system is operating on old, or memory, wind information. If this occurs, the position of the aircraft displayed on the plotting board will be accurate only if the airspeed and heading are held the same as they were when the doppler signal was lost, and if the wind remains the same. If any of these factors change, the displayed position will become unreliable. A reliable ground track may then be obtained only by manually inserting the correct, reported wind direction and velocity, and flying at an airspeed above 120 knots.

RADAR ALTIMETER SET AN/APN-117.

Description.

The radar altimeter set provides a continuous indication of the height of the aircraft above the surface from zero to 1000 feet. The system includes two radar altitude indicators (figure 1–51), an electronic control amplifier located under the floor in the forward cabin, and a receiver-transmitter located in the bottom of the aft fuselage. A signal is emitted by the transmitter, reflected from the terrain, and picked up by the receiver. The time lapse between the transmission and receipt of the signal is converted into a difference frequency, amplified, and converted to mechanical movement of the indicator needle. A reliability circuit disables the indicator and puts the indicator needle behind a mask when the received signal is too weak to provide reliable information. The

Radar Altimeter



1. WARNING LIGHT
2. MASK
3. LIMIT POINTER
4. LIMIT—ON KNOB

Figure 1—51

radar altimeter set draws power from the 28-volt dc primary bus and from the 115-volt ac monitor bus through the two radar altimeter (RAD ALT) circuit breakers. The radar altimeter furnishes an electrical signal, which varies with altitude, to the ASE.

Pilot's Limit-On Knob. This knob is used to turn the radar altimeter set on and off, and to set the pilot's limit pointer to the desired altitude at which the warning lights on both pilots' radar altimeters will glow.

Copilot's Limit-On Knob. This knob is used to turn the system on and off, and to set the copilot's limit pointer to the desired altitude which the ASE RAD ALT mode will seek and hold when engaged.

Warning Lights. The red warning lights on both indicators will glow when the aircraft descends below the altitude as set by the pilot's limit-on knob. To insure maximum brilliance of the warning lights for daylight operations, make sure that the pilot's and copilot's flight instrument rheostat knobs are turned OFF.

Normal Operation.

1. Pilot's limit-on knob – Set for desired warning light altitude.
2. Copilot's limit-on knob – Set for desired flight altitude.

Note

- If the radar altimeter is turned off and then it becomes necessary to turn it back on again, you should wait at least 35 seconds before turning it back on. This time delay is necessary to allow certain critical components to cool off. Accuracy of the system may be impaired if this instruction is not observed.
- Under some circumstances an external load can cause the RAD ALT to read incorrectly.

WARNING

Radar measurements of terrain clearance are unreliable over areas which are covered by large depths of snow and ice. Radar waves can penetrate the surface of snow and ice fields, and may indicate greater terrain clearance than actually exists.

RADAR ALTIMETER WARNING SET AN/APQ-107.
Description.

The radar altimeter warning set (RAWS) receives its information from the radar altimeter, and provides indications to the pilot in the form of a flashing red light (52B, figure 1–9) on the instrument panel and a repetitive tone in the pilots' headsets. The signals occur at two different altitudes, referred to as the high altitude index and the low altitude index. The high altitude index is normally preset on the ground by maintenance personnel at 250 feet, and the low altitude index is set in the cockpit, using the pilot's limit-on knob. Using activities may establish their own high altitude setting, dependent upon mission or local conditions.

If the aircraft descends through the high altitude index with the wheels up, the light will flash for about 3 seconds and the tone will sound for about 3 seconds. No further indications will be produced until the aircraft descends to the low altitude index. When the low altitude index is reached, the light and the tone will start, and continue as long as the helicopter remains below that level, except that the tone will stop when the landing gear is lowered. Both the light and the tone will stop when the aircraft climbs above the low altitude index level. When the helicopter climbs through the high altitude index, the signals will not occur. The warning set can be checked by pressing the press-to-test button located above the red light on the instrument panel. If the light comes on and the tone is heard in the headset, the set is operating properly. The warning set will also indicate, by the flashing red light and the repetitive tone, when the radar altimeter is off or becomes unreliable at altitudes below 1000 feet.

RAWS Indications:

Helicopter Situation	*Wheels Down**	*Wheels Up*
Ascending thru high index	No indication	
Above 1000 feet	No indication	
Descending thru high index	No ind.	L + T**
Above low index	No indication	
Below low index	L	L + T
Failed APN-117 or APQ-107	L	L + T
Test RAWS in air	L + T	L + T
Test RAWS on ground	L +T	***

L = Flashing RAWS light on instrument panel.

T = Repetitive RAWS tone in headset.

*Wheels down and locked.

**Light flashes for about 3 seconds; tone repeats for about 3 seconds.

***Not applicable.

Note

If a radar altimeter or warning set failure occurs, causing a continuous flashing light or tone, the system can be disabled by pulling the appropriate circuit breakers. Deactivation of the RAWS alone will not interfere with the low altitude warning function of the radar altimeter.

Pilot's Limit-On Knob. This knob is used to set the pilot's limit pointer to the desired low altitude index, at which the flashing warning light, the two steady warning lights, and the repetitive tone in the pilots' headsets will occur.

Warning Lights. The steady red warning lights on both indicators will glow and the red warning light on the instrument panel will flash when the aircraft descends below the low altitude index, as set by the pilot's limit-on knob. In addition, if the wheels are up, the red warning light on the instrument panel will flash for 3 seconds as the aircraft descends through the preset high altitude index.

Normal Operation.

1. Pilot's limit-on knob – Set for desired low altitude index.
2. Copilot's limit-on knob – Set for desired ASE RAD ALT flight altitude.

SYSTEM (AFC 157).
AN/ALQ-98 ELECTRONIC COUNTERMEASURE

Description.

The equipment provides a suitable response when the helicopter is illuminated by radar. Electrical power to operate the equipment is supplied from the 28-volt dc monitor bus, and the 115-volt ac monitor bus, through the two AN/ALQ-98 circuit breakers (figure 1–31). The cockpit control panel (figure 1–51A) is located below the left end of the instrument panel. The system can also be controlled from the electronic unit located at the right rear of the cabin.

Local-Remote Switch. The local-remote switch on the cockpit control panel determines which station has control of the system. When the cockpit panel switch is in local position, the system is controlled from the electronic unit; when the switch is in remote position, the system is controlled from cockpit.

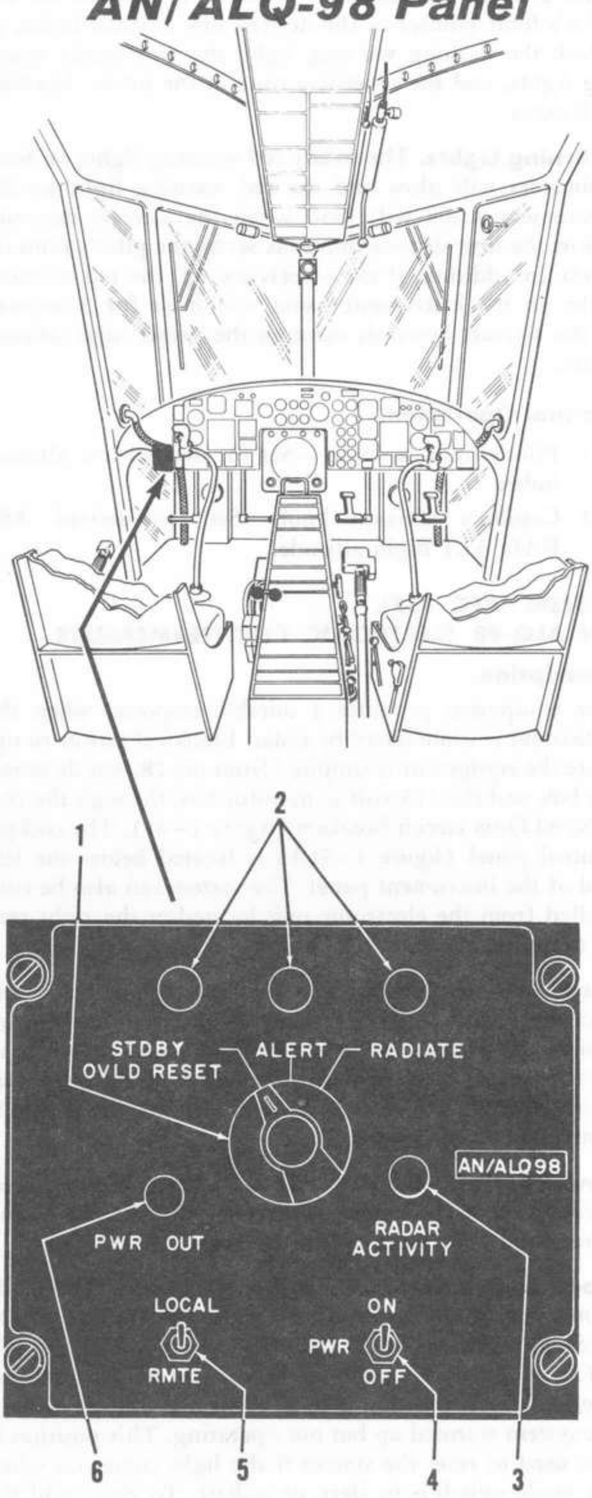
Power Switch. The power (PWR) switch applies electrical power to the system. A three-minute warmup period is required before the system becomes operational.

Mode Switch and Mode Indicator Lights. The mode switch has three positions: STANDBY OVERLOAD/RESET (STDBY OVLD RESET), ALERT AND RADIATE, with corresponding indicator lights. The standby overload/reset position is used when it is desired to have the system warmed up but not operating. This position is also used to reset the system if the light comes on when the mode switch is in alert, or radiate. To reset hold the switch in reset for 10 seconds.

With the mode switch in radiate the radar activity and the power out lights will be operational and the system will transmit countermeasures.

Radar Activity Light. This light glows steadily or intermittently when the mode switch is in alert or radiate and the helicopter is illuminated by radar capable of countermeasures.

AN/ALQ-98 Panel



1. MODE SWITCH
2. MODE INDICATOR LIGHTS
3. RADAR ACTIVITY LIGHT
4. POWER SWITCH
5. LOCAL – REMOTE SWITCH
6. POWER OUT LIGHT

Figure 1–51A

Power Out Light. The power (PWR) out light glows when the system is producing useable countermeasure power. The power is absorbed within the set if the mode switch is in alert. The power is transmitted as countermeasures if the mode switch is in radiate.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING.

The exterior lighting system (figure 1–52) consists of the following: position lights, taillight, a landing light, floodlights, and upper and lower anti-collision lights. Switches for the position lights and anti-collision lights are on the EXTERIOR LIGHTS panel (figure 1–53) located on the forward cabin ceiling. The switches for the landing light and the floodlights (1 and 2, figure 1–54) are on the pilot's collective pitch lever switchbox. The landing light may also be controlled by the copilot from a switch on the instrument panel (7, figure 1–53). Circuit breakers for the lighting equipment are located on the fuse and circuit breaker panel (figure 1–31) which is installed on the forward cabin ceiling.

Position Lights and Switches.

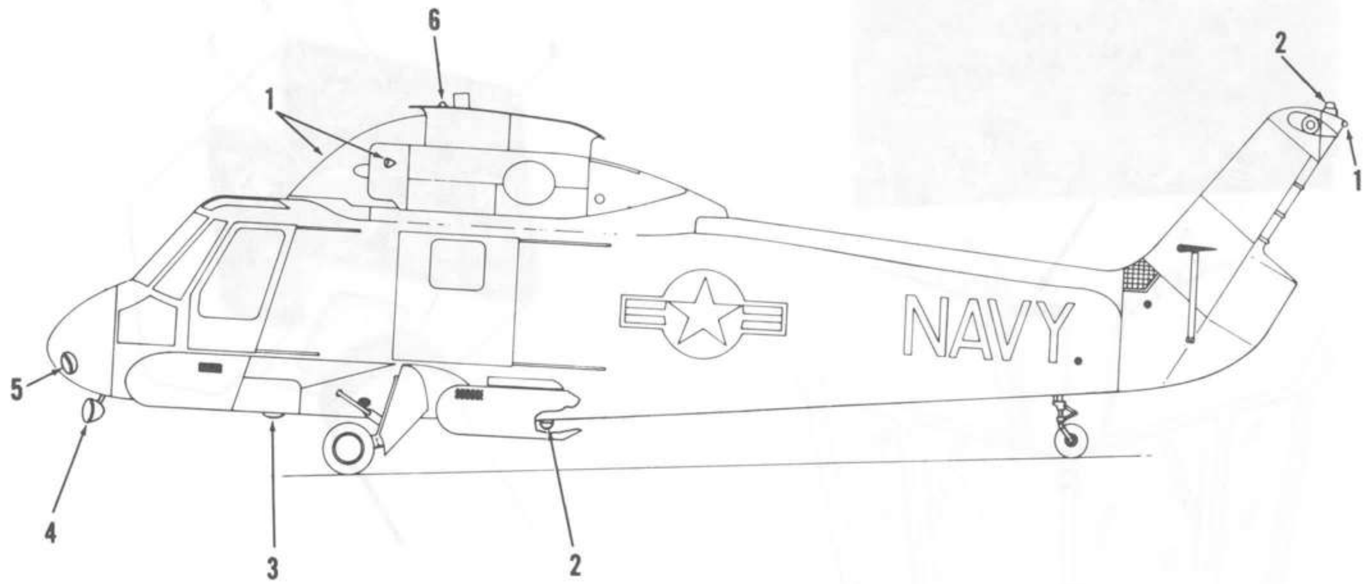
Three position lights are provided as follows: a white taillight on the trailing edge of the upper tail pylon, a green light (not shown) on the right side of the upper cabin, and a red light on the left side of the upper cabin (1, figure 1–52). The position light switches DIM-OFF-BRT (2, figure 1–53) and master switch ON-OFF (1, figure 1–53) are on the exterior lights panel. The master switch must be on before the position lights can be turned on. A position/taillight key (POS/TAIL LT KEY) (4, figure 1–53) allows the pilot to flash code messages with the position lights. Before using the key for code messages, the master switch must be ON and the position light switches shall be OFF. A red blinker light (5, figure 1–53) will flash in the cockpit when the key is pressed. Electrical power to operate the lights is supplied from the lighting bus through the position light (POSITION LT) circuit breaker.

Anti-Collision Lights and Switches.

Two red rotary anti-collision lights (2, figure 1–52) are provided. One is mounted on top of the tail rotor pylon and the other is located on the belly of the helicopter under the cargo compartment. The lights are controlled by separate ON-OFF switches (3 and 6, figure 1–53) and the master switch (1, figure 1–53) on the exterior lights panel. The master switch must be on before the anti-collision lights can be turned on.

Power Supply Before AFC-114. Electrical power for the anti-collision lights is supplied from the 26-volt ac monitor bus through the anti-collision light (ANTI COLLISION LT) circuit breaker. Power for the motors which rotate the lights comes from the 28-volt dc monitor bus through the anti-collision light motor (ANTI COLLISION MOTOR) circuit breaker.

Exterior Lights



1. POSITION LIGHTS
2. ANTI-COLLISION LIGHTS
3. HOIST FLOODLIGHT
4. LANDING LIGHT
5. NOSE FLOODLIGHT (2)
6. DROOP STOP LIGHT

Figure 1–52

Power Supply After AFC-114. Electrical power for the anti-collision lights and motors is supplied from the 28-volt dc primary bus through the anti-collision light (ANTI COLLISION LT) and the anti-collision light motor (ANTI COLLISION MOTOR) circuit breakers.

Note

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

Landing Light and Switches.

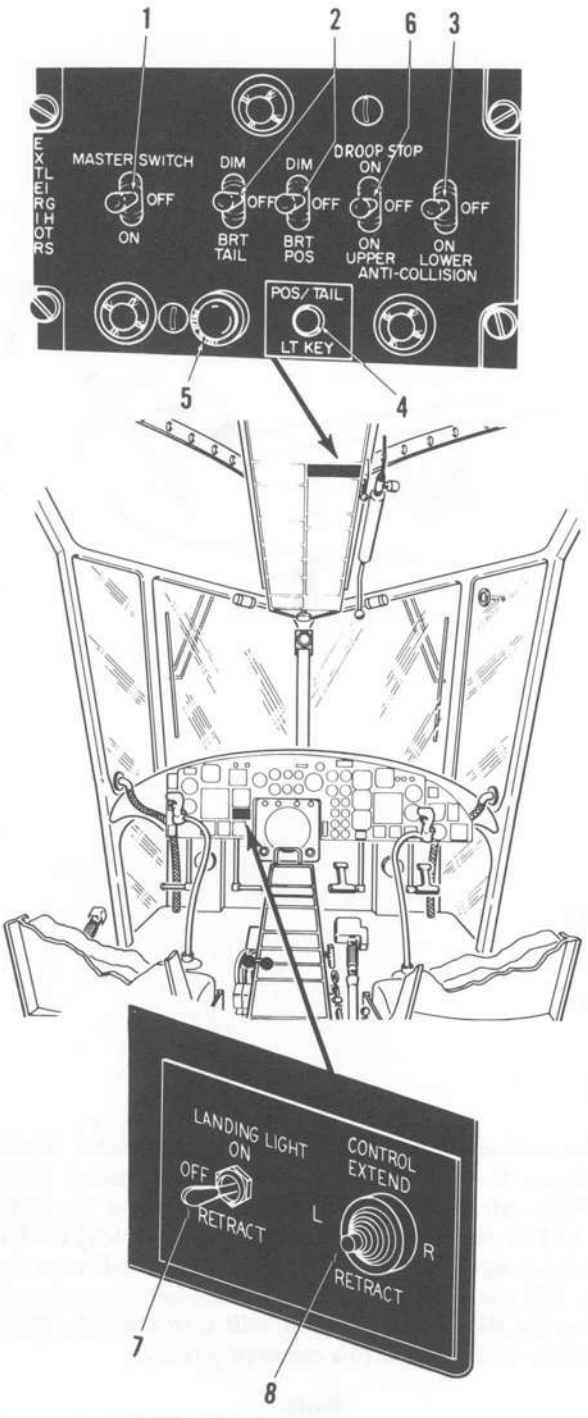
The landing light (4, figure 1–52) may be extended, retracted, and rotated to the left or right. The landing light is controlled by two switches on the pilots' collective pitch lever switchbox, and in some aircraft may also be controlled by switches mounted on the copilot's side of the instrument panel. The landing light motor switch (3, figure 1–54 and 8, figure 1–53) will extend (EXTEND), retract (RETRACT), or will rotate the light left (L) or right (R). The landing light ON-OFF-RET switch (2, figure 1–54 and 7, figure 1–53) will turn the light ON and OFF when either extended or retracted; and in the RETRACT position, will turn the light OFF, retract it, and rotate it to a centered position.

Note

The pilot's and copilot's switches are not interlocked. Therefore, before either pilot's switches will be operative, the other pilot's landing light switch must be out of RETRACT.

Electrical power to operate the light is supplied from the lighting bus through the landing light (LDG LT) circuit breaker. Power for the control circuit is supplied from the 28-volt dc primary bus through the landing light control (LDG LT CONTROL) circuit breaker.

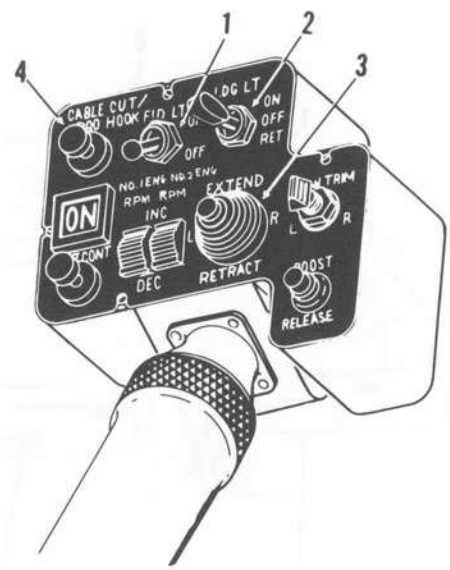
Exterior Lights Panel



1. MASTER SWITCH
2. POSITION LIGHT SWITCHES
3. LOWER ANTI-COLLISION SWITCH
4. POSITION/TAILLIGHT KEY
5. BLINKER LIGHT
6. UPPER ANTI-COLLISION LIGHT AND DROOP STOP LIGHT SWITCH
7. COPILOT'S LANDING LIGHT SWITCH
8. COPILOT'S LANDING LIGHT MOTOR SWITCH

Figure 1—53

Pilot's Collective Pitch Lever Switchbox



1. FLOODLIGHTS SWITCH
2. LANDING LIGHT SWITCH
3. LANDING LIGHT MOTOR SWITCH
4. DROP BUTTON

Figure 1—54

Floodlights and Switch.

A floodlight (3, figure 1—52) for use with the hoist is located in the belly of the helicopter under the pilot's seat. Two floodlights (5, figure 1—52) are mounted in the nose doors. All three lights are controlled by the floodlights ON-OFF switch (1, figure 1—54) on top of the pilot's collective pitch lever. Electrical power is supplied as follows: power for the control circuit comes from the 28-volt dc primary bus through the floodlight control (FLOOD LT CONTROL) circuit breaker; power to operate the hoist floodlight is supplied from the lighting bus through the hoist floodlight (HOIST FLOOD LT) circuit breaker; power to operate the nose floodlights is supplied from the 26-volt ac monitor bus through the nose floodlight (NOSE FLOOD LT) circuit breaker.

Droop Stop Light.

The droop stop light is incorporated by AFC-114. When the upper anti-collision light and droop stop light switch (6, figure 1—53) is placed in the droop stop ON position, a light is positioned on the droop stops to enable their visibility at night for rotor disengagement and shutdown. Electrical power for the droop stop light is supplied from the 28-volt dc primary bus.

INTERIOR LIGHTING.

The interior lighting system consists of the following: console lights, instrument lights, console and instrument floodlights, cockpit lights, and a cabin dome light. Circuit breakers for the interior lights are on the fuse and circuit breaker panel (figure 1–31).

Console Lights and Rheostats.

Illumination of the console panels is provided by red edge lights built into the panels. The lights can be turned on and their intensity can be varied from DIM to BRIGHT by a rheostat knob marked CONSOLE (6, figure 1–55) on the INTERIOR LIGHTS panel. Electrical power for the lights is supplied from the lighting bus through the instrument lights (INST LT) circuit breaker.

Instrument Lights and Rheostats.

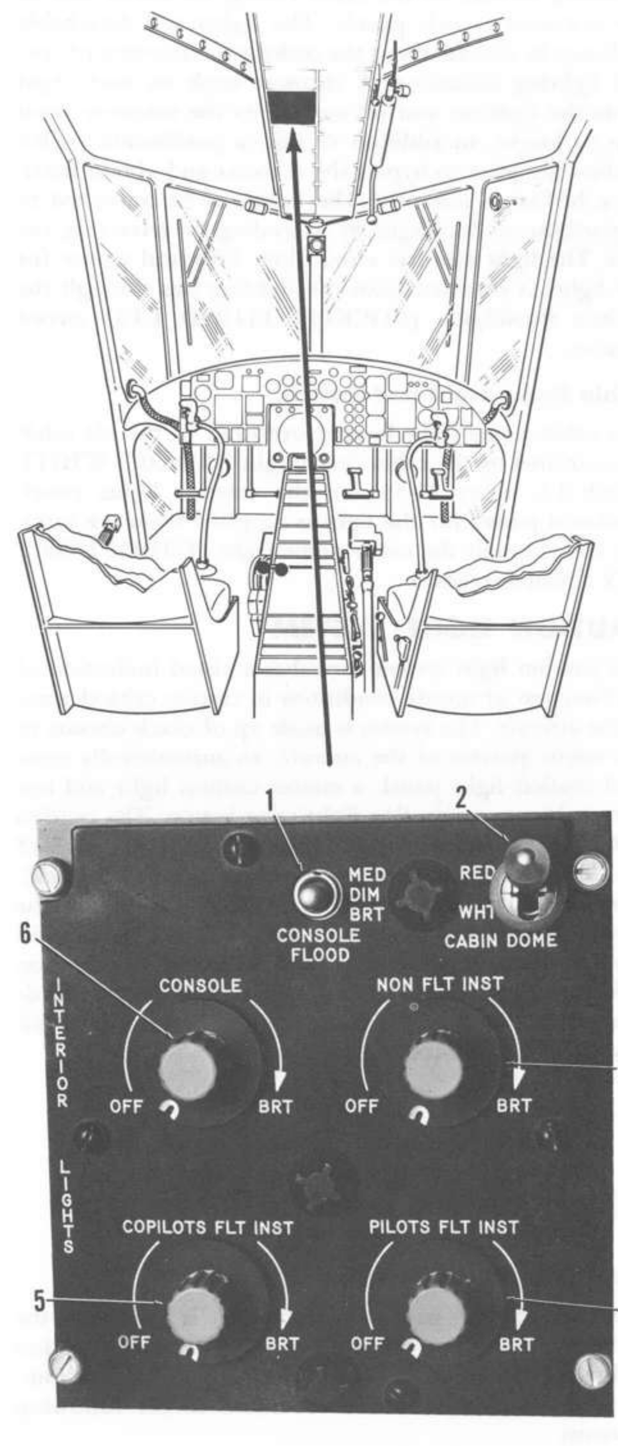
Instruments are lighted by individual lights placed over or adjacent to each instrument. The center instrument panel is edge lighted by lights built into the panel. The instrument lights can be turned on and their intensity varied by means of three rheostat knobs (3, 4 and 5, figure 1–55) on the interior lights panel. An additional feature is incorporated into the two rheostat knobs labeled PILOTS FLT INST and COPILOTS FLT INST. (Later helicopters contain only one flight instrument knob.) When the knobs are turned on, the master caution light, the master caution light panel, and the limit altitude warning lights on the radar altimeters are dimmed to glow at a lower than normal intensity for night operations. When the knobs are turned off, these same lights are restored to glow at normal intensity for daylight operations. Be sure to turn the flight instrument lights off at the end of all night flights. If this is not done, the master caution light, the caution light panel, and the radar altimeter limit altitude warning lights can only glow at a low intensity and may be overlooked in daylight operation.

Electrical power for the lights is supplied from the lighting bus through the instrument lights (INST LT) circuit breaker.

Console and Instrument Floodlights and Switches.

Three console floodlights are mounted on the canted bulkhead at the rear of the pilot's compartment. Three instrument floodlights and a fourth console floodlight are mounted under a glare shield mounted above the instrument panel. These lights are turned on when the console edge lights are turned on by means of the console rheostat knob. Light intensity is regulated by a MED-DIM-BRT switch (1, figure 1–55) marked CONSOLE FLOOD on the interior lights panel. Electrical power for the lights is supplied from the lighting bus through the cockpit floodlights (COCKPIT FLOOD LTS) circuit breaker.

Interior Lights Panel



1. CONSOLE FLOODLIGHTS SWITCH
2. CABIN DOME LIGHTS SWITCH
3. NON-FLIGHT INSTRUMENTS RHEOSTAT KNOB
4. PILOT'S FLIGHT INSTRUMENTS RHEOSTAT KNOB
5. COPILOT'S FLIGHT INSTRUMENT RHEOSTAT KNOB
6. CONSOLE LIGHTS RHEOSTAT KNOB

Figure 1–55

Cockpit Lights and Rheostats.

Two cockpit lights with flexible cords are mounted in retaining sockets on the cabin ceiling on either side of the overhead switch panels. The lights are detachable and may be moved about the cockpit to take care of special lighting situations. A rheostat knob on each light turns the light on and off and varies the intensity from dim to bright. In addition to this, a pushbutton switch enables the pilot to bypass the rheostat and obtain maximum brilliance instantly. The light can be converted to a spotlight or floodlight by extending or retracting the lens. The light also has a red filter. Electrical power for the lights is supplied from the lighting bus through the cockpit floodlights (COCKPIT FLOOD LTS) circuit breaker.

Cabin Dome Light and Switch.

The cabin dome light located overhead in the aft cabin is controlled by the cabin dome light RED-OFF-WHITE switch (2, figure 1–55) on the interior lights panel. Electrical power for the light is supplied from the lighting bus through the cabin dome light (CABIN DOME LT) circuit breaker.

CAUTION LIGHT SYSTEM

The caution light system furnishes a visual indication of malfunction or unsafe conditions in certain critical areas of the aircraft. The system is made up of check circuits in the major systems of the aircraft, an automatically actuated caution light panel, a master caution light and test bar, and a master caution light reset button. The caution light panel contains placard-type warning lights, each of which is energized by one of the check circuits. If a malfunction or unsafe condition develops in any of the monitored systems, the caution light for that system will glow until the condition has been corrected. The caution light system receives electrical power from the 28-volt dc primary bus through the master caution light (MASTER CAUTION LT) circuit breaker.

Note

To insure maximum brilliance of the master caution light and caution light panel for daylight operations, make sure that the pilot's flight instrument rheostat knob is turned OFF.

CAUTION LIGHT PANEL.

The caution light panel (figure 1–56) is located at the forward part of the overhead panel. The amber caution lights are placarded as shown in figure 1–56, and indicate malfunction or unsafe conditions in the following systems:

- Transmission system
- Transmission oil system
- Engine oil supply system
- Hydraulic power supply system
- Direct current power supply system
- Alternating current power supply system
- Fuel supply system
- Rotor tracking system

Refer to the paragraphs describing these systems for the specific conditions indicated by the caution lights.

MASTER CAUTION LIGHT AND TEST BAR.

The master caution light and test bar (23, figure 1–9) will glow whenever any of the lights on the caution light panel glow. When the master caution light glows, you should consult the caution light panel to determine the nature of the detected trouble. The master caution light also acts as a test bar for the caution light system. When the bar is pressed, the master caution light and all the lights on the caution light panel should glow. All the lights should turn off when the bar is released. After having indicated a malfunction the master caution light can be turned off by pushing the master caution light reset button.

MASTER CAUTION LIGHT RESET BUTTON.

The master caution light reset button (23A, figure 1–9) is located on the instrument panel at the right of the master caution light. The button is labeled PUSH TO RESET. 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.

INSTRUMENTS

Instruments are described in this section under the specific aircraft system of which they are a part, or in the paragraphs following this list.

- Airspeed indicator (2)
- Altimeter (2)
- Clock (2)
- Combining gearbox oil pressure gage
- Combining gearbox oil temperature gage
- Course indicator
- Dual torquemeter
- Engine oil pressure gage (2)
- Engine oil temperature gage (2)
- Fuel quantity gage
- Gas generator tachometer (2)
- Groundspeed direction-velocity indicator (2)
- Groundspeed drift-angle indicator
- Hydraulic pressure gage
- Magnetic standby compass (upper center windshield)
- Main gearbox oil pressure gage
- Main gearbox oil temperature gage
- Outside air temperature gage (upper right windshield)
- Radar altimeter (2)
- Radio magnetic indicator (2)
- Range indicator
- Remote attitude indicator (2)
- Speed decreaser gear oil pressure gage (2)
- Speed decreaser gear oil temperature gage (2)
- Triple tachometer
- Turbine inlet temperature gage (2)
- Turn and slip indicator (2)
- Vertical velocity indicator (2)

Caution Lights Panel

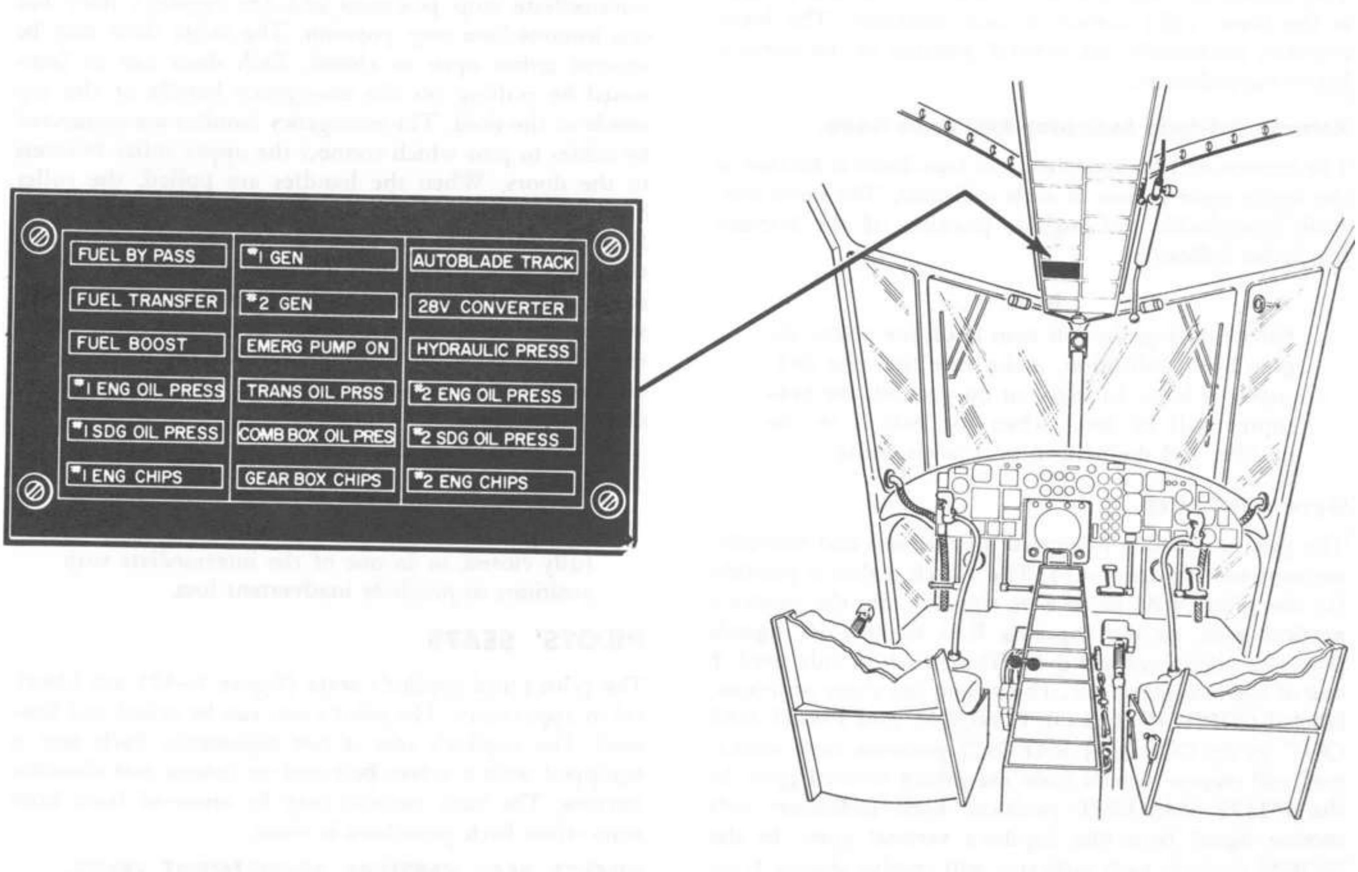


Figure 1—56

TURN AND SLIP INDICATORS.

The two turn and slip indicators operate independently of one another. The indicators receive electrical power from the 28-volt dc primary bus through the pilot's turn indicator (PLT TURN IND) circuit breaker and the co-pilot's turn indicator (CO-PLT TURN IND) circuit breaker.

REMOTE ATTITUDE INDICATORS (RAI).

The two remote attitude indicators (RAI) provide conventional indication of the pitch and roll attitude of the helicopter. The indicators can be trimmed, according to the pilot's wishes, for various pitch and roll attitudes. The indicators receive signals from different gyros and, as a result, operate independently of one another. Power is supplied to the pilot's vertical gyro from the 28-volt dc primary bus and from the 26-volt ac primary bus through the two pilot's vertical gyro (PLT VERT GYRO) circuit breakers. Three-phase power is supplied to the pilot's remote attitude indicator from the 115-volt ac primary bus through the pilot's remote attitude indicator (PILOTS RAI) circuit breaker (or three circuit breakers). Power is supplied to the copilot's vertical gyro and remote attitude indicator through the automatic stabilization equipment (ASE) system which utilizes pitch and roll signals from the copilot's vertical gyro. A flag marked OFF will appear at the lower left of the face of the indicator if any of the power to the ASE is cut off, or if gyro erection time delay of approximately 2 minutes has not expired. The off flag disappearance on the copilot's RAI also indicates that the ASE has warmed up, and is engageable.

RAI Gyro Erection Button.

A pushbutton labeled GYRO ERECTION (8A and 47A, figure 1—9) is mounted adjacent to each RAI. 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 remote attitude indicator off flag will appear when the gyro erection button is pressed. The gyro erection buttons should not be used in flight except when the helicopter is known to be level. Ordinarily, the button is used only on the ground.

WARNING

Actuation of the copilot's gyro erection button will cause the ASE to disengage.

Remote Attitude Indicator Pitch Trim Knob.

The remote attitude indicator pitch trim knob is located at the lower right corner of each indicator. The knob controls, electrically, the vertical position of the horizon bar in the indicator.

Remote Attitude Indicator Roll Trim Knob.

The remote attitude indicator roll trim knob is located at the upper right corner of each indicator. The knob controls, electrically, the angular position of the horizon bar in the indicator.

Note

Before setting the roll trim knob for a zero degree bank indication, make sure that the helicopter is level. In flight or on ground, the helicopter will be level when the ball is in the middle, and the helicopter is not turning.

Gyro Out Switch.

The gyro out switch is located on the heat and miscellaneous panel (figure 1–61). The switch makes it possible for the pilot's RAI to take its signals from the copilot's vertical gyro, or the copilot's RAI to take its signals from the pilot's vertical gyro. The switch is only used if one of the two gyros fail. The switch has three positions, labeled COPILOT RAI OUT, NORM, and PILOT RAI OUT. In the COPILOT RAI OUT position, both indicators will receive signals from the pilot's vertical gyro. In the PILOT RAI OUT position, both indicators will receive signal from the copilot's vertical gyro. In the NORM position each indicator will receive signals from its own vertical gyro.

AIRSPEED PITOT SYSTEM.

The pitot tube is located immediately aft of the left nose door on the underside of the fuselage and is protected from icing by an electrical heating element.

STATIC VENT SYSTEM.

A simple tubing system leading from the rear of the instrument panel to two ports, one in each side of the aft fuselage, provides static pressure for the airspeed indicator, the altimeters, and the rate-of-climb indicators.

ENTRANCE DOORS

The aircraft has three entrance doors. The doors are attached at the top and bottom by rollers which ride in tracks attached to the fuselage. The doors fit flush with the fuselage skin when they are fully closed. Each door can be opened or closed from inside or outside by means of handles located on the doors. Each door can be jettisoned in an emergency. The pilot and rescue door covers the pilot's entrance and the rescue hatch on the right side of the fuselage. The pilot and rescue door can be operated from the cockpit or from the aft cabin. The copilot's door covers the copilot's entrance at the left side of the cockpit, and the cargo door covers the cargo hatch at the left side of the aft cabin. All doors open and shut in the same way; forward to close, aft to open. The pilot's and copilot's doors may be secured either full open or closed. In addition, the pilot's door has two intermediate stop positions and the copilot's door has one intermediate stop position. The cargo door may be secured either open or closed. Each door can be jettisoned by pulling on the emergency handle at the top inside of the door. The emergency handles are connected by cables to pins which connect the upper roller brackets to the doors. When the handles are pulled, the roller brackets are released and the doors are free except for a lanyard attached to the lower door track which prevents the doors from flying into the main rotor blades or tail rotor. The pilot and rescue door has duplicate controls so that the door may be opened or jettisoned by either the pilot or crew. In addition, each of the doors in the aft cabin has a transparent plastic kick-out panel for emergency escape.

CAUTION

In flight all doors should be secured fully open, fully closed, or in one of the intermediate stop positions to preclude inadvertent loss.

PILOTS' SEATS

The pilot's and copilot's seats (figure 1–57) are identical in appearance. The pilot's seat can be raised and lowered. The copilot's seat is not adjustable. Each seat is equipped with a safety belt and an inertia reel shoulder harness. The back cushion may be removed from both seats when back parachute is worn.

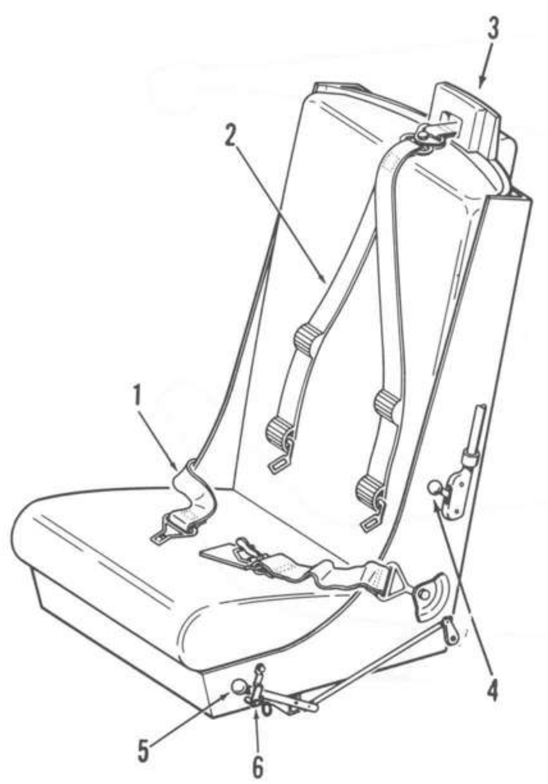
PILOT'S SEAT VERTICAL ADJUSTMENT LEVER.

The vertical adjustment lever (5, figure 1–57) is located at the left side of the pilot's seat. A clip (6, figure 1–57) holds the lever in LOCK position. To move lever to RELEASE position, push inward toward seat to disengage clip and raise lever. When the lever is raised, the seat locking pins are released. The pilot may then adjust the spring-suspended seat by varying his weight on the seat. When the vertical adjustment lever is released, the locking pins will seek the nearest adjustment holes. After releasing the lever, make certain that the seat is locked by allowing the seat to move up or down until it is held firm. Push lever down to engage clip.

SHOULDER HARNESS LOCK HANDLE.

A 2-position shoulder harness lock handle (4, figure 1–57) is located on the left side of the seat back. The handle 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 handle is in the UNLOCKED (up) position, the cable will extend to allow freedom of movement; however, the reel will automatically lock when an impact force of 2G is encountered. When the reel is locked in this manner it will stay locked until the handle is moved to the LOCKED (down) position and then returned to the UNLOCKED position. When the handle is in the LOCKED position, the inertia reel is manually locked and restrains your shoulders against the seat back.

Pilot's Seat



1. SAFETY BELT-
2. SHOULDER HARNESS
3. INERTIA REEL
4. SHOULDER HARNESS LOCK HANDLE
5. PILOT'S SEAT VERTICAL ADJUSTMENT LEVER
6. CLIP

Figure 1—57

PASSENGER CARRYING EQUIPMENT

Four nylon web seats with back rests and lap-type safety belts are installed in the aft cabin (see figure 1—4). A three-man seat is mounted on the right bulkhead and a one-man seat is mounted on the left. The seats are supported by legs which connect into fittings in the cabin floor. When not in use, the seats may be folded up against the bulkhead and secured by straps. When litters are installed, the one-man seat must be folded to make room for the litters.

CASUALTY CARRYING EQUIPMENT

Two litters can be carried in the aft cabin. When installed, the litters are mounted one above the other on the left side of the cabin (see figure 1—4). Each litter is held in place by two support brackets mounted on the left cabin bulkhead, and by two support brackets mounted on straps suspended from the center cabin roof and connected to fittings in the floor. To make room for the litters, the one-man passenger seat must be stowed. When the litters are not installed, the straps are folded and stowed in a pocket aft of the cargo door. The litters are loaded and unloaded through the cargo door.

INTERNAL CARGO CARRYING EQUIPMENT

The cabin is accessible for loading through the cargo door (7, figure 1—3) and the smaller pilot and rescue door (19, figure 1—3). The cabin floor is equipped with thirteen cargo tiedown rings. The cargo tiedown rings will sustain a 1250-pound load perpendicular to the floor surface, and a 500-pound load parallel to the floor surface in any direction, both loads simultaneously applied.

The cargo floor will support dead weight loading up to 200 pounds per-square-foot, based on a 3G limit condition.

The cabin is approximately 54 inches wide, 112 inches long, and 55 inches high. The largest single container that can be loaded into the cabin through the cargo door, and be moved fore and aft within the cabin for center of gravity adjustment, is as follows:

1. With litter brackets installed:

Width	46 inches	53.66 cubic feet
Height	48 inches	
Depth	42 inches	

2. With litter brackets removed:

Width	46 inches	57.50 cubic feet
Height	48 inches	
Depth	45 inches	

WARNING

This information is not intended as weight and balance data or cargo weight limits (refer to part 4 of this section).

Refer to figure 1—57A for approximate cabin and door dimensions.

CARGO HOOK SYSTEM

DESCRIPTION.

A cargo hook (figure 1—58) is mounted on the underside of the fuselage aft of the main landing gear. The hook may be opened by the ground crew by an external lever located on the side of the hook. Some helicopters have an automatic cargo hook that will relatch and lock after the cargo is released. These helicopters can be identified by the "pelican" shape of the hook, which faces forward, and by the presence of one or two cargo hook lights on the instrument panel glareshield. Cockpit controls for the hook are:

Cabin Dimensions

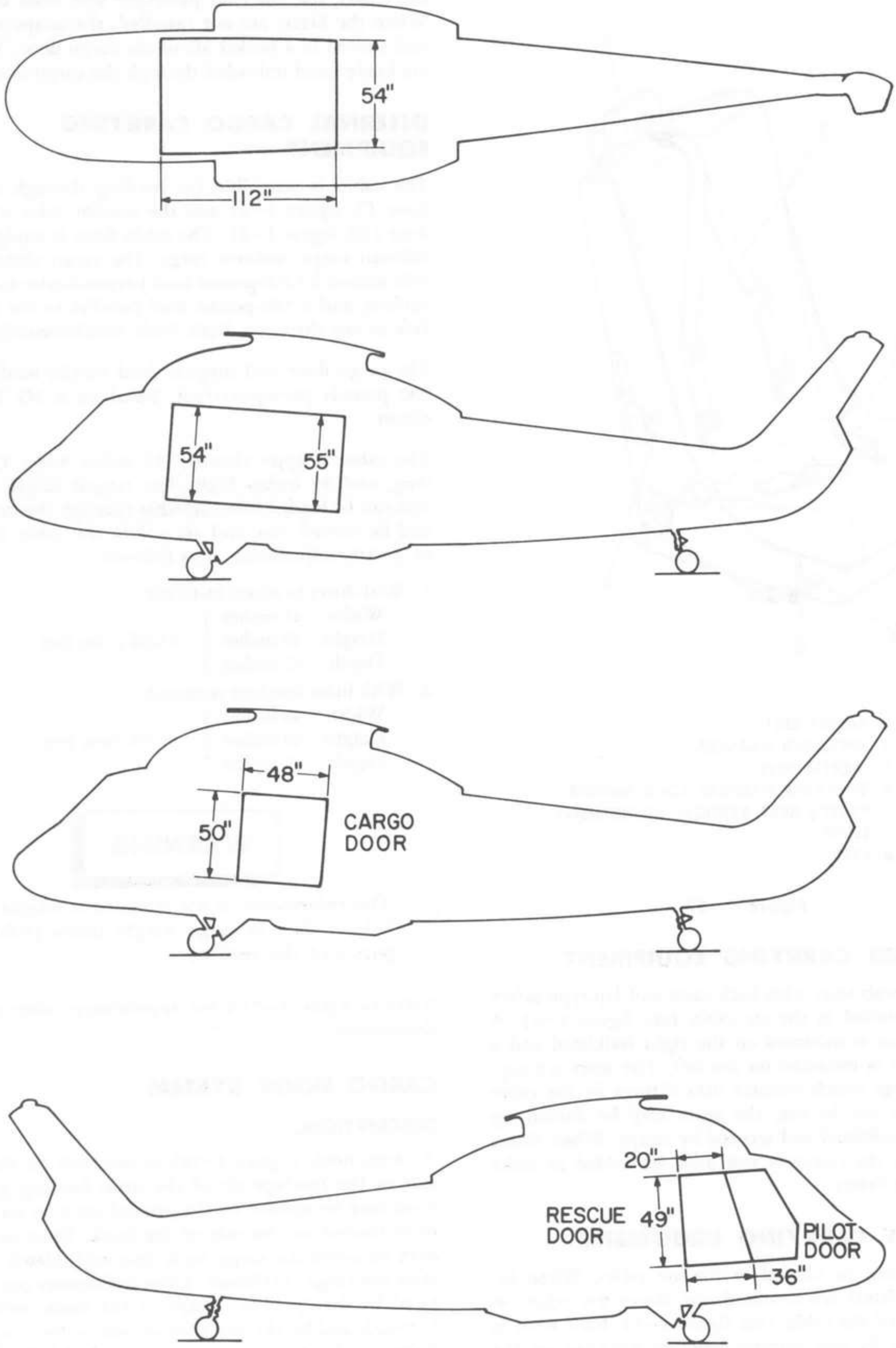


Figure 1—57A

Arming Switch.

The arming switch (2, figure 1–23) is marked CABLE CUT POWER, OFF, SLING DROP POWER. The arming switch serves two systems. When the switch is moved to the SLING DROP POWER position, the cargo hook circuit is armed, and when the drop button is pressed, the cargo hook is opened. The arming switch also arms the cable cutter in the rescue hoist system. Refer to the rescue hoist system paragraphs in this section.

Drop Button.

The drop button (4, figure 1–54) is located on the pilot's collective pitch lever switchbox, and is marked CABLE CUT, CARGO HOOK. The drop button serves two systems. Pressing the drop button with the arming switch in the SLING DROP POWER position will complete the cargo hook release circuit, and open the cargo hook. With the arming switch in the OFF position, the drop button is inoperative. The drop button is also used to operate the cable cutter in the rescue hoist system. Refer to the rescue hoist system paragraphs in this section.

Note

> If the helicopter has an automatic cargo hook, the drop button should be held for at least 1 second when releasing cargo. This will allow sufficient time for the hook to relatch after the load clears the hook.

Automatic Sling Release Switch.

The automatic sling release switch (1, figure 1–23) is marked AUTO SLING RELEASE, OFF. With this switch in the AUTO SLING RELEASE position, and the arming switch in the SLING DROP POWER position, the load will be released automatically when it touches the ground and its pull on the hook has decreased to 75 pounds. The automatic sling release switch should be turned OFF as soon as it is evident the cargo has been released. If the helicopter has an automatic cargo hook, the hook will cycle rapidly between open and close, and the red cargo hook light will glow until the auto release switch is turned OFF.

Cargo Hook Emergency Release Handle.

When the cargo hook emergency release handle (5, figure 1–27) is moved forward, the hook is mechanically opened, regardless of the position of the electrical switches.

Cargo Hook Lights.

If the helicopter is equipped with an automatic cargo hook, one or two cargo hook lights are installed on the instrument panel glareshield. Power for the lights is supplied from the 28-volt dc primary bus through the CARGO HOOK INDICATOR circuit breaker. The red (or amber) HOOK UNLOCKED light will glow when the hook is not closed and locked. The green HOOK LOADED light (if installed) will glow when a load is suspended from the hook and the hook is safely locked. The lights are controlled by sensing switches within the hook body.

Cargo Hook

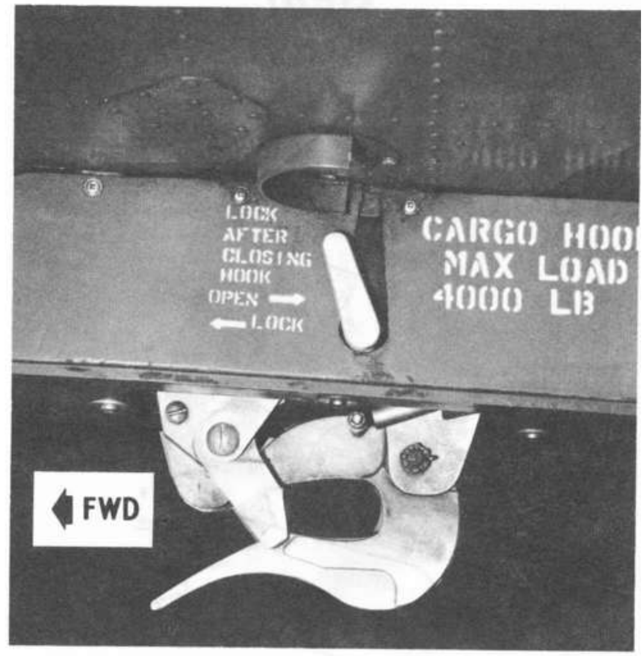


Figure 1–58

NORMAL OPERATION.

To pick up and carry an external cargo load, proceed as follows:

1. Arming switch – SLING DROP POWER.
   This arms the drop circuit so that the pilot can drop the load in a hurry by pressing the drop button, if trouble should develop.
2. Pick up the cargo hook load.
   Hover over the pickup spot and allow the ground crew to attach the load to the hook. (Refer to part 4 of this section for limitations on the cargo weight.) After the load is attached, gradually raise the collective pitch lever until you can feel the weight of the load. Firmly increase power, as necessary, and apply forward cyclic to obtain forward airspeed.

WARNING

> To avoid accidental release of the load, do not place the automatic sling release switch in the AUTO SLING RELEASE position when carrying loads weighing less than 300 pounds.

Emergency Floatation Gear

1. EMERGENCY FLOATATION GEAR

Figure 1–59

To release the cargo using the drop button, proceed as follows:

1. Drop button – Depress.

CAUTION

The drop button should be released as soon as it is evident that the cargo has been released and the hook relocked if an automatic hook is installed. Pressing the button longer than necessary may damage the release circuit.

To release the cargo automatically, proceed as follows:

1. Arming switch – SLING DROP POWER.
2. Automatic sling release switch – AUTO SLING RELEASE.
3. Allow cargo to rest on the ground.
4. Automatic sling release switch – OFF when evident that cargo has been released.

EMERGENCY OPERATION.

If unable to release the cargo electrically, pull the cargo hook emergency release handle.

EMERGENCY FLOATATION GEAR

Emergency floatation gear (1, figure 1–59) is installed in the aircraft to provide lateral stability during crew evacuation, in the event that a power-off water landing is made. The gear consists of two large inflatable gas bags, folded into the fairings (9, figure 1–3) at each side of the fuselage, and two electrically actuated gas generator inflation units; one connected to each bag. When inflated, the bags are cylindrical in shape, and extend fore-and-aft along each side of the fuselage. Some aircraft buoyancy is provided by the aircraft's hull. The landing gear may be raised or lowered with the bags inflated. Refer to part 4 of this section for floatation gear operating limitations.

EMERGENCY FLOATATION GEAR HANDLE.

The emergency floatation gear handle (1, figure 1–8) is located on the emergency panel. When the handle is pulled, two cartridge-type bolt cutters are electrically fired which cause the ditching gear fairings to be opened. At the same time, the two gas generator inflation units are electrically actuated, and the bags are inflated in approximately 4 seconds. Electrical power for the actuating circuit is provided from the 28-volt dc primary bus through the floatation gear (FLOAT GEAR) circuit breakers.

EMERGENCY EQUIPMENT

The following listed emergency equipment is installed in the aircraft:

- one hand-operated CO_2 fire extinguisher
- two first aid kits
- one pyrotechnic case containing a signal pistol and flares
- two canteens

See figure 5–5 for the location of emergency equipment in the aircraft.

EMERGENCY EXITS.

Emergency exits are made from the aircraft through the pilot and rescue door, the copilot's door, and the cargo door.

HEATING, VENTILATING, AND DEFOGGING SYSTEM

DESCRIPTION.

Hot compressed air, for heating the cockpit and cabin and for side window defogging, is obtained from a port on the left-hand side of each engine compressor section. This air is released to the system by an electrically operated solenoid valve. The air passes through fiberglass wrapped tubes to the plenum chamber below the cockpit, where the heated air mixes with fresh air which is drawn up through a screened opening in the bottom of the fuselage. (See figure 1–60.) A fan then pushes the mixed air through flexible hoses and diffusers to the cockpit and cabin. A diffuser on the right side of the cabin is not connected to the plenum chamber but receives hot air directly from the engines.

Heating, Ventilating and Defogging System

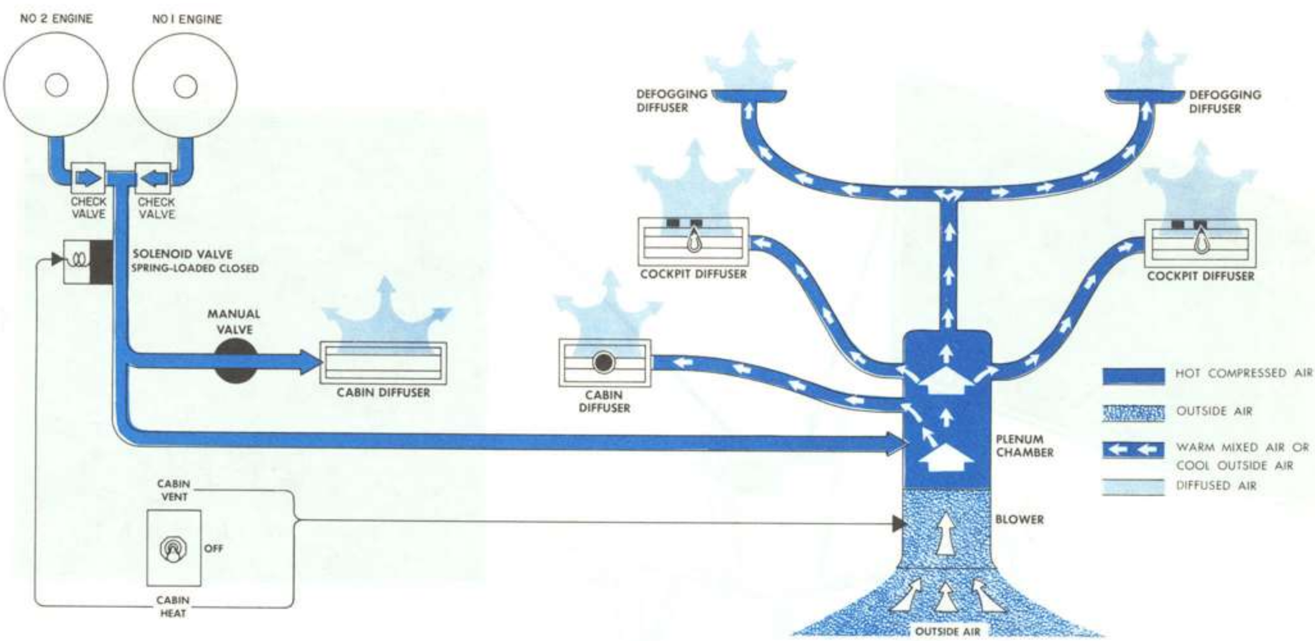


Figure 1–60

Cabin Heating and Ventilating Switch.

A 3-position (CABIN VENT, OFF, CABIN HEAT) switch (1, figure 1–61), located on the heat and miscellaneous panel, is used to select heated air, or unheated ventilating air. With the switch in CABIN HEAT position, power is supplied to the solenoid valve and to the fan releasing heated air to the system, and drawing outside air into the system. Electrical power for the solenoid valve is supplied from the 28-volt dc monitor bus through the CABIN HEAT VALVE fuse on the fuse and circuit breaker panel (figure 1–31). Power for operating the fan is supplied from the 115-volt ac monitor bus through the CAB HT FAN circuit breaker (or three fuses). In CABIN VENT position, the fan operates independently of the heating system, circulating unheated outside air. In the OFF position the equipment is inoperative.

Diffuser Valves.

All the diffusers except the side window defogging diffusers are equipped with valves that may be used to regulate the flow of air at that location. The side window defogging diffusers are open at all times and are not adjustable.

NORMAL OPERATION.

Place the heating and ventilating switch as desired. Adjust diffuser valves to obtain desired air flow. To increase flow of defogging air, close cockpit and cabin diffusers.

PILOTS' SUIT VENTILATING SYSTEM

The suit ventilating system consists of two blowers, mounted on the bulkhead behind the pilots' seats. Cabin air is drawn into the blowers and expelled through hoses that can be connected to the pilot's anti-exposure suits. Power for the blowers is provided from the 115-volt ac monitor bus through the PILOT'S SUIT VENT and COPILOT'S SUIT VENT circuit breakers. The blowers are turned on and off by use of two suit vent switches on miscellaneous control panel (figure 1–61).

ROTOR DEICING SYSTEM

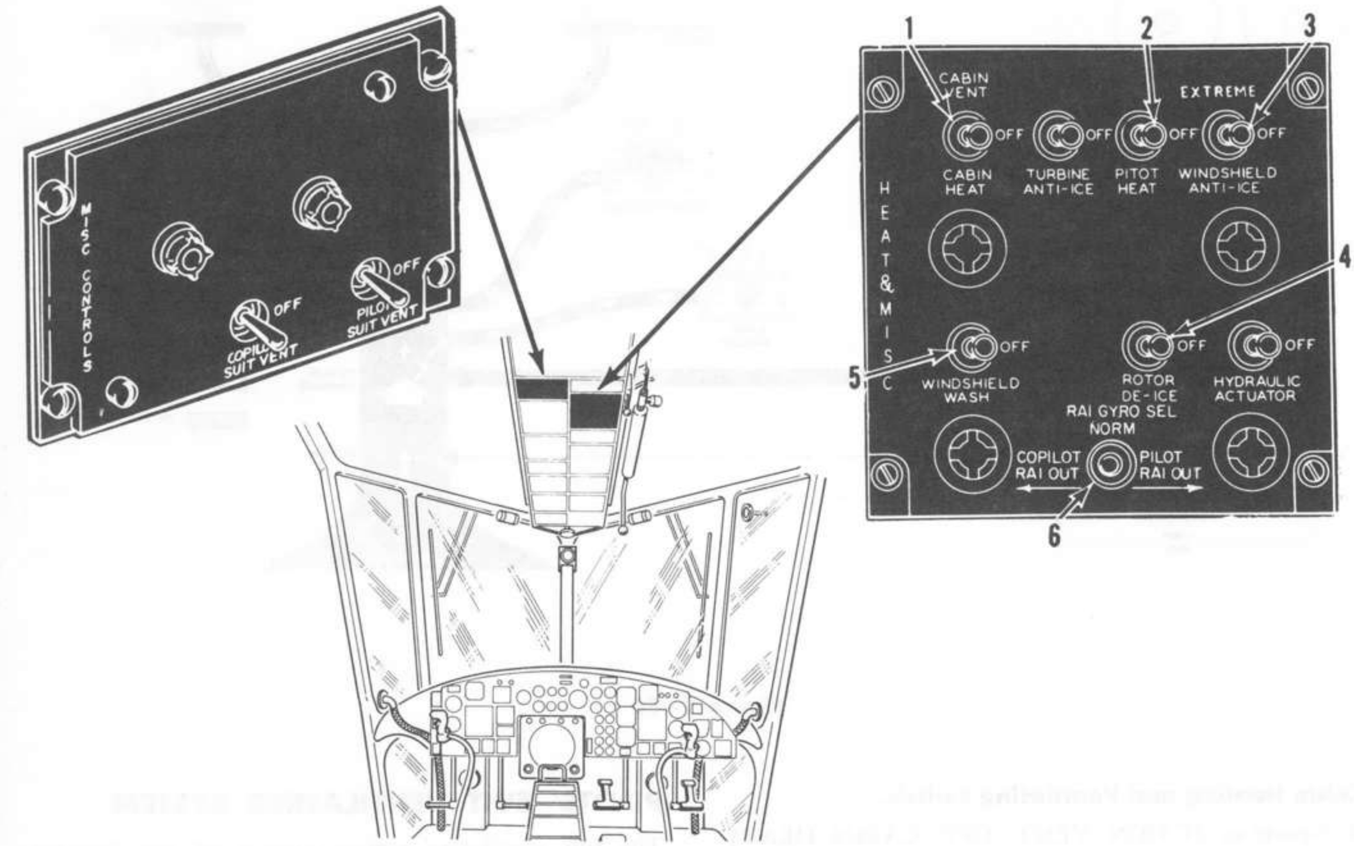
DESCRIPTION.

Deicing of the main rotor blades is accomplished electrically. Resistance-type heating elements are located just below the top surface of each rotor blade near the leading edge. Application of electrical power to the rotor deicing system is controlled by the rotor deice switch.

Rotor Deice Switch.

The rotor deice switch (4, figure 1–61) is located on the heat and miscellaneous panel on the cockpit ceiling. The switch positions are ON (ROTOR DEICE) and OFF. When the switch is in the ON position, the outside air temperature is detected by a sensor located in the lower aft fuselage. A signal from the sensor then calls for a long or short time interval (depending on the temperature) from a timer and relay located in the aft cabin

Heat and Miscellaneous Panels



1. CABIN HEATING AND VENTILATING SWITCH
2. PITOT HEAT SWITCH
3. WINDSHIELD ANTI-ICE SWITCH
4. ROTOR DEICE SWITCH
5. WINDSHIELD WASHER SWITCH
6. GYRO OUT SWITCH

Figure 1—61

ceiling. During this interval, ac power flows through a rectifier, where it is converted to dc, and then to a stepping switch on the main rotor hub, from which it is distributed to heating elements in each rotor blade. There are eight heating elements in each rotor blade. During any single time interval, only one heating element in each of two opposing blades receives power. At the beginning of each time interval, the stepping switch moves to a new position and distributes power to one element in each of the other two blades. In this way power is distributed, in automatically measured amounts, to all of the heating elements in the four blades. When icing conditions are not anticipated, the control should be placed in the OFF position. Electrical power for deicing is provided from the number 2 generator bus through three rotor blade deicing (ROTOR BLADE DEICE) circuit breakers. Power for the control components is provided from the 28-volt dc primary bus through the rotor blade deice control (ROTOR BLADE DEICE) circuit breaker.

NORMAL OPERATION.

The rotor deice switch should be placed in the ON position, whenever icing conditions prevail or are anticipated. Refer to Section VI.

WINDSHIELD ANTI-ICING SYSTEM

DESCRIPTION.

The laminated windshield installation incorporates electrical resistance heating units to prevent the formation of fog or ice. Bus bars in the top of each windshield panel introduce current to an electrically conductive lamination, which internally heats the entire glass area. With the system energized, when windshield temperatures fall below 85° F (29° C), thermostats attached to the windshields automatically activate the control relay, sending electric current through the windshields. The thermostats stop current flow when the windshield temperature reaches 100° F (38° C) and act as overheat limiters when necessary.

Windshield Anti-Ice Switch.

A 3-position switch (3, figure 1–61) is used to operate the windshield anti-ice system. It is located on the heat and miscellaneous panel on the cockpit ceiling. With the switch in NORMAL position, the heating element voltage is approximately 115 volts. With the switch in EXTREME position, the voltage is boosted from 115 volts to 200 volts, thereby increasing the rate at which heat is applied to the glass.

CAUTION

Use EXTREME heat only after attempts to de-ice in the NORMAL position have failed because of severe icing conditions. Use of the EXTREME position without previous use of the NORMAL position may crack the windshield.

OFF position cuts off all current to the windshield. Electric power for energizing the two control relays comes from the 28-volt dc monitor bus through two WINDSHIELD HEAT fuses on the fuse and circuit breaker panel. Power for energizing the windshield heating elements comes from the 115-volt ac monitor bus, through two WINDSHIELD HEAT circuit breakers on the fuse and circuit breaker panel.

PITOT HEATER AND SWITCH

The pitot heater is an electrical resistance heating unit designed to prevent or eliminate icing in the pitot tube. The heating unit is incorporated directly into the structure of the pitot tube. The pitot heater is turned ON (PITOT HEAT) and OFF by a 2-position switch (2, figure 1–61) located on the heat and miscellaneous panel on the forward cabin ceiling. Power to operate the heating unit is supplied from the lighting bus through the PITOT HEAT circuit breaker on the fuse and circuit breaker panel (figure 1–31).

MISCELLANEOUS EQUIPMENT

CORRECTION CARDS.

Two airspeed indicator correction cards (4 and 41, figure 1–9) are located on the instrument panel. The copilot's MA-1 compass correction card is mounted on the left side of the instrument panel. The pilot's MA-1 compass correction card is located on the windshield center column.

A standby compass correction card is mounted on the center windshield post directly under the standby compass.

RELIEF TUBES.

Relief tubes are installed under the pilot's and copilot's seats.

WARNING

When stowing relief tube horn after use, make sure that the horn is fully engaged in its bracket by the click which indicates full engagement. This is to preclude the possibility of the horn falling free and interfering with cockpit controls.

PLOTTING BOARD.

A plotting board is mounted on the cockpit ceiling above the copilot's seat.

DATA CASE.

The data case is located above the copilot's seat on the the bulkhead.

CHECKLIST.

A takeoff and landing checklist is mounted on either side of the instrument panel.

PART 3 AIRCRAFT SERVICING

MOORING REQUIREMENTS

Wind 0 to 50 knots – Blades spread, not booted.
Wind 50 to 65 knots – Blades spread, booted.
Wind over 65 knots – Blades folded.
Refer to NAVAIR 01-260HCB-1C for mooring instructions.

AIRCRAFT FUELING AND SERVICING

CREW AND TRUCK.

Only authorized and qualified personnel will be permitted to operate fueling equipment. The plane captain will be responsible for fueling his aircraft after each flight. He will make a visual check to insure the proper fuel is used. During fueling process, loose pyrotechnics, smoking, striking matches, working on aircraft or the use of any device producing flame within 50 feet of the aircraft or truck are strictly prohibited.

POSITION OF AIRCRAFT AND TRUCK.

The aircraft should not be located in the vicinity of possible sources of ignition such as blasting, drilling, or welding operations. A minimum of 50 feet should be maintained from other aircraft or structures and 75 feet from any operating radar set.

GROUNDING.

Prior to fueling, grounding devices on aircraft and drag chains on trucks will be inspected by fueling personnel for proper ground.

ELECTRICAL HAZARD.

Battery switch may be left ON to monitor the fuel totalizer. Turn off all radio switches and electrical equipment in aircraft. Check that no electrical apparatus, supplied by outside power (electrical cords, droplights, floodlights, etc.) is in or near the aircraft. For night fueling, safety flashlights instead of aircraft lights shall be used.

ATTACHING WIRE CLAMP.

Before removing the tank filler caps, the hose nozzle grounding attachment must be connected to a metal part of the aircraft at a safe distance from the filler openings and tank vents.

FIRE EXTINGUISHERS AND ATTENDANT.

During fueling, a secondary operator or assistant plane captain will man a CO_2 hand extinguisher with a second extinguisher readily available.

FILLER CAPS.

The filler cap of one fuel tank at a time will be removed. It must be replaced immediately after that tank is filled and before removing the cap of the other tank. If dual fuel equipment with a full complement of trained personnel is available, an exception to the above rule may be made. During pressure fueling it is recommended that filler caps be loosened to prevent damage to tanks in the event of failure of high level limit switch.

PRESSURE FUELING TO A PARTIAL FUEL LOAD.

When less than a full internal fuel load is desired, the fuel should be shut off at the precheck panel, and the fuel quantity gage monitored to insure that the shutoff valve closes. This should prevent the possibility of loss of transfer from the aft tank if the shutoff valve is jammed open by a foreign object.

FUEL AND OIL SPECIFICATION.

(See figure 1–62.)

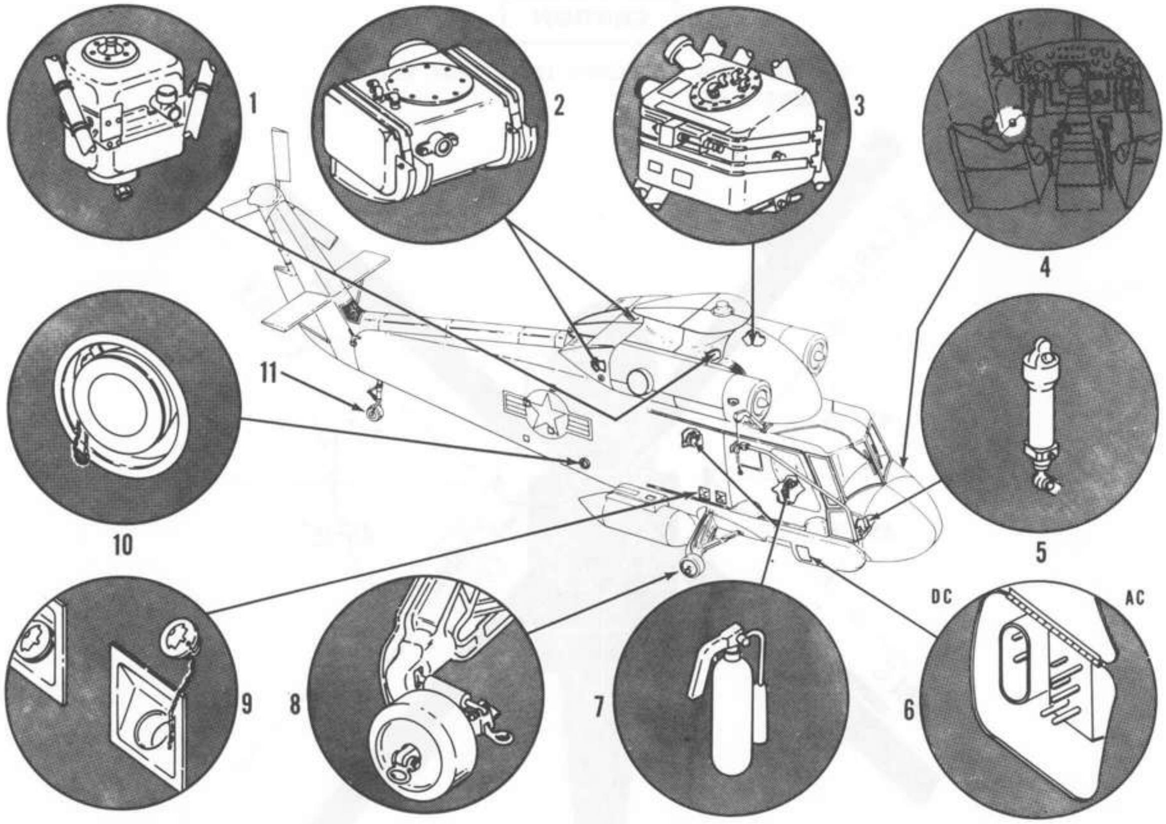
WARNING

Oil, Specification MIL-L-7808, contains toxic additives. Avoid ingestion, contact with skin and mucous membranes, or inhalation of vapors. Decontaminate promptly if contact occurs.

CAUTION

It is not necessary to drain the aircraft fuel system when changing from one type of approved fuel to another (JP-4, JP-5). However, it must be borne in mind that the fuels differ as to volatility and BTU output (JP-4 more volatile, less BTU/GAL. than JP-5) so that fuel control and flow divider adjustments differ for the two fuels. For off-base refueling, where it may not always be practicable to make these adjustments when changing fuel types, the information in figure 1–62 is provided:

Servicing Diagram



1. HYDRAULIC SYSTEM SPEC MIL-H-5606B
2. ENGINE OIL SPEC MIL-L-23699
3. TRANSMISSION OIL SPEC MIL-L-23699
4. WINDSHIELD WASHER
5. WHEEL BRAKES SPEC MIL-H-5606
6. EXTERNAL POWER RECEPTACLES: DC, 28 VOLTS, 750 AMPS CONTINUOUS, 1000 AMPS INTERMITTENT AC, 115/200 VOLTS, 400 CPS, 3 PHASE, 6 PIN STANDARD CONNECTOR (Y CONNECTED GROUNDED NEUTRAL)
7. FIRE EXTINGUISHER CO_2
8. MAIN WHEELS, TIRE PRESSURE 250 PSI
9. FUEL FILLERS JP-4 OR JP-5
10. SINGLE-POINT FUEL, DEFUEL JP-4 OR JP-5
11. TAILWHEEL, TIRE PRESSURE 160 PSI

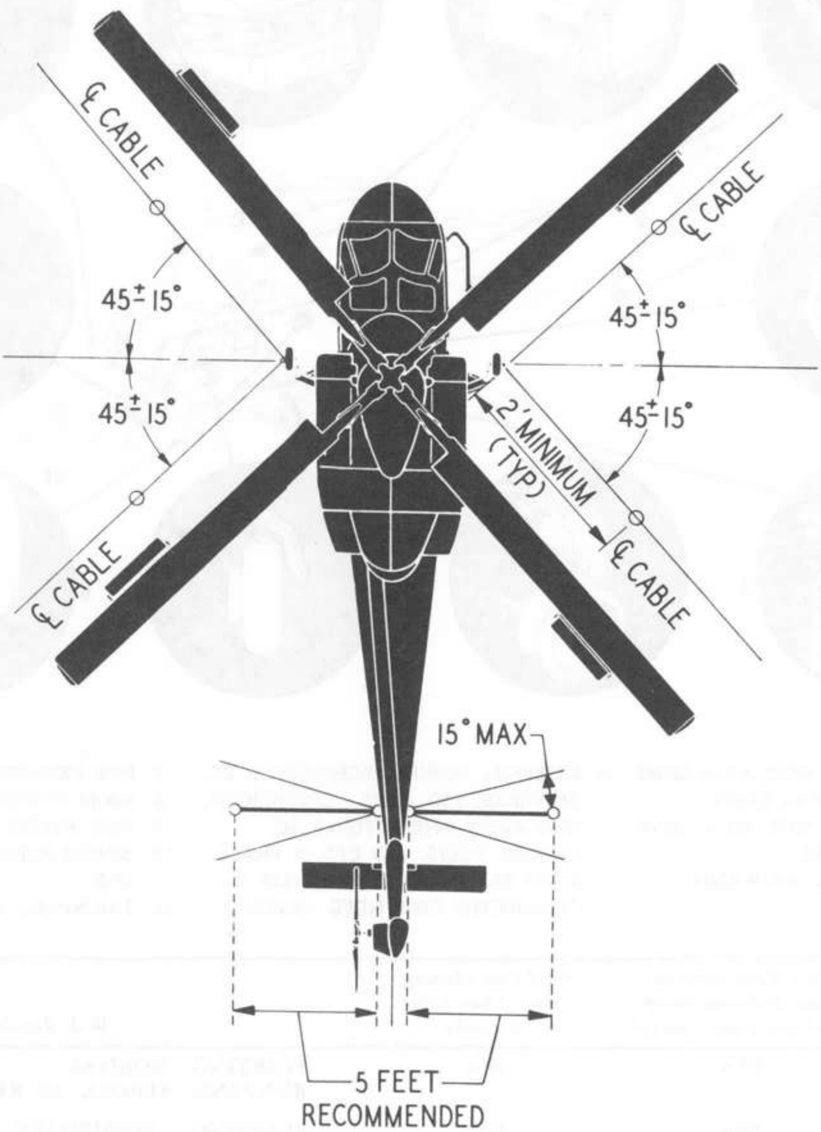
Fuel Control Flow Divider Set for:	*Fuel Remaining in Lines Between Sump Tank and Fuel Control*	*Fuel Constituting More Than 50% in Tanks*	*Will Result in:*
JP-5	JP-5	JP-4	STARTING: NORMAL RUNNING: APPROX. 1% REDUCED MAX. POWER
JP-5	JP-4	JP-4	STARTING: POSSIBILITY OF "HOT START," ESPECIALLY IF APU IS WEAK. IF BATTERY START BEING USED, WILL REQUIRE CLOSER MONITORING OF STARTING FUEL RUNNING: APPROX. 1% REDUCED MAX. POWER
JP-4	JP-4	JP-5	STARTING: NORMAL RUNNING: POSSIBILITY OF OVERTEMPERATURE OPERATION. REQUIRES CLOSE MONITORING OF T_5 TEMPERATURES
JP-4	JP-5	JP-5	STARTING: POSSIBILITY OF "COLD HANGUP," ESPECIALLY AT COLD TEMPERATURES. RUNNING: POSSIBILITY OF OVERTEMPERATURE OPERATION. REQUIRES CLOSE MONITORING OF T_5 TEMPERATURES

Figure 1—62

Shipboard Prelaunch Tiedown

CAUTION

DO NOT RIG TIEDOWN LINES TAUT, BUT DO REMOVE SLACK.



MAIN LANDING GEAR TIEDOWNS:

1. REQUIRED FOR ALL OPERATIONS.
2. INCLUDED ANGLE BETWEEN THE TWO TIEDOWNS ON EACH MAIN GEAR SHOULD BE APPROXIMATELY 90°.
3. DISTANCE BETWEEN AXLE TIEDOWN RING AND DECK ATTACHMENT IS TO BE AT LEAST 2 FEET.

CAUTION

TOW RINGS LOCATED INBOARD OF LANDING GEAR SHOULD NOT NORMALLY BE USED AS TIEDOWN RINGS.

TAIL TIEDOWNS:

TAIL TIEDOWNS WILL BE ADDED WHEN THE RELATIVE WIND FROM THE LATERAL QUADRANTS EXCEEDS 30 KNOTS AND/OR THE RELATIVE WIND FROM THE FORWARD AND AFT QUADRANTS EXCEEDS 45 KNOTS.

Figure 1—63

Turning Radius and Minimum Ground Clearance

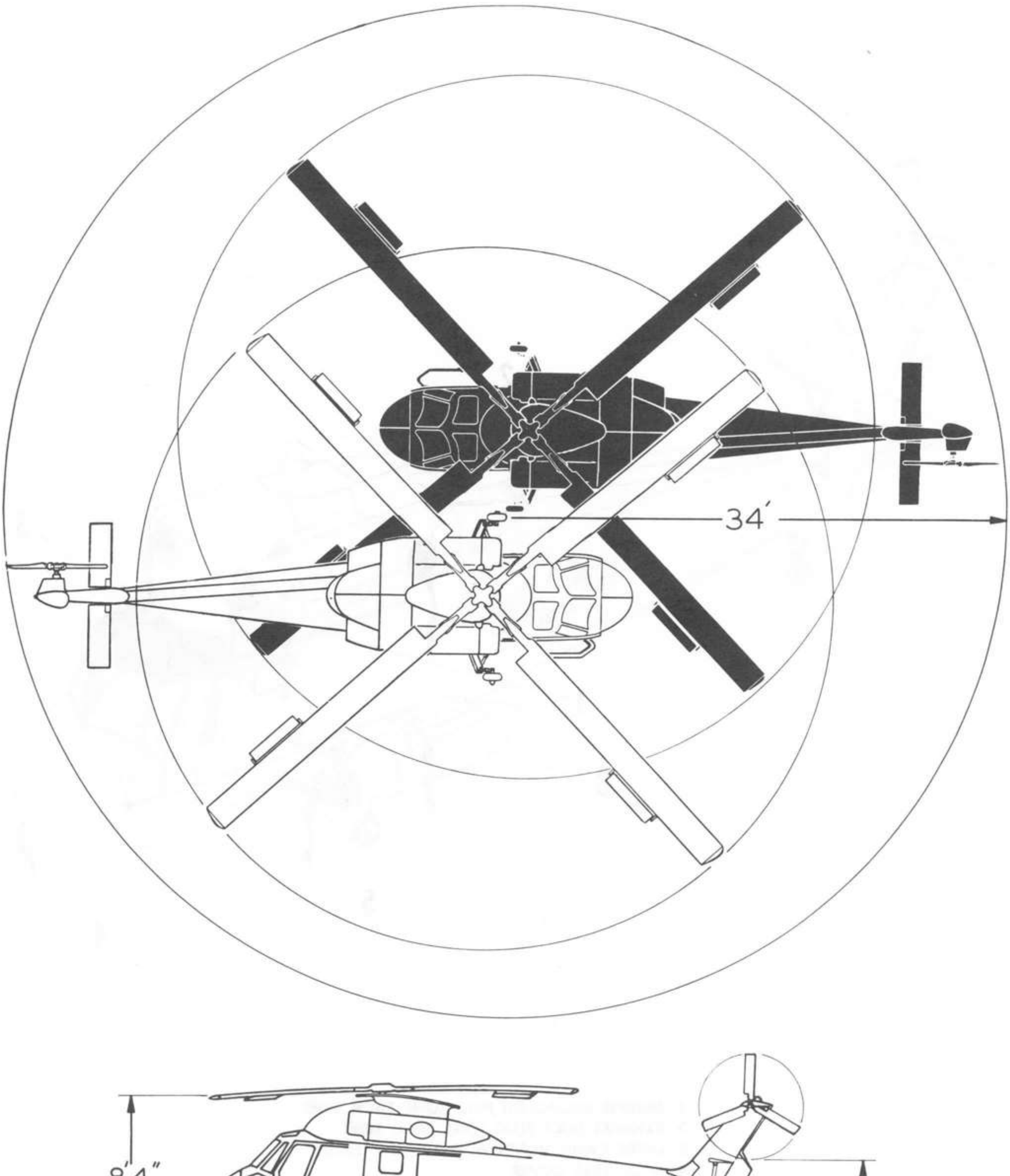
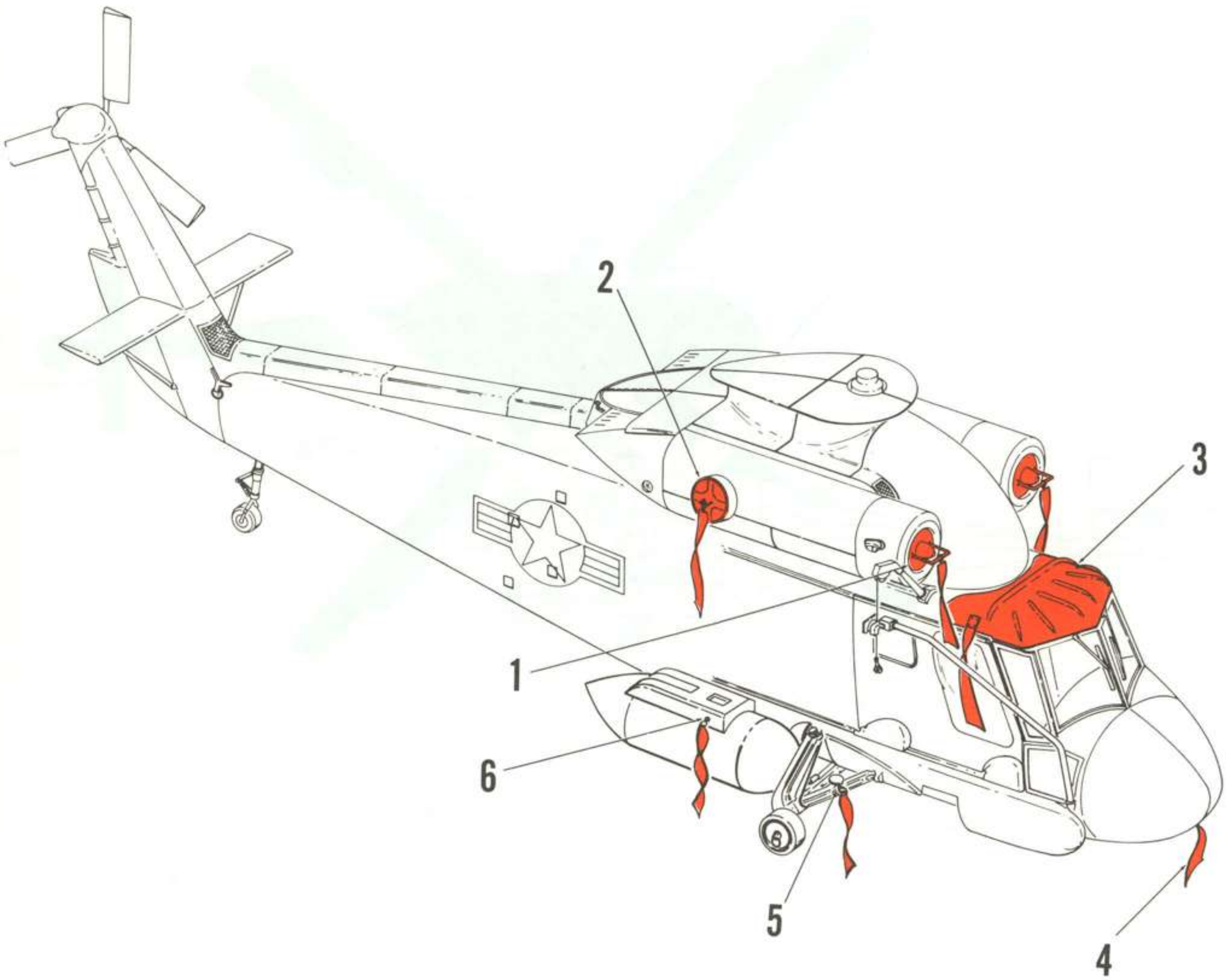


Figure 1—64

Ground Safety Equipment



1. ENGINE BELLMOUTH PLUG (ONE EACH SIDE)
2. EXHAUST DUCT PLUG (ONE EACH SIDE)
3. UPPER CABIN WINDOW PROTECTIVE SHIELD
4. PITOT TUBE COVER
5. LANDING GEAR GROUND SAFETY PINS (ONE ON EACH SIDE)
6. AUXILIARY FUEL TANKS SAFETY PINS (ONE EACH SIDE)

Figure 1—65

Danger Areas

EQUAL POWER SHARING 750 HP/ENGINE

TEMPERATURE — DEGREES FAHR.

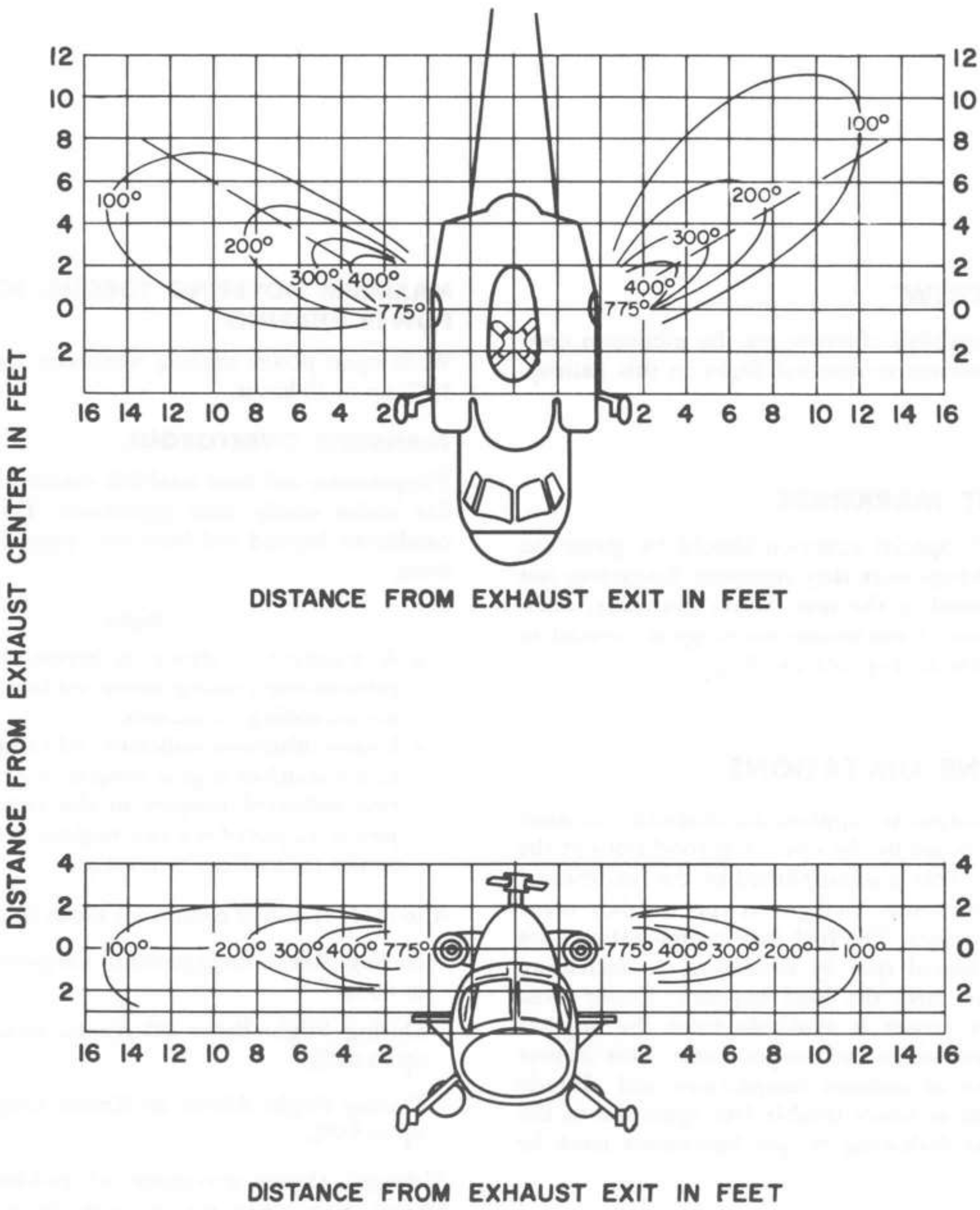


Figure 1—66

PART 4 OPERATING LIMITATIONS

MINIMUM CREW

A pilot and a qualified observer are the minimum crew required for a normal nontactical flight in this helicopter.

INSTRUMENT MARKINGS

See figure 1–67. Special attention should be given the instrument markings since they represent limitations not necessarily repeated in the text. When necessary, additional explanation of instrument markings is covered in the text under the appropriate heading.

DUAL ENGINE LIMITATIONS

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 units which sense minor changes in rpm as they occur due to load variations. The fuel flow compensation thus maintains the desired rpm by increasing or decreasing engine power to meet the load imposed. Under most conditions more power is available from the engines than is permitted within the torque limits. This insures full performance as ambient temperature and altitude increase. In order to assure trouble free operation of the drive system the following torque limitations must be adhered to.

NORMAL TORQUE RANGE, EQUAL POWER SHARING, FORWARD FLIGHT.

In forward flight above 20 knots with equal power sharing (needles married) the engines can be operated continuously up to 47% torque output, providing the tachometer readings are kept within operating limits.

MAXIMUM HOVERING TORQUE, EQUAL POWER SHARING.

With equal power sharing maximum hovering torque is 53% up to 20 knots.

TRANSIENT OVERTORQUE.

Torquemeter red lines establish maximum limits for long life under steady state conditions. However, transient conditions beyond red lines may occur in normal operations.

Note

- A transient condition is herein defined as a torquemeter reading above red line for a period not exceeding 10 seconds.
- Unless otherwise indicated, all torques referred to are matched engine torques or average of the two indicated torques in the case where the power output of the two engines is not matched at the time of the overtorque.

Allowable *transient* conditions are as follows:

During Rotor Engagement: torquemeter reading up to 60%.

During Flight Below 20 Knots: torquemeter reading up to 60%.

During Flight Above 20 Knots: torquemeter reading up to 55%.

Although abrupt movement of rudder pedals is prohibited, such action may at times be necessary in emergency. Under these conditions, transient increases of indicated torque will occur which can approach tail rotor drive limits without exceeding torquemeter red lines. The magnitude of change in torquemeter reading, following a rapid pedal input, is related to the torque absorbed by the tail rotor.

Tail Rotor Transient: 25% above steady state or 50% if operating on single engine.

Exceeding any of the above limits is an overtorque.

WARNING

Report both the amount and duration of all overtorque and overspeeds. This will enable maintenance and overhaul personnel to evaluate the need for replacement of drive system components.

SPEED DECREASER GEAR OIL (OUT) OVERTEMPERATURE.

Excessive speed decreaser gear oil (out) temperature may damage the sleeve bearing in the speed decreaser gearbox. Report the extent and duration of all overtemperatures. If the temperature exceeds 127° C for more than 1 minute, or if the temperature exceeds 135° C, the gearbox must be overhauled. If the temperature rises to between 127° C and 135° C for less than 1 minute, the gearbox must be inspected in accordance with the Handbook of Service Instructions.

SINGLE ENGINE LIMITATIONS

The following limitations apply to the operation of each engine alone and do not represent power limitations for two-engine operation.

ENGINE SPEED.

Power Turbine Speed.

Maximum power turbine speed (N_f) is 106 percent as limited by maximum rotor speed.

Gas Generator Speed.

Maximum gas generator speed (N_g) is 100 percent. Minimum gas generator speed for steady state operation is ground idle speed. Ground idle speed will normally vary between 52% to 60% dependent upon outside air temperature.

TURBINE INLET TEMPERATURE (T_5).

Starting Engine Temperature Limitations.

Momentary peaks of turbine inlet temperatures to 950° C are permitted on start. Repeated occurrences require troubleshooting. Duration and amount of temperatures over 780° C must be reported.

Normal Power Range.

Normal power turbine inlet temperature (300 to 635° C) is that power at which the engine can be operated continuously.

Military Power Range.

Military power range is 635 to 677° C turbine inlet temperature. Use of military power range is limited to 30 minutes duration per flight.

Maximum Military Power.

Maximum turbine inlet temperature for periods of not over 30 minutes duration is 677° C.

Note

- Turbine inlet temperatures of 677° C to 780° C are permitted for transient periods of not over 20 seconds.

ENGINE TORQUE.

Maximum engine torque is 83% as limited by the speed decreaser gearbox for all phases of operation including rotor engagement on one engine.

ROTOR LIMITATIONS

STARTING AND STOPPING ROTOR.

See figure 3–15 for maximum relative wind velocity for starting and stopping the rotors. Starting rotors with an accumulation of ice on the blades is prohibited.

ROTOR SPEED.

Powered Flight.

During powered flight rotor speed (N_r) shall be maintained within the following limits:

0 to 100 knots IAS – 98% to 102% rpm

over 100 knots IAS – 100% to 102% rpm

Autorotation.

During autorotation, rotor speed (N_r) shall be maintained within the range of 85% to 106% rpm.

ROTOR OVERSPEED.

All rotor overspeeds in excess of 106% will be reported. Inspection and replacement of various rotor and drive system components must be accomplished in accordance with the Handbook of Maintenance Instructions, NAVAIR 01-260HCA-2-4.2.

Instrument Markings

FUEL GRADE JP–4, JP–5

MAIN GEARBOX OIL TEMPERATURE

- 50 TO 127°C DESIRED
- 127°C MAXIMUM

COMBINING GEARBOX OIL TEMPERATURE

- 50 TO 127°C DESIRED
- 127°C MAXIMUM

SPEED DECREASER GEAR OIL(OUT) TEMPERATURE

- 50 TO 127°C DESIRED
- 127°C MAXIMUM

ENGINE OIL (IN) TEMPERATURE

- 70 TO 103°C DESIRED
- 120°C MAXIMUM

TURBINE INLET TEMPERATURE(T_5)

- 677°C MAXIMUM FOR NOT OVER 30 MINUTES
- 300°C TO 635°C NORMAL
- 635°C MAXIMUM FOR CONTINUOUS OPERATION

MAIN GEARBOX OIL PRESSURE

- 20 PSI MINIMUM
- 25 TO 60 PSI DESIRED
- 75 PSI MAXIMUM

SPEED DECREASER GEAR OIL PRESSURE

- 8 PSI MINIMUM
- 20 TO 60 PSI DESIRED
- 100 PSI MAXIMUM

COMBINING GEARBOX OIL PRESSURE

- 20 PSI MINIMUM
- 25 TO 60 PSI DESIRED
- 75 PSI MAXIMUM

ENGINE OIL PRESSURE

- 10 PSI MINIMUM
- 15 TO 45 PSI DESIRED
- 60 PSI MAXIMUM

Figure 1–67 (Sheet 1)

Instrument Markings

FUEL GRADE JP-4, JP-5

GAS GENERATOR TACHOMETER(Ng)

- 53% TO 100% DESIRED
- 100% MAXIMUM

HYDRAULIC PRESSURE

- 1350 TO 1600 PSI DESIRED
- 1600 PSI MAXIMUM

DUAL TORQUEMETER

- 20% TO 47% NORMAL OPERATION, EQUAL POWER SHARING, FORWARD FLIGHT ABOVE 20 KNOTS
- 53% MAXIMUM, EQUAL POWER SHARING BELOW 20 KNOTS AND HOVER
- 83% MAXIMUM, SINGLE ENGINE FLIGHT

TRIPLE TACHOMETER

Nr

- 85% MINIMUM FOR AUTOROTATION
- 85–106% AUTOROTATION 98 TO 102% CONTINUOUS POWERED FLIGHT
- 106% MAXIMUM

Nf

- 98 TO 102% CONTINUOUS OPERATION
- 106% MAXIMUM

AIRSPEED

- 150 KNOTS MAXIMUM

Figure 1–67 (Sheet 2)

AIRSPEED LIMITATIONS

Maximum indicated airspeeds for flight in smooth air or light turbulence, with ASE on or off, are as follows:

Landing Gear Up

Forward Flight – As determined by figure 4–1.

Sideward Flight – 35 knots

Rearward Flight – 30 knots

Landing Gear Down – 110 knots.

Landing Gear Retraction – 110 knots.

Landing Gear Extension – 100 knots.

Fuel Dumping – From a minimum of 30 to a maximum of 40 knots, in forward flight only, and over uninhabited area if possible. If the operational situation dictates, emergency dumping can be safely accomplished at speeds outside this envelope except in an autorotation, gliding flight, or a hover in ground effect.

Jettisoning Auxiliary Fuel Tanks – From a minimum of zero, to a maximum of 135 knots, in hover or straight forward flight, either powered or in autorotation. Tanks may be jettisoned regardless of fuel quantity.

Autorotation Entry – The airspeed and altitude combinations in the shaded areas of figure 1–68 should be avoided during powered flight, if possible.

Doors full open – 100 knots.

First stop – 115 knots.

Closed – Maximum speed.

Cargo door – Closed above 100 knots.

ROTOR AND ENGINE SPEED INFORMATION

Item	*Speed*	*Remarks*
ROTOR RPM (N_r) ON TRIPLE TACHOMETER	98 – 102%	Continuous powered flight limitation range
	85 – 106%	Autorotation limitation range
	106%+	Abnormal overspeeding condition – This RPM typical of electric throttle hardover in UP direction with full down collective pitch
	113%+	Severe emergency – Yellow flag appears in left window on overspeed recorder
	122%+	Rotor badly overstressed – Must be removed – Yellow flag appears in right window
POWER TURBINE RPM (N_f) ON TRIPLE TACHOMETER	98 – 102%	Continuous power flight limitation range
	121.8% (Unloaded)	Maximum
	121.8%+	Overspeed – Possible power turbine rotor overstress
		NOTE – Report degree and duration of overspeed
	123% Approx.	Fuel control overspeed shutoff actuates. Engine may or may not relight as overspeed decelerates.
GAS GENERATOR RPM (N_g) FROM N_g TACHOMETER	100%	Maximum N_g unless limited by turbine inlet temperature (T_5)
	100 – 106%	Overspeed – No action required
	106%+	Overspeed – Possible compressor and turbine overstress
		Report degree and duration of overspeed

SPEED OF DRIVE TRAIN COMPONENTS

Main Rotor In % N_r	*Actual N_r*	*Power Turbine N_f*	*Speed Decreaser Output*	*Combining Box Output*	*Tail Rotor Drive Shaft*	*Tail Rotor*
106	298	20150	6190	6360	3220	1780
104	292	19715	6066	6240	3158	1742
102	287	19336	5950	6120	3122	1712
100	281	18957	5833	6000	3060	1675
98	275	18578	5716	5860	3000	1642
96	270	18199	5600	5750	2950	1608

PROHIBITED MANEUVERS

The following maneuvers are not permitted:

1. Acrobatic flight.
2. Abrupt movement of the flight controls.
3. Bank angles greater than 45°.
4. Turns at a rate in excess of 24° per second.
5. Sideslip angles in excess of those shown in figure 1–68.
6. Practice full autorotation landing unless gross weight is 10,000 pounds or less, N_r is maintained at 96-100% and a UH-2C plane commander is in the cockpit.
7. Practice autorotation landings on rough terrain.
8. Intentional approaches to or inducement of retreating blade stall.

ACCELERATION LIMITATIONS

The maximum permissible accelerations for flight in smooth air or light turbulence are shown in figure 1–69. When flying in conditions of moderate turbulence it is essential that the accelerations resulting from deliberate maneuvers be reduced below that determined from figure 1–69. This is to minimize the possibility of exceeding the design limits due to the combined effects of gust and maneuvering loads.

HOVERING LIMITATIONS

Do not hover so that the relative tail wind exceeds 30 knots, as abrupt movement of the directional pedals may be required to maintain heading.

The directional controllability in hover varies with rotor rpm. At low rotor speed the resulting increased main rotor torque will increase the requirement for left pedal input. "On the spot" hover turns to the right require more technique on the part of the pilot to control the rate of turn than do hover turns to the left. More rudder input is required to initiate a turn than to sustain it, especially when turning to the left. If main rotor torque is increased during a hover turn to the right or if winds cause an increased rate of turn, there may be insufficient left pedal response to promptly stop rotation when operating at low rotor rpm. Directional control effectiveness decreases with decreased rotor rpm.

CAUTION

Minimum beep rpm will provide marginal directional control for turns-on-a-spot in winds above 10 knots and during right sideward flight. Maintain 100-102% N_r to assure adequate left rudder control.

HOVERING OVER SALT WATER

Salt spray ingestion in the engine will result in a loss in performance as well as a loss in compressor stall margin. This reduction in stall margin makes the engine susceptible to stalls particularly during decelerations. As the spray is ingested and strikes the compressor blades and stator vanes, salt is deposited. The resulting buildup gradually changes the airfoil sections which in turn affects performance. This deterioration will be noticed as an increase in T_5 for a given torque. Should the deterioration reach a point where the compressor acutally stalls, a muffled explosive sound will be heard, T_5 will rapidly overtemp, while N_g and torque decrease rapidly. Although these salt encrustation type stalls do generally occur during conditions of N_g deceleration, compressor surges can occur at steady state power or during acceleration. A surge, partial stall, is characterized by one or more muffled but quite discernible explosions or pops without attendant loss of T_5 or power, Natural pilot reaction is to immediately lower collective following a noise of this type; however, as deceleration precipitates the stall, the most beneficial pilot action would be to hesitate momentarily. If only a surge has occurred, chances are good that power will be retained as long as the engine or engines are not decelerated. The circumstances under which power deterioration may occur during salt water operation vary with a number of factors, the most significant of which are wind velocity and hover altitude as follows:

1. The rate of salt buildup in the engines is greatest in winds of 8 to 12 knots. In this condition there are white caps on the water with the result that a moderately heavy salt spray is lifted off the water. The salt forms a relatively well defined torus about the aircraft, the forward portion of which is blown back to the immediate vicinity of the engine inlets and windshield.
2. At wind velocities of 15 to 20 knots and higher, salt spray is generated but it is blown aft underneath the engines so that the rate of salt buildup is small.
3. For a given wind condition the rate of salt buildup varies in a non-linear manner with hover altitude. At 30 feet there is generally no significant buildup regardless of wind condition. The change in rate of buildup is moderate down to 15 or 20 feet. As the altitude is lowered further, the rate of salt buildup increases. However, even at altitudes as low as 5 feet, the winds usually have to be in the range of 8 - 12 knots to cause a rapid deterioration of engine performance and stall margin due to salt spray.

CAUTION

Take note of windshield spray deposits. The amount of salt water spray observed on the windshield is usually the best indication of the salt spray environment to which the engines are being subjected. If the spray on the windshield is sufficient to require use of the windshield wipers, the engines are receiving a very significant amount of salt water. In this condition, deteriorating performance and reduction of stall margin is quite certain, thus an increase in altitude is recommended.

In the event that hovering is necessary in the above conditions the best indication of performance and stall margine loss is the relationship between T_5 and torque.

A T_5 increase of 30 to 40°C. for the same torque represents the maximum deterioration that can be accepted without complete loss of stall margin on those engines which have marginal stator vane scheduling and/or compressor condition. Therefore, in a severe salt spray environment, the time for a deterioration of this magnitude may not exceed 3 to 4 minutes.

WARNING

When the stall margin is entirely lost due to salt encrustation, relatively minor power reduction can cause the near simultaneous loss of power from both engines.

In the event that maximum loss of stall margin is suspected, increase collective and commence a climb out, ensuring that the engines do not decelerate. Do not beep down or lower collective. Without reducing power, proceed to point of intended landing. When the aircraft has been favorably positioned for an emergency landing, check the condition of each engine by beeping down individually to check for deceleration stalls. Be prepared for engine deceleration stall.

Note

Continued engine operation in clean air may dissipate some of the salt buildup but this cannot be assured. Flight through rain may also be beneficial in reducing salt buildup thereby improving stall margin. Engines should be washed after each over-salt-water flight under 30 feet and daily after each over-salt-water flight at 30 feet or above.

MINIMUM HEIGHT FOR SAFE LANDING AFTER DUAL ENGINE FAILURE

Figure 11—19 indicates the altitude and airspeeds from which a safe power-off landing is difficult to perform. Intentional autorotations should not be entered from any speed-altitude condition within the shaded areas of figure 11—19. The negative airspeeds indicated may be a result of rearward flight, a tailwind, or a combination of the two.

CENTER OF GRAVITY LIMITATIONS

To assure adequate control, the helicopter shall be loaded so that the center of gravity is between stations 160.0 and 173.0. For information on how to determine the center of gravity for any load condition, refer to the Handbook of Weight and Balance, AN 01-1B-40.

WEIGHT LIMITATIONS

Maximum gross weight for all operations is 11,614 pounds. See figure 11—7 for maximum weight for vertical takeoff and hovering out-of-ground effect as limited by maximum permissible torque.

CARGO HOOK LOADS.

Loads attached to the cargo hook shall not exceed 4000 pounds; load angles shall not be greater than 20 degrees from vertical.

RESCUE HOIST LOADS.

Loads attached to the rescue hoist without use of the fishpole shall not exceed 600 pounds. When raising the hook with no load, the cable should be hand-guided as the hook approaches the up limit, to prevent swinging or whipping of the cable. Such swinging or whipping could cause damage and would subject the cable to unnecessary strain.

Sideslip Angle Limitation

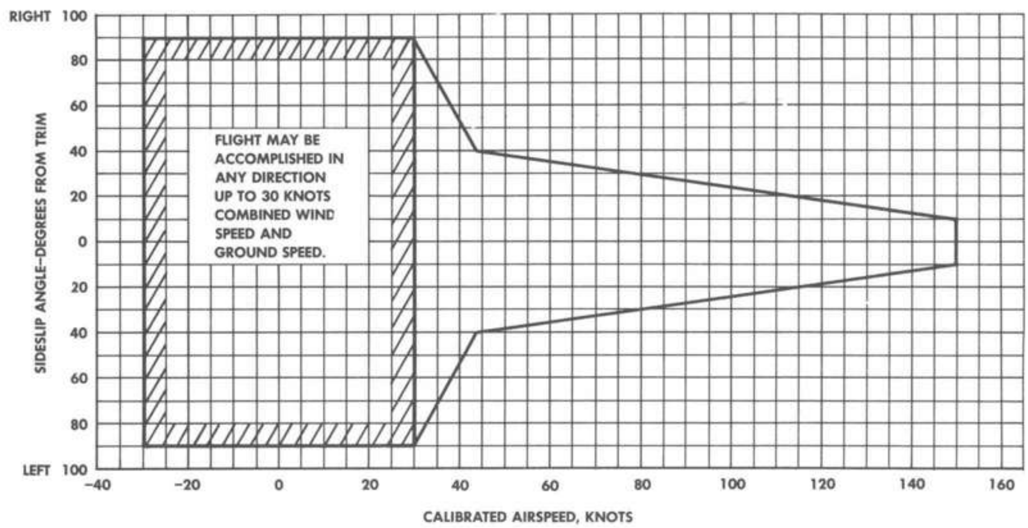
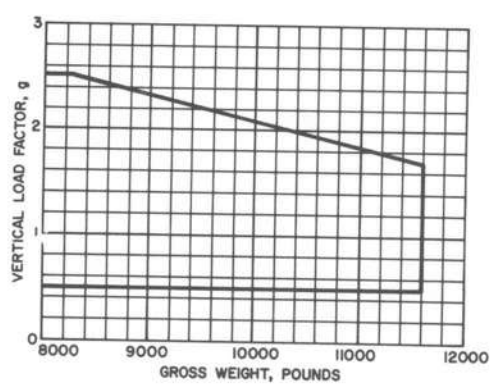


Figure 1—68

Load Factor Limitation



Note

THE LOAD FACTOR VALUES SHOWN ON THIS CHART APPLY FOR OPERATION UP TO 2000 FEET. ABOVE 2000 FEET, REDUCE VALUES SHOWN BY 0.1G FOR EACH ADDITIONAL 200 FEET OF ALTITUDE.

Figure 1—69

RESCUE BOOM (FISHPOLE).

Loads hoisted with the fishpole shall not exceed 520 pounds.

ALTITUDE LIMITATION

Maximum operating density altitude at basic gross weight (9951 pounds) is 15,000 feet.

Maximum operating density altitude at maximum gross weight (11,614 pounds) is 12,000 feet.

LANDING LIMITATIONS

Downwind landings should be avoided. Water landings are not permitted except in an emergency. Refer to Section V for emergency ditching procedures.

MISCELLANEOUS LIMITATIONS

Only tiedowns depicted in figure 1—63 will be attached while rotors are turning. Attaching high tiedowns with rotors turning may cause rig instability (ground resonance).

Avoid unnecessary or prolonged operation in beach, desert, or other sandy conditions. Refer to Section VI for operating details.

The aircraft is equipped with rotor deicing and turbine and windshield anti-icing equipment, and may, if necessary, be flown in certain icing conditions. Refer to Section VI. However, flight through known or forecast icing conditions is not recommended. Operations at temperatures below —30° F are not permitted.

SECTION II

INDOCTRINATION

TABLE OF CONTENTS

Ground Training Requirements 2-1
Flight Crew Qualifications 2-1
Flight Crew Requirements 2-3
Recommended Requirements For Transitioning Naval Aviators 2-3
Flight Support Training Syllabus 2-3
Flight Training Syllabus 2-4
Personal Flying Equipment Requirements 2-7
Special Aircraft Rescue Equipment Required 2-8

GROUND TRAINING REQUIREMENTS

The following minimum requirements are established for qualifications in the UH-2C helicopter.

PILOTS' GROUND TRAINING.

1. NAMTD Pilots' Course (if available)
2. Ground School Syllabus
3. Flight Operation Lectures
4. Handbook and Ground School Exams

AIRCREWMAN GROUND TRAINING.

a. NAMTD Plane Captain's Course (if available) .... 5 days
b. UH-2C Familiarization Lectures .... 2 hours
c. Helicopter Safety & Survival Equipment .... 2 hours

FLIGHT CREW QUALIFICATIONS

PILOT QUALIFICATIONS.

All pilots meeting the following minimum qualifications are subject to NATOPS evaluation checks in the UH-2C.

Flight Evaluation.

Prior to taking any NATOPS flight check, the following criteria must be met:

1. Successfully complete the written NATOPS examination.
2. Successfully complete the UH-2C cockpit check.
3. Successfully complete the oral examination.

Initial Flight Check Criteria.

HELICOPTER SECOND PILOT (H2P).

1. Minimum of 250 total flight hours, of which 100 must be in rotary wing.
2. Minimum of 30 pilot hours in model.
3. Complete flight and ground training phases as outlined in Squadron Flight Syllabus.
4. Be familiar with applicable technical orders and notes, OPNAV Instructions, Civil Air Regulations, and COMNAVAIR Instructions.
5. Be familiar with search and rescue standard operating procedures of a general nature which are of squadron policy in the operation of Naval aircraft
6. Possess valid instrument rating.

HELICOPTER AIRCRAFT COMMANDER.

1. In addition to the requirements set forth for Helicopter Second Pilot, a Helicopter Aircraft Commander will be required to have a minimum of 500 total pilot hours of which 150 must be in rotary wing. A Helicopter Aircraft Commander designation will also require 50 pilot hours in model, of which 25 must be as first pilot, and demonstrate the proficiency and judgment to insure the successful accomplishment of all tasks of the squadron mission.

Certification.

Pilots who have qualified as Helicopter Second Pilot or Helicopter Aircraft Commander shall be designated in writing by the commanding officer. This certification shall be placed in the pilot's flight logbook and file jacket.

Minimum Currency Requirements.

HELICOPTER SECOND PILOT (H2P).

1. 40 flight hours in model in previous 12 months, of which 20 hours must be in the preceding 6 months.
2. 10 night hours in model previous 12 months.
3. Satisfactorily demonstrate a thorough knowledge of the operation and application of the doppler equipment, if installed in assigned aircraft.

HELICOPTER AIRCRAFT COMMANDER.

1. 20 flight hours conducting operational or training flights under actual or simulated instruments conditions in model within the previous 12 months.
2. 10 hours of night time each 6 months in model.
3. Maintain a current designation as plane commander.
4. Satisfactorily complete a NATOPS evaluation check.

Requalification.

Pilots who during any 6-month period have not regularly flown the aircraft in which qualified or have not regularly performed the mission required of the command shall be considered no longer currently qualified. Such pilots and second tour pilots requalifying in the UH-2C may be allowed to requalify without progressing through lower designations. Requalification shall consist of an appropriate checkout, including a flight familiarization phase and demonstration of the knowledge, skill, and capabilities required for the qualification or designation.

Waiver of Requirements.

Commanding Officers are authorized to grant waivers of minimum flight and/or training requirements where recent experience in similar model helicopters warrant.

AIRCREW QUALIFICATIONS.

All crew members meeting the following minimum qualifications are subject to NATOPS evaluation checks in the UH-2C.

Helicopter Rescue Aircrewman.

1. Be highly motivated and volunteer for this type of duty.
2. Satisfactorily complete NAMTD familiarization course, if available.
3. Satisfactorily complete squadron training syllabus.
4. Become a qualified first class swimmer.
5. Successfully complete an established survival course, if available.
6. Have a minimum of 50 flight hours experience as a Helicopter Rescue Aircrewman trainee.
7. Perform a minimum of 20 successful practice rescues, five of which must be simulated rescues of an immobile man.
8. Demonstrate an expert knowledge of all types of survival equipment presently installed in assigned aircraft and used by fleet squadrons.

Helicopter Aircrewman.

1. Be highly motivated and volunteer for this type of duty.
2. Satisfactorily complete squadron training syllabus.
3. Complete a minimum of 6 actual or simulated survival rescue operations.

Aircrew Currency Requirements.

Crew members meeting the following requirements will be considered current in all respects and will be subject to standard evaluation checks annually in the UH-2C.

HELICOPTER RESCUE AIRCREWMAN.

1. Satisfactorily complete specified portions of squadron rescue aircrewman training syllabus.
2. Log a minimum of 50 flight hours as a Helicopter Rescue Aircrewman within the preceding 12 months.
3. Perform a minimum of 6 actual or simulated survival rescue operations in the preceding 12 months.

HELICOPTER AIRCREWMAN.

1. Satisfactorily complete specified portions of squadron aircrewman training syllabus.
2. Complete a minimum of 6 actual or simulated survival rescue operations within the preceding 12 months.

Waiver of Requirements.

Commanding Officers are authorized to grant waivers of aircrew qualification requirements when the individual's experience warrants such action.

FLIGHT CREW REQUIREMENTS

Only those personnel considered necessary to perform the specific mission will be carried on flights which are determined to be extra hazardous. Such other personnel as can be accommodated with approved seats and securing devices may be carried during normal operating conditions.

FAMILIARIZATION TRAINING.

Two helicopter pilots are required in the cockpit. One of the pilots will be designated as pilot in command. The cabin will be occupied by at least one qualified aircrewman.

MAINTENANCE TEST FLIGHTS.

The flight crew for maintenance test flights shall consist of one test pilot, designated in writing by the commanding officer, and one qualified observer, preferably another helicopter pilot. Only such personnel who are required to complete the flight shall occupy the cabin.

RECOMMENDED REQUIREMENTS FOR TRANSITIONING NAVAL AVIATORS

The requirements for transitioning of non-helicopter designated pilots shall be governed by the provision of OPNAV inst 3710.7 series.

The flight support and flight syllabus outlines which follow are recommended for use in the preparation of individual unit syllabi. Commands will submit local training programs for approval in accordance with the above instructions prior to commencement of the flight training phase.

FLIGHT SUPPORT TRAINING SYLLABUS

I. GENERAL FLIGHT CHARACTERISTICS
- a. performance data
- b. operating limitations
- c. chart usage

II. T58-8B ENGINE OPERATIONS
- a. engine fuel and control system
- b. engine oil system
- c. ground and flight operation
- d. limitations

III. FUEL AND OIL SYSTEM
- a. fuel
  - 1. specification
  - 2. servicing
  - 3. supply system
  - 4. management
  - 5. caution system
- b. oil
  - 1. specifications
  - 2. servicing
  - 3. supply system
  - 4. caution system

IV. ELECTRICAL SYSTEM
- a. general description
- b. AC power
- c. DC power
- d. distribution
- e. functional flow

V. FLIGHT CONTROL SYSTEM
- a. rotor system
  - 1. main rotor
  - 2. tail rotor
- b. control modes
  - 1. non-boost
  - 2. boost
  - 3. ASE
- c. blade tracking system

VI. AUTOMATIC STABILIZATION EQUIPMENT
- a. description
- b. controls
- c. operation

VII. COMMUNICATION EQUIPMENT AND NAVIGATION SYSTEMS
- a. communication equipment
  - 1. ICS
  - 2. UHF
  - 3. LF
  - 4. IFF/SIF
- b. navigation equipment
  - 1. UHF/DF
  - 2. LF/ADF
  - 3. TACAN
  - 4. IFF/SIF
  - 5. ASA 13/PT 429/APN-130

VIII. UTILITY SYSTEMS
- a. hydraulic
- b. heating-defrosting
- c. windshield washer
- d. cargo
- e. emergency ditching gear
- f. rotor deicing
- g. auxiliary equipment in aircraft

IX. EMERGENCY PROCEDURES
- a. insure detailed instruction on all items covered in section V "Emergency Procedures"

FLIGHT TRAINING SYLLABUS

Syllabus Periods	Description	Hours
	FAMILIARIZATION	
F-1	Left seat	2.0
Dual	1. Instructor introduce:	
	a. Pre-flight inspection	
	b. Pilot and Copilot duties (cockpit team work)	
	c. Cockpit pre-flight	
	d. Local radio procedures and course rules	
	e. ASE on & off flight emphasizing use of trim	
	(1) Normal flight maneuvers	
	(2) Vertical takeoff	
	(3) Hovering	
	(4) Transition to forward flight	
	(5) Normal approaches	
	(6) Vertical landing	
	f. Ground taxi	
	g. Post flight inspection	
	2. Instructor demonstrate:	
	a. Engine start, discuss abnormal starts	
	b. Rotor engagement	
	c. System ground checks	
	d. Rotor and engine shutdown	
F-2	(Same as F-1)	
F-3	Right seat	2.0
	1. PUI practice:	
	a. Walk around inspection	
	b. Use of checklist	
	c. ASE on & off	
	(1) Normal flight maneuvers	
	(2) Vertical takeoff	
	(3) Hovering	
	(4) Transition to forward flight	
	(5) Normal approach	
	(6) Vertical landing	
	d. Ground taxi	
	e. Post flight inspection	
	2. Instructor introduce:	
	a. Engine start	
	b. Rotor engagement	
	c. System ground checks	
	d. Engine & rotor shutdown	
F-4	(Same as F-3)	
F-5	Right seat	2.0
	1. PUI practice:	
	a. Maneuvers introduced on F-1, 2, 3, and 4	
	2. Instructor introduce:	
	a. Blade tracker	
	b. Boost off	
	c. Use of emergency throttle	
	d. Landing gear emergency operation	
F-6	Right seat	2.0
	1. PUI practice:	
	a. Maneuvers introduced on F-1, 2, 3, 4, and 5	
	2. Instructor introduce:	
	a. Run-on landing	
	b. Power recovery autorotation	
	(1) Straight-in from 1000′ above terrain	
	(2) 90° from 1000′ above terrain	
	c. Emergency procedures	
	(1) Fires during flights	
	(2) Loss of tail rotor control	
	(3) Bail-out and ditching procedures (after shutdown)	
	(4) Single engine	
F-7	(Same as F-6)	2.0
F-8	(Same as F-7)	2.0
F-9	Right seat	2.0
	1. PUI practice:	
	a. Run-on landing and running take-offs	
	b. Power recovery autorotation	
	(1) Straight-in 1000′	
	(2) 90° 1000′	
	c. Other maneuvers as necessary	

Syllabus Periods	Description	Hours
	2. Instructor introduce:	
	a. 180° power recovery autorotation from 1000′	
	b. ASE off autorotation	
	c. Fuel dumping and fuel management	
	d. Crosswind takeoff and landing	
	e. Vertical takeoff and landing ASE on with feet off rudder pedals	
F-10	Right seat	2.0
	1. PUI practice:	
	a. All maneuvers introduced on F-1 thru 9 as necessary	
	2. Instructor introduce:	
	a. Precision approach	
F-11	Right seat	1.5
	Safe for solo check	
	1. Instructor check PUI's performance on:	
	a. Pre-flight inspection	
	b. Use of checklist	
	c. Engine start	
	d. Rotor engagement	
	e. System ground checks	
	f. Ground taxi	
	g. Takeoffs	
	h. Normal flight maneuvers ASE on & off, Boost off	
	i. Power recovery autorotation	
	j. Emergency procedures	
	k. Use of Nav equipment	
	l. Shutdown of rotors and engines	
	m. Post-flight inspection	
F-12 and 13	Right seat	1.5
	1. PUI practice procedures and maneuvers introduced on F-1 thru F-11 except emergency throttle operation	

DAY INSTRUMENTS

Syllabus Periods	Description	Hours
I-1	Right seat	1.5
Dual	1. Instructor introduce:	
	a. Instrument takeoff	
	b. Use of BAR ALT MODE	
	c. Use of coordinated turn button	
	d. Use of YAW TRIM Switch	
	e. Turn pattern	
	f. BRAVO pattern	
	g. DELTA pattern	
	h. ASE OFF flight	
	i. Instrument autorotation	
I-2	Right seat	1.5
Dual	1. PUI practice:	
	a. Instrument takeoff	
	b. BRAVO pattern	
	c. ASE OFF flight	
	d. Instrument autorotation	
	2. Instructor introduce:	
	a. OSCAR pattern	
	b. CHARLIE pattern	
	c. High speed entry into autorotation	
	d. Boost OFF flight	
I-3	Right seat	1.5
Dual	1. PUI practice:	
	a. Instrument takeoff	
	b. CHARLIE pattern	
	c. Instrument autorotation	
	(1) High speed entry	
	2. Instructor introduce:	
	a. TACAN procedure	
	b. TACAN approach	
I-4	Right seat	1.5
Dual	1. PUI practice:	
	a. Instrument takeoff	
	b. Instrument autorotation	
	2. Instructor introduce:	
	a. ADF procedures	
	b. ADF approach	
	c. GCA approach	

HOIST

Syllabus Periods	Description	Hours
H-1	Right seat	1.0
Dual	1. Instructor introduce:	
	a. Crew briefing	
	b. Pre-flight and ground check of hoist system	

Syllabus Periods	Description	Hours
	c. Hoist pattern & course rules	
	d. Voice procedures	
	e. ASE OFF operations	
	2. PUI complete a minimum of 4 dummy hoists including one with the PUI operating the hoist and one strokes litter pick up	
H-2	Right seat	1.0
Dual	1. PUI practice procedures introduced on hoist 1. A minimum of 5 dummy hoist and 2 strokes litter pickups will be completed including one (1) ASE OFF pickup	
H-3	Right seat	1.0
Dual	1. Instructor introduce:	
	a. Crew briefing on:	
	(1) Emergency signals	
	(2) Voice procedures	
	(3) Number of pickups to be accomplished	
	(4) Emergency procedures	
	b. Pattern and approach	
	c. Overwater hovering	
	2. Practice	
	a. Pre-flight and ground check of hoist system	
	b. PUI will make a minimum of 3 pickups including one with the PUI operating the hoist	
H-4	Right seat	1.0
Solo	1. PUI practice procedures introduced on hoist 3. A minimum of 3 pickups will be completed	
H-5	(Same as H-4)	
H-6	Right seat	1.0
Dual	1. Instructor introduce:	
	a. Crew briefing	
	b. Ground checks of cargo hook system	
	c. Pattern	
	d. Hook-up procedures	
	e. Transition to forward flight with external cargo	

Syllabus Periods	Description	Hours
	f. Approach and transition to hover with external cargo	
	g. Releasing external cargo	
	(1) Electrically	
	(2) Manually	
	h. ASE OFF operation	
	2. PUI complete a minimum of 5 hook-ups and releases	
	NIGHT FAMILIARIZATION	
NF-1	Right seat	2.0
Dual	1. Instructor introduce:	
	a. Cockpit light and controls	
	b. Exterior lights	
	c. Landing and floodlights	
	2. Practice	
	a. Vertical takeoff	
	b. Transition to forward flight	
	c. Cruise – familiarization with lighting	
	d. Night familiarization with local area	
	e. Basic airwork	
	f. Normal approaches	
	g. Mat work	
	h. Hovering	
	i. Vertical landing	
	j. Ground taxi	
	k. ASE OFF flight	
NF-2	Right seat	1.0
Solo	1. Same as NF-1	
	NIGHT INSTRUMENTS	
NI-1	Right seat	2.0
Dual	1. Familiarization with airways work, holding and all instrument approaches	
	a. Pilot under instruction will make up a flight plan of approximately two hours duration. Plan for either approaches enroute or at Base Field	

Syllabus Periods	Description	Hours
NI-2	Right seat	4.0
Dual	1. Familiarization with airways work, holding fuel management and all instrument approaches. a. Pilot under instruction will make up a flight plan of approximately four hours duration. Plan for either approaches enroute or at Base Field	
NI-3	Right seat	2.0
Dual	1. To increase the proficiency of pilots on GCA, TACAN, Low frequency and ASR approaches. Approaches may be completed at any facility in the local area	
NI-4	Right seat	2.0
Solo	1. Same as NI-3	
	STANDARDIZATION	
SG-1	Right seat	2.0
Dual	1. Stan check the following: a. Pre-flight inspection b. Use of check list c. Engine start d. Rotor engagement e. Systems f. Ground taxi g. Vertical and running takeoffs h. Transition to forward flights i. Normal flight maneuvers ASE ON & OFF BOOST OFF j. Normal and precision approaches k. Power recovery autorotations l. Understanding and use of systems m. Vertical and running landings n. Hoist and cargo work o. TACAN approaches p. Emergency procedures q. Shutdown of rotor and engine r. Post-flight inspection s. DEMO AND LET THE STUDENT PERFORM AN EMERGENCY THROTTLE APPROACH	

PERSONAL FLYING EQUIPMENT REQUIREMENTS

UH-2C flight personnel shall be familiar with and utilize those items of flight clothing, and survival and rescue equipment as prescribed in the current OPNAV Instruction 3710.7 series. In addition, the pilot in command of an aircraft engaged in carrying crewmen or passengers shall insure their compliance with this instruction.

Regularly scheduled ditching drills will be held by the pilot in command to insure that all crewmembers are fully qualified in ditching procedures and the use of all survival equipment. It will be the responsibility of the pilot in command to insure that all passengers are adequately briefed before any flight as to the proper ditching and evacuation procedures in the UH-2C, on land or water as applicable, and that passengers are instructed on the use of land and water survival equipment.

The equipment indicated below shall be worn or carried on all flights in Naval aircraft unless other safety considerations or the design characteristics of the model aircraft dictate otherwise:

1. An anti-buffet protective helmet adorned with high visibility paint or reflective tape.
2. Fire retardant flight coveralls.
3. Flight gloves.
4. Ankle high lace boots.
5. Identification tags.
6. An approved survival knife and sheath not to be worn exposed or attached to the life preserver.
7. A life preserver shall be worn by all personnel when flying over water. Life preservers will be equipped with a whistle, dye marker, compass, shark chaser, and flares.
8. Personal survival kits will be carried at all times by pilots and crewmembers when engaged in operations and training missions away from home base.
9. The latest available type continuous-wear anti-exposure suit shall be worn when beyond gliding distance of land:
    a. When the water temperature is 59° F or below.
    b. When the outside air temperature is 32° F or below.
    c. When the combination of air and water temperature is 120° F or below.
10. The pilot in command will insure that one (1) PR-2 liferaft per person is aboard the aircraft on all overwater flights. In addition, two (2) PK-2 combination liferaft/survival kits will be carried on all operational and ferry flights.
11. A two-cell flashlight will be carried on all night or cross-country flights. In addition, each pilot will carry a one-cell or pencil flashlight.
12. Parachutes will be worn on all operational or training flights planned or conducted over 3,000 feet above the terrain.

13. A pistol with tracer ammunition will be worn by all crewmembers for all night flights and for all flights, night or day, over water or sparsely populated areas. An approved signaling device is authorized as a substitute for the pistol when operational or security conditions warrant.

SPECIAL AIRCRAFT RESCUE EQUIPMENT REQUIRED

The articles listed in this paragraph are special tools required in helicopter rescue work, and will normally be carried on all plane guard and SAR missions.

a. One Rescue Seat

b. One Kapok Rescue Sling

c. One Rescue Equipment Belt

d. One Webbing Cutter

e. One Cable Cutter

f. One Crewman's Sling

g. One Chicago Grip

h. One Gunner's Belt

i. One Wool Blanket

j. One Resuscitube

k. Three Electric Marking Lights

l. Five Smoke Lights

m. One Cable Quick Splice

n. One Rescue Net, if conditions warrant

o. One Stokes Litter, if conditions warrant

SECTION III

NORMAL PROCEDURES

TABLE OF CONTENTS

PART 1 — MISSION PLANNING

Introduction 3-2
Factors Affecting Mission Planning 3-2

PART 2 — BRIEFING/DEBRIEFING

Briefing 3-4

PART 3 — SHORE-BASED PROCEDURES

Flight Scheduling 3-5
Line Operations 3-5
Before Starting Engine 3-9
Starting Engine 3-9
Starting Rotor and Before Taxiing 3-11
Taxiing 3-12
Before Takeoff 3-12
Before Landing 3-13
After Landing 3-13
Shutdown 3-13
Before Leaving Aircraft 3-13
Systems Check 3-16
Takeoff Procedures 3-17
Hovering 3-18
Turns on the Spot 3-18
Climbout Procedures 3-20
Flight Procedures 3-20
Descent 3-20
Landings 3-20
Autorotations 3-22
Normal Approach 3-25
Precision Approach 3-26
Rescue Pattern, Approaches, Hover and Climbout 3-27

PART 4 — CARRIER-BASED PROCEDURES

Flight/Hangar Deck Procedures 3-32
Launch and Recovery Procedures 3-34
Night and IFR Operations 3-35
Day Operations Patterns 3-35
Minimum Crew 3-37
Emergency Missions 3-37
Weather 3-37
Operating Considerations 3-37

PART 5 — NON-AVIATION SHIP PROCEDURES

Flight/Hangar Deck Procedures 3-38
Launch and Recovery Procedures 3-38
Minimum Crew 3-39
Helicopter Transfers 3-39
Fuel 3-39

PART 1 MISSION PLANNING

INTRODUCTION

The UH-2C offers an increased capability in night and instrument flight, higher speed and payload, and greater radius of action. However, even with all these advantages, utilization of the aircraft to its maximum capability must be based on careful mission planning.

FACTORS AFFECTING MISSION PLANNING

WEIGHT.

At maximum gross weight (11,614 pounds) the UH-2C has the ability to hover OGE at any temperature up to 50° C (122° F) in a no wind condition at sea level.

An increase in wind velocity or a rolling takeoff will even further increase takeoff performance.

Maximum weight for vertical takeoff is shown in figure 11–7. The chart shows that at sea level and 11,614 lbs. maximum gross weight:

(a) OGE hover without wind up to 50° C (122° F)

(b) takeoff with 100 fpm vertical climb without wind up to 34° C (93° F)

(c) takeoff with 100 fpm vertical climb with a 10 knot wind up to 50° C (122° F)

Helicopter gross weight has a significant effect on limit airspeed when under hot day or high altitude conditions as shown in figure 11–6.

WIND.

Wind is not critical for takeoff except in extremes of temperature and/or altitude as the UH-2C can hover OGE at maximum gross weight under most operating conditions.

TEMPERATURE.

Temperature effect on engine power available will not become apparent until the power available has been reduced to a level below the transmission limit. This occurs only at very hot or very high altitude conditions.

PRESSURE ALTITUDE.

Range capability is increased as the pressure altitude for cruise is increased. The range chart shows possible range increases from 15 to over 30% when flying at the best altitude for range. The chart shows the pressure altitude for maximum range is increased as gross weight is reduced from 6000 feet at 11,500 pounds to about 12,000 feet at 9500 pounds.

DENSITY ALTITUDE.

Density altitude is a result of temperature and pressure altitude. Under high density altitude conditions the limit airspeed will be reduced. Figure 11–6 presents airspeed limitation in terms of pressure altitude and temperature for pilot convenience.

WEIGHT AND BALANCE.

Proper weight and balance is essential to safety and must be considered for all operations. Weight and balance will be computed in accordance with OPNAV INST 3710.7 (current edition) using a weight and balance handbook (AN-01-1B-40).

PAYLOAD.

Payload may be estimated using the Handbook for Weight and Balance Data. For an approximate value the following may be used.

Basic Weight.

UH-2C basic weight is approximately 7850 pounds. This weight includes APN-130 and ASA-13, auxiliary floatation system, auxiliary fuel system provisions and tanks, trapped fuel and oil. The basic weight will vary from aircraft to aircraft. For the exact basic weight of a particular aircraft, refer to Chart C of the Handbook for Weight and Balance for the aircraft.

Operating Weight (For Plane Guard Configuration).

Aircraft with 3 man crew (180 lbs. each approx.)	8450 lbs.
Aircraft with 4 man crew (180 lbs. each approx.)	8650 lbs.

The operating weight is calculated for plane guard configuration with the following survival and rescue gear: seat, sling, PK-2 raft, one back pack per man, crewman gear, and five Mae West units. The weight of survival and rescue gear is:

Mae West	5.5 lbs.
Back pack	7.5 lbs.
PK2 raft	19.0 lbs.
Rescue seat	10.0 lbs.
Rescue sling	4.0 lbs.
Crewman gear	3.0 lbs.
Parachute	24.0 lbs.

Maximum Gross Weight.

Maximum gross weight is 11,614 pounds. Refer to figures 11–7 and 11–8 for variations with temperature.

Maximum payload may be determined as follows:

Max Gross Weight	________
Less Operating Weight	________
Payload + Fuel	________
Less Fuel	________
Payload	________

PART 2 BRIEFING/DEBRIEFING

BRIEFING

Planning and flight briefings will be conducted by the flight leader or pilot in command.

The squadron briefing format will contain current weight and balance data for the assigned helicopter, and operational loading for the mission assigned.

Required fuel, power settings, and airspeed, takeoff, climb, and landing data should be determined by use of the performance charts in Section XI.

BRIEFING FORMAT.

Mission.

1. Primary.
2. Secondary.
3. Operating Area.
4. Control Agency (where applicable).

Air Intelligence (Where Applicable).

1. Force disposition.
2. PIM information.

Communications.

1. Frequencies.
2. Navigational aids.
3. Identification/ADIZ.

Weight and Balance.

Flight Planning.

1. Takeoff.
2. Routes.
3. Mission plan.
4. CATTC procedures.
5. Recovery.

Emergencies.

Weather.

Survival/Emergency Equipment.

DEBRIEFING FORMAT.

Each flight should be thoroughly debriefed immediately upon its return by the flight leader or pilot in command, as applicable, covering the following:

1. Success of the mission.
2. Recommendations for improvement of tactics, procedures, techniques, flight, and radio discipline, etc.
3. On completion of syllabus training flights, comments concerning attainment of pilot and crew qualifications.

PART 3 SHORE-BASED PROCEDURES

FLIGHT SCHEDULING

The Commanding Officer or his designated representative is responsible for the promulgation of the flight schedule when based ashore. The flight schedule becomes an order of the Commanding Officer. It shall be followed rigidly, and any variations require the approval of the Commanding Officer or his designated representative.

The flight schedule will contain sufficient information to assure that all preparations relative to the flight can be accomplished in a smooth and timely manner. Such information is given below:

1. Time of takeoff
2. Time of landing
3. Type helicopter and model number
4. Pilot in command
5. Crew
6. Fuel load (pounds)
7. Mission
8. Alternate mission (if applicable)

LINE OPERATIONS

Observe line safety practices in accordance with NAVSO-P-2455 series.

GROUND OPERATIONS OF HELICOPTER ENGINE AND ROTORS.

Pre-flight Inspection.

Prior to flight, the pilot, copilot, and aircrewmen shall conduct a complete visual check of the helicopter.

Fire Guard.

Prior to starting an engine a qualified fire guard shall be stationed near the engine and shall remain in readiness with the fire bottle until the engine is operating.

Note

The standard fire bottle without the 8-foot extension must be elevated in order to reach the engine fire access door.

Starting Engines.

A qualified pilot or person designated by the Commanding Officer shall be in the pilot's seat whenever an engine is started. This person shall receive and acknowledge plane-captain and fire guard's all-clear signals before starting an engine. Engines shall not be started until the helicopter is properly secured with approved chocks, parking brakes are on, tail wheel is locked, and personnel in the near vicinity are wearing sound attenuators. Engines shall not be started in a hangar unless required by an emergency. Chocks and tiedowns shall be removed with the utmost caution when an engine or rotors are operating, and then only upon the proper signal.

Rotor Engagement.

A qualified helicopter pilot shall be in the pilot's seat at all times when the rotors are engaged. Goggles that provide adequate peripheral vision shall be worn by ground personnel. Before rotor engagement, the surrounding area must be clear of unnecessary personnel, equipment, and obstructions. The pilot must receive and acknowledge all-clear signals from ground personnel. Rotor engagement and disengagement will normally not be attempted in wind velocities above 45 knots. (Refer to figure 3—15.)

TAXIING.

Taxi Signals.

Only approved standard taxi signals shall be used.

Taxi Pilots.

No one shall be permitted to taxi a helicopter except such persons as are authorized to fly it.

Taxi Director.

Sufficient ground control personnel must be available to provide for the safe taxiing of helicopters in the vicinity of obstructions or other aircraft.

Taxiing.

All taxiing will be done at a safe slow speed. Air taxiing may be authorized during high wind conditions. Use extreme caution during night operations.

TOWING.

Operation of Equipment.

Only qualified personnel will operate towing equipment. Towing couplings will be inspected prior to towing. Only approved attachment devices will be used. Towing will not begin until a qualified pilot or plane-captain is in the cockpit and ready to operate the brakes.

Towing Speed.

Towing speed will not exceed 5 miles per hour. Sudden stops and starts will be avoided. Extreme caution should be exercised when towing in a congested area.

Wing Walker.

When towing a helicopter near hangars, obstructions or other aircraft, a wing walker will be stationed on each side of the helicopter to ensure adequate clearance. In addition, a director equipped with a whistle should be positioned to supervise towing. When helicopters are being pushed backward, a man will be stationed at the tail to ensure clearance to the rear of the helicopter. At night the wing walker will carry a flashlight or luminous wand and the A/C position lights shall be turned on.

Movement.

Helicopters may be pushed from the tail, provided adequate clearance is available and the helicopter is under positive control of a taxi director.

HELICOPTER ACCEPTANCE.

The pilot in command should not accept the helicopter for flight until he has ensured that the helicopter is satisfactory for safe flight and accomplishment of the assigned mission. The two major steps to be taken prior to acceptance of the helicopter are a careful examination of the helicopter's recent discrepancies and a thorough preflight inspection.

Yellow Sheets.

At least the last ten discrepancy portions of the yellow sheet will be made available to the pilot for his examination. Any additional discrepancies should also be brought to the pilot's attention.

1. The pilot in command will ensure that the plane-captain has conducted a standard Pre-flight Inspection as set forth in the NAVAIR 01-260HCB-6-1 handbook, and that he has signed the yellow sheet.
2. The pilot in command shall ensure that all safety of flight discrepancies have been signed off.
3. The pilot in command, when satisfied with the yellow sheet information, will sign applicable portions of the yellow sheet.

Exterior Preflight Paths

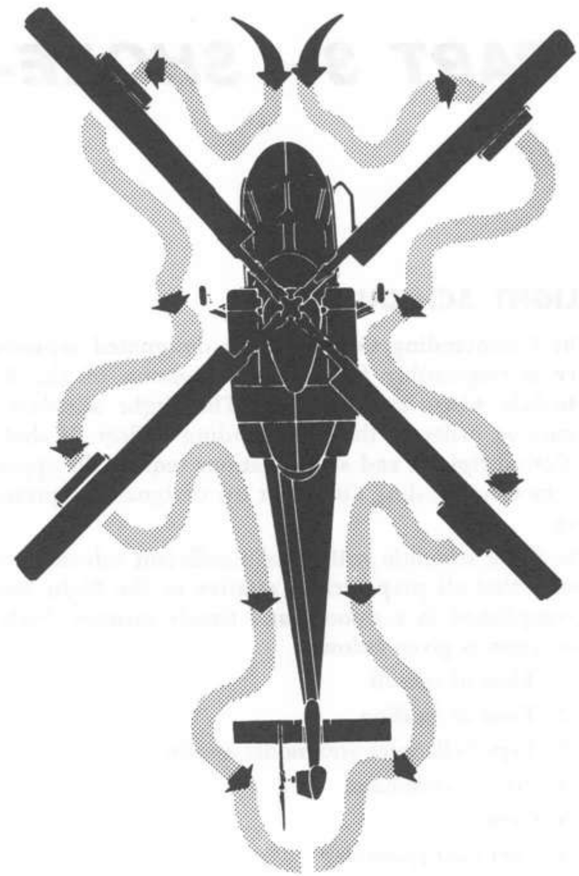


Figure 3—1

EXTERIOR PREFLIGHT INSPECTION

It is recommended that the following areas be inspected prior to flight using path shown in figure 3-1.

1. Hoist for security and hook for damage.
2. No. 2 engine for FOD.
3. No. 1 engine for FOD.
4. Forward Rotor Blades and Hub:
   a. Check blades and flap for damage and cleanliness.
   b. Control linkage for wear and security.
   c. Blade locking handle in locked position.
   d. Security of droop stop, pitch, and anti-coning stop.
   e. Damper for servicing.
   f. Position of blade tracking motor.
   g. Security of blade de-ice turret and wiring.

5. Forward Transmission Cowling:
   a. Transmission/combining box oil level and cap.
   b. Hydraulic oil level.
   c. Forward transmission area for foreign objects.
   d. Forward half of azimuth assembly and transmission.
   e. Hydraulic filter for evidence of clogging.
   f. Hoist motor.
   g. Cowling for security.
6. Transmission Area.
   a. Forward part of combining box for leakage.
   b. Azimuth.
   c. Lower portion of transmission.
   d. Combining box drive shaft.
   e. Tail rotor drive shaft.
7. Combining gearbox area for security of all hydraulic lines and generator cooling tubes.
   a. Oil cooler blower for security & damage.
   b. Blower drive shaft.
   c. Tail rotor drive shaft and cover.
   d. Rotor brake.
   e. Combining box for leakage.
   f. No. 1 and No. 2 engine oil tanks for security.
   g. Hydraulic pump for leakage.
8. Aft Rotor Blades and Hub same as Forward Rotor Blades and Hub.
9. Check security of all cowling.
10. Check all windows for cracks and cleanliness.
11. Windshield wipers for security.
12. OAT gage for security, window cracking, and temperature to check fire extinguisher bottle pressure later in preflight.
13. Check security of electronic equipment in nose door, battery connected, absorber for security, circuit breakers in and control rods for security.
14. Nose doors and lights for security.
15. Check underside of aircraft for security of antennas.
16. Floatation fairing for security and rubbing on pilot's step.
17. Pilot's door for operation and security. Jettison handles safety wired (2).
18. Starboard Landing Gear:
   a. Check wheel well for evidence of interference, hydraulic lines and actuator for leaks, aux tank jettison and uplock cables for security, and electrical wiring for security.
   b. Landing gear and attaching points for damage fairing for cracks and security.
   c. Gear pin in place and flag attached.
   d. Liquid spring for correct extension.
   e. Brake disc for proper installation, cracks and excessive scoring and brake assembly for leakage
   f. Check tires.

      Tire is to be removed from service if any of the following conditions exist:

      (1) Tread wear to bottom of any tread-wear indicator hole.
      (2) Tread separation, swelling, bead damage, or flat spots.
      (3) Tread cuts greater than 2 inches long which expose but do not penetrate the first steel restraining ply.
      (4) Tread cuts greater than 1 inch long that penetrate the first steel restraining ply.
      (5) Cuts deeper than 1/4 inch below the bottom of nearest tread-wear indicator hole.
      (6) Sidewall cuts, or damage that exposes the fabric cord.
   g. Check wheel for evidence of corrosion.
19. Fuselage fuel caps for security.
20. No. 2 Engine:
   a. Security of lines and wires.
   b. Security of pressure transmitters.
   c. Stator vane actuator for evidence of leakage and linkage for damage.
   d. Check engine casing for indication of hot spots.
   e. Check setting of flow divider.
   f. Fuel control for security & evidence of leakage.
   g. Check power turbine casing for cracks, particularly in the area of welds and rivets.
   h. Tail pipe and power turbine for damage.
   i. Speed decreaser gearbox for evidence of cracks and leakage.
   j. Inspect entire compartment for evidence of fuel and oil leakage.
   k. Check fire wall flanges for security.
   l. Check security of detuner clamps.
   m. Emergency actuator for proper position.
   n. Check power turbine fuel control flex shaft for leakage.
   o. No. 2 Engine fire extinguisher for security and correct pressure.
   p. Check ball protruding on two quick disconnect fittings at SDG oil inlet and oil cooler inlet.

21. No. 2 engine oil level.
22. Starboard Aux Tank Installation:
    a. Fuel cap for security.
    b. Tank safety pin installed and flag attached.
    c. Fuel and pressure lines for security and leakage.
    d. Mounting shackle, sway braces for tank security.
    e. Tank seams and drain plug for leakage.
23. Pressure fueling cap for security.
24. Check fuselage for wrinkles and damage.
25. Check bottom of helicopter for damage, security of antennas, cargo hook, and rotation beacon.
26. Check static port for cleanliness.
27. Check tail rotor drive cover fasteners for security.
28. Check intermediate gearbox for oil level and evidence of leakage.
29. Tail Wheel:
    a. Locking pin mechanism secure and locked.
    b. Proper strut extension and security.
    c. Tire:
        (1) Cuts: Any tail wheel tire cut to a depth which exposes any cords is cause for removal prior to flight.
        (2) Inflation: Tire should be obviously firm.
    d. Ground wire for security and ground contact.
    e. Scissor bolts for movement.
30. Stabilizer for damage and security.
31. HF antenna for security.
32. Tail rotor gearbox for oil level and evidence of leakage.
33. Check security of folding tip and rotating beacon.
34. Tail Rotor:
    a. Blades for damage and cleanliness.
    b. Control linkage for security.
    c. Pull flap locks and check for ease of movement.
35. Check fuselage for wrinkles and damage.
36. Check tail rotor drive cover fasteners for security.
37. Check static port for cleanliness.
38. No. 1 engine oil level.
39. Fire extinguisher for pressure.
40. No. 1 Engine:
    a. Speed decreaser gearbox for evidence of cracks and oil leakage.
    b. Tail pipe and power turbine damage.
    c. Check power turbine casing for cracks, particularly in the area of welds and rivets.
    d. Check fuel density adjustment.
    e. Emergency actuator for proper position.
    f. Fuel control for security and evidence of leakage.
    g. Check setting of flow divider.
    h. Check engine casing for indications of hot spots.
    i. Stator vane actuator for evidence of leakage and linkage for damage.
    j. Security of pressure transmitters.
    k. Security of all lines and wires.
    l. Inspect entire compartment for evidence of fuel leakage.
    m. Check fire wall flanges for security.
    n. Check security of detuner clamp.
    o. Check power turbine/fuel control flex shaft for leakage.
    p. Check ball protruding on two disconnect fittings at SDG oil inlet and oil cooler inlet.
41. Check port aux tanks as before.
42. Check cargo door for operation and security. Jettison handle safety wired.
43. Cowling for security.
44. Check port landing gear and wheel well as before.
45. Check copilot's door for operation and security. Jettison handle safety wired.
46. Check tail rotor pitch changes by pushing rudder pedal.
47. Floatation gear fairing for security and copilot's step for rubbing.
48. Check pitot tube for security and obstruction.
49. Check cotter pins in four blade servo flaps.
50. Check underside of blades for cracks and cleanliness.
51. At all times check for corrosion.

INTERIOR INSPECTION

1. Fire extinguisher secure.
2. Seats for security.
3. Juliet 28 circuit breaker — IN.
   If installed.
4. Check pilot's and copilot's relief tube for security.
5. Cargo and loose equipment secured.
6. Tail Section:
    a. Electronic gear for security.
    b. Fuel and oil lines for security and leakage.
    c. Directional control cables for security.
    d. Tail wheel lock control cable for security.
    e. Bilge for cleanliness.
    f. Manual diverter valve up and shear-wired.
7. Soundproofing for security.
8. Check necessary rescue equipment aboard and properly stowed.

BEFORE STARTING ENGINE

All cockpit checks shall be performed using the challenge and reply method when two pilots are in the cockpit. This includes the panel checklists for take-off and landing.

1. Controls – Check.

   a. Cyclic rigging – Check.

   Rotor may be in any position. Move cyclic stick full travel, perpendicular to leading edge of any selected blade in direction of blade rotation. Observe the direction in motion of the blade flaps on both the selected blade and the next following blade. If properly rigged, the trailing edges of both flaps will move downward. Repeat this check on the three remaining blades, each time observing the flap motion on the selected blade and the next following blade.

   Note

   Depending on the lead-lag static position of the blades, the degree of flap motion on the following blade can be very small, approaching zero motion. However, this is of no consequence if all other blades check out correctly. If incorrect flap movement is noted, final determination should be made using azimuth rod phasing check provided in HMI (NAVAIR 01-260HCA-2-2.1).

   b. Directional pedals – Check for travel, then neutral.

   c. Collective pitch lever – Check for down load.

2. Belt, seat and pedals – Adjusted.

   a. Seat belt – Fastened.

   b. Pilot's seat – Adjusted.

   c. Directional pedals positioning knob – Adjusted.

3. a. Fuse covers – Tight.

   b. Circuit breakers – As desired.

4. Exterior light switches – As desired.

5. Interior light switches – As desired.

6. Heat & Miscellaneous Panel switches – Gyro selector normal, others off:

   a. Cabin heat and pitot heat switches.

   b. Turbine anti-ice switch.

   c. Windshield anti-ice switch.

   d. Rotor deice switch.

7. Hydraulic Actuator switch – ON.

8. Hoist and hook panel switches – OFF.

9. ICS and radio panel switches – As desired.

10. Starting Panel switches –

    a. Generator number one and number two switches – ON.

    b. Battery switch – OFF.

    c. Fuel pumps switch – OFF.

11. Emergency Panel switches –

    a. Fire warning light T-handles – IN.

    b. Fuel control selector switch – NORMAL.

    c. Fuel dump switch – NORMAL.

    d. Floatation gear handle – In.

12. Windshield wipers – OFF.

13. Rotor brake – ON (Green).

14. Tail wheel lock – Locked.

15. Communication and navigation equipment switches – OFF.

16. Plotting board – OFF and STANDBY.

17. Clocks and altimeters – Set.

18. Radar altimeter – OFF.

19. Auxiliary fuel tank jettison handle – Seated and wired.

20. Landing gear lever – Down.

21. Landing gear emergency handle – Up.

22. Parking brake – Reset.

23. Cargo hook emergency release handle – Full aft.

24. Collective pitch lever friction nut – As desired.

25. Landing and floodlight switches – OFF.

STARTING ENGINE

1. Fire extinguisher – Available and manned.

2. External dc power (and ac, if available) – Connected.

Note

To avoid excessive drain on the helicopter battery, particularly during cold weather, all ground operation up to rotor engagement should be conducted with the use of supplementary source of electrical power. The battery should be used only when such a power source is not available. When the battery is used, the operation of electrical equipment should be kept to a minimum until after rotor engagement.

3. Landing Gear Indicators – Down, red light out.

4. Fire warning lights –Test.

5. Caution light panel and Master caution light – Test and reset.

6. Fuel quantity gage – Test and check fuel quantity in all tanks. (Refer to Systems Checks.)

7. 30-minute fuel and compressor lights – TEST.

8. Engine condition levers – OFF.

9. Actuator control switches – NORMAL.

10. RPM switches – DECREASE to minimum. Move to DECREASE and hold for 6 seconds.

11. Fuel pumps switch – ON.

12. Start engines. (No. 1 first).

WARNING

Be sure all personnel and movable objects are clear of the engine inlet and exhaust areas.

NORMAL STARTING PROCEDURE.

a. Starter switch – Depress and hold.

b. Engine condition lever – Moved to the IDLE-START FUEL-MAX. position when the gas generator speed reaches approximately 20% (19% minimum), and a maximum of 100° C inlet temperature. Lightoff should occur at or before 23% gas generator speed.

c. Turbine inlet temperature – Monitor. Refer to Section I for operating limits.

CAUTION

If temperature is approaching the red line at a rapid rate, immediately move the engine condition lever to the START FUEL-MIN position to close the solenoid valve, stopping the flow of auxiliary fuel. If this fails to arrest the temperature rise, move the condition lever to OFF. If fire follows, refer to Section V (Engine Fire on Start).

d. Starter switch – Release at 46% gas generator rpm.

e. Gas generator tachometer – 56±4%.

CAUTION

Stopcock the engine condition lever to OFF in the event that N_g should continue increasing above 70%.

f. Engine oil pressure gage – Check 8-10 psi minimum.

g. Turbine inlet temperature gage – Check.

CAUTION

Do not operate the starter continuously for more than 30 seconds, and do not attempt more than three starts in any 30-minute period.

13. Turbine anti-ice switch – Checked and as desired. (Refer to Systems Checks.)

14. Battery switch – ON.

15. External power – Disconnect.

BATTERY STARTING PROCEDURE.

a. Follow the normal procedures through the BEFORE STARTING ENGINE checklist.

b. Battery switch – ON.

c. Starter switch – Depress and hold.

d. Engine condition lever – Move to IDLE, START FUEL-MIN position as N_g RPM reaches 12%.

Note

A little more time is required for lightoff due to lower cranking speeds.

e. Carefully observe turbine inlet temperature (T_5) for a rise indicating lightoff. As usual, be prepared to abort start if T_5 appears to be going too hot.

f. After lightoff is accomplished and T_5 is within limits, use START FUEL – MAX. position to allow auxiliary starting fuel to flow.

g. Observe turbine inlet temperature (T_5). It will rise as auxiliary starting fuel flows into the engine. If the temperature reaches the 635° red line or is approaching the red line at a rapid rate, move the engine condition lever back to the START FUEL-MIN position stopping the flow of auxiliary starting fuel. As soon as T_5 is within limits, advance engine condition lever to START FUEL-MAX position again allowing auxiliary starting fuel to flow.

h. Repeat step f as necessary until N_g has accelerated to 46%.

i. Release starter at 46% N_g.

j. Check all engine instruments for indications in the normal range, and continue normal procedures.

Note

If a battery start must be made on both engines, it is advisable to engage the rotor before battery starting the second engine. This will take some electrical load off the battery.

STARTING ROTOR AND BEFORE TAXIING

1. Rotor clearance – Checked.

2. Wind direction and velocity – Check. Refer to figure 3–15 for maximum relative wind velocity for starting rotors.

3. Shoulder harness – Locked.

4. Rotor brake – OFF.

5. Engage rotor (No. 1 engine) noting temperatures and pressures.

CAUTION

Maintain neutral (or slightly into wind) cyclic control while starting rotors, and avoid excessive cyclic inputs during all ground operations. This will reduce possibility of damage to droop stops at low rpm, and will reduce stresses on the rotor hub at all speeds.

a. Speed decreaser oil pressure gages – Check.

b. All other pressure and temperature gages – Check.

c. No. 1 engine condition lever – FLY.

To avoid the possibility of swerving due to sudden application of torque to the main rotor, the following technique is recommended when advancing the engine condition lever to the FLY position:

Adjust the lever as necessary to maintain 25 to 30 percent torque until rotor speed reaches 50 percent. Then move the lever to the FLY position.

As an alternative to the monitoring torque, th following procedure may be used:

Move the lever toward the FLY position unt the gas generator rpm is 70-75 percent. As roto speed increases, adjust the lever as necessary t maintain gas generator rpm at 70-75 percen When rotor speed reaches 50 percent, advanc the engine condition lever until the gas genera tor is 80-85 percent. Maintain 80-85 percent ga generator rpm until rotor is up to speed, an engine condition lever is in the FLY position.

CAUTION

Use only minimum cyclic pitch necessary to counteract wind, and do not increase collective pitch until after all tiedown lines have been cast off. Removing slack from tiedowns with rotor engaged can cause structural damage to helicopter.

6. Caution lights – Check off.

7. Communication and navigation equipment switche – As desired.

8. MA-1 compass – Check and align.

9. Plotting board – ON.

10. Radar altimeter – As desired.

11. Emergency throttle – No. 2 engine. (Refer t Systems Checks.)

12. Min/Max beep – No. 1 engine.
Minimum 95%±1%, maximum 102½%±½%.

13. No. 1 Actuator switch – Off, test, normal. (Refe to Systems Checks.)

14. No. 2 engine to Fly and No. 1 engine to Idle.

15. Emergency throttle – No. 1 engine. (Refer t Systems Checks.)

16. Min/Max beep – No. 2 engine.
Minimum 95%±1%, maximum 102½%±½%.

17. No. 2 actuator switch – Off, test, normal. (Refe to Systems Checks.)

18. Both condition levers – Fly.

19. Hoist and fishpole – Check.

20. Control response and trim actuator – Check.
    a. Move cyclic stick from neutral and observe control response at the rotor tip paths. Maximum tip deflection should take approximately 30° counterclockwise from the direction in which the stick is moved. For example, if the stick is moved straight forward, the low point of the rotor tip should be about 30° to the left of the nose.
    b. Trim actuators – Refer to Systems Checks.
21. Boost – Check. (Refer to Systems Checks.)
22. ASE – Check. (Refer to Systems Checks.)

Note

The ASE requires a warmup of 2 minutes on ac power. An automatic time delay prevents the equipment from being engaged until the 2 minutes are up.

23. APN-130 and ASA-13A – Test. (Refer to Systems Checks.)
24. Fuel pumps – Check. (Refer to Systems Checks.)
25. Remote attitude indicator – Set.
26. Hydraulic pressure gage – Check.
27. Taxi clearance.
28. Taxiing rpm – 102%, torques married.
29. Aux tank and landing gear ground safety pins – OUT.
30. Parking brake – OFF.
31. Tail wheel – Unlocked.

TAXIING

Caution should be exercised when ground taxiing in winds above 20 knots. Maintain rotor rpm at 102% to insure directional control in the event an emergency lift-off is required.

a. Collective pitch lever – Increase to 15-20% torque. This setting may vary with gross weight, terrain, wind conditions, etc.
b. Cyclic stick – Coordinate with collective pitch lever to obtain desired taxi speed. The amount of stick displacement will vary with the velocity of the wind. Keep cyclic control in the wind.
c. Directional pedals and brakes – Apply as necessary to maintain directional control.
d. Standby compass – Check.
e. MA-1 compass – Check.
f. Turn and slip indicator – Check.

CAUTION

- Do not attempt to taxi without using collective pitch. Taxiing without the use of collective involves large displacements of cyclic from neutral which impose harmful loads on the rotor hub.
- Too much forward cyclic may also cause the tail wheel to become airborne, resulting in poor ground handling characteristics.
- Keep taxi speed under 10 knots in confined areas or on rough surfaces. Use judgment.

Note

- CROSSWIND TAXIING. The helicopter will tend to weathercock when taxiing crosswind. It is therefore necessary to maintain rudder in the downwind direction to desired heading. Hold cyclic control into the wind. Once desired heading is established, locking the tail wheel will assist in maintaining heading.
- DOWNWIND TAXIING. Directional control must be monitored closely when taxiing downwind, particularly in high wind conditions. Lock the tail wheel to assist in maintaining desired heading. When turning into the wind from a downwind heading, exercise caution and use rudder, augmented with brakes as required, to control rate of turn, as the helicopter will want to weathercock into wind.
- AIR TAXIING. During high wind conditions (above 20 knots) air taxiing, heading into the wind, is recommended. Extreme caution should be taken when air taxiing. The pilot, copilot, and crewman should act as lookouts. Taxiing altitude should be high enough to clear all obstructions.

BEFORE TAKEOFF

1. APN-130 – Transmitting.
2. TACAN – Trans/Rec.
3. IFF – As desired.
4. Plotting board – Track.
5. Engine and gearbox instruments – Check.
6. Caution panel – Check.

7. Hoist – OFF.
8. Heat and miscellaneous panel – As desired.
9. Tail wheel – Locked.
10. Shoulder harness – Locked.
11. Parking brake – As desired.
12. Takeoff clearance.
13. Lights – As desired.
14. ASE engage switch – ON.

BEFORE LANDING

1. Panel landing checklist – Complete before final approach.
   a. Landing gear – Down.
   b. Parking brake – Off (may be on for shipboard landing).
   c. Tail wheel – Locked.
   d. Shoulder harness – Locked.

AFTER LANDING

1. ASE – OFF.
2. Radar altimeter – OFF.

CAUTION

Failure to turn OFF RAD ALT may damage equipment on subsequent application of electrical power.

3. APN-130 – OFF.
4. RPM switches – Set at 102%.
5. Heat and Miscellaneous panel switches – All OFF.
6. Tail wheel – Unlocked if taxiing is necessary.

   Shore based operations – Refer to TAXIING Procedure, this section.

SHUTDOWN

Note

Check wind direction and velocity. Refer to figure 3–15 for maximum wind velocity for stopping rotors.

1. Tail Wheel – Locked.
2. Parking brake – ON.
3. Communication and navigation equipment switches – OFF.
4. Plotting board –
   a. Scale knob – OFF.
   b. Mode knob – STANDBY.
5. Windshield wipers – OFF.
6. Aux tank and landing gear ground safety pins – In.
7. Shoulder harness – Locked.
8. RPM switches – Full decrease rpm
9. Engine condition levers – IDLE.
10. Droop stops – Check IN.

CAUTION

Droop stops must be in before engine shutdown.

11. Engine condition levers – OFF.

CAUTION

Maintain neutral (or slightly into wind) cyclic control while stopping rotors. Excessive cyclic inputs during ground operation can damage droop stops and hub.

12. Rotor brake – ON, after droop stop, are in.

Note

Apply rotor brake with controlled pressure, reducing pressure as rpm decreases. Holding full pressure until rotor stops can cause excessive rotor flapping and may damage pitch locks. After rotor has stopped, lock rotor brake ON.

13. All overhead switches – OFF.
    a. Fuel pumps switch – OFF, after engines hav stopped.
    b. Battery switch – OFF.

BEFORE LEAVING AIRCRAFT

Tiedown gear – Climatic.
Secure aircraft if high winds are expected.

WARNING

Make appropriate entries on the yellow sheet, covering any operating limitations (part 4, Section I) that have been exceeded during any phase of the flight, including both amount and duration of all overtorques and overspeeds, etc. 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.

Pilot's Checklist

BEFORE STARTING ENGINE

1. Controls – Check.
2. Belt, seat and pedals – Adjusted.
3. Fuses, Circuit breakers – Checked.
4. Exterior lights – As desired.
5. Interior lights – As desired.
6. Heat & Misc panel – Gyro switch NORMAL, others OFF.
7. Hydraulic actuator – ON.
8. Hoist & hook panels – OFF.
9. ICS and Radio panels – As desired.
10. Starting panel – Gens ON, Batt, Fuel Pumps OFF.
11. Emergency panel – NORMAL.
12. Wipers – OFF.
13. Rotor brake – ON (Green).
14. Tailwheel – Locked.
15. Comm & nav switches – OFF.
16. Plotting board – OFF & STANDBY.
17. Clocks and altimeters – Set.
18. Radar altimeter – OFF.
19. Aux tank jettison handle – In & wired.
20. Landing gear handle – Down.
21. Landing gear emergency handle – Up.
22. Parking brake – Reset.
23. Cargo hook release – Aft.
24. Friction – As desired.
25. Landing & floodlights – OFF.

STARTING ENGINE

1. Fire extinguisher – Available and manned.
2. APU – Connect.
3. Landing gear indicators – Down.
4. Fire warning lights – Test.
5. Caution lights – Test.
6. Fuel quantity gage – Check.
7. 30 minute fuel and compressor lights – Test.
8. Engine Condition levers – OFF.
9. Actuator switches – NORMAL.
10. RPM switches – Decrease for 6 seconds.
11. Fuel pumps – ON.
12. Start engines (No. 1 first).
13. Turbine anti-ice – Checked.
14. Battery – ON.
15. APU – Disconnect.

STARTING ROTOR AND BEFORE TAXIING

1. Rotor clearance – Checked.
2. Wind direction and velocity – Check.
3. Shoulder harness – Locked.
4. Rotor brake – Off.
5. Engage rotor – No. 1 Engine noting temperatures and pressures.
6. Caution lights – Off.
7. Comm & nav switches – As desired.
8. MA-1 – Check and Align.
9. Plotting board – On.
10. Rad altimeter – As desired.
11. Emergency throttle – No. 2 engine.
12. Min/Max beep – No. 1 engine.
13. No. 1 Actuator switch – Off, test, normal.
14. No. 2 engine to Fly and No. 1 engine to idle.
15. Emergency throttle – No. 1 engine.
16. Min/Max beep – No. 2 engine.
17. No. 2 actuator switch – Off, test, normal.
18. Both condition levers – Fly.
19. Hoist and fishpole – Check.
20. Control response – Check.
21. Boost – Check.
22. ASE – Check.
23. APN-130 and ASA-13A – Test.
24. Fuel pumps – Check.
25. RAI – Set.
26. Hydraulic pressure – Check.
27. Taxi clearance.
28. Taxiing rpm – 102%, torques married.
29. Aux tank and gear pins – Out.
30. Parking brake – Off.
31. Tailwheel – Unlocked.

BEFORE TAKEOFF

1. APN-130.
2. TACAN.
3. IFF.
4. Plotting Board.
5. Engine and Gearbox Instruments.
6. Caution Panel.
7. Hoist.
8. Heat and Miscellaneous.
9. Tailwheel.
10. Inertia Reel.
11. Parking Brake.
12. Takeoff Clearance.
13. Lights.
14. ASE.

Figure 3–2 (Sheet 1)

Pilot's Checklist

BEFORE LANDING

1. Panel landing checklist – Complete.

AFTER LANDING

1. ASE – OFF.
2. Radar altimeter – OFF.
3. APN-130 – OFF.
4. RPM switches – 102%.
5. Heat and misc panel – All OFF.
6. Tail wheel – As needed.

SHUTDOWN

1. Tail wheel – Locked.
2. Parking brake – ON.
3. Comm & nav switches – OFF.
4. Plotting board – OFF & STANDBY.
5. Wipers – OFF.
6. Aux tank and gear pins – In.
7. Shoulder harness – Locked.
8. Rpm switches – Minimum beep.
9. Condition levers – IDLE
10. Droop stops – In (55%).
11. Condition levers – OFF.
12. Rotor brake – ON, after droop stops are in.
13. Overhead switches – OFF.
    a. Fuel pumps switch – OFF, after engines have stopped.
    b. Battery switch – OFF.

SHIPBOARD OPERATIONAL CHECKLIST

PRE-START.

1. Seat Belts & Pedals.
2. Controls.
3. Circuit Breakers, overhead, & Emer. Panel.
4. Rotor Brake – ON. Tail Wheel – LOCKED.
5. Console – ALL OFF. Landing & Flood Lights – OFF.
6. Inst Panel – OFF. Altimeters – SET.
7. Condition Levers – OFF. Actuators – NORMAL.
8. Parking Brake– RESET.

START.

1. APU – CONNECT. Firebottle – READY.
2. Caution & Fire Warning Lights – TEST.
3. Fuel – CHECK.
4. Fuel Pump – ON.
5. Min Beep
6. Start No. 1 & No. 2 (Monitor Pressures).
7. Battery – ON.
8. APU – DISCONNECT.
9. Turbine anti-ice – CHECKED.

ENGAGEMENT.

1. Rotor Clearance & Shoulder Harness.
2. Engage No. 1.
3. Radios, Nav Equip. & MA-1 – ON & SET.
4. Rad Alt – ON Raws – SET.
5. Controls & Trims – CHECK.
6. Hoist – CHECK.
7. Max Beep No. 1.
8. N_f/N_r No. 1 100%.
   a. Actuator No. 1 – TEST.
   b. Emergency Throttle No. 2 – TEST.
9. No. 2 Eng – FLY. No. 1 Eng – IDLE.
10. Max Beep No. 2.
11. N_f/N_r No. 2 100%.
    a. Actuator No. 2 – TEST.
    b. Emergency Throttle No. 1 – TEST.
12. No. 1 Eng – FLY.
13. RAI – SET.
14. ASE – CHECK.
15. APN 130 – CHECK.
16. Fuel Pumps – TEST.
17. Boost & Hydraulic Pressure – CHECK.

TAKEOFF.

1. Chocks out & chains off signal.
2. Takeoff checklist completed.
3. APN-130 in transmit.
4. Chains counted.

AFTER LANDING.

1. Brakes on, ASE off.
2. Check chains & gear pins in place.
3. RPM minimum.
4. Comm & nav. gear off (UHF last).
5. Disengage when cleared.

Figure 3–2 (Sheet 2)

SYSTEMS CHECK

EMERGENCY THROTTLE CHECK.

Check emergency throttle with one engine in fly and one in idle.

1. Select emergency throttle on the engine in idle.
2. Beep up the engine in emergency throttle, increasing N_g to marry the two N_f needles.
3. Observe the torque on the engine in emergency throttle increase ½%, then stop beeping up and allow N_g to stabilize.

CAUTION

Stopcock the engine condition lever in the event N_f/N_r rises above 102%.

4. Beep back ½% torque, and allow N_g to stabilize.
5. Return emergency fuel control switch to normal and observe N_g decrease to ground idle and the N_f needle split away from N_r.

ACTUATOR CHECK.

Check the actuator with the engine being checked in fly and the other in idle.

1. Set N_r at 100%.
2. Place actuator switch on enging being checked to off. Move condition lever out of fly and note that N_r/N_f remains at 100%, then return condition lever to fly.
3. Place actuator switch to test, and hold until hard over downlimit is reached. Observe N_g drop to approximately 70% and N_r/N_f to stabilize between 87% and minimum beep.
4. Place actuator switch to normal, and observe N_g, T_5 and torque to increase and then decrease. If at any time in the movement of the actuator switch to test and back to normal, any audible engine rumble is heard, or if an abnormal rise in T_5 is noted, an engine compressor stall is indicated.

CAUTION

If T_5 rises abnormally toward the limit, stopcock the engine.

TURBINE ANTI-ICE.

Turn on turbine anti-icing and in each engine note approximately ½% decrease in N_g or a noticeable increase in T_5. If OAT is below, or expected to be below 10° C (50° F), leave switch on. Turbine anti-icing is used as a preventive measure, not a corrective one, and must be turned on whenever icing conditions are anticipated.

FUEL QUANTITY CHECK.

When checking fuel in the individual tanks, move the fuel quantity selector switch to the TEST position and allow the pointer to move to zero prior to selecting either AUX tank or AFT tank. This will preclude the possibility of an erroneous reading due to a stuck pointer.

FUEL TRANSFER PUMP CHECK.

Either of the two transfer pumps located in the aft tank is capable of complete fuel transfer. To check the pumps, proceed as follows:

1. Fuel pumps switch – No. 1 TEST, and hold for 5 seconds.
2. Fuel transfer caution light – Check. If light comes on, the number one transfer pump is inoperative.
3. Fuel pumps switch – No. 2 TEST, and hold for 5 seconds.
4. Fuel transfer caution light – Check.
5. Fuel pumps switch – Release.

YAW TRIM.

Actuate to the left and note the resulting left rudder input. Then actuate to the right, and note a corresponding rudder input. Use minimum actuation to prevent tail skid.

CYCLIC TRIM.

Actuate longitudinal trim fore and aft, and lateral trim left and right, noting corresponding movement in tip path plane and cyclic stick.

BOOST.

Beep N_f/N_r to 99%, raise collective slightly off bottom, and disengage hydraulic control boost with boost release button on the pilot's collective switchbox, noting no abrupt control inputs to cyclic or collective. A slight thump is normal. Lower collective, and have copilot cycle the hydraulic actuator switch, again noting no abrupt control inputs.

ASE.

Ground check the ASE in the following manner – the pilot going through the entire procedure, monitored by the copilot and then the copilot repeating the procedure, monitored by the pilot:

1. Check that OFF flag on copilot's remote attitude indicator (RAI) is covered, indicating that the ASE warmup time is complete, and ASE is ready for engagement.
2. Engage ASE and check for erratic movement in cyclic, and rudders. Disengage ASE with cyclic disengage button.

3. Engage ASE and actuate trims, checking for smooth and free movement. Note corresponding movement of tip path plane on actuation of cyclic trim. Do not allow excessive cyclic input. Neutralize trim as soon as proper response is noted.
   a. Yaw trim – When yaw trim switch is moved left, left rudder should move forward. When switch is released, movement should continue until stopped by briefly depressing the left rudder pedal. When the switch is moved right, the right rudder should move forward. When the switch is released, movement should continue until stopped by briefly depressing the right rudder pedal.

Note

If the rudder pedal is depressed and released quickly after releasing the trim switch the movement of the rudder pedals may reverse.

   b. Lateral trim – After releasing trim button, trim should cease travel in the originally established direction.
   c. Longitudinal trim – After releasing trim button, trim should continue to travel in the originally established direction.
4. Move BAR ALT switch to BAR ALT, raise collective slightly, and depress altitude control button on the collective. Ensure that no erratic collective movement results and that the ON flag appears in the window above the altitude control button.
5. Check that copilot's radar altimeter is set above 20 feet. Engage RAD ALT and note a smooth increase in collective pitch.

CAUTION

Do not allow aircraft to become light on the gear during this check.

6. Disengage ASE. BAR ALT and RAD ALT should also disengage.

IN-FLIGHT RAD ALT HOLD CHECK.

1. Altitude – 150 feet.
2. Airspeed – 70 knots.
3. Copilot's radar altimeter bug – 175 feet.
4. ASE, BAR ALT, and RAD ALT – Engaged.

   Aircraft should climb to 175 feet.

Note

Doppler memory light must be out or system is unreliable.

5. Copilot's radar altimeter bug – 125 feet.

   Aircraft should descend to 125 feet at a rate of de scent not exceeding 350-450 feet per minute.
6. Disengage BAR ALT and RAD ALT.

APN-130 AND ASA-13A CHECK.

1. ASA-13A computer power switch – ON.
2. ASA-13A variation knob – Zero.
3. APN-130 power switch – ON.
4. Land-sea switch – LAND.
5. Transmit-standby switch – STANDBY.
6. Hover-auto switch – AUTO.
7. Plotting-board mode knob – STANDBY.
8. Plotting board scale knob – As desired.
9. APN-130 test-operate switch – TEST.
10. Check for the following indications:
    a. Memory light – OUT.
    b. DVI: heading velocity – 1.5 divisions up.
       drift velocity – 1.5 divisions right.
       vertical velocity – 1.0 divisions up.
       hover flag – showing.
    c. GSDA: groundspeed needle – 21 knots.
       drift angle needle – 225°.
    d. ASA-13A computer panel: wind speed 21 knots (approx) and wind direction reading from 045° relative if magnetic variation is 0°.
    e. The plotting board bug should track 225° relative if magnetic variation is 0°.
11. APN-130 test-operate switch – Return to OPERATE position.

TAKEOFF PROCEDURES

After reaching takeoff position, head the aircraft into the wind. Move the tail wheel locking lever to the locked position while still rolling and displace directional controls slightly to ensure the tail wheel is locked. The locking pin is spring-loaded and will lock in place when the tail wheel is fore and aft. Use brakes, and aft cyclic cautiously, if necessary, to stop the aircraft. When stopped, neutralize cyclic and collective to minimum.

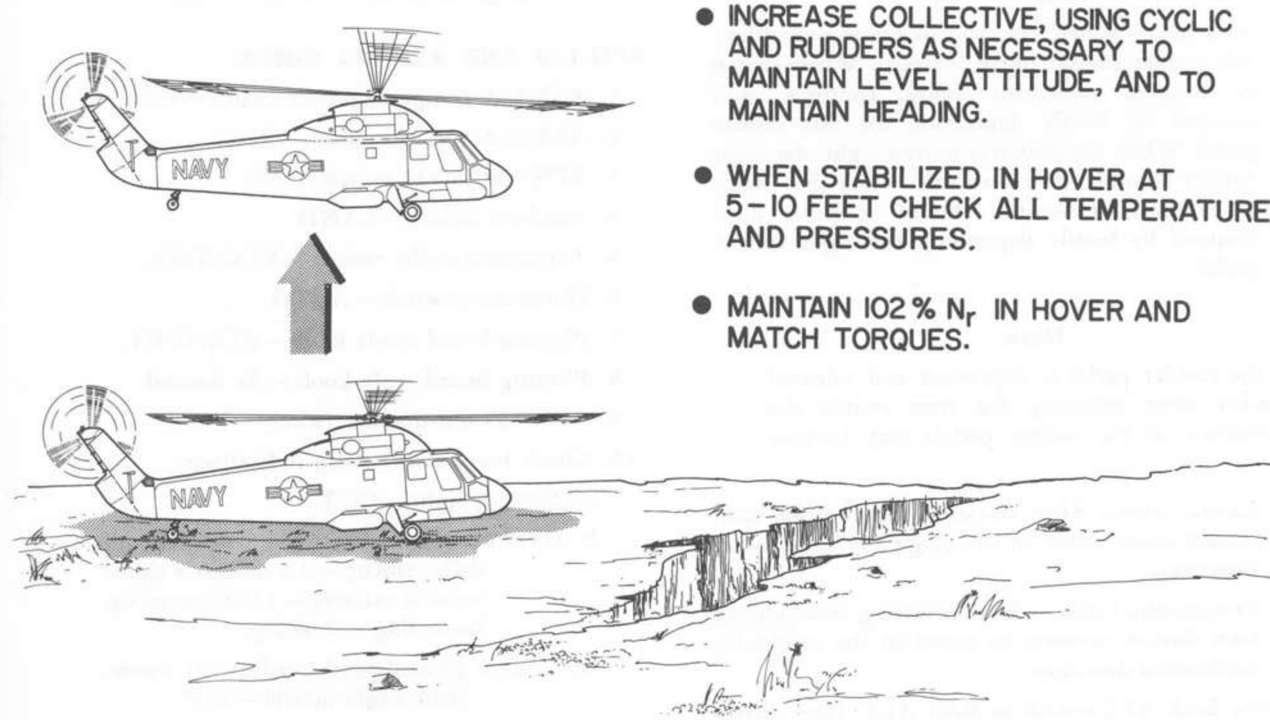
CAUTION

Check tip path plane to ensure neutral position.

VERTICAL TAKEOFF AND HOVER.

Increase collective using cyclic and rudders as necessary to maintain level attitude and to maintain heading. (See figure 3–3.) When stabilized in hover at 5-10 feet, check all temperatures and pressures. Maintain 102% N_r in hover and match torques.

Vertical Takeoff and Hover



- INCREASE COLLECTIVE, USING CYCLIC AND RUDDERS AS NECESSARY TO MAINTAIN LEVEL ATTITUDE, AND TO MAINTAIN HEADING.
- WHEN STABILIZED IN HOVER AT 5-10 FEET CHECK ALL TEMPERATURES AND PRESSURES.
- MAINTAIN 102% N_r IN HOVER AND MATCH TORQUES.

Figure 3–3

MAXIMUM PERFORMANCE TAKEOFF.

Maximum takeoff performance is obtained by the normal takeoff procedure using maximum power. (See figure 3–4.) Add collective and coordinated cyclic to obtain translational lift as efficiently as possible.

RUNNING TAKEOFF.

When operating at high gross weights, pressure altitudes, or outside air temperatures, running takeoffs may be required. (See figure 3–5.) The takeoff should be made into the wind when possible. With the takeoff checklist complete and a clear runway ahead, increase collective pitch and use forward cyclic to obtain desired takeoff speed. Maintain directional control and, at takeoff speed, move cyclic stick aft to become airborne. For practice purposes use 5% less torque than is required to hover for the particular conditions.

CROSSWIND TAKEOFF.

Normally it is best to taxi the aircraft into the wind for takeoff. When this cannot be done, maintain directional control and use of cyclic as necessary to prevent tipping and drift. When airborne, turn into the wind if possible for climbout, or takeoff crosswind with zero drift. (See figure 3–6.)

CAUTION

Crosswind takeoffs are not recommended with winds exceeding 15 knots or in gusty wind conditions.

HOVERING

Into the wind: The most comfortable hover is approximately 10 feet wheel to ground clearance (10 ft by RAD ALT). This is sufficient altitude to be clear of rotor wash with no wind and low enough for a safe landing in case of malfunction.

Crosswind or Downwind: Normally crosswind and downwind hovers in winds in excess of 15 knots will be avoided due to the difficulty in maintaining directional control.

TURNS ON THE SPOT

Turns on the spot shall not be attempted when wind velocity exceeds 15 knots. Normally the first turn will be made to the left, to check directional control and ensure that sufficient left rudder is available to maintain control. Abrupt and erratic movement of the controls, and high rates of turn shall be avoided.

Maximum Performance Takeoff

Figure 3—4

Running Takeoff

- MAKE TAKEOFF INTO THE WIND IF POSSIBLE.
- COMPLETE TAKEOFF CHECKLIST.
- INSURE THAT RUNWAY IS CLEAR.
- INCREASE COLLECTIVE PITCH
- USE FORWARD CYCLIC TO OBTAIN DESIRED TAKEOFF SPEED
- MAINTAIN DIRECTIONAL CONTROL
- AT TAKEOFF SPEED MOVE CYCLIC AFT TO BECOME AIRBORNE.

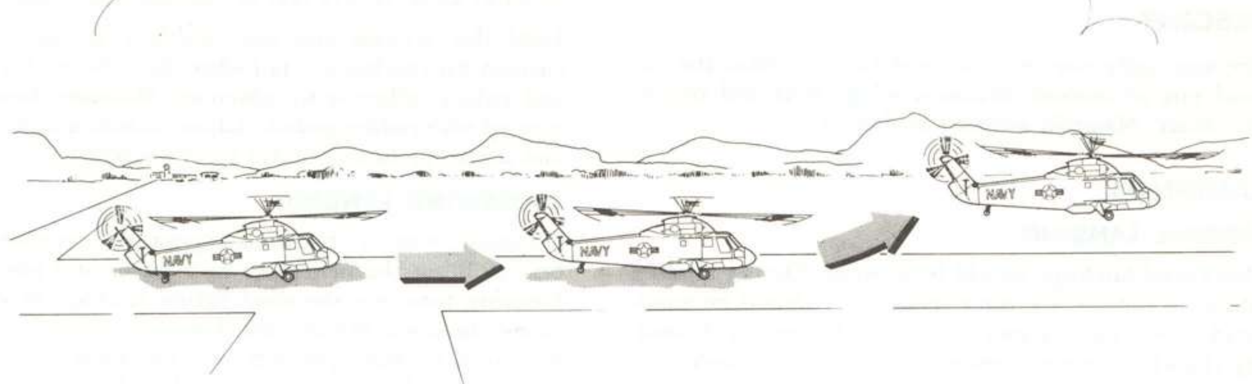


Figure 3—5

Crosswind Takeoff

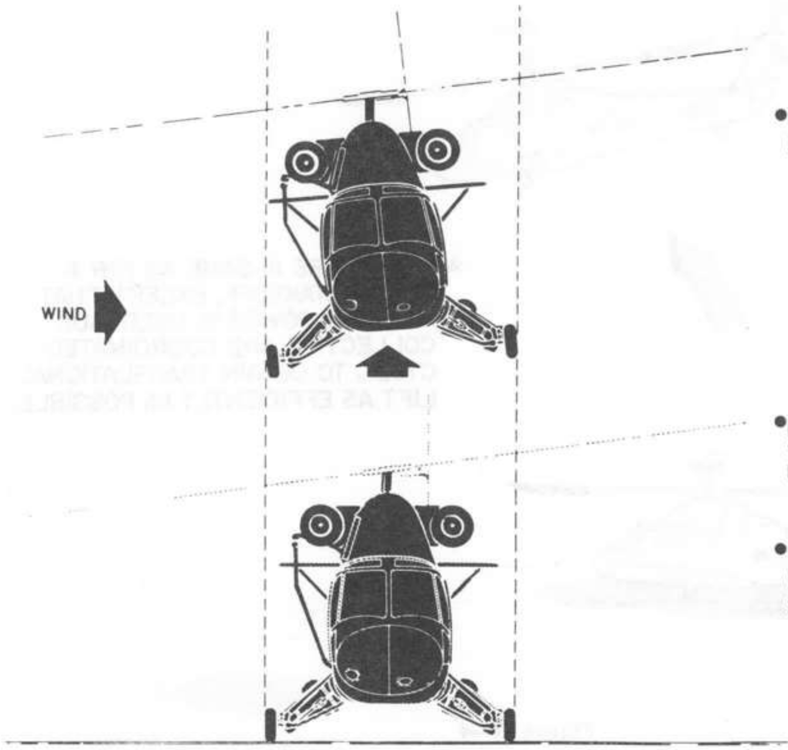


Figure 3–6

CLIMBOUT PROCEDURES

From a hover, trim the cyclic stick forward while increasing collective to prevent settling. Establish a climb at 70 knots.

FLIGHT PROCEDURES

For information regarding Flight Procedures, refer to Section IV.

DESCENT

Decrease collective pitch as necessary to attain the desired rate of descent. Maintain wings level and ball in the center. Maintain airspeed as desired.

LANDINGS

NORMAL LANDING.

Downwind landings should be avoided. During landing and after touchdown, rotor speed (N_r) should be monitored to maintain desired rpm. From a hover, with landing checklist complete, reduce collective pitch slightly to approach the ground. (See figure 3–7.) Keep the aircraft level with cyclic control and maintain heading until ground contact is made. Use collective as necessary to cushion the landing. Normally the tail wheel will touch first, and then both main gear will touch simultaneously. Decrease collective pitch to full down after landing. Monitor N_f/N_r as collective is lowered to prevent possible overspeed.

RUNNING LANDING.

On final landing from a normal approach, begin raising the nose at approximately 100 feet to achieve an airspeed of 40-45 knots at 5-10 feet of altitude. (See figure 3–8).

Hold this attitude and use collective as necessary to cushion the touchdown, tail wheel first. Neutralize cyclic and reduce collective to minimum. Maintain directional control with rudder pedals. Adjust collective as necessary and use aft cyclic and brakes to stop aircraft.

CROSSWIND LANDING.

Normally, when a crosswind approach is necessary, it is best to bring the helicopter to a hover and perform a hovering turn into the wind before landing. When this cannot be done, execute the flare and hover, as though making a normal approach into the wind. (See figure 3–9.) Stop all drift before touching down. In a strong wind, it will be necessary to hold the helicopter in a slip,

Normal Landing

- MONITOR ROTOR SPEED THROUGHOUT TO MAINTAIN DESIRED RPM.
- COMPLETE LANDING CHECKLIST.
- REDUCE COLLECTIVE PITCH SLIGHTLY TO LET DOWN.
- KEEP AIRCRAFT LEVEL WITH CYCLIC.
- MAINTAIN HEADING.
- USE COLLECTIVE AS NECESSARY TO CUSHION LANDING.
- NORMALLY TAIL WHEEL WILL TOUCH FIRST FOLLOWED BY BOTH MAIN GEAR TOUCHING SIMULTANEOUSLY.
- DECREASE COLLECTIVE TO FULL DOWN AFTER LANDING.

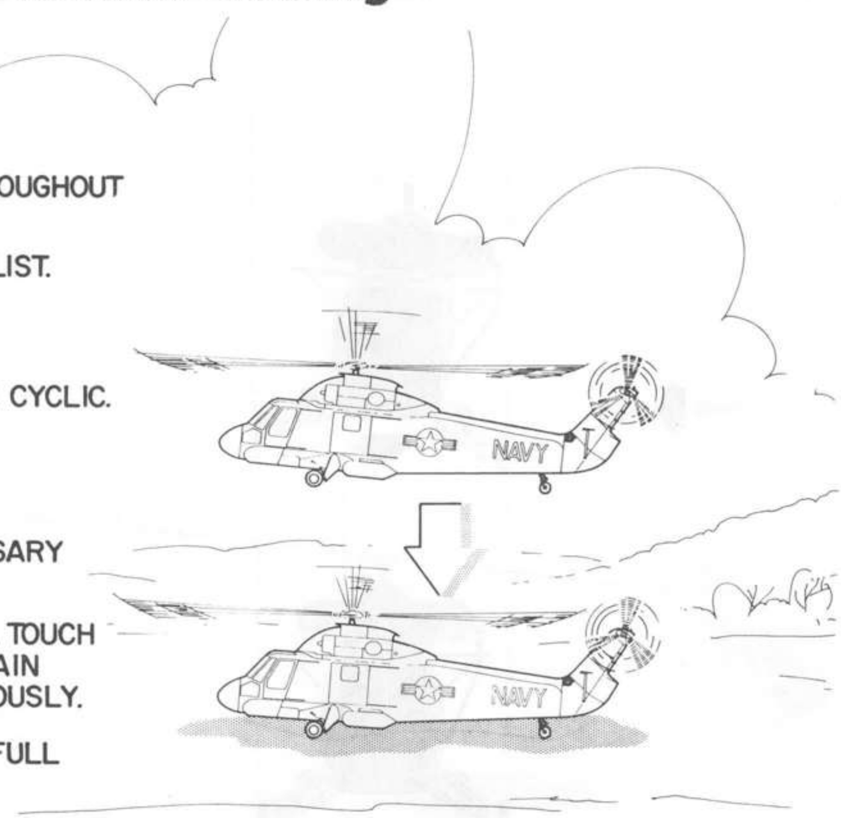


Figure 3–7

Running Landing

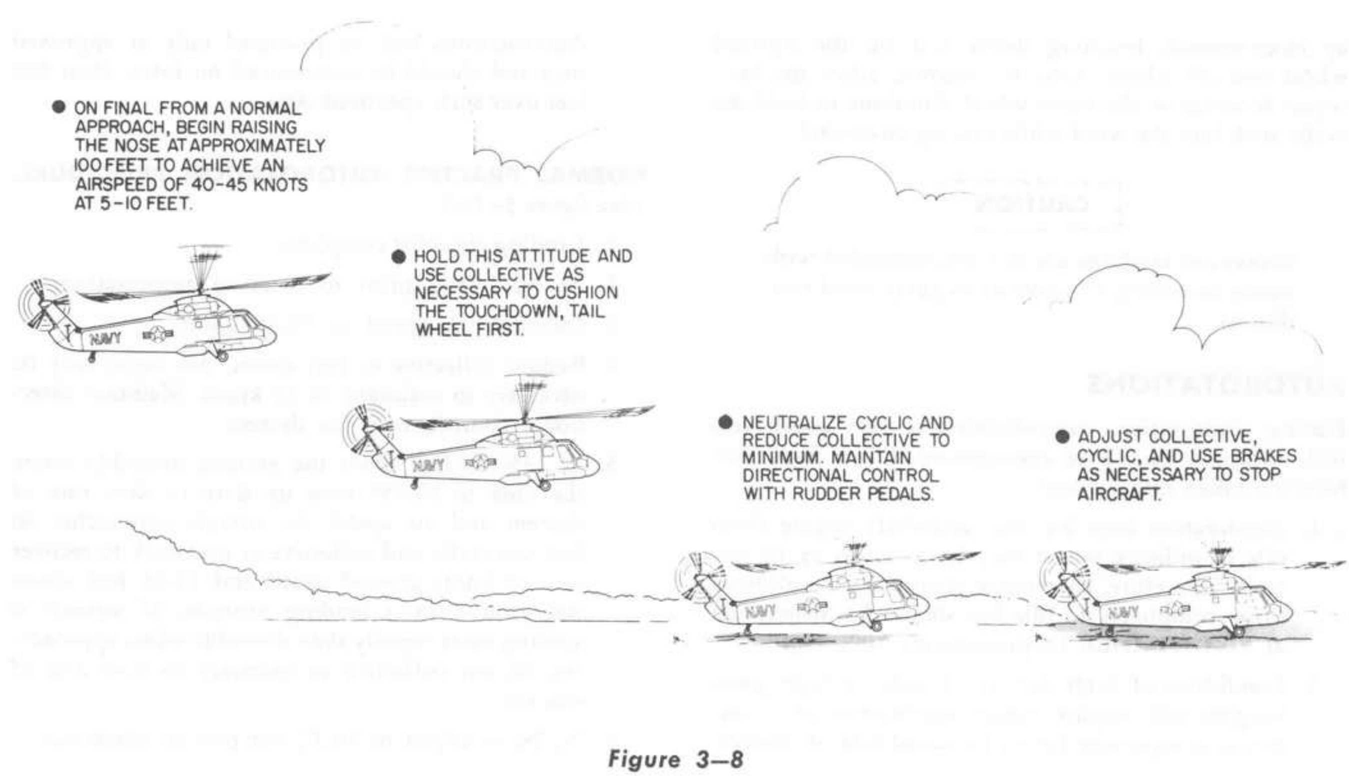


Figure 3–8

Crosswind Landing

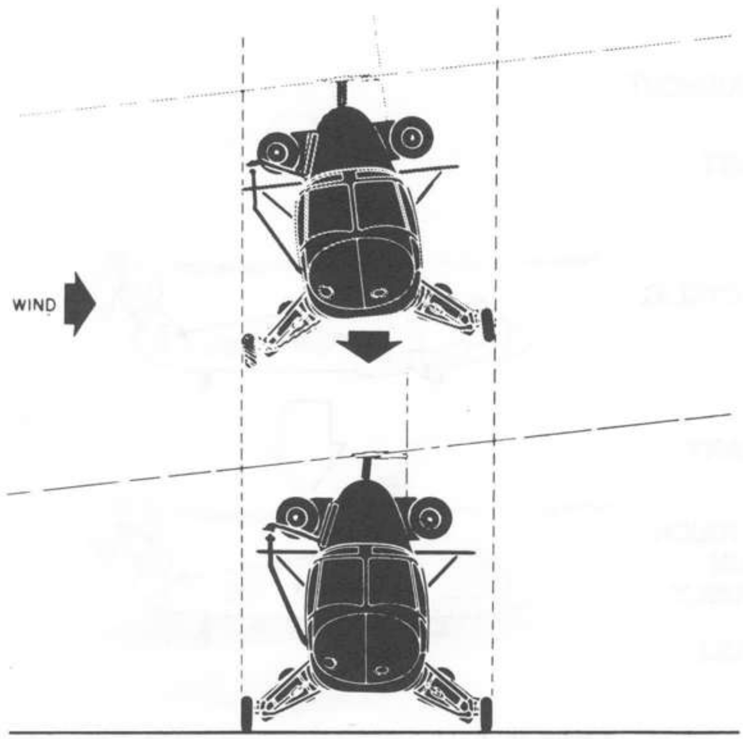


Figure 3—9

by cross-control, touching down first on the upwind wheel and tail wheel. After touchdown, allow the helicopter to settle on the other wheel. Continue to hold the cyclic stick into the wind while taxiing crosswind.

CAUTION

Crosswind landings are not recommended with winds exceeding 15 knots or in gusty wind conditions.

AUTOROTATIONS

During autorotation, controllability is very good, and little difficulty should be encountered if two important facts are taken into account:

1. Acceleration time for the turboshaft engine from idle to military power may be as much as 10 seconds. Therefore, the engine should not be allowed to go completely to idle but should be maintained at FLIGHT IDLE (approximately 70% N_g).
2. Conditions of high density altitude or high gross weights will require earlier application of collective to compensate for an increased rate of descent.

Autorotations will be practiced only at approved sites and should be commenced no lower than 500 feet over such approved sites.

NORMAL PRACTICE AUTOROTATION PROCEDURE. (See figure 3—10.)

1. Landing checklist complete.
2. N_f/N_r — 98% prior to entering autorotation.
3. Establish air speed at 70-75 knots.
4. Reduce collective to full down. Aft cyclic may be necessary to maintain 70-75 knots. Maintain directional control, trim for descent.
5. At 125-150 feet above the ground, smoothly rotate the nose to 20-25° nose up flare to slow rate of descent and air speed. As aircraft approaches 60 feet use cyclic and collective as necessary to recover at 0-10 knots ground speed and 10-15 feet above the ground in a landing attitude. If aircraft is settling more rapidly than desirable when approaching 60, use collective as necessary to slow rate of descent.
6. N_f/N_r — Adjust to 102% for normal climb out.

Normal Practice Autorotation Procedure

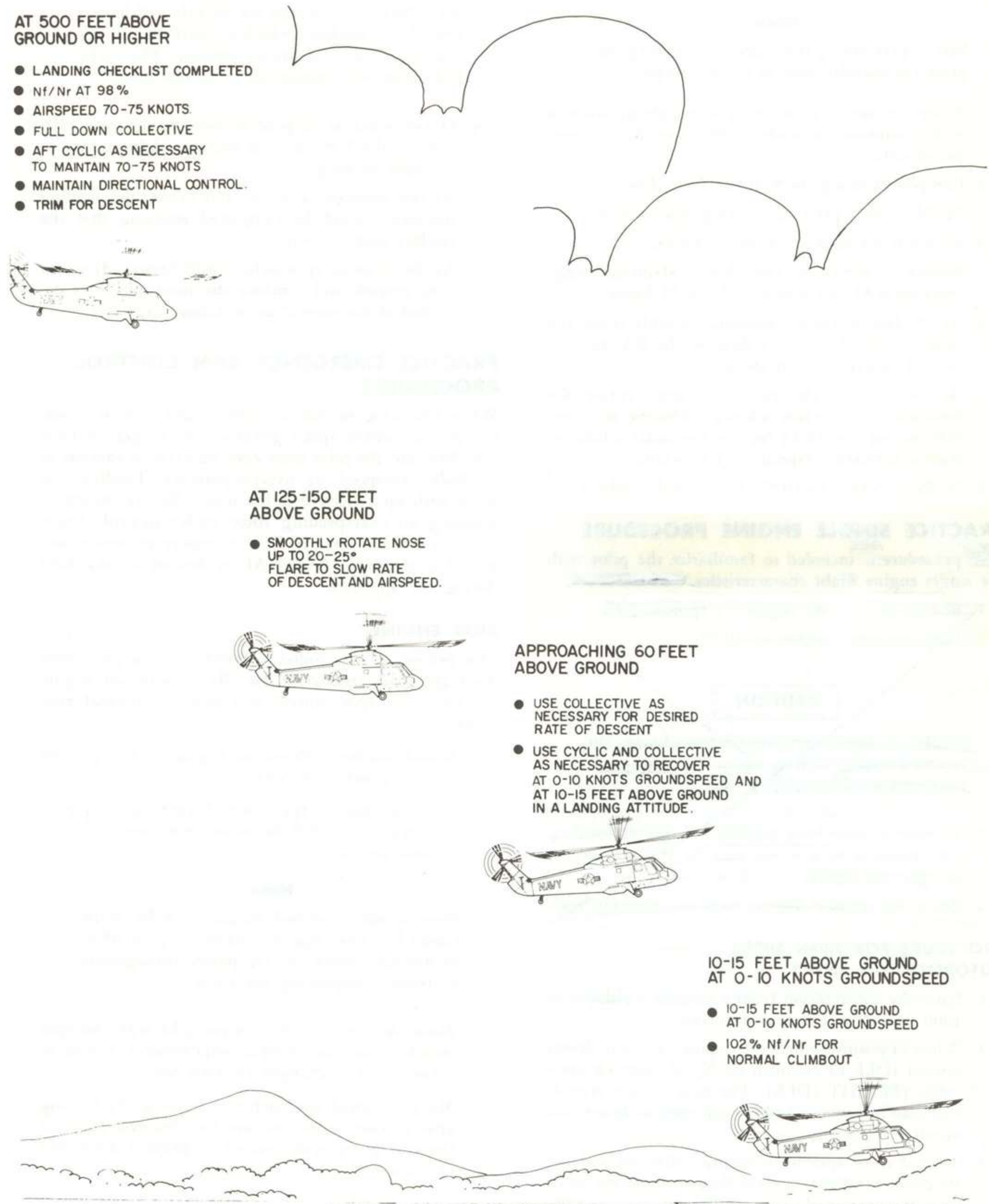


Figure 3—10

PRACTICE NIGHT AND INSTRUMENT AUTOROTATION PROCEDURE.

Note

Before performing this maneuver, a designated plane commander must be in the cockpit.

1. Enter the autorotation from a straight-in position with a minimum altitude of 1000 feet above a prepared surface.
2. Complete landing checkoff list. Gear down.
3. N_f/N_r – 98% prior to entering autorotation.
4. Establish airspeed at 70 to 75 knots.
5. Reduce collective to full down. Maintain wings level on RAI and maintain 70 to 75 knots.
6. At 175 feet on radar altimeter, smoothly rotate the nose to a 20-25° nose up flare on the RAI to slow rate of descent and airspeed.
7. At 60 feet on the radar altimeter, rotate the helicopter level while adding collective to effect full recovery by 10-15 feet on the radar altimeter, with a forward airspeed of 5-15 knots.
8. N_f/N_r – Adjust to 102% for normal climbout.

PRACTICE SINGLE ENGINE PROCEDURE

These procedures are included to familiarize the pilot with the single engine flight characteristics.

HOVER

Warning

Before simulating single engine failure in a hover, ensure that the helicopter can be hovered in ground effect at 5 FT wheel height on one engine by landing and inducing a hardover down (actuator control switch to test position) on one engine. Carefully perform a single engine takeoff to a hover. If single engine IGE hover can be maintained with a minimum of 100 percent NR, adequate margin exists for safely practicing single engine in a hover. See figures 11-2, 11-14, and S11-19 (sheet 2).

(1) Establish 40 FT hover; both engines in fly, NR at 102 percent.

(2) Induce hardover down on one engine by placing the actuator control switch on the quadrant to the test position.

Note

Condition lever must be in fly

CAUTION

As collective is lowered the aircraft will have a nose down tendency which is controlled by using aft cyclic to maintain attitude. The cyclic bobweight will initiate aft cyclic movement.

4. Dissipate excess airspeed by holding the nose position on the horizon, and increase right rudder to maintain heading.
5. As the airspeed slows to 100 knots, the landing checklist should be completed ensuring that the landing gear is down.
6. As the airspeed approaches 70-75 knots, adjust the nose attitude and continue the autorotation as described in the normal autorotation procedure.

PRACTICE EMERGENCY RPM CONTROL PROCEDURES

When operating in the emergency rpm control mode, the power turbine speed governor no longer controls fuel flow and the pilot must exercise extreme caution to preclude overspeed or overtemperature. Loading the rotor with up collective is the most effective means of bringing an overspeeding rotor under control. Leave engine condition lever in FLY to ensure governor control if a return to NORMAL is desired at any time during the approach.

DUAL ENGINE.

This procedure is included to familiarize the pilot with the flight characteristics of the UH-2C with one engine in emergency rpm control and other in normal rpm control.

1. Induce hardover down on engine to be operated by emergency rpm control.
2. Select emergency rpm control. Increase torque to maintain 10 to 15% below other engine with rpm control switch.

Note

More closely matched torques can be maintained but this requires additional pilot effort to maintain more precise power management to avoid overspeeding the rotor.

3. Maintain a 10 to 15% torque split with the rpm switch. Anticipate torque requirements whenever collective pitch changes are required.
4. Make a normal approach to a landing. As landing gear touches down, initiate full decrease beep on the emergency rpm control to prevent overspeed of rotor.
5. Upon completion of practice, select normal rpm control.

Normal Approach

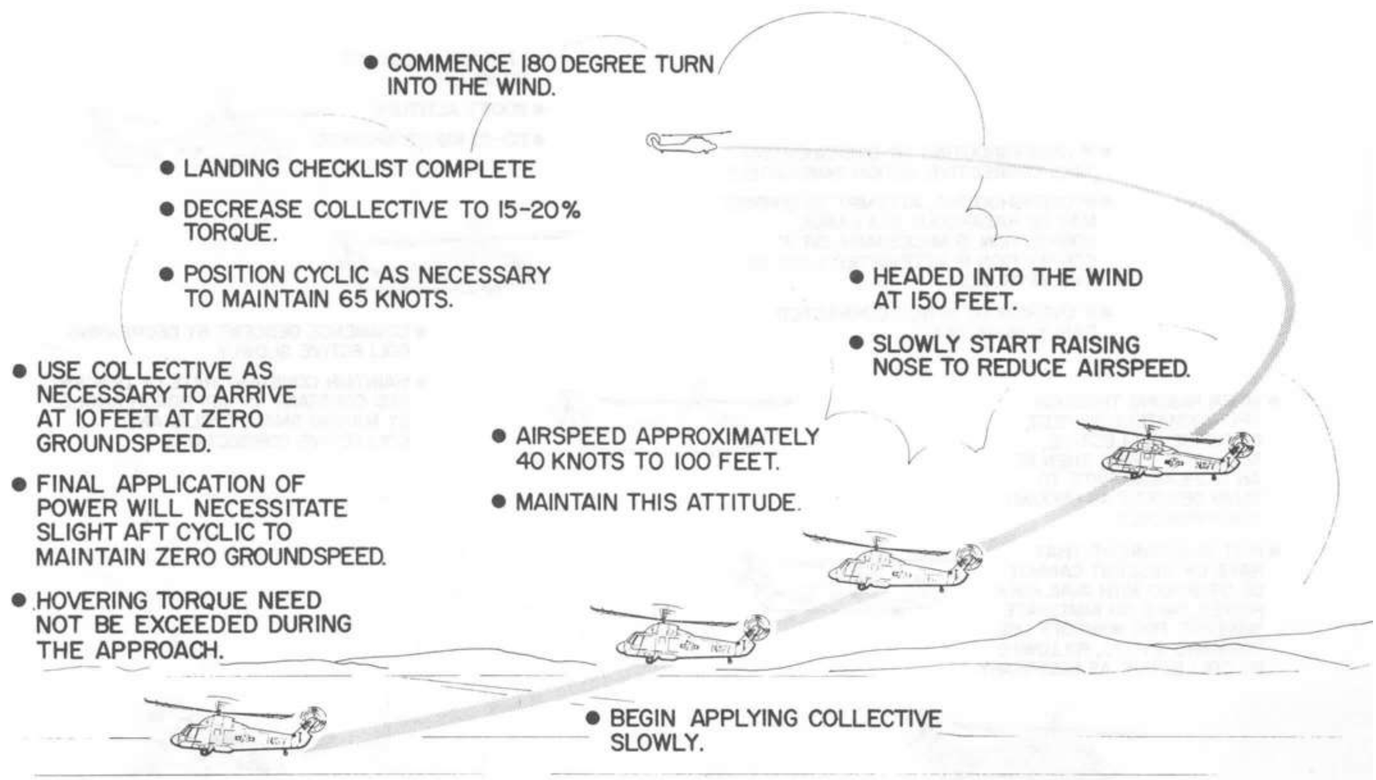


Figure 3—11

SINGLE ENGINE.

This procedure is included to familiarize the pilot with the flight characteristics of the UH-2C with one engine in emergency rpm control and the other engine simulated failed.

1. Induce hardover down on engine to be operated by emergency rpm control. Other engine set at min. beep or hardover down.
2. Select emergency control on engine in hardover down, beep up to 98% N_f/N_r.
3. Slowly increase N_g to maintain 98-100% N_f/N_r for hover and take-off.
4. Make speed changes at a slow rate to minimize power and rpm changes.
5. Adjust N_g to maintain 98-100% N_f/N_r in approach to a hover or run-on landing.
6. After touchdown, slowly lower collective and decrease (min beep) rpm to avoid overspeed.
7. Upon completion of practice, select normal rpm control.

RAPID DECELERATION MANEUVERS

These maneuvers are accomplished while maintaining a constant altitude. They can be employed in any situation where it is necessary to rapidly reduce airspeed, such as obstruction avoidance, aircraft avoidance, or quick stops. In the controlled environment, the maneuver is best practiced while climbing out following takeoff. At 50 feet and 60 to 70 knots begin a smooth reduction of collective, coordinated with aft cyclic so as to maintain altitude. The down collective should be led with down beeps on the rpm switch so as to maintain N_f/N_r at 102%. The peak nose attitude (approximately 30° above this horizon) is reached with full down collective and enough aft cyclic to produce a level flight path. Recovery is commenced at 25 to 30 knots groundspeed with smooth application of up collective and forward cyclic. Again, up collective is led by up beeps on the RPM switch to maintain N_f/N_r at 102%. The maneuver is complete when the aircraft is in a level attitude at 10 to 15 knots groundspeed and at the original altitude. At this point, the pilot can wave off straight ahead or enter a hover if he is into the wind.

NORMAL APPROACH

A normal approach is a transition maneuver beginning with 65-70 knots at a position on the downwind leg abeam the landing area at 500 feet altitude, and ending with a hover at an altitude of 10 feet with zero groundspeed. (See figure 3—11.)

Precision Approach

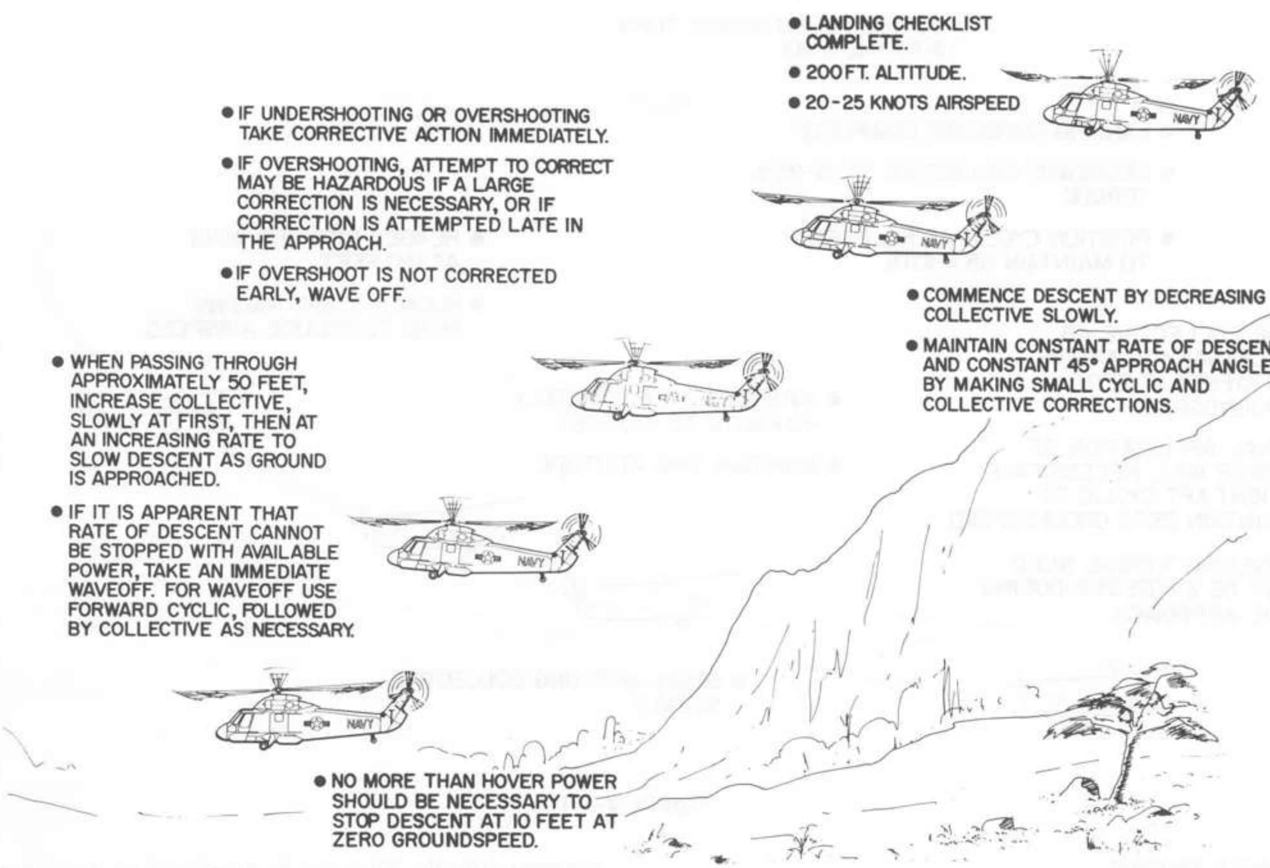


Figure 3—12

Just prior to reaching the abeam position, slowly decrease the collective pitch to between 15 and 20% torque and, at the same time, position the cyclic stick as necessary to maintain an airspeed of 65 knots. When at the abeam position, commence a 180° turn into the wind. Normally, the helicopter should be into the wind at approximately 150 feet altitude. When passing through 150 feet of altitude, slowly raise the nose to reduce airspeed. Continue raising the nose slowly as altitude decreases so as to pass through 100 feet at an airspeed of approximately 40 knots. (This attitude is only slightly nose high.) Maintain this attitude by use of the cyclic, and when passing through 80 feet altitude, begin applying collective pitch slowly. As the airspeed and altitude decrease, use collective as required to attain 10 feet of altitude and zero groundspeed. The helicopter will reach zero groundspeed in a slightly nose-high attitude. Final application of power will level the helicopter and necessitate a slight application of back cyclic stick to maintain zero groundspeed. If collective pitch is properly applied, hovering torque will not be exceeded during the approach.

PRECISION APPROACH

A precision approach is any approach made to a specific, preselected spot. Such an approach may be required by the mission for landings or pickups in confined areas or sites with high surrounding obstructions.

The practice precision approach is a straight-in, high angle (45°) approach to a definite spot from an altitude of 200 feet. (See figure 3—12.)

Approach the landing site at 200 feet, reducing airspeed to 20 to 25 knots prior to arrival at the 45° approach path. Commence descent on the 45° approach path by decreasing collective slowly to maintain a constant rate of descent and approach angle.

Rescue Pattern

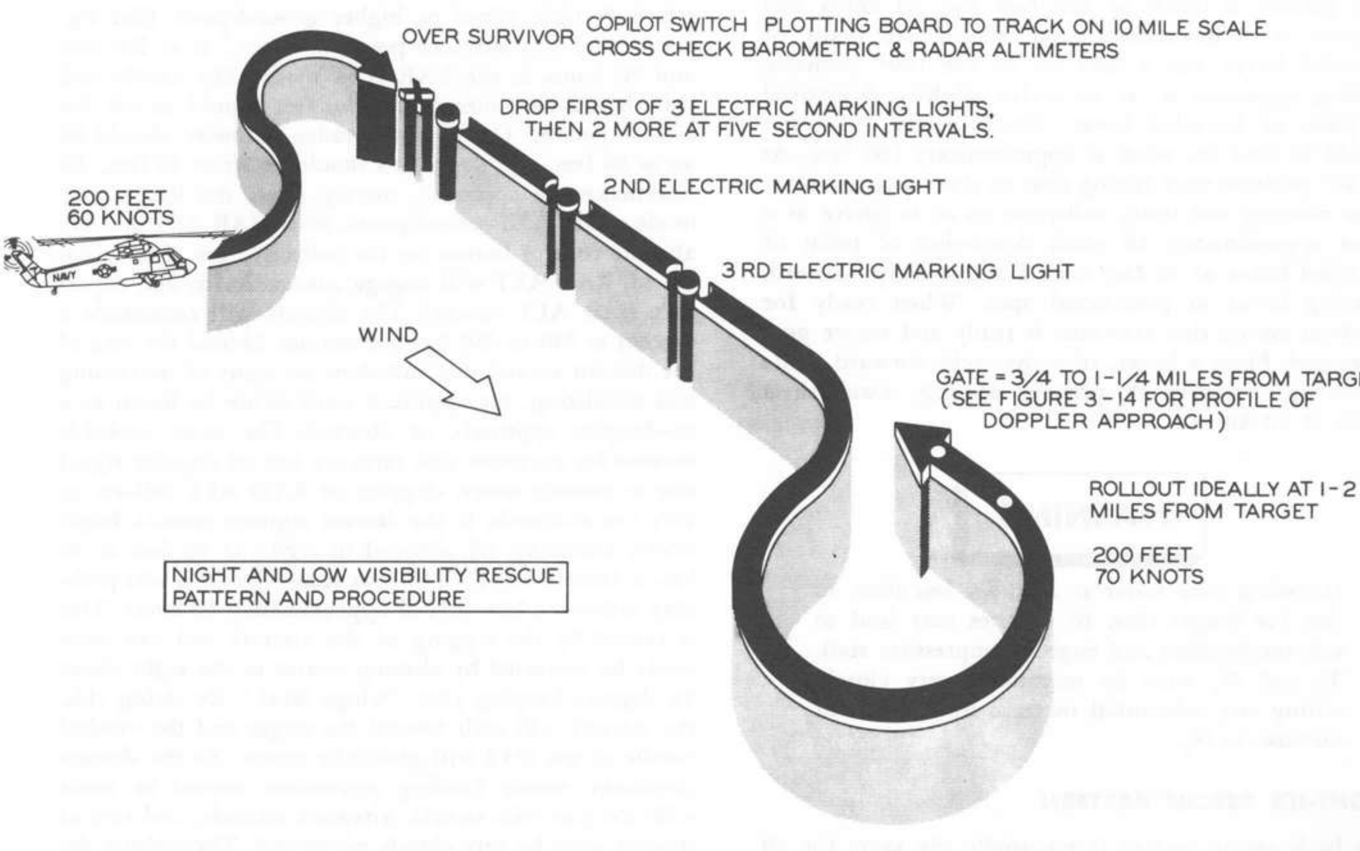


Figure 3—13

When passing through approximately 50 feet, increase collective, slowly at first, then at an increasing rate, to slow the descent as the ground is approached. If the maneuver has been properly executed, only hovering power will be necessary to stop the descent completely at 10 feet of altitude and zero groundspeed. If collective is applied at 50 feet and it is apparent that the rate of descent cannot be stopped with available power, take an immediate waveoff, applying forward cyclic to regain translational lift and follow with collective pitch and power as necessary to minimize further loss of altitude or to clear obstructions.

Proper application and feel of the collective pitch is the key to a safe and effective precision approach. The collective is used to establish and maintain the constant rate of descent. The cyclic is used to establish and maintain the proper nose attitude. As descent progresses, proper groundspeed (which will also decrease in proportion to altitude decrease) is maintained by reference to the selected spot, and keeping the angle of descent toward it as near constant as possible. Small amounts of cyclic and corresponding collective must be used to maintain this path and to control the rate of descent, which should not be allowed to become excessive. If undershooting (dropping below the intended path) take corrective action immediately. Overshooting is difficult to correct unless detected early in the approach. The correction for overshooting must be made by decreasing collective, thereby increasing the rate of descent. This may be hazardous if attempted in the latter stages of the approach, because an increase in rate of descent will bring on a rapid decrease in airspeed. If not detected early, a waveoff should be effected immediately. A power settling possibility exists below 10 knots of airspeed, especially if the rate of descent becomes excessive and collective is applied. The airspeed indicators are not reliable at that speed and angle of flight. Groundspeed into the wind will ensure some measure of airspeed.

RESCUE PATTERN, APPROACHES, HOVER, AND CLIMBOUT

The type and variation of rescue pattern flown for an actual rescue will depend on the situation itself. However, there are two patterns which are recommended for practice, one for day VFR and one for night and/or IFR.

DAY-VFR RESCUE PATTERN, APPROACH AND CLIMBOUT.

The pattern is flown at 200 feet and 70 knots and consists of a downwind entry abeam the point of intended hover and a turn aft of the 180° position, planing approach so as to arrive slightly downwind of point of intended hover. Normally the helicopter should be into the wind at approximately 100 feet. At the 90° position start raising nose to slow airspeed. Continue slowing and using collective so as to arrive at a point approximately 50 yards downwind of point of intended hover at 30 feet with a slight creep forward, entering hover at preselected spot. When ready for climbout ensure that crewman is ready and rescue gear is secured. From a hover, trim the cyclic forward while increasing collective to prevent settling. Establish a climb at 70 knots.

WARNING

Hovering over water at altitudes less than 30 feet for longer than 10 minutes may lead to salt encrustation and engine compression stall. T_5 and N_g must be monitored very closely noting any substantial increase in T_5 without increase in N_g.

NIGHT-IFR RESCUE PATTERN.

The basic rescue pattern is essentially the same for all types of approaches made at night and IFR. (See figure 3–13.) The pattern is flown at 200 feet and 70 knots, and consists of a downwind straight away from over the point of intended hover, and a 90-270 degree reversal-turn into final. In an actual rescue, the situation itself will dictate the type or variation of pattern to be flown. The pattern commences when the aircraft passes directly over the target, heading downwind. All electronic gear should be rechecked on, set, and functioning properly. ASE should be on. BAR ALT may be selected and engaged. As the aircraft passes over the target initially, the plotting board, on which the bug has previously been centered, should be switched to track on the 10-mile scale. Barometric altimeter readings must be constantly cross-checked with radar altimeter readings to ensure accurate altitude information. After passing over the target, the downwind straightaway should be adjusted according to the prevailing wind conditions. A combination of wind velocity and time downwind totaling 30 usually suffices, i.e., wind velocity 15 knots, time downwind would then be 15 seconds. At the end of the timed downwind leg, a 90-270 degree standard rate turn is performed. Upon rolling out of the reversal turn, the aircraft should be located, ideally, between 1 and 2 miles downwind from the target. With the altitude and airspeed stabilized at 200 feet and 70 knots, continue toward the target until the separation has decreased to 1¼ to ¾ miles, depending again on prevailing wind conditions.

DOPPLER APPROACH.

The doppler approach is commenced at ¾ to 1¼ miles downwind of the target, the distance being greater with relatively light winds or higher groundspeed. (See figure 3–14.) The entrance point, or "gate," is at 200 feet and 70 knots in the BAR ALT mode. The needle and ball should be centered and the feet should be off the rudder pedals. The copilot's radar altimeter should be set at 80 feet, and the pilot's should be set at 30 feet. To commence the approach, merely select the RAD ALT mode on the ASE control panel. Since BAR ALT and the altitude control button on the collective are already engaged, RAD ALT will engage automatically, and supersede BAR ALT control. The aircraft will commence a descent at 350 to 450 feet per minute. Should the rate of the descent exceed this and show no signs of decreasing and stabilizing, the approach must either be flown as a no-doppler approach, or aborted. The most probable reasons for excessive sink rates are loss of doppler signal due to smooth water, doppler or RAD ALT failure, or very low airspeeds. If the descent appears normal, begin slowly trimming off airspeed to arrive at 80 feet at 40 knots. Include the DVI in your scan. The DVI will probably indicate a left drift of approximately 10 knots. This is caused by the rigging of the aircraft and can most easily be corrected by altering course to the right about 10 degrees keeping your "wings level." By doing this, the aircraft will crab toward the target and the vertical needle of the DVI will gradually center. As the descent continues, minor heading corrections should be made with the yaw trim switch. Airspeed, altitude, and rate of descent must be very closely monitored. Throughout the approach, hover, and transition to forward flight, the thumb of the left hand must remain on the collective altitude control button so that transient or excessive download or upload signals may be immediately negated by disengaging the altitude control feature of the ASE. It cannot be over-emphasized that the altitude control feature of the ASE is extremely hard to overpower and, if unreliable, must be disengaged immediately and the aircraft's altitude controlled manually. As the descent progresses, a rate of descent correction signal should be forthcoming from the altitude control system between 110 and 95 feet, so as to reduce the aircraft's sink rate and stabilize it at the preselected 80 feet. If no such correction can be seen and felt, the altitude control must be disengaged and the aircraft flown manually to the desired hover altitude. If the altitude control functions properly and the aircraft stabilizes at 80 feet at 40 knots, the copilot will manually crank his radar altimeter down to 40 feet. The aircraft will again commence a rate of descent, this time approximately 200 to 250 feet per minute. Airspeed should be trimmed off slowly to arrive at 40 feet with 30 knots indicated airspeed. A rate of descent correction signal should be expected between 55 and 50 feet. Once again, if the rate of descent does not decrease as the hover altitude approaches, the altitude control must be disengaged, and the aircraft's altitude controlled manually. With the aircraft established at 40 feet and 30 knots, the target should be approximately ¼ to ½ mile ahead.

Doppler Approach

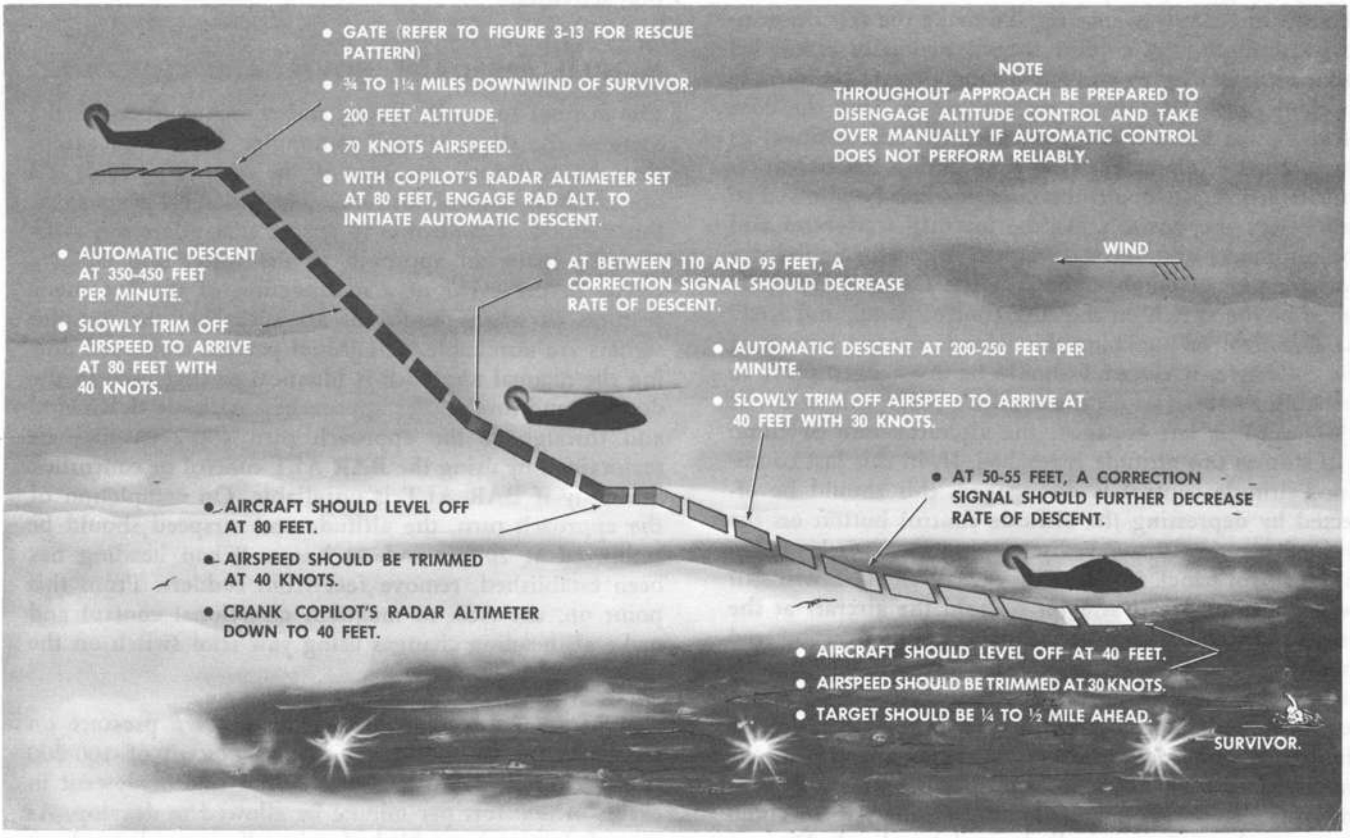


Figure 3—14

NO-DOPPLER APPROACH.

The no-doppler approach is essentially the same as the doppler approach except that RAD ALT altitude control feature cannot be utilized since it derives its rate dampening signals from the vertical velocity signal of the APN-130. DVI and GSDA information will also be unreliable, so the aircraft must be flown on basic instruments. BAR ALT control may be engaged during the approach, and overpowered with a manual down load on the collective to control rate of descent.

DOPPLER HOVER.

The doppler hover commences with the aircraft closing the target at 30 knots and at an altitude of 40 feet. Engage the GROUNDSPEED mode of the ASE and shift the center of your scan from the RAI to the DVI. Groundspeed and drift are now most important so the DVI must be closely monitored and lateral and longitudinal stick trim corrections made immediately to control the aircraft's drift. With groundspeed mode engaged, the aircraft will be automatically maintained at any groundspeed and drift for which the aircraft has been trimmed. As the aircraft approaches the target, commence slowly trimming off groundspeed so as to arrive over the target with zero groundspeed, and zero lateral drift. This hover condition will be indicated by the DVI when both needles are centered. Movement from this hover position to a new position should be accomplished by small trim corrections laterally or longitudinally and the speed monitored by observing the DVI. During these repositioning flight movements, unless an emergency situation dictates otherwise, the DVI needles should not leave the 5-knot inner circle until transition to forward flight for the hover departure is commenced. Hover below 20 feet is not recommended as lower hovers can result in unreliable doppler return and erroneous DVI drift readouts. The almost constant use of cyclic trim during the approach, transition, and hover phases cannot be over-emphasized. These trim corrections are necessitated by the variation in groundspeed as the wind velocity varies, and by the effect on cyclic trim caused by collective inputs as the radar altitude control mode of the ASE varies collective position.

DOPPLER CLIMBOUT.

With the aircraft established in a 20 to 40 foot no-drift hover, the gyro (RAI) indicated nose position will be about 5 to 6 degrees nose up. To make the transition to forward flight, the copilot should manually crank his radar altimeter up to 80 feet. As the aircraft commences to climb, with feet off the rudder pedals, trim the nose down to the horizon and maintain this nose attitude as the aircraft accelerates. At no time during the transition to forward flight should the nose position be allowed to fall below the horizon. As the aircraft accelerates and the altimeters and vertical velocity indicator indicate a positive rate of climb, disengage the GROUNDSPEED mode by the switch on the ASE control panel, and RAD ALT control by punching the altitude control button of the collective. RAD ALT should be disengaged prior to reaching 80 feet (set on the copilot's radar altimeter). If RAD ALT is left engaged, the aircraft's rate of climb will stop as this altitude is reached. If, in this last condition, altitude control is disengaged, this should be effected by depressing the altitude control button on the collective rather than by disengaging the switch on the ASE control panel. In the latter case, BAR ALT will still be engaged and will attempt to hold the aircraft at the present altitude, though this control can be overpowered manually (force trimmed). The use of GROUNDSPEED mode at airspeeds greater than 70 knots is not recommended since loss of doppler when operating in this mode can result in excessive cyclic corrections, the inputs being most severe at high speeds. After disengaging altitude control, manually adjust collective to climb power and continue to climb straight ahead. Do not attempt any turns prior to reaching 300 feet. Upon reaching the desired altitude place RAD ALT switch in STANDBY on the ASE control panel and reengage BAR ALT altitude control on the collective. RAD ALT control should never be selected above 200 feet. When doing practice approaches, recenter the bug over the target before transitioning to forward flight.

ALTERNATE APPROACH.

When the helicopter is under positive radar control, the controlling activity can assist in pre-positioning the helicopter at the gate for initial approach, and thus eliminate a portion of the time required for a complete unassisted doppler pattern. The radar pattern should position the helicopter at a point 1 mile downwind from DATUM at 200 feet altitude and with the heading aligned into the wind. From this position the helicopter can be flown in the same manner as the final portion of a normal doppler approach. The tracking bug on the plotting board should be slewed to 1 mile on the downwind bearing from DATUM and placed in STANDBY. Upon being notified of attainment of that position by the radar control activity, the plotting board will be placed in the track position. The controlling activity can continue to provide limited information when requested by the pilot or when the helicopter track will obviously take it wide of DATUM. Minimum communications are desired during the final portion of the approach in order to prevent distraction from necessary flight and crew coordination activities.

MANUAL APPROACH, HOVER, AND CLIMBOUT.

The manual approach, hover, and climbout are much the same as the doppler and no-doppler maneuvers except that the automatic features of the aircraft systems are not used to control altitude. The primary purpose of this method of control is to ensure that pilots can satisfactorily make an approach to the water and effect a rescue in the event of a malfunction of the automatic features or when conditions are such that the doppler signals are unreliable. The initial pattern employed during the manual approach is identical to that used in the doppler and no-doppler approaches. Altitude downwind and throughout the approach turn (90-270) may be maintained by using the BAR ALT control or controlled manually if BAR ALT is unreliable. On completion of the approach turn, the altitude and airspeed should be stabilized at 200 ft and 70 knots. When heading has been established, remove feet from rudders. From this point on, use ASE to maintain directional control and make all heading changes using yaw trim switch on the collective.

Commence the descent with a slight down pressure on the collective to establish a rate of descent of 100-200 feet per minute. At no time should a rate of descent in excess of 200 feet per minute be allowed to develop. As rate of descent is established, trim off airspeed slowly so as to pass through 100 feet at 50 knots. From this point on in the approach, altitude control is extremely critical and changes in altitude and airspeed should not be made simultaneously. When altitude is stabilized at 60 feet, trim airspeed down to 40 knots. This altitude and airspeed is optimum for search and should be maintained until visual contact with the survivor is established. When contact is made, reduce altitude to 20-40 feet and then trim airspeed down to 20 knots. Adjust airspeed as required to arrive at a hover 150-200 feet downwind of the survivor. Since the success of the manual approach and hover is based on contact conditions, flood and search lights must be used. It is recommended that they be turned on after completing the approach turn (90-270) to ensure that the pilot will have time to adjust to the lights prior to getting close to the water.

HOVER.

If doppler information is not available, it will be necessary to establish contact with a visual reference in the water in order to establish and maintain a hover. Either the survivor or rotor wash may be used for this purpose. However, extreme caution must be exercised when using the rotor wash because motion over the water will be difficult to detect during the transition to a hover. When the hover has been established, the pilot should shift to contact conditions and include the visual reference in his scan. During this period, the copilot should monitor the instruments, concentrating on the altimeter, and checking the DVI to detect any motion over the water. When established and trimmed in a hover, commence slowly, closing the survivor under the guidance and direction of the rescue aircrewman. Closure rate should be kept at a minimum and should never exceed 5 knots.

CLIMBOUT.

When ready for climbout, ensure that crewman is ready and rescue gear is secured. Smoothly increase collective to establish a positive vertical climb. With a positive rate of climb indicated on the barometric altimeter, the radar altimeter, and the vertical velocity indicator, trim the nose down to the horizon. Turn lights off and monitor instruments to ensure that the established rate of climb has not been interrupted and that the aircraft accelerates to 70 knots in forward flight. Climb straight ahead to 300 feet at 70 knots prior to commencing any maneuver. During climbout, maintain directional control with the ASE. The pilot should not place his feet on the rudder pedals until the aircraft's altitude is above 200 feet.

PART 4 CARRIER-BASED PROCEDURES

FLIGHT/HANGAR DECK PROCEDURES

MOVEMENT OF HELICOPTERS.

Movement of helicopters aboard ship shall be in accordance with CVA/CVS NATOPS Manual. Caution must be observed in all movements to prevent possible damage to the helicopter or rotor system. Normally, movement of helicopters, both on the hangar and flight deck, shall be accomplished utilizing plane pushers and a tailwheel tow bar. At all times when the tow bar is attached to the tail wheel, the tail wheel shall be unlocked to preclude shearing of locking pins. When towing or turning the helicopter with a tail wheel tow bar, great care should be exercised as injuries to handlers or aircraft damage can result if the tailwheel cocks rapidly when executing a turn. A qualified brake rider from the helicopter detachment shall be in the pilot's seat for all movements aboard ship. For movements on the flight deck, and when on the deck edge elevators, the brake rider shall wear appropriate survival gear and be strapped into the pilot's seat. The pilot's hatches shall be open to enable the brake rider to hear the director's signals and to permit his exit from the helicopter in the event it goes over the side.

HANGAR DECK.

Normally, engines will not be started on the hangar deck. In the event a requirement exists to start engine for a maintenance turn up, all standard safety precautions shall be utilized. Under no circumstances will the rotors be engaged on the hangar deck, or engine started with the blades folded. Due to the susceptibility of helicopters to corrosion and the effects of corrosion on its control systems, hangar deck sites selected for helicopter stowage should avoid areas aft of weather deck openings.

FLIGHT DECK.

Blade Folding and Spreading.

The helicopter will always be chocked and tied down when spotted on the flight deck. Rotor blade folding and spreading operations should be accomplished with caution. The maximum non-turbulent wind for folding/spreading is limited to 35 knots for normal operations, and 45 knots for emergencies. This limit is reduced to 15 knots in turbulent air, or when the relative winds are more than 45 degrees off the aircraft heading. Fifteen minutes should be allowed for folding and spreading in turbulent air and at night. If the particular class carrier has elevators large enough to accommodate the helicopter with blades spread, the helicopter should always be moved to the hangar decks at night before folding the blades. This procedure not only expedites clearing of the flight deck area but is safer for the helicopter crew.

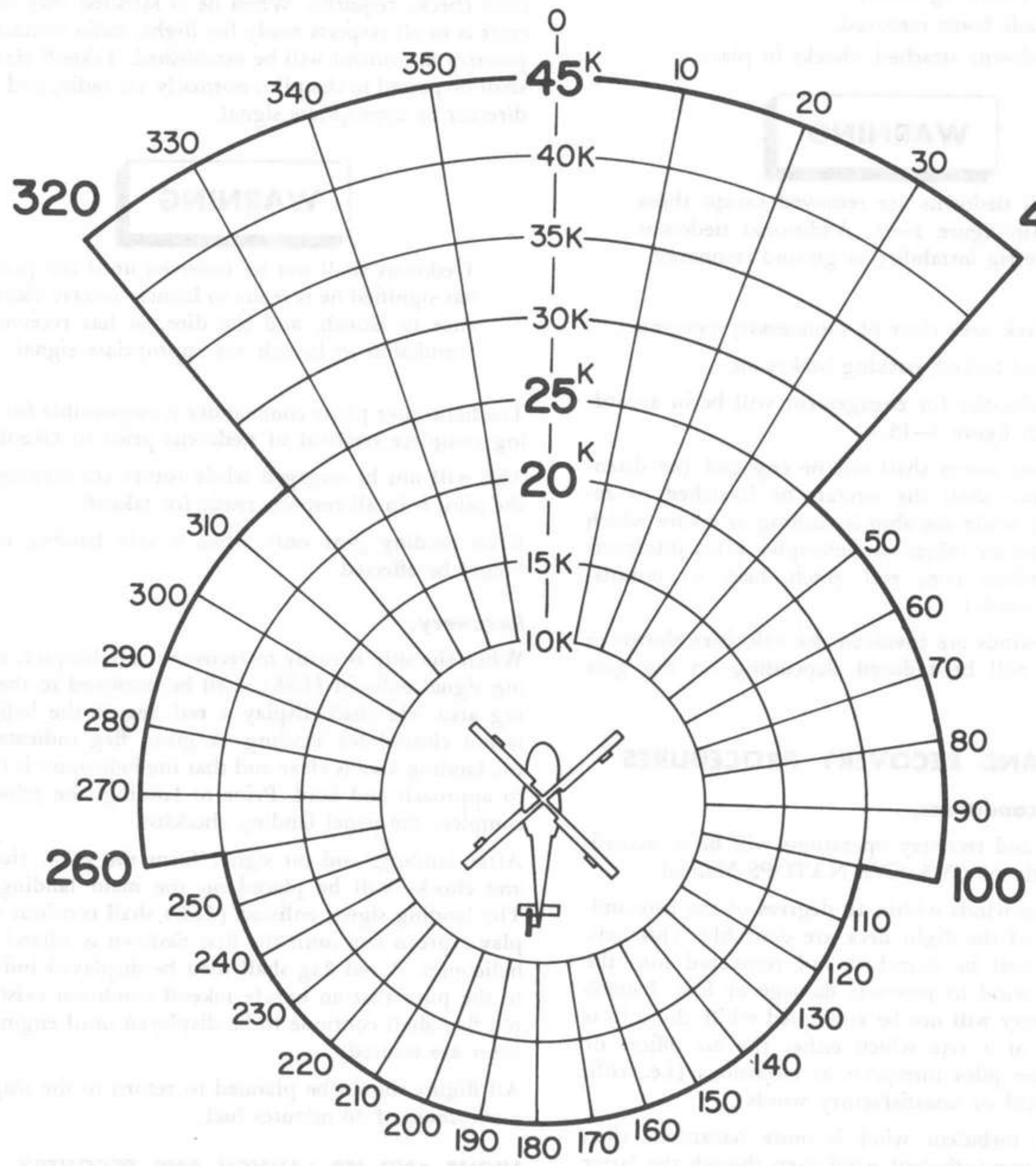
Starting and Engagement Procedures.

In general, starting and engagement signals and procedures will be in accordance with CVA/CVS NATOPS Manual. Refer to figure 3–15 for maximum winds for starting or stopping rotors.

The UH-2C helicopter requires dc external power for starting. A complete systems check cannot be made, or radio communications established, with just the engine running, rotors disengaged. For warmup of systems and radio without engaging the rotors, ac external power along with the dc power must be used. The battery start feature, when installed, is used only for starting the helicopter at remote locations and aboard ship when adequate dc power is not available. (Refer to the servicing diagram for specific external power requirements.)

Engine will be started and rotors engaged only on signal from a director and under the positive control of Primary fly. The pilot shall indicate that he is ready to engage rotors by giving his director the "engage rotor" signal. Before the rotors are engaged, the air officer shall warn personnel over the flight deck announcing system to stand clear. He will then signal to engage rotors, if the relative wind is within the prescribed engaging envelope. After ensuring that personnel are clear, chocks and tiedowns are secure and rotor boots have been removed, director will give pilots the signal to engage rotors.

Maximum Wind For Starting Or Stopping Rotors



1. LIMITING VELOCITIES OF THE ENCLOSED AREA REPRESENT MAXIMUM FOR STEADY STATE, NON-TURBULENT WINDS. WHEN TURBULENCE OR PITCHING DECK CONDITIONS EXIST WHICH MAY IN ANY WAY JEOPARDIZE THE SAFETY OF THE HELICOPTER OR FLIGHT DECK PERSONNEL, THESE MAXIMUMS WILL BE REDUCED ACCORDINGLY.
2. ROTOR ENGAGEMENT IN WIND VELOCITIES NEAR THE LIMITING VALUES SHOULD BE MADE AS RAPIDLY AS POSSIBLE. HOLD CYCLIC STICK SLIGHTLY INTO WIND AND USE 30 PSI TORQUE TO ACCELERATE ROTOR SYSTEMS AS RAPIDLY AS POSSIBLE.
3. ROTOR DISENGAGEMENT IN WIND VELOCITIES NEAR THE LIMITING VALUES SHOULD BE MADE AS RAPIDLY AS POSSIBLE. APPLY POSITIVE ROTOR BRAKE TO ENSURE STEADY DECELERATION OF ROTOR BLADES.

Figure 3—15

Mandatory Requirements for Engagement of Rotors.

Mandatory requirements for engagement of rotors shall consist of the following items:

1. Rotor blade boots removed.
2. Deck tiedowns attached, chocks in place.

WARNING

Ensure all tiedowns are removed except those depicted in figure 1–63. Additional tiedowns may cause rig instability or ground resonance.

3. Flight deck area clear of unnecessary personnel.
4. Tail wheel locked, parking brakes on.
5. Wind velocities for engagement will be in accordance with figure 3–15.
6. Helicopter rotors shall not be engaged (or disengaged, nor shall the aircraft be launched or recovered) while the ship is turning at a rate which either the air officer or helicopter pilot interprets as hazardous (i.e., roll, pitch, heel, or unsatisfactory winds).

When gusty winds are involved the velocities shown in figure 3–15 will be reduced depending on the gust magnitude.

LAUNCH AND RECOVERY PROCEDURES

Operating conditions.

1. Launch and recovery operations will be in accordance with the CVA/CVS NATOPS Manual.
2. Optimum winds within 10 degrees of the fore-and-aft axis of the flight deck are desirable. This helicopter must be launched and recovered into the relative wind to preclude damage or loss. Launch or recovery will not be attempted while the ship is turning at a rate which either the air officer or helicopter pilot interprets as hazardous (i.e., roll, pitch, heel or unsatisfactory winds).
3. A light turbulent wind is more hazardous than smooth non-turbulent wind even though the latter may be of considerable velocity. In general, deck turbulence can be minimized by operating the helicopter amidships with the wind straight down the deck. Turbulent and unpredictable wind patterns cannot be reliably anticipated and when operating in the lee of any obstruction or near the deck edge, consideration must be given to reducing the wind velocities.
4. Carrier landings and takeoffs may be safely made with the parking brake on or off. The pilot in command will make his decision concerning brake position based on consideration of wind, gross weight, pitching or rolling deck, etc.

DAY LAUNCH AND RECOVERY OPERATIONS.

Launch.

After start and engagement, the pilot will make all systems checks required. When he is satisfied that the aircraft is in all respects ready for flight, radio contact with primary fly control will be established. Takeoff clearance shall be passed to the pilot normally via radio, and to the director by appropriate signal.

WARNING

Tiedowns shall not be removed until the pilot has signified he is ready to launch, receive clearance to launch, and the director has received permission to launch via appropriate signal.

The helicopter plane commander is responsible for assuring complete removal of tiedowns prior to takeoff.

ASE will not be engaged while rotors are turning until the pilot is in all respects ready for takeoff.

Raise landing gear only when a safe landing can no longer be effected.

Recovery.

When the ship is ready to recover the helicopter, a landing signal enlisted (LSE) shall be stationed in the landing area. He shall display a red flag if the helicopter is not cleared for landing. A green flag indicates that the landing area is clear and that the helicopter is cleared to approach and land. Prior to landing, the pilot shall complete the panel landing checklist.

After landing, and on signal from the pilot, tiedowns and chocks will be placed on the main landing gear. The landing signal enlisted (LSE) shall continue to display a green flag until the first tiedown is affixed to the helicopter. A red flag shall then be displayed indicating to the pilot that an unsafe takeoff condition exists. The red flag shall continue to be displayed until engines and rotor are secured.

All flights should be planned to return to the ship with a minimum of 30 minutes fuel.

NIGHT AND IFR LAUNCH AND RECOVERY OPERATIONS.

Deck Conditions.

During the hours of darkness all recovery operations shall normally be conducted on the centerline of the angled deck. Only under emergency or unusual circumstances should the helo be recovered on the bow due to the lack of visual references. The launch, when practical, will be conducted from the centerline of the axial deck no further forward than the No. 1 elevator on those carriers with center elevator, and no further forward than 100 feet from the bow on other carriers. The helo may be launched from the angled deck when circumstances require. Winds should be from ahead of the ship and within 10° of the deck axis. Normal carrier deck lighting will be used.

Note

On any night launch from the flight deck of a carrier, the helo should be spotted far enough aft of the bow to enable the pilot to transition to forward flight before losing visual reference to the deck.

Night Launches.

During night and IFR operations, controlling activities should anticipate an additional delay between rotor engagement and launch. This period is required for electronics systems warmup and checks and should not normally exceed 5 minutes.

Note

Night launches are governed by the same requirements for proper clearance, signals, and tiedown removal responsibility as outlined for day launches. When in all respects ready, the helicopter is raised to a hover approximately 15 feet above the deck and then transitioned to forward flight into the relative wind. This transition will be accomplished by application of sufficient additional power to ensure a positive climb rate. After loss of the visual reference with the ship, the climb will be continued on instruments, straight ahead to a minimum altitude of 300 feet prior to commencing a turn.

Night Recoveries.

During the hours of darkness and under instrument conditions, recovery will be conducted under the control of the ship's carrier air traffic control center and by the pilot's reference to the mirror optical landing system. Holding and approach patterns will be as published in the current NWP/NWIP Publications and/or CVA/CVS NATOPS Manual. Airspeed during holding and the approach will be 80 knots until commencing the creep. (CREEP: An airspeed that will provide a closing or relative speed of 15 to 20 knots between the helicopter and the carrier.)

Mirror/Optical Landing System Approach.

The helicopter will intercept the glide path in landing configuration at an altitude of 300 feet on the landing axis. The helicopter will be flown down the glide slope and commence creep airspeed at approximately one-fourth (1/4) mile from the carrier to cross the ramp with 15 to 20 knots of relative motion at a minimum altitude of 15 feet above the flight deck.

NIGHT AND IFR OPERATIONS

PATTERNS.

During night and IFR conditions the helicopter plane guard station will be maintained by use of TACAN bearing and distance points for pattern definition. The dimensions of such pattern will be established to provide the following:

1. Avoidance of radar and communications blind spots.
2. Adequate separation from fixed wing, holding, approach, and waveoff areas and corridors.
3. Maximum surveillance of carrier traffic pattern.
4. Maneuvering with minimum bank angles and power changes.
5. Maintaining position with no visual reference to ship.

Two patterns which operating experience has shown to meet these requirements are as depicted in figures 3–16 and 3–17. Operating units may select the pattern best suited to the particular carrier, based on ship configuration, fixed wing operating procedures, etc.

LIGHTS AND SIGNALS.

Lights for night and IFR plane guard will be steadily bright with rotating beacons ON. For day or night operations refer to CVA/CVS NATOPS Manual.

Pilots Desire or Intention	*Visual Signal*
(1) I require immediate landing	Fly close aboard starboard quarter, remaining clear of other traffic, with gear down and floodlights/landing lights on. With complete electrical failure, fire a red flare to seaward.
(2) I desire to land, but can wait for the next recovery	Fly by or hover on the starboard side of the ship, low and close aboard, with navigation lights BRIGHT and FLASHING and anti-collision light ON.

Note

Flashing of position/tail lights may be accomplished by turning those switches OFF, and utilizing the key button.

DAY OPERATIONS PATTERNS

The daylight VFR plane guard station will be a pattern which will allow the helicopter to be flown in a forward flight environment at normal power settings. Patterns similar to those contained in figures 3–16 and 3–17 are recommended.

Race Track Plane Guard Pattern

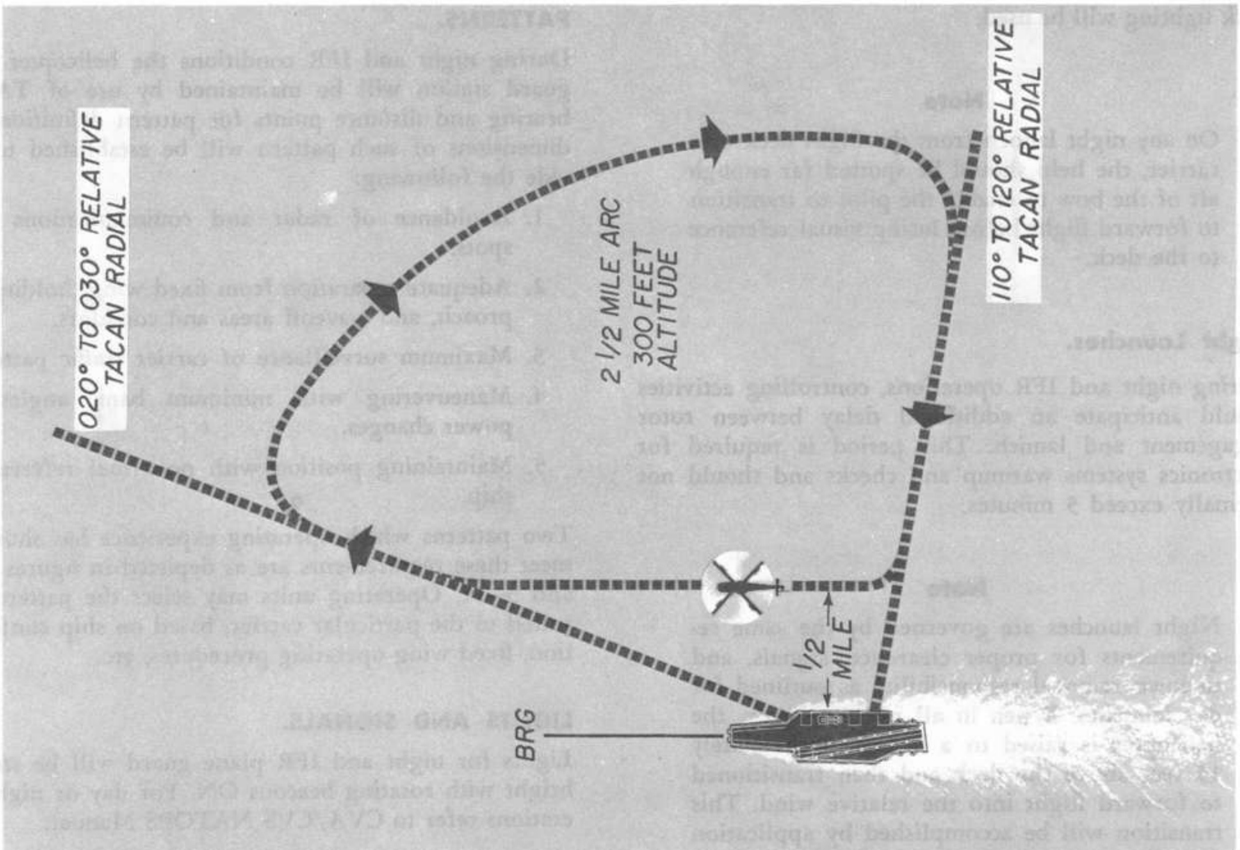


Figure 3–17

Zig Zag Plane Guard Pattern

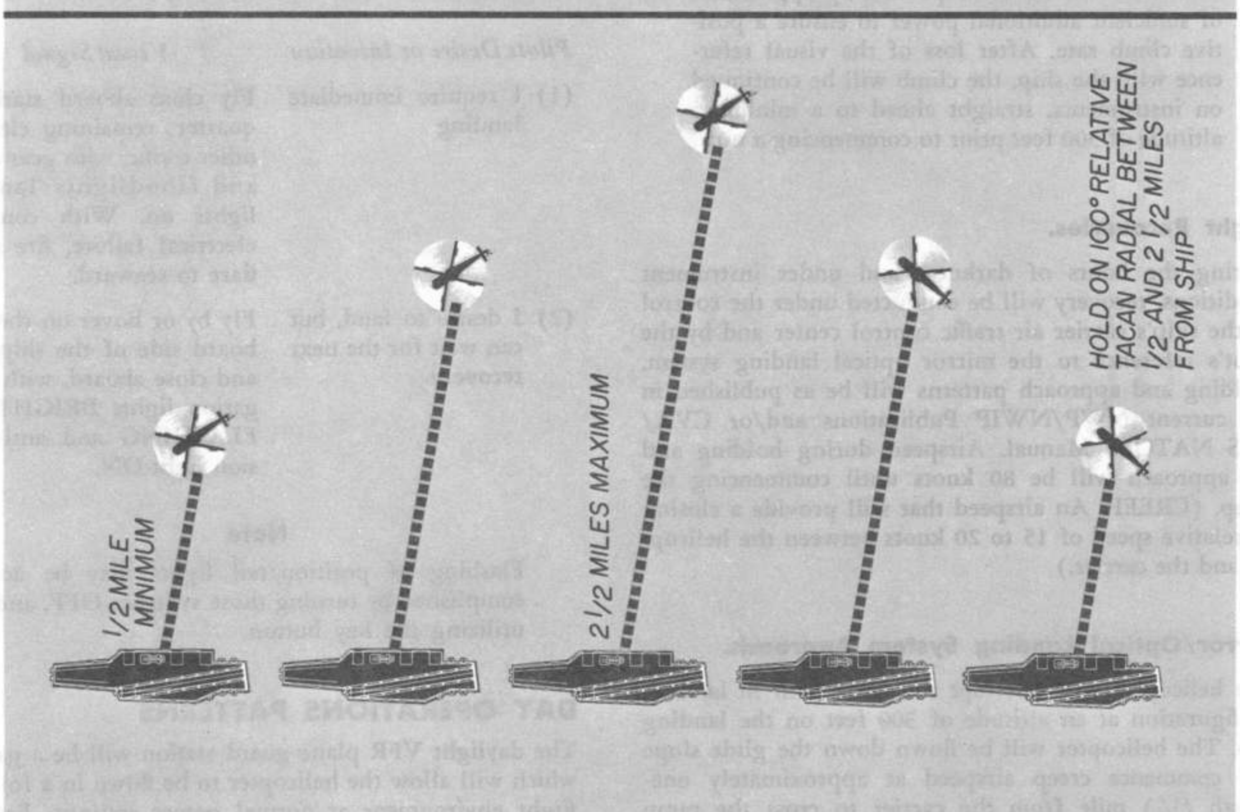


Figure 3–16

MINIMUM CREW

Minimum crew for day VFR plane guard will be a designated aircraft commander, two crewmen, and a qualified observer in the copilot's seat. Minimum crew for night and IFR plane guard will be a designated aircraft commander, a designated helicopter second pilot, and two crewmen.

Passengers should not be carried while actually on station for plane guard to insure that the rescue capability is not impaired.

EMERGENCY MISSIONS

In the event of an emergency situation developing while on plane guard station requiring dispatching of the helicopter away from the ship, a determination must be made as to the adequacy of the remaining fuel aboard. Figure 11–13 provides radius of action capabilities for varying fuel loads and can be used in determining whether refueling is required prior to departure. If refueling is necessary, the time required to land aboard, refuel, and launch will be approximately 10 minutes.

WEATHER

Recommended weather minimums for launching the helicopter on a search and rescue mission are 300 feet ceiling and 1-mile visibility. Attempting to conduct a search in weather below these minimums is not practicable in that all attention would have to be given to flying the helicopter on instruments and little attention could be given to searching.

OPERATING CONSIDERATIONS

In the accomplishment of the search and rescue mission the helicopter operates at low altitude and relatively slow speed, and is equipped with limited long range navigational and communications capabilities. A single unaccompanied helicopter should not be sent on a mission beyond voice navigation communication capabilities, except in emergency or urgent operational circumstances.

FUEL VS. RESCUE DISTANCE CHART.

This chart (figure 11–13) presents the operating radius of the helicopter as it is limited by the fuel load and the amount of time on station.

OPERATING CONDITIONS.

Emergency or last minute variations of scheduled operations make changes unavoidable. The adverse effects of these changes can be minimized by:

1. Meticulous adherence to standard helicopter operating doctrine and refusal to permit haste to take precedence over safety, necessary preflight, and other required procedures.
2. Complete dissemination, at the earliest possible time, of schedules and changes thereto.

HOT FUELING.

Gravity fueling is not authorized with engines or rotors operating. In addition to the hazard caused by the location of the tank openings relative to the engine exhaust, the rotors constantly build up a static electrical charge of 15,000 to 20,000 volts creating an extremely dangerous spark potential.

CAUTION

Continuous flight time must be limited to the minimum lubrication interval in Post Flight/ Servicing/Conditional Requirements Cards, NAVAIR 01-260HCB-6-2.

Refer to Section I for pressure fueling procedure.

SPECIAL PROBLEM OF THE COMBAT SUPPORT HELICOPTER.

Helicopter detachment personnel shall not be assigned additional or collateral ship's duties. The requirement of the helicopter to fly, or to be immediately ready to do so, around the clock puts the helicopter detachment personnel on a 24-hour call basis. The Officer-in-Charge must have sufficient flexibility to schedule meals, work, rest, and training periods to meet this demanding schedule. Similarly, liberty for the detachment personnel should be controlled in accordance with ship's policy by the detachment Officer-in-Charge who is cognizant of the full workload of the detachment. This is particularly true because of the in-port flying often required.

PART 5 NON-AVIATION SHIP PROCEDURES

GENERAL.

Operational procedures will be standardized and be in accordance with NWIP 41-6 Series.

FLIGHT/HANGAR DECK PROCEDURES

MOVEMENT OF HELICOPTER.

Utmost caution must be observed in all movement to prevent damage or loss of helicopter due to restricted deck space or hangar area and the relative instability of non-aviation ships. A qualified brake rider from the helicopter detachment will be in the pilot's seat for all movements aboard ship, plus a man with chocks will be stationed at each main landing gear.

FLIGHT DECK.

Blade Folding/Spreading.

The helicopter shall always be chocked and tied down when spotted on the flight deck. Rotor blade folding and spreading operations should be accomplished with caution. The maximum non-turbulent wind for folding/spreading is limited to 35 knots for normal operations, and 45 knots for emergencies. This limit is reduced to 15 knots in turbulent air, or when the relative winds are more than 45 degrees off the aircraft heading.

Starting the Helicopter.

The UH-2C helicopter normally uses external power for starting. Battery start should only be used when external power is not available or has not been tested for proper output.

A complete systems check cannot be made, or radio communications established, prior to engaging rotors. For warmup of systems and radio without engaging the rotors 200-volt ac power along with the 28-volt dc power must be used. Starting will normally be accomplished upon clearance from controlling authority. When the pilot is satisfied in all respects with his pre-engagement checks, further clearance is obtained for rotor engagement. Controlling authority is normally stationed in the ship's bridge, and flight deck area clearance is transmitted by voice or visual signals.

Rotor Engagement.

The following requirements are mandatory for engagement of rotors:

1. Rotor blade boots removed if used.
2. Check tiedowns, chocks in place.

WARNING

Ensure all tiedowns are removed except those depicted in figure 1–63. Additional tiedowns may cause rig instability or ground resonance.

3. Flight deck area clear of unnecessary personnel.
4. Tail wheel locked, parking brakes on.
5. Relative winds must not exceed limits set forth in figure 3–15. When gusty or turbulent winds are involved, these velocities will be reduced by 30 percent.

Note

Pitching and rolling motion must be taken into consideration to effect safe rotor engagement.

LAUNCH AND RECOVERY PROCEDURES

DAY OPERATIONS.

1. Launch and recovery operations, signals and procedures shall be in accordance with NWIP 41-6 Series.
2. The helicopter pilot in command is responsible for assuring complete removal of tiedowns prior to takeoff.
3. ASE shall not be engaged while rotors are turning until the pilot is ready for takeoff.
4. Wind velocity should not exceed 50 knots for launch or recovery operations. When true winds

permit, the wind direction relative to the ship's heading will fall between 10° and 60° off either bow; 30° to 45° is desired.

5. All landings will be made with parking brakes set.
6. ASE off when firmly on deck.
7. Tiedown and chocks will be applied on signal from the pilot.

NIGHT OPERATIONS.

The UH-2C is not normally flown from a non-aviation ship at night unless the ship is certified for night operations. Flights to and from ships without certified night lighting should be of an emergency nature only.

MINIMUM CREW

Minimum crew for day VFR flight will consist of one qualified pilot and one qualified observer. For night, IFR, and other flights designated by the detachment Officer-in-Charge, two pilots will be required. On all operational administrative and tactical flights the pilot in command will be a designated Helicopter Aircraft Commander. A Helicopter Aircraft Commander will be in command of any flight wherein the transport of passengers is involved.

HELICOPTER TRANSFERS

COMMUNICATIONS.

Exchange of information regarding transfer normally is made by radio. If radio contact cannot be established, the ship is alerted for pickup or delivery by a low pass across the bow, followed by orbiting clockwise until the KILO ONE flag is placed at the dip. When the ship is ready to receive the helo, KILO ONE will be closed up. The ship shows a red flag in the landing or hoisting area if not prepared for transfer. A green flag is displayed when the ship is ready in all respects.

TRANSFERS OF PERSONNEL AND MATERIAL.

When possible, the helicopter should land to transfer material and personnel. Transfers involving destroyers and most smaller ships not having landing platforms will be conducted by hovering over the fantail. The relative wind should be broad on either bow with a minimum force of ten knots. Personnel being transferred shall remain seated with safety belts secured at all times, except as directed for necessary movement preparatory to, during, and subsequent to actual transfer by hoist. The crewman should ensure that passengers entering the helicopter by hoist assume a seat and secure the safety belt immediately. Personnel being transferred shall be required to wear appropriate survival equipment.

Upon landing, tiedowns will not be attached to helicopter unless so directed by the pilot in command. If cargo is to be loaded internally, weight and balance limitations will be in accordance with Handbook of Weight and Balance, AN01-1B-40.

When transferring material by externally mounted cargo hook, weight shall not exceed gross weight limitations or weight specified by pilot as being maximum for helicopter capability. Cargo hook should be armed for electrical drop only. Automatic sling release shall not be armed or used in order to prevent inadvertent loss of loads. Load angles attached to the cargo hook should not exceed 20 degrees from vertical in any direction.

SHIP TO SHIP TRANSFERS.

When ships are fueling or transferring cargo and the helicopter is not being utilized, the helicopter crew will remain in the appropriate ready condition, as specified in NWIP41-6 Series.

FUEL

The probability of fuel contamination on ships which seldom service helos is greatly increased. Samples should be taken from the fuel nozzle before each fueling. The inflight refueling receptacle should be used both in flight and on deck to increase the fuel filtering.

TRANSFERS OF PERSONNEL AND MATERIAL

When possible, the helicopter should land to transfer personnel and passengers, [illegible] deck [illegible] and [illegible] [illegible] sling [illegible] the [illegible]. The [illegible] used should [illegible] with a [illegible] [illegible] should be [illegible] with [illegible].

[illegible] Weight and Balance [illegible].

When [illegible].

[illegible] TO [illegible] TRANSFER

When [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

FUEL

[illegible] [illegible].

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] will be [illegible] [illegible] [illegible].

W[illegible] [illegible] [illegible].

[illegible] [illegible] and [illegible] will be [illegible] [illegible] [illegible] [illegible].

NIGHT OPERATIONS

The [illegible].

MINIMUM CREW

[illegible] [illegible].

HELICOPTER TRANSFERS

[illegible]

[illegible] [illegible].

SECTION IV
FLIGHT PROCEDURES

TABLE OF CONTENTS

Flight Characteristics 4-1
Night Flying 4-3
Flight Test Procedures 4-3
Emergency RPM Control 4-6
Electrical Throttle Malfunctions 4-6
Mountain and Rough Terrain Flying 4-7
Formation Flying 4-13

FLIGHT CHARACTERISTICS

LEVEL FLIGHT CHARACTERISTICS UNDER VARIOUS SPEED CONDITIONS.

Because of a built-in forward tilt of the rotor, the UH-2C remains level in forward flight. At airspeeds of 40 to 100 knots the fuselage remains essentially level. At higher airspeeds the fuselage will tilt slightly nose down. The main rotor shaft is also tilted laterally to the left, to provide for level takeoff, hover, and landing attitude. The sideward thrust component of the tail rotor causes this helicopter to fly with a built-in sideslip angle.

This is apparent when the helicopter is trimmed in level balanced flight. Sideslip varies with airspeed and power, and is greatest at an airspeed of approximately 30 knots, decreasing to a minimum at 120 knots and above. Through this speed range, the sideslip angle affects ground track equivalent to a 6-knot crosswind from the right. For dead reckoning flight planning purposes, it may be desirable to allow for this characteristic. The aircraft may be flown at zero sideslip by trimming laterally to produce a right bank of 2 degrees or less. When flying at zero sideslip, at low speeds, the ball will be displaced to the right one-fourth ball width or less.

In the 75 to 85 knots range turbulence from the rotor head passing through the tail rotor causes a slight "tail kick." This condition is more noticeable with aft C.G. loading, in turns, or ASE off operation.

HOVERING.

One of the major advantages of the helicopter over fixed wing aircraft is its ability to fly at extremely low airspeeds and to hover. Hovering is remaining motionless over a spot while maintaining a constant heading and altitude. The most comfortable hover is approximately 10 feet wheel to ground clearance (10 feet by RAD ALT). This is sufficient altitude for a safe landing in case of engine malfunction.

TURNS ON A SPOT.

The UH-2C is limited to a maximum rate of turn on a spot of 24° per second. Turns on a spot should not be performed in winds in excess of 15 knots. Turns on a spot should be started to the left to ensure adequate directional control. A turn to the right with insufficient left directional control may produce uncontrolled fuselage rotation. All control inputs should be slow, smooth and trimmed.

SIDEWARD AND REARWARD FLIGHT.

Sideward and rearward flight are executed at a constant ground speed, altitude and heading. An altitude of 15 feet (wheels to ground) over paved surfaces and 40 feet over unpaved or water surfaces should be maintained.

AUTOROTATIONAL CHARACTERISTICS.

One of the unique characteristics of helicopters is their ability to autorotate to a safe landing with no power. Refer to Section III for procedure.

GROUND INSTABILITY.

Ground instability characteristics, or susceptibility to ground instability, in the normal operating range of rpm and gross weight are generally of no concern due to the laterally level landing and takeoff attitude, and the design of various landing gear components. Overload gross weight and rotor overspeed increases the susceptibility to ground instability. During landings, rpm must be monitored carefully to keep it within the normal operating range.

There are other conditions that can increase susceptibility to ground instability, such as improperly serviced tires, struts, and hub-to-blade dampers.

When operating in conditions of soft ground, such as plowed fields, mud, snow or sand, caution should be exercised as these conditions increase ground instability tendencies. Ground oscillations in the above conditions, if encountered, are generally slow in buildup and the normal procedure is to apply up collective to become airborne as quickly as possible.

The recommended procedure for recovery from any ground instability is to get airborne at first indication. If this is not possible, cut engine power immediately and apply rotor brake.

POWER SETTLING.

At high altitudes, at high gross weights, or when operating with reduced power at low airspeeds, power settling may occur. It is first recognized by roughness in the helicopter, followed by an apparent loss of control effectiveness and by a rapid increase in rate of descent. Increasing collective pitch or adding more power normally has very little effect towards recovery as it only antagonizes the turbulent airflow. Recovery may be accomplished in the following manner:

1. Increase forward speed.
2. Decrease collective pitch.

CAUTION

Flight conditions causing power settling should be avoided at low altitudes because of the attendant loss of altitude necessary for recovery.

STALLS.

The helicopter will not stall in the sense that a stall is normally considered in relation to fixed wing aircraft. However, in downwind flares, the helicopter will go through a condition of zero airspeed accompanied by settling inertia, which may make it difficult or impossible to avoid inadvertent contact with the ground. As in other helicopters, therefore, it is recommended that downwind flares be avoided.

ROTOR BLADE STALL.

Blade stall occurs when the angle of attack on the retreating blade exceeds the stall angle of the blade airfoil section. Factors which affect blade stall are altitude, gross weight, temperature, rotor rpm, and angle of bank and are shown in figure 11–6. Adherence to the airspeed limitation as determined from figure 11–6 will insure that blade stall is not encountered. If the limitations are exceeded and stall is encountered, the first indication of blade stall is a momentary 4/rev vibration buildup followed by an abrupt severe 1/rev vibration. The 4/rev vibration may not be apparent to the pilot depending on altitude and how fast blade stall is approached. An increase in bank angle from 30° to 45° will produce an increase in load factor from 1.15g to 1.40g and consequently a reduction of approximately 10 knots in the stall speed. Retreating blade stall may be eliminated by one or more of the following corrective measures:

1. Decrease collective
2. Increase rotor speed
3. Decrease angle of bank.
4. Decrease airspeed

Note

Avoid abrupt control movement.

If blade stall is encountered in a banked turn, recovery may be effected by lowering collective and simultaneously rolling to a level attitude, and maintaining the nose attitude at or slightly above the horizon. Once blade stall is encountered, the airspeed must be reduced approximately 10 knots before all vibrations cease. All control motions must be smooth to prevent imposing additional load factor which aggravates stall. Turbulent air increases load factor which will indirectly affect the airspeed at which retreating blade stall occurs.

WARNING

The initial 4/rev vibration buildup cannot be depended upon for adequate warning of impending blade stall. The 1/rev vibration characteristic of fully developed blade stall may be of such magnitude that smooth corrective action becomes extremely difficult, and structural failure may result. Entering blade stall in diving flight further aggravates this situation since additional time is required to reduce airspeed, and g-loads are increased during the pullout.

AIRSPEED LIMITATION CHART.

The function of the airspeed limitation chart (figure 11–6) is to provide the pilot and copilot with a rapid means of determining the maximum recommended airspeed for various altitudes, rotor speed, gross weight, and angle of bank. The procedure for reading the chart is shown by arrows on the chart for the following example:

Find the maximum airspeed under these conditions:

Pressure Altitude	4000 feet
OAT	30° C
Gross Weight	10,000 pounds
Desired Rotor RPM	100%
Desired Bank Angle	20°

The chart shows that 108 knots CAS is the maximum airspeed.

FLIGHT WITH EXTERNAL AUXILIARY FUEL TANKS.

The addition of external auxiliary fuel tanks results in a decrease of about 5 knots in the forward speed capability of the helicopter. The external tanks do not affect the maneuverability of the aircraft.

BOOST OFF FLIGHT.

The aircraft may be maneuvered satisfactorily with the hydraulic control boost off. With the boost off there will be a noticeable increase in the amount of pressure required to move the collective pitch lever, and only a slight increase in the amount of pressure required to move the cyclic stick and directional pedals.

Note

If the boost is turned off during flight, a kick will be felt in the controls. This kick is noticeable, but not severe at lower airspeed. However, at higher airspeeds the kick becomes more severe and the controls shall be monitored closely.

NIGHT FLYING

In order to safely operate the UH-2C during night operations all pilots will have successfully demonstrated basic instrument proficiency. A night flying briefing folder, or its equivalent, will be utilized prior to all night operations. In congested areas, all ground taxiing shall be under the supervision of a qualified taxi director equipped with lighted wands. For further information refer to Section III.

MINIMUM AIRCRAFT EQUIPMENT FOR NIGHT AND IFR FLIGHTS.

1. Flight instruments: Gyro horizon, airspeed indicator, altimeters (Radar and Barometric) turn and bank indicator, MA-1 compass, standby compass vertical speed indicator, and clock.
2. All engine instruments.
3. All instrument, navigation, landing, cockpit and cabin lights.
4. Radio equipment: UHF, ICS, TACAN or LF/ADF
5. ASE (directional, longitudinal & lateral).
6. A Very pistol and cartridges will be carried in each helicopter.
7. Satisfactorily operating RAWS, doppler and DVI or visual horizon, and BAR ALT mode for plane guard or over water hovering.
8. A visual watch shall be posted on the plane guard helicopter.

FLIGHT TEST PROCEDURES

The flight test procedures listed herein are for the purpose of promulgating standard criteria for the conduct of ground and flight test of UH-2C helicopters. All test flights shall be flown by qualified pilots designated in writing by the Commanding Officer.

PROCEDURES.

The aircraft maintenance officer will recommend designated aircraft commanders, who have completed the indoctrination program to the Commanding Officer, via the Operations Officer, for designation as maintenance test pilots.

The Operations Officer will forward such recommendations with appropriate comments to the Commanding Officer.

Test Pilot Qualification.

The following will be considered minimum for test pilot qualification:

1. Test pilot ground checkout.
2. Read and initial test pilot folder.
3. Read pertinent sections of the Handbook of Maintenance Instructions.
4. Read applicable general engine bulletins.
5. Maintain familiarity with this manual.
6. Completion of a locally prepared ground training syllabus for prospective test pilots.

Note

Test pilots shall be thoroughly familiar with procedures and requirements for engine power checks (topping), autorotation checks, and engine acceleration checks as set forth in applicable portions of the Handbook of Maintenance Instructions.

DEFINITIONS.

Ground Checks.

Ground checks are defined as checks accomplished on the ground to ensure that equipment has been repaired, reassembled, adjusted, and inspected satisfactorily. These checks will be accomplished after the helicopter systems or components have undergone routine maintenance or repair operations.

Maintenance Test Flight.

Maintenance test flights are flights performed to determine if the airframe, power plant, accessories and items of equipage are functioning in accordance with predetermined requirements while subjected to the intended operating environments. Such flights are conducted when it is not feasible to determine safe or required functioning by means of ground check or shop tests.

Conditions Requiring Maintenance Test Flight.

Maintenance test flights are required under the following conditions after the necessary ground check or test, and prior to release of the helicopter for operational flight or training flights:

1. At the completion of a calendar inspection.
2. At the completion of helicopter rework.
3. After installation or reinstallation of engine.
4. After installation or reinstallation of a rotor blade, or blades.
5. After installation or reinstallation of any major helicopter component.
6. After installation or reinstallation of any major components of the fuel system.
7. When flight control surfaces have been replaced, removed for major repairs and reinstalled or re-rigged.
8. When primary control cables, rods or tubes have been replaced, rerigged, or rerouted.
9. When control system components have been adjusted or replaced, and where improper adjustment or installation of such components could adversely affect flight characteristics or result in loss of control of the helicopter.
10. After accomplishment of any modifications or repairs affecting any of the foregoing.
11. When requirement for a maintenance test flight under circumstances other than those specified above is determined to be needed.

MAINTENANCE TEST FLIGHT REQUIREMENT.

Designation of Pilots.

The flight crew for maintenance test flights shall consist of one test pilot, designated in writing by the commanding officer, and one qualified observer, preferably another helicopter pilot. Only such personnel who are required to complete the flight shall occupy the cabin.

Maintenance Test Flight.

Maintenance test flights will be conducted under VFR conditions during daylight hours within autorotation distance of an airfield when feasible. Maintenance test flights from ships at sea should be deferred until the ship returns to port unless such delay is operationally not feasible. If such flights are required at sea, they will be made in close proximity to the ship. Maintenance test flights may be combined with operational flights, providing the operational portion of the flight is not conducted until the maintenance test pilot is satisfied that the helicopter is safe for operational flight. A maintenance test pilot folder containing detailed flight test procedures will be available to all maintenance test pilots.

Blade Tracking and Ground Checks.

Whenever a track is required as a result of a main rotor head change, a main rotor blade change, a main transmission change or a rerig, the cockpit shall be manned by a designated maintenance test pilot.

Note

All personnel in the helicopter are to be strapped in securely and in flight gear during each engagement.

Ashore, whenever the rotors are to be engaged, the helicopter will be free of all tiedowns and headed into the wind.

The following checks should be accomplished whenever any of the following components have been removed or replaced: Main Transmission, Rotor Hub, Azimuth.

1. With the rotor brake released, have one man hold full forward cyclic (neutral lateral) while another manually rotates the rotor blades.
2. Deflection of each flap must be as follows:
   a. Aircraft's 12 o'clock – neutral flap.
   b. Aircraft's 9 o'clock – full up deflection (approx. 1 inch).
   c. Aircraft's 6 o'clock – neutral flap.
   d. Aircraft's 3 o'clock – full down deflection (approx. 1 inch).
3. Upon completion of flap deflection check, engage rotor and check control response as follows: Move cyclic from neutral and observe control response at the rotor tip paths. Maximum tip deflection should take place approximately 30 degrees counterclockwise from the direction in which the stick is moved. For example, if the stick is moved straight forward, the low point of the rotor tip should be about 30 degrees to the left of the nose.

Topping.

The following paragraphs discuss topping as a function of compressor inlet temperature (T_2).

T_2 is not presented as such on any of the cockpit instruments; however, the OAT gage may be used to determine the approximate T_2, except when the engine inlet anti-icing system is functioning. The actual T_2 will then be higher than the ambient temperature indicated on the OAT gage.

The engine produces maximum power (topping) available when any one of the following engine operating limits is reached: maximum gas generator speed (N_g) maximum fuel flow (W_f), or maximum turbine inlet temperature (T_5). The ambient temperature and altitude determine which of the three engine operating limits will define the topping limit.

Figure 11–5 illustrates the conditions under which either the gas generator speed, turbine inlet temperature or the fuel flow limit determines the topping limit. The bottom curve shows altitude and ambient temperature conditions below which fuel flow limit may be reached first. Considering altitudes above this curve, the maximum T_5 limit of 677° C will be reached before the maximum N_g speed of 100% when operating at temperatures above approximately 4° C. Conversely, maximum N_g will be reached before maximum T_5 when operating below approximately 4° C.

Gas Generator Speed Governor. The gas generator speed governor prevents N_g overspeed and indirectly prevents T_5 overtemperature. The relationship between T_5 and N_g is a function of T_2. The gas generator speed governor limits the maximum attainable N_g by adjusting W_f for varying T_2. Varying W_f to control N_g also indirectly controls T_5.

The gas generator speed governor should be set so as to prevent N_g overspeed and/or T_5 overtemperature. On figure 11–5 in example #1, at the assumed OAT of 20° C, the gas generator speed governor should limit the fuel flow so as not to exceed 677° C T_5. This T_5 value should correlate closely with 99.4% N_g. Similarly in example #2, at the assumed OAT of −15° C, the gas generator speed governor should limit the fuel flow so as not to exceed 100% N_g. This N_g value should correlate closely with 645° C T_5. However, due to efficiency variations between engines, the gas generator speed and T_5 correlation as illustrated in figure 11–5 may vary. In order to ensure maximum performance, adjust topping to gas generator speed limit (100%) when OAT is +4° C or below (as long as T_5 limit of 677° C is not exceeded). Set topping to 677° C T_5 when OAT is above +4° C (as long as gas generator speed limit of 100% is not exceeded).

Large discrepancies from the correlation between N_g and T_5 specified in figure 11–5 may indicate a faulty T_5 gage or FOD.

Note

When setting topping to max N_g (when below +4° C OAT) if T_5 falls *above* the average T_5 temperature line indicated on figure 11–5 this temperature will likely follow the same trend, as OAT increases. It would then be possible to over-temp by this equivalent amount when operating in ambient temperatures near or above that where the engine should be T_5 limited (near +4° C or above). Conversely, when setting topping to max T_5 (above +4° C OAT) and N_g is above the average N_g line in figure 11–5 (below 100%), this N_g value will likely follow the slope of the curve and it would be possible to overspeed N_g as OAT goes down. It is therefore necessary that the pilot closely monitor red lines, particularly when operating in ambient temperature near +4° C where the engine topping limits change and *either* T_5 or N_g may be the limit. It is recommended that a topping check and necessary adjustments be made when operating ambient temperatures change by 15 to 20° C.

Fuel Flow Limit. The fuel flow limit functions to prevent excessive engine power output. Excessive engine power output would be available at sea level conditions with low ambient temperatures. To check topping under this condition it is necessary to climb to a higher altitude, where less fuel flow is required to maintain a given gas generator speed. The engine then will not be flow limited, allowing a gas generator speed governor topping check to be made. The curve for minimum altitude for engine topping enables the pilot to determine the altitude at which a true topping check can be made (see figure 11–5). In example 3, figure 11–5 indicates that at an OAT of −15° C, an altitude of 3200 feet or higher is required to eliminate fuel flow limit for a topping check.

Autorotation Check.

Autorotation checks must be performed whenever maintenance has been performed on the rotor head or flight controls. Also, whenever the mean minimum temperature varies from 5° C below to 10° C above the minimum seasonal temperature for which the helicopter is rigged. The minimum seasonal temperature is the mean minimum temperature expected to occur at the location in which the helicopter is being operated.

Autorotation RPM with full down collective will vary with airspeed, gross weight, altitude and temperature. Consult autorotation rigging chart Figure 11–20, to assure proper autorotation RPM for any combination of the above variables.

EMERGENCY RPM CONTROL

In normal operation, the fuel flow (W_f) for any given operating condition is determined by several variables which are sensed by the fuel control, which in turn positions the metering valve.

These variables are:

1. Engine condition lever
2. Gas generator RPM (N_g)
3. Power turbine RPM (N_f)
4. Compressor discharge pressure (P_3)
5. Compressor inlet temperature (T_2)

All of the above are integrated, and a signal is transmitted to the metering valve to control fuel flow.

If any of these inputs fail to reach the fuel control, or a malfunction occurs which results in an improper fuel flow, loss of power can occur. In this event, the emergency rpm control will permit continued flight under circumstances which otherwise might require an immediate landing. The emergency rpm control consists of an electrical actuator which directly controls the metering valve. Since the metering valve is now directly controlled by the pilot, the fuel control no longer senses the above variables, and the pilot is now responsible for controlling N_g, N_f and T_5.

The reason an electrical actuator is provided is to assist the pilot in keeping T_5 within limits by controlling the rate of actuation of the metering valve. Too rapid actuation of the metering valve could dump too much fuel into the engine and result in over-temperature or overspeed. The emergency rpm control is only effective above the lower limit set by the engine condition lever.

For this reason, the switchover from normal to emergency is not complete until the pilot runs the emergency actuator to an rpm above that set by normal controls (engine condition lever and beeper rpm control). The normal controls (engine condition lever and beeper) set the bottom stop or minimum fuel flow for emergency rpm control.

The emergency actuator is automatically retracted to full decrease when the fuel control selector switch is in NORMAL. When the pilot switches to emergency and starts beeping, he has to bring the actuator from its full decrease position to at least as high a fuel flow setting as existed at the time of switchover. It follows that if the switchover is accomplished at a relatively high rpm and power, some time lag will occur before the manual control becomes effective.

In analyzing the operation of the emergency rpm control and applying its use to an actual emergency situation, it can be seen that the procedure for switchover will vary with the type of malfunction that has occurred. For example, if the malfunction results in an overspeed it would be unrealistic to switch to emergency and start beeping up without first getting the overspeed under control. In this situation it would be better to load the rotors (increase collective pitch) to absorb the excess power, and then reduce the engine condition lever to IDLE while switching to emergency and beeping up. This must be a coordinated maneuver since the object is to reduce the engine condition lever to IDLE to disable the N_f governor while maintaining rotor rpm by entering autorotation as engine power is reduced. As a matter of technique, it would be better to absorb the excess power in a relatively slow climb (60-80 knots) rather than high speed level flight since the entry into autorotation would be easier at low speed.

On the other hand if the malfunction resulted in a loss of power it would be best to immediately switch to emergency control and begin beeping to regain power. It may be necessary in this case to reduce collective immediately to maintain rpm while the switchover is being made.

Refer to Section III for practice procedure, and Section V for emergency procedure.

ELECTRICAL THROTTLE MALFUNCTIONS

Type Failure	*Symptoms*
Dead Actuator. (Motor, amplifier, or wiring failure.)	1. No response to rpm beep. 2. No collective compensation. 3. No response to engine condition lever between IDLE and FLY.
Erratic Fuel Control Actuator.	Fluctuation of N_r in governed range.
No Response to RPM Switch.	No response to rpm beep in either or both directions. (RPM may go to either maximum or minimum governed speed, or stay where previously set.)
Complete Helicopter Electrical Failure.	1. No rpm beep control. 2. No collective compensation. 3. No response to engine condition lever.
Fuel Control Actuator Hardover Down.	N_f decreases to about 94% (N_r and N_f of other engine may droop if power required exceeds single engine power available.)
Fuel Control Actuator Hardover Up.	N_f/N_r increases to above selected speed, but is not above 109%.

Crosswind Effect on Ridgeline Approach

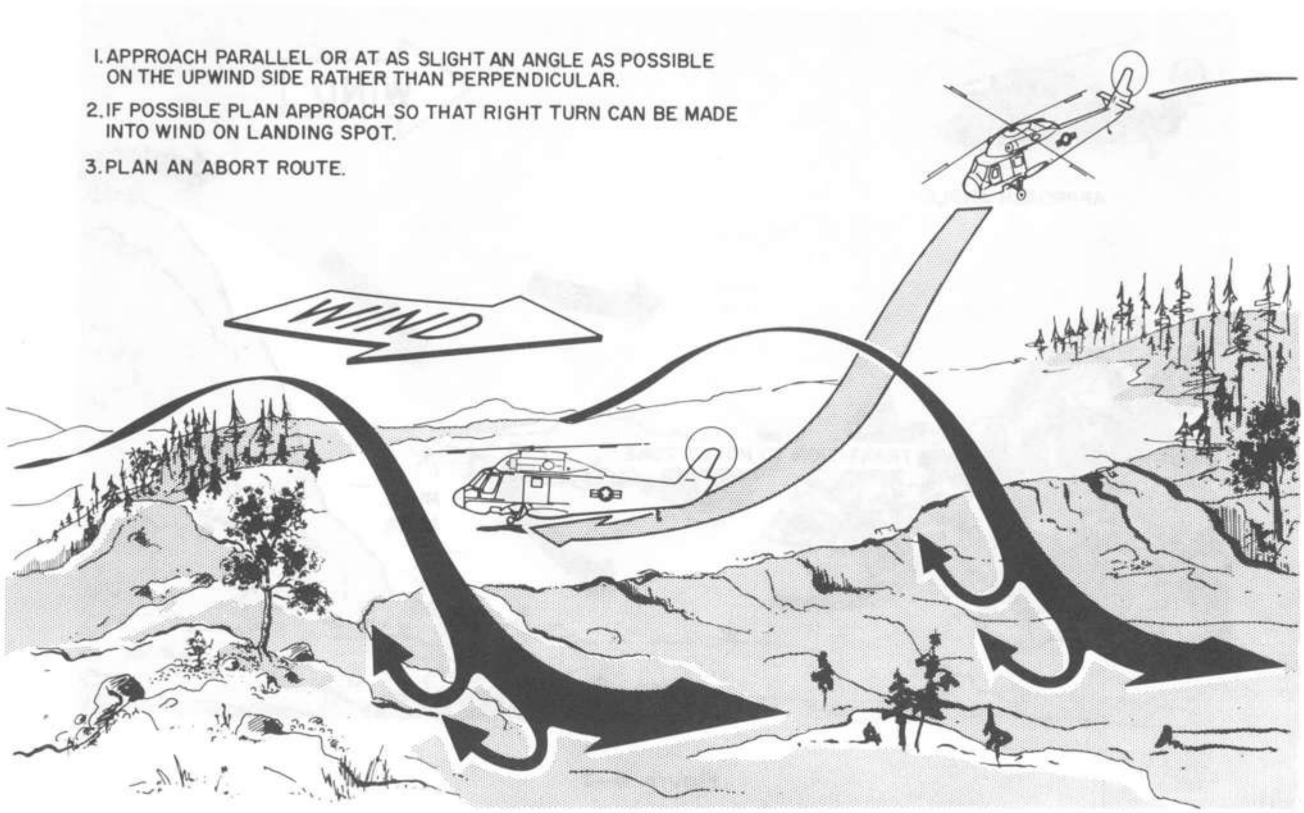


Figure 4—1

MOUNTAIN AND ROUGH TERRAIN FLYING

Many helicopter missions require flight and landings in rough and mountainous terrain. Refined flying techniques along with complete and precise knowledge of the individual problems to be encountered is required. Landing site condition, wind direction and velocity, gross weight limitations, and effects of obstacles are but a few of the considerations for each landing or takeoff. In a great many cases, meteorology facilities and information are not available at the site of intended operation. The effects of mountains and vegetation can greatly vary wind conditions and temperatures. For this reason, each landing site must be evaluated at the time of intended operation. Air density is the major factor involved in determining helicopter performance. The variables affecting air density are atmospheric pressure, temperature and humidity. As altitude, temperature, and humidity increase, helicopter lifting capabilities decrease; therefore, it is essential that meteorology planning data be as close as possible to that expected to be encountered in the intended area of operation. If precise operating area information is not available, then intelligent estimates must be made as to the expected pressure altitude, surface ambient air temperature, wet bulb temperature, or specific humidity. These estimates may then be entered in the Hovering Out of Ground Effect Charts to determine the gross weight allowable. The second greatest factor affecting helicopter performance is wind. Weight carrying capability increases rapidly with increases in wind velocity relative to rotor system. However accurate wind information is more difficult to obtain and more variable than the other planning data previously discussed. It is therefore not advisable to include wind in the planning data except to note that any wind encountered in the operating area may serve to improve helicopter performance. In a few cases, operation necessity will require landing on a prepared surface at an altitude above the hovering capability of the helicopter. In these cases a roll-on landing and takeoff will be necessary to accomplish the mission. Data for these conditions will have to be computed from the charts in this manual.

WIND DIRECTION AND VELOCITY.

There are several methods of determining the wind direction and velocity in rough area. The most reliable method is by the use of smoke generators. However, it must be noted that the hand held day/night distress

Wind Effect in Confined Area

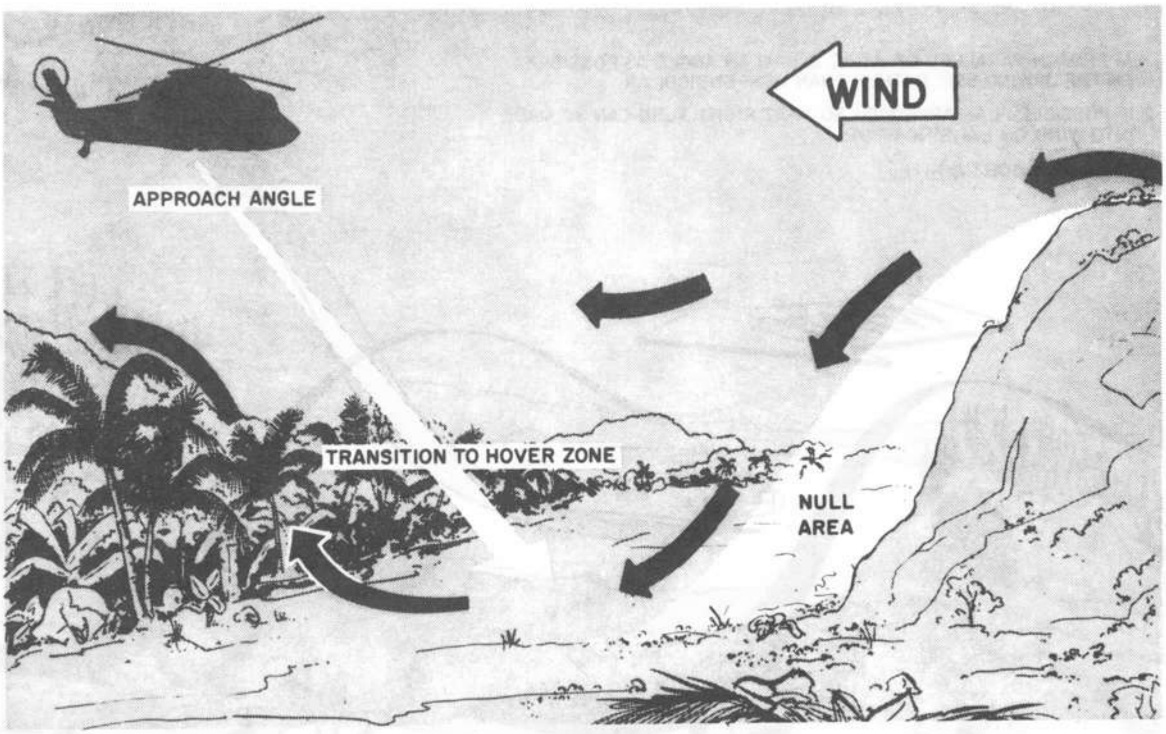


Figure 4—2

Wind Flow Over and Around Peaks

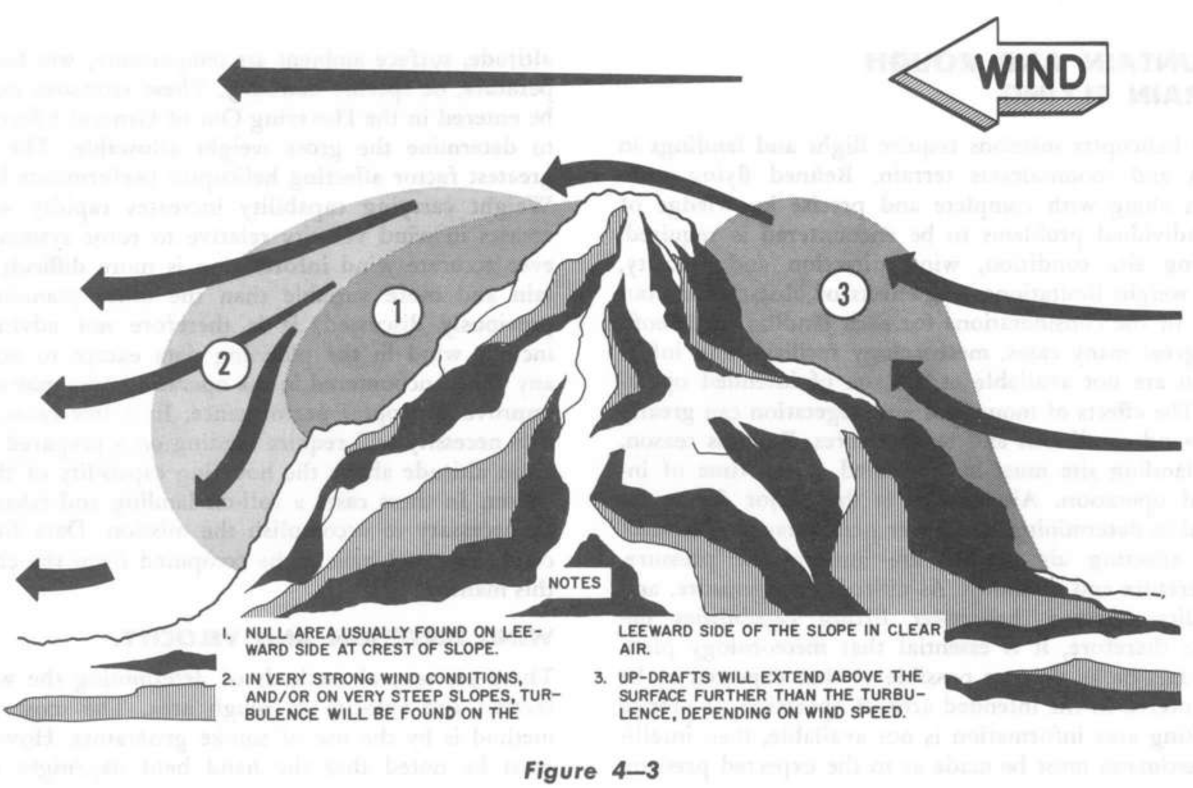


Figure 4—3

signal and the standard ordnance issue smoke hand grenade are satisfactory for wind indication but constitute a fire hazard when used in areas covered with combustible vegetation. Observations of foliage will indicate to some degree the direction of the wind, but is of limited value in estimating wind velocity. Helicopter drift determined by eyesight without the use of navigational aids is the first method generally used by experienced pilots. The accuracy with which wind direction may be determined through the "drift" method becomes a function of wind velocity. The greater the wind value the more closely the direction may be defined.

LANDING SITE EVALUATION.

Five major considerations in evaluating the landing area are: (1) height of obstacles which determine approach angle; (2) size and topography of the landing zone; (3) possible loss of wind effect; (4) power available; and (5) departure route. The transition period is the most difficult part of any approach. As helicopter performance decreases, the transition period becomes more critical, and of necessity approaches must be shallower and transition more gradual. Therefore, as the height of the obstacle increases, larger areas will be required. As wind velocity increases so does helicopter performance; however, when the helicopter drops below an obstacle, a loss of wind generally occurs as a result of the airflow being unable to immediately negotiate the change prevalent at the upwind side of the landing zone where a virtual null area exists. This null area extends toward the downwind side of the clearing and will become larger as the height of the obstacle and wind velocity increases. It is therefore increasingly important in the landing phase that this null area be avoided if marginal performance capabilities are anticipated. The null area is of particular concern in making a takeoff from confined area. Under heavy load, or limited power conditions it is desired to achieve a significant value of forward velocity and translational lift prior to transitioning to a climb so that the overall climb performance of the helicopter will be improved. If the takeoff cycle is not commenced from the most downwind portion of the area, and translational velocity achieved prior to arrival in the null area, a significant loss in lift may occur at the most critical portion of the takeoff. It must also be noted that in the vicinity of the null area nearly vertical downdraft of air may be encountered, which will further reduce the actual climb rate of the helicopter. It is feasible that under certain combinations of limited area, high obstacles upwind, and limited power available, the best takeoff route would be either crosswind or downwind, terrain permitting. The effects of detrimental wind flow and the requirement to climb may thus be minimized or circumvented. Even though this is a departure from the cardinal rule of "takeoff into the wind," it may well be the proper solution when all factors are weighed in their true perspective. Never plan an approach to a confined area wherein there is no reasonable route of departure. The terrain within a site is considered from an evaluation of vegetation, surface characteristics, and slope. Care must be taken to avoid placing the tail in low brush or branches. Obstacles covered by grass may be located by flattening the grass with rotor wash prior to landing. Takeoff rpm should be maintained until the collective is placed smoothly in the full down position so that an immediate takeoff may be accomplished should the helicopter start tipping from soft earth or a gear being placed in a hidden hole. Cross-slope, up-slope, or down-slope landings can be accomplished. Landing up-slope affords maximum tail clearance. Landing down-slope affords an easier wave-off, but greatly reduces the ramp and aft rotor clearance to the ground and should be avoided whenever possible.

CAUTION

Extreme care must be taken to prevent the rotor blades from striking terrain or obstacles on either side of the helicopter.

EFFECTS OF HIGH ALTITUDE.

Engine power available at altitude is less, and operations can easily be in a situation of full throttle with only limited hovering ability. High gross weight at altitude increases the susceptibility of the helicopter to blade stall. Conditions that contribute to blade stall are high forward speed, high gross weight, high altitude, low rpm, induced "G" loading and turbulence. Shallower turns at slower airspeeds with higher rpm are required to avoid blade stall. A permissible maneuver at sea level must be tempered at a higher altitude. Smooth and timely control application and anticipation of power requirements will do more than anything else to improve altitude performance. While blade stall is of primary importance during level flight, one other flight phenomenon is of some concern in the approach phase of operations. This is called the vortex ring state or power settling. At certain high rates of descent and slow forward speeds the rotor system will settle into rotor wash which will substantially decrease rotor efficiency and net lift to a minimal value. Indications of the vortex ring state may be recognized by a severe buffeting in the airframe, partial or complete loss of control, and sudden increase in the rate-of-descent. Corrective action must be taken to move the helicopter out of its own downwash into undisturbed air by increasing forward speed and, possibly, by decreasing collective pitch.

CAUTION

Do not attempt to maintain altitude once power settling has started, because an increase of collective pitch will aggravate the condition. A very low percentage of helicopter pilots have experienced power settling. For this reason most pilots have developed a tendency to overlook this problem during the final approach stages. Flight conditions causing power settling should be avoided at low altitudes because of the attendant loss of altitude necessary for recovery. If power settling occurs at a low altitude, insufficient altitude may be available to effect a safe recovery.

A more commonly encountered danger is a high rate-of-descent with insufficient power for recovery. This condition can occur at both slow and moderate forward speeds; however, this is not a condition of flying through rotor downwash and should not be confused with power settling. If not detected in time this condition may result in an increased rate-of-descent, loss of rpm, or entry into power settling.

TURBULENT AIR FLIGHT TECHNIQUES.

Helicopter pilots must be constantly alert to evaluate and avoid areas of severe turbulence; however, if encountered, immediate steps must be taken to avoid continued flight through it to preclude the structural limits of the helicopter being exceeded. Severe turbulence is often found in thunderstorms and helicopter operations should not be conducted in their vicinity. The most frequently encountered type of turbulence is orographic turbulence. It can be dangerous if severe and is normally associated with updrafts and downdrafts. It is created by moving air being lifted by natural or manmade obstructions. It is most prevalent in mountainous regions and is always present in mountains if there is a surface wind. Orographic turbulence is directly proportional to the wind velocity. It is found on the upwind of slopes and ridges near the tops and extending down the downward slope. It will always be found on the tops of ridges associated with updrafts on the upwind side and downdrafts on the downwind side. Its extent on the downwind slope depends on the strength of the wind and the steepness of the slope. If the wind is fairly strong (15 to 20 knots) and the slope is steep, the wind will have a tendency to blow off the slope and not follow it down; however, there will still be some tendency to follow the slope. In this situation there will probably be severe turbulence several hundred yards downwind of the ridge at a level just below the top. Under certain atmospheric conditions, a cloud may be observed at this point. On more gentle slopes the turbulence will follow down the slope, but will be more severe near the top. Orographic turbulence will be affected by other factors. The intensity will not be as great when climbing a smooth surface as when climbing a rough surface. It will not follow sharp contours as readily as gentle contours. Manmade obstructions and vegetation will also cause turbulence. Extreme care should be taken when hovering near buildings, hangars, and similar areas. The best method to overfly ridge lines from any direction is to acquire sufficient altitude prior to crossing to avoid leeside downdrafts. If landing on ridge lines, the approach should be made along the ridge in the updraft, or select an approach angle into the wind that is above the leeside turbulence. When the wind blows across a narrow canyon or gorge, it will often veer down into the canyon. Turbulence will be found near the middle and downwind side of the canyon or gorge. When a helicopter is being operated at or near its service ceiling and encounters a downdraft of more than 1.6 feet per second the helicopter will descend. A downdraft can not continue into the ground, while within a downdraft a rate-of-descent may be established of such magnitude that the helicopter will continue descending and crash even though the helicopter is no longer affected by the downdraft. Therefore, the procedure for transitioning a mounting pass shall be to fly close aboard that side of the pass or canyon which affords an upslope wind. This procedure not only provides additional lift but also provides a readily available means of exit in case of emergency. Maximum turning space is available and a turn into the wind is also a turn to lower terrain. The often used procedure of flying through the middle of a pass to avoid mountains invites disaster. This is frequently the area of greatest turbulence and in case of emergency, the pilot has little or no opportunity to turn back due to insufficient turning space. Rising air currents created by surface heating causes convective turbulence. This is most prevalent over bare areas. Convective turbulence is normally found at a relatively low height above the terrain, generally below 2000 feet. It may, however, under certain conditions and in certain areas, reach as high as 8000 feet above the terrain. Attempting to fly over convective turbulence should be carefully considered, depending on the mission assigned. The best method is to fly at the lowest altitude consistent with safety. Attempt to keep your flight path over areas covered with vegetation. Turbulence can be anticipated when transitioning from bare areas to areas covered by vegetation or snow. Convective turbulence seldom gets severe enough to cause structural damage.

ADVERSE WEATHER CONDITIONS.

When flying in and around mountainous terrain under adverse weather conditions, it should be remembered that the possibility of inadvertent entry into clouds is ever present. Air currents are unpredictable which may cause cloud formations to shift rapidly. Since depth perception with relation to distance from cloud formations and cloud movement is poor, low hanging clouds and scud should be given a wide berth at all times. The route to be flown should be studied carefully by each pilot, in addition to being well briefed. A careful check on the helicopter compass should be maintained in order to fly a true heading if the occasion demands.

MAXIMUM GROSS WEIGHT TAKEOFF.

Whether operating at sea level or at altitude, all helicopter control movements, attitude changes, and power adjustments must be smoothly and patiently executed when operating at gross weights near the maximum as calculated from figure 11—8.

When desiring to take off with high gross weight from an unprepared surface that has no vertical obstructions, the following techniques shall be used to safely facilitate the maneuver:

1. Slowly and gently establish a smooth 5-foot hover into the wind at 102% N_r.

Wind Flow Over Gorge or Canyon

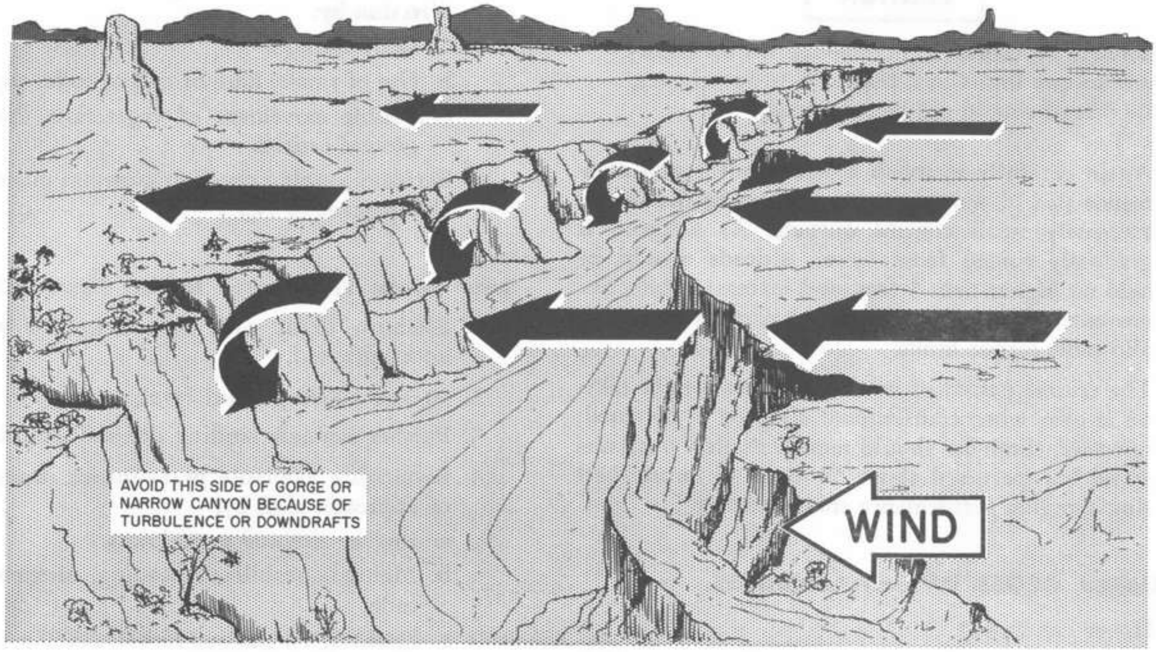


Figure 4—4

Wind Flow in Valley or Canyon

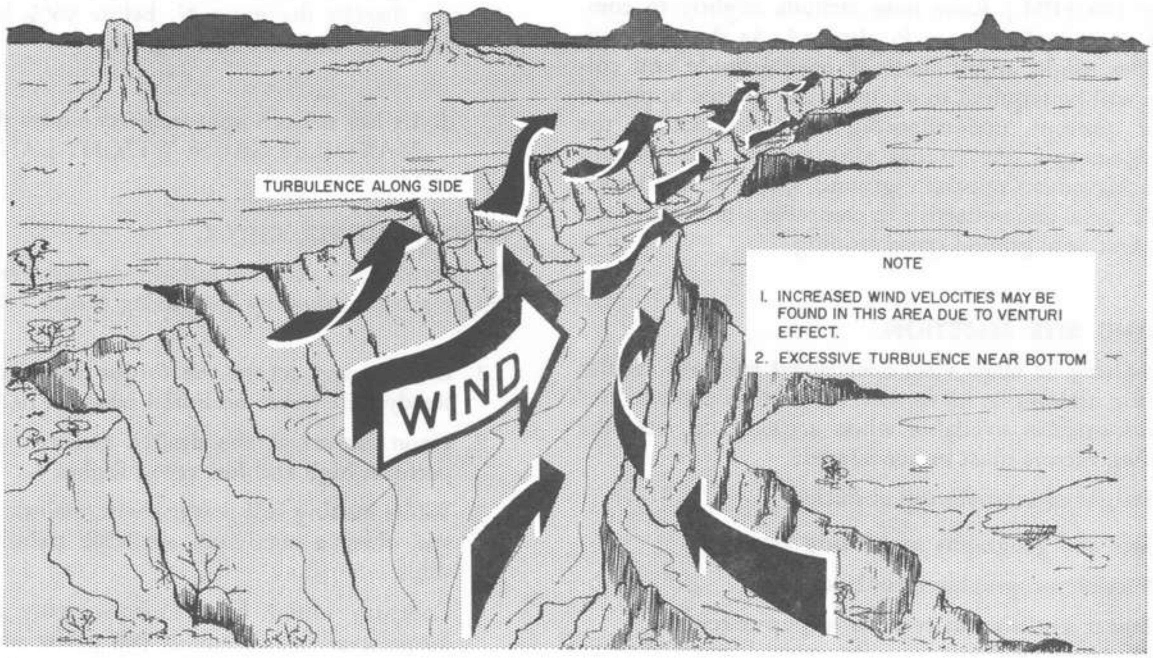


Figure 4—5

2. After getting the "feel" of the aircraft, very gradually increase collective until stabilized at a 10-foot hover.

CAUTION

If 102% N_r cannot be maintained within allowable torque limits in a balanced 10-foot hover, the takeoff should not be continued.

3. Again carefully establish a 5-foot hover and commence slowly, moving forward through the use of extremely small control outputs. As airspeed is gradually gained from hover, altitude should be held no higher than 5 feet, and increased collective movements made in a manner to prevent exceeding allowable torque limits.
4. The critical period of maximum gross weight takeoff is over when translational airspeed is obtained; however, climb-out should remain shallow until airspeed has increased above 50 knots to ensure best single engine performance characteristics.

MAXIMUM GROSS WEIGHT LANDINGS.

(No Hover Landings.)

When a hovering landing is not possible due to high gross weights and/or power available, a running landing should be executed if a hard surface is available (refer to figure 3–8). If surface conditions prohibit a running landing, proceed with a no-hover spot landing. Fly approach pattern at 50-55 knots until reaching 100-foot altitude on final. From this position until touchdown, a shallow, slow descent is established and maintained. (Approach path about 15° and rate of descent approximately 150 FPM.) Raise nose attitude slightly to commence a gradual decrease in airspeed. As the approach continues, slight adjustments of nose attitude and collective will be required to maintain the desired approach and/or prevent undershooting or overshooting the touchdown spot. At 10-foot altitude, the pilot should have achieved an apparent ground speed of 4-5 knots. Use aft cyclic and collective to complete a moderate, tail wheel first, zero ground speed landing.

LANDING SITE SELECTION.

When rescue or other vital operational missions require a landing attempt be made with little or no accurate terrain information available when arriving on site, the following factors must be considered:

1. Height of surrounding obstacles.
2. Size and geography of landing area.
3. Possible orographic turbulence.
4. Power available in relation to power required.
5. Departure route.
6. Possible full-power wave-off routes.

High Recon Flight.

1. Normal Cruise.
2. 300 feet above ground level.
3. Fly directly over landing area and determine wind direction by:
   a. Drift method.
   b. Use of smoke flare or roll of toilet paper.
   c. Visible movement of vegetation, dust or other ground articles.
4. Perform topping check to ascertain maximum available percent of N_g.

Low Recon Flight and Hover Power Check.

1. Establish flight path into estimated wind at 60 knots airspeed.
2. 50 feet above ground level.
3. Further evaluate landing site and wind direction.
4. Investigate available performance during last half of approach path by:
   a. Reduce airspeed to 30 knots.
   b. Maintain stabilized heading, airspeed and altitude.
   c. Establish a stabilized rate-of-climb at 25-30 knots airspeed and maximum power (not to exceed 47% torque). If rate of climb exceeds 750 fpm then the power available is sufficient to hold a no-wind hover at 5 feet.

CAUTION

At higher altitudes do not apply rapid collective thereby dropping N_r below 98% because lateral control will be marginal.

   d. Utilize smooth approach techniques described in MAXIMUM GROSS WEIGHT LANDINGS.

TORQUE POWER CHECK.

An alternate and accurate inflight check for hover power can be accomplished by comparing torque values as follows:

1. Observe and record the torque value required for steady state hover on initial takeoff (102% N_r).
2. Upon arrival at the desired remote landing area perform high and low recon flights.
3. While making full power check, maintain 102% N_r and observe maximum available stabilized torque value.
4. Compare initial hover torque with full power torque available on site. If full power torque equals torque required for original hover, it follows that adequate power is available for a second hover.

CAUTION

If the elevation and/or density altitude at the proposed landing site is substantially higher than the takeoff field, the pilot must ensure that sufficient excess torque is available to satisfy the following correction factor:

½% additional torque required for each 1000-foot altitude increase.

SUMMARY.

The following guide lines are considered to be most important for mountain and rough terrain flying:

1. Make a continuous check of wind direction and estimated velocity.
2. Plan your approach so that an abort can be made downhill and/or into the wind without climbing.
3. If wind is relatively calm try to select a hill or knoll for landing so as to take full advantage of any possible wind effect.
4. When evaluating a landing site in noncombat operations, execute as many fly-bys as necessary with at least one high and one low pass before conducting operations into a strange landing area.
5. Evaluate the obstacles in the landing site and consider possible null areas and routes of departure.
6. Landing site selection should not be based solely on convenience but consideration should be given to all relevant factors.
7. Determine ability to hover out of ground effect prior to attempting a landing.
8. Watch for rpm surges during turbulent conditions. Strong updrafts will cause rpm to increase, whereas downdrafts will cause rpm to decrease.
9. Avoid flight in or near thunderstorms.
10. Give all cloud formations a wide berth.
11. Fly as smoothly as possible and avoid steep turns.
12. Cross mountain peaks and ridges high enough to stay out of downdrafts on the leeside of the crest.
13. Avoid downdrafts prevalent on leeward slopes.
14. Plan your flight to take advantage of the updrafts on the windward slopes.
15. Whenever possible, approaches to ridges should be along the ridge rather than perpendicular.
16. Avoid high rates of descent when approaching landing sites.
17. Know your route and brief well for flying in these areas.

FORMATION FLYING

GENERAL.

Helicopter formation flight is conducted for the following reasons:

1. Improved operational capability. When properly executed the flight leader can expect complete flexibility of operation within the limitations of helicopter maneuverability without danger of creating unsafe conditions within his formation (free cruise), or the encumbrance of delay while intentions are passed via signal or radio.
2. Mutual safety and accountability. (The danger of mid-air collision is greatly reduced when every flight member knows where he is supposed to be, and remains in his designated space. Furthermore, the flight leader, by checking positions, can account at a glance for any absenteeism from the flight.)
3. Esprit de corps. (Few factors can create a greater pride in a unit than a sharp, correctly executed formation doctrine. Few factors can destroy unit pride more thoroughly than a poor formation capability.)

Certain helicopter characteristics which should be considered in formation flight are:

1. Formation flying is performed in a step-up position to avoid rotor wash and improve visibility and to provide a greater safety margin between the main rotor and the helicopter ahead.
2. There is no wing to observe to indicate movement and changes of direction. At night it is difficult to ascertain when the lead A/C changes direction and altitude. (Refer to NIGHT FORMATION in this section.)
3. Probable loss of both helicopters in event of mid-air collision due to fragility of components.

Section and division leaders must endeavor to fly as smoothly and as steadily as possible. It is imperative that their power settings remain as near constant as possible. Constancy of heading and altitude should be a rule of flight insofar as considered practical and within the mission requirements. Quick stops in any formation or rendezvous are strictly forbidden. Illustrations of free cruise and parade formations are shown in figures 4–6, 4–7, and 4–8.

In judging altitude separation between helicopters, the horizon is considered level with the eye.

FORMATION COMPOSITION.

Section.

The section will consist of two helicopters, and will constitute the basic unit of a formation.

Free Cruise—Straight and Level

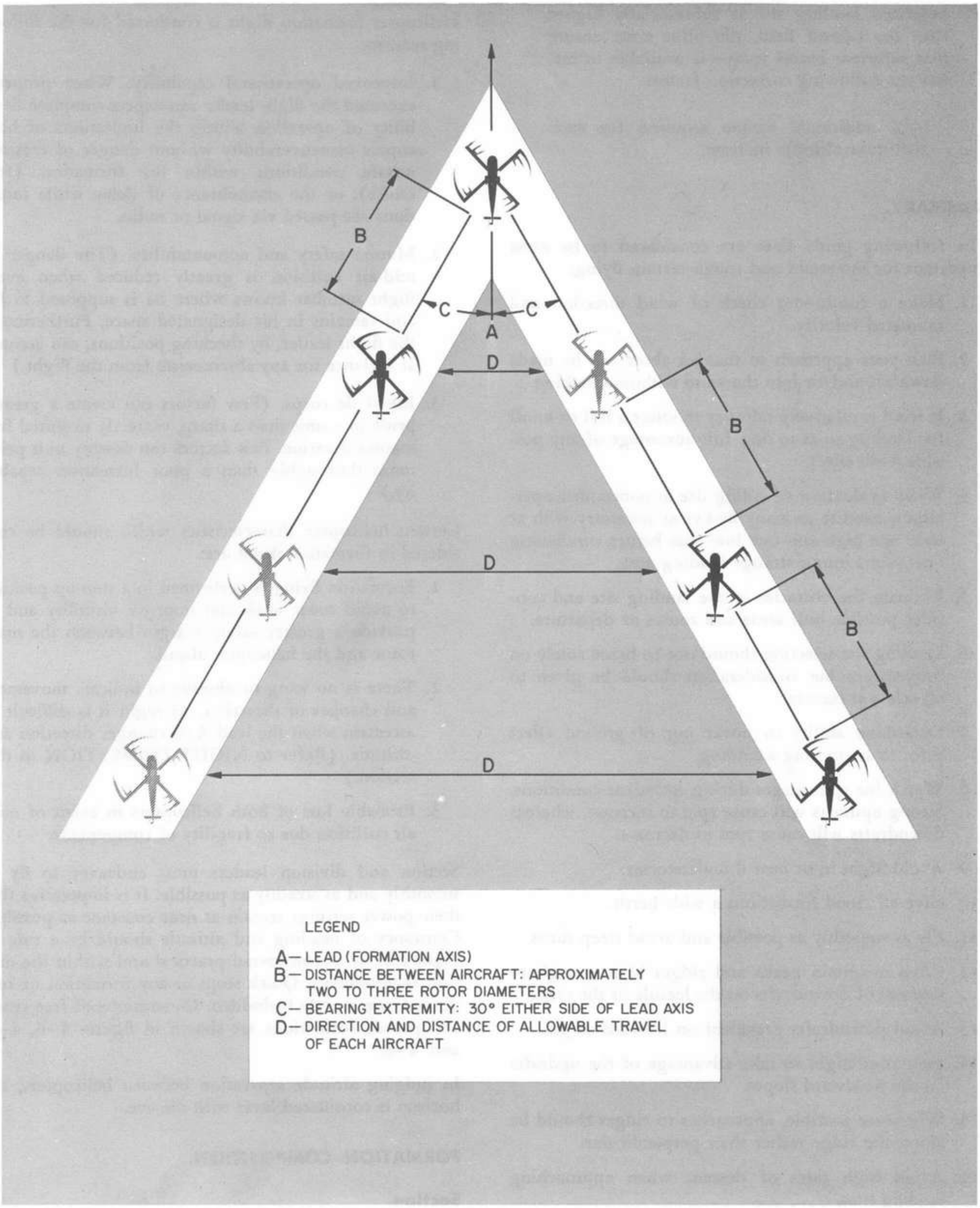


Figure 4–6

Free Cruise Turn

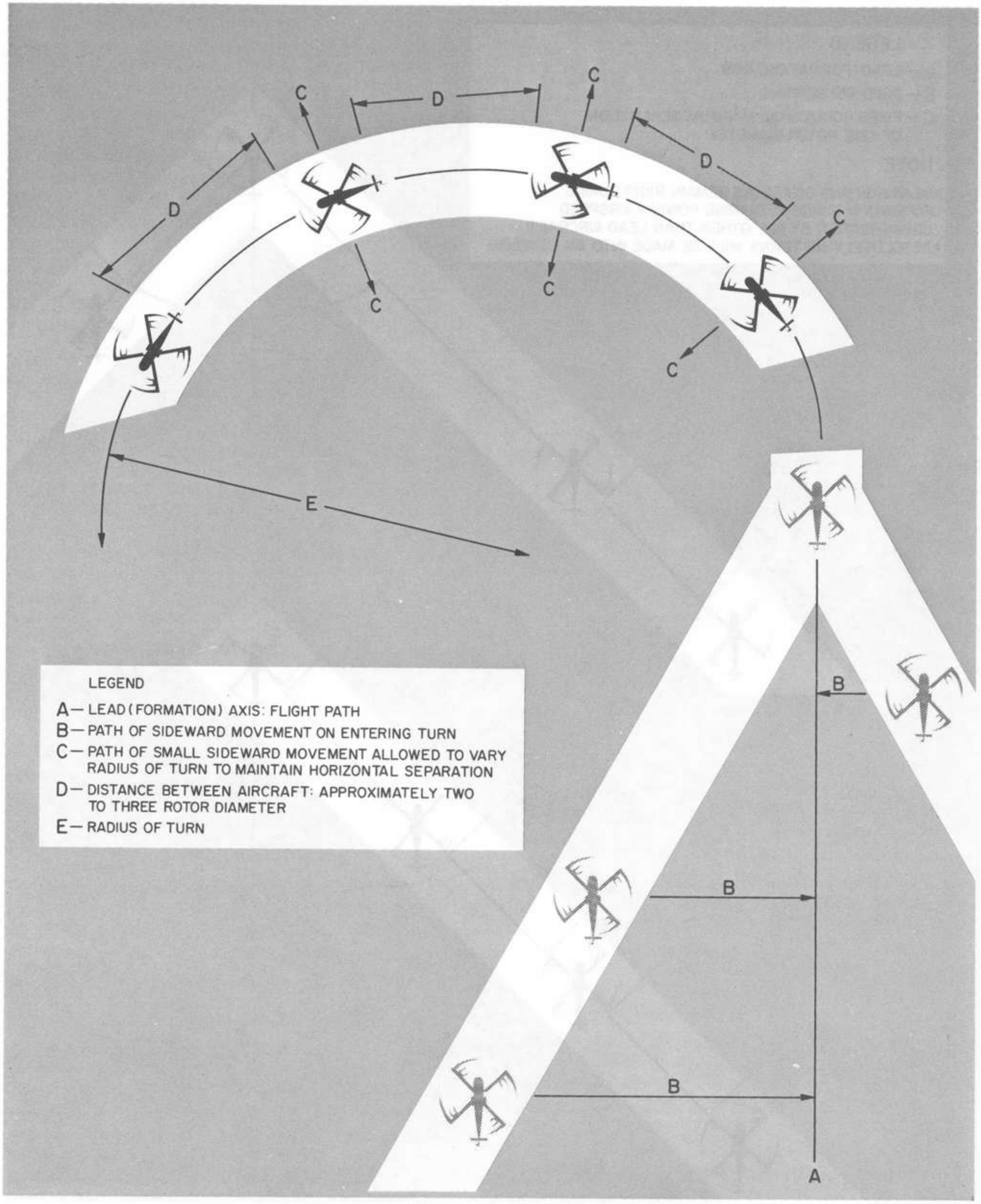


Figure 4–7

Parade

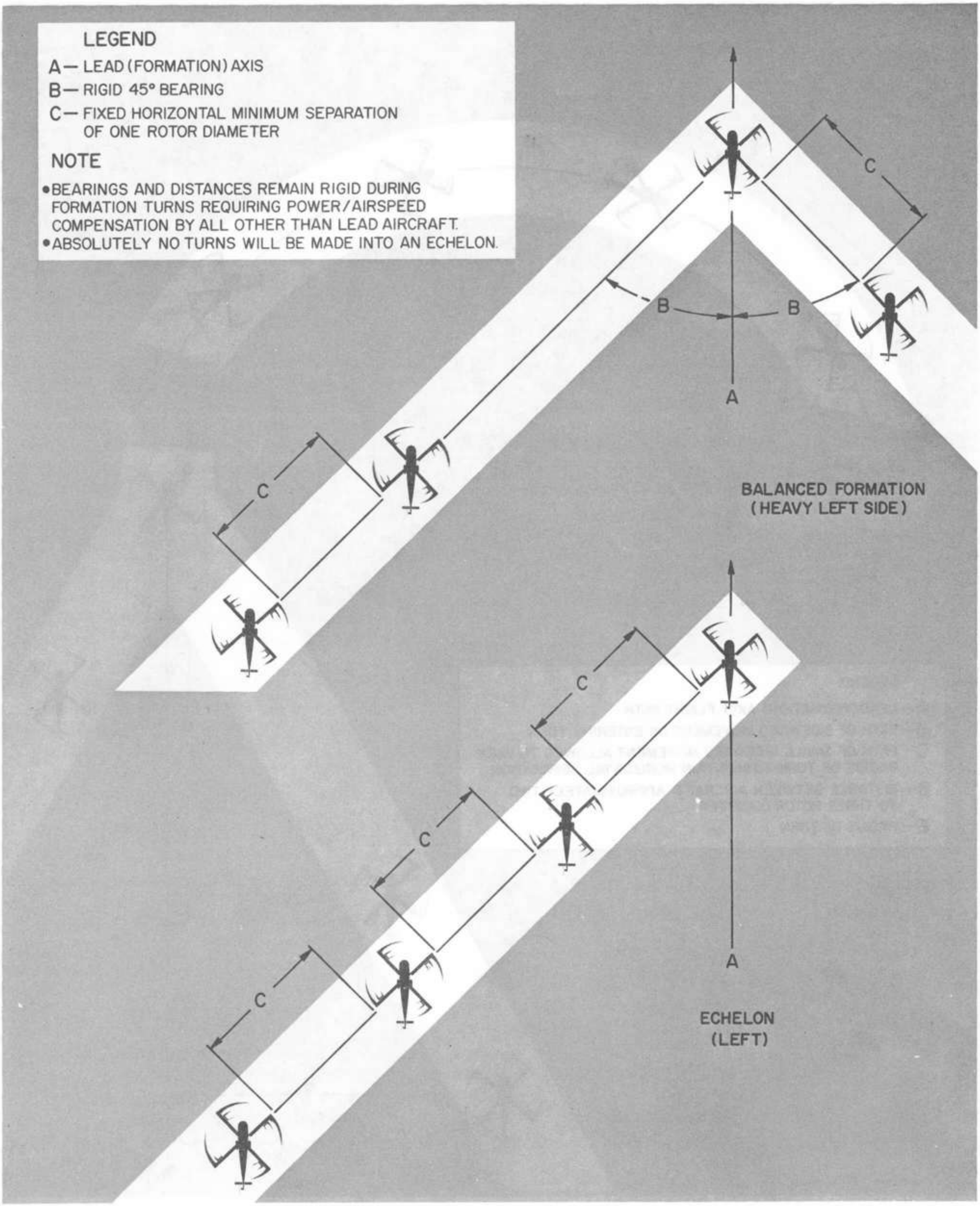


Figure 4—8

Parade. The wingman will fly at a 45-degree bearing abaft the beam on the appropriate side of the section leader. The horizontal helicopter-to-helicopter separation will be one rotor diameter, minimum, between rotor tips. The vertical separation (step-up) will be 10 feet between closest components of helicopters. The wingman's position in the parade section is fixed.

Free Cruise. The wingman will fly within bearings approximately 60 degrees abaft the beam of the section leader. The horizontal helicopter-to-helicopter separation will be approximately two to three rotor diameters. The vertical separation (step-up) will be 10 feet between closest components of helicopters. Normally, the free cruise wingman maintains a position 30 degrees off the axis of the lead helicopter during straight and level flight. During turns he crosses over from one side of the section leader to the other to maintain position with minimum changes of power.

Note

In free cruise, helicopters in the formation are not to be considered bound to a fixed position, but rather assigned a 60-degree segment of airspace behind the leader in which they are free to move as necessary to maintain constancy of horizontal and vertical separation. Normally, when straight and level, a position on the outward extremity of this segment is assumed in order that the leader may have ready visual accountability, and for avoidance of turbulence of downwash problems.

Division.

A division will consist of two sections, and be considered the main unit of a formation.

Parade. The second section leader is the number three man in the division. His position is on the opposite of the wingman of section one. Section two wingman always views both his section leader and division leader in line from his position.

Free Cruise. The section leader will fly a bearing approximately 60 degrees abaft the beam of the division leader when in straight and level flight. The horizontal and vertical clearance will be approximately two to three rotor diameters and 10 feet between closest components of helicopters, respectively, from the section one wingman. During turns, the second section leader is free to cross over his section from side to side of the division leader to maintain horizontal clearance with minimum changes of power. The second section leader's wingman will conform to the requirements delineated in the preceding paragraph. When a flight consists of more than four helicopters, amount over four will form subsequent divisions. The last division may be comprised of less than four helicopters. The general rules applying to individual helicopters in formation may be expanded to apply to divisions of helicopters within the limits of safety and capability. The side of the division on which the section is placed will be known as the "heavy side," and the side of the leader's wingman the "light side."

RENDEZVOUS.

Normally, the running rendezvous will be employed. The leader will fly on course at slow cruise, and the flight will take position as briefed, or in the order of arrival. When the flight is joined, the leader will proceed at cruise speed. An orbiting rendezvous may be used. The leader will fly a right or left circular pattern at normal cruise speed around a designated point until the flight is joined. In an orbiting rendezvous, helicopters will join in column formation using the free cruise principle until the leader rolls out on departure heading. All rendezvousing helicopters should pass across the designated point, pick up altitude separation and join on the helicopter ahead. Any "overshoot" tendency should be taken to the outside of the turn. Normally, thereafter, the flight will continue to maintain free cruise formation at cruise speed unless otherwise directed by the flight leader. The flight positions are as briefed, or in order of arrival. Extreme caution should be exercised during night rendezvous due to reduction of perception of relative motion.

CONDUCT OF FLIGHT.

Formation flight will be practiced in accordance with this doctrine during all normal multiple helicopter movements in order to improve proficiency. Free cruise formation will be used for most operations. Parade formation is normally used only for "fly-over" of ships or base. Unless otherwise specified, the flight leader will normally fly the lead from number one position. Assuming the lead – A change of lead should be passed only when the flight is in echelon and when positive change of lead is indicated by visual or oral communications.

RESPONSIBILITY.

The flight leader is responsible for flight briefing, conduct, and discipline of flight. He will normally handle radio transmissions for the flight, including takeoff and landing clearances. Division and section leaders are responsible for maintaining position, and should be prepared to assume the lead when required. All pilots are responsible for maintaining positions as outlined, bearing in mind the necessity for being in view of lead plane when not maneuvering in free cruise formation. No deviation of position, such as change of lead, will be made until appropriate signals have been given and acknowledged. When changes of lead are made the lead helicopter will drift slightly away from the echelon until safely clear, and then back to assume position on the new formation. Safety will govern all actions. Wingman must avoid flying behind leaders in straight and level flight.

BRIEFING.

Briefing for a formation flight is the responsibility of the flight leader. The briefing should include the following information:

1. Rendezvous (type, area, altitude, positions, speed, and other pertinent data).
2. Position of each helicopter in the flight.
3. Communications (whether by radio or hand signals).
4. Review of signals.
5. Conduct of flight (what maneuvers will be accomplished, whether there will be changes of lead within the section, within the division, etc.).

SIGNALS.

The following signals should be used in formation flying:

Maneuver	*Signal* Day	Night
Join up	Radio and/or zoom (Fore-and-aft movement of cyclic)	Radio.
Right echelon (wingman)	Right arm up	Radio or R (.–.) on lights.
Left echelon (wingman)	Left arm up	Radio or K (–.–) on lights.
Echelon (Section)	Pumping arm signal or radio	Radio.
Break-up	Vertical rotary motion of hand, pass lead, and kiss off. Radio	Blink lights, then switch lights to bright. Radio.

NIGHT FORMATION.

Night formation should be flown in the same manner as day formation, only when complete visual reference between helicopters can be maintained. Separation between helicopters may be adjusted as deemed prudent by members of the flight and as directed by visibility conditions. Caution should be exercised to avoid unnecessarily extending the formation to the extent of limiting its operational capability, mutual safety, or ability to maintain firm visual contact with other formation members. At any time firm and complete visual contact cannot be maintained between helicopters, or silhouette definition is lost, discontinue the formation flight. Helicopters in formation at night should have position light on DIM or BRIGHT (as required), with the rotating beacon lights OFF, with the exception of the last helicopter in each division turning lights on BRIGHT and actuating its rotating beacons.

SECTION V

EMERGENCY PROCEDURES

TABLE OF CONTENTS

Engine or Throttle Malfunctions	5-2
Emergency Landings	5-5
Tail Rotor Failure	5-6
Instrument Flight Conditions in Formation	5-7
Fire	5-7
Ditching	5-9
Bailout	5-10
Emergency Jettisoning	5-10
Master Caution Light On	5-12
Fire Warning Light On	5-12
Combining Gearbox or Tranmission Oil Pressure Caution Light On	5-12
Engine Chip Detector Caution Light On	5-12
Gearbox Chip Detector Caution Light On	5-12
Engine Oil Pressure Caution Light On	5-12
Speed Decreaser Gear Oil Pressure Caution Light On	5-12
Hydraulic Pressure Caution Light On	5-12
Erratic Control Inputs	5-12
Landing Gear Fails to Lower	5-13
28-Volt Converter Caution Light On	5-13
No. 1 Generator Caution Light On	5-13
No. 2 Generator Caution Light On	5-13
Both Generator Caution Lights On	5-13
Fuel Boost Caution Light On	5-13
Fuel Transfer Caution Light On	5-13
Fuel Bypass Caution Light On	5-13
30-Minute Fuel Caution Light On	5-13
Emergency Pump Caution Light On	5-13
Compressor Pressure Caution Light On	5-14
Automatic Blade Track Caution Light On	5-14

ENGINE OR THROTTLE MALFUNCTIONS

If a malfunction occurs in the automatic portion of the fuel control, the malfunction could become evident in either of two ways: one, a power loss; two, a power surge or a tendency for the engine and rotor to overspeed.

In the case of single engine power loss, the good engine will take the full load and the faulty engine rpm will drop. However, in the case of an overspeed, the faulty engine can rise above the selected rpm and the good engine, sensing more than the selected rotor rpm, will drop. Thus, with a malfunctioning fuel control, the good engine may maintain rpm or may lose rpm. It cannot be assumed that the engine which has reduced power is the faulty one.

POWER OSCILLATION.

1. Positively identify which engine is oscillating.
2. Move actuator control switch to OFF.
3. Refer to PARTIAL POWER LOSS or ROTOR OVERSPEED Procedures as necessary.

PARTIAL POWER LOSS.

1. Positively identify which engine has reduced power.
2. Switch to emergency rpm control on the malfunctioning engine. Leave engine condition lever in FLY position.
3. Actuate emergency rpm control until desired power level is achieved.

CAUTION

The partial power loss may be the result of a throttle system malfunction; therefore, do not move engine condition lever out of FLY as the engine could go to stopcock.

4. If engine does not respond to emergency rpm control, stopcock engine.
5. Follow single engine procedures found in this section.

ROTOR OVERSPEED (RPM IN EXCESS OF 106% N_r).

1. Add collective to keep rotor rpm within limits.
2. Determine which engine is causing the overspeed.
3. Move engine condition lever on malfunctioning engine to idle (control rotor rpm with collective).
4. Switch to emergency rpm control on malfunctioning engine.
5. Actuate emergency rpm control until desired power level is reached.
6. If engine does not respond to emergency rpm control. Stopcock engine.
7. Follow single engine procedures found in this section.

POWER SURGE.

1. Add collective to keep rotor rpm within limits.
2. Determine which engine is causing the overspeed.
3. Place the actuator control switch for the overspeeding engine to test, in an attempt to reduce rpm. If rpm comes down the malfunction is in the throttle system. Do not return the switch to normal.
4. If step 3 is ineffective the problem is likely in the fuel control and the engine condition lever should be placed in idle. Control rotor rpm with collective.
5. Switch to emergency rpm control on the bad engine.
6. Actuate emergency rpm control until desired power level is reached.
7. If engine does not respond to emergency rpm control, stopcock the engine and follow single engine procedures.

ENGINE FAILURE ANALYSIS.

Excellent single engine flight characteristics permit ample time for the pilot to accurately determine the proper corrective action to be taken following an engine malfunction.

Carefully observe N_g, T_5, N_f, and torque gauge readings to ascertain which engine is the faulty one. A flex drive shaft failure will cause the N_f needle on the faulty engine to go to zero.

In the case of an overspeeding rotor, the engine with the highest N_g, T_5, and torque is usually the faulty one even though at first glance one engine has obviously reduced power.

A power loss is more straight forward as a reduction in N_f/N_r will be seen and the faulty engine will likely show the lowest N_g/T_5 and torque readings.

Deferred Emergencies.

Partial system failures can occur where immediate corrective action is not required. Urgency of the mission, weather conditions etc. would all be factors in deciding whether to proceed or land as soon as practicable.

SINGLE ENGINE FAILURE.

Single Engine Failure At Less Than 40 Knots.

It can be seen from a review of the performance data, that under most normal gross weight configurations, flight may be maintained with one engine, even at zero airspeed. However, there are combinations of high gross weight, high density altitude, and low airspeed, at which continued flight on one engine becomes marginal. Let us assume an adverse set of conditions as follows:

Gross weight	11,600 pounds
Pressure altitude	Sea level
OAT	33° C (90° F)

The chart for MINIMUM AIRSPEED FOR CONTINUING FLIGHT ON ONE ENGINE (figure 11–14) indicates that under these conditions, the minimum airspeed for continued flight is about 40 knots. If your speed at the time of failure is below this speed and altitude is sufficient to attain it by diving, dive to increase speed so that flight can be continued. Proceed as directed under SINGLE ENGINE LANDING AT HIGH GROSS WEIGHT. If altitude is not sufficient at time of failure to gain the necessary speed by diving, an immediate landing must be made. Since hover power is not available, a no-hover landing must be made; either a zero speed touchdown landing using available power, or a roll on landing, depending on power available and/or condition of landing site.

1. Collective pitch lever – Lower as necessary to maintain rotor speed.
2. Landing gear lever – Down, if over land.
3. Cyclic stick – Flare as necessary to make a zero groundspeed landing or, if terrain permits, establish a roll on landing attitude.
4. Collective pitch lever – As necessary to make a soft landing.
5. If the landing is made on water, use power on the good engine to keep the fuselage riding high. It may be possible to reduce gross weight to single engine takeoff capability by jettisoning cargo, aux fuel tanks, and embarking passengers into life raft. Attempt a takeoff into the wind.

CAUTION

Water contact should be kept to a minimum because of probable induction of water into the fuel system through the vent lines. Do not open fuel jettison valve because the aft tanks will rapidly fill with water.

Single Engine Failure At 40-115 Knots.

1. Continue forward flight.
2. Adjust power as necessary.
3. Inoperative engine – Shut down, or if nature of malfunction indicates that a restart is feasible, proceed with restart procedure.
4. Decide whether gross weight and density altitude are such that a no-hover landing will be necessary. Refer to the chart for MINIMUM AIRSPEED FOR CONTINUING FLIGHT ON ONE ENGINE. (See figure 11–14.) In most cases a normal landing can be made on one engine. However, if a no-hover landing is required, and the landing site is such that a no-hover landing can easily be made, proceed as directed under SINGLE ENGINE LANDING AT HIGH GROSS WEIGHT. If the landing site is such that a no-hover landing is not feasible, it may be necessary to reduce gross weight by jettisoning cargo so that a normal landing can be made.

Single Engine Failure Above 115 Knots.

1. Collective pitch lever – Lower as necessary to prevent or reduce rotor rpm decay.
2. Directional pedals – As necessary to maintain heading.
3. Continue flight on one engine (observe single engine power limitations Section I, Part IV.)
4. If feasable, attempt engine restart.
5. If engine restart is unsuccessful, refer to single engine landing procedures.

Single Engine Landing at High Gross Weight (No-Hover Landing).

This procedure is intended primarily for those situations in which the gross weight-density altitude combination is such that a hover landing is not feasible. Refer to the chart for MINIMUM AIRSPEED FOR CONTINUING FLIGHT ON ONE ENGINE (figure 11–14).

1. Panel landing checklist – Complete.
2. RPM switch – Set rotor rpm at 102%.
3. Make final approach at 40 to 60 knots at a slow rate of descent.
4. Make a smooth no-hover landing, either rolling on, or at zero speed, depending on the landing site. Avoid attitudes or flight conditions requiring large power inputs. If available landing area is small, use a standard precision approach and a no-hover landing.
5. Collective pitch lever – Full down when on the ground.

SINGLE ENGINE WATER TAKEOFF.

Normally all takeoffs should be executed into the wind. In high sea states it may be preferable to execute the running takeoff slightly off the wind line in order to minimize wave impact. The most difficult takeoff conditions will result from calm wind smooth sea states and high gross weights. In addition to marginal lifting capability, power loss or compressor stall due to salt ingestion must be continuously considered. Execute single engine water takeoff as follows:

1. Maintain stability with cyclic.
2. Inflate bags, if not already done.
3. Attempt lightening load sufficiently for takeoff by dropping auxiliary fuel tanks and jettisoning internal cargo.

CAUTION

Do not jettison internal fuel while aircraft is in water.

4. Attempt vertical takeoff, maintaining 92% N_r.
5. If takeoff is unsuccessful attempt water taxi to gain airspeed and follow procedures for running takeoff. An abrupt increase of collective may be needed to overcome the surface tension of the water.
6. If takeoff is still unsuccessful use emergency throttle on operable engine. Beep up to 110% N_f/N_r and attempt a running takeoff.
7. Further attempts to takeoff require considering placing crew in water, waiting for fuel to burn down, water taxiing to the vicinity of the ship for controlled ditching, or water taxiing to land.
8. If takeoff is successful, fly in ground effect until single engine climb speed is attained, and reduce N_f/N_r to 102%.

TWO ENGINE FAILURE.

Two Engine Failure While Hovering or on Takeoff.

Settling will be so rapid that little can be done to avoid a hard landing. The landing can be cushioned somewhat by increasing collective pitch as the aircraft settles to the ground. Do not decrease collective pitch as you normally would in the event of two engine failure at higher altitudes. This would only cause the aircraft to settle more rapidly. The aircraft should be held in a landing attitude and collective increased to cushion landing. Regardless of the impact force, damage will be much less if all three wheels hit at the same time.

1. Maintain control.
2. Establish landing attitude.
3. Landing gear lever – Down.
4. Collective pitch lever – Raise to cushion landing.
5. Collective pitch lever – Lower after ground contact.
6. Engines – Shut down after landing.

Two Engine Failure During Flight.

A safe autorotation landing can be made if altitude and airspeed are sufficient and if a suitable landing spot is available. If altitude permits, a restart should be attempted. If engines fail to start, make a landing as described under LANDING AFTER TWO ENGINE FAILURE in this section.

1. Collective pitch lever – Lower to minimum to establish autorotation, then vary as necessary to maintain desired rotor rpm. Simultaneously, apply directional pedals to prevent yawing and use cyclic stick to establish 70-75 knots IAS. Excess speed can best be dissipated by holding the nose on the horizon. If ASE is in BAR ALT or RAD ALT mode, the altitude control button should be pressed to disengage ASE altitude control.

Note

The nose will tend to lower as the collective pitch lever is lowered. This can be controlled easily with aft cyclic stick.

2. Select a landing spot.
3. Shoulder harness – Locked.
4. Landing gear lever – Down when airspeed has decreased to 100 knots IAS or below.
5. Tail wheel – Locked.
6. Transmit distress message.
7. Engines – Restart if time permits.

WARNING

With both engines out, the time required for restart may involve a loss of as much as 3000 feet of altitude. During the restart procedure it is essential to continue the autorotation landing procedure.

8. Engine – Shut down if engine cannot be restarted.
   a. Engine condition levers – OFF.
   b. Fuel pumps switch – OFF.
9. Land the helicopter.
10. Battery switch – OFF.

ENGINE RESTART IN FLIGHT.

It is unlikely that an engine will flame-out in flight, except in the case of failure of some critical component. If an engine does flame-out, it is unlikely that an attempt to restart it will be successful. However, if sufficient time and altitude are available, an attempt to restart should be made.

1. Engine condition lever – OFF.
2. Starter switch – Press and hold.
3. Engine condition lever – IDLE, START FUEL MAX at 12% gas generator rpm.
4. Turbine inlet temperature gage – Observe for indication of lightoff. Use START FUEL MIN to control hot start. If temperature is excessive, shut down the engine. If cold hang-up occurs, use emergency rpm control.
5. Starter switch – Release at 46 percent gas generator rpm and advance engine condition lever to fly.

EMERGENCY LANDINGS

EMERGENCY RPM CONTROL APPROACH

The approach should be made with minimum power changes and control inputs. (Refer to PRACTICE EMERGENCY RPM CONTROL PROCEDURE, Section III.)

Note

When operating on emergency, rotor rpm is controlled by collective; power is controlled by the emergency rpm beeper.

1. Minimize maneuvering and control inputs to avoid large power changes.
2. Stabilize rpm at 98%-100% N_r.
3. Establish a slow rate of descent.
4. Make speed changes at a slow rate which will result in small power changes.
5. Make a running landing with 10-15 knots groundspeed, if possible.
6. After touchdown, maintain heading with rudders and brakes.
7. Slowly beep down while slowly lowering collective to prevent rotor overspeed.

EMERGENCY DESCENT.

If the emergency is such that damage to the aircraft is considered secondary to getting the aircraft on the ground, the following factors will increase the rate of descent:

a. high autorotation airspeed.

b. coordinated turns while autorotating.

AUTOROTATION GLIDING DISTANCE.

(See figure 11–18.)

Increasing airspeed will increase gliding distance, but will also increase the rate of descent. Increasing rotor speed will also increase rate of descent and decrease gliding distance. The average rate of descent is about 2200 feet-per-minute.

LANDING AFTER TWO ENGINE FAILURE.

Safe autorotation landings may be made except when operating at low altitude and airspeed combinations.

For the following procedures it is assumed that the pilot has completed the procedures listed under TWO ENGINE FAILURE DURING FLIGHT. Therefore, the aircraft will be ready for landing, landing gear down, tail wheel locked, etc., and autorotation will be established.

FULL FLARE AUTOROTATION LANDING.

Establish gliding speed at 70-75 knots IAS. At 125-150 feet above the ground, raise the nose in a flare to slow rate of descent and airspeed. This will also cause an crease in rotor rpm. Gradually increase the flare while descending so that at approximately 10 feet, groundspeed will be zero. Move the cyclic stick forward to establish a landing attitude, and increase collective pitch as necessary to cushion the touchdown. Immediately after touchdown, decrease collective pitch all the way.

RUNNING AUTOROTATION LANDING.

Establish gliding speed at 70-75 knots IAS. At 125-150 feet above the ground, raise the nose in a flare to slow rate of descent and airspeed. This will also cause an increase in rotor rpm. Gradually increase the flare while descending so that at approximately 10 feet, the airspeed will be between 20 and 30 knots. Move the cyclic stick forward to establish a landing attitude, and increase the collective pitch as necessary to cushion the touchdown. Immediately after touchdown, decrease the collective pitch to the minimum. Use directional pedals and brakes to control heading and speed.

NIGHT AND INSTRUMENT AUTOROTATION LANDING.

1. Establish gliding speed at 70-75 knots IAS.
2. Turn on landing and floodlights at night.
3. At 175 feet on the radar altimeter, commence a 20° nose-up flare on the RAI to slow rate of descent and airspeed.
4. At 60 feet, steadily add collective and allow aircraft to assume a level attitude.
5. Immediately after touchdown, decrease collective pitch all the way. (For water landing increase collective after touchdown.)

TAIL ROTOR FAILURE

The first indication of tail rotor failure is a loss of directional control. The severity of the control loss will depend on the nature of the failure. This could vary from a loss of tail rotor control to a failure of the drive system, or a loss of the tail rotor blades or the entire tail rotor pylon. When the failure occurs, torque from the main rotor will cause the nose to yaw to the right. The rate of yaw will be governed by the amount of torque being applied to the main rotor at the time of failure, and the nature of the failure. The amount of yaw will be governed by the airspeed at the time of the failure, and the promptness of the corrective action. At slow airspeeds or hover, if the pilot responds too slowly, the fuselage could rotate about its vertical axis 180° or more. This could result in a total loss of control. The necessity of immediate action by the pilot cannot be overemphasized.

Assuming that the directional pedals have ceased to be useful for directional control, three controls remain which can be used to change or stabilize the heading of the helicopter; these are: collective pitch, lateral cyclic pitch, and the engine condition levers. They can be used as follows:

Control	*To Move Nose LEFT*	*To Move Nose RIGHT*
Collective	LOWER	RAISE
Engine Condition Levers	toward IDLE	toward FLY
Cyclic	LEFT	RIGHT

LOSS OF TAIL ROTOR THRUST IN FORWARD FLIGHT.

Loss of tail rotor thrust will be indicated by right yaw, the severity of which will vary with the flight condition (airspeed and power). In order to maintain control of the aircraft, immediate entry into autorotation is necessary. A reduction in yaw angle will be immediately evident. ASE should be disengaged to preclude control force buildups. Yaw angles can be held to near zero by use of lateral cyclic control. Maintain 65-70 knots throughout the approach and effect a mild flare and a minimum collective running landing if terrain permits. If unable to accomplish a running landing due to obstructions, a steep flare is recommended to accomplish a zero groundspeed touchdown. This will require a greater collective input at touchdown. Some yaw may result but will not be severe. Move engine conditions levers to OFF during the flare to prevent reapplication of power during touchdown and to minimize fire hazard in the event of a rollover.

Note

Airspeeds above 70 knots are not recommended since only an increase in the rate of descent occurs with little or no increase in directional stability.

LOSS OF TAIL ROTOR THRUST DURING TAKEOFF OR WHILE HOVERING.

1. Helicopter attitude – Hold level with cyclic stick.
2. Collective pitch lever – Reduce slightly until landing is effected, then increase lever slightly after touchdown to cushion as much as possible.
3. Wheel brakes – As neccessary.
4. Engine condition levers – OFF.
5. Rotor brake – ON.
6. Fuel pumps and battery switch – OFF.

LOSS OF TAIL ROTOR CONTROL IN FORWARD FLIGHT.

Loss of tail rotor control will be indicated by lack of response to pedal input, possibly accompanied by small yaw angle changes. Centrifugal force acting on the tail rotor counterweights will cause the tail rotor blades to go to a position approximating neutral pedal. The rate at which this occurs will vary with airspeed, power and control system friction. The resulting yaw will be small and sustained level flight is possible. The yaw angles will approach zero at 125 knots. At lower airspeeds, sideslip angles of less than 25° can be maintained by use of lateral cyclic. Final approach to a running landing should be made at 30-40 knots with a maximum rate of descent of 300 ft./min. If a running landing is not possible due to terrain, make a no-hover, zero groundspeed landing. An attempt to hover will result in a right turning moment since left pedal is normally required.

LOSS OF TAIL ROTOR CONTROL DURING TAKEOFF OR WHILE HOVERING.

1. Helicopter attitude – Hold level with cyclic stick.
2. Collective pitch lever – Lower – Land with reduced power to minimize torque reaction.
3. Wheel brakes – As necessary after landing.
4. Secure engines and rotor – Do not attempt to taxi.

Note

If over an unsuitable landing area, such as water, it may be possible to transition into forward flight and proceed to a safe landing site. Reference paragraph on "LOSS OF TAIL ROTOR CONTROL IN FORWARD FLIGHT."

INSTRUMENT FLIGHT CONDITIONS IN FORMATION

Formation flying shall not be flown when the visibility is so low that aircraft are likely to lose sight of one another. When situations can be anticipated, the leader shall take such action as necessary to ensure formation integrity. Flight conditions permitting, the formation should be maintained intact, return to a clear area, and either land or file an IFR Flight plan.

LOST SIGHT DURING IFR FLIGHT PROCEDURES.

The reversal base course will be the reciprocal of the flight's present heading. Upon signal, the aircraft will acknowledge and take the following action (see figure 5–1):

a. Aircraft 2 and 4 will commence a standard rate turn, away from the flight. They will call, passing through 90° of turn, and will turn 170°.

b. Aircraft 3 will climb 500 feet on the present heading. After completing the climb, and when aircraft 4 reports passing 90°, aircraft 3 will reverse heading away from flight leader, 170°. Upon completion of the reversal turn, aircraft 3 will descend to the initial altitude.

c. The flight leader, upon receiving the radio call of aircraft number 2 passing through 90° of turn, will reverse course 180° on the same side as aircraft number 2.

It is essential that all aircraft maintain the airspeed of the flight when the dispersal was commenced. The flight will regroup when in a clear area.

FIRE

GROUND.

Engine Compartment (Observed or Fire Warning Light).

1. Engine condition lever – OFF.
2. Fire warning T-Handle – Pull.
3. Extinguishing agent switch – STANDBY. Activate if steps 1 & 2 not successful in extinguishing fire.

Internal Engine (Observed or High T_5 after shutdown).

1. Engine condition lever – OFF.
2. Starter switch – Press for 30 seconds.
3. If fire continues pull fire warning T handle.
4. CO_2 Bottle – STANDBY – Direct into engine inlet while continuing to motor engine.

ENGINE FIRE DURING FLIGHT.

1. Engine condition lever – OFF.
2. Fire warning light T-Handle – Pull.
3. Fire extinguisher agent discharge switch – Actuate
4. Land as soon as a safe landing site is available.

CABIN FIRE.

1. Fire extinguisher – As necessary.
2. Cockpit and cabin doors – Open if necessary to disperse smoke and fumes.
3. Land immediately.

ELECTRICAL FIRE.

1. Battery switch – OFF. If this eliminates the odor or smoke, leave both generators on. If odor, smoke, or fire still exist, proceed with step 2.
2. Secure electrical equipment in an attempt to isolate source of fire. If smoke/fumes continue, proceed with step 3.
3. Battery – ON, Generators – OFF.

WARNING

If the battery and both generators are turned off total electrical failure will be experienced, the hydraulic control boost will become disengaged, and the fuel pump and emergency pumps will be inoperative. Above 8000 feet this may result in engine failure due to fuel starvation.

4. Fire extinguisher – Apply as necessary to visible flames.
5. Cockpit and cabin doors – Open if necessary to disperse smoke and fumes.
6. Land immediately.

Note

If it becomes necessary to ditch due to an uncontrollable electrical fire, it will be necessary to turn on the battery long enough to supply electrical power for actuation of the flotation gear.

Lost Sight Dispersal—Inadvertent IFR (VFR Flight Plan)

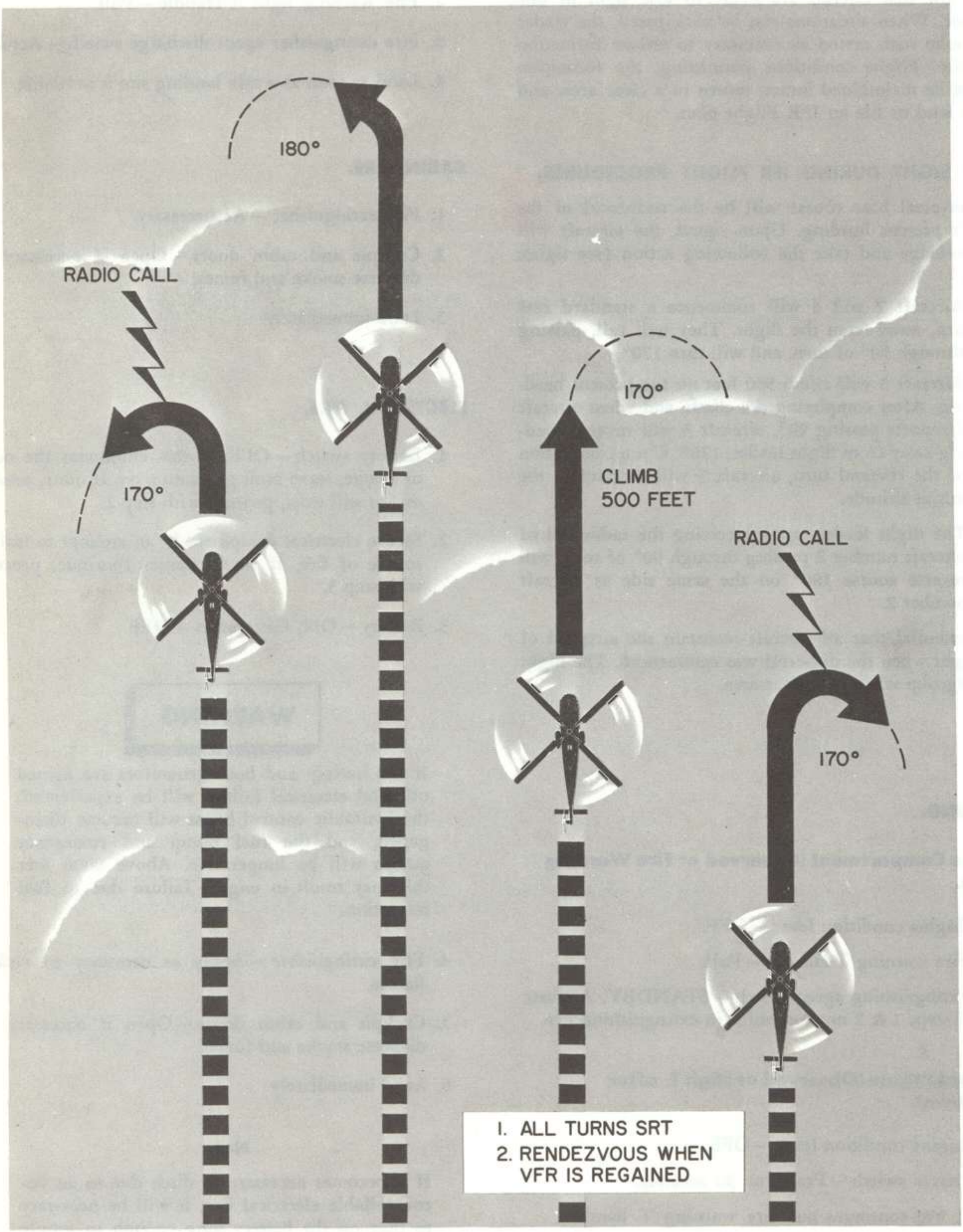
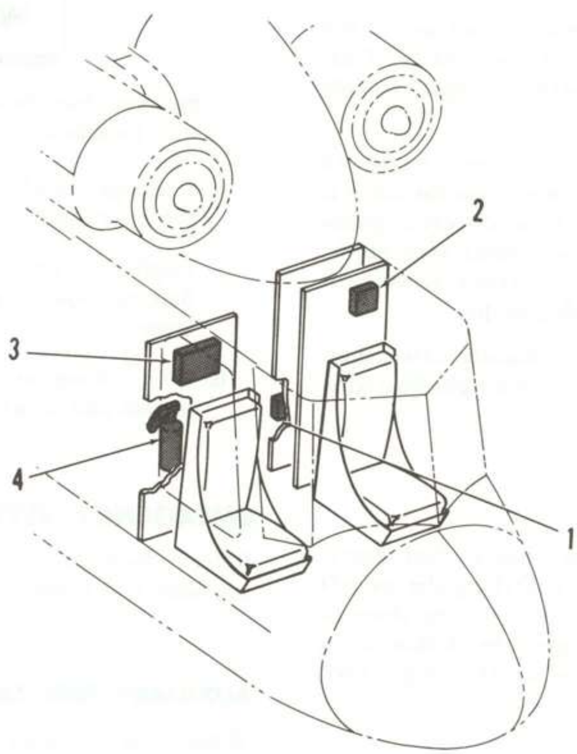


Figure 5—1

Emergency Equipment



1. FIRST AID KIT
2. FIRST AID KIT
3. PYROTECHNIC CASE
4. FIRE EXTINGUISHER

Figure 5—2

SMOKE AND FUME ELIMINATION.

Open cockpit and cabin doors for best ventilation.

WARNING

Avoid hovering for prolonged periods with your tail into the wind to prevent concentration of carbon monoxide fumes in the cockpit and cabin.

DITCHING

The emergency floatation gear is designed to keep the helicopter laterally stable until occupants abandon the aircraft.

The following limitations are necessary to prevent damage to the bags during inflation:

- Maximum pressure altitude for bag inflation is 4000 feet.
- Maximum airspeed for bag inflation is 80 knots.
- If possible, floatation gear bags should be fully inflated prior to water touchdown.

WARNING

To prevent jamming of cockpit doors in closed position, both pilot's and copilot's doors must be open before inflating floatation gear bags.

In the event of a ditching with both bags inflated, and the aircraft remains upright, the following rotor shutdown procedure should be followed:

1. Allow the rotor to coast down without use of the rotor brake, to approximately 12 percent N_r. During coast down, the aircraft will list approximately 8 degrees to the left.
2. Apply moderate rotor brake at speeds below 12 percent N_r in such a manner that when the rotor is fully stopped, the blades line up as closely as possible with the longitudinal and lateral axes of the aircraft. After the blades stop, scissor action will result in approximately 10-degree list.
3. The list can be reduced significantly after shutdown by the crew climbing onto the right floatation bag.

PLANNED DITCHING.

In the event of ditching due to anticipated fuel starvation, or for any other reasons where ditching the aircraft is imminent but not immediate, much can be done to protect personnel and survival gear by following a planned ditching procedure. Refer to Ditching Chart, figure 5—3.

WARNING

Do not abandon the aircraft before the rotor has stopped turning.

IMMEDIATE DITCHING.

If ditching is caused by engine failure, proceed as instructed in the immediate ditching procedure. Refer to Ditching Chart, figure 5—3.

WARNING

Do not abandon the aircraft before the rotor has stopped turning.

BAILOUT

Bailout is recommended only if uncontrollable fire, damage to the rotor system, or other circumstances make it impossible to ditch or make an emergency landing.

1. Passengers and crew — Alerted.
2. Cockpit and cabin doors — Open. If door sticks, pull the emergency release handle and push door out.
3. Safety belt — Released.

WARNING

Be sure that shoulder harness is not tangled with parachute.

4. Passengers and crew — Dive out, head first, from the right cabin door.
5. Copilot — Turn to the right and push out, back first, to avoid tangling with the left collective pitch lever.
6. Pilot — Keep aircraft level, if possible, until last instant and dive out.

EMERGENCY JETTISONING

Refer to Part 4 of Section I for limitations on jettisoning auxiliary fuel tanks, and on dumping fuel.

AUXILIARY FUEL TANKS.

When it is necessary to lighten the load, jettison the auxiliary fuel tanks, if carried. To jettison the auxiliary fuel tanks, simply pull the auxiliary fuel tank jettison handle located at the forward part of the console.

CARGO.

External cargo carried on the cargo hook may be jettisoned electrically by placing the arming switch in the SLING DROP POWER position, and pressing the drop button. If unable to release the cargo electrically, pull the cargo hook emergency release handle. Internal cargo may be jettisoned by dropping it overboard.

WARNING

Use care in jettisoning articles of internal or external cargo that may have aerodynamic characteristics, or any articles that may blow up or back into the rotor system.

DUMPING FUEL.

When it is necessary to lighten the load, any portion of the aft tank fuel may be jettisoned through a dump valve in the tank by moving the fuel jettison switch to the FUEL JETTISON position. Allow 2 minutes for the fuel to dump if the aft tank is full.

Ditching Chart

PLANNED DITCHING

PILOT

1. ALERT CREW AND PASSENGERS AND ORDER TO PREPARE SURVIVAL GEAR FOR AERIAL DROP.
2. TRANSMIT DISTRESS MESSAGE.
3. PILOT'S DOOR — OPEN BEFORE FLOATATION GEAR IS ACTUATED.
4. SHOULDER HARNESS — LOCKED.
5. PARACHUTE — UNBUCKLE.
6. HOVER WHILE CREW AND PASSENGERS DROP SURVIVAL GEAR AND JUMP OUT.
7. EMERGENCY FLOATATION GEAR HANDLE — PULL. AIRSPEED MUST BE LESS THAN 80 KNOTS. PRESSURE ALTITUDE MUST BE UNDER 4,000 FEET.
8. PROCEED 50 YARDS DOWNWIND AND DITCH THE HELICOPTER.
   - Landing gear lever down.
   - From a hover lower the aircraft into the water.
   - Engine condition levers — OFF.
   - Hold a level attitude.
   - Collective pitch lever — FULL UP.
   - Allow rotor to coast to 12 percent rpm.
   - Rotor Brake — ON.
9. STOP ROTOR FORE-AND-AFT, UNFASTEN SAFETY BELT AND ABANDON AIRCRAFT.

COPILOT

1. OPEN COPILOT'S DOOR.
2. ASSIST PILOT AS DIRECTED.
3. JUMP OUT WITH SURVIVAL GEAR WHEN DIRECTED.

CREW AND PASSENGERS

1. OPEN CARGO AND RESCUE DOORS.
2. PREPARE SURVIVAL GEAR FOR DROP.
3. JETTISON ALL UNNECESSARY LOOSE GEAR.
4. WHEN DIRECTED, DROP SURVIVAL GEAR.
5. FASTEN SAFETY BELT AND BRACE FOR DITCHING.
6. WHEN DIRECTED, RELEASE SAFETY BELT AND ABANDON AIRCRAFT.

IMMEDIATE DITCHING

PILOT

1. AUTOROTATE AT 70-75 KNOTS IAS INTO THE WIND.
2. ALERT CREW AND PASSENGERS.
3. TRANSMIT DISTRESS MESSAGE. INSTRUCT CREW TO OPEN ALL DOORS BEFORE FLOATATION GEAR IS ACTUATED.
4. PILOT'S DOOR — OPEN BEFORE FLOATATION GEAR IS ACTUATED.
5. SHOULDER HARNESS — LOCKED.
6. PARACHUTE — UNBUCKLE.
7. EMERGENCY FLOATATION GEAR HANDLE — PULL. AIRSPEED MUST BE LESS THAN 80 KNOTS. PRESSURE ALTITUDE MUST BE UNDER 4,000 FEET.
8. NOTIFY CREW TO BRACE FOR DITCHING.
9. ENGINES — SHUTDOWN.
   - Engine condition levers — OFF.
   - Fuel pumps switch — OFF.
   - Battery and generator switches — OFF.
10. HELICOPTER — DITCH.
    - At 10 feet altitude — ZERO SPEED.
    - Collective pitch lever — INCREASE.
    - After water contact — FULL UP COLLECTIVE.
    - Landing gear lever down (conditions permitting).
    - Hold a level attitude.
    - Allow rotor to coast to 12 percent rpm.
    - Rotor brake — ON.
11. STOP ROTOR FORE-AND-AFT, UNFASTEN SAFETY BELT AND ABANDON AIRCRAFT.

COPILOT

1. OPEN COPILOT'S DOOR BEFORE DITCHING GEAR IS ACTUATED.
2. SHOULDER HARNESS — LOCKED.
3. PARACHUTE — UNBUCKLE.
4. ASSIST PILOT AS DIRECTED.
5. WHEN ROTOR STOPS, RELEASE SAFETY BELT AND ABANDON AIRCRAFT.

CREW AND PASSENGERS

1. OPEN CARGO AND RESCUE DOORS.
2. JETTISON LOOSE GEAR IF TIME PERMITS.
3. SAFETY BELTS — FASTEN.
4. BRACE FOR DITCHING WHEN DIRECTED.
5. WHEN ROTOR STOPS, RELEASE SAFETY BELT AND ABANDON AIRCRAFT.

Figure 5—3

MASTER CAUTION LIGHT ON

1. Caution light panel – Check.
2. Master caution light reset button – Press.

FIRE WARNING LIGHT ON

1. Confirm that there is a fire.
2. Refer to FIRE paragraphs.

COMBINING GEARBOX OR TRANSMISSION OIL PRESSURE CAUTION LIGHT ON

OVER LAND.

If oil pressure is low or if oil temperature should exceed red line in flight, make an immediate safe landing, as the gearbox is not receiving proper lubrication. Flight should not be resumed until the cause has been determined and correct.

AT SEA.

If main or combining transmission oil pressure is low or if oil temperature in either gearbox should exceed red line, a ditching at sea may be prevented by heading for the nearest landing site (either ship or shore) at a slow cruising speed and low altitude.

1. Oil pressure gage – Check to confirm that pressure is low.
2. Prepare to ditch.
3. Head for the nearest landing site – Ship or shore.
4. Establish a slow cruise speed (approximately 40 knots) at a low enough altitude to permit a quick flare followed by ditching at first sign of failure.

ENGINE CHIP DETECTOR CAUTION LIGHT ON

1. Check temperatures and pressures on suspected engine and speed decreaser gearbox.
2. If temperatures and pressure are normal leave engine in fly, monitor temperatures and pressure and land as soon as practicable.
3. If temperature and pressures indicate failure, secure engine. Proceed with single engine procedures and land as soon as practicable.

GEARBOX CHIP DETECTOR CAUTION LIGHT ON

1. Land as soon as a safe landing site is available. If at altitude, descend immediately.

ENGINE OIL PRESSURE CAUTION LIGHT ON

1. Engine oil pressure gage – Check. Confirm that pressure is low.
2. Engine – Shutdown. Refer to single engine failure procedure.

SPEED DECREASER GEAR OIL PRESSURE CAUTION LIGHT ON

1. Speed decreaser gear oil pressure gage – Check. Confirm that pressure is low.
2. Engine – Shutdown. Refer to single engine failure procedure.

HYDRAULIC PRESSURE CAUTION LIGHT ON

1. Hydraulic pressure gage – Check. Confirm that pressure is low.
2. If the hydraulic pressure is low, the boost system should be disengaged and operation of the rescue hoist should be avoided. If the light goes on while hoisting, be prepared for stoppage of the hoist.

HYDRAULIC SYSTEM CONTAMINATION

In the early stages of hydraulic fluid contamination, the ASE will frequently develop small amplitude oscillations in pitch, roll, yaw, or altitude. If not corrected, the contamination increases until erratic control inputs in pitch, roll or yaw are produced as the contaminants alternately block and unblock the servo valve passages. In the case of extreme blockage due to contamination, the servo hardovers which may result upon ASE engagement are limited in rotor response to the equivalent of ± 1.6 inches of cyclic stick or ± 0.5 inch of pedal displacement. Since a hardover will reduce the maximum control power in the direction opposite to the hardover, in cases of suspected hydraulic system contamination exercise extreme caution, when taking off, and when operating in crosswind with ASE on near the deck, due to possible high roll rate from lateral hardover.

ERRATIC CONTROL INPUTS.

1. Check for hydraulic system contamination by disengaging ASE. In the majority of cases this will eliminate the erratic signals. The mission may then be carried out, or aborted, depending upon the urgency of the mission and experience of the pilot.
2. If the inputs are still present with ASE disengaged, disconnect the hydraulic boost.

WARNING

When the boost is turned off in flight, a kick will be felt in the controls. This kick is noticeable, but not severe at low speeds. However, at higher speeds the kick becomes more severe, and the controls shall be monitored closely when disconnecting boost. The UH-2C can be flown for an unlimited length of time with the hydraulic boost system turned off. The pilot shall be aware that increased force will be required to move the controls with boost off, but that no unusual or radical changes in flight characteristics will result.

3. If the foregoing steps do not eliminate the control problem, land as expeditiously as practical and investigate.

LANDING GEAR FAILS TO LOWER

1. Landing gear emergency handle – Push down.
2. If landing gear emergency control fails, request assistance from ground maintenance personnel.
3. If unable to extend landing gear, land the aircraft on the auxiliary tanks. A smooth landing will not rupture the tanks.

28-VOLT CONVERTER CAUTION LIGHT ON

1. Electrical load – Reduce.

   Turn off all nonessential equipment to conserve battery power.

NO. 1 GENERATOR CAUTION LIGHT ON

1. No. 1 Generator switch – OFF RESET, then ON. If light goes out, system is restored to normal operation.

   If light remains on, generator is inoperative, and monitor busses are cut OFF when rotor deice system is on. If rotor deice system is not in use, all the busses continue to receive power from the No. 2 generator.

NO. 2 GENERATOR CAUTION LIGHT ON

1. No. 2 generator switch – OFF RESET, then ON. If light goes out, system is restored to normal operation.

   If light remains on, generator is inoperative. A properly operating No. 1 generator is capable of carrying the load.

BOTH GENERATOR CAUTION LIGHTS ON

1. Electrical load – Reduce.
   Turn off all nonessential equipment to conserve battery power. Any nonessential equipment or systems can be deactivated by switching or pulling circuit breakers. The minimum electrical load wil depend on existing mission requirements.
2. Generator switches – RESET.
   Attempt to restore ac power.
3. Change flight plan as deemed necessary.

Note

Both remote attitude indicators will be inoperative.

4. Have crewman switch to diverter system after th aux fuel tanks have been jettisoned. Remain belov 8000 ft. Monitor fuel quantities.

FUEL BOOST CAUTION LIGHT ON

1. Helicopter altitude – Remain below 8000 ft. if possible.
2. ~~If operation above 8000 ft. is required jettison au tanks, and have crewman switch to diverter mode thereby permitting the aft tank transfer pumps t provide boost pressure to the engines. Monitor fu quantities. After completion of altitude mission, th system may then be returned to normal or left i diverter mode.~~

FUEL TRANSFER CAUTION LIGHT ON

1. Check fuel quantity in aft tank over a period o time to positively determine transfer pump failure

2. After determining that transfer pumps are not operating, and only if aft tank fuel is required to enable the A/C to reach a safe landing site, jettison the a tanks and have crewman switch to manual diverter mode, have crewman remain in a position where he can immediately return diverter valve to the normal position at the first indication of engine malfuncti

30-MINUTE FUEL CAUTION LIGHT ON

1. Fuel quantity gage – CHECK.
   a. Determine actual fuel remaining
   b. Check fuel quantity gage for proper operation
2. Avoid abrupt maneuvers.
3. Land the aircraft before fuel is exhausted.

EMERGENCY PUMP CAUTION LIGHT ON

Sump pump is inoperative. A decision must be made based on the urgency of the mission, to continue th mission using emergency pump, or to abort.

COMPRESSOR PRESSURE CAUTION LIGHT ON

1. Check fuel quantity in auxiliary fuel tanks over a period of time to positively determine compressor failure.
2. Change flight plan as necessary to assure reaching safe landing site on internal fuel only.
3. Jettison aux tanks to reduce drag if necessary to reach safe landing site.
4. Remain below 8000 ft.

Note

It is normal for the compressor pressure caution light to come on when the landing gear is raised after takeoff. This indicates that the compressor has not yet developed sufficient pressure in the system to transfer fuel from the auxiliary fuel tanks. The time required will vary from about 5 minutes for full tanks to about 20 minutes for empty tanks and will probably be longer with both engines operating.

AUTOMATIC BLADE TRACK CAUTION LIGHT ON

1. Auto track reset button – Press and hold for at least 10 seconds.

   If light remains on, track the rotor blades manually.

MANUAL OPERATION.

This mode of operation should only be used when the automatic blade track caution light comes on.

1. Auto track reset button – Press, hold for 3 seconds and release.

   If caution light goes out and stays out, proceed no further. Normal operation of the system is restored. If caution light comes back on, proceed as follows:

2. D blade switch – As necessary.

   Move switch to UP, then DOWN, noting carefully converging or diverging blade tip paths and any decreasing or increasing of vertical vibration. Move switch to OFF when tip paths are closest and vibration is at a minimum.

3. C blade switch – As necessary.

   Repeat procedure described in step 2.

4. Auto track reset button – Press, hold for 3 seconds, and release.

   If the caution light goes out and stays out, proceed no further. Normal operation of the system is restored. If the light comes back on, the blades must be tracked manually, as in steps 2 and 3, for the duration of the flight.

WARNING

If severe one-per-rev vibration develops and cannot be tracked out, land as soon as practicable.

USE OF THE DIFFERENTIAL CONE SWITCH.

If an out-of-track condition is observed and the automatic blade track caution light does not come on, it is probably caused by a difference in the tracks of the two pairs of blades, which is not normally corrected automatically, and which produces no noticeable vibration. Move the differential cone switch to UP, then DOWN, noting carefully the converging or diverging of the blade tip paths, and a possible decrease or increase of vibration. Move the switch to OFF when the tip paths are together.

SECTION VI

ALL WEATHER OPERATION

TABLE OF CONTENTS

Instrument Flight Procedures	6-1
Cold Weather Operations	6-7
Hot Weather Operations	6-9
Beach or Desert Operations	6-9
Ice and Rain	6-9
Turbulence and Thunderstorms	6-9

INSTRUMENT FLIGHT PROCEDURES

The UH-2C is fully instrumented and the navigation system is capable of supplying the pilot with continuous range and bearing information from the helicopter's present position to a preselected base or destination position. The ASE provides automatic stabilization and permits hands-off flight. Normal instrument airways flight may be accomplished within the limitation of the navigational equipment installed in the helicopter. As with all instrument flying, careful preflight planning is mandatory.

ON ENTERING THE HELICOPTER.

All normal preflight procedures as described in Section III will be adhered to. In addition, the following items should be carefully checked prior to takeoff:

1. Map case.
2. Altimeter set on field elevation.
3. MA-1 compass system checked for stabilization of needle and check for 180-degree ambiguity against standby compass.
4. Remote attitude indicator checked, warning flag OFF. Adjust reference for level indication.
5. Vertical velocity indicator checked for zero reading
6. Pitot heat operation checked by plane captain.
7. Automatic stabilization equipment checked.
8. Automatic direction finder checked for frequency alignment, antenna reception, manual loop rotation and compass operation. Tune to low frequency range or homer that serves the field you are departing from, identify it, and turn function switch to COMP.
9. Radio communication. Check all frequencies possible which are anticipated.
10. Navigation system checked.
11. Clock set.
12. Altimeter checked with control tower. Note altimeter correction.
13. Windshield wipers as required.
14. Turn and slip indicator checked for deflection during taxi turns.

15. Radio magnetic indicator or BDHI checked for operation.

16. Attitude indicator operation checked.

17. Monitor relative bearings on RMI to selected station during taxi turns.

18. Check actual changes of heading against index on Standby Compass line while taxiing.

INSTRUMENT TAKEOFF.

If visibility will allow a normal hover, the safety checks of flight controls, engines, and ASE should be accomplished. When a normal hover is not possible, the helicopter may be flown off the deck and into a normal climb without any outside reference. In the case of a full instrument takeoff (when outside visual reference cannot be maintained at hover altitudes) the doppler indicator must be used for stability of vertical position. The collective should be increased steadily as the helicopter leaves the ground. A level attitude must be maintained with reference to the attitude indicator. As altitude increases through 50 feet as indicated on the radar altimeter the nose should be trimmed to the horizon. Establish a normal climb airspeed at 70 knots.

INSTRUMENT CLIMB.

Climb, under instrument conditions, is similar to the climb technique and procedure prescribed for normal climb. An airspeed of 70 knots is recommended. ASE will maintain the heading and attitude established by the pilot. Climbing turns should be limited to a maximum bank of 15 degrees. At night or during actual instrument conditions, 300 feet above the surface is established as the minimum altitude for proceeding at speeds in excess of 80 knots and for initiating a turn following takeoff or departure from a hover.

INSTRUMENT CRUISING FLIGHT.

After leveling off, stabilizing airspeed and power, apply friction to the collective pitch lever. The BAR ALT channel of the ASE may be engaged. Straight and level cruising flight can be maintained for extended periods. Particular attention should be paid to navigation at slow airspeeds due to large drift angles.

Speed Range.

Performance data must be checked prior to flight for accurate airspeed limitations based on proposed cruising altitudes at various temperatures and gross weights.

WARNING

Airspeed must be reduced as altitude is increased.

Level Turns.

Level turns during low level instrument flying should normally be made by overcoming the stick trim pressure for the following reasons:

1. The pitch attitude, as referenced by a fixed fore-and-aft cyclic position, will be retained.
2. Level roll attitude will be preserved in the trimmed position of the cyclic.
3. The feel of pressure indicates to the pilot the direction of turn.
4. An excessive rate of roll is retarded.
5. A quick recovery is provided.

Attitude Changes.

Attitude changes during the low level night mission should be made with trim. Changes in airspeed are comparatively more permanent than changes in banks for turns. Therefore, overcoming trim pressure is not recommended.

RADIO AND NAVIGATION EQUIPMENT.

Radio and navigation equipment is operated in the normal manner. Should the ASE malfunction during instrument flight, the pilot must decide whether the degree of failure necessitates complete disengagement. Instrument flight at reduced airspeed (60 to 80 knots) and mildly banked turns (5 to 10 degrees) can be accomplished without ASE by good technique. If the ASE completely fails, the flight should be terminated as soon as practicable.

HOLDING.

An airspeed of approximately 70 knots can be easily maintained during normal holding, and presents no fuel problem. However, a navigational problem will be present while attempting to maintain a pattern in high winds. For normal shipboard holding procedures the CVA/CVS NATOPS Manual should be consulted. Drift correction angles of 30 degrees are as common to the helicopter as 10-degree corrections are to a fixed wing aircraft.

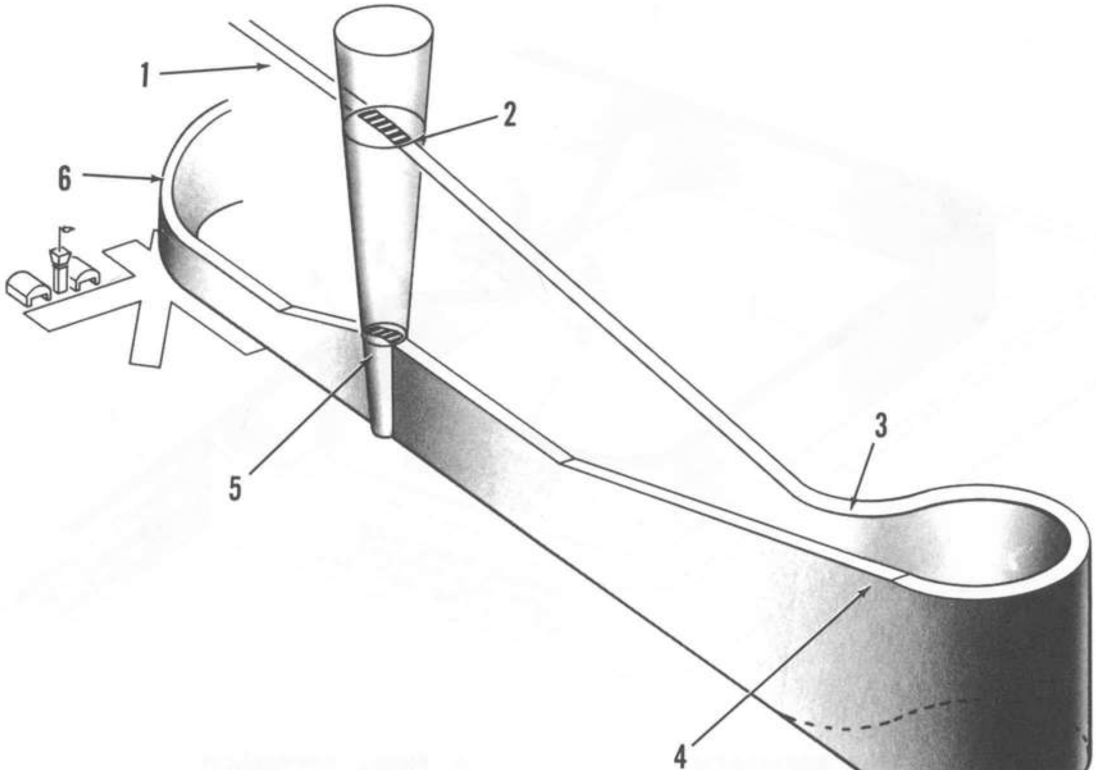
DESCENT.

Normal descents are made by reducing power until the desired rate of descent is achieved. Enroute descents are normally made at cruising speed. Emergency or maximum rate of descent can be made by entering autorotation and maintaining 70 knots IAS.

INSTRUMENT APPROACHES.

Instrument approaches are performed using standard instrument approach procedures prescribed for fixed wing aircraft and those prescribed in the CVA/CVS NATOPS Manual. By utilizing cruising speed during the entire approach, the pilot can reduce the effect of wind on the track and groundspeed of the helicopter and be able to fly a more precise approach.

Typical Tacan, ADF, or LF Range Approach



1. INITIAL APPROACH

2. STATION PASSAGE
START 500 FPM LETDOWN TO PROCEDURE TURN ALTITUDE. TURN OUTBOUND HEADING. COMPLETE BEFORE LANDING CHECK.

3. LEVEL 90°-270° PROCEDURE
TURN IN PRESCRIBED DIRECTION

4. LETDOWN AT 500 FPM TO FINAL APPROACH ALTITUDE
MAINTAIN INBOUND COURSE. HOLD AIRSPEED CONSTANT

5. LETDOWN
TO MINIMUM ALTITUDE BEFORE REACHING FIELD.

6. EXECUTE MISSED APPROACH PROCEDURE
IF VISUAL CONTACT IS NOT ESTABLISHED — INFORM CONTROLLER OF SITUATION.

Figure 6—1

RADIO RANGE APPROACH.

During the final approach, it is important that the airspeed be held constant to control drift and ground speed. Small changes in heading may be made by the yaw trim switch of the ASE.

GROUND CONTROLLED APPROACHES.

A short pattern, with a crosswind altitude of about 800 feet and a final approach of approximately 3 miles, will reduce the total time required to complete a GCA. During the final approach small changes in heading may be made by the yaw trim switch of the ASE.

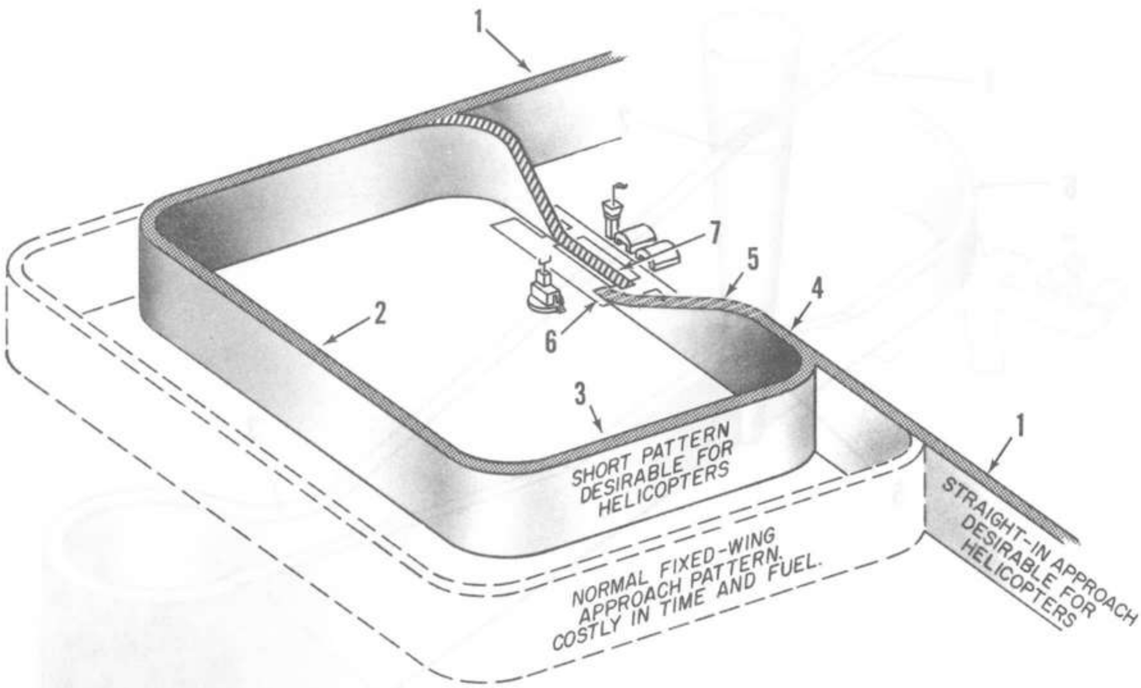
INSTRUMENT FLIGHT CREW REQUIREMENTS.

During instrument flight (simulated or actual) two $H2P_s$ or a HAC and a designated naval aviator shall occupy the cockpit. One pilot must hold a valid instrument card. A qualified aircrewman shall be present in the cabin during simulated or actual instrument flight to serve as lookout.

SIMULATED INSTRUMENT FLIGHTS.

The probability of a mid-air collision requires continuous caution on the part of pilots and crewmen engaged in simulated instrument flights. When a pilot's attention is directed toward controlling the aircraft on instruments, the area of surveillance for which he is responsible must be covered by another person familiar with aviation, instructed in his duties, and provided with direct communication with the safety pilot.

Typical Ground Controlled Approach



1. INITIAL APPROACH
ESTABLISH APPROACH AIRSPEED.
ACCOMPLISH BEFORE LANDING CHECK.
ESTABLISH HEADING AND ALTITUDE AS DIRECTED

2. DOWNWIND LEG
MAINTAIN AIRSPEED AND ALTITUDE.

3. BASE LEG
MAINTAIN AIRSPEED AND ALTITUDE

4. GUIDE SLOPE INTERCEPTION POINT
BEGIN RATE OF DESCENT.

5. FINAL APPROACH
CORRECT COURSE AND GLIDE PATH AS DIRECTED BY CONTROLLER.

6. MINIMUM ALTITUDE
LEVEL OFF IF VISUAL CONTACT NOT ESTABLISHED.

7. MISSED APPROACH
APPLY POWER AND INITIATE CLIMB TO MISSED APPROACH HEADING AND ALTITUDE. INFORM CONTROLLER OF SITUATION

Figure 6—2

SAFETY PRECAUTIONS.

When engaged in simulated instrument flights, the pilots and aircrewmen involved are responsible for the knowledge of and compliance with the following safety precautions:

1. Communications shall be tested between all stations, and when they cannot be established, simulated instrument flight shall not be attempted.
2. The lookout shall be indoctrinated thoroughly in the nature and importance of his duties, and should be selected from aircrewmen currently receiving flight orders.
3. The safety pilot shall observe and be responsible for the performance of the lookout. No lookout shall be permitted to read or otherwise be distracted from his duty. The safety pilot shall keep the lookout informed when approaching congested areas.

PROCEDURES.

Procedures and knowledge gained in basic instruments will form the basis for simulated and actual all-weather missions.

Since the pilot will be devoting all of his attention to instrument flying, the copilot will operate the navigation equipment and assume visual lookout responsibility.

INSTRUMENT CHECK.

Before leaving the ground or deck on an instrument flight, all instruments, radio receivers, and navigational equipment must be checked for proper operation. In addition, special emphasis must be placed on checking for instrument calibration. Check proper settings for RAI, altimeters, etc. The following airspeeds for the various conditions of flight are designated as standard for the UH-2C helicopter:

Maneuver	*Speed*
Slow Cruise	70 knots
Normal Cruise	90 knots
Fast Cruise	110 knots
Climb (500 feet per minute)	70 knots
Descent (500 feet per minute)	70 knots

STRAIGHT AND LEVEL FLIGHT WITH POWER CHANGES.

Straight and level flight is easy to master for one reason: it is a steady-state maneuver and requires a minimum of cross checking or scanning. However, in order to sustain this regime of flight, a pilot must be quick to recognize any deviation of his aircraft through the primary instruments; in this case, airspeed altitude and slaved compass. At any given airspeed the power setting determines whether the helicopter is in level flight, in a climb or descent. Airspeed shall be maintained during climb and descent with very little movement of the cyclic control. It will be noted in single rotor configured helicopters that when increasing power, the nose will yaw to the right.

MANEUVERS TO BE AVOIDED.

Extreme caution is necessary during any unusual attitude maneuver to avoid angles of bank exceeding 30 degrees, 1.5g maximum acceleration, excessive forward airspeed, and abrupt flight control movements. Avoid conditions of flight near a hover where power settling conditions may occur.

At night or during actual instrument conditions, 300 feet above the surface is established as the minimum altitude for proceeding at speeds in excess of 80 knots and for initiating a turn following takeoff or departure from a hover.

TURNS.

A turn made by reference to instruments should be made at a definite rate. Except for practicing unusual attitude maneuvers, a 3° per second turn is usually used in programming precision instrument turns. Airspeed determines the angle of bank necessary to maintain a standard rate turn at a given weight. The standard rate turn is a one needle width turn. Combining bank and pitch control requires a more rapid cross check, and interpretation must be accurate. This rapid cross check should be practiced until it has become second nature to the pilot and, as a result, will allow him to direct more attention to other matters in the more advanced phase. In entering a level turn, the RAI is the primary pitch attitude instrument and the airspeed indicator is the primary power control instrument. During entry into the turn increase power to compensate for loss of vertical lift caused by the banking of the helicopter. Remember however, not to apply any corrective action until the flight instruments indicate a deviation from the desired condition of flight. Only experience in the helicopter can teach the pilot to anticipate certain conditions. Although there is no lag in a slaved MA-1 compass, a lead should be established in rolling out of a turn. The amount of lead is determined by the individual pilot's technique. A good rule of thumb is one-third the degree of bank used in the turn; for example, if you are using a 12-degree bank, then your rollout should commence at a 4-degree lead. This lead will serve as an aid in keeping the rollout smooth with less chance of an overshoot.

CONSTANT AIRSPEED CLIMBS, DESCENTS, AND LEVEL OFFS.

For any power setting and load condition there is only one airspeed which will give the most efficient rate of climb. In a climb at any predetermined constant airspeed and power setting, the pilot must accept whatever vertical velocity results. The entry to either is made by first adjusting the collective pitch and power to the desired power setting. The pitch attitude may be changed momentarily to hold the desired airspeed during the entry or level off. However, once the descent or climb has been established and the airspeed stabilized, the pitch attitude will remain constant. Use the vertical velocity indicator only after it is stabilized, to maintain a standard rate of climb or descent. By continuous cross check you will be able to conduct a good programmed descent with small power changes. The level off from a climb must be started before reaching the desired altitude. Although the necessary amount of lead varies with the helicopter and pilot's technique, the most important factor is the vertical velocity. Normally, the lead for each 500 ft per minute rate of climb will be 40 to 50 feet.

SUGGESTED PATTERNS TO BE FLOWN FOR EXERCISING TIMED MANEUVERS (FULL AND PARTIAL PANEL).

The illustrations of instrument patterns (see figures 6–3 and 6–4) will serve as an aid in training in precision instrument flight. Other instrument patterns may also be utilized.

Papa Pattern

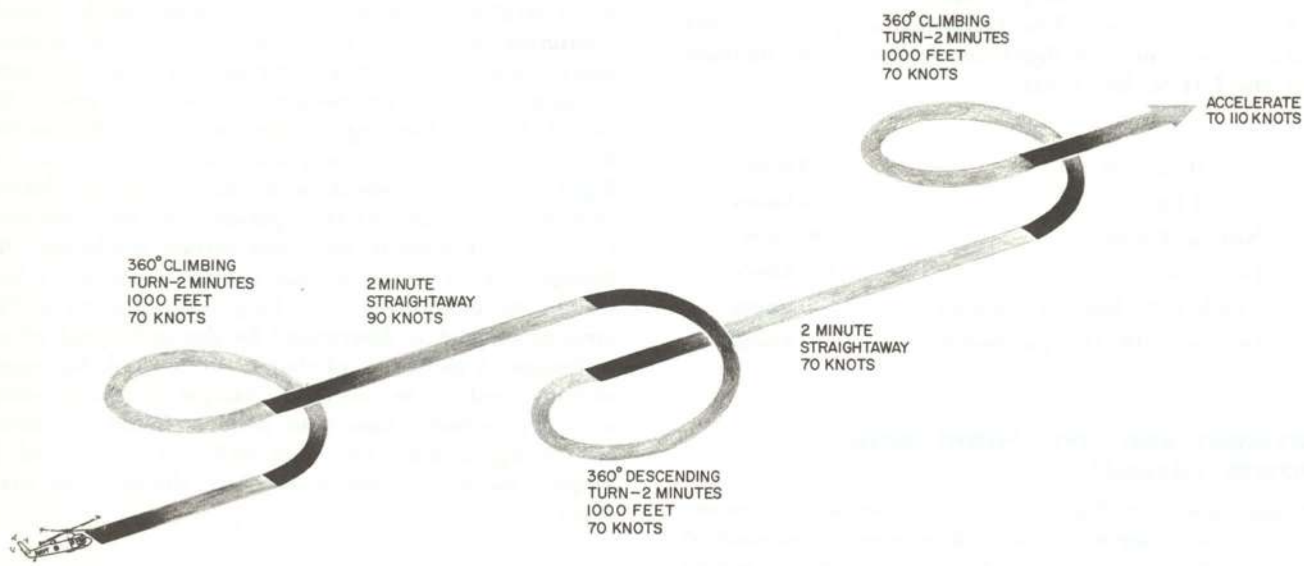


Figure 6–3

Modified Charlie Pattern

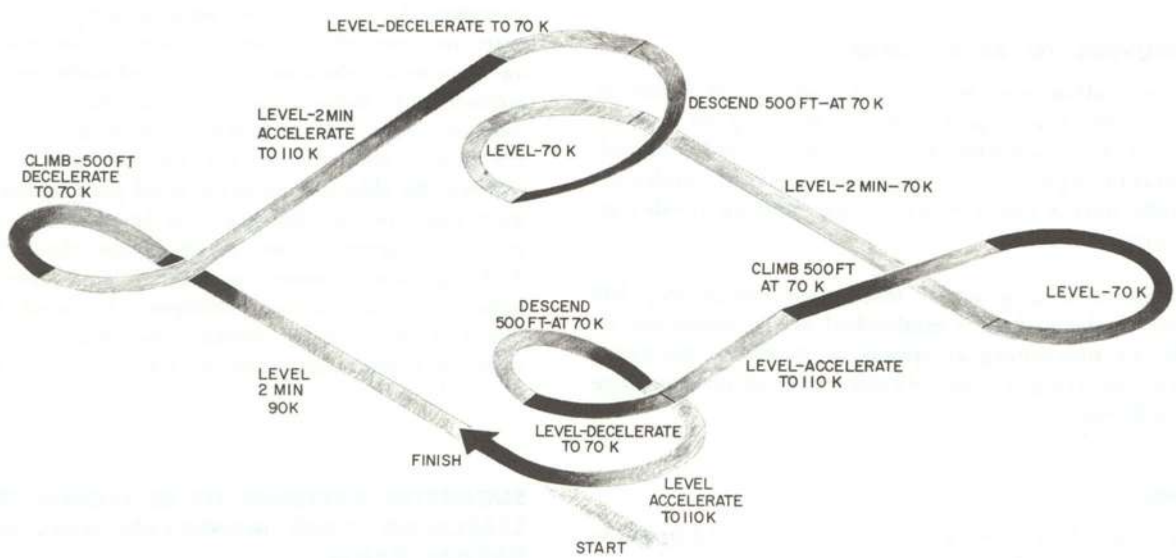


Figure 6–4

UNUSUAL ATTITUDES.

The importance of cross checking the nontumbling attitude indicator (RAI) must be stressed. If the pilot uses the information presented by it correctly, he can execute a recovery from an unusual attitude very easily. Airspeed which should be checked simultaneously with RAI also gives an instant indication of pitch attitude. As soon as the angle of bank and power are corrected, the airspeed indicator and altimeter become the primary pitch instruments. When a diving spiral is experienced, too much aft cyclic may aggravate the maneuver and will tighten the turn and may result in blade stall. It must be emphasized that when flying at low altitudes, at low speeds, the RAI will only give attitude and will not present any information on rate of descent or climb. High sink rates can be experienced with no change in attitude. Therefore, radar altimeter and rate instruments should be given strong emphasis. When reducing speed during recovery from an unusual attitude is important, the only possible way to expedite the recovery is to decrease the angle of bank while simultaneously applying back cyclic.

Do not chase the vertical speed indication on recovery from any maneuver. This is a rate instrument and is fairly reliable in a steady state, but should be disregarded after a pitch change is made.

AUTOROTATION (HOODED).

Realistic and effective instrument training is necessary to fully exploit the all-weather capability of the UH-2C. Hooded autorotation should be practiced to provide a reasonable assurance that individual pilots can safely execute the maneuver during instrument conditions.

COLD WEATHER OPERATION

GENERAL.

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. Extreme diligence on the part of both ground and flight crews is required to insure successful cold weather operations. Since it is not usually practical to completely cover an unhangared aircraft, those parts not protected by covers require particular attention. If hangar space is available, the aircraft should be kept in a heated hangar when outside air temperatures drop below 0° F.

For cold weather flights, use the normal procedures in Section III with the following exceptions or additions:

PREFLIGHT CHECK.

Exterior Inspection.

1. Check vents for ice stoppage.
   a. Fuel vents.
   b. Engine oil tank vents.
   c. Transmission breather.
   d. Battery vent.
2. Check that tires are not frozen to the ground.
3. Remove ice and snow from rotor blades and flaps and all exterior surfaces and openings. Use ap proved deicing fluids.

CAUTION

Do not attempt to chip or scrape ice from fuselage or rotor and flap surfaces. Damage will likely result.

4. Apply preheat.
   a. Engine.
   b. Transmission.
   c. Cabin.

Interior Inspection.

1. Remove snow accumulations.
2. Flight controls may be difficult to move after th aircraft has been cold soaked. If the controls ar not sufficiently free for a safe start and low powe warmup, have the affected controls thawed b heating.

STARTING PROCEDURE.

Gas generator IDLE speed may be as low as 45 percent

TAKEOFF.

Cold weather presents no particular takeoff problems unless the cold weather is accompanied by snow. Th problem of restricted visibility due to blowing or swirl ing snow (from the rotor wash) can be acute, and ma require a maximum performance takeoff, or perhap even an instrument takeoff to get the helicopter safel airborne. If the takeoff area is surrounded by a larg expanse of smooth, unbroken snow, there is the dange that the pilot may become disoriented because of th absence of visible ground reference objects. In this case use any available objects for reference, such as smok grenades, oil drums, rocks, seat cushions, etc. If possi ble, use three such objects, placed as shown in figur 6–5. The distances used will depend on the size an color of the objects and the type of takeoff to be made

LANDING.

In normal operations, helicopters are often required t land or maneuver in areas other than prepared airfields In cold weather operations this frequently involves land ing and taking off from snow covered terrain. The snov depth is usually less in open areas where there is littl or no drift effect. The snow depth is usually greater o the downward side of ridges and wooded areas. When ever possible, the pilot should familiarize himself wit the type of terrain under the snow (tundra, brush marshland, etc.).

Placement of Ground Reference Objects for Takeoff from Snow Covered Expanse

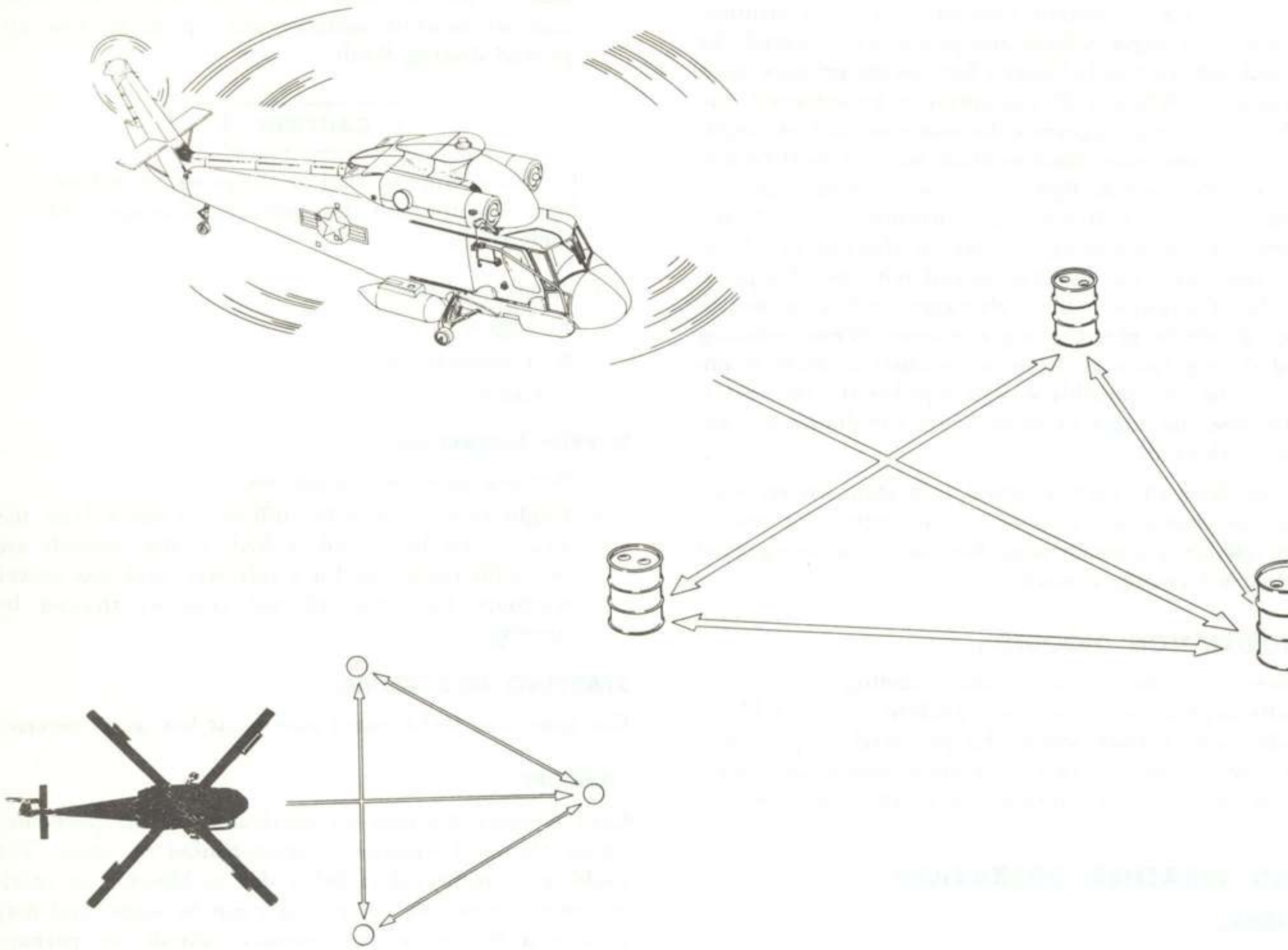


Figure 6—5

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 wave-off if visual reference is lost.

After contacting the surface, maintain rotor rpm and slowly decrease collective pitch until the aircraft is firmly on the ground. Be ready to take off immediately if, while decreasing collective pitch, one wheel 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 possible, have a crewman get out and check the surface before reducing rpm.

BEFORE LEAVING THE HELICOPTER.

1. Protect the wheels from freezing to the ground by placing them on planks or sandbags.
2. Leave the parking brakes off.
3. 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.

4. Drain moisture accumulations as soon as possible.
    a. Fuel cell sumps.
    b. Fuel strainer.
    c. Transmission oil tank sump.
    d. Engine oil tank sump.

HOT WEATHER OPERATIONS

There are no restrictions on hot weather operation for this helicopter other than performance limitations resulting from reduced air density. (Refer to Section XI.)

Note

To prevent excessive heat buildup in the cockpit and cabin while the aircraft is sitting in the sun, keep the sliding doors open slightly, if sand and wind conditions permit.

BEACH OR DESERT OPERATIONS

While operating in beach or 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. When preparing for a flight, inspect the air intakes carefully. Keep taxiing and ground operation 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, make no-hover approaches and landings. Make sure that protective covers are installed immediately after each flight.

ICE AND RAIN

ICE.

Flight through known or forecast icing conditions is not recommended. However, the aircraft is equipped with rotor deicing and turbine and windshield anti-icing equipment. The following procedures are recommended:

Turbine/Inlet Anti-Icing.

When the outside air temperature drops below 10°C (50° F), the engine front struts, the inlet guide vanes, the bullet-nose and the inlet bellmouth are susceptible to icing. Turn on turbine anti-icing switch.

CAUTION

If icing conditions are encountered inadvertently, maintain airspeed above 100 knots when gross weight is 10,000 pounds or less.

Windshield Anti-icing.

When icing is suspected or forecast, or if ice is collecting on the windshield, turn on the windshield anti-icing system.

Rotor Deicing.

When icing is suspected or forecast, or if ice is observed to be collecting on the windshield or any part of the helicopter, turn on the rotor deicing system.

RAIN.

In severe rainstorms, uninitiated deceleration of N_g is possible to a point where insufficient power is available to maintain N_r. Power may be regained by use of emergency throttle.

Note

Turbulence and sudden changes in rain intensity require continuous monitoring of instruments to prevent possible overspeed, overtorque, or overtemperature while using emergency throttle.

TURBULENCE AND THUNDERSTORMS

TURBULENCE.

The aircraft should not be flown in a manner that will result in sustained deviations from the normal g limitations. (Refer to Part 4 of Section I for acceleration limitations.) Use the following techniques when operating in turbulent air.

Starting Rotors.

Make certain that helicopter is headed into the wind. Hold cyclic into the wind and increase rotor rpm immediately to prevent excessive flapping of the blades. (Refer to Part 4 of Section III for the maximum wind velocity for starting the rotors.)

Cruising.

When operating in turbulent air, pilot discomfort may be used as a guide to determine the extent of roughness that is acceptable. If it gets too rough for comfort, slow down.

Descending.

When descending, keep rate of descent low and maintain a comfortable amount of airspeed, preferably over 60 knots. A long, fairly flat approach with power on will afford better handling characteristics than will a steep, slow or low power approach.

Stopping Rotors.

Use the normal procedure for stopping rotors, making certain that the helicopter is headed into the wind. Hold cyclic into the wind, as necessary to reduce tendency of blades to bump against the droop stops. Apply rotor brake when rotor speed is reduced to 45 percent.

THUNDERSTORMS.

Avoid flight through or near thunderstorms. If thunderstorms are encountered during flight, land and wait for the storm to pass.

SECTION VII

COMMUNICATIONS PROCEDURES

TABLE OF CONTENTS

Introduction	7-1
Visual Communications	7-2
Intercommunications	7-2
Radio Communications	7-2
SAR Communications	7-2

INTRODUCTION

The role of communications is to provide an effective means of control and coordination.

It is of primary importance that all transmissions be as brief and accurate as possible. To accomplish this without overloading the tactical circuits requires strict adherence to proper voice procedures and radio discipline. Brevity code words will be used whenever appropriate. Refer to Section I for a description and operating procedures for the following systems:

UHF COMMUNICATIONS	AN/ARC-52X
UHF DIRECTION FINDER	AN/ARA-25
HF COMMUNICATION	AN/ARC-39
DIRECTION FINDER	AN/ARN-59
UHF NAVIGATION (TACAN)	AN/ARN-21 OR AN/ARN-52
IFF & SIF	AN/APX-6B AN/APA-89

VISUAL COMMUNICATIONS

This helicopter has the capability of signal light communications by the addition of a portable standard type aldis lamp with detachable colored lens covers. This aldis lamp may be used during conditions of EMCON which prohibit use of radio communication. Its use includes plane to plane, and plane to ship communications. The lamp may be plugged into the dc utility receptacle on the cabin ceiling.

INTERCOMMUNICATIONS

The AIC-14 interphone system provides full control and amplification of interphone communications from each crew position and allows selection of UHF or HF communications, and ADF and TACAN from all positions. Hot mike selection may be made from any position.

RADIO COMMUNICATIONS

Channelization of the UHF radio will be in accordance with appropriate directives and a complete frequency channelization card will be placed in each aircraft. Civil airways control communications will be in accordance with procedures set forth by the appropriate FAA instructions. A continuous guard of the emergency frequency will be maintained at all times. Transmission on the guard frequency, however, will be made only in an emergency condition.

SAR COMMUNICATIONS

During shipboard operations the controlling activity shall provide for back-up communications on a suitable HF frequency when any of the following conditions exist:

1. The helicopter is dispatched on long range missions of any type.
2. When efforts to establish communications on normal UHF frequencies have not been successful.

The selection of frequencies will be determined in advance of such operations, dependent on crystals available for the helicopter and equipment available to the controlling activity.

SECTION VIII

WEAPONS SYSTEMS

Not applicable at this time.

SECTION IX

FLIGHT CREW COORDINATION

TABLE OF CONTENTS

Introduction	9-1
Rescue Situation	9-1
Inform Pilot	9-2
Use of Hot Mike	9-2
Jammed Hoist	9-2
Cable Cutter	9-2
RON Duties	9-3
Cargo Operations	9-3
Threading the Fishpole Eye	9-3

INTRODUCTION

The success of any mission will depend on the degree of flight crew coordination and the proficiency of assigned personnel. Duties will be widely varied and require imagination and determination on the part of the crewmen to meet the many and varied requirements of the mission. Each crewman must be able to operate all aircraft equipment, know and understand rescue and survival equipment, and administer first aid when required. All aircrewmen will be qualified and designated as outlined in Section II.

RESCUE SITUATION

The circumstances that can be expected in any given rescue situation will be so widely varied that no attempt will be made to describe a standard or normal situation. Crewmen must be prepared to enter the water and effect an immobile rescue on each occasion. Normally, only those rescue methods set forth in NWIP 41-6 (current series) will be used during rescue operations. The crewman's assistance may be required in directing the aircraft over the rescue, and he should use the following terminology as required:

1. Forward .... Direction of movement — straight ahead.
2. Back .... Direction of movement — straight back.
3. Right .... Direction of movement — slip to the right, maintain present heading.
4. Left .... Direction of movement — slip to the left, maintain present heading.
5. Up .... Direction of movement — up collective, maintain relative position.
6. Down .... Direction of movement — down collective, maintain relative position.
7. Steady .... Hold what you've got, stop movement in all directions.

8. Easy	An indication of rate of movement – precedes the basic command.
9. Cabin Secure	Cabin area position
10. Clear to go	Aircraft cargo, pendant, survivor, etc. clear of obstructions – crew ready for forward flight.

Plane is to the left and aft of the pickup	"Forward ... Easy Forward ... Steady"
Plane is even but to the left of the pickup	"Right ... Easy Right ... Steady"
Plane is ahead of the pickup	"Easy Back ... Steady"
Plane is in a good position	"Steady ... Steady ... Steady"
Hoist is going down	"Hoist is going down"
Sling is in the water	"Sling is in the water"
Man is in the sling	"Man is in the sling"
Hoist is coming up	"Weight is coming on aircraft"
Man is clear of the water	"Man is clear of the water"
Man is halfway up	"Man is halfway up"
Man is entering aircraft	"Man is entering aircraft"
Man is safely aboard	"Man is safely aboard"

WARNING

The hoist should be permitted to touch the ground or water to discharge static electricity before personnel pickup.

INFORM PILOT.

Always keep the pilot informed of the status of the "pickup" and of any possible danger to the helicopter or rescuee, using the above terminology and any other words that are concise and clearly understandable.

USE OF HOT MIKE.

Use the Hot Mike, unless ordered not to. This will permit the use of both hands for guiding the cable and operating the hoist. Be sure to turn the Hot Mike switch off after the pickup is aboard.

JAMMED HOIST.

If, during any hoisting operation, the hoist cable stops, do not attempt to move cable up or down until the load on the cable is removed. Since jamming cannot be observed on the hoist drum and further attempts to move the cable could shear it, inform the pilot of the possible jam and continue as directed. Once the load is off the cable, attempts may be continued manually if it is determined that the cable stopped due to electrical failure. Do not attempt to use the hoist if it is suspected jammed.

CABLE CUTTER.

The hoist is equipped with a cartridge actuated cable cutter for emergency use. This system can be energized only by the pilot or copilot.

RON DUTIES

The aircrewman shall be required to perform the standard daily preflight as set forth in the NAVAIR 01-260HCB-6-1 cards. He will also be required to handle the helicopter, which includes ground and air taxi signals, service (oil and fuel) and tiedown. He shall be familiar with the location of installed electronic equipment, have a thorough knowledge of the OPNAV 4760-2 form, and be able to act as a lookout.

CARGO OPERATIONS

Crewmen may be required to perform LSE duties to direct the pilot in positioning the helicopter over the cargo, direct the hookup, and give clearance to transfer cargo. He shall be thoroughly familiar with the operation of the cargo hook and related cargo equipment. While acting as LSE or hookup man, he shall be required to wear goggles, hard hat, and protective gloves.

THREADING THE FISHPOLE EYE

Refer to figure 9–1.

1. If in flight, put on and connect the hoist operator's safety harness.
2. Reel out about 2 or 3 feet of hoist cable.
3. Grasp the T-handle on the side of the fishpole eye pulley housing, depress the button on the handle, and swing open the pulley housing.
4. Thread the cable over the pulley as shown.
5. Press the button and push the T-handle in to close and lock the pulley housing.
6. Pull T-handle (Do not press button) to check that pulley housing is securely locked.
7. Reel in the hoist cable until the hoist hook bumper is up against the limit switch at the bottom of the pulley housing. The fishpole is now ready for operation.

Threading the Fishpole Eye

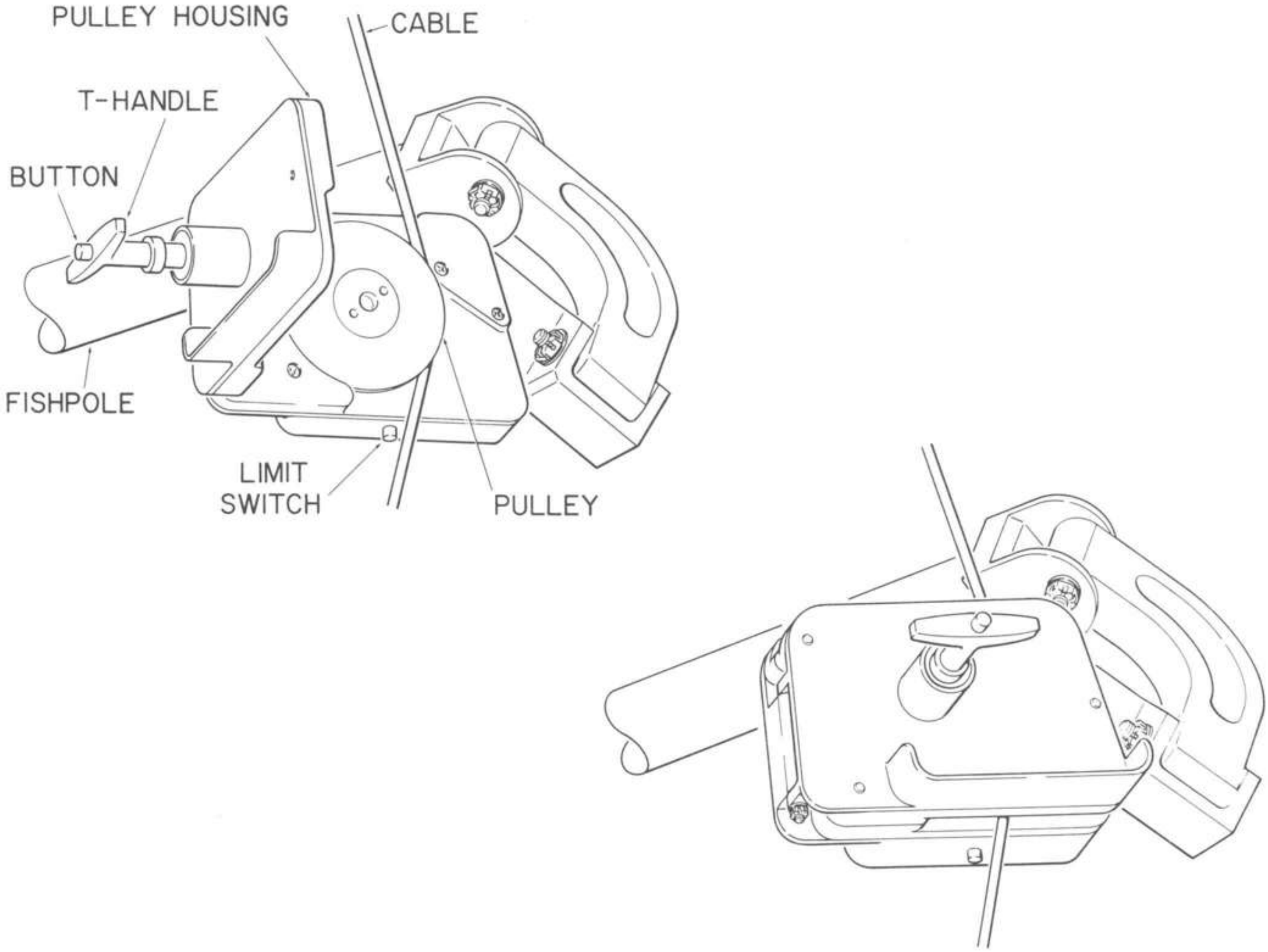


Figure 9—1

SECTION X
NATOPS EVALUATION

TABLE OF CONTENTS

Concept	10-2
Implementation	10-2
Definitions	10-2
Ground Evaluation	10-2
Flight Evaluation	10-3
Final Grade Determination	10-4
Records and Reports	10-4
NATOPS Evaluation Question Bank	10-4
NATOPS Evaluation Forms	10-7

CONCEPT

The standard operating procedures prescribed in this manual represent the optimum method of operating UH-2C aircraft. The NATOPS Evaluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatability with various operational commitments and missions of both Navy and Marine Corps units. The prime objective of the NATOPS Evaluation program is to assist the unit commanding officer in improving unit readiness and safety through constructive comment. Maximum benefit from the NATOPS Program is achieved only through the active vigorous support of all pilots and flight crewmembers.

IMPLEMENTATION

The NATOPS Evaluation program shall be carried out in every unit operating naval aircraft. The various categories of flight crewmembers desiring to attain/retain qualification in the UH-2C shall be evaluated in accordance with OPNAV Instruction 3510.9 series. Individual and unit NATOPS Evaluation will be conducted periodically; however, instructions in and observation of adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS Coordinators, Evaluators, and Instructors shall administer the program as outlined in OPNAVINST 3510.9 series. Evaluees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a re-evaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

DEFINITIONS

The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS program.

NATOPS EVALUATION.

A periodic evaluation of individual flight crewmember standardization consisting of an open book examination, a closed book examination, an oral examination, and a flight evaluation.

NATOPS RE-EVALUATION.

A partial NATOPS Evaluation administered to a flight crewmember who has been placed in an Unqualified status by receiving an Unqualified grade for any of his ground examinations or the flight evaluation. Only those areas in which an unsatisfactory level was noted need be observed during a re-evaluation.

QUALIFIED.

That degree of standardization demonstrated by a very reliable flight crewmember who has a good knowledge of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

CONDITIONALLY QUALIFIED.

That degree of standardization demonstrated by a flight crewmember who meets the minimum acceptable standards. He is considered safe enough to fly as a pilot in command or to perform normal duties without supervision, but more practice is needed to become Qualified.

UNQUALIFIED.

That degree of standardization demonstrated by a flight crewmember who fails to meet minimum acceptable criteria. He should receive supervised instruction until he has achieved a grade of Qualified or Conditionally Qualified.

AREA.

A routine of preflight, flight, or postflight.

SUB-AREA.

A performance sub-division within an area, which is observed and evaluated during an evaluation flight.

CRITICAL AREA/SUB-AREA.

Any area or sub-area which covers items of significant importance to overall mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

EMERGENCY.

An aircraft component, system failure, or condition which require instantaneous recognition, analysis, and proper action.

MALFUNCTION.

An aircraft component or system failure or condition which requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

GROUND EVALUATION

The purpose of the ground evaluation is to measure the pilot/crewmembers knowledge of appropriate publications and aircraft. Prior to commencing the flight evaluation, an evaluee must achieve a minimum grade of Qualified on the open book and closed book examinations. The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation. To assure a degree of standardization between units, the NATOPS Instructors may use the bank of questions contained in this section in preparing portions of the written examinations.

OPEN BOOK EXAMINATION.

The open book examination may consist of but shall not be limited to the questions from the question bank. The number of questions shall not exceed 100 or be less than 75. The maximum time allowed for this examination should not exceed 5 working days.

CLOSED BOOK EXAMINATION.

Questions for the closed book examination may include but shall not be limited to questions from the question bank. The number of questions on the examination shall not exceed 50 or be less than 35. The maximum time allowed for this examination should not exceed 1 hour. Questions designated critical will be so marked. An incorrect answer to any question in the critical category will result in a grade of unqualified being assigned to the examination.

ORAL EXAMINATION.

The questions may be taken from this manual and drawn from the experience of the Instructor/Evaluator. Such questions should be direct and positive and should in no way be opinionated.

OFT/WST PROCEDURES EVALUATION (If Applicable).

An OFT may be used to assist in measuring the crewmember's performance in the execution of prescribed operating procedures and his reaction to emergencies and malfunctions. In areas not served by these facilities, this may be done by placing the crewmember in an aircraft and administering appropriate questions.

GRADING INSTRUCTIONS.

Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

Open Book Examination.

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5.

Closed Book Examination.

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3.

Oral Examination of OFT Procedure Check. (If conducted.)

A grade of Qualified or Unqualified shall be assigned by the Instructor/Evaluator.

FLIGHT EVALUATION

The NATOPS Flight Evaluation is intended to measure pilot and crewmembers performance with regard to knowledge of and adherence to prescribed procedures. The number of flights required to complete the flight evaluation should be kept to a minimum, normally one flight. It may be conducted on any operational or training flight and only those areas observed will be graded. The grade for the flight evaluation and overall NATOPS Evaluation shall be determined as outlined in this section. (Areas and sub-areas to be evaluated may be outlined here with the critical areas/sub-areas marked by an asterisk.)

FLIGHT EVALUATION GRADING CRITERIA.

Only those sub-areas provided or required will be graded. The grades assigned for a sub-area shall be determined by comparing the degree of adherence to standard operating procedures with adjectival ratings listed below. Momentary deviations from standard operating procedures should not be considered as unqualifying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action.

PILOT GRADING ITEMS

Flight Planning	Doppler Hover
Briefing	Emergency Procedures
Preflight	Shutdown
Start, engage, taxi	Postflight Procedures
Take off, transition	De-brief
Climb, cruise	Crew Coordination
Approach Landing	Navigation
Autorotation	Personal Flight Equipment
Hoisting	
Rescue Pattern	

AIRCREW GRADING ITEMS

Briefing
Personal Flight Equipment
Pre Flight
Hoist Operations
Communications
Post Flight

Qualified.

Well standardized evaluee demonstrated highly professional knowledge of and compliance with NATOPS standards and procedures; momentary deviations from or minor omissions in non-critical areas are permitted if prompt and timely remedial action is initiated by the evaluee.

Conditionally Qualified.

Satisfactorily standardized; one or more significant deviations from NATOPS standards and procedures, but no errors jeopardizing mission accomplishment or flight safety.

Unqualified.

Not acceptably standardized; evaluee fails to meet minimum standards regarding knowledge of and/or ability to apply NATOPS procedures; one or more significant deviations from NATOPS standards and procedures which could jeopardize mission accomplishment or flight safety.

FLIGHT EVALUATION GRADE DETERMINATION.

The following procedure shall be used in determining the flight evaluation grade: A grade of Unqualified in any critical area/sub-area will result in an overall grade of Unqualified for the flight. Otherwise, flight evaluation (or area) grades shall be determined by assigning the following numerical equivalents to the adjective grade for each sub-area. Only the numerals 0, 2, or 4 will be assigned in sub-areas. No interpolation is allowed.

Unqualified 0.0
Conditionally Qualified 2.0
Qualified 4.0

To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the sub-areas and divide this sum by the number of sub-areas graded. The adjective grade shall then be determined on the basis of the following scale:

0.0 to 2.19 – Unqualified
2.2 to 2.99 – Conditionally Qualified
3.0 to 4.0 – Qualified

Example: (Add sub-area numerical equivalents)

$$\frac{4+2+4+2+4}{5} = \frac{16}{5} = 3.20 \text{ Qualified}$$

FINAL GRADE DETERMINATION

The final NATOPS Evaluation grade shall be the same as the grade assigned to the flight evaluation. An evaluee who receives an Unqualified on any ground examination or the flight evaluation shall be placed in an Unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a re-evaluation.

RECORDS AND REPORTS

A NATOPS Evaluation Report (OPNAV Form 3510.8) shall be completed for each evaluation and forwarded to the evaluee's commanding officer.

This report shall be filed in the individual flight training record and retained therein for 18 months. In addition, an entry shall be made in the pilot/NFO flight log book under "Qualifications and Achievements" as follows:

QUALIFICATION			DATE	SIGNATURE	
NATOPS EVAL.	(Aircraft Model)	(Crew Position)	(DATE)	(Authenticating Signature)	(Unit which Administered Eval.)

In the case of enlisted crewmembers, an entry shall be made in the Administrative Remarks of his Personnel Record upon satisfactory completion of the NATOPS Evaluation as follows:

(Date) Completed a NATOPS Evaluation (Aircraft Designation) as (Flight Crew position) with an overall grade of (Qualified or Conditionally Qualified.)

NATOPS EVALUATION QUESTION BANK

The following bank of questions is intended to assist the NATOPS Instructor/Evaluator in the preparation of ground examinations and to provide an abbreviated study guide. The questions from the bank should be combined with locally originated questions as well as questions obtained from the Model Manager in the preparation of the ground examinations.

1. What two limitations may be exceeded with abrupt movement of the RPM switch and collective pitch lever when using the Emergency RPM control?
2. Is turbine anti-ice used as a preventive measure or a corrective measure?
3. Which rotor blade is the master blade and cannot be adjusted in flight?
4. If the hydraulic actuator is disengaged in flight a kick will be felt in the controls. Is this kick more severe at high or low speeds?
5. If the cyclic stick is displaced longitudinally without the use of trim, will it return immediately to its original position if released?
6. Is it recommended to use ASE during ground taxi? Why?
7. What is the function of the resolver? Where is it located?
8. What is the function of the accelerometer? Where is it located?
9. The ASE radar altitude control requires what electronic gear on and operating to function properly?
10. What switch or switches dim the master caution light and caution light panel?

11. If the hydraulic boost is disengaged, how may it be re-engaged?

12. What does the "EMRG PUMP ON" caution light indicate?

13. What four conditions are necessary for the air compressor to run?

14. Turbine inlet temperatures of 677° C to 780° C are permitted for transient periods of not over .... seconds.

15. At what airspeed(s) does the blade tracking system annunciator normally cut in and cut out?

16. Is it permissible to hot fuel the UH-2C helicopter?

17. Is it permissible to gravity fuel all tanks of the UH-2C?

18. Is it permissible to gravity fuel the UH-2C with the engine running?

19. What happens to the collective pitch lever friction lock when the altitude mode of the ASE is engaged?

20. What is the winding speed of the rescue hoist?

21. Name the three sources of electrical power.

22. In what publication can the emergency procedures for lost radio communications in the plane guard pattern be found?

23. What may become inoperative if the hoist emergency levers are used?

24. During normal operation of the blade tracking system, which blades are automatically adjusted?

25. Due to the built-in forward tilt of the rotor, the UH-2C fuselage remains level at airspeeds of .... to .... knots.

26. Which automatic switch(s) is bypassed when using the auto track reset button?

27. What steps should be taken to recover from power settling?

28. In the blade tracking system the primary guard circuit will de-energize the system immediately if vibrations exceed .... g.

29. What five systems are operated by hydraulic power?

30. The hydraulic pressure caution light will come on if the hydraulic pressure falls below .... psi.

31. What is the maximum gas generator speed (N_g)?

32. Why should the cockpit doors be opened prior to inflation of the emergency ditching gear?

33. The gearbox chip detector caution light indicates metal particles in any one or more of what locations?

34. Air is bled from the engine compressor for ...., ..., and for ....

35. During flight what is the normal operation of the inverter?

36. Where do the following signals come from to operate the ASE?

a. Heading: ....

b. Airspeed: ....

c. Altitude: ....

d. Groundspeed: ....

37. Why is it recommended that the cable be threaded through the fishpole eye for all hoisting operations?

38. What is the maximum power turbine speed (N_r)?

39. What airspeed will result in a minimum rate of descent during autorotation?

40. The shoulder harness inertia reel will automatically lock when an impact force of .... g is encountered.

41. Practice autorotations should be commenced no lower than .... feet over an approved site.

42. How long does it take the ASE to warm up after ac power is applied?

43. The transmission oil system supplies oil for the lubrication of .... and ....

44. The transmission oil tank has a usable capacity of .... gallons.

45. In normal operation, the landing gear requires how much time to retract or extend?

46. If operating properly in the A/A position, the TACAN will display what information?

47. Why should caution be exercised if it is necessary to actuate the copilot's erection button in flight?

48. Is it possible to extend the fishpole after the hoist has been lowered?

49. What is the maximum allowable gross weight for practice full touchdown autorotation landings?

50. The hydraulic pump is designed to deliver .... psi.

51. The approximate basic weight of the UH-2C is .... lbs.

52. How long does it take for the emergency ditching gear to inflate once the handle has been pulled?

53. The tail rotor blades are free to lead and lag approximately how many degrees?

54. Do the transfer pumps run continuously as long as there is fuel in the aft tank during normal operation?

55. The engine chip detector caution light is connected to two magnetic chip detector plugs located ....

56. The principal source of electrical power comes from the ....

57. The droop stops engage at approximately ....% N_r.

58. The droop stops disengage at approximately .... % N_r.

59. The fire warning system depends on .... rays.

60. What is the maximum allowable airspeed with the cargo and cockpit doors full open?

61. The acceleration time for the engine from ground idle to gas generator topping may take as long as .... seconds.
62. What is the purpose of MIN/MAX fuel flow?
63. Can the landing gear be raised while the weight of the helicopter is on the wheels?
64. In the event of complete electrical power failure, how is the collective pitch lever friction affected?
65. The engine fuel control system automatically maintains the selected power turbine speed (N_f) within ....%.
66. What three instruments operate off the static vent system?
67. The maximum nonturbulent wind for folding or spreading the rotor blades is limited to .... knots for normal operations and .... knots for emergency.
68. With the fuel control set for JP-5, and JP-4 is put into the lines, what may occur?
69. With a full internal fuel load, how much fuel can be jettisoned?
70. How long does it take to jettison all the fuel from a full aft tank?
71. What is the normal taxiing RPM?
72. What is the purpose of the downlock override button?
73. The MIN IDLE position on the throttle quadrants allows the pilot to control ....
74. What is the capacity of the hydraulic system reservoir?
75. Putting the fuel pumps switch to the "No. 1 TEST" position turns off which transfer pump?
76. What is the recommended autorotation airspeed?
77. What is the usable capacity of the engine oil tank?
78. What prevents the engine condition lever from being advanced to the FLY position while the rotor brake is engaged?
79. If all fuel tanks are full, what is the normal order in which fuel is transferred?
80. Can the engine be started with external ac power without having the battery on?
81. It is recommended that the BAR ALT mode be used only above .... feet and below .... knots.
82. When checking the fuel transfer pumps, the fuel pumps switch is held in the test position for at least .... seconds.
83. The starter motor accelerates the gas generator from zero to ....%.
84. During normal start the maximum turbine inlet temperature for advancing the engine condition lever to Idle is ....° C.
85. The number 2 needle indicates the .... bearing to the TACAN beacon.
86. Which pumps and valves are controlled by use of the fuel pumps switch?
87. The anti-coning stops disengage at approximately ....% N_r.
88. The anti-coning stops engage at approximately ....% N_r.
89. During normal start, light-off should occur at or before ....% gas generator speed.
90. Which RAD ALT indicator index determines the altitude for the ASE RAD ALT hold mode?
91. What may happen if the plotting board bug is slewed or allowed to track off the perimeter of the screen?
92. During normal start, the starter button is released at ....% N_g.
93. Why should the hoist be permitted to touch the ground, water, or ship prior to personnel pickup?
94. During autorotation, rotor speed shall be maintained within what range?
95. What is the maximum recommended airspeed for use of the RAD ALT mode of ASE?
96. The turbine anti-icing provides hot air for ...., ..., ..., and ....
97. The arming switch on the Hoist and Hook panel arms what two systems?
98. Normally the fishpole switch will operate only when the hoist is ....
99. Never plan an approach to a confined area wherein there is no reasonable route of ....
100. The A/A position on the TACAN requires the cooperating aircraft to set their channel selectors .... channels apart.
101. Why should the rotating anti-collision lights be turned off during flight through heavy fog and clouds?
102. What is the length of the hoist cable.
103. The average rate of descent in an autorotation is about ....feet per minute.
104. Where do the fueling precheck valves and switches obtain electrical power for their operation?
105. The recommended rotor speed for practice power recovery autorotation is ....%.
106. The low-level fuel caution light gives you an indication of approximately how much fuel remaining?
107. What is the maximum load capacity of the fishpole?
108. During powered flight from 0-100 kts, rotor speed shall be maintained within what range?

109. On night carrier launches you will climb straight ahead to a minimum altitude of .... feet prior to commencing any turns.

110. Can the Aux tanks pressurize if the fuel precheck panel door is open?

111. If the radar altimeter is turned off, how long should you wait before turning it back on?

112. When using the automatic sling release, the load on the cargo hook will release when the pull on the hook decreases to .... lbs.

113. The hoist will not operate under what conditions?

114. What is the maximum turbine inlet temperature for continuous operations?

115. What does a generator caution light indicate?

116. The time required to pressurize the Aux tanks after takeoff should not exceed .... minutes.

117. How will a pilot know when his only source of dc power is the battery?

118. What is the maximum gross weight for the UH-2C?

119. The ASE RAD ALT mode should not be used above .... feet.

120. With the fishpole installed, range at maximum speed is decreased by how much?

121. The ADF low frequency equipment displays what type of bearing information (relative, magnetic, or true)?

122. What kind of external power is required for starting?

123. The boost system is checked at .... % rotor speed.

124. Use of military power is limited to .... minutes duration ....

125. The maximum pressure altitude for inflating the emergency floatation gear is .... feet.

126. The engine fuel pump will supply fuel to the engine to a maximum altitude of .... feet without boosted fuel.

127. Normally, crosswind and downwind hovers in winds in excess of .... kts will be avoided.

128. Hot air for cabin heating is obtained where?

129. Optimum autorotation RPM (N_r) is .... % to .... %.

130. Hovers should be in excess of .... feet over water, to eliminate .... ?

131. The maximum load capacity of the rescue hoist is .... lbs.

132. What is the recommended airspeed for fuel dumping.

133. On a practice instrument autorotation the nose is raised .... degrees on the RAI, at .... feet on the radar altimeter.

134. What is the maximum operating density altitude for the UH-2C?

135. With the fuel control set for JP-4, and JP-5 is put into the lines what may occur?

136. What is the maximum airspeed for inflating the emergency floatation gear?

137. What airspeed will result in the maximum gliding distance during autorotation?

138. The turbine anti-icing should be used when?

139. If the converter caution light comes on, an attempt should be made to reduce the dc power load. Of particular importance is minimum use of .... , ... , and HF (ARC-39) communications.

140. Under single engine conditions, military power is .... T_5. Use of military power is limited to .... minutes duration per flight.

141. What are the procedures for flying a Low Recon Flight?

142. Will loss of both generators affect the remote attitude indicators?

143. What procedure should be followed in event of a power loss?

144. What procedure should be followed in event of a power surge?

145. What procedure should be followed in event of engine and rotor overspeed?

146. An Engine chip detector caution light indicates the possibility of metal particles in ....

147. What procedure should be followed in event of a GEARBOX CHIP Detector caution light?

148. How much wind would be required to ensure 100 feet per minute vertical rate of climb at sea level if the gross weight is 10,250 lbs and the outside air temperature is 30° C? (Assume 102% rotor RPM.)

149. Do the BEST RANGE and MAXIMUM ENDURANCE charts include provisions for fuel reserve at destination, etc?

150. How much fuel will be required to have one-half hour of time on station and have 300 lbs remaining at ETA if the distance to station is 100 n.mi.?

NATOPS EVALUATION FORMS

In addition to the NATOPS Evaluation Report, worksheets are provided for use by the Evaluation/Instructor during the evaluation flight. All of the flight areas and sub-areas are listed on the worksheet with space allowed for related notes.

NATOPS EVALUATION REPORT
OPNAV FORM 3510-8 SERIES

NAME (Last, first initial)	GRADE	SERVICE NUMBER
SQUADRON/UNIT	AIRCRAFT MODEL	CREW POSITION
TOTAL PILOT/FLIGHT HOURS	TOTAL HOURS IN MODEL	DATE OF LAST EVALUATION

NATOPS EVALUATION

REQUIREMENT	DATE COMPLETED	GRADE		
		Q	CQ	U
OPEN BOOK EXAMINATION				
CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
*EVALUATION FLIGHT				

FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE

REMARKS OF UNIT COMMANDER

☐ CHECK IF CONTINUED ON REVERSE SIDE

GRADE, NAME OF EVALUATOR/INSTRUCTOR	SIGNATURE	DATE
GRADE, NAME OF EVALUEE	SIGNATURE	DATE

REMARKS OF UNIT COMMANDER

RANK, NAME OF UNIT COMMANDER	SIGNATURE	DATE

*WST, OFT, COT, or cockpit check in accordance with OPNAVINST 3510.9 (effective edition).

FORM C-1C

NATOPS EVALUATOR/INSTRUCTOR WORKSHEET
UH-2

Name ____________________ Rank __________

Written Exam Grade [ ] Flight Exam Grade [ ]

ACTIVITY ____________________

Name (NATOPS Evaluator) ____________________ Rank __________

Date Completed __________

INSTRUCTIONS

A complete description of all performance during the mission is required. All inflight notes to be used for critique and grading will be recorded on worksheet. The remarks page provided is not to be regarded as a limit to necessary comments, notes, or remarks. Discrepancies and/or omissions will be noted in the remarks section as they occur.
This worksheet will be used as a critique outline.

FORM C-1D

EVALUATION REMARKS

Form C-1E

UH-2 PILOT NATOPS EVALUATION SUMMARY

GROUND EVALUATION	U	CQ	Q
Oral Examination			
Written			
Open book			
Closed book			

FLIGHT EVALUATION	U	CQ	Q
Mission Planning			
Preflight			
Start/Engage/Taxi			
Takeoff/Transition			
Climb/Cruise			
Approach/Landing			
Autorations			
Hoisting			
Rescue Pattern/Doppler Hover (if applicable)			
Emergency Procedures			
Shutdown/Post Flight			
Debriefing			
Crew Coordination			
Navigation			
Pilot Equipment			

Form C-1F

GROUND EVALUATION

	U	CQ	Q
ORAL EXAMINATION			
a. Emergencies			
b. Light and Hand Signals			
(1) Wingman			
(2) Plane Captain to Pilot			
c. Malfunctions			
d. Aircraft Systems			
*(1) Power Plant			
*(2) Fuel			
(3) Hydraulic			
*(4) Electrical			
(5) Stabilization			
(6) Hoist			
(7) Hook			
*(8) Rotor			

REMARKS:

Form C-1G

WRITTEN EXAMINATION

	U	CQ	Q
a. Open Book			
b. Closed Book			

Remarks:

NAMT (If Applicable)			

REMARKS:

Form C-1H

UH-2

FLIGHT EVALUATION WORKSHEET

MISSION PLANNING	U	CQ	Q
1. Flight Plan (as required)			
2. Computed Takeoff Weight			
3. Weather (local and forecast)			

REMARKS

BRIEFING

1. Organization			
2. Emergency Procedures			

PREFLIGHT

*1. Records Check (yellow sheet)			
*2. Preflight Check			
3. Crew Briefing			

REMARKS:

Form C-1I

FLIGHT EVALUATION WORKSHEET (Cont)

START/ENGAGE/TAXI	U	CQ	Q
*1. Start			
*2. Engage			
3. Post Engagement			
*4. Use of checklist			
5. Utilization of copilot			
6. Taxi			
7. Pre-takeoff checklist			

REMARKS:

TAKEOFF/TRANSITION	U	CQ	Q
1. NATOPS procedures			
*2. Clearing turns			
*3. Takeoff			
4. Transition			
(a) heading control			
(b) altitude control			
(c) Speed control			
5. Safety precautions			

CLIMB/CRUISE	U	CQ	Q
1. NATOPS procedures			
*2. Power control			
3. Heading control			
4. Altitude control			
5. Scan pattern			

Form C-1J

FLIGHT EVALUATION WORKSHEET (Cont)

APPROACH AND LANDING	U	CQ	Q
*1. Landing checklist			
2. Power control			
*3. Aircraft control			
4. Landings			
(a) transition			
*(b) hover			
*(c) vertical landing			
(d) airspeed & altitude control			

REMARKS:

AUTOROTATIONS	U	CQ	Q
1. NATOPS procedures			
*2. Heading control			
3. RPM control			
*4. Altitude control			
5. Recovery			
6. Autorotations			
(a) straight-in			
(b) 90°			
(c) 180°			

REMARKS:

Form C-1K

FLIGHT EVALUATION WORKSHEET (Cont)

HOISTING	U	CQ	Q
1. Hover			
(a) heading			
(b) altitude			
2. C/P and Crewman Coordination			
3. Approach to Hover			
4. Visual signal observance			
5. NATOPS procedures			

RESCUE PATTERN/DOPPLER HOVER			
1. NATOPS procedures			
2. Knowledge of equipment			
3. Pattern			
(a) altitudes			
(b) attitudes			
(c) airspeeds			
4. Approach			
5. Hover			
6. Departure			
7. Scan			

Form C-1L

FLIGHT EVALUATION WORKSHEET (Cont)

	U	CQ	Q
EMERGENCY PROCEDURES			
(1) NATOPS procedures			
(2) Response			
(3) Control			
(4) Utilized c/p and crewman			

REMARKS (List emergencies covered on check):

SHUTDOWN/POSTFLIGHT			
(1) Shutdown Procedure			
(2) Postflight Inspection			
(3) Records Check (yellow sheet)			

REMARKS:

DEBRIEFING			

REMARKS:

CREW COORDINATION			

REMARKS:

Form C-1M

FLIGHT EVALUATION WORKSHEET (Cont)

NAVIGATION	U	CQ	Q
1. Maintained knowledge of position			
(a) Course			
(b) Alt			
(c) A/S			
2. Utilization of c/p			

UH-2

PILOT EQUIPMENT	U	CQ	Q
1. Helmet			
2. Flight Suit			
3. Flight Shoes			
4. Mae West (as required)			
5. Sheath Knife			
6. Two Cell Flashlight (night)			
7. One Cell Flashlight (pen light)			
8. Flight Gloves			
9. ID Tags			
10. Exposure Suit (as required)			
11. Survival Kits (as required)			
12. Pilot's Pocket Checklist			

REMARKS:

Form C1N

CREWMAN CHECK WORKSHEET

BRIEFING	U	CQ	Q
1. Attended			
2. Arrived at scheduled time			
3. Obtain all equipment and information			
pertinent to completing mission			
PERSONAL FLIGHT EQUIPMENT			
1. Helmet (reflective tape)			
2. Flight suit			
3. Flight gloves			
4. Flight boots			
5. ID tags			
6. Sheath knife			
7. Life preserver (all equipment)			
8. Survival kit (as required)			
9. Life raft			
10. Extra PK-2 lift rafts (survival kits)			
11. Two cell flashlight (night flights)			
12. Parachutes (if applicable)			
13. Aircrewman's Pocket Checklist			

PRE-FLIGHT	U	CQ	Q
1. Records check (OPNAV 3760-2)			
2. "C" part of OPNAV 3760-2 (name, service number and rate)			
3. Flight line safety precautions			
4. Helicopter external inspection			
5. Helicopter internal inspection			
6. Rescue hoist check			

Form C1O

CREWMAN CHECK WORKSHEET (Cont)

HOIST TRAINING OPERATIONS	U	CQ	Q
1. Understands all phases of hoist operations			
2. Completed mission			
a. No excessive time delays			
3. Emergencies			

COMMUNICATIONS	U	CQ	Q
1. Understands ICS system			
2. Proper terminology and phraseology			

POST-FLIGHT	U	CQ	Q
1. Equipment security			
2. Equipment condition			
3. Aircraft security			
4. Report of descrepancies to pilot			
5. Records (yellow sheet)			

RON DUTIES	U	CQ	Q
1. Performed daily preflight			
2. Demonstrated taxi-signals			
3. Servicing			
a. oil			
b. fuel			
c. tie-downs			
4. Demonstrate knowledge of OPNAV 3760-2 form			
5. Guard duties at RON base			

Form C-1P

UH-2 AIRCREW NATOPS EVALUATION REPORT

AIRCREWMAN EVALUATION	U	CQ	Q
briefing			
personal flight equipment			
preflight			
hoist operations			
communications			
postflight			
RON duties			

STATUS (Check one)

- ☐ unqualified
- ☐ conditionally qualified
- ☐ qualified

CERTIFICATION

Date:

Name of Evaluator/Instructor

Signature:

SECTION XI
PERFORMANCE DATA

TABLE OF CONTENTS

Purpose of Data	11-1
Operating Limitations	11-1
Symbols	11-2
Calibrated Airspeed	11-2
Pressure Altitude	11-2
Density Altitude	11-2
Flight Charts	11-2

PURPOSE OF DATA

The charts on the following pages are provided to define the capabilities of the helicopter as well as to aid in selecting the flight conditions that will result in efficient operation of the helicopter.

OPERATING LIMITATIONS

The performance data in this section are not intended to serve as operating limitations. All operating limitations are given in Part 4 of Section I, and in any outstanding Interim Revisions. If a discrepancy arises between the current limitations and the performance data, the limitations should be the controlling factor in all cases.

SYMBOLS

The following abbreviations are used in this section:

Symbol	*Definition*
alt	Altitude
C	Centigrade
CAS	Calibrated Airspeed
F	Fahrenheit
fpm	Feet Per Minute
ft	Feet
lb	Pound
lb/hr	Pounds Per Hour
min	Minutes
OAT	Outside Air Temperature
press	Pressure
rpm	Revolutions Per Minute
R/C	Rate of Climb
SL	Sea Level
TAS	True Airspeed
$1/\sqrt{\sigma}$	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

Airspeed indicator correction cards are located on the instrument panel. Values shown on the cards correct slight instrument and pilot static system errors for the adjacent airspeed indicator. Calibrated airspeed (CAS) is obtained by applying the instrument and pitot static system correction value to indicated airspeed.

PRESSURE ALTITUDE

Pressure altitude is the altitude indicated on the altimeter when the barometric scale is set on 29.92. It is the height above a theoretical plane, where the air pressure is equal to 29.92 inches of mercury.

DENSITY ALTITUDE

Density altitude is pressure altitude corrected for temperature.

FLIGHT CHARTS

The following paragraphs explain the use of the flight charts in this appendix. Each chart indicates the basis of the information, flight tests or estimates.

A sample problem is given for each of the charts. Procedures for reading the sample problems are shown by arrows on the charts.

DENSITY ALTITUDE CHART.

The density altitude chart (figure 11–1) provides a means of determining density altitude from outside air temperature and pressure altitude. The chart also provides the air density conversion factor ($1/\sqrt{\sigma}$) for changing calibrated airspeed to true airspeed.

Example:

OAT	5.6° C (42° F)
Pressure Altitude	2500 feet
CAS	125 knots

The chart shows that density altitude is 2000 feet, and the air density conversion factor is 1.03. Use the following procedure to obtain these results:

1. Enter the chart at 5.6° C (42° F)
2. Move vertically to the 2500 foot pressure altitude line.
3. Move left to the density altitude scale. Density altitude is 2000 feet.
4. Move right to the air density conversion factor ($1/\sqrt{\sigma}$) scale. Air density conversion factor is 1.03.
5. To convert CAS to TAS multiply CAS by air density conversion factor, CAS or 125 knots $\times$ 1.03 $=$ 129 knots TAS.

ENGINE OPERATING LIMITS CHART.

The engine operating limits chart (figure 11–2) shows the manufacturer's specification military power available in terms of torque as a result of pressure altitude, outside air temperature, and rotor rpm.

Example:

Find the maximum torquemeter pressure available with the following conditions:

Pressure Altitude	4000 feet
OAT	30° C
Rotor rpm	100%

The chart shows that the maximum torque available on each engine is 59%. Use the following procedure to obtain this result:

1. Enter the chart at 4000 feet pressure altitude.

2. Move horizontally to intersect the 30° C line.
3. Move straight down to intersect the rotor speed base line.
4. Move downward, parallel to the angled lines of the rotor rpm scale until the 100% rotor speed line is intersected.
5. Drop vertically to the torquemeter pressure scale, and read 59%.

ENGINE HORSEPOWER-TORQUEMETER PRESSURE CONVERSION CHART.

This chart (figure 11–3) provides a means of converting torque to horsepower, and vice versa, for rotor rpm settings of 98%, 100%, and 102%. A sample problem shows that for a torque of 59%, at 100% rotor speed, the horsepower is 940. For dual engine torques, smply add the results to obtain total torque.

FUEL FLOW CHART.

The fuel flow chart (figure 11–4) shows fuel flows as a result of torque and altitude. The example shows that for a single engine torque of 44% at 4000 feet, the fuel flow will be 478 pounds per hour. For dual engine operations, simply add the results to obtain total fuel flow.

MAXIMUM GROSS WEIGHT FOR VERTICAL TAKEOFF.

The chart (figure 11–7) presents the maximum takeoff weight as limited by the vertical climb capability of the helicopter. The chart is based on the ability to take off vertically at a desired rate of climb out of ground effect, using military power, or maximum torque.

Example:

Find the maximum gross weight for vertical takeoff with the following conditions:

pressure altitude	4000 feet
OAT	30° C (86° F)
rotor rpm	102%
desired vertical rate of climb	200 fpm
head wind	10 knots

The chart shows that 11,400 pounds is the maximum gross weight for this type takeoff.

Use the following procedure to obtain this result:

1. Enter the chart on the pressure altitude scale at 4000 feet.
2. Move horizontally to the right to intersect the 30° C temperature line.
3. Drop vertically to the vertical rate of climb base line.
4. Move downward, parallel to the angled lines of the vertical rate of climb scale until the 200 fpm rate of climb line is intersected.
5. Drop vertically to the head wind base line.
6. Move downward, paralleling the curved lines until the 10 knot line is intersected.
7. Drop vertically to the gross weight scale and read 11,400 pounds.

Note that under the same atmospheric conditions the maximum gross weight is increased as the desired rate of vertical climb is reduced. For example, if the ability to hover out of ground effect is chosen as the criterion for the limit takeoff gross weight, the resulting maximum gross weight will be somewhat higher.

MAXIMUM GROSS WEIGHT FOR HOVERING.

This chart (figure 11–8) shows the maximum gross weight for hovering in or out of ground effect as a result of outside air temperature, pressure altitude, and head wind, at 102% rotor rpm.

Example:

Find the maximum gross weight for hovering in ground effect with the following conditions:

Pressure altitude	4000 feet
OAT	50° C
Wind velocity	10 knots
Rotor rpm	102%
Wheel height	15 feet

The chart shows that 10,530 pounds is the maximum gross weight for hovering in ground effect under these conditions.

Use the following procedure to obtain this result:

1. Enter the chart on the pressure altitude scale at 4000 feet.
2. Move horizontally to the right to intersect the 50° C temperature line.
3. Descend vertically to the wheel height base line.
4. Move downward, paralleling the curved lines until the 15 foot line is intersected.
5. Drop vertically to the wind velocity base line.
6. Move downward, paralleling the curved lines, until the 10 knot line is intersected.
7. Drop vertically to the gross weight scale and read 10,530 pounds.

CLIMB CHART FOR MAXIMUM CONTINUOUS TORQUE.

This chart (figure 11–9) presents best forward rate of climb with maximum continuous torque and the corresponding CAS. The chart also gives the time it takes to climb from sea level to any desired altitude, and the fuel required. In planning climbs from sea level, time to climb and fuel quantity used can be read directly. If, however, the climb is to be started at an altitude other than sea level, then the time and fuel quantity used must be calculated as illustrated by the following sample calculation. The information is shown at 8500, 9500, 10500, and 11500 pounds. For intermediate gross weights use the next higher weight shown. Since density altitude is used, no corrections are necessary for varying atmospheric conditions.

Example:

With the following conditions, use the chart to obtain the results shown:

takeoff altitude	2000 feet
desired altitude	10,000 feet
gross weight	9500 pounds

The chart shows that the time to climb to the desired altitude is 4 minutes at 59 knots CAS, using 111 pounds of fuel for the climb. Use the following procedure to obtain the results shown in this example:

1. Select the 9500 pound gross weight column on the chart.
2. Note that best calibrated airspeed is 59 knots.
3. Read across the 2000 foot line to determine that 1 minute is required to climb from sea level to 2000 feet. Then read across the 10,000 foot line to determine that 5 minutes are required to climb from sea level to 10,000 feet. Since the climb is to be started at 2000 feet, subtract 1 minute from 5 minutes to obtain 4 minutes as the time required to climb from 2000 to 10,000 feet.
4. Note that 52 pounds of fuel are required to climb from sea level to 2000 feet, and that 125 pounds are needed to climb from sea level to 10,000 feet. Subtract 52 pounds from 125 pounds to obtain 73 pounds as the fuel required to climb from 2000 feet to 10,000 feet. Add 38 pounds of fuel required for warmup and takeoff to the 73 pounds required for climb to obtain 111 pounds total.

Note

It is important to realize that the base of the fuel column is 38 pounds, rather than zero. Therefore, when the fuel quantity for the lower altitude is subtracted from the higher altitude, the 38 pound allowance for warmup and takeoff is also subtracted.

BEST RANGE CHART.

The best range chart (figure 11–10) is provided to show the air distances that can be flown with various quantities of fuel, or conversely, to show the fuel needed to fly a given air distance. The information is given for several gross weights and various altitudes. The chart also shows the forward speed that will provide the air distances shown.

Usable fuel is listed in the fuel quantity data Table. Depending on reserves and other requirements, the corresponding fuel quantity available for cruise is somewhat less. On the bottom of the chart, factors are listed by which airspeed and range must be corrected when flying with external equipment attached.

Since the chart is easy to read, a specific example is not provided. Enter chart at the correct gross weight column (use the next higher weight if desired weight is not shown). Select the altitude line nearest to the cruise altitude chosen for the mission and read across to obtain forward speed. For a known fuel load, read range, or for a desired range read fuel required.

Note

- Fuel loads indicated on the chart are the fuel quantities needed to fly the distances shown. For a given total fuel load the desired reserves and the fuel quantities needed for other phases of the mission must be subtracted from the total fuel load before using the chart.
- The chart was compiled for standard day conditions. However, because the effect of temperature on performance is negligible, corrections need not be made for varying temperature.

RANGE AT MAXIMUM AIRSPEED CHART.

This chart (figure 11–11) shows the air distances that can be flown at maximum airspeed with various quantities of fuel, or conversely, to show the fuel needed to fly a given air distance at maximum airspeed. The information is given for several gross weights and altitudes.

Usable fuel is listed in the fuel quantity data table. Depending on reserves and other requirements, the corresponding fuel quantity available for cruise is somewhat less. On the bottom of the chart, factors are listed by which airspeed and range must be corrected when flying with external equipment attached.

Since the chart is easy to read, a specific example is not provided. Enter chart at the correct gross weight column (use the next higher weight if desired weight is not shown). Select the altitude line nearest to the cruise altitude chosen for the mission and read across to obtain forward speed. For a known fuel load, read range, or for a desired range read fuel required.

Note

Fuel loads indicated on the chart are the fuel quantities needed to fly the distances shown. For a given total fuel load the desired reserves and the fuel quantities needed for other phases of the mission must be subtracted from the total fuel load before using the chart.

Note

The chart was compiled for standard day conditions. However, because the effect of temperature on performance is negligible, corrections need not be made for varying temperature.

ENDURANCE CHART.

This chart (figure 11—12) is provided to show maximum flight time with various quantities of fuel, or conversely, to show the fuel needed to fly a given time. The chart gives airspeeds and maximum endurance time for various gross weights, altitudes and fuel loads. At the airspeeds shown the effect of external equipment on performance is negligible. Therefore, no corrections need be made to the values shown when flying with external fuel tanks attached.

Note

- Fuel loads indicated on the chart are the fuel quantities needed to fly the time shown. For a given total fuel load the desired reserves and the fuel quantities needed for other phases of the mission must be subtracted from the total fuel load before using the chart.
- The chart was compiled for standard day conditions. However, because the effect of temperature on performance is negligible, corrections need not be made for varying temperature.

MINIMUM AIRSPEED CHARTS FOR SINGLE ENGINE OPERATION.

These charts (figures 11—14 and 11—15) show the minimum airspeeds at which flight can be maintained, at sea level, for varying gross weights, with one engine operating. Figure 11—14 shows minimum speeds for flight out of ground effect, and figure 11—15 shows minimum speeds for flight in ground effect.

Example:

Find the minimum airspeed required for flight with one engine under the following conditions:

Gross weight	9850 pounds
OAT	20° C (68° F)
Desired altitude	Out of ground effect

Figure 11—14 shows that the minimum airspeed required under these circumstances is 18 knots.

Figure 11—15 shows that for the same gross weight and OAT, but in ground effect, that the minimum airspeed required is 10.5 knots.

CLIMB CHART FOR SINGLE ENGINE OPERATION.

This chart (figure 11—16) presents best forward rate of climb with military power on one engine and the corresponding CAS. The chart also gives the time it takes to climb from sea level to any desired altitude, and the fuel required. In planning climbs from sea level, time to climb and fuel quantity used can be read directly. If, however, the climb is to be started at an altitude other than sea level, then the time and fuel quantity used must be calculated as illustrated by the following sample calculation. The information is shown for standard day atmospheric conditions at 8500, 9500, 10500, and 11500 pounds. For intermediate gross weights use the next higher weight shown. For atmospheric conditions other than standard day, the chart presents data for adjusting rate of climb to actual atmospheric conditions.

Example:

With the following conditions, use the chart to obtain the results shown:

takeoff altitude	2000 feet
desired altitude	10,000 feet
gross weight	9500 pounds

The chart shows that the time to climb to the desired altitude is 9 minutes at 59 knots CAS, using 123 pounds of fuel for the climb. Use the following procedure to obtain the results shown in this example:

1. Select the 9500 pound gross weight column on the chart.
2. Note that best calibrated airspeed is 59 knots.
3. Read across the 2000 foot line to determine that 2 minutes are required to climb from sea level to 2000 feet. Then read across the 10,000 foot line to determine that 11 minutes are required to climb from sea level to 10,000 feet. Since the climb is to be started at 2000 feet, subtract 2 minutes from 11 minutes to obtain 9 minutes as the time required to climb from 2000 to 10,000 feet.
4. Note that 42 pounds of fuel are required to climb from sea level to 2000 feet, and that 143 pounds are needed to climb from sea level to 10,000 feet. Subtract 42 pounds from 143 pounds to obtain 101 pounds as the fuel required to climb from 2000

feet to 10,000 feet. Add 22 pounds of fuel required for warmup and takeoff to the 101 pounds required for climb to obtain 123 pounds total.

Note

It is important to realize that the base of the fuel column is 22 pounds, rather than zero. Therefore, when the fuel quantity for the lower altitude is subtracted from the higher altitude, the 22 pound allowance for warmup and takeoff is also subtracted.

RANGE CHART FOR SINGLE ENGINE OPERATION.

This chart (figure 11–17) shows the best range that can be attained with various quantities of fuel with only one engine operating, or conversely, to show the fuel needed to fly a given air distance with one engine. The information is given for several gross weights and various altitudes. The chart also shows the forward speed that will provide the air distances shown. The speeds shown are also the maximum attainable.

Usable internal fuel is listed in the fuel quantity data table. Depending on reserves and other requirements, the corresponding fuel quantity available for cruise is somewhat less. On the bottom of the chart, factors are listed by which airspeed and range must be corrected when flying with external equipment attached.

Since the chart is easy to read, a specific example is not provided. Enter chart at the correct gross weight column (use the next higher weight if desired weight is not shown). Select the altitude line nearest to the cruise altitude chosen for the mission and read across to obtain forward speed. For a known fuel load, read range, or for a desired range read fuel required.

Note

Fuel loads indicated on the chart are the fuel quantities needed to fly the distances shown. For a given total fuel load the desired reserves and the fuel quantities needed for other phases of the mission must be subtracted from the total fuel load before using the chart.

Density Altitude

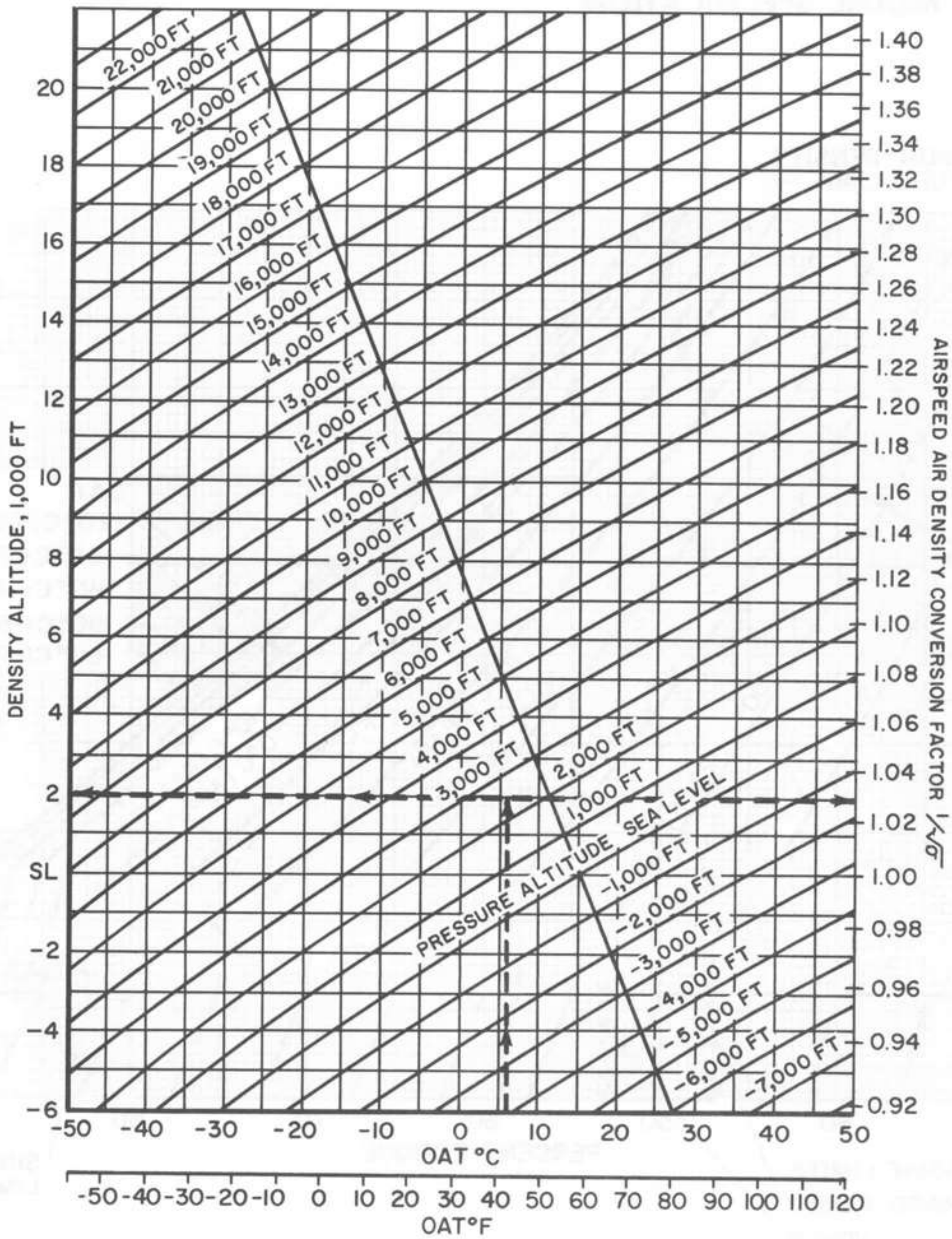


Figure 11—1

Engine Operating Limits

MILITARY POWER AVAILABLE — ONE ENGINE

MODEL: UH-2C
DATE: NOVEMBER 1966
DATA BASIS: MODEL SPECIFICATION

ENGINE: T58-GE-8

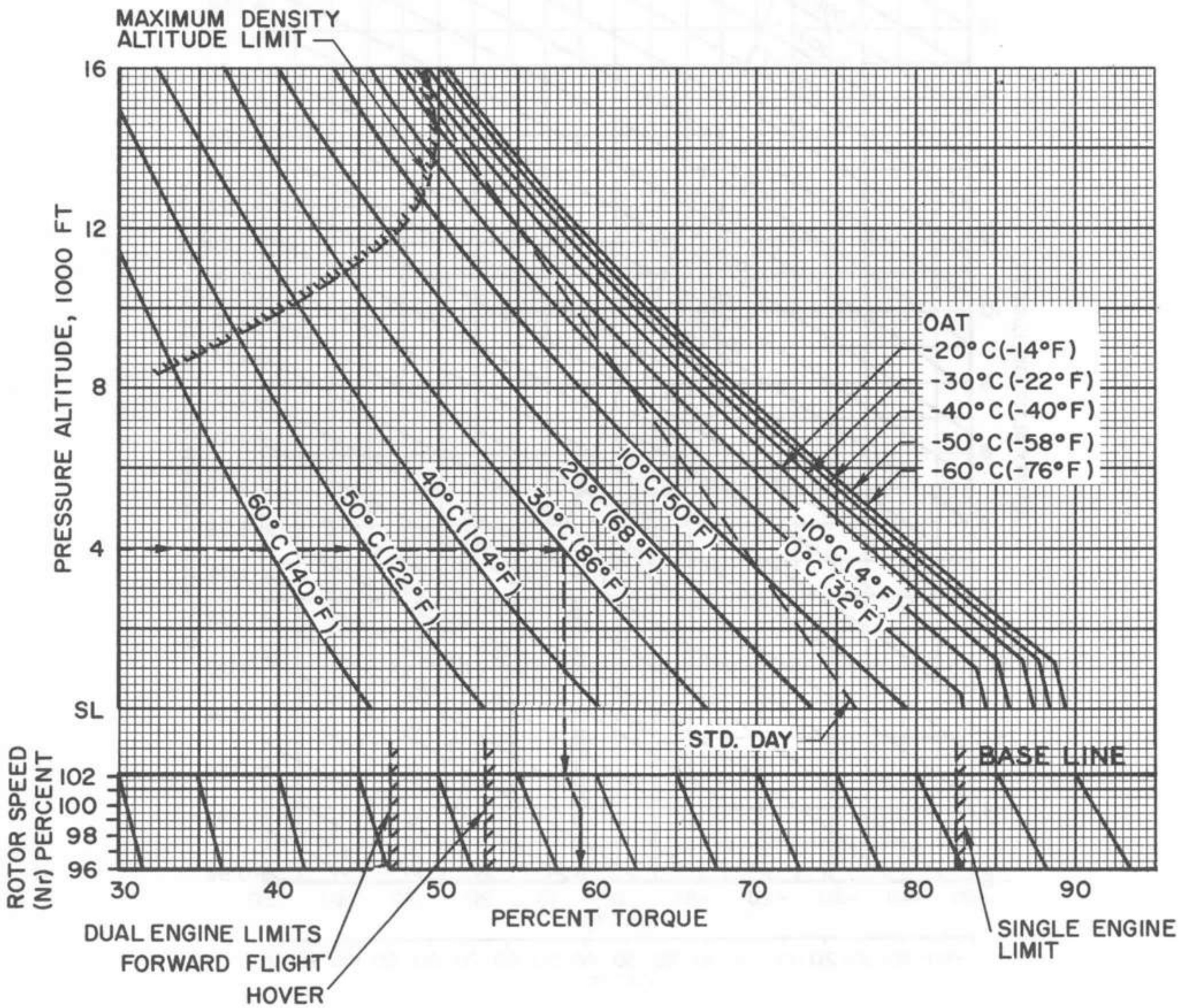


Figure 11—2

Engine Horsepower Percent Torque Conversion

MODEL: UH-2C **ENGINE: T58-GE-8**
DATE: 1 NOVEMBER 1966

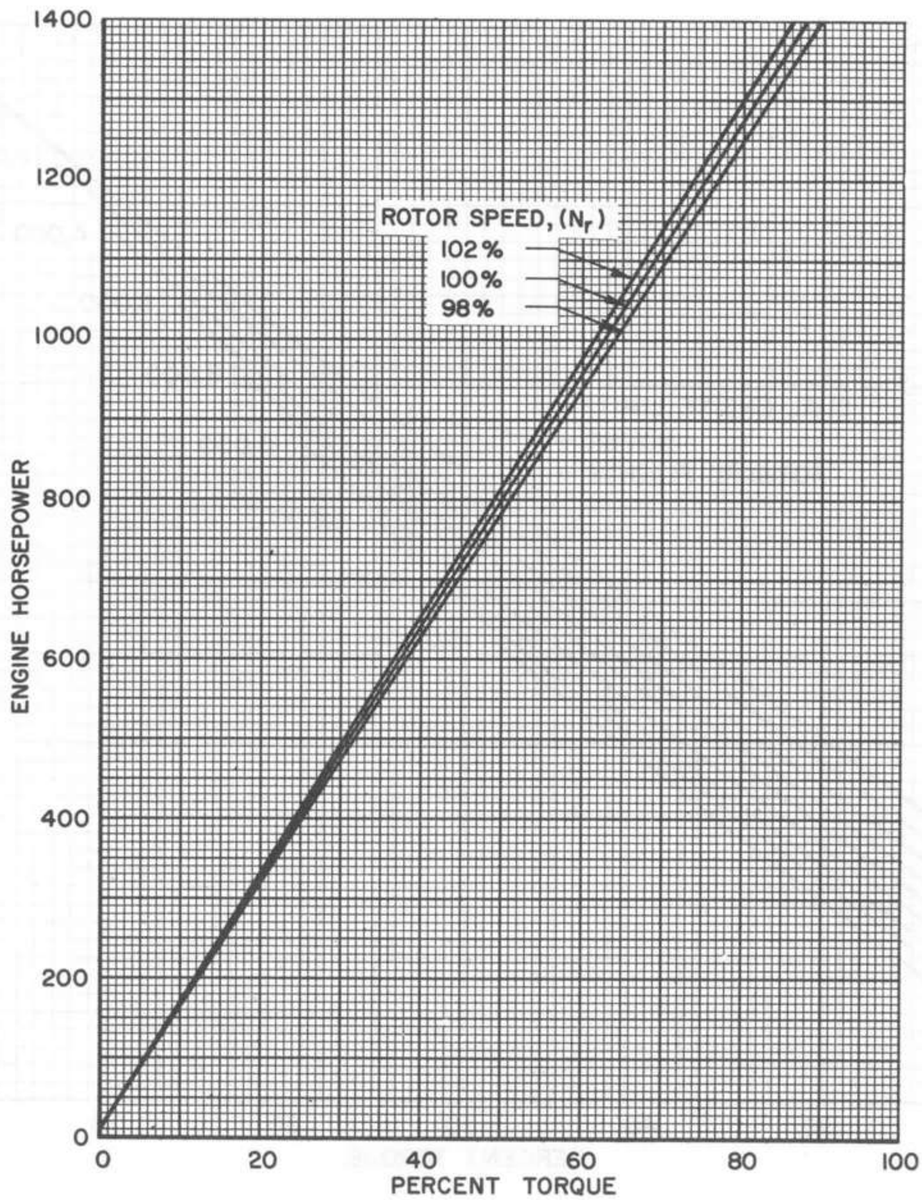


Figure 11–3

Fuel Flow

MODEL: UH-2C
DATE: 1 NOVEMBER 1966
DATA BASIS: MODEL SPECIFICATION

ENGINE: (1) T58-GE-8
FUEL GRADE: JP-5 & JP-4

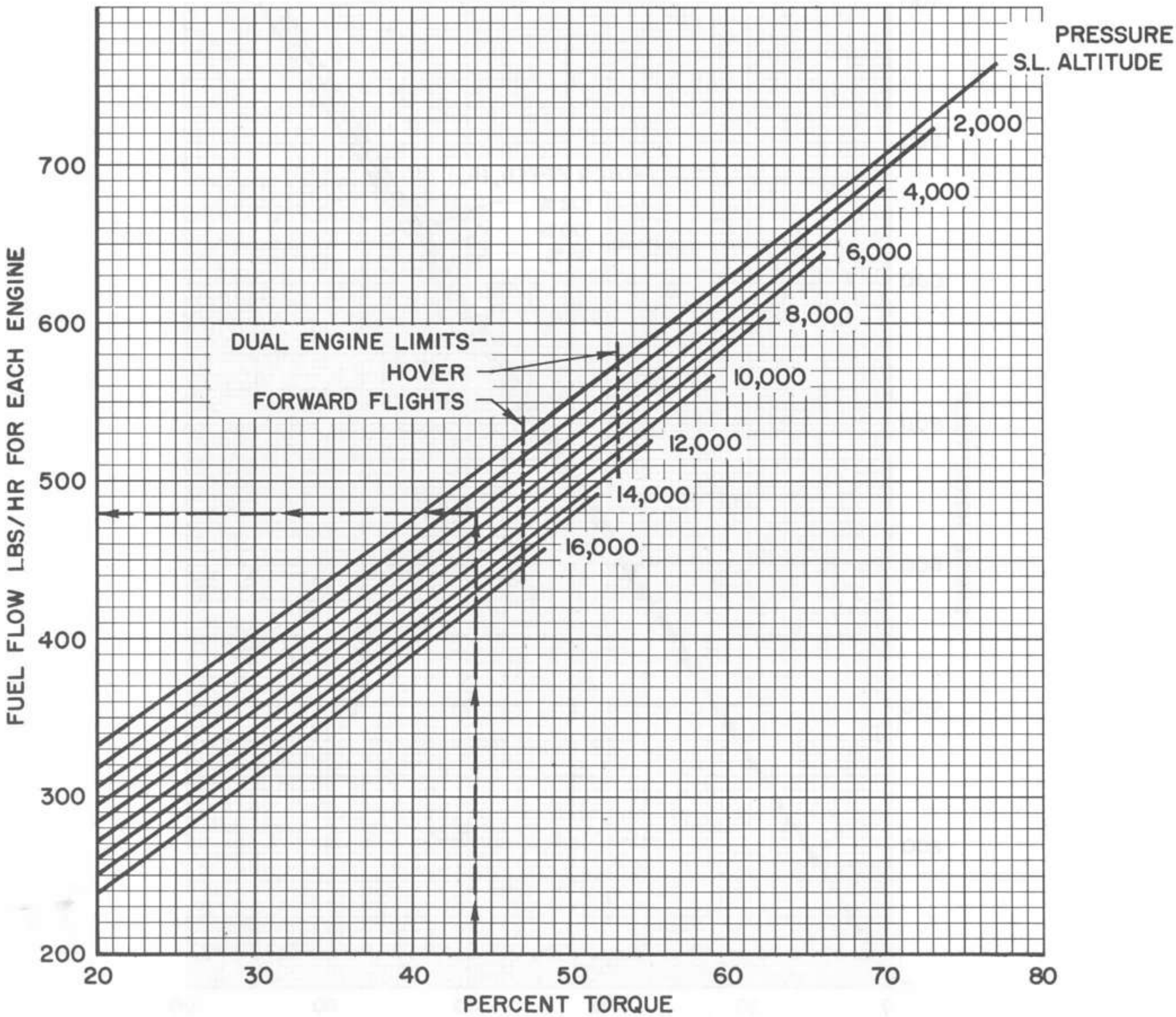


Figure 11–4

Topping Charts

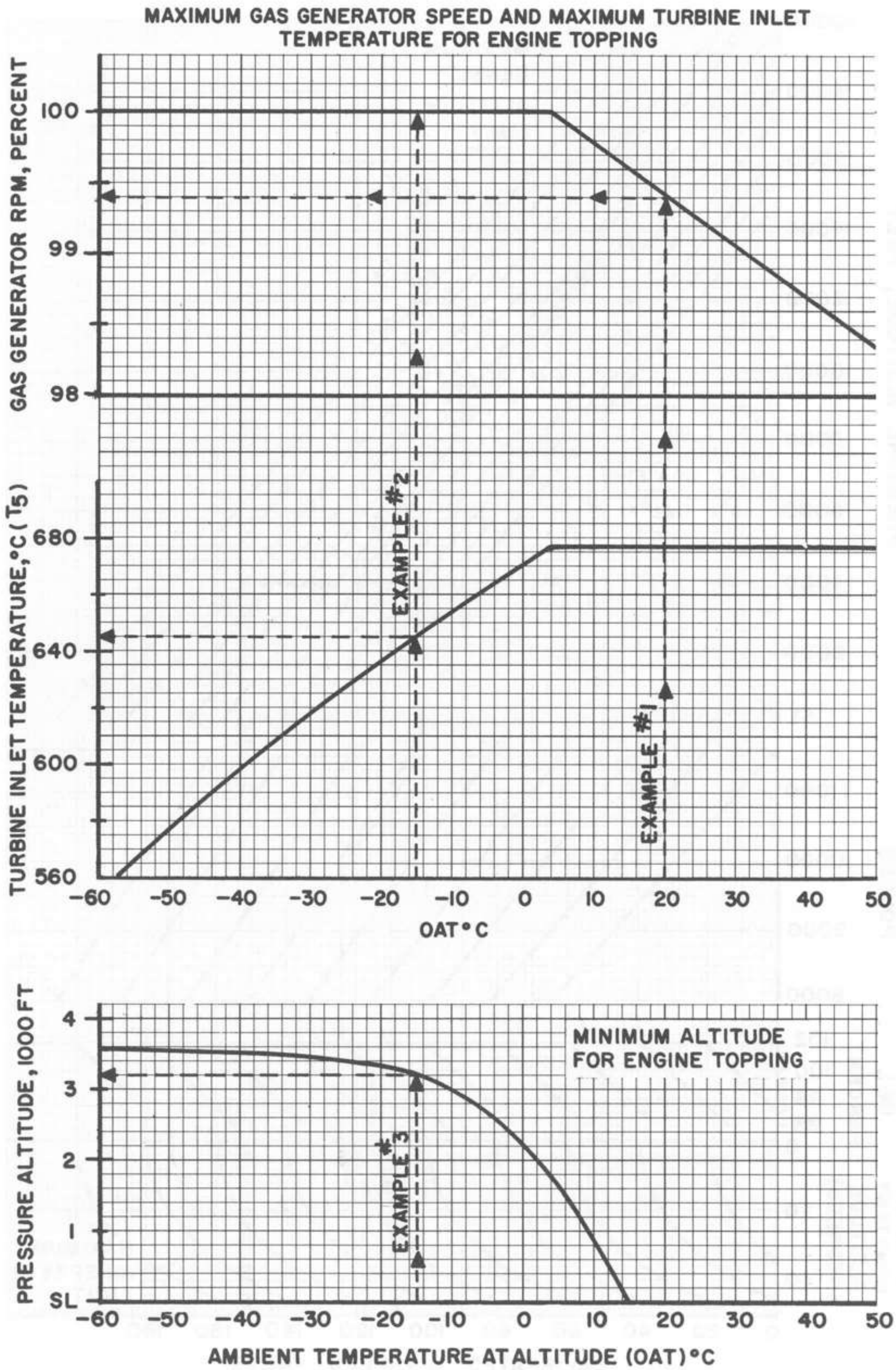


Figure 11–5

Airspeed Limitation Chart

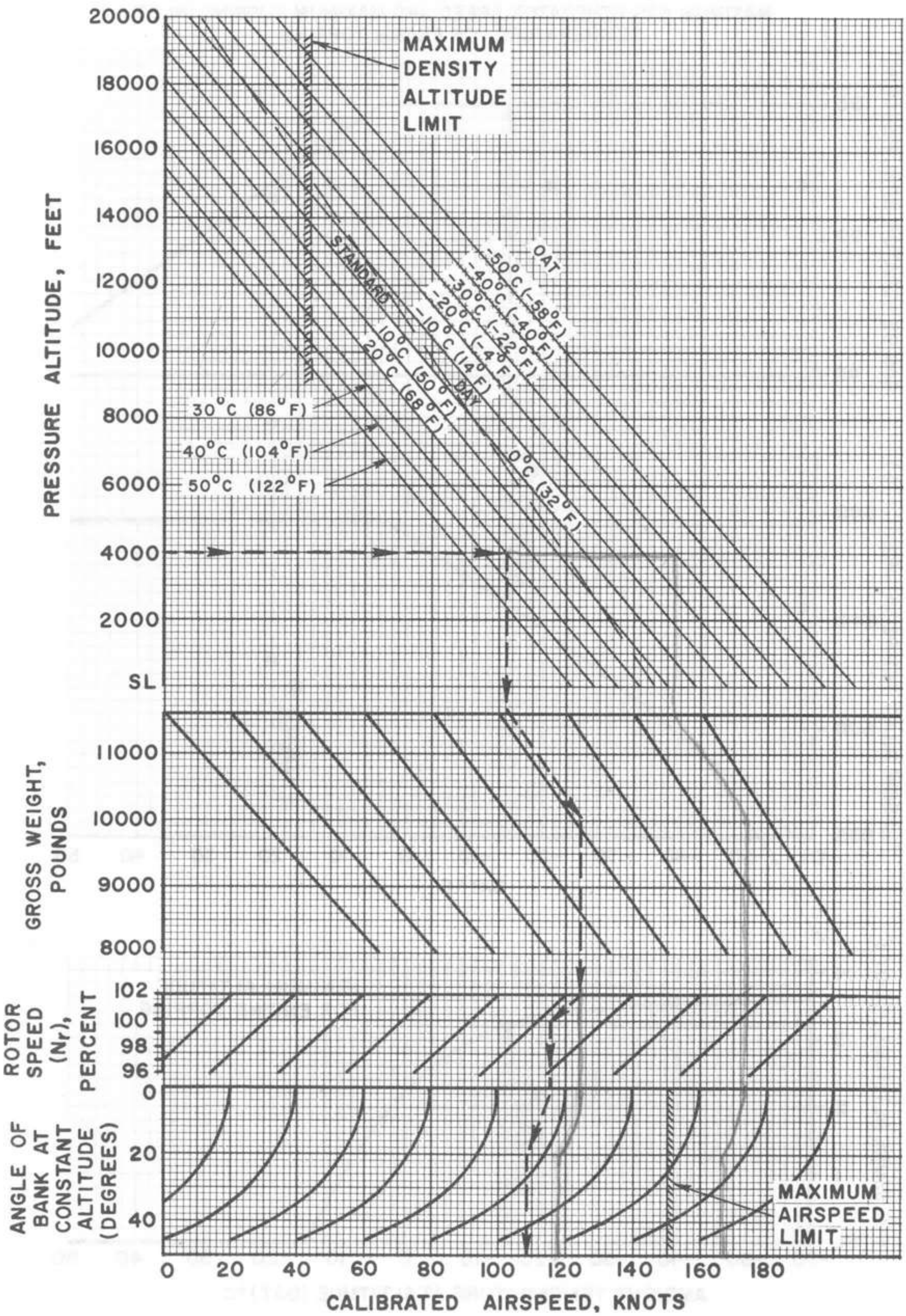
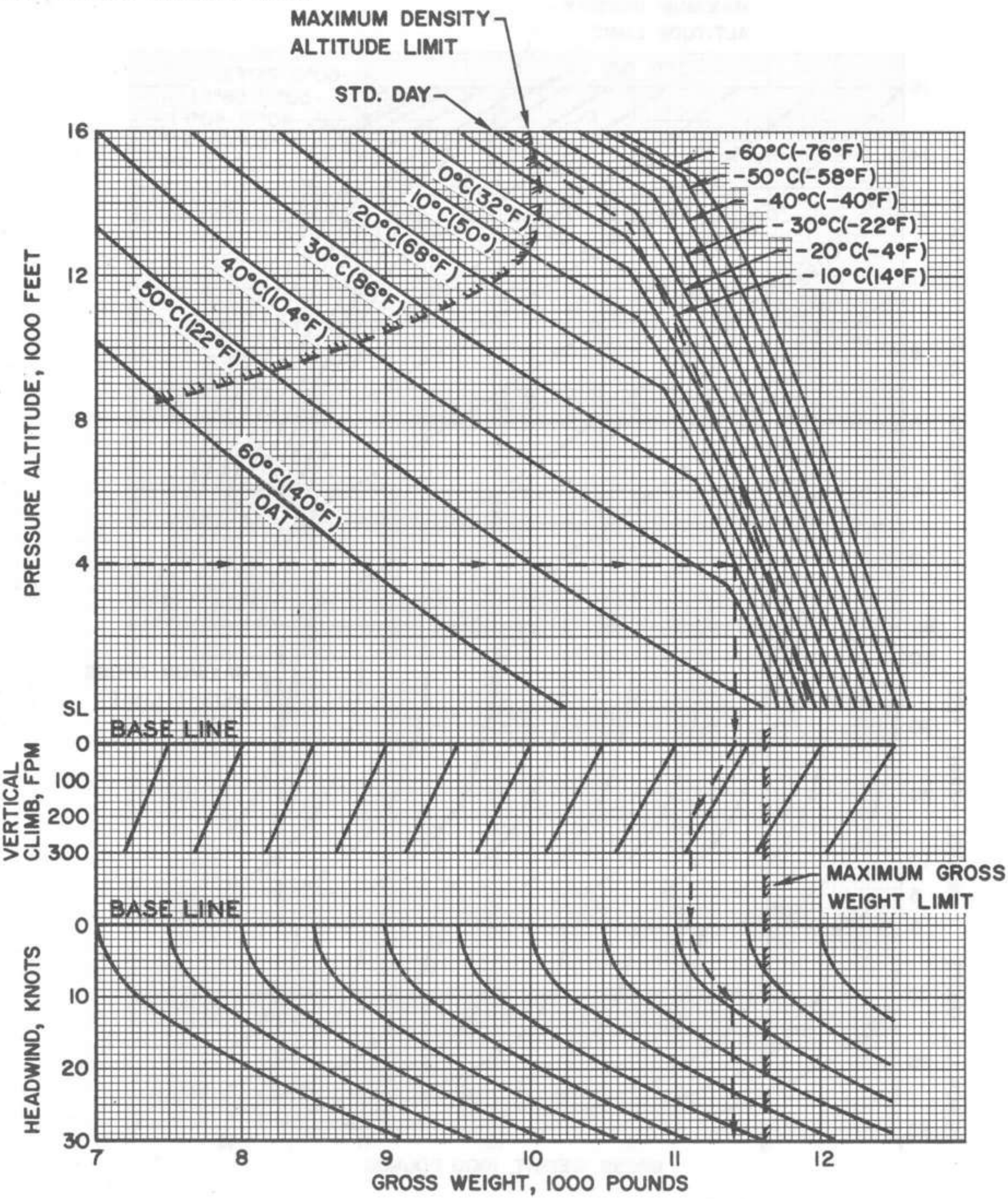


Figure 11–6

Maximum Gross Weight For Vertical Takeoff

MODEL: UH-2C
DATE: 1 NOVEMBER 1966
DATA BASIS: FLIGHT TEST

ENGINE: (2) T58-GE-8B
FUEL GRADE: JP-5 & JP-4



BASED ON

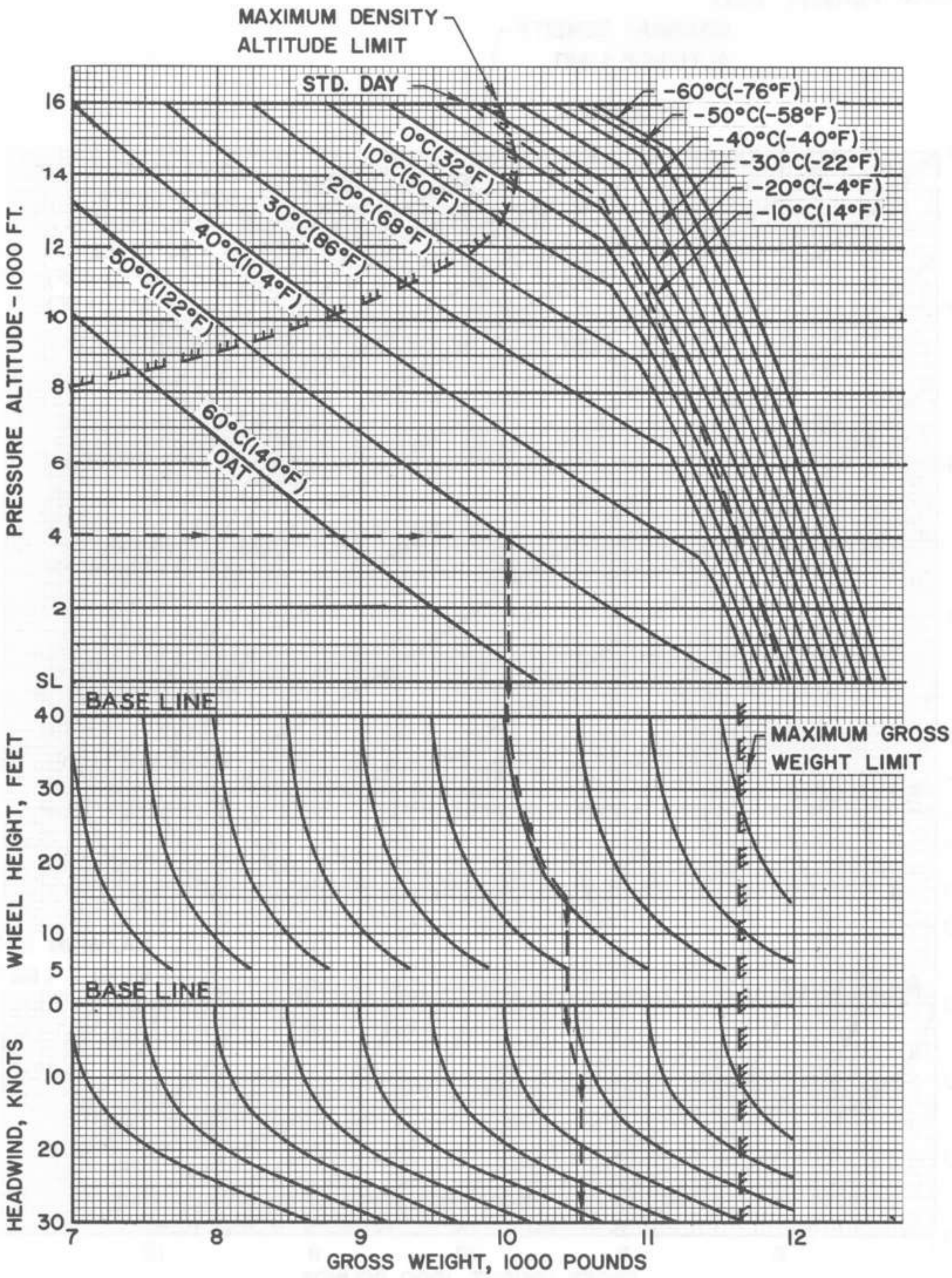
1. MILITARY POWER OR MAXIMUM TORQUE LIMIT
2. 102% ROTOR RPM

Figure 11—7

Maximum Gross Weight for Hovering

MODEL: UH-2C
DATE: 1 NOVEMBER 1966
DATA BASIS: FLIGHT TEST

ENGINE: (2) T58-GE-8
FUEL GRADE: JP-5 & JP-4



BASED ON

1. MILITARY POWER OR MAXIMUM TORQUE LIMIT
2. 102% ROTOR RPM

Figure 11–8

Climb At Maximum Continuous Torque

MODEL: UH-2C
DATE: 1 NOVEMBER 1966
DATA BASIS: FLIGHT TEST

ENGINES: (2) T58-GE-8
FUEL GRADE: JP-5 & JP-4

GROSS WEIGHT: 11,500 POUNDS

DENSITY ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
12	65	1140	9	190
10	65	1250	8	164
8	65	1290	6	139
6	65	1330	5	114
4	65	1360	3	89
2	65	1390	2	64
SL	65	1410	0	38

GROSS WEIGHT: 10,500 POUNDS

DENSITY ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
14	62	1410	9	181
12	62	1520	7	160
10	62	1590	6	140
8	62	1620	5	120
6	62	1640	4	100
4	62	1650	2	80
2	62	1660	1	59
SL	62	1670	0	38

GROSS WEIGHT: 9500 POUNDS

DENSITY ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
14	59	1810	7	159
12	59	1870	6	142
10	59	1910	5	125
8	59	1930	4	108
6	59	1950	3	92
4	59	1950	2	74
2	59	1940	1	52
SL	59	1930	0	38

GROSS WEIGHT: 8500 POUNDS

DENSITY ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
14	56	2160	7	143
12	56	2180	6	128
10	56	2210	5	114
8	56	2230	4	99
6	56	2240	3	85
4	56	2240	2	70
2	56	2230	1	54
SL	56	2200	0	38

REMARKS:
1. Use maximum continuous torque.
2. Use 102% rotor speed.
3. Fuel includes 38 pounds for warmup and takeoff.

Figure 11–9

Best Range

MODEL: UH-2C
DATE: 1 JANUARY 1967
DATA BASIS: FLIGHT TEST

ENGINES: (2) T58-GE-8
FUEL GRADE: JP-5 & JP-4

GROSS WEIGHT LB	PRESS. ALTITUDE FT	TOTAL FUEL FLOW LB/HR	SPEED, CAS KNOTS	AIR RANGE — NAUTICAL MILES: 2600 LB FUEL	2400 LB FUEL	2200 LB FUEL	2000 LB FUEL	1800 LB FUEL	1600 LB FUEL	1400 LB FUEL	1200 LB FUEL	1000 LB FUEL	800 LB FUEL	600 LB FUEL	400 LB FUEL	200 LB FUEL
11500	6	857	107	356	328	301	274	246	219	192	164	137	109	82	55	27
	5	917	114	349	322	295	268	242	215	188	161	134	107	80	54	27
	4	980	121	341	315	289	262	236	210	184	157	131	105	79	52	26
	3	1017	124	332	307	281	256	230	204	179	153	128	102	77	51	26
	2	1040	126	325	300	275	250	225	200	175	150	125	100	75	50	25
	1	1063	128	318	294	269	245	220	196	171	147	122	98	73	49	24
	S.L.	1084	130	311	287	263	239	215	191	167	144	120	96	72	48	24
10500	10	718	95	400	369	338	308	277	246	215	185	154	123	92	61	31
	8	820	108	386	356	327	297	267	238	208	178	149	119	89	59	30
	6	916	119	369	341	312	284	255	227	199	170	142	114	85	57	28
	5	935	121	361	334	306	278	250	222	195	167	139	111	83	56	28
	4	959	122	352	325	298	271	244	217	190	163	136	108	81	54	27
	3	981	124	345	318	292	265	239	212	186	159	133	106	80	53	27
	2	1005	126	336	310	284	259	233	207	181	155	129	103	78	52	26
	1	1029	128	328	303	278	253	227	202	177	152	126	101	76	51	25
	S.L.	1053	130	321	296	272	247	222	198	173	148	124	99	74	49	25
9500	10	790	110	421	389	356	324	292	259	227	194	162	130	97	65	32
	8	842	115	401	371	340	309	278	247	216	185	154	124	93	62	31
	6	880	119	384	354	325	295	266	236	207	177	148	118	89	59	30
	5	900	121	375	347	318	289	260	231	202	173	144	116	87	58	29
	4	922	122	367	338	310	282	254	226	197	169	141	113	85	56	28
	3	942	124	359	331	304	276	248	221	193	166	138	110	83	55	28
	2	971	126	348	321	295	268	241	214	187	161	134	107	80	54	27
	1	997	128	339	313	287	261	235	209	183	156	130	104	78	52	26
	S.L.	1021	130	331	306	280	255	229	204	178	153	127	102	76	51	25
8500	10	767	112	441	407	373	339	305	271	237	203	170	136	102	68	34
	8	810	115	417	385	353	321	289	257	225	193	161	128	96	64	32
	6	850	119	398	367	336	306	275	245	214	183	153	122	92	61	31
	5	870	121	388	359	329	299	269	239	209	179	149	120	90	60	30
	4	893	122	379	349	320	291	262	233	204	175	146	116	87	58	29
	3	916	124	369	341	312	284	255	227	199	170	142	114	85	57	28
	2	942	126	359	331	304	276	248	221	193	166	138	110	83	55	28
	1	967	128	349	323	296	269	242	215	188	161	134	108	81	54	27
	S.L.	995	130	340	313	287	261	235	209	183	157	131	104	78	52	26

REMARKS: 1. When flying with external fuel tanks or fishpole installed, decrease speed by 5 knots, and decrease range by 4 percent. With both installed decrease speed by 10 knots, and range by 8 percent.
2. Use 102 percent rotor rpm throughout.

Figure 11—10

Range At Maximum Airspeed

MODEL: UH-2C
DATE: 1 JANUARY 1967
DATA BASIS: FLIGHT TEST

ENGINES: (2) T58-GE-8
FUEL GRADE: JP-5 & JP-4

GROSS WEIGHT LB	PRESS. ALTITUDE FT	TOTAL FUEL FLOW LB/HR	SPEED, CAS KNOTS	AIR RANGE — NAUTICAL MILES 2600 LB FUEL	2400 LB FUEL	2200 LB FUEL	2000 LB FUEL	1800 LB FUEL	1600 LB FUEL	1400 LB FUEL	1200 LB FUEL	1000 LB FUEL	800 LB FUEL	600 LB FUEL	400 LB FUEL	200 LB FUEL
11500	12	715	67	292	269	247	224	202	180	157	135	112	90	67	45	22
	10	721	80	336	310	284	258	232	207	181	155	129	103	77	52	26
	8	770	93	356	328	301	274	246	219	192	164	137	109	82	55	27
	6	857	107	356	328	301	274	246	219	192	164	137	109	82	55	27
	5	917	114	349	322	295	268	242	215	188	161	134	107	80	54	27
	4	980	121	341	315	289	262	236	210	184	157	131	105	79	52	26
	3	1039	126	330	305	280	254	229	203	178	153	127	102	76	51	25
	2	1054	128	324	299	274	249	224	199	174	150	125	100	75	50	25
	1	1069	129	317	293	269	244	220	195	171	147	122	98	73	49	24
	S.L.	1084	130	311	287	263	239	215	191	167	144	120	96	72	48	24
10500	14	640	69	347	320	293	267	240	213	187	160	133	107	80	53	27
	12	664	82	385	356	326	296	267	237	207	178	148	118	89	59	30
	10	718	95	400	369	338	308	277	246	215	185	154	123	92	61	31
	8	820	108	386	356	327	297	267	238	208	178	149	119	89	59	30
	6	942	121	367	338	310	282	254	226	197	169	141	113	85	56	28
	5	1011	128	354	327	300	272	245	218	191	163	136	109	82	54	27
	4	1024	129	348	321	294	267	241	214	187	160	134	107	80	53	27
	3	1039	130	340	314	288	262	235	209	183	157	131	105	78	52	26
	2	1054	131	333	307	282	256	231	205	179	154	128	102	77	51	26
	1	1069	132	326	301	276	251	226	200	175	150	125	100	75	50	25
	S.L.	1084	133	319	294	270	245	221	196	172	147	123	98	74	49	25

REMARKS: 1. When flying with external fuel tank or fishpole installed, decrease speed by 5 knots, and decrease range by 4 percent. With both installed decrease speed by 10 knots, and range by 8 percent.
2. Use 102 percent rotor rpm throughout.

Figure 11—11 (Sheet 1)

Range At Maximum Airspeed

MODEL: UH-2C
DATE: 1 JANUARY 1967
DATA BASIS: FLIGHT TEST

AIRSPEED LIMITED BY MAXIMUM CONTINUOUS TORQUE OR BY AIRSPEED LIMITATION PER FIG. 11-6

ENGINES: (2) T58-GE-8
FUEL GRADE: JP-5 & JP-4

				AIR RANGE — NAUTICAL MILES												
GROSS WEIGHT LB	PRESS. ALTITUDE FT	TOTAL FUEL FLOW LB/HR	SPEED, CAS KNOTS	2600 LB FUEL	2400 LB FUEL	2200 LB FUEL	2000 LB FUEL	1800 LB FUEL	1600 LB FUEL	1400 LB FUEL	1200 LB FUEL	1000 LB FUEL	800 LB FUEL	600 LB FUEL	400 LB FUEL	200 LB FUEL
9500	14	610	85	448	414	379	345	310	276	241	207	172	138	103	69	34
	12	685	97	444	410	376	342	308	273	239	205	171	137	102	68	34
	10	790	110	421	389	356	324	292	259	227	194	162	130	97	65	32
	8	910	122	395	365	334	304	273	243	213	182	152	122	91	61	30
	6	997	130	371	342	314	285	257	228	200	171	143	114	86	57	29
	5	1011	131	364	336	308	280	252	224	196	168	140	112	84	56	28
	4	1024	132	356	329	302	274	247	219	192	165	137	110	82	55	27
	3	1039	133	349	322	295	268	242	215	188	161	134	107	81	54	27
	2	1054	134	341	315	289	262	236	210	184	157	131	105	79	52	26
	1	1069	135	334	308	282	257	231	205	180	154	128	103	77	51	26
	S.L.	1084	136	326	301	276	251	226	201	176	151	126	100	75	50	25
8500	14	665	101	489	451	414	376	338	301	263	226	188	150	113	75	38
	12	775	113	454	419	384	349	314	280	245	210	175	140	105	70	35
	10	885	124	426	394	361	328	295	262	230	197	164	131	98	66	33
	8	972	131	394	364	334	303	273	243	212	182	152	121	91	61	30
	6	997	133	379	350	321	292	263	233	204	175	146	117	88	58	29
	5	1011	134	372	343	314	286	257	229	200	171	143	114	86	57	29
	4	1024	135	364	336	308	280	252	224	196	168	140	112	84	56	28
	3	1039	136	356	329	302	274	247	219	192	165	137	110	82	55	27
	2	1054	137	349	322	295	268	241	215	188	161	134	107	80	54	27
	1	1069	138	341	315	288	262	236	210	184	157	131	105	79	52	26
	S.L.	1084	139	333	308	282	256	231	205	179	154	128	103	77	51	26

REMARKS: 1. When flying with external fuel tanks or fishpole installed, decrease speed by 5 knots, and decrease range by 4 percent. With both installed decrease speed by 10 knots, and range by 8 percent.
2. Use 102 percent rotor rpm throughout.

Figure 11—11 (Sheet 2)

Maximum Endurance

MODEL: UH-2C
DATE: 1 JANUARY 1967
DATA BASIS: FLIGHT TEST

STANDARD DAY

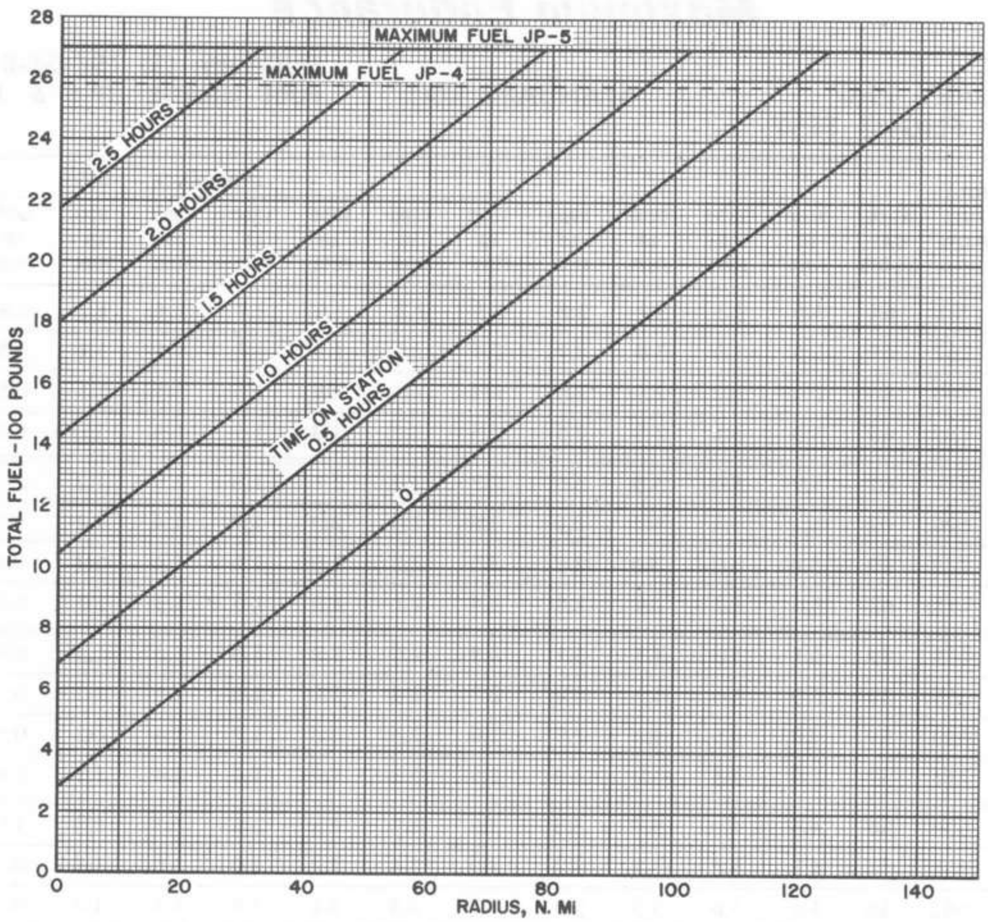
ENGINES: (2) T58-GE-8
FUEL GRADE: JP-5 & JP-4

GROSS WEIGHT LB	PRESS. ALTITUDE FT	TOTAL FUEL FLOW LB/HR	SPEED, CAS KNOTS	ENDURANCE — HOURS 2600 LB FUEL	2400 LB FUEL	2200 LB FUEL	2000 LB FUEL	1800 LB FUEL	1600 LB FUEL	1400 LB FUEL	1200 LB FUEL	1000 LB FUEL	800 LB FUEL	600 LB FUEL	400 LB FUEL	200 LB FUEL
11500	6000	721	65	3.6	3.3	3.1	2.8	2.5	2.2	1.9	1.7	1.4	1.1	0.8	0.6	0.3
	4000	737	65	3.5	3.3	3.0	2.7	2.4	2.2	1.9	1.6	1.4	1.1	0.8	0.5	0.3
	2000	760	65	3.4	3.2	2.9	2.6	2.4	2.1	1.8	1.6	1.3	1.1	0.8	0.5	0.3
	S.L.	788	65	3.3	3.1	2.8	2.5	2.3	2.0	1.8	1.5	1.3	1.0	0.8	0.5	0.3
10500	6000	671	62	3.9	3.6	3.3	3.0	2.7	2.4	2.1	1.8	1.5	1.2	0.9	0.6	0.3
	4000	696	62	3.7	3.4	3.2	2.9	2.6	2.3	2.0	1.7	1.4	1.1	0.9	0.6	0.3
	2000	728	62	3.6	3.3	3.0	2.7	2.5	2.2	1.9	1.6	1.4	1.1	0.8	0.5	0.3
	S.L.	757	62	3.4	3.2	2.9	2.6	2.4	2.1	1.8	1.6	1.3	1.1	0.8	0.5	0.3
9500	6000	635	59	4.1	3.8	3.5	3.1	2.8	2.5	2.2	1.9	1.6	1.3	0.9	0.6	0.3
	4000	665	59	3.9	3.6	3.3	3.0	2.7	2.4	2.1	1.8	1.5	1.2	0.9	0.6	0.3
	2000	690	59	3.8	3.5	3.2	2.9	2.6	2.3	2.0	1.7	1.4	1.2	0.9	0.6	0.3
	S.L.	722	59	3.6	3.3	3.0	2.8	2.5	2.2	1.9	1.6	1.4	1.1	0.8	0.6	0.3
8500	6000	600	56	4.3	4.0	3.7	3.3	3.0	2.7	2.3	2.0	1.7	1.3	1.0	0.7	0.3
	4000	631	56	4.1	3.8	3.5	3.2	2.9	2.5	2.2	1.9	1.6	1.3	0.9	0.6	0.3
	2000	662	56	3.9	3.6	3.3	3.0	2.7	2.4	2.1	1.8	1.5	1.2	0.9	0.6	0.3
	S.L.	695	56	3.7	3.4	3.2	2.9	2.6	2.3	2.0	1.7	1.4	1.1	0.9	0.6	0.3

REMARKS:
Use 102% rotor speed.

Figure 11—12

Fuel vs. Rescue Distance



BASED ON

1. 1000 LB/HR FUEL FLOW WHEN AT 125 KNOT CRUISE
2. 750 LB/HR FUEL FLOW WHEN ON STATION AT SPEED FOR BEST ENDURANCE
3. NO WIND
4. 300 POUND FUEL RESERVE AT ETA

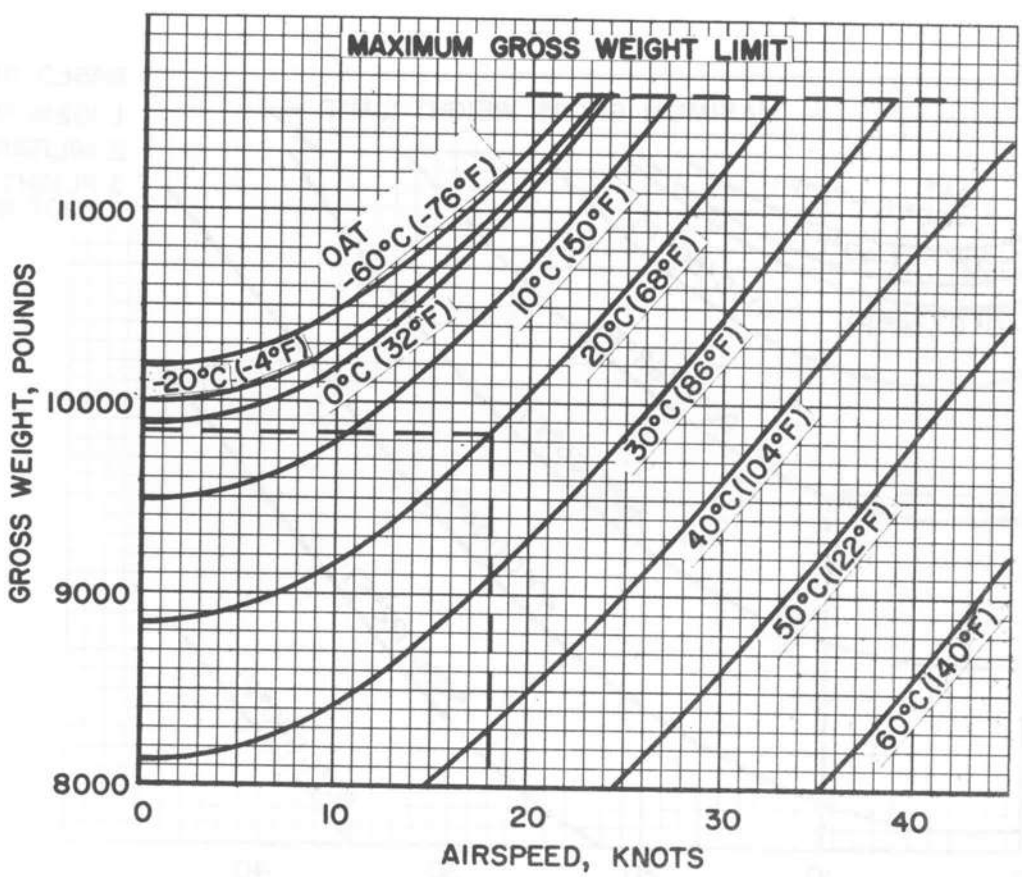
Figure 11—13

Minimum Airspeed For Flight With One Engine

OUT OF GROUND EFFECT
SEA LEVEL

MODEL: UH-2C
DATE: 1 NOVEMBER 1966
DATA BASIS: ESTIMATED

ENGINE: (1) T58-GE-8
FUEL: JP-4 & JP-5



BASED ON
1. 102% ROTOR RPM
2. MILITARY POWER
3. OUT OF GROUND EFFECT

Figure 11—14

Minimum Airspeed For Flight With One Engine

IN GROUND EFFECT
SEA LEVEL

MODEL: UH-2C
DATE: 1 NOVEMBER 1966
DATA BASIS: ESTIMATED

ENGINE: (1) T58-GE-8
FUEL: JP-4 & JP-5

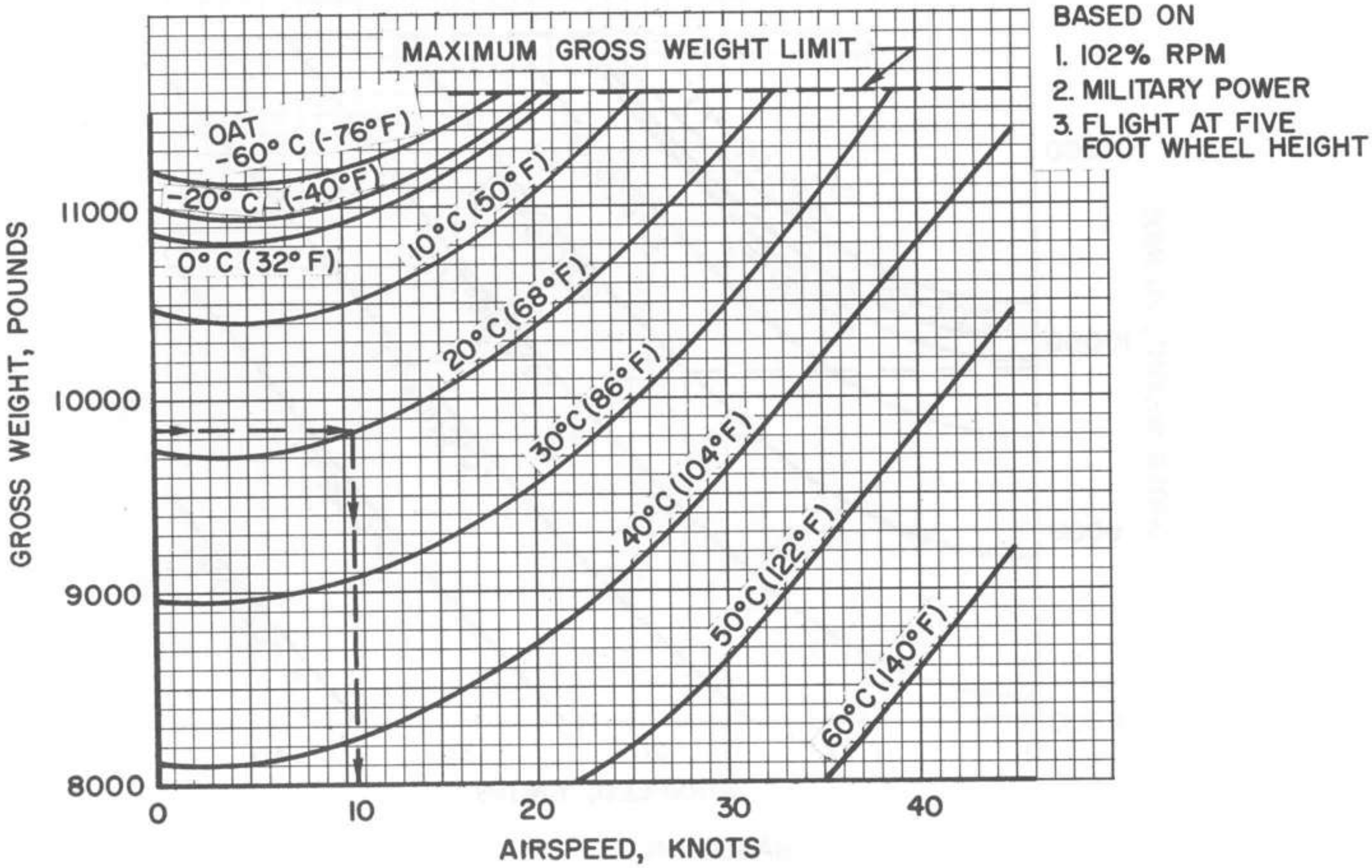


Figure 11—15

Climb With One Engine

MODEL: UH-2C
DATE: 1 NOVEMBER 1966
DATA BASIS: FLIGHT TEST

STANDARD DAY

ENGINES: (1) T58-GE-8
FUEL GRADE: JP-4 & JP-5

GROSS WEIGHT: 11,500 POUNDS

ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
8	65	90	21	254
6	65	310	11	151
4	65	500	6	96
2	65	660	3	56
SL	65	780	0	22

GROSS WEIGHT: 10,500 POUNDS

ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
10	62	200	17	210
8	62	420	11	148
6	62	610	7	108
4	62	780	5	75
2	62	910	2	48
SL	62	1010	0	22

GROSS WEIGHT: 9500 POUNDS

ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
10	59	550	11	143
8	59	730	8	112
6	59	890	6	87
4	59	1040	4	64
2	59	1150	2	42
SL	59	1240	0	22

GROSS WEIGHT: 8500 POUNDS

ALTITUDE 1000 FEET	CAS KNOTS	CLIMB RATE FPM	FROM SL TIME MINUTES	FROM SL FUEL POUNDS
10	56	870	8	114
8	56	1040	6	94
6	56	1190	5	75
4	56	1310	3	57
2	56	1390	2	40
SL	56	1440	0	22

REMARKS:

1. Use of military power 102% rotor speed.
2. Fuel includes 22 pounds for warmup and takeoff.
3. Subtract (or add) 250 fpm per 10°C increase (or decrease) in OAT below (or above) standard.
4. Based on engine manufacturer's specification military power.

Figure 11—16

Range With One Engine

MODEL: UH-2C
DATE: 1 JANUARY 1967
DATA BASIS: FLIGHT TEST

ENGINE: (1) T58-GE-8
FUEL GRADE: JP-5 & JP-4

GROSS WEIGHT LB	PRESS. ALTITUDE FT	TOTAL FUEL FLOW LB/HR	SPEED, CAS KNOTS	AIR RANGE — NAUTICAL MILES												
				2600 LB FUEL	2400 LB FUEL	2200 LB FUEL	2000 LB FUEL	1800 LB FUEL	1600 LB FUEL	1400 LB FUEL	1200 LB FUEL	1000 LB FUEL	800 LB FUEL	600 LB FUEL	400 LB FUEL	200 LB FUEL
11500	6	646	95	421	388	356	324	291	259	227	194	162	129	97	65	32
	5	666	99	418	386	354	321	289	257	225	193	161	129	96	64	32
	4	688	102	410	378	347	315	284	252	221	189	158	126	95	63	32
	3	708	105	403	372	341	310	279	248	217	186	155	124	93	62	31
	2	725	108	398	367	337	306	276	245	214	184	153	122	92	61	31
	1	747	110	390	360	330	300	270	240	210	180	150	120	90	60	30
	S.L.	765	113	384	354	325	295	266	236	207	177	148	118	89	59	30
10500	10	566	86	463	427	391	356	320	285	249	213	178	142	107	71	36
	8	606	95	461	425	390	354	319	284	248	213	177	142	106	71	35
	6	646	101	447	412	378	344	309	275	241	206	172	137	103	69	34
	5	666	104	439	405	372	338	304	270	236	203	169	135	101	68	34
	4	688	107	430	397	364	331	298	264	231	198	165	132	99	66	33
	3	708	110	421	389	357	324	292	259	227	195	162	130	97	65	32
	2	725	112	414	383	351	319	287	255	223	191	159	128	96	64	32
	1	747	115	406	374	343	312	281	250	218	187	156	125	94	62	31
	S.L.	765	117	399	368	338	307	276	246	215	184	154	123	92	61	31
9500	10	566	94	505	466	427	389	350	311	272	233	194	155	117	78	39
	8	606	101	488	450	413	375	338	300	263	225	188	150	113	75	38
	6	646	106	469	432	396	360	324	288	252	216	180	144	108	72	36
	5	666	109	458	423	387	352	317	282	247	211	176	141	106	70	35
	4	688	111	447	412	378	344	309	275	241	206	172	137	103	69	34
	3	708	114	437	403	370	336	303	269	235	202	168	134	101	67	34
	2	725	116	430	396	363	330	297	264	231	198	165	132	99	66	33
	1	747	119	419	387	355	323	290	258	226	194	161	129	97	65	32
	S.L.	765	121	411	380	348	316	285	253	221	190	158	127	95	63	32
8500	10	566	99	532	491	450	409	368	327	286	246	205	164	123	82	41
	8	606	105	509	470	431	391	352	313	274	235	196	157	117	78	39
	6	646	110	486	448	411	374	336	299	262	224	187	149	112	75	37
	5	666	113	474	438	401	365	328	292	255	219	182	146	109	73	36
	4	688	115	462	426	391	355	320	284	249	213	178	142	107	71	36
	3	708	117	451	416	381	347	312	277	243	208	173	139	104	69	35
	2	725	120	442	408	374	340	306	272	238	204	170	136	102	68	34
	1	747	122	430	397	364	331	298	265	232	199	166	132	99	66	33
	S.L.	765	124	421	389	357	324	292	259	227	195	162	130	97	65	32

REMARKS: 1. When flying with external fuel tanks or fishpole installed, decrease speed by 5 knots, and decrease range by 4 percent. With both installed decrease speed by 10 knots, and range by 8 percent.
2. Use 102 percent rotor rpm throughout.

Figure 11—17

Autorotation Gliding Distance

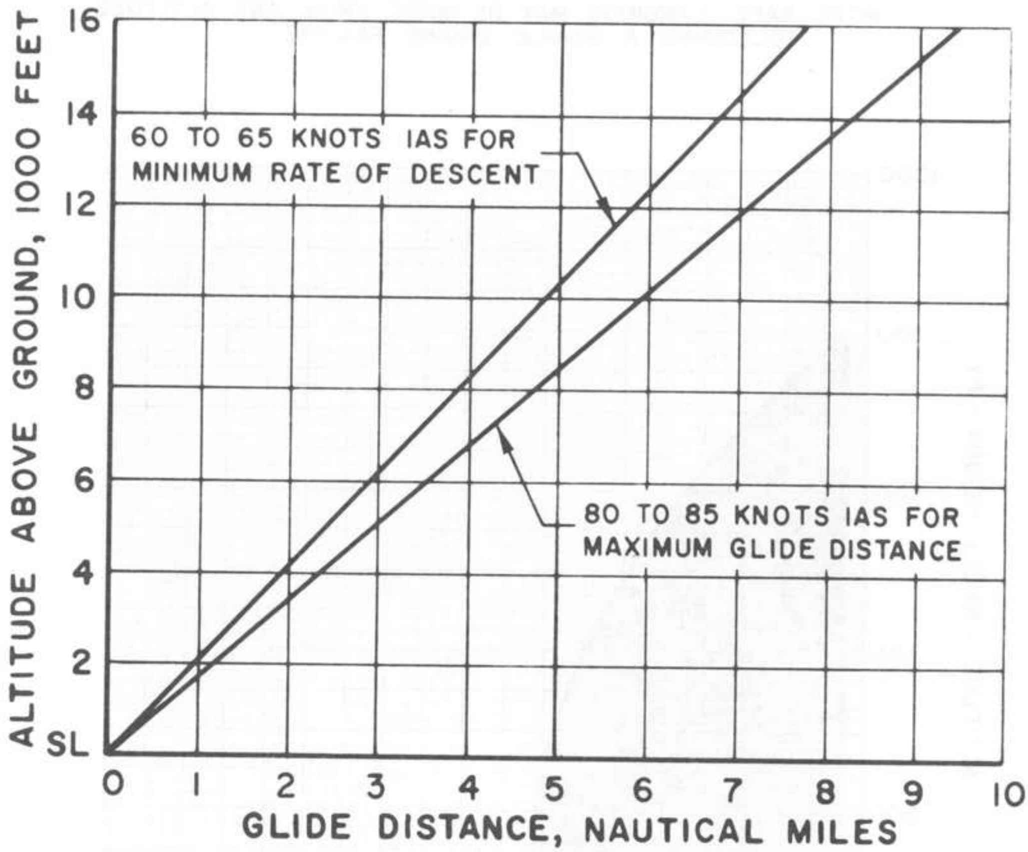
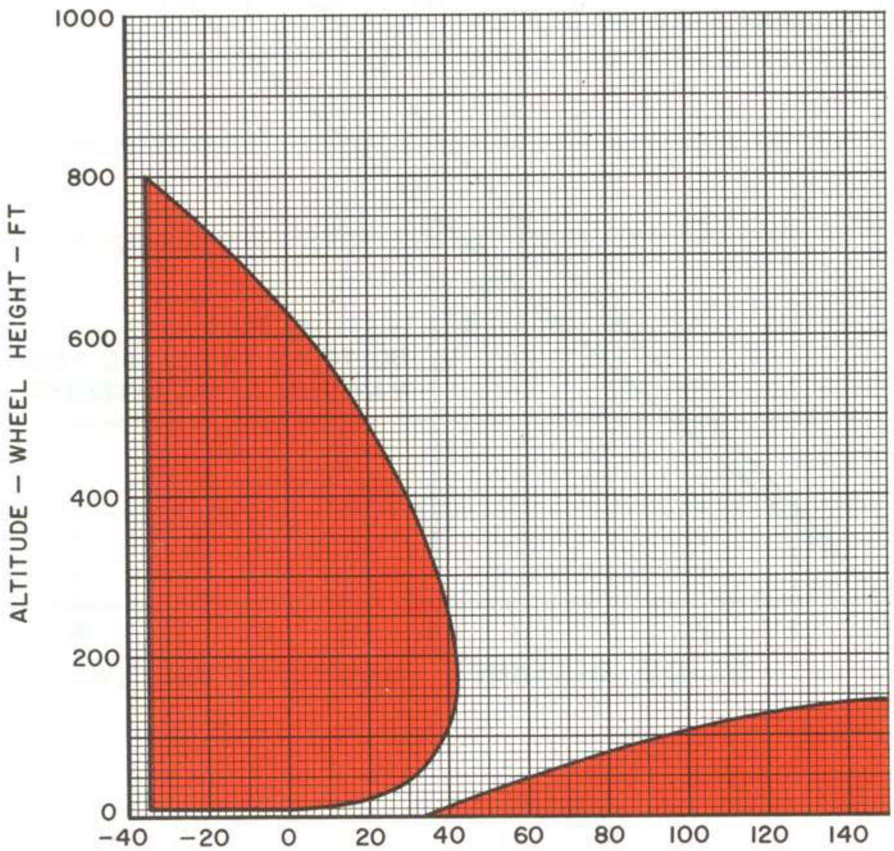


Figure 11—18

Minimum Height for Safe Landing After Dual Engine Failure

10,000 POUNDS GROSS WEIGHT, STANDARD DAY, SEA LEVEL

NOTE: SAFE LANDINGS MAY BE MADE FROM ANY ALTITUDE FOLLOWING A SINGLE ENGINE FAILURE.



BASED ON ONE SECOND DELAY BETWEEN POWER LOSS AND LOWERING COLLECTIVE PITCH

AVOID CONTINUOUS OPERATION

Figure 11—19

Autorotation Chart

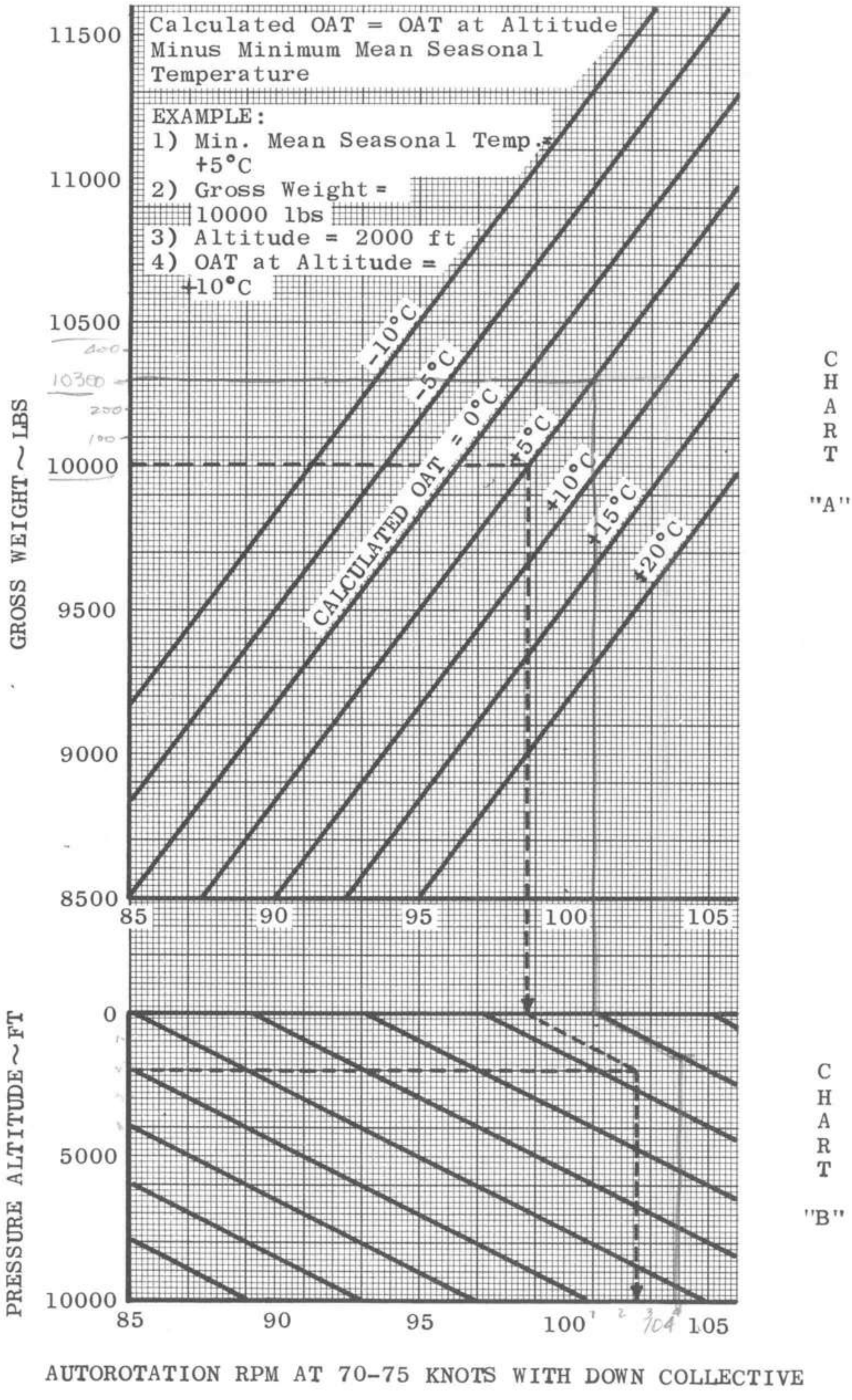


Figure 11—20

APPENDIX

LIST OF SELECTED REFERENCES

NATOPS Instrument Flight Manual LPH NATOPS Manual CVA/CVS NATOPS Manual

NAVSO-P-2455 Series:	Department of the Navy Safety Precautions for Shore Activities
NAVAIR 00-80T-56:	Survival Training Guide
NAVAIR 01-1B-40:	Weight and Balance Manual
NAVAIR 01-260HCA-2 Series:	UH-2C Maintenance Instructions Manual
NAVAIR 02B-105AHB-2:	T58 Turboshaft Engine Intermediate Maintenance Manual

NWP-37: Search and Rescue

NWP-41: Naval Air Operations

NWIP-41-6: Helicopter Operations

NWIP 10-1: Operational Reports

BUPERS Manual: Chapter 7

OPNAVINST 3710.7 Series:	General Flight and Operating Instructions for Naval Aircraft
OPNAVINST 3720.2 Series:	Instrument Flight Requirements
OPNAVINST 3740.6 Series:	Qualifications for Command of Multipiloted Rotary Wing Aircraft
OPNAVINST 4630.10 Series:	Responsibilities and Policies for Movement of Traffic on Other Than MAC Scheduled Aircraft

EXHIBIT A

ALPHABETICAL INDEX

Page

A

AC and DC External Power Receptacles **1-4**, 1-52
AC Power Supply System 1-52
Acceleration Limitations 1-103
Acceptance, Helicopter 3-6
Actuator Control Switch 1-8
ADF Approach **6-3**
Adverse Weather Conditions 4-10
AFC 114, Power Supply After 1-79
AFC 114, Power Supply Before 1-78
AFC 152, Juliet 28 UHF Communications Encoding Equipment 1-61, **1-62**
After Landing 3-13, **3-15**
Aircraft, Before Leaving the 3-13
Aircraft, Commander, Helicopter 2-2
Aircraft Equipment Night and IFR Minimums 4-3
Aircraft Fueling and Servicing 1-92
Aircraft Rescue Equipment, Special 2-8
Aircraft Servicing 1-92
Aircrew Currency Requirements 2-2
Aircrew Grading Items, NATOPS 10-3
Aircrew NATOPS Evaluation Report 10-17
Aircrew Qualifications 2-2
Aircrewman Ground Training 2-1
Aircrewman, Helicopter 2-2
Aircrewman, Rescue, Helicopter 2-2
Airspeed, Calibrated 11-2
Airspeed Corrections 1-91, 11-2
Airspeed Indicator **1-12**, 1-82
Airspeed Limitation Chart 4-3, **11-12**
Airspeed Limitations 1-102
Airspeed Limits **1-100**, 1-102, **11-12**
Airspeed Pitot System 1-84
All Weather Operation 6-1
Alternate Approach 3-30
Alternating Current External Power Receptacle 1-53
Alternating Current Power Supply System 1-52
Altimeter, Radar **1-12**, 1-75, **1-76**
Altitude Control Button and Annunciator 1-27
Altitude, Density 3-2, 11-2, **11-7**
Altitude, High Effects of 4-9
Altitude Limitation 1-106
Altitude, Pressure 11-2

Page

AN/AIC-14 Intercommunication System **1-55**, 1-55
AN/ALQ-98 Electronic Countermeasure System (AFC 157) 1-77
AN/ALQ-98 Panel **1-78**
AN/APA-89 SIF Coder Group 1-67
AN/APN-117 Radar Altimeter 1-75, **1-76**
AN/APN-130 Radar Groundspeed Panel 1-69, **1-72**
AN/APN-130 Radar Navigation Set 1-69
AN/APQ-107 Radar Altimeter Warning Set 1-76
AN/APX-6B Radar Identification Set 1-67
AN/ARA-25A Direction Finder Group 1-59
AN/ARC-39 HF Communications System 1-63
AN/ARC-39 HF Radio Panel **1-63**
AN/ARC-52X UHF Communications System 1-59
AN/ARC-52X UHF Radio Panel **1-61**
AN/ARN-21 TACAN 1-65
AN/ARN-52 TACAN 1-65
AN/ARN-59 Automatic Direction Finder Receiver 1-63, **1-64**
AN/ARN-59 Radio Panel **1-64**
AN/ASA-13A Computer Group 1-73
AN/ASA-13A Computer Panel **1-73**
Annunciator, Altitude Control 1-27
Annunciator, Blade Track 1-30
Antennas **1-56**
Anti-Collision Lights and Switches 1-78
Anti-Ice Switch, Windshield 1-91
Anti-Ice Switch, Turbine 1-11
Anti-Ice System, Windshield 1-90
Anti-Ice, Turbine, Check 3-16
APN-130 and ASA-13A Check 3-17
Appendix A-1
Approach, ADF **6-3**
Approach, Alternate 3-30
Approach, Crosswind 4-7
Approach, Doppler 3-28, **3-29**
Approach, Emergency RPM Control 5-4
Approach, GCA **6-4**
Approach, Manual 3-30
Approach, Mirror/Optical Landing System 3-35
Approach, No-Doppler 3-29

Pag

Approach, Normal 3-2
Approach, Precision 3-26, **3-2**
Approach, Radar 6-
Approach, Radio Range 6-
Approach, Ridgeline **4-**
Approaches, Hover and Climbout, Rescue Pattern 3-2
Approaches, Instrument 6-
Arming Switch 1-8
Arrangement, General **1-**
ASA-13A and APN-130 Check 3-1
ASE 1-2
ASE Block Diagram **1-2**
ASE Check 3-1
ASE Controls **1-2**
ASE Disengage Button 1-2
ASE Engage Switch 1-2
Attaching Wire Clamp 1-9
Attitude Indicator, Remote (RAI) 1-8
Attitudes, Unusual 6-
Auto Track Reset Button 1-3
Automatic Blade Track Caution Light 1-30, 5-1
Automatic Direction Finder Receiver, AN/ARN-59 1-6
Automatic Sling Release Switch 1-8
Automatic Stabilization Equipment (ASE) 1-23, 3-1
Autorotation Chart **11-2**
Autorotation Check 4-
Autorotation Entry, High Speed, Procedure for 3-2
Autorotation Gliding Distance 5-5, **11-2**
Autorotation, Hooded 6-
Autorotation Landing, Full Flare 5-
Autorotation Landing, Night and Instrument 5-
Autorotation Landing, Running 5-
Autorotation, Practice 3-2
Autorotation Procedure, Normal Practice 3-22, **3-2**
Autorotation Procedure, Practice Instrument 3-2
Autorotational Characteristics 4-
Autorotations 3-2
Auxiliary Battery 1-5
Auxiliary Fuel Tank Jettison Handle 1-3
Auxiliary Fuel Tanks, External, Flight with 4-
Auxiliary Fuel Tanks, Jettisoning 5-

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Auxiliary Tanks Fuel 1-39

B

Bailout 5-10
Bank Angles Limitations 1-103
Barometric Altitude Switch 1-25
Battery (inside nose doors) **1-4**
Battery 1-53
Battery Starting Procedure 3-10
Battery Switch 1-54
Beach or Desert Operations 6-9
Bearing, Distance, Heading Indicator 1-60
Beat Frequency Oscillator Switch 1-64
Before Landing 3-13, **3-15**
Before Leaving the Aircraft 3-13
Before Leaving the Helicopter 6-8
Before Starting Engine 3-9, **3-14**
Before Takeoff 3-12, **3-14**
Before Taxiing 3-12
Best Range Chart 11-4, **11-16**
BFO Operation 1-64
BFO Switch 1-64
Blade Flaps **1-4**
Blade Folding and Spreading 3-32, 3-38
Blade Track Annunciator 1-30
Blade Track Caution Light On, Automatic 5-13
Blade Track Panel **1-31**
Blade Tracking and Ground Checks 4-4
Blade Tracking System 1-29
Board, Plotting 1-91
Boom Control (Fishpole) 1-37
Boost Check 3-16
Boost Off Flight 4-3
Boost Release Button 1-25
Both Generator Caution Lights On 5-13
Brake Handle, Parking 1-38
Brake Pedals 1-38
Brake Rotor 1-19
Brake System 1-38
Briefing 3-4, 4-18
Briefing/Debriefing 3-4
Briefing Format 3-4, 4-18
Button, Altitude Control **1-26**, 1-27
Button, ASE Disengage **1-26**, 1-28
Button, Auto Track Reset 1-30
Button, Boost Release 1-25, **1-26**
Button, Coordinated Turn 1-25, **1-26**
Button, Downlock Override 1-33
Button, Drop 1-87
Button, Fishpole Emergency Extend **1-35**
Button, Master Caution Light Reset 1-82
Button, RAI Gyro Erection 1-83
Buttons, Rotor Brake Interlock Override 1-8, **1-9**

C

C Blade and D Blade Switches 1-30
Cabin Dimensions **1-86**
Cabin Dome Light and Switch 1-82
Cabin Fire 5-7
Cabin Heating and Ventilating Switch 1-89
Cable Cut Arming Switch **1-35**, 1-35
Cable Cutter 1-35, 9-2
Calibrated Airspeed 11-2
Canteen **1-4**
Canyon, Valley, or Gorge, Wind Flow in and Over **4-11**
Cards, Correction 1-91
Cargo Carrying Equipment, Internal 1-85
Cargo Door **1-4**
Cargo Hook Emergency Release Handle 1-87
Cargo Hook Lights 1-87
Cargo Hook Loads 1-104
Cargo Hook System 1-85
Cargo Hook, Typical **1-87**
Cargo, Internal Carrying Equipment 1-85
Cargo, Jettisoning 5-8
Cargo Operations 9-2
Carrier-Based Procedures 3-32
Case, Data 1-91
Casualty Carrying Equipment 1-85
Caution Light and Test Bar, Master 1-82
Caution Light, Automatic Blade Track 1-30, 5-13
Caution Light, Compressor Pressure 1-40, 5-13
Caution Light, Converter 1-53, 5-12
Caution Light, Emergency Pump 1-40, 5-13
Caution Light, Engine Chip Detector 1-18, 5-12
Caution Light, Engine Oil Pressure 1-16, 5-12
Caution Light, Fuel, 30 Minute 1-45
Caution Light, Fuel Boost 1-40, 5-13
Caution Light, Fuel Bypass 1-41, 5-13
Caution Light, Fuel Low 1-44
Caution Light, Fuel Transfer 1-39, 5-13
Caution Light, Gearbox Chip Detector 1-19, 5-12
Caution Light, Hydraulic Pressure 1-33, 5-12
Caution Light, Master 1-82, 5-12
Caution Light, Number One Generator 1-52, 5-12
Caution Light, Number Two Generator 1-53, 5-12
Caution Light Panel **1-83**
Caution Light, Radar Altimeter (Warning) 1-76
Caution Light Reset Button, Master 1-82
Caution Light, Speed Decreaser Gear Oil Pressure 1-16, 5-12
Caution Light System 1-82
Caution Light, Transmission Oil Pressure 1-19, 5-12
Caution Lights Panel 1-82, **1-83**
Cautions, Notes, and Warnings iii
Ceiling, Cockpit **1-20**
Center of Gravity Limitations 1-104
Certification 2-2
Change Recommendations ii
Change Symbols iii
Characteristics, Autorotational 4-2
Characteristics, Flight 4-1
Charlie Pattern, Modified **6-6**
Chart, Airspeed Limitations 4-3, **11-12**
Chart, Best Range 11-4, **11-16**
Chart, Climb at Maximum Continuous Torque 11-3, **11-15**
Chart, Density Altitude 11-2, **11-7**
Chart, Ditching **5-11**
Chart, Endurance 11-5
Chart, Engine Horsepower-Torquemeter Pressure Conversion 11-3, **11-9**
Chart, Engine Operating Limits 11-5, **11-21**, **11-22**
Chart, Fuel Flow 11-2, **11-8**
Chart, Fuel vs. Rescue Distance **11-20**
Chart, Maximum Endurance 11-5, **11-19**
Chart, Maximum Gross Weight for Hovering 11-3, **11-14**
Chart, Maximum Gross Weight for Vertical Takeoff 11-3, **11-13**
Chart, Topping **11-11**
Charts, Flight 11-2
Check, APN-130 and ASA-13A 3-17
Check, ASE 3-16
Check, Boost 3-16
Check, Cyclic Trim 3-16
Check, Fuel Quantity 3-16
Check, In-flight RAD ALT Hold 3-17
Check, Systems 3-16
Check, Yaw Trim 3-16
Checklist 1-91, **3-14**, **3-15**
Checklist, Shipboard Operational, Day VFR Only **3-15**
Chip Detector Caution Light 1-18, 5-12
Circuit Breaker and Fuse Panel **1-50**, **1-51**
Clearance, Minimum Ground **1-95**
Climb at Maximum Continuous Torque 11-3, **11-15**
Climb Chart for Single Engine Operation 11-5, **11-23**
Climb, Instrument 6-2, 6-5
Climbout 3-31
Climbout, Doppler 3-30
Climbout, Manual 3-30
Climbout Procedures 3-20
Climbout, Rescue Pattern, Approaches, Hover and 3-27
Closed Book Examination, NATOPS 10-3
Cockpit Ceiling **1-20**
Cockpit Lights and Rheostats 1-82
Cockpit Preflight **3-14**
Coder Group (SIF) AN/APA-89 and Radar Identification Set (IFF) AN/APX-6B) 1-67
Cold Weather Operation 6-7
Collective Pitch Lever 1-22
Collective Pitch Lever Friction Nut 1-22
Collective Pitch Lever Switchbox **1-80**

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Collective Pitch Levers and Quadrant **1-9**
Combat Support Helicopter, Special Problem of the 3-37
Combining Gearbox 1-18
Combining Gearbox or Transmission Oil Pressure Caution Light On 5-12
Commander, Helicopter Aircraft 2-2
Communications 3-39
Communications and Radio Navigation Equipment 1-54, **1-55**
Communications Procedures 7-1
Communications, Radio 7-1
Communications, SAR 7-1
Communications, Visual 7-1
Compartment Diagram **1-5**
Compass Correction Card 1-91
Compass Equipment, MA-1 1-68
Compass Panel, MA-1 .... **1-69**
Compressor 1-40
Compressor Pressure Caution Light 1-40, 5-14
Computer, Navigational 1-73
Computer Panel, AN/ASA-13A **1-73**
Concept, NATOPS Evaluation 10-2
Conditions, Deck 3-34
Conditions, Operating 3-34, 3-37
Conditions Requiring Maintenance Test Flight 4-4
Conduct of Flight 4-17
Cone Switch, Differential 1-31, 5-14
Confined Area, Wind Effect in **4-8**
Considerations, Operating 3-37
Console and Instrument Floodlight and Switches 1-81
Console Lights and Rheostats 1-81
Console, Typical **1-43**
Constant Airspeed Climbs, Descents and Level Offs 6-5
Contamination, Hydraulic System 5-8
Control Inputs, Erratic 5-8
Control Panel, Juliet 28 .... **1-62**
Control Panel, Loud Hailer **1-58**
Control, RPM Emergency 4-6, 5-4
Control System, Engine Fuel and 1-6, **1-7**
Controls, ASE **1-26**
Controls, Flight 1-22
Converter 1-53
Converter Caution Light 1-53, 5-12
Cooler, Transmission Oil 1-19
Coolers, Oil 1-16
Cooling, Engine 1-11
Coordinated Turn Button 1-25
Copilot's Landing Light Switch **1-80**
Copilot's, Pilot's, and Hoist Operator's Grips **1-56**
Correction Cards 1-91
Course Indicator **1-66**
Crew and Mission Provisions 1-2
Crew and Truck 1-92
Crew, Flight Requirements 2-1, 2-3
Crew, Minimum 1-98
Crewman Check Worksheet 10-16
Criteria, Initial Flight Check 2-1
Crosswind Effect on Ridgeline Approach **4-7**
Crosswind Landing 3-20, **3-22**
Crosswind Takeoff 3-18, **3-20**
Crosswind Taxiing 3-12
Cruising, Flight Instrument 6-2
Currency Requirements, Aircrew 2-2
Currency Requirements, Minimum 2-2
Cutter, Cable 9-2
Cyclic Stick 1-23
Cyclic Stick Grips **1-23**
Cyclic Stick Trim Switch 1-23
Cyclic Trim Check 3-16

D

D Blade and C Blade Switches 1-30
Danger Areas **1-97**
Data Case 1-91
Data, Fuel Quantity 1-39
Data, Performance 11-1
Day Launch and Recovery Operations 3-34
Day Operations Patterns 3-35, 3-38
Day-VFR Rescue Pattern Approach and Climbout 3-28
DC Power Supply 1-53
DC Utility Receptacle 1-54, **1-57**
DC Utility Receptacle Fuse **1-57**
Deadman's Curve **11-26**
Debriefing Format 3-4
Deck Conditions 3-34
Deferred Emergencies 5-2
Definition of Terms, NATOPS Evaluation 10-2
Definitions, Flight Test Procedures 4-4
Definitions, NATOPS Evaluation 10-2
Defogging System 1-88
Deice Switch, Rotor 1-89
Deicing System, Rotor 1-89
Density Altitude 3-2, 11-2, **11-7**
Descent 3-20, 6-2
Descent, Emergency 5-8
Descent, Instrument 6-2, 6-5
Description, General 1-2
Desert or Beach Operations 6-9
Diagram, ASE Block **1-24**
Diagram, Compartment **1-5**
Diagram, Servicing **1-93**
Differential Cone Switch 1-31, 5-14
Diffuser Valves 1-89
Dimensions, Cabin **1-86**
Dimensions, Helicopter 1-2, **1-3**
Direct Current External Power Receptacle 1-54
Direct Current Power Supply 1-53
Direction Finder Group AN/ARA-25A 1-59
Direction Indicators **1-60**
Direction Velocity Indicator **1-70**, 1-71
Directional Pedal Switches 1-25
Directional Pedals 1-23
Directional Pedals Positioning Knob 1-23
Director, Taxi 3-5
Distance, Autorotation Gliding **11-25**
Distance Indicator **1-60**
Ditching 5-9
Ditching Chart **5-11**
Ditching, Immediate 5-10, **5-11**
Ditching, Planned 5-10, **5-11**
Diverter Valve, Manual 1-40, **1-41**
Division 4-17
Doors, Entrance 1-84
Doppler Approach 3-28, **3-29**
Doppler Climbout 3-30
Doppler Hover 3-29
Downlock Override Button 1-33
Downwind Taxiing 3-12
Drive Train Components, Speed of 1-103
Droop Stop Light 1-80
Drop Button 1-35, **1-80**, 1-87
Dual Engine 3-24
Dual Engine Limitations 1-98
Dump Switch, Fuel 1-41
Dumping Fuel 5-10

E

Effects of High Altitude 4-9
Electrical Fire 5-7
Electrical Hazard 1-92
Electrical Power Supply Distribution **1-49**
Electrical Power Supply Functional Flow Diagram **1-48**
Electrical Power Supply System **1-48**, 1-48A, **1-49**
Electrical Throttle Malfunctions 4-6
Emergency Descent 5-5
Emergency Disengagement 1-29
Emergency Equipment 1-88, **5-9**
Emergency Exits 1-88
Emergency Extend Button, Fishpole **1-35**
Emergency Floatation Gear 1-88, **1-88**
Emergency Floatation Gear Fairing **1-4**
Emergency Floatation Gear Handle 1-88
Emergency Handle, Landing Gear 1-33
Emergency Jettisoning 5-10
Emergency Landings 5-5
Emergency Missions 3-37
Emergency Panels **1-10**
Emergency Procedures 5-1
Emergency Pump Caution Light 1-40, 5-13
Emergency Release Handle, Cargo Hook 1-87
Emergency RPM Control 4-6, 5-4
Emergency RPM Control Practice Procedure 3-24
Encoding Equipment, Juliet 28 UHF Communications (AFC 152) 1-61
Encoding Equipment, UHF Encoder KY28 .... **1-55**
Endurance Chart 11-5, **11-19**
Engagement Procedures 3-22, 3-38

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Engagement Rotor 3-5, **3-33**, 3-38
Engine **1-6**, 1-6
Engine and Rotor Speed Information 1-102
Engine and Speed Decreaser Gear Oil System **1-17**
Engine, Before Starting 3-9, **3-14**
Engine Bellmouth **1-4**
Engine Chip Detector Caution Lights 1-18, 5-12
Engine Compartment Fire (Observed or Fire Warning Light) 5-8
Engine Condition Lever 1-8
Engine Cooling 1-11
Engine Exhaust Duct **1-4**
Engine Failure Analysis 5-2
Engine Failure, Single 5-2
Engine Failure, Two 5-3
Engine Fire During Flight 5-7
Engine Fire, Ground 5-8
Engine Fuel and Control System 1-6, **1-7**
Engine Horsepower-Torquemeter Pressure Conversion Chart 11-3, **11-9**
Engine Instruments 1-11, **1-12**, **1-13**
- engine oil pressure gage 1-15
- engine oil temperature gage 1-15
- fire warning light and test switch 1-15
- gas generator tachometer 1-11
- rotor overspeed recorder 1-15
- speed decreaser gear oil pressure gage 1-15
- speed decreaser gear oil temperature gage 1-15
- torquemeter 1-15
- triple tachometer 1-14
- turbine inlet temperature gage 1-15

Engine Limitations, Dual 1-98
Engine Limitations, Single 1-99
Engine Malfunctions 5-2
Engine Oil Pressure Caution Lights 1-16, 5-12
Engine Oil Pressure Gage 1-15
Engine Oil Pressure Limits **1-100**
Engine Oil Specifications **1-93**
Engine Oil System 1-16
Engine Oil Temperature Gage 1-15
Engine Oil Temperature Limits **1-100**
Engine Operating Limits Chart 11-2, **11-8**
Engine Operating—Pressure Fueling 1-46, **3-15**
Engine or Throttle Malfunctions 5-2
Engine Power Check, Topping 4-5
Engine Restart in Flight 5-5
Engine Shutdown 3-13, **3-15**
Engine Speed 1-99
Engine Speed and Rotor Information 1-102
Engine Starter and Ignition System 1-11
Engine, Starting 3-5, 3-9, **3-14**

Page

Engine Torque 1-99
Engines 1-6
Entrance Doors 1-84
Equipment, Emergency 1-88, **5-9**
Equipment, Ground Safety **1-96**
Equipment, Lighting 1-78
Equipment, Radio and Navigation 6-2
Erratic Control Inputs 5-12
Evaluation, Flight 2-1
Evaluation, Flight, NATOPS 10-3
Evaluation Grade Determination, Flight, NATOPS 10-4
Evaluation, Grading Criteria, NATOPS 10-3
Evaluation, Ground, NATOPS 10-2, 10-12
Evaluation, Landing Site 4-9
Evaluation, NATOPS 10-1
Evaluation, Question Bank, NATOPS 10-4
Examination, Oral, NATOPS 10-3
Exits, Emergency 1-88
Extend Button, Fishpole Emergency **1-35**
Exterior Inspection 6-7
Exterior Lighting 1-78
Exterior Lights **1-79**
Exterior Lights Panel **1-80**
Exterior Preflight Paths **3-6**
External Power Receptacle, AC **1-4**, 1-53
External Power Receptacle, DC **1-4**, 1-54

F

Factors Affecting Mission Planning 3-2
Failure, Engine 5-2
Failure, Engine, Single 5-2
Failure, Engine, Two 5-3
Failure, Landing After Two Engine 5-5
Failure, Tail Rotor 5-5
Familiarization Training 2-3
Features, Special 1-2
Filler Caps 1-92
Final Grade Determination, NATOPS 10-4
Fire 5-7
Fire Extinguisher **1-93**, **5-9**
Fire Extinguisher Agent Discharge Switch **1-10**
Fire Extinguishers and Attendant 1-92
Fire Extinguishing System 1-16
Fire Guard 3-5
Fire Warning Light On **5-12**
Fire Warning Light T-Handles **1-10**
Fire Warning System and Test Switch 1-15
First Aid Kits **5-9**
Fishpole and Rescue Hoist **1-34**
Fishpole Emergency Extend Button **1-35**
Fishpole Extend Switch **1-35**
Fishpole Eye, Threading the 9-2
Fishpole, Hoist and Hook Panels **1-35**

Page

Fishpole (Rescue Boom System) 1-37
Flashing Light, Radar Altimeter Warning Set Tone and 1-33
Flight Characteristics 4-1
Flight Charts 11-2
Flight Check Criteria, Initial 2-1
Flight Control System 1-22
Flight Controls 1-22
Flight Crew Coordination 9-1
Flight Crew Qualifications 2-1
Flight Crew Requirements 2-3
Flight Crew Requirements, Instrument 6-3
Flight Deck 3-32, 3-38
Flight Evaluation 2-1
Flight Evaluation Grade Determination, NATOPS 10-4
Flight Evaluation Grading Criteria 10-3
Flight Evaluation, NATOPS 10-3
Flight Evaluation Worksheet 10-13
Flight/Hangar Deck Procedures 3-32, 3-38
Flight Instrument Rheostat Knobs **1-81**
Flight, Maintenance Test 4-4
Flight Procedures 3-20, 4-1
Flight Procedures, Instrument 6-1
Flight Scheduling 3-5
Flight Support Training Syllabus 2-3
Flight Techniques, Turbulent Air 4-10
Flight Test Procedures 4-3
Flight Training Syllabus 2-4
Flight with External Auxiliary Fuel Tanks 4-3
Flights, Test and Maintenance 2-3
Floodlights and Switch 1-80
Floodlights, Console and Instrument 1-81
Flying Equipment Requirements, Personal 2-7
FMIC's ii
Folding Blades 3-32, 3-38
Foreword ii
Formation Composition 4-13
Formation Flying 4-13
Formation, Instruments 5-6
Free Cruise 4-17
Free Cruise-Straight and Level **4-14**
Free Cruise Turn **4-15**
Friction Nut, Collective Pitch Lever 1-22
Fuel 3-39
Fuel and Control System, Engine 1-6, **1-7**
Fuel and Oil Specification 1-92, **1-93**
Fuel Boost Caution Light 1-40, 5-13
Fuel Bypass Caution Light 1-41, 5-13
Fuel Control Selector Switch 1-10
Fuel Dump Switch 1-41
Fuel Dumping 5-10
Fuel Flow Chart 11-3, **11-10**
Fuel Jettison 1-41
Fuel Jettison Switch 1-41

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Fuel Low Caution Light 1-44
Fuel Pressure Limits **1-100**
Fuel Pumps Switch 1-39
Fuel Quantity Check 3-16
Fuel Quantity Data 1-39
Fuel Quantity Gage 1-45
Fuel Quantity Gage System **1-44**, 1-45
Fuel Quantity Selector Switch 1-45
Fuel Specifications **1-93**
Fuel Supply System 1-38, **1-42**
Fuel Tanks 1-39
Fuel Transfer Caution Light 1-39, 5-13
Fuel Transfer Pump Check 3-16
Fuel vs. Rescue Distance Chart 3-37, **11-20**
Fueling and Servicing Aircraft 1-92, **1-93**
Fueling, Pressure-Engine and Rotors Operating Helicopter on Deck 1-47
Fueling, Pressure-In Flight 1-46
Full Flare Autorotation Landing 5-5
Fume Elimination 5-10
Function Switch and Channel Selector Knob 1-60
Fuse and Circuit Breaker Panels, Typical **1-50**, **1-51**

G

Gage, Engine Oil Pressure 1-15
Gage, Engine Oil Temperature 1-15
Gage, Fuel Quantity 1-44
Gage, Hydraulic Pressure 1-31
Gage, Outside Air Temperature **1-4**
Gage, Speed Decreaser Gear Oil Pressure 1-15
Gage, Speed Decreaser Gear Oil Temperature 1-15
Gage, Transmission Oil Pressure 1-19
Gage, Transmission Oil Temperature 1-19
Gage, Turbine Inlet Temperature 1-15
Gas Generator Speed 1-99
Gas Generator Tachometer 1-11
Gas Generator Tachometer Limits 1-99, 1-101
Gearbox Chip Detector Caution Light 1-19, 5-12
Gearbox, Combining 1-18
Gearbox, Intermediate 1-19
Gearbox, Main 1-18
Gearbox, Tail Rotor 1-19
General Arrangement **1-4**
General Description 1-2
Generator Caution Light,
No. 1 ..... 1-52, 5-12
No. 2 ..... 1-53, 5-12
Generator Number One 1-52
Generator Number One Caution Light 1-52, 5-12
Generator, Number One Switch 1-52
Generator, Number Two 1-52

Page

Generator, Number Two Caution Light 1-53, 5-12
Generator, Number Two Switch 1-52
Gliding Distance, Autorotation 5-5, **11-25**
Gorge or Canyon, Wind Flow Over **4-11**
Grading Instructions, NATOPS 10-3
Grips, Pilot's and Hoist Operator's **1-56**
Ground Checks 4-4
Ground Controlled Approach 6-3
Ground Evaluation, NATOPS 10-2, 10-12
Ground, Fire 5-7
Ground Instability 4-2
Ground Operations of Helicopter Engine and Rotors 3-5
Ground Safety Equipment **1-96**
Ground Training, Aircrewman 2-1
Ground Training, Pilots' 2-1
Ground Training Requirements 2-1
Grounding 1-92
Groundspeed Drift-Angle Indicator **1-71**, 1-71
Groundspeed Radar Panel **1-72**
Groundspeed Radar System AN/APN-130 1-69
Groundspeed Switch 1-28
Gyro Erection Button, RAI 1-83
Gyro Out Switch 1-84

H

H2P, Helicopter Second Pilot 2-2
Hailer Control Panel, Loud **1-58**
Hailer System, Loud 1-59
Handle, Auxiliary Fuel Tank Jettison 1-39
Handle, Cargo Hook Emergency Release 1-87
Handle, Emergency Floatation Gear 1-88
Handle, Landing Gear Emergency 1-33
Handle, Manual Diverter **1-41**
Handle, Parking Brake 1-38
Handle, Shoulder Harness Lock 1-84
Hangar Deck 3-32, 3-38
Hangar/Flight Deck Procedures 3-32, 3-38
Hazard, Electrical 1-92
Heading Indicator **1-60**
Headset and Microphone Connectors 1-54
Heat and Miscellaneous Panels **1-90**
Heating, Ventilating and Defogging System 1-88, **1-89**
Height 1-2
Helicopter ..... iv, 1-2
Helicopter Acceptance 3-6
Helicopter Aircraft Commander 2-2
Helicopter Aircrewman 2-2
Helicopter Dimensions 1-2, **1-3**

Page

Helicopter Engine and Rotors, Ground Operations of 3-5
Helicopter Rescue Aircrewman 2-2
Helicopter Second Pilot (H2P) 2-2
Helicopter, Starting the 3-38
Helicopter Transfers 3-39
HF Communications System, AN/ARC-39 1-63
High Altitude, Effects of 4-9
High Recon Flight 4-12
High Speed Autorotation Entry, Procedure for 3-24
Hoist, Fishpole and Hook Panels **1-35**
Hoist, Jammed 9-2
Hoist Manual Controls **1-36**
Hoist Operator's Grip **1-56**
Hoist Power Switch 1-35
Hoist, Rescue and Fishpole **1-34**
Hoist Up-Down Manual Controls 1-36
Holding 6-2
Hooded Autorotation 6-7
Hook, Cargo 1-85
Hook, Hoist and Fishpole Panels **1-35**
Hook Lights, Cargo 1-87
Hot Fueling 3-37
Hot Mike, Use of 9-2
Hot Weather Operations 6-9
Hover 3-30
Hover-Auto Switch 1-72
Hover, Doppler 3-29
Hover, Manual 3-30
Hover, Vertical Takeoff and 3-17
Hovering 3-18, 4-1
Hovering Limitations 1-103
Hovering Over Salt Water 1-103
How to Get Copies of Manual ii
Hydraulic Actuator Switch 1-24
Hydraulic Fluid Specifications **1-93**
Hydraulic Power Supply System 1-31, **1-32**
Hydraulic Pressure Caution Light 1-33, 5-12
Hydraulic Pressure Gage 1-31
Hydraulic Pressure Limits **1-100**
Hydraulic Pump 1-31
Hydraulic System Contamination 5-12

I

Ice and Rain 6-9
ICS (Intercommunication System) 1-55
ICS Panels 1-55, **1-58**
IFF and SIF Panels **1-68**
IFR and Night Launch and Recovery Operations 3-34
IFR and Night Operations 3-35
Ignition and Engine Starter System 1-11
Ignition System Test Switch 1-11
Immediate Ditching 5-10, **5-11**
Implementation, NATOPS Evaluation 10-2

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Indicator, Bearing, Distance, Heading **1-60**
Indicator, Course **1-66**
Indicator, Direction **1-60**
Indicator, Direction Velocity **1-70**, 1-71
Indicator, Groundspeed Drift-Angle **1-71**, 1-71
Indicator, Landing Gear Position 1-33
Indicator, Radio Magnetic 1-60
Indicator, Range **1-65**
Indicator, Remote Attitude **1-12**, 1-83
Indicator, Turn and Slip **1-12**, 1-83
Indicators, Landing Gear Position 1-33
Indoctrination 2-1
Inertia Reel **1-85**
In-flight Pressure Fueling Equipment 1-46, **1-47**
In-flight RAD Alt Hold Check 3-17
Inform Pilot, Rescue Situation 9-2
Initial Flight Check Criteria 2-1
Inputs, Erratic Control 5-8
Inspection, Interior 3-8
Inspections, Preflight 3-5
Instability, Ground 4-2
Instrument and Console Floodlights and Switches 1-81
Instrument Approaches 6-2
Instrument Autorotation Landing, Night and 5-5
Instrument Check 6-5
Instrument Climb 6-2
Instrument Cruising Flight 6-2
Instrument Descent 6-5
Instrument Flight Conditions in Formation 5-7
Instrument Flight Crew Requirements 6-3
Instrument Flight Procedures 6-1
Instrument Flights, Simulated 6-4
Instrument Lights and Rheostats 1-81
Instrument Markings 1-98, **1-100**, **1-101**
Instrument Panel **1-12**, **1-13**
Instruments Safety Precautions 6-4
Instrument Takeoff 6-2
Instrument Turns 6-5
Instruments, Complete List 1-82
Instruments, Engine 1-11, **1-12**
Intercom and Loud Hailer Panels **1-58**
Intercommunication System AN/AIC-14 .... 1-55, **1-56**
Intercommunication System Panel 1-55
Intercommunications 7-1
Interim Change Summary .... Flyleaf, ii
Interior Inspection 3-8, 6-7
Interior Lighting 1-81
Interior Lights Panel **1-81**
Intermediate Gearbox 1-19
Internal Cargo Carrying Equipment 1-85
Internal Engine Fire (Observed or High T_5 After Shutdown) 5-8
Inverter 1-53

J

Jammed Hoist 9-2
Jettison Handle, Auxiliary Fuel Tank 1-39
Jettisoning Auxiliary Fuel Tanks 5-8
Jettisoning, Cargo 5-8
Jettisoning, Emergency 5-10
Juliet 28 Control Panel **1-62**
Juliet 28 UHF Communications Encoding Equipment (AFC 152) 1-61

K

Knob, Channel Selector and Function Switch 1-60, **1-61**
Knobs, Manual Frequency Selector 1-60, **1-61**
KY28 Panel **1-43**
KY28 UHF Encoder **1-55**

L

Land-Sea Switch 1-71, **1-72**
Landing 6-7
Landing, After 3-13, **3-15**
Landing, After Two Engine Failure 5-5
Landing, Autorotation **11-25**
Landing, Before 3-13, **3-15**
Landing, Crosswind 3-22
Landing, Full Flare Autorotation 5-5
Landing Gear Emergency Handle 1-33
Landing Gear Fails to Lower 5-13
Landing Gear Lever 1-33
Landing Gear Position Indicators 1-33
Landing Gear System 1-33
Landing Light and Switches 1-79
Landing Limitations 1-106
Landing, Maximum Gross Weight 4-12
Landing, Night and Instrument Autorotation 5-5, **11-25**
Landing, Normal 3-20, **3-21**
Landing, Running 3-20, **3-21**
Landing, Running Autorotation 5-5, **11-25**
Landing Site Evaluation 4-9
Landing Site Selection 4-12
Landings 3-20
Landings, Emergency 5-10
Launch and Recovery Operations, Day 3-34
Launch and Recovery Operations, Night and IFR 3-34
Launch and Recovery Procedures 3-34, 3-38
Launches, Night 3-35
Leaving the Aircraft, Before 3-13
Length 1-2
Level Flight Characteristics Under Various Speed Conditions 4-1

Lever, Collective Pitch **1-9**, 1-22
Lever, Engine Condition 1-8, **1-9**
Lever, Landing Gear 1-33
Lever, Pilot's Seat Vertical Adjustment 1-84
Lever, Rotor Brake 1-20
Lever, Tail Wheel Lock 1-34
Levers, Collective Pitch and Quadrant **1-9**
LF Range Approach **6-3**
Light, Cabin Dome 1-82
Light, Flashing and Radar Altimeter Warning Set Tone 1-33
Light, Landing **1-79**
Lighting Equipment 1-78
Lighting, Exterior 1-78
Lighting, Interior 1-81
Lights and Signals 3-35
Lights, Anti-Collision 1-78
Lights, Cargo Hook 1-87
Lights, Cockpit 1-82
Lights, Console and Instrument Floodlights 1-81
Lights, Console and Rheostats 1-81
Lights, Engine Oil Pressure Caution 1-16
Lights, Exterior **1-79**
Lights, Flood 1-80
Lights, Instrument 1-81
Lights, Interior 1-81
Lights, Position 1-78
Limitations, Acceleration 1-103
Limitations, Airspeed 1-102, 4-3, **11-12**
Limitations, Altitude 1-103
Limitations, Bank Angles 1-103
Limitations, Center of Gravity 1-103
Limitations, Dual Engine 1-98
Limitations, Fuel Dumping 1-103
Limitations, Hovering 1-103
Limitations, Landing 1-103
Limitations, Landing Gear 1-103
Limitations, Load Factor 1-104
Limitations, Miscellaneous 1-106
Limitations, Operating 1-98, 11-1
Limitations, Rotor 1-99, **3-33**
Limitations, Sideslip Angle 1-106
Limitations, Single Engine 1-99
Limitations, Weight 1-104
Line Operations 3-5
Litters 1-85
Load Factor Limitation **1-106**
Loss of Tail Rotor Control During Takeoff or While Hovering 5-6
Loss of Tail Rotor Control in Forward Flight 5-6
Loss of Tail Rotor Thrust in Forward Flight 5-6
Lost Sight Dispersal-Inadvertent IFR (VFR Flight Plan) **5-8**
Lost Sight During IFR Flight Procedures 5-6
Loud Hailer and Intercom Panels **1-58**
Loud Hailer System **1-58**, 1-59
Low Recon Flight and Hover Power Check 4-12

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

M

MA-1 Compass Equipment ... 1-68
MA-1 Compass Panel ... **1-69**
Main Gearbox ... 1-18
Main Rotor ... 1-20
Maintenance Test Flight Requirements ... 4-4
Maintenance Test Flights ... 2-3
Mandatory Requirements for Engagement of Rotors ... 3-34
Maneuvers, Prohibited ... 1-103
Maneuvers to be Avoided ... 6-5
Manual Approach, Hover and Climbout ... 3-30
Manual Diverter Valve ... 1-40, **1-41**
Manual Frequency Selector Knobs ... 1-61
Markings, Instrument ... 1-98, **1-100**, **1-101**
Master Caution Light and Test Bar ... 1-82
Master Caution Light On ... 5-12
Master Caution Light Reset Button ... 1-82
Maximum Airspeed Chart ... 11-4, **11-17**, **11-18**
Maximum Endurance Chart ... 11-5, **11-19**
Maximum Gross Weight for Hovering ... 11-3, **11-14**
Maximum Gross Weight for Vertical Takeoff ... 11-3, **11-13**
Maximum Gross Weight Landings ... 4-12
Maximum Gross Weight Takeoff ... 4-10
Maximum Hovering Torque, Equal Power Sharing ... 1-98
Maximum Performance Takeoff ... 3-18, **3-19**
Maximum Wind for Starting or Stopping Rotors ... **3-33**
Memory Light ... 1-72
Microphone and Headset Connectors ... 1-54
Microphone Switches ... 1-54
Military Power ... 1-99
Minimums, Aircraft Equipment Night and IFR ... 4-3
Minimum Crew ... 1-98, 3-37, 3-39
Minimum Currency Requirements ... 2-2
Minimum Ground Clearance and Turning Radius ... **1-95**
Minimum Height for Safe Landing After Dual Engine Failure ... 1-104, **1-105**, **11-26**
Mirror/Optical Landing System Approach ... 3-35
Miscellaneous and Heat Panels ... **1-90**
Miscellaneous Equipment ... 1-91
Miscellaneous Limitations ... 1-106
Mission and Crew Provisions ... 1-2
Mission Planning ... 3-2
Mission Planning, Factors Affecting ... 3-2
Missions, Emergency ... 3-37
Modified Charlie Pattern ... **6-6**
Mooring Requirements ... 1-92
Mountain and Rough Terrain Flying ... 4-7
Movement of Helicopter ... 3-32, 3-38

Page

N

Nacelle and Cowling ... **1-4**
NATOPS Evaluation ... 10-1
NATOPS Evaluation Forms ... 10-7
NATOPS Evaluation Question Bank ... 10-4
NATOPS Evaluation Report ... 10-9
NATOPS Evaluator/Instructor Worksheet ... 10-11
NATOPS Flight Evaluation Worksheet ... 10-11, 10-12, 10-13, 10-14, 10-15, 10-16, 10-17
NATOPS Flight Manual Interim Changes (FMIC's) ... ii
NATOPS Grading Criteria ... 10-3
NATOPS Ground Evaluation ... 10-2
NATOPS Records and Reports ... 10-4
Navigation Equipment ... 1-68, 6-2
Navigational Computer Group, AN/ASA-13A with Tactical Display Plotting Board ... 1-73, **1-74**
Night and IFR Launch and Recovery Operations ... 3-34
Night and IFR Operations ... 3-35
Night and Instrument Autorotation Landing ... 5-5
Night and Instrument Autorotation Practice Procedure ... 3-24
Night Flying ... 4-3
Night Formation ... 4-18
Night-IFR Rescue Pattern ... 3-28
Night Launches ... 3-35
Night Operation ... 3-39
Night Recoveries ... 3-35
No-Doppler Approach ... 3-29
Non-Aviation Ship Procedures ... 3-38
Normal Approach ... **3-25**, 3-25
Normal Autorotation Procedure ... 3-22
Normal Landing ... 3-20, **3-21**
Normal Operation, ASE Equipment ... 1-28
Normal Power ... 1-99
Normal Practice Autorotation Procedure ... 3-22, **3-23**
Normal Procedures ... 3-1
Normal Starting Procedure ... 3-10
Normal Takeoff Procedure ... 3-17
Normal Torque Range, Equal Power Sharing, Forward Flight ... 1-98
Nose Doors ... **1-4**
Notes, Cautions, and Warnings ... iii
Number One Generator ... 1-52
Number One Generator Caution Light ... 1-52, 5-13
Number One Generator Switch ... 1-52
Number Two Generator ... 1-52
Number Two Generator Caution Light ... 1-53, 5-13
Number Two Generator Switch ... 1-52

O

Odometer ... **1-60**
OFT/WST Procedures Evaluation, NATOPS ... 10-3

Page

Oil Cooler, Transmission ... 1-19
Oil Coolers ... 1-16
Oil Pressure Gage, Engine ... 1-15
Oil Pressure Gage, Speed Decreaser Gear ... 1-15
Oil Specification, Fuel, and ... 1-92, **1-93**
Oil System, Engine ... 1-16
Oil System, Transmission ... 1-19
Oil Temperature Gage, Engine ... 1-15
Oil Temperature Gage, Speed Decreaser Gear ... 1-15
Open Book Examination, NATOPS ... 10-3
Operating Conditions ... 3-37
Operating Considerations ... 3-37
Operating Limitations ... 1-98, 11-1
Operation of Towing Equipment ... 3-6
Operations, Cargo ... 9-2
Operations, Day ... 3-35, 3-38
Operations, Line ... 3-5
Operations, Night and IFR ... 3-35
OPNAV Form 3500-22 (10-63) ... Flyleaf
OPNAV Form 3510-8 Series ... 10-9
Oral Examination, NATOPS ... 10-3
Overspeed ... 1-99
Overspeed Recorder, Rotor ... 1-15
Overtorque, Transient ... 1-98

P

Panel, AN/AIC-14 Intercom ... **1-43**
Panel, AN/APN-130 Radar Groundspeed ... **1-43**, **1-72**
Panel, AN/ARC-39 HF Radio ... **1-43**, **1-62**, **1-64**
Panel, AN/ARC-52X UHF Radio ... **1-43**, **1-61**
Panel, AN/ARN-59 Radio ... **1-43**, **1-64**
Panel, AN/ASA-13A Computer ... **1-43**, **1-73**
Panel, ASE ... **1-43**
Panel, Blade Track ... **1-31**
Panel, Caution Lights ... 1-82, **1-83**
Panel, Emergency ... **1-10**
Panel, Exterior Lights ... **1-80**
Panel, Fuse and Circuit Breaker ... **1-50**, **1-51**
Panel, Groundspeed Radar ... **1-72**
Panel, Heat and Miscellaneous ... **1-90**
Panel, Hoist, Fishpole, and Hook ... **1-35**
Panel, ICS ... 1-55
Panel, IFF and SIF ... **1-43**, **1-68**
Panel, Instrument ... **1-12**
Panel, Intercom and Loud Hailer ... **1-58**
Panel, Interior Lights ... **1-81**
Panel, Juliet 28 Control ... **1-62**
Panel, KY28 ... **1-43**
Panel, Loud Hailer and Intercom ... **1-58**
Panel, MA-1 Compass ... **1-43**, **1-69**
Panel, Miscellaneous ... **1-90**
Panel, Navigational Computer ... **1-73**
Panel, Radio Selector ... **1-43**, 1-54, **1-57**
Panel, SIF ... **1-43**, **1-68**
Panel, Starting ... **1-14**
Panel, TACAN ... **1-43**, **1-67**
Panel, UHF Radio, AN/ARC-52X ... **1-61**
Parade ... **4-16**, 4-17
Parking Brake Handle ... 1-38

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Partial Power Loss (One Engine) 5-4
Passenger Carrying Equipment 1-85
Pattern, Modified Charlie **6-6**
Pattern, Papa **6-6**
Pattern, Race Track Plane Guard **3-36**
Pattern, Rescue **3-27**
Pattern, Zig-Zag Plane Guard **3-36**
Patterns 3-35, **3-36**, 6-5
Payload 3-2
Pedals, Brake 1-38
Pedals, Directional 1-23
Performance Data 11-1
Personal Flying Equipment Requirements 2-7
Pilot and Rescue Door **1-4**
Pilot Grading Items, NATOPS 10-3
Pilot Qualification, Test 4-3
Pilot Qualifications 2-1
Pilot NATOPS Evaluation Summary 10-12
Pilot's and Hoist Operator's Grips **1-56**
Pilot's Checklist **3-14**, 3-15
Pilot's Collective Pitch Lever Switchbox **1-80**
Pilot's Ground Training 2-1
Pilot's Preflight Inspection 3-5
Pilot's Seat Vertical Adjustment Lever 1-84
Pilots' Seats 1-84, **1-85**
Pilots' Suit Ventilating System 1-89
Pilots, Taxi 3-5
Pitot Heater and Switch 1-91
Pitot System, Airspeed 1-84
Placement of Ground Reference Objects for Takeoff from Snow Covered Expanse **6-8**
Plane Guard Patterns **3-36**
Planned Ditching 5-10, **5-11**
Plotting Board 1-91
Plotting Board, Tactical Display **1-74**
Position Indicators, Landing Gear 1-33
Position Lights and Switches 1-78
Position of Aircraft and Truck 1-92
Power, Military 1-99
Power, Normal 1-99
Power Settling 4-2
Power Supply After AFC 114 1-79
Power Supply Before AFC 114 1-78
Power Supply, Hydraulic **1-32**
Power Supply System, AC 1-52
Power Supply System, DC 1-53
Power Supply System, Electrical 1-47
Power Surge Cone Engine 5-5
Power Turbine Speed Limitation 1-99
Practice Autorotation, Normal 3-22
Practice Emergency RPM Control Procedure 3-24
Practice Night and Instrument Autorotation Procedure 3-24
Practice Single Engine Procedure 3-24
Precision Approach **3-26**, 3-26
Preflight Check 3-6, 6-7
Preflight, Cockpit **3-14**

Page

Preflight Inspection 3-5, **3-14**, **3-15**
Preflight Inspection, Pilot's 3-5, **3-14**, **3-15**
Prelaunch Tiedown, Shipboard **1-94**
Pressure Altitude 3-2, 11-2
Pressure Fueling 1-46
Pressure Fueling — Engines and Rotors Operating 1-47
Pressure Fueling — In Flight 1-46
Pressure Fueling to a Partial Fuel Load 1-92
Procedure for High Speed Autorotation Entry 3-24
Procedure, Normal Practice Autorotation 3-22, **3-23**
Procedure, Normal Starting 3-10
Procedure, Practice Instrument Autorotation 3-24
Procedure, Taxiing 3-12
Procedures, Carrier-Based 3-32
Procedures, Climbout 3-20
Procedures, Flight 3-20
Procedures, Flight Test 4-3
Procedures, Instrument Flight 6-1
Procedures, Launch and Recovery 3-34, 3-38
Procedures, Normal 3-1
Procedures, Starting and Engagement 3-32
Prohibited Maneuvers 1-103
Pump, Hydraulic 1-31
Pump, Sump and Emergency 1-40
Pumps, Transfer 1-39
Pyrotechnic Case **5-9**

Q

Quadrant **1-43**
Quadrant and Collective Pitch Levers **1-9**
Qualification, Test Pilot 4-3
Qualifications, Aircrew 2-2
Qualifications, Flight Crew 2-1
Qualifications, Pilot 2-1

R

Race Track Plane Guard Pattern **3-36**
RAD ALT Hold Check 3-17
RAD/ALT (Radar Altitude) Switch 1-27
Radar Altimeter **1-76**
Radar Altimeter Set AN/APN-117 1-75, **1-76**
Radar Altimeter Warning Light **1-76**, 1-77
Radar Altimeter Warning Set AN/APQ-107 1-76
Radar Altimeter Warning Set Tone and Flashing Light 1-33
Radar Altitude (RAD ALT) Switch 1-27
Radar Approach **6-3**
Radar Groundspeed Panel, AN/APN-130 **1-72**

Page

Radar Identification Set (IFF) AN/APX-6B, and Coder Group (SIF) AN/APA-89 1-67
Radar Navigation Set, AN/APN-130 1-69
Radio and Navigation Equipment 6-2
Radio Communications 7-1
Radio Magnetic Indicator **1-60**
Radio Navigation and Communications Equipment 1-54, **1-55**
Radio Range Approach 6-3
Radio Selector and Volume Panels **1-57**
Radio Selector Panels 1-54, **1-57**
Radio Volume Controls 1-54
RAI 1-83
RAI Gyro Erection Button 1-83
RAI Pitch Trim Knob 1-84
Rain and Ice 6-9
Range 11-4, **11-17**
Range Chart **11-16**
Range Chart for Single Engine Operation 11-6, **11-24**
Range Indicator **1-65**
Rapid Deceleration Maneuvers 3-25
Rate-of-Climb Indicator **1-12**, 1-82
RAWS Indications 1-77
Rearward and Sideward Flight 4-2
Recommended Requirements for Transitioning Naval Aviators 2-3
Recon Flights, High 4-12
Recorder, Rotor Overspeed 1-15
Records and Reports, NATOPS 10-4
Recovery and Launch Operations, Night and IFR 3-34
Recovery and Launch Procedures 3-34, 3-38
Recovery Operations, Day Launch and 3-34
Relief Tubes 1-91
Remote Attitude Indicator Gyro Erection Button 1-83
Remote Attitude Indicator Pitch Trim Knob 1-84
Remote Attitude Indicator Roll Trim Knob 1-84
Remote Attitude Indicators (RAI) **1-12**, 1-83
Rendezvous 4-17
Requalification 2-2
Required Special Aircraft Rescue Equipment 2-8
Requirements, Aircrew Currency 2-2
Requirements, Flight Crew 2-3, 6-3
Requirements for Engagement of Rotors, Mandatory 3-34
Requirements for Transitioning Naval Aviators, Recommended 2-3
Requirements, Minimum Currency 2-2
Requirements, Personal Flying Equipment 2-7
Requirements, Waiver of 2-2
Rescue Boom (Fishpole) System 1-37, 1-106

(Illustration page numbers appear in ***boldface***)

ALPHABETICAL INDEX (Cont)

Page

Rescue Distance vs. Fuel Chart **11-20**
Rescue Hoist and Fishpole **1-34**
Rescue Hoist Loads 1-104
Rescue Hoist System 1-34
Rescue Hoist Up-Down Switches 1-35
Rescue Pattern **3-27**, 3-27
Rescue Pattern, Approaches, Hover and Climbout 3-27
Rescue Situation 9-1
Reset Button, Auto Track 1-30
Reset Button, Master Caution Light 1-82
Responsibiliy, Formation 4-17
Rheostats and Cockpit Lights 1-82
Rheostats and Console Lights 1-81
Rheostats and Instrument Lights 1-81
Ridgeline Approach, Crosswind Effect On **4-7**
RON Duties 9-2
Rotor and Engine Speed Information 1-102
Rotor Blade Identification **1-30**
Rotor Blade Stall 4-2
Rotor Blade Tracking System 1-29
Rotor Blades **1-4**
Rotor Brake Interlock Override Buttons 1-8
Rotor Brake Lever 1-20
Rotor Brake System 1-19
Rotor Deice Switch 1-89, **1-90**
Rotor Deicing System 1-89
Rotor Engagement 3-38
Rotor Hub **1-4**
Rotor Limitations 1-99, **3-33**
Rotor, Main 1-20
Rotor Overspeed 1-99
Rotor Overspeed Recorder 1-15
Rotor Overspeed (RPM in Excess of 106% N_r) 5-2
Rotor Speed 1-99
Rotor System 1-20
Rotor System Control 1-22
Rotor, Tail 1-22
Rotor, Tail, Failure 5-5
Rotors, Ground Operations of Helicopter Engine and 3-5
Rotors, Mandatory Requirements for Engagement of 3-34
Rotors, Maximum Wind for Starting or Stopping **3-33**
Rotors, Starting 1-99, 3-11, **3-14**
Rough Terrain and Mountain Flying 4-7
RPM Control, Emergency 4-6, 5-4
RPM Control Procedures, Practice Emergency 3-24
RPM Switch 1-8
Running Autorotation Landing 5-5
Running Landing 3-20, **3-21**
Running Takeoff 3-18, **3-19**

S

Safe Landing After Engine Failure, Minimum Height **1-103**

Page

Safety Belt **1-85**
Safety Equipment, Ground **1-96**
Safety Precautions 6-4
Safety Precautions, Instrument 6-4
SAR Communications 7-1
Scheduling, Flight 3-5
Scope of Flight Manual ii
Seats, Pilots' 1-84, **1-85**
Second Pilot, Helicopter (H2P) 2-2
Section, Formation Composition 4-13
Secure Speech, KY28 UHF Encoding **1-55**
Selection, Landing Site 4-12
Servicing and Fueling Aircraft 1-92
Servicing Diagram **1-93**
Ship to Ship Transfers 3-39
Shipboard Operational Checklist Day VFR Only **3-15**
Shipboard Prelaunch Tiedown **1-94**
Shore-Based Procedures 3-5
Shoulder Harness **1-85**
Shoulder Harness Lock Handle 1-84, **1-85**
Shutdown 3-13, **3-15**
Sideslip Angle Limitation **1-106**
Sideward and Rearward Flight 4-2
SIF and IFF Panels **1-68**
Signal, Emergency 3-37
Signals and Lights 3-35
Signals, Formation 4-18
Signals, Taxi 3-5
Simulated Instrument Flights 6-3
Single Engine 3-25
Single Engine Failure 5-2
Single Engine Limitations 1-99
Single Engine Water Takeoff 5-4
Single-Point Pressure Fueling System 1-45
Situation, Rescue 9-1
Sling Release Switch, Automatic 1-87
Smoke and Fume Elimination 5-9
Special Aircraft Rescue Equipment Required 2-8
Special Features 1-2
Special Problems of the Combat Support Helicopter 3-37
Specification, Fuel and Oil 1-92, **1-93**
Speed Decreaser Gear Oil (Out) Overtemperature 1-99
Speed Decreaser Gear Oil Pressure Caution Light On 5-12
Speed Decreaser Gear Oil Pressure Caution Lights 1-16
Speed Decreaser Gear Oil Pressure Gage 1-15
Speed Decreaser Gear Oil System and Engine **1-17**
Speed Decreaser Gear Oil Temperature Gage 1-15
Speed Information, Rotor and Engine 1-102
Speed of Drive Train Components 1-103
Spreading Blades 3-32, 3-38
Stabilizer **1-4**

Page

Stall, Rotor Blade 4-2
Stalls 4-2
Starter and Ignition System 1-11
Starter and Ignition System Test Switch 1-11
Starter Switches 1-11
Starting and Engagement Procedures 3-32
Starting and Stopping Rotor 1-99, **3-33**
Starting Engines 3-9, **3-14**
Starting Engine, Before 3-9, 3-14
Starting, Engine Fire 5-9
Starting Panel **1-14**
Starting Procedure, Battery 3-10
Starting Procedure, Normal 3-10, 6-7
Starting Rotor and Before Taxiing 3-11, **3-14**
Starting Rotors 1-99, 3-11, **3-14**, 6-9
Starting the Helicopter 3-38
Static Vent System 1-84
Stick, Cyclic 1-23
Stopping Rotors 6-9
Straight and Level Flight with Power Changes 6-5
Suit Ventilating System, Pilots' 1-89
Suggested Patterns to be Flown for Exercising Timed Maneuvers (Full and Partial Panel) 6-5
Summary, Mountain and Rough Terrain Flying 4-13
Sump Pump and Emergency Pump 1-40
Sump Tank Fuel 1-39
Switch, Actuator Control 1-8, **1-9**
Switch, Anti-Collision Lights and 1-78
Switch, Arming 1-87
Switch, ASE Engage 1-25, **1-26**
Switch, Auto-Hover 1-72
Switch, Automatic Sling Release 1-87
Switch, Barometric Altitude 1-25, **1-26**
Switch, Battery **1-14**, 1-54
Switch, BFO 1-64
Switch, Boost Release **1-9**
Switch, C Blade 1-30, **1-31**
Switch, Cabin Dome Light 1-82
Switch, Cabin Heating and Ventilating 1-89
Switch, Cable Cut Arming 1-35
Switch, Console and Instrument Floodlights 1-81
Switch, Copilot's Landing Light **1-80**
Switch, Cyclic Stick Trim 1-23, **1-26**, **1-56**
Switch, D Blade 1-30, **1-31**
Switch, Differential Cone **1-31**, 1-31
Switch, Directional Pedals 1-25
Switch, Fire Extinguisher Agent Discharge **1-10**
Switch, Fishpole Extend **1-35**
Switch, Floodlights 1-80
Switch, Fuel Control Selector 1-10
Switch, Fuel Dump 1-41
Switch, Fuel Jettison **1-10**, 1-41
Switch, Fuel Pumps **1-14**, 1-39
Switch, Fuel Quantity Selector 1-45
Switch, Groundspeed **1-26**, 1-28

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Switch, Gyro Out 1-84
Switch, Hoist Power 1-35
Switch, Hydraulic Actuator **1-14**, 1-24
Switch, Ignition and Starter System Test 1-11
Switch, I/P-Out-Mic 1-68
Switch, Land-Sea 1-71, 1-72
Switch, Landing Light 1-79
Switch, Microphone 1-54, **1-56**
Switch, No. One Generator **1-14**, 1-52
Switch, No. Two Generator **1-14**, 1-52
Switch, Pitot Heater 1-91
Switch, Position Lights and 1-78
Switch, Radar Altitude **1-26**, 1-27
Switch, Rescue Hoist Up-Down 1-35
Switch, Rotor Deice 1-89, **1-90**
Switch, RPM 1-8, **1-9**
Switch, Starter **1-9**, 1-11
Switch, Starter and Ignition System Test 1-11, **1-14**
Switch, Turbine Anti-Ice 1-11, **1-14**
Switch, Windshield Anti-Ice 1-91
Switch, Yaw Trim **1-9**, 1-23, **1-26**
Switch, Yaw Trim When Under ASE Control 1-25
Switch, Zeroize **1-62**
Switchbox, Pilots' Collective Pitch Lever **1-80**
Syllabus, Flight Support Training 2-3
Syllabus, Flight Training 2-4
Symbols, Performance Data 11-2
System, AC Power Supply 1-52
System, Airspeed Pitot 1-84
System, AN/ARN-59 Automatic Direction Finder 1-63
System, Blade Tracking 1-29
System, Brake 1-38
System, Cargo Hook 1-85
System, Caution Light 1-82
System Contamination, Hydraulic 5-8
System, DC Power Supply 1-53
System, Electrical Power Supply 1-47, **1-48**, **1-49**
System, Engine Fuel and Control 1-6, **1-7**
System, Engine Oil 1-16
System, Engine Starter and Ignition 1-11
System, Flight Control 1-22
System, Fuel Quantity Gage 1-44, **1-45**
System, Fuel Supply 1-38, **1-42**
System, Groundspeed Radar, AN/APN-130 1-69
System, Heating, Ventilating, and Defogging 1-88, **1-89**
System, HF Communications, AN/ARC-39 1-63
System, Hydraulic Power Supply 1-31, **1-32**
System, IFF and SIF 1-67
System, Intercommunication 1-55
System, Landing Gear 1-33
System, Loud Hailer **1-58**, 1-59
System, MA-1 Compass 1-68
System, Pilots' Suit Ventilating 1-89
System, Rescue Boom (Fishpole) 1-37
System, Rescue Hoist 1-34
System, Rotor 1-20
System, Rotor Brake 1-19
System, Rotor Deicing 1-89
System, Single Point Fueling 1-44
System, Static Vent 1-84
System, TACAN 1-65
System, Transmission **1-18**, 1-18
System, Transmission Oil 1-19, **1-21**
System, UHF Communications, AN/ARC-52X with AN/ARA-25A DF Group 1-59
System, Windshield Anti-Icing 1-90
System, Windshield Washer 1-38
System, Windshield Wiper 1-37
Systems 1-6
Systems Check 3-16

T

TACAN, AN/ARN-52 (or AN/ARN-21) 1-65
TACAN Panel 1-65, **1-67**
Tachometer, Gas Generator 1-11
Tachometer, Triple 1-14
Tactical Display Plotting Board 1-73, **1-74**, 1-74
Tail Rotor **1-4**, 1-22
Tail Rotor Failure 5-6
Tail Rotor Gearbox 1-19
Tail Rotor Pylon **1-4**
Tail Rotor Pylon Tip **1-4**
Tail Wheel Lock Lever 1-34
Takeoff 3-17
Takeoff and Hover, Vertical 3-17
Takeoff, Before 3-12, **3-14**
Takeoff, Cold Weather Operation 6-7
Takeoff, Crosswind 3-18, **3-20**
Takeoff, Instrument 6-2
Takeoff, Maximum Gross Weight 4-10
Takeoff, Maximum Performance 3-18, **3-19**
Takeoff, Normal 3-17
Takeoff Procedures 3-17
Takeoff, Running 3-18, **3-19**
Tanks, Auxiliary Fuel Jettisoning 1-39, 5-8
Tanks, External Auxiliary Fuel, Flight With 4-3
Tanks, Fuel 1-39
Taxi Director 3-5
Taxi Pilots 3-5
Taxi Signals 3-5
Taxiing 3-5, 3-12
Taxiing, Before 3-12, **3-14**
Taxiing Procedure 3-17
Techniques, Turbulent Air Flight 4-10
Test and Maintenance Flights 2-3, 4-4
Test Pilot Qualification 4-3
Test Switch, Starter and Ignition System 1-11
The Aircraft 1-1
Thirty-Minute Fuel Caution Light On 5-13
Threading the Fishpole Eye 9-2, **9-3**
Thunderstorms and Turbulence 6-9
Tiedown, Shipboard Prelaunch **1-94**
Tire Pressures **1-93**
Topping 4-5, **11-11**
Topping Charts **11-11**
Torque Power Check 4-12
Torquemeter 1-15
Torquemeter Limits **1-101**
Towing 3-6
Towing Speed 3-6
Tracking, Blade 1-29
Training, Aircrewman Ground 2-1
Training, Familiarization 2-3
Training, Pilots' Ground 2-1
Training Requirements, Ground 2-1
Training Syllabus, Flight 2-4
Training Syllabus, Flight Support 2-3
Transfer Pump No. 1 Test, No. 1 Test Position 1-39
Transfer Pump No. 2 Test, No. 2 Test Position 1-39
Transfer Pumps 1-39
Transfers, Helicopter 3-39
Transfers of Personnel and Material 3-39
Transfers, Ship to Ship 3-39
Transformers 1-53
Transient Overtorque 1-98
Transitioning Naval Aviators, Recommended Requirements For 2-3
Transmission Oil Cooler 1-19
Transmission Oil Pressure Caution Light 1-19, 5-15
Transmission Oil Pressure Gage 1-19
Transmission Oil Pressure Limits **1-100**
Transmission Oil Specifications **1-93**
Transmission Oil System 1-19, **1-21**
Transmission Oil Temperature Gage 1-19
Transmission Oil Temperature Limits **1-100**
Transmission System **1-18**, 1-18
Transmission System Oil Pressure Caution Lights 1-19
Transmission System Oil Pressure Gages 1-19
Transmission System Oil Temperature Gages 1-19
Transmit-Standby Switch 1-72
Trim Check, Yaw 3-16
Trim, Cyclic 3-16
Trim Switch, Cyclic Stick 1-23
Trim Switch, Yaw 1-23
Trimming the Helicopter with ASE Engaged 1-28
Triple Tachometer 1-14
Tropical Operations 6-9
Truck and Crew 1-92
Turbine Anti-Ice Check 3-16
Turbine Anti-Ice Switch 1-11, **1-14**
Turbine/Inlet Anti-Icing 6-9
Turbine Inlet Temperature Gage 1-15
Turbine Inlet Temperature (T_5) 1-99
Turbulence and Thunderstorms 6-9

(Illustration page numbers appear in **boldface**)

ALPHABETICAL INDEX (Cont)

Page

Turbulent Air Flight Techniques 4-10
Turn and Slip Indicators **1-12**, 1-83
Turn Button, Coordinated 1-25
Turning Radius and Minimum
Ground Clearance **1-95**
Turns, Instrument 6-5
Turns on the Spot 3-18, 4-1
Twenty-Eight Volt Converter
Caution Light On 5-13
Two Engine Failure 5-2
Typical Ground Controlled
Approach **6-4**
Typical TACAN, ADF or LF
Range Approach **6-3**

U

UHF Communications Encoding
Equipment, Juliet 28
(AFC 152) 1-61, **1-62**
UHF Communications System
AN/ARC-52X with Direction
Finder Group AN/ARA-25A .. 1-59
UHF Radio Panel, AN/ARC-52X .. **1-61**
Unusual Attitudes 6-7
Updating the Manual ii
Use of Differential Cone Switch 5-14
Use of Differential Switch 1-31
Use of Hot Mike 9-2

Page

Utility Helicopter, Special
Problems of 3-37
Utility Receptacle, DC 1-54

V

Valley or Canyon, Wind Flow In **4-11**
Valve, Manual Diverter 1-40, **1-41**
Valves, Diffuser 1-89
Ventilating System 1-88
Ventilating System, Pilot's Suit 1-89
Vertical Takeoff and Hover 3-17, **3-18**
Visual Communications 7-1

W

Waiver of Requirements 2-2
Warning Light, Fire 1-15, 5-12
Warning Light, Radar
Altimeter **1-76**, 1-77
Warning Set, Radar Altimeter 1-76
Warning Set, Tone and Flashing
Light, Radar Altimeter 1-33
Warnings, Cautions, and Notes iii
Weapons System 8-1
Weather 3-37
Weather Conditions, Adverse 4-10
Weight and Balance 3-2
Weight Limitations 1-104

Pag

Wheel Brake Fluid Specifications **1-9**
Width 1-
Wind Direction and Velocity 4-
Wind Effect in Confined Area **4-**
Wind Flow in Valley or Canyon **4-1**
Wind Flow Over and Around Peaks **4-**
Wind Flow Over Gorge or Canyon .. **4-1**
Wind for Starting or Stopping
Rotors, Maximum **3-3**
Windshield Anti-Ice Switch 1-9
Windshield Anti-Icing System 1-9
Windshield Washer System 1-3
Windshield Wiper System 1-3
Wing Walker 3-
Wording ii
Written Examination, NATOPS 10-1

Y

Yaw Damper 1-2
Yaw Trim Check 3-1
Yaw Trim Switch 1-2,
Yaw Trim Switch When Under
ASE Control 1-2
Yellow Sheets 3-
Your Responsibility i

Z

Zig-Zag Plane Guard Pattern **3-3**

(Illustration page numbers appear in **boldface**)

1 AIRCRAFT

2 INDOCT

3 NORMAL PROCD

4 FLIGHT PROCD

5 EMERG PROCD

6 ALL-WTHR OPERATION

7 COMM PROCD

8 WEAPONS SYSTEMS

9 FLT CREW COORD

10 NATOPS EVAL

11 PERFORM DATA

APPENDIX

INDEX