

DOCUMENT RESUME

ED 226 191

CE 035 080

TITLE Search and Rescue Aircrewman/HH3F Flight Mechanic, 2-10. Military Curriculum Materials for Vocational and Technical Education.

INSTITUTION Coast Guard Inst., Oklahoma City, Okla.; Ohio State Univ., Columbus. National Center for Research in Vocational Education.

SPONS AGENCY Department of Education, Washington, DC.

PUB DATE May 81

NOTE 300p.; For a related document see CE 035 081.

PUB TYPE Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01/PC12 Plus Postage.

DESCRIPTORS *Aircraft Pilots; *Aviation Mechanics; Aviation Vocabulary; Behavioral Objectives; Correspondence Study; Engines; *Learning Activities; Learning Modules; *Mechanics (Process); Military Training; Postsecondary Education; Programed Instructional Materials; Secondary Education; Technical Education; *Units of Study; Vocational Education; Workbooks

IDENTIFIERS *HH 3F Helicopter; Military Curriculum Project

ABSTRACT This self-paced, individualized course, adapted from military curriculum materials for use in vocational and technical education, teaches students the skills needed to become a qualified avionics worker on the HH-3F helicopter. The course materials consist of three pamphlets: two student workbooks and a composite ground/flight syllabus. Each assignment in the first two pamphlets is divided into three parts: the reading assignment and objectives, the reading material, and the self-quiz with accompanying answers and text references. Subjects covered in the HH-3F avionics pamphlet are HH-3F helicopter systems, engine and rotor systems, helicopter transmission and other systems, flight systems, communication systems, navigation systems, Loran C Navigator, flight director systems, electronic flight aids, and avionics worker duties. The second pamphlet covers flight preparation, emergency procedures and equipment, hoisting, rescue platform and cargo sling procedures, and high-intensity searchlight system. The third pamphlet is a standardized syllabus designed to give the students training to become proficient and safety-conscious avionics aircrew workers. Materials are illustrated with line drawings. (KC)

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MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
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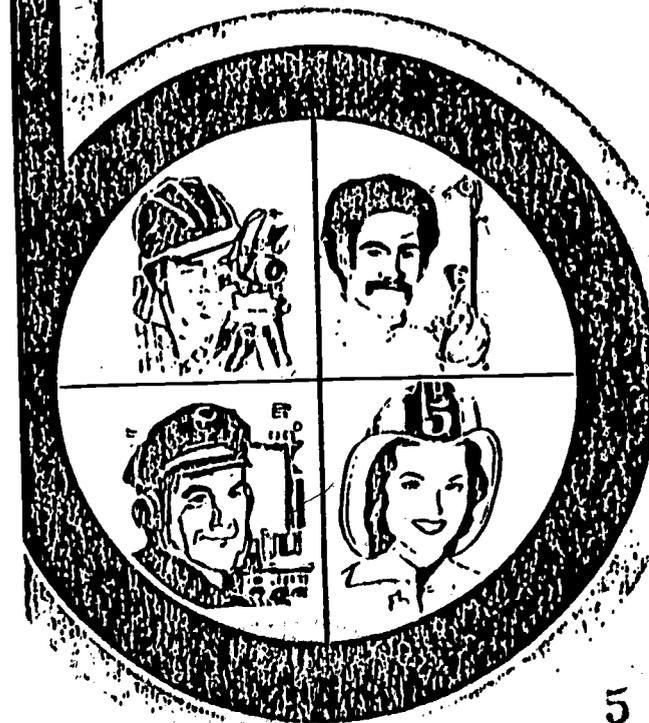
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Military Curriculum Materials for Vocational and Technical Education

Information and Field
Services Division

The National Center for Research
in Vocational Education



Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse
Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

Agriculture	Food Service
Aviation	Health
Building & Construction	Heating & Air Conditioning
Trades	Machine Shop Management & Supervision
Clerical Occupations	Meteorology & Navigation
Communications	Photography
Drafting	Public Service
Electronics	
Engine Mechanics	

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

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Springfield, IL 62777
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SAR AIRCREWMAN-HH3F FLIGHT MECHANIC 2-10

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ACH3FM-0443

Developed by:

United States Coast Guard

Occupational Area:

Aviation

Development and Review Dates:

May 1981

Print Pages:

271

Availability: The National Center for Research in Vocational Education; ERIC**Suggested Background:**

NONE

Target Audiences:

Grade 11 - Adult

Organization of Materials:

Student workbook with objectives, assignments, tests and answers. Also a composite ground/flight syllabus.

Type of Instruction:

Individualized, self-paced

Type of Materials:**No. of Pages:****Average Completion Times:**

HH-3F Avionics Student Workbook	185	Flexible
HH-3F Flight Prep Student Workbook	74	Flexible
HH-3F Avionicsman Standardized Workbook	25	Flexible

Supplementary Materials Required:

NONE

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Course Description:

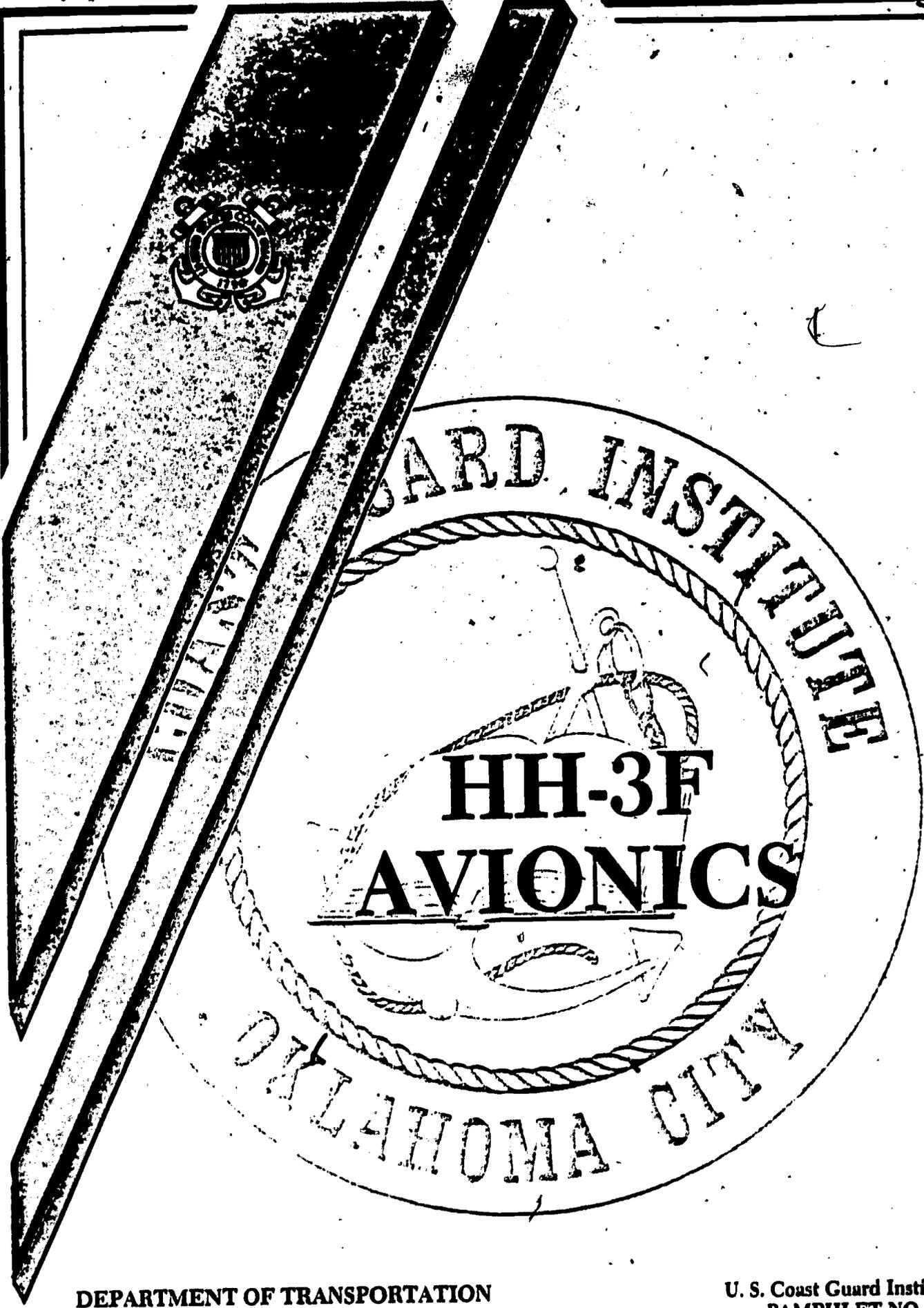
This course includes three pamphlets with the main purpose of becoming a qualified avionicsman on the HH-3F helicopter.

Each assignment in the first two pamphlets is divided into three basic parts; the reading assignment and objectives, the reading material, and the self-quiz with accompanying answers and text references.

Subjects covered in the HH-3F Avionics pamphlet are: HH-3F Helicopter Systems; HH-3F Engine and Rotor Systems; HH-3F Helicopter Transmission and Various Systems; HH-3F Flight Systems; HH-3F Systems; Communication Systems; Navigation Systems; HH-3F Loran C Navigator; Flight Director Systems; Electronic Flight Aids; and Avionicsman's Duties.

The HH-3F Flight Prep pamphlet covers: Flight Preparation; Emergency Procedures and Equipment; Hoisting, Rescue Platform, and Cargo Sling Procedures; and High-Intensity Searchlight System.

The third pamphlet is a standardized syllabus designed specifically to give the student training to become a proficient and safety-conscious avionics SAR aircrewman.



DEPARTMENT OF TRANSPORTATION
 U. S. Coast Guard (05/81)

U. S. Coast Guard Institute
 PAMPHLET NO. 658

HH-3F AVIONICS

Second Edition: August 1980
Revised: May 1981

**U.S. Coast Guard Institute
Aviation Branch
P.O. Substation 18
Oklahoma City, OK 73169**

FTS: 749-4464

**Questions about this text should be addressed to the Subject
Matter Specialist for the Aviation Electronics Technician Rating.**

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ACKNOWLEDGEMENT

This pamphlet contains original material developed at the Coast Guard Institute and also excerpts from:

USCG Communications Manual

CG-233

HH-3F Maintenance Instructions Manual

T.O.1H-3(H)F-1

HH-3F Flight Manual

T.O.1H-3(H)F-1

The Coast Guard Institute appreciates permission of these sources to use this material which contributes greatly to the effectiveness of this course. No copies or reproduction of the material is authorized without permission of the appropriate source.

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NOTICE TO STUDENT

The primary purpose of this self-paced, nonresident training pamphlet is to help you become qualified as an avionicsman on the HH-3F helicopter.

This pamphlet briefly covers the aircraft and aircraft systems; the communications and navigation systems are covered in detail.

IMPORTANT NOTE: This text has been compiled for **TRAINING ONLY**. It should NOT be used in place of official directives or publications. The text information is current according to the references listed. You should, however, remember that it is your responsibility to keep up with the latest professional information available for your rating. Current information is available in the Coast Guard Enlisted Qualifications Manual (CG-311).

The objectives for each assignment should lead you in the right direction for study purposes. The self-quizzes test your mastery of the objectives. When you complete all the assignments for the course and master each objective, you should have a thorough understanding of the material and should be ready to pass your End-of-Course Test.

REMEMBER -- You must receive a score of 80% or better to pass the End-of-Course Test. You should use your spare time to **REVIEW** the material before you take the EOCT.

SWE STUDY SUGGESTION: Servicewide exam questions for your rate and pay grade are based on the Professional and Military Requirements sections of the Enlisted Qualifications Manual (CG-311). If you use the references from this text and consult the Enlisted Qualifications Manual, you should have good information for review when you prepare for your servicewide exam. However, this course covers only a few of the qualifications tested on the SWE.

This course is only one part of the total Coast Guard training program. By its very nature, it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and the desire for accomplishment are also necessary to round out a successful training program.

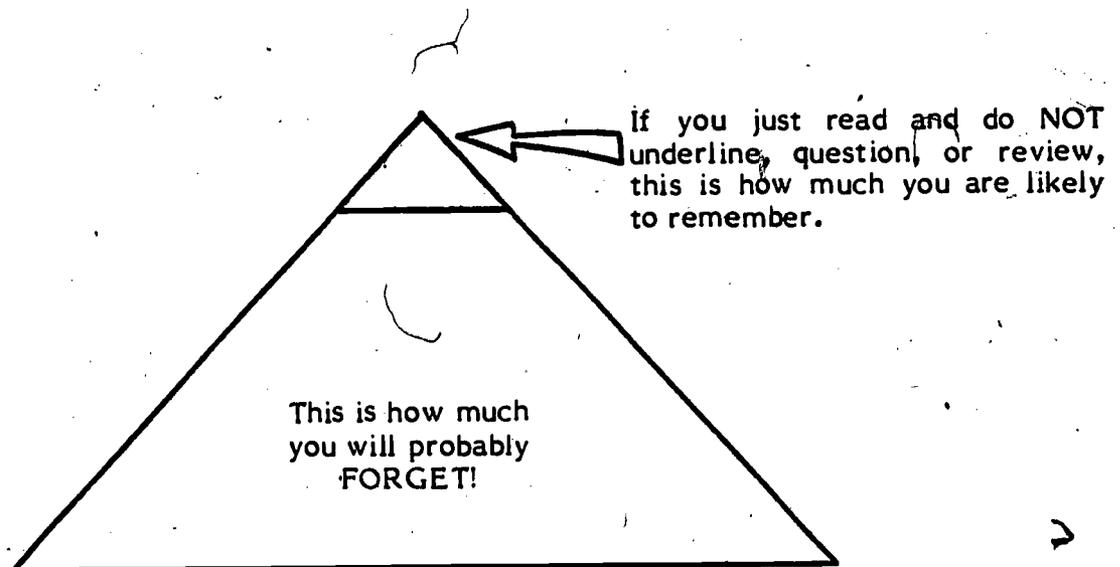
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HOW TO STUDY THIS COURSE

You can remember more of what you read if you

- 1 "Look over" the reading assignment first. Read the objectives and section headings, and look at the pictures. This gives you an idea of what to expect in the reading assignment and helps you understand the objectives.
- 2 Question the reading material. Ask yourself questions about a heading or a picture to help you remember what you read.
- 3 Note points to review later. Don't just run your eyes over a page. Underline important facts and make notes in the margin.
- 4 Close your pamphlet and repeat important points out loud. Discuss the reading assignment with someone if possible. This helps you recall information for a quiz or end-of-course test.
- 5 Review your underlined material, notes, quizzes, and objectives. This also helps you remember what you read.



HH-3F HELICOPTER SYSTEMS

Reading Assignment:
Pages 1-1 through 1-11.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the HH-3F helicopter's general characteristics, and dimensions.

HELICOPTER FAMILIARIZATION

The helicopter manufactured by Sikorsky Aircraft, Division of United Aircraft Corporation, Stratford, Connecticut, is equipped with a single main rotor, twin engines rated at 1,500 shp each, a fully retractable tricycle landing gear, amphibious capabilities, and hydraulically operated aft ramp that may be opened in flight, on the ground, or on water. The helicopter may be used as a general purpose vehicle to locate, recover, and render assistance to persons in distress. In addition, it may be used for logistic support, reconnaissance, and general utility. The maximum span with the main rotor blades rotating is 62 feet. The maximum length of the helicopter with the rotor blades extended is 73 feet. The height of the highest point of the helicopter (tail rotor) is 18 feet 1 inch. You may become familiar with the configuration of the helicopter by referring to the exterior and interior general arrangement illustrations. (Figures 1-1 and 1-2.) The helicopter's maximum gross weight is 22,050 pounds.

The fuselage is composed of the cockpit, the upper fuselage, the aft fuselage, the pylon, and the lower fuselage. The upper fuselage section contains the cargo compartment, the engine transmission, and APU compartments. The aft fuselage extends from the cabin to the pylon. The lower fuselage contains four fuel tanks and an electronics rack in the forward section. Sponsons are mounted on each side of the lower fuselage. The pylon is attached to the rear of the aft fuselage. A horizontal stabilizer is mounted on the upper right side of the pylon. The intermediate gear box is installed in the lower portion of the pylon with a shaft extending upward to

the tail rotor gear box at the top of the pylon. The five-bladed tail rotor is splined to the tail rotor gear box.

The cockpit provides side-by-side seating for the pilot and copilot, with the pilot on the right side. To the rear of the cockpit is the cabin. Access between the cockpit and the cabin may be used in flight. A folding jump seat is provided in the cockpit entry. A sliding cargo door is located on the right side of the forward end of the cabin. An 8-foot ramp is located at the rear of the cabin. The cabin accommodates two crewmen and six passengers. Two large windows, located in the forward cabin, will be used as search stations. Swivel-type crewman's seats are located adjacent to the search stations. Two electronics racks are located in the cabin; one immediately aft of the copilot and one in the aft portion of the cabin. A folding-type navigator's table is mounted on the electronics rack aft of the copilot and forward of the left crewman's seat. Structural provisions are made for 14 additional passenger seats and 15 USAF pole-type litters. The cabin is 6.6 feet wide, 6 feet high, and 26 feet 2.5 inches long. Eight feet of the length is ramp area. The cabin is equipped with tie-down rings for transportation of cargo. A 600-pound capacity hydraulic rescue hoist with approximately 240 feet of usable cable is suspended on a fixed truss over the cargo door.

Two gas turbine engines are mounted side by side in the engine compartment, located above the forward portion of the cabin. The engine drive shafts extend aft into the main gear box, located in the transmission compartment. The main rotor assembly, to which the five rotor blades are attached, is splined to the main gear box drive shaft. The APU,

located aft of the main gear box, is capable of driving the main gear box accessory section and is used for engine starting and checkout of systems. A removable deflector is installed to reduce the possibility of foreign object damage to the engines.

The HH-3F has three separate hydraulic systems.

DIMENSIONS

Length

Maximum main and tail rotor blades extended 73 feet 0 inches

Minimum main and tail rotor blades removed 57 feet 3.53 inches

Height

Maximum to top of tail rotor blade - vertical static 18 feet 1 inch

Kneeled 20 feet 2 inches

Tail rotor diameter 10 feet 4 inches

Minimum tail rotor blades removed 16 feet 1 inch

Width

Minimum main rotor blades removed 17 feet 4 inches

Main rotor diameter 62 feet 0 inches

Minimum Main Rotor Ground Clearance (Tip clearance - forward section) Static 10 feet 1 inch

Kneeled 7 feet 4 inches

Tail Rotor Ground Clearance Static 7 feet 9 inches

Kneeled 9 feet 11 inches

Tail Pylon Ground Clearance Static 6 feet 5 inches

Kneeled 8 feet 0 inches

Main landing gear tread 13 feet 4 inches

CABIN EQUIPMENT

The cabin (figure 1-3) located from station 137.0 to station 379.5, is capable of carrying cargo, personnel, litters, and wheeled vehicles. The impact and wear-resistant cabin floor has a positive non-skid surface for personnel footing, and skid strips to facilitate the movement of cargo and provide floor protection. The cabin floor is divided into six sections and is capable of sustaining static loads of 200 pounds per square foot. Tiedown fittings, rated at 2,500 pounds, are installed on the cabin floor to facilitate cargo tiedown, and are provided with fittings that serve as troop-seat and litter attachment points. The cabin contains a personnel door and a ramp, both of which may be used for loading personnel and cargo. When loading the helicopter, refer to T.O. 1-1B-40, Handbook of Weight and Balance Data.

CARGO LOADING STATIONS

The cabin is divided into marked cg stations between fuselage stations 150 and 375. Cargo loading scales, corresponding to these marked stations, are provided on the load adjuster. The cg loading stations are marked at eye level for easy reference.

CABIN FLOOR

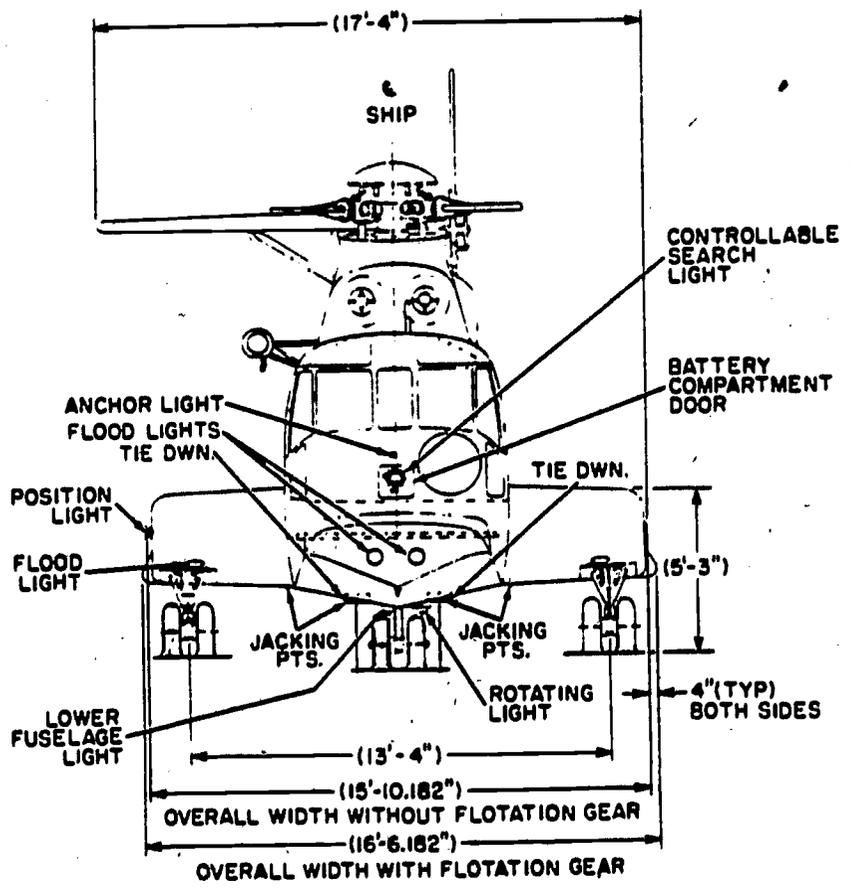
The cabin floor, made of 3/4 inch plywood floor panels, is supported by transverse bulkheads and beams. The cabin floor is approximately 310.5 inches long and 76 inches wide. The forward ramp forms the last 68 inches of horizontal floor. The floor has a positive non-skid surface. Three rows of low friction longitudinal skid strips are installed on top of the cabin floor to provide floor protection and facilitate cargo handling. The cabin floor area is designed to support a maximum load of 200 pounds per square foot; however, higher weights may be carried if shoring is used to distribute the weight over a larger area.

TIEDOWN FITTINGS

The type of tiedown fitting (figure 1-4) used is the combination cargo restraint and lug for troop seat and litter floor attachments. The recessed tiedown fittings have a 2,500-pound restraint capability. The 2,500-pound tiedown fittings are used to secure cargo, litter support straps, troop seat legs, and the crewman's safety harness.

TIEDOWN DEVICES

Various types of tiedown devices may be used for securing cargo. One type is a turnbuckle arrangement for tightening the tiedown chains, another is a webbed type strap with hooks for attaching to tiedown fittings.



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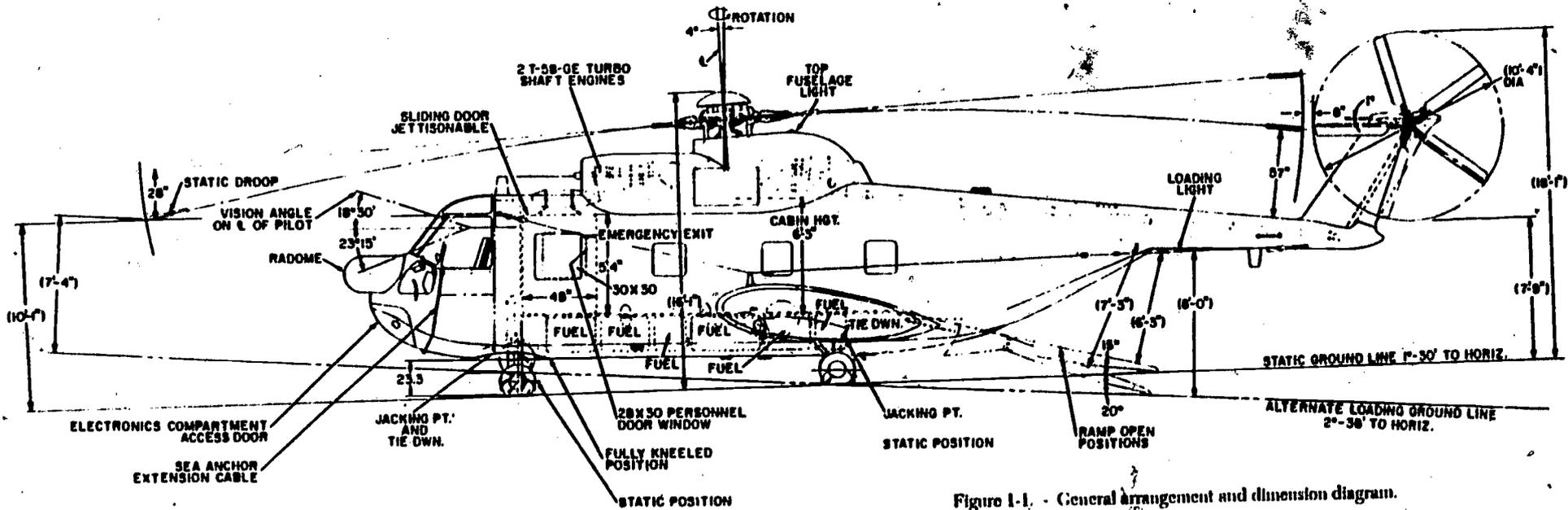
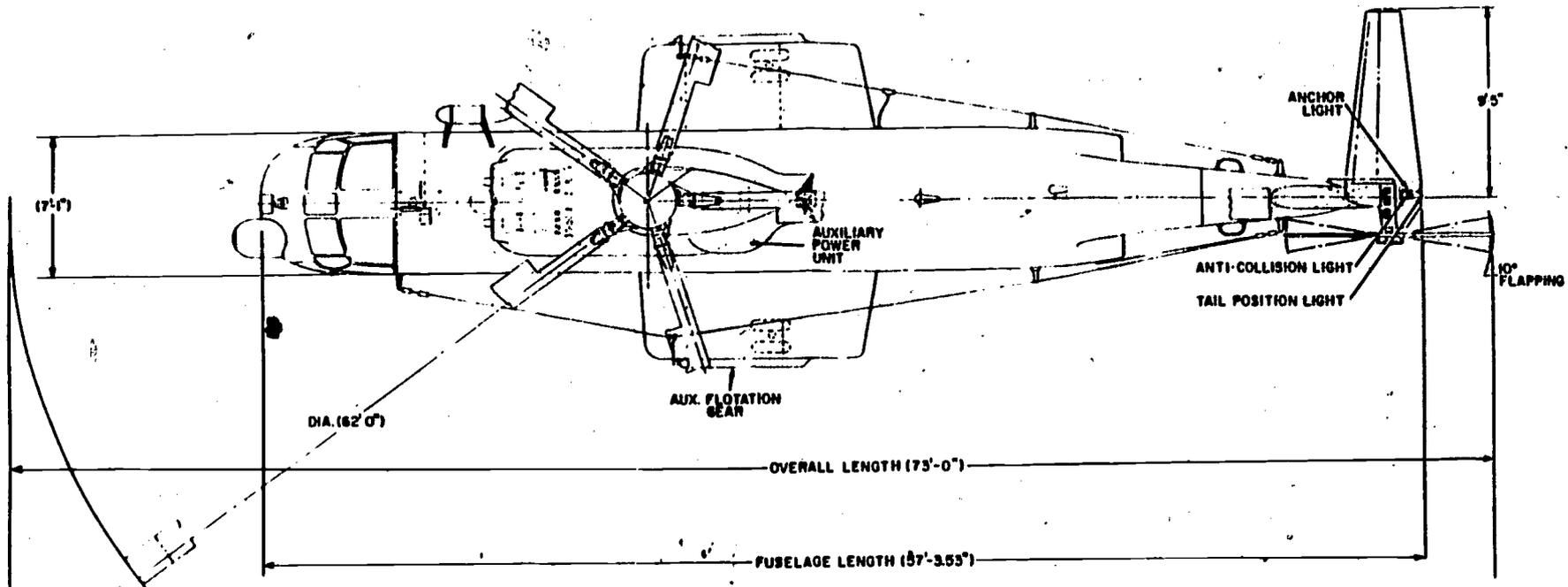


Figure 1-1. - General arrangement and dimension diagram.

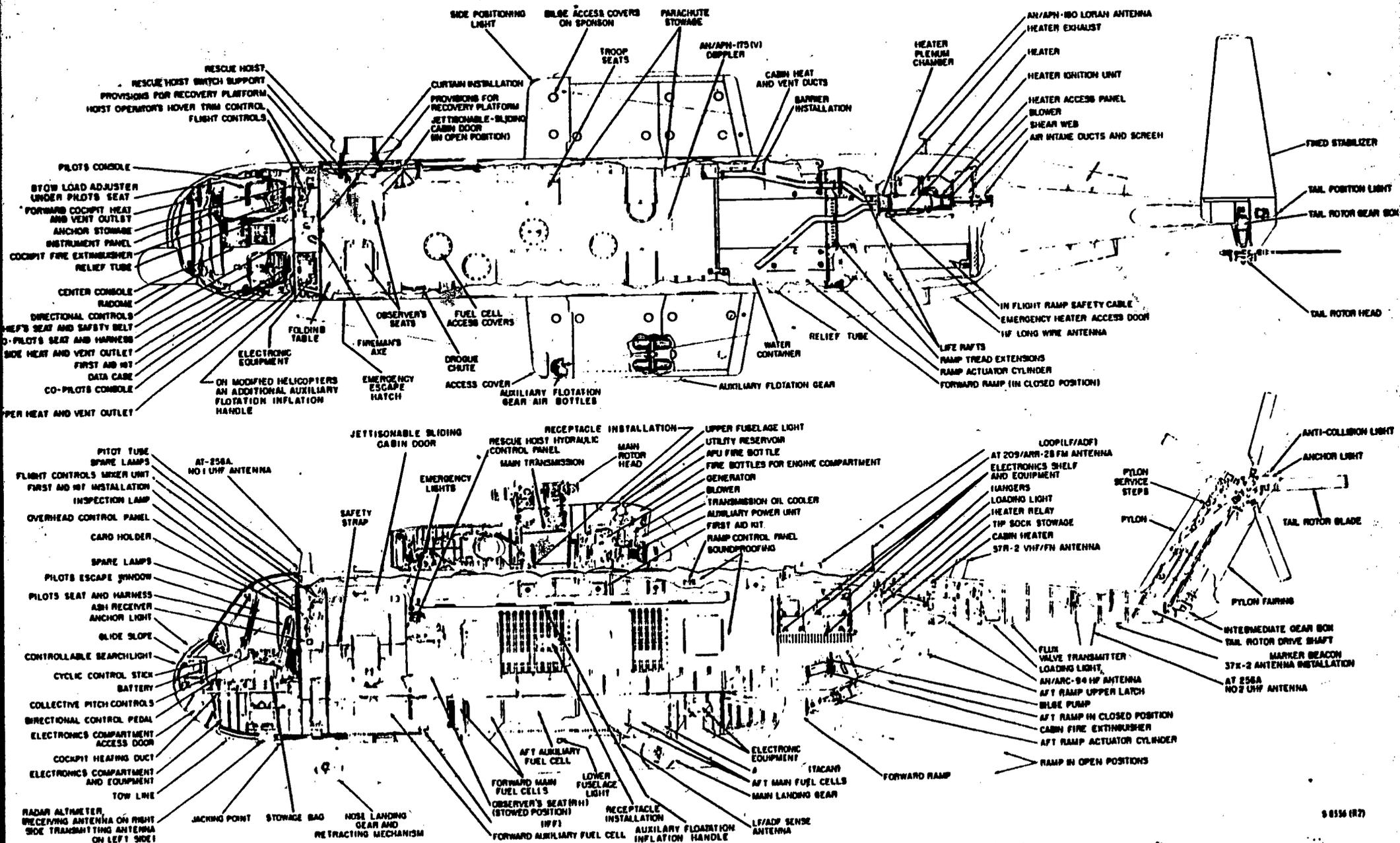
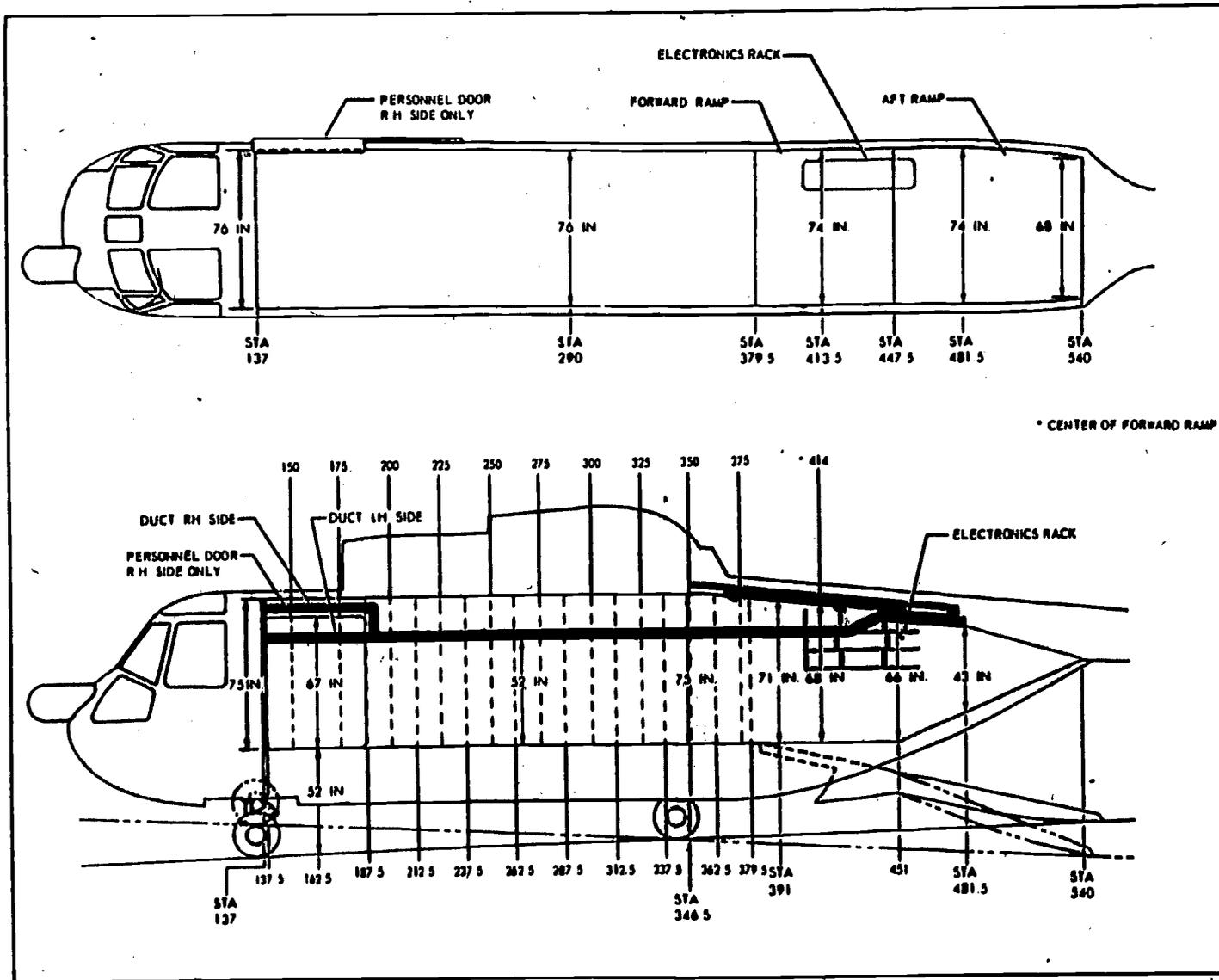


Figure 1-2. - Interior arrangement diagram.

Figure 1-3. - Cabin.



1-7

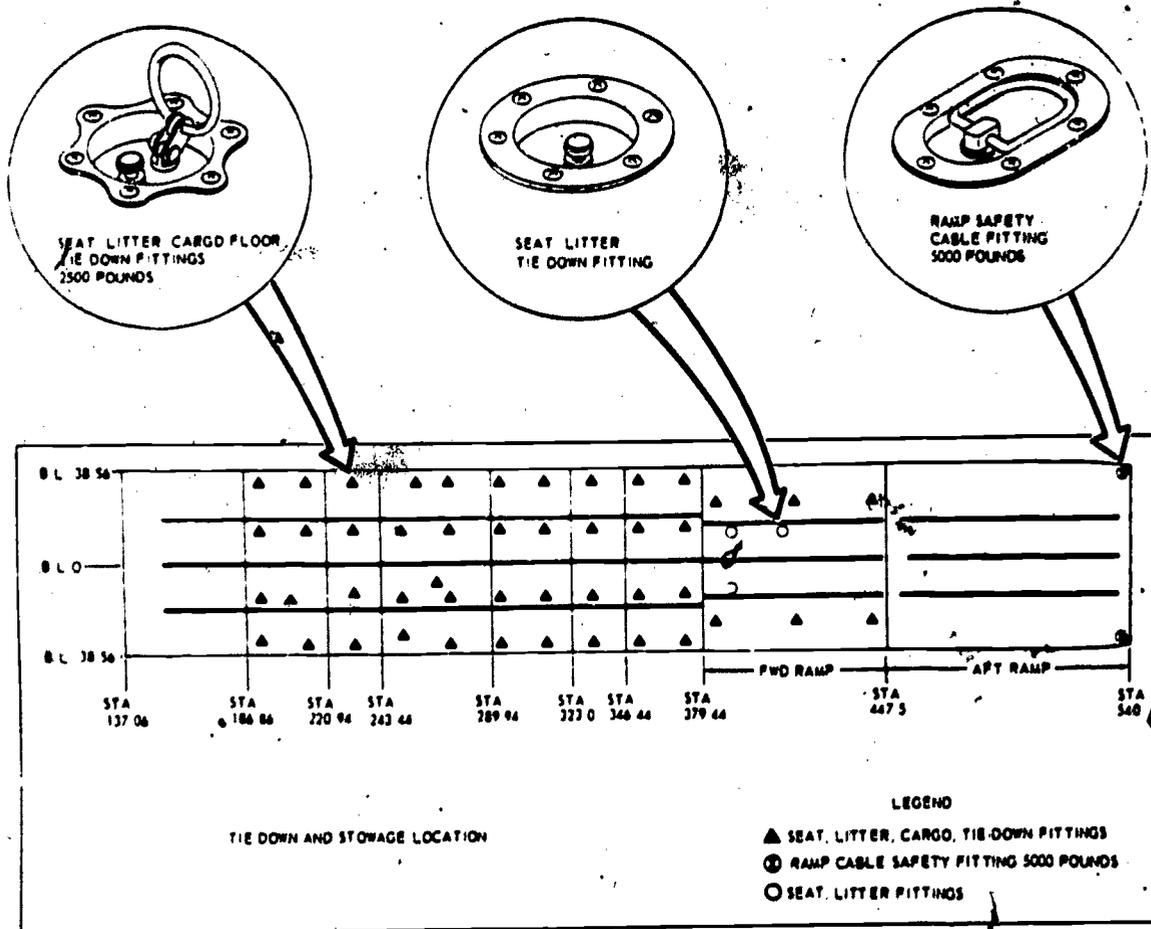


Figure 1-4. - Tiedown fittings, location.

FIRE DETECTION SYSTEMS

Three fire detection systems, one for each engine compartment and one for the APU compartment, provide warning in the event of fire. A single switch is used to test the three systems.

ENGINE AND APU COMPARTMENT FIRE DETECTION SYSTEMS

Four heat-sensitive fire detector elements, located in each engine compartment, are wired into a closed series loop and connected to control units. The elements are mounted on the inside of the engine compartment doors and on both sides of the center firewall. The fire detector elements terminate at the aft firewall. The control units, located overhead in the cargo compartment, continuously monitor the output of the detector elements. In event of fire in an engine compartment, the detector element senses excessive heat and the control unit will close the circuit to fire warning lights in the cockpit.

Power for the No. 1 engine fire detection system is supplied by the No. 1 AC primary bus through a circuit breaker, marked (FIRE DET), on the copilot's overhead circuit breaker panel. Power for the No. 2 engine fire detection system is supplied by the No. 2 AC primary bus through a circuit breaker, marked FIRE DET, on the pilot's overhead circuit breaker panel.

The APU fire detection system uses five probe-type detector switches mounted at strategic locations in the APU compartment. When any one of these switches senses excessive heat, it closes a circuit to the APU fire warning lights. Current is supplied from the DC primary bus through a circuit breaker, marked APU, FIRE DET, on the overhead circuit breaker panel.

Fire Warning Lights and Test Switch

When fire is detected in an engine compartment, two red master fire warning lights and red lights installed in the ends of the T-shaped fire emergency

shutoff selector handle for that engine will illuminate. The master fire warning lights marked FIRE are mounted in the instrument panel hood. One light is (10, figure 1-5) located in front of the pilot and the other (36, figure 1-5) in front of the copilot. Fire detected in the APU compartment causes illumination of a light marked FIRE located on the APU control panel, and a light marked APU Fire on the caution advisory panel. A fire warning test switch, marked FIRE WARN TEST, is located on the right side of the instrument panel. The switch is spring-loaded to the center (off) position and has two test positions marked NO. 1 ENG and NO. 2 ENG and APU.

The engine fire detection system is tested by holding the test switch in either test position. The two master fire warning lights and the respective fire emergency shutoff-selector handle lights should illuminate. The test switch should return to center when released, and all fire warning lights should go out. The APU fire detection system is tested by holding the test switch in the NO. 2 ENG and APU position. The fire warning lights will illuminate. Current for the engine fire warning test system is supplied by the AC and DC primary buses through appropriately marked circuit breakers. Current for the APU fire warning test system is supplied by the DC primary bus through a circuit breaker marked APU, FIRE DET.

FIRE EXTINGUISHING SYSTEMS

There are two similar Bromotrifluoromethane (CF₂BR) fire extinguishing systems. The engine compartments systems has two CF₂BR containers with associated circuitry and plumbing. The APU compartment system has only one container.

WARNING

CF₂BR is highly volatile and is not easily detected by odor. It is not toxic and is considered to be about the same as other freons and carbon dioxide, causing danger primarily by reduction of oxygen. Do not allow liquid to contact the skin because the liquid may cause frostbite or low temperature burns because of its low boiling point.

ENGINE COMPARTMENT FIRE EXTINGUISHING SYSTEMS

The CF₂BR containers, located aft of the main gear box, are charged with 2.5 pounds of CF₂BR

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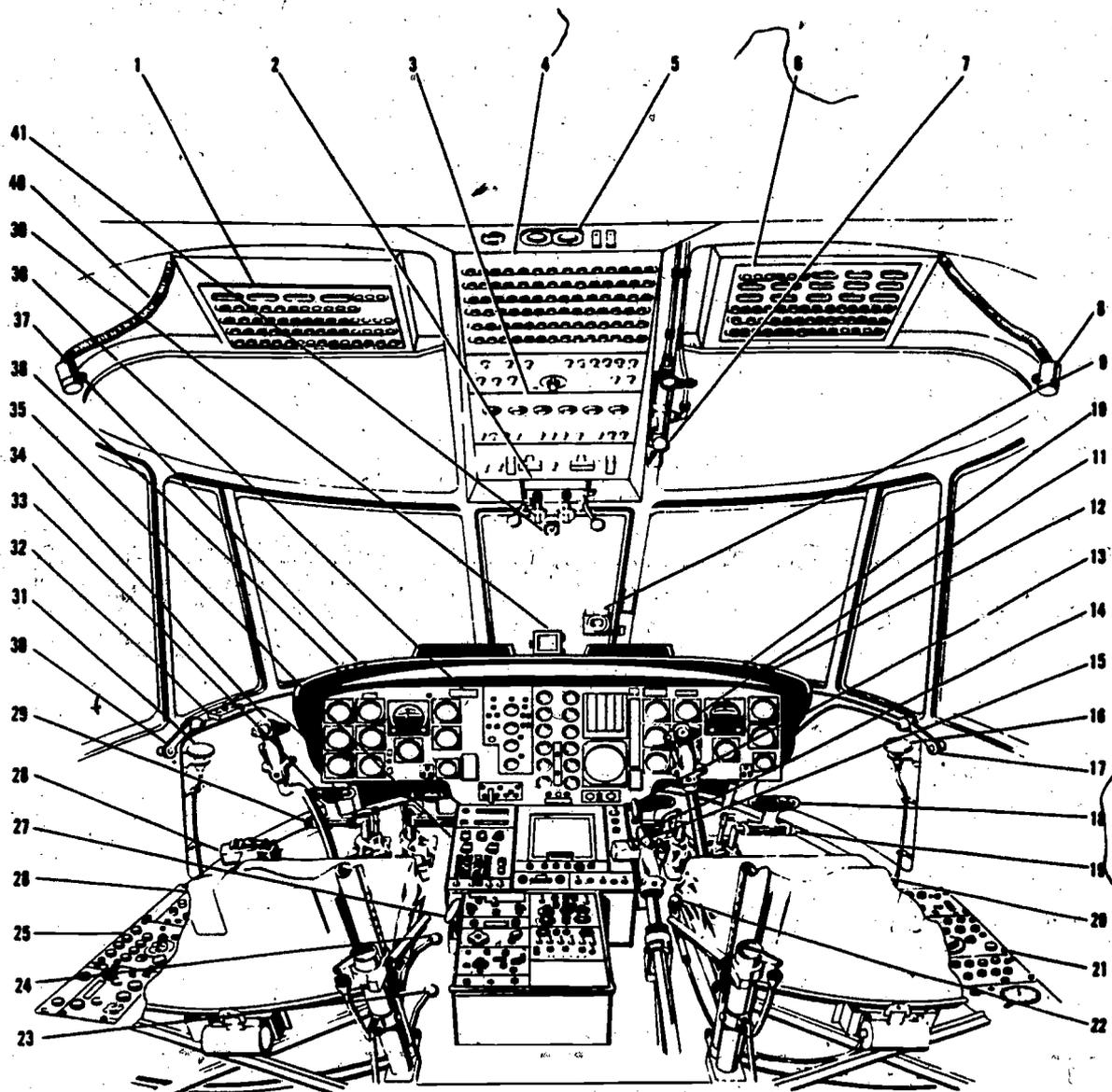
plus a nitrogen charge to propel the agent through tubing to the engine compartments. The tubes for each engine compartment are mounted on the center firewall with discharge nozzles directed at the combustion and power turbine sections of the engine. Each container is equipped with a pressure gage and a thermal discharge valve, which will allow discharge of the containers through a common line when the temperature of the containers reaches 96° to 104°C. (208°F to 220°F.). Each container is equipped with two frangible discs and two explosive cartridges and slugs. The tubing from the disc of each container is tied together to form a single line to each engine. Choice of engine compartment and explosive cartridges is made by pulling out the appropriate engine fire emergency selector handles. The explosive cartridge is fired and the extinguishing agent is discharged by use of the engine fire extinguisher switch. Current for the engine compartment fire extinguishing systems is supplied by the DC primary bus through the circuit breaker marked ENGINE FIRE EXT located on the overhead circuit breaker panel.

Engine Fire Emergency Shutoff Selector Handles

Two T-shaped handles, located on the overhead switch panel, are marked FIRE EMER SHUTOFF SELECTOR, NO. 1, ENGINE and NO. 2 ENGINE. When either handle is pulled down, power from the DC primary bus actuates the fuel shutoff valve, which closes the fuel for that engine, selects that engine compartment to receive the fire extinguishing agent, and energizes the circuit to the fire extinguisher switch. A fire warning light is located in each end of each handle.

Engine Fire Extinguisher Switch

An engine fire extinguisher switch, marked FIRE, EXT, located on the overhead switch panel in the pilot's compartment, has marked positions RESERVE, OFF, and MAIN. The lock lever type switch is operative only after one of the fire emergency shutoff selector handles has been pulled. When the engine fire extinguisher switch is held in the MAIN position, after a fire emergency shutoff selector handle has been pulled, the contents of the main fire extinguisher container are discharged into the corresponding engine compartment. When the engine fire extinguisher switch is held in the RESERVE position, after a fire emergency shutoff selector handle has been pulled, the contents of the reserve fire extinguisher container are discharged into the last selected engine compartment.



- 1. COPILOT'S CIRCUIT BREAKER PANEL
- 2. ENGINE CONTROL QUADRANT
- 3. OVERHEAD SWITCH PANEL
- 4. OVERHEAD DC CIRCUIT BREAKER PANEL
- 5. PILOT'S COMPARTMENT DOME LIGHT
- 6. PILOT'S CIRCUIT BREAKER PANEL
- 7. ROTOR BRAKE LEVER
- 8. PILOT'S MAP LIGHT
- 9. STANDBY COMPASS
- 10. FIRE WARNING LIGHT
- 11. PILOT'S CYCLIC STICK
- 12. MASTER CAUTION LIGHT
- 13. PARKING BRAKE HANDLE
- 14. NOSE WHEEL LOCK HANDLE
- 15. PILOT'S COLLECTIVE PITCH LEVER
- 16. PILOT'S TAIL ROTOR PEDAL ADJUSTMENT KNOB
- 17. PILOT'S WINDOW EMERGENCY RELEASE HANDLE
- 18. PILOT'S TOE BRAKES
- 19. PILOT'S TAIL ROTOR PEDALS
- 20. PILOT'S SEAT
- 21. PILOT'S CONSOLE

- 22. PILOT'S SHOULDER HARNESS LOCK LEVER
- 23. COPILOT'S SEAT HEIGHT ADJUSTMENT LEVER
- 24. COPILOT'S SEAT FORWARD AND AFT ADJUSTMENT LEVER
- 25. COPILOT'S CONSOLE
- 26. COPILOT'S SEAT
- 27. ALTERNATE LANDING GEAR HANDLE
- 28. COPILOT'S COLLECTIVE PITCH LEVER
- 29. COPILOT'S TAIL ROTOR PEDALS
- 30. COPILOT'S WINDOW EMERGENCY RELEASE HANDLE
- 31. COPILOT'S TAIL ROTOR PEDAL ADJUSTMENT KNOB
- 32. LOG LYS AND REMOVE ICS CONTROL PANEL
- 33. COPILOT'S TOE BRAKES
- 34. COPILOT'S CYCLIC STICK
- 35. COCKPIT CONSOLE
- 36. FIRE WARNING LIGHT
- 37. MASTER CAUTION LIGHT
- 38. INSTRUMENT PANEL
- 39. SCROLL CHECK LIST
- 40. COPILOT MAP LIGHT
- 41. FREE AIR TEMPERATURE GAGE

S 8577 (C4)

Figure 1-5. - Cockpit Arrangement.

Thermal Discharge Indicator

Two red thermal discharge indicators are located aft of the third window on the left side of the fuselage. The indicator marked ENG is connected through a common line to both engine fire extinguisher containers. The indicator marked APU is connected to the APU engine fire extinguisher container. When the temperature reaches 96°C. to 104°C. (208°F. to 220°F.) in any of the containers, the valve in that container will open to relieve pressure. The fire extinguisher agent will then be forced through the lines, eject the seal, and be discharged overboard.

APU FIRE EXTINGUISHER SYSTEM

The fire extinguisher system for the APU unit consists of a charged container of CF₃BR, located

adjacent to the APU compartment, with lines, nozzles, and controls similar to the engine compartment extinguisher system. The container holds 2.5 pounds of CF₃BR.

APU Fire Detector and Extinguisher Control Panel

The APU unit fire detector and extinguisher control panel is located on the APU control panel on the pilot's console. The APU fire extinguisher system is energized by first placing the toggle switch marked FUEL SHUTOFF and NORM, in the FUEL SHUTOFF position, then placing the toggle switch, marked FIRE EXTING and OFF, in the FIRE EXTING position. Power for this system is provided by the DC primary bus, through a circuit breaker marked APU, EXT.



SELF-QUIZ #1

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. Which of the following are features of the HH-3F helicopter?

- 1. Retractable nose landing gear
- 2. Five-blade tail rotor
- 3. A utility hydraulic system used to provide power for an automatic flight control system
- 4. An auxiliary power unit for driving the gear box accessories
- 5. Three separate hydraulic systems

- A. 1, 2, and 3 only
- B. 3, 4, and 5 only
- C. 1, 2, 4, and 5
- D. 1, 2, 3, and 4

2. What is the MINIMUM tail rotor ground clearance when the blades are rotating?

- A. 6 ft. 3 in.
- B. 6 ft. 6 in.
- C. 7 ft. 4 in.
- D. 7 ft. 9 in.

3. Tiedown fittings installed on the HH-3F cabin floor are rated at _____ pounds.

- A. 200
- B. 500
- C. 2,000
- D. 2,500

4. To sense excessive heat, the APU fire detection system uses _____

- A. only four fire detector elements
- B. only four probe-type detector switches
- C. five fire detector elements
- D. five probe-type detector switches

5. The FIRE EXT switch is placed in the MAIN position with neither of the FIRE EMER SHUTOFF SELECTOR handles pulled. What, if anything, should you expect to happen?

- A. The MAIN bottle will discharge into the last selected engine
- B. The circuit breaker will pop
- C. The MAIN bottle will be discharged into the thermal discharge tube
- D. Nothing

6. The purpose of the thermal discharge indicator in a fire extinguisher system is to indicate _____

- A. that the container has discharged due to an abnormally high container pressure
- B. that the container chemical has become overage
- C. that the container pressure has dropped too low to be effective
- D. the temperature of the chemicals within the container

ANSWERS TO SELF-QUIZ #1

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	1-1
2	D	1-2
3	D	1-2
4	D	1-8
5	D	1-9
6	A	1-11

HH-3F HELICOPTER ENGINE AND ROTOR SYSTEMS

Reading Assignment:
Pages 2-1 through 2-9

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

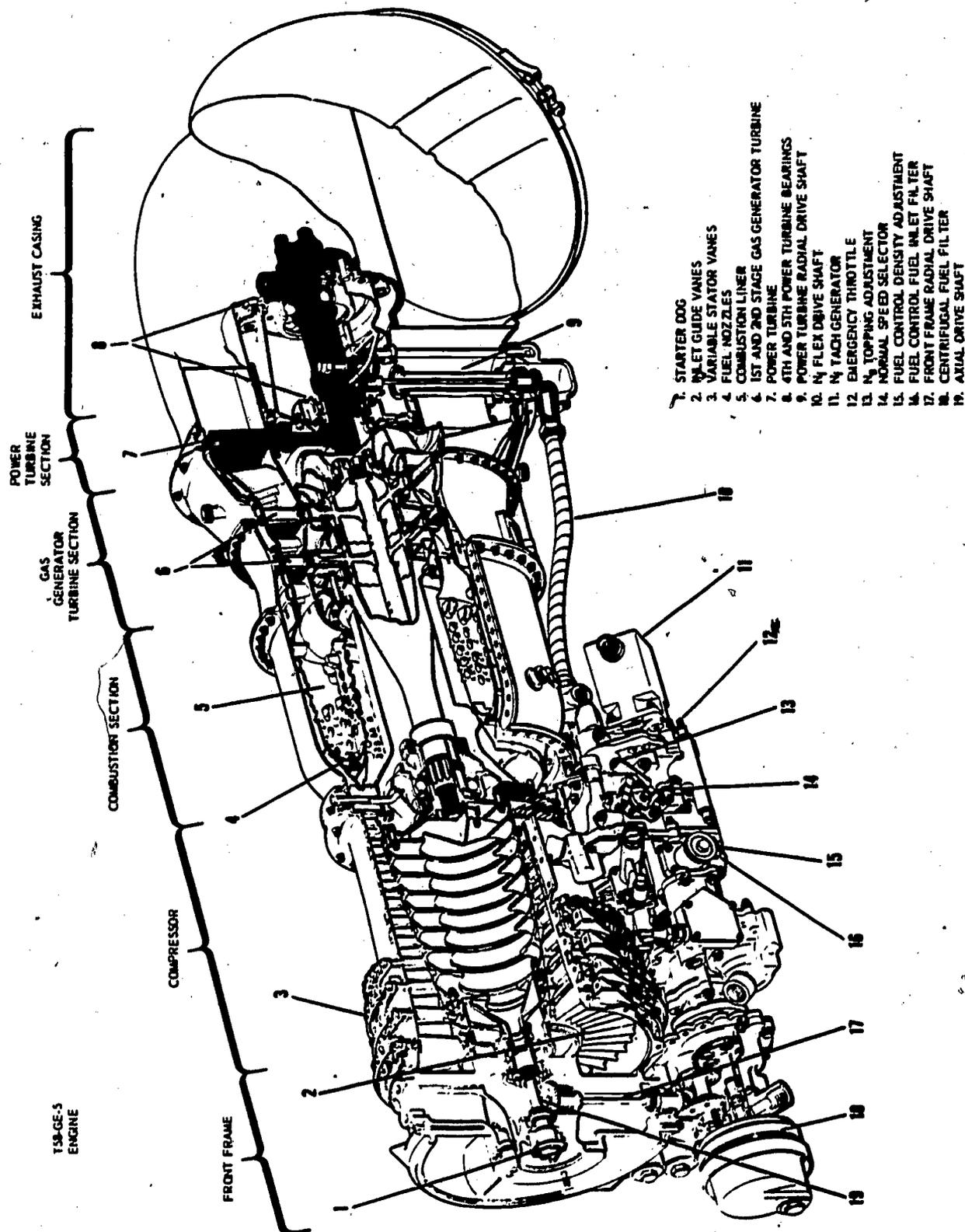
1. Explain the basic operation of the T58-GE-5 engine.
2. Describe the following engines systems:
 - a. Fuel
 - b. Oil
3. Explain the operation of the following rotor systems:
 - a. Main
 - b. Tail
 - c. Rotor brake.

ENGINES

The helicopter is equipped with two General Electric T58-GE-5 engines (figures 2-1 and 2-2), each rated at 1,500 shp. The engines are compact turboshaft engines with high power-to-weight ratio and use the free turbine principle. The power turbine is mechanically independent of the gas generator and, within the power turbine governing range, power turbine speed is independent of output power. High torque is available at low output speeds, providing rapid acceleration characteristics. The engines are mounted side-by-side above the cargo compartment forward of the main gear box. Each engine consists of the following major components: an axial-flow compressor, combustion chamber, a two-stage gas generator turbine, and a single-stage free power turbine, which is independent of the gas generator turbine. The gas generator consists of the compressor, annular combustor, and two-stage generator turbine.

The free turbine principle provides a constant free turbine speed output which results in a constant rotor rpm. Power requirements to maintain constant free turbine speed are varied by automatic increases

or decreases in gas generator speed. A hydromechanical fuel metering unit provides maximum engine performance without exceeding safe engine operating limits. In the normal operating range, engine speed is selected by positioning the speed selector. The integrated fuel control system delivers atomized fuel in controlled amounts to the combustion chamber. Flow of fuel and air through the combustion chamber is continuous, and once the mixture is ignited, combustion is self-sustained. Changes in air pressure, air temperature, and rotor operation all affect engine performance. With the FOD deflector installed, helicopter velocity has practically no effect on engine performance. The engine fuel control system automatically maintains selected power turbine speed by changing fuel flow to increase or decrease gas generator speed as required, thus regulating output power to match the load under changing conditions. A start bleed valve, mounted on the compressor, automatically opens during the starting cycle to bleed approximately 6.7% of compressor discharge airflow overboard. This decreases compressor discharge pressure, which lessens the possibility of compressor stall and allows the starter to accelerate the gas generator faster. The valve automatically opens when the starter is engaged and remains open until starter dropout. A



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Figure 2-1 - Engine cutaway view.

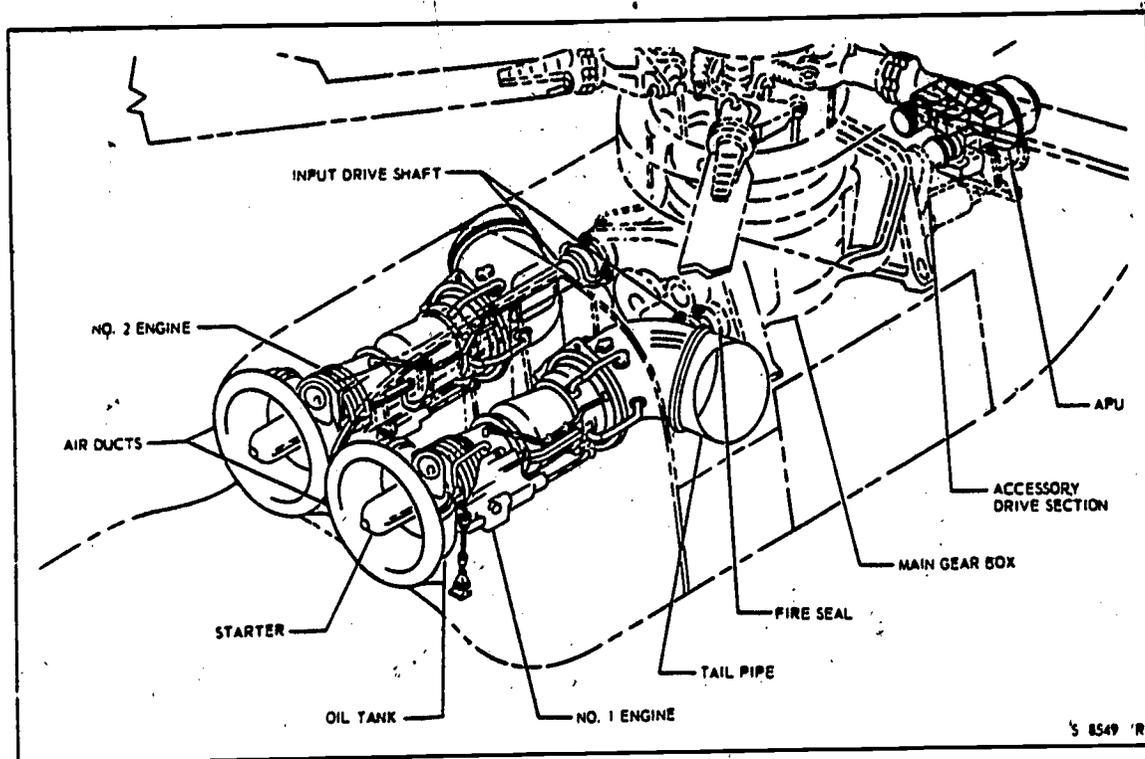


Figure 2-2. - Engine, main gear box, and APU installation.

port fuel valve is installed between the engine fuel control and flow divider. This valve, when closed, shuts off auxiliary starting fuel flow. The pilot may use the valve during the starting cycle to reduce starting fuel flow, which decreases the possibility of a hot start.

COMPRESSOR

The ten-stage compressor consists of the compressor rotor and stator. The compressor rotor is supported by the front frame section and the compressor rear frame section. The stator is bolted between the front frame section and compressor rear frame section. The stator is bolted between the front frame section and compressor rear frame. The primary purpose of the compressor is to compress air for combustion. Ambient air enters through the front frame and is directed to the compressor inlet, passes through ten stages of compression, and is directed to the combustion chambers. The inlet guides vanes (2, figure 2-1) and the first three stages of the stator vanes (3, figure 2-1) are variable, and change their angular position as a function of compressor inlet temperature and gas generator speed to prevent stall of the compressor.

COMBUSTION CHAMBER

In the combustion chamber, fuel is added to the compressed air. This mixture is ignited, causing a rapid expansion of gases toward the gas generator turbine section. As the air enters the combustion section, a portion goes into the combustion chamber where it is mixed with the fuel and ignited, while the remaining air forms a blanket between the outer combustion casing and the combustion liner (5, figure 2-1) for cooling purposes. Once combustion is started by the two igniter plugs, it is self-sustaining. After the air has been expanded and increased in velocity by combustion, it is passed through the first-stage turbine wheel of the gas generator turbine (6, figure 2-1).

GAS GENERATOR TURBINE

The two-stage gas generator turbine (6, figure 2-1) is the rotating component which is coupled directly to the compressor. The turbine extracts the required power from the exhaust gases to drive the compressor. The turbine nozzles that comprise the stator blades direct the exhaust gases to the turbine wheels.

2-3

POWER TURBINE

The power turbine (7, figure 2-1) is bolted to the rear flange of the second-stage turbine casing. The engine uses the free turbine principle wherein engine output power is provided by the power turbine rotor, which is mechanically independent of the gas generator rotor. This rotor derives its power from the gases which are directed to it by the gas generator turbine nozzles. Within the normal operating range, power turbine speed may be maintained or regulated independent of output power. This principle also provides more rapid acceleration because of the availability of high engine torque at low output speeds.

GAS GENERATOR SPEED (N_g)

Gas generator speed (N_g) is primarily dependent upon fuel flow and is monitored by the engine fuel control unit. The principal purpose of monitoring N_g is to control acceleration and deceleration characteristics, prevent overspeed, and establish a minimum idle setting. Gas generator speed controls mass air-flow pumped through the engine and consequently the power available to the power turbine.

FREE POWER TURBINE SPEED (N_f)

The free power turbine speed (N_f) is dependent upon speed selector position and rotor load. The fuel control monitors N_f to regulate fuel flow to maintain an essentially constant power turbine speed for a given speed selector position.

ENGINE FUEL SYSTEM

The engine fuel systems (figure 2-3), one for each engine, consists of an engine-driven pump, a dynamic filter, a fuel control unit, a static filter, an oil cooler, a flow divider, a fuel manifold, and associated piping. The fuel control unit is supplied fuel from the engine-driven fuel pump. Metered fuel from the engine fuel control unit is piped through an oil-fuel heat exchanger and then enters the flow divider connected directly to the fuel manifold on the engine. For normal flight, rotor speed is selected by positioning the speed selectors, and the engine fuel controls will meter fuel to maintain the selected rotor speed.

Engine-Driven Fuel Pump

A dual operation engine-driven fuel pump is mounted on each engine. The pump consists of a

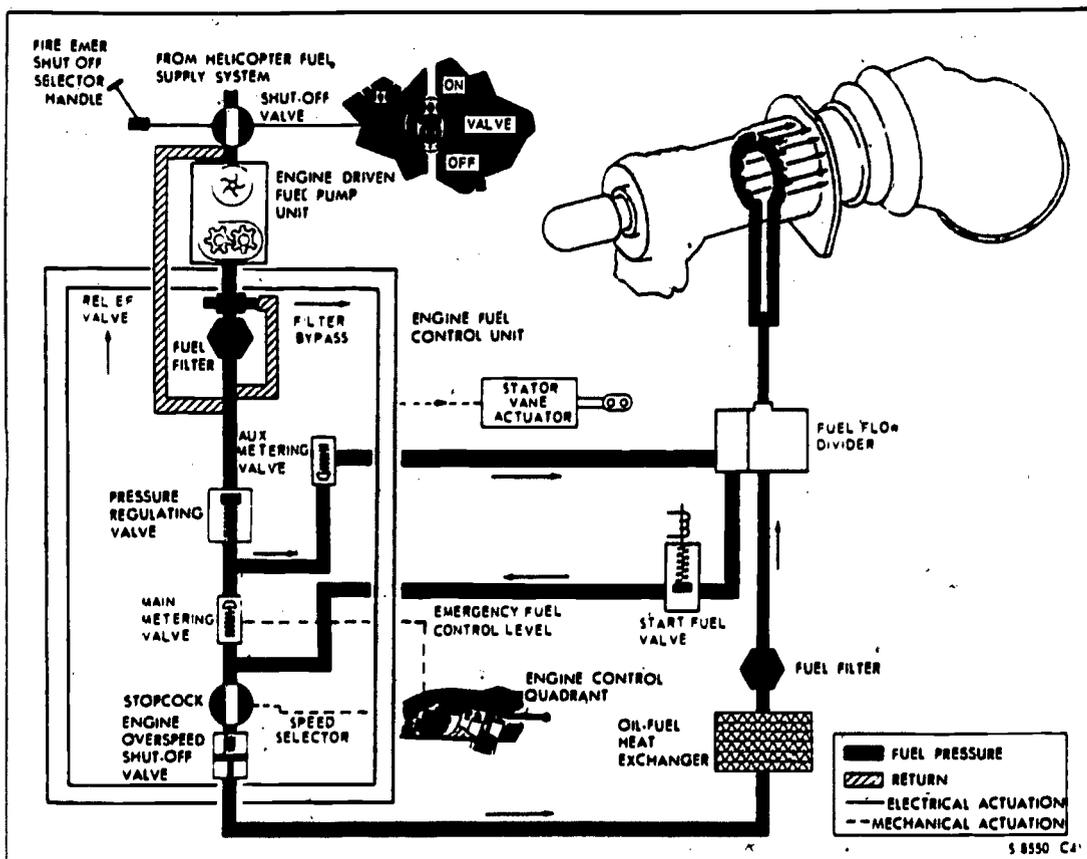


Figure 2-3. - Engine fuel system.

positive displacement type gear pump and a centrifugal boost pump and is built into a single housing. The engine accessory drive section furnishes power for each pump by means of a splined shaft. This shaft drives the fuel pump and simultaneously acts as a link to transmit gas generator speed information to the engine fuel control unit. If the engine-driven fuel pump or splined shaft fails, the engine will flame out due to fuel starvation.

Engine Fuel Control Unit

The engine fuel control units, one located on each engine, are hydromechanical units that regulate engine fuel flow to maintain a selected constant free power turbine speed and a constant rotor speed (N_r). Fuel from the engine fuel pump enters the fuel control unit through the inlet and passes through the fuel filter. The fuel control has a fuel metering section and a computing section. The metering section selects the rate of flow to the combustion chambers, based on information received from the computing sections. The metering section has a metering valve and a pressure regulating valve. The pressure regulating valve maintains a constant pressure across the main metering valve by bypassing excess fuel back to the engine fuel pump inlet. The metering valve is positioned in response to various internal operating signals, and meters fuel to the engine as a function of these intergrated signals. The engine fuel control unit prevents compressor stall, turbine overtemperature, rich or lean blowouts, governs gas generator idle and maximum speeds, and schedules inlet guide and stator vane positions to provide optimum compressor performance.

SPEED SELECTORS (ENGINE SPEED SELECTOR LEVERS)

Two speed selectors, marked NUMBER 1 ENGINE and NUMBER 2 ENGINE, are located on the overhead engine control quadrant. Marked positions on the overhead quadrant are SHUT-OFF, GRD IDLE, MIN GOV, and 100% SPEED. The speed selectors are connected directly to the fuel stopcock and indirectly to the fuel metering valve in the fuel control unit. When the speed selectors are in the SHUTOFF position, fuel flow to the fuel nozzles is stopped by means of a stopcock that prevents fuel from entering the combustion chambers. The stopcock is open whenever the speed selector is 6 degrees or more from the SHUTOFF position and is closed when the speed selector is 3 degrees or less from the SHUTOFF position. The GRD IDLE position schedules fuel flow to produce approximately 56 percent N_r . Gas generator idle speed will vary with inlet air temperature. A limit stop at GRD IDLE prevents inadvertent retarding of the speed

selectors below the idle speed of the engines. The speed selectors may be retarded from the limit stop by exerting a downward and rearward pressure on the speed selectors. The MIN GOV position of the speed selector is the point where the governing range of the power turbine is entered and is approximately 87% N_r . When the speed selector is at the full forward position, the engine is producing maximum power turbine speed. Engine speed trim switches are installed on the collective stick grip to provide accurate speed changes and engine synchronization. With the speed selectors in the governing range, any force tending to slow the rotor system, such as increases in collective pitch, will be sensed by the fuel control unit, which will attempt to maintain constant N_r/N_r by increasing power.

ENGINE SPEED TRIM SWITCHES

The engine speed trim switches, located on each collective lever grip, are used to make adjustments to power turbine speed and for engine synchronization. The switches, marked ENG TRIM, 1 and 2, + (plus) - (minus), provide electrical power to actuators in the overhead control quadrant, which are connected to the speed selectors. The pilot's engine speed trim switches will override the copilot's. Moving the ENG TRIM switches forward will cause increases in power turbine speed, and moving the switches aft will cause decreases in power turbine speed. When the desired power turbine speed is attained, the switches are released and will return to the spring-loaded center position. The switches are capable of advancing the speed selectors from shutoff to the ground idle detent and, if manually removed from the detent, to the full forward position. The switches are capable of retarding the speed selectors from full forward to 93 + 1% N_r . The ENG TRIM switches receive electrical power from the DC primary bus through circuit breakers under the general heading ENGINE (SPEED TRIM, 1-ENG-2), located on the center overhead DC circuit breaker panel.

EMERGENCY FUEL CONTROL LEVERS

Two emergency fuel control levers, one for each engine, marked EMER FUEL CONTROL, are located on each side of the engine control quadrant. The emergency fuel control levers operate independently and are used if the fuel control unit malfunctions. Each emergency fuel control lever has positive stops, marked OPEN and CLOSE, and is connected directly by a flexible cable and linkage to the main metering valve in each engine fuel control unit. The primary function of the emergency fuel control lever is to manually override the automatic features of the fuel control, and must be used with extreme caution.



ENGINE OIL SYSTEM

Each engine has an independent oil tank and dry sump full scavenge oil system (figure 2-4). Oil is gravity fed from the tank to the engine-driven oil pump mounted on the forward right-hand side of the engine. The engine-driven pump distributes oil, under pressure, through a filter to accessory gears and engine bearings. The oil serves both lubricating and cooling purposes, and the system is completely automatic. The scavenge side of the pump returns the oil through an oil cooler to the oil tank. The oil cooler is an oil-to-fuel heat exchanger with an associated oil bypass system. The oil flow through the cooler depends on oil temperature. At low oil temperature, most of the oil bypasses the cooler. Higher oil temperatures close the bypass valve and cause all of the oil to flow through the cooler. Each engine oil system has a useful capacity of 2.5 U.S. gallons of oil in a 3.0 U.S. gallon tank (0.5 gallon expansion space). The circular tanks are located around the forward section of each engine.

ROTOR SYSTEMS

The rotor systems consist of a single main rotor and an anti-torque tail rotor. Both systems are driven by the two engines through the transmission system and are controlled by the flight controls. (See figure 2-5.)

MAIN ROTOR SYSTEM

The main rotor system consists of the main rotor head assembly and the rotor blades. The head assembly, mounted directly above the main gear box, consists of a hub assembly and a swashplate assembly. The hub assembly, consisting of five sleeve-spindle assemblies and five hydraulic dampers clamped between two parallel plates, is splined to the main rotor drive shaft. The root ends of the five rotor blades are attached to the sleeve-spindle assemblies, which permit each blade to flap vertically, hunt horizontally, and rotate about their span-

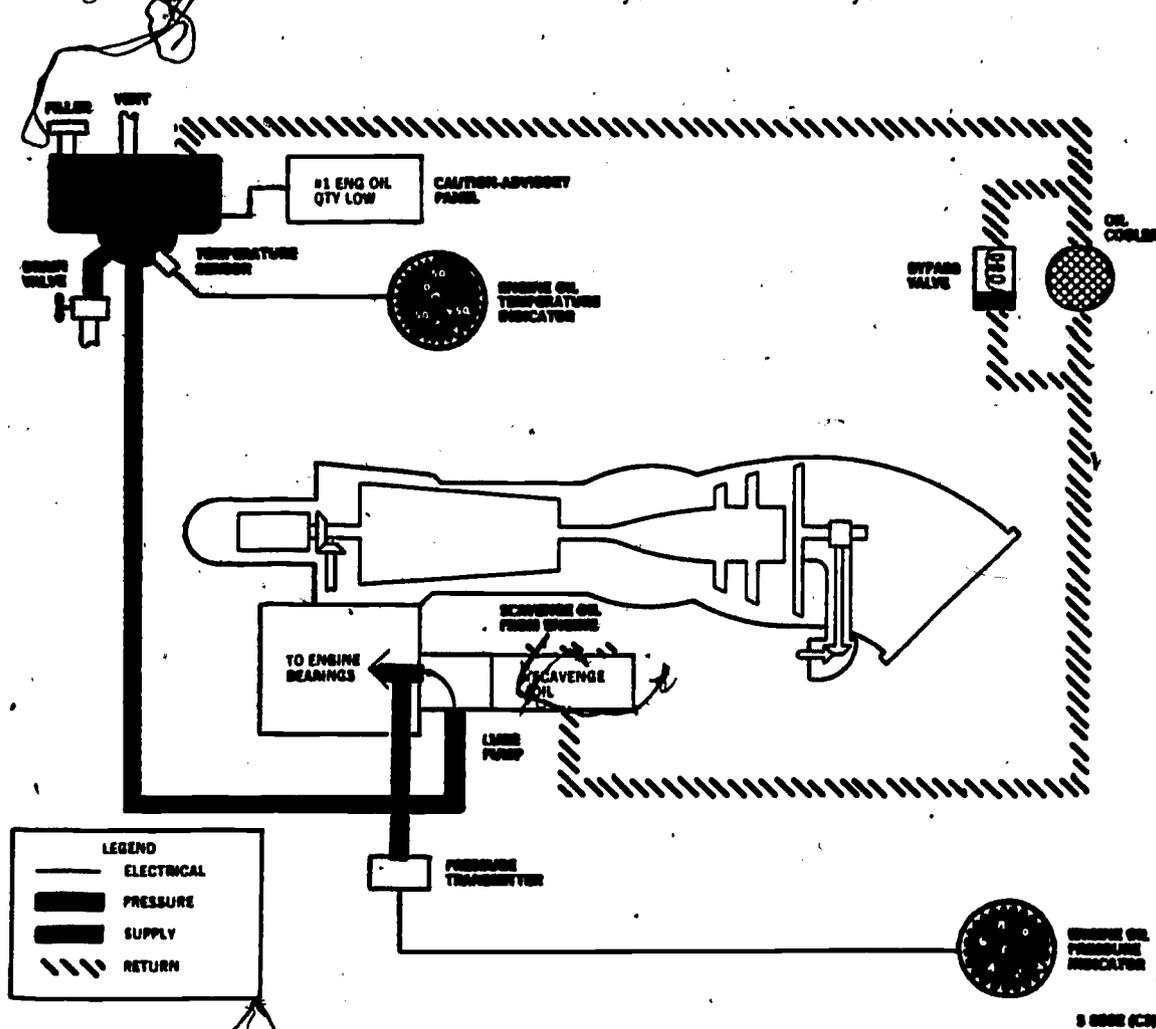


Figure 2-4. - Engine oil system.

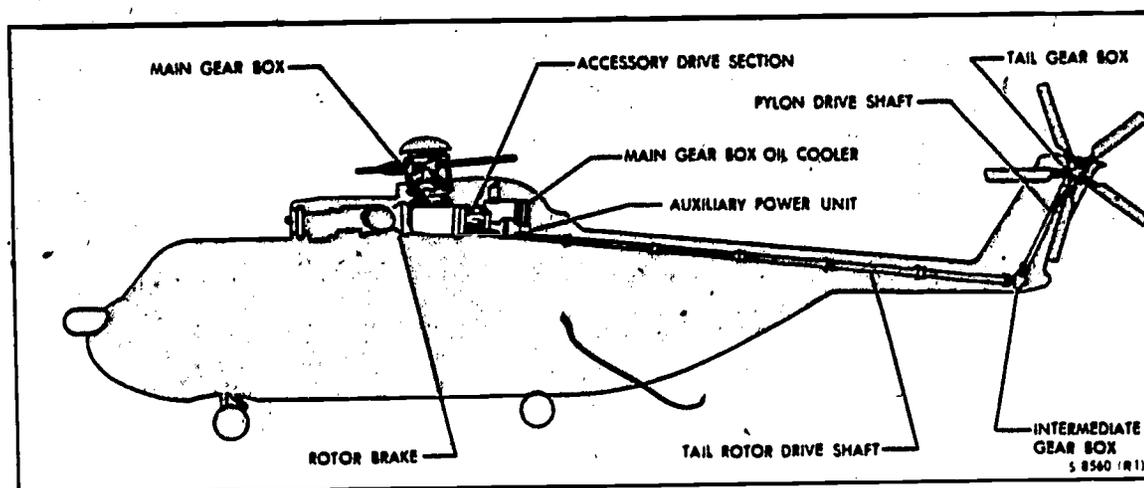


Figure 2-5. - Rotor systems.

wise axis. Anti-flapping restrainers limit the upward movement of the blades, and droop stops limit the downward movement of the blades. Both are in operation when the blades are stopped or turning at low speed. When speed is increased to approximately 25 percent (50 rpm) rotor speed, centrifugal force automatically releases the anti-flapping restrainers. The droop stops release at approximately 75 percent (152 rpm) rotor speed. The hydraulic dampers minimize hunting movement of the blades about the vertical hinges as they rotate, prevent shock to the blades when the rotor is started or stopped, and aid in the prevention of ground resonance.

The five all-metal main rotor blades are of the pressurized spar type, identified as BIM blades. The blades are constructed of aluminum alloy, with the exception of forged steel cuffs which attach the root ends of the blades to the sleeve-spindle assemblies on the main rotor hub. Each blade consists of a hollow extruded aluminum spar pressurized with nitrogen, 25 aluminum blade pockets, a tip cap, an aluminum root cap, a steel cuff, a pressure (BIM) indicator, an air valve, and an abrasion strip. Vent holes on the underside of each pocket prevent accumulation of moisture inside the blade. Each blade is balanced statically and dynamically within tolerances that permit individual replacement of the blades. In addition, a pretrack number is stenciled on each blade to eliminate the necessity for blade tracking. Balancing and the assignment of a pretrack number is done during manufacture or overhaul.

The swashplate assembly consists of an upper (rotating) swashplate, which is driven by the rotor

hub, and a lower (stationary) swashplate, which is secured by a scissors assembly to the main gear box to prevent rotation. Both swashplates are mounted on a ball-ring and socket assembly, which keeps them parallel at all times, but allows them to be tilted, raised, or lowered simultaneously by components of the main rotor flight control system, which connect to arms on the lower (stationary) swashplate. Cyclic or collective pitch changes, introduced at the stationary swashplate, are transmitted to the blades by linkage on the rotating swashplate.

Bifilar Absorber

The main rotor system is equipped with a bifilar absorber assembly to reduce fatigue stress and improve the overall vibration comfort level throughout the helicopter. The bifilar absorber assembly, secured to the main rotor hub, consists of a five-pointed, star-shaped, aluminum forging with a 17-pound weight attached to each star point. Each weight is enclosed by a fairing to reduce drag.

The HH-3F helicopter is equipped with an In-Flight Blade Inspection System (IBIS) that visibly indicates in the cockpit that the pressure in one or more main rotor blade spars has dropped below the allowable limit.

The IBIS indicator, located on the back wall of the spar of each main blade, contains a small radioactive source (100 microcuries strontium 90) which is completely shielded and emits no radiation when the rotor blade spar is at normal pressure. When the pressure in the rotor blade spar drops below 6.1 (± 0.4) psi, the indicator will activate,

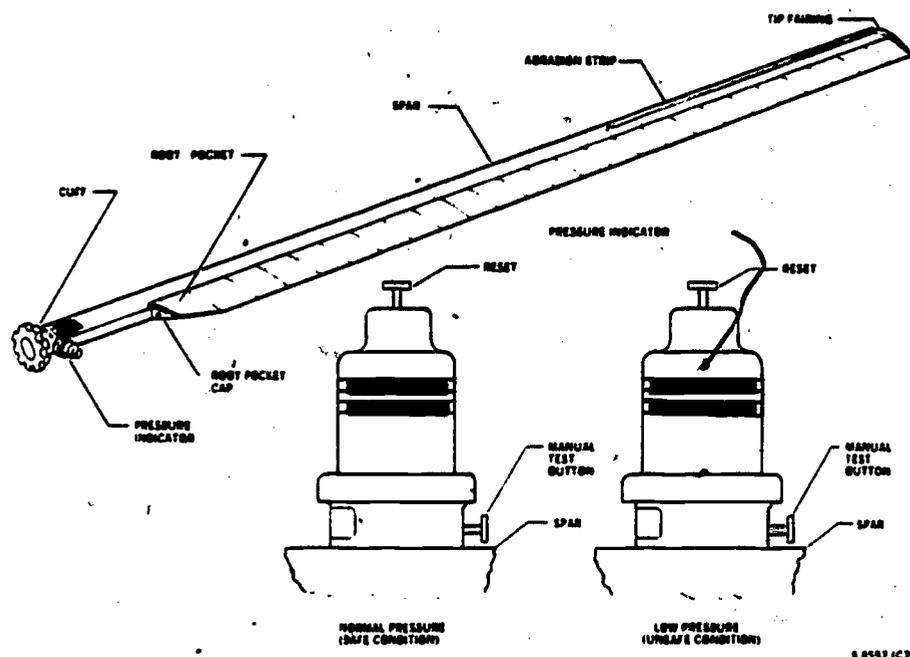


Figure 2-6. - IBIS indicator.

causing the radioactive source to move to an unshielded position, thereby emitting beta radiation. The detector assembly, located aft of the main rotor shaft under the transmission cowling, detects the beta radiation and sends a signal to the blade processor. This signal processor causes the **BLADE PRESS** light on the caution advisory panel to illuminate, indicating a loss of pressure in one or more of the blade spars. Loss of pressure in the blade spar is also indicated by the IBIS indicator located in the back wall of the spar of each main blade. The indicator, compensated for temperature changes, compares a reference pressure built into the indicator with the pressure in the blade spar. When the pressure in the blade spar is within the required service limits, two yellow strips show in the indicator. If the pressure in the blade spar drops below the minimum permissible service pressure, the indicator will be activated and will show two red stripes. Loss of 115 volt AC power, failure of the detector, and/or failure of the signal processor will cause the **BLADE PRESS** caution light to illuminate. The system receives electrical power from the No. 1 AC primary bus and is protected by a circuit breaker on the copilot's overhead circuit breaker panel marked IBIS, under the general heading NO 1 AC PRI. The **BLADE PRESS** caution light is powered by the DC primary bus, and is protected by a circuit breaker on the copilot's overhead circuit breaker panel marked IBIS, under the general heading DC PRI.

WARNING

When red is visible in the indicator, determine the cause of the red indication before accepting the helicopter for flight.

TAIL ROTOR

The tail rotor consists of the tail rotor assembly and tail rotor blades. The tail rotor assembly, mounted at the upper end of the pylon, consists of a tail rotor hub and pitch-changing mechanism. The splined hub is supported and driven by the horizontal output shaft of the tail gear box. The five tail rotor blades are attached to the tail rotor hub in such a way that they are free to flap and rotate about their spanwise axis for pitch variation. The blade pitch-changing mechanism transmits tail rotor control pedal movements to the tail rotor blades through the pitch change beam of the tail gear box (See figure 2-5).

ROTOR BRAKE

A hydraulically actuated rotor brake (figure 2-7), mounted on a brake shaft forward of the main gear box, stops the rotation of the rotor system and prevents its rotation, when the helicopter is parked. The rotor brake system consists of a hydraulic actuating cylinder and lever, pressure gage, hydraulic brake cylinders, rotor brake reservoir, and brake

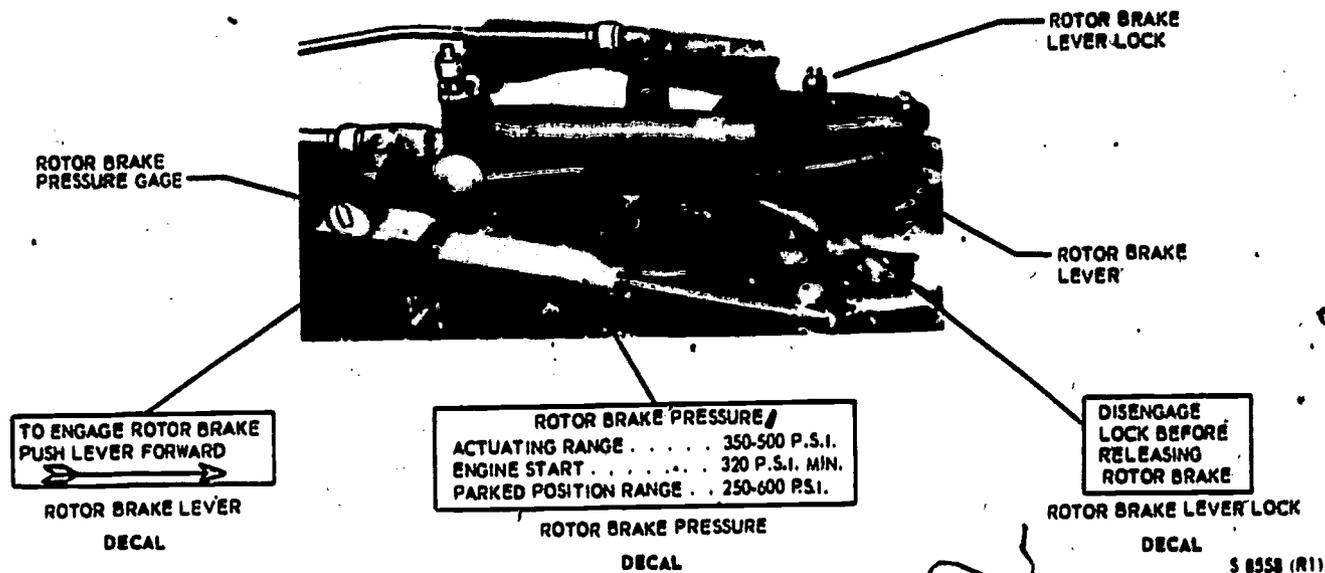


Figure 2-7. - Rotor brake.

disc. The rotor brake hydraulic actuating cylinder and lever, located on the pilot's compartment ceiling, operates independently from the hydraulic systems. A spring-loaded accumulator, connected to the rotor brake hydraulic lines at the forward end of the transmission compartment, assures continuous hydraulic pressure when the rotor brake lever is applied. The rotor brake hydraulic actuating cylinder in the cockpit is gravity fed with hydraulic reservoir, located on the right aft side of the main gear box. When filled to the FULL mark, the reservoir contains approximately 3.2 ounces of fluid. The hydraulic brake cylinders are located on supports attached to the main gear box. The brake disc is positioned on the main input shaft of the main gear box. The rotor brake system components are discussed in detail in the following paragraphs.

Rotor Brake Cylinder and Lever

A rotor brake lever (figure 2-7) is connected directly to the rotor brake hydraulic actuating cylinder on the pilot's compartment ceiling to the right and forward of the overhead switch panel. The rotor brake is applied by pulling down and pushing forward as indicated on the decal aft of the lever on the upper structure. The decal is marked TO ENGAGE ROTOR BRAKE PUSH LEVER FORWARD. The decal also has an arrow pointing forward. A spring-loaded lock, located at the forward outboard side of the cylinder, automatically locks the brake lever in the applied (forward) position if the pilot places the small handle on the horizontal, forward position. The lockpin must be pulled out to allow rotor brake

release. The lockpin may be rendered inoperative by rotating it until it remains in the OUT position.

Rotor Brake Pressure Gage

A hydraulic actuated rotor brake pressure gage is located to the rear of the rotor brake lever (figure 2-7) on the pilot's compartment ceiling. The reading is indicated by the pointer and indicates psi. A decal, marked ROTOR BRAKE PRESSURE, ACTUATING RANGE 350-500 PSI., ENGINE START 320 PSI MIN., PARKED POS. RANGE 250-600 PSI., is located adjacent to the rotor brake pressure gage. To ensure that the rotors will not turn with both engines in GRD IDLE, a minimum of 320 psi is required before the engines are started. For parking, 250-600 psi is the normal pressure range.

Rotor Brake Caution Light

The rotor brake caution light, marked ROTOR BRAKE, is located on the caution advisory panel on the pilot's side of the instrument panel. The light is provided as an aid in the prevention of rotor engagement while the rotor brake is engaged. Whenever the rotor brake hydraulic pressure is 10 ± 1 psi or above and electrical power is supplied to the DC primary bus, the caution light will go on. When the rotor brake pressure drops below 10 ± 1 psi, the light will go out. Normally with rotor brake off, pressure should be zero; however, after the rotor brake is released and pressure at 10 ± 1 psi or above is trapped in the system, the caution light will remain on. If the pressure reaches 20 psi, the pucks will begin to drag.

SELF QUIZ #2

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The HH-3F is equipped with two _____
 - A. T58-GE-8 engines rated at 1300 shp
 - B. T58-GE-5 engines rated at 1500 shp
 - C. T58-GE-8 engines rated at 1100 shp
 - D. T58-GE-5 engines rated at 1400 shp

2. The HH-3F engine centrifugal fuel filter is located _____
 - A. under the engine front frame
 - B. under the engine compressor section
 - C. above the engine fuel control
 - D. on the engine fuel control

3. What is the function of the fuel control?
 - A. Maintain a constant selected power turbine speed
 - B. Permit helicopter rotor speed to vary up to 50 percent
 - C. Vary the power turbine speed to maintain a constant helicopter rotor rpm
 - D. Maintain a constant helicopter rotor load to maintain a constant power turbine speed

4. The engine speed trim switches are located on _____
 - A. the overhead engine control quadrant
 - B. each cyclic pitch stick grip
 - C. each collective stick grip
 - D. pilot's overhead emergency console

5. Which statement is NOT true concerning the bifilar vibration absorber?
 - A. It is a five-armed aluminum forging
 - B. It uses a 17-pound steel weight
 - C. The bifilar arms have an H-beam cross section
 - D. Each weight is enclosed in a special fairing

6. What color on a blade pressure indicator indicates a NORMAL condition?
 - A. Gray
 - B. Green
 - C. Yellow
 - D. White

7. The tail blade pitch is changed by movement of the _____
 - A. output gear shaft
 - B. pitch change beam
 - C. counterweight assembly
 - D. flapping spindles

8. For effective rotor brake operation, you must develop a MINIMUM of _____ psi with the rotor brake handle.
 - A. 10
 - B. 100
 - C. 320
 - D. 600

ANSWERS TO SELF-QUIZ #2

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	2-1
2	A	2-2
3	A	2-5
4	C	2-5
5	C	2-7
6	C	2-8
7	B	2-8
8	C	2-9

HH-3F HELICOPTER TRANSMISSION AND VARIOUS SYSTEMS

Reading Assignment:
Pages 3-1 through 3-9

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the basic operation and characteristics of the:

1. Transmission system: Main gear box, intermediate gear box, tail gear box.
2. Transmission oil systems: Main, augmented main, intermediate and tail gear box.
3. Fuel supply system.
4. Electrical supply system.
5. Utility hydraulic supply system.

TRANSMISSION SYSTEM

The transmission system (figure 3-1) consists of three gear boxes that transmit power to the main and tail rotors. The main gear box reduces engine rpm and interconnects the two engines to the rotor head. A freewheeling unit, located at each engine input to the main gear box, permits the rotor head to autorotate without power turbine drag if the engine (or engines) fails, or when power turbine rpm decreases below rotor rpm. Engine torque is transmitted through the main gear box to the main rotor drive shaft to drive the main rotor, and aft through a tail rotor drive shaft to the intermediate gear box at the base of the pylon. From the intermediate gear box, a pylon drive shaft extends upward to the tail gear box to drive the tail rotor. Each of the three gear boxes has a chip detector.

MAIN GEAR BOX

The main gear box, mounted above the cargo compartment aft of the engines, is a four-stage reduction gear system which reduces engine rpm at a ratio of approximately 93.4 to 1 for driving the rotor head. The main gear box contains a spur, helical bevel gear, and a single planetary gear stage. Shafting extends from the main gear box lower housing to the intermediate gear box and then to the tail

gear box to drive the tail rotor. The main gear box accessory section, located at the rear of the main gear box lower housing, drives the primary, utility, and auxiliary hydraulic pumps, the main gear box oil pumps, the high pressure torque meter oil pump, and the two generators. The auxiliary power unit drives the accessory section of the main gear box on the ground before the engines are started. When the APU is operated at 100% speed, the APU drive shaft will drive the accessory section until the rotor reaches 100% N_r. The APU has a clutch, which contains a freewheel unit, that enables shutdown of the APU when the rotor head is engaged. There is a through shaft, driven by the No. 1 engine, in the main gear box. Under normal conditions with the rotor turning, the gear box accessories are driven by the tail takeoff drive unit, which is provided with a freewheel unit. If this freewheel unit fails, the through shaft will drive the accessories.

INTERMEDIATE GEAR BOX

The intermediate gear box, located at the base of the tail rotor pylon, contains a bevel gear direct-drive system to change the direction of the shafting that transmits engine torque to the tail gear box. The intermediate gear box is splash-lubricated. Screened air outlets in the pylon fairing permit the gear box to be cooled by the rotor downwash.

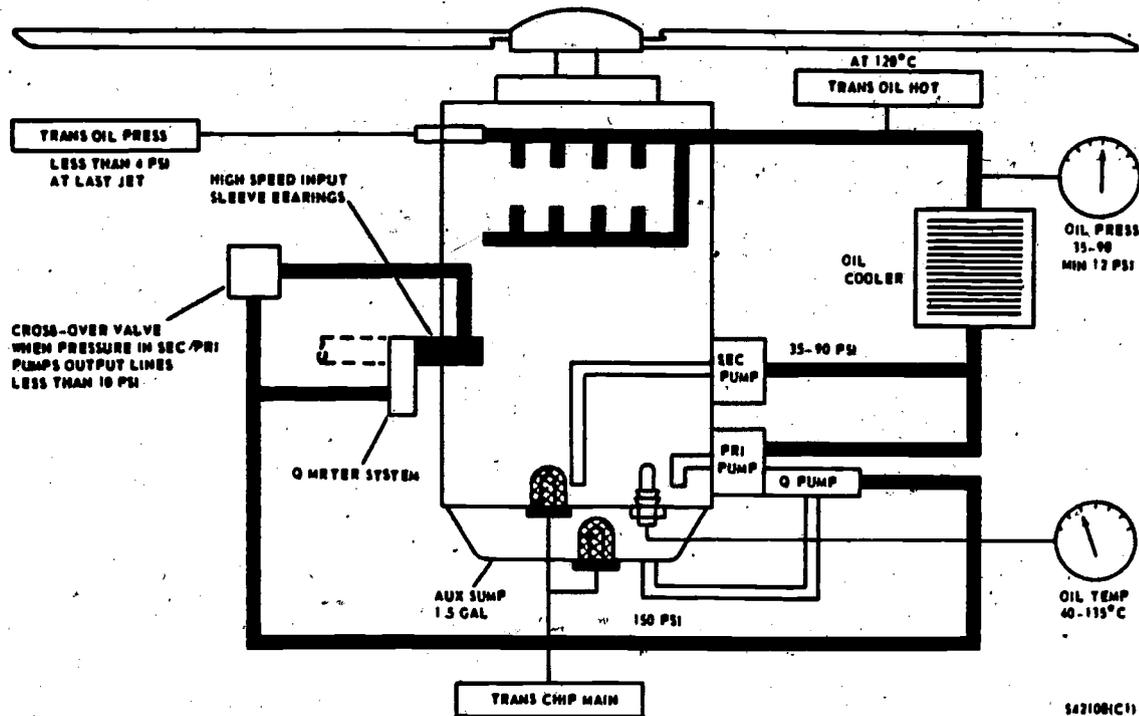


Figure 3-1. - Main transmission with auxiliary sump.

TAIL GEAR BOX

The tail gear box, located at the upper end of the tail rotor pylon, contains a bevel gear reduction-drive system to transmit engine torque to the tail rotor. The tail gear box also contains part of the pitch change linkage which extends through the hollow output shaft to the tail rotor hub. The tail gear box is splash-lubricated.

TRANSMISSION OIL SYSTEMS

Main Gear Box Oil System

(See figure 3-1)

Primary and secondary oil pumps are provided for lubrication. The torque system oil pump is mounted piggy back to the primary pump on the lower portion of the rear cover of the main gear box, and uses main transmission oil for the torque sensing system. The secondary oil pump is mounted between the utility hydraulic pump and the rear cover mounting pad. Oil is pumped from the gear box sump to the oil cooler located behind the main gear box. Cooling air is forced through the cooler by a blower driven by belts from the tail drive shaft. The air is then exhausted through a screened transmission accessories cooling air outlet at the rear of cooler, the oil returns to the main gear box where it is sprayed onto the gears and bearings through jets built into the gear box castings. An oil filler, acces-

sible from the left side of the main gear box fairing, is located on the left side of the gear box. A window in the gear box below the oil filler provides a sight check for the oil level in the main gear box. Oil capacity is 15 gallons; normal servicing is 11 gallons.

AUGMENTED MAIN GEAR BOX OIL SYSTEM

The augmented main gear box oil system will permit the helicopter to continue operating for approximately 45 minutes if there is a failure in the main lubrication system. In this case, the auxiliary sump, at the base of the main gear box, provides an oil supply of about 1.5 gallons to lubricate the input sleeve bearings in the high speed section of the main gear box. The torque meter pump uses oil from the auxiliary sump to lubricate these bearings and to supply oil to the torque sensing system. An additional chip detector is installed in the auxiliary sump and lights the XMSN CHIP MAIN caution light.

INTERMEDIATE AND TAIL GEAR BOX OIL SYSTEMS

Both the intermediate and tail gear boxes are splash-lubricated from individual sump systems. Internal spiral channels ensure oil lubrication to all bearings. An oil filler plug, drain plug, and oil level sight gage are located in each gear box casting. When the oil in the intermediate gear box is at

LL-JP-4, JP-5 OR OTHER APPROVED ALTERNATE FUELS

ALTERNATE APPROVED FUELS

ALTERNATE APPROVED FUELS-CONFORM TO ASM TYPE A-1, JET A-1

THESE FUELS LIMIT STARTING TO -25°F, NATO F-34,

ARCOJET-1

AMERICAN TYPE A-1

CALTEX JET A-1

440 UNIVERSAL TURBINE FUEL NO. 1

GULFLITE TURBINE FUEL A

ESSO TURBO FUEL 1-A

KEROSENE-AVIATION TYPE

PUREJET TYPE A-1

AEROSHELL 650

AVTUR 50

AVIATION TURBINE FUEL TYPE A

AVIATION TURBINE FUEL TYPE 1

CHEVRON TURBINE FUEL TYPE 1

ATF-1A

407 AVJET K-58

NOTE: MIXING OF FUELS IS NOT RECOMMENDED
BECAUSE OF PROBLEMS ENCOUNTERED
WITH FUEL CONTROL SETTINGS.

OIL, ENGINE, APU AND ALL GEAR BOXES

MIL-L-23699 NATO SYMBOL O-156

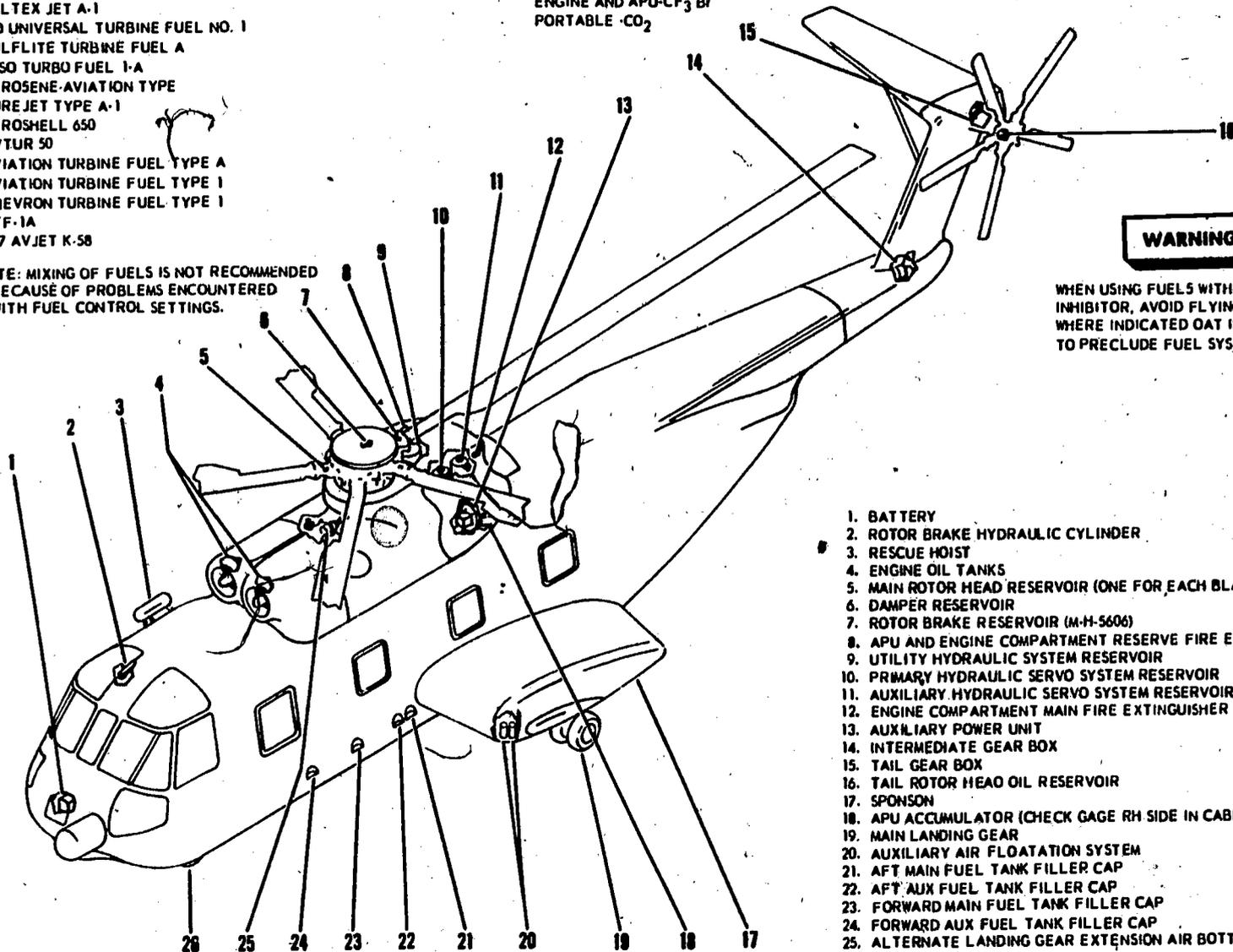
HYDRAULIC FLUID-PRIMARY, AUXILIARY
AND UTILITY SYSTEMS

MIL-H-5606-NATO SYMBOL H-515

FIRE EXTINGUISHER AGENT

ENGINE AND APU-CF₃ Br

PORTABLE -CO₂



WARNING

WHEN USING FUELS WITHOUT ICING
INHIBITOR, AVOID FLYING AT ALTITUDES
WHERE INDICATED OAT IS BELOW 0°C
TO PRECLUDE FUEL SYSTEM ICING.

1. BATTERY
2. ROTOR BRAKE HYDRAULIC CYLINDER
3. RESCUE HOIST
4. ENGINE OIL TANKS
5. MAIN ROTOR HEAD RESERVOIR (ONE FOR EACH BLADE)
6. DAMPER RESERVOIR
7. ROTOR BRAKE RESERVOIR (M-H-5606)
8. APU AND ENGINE COMPARTMENT RESERVE FIRE EXTINGUISHER BOTTLES
9. UTILITY HYDRAULIC SYSTEM RESERVOIR
10. PRIMARY HYDRAULIC SERVO SYSTEM RESERVOIR
11. AUXILIARY HYDRAULIC SERVO SYSTEM RESERVOIR
12. ENGINE COMPARTMENT MAIN FIRE EXTINGUISHER BOTTLE
13. AUXILIARY POWER UNIT
14. INTERMEDIATE GEAR BOX
15. TAIL GEAR BOX
16. TAIL ROTOR HEAD OIL RESERVOIR
17. SPONSON
18. APU ACCUMULATOR (CHECK GAGE RH SIDE IN CABIN)
19. MAIN LANDING GEAR
20. AUXILIARY AIR FLOATATION SYSTEM
21. AFT MAIN FUEL TANK FILLER CAP
22. AFT AUX FUEL TANK FILLER CAP
23. FORWARD MAIN FUEL TANK FILLER CAP
24. FORWARD AUX FUEL TANK FILLER CAP
25. ALTERNATE LANDING GEAR EXTENSION AIR BOTTLE
26. NOSE LANDING GEAR

S 8584 (R2)

Figure 3-2. - Servicing diagram.

FULL on the oil level sight gage the gear box contains 0.2 gallons. When the oil in the tail gear box is at FULL on the oil level sight gage, it contains 0.4 gallons.

FUEL SUPPLY SYSTEM

The helicopter is equipped with two independent pressure-type fuel systems, joined together by a crossfeed system to ensure maximum fuel utilization, and two internal auxiliary systems. The two main systems are divided into a forward and aft system and are augmented by the auxiliary systems. The main systems consists of fuel tanks with individual bladder-type cells, collector cans, and ejector units in which two submerged boost pumps are located. The auxiliary systems consist of a forward and aft tank with a bladder-type cell and ejector units. Transfer of fuel from auxiliary to main tanks is controlled by the pilot. The ejector system and boost pump arrangement provides for a minimum of unusable fuel.

The crossfeed system provides diversified main fuel system operation. The crossfeed system is electrically controlled by a crossfeed valve switch and allows fuel from both main systems to be directed to one engine during single-engine operation, or fuel from one system to supply both engines should the need arise.

Under normal conditions, the forward main system supplies fuel to the No. 1 engine, and the aft main system supplies fuel to the No. 2 engine. All tanks may be filled by either a pressure refueling system or by gravity through conventional filler necks on each tank. Auxiliary tanks may also be refueled through in-flight gravity refueling connections. For fuel specification grade, see figure 3-2.

FUEL TANKS

There are two main fuel tanks and two auxiliary fuel tanks located beneath the cabin floor in the following sequence from nose to tail: forward auxiliary tank, with a capacity of 184 gallons; forward main tank, with a capacity of 348 gallons; aft auxiliary tank, with a capacity of 245 gallons; and aft main tank with a capacity of 345 gallons (figure 3-3).

The forward main tank system, consisting of two cells, contains one collector can, five check valves, two pressure switches, two pump failure caution light circuits, one primary bus powered boost pump, one monitor bus powered boost pump, one flapper valve, one pressure refueling and defueling valve, one fuel ejector unit, one gravity filler, two sump drain valves, one dual high-level sensor, and two float-operated shutoff valves. The aft main tank system, consisting of two cells, contains the same items as the forward main tank except that it has one instead of two float-operated shutoff valves. The fuel boost pumps within each main tank provide fuel to the associated fuel ejectors and the appropriate engine. The boost pumps are located in collector cans.

FUEL QUANTITY DATA

FUEL TANKS	USABLE		UNUSABLE		FULLY SERVICED	
	US GALLONS	POUNDS	US GALLONS	POUNDS	US GALLONS	POUNDS
FWD MAIN	344.6	2239.9	3.48	22.62	348	2262.0
AFT MAIN	342.4	2225.6	2.61	16.96	345	2242.5
FWD AUXILIARY	183.2	1190.8	0.8	5.20	184	1196.0
AFT AUXILIARY	244.2	1587.3	0.8	5.20	245	1592.5
TOTAL	1114.4	7243.6	7.69	49.98	1122.0	7293.0

1. Usable fuel determined at 0 degree nose-down attitude.
2. Fuel density of 6.5 lb/gal (JP-4) at standard day temperature.
3. Gravity refueling method used.

Figure 3-3. - Fuel quantity data.



The fuel level in the collector cans is maintained by ejector and flapper valve action. This fuel ejector unit and boost pump arrangement provides integral fuel transfer within each main tank at all operating attitudes, and provides for a maximum of usable fuel.

The single-cell forward auxiliary fuel tank system contains one check valve, one gravity filler, one fuel ejector, one sump drain valve, one pressure refueling and defueling valve, one dual high-level sensor, one gravity refueling connection in the cabin, and one motor operated gate valve. The single-cell aft auxiliary fuel tank system contains the same items as the forward auxiliary tank system except that it has two check valves, two motor-operated gate valves, and two fuel ejectors. All fuel tank vent lines are routed through the cabin to minimize vent icing, then to both sides of the helicopter, where the tanks are vented to the atmosphere.

FUEL TRANSFER

Three DC motor operated gate valves located in the fuel ejector motive flow lines enable the pilot to have complete control of fuel transfer. Fuel is transferred from auxiliary to main tanks by fuel ejectors; motive flow is obtained from the boost pumps. Fuel in the forward auxiliary tank can be transferred only to the forward main tank. A float-operated shutoff valve prevents overfilling of the forward main tank. Fuel from the aft auxiliary tank can be transferred to either the forward or aft main tank. Float-operated shutoff valves prevent overfilling of either main tank. When either main tank level is above 1,600 pounds, any attempt to transfer fuel will result in a transfer to the auxiliary tank in use due to the inability of the fuel to pass the float-operated gate valve in the respective main tank.

CAUTION

Do not transfer fuel when main tank level is above 1,600 pounds, because fuel may be forced overboard through the auxiliary tank vents if the auxiliary tank fuel level is high.

Fuel Transfer Switches

Two fuel transfer switches are located on the fuel management panel. The switch marked AFT AUX, OFF controls the transfer of fuel from the aft auxiliary tank to the aft main tank. The switch marked FWD AUX, OFF, AFT AUX controls the transfer of fuel from the forward auxiliary tank and the aft auxiliary tank to the forward main tank. The switches are powered by 28 volts DC from the primary bus

and are protected by circuit breakers, marked TRANSFER, 1, 2, 3, located on the overhead circuit breaker panel.

NOTE

The position of the fuel transfer lines may cause fuel to feed from the auxiliary to the main fuel tanks without the use of a transfer system. This condition occurs when the fuel level in the auxiliary tank is above the fuel transfer lines and at the same time the fuel level in the main tanks is lower.

FUEL DUMP SYSTEM

Fuel may be dumped at a limited rate from either main tank, or from both main tanks simultaneously, through a single overboard drain located in the trailing edge of the right sponson. Fuel flow is provided by the fuel boost pumps. Two manually operated dump valves, one for each main tank, are located overhead in the forward area of the cabin. The dump system is activated by holding or locking over center one or both of these valves in the open position. Rate of dump from one tank is approximately 80 pounds per minute and from both tanks approximately 160 pounds per minute.

PRESSURE REFUELING SYSTEM

The pressure refueling system consists of one external pressure fueling adapter, four dual high-level sensors, and four pressure refueling and defueling valves, one in each tank. The location of the pressure fueling adapter directly beneath the cabin door permits refueling while the helicopter is in a hover. Each dual high-level sensor contains one primary and one secondary valve, each of which can be solenoid operated during precheck or float operated by fuel level. The shutoff capability of the system is tested by positioning the high-level shutoff switch, located above the fueling adapter, to PRI TEST and SEC TEST independently. This energizes the corresponding solenoids of all four dual high-level sensors. The solenoids raise the floats electrically, which in turn close the pressure refueling/defueling valves, stopping flow into all tanks. When the switches are returned to the OFF position, the floats operate in conjunction with the fuel level of each tank. When each tank reaches full capacity, its dual high-level sensor closes its pressure refueling and defueling valve and stops fuel flow into that tank. Electrical power for the system TEST is supplied by the 28-volt DC primary bus through the HI-LEVEL SHUTOFF TEST circuit breaker on the overhead circuit breaker panel.

PRESSURE DEFUELING SYSTEM

Limited pressure defueling is accomplished by attaching the pressure fueling nozzle to the pressure refueling adapter and applying suction. Fuel will then be drawn from all tanks simultaneously until one of the four tanks is empty. Defueling will then cease from the remaining tanks due to air ingestion from the empty tank. The amount of fuel remaining in the various tanks depends entirely on the initial quantities of fuel in each tank.

ELECTRICAL POWER SUPPLY SYSTEM

The electrical power supply system consists of an alternating current power supply system and a direct current power supply system. Two permanent magnet generators (PMG) supply 115/200-volt, three phase, 400 Hz AC power to the electrical system. Three transformers provide 26-volt single phase AC power. Both generators also supply 28-volt DC power to the electrical system control circuits. Two converters provide 28-volt DC control and operating power. One battery supplies 24-volt DC power.

ALTERNATING CURRENT POWER SUPPLY SYSTEM

Alternating current power is supplied by two generators designated as No. 1 and No. 2. Associated system components are designated in a similar manner. System operation is automatic, and control switches on the overhead switch panel and monitoring caution-advisory light capsules on the caution-advisor panel are provided. Normally, associated primary and monitored bus loads are assumed by each generator. Primary bus loads are essential for night instrument flight but monitor bus loads are not essential for this type of flight. If either generator fails, its primary bus load is automatically transferred to the remaining generator. With a failed generator, all monitor bus loads are automatically dropped. An AC external power receptacle permits use of an AC external power unit for ground power application.

Supervisory Panels

The supervisory panels, designated No. 1 and No. 2, provide control for all AC relays and one DC relay in the electrical system. When the No. 1 generator is developing normal AC power and the generator switch is placed ON, DC power from the same generator will be used by the No. 1 supervisory panel to close the No. 1 generator contactor relay. Closing the No. 1 generator contactor relay permits the No. 1 generator to power the No. 1 AC primary bus and

to deliver 28 volts DC to the AC monitor bus relay. In addition, closing the relay opens the No. 1 generator caution light circuit, causing the light to go out. The No. 2 supervisory panel operates the same way to power the No. 2 AC primary bus and to turn out the No. 2 caution light. DC power from the No. 2 supervisory panel also closes the AC monitor bus control relay, which permits 28 volts DC from the No. 1 supervisory panel to close the DC monitor bus relay and the No. 1 and No. 2 monitor bus contactor relays. Therefore, 28-volt DC power is required from both the No. 1 and No. 2 supervisory panels to energize the AC and DC monitor buses. If either generator fails to produce 28 volts DC, the primary DC bus supplies back-up DC voltage to each supervisory panel through circuit breakers. The circuit breakers, located on the overhead circuit breaker panel, are marked 1 and 2 under the general headings PMG BACKUP.

The supervisory panels provide protection for the electrical system. AC power delivered to the panel from its associated generator is monitored by the panel for open phase, overvoltage, and undervoltage at all times. The panel monitors for underfrequency when the helicopter is on the ground with its main landing gear struts compressed activating the scissor switches. If any of the monitored conditions are not normal, the generator contactor relay will open, taking the associated generator off the line, deenergizing all monitor buses, and illuminating the associated generator caution light. If a generator fails, primary AC bus loads will be switched automatically to the remaining generator.

NOTE

Should a low-voltage condition occur in either generator, there will be a 6-second delay before the load is shifted to the other generator.

Generators

Two 115/200-volt, 3-phase, 400 Hz, PMG, AC generators are mounted on and are driven by the accessory section of the main gear box. Generator output varies with temperature and altitude (approximately 20 KVA at sea level to 25 KVA at 15,000 feet altitude). Generator AC voltage is delivered to the associated supervisory panel and generator contactor relay. The permanent magnet sections of the generators also develop DC power to be used in the control circuits. This DC power is delivered to the associated supervisory panel. The auxiliary power unit (APU) drives the generators through the main gear box accessory section when the rotor rpm is below 100% N_r. When the

rotor speed reaches 100% N_r, the accessory section is driven through the main gear box.

GENERATOR SWITCHES: The generator switches are located on the overhead switch panel under the general heading 1 GEN 2 and have marked positions ON-OFF, RESET-TEST. Placing the switch in the ON position puts the respective generator on the line by closing the generator contactor relay. The OFF-RESET position turns the generator off and resets the cycle. The TEST position is only used for maintenance.

GENERATOR CAUTION LIGHTS: Two generator caution lights, marked 1 GEN and 2 GEN respectively, are located on the caution-advisory panel. These lights will illuminate whenever the associated generator is taken off the line by opening the generator contactor relay, which causes the caution light circuit to be completed. The generator caution lights are powered by the DC primary bus and are protected by circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked No. 1 and No. 2 under the general headings GENERATOR and INDICATOR LTS.

Autotransformers

Three autotransformers in the AC system convert 115-volt power from the primary AC buses to 26 volts. Two of the autotransformers are powered by the No. 1 primary bus and are protected by circuit breakers in the copilot's overhead circuit breaker panel, marked 26 V XMFR and RADIO XMFR 26V 0B under the general heading No. 1 AC PRI. The autotransformer protected by the circuit breaker, marked 26V XMFR, supplies 26 volts AC to the copilot's course indicator azimuth card, copilot's ID-250 RMI card, primary hydraulic pressure gage, transmission oil pressure gage, and the No. 1 engine torque sensor and oil pressure gages. The autotransformer protected by the circuit breaker, marked RADIO XMFR 26V 0B, supplies 26 volts AC to:

1. Pilot's course indicator azimuth card
2. Pilot's ID-250 RMI card
3. Both pilot's ID-250 needles
4. TACAN AN/ARN-118 azimuth and DME
5. Doppler radar (AN/APN-175(V)-1)
6. Heading information to the navigation computer and VOR inputs to the AN/AYN-2 computer

The third autotransformer is powered by the No. 2 primary bus and is protected by a circuit breaker in the pilot's overhead circuit breaker panel. The

circuit breaker is marked 26V XMFR under the general heading NO. 2 AC PRI. This autotransformer supplies 26 volts AC to operate the auxiliary and utility hydraulic pressure gages and the No. 2 engine oil pressure and torque sensor gages.

On helicopters modified by T.C.T.O. 1H-3(H)F-536 and CG No. 1487 and subsequent, two radio autotransformers are installed to provide a redundant source of 26 volts AC power for the navigation instruments. The output of each autotransformer is applied to the contacts of the RADIO XFMR switch on the overhead switch panel. The switch selects either the No. 1 or the No. 2 autotransformer output to energize the transformer fail relay and the NAV and PILOT circuit breakers. Should the relay become de-energized, 28 volts DC from the RADIO XMFR CAUT circuit breaker is applied to the caution/advisory panel, illuminating the RADIO XFMR caution capsule to indicate loss of 26 volts AC from the selected autotransformer.

AC Utility Power Receptacles

Two 115-volt AC 400-Hz utility receptacles are provided. The receptacles receive power from the No. 1 AC monitor bus through two circuit breakers on the copilot's overhead circuit breaker panel. The circuit breakers are marked CABIN and XMSN under the general headings UT RECP and NO. 1 AC MON.

Alternating Current Circuit Breakers

Alternating current circuit breakers are located on the pilot's and copilot's overhead circuit breaker panels.

DIRECT CURRENT POWER SUPPLY SYSTEM

Direct current power is supplied by two 28-volt, 200-ampere converters, designated as No. 1 and No. 2, which are powered by respective No. 1 and No. 2 AC primary buses. The DC system operation is automatic, and control switches and converter caution lights are provided. Normally, primary and monitor bus loads are assumed by both converters. Primary bus loads are essential for flight under night instrument conditions, but monitor bus loads are not essential for this type of flight. If one converter fails, the associated reverse current cutout relay will remove the failed converter from the DC primary bus. The remaining converter will assume the DC primary bus loads, and the DC monitored bus loads will be dropped. The battery can provide power to the DC primary bus when no other source is available. The DC external power receptacle and associated circuitry permit use of an external power unit for ground power application.



Converters

Two 200-ampere, 28-volt DC converters are located in the electronics compartment. The converters require an AC input from the generators or from an AC external power source. The two converters are designated as No. 1 and No. 2, and the associated components are designated in a similar manner. Both converters normally supply power to the DC primary bus. The DC primary bus supplies power to the DC monitor bus. The No. 1 converter receives three-phase power from the No. 1 AC primary bus, and the No. 2 converter receives three-phase power from the No. 2 AC primary bus. The AC input is stepped down, rectified, and filtered within each converter, and the DC output is fed to the associated reverse current cutout relay. During normal operation, DC power from the reverse current cutout relay is fed to the DC primary bus. If either converter or either AC generator fails, the monitor bus is automatically dropped from the line, and an appropriate caution light will illuminate. The reverse current cutout relay prevents current flow from the DC primary bus to a failed converter. The DC monitor bus relay must be closed for the monitor bus to receive power. Power to close this relay comes from the DC primary bus and is routed through the No. 2 and No. 1 reverse current cutout relays. If either converter, either reverse current cutout relay, or either AC generator is inoperative (or if either converter switch is OFF), the DC monitor bus will be dropped from the line. The No. 1 converter is protected by a circuit breaker on the copilot's overhead circuit breaker panel. The circuit breaker is marked No. 1 CONVERTER under the general heading No. 1 AC PRI. The No. 2 converter is protected by a circuit breaker on the pilot's overhead circuit breaker on the pilot's overhead circuit breaker panel. The circuit breaker is marked No. 2 CONVERTER under the general heading No. 2 AC PRI.

CONVERTER SWITCHES: The converter switches, located on the overhead switch panel under the general heading 1 CONVERTER 2, have marked positions ON and OFF.

CONVERTER CAUTION LIGHTS: Two converter caution lights, marked #1 CONV and #2 CONV, are located on the caution-advisory panel. Failure of a converter, or reverse current cutout relay (or turning a converter switch OFF), will illuminate the associated caution light.

Battery

A 24-volt, 22-ampere-hour nickel cadmium battery, located in the nose section forward of the pilot's compartment, is accessible from outside the

helicopter. Battery power is used for limited ground operations, when no external power is available, and as an emergency source of power to the DC primary bus. The battery bus is continually energized and provides power for the anchor lights. The battery bus is connected to the DC primary bus when the battery switch is ON.

BATTERY SWITCH: The battery switch, located on the overhead switch panel, is labeled BATTERY, with positions marked ON and OFF.

DC Utility Power Receptacle

Three 28-volt DC utility receptacles are installed. The receptacles receive power from the DC monitor bus through three circuit breakers on the pilot's overhead circuit breaker panel. The circuit breakers are marked COCKPIT, CABIN, and XMSN under the general headings UT RECEPTACLE, MON, and DC.

Direct Current Circuit Breakers

Direct current circuit breakers are located on all three overhead circuit breaker panels and on the battery bus circuit breaker panel.

EXTERNAL POWER

External Power Switch

The external power switch is located on the overhead switch panel, under the heading EXT PWR, with positions marked ON and OFF. The external power switch is protected by a circuit breaker on the overhead circuit breaker panel, marked EXT PWR under the general heading DC PRI BUS.

EXTERNAL POWER ADVISORY LIGHT: The external power advisory light, located on the caution-advisory panel and marked EXT POWER, will illuminate when the external power switch is ON and external power is being supplied to the aircraft.

AC EXTERNAL POWER: An AC external power receptacle, located on the left side of the fuselage aft of the sponson, is used to connect 115/200-volt, 3-phase, 400-Hz power to the helicopter. A phase sequence relay is incorporated to sense proper external power phase rotation. When the phase rotation is correct, the EXT PWR switch is ON, and the BATT switch is ON, 3-phase power will be admitted to the aircraft, and the AC systems will function normally. The battery switch must be ON to power the DC primary bus, and the external power switch must be ON to permit the DC primary bus to supply control power to the phase sequence relay. With the converter switches ON, the DC monitor bus control relay

and the DC monitor bus relay will close, and the DC power system will function normally. At this point, the battery switch should be turned OFF to avoid possible overcharging of the battery.

DC EXTERNAL POWER: A DC external power receptacle, located on the right side of the fuselage below the pilot's window, is used to connect 28 volt-DC power to the helicopter. With the external power switch ON, 28-volt DC power from an external power source is delivered through the DC power receptacle to illuminate the external power advisory light, close the external power relay, energize the DC primary bus, and close the DC monitor bus relay, providing power to the DC monitor bus.

CAUTION

When securing either AC or DC external power, secure the EXT PWR switch before removing the power cables to prevent possible arcing and damage to the external power receptacles.

UTILITY HYDRAULIC SUPPLY SYSTEM

The utility hydraulic supply system provides hydraulic pressure for all hydraulic equipment not

included in the flight control servo hydraulic systems. The utility hydraulic system reservoir (9, figure 3-2), located aft of the main gear box, has a capacity of 3.05 gallons of hydraulic fluid. The utility hydraulic pump is located on the accessory drive section of the main gear box and provides 3,000 psi hydraulic pressure. An oil cooler is provided in the hydraulic line to maintain utility hydraulic oil temperatures within limits. The blower in the oil cooler operates on power from the No. 1 AC primary bus, and the control relay is actuated by power from the DC primary bus. The blower operates continuously when these busses are energized. The utility hydraulic system operates the main landing gear, nose landing gear, APU start system, ramp actuating system, and the rescue hoist.

UTILITY HYDRAULIC PRESSURE INDICATOR

The utility hydraulic pressure indicator, located on the instrument panel, operates on 28-volt AC power from an autotransformer. The gage, marked UTI, indicates pressure in the utility hydraulic system in psi. The indicator receives electrical power from the No. 2 AC primary bus through a circuit breaker on the pilot's AC circuit breaker panel. The circuit breaker is marked UT under the heading HYD PRESS IND.

SELF QUIZ #3

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. To check the main gear box oil level, you should use a/an _____

- A. oil quantity gage in the cockpit
- B. oil quantity gage on the gear box
- C. sight gage on the lower left side of the main gear box housing
- D. sight gage on the lower right side of the main gear box housing

2. The augmented main gear box oil system will permit the helicopter to continue operating for approximately _____ minutes if there is a failure in the main lubrication system.

- A. 15
- B. 30
- C. 45
- D. 60

3. What is the HH-3F's total fuel capacity in gallons?

- A. 988
- B. 1,044
- C. 1,088
- D. 1,122

4. Before pressure refueling the HH-3F, you must ensure that the _____ will operate correctly.

- A. motor operated shutoff valve
- B. high-level shutoff valve
- C. float valve
- D. boost pump

5. What terminates an HH-3F pressure defueling operation?

- A. A tank becoming empty
- B. Low-level warning actuation
- C. The high-level shutoff valve
- D. Pressure fueling valve actuation

6. The primary bus provides power for all components that are essential for _____ flight operations.

- A. SAR
- B. night VFR
- C. night instrument
- D. any

7. If the No. 1 generator fails, you should expect to lose all components powered by the _____ bus.

- A. No. 1 primary AC
- B. No. 1 AC monitor
- C. primary DC
- D. No. 2 primary AC

8. Assume that the No. 2 converter fails. Which buses will be dropped from the line?

- A. No. 1 AC primary
- B. DC primary
- C. DC monitor
- D. No. 2 DC primary

9. The utility hydraulic system operates at _____

- A. 750 psi
- B. 1,500 psi
- C. 1,750 psi
- D. 3,000 psi



ANSWERS TO SELF-QUIZ #3

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	3-2
2	C	3-2
3	B	3-4
4	B	3-5
5	A	3-6
6	C	3-6
7	B	3-6
8	C	3-8
9	D	3-9

HH-3F FLIGHT SYSTEMS

Reading Assignment:
Pages 4-1 through 4-13

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the basic operation and characteristics of the:

1. Flight control systems: Main and tail rotor.
2. Flight control hydraulic control systems.
3. Automatic flight control (AFCS) and coupler systems.
4. Magnetic compass, free air temperature gage, clocks, pilot-static system, vertical velocity indicators.
5. Heading altitude reference system (HARS).
6. Caution-advisory panel.
7. Landing gear system.
8. Brake system.
9. Ramp system and cargo door.

FLIGHT CONTROL SYSTEMS

The flight control system is divided into three systems: the main rotor flight control system, the tail rotor flight control system, and the flight control hydraulic supply systems. When the automatic flight control system and coupler system are engaged, they provide corrections of limited authority to the flight control system, causing the helicopter to respond in a stable manner to the maneuver called for by the position of the cyclic stick or referenced ground speed from AFCS control panel drift pots. This equipment also provides a constant altitude. The description and operation of the automatic flight control system and coupler system are included in the paragraphs, **AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS) AND COUPLER SYSTEM** in this section. A cyclic stick trim system is installed.

MAIN ROTOR FLIGHT CONTROL SYSTEM

The main rotor flight control system provides both vertical, lateral, and longitudinal control. Control motions are sent from the collective pitch lever for vertical control, and from the cyclic stick for lateral and longitudinal control. The motions are combined in a mixing unit, located in the AFCS control compartment aft of the pilot's seat, and are transmitted to the main rotor assembly by mechanical linkage. Control action is assisted by two hydraulically operated flight control servo systems. The main rotor flight controls terminate at the stationary swashplate of the main rotor head. Control action is transmitted through the rotating swashplate and linkage on the main rotor hub to the blades.

Collective To Yaw Coupling

A collective to yaw coupling, located in the mixing unit, provides automatic tail rotor blade angle

changes to compensate for changes in collective pitch settings. In flight, the coupling is irreversible in that collective pitch motion will act to displace the tail rotor but tail rotor pedal motion will not affect main rotor collective pitch blade angle.

Collective To Cyclic Coupling

A bias in the collective to cyclic coupling is incorporated in the mixing unit to apply a slight left roll correction when the collective pitch is increased.

Collective Pitch Levers

Two collective pitch levers are located in the pilot's compartment. Both levers operate simultaneously to change the collective pitch of the main rotor blades. A friction lock on the pilot's collective pitch lever can be rotated to apply friction to prevent the collective pitch levers from creeping while in flight.

Cyclic Sticks

The cyclic sticks provide lateral and longitudinal control of the helicopter. Moving the cyclic stick in any direction tilts the tip path plane of the main rotor blades in that direction and moves the helicopter in the same direction. The stick grip (figure 4-1) contains pushbutton and thumb-operated switches for controlling various equipment installed in the helicopter.

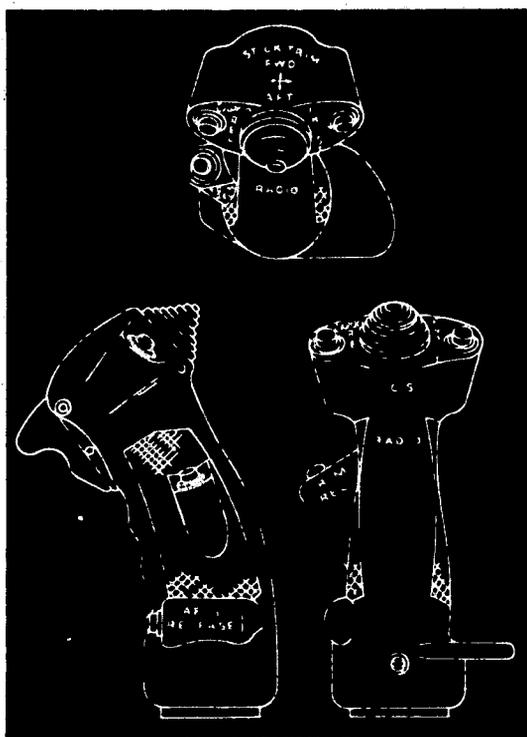


Figure 4-1. - Cyclic stick grip.

Cyclic Stick Trim System

The cyclic stick trim system holds the stick in a selected trim position. Two actuators are hydraulically powered by the auxiliary servo system and energized electrically from the DC primary bus. One actuator positions the cyclic stick laterally, and the other positions the cyclic stick fore and aft. The actuators are operated by a four-way cyclic trim switch mounted on both the pilot's and copilot's cyclic stick grips. To trim the cyclic stick, the cyclic trim switch is pushed in the direction of desired cyclic stick movement, causing the actuators to move the stick until the cyclic trim switch is released. The cyclic stick may be manually displaced from the trimmed position against a resistance force caused by spring compression, which increases progressively with stick displacement. The spring action provides cyclic stick feel and amounts to approximately 1.5 pounds initial force, plus 0.5 pounds for each 1 inch of cyclic stick displacement. When the pressure on the cyclic stick is released, spring action returns the stick to the original trim position. The cyclic stick trim system will operate as long as there is both DC power to the primary bus and auxiliary hydraulic pressure to the actuators.

CYCLIC STICK TRIM MASTER SWITCH: A cyclic stick trim master switch, marked **STICK TRIM MASTER, ON, and OFF**, is located on the overhead switch panel. When the switch is **ON**, the cyclic stick is held in position. When the switch is **OFF**, the force gradient system is inoperative, and the cyclic trim system will not maintain the position of the stick.

CYCLIC (BEEPER) TRIM SWITCHES: The cyclic trim switches, located on the pilot's and copilot's cyclic stick grips (figure 4-1), have marked positions **FWD, AFT, L, and R**. The four-way thumb switch is spring-loaded to the center (off) position. When the switch is placed in any of the four positions, hydraulic pressure will drive the cyclic stick in the same direction. Release of the switch stops stick motion. The action of the cyclic stick trim system will then function about this location of the cyclic stick. The cyclic trim switches receive electrical power from the DC primary bus through a circuit breaker marked **BEEPER-TRIM**, located on the overhead DC circuit breaker panel.

CYCLIC TRIM RELEASE BUTTON: The spring-loaded, pushbutton switches are located on the pilot's and copilot's cyclic stick grips (figure 4-1) and marked **TRIM REL**. Cyclic trim position can be changed by depressing the cyclic trim release button, manually moving the stick to the new position, and then releasing the cyclic trim release button.

The cyclic trim system will then hold the new selected position of the cyclic stick. The cyclic trim release button controls DC primary bus power to the trim actuators.

TAIL ROTOR FLIGHT CONTROL SYSTEM

The functions of the tail rotor flight control system are to compensate for main rotor torque and to provide a means for changing the heading of the helicopter. The torque developed by the main rotor blades turning counterclockwise tends to rotate the fuselage in a clockwise direction. Any change in power setting will vary the amount of main rotor torque. To compensate for torque variations, the pitch and resulting thrust of the tail rotor blades can be increased or decreased. Turns are accomplished by increasing tail rotor thrust, which overcompensates for main rotor torque and changes the heading of the fuselage to the left, or by decreasing the tail rotor thrust, which undercompensates for the main rotor torque and changes the heading of the fuselage to the right.

Tail rotor control pedal movements are transmitted to the tail rotor assembly by mechanical linkage and cables. Control action is assisted by the auxiliary servo system only. A hydraulic damping device incorporated in the auxiliary servo resists abrupt movements of the pedals, which could cause sudden yaw acceleration and possible damage to the helicopter. The pedal damper is inoperative when the auxiliary servo system is inoperative or shut off. Yaw compensation is accomplished by mechanical linkage in the mixing unit, which automatically changes tail rotor blade angles for changes in collective pitch without moving the pedals. A tail rotor negative force gradient system is installed to relieve the pilot of tail rotor forces created by aerodynamic loads when the auxiliary servo system is inoperative. Because of this, when the system is checked on the ground with tail rotor stationary and the auxiliary servo off, a negative spring centering effect is created. The normal tendency of the pedals is then to go to either extreme. Under these conditions, considerable force is required to push the pedals from the extreme position; however, the force will decrease as the neutral pedal position is approached. The initial force to move the pedals from either extreme position is 30 to 40 pounds.

Tail Rotor Pedals

The tail rotor pedals change the pitch and thrust of the tail rotor and consequently the heading of the helicopter. Electrical switches, mounted on the pedals, null the directional signals of the automatic flight control system when feet are placed on the pedals. Toe brake pedals for the main landing gear

wheel brakes are mounted on both the pilot's and copilot's pedals.

TAIL ROTOR PEDAL ADJUSTMENT KNOBS:

Pedal adjustment knobs are located on each side of the fuselage, just forward of the ash trays in the pilot's compartment. The adjustment knobs are connected to mechanical linkages that provide for fore-and-aft adjustment of the pedals. The knobs are rotated to the right, as indicated by the arrow marked FWD, for forward adjustment and to the left, as indicated by the arrow marked AFT, for aft adjustments. Adjustments should be made with feet away from the pedals to avoid damage to the adjustment cables striker plates or microswitches.

FLIGHT CONTROL HYDRAULIC SYSTEM

A primary and an auxiliary flight control servo hydraulic system provides power boost to operate the controls. The servos also prevent feedback of rotor system vibratory loads to the controls. Each servo system operates from an independent hydraulic system and uses similar servo hydraulic units to vary the main and tail rotor blade pitch through the mechanical linkage of the flight control system. The servo unit output is connected to the flight control linkage to provide power boost. The continuity of the direct control linkage is maintained from the controls in the pilot's compartment through the auxiliary and the primary servos to the main rotor blades, except for a slight amount of end play at each servo unit to permit the pilot valves to move before the direct control linkage. Normally, both servo systems are in operation.

Primary Flight Control Servo System

The primary flight control servo system consists of three hydraulic servo units which connect the flight control linkage to the stationary swashplate of the main rotor assembly. All three servo units respond simultaneously and move in the same direction in response to movements of the collective. Two of the servo units (lateral servo units) respond simultaneously, but move in opposite directions in response to lateral movements of the cyclic stick. One of the servo units (fore-and-aft servo unit) responds to the fore-and-aft movements of the cyclic stick. Since all three movements can occur simultaneously through the action of the mixing unit, the position of any primary servo unit is the result of the combined input of the cyclic stick and collective. This results in a primary servo system in which any one servo may have an effect on both collective pitch and cyclic (lateral or fore-and-aft) pitch. The servos provide power boost only to the main rotor flight

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control system. The primary servo hydraulic pump is driven by the accessory section of the main gear box. The primary hydraulic system reservoir, mounted aft of the main gear box, has a capacity of approximately 0.45 gallon of hydraulic oil. A light on the caution panel, marked PRI SERVO PRESS, illuminates when primary servo pressure fails.

Auxiliary Flight Control Servo System

The auxiliary flight control servos, consisting of a bank of four hydraulic servo units, are located between the pilot's controls and the flight control system mixing unit. Each control input acts independently on the corresponding auxiliary servo. The collective positions the collective servo. The cyclic stick positions either, or both, the fore-and-aft servo and the lateral servo. This results in an auxiliary servo system in which only one servo has an effect on collective pitch, one on fore-and-aft cyclic pitch, and one on lateral cyclic pitch. They provide power boost to both the main and tail rotor flight control systems and the means of introducing AFCS corrective signals into the flight control systems. The auxiliary servo hydraulic pump is driven by the main gear box accessory section. The auxiliary hydraulic system reservoir, located aft of the primary hydraulic system reservoir, has a capacity of approximately 0.45 gallon of hydraulic oil. A light on the caution panel, marked AUX SERVO PRESS, illuminates when auxiliary servo hydraulic pressure fails.

Flight Control Servo Switches

The primary and auxiliary flight control servo systems are controlled by the servo switches, marked SERVO, located on the pilot's and copilot's collective pitch lever grip. The marked switch positions are PRI OFF and AUX OFF. Both servo systems are normally in operation with both switches in the unmarked center (ON) position. To turn off the primary servos, place either of the switches in the forward (PRI OFF) position. To turn off the auxiliary servos, place the switch in the aft (AUX OFF) position. The systems are interconnected electrically in such a way that regardless of switch position, it is impossible to turn either system off unless there is 1,000 psi in the remaining system. The servo shutoff valves operate on current from the DC primary bus. Protection is provided by circuit breakers on the overhead DC circuit breaker panel. The circuit breaker is marked PRI and AUX under the heading SERVO CUTOFF.

Servo Hydraulic Pressure Indicators

The primary and auxiliary servo hydraulic pressure indicators, located on the instrument panel, operate on 26 volts AC from the autotransformers

powered by the AC primary buses. The primary hydraulic pressure indicator is protected by a circuit breaker on the copilot's overhead circuit breaker panel. The circuit breaker is marked PRI under the heading HYD PRESS IND. The auxiliary hydraulic pressure indicator is protected by a circuit breaker on the pilot's overhead circuit breaker panel. The circuit breaker is marked AUX under the heading HYD PRESS IND.

Primary and Auxiliary Servo Pressure Caution Lights

The primary and auxiliary servo pressure caution lights, marked PRI HYD PRESS or AUX HYD PRESS, are located on the caution panel. When servo pressure in either system drops below 1,000 psi, the associated light will illuminate.

AUTOMATIC FLIGHT CONTROL (AFCS) AND COUPLER SYSTEMS

The automatic flight control system (AFCS) provides added stability in pitch, roll, and yaw, plus attitude, heading, and altitude hold. The coupler system is used in conjunction with the AFCS for hovering operations when accurate ground speed and altitude control is desired.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The AFCS used in this helicopter differs from the autopilot used in fixed-wing aircraft in that the AFCS may be engaged at all times, has less control authority than the primary flight control system, and may be easily overridden through normal use of the flight controls. The pilot has direct control of the system at all times and can engage or disengage the entire AFCS or any channel, as desired, by means of switches on the AFCS control panel, channel monitor panel, cyclic sticks, and collective pitch levers. The AFCS indicators provide the pilot and copilot with visual indication of all AFCS signals.

The AFCS has two modes of operation: (1) Attitude and directional stabilization, and (2) barometric altitude hold. Attitude and directional stabilization is controlled through the pitch, roll, and yaw channels, and barometric altitude hold is controlled through the collective channel. The AFCS is capable of maintaining the barometric altitude of the helicopter within ± 25 feet or 5% of the altitude, whichever is greater, during straight unaccelerated flight, or when hovering out of ground effect by using barometric altitude reference.

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In the pitch and roll channels, the fuselage attitude is held constant by comparing the actual attitude signal received from the vertical gyro with the reference attitude signal received from the cyclic stick position sensor. Automatic pitch and roll attitude stability correction occurs any time the helicopter is displaced from the reference attitude. Pitch and roll gyro information source is selected on the channel monitor panel.

In the yaw channel, the helicopter is held constant by comparing actual heading signals received from the A/A24G-39 HARS heading reference system with reference heading signals received from the YAW TRIM knob and the yaw synchronizer. While the pilot establishes a reference heading by use of the pedals, the yaw channel is placed in a synchronizing mode, the yaw rate gyro develops a signal proportional to the manual heading displacement rate of the helicopter. This signal initiates an open-loop spring condition that produces a proportional feedback force at the pedals. As the pilot presses either pedal, he feels the proportional feedback force opposing the pedal pressure applied. The feedback force remains until the pilot has established the new reference heading. Heading stability correction occurs any time the helicopter is displaced from the desired reference heading.

In the collective channel, the altitude of the helicopter is held constant by signals developed from the altitude controller, which sense changes in barometric pressure from the engage point. Automatic barometric altitude stability correction occurs any time the helicopter is displaced up or down from the reference altitude.

AFCS utilizes power from the No. 1 AC primary bus and the DC primary bus. A thermal time delay relay is incorporated to allow approximately 120 seconds for the vertical gyros to reach a stabilized state before DC power is applied to the system. The AFCS ENG button may then be depressed to engage the pitch, roll, and yaw channels. The collective channel is engaged by depressing the BAR ALT ENG button. With BAR ALT engaged, collective friction should be removed so as not to inhibit collective movement. AC power to the AFCS is protected by circuit breaker panel. The circuit breakers are marked ØA and ØB under the general heading of AFCS. DC power to the AFCS is protected by a circuit breaker, marked AFCS, on the overhead circuit breaker panel.

Automatic Flight Control System Control Panel
The AFCS and coupler controls are located on the panel, marked AFCS CONTROL PANEL, mounted on the center console between the pilot and copilot. Five Pushbutton switches, marked AFCS, BAR ALT, CPLR, BAR OFF and HOVER TRIM ENG are located on the AFCS control panel. All except BAR OFF illuminate when engaged. When the AFCS button is pressed, the pitch, roll and yaw channels become operative. Pressing the BAR ALT button engages the barometric altitude controller. Pressing the CPLR button engages the cyclic and collective coupler, if the coupler control switches are both on. In addition, the barometric controller will be engaged if the collective coupler switch is ON. Pressing the button marked HOVER TRIM ENG energizes the hover trim panel, illuminating the button and a red engage light on the top of the hover trim stick. The fifth pushbutton, marked BAR OFF, is used for permanent disengagement of the barometric altitude controller, provided the collective coupler is not engaged. The barometric altitude controller can be released momentarily by pressing and holding the button marked BAR REL on the pilot's or copilot's collective stick grips. Hover trim is disengaged by disengaging the coupler or by cycling the cyclic coupler control switch to OFF then ON. Two coupler control switches are provided for individual operation of the cyclic or collective channels of the coupler when it is engaged.

The five remaining controls are knobs used for trimming various systems. The knobs are designed with characteristic shapes to enable identification by touch. Specific knobs and their identifying shapes and markings are as follows: DRIFT, bar shape; CG TRIM, clover leaf shape; SPEED, indented circle shape; YAW trim, triangular shape; ALTITUDE, cross shape. The DRIFT knob allows the pilot to control the lateral drift of the helicopter with approximately a ± 10 -knot ground speed authority when the cyclic coupler is engaged. The CG TRIM knob is used to trim the pitch channel of AFCS for actual cg location. The SPEED knob allows the pilot to control the forward and aft ground speed with approximately a ± 10 -knot authority when the cyclic coupler is engaged. The YAW trim knob enables the pilot to make small heading corrections in forward flight with the yaw channel of AFCS engaged. In a hover, the knob may be used for larger heading changes. One rotation of the knob turns the helicopter approximately 72 degrees. The ALTITUDE knob allows the pilot to accurately select hovering altitudes and make altitude changes between zero and 200 feet. The knob has a graduated scale from zero to 200 feet with increments of 5 feet.

Automatic Flight Control System

Caution Light

An AFCS caution light marked AFCS OFF is on the caution panel. When the AFCS is disengaged, the light will come on.

CHANNEL MONITOR PANEL

The channel monitor panel, located on the starboard side of the cockpit underneath the pilot's window, provides switches that enable individual disengagement of the channels of AFCS, switches for minor testing, a switch to select gyro input to the AFCS, and a switch to select the inputs to the hover indicators. The channel disengage switches, located in the forward row, enable the pilot to disengage individual channels as desired. The four hardover switches enable technicians to introduce hardover signals to the individual AFCS channels. The channel monitor test switch, located on the overhead switch panel, must be in the TEST position to power the hardover switches. The switches are protected by red safety covers that should be in the down position for flight. The gyro selector switch enables the pilot to select either the port or starboard gyro for pitch and roll inputs to the AFCS. The port gyro position selects the A/A24G-39 HARS gyro and is normally selected for flight. The starboard gyro position selects the 1080Y gyro. The meter selector switch enables either AFCS or coupler inputs to be monitored on the hover indicators when they are in the A mode.

NOTE

The position of the gyro selector switch has no effect on the inputs to the pilot's or copilot's AYN-2 flight director system or the yaw channel or AFCS.

MAGNETIC COMPASS

A standby compass, located on the right side frame of the center windshield above the instrument panel, is marked TO BE USED AS A STBY COMPASS ONLY. A light switch is located at the lower right of the compass. A standby compass correction card is located at the upper right of the compass.

FREE AIR TEMPERATURE GAGE

The free air temperature indicating system consists of a gage, marked FREE AIR, and a tempera-

ture sensing bulb. The temperature sensing bulb, extending through the center windshield above the instrument panel, is a direct reading instrument calibrated in degrees Centigrade.

CLOCKS

Three eight-day, 12 hours clocks are installed in the helicopter; two on the instrument panel, and one at the avionicsman's positions.

PITOT-STATIC SYSTEM

There are two pitot-static systems. The pitot portion of the pilot's and copilot's systems are independent of each other, but the static portion of each system is common. Each pitot-static pressure system consists of a heated pitot-static tube, altimeter, airspeed and vertical velocity indicator. The pitot and static lines both originate at the pitot-static tubes. The opening at the head of the tubes furnishes ram air pressure, and ports near the center of the tubes furnish static pressure. The static system vents the airspeed, altimeter, and vertical velocity indicators to atmospheric pressure. The pitot-static tube on the right side of the cockpit canopy furnishes ram air pressure to the pilot's airspeed indicator and static pressure to the common static system. The pitot tube on the right side of the cockpit canopy also furnishes pitot and static pressures to the true airspeed transducer. The pitot-static tube on the left side of the cockpit canopy furnishes ram air pressure to the copilot's airspeed indicator and static pressure to the common static system. Capped tees in the lines in the electronics compartment and in the cabin permit draining moisture from the lines. The AFCS barometric altitude control sensing unit is connected into the common static system. Resistance-type heaters in the pitot-static tubes, controlled by the PITOT HEAT switch on the overhead control panel, prevent formation of ice at the openings. Power for the pitot-static tube heaters is supplied by the DC primary bus system, through the circuit breakers marked, ICE PROTECTION, PITOT HEAT 1 and 2, on the overhead circuit breakers panel.

VERTICAL VELOCITY INDICATORS

Two vertical velocity indicators, located on the instrument panel, indicate the rate of ascent or descent up to 3,000 fpm. The vertical velocity indicators use the same static source as the altimeter.

HEADING ALTITUDE REFERENCE SYSTEM (HARS)

A/A24G-39 FUNCTIONAL DESCRIPTION

The A/A24G-39 is comprised of a displacement gyroscope, an electronic control amplifier, a compass system controller, and a HARS coupler. The displacement gyroscope consists of vertical and directional gyros mounted in multiple gimbals. The electronic control amplifier contains an azimuth servo amplifier, slaving amplifier, deviation compensator, turn and acceleration control features, fast synchronization circuitry, and associated power supplies. It also functions as a system interconnection box. The compass system controller includes a function selector switch, synchronizer and heading set, latitude correction controller, and synchronizing indicator.

The HARS coupler is essentially a signal output multiplier. With signals from ECA, it produces multiple roll, pitch, and heading output signals.

The A/A24G-39 has three modes of operation. In the SLAVED mode, the system operates as a gyro stabilized magnetic compass. In the Directional Gyro (DG) mode, the system operates independently of the remote compass and provides a heading reference as a latitude corrected directional gyroscope. In the compass (COMP) mode, the system operates as an undamped magnetic compass, slaved to the magnetic azimuth detector.

The A/A24G-39 provides analog (synchro) signal information of the aircraft's attitude (pitch and roll) and heading.

A/A24G-39 OFF/FAST ERECT PANEL

The A/A24G-39 OFF and FAST ERECT switches, marked VERT GYRO and NORMAL/FAST ERECT are located on the instrument panel at the lower left corner of the fuel management panel. The VERT GYRO switch, marked ON/OFF, enables the pilot to control power to the A/A24G-39 displacement gyro after the power passes the AC GYRO COMPASS circuit breaker on the copilot's overhead circuit breaker panel. The OFF position of the VERT GYRO switch secures power to the displacement gyro but does not interfere with power to the compass control system. The FAST ERECT switch, with marked positions NORMAL/FAST ERECT, is spring-loaded to the NORMAL position. Holding the switch in the FAST ERECT position enables the pilot to select a fast erect cycle for the A/A24G-39 displacement gyro. When FAST

ERECT is selected, an increased erection voltage is applied to the displacement gyro. If the A/A24G-39 gyro is in a partially erect state, the FAST ERECT switch may be used to maintain the gyro in the fast erect mode until it is completely erected. If the gyro is not completely erected, the gyro warning flag on the copilot's attitude indicator will remain in view and the PORT GYRO caution/light will remain on. The switch should be held to FAST ERECT for a maximum of 30 seconds and then released. Check that the GYRO flag disappears. If the GYRO flag still shows, repeat the use of the FAST ERECT switch until the gyro is erect and the GYRO flag disappears. The use of the FAST ERECT switch is required only when reenergizing the system during coast down.

COMPASS CONTROL PANEL (A/A24G-39) (Figure 4-2)

The control panel, marked COMP on the pilot's console, provides the pilot with system operating controls.

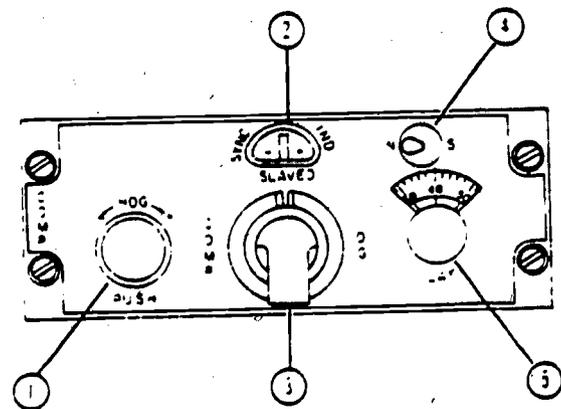


Figure 4-2.

CAUTION

Landing sites with abnormally strong magnetic fields may affect helicopter compass synchronization. Extended time at these areas can cause the remote compass transmitter to slew off heading. The use of the DG mode during operations in the vicinity of these magnetic fields will provide proper heading information after initial departure from the site.

NOTE

If the COMP position is used, disengage the yaw channel of the AFCS.

CONTROL/INDICATORFUNCTION

1. Heading Set Control (Knob)
(HDG/PUSH)

In the SLAVED mode of operation, depressing and holding this knob automatically causes synchronization of heading outputs to the aircraft compass transmitter heading and sets heading on the Remote Heading Indicator(s). In the DG mode of operation, this knob may be pushed and turned either clockwise or counterclockwise to generate a rate control signal which drives the heading output synchros in either desired direction to a selected heading. In either SLAVED or DG modes, when pushed, the knob also activates the auto-pilot interlock.

2. Synchronization Indicator
(SYNC IND)

The SYNC IND displays the status of the SR3 System heading system. In the SLAVED and COMP modes, the pointer indicates the degree of synchronization between SR3 System heading and the compass transmitter heading. In DG mode the pointer remains fixed in the center position.

3. Mode Selector Switch
(COMP-SLAVED-DG)

Use for setting mode of operation. In the COMP mode the SR3 System provides magnetic heading only and also activates auto-pilot interlock. In the SLAVED mode the Displacement Gyroscope heading information is automatically corrected to agree with the compass transmitter heading. In the DG mode the SR3 System provides free gyroscope heading information. Correction for apparent drift resulting from the rotation of the earth is applied in both DG and SLAVED modes.

4. Hemisphere Selector Switch
(N/S)

Use for setting the polarity of the correction signal for apparent drift due to earth's rotation. This is determined by the hemisphere of operation (Northern or Southern).

5. Latitude Control
(LAT)

Use for setting latitude of operation (0 to 90°) to establish the proper correction for apparent gyroscope drift caused by earth's rotation.

Figure 4-3.

CAUTION-ADVISORY PANEL

The caution-advisory panel is located in the right center of the instrument panel. The caution section of the panel provides visual indication of certain failures or unsafe conditions through illumination of amber lights. The advisory section provides visual indication of certain noncritical conditions through illumination of green lights. Each light has its own operating circuit and will remain illuminated as long as the condition which caused the light to illuminate prevails. The caution and advisory lights are powered by the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked PWR under the heading CAUTION PANEL. A switch, marked DIM and DRT, located on the caution panel, enables selection of a dim or bright brilliance of the caution and advisory lights. The switch cannot be used until the rheostat, marked PILOT, FLT INST, located on the overhead switch panel, has been turned on.

MASTER CAUTION LIGHT

Two master caution lights, marked MASTER CAUTION, located on the instrument panel hood, one in front of each pilot, illuminate whenever a caution light on the caution-advisory panel illuminates. The purpose of these lights is to alert the pilots and direct attention to the caution-advisory panel. The lights are press-to-reset type. After the specific condition or malfunction has been noticed on the caution panel, the master lights should be reset to provide a similar indication if a second condition or malfunction occurs while the first is still present.

CAUTION-ADVISORY LIGHT TEST SWITCH

The caution-advisory lights test switch, marked TEST, located on the caution panel, provides a means of simultaneously checking all lights by a single pushbutton switch. The switch receives power from the 28-volt DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked TEST under the heading CAUTION PANEL.

LANDING GEAR SYSTEM

The tricycle landing gear system consists of two retractable main landing gear assemblies, a partially retractable nose gear assembly, and an actuating system. The landing gear hydraulic system operates on 3,000 psi hydraulic pressure from the utility hydraulic system. The necessary electrical power is

provided from the DC primary bus, through circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked EMER DN, NOSE, MAIN, and WARN under the general heading LAND GEAR. The main landing gear system is equipped with a one-shot pneumatic alternate extension system, and the APU accumulator is used as an alternate extension power source for the nose gear assembly. The nose gear assembly retraction system can be used on the ground to kneel the helicopter to facilitate cargo handling. The landing gear control panel is located on the instrument panel.

MAIN LANDING GEAR

The two main landing gear assemblies are located below the spousons and retract forward and upward into the spousons. Each main landing gear is equipped with dual wheels and hydraulic brakes, a retracting cylinder, a pneudraulic strut, attaching drag links and supports, up-and down-lock mechanisms, and emergency release mechanisms.

NOSE LANDING GEAR

The single nose landing gear, mounted vertically at the centerline of the helicopter, is free to rotate 360 degrees about the strut centerline. All shock stroke, kneeling, jacking and retraction motion is vertical. The nose gear assembly is equipped with dual wheels, a retracting cylinder, a pneudraulic strut and shimmy damper, and attaching drag links and supports. The entire pneudraulic strut acts as a piston, which is lowered or raised for retracting, jacking, and kneeling. The nose gear may be retracted (kneeled) to alter the ground clearance (figure 4-4) of the tail section to facilitate cargo handling. The nose gear assembly is hydraulically locked in the extended, retracted, or kneeled positions. A centering cam centers the nose gear assembly when the helicopter is airborne. A nose wheel lock is installed to improve ground stability of the helicopter on uneven terrain.

Nose Wheel Lock Handle

The nose wheel lock handle, marked PARK LOCK, is located on the pilot's side of the center console. The nose wheel is locked by pulling the lock handle aft and up, and unlocked by pulling aft and pushing down.

LANDING GEAR ACTUATING SYSTEM

The landing gear actuating system operates on 3,000 psi hydraulic pressure, supplied by the utility hydraulic system to raise or lower the main and nose landing gear assemblies. Each main landing gear is equipped with down-lock release limit switches

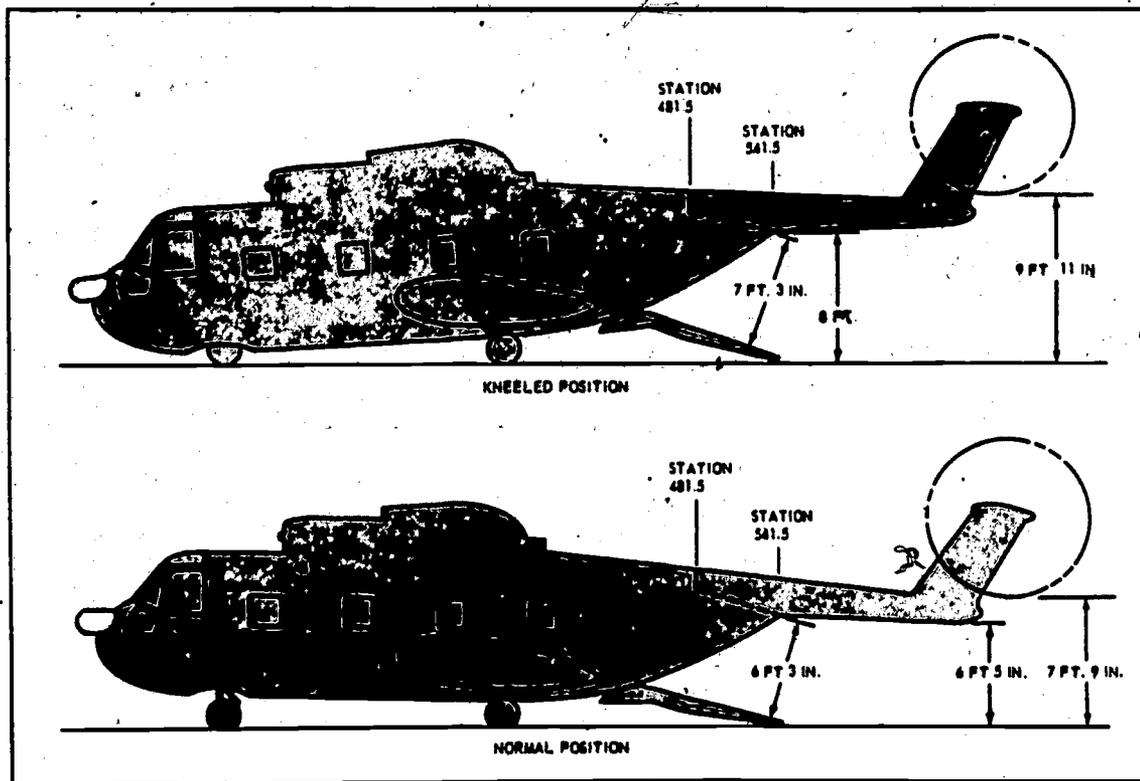
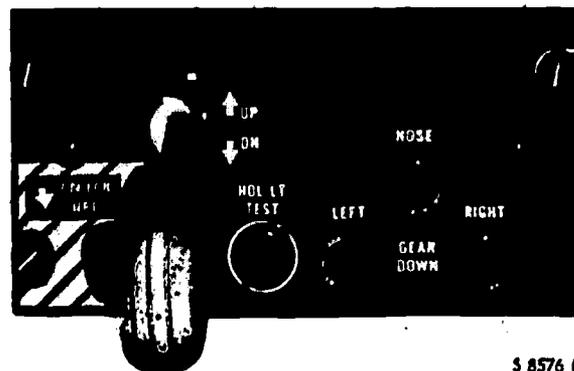


Figure 4-4. - Ground clearances (normal and kneeled).

which prevent inadvertent retracting of the landing gear when the weight of the helicopter compresses the oleo struts. When airborne, the struts extend and close the contacts of the down-lock release limit switches.

The landing gear control panel (figure 4-5) is located on the instrument panel. Placing the landing gear control handle in the UP position retracts the landing gear. As the landing gear retracts, limit switches are actuated that cause the landing gear warning light to go out, and a circuit to be completed that assures electrical power to lower the gear. When the landing gear is fully retracted, limit switches are actuated that cause the landing gear warning light in the handle to go out. The main gears are held up by mechanical uplocks. The retraction cycle of the nose gear system remains energized to maintain the nose gear in the retracted position. The landing gear is extended by placing the landing gear lever in the DN position. This completes the electrical circuit to the solenoid valve that directs fluid to the uplock cylinders of the main landing gears, unlocks them from the up position, simultaneously directs fluid to the actuator, energizes the landing gear control handle warning light, and causes the landing gear

to extend. Mechanical spring-loaded locks are engaged to lock the main gear in the down position. As the main landing gear extension phase is initiated, the retraction port of the actuator is vented to relieve pressure that had been holding the nose gear in the retracted position, and hydraulic pressure is directed to the extension port of the actuator to lower the nose gear. Hydraulic pressure is retained in the actuating cylinder to lock the nose gear down. When all gears are fully extended, limit switches are actuated that energize the landing gear position lights and extinguish the control handle warning lights.



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Figure 4-5. - Landing gear control panel.

Landing Gear Control Handle Down-Lock Release

A manually operated down-lock release, marked DN LCK REL, is located on the landing gear control panel. The release provides a mechanical override of the landing gear control handle down-lock solenoid if electrical power to the solenoid is interrupted. Should the down-lock solenoid become inoperative, the down-lock release can be actuated to mechanically release the landing gear control handle from the DN position.

Nose Gear Switch and Caution Light

The nose gear switch, marked NOSE GEAR, NORMAL, KNEEL, is located on the overhead switch panel. Kneeling is accomplished by placing the switch in the KNEEL position. Placing the switch in the NORMAL position extends (jacks) the nose gear to the normal down position. An advisory light, marked KNEEL SW, located on the caution-advisory panel, will illuminate when the kneel switch is in the KNEEL position. The green nose gear position light will be out and the red warning light in the landing gear handle will be on when the nose gear is kneeled.

LANDING GEAR ALTERNATE EXTENSION SYSTEM

An alternate gear handle, located on the left side of the center console, is used to lower the landing gear in the event of an electrical or hydraulic failure. The handle mechanically unlocks the main landing gear uplocks, positions a directional valve, and discharges a 3,000 psi air bottle. The compressed air charge actuates valves that vent the return side of the actuators to the reservoir, and then pressurizes the actuators to lower and lock the main landing gear. Simultaneously, fluid from the APU accumulator is directed through an electrically actuated valve to the top side of the nose gear actuating cylinder to lower the nose gear. After an actuation, the valves must be manually reset before the main landing gear air cylinder can be recharged and the landing gear retracted. If the air charge in the cylinder is depleted when the alternate landing gear handle is actuated, main landing gear hydraulic pressure is vented back to the utility reservoir, the uplocks are disengaged, and the main landing gear will lower by its own weight. The mechanical down-locks may not

Landing Gear Pins

When the landing gear pins are inserted into the main landing gear drag link assembly, they provide an additional mechanical down-lock.

BRAKE SYSTEM

The main landing gear wheels are each equipped with hydraulic brakes. The self-contained brake system is operated by toe pedals located on the pilot's and copilot's tail rotor pedals. A parking brake system is also provided. The parking brake handle, marked PARKING BRAKE, is located on the right side of the center console. The parking brakes are applied by depressing the brake pedals, manually pulling the parking brake handle to the PARK position, and then releasing the brake pedals. Depressing the brake pedals will release the parking brakes, allowing the parking brake handle to return to the OFF position.

NOTE

The parking brake handle can be raised and locked in the extended position, thereby illuminating the advisory light, without pressurizing the wheel brake system.

RAMP SYSTEM

The ramp system is divided into two sections, the forward ramp which is horizontal with the cabin floor, in the closed position, and the aft ramp which conforms to the contour of the fuselage, in the closed position. The aft ramp is hinged to the forward ramp and opens outward and downward. The clearance between the ramp, in the open position, and the fuselage structure may be increased by KNEELING the helicopter. The ramp surface has transverse nonskid material installed for personnel footing and for loading vehicular cargo. Fittings rated at 2,500 pounds are installed to secure light cargo carried on the forward ramp. There are no cargo tiedown fittings on the aft ramp floor. Two tiedown fittings rated at 5,000 pounds each are used to suspend the ramp.

The ramp system is electrically controlled and hydraulically actuated by hydraulic pressure from the utility hydraulic system. The auxiliary power unit is the normal source of power for operation of the ramp. The ramp may be lowered manually when hydraulic or electrical power is not available. The aft ramp may be opened in the air, on the ground, or on the water. The forward ramp can be opened beyond the horizontal position only when the weight of the helicopter is on the helicopter's wheels and the aft

ramp is unlocked. The ramp system controls consist of a pilot's ramp control panel, a crewmember's ramp control panel, and a manual uplock release. When actuated, electrical switches on the ramp control panels energize hydraulic solenoid valves which direct hydraulic pressure to the top or down side of the ramp actuating cylinders.

CAUTION

Personnel should refrain from standing on the aft ramp unless it is resting on a surface or supported by the cables, to avoid possible damage to the ramp hydraulic system.

AFT RAMP

An aft ramp, approximately 8 feet in length, at the aft end of the cargo compartment, is used for the loading and unloading of cargo and personnel. The aft ramp is locked in the closed position by two uplock cylinders. The uplock cylinders are mechanically latched and hydraulically released. Two safety cables are to be attached to the aft ramp before and during flight, whether the aft ramp is open or closed. The cables are attached to the fuselage structure and are stowed above the aft ramp. Before and during flight, the cables shall be attached to the ramp. A caution light, marked RAMP, on the caution-

advisory panel will illuminate when the aft ramp is not up or not locked. The light receives electrical power from the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked RAMP WARN under the general heading INDICATOR LTS.

FORWARD RAMP

The forward ramp, approximately 5 feet 8 inches in length, may be lowered with the aft ramp, making an inclined entrance to the cabin. The forward ramp contains tiedown fittings for cargo tiedown, troop seats, skid strips, and a nonskid material surface for traction. The forward ramp is normally lowered after the aft ramp is lowered, and raised before the aft ramp is raised. The forward ramp is locked in the closed position by mechanically latched uplocks incorporated in the forward ramp actuating cylinders. The forward ramp is released by hydraulic pressure.

PILOT'S AND CREWMEMBER'S RAMP CONTROL PANELS

A pilot's RAMP CONTROL panel (figure 4-6) is located on the center console. The crewmember's ramp control panel is located on the right-hand cabin side panel above the ramp. The control is

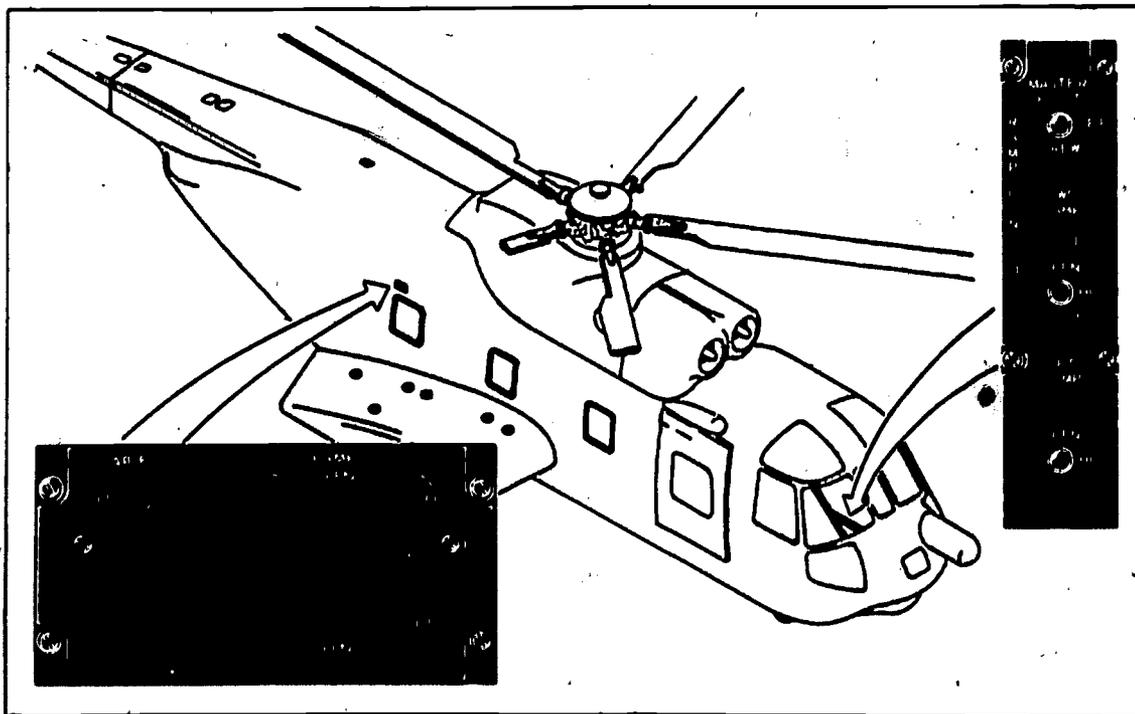


Figure 4-6. - Ramp control panels.

marked RAMP CONT. Both ramp control panels consist of a forward ramp switch, aft ramp switch, forward and aft RAMP OPEN caution lights. An inoperative CABLE caution light is on the crewmember's ramp control panel. The aft ramp switch, marked AFT with marked positions CLOSE, HOLD, and OPEN, controls operation of the aft ramp. The RAMP OPEN caution light, marked AFT, will illuminate when the aft ramp is not up and locked. The forward ramp switch, marked FWD with marked positions CLOSE, HOLD, and OPEN, controls the operation of the forward ramp. The RAMP OPEN caution light, marked FWD, will illuminate when the forward ramp is not up and locked. Extra long cargo may be extended over the aft ramp door with the aft ramp open (horizontal) in flight, but should be loaded in such a way that cargo does not come in contact with the aft ramp. Due to interlocks in the forward ramp control circuit, the forward ramp cannot be opened until the aft ramp is unlocked and the weight of the helicopter is on the helicopter's wheels. The caution lights on both ramp control panels are powered by the DC primary bus and are protected by the same circuit breaker on the overhead circuit breaker panel that protects the RAMP caution light on the caution-advisory panel.

AFT RAMP UPLOCK RELEASE LEVERS

There are two aft ramp manual uplock release levers (figure 4-7). One lever is located on the right side of the cabin above the ramp. The other, the handle type, is located externally under the right-hand side of the tail pylon, aft of the ramp, in an oblong metal container with a hinged cover marked alongside RAMP RELEASE HANDLE PULL. Both controls are connected by a cable to provide a mechanical release of the aft ramp uplocks when electrical or hydraulic power is not available. When the release levers are actuated, the uplocks are released and the ramp will lower under its own weight. Snubbing action, during the ramp opening is provided by a restrictor in the ramp actuating system hydraulic lines. (See figure 4-7.)

FORWARD RAMP UPLOCK RELEASE LEVERS

A manual release lever for the forward ramp actuating cylinder uplocks is installed on the top side of each actuating cylinder. The manual releases provide the means of unlocking the forward ramp when electrical or hydraulic power is not available. The ramp will then lower under its own weight. The rate of ramp lowering is controlled by a restrictor.

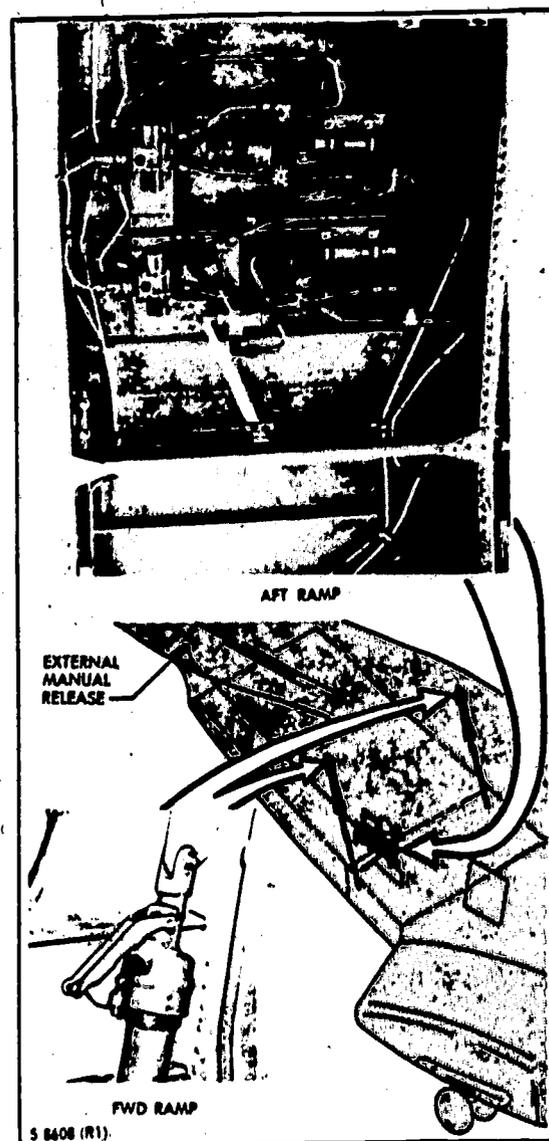


Figure 4-7. - Ramp uplock release levers.

CARGO DOOR

A door is installed in the forward section of the cabin on the right-hand side of the fuselage. The door, approximately 5.5 feet high and 4 feet wide, rides on tracks mounted above and below the door on the outside of the fuselage. A positive acting latch is installed in the door to prevent inadvertent opening in flight. The latch allows the door to be held open in three different positions. The door may be opened from inside the cabin or from the outside by turning the latch handle and sliding the door aft. A removable personnel ladder is installed in the sill of the door to permit entry of personnel. A light, marked CARGO DOOR, on the caution-advisory light panel will illuminate any time the door is not closed and latched.

SELF QUIZ #4

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. When the main rotor blade pitch is increased, tail rotor blade pitch is automatically increased by the action of the _____

- A. negative force gradient spring
- B. primary servocylinders
- C. stick trim system
- D. mixing unit

2. The cyclic control stick trim system holds the stick in a selected trim position by the use of _____

- A. electrical power
- B. hydraulic pressure
- C. mechanical linkage
- D. friction blocks

3. Sudden movements of the tail rotor control pedals are prevented by _____

- A. a pedal damper in the auxiliary servocylinder
- B. mechanical stops at the extreme ends of pedal travel
- C. a restrictor assembly in the control rigging
- D. a counterweight assembly on the tail rotor blades

4. The capacity of the primary hydraulic system reservoir is approximately _____ gallons(s) of hydraulic fluid.

- A. 0.40
- B. 0.45
- C. 1.45
- D. 1.40

5. What happens if the pressure in the auxiliary hydraulic system drops below 1,000 psi?

- A. The auxiliary hydraulic system is automatically shut off
- B. The primary hydraulic system cannot be shut off
- C. The auxiliary system is pressurized by primary system pressure
- D. The primary system is automatically shut off

6. The yaw trim knob on the automatic flight control system control panel is _____ shaped.

- A. bar
- B. circular
- C. triangular
- D. clover leaf

7. The pitot static tube on the right side of the cockpit canopy furnishes ram air pressure to which of the following?

- 1. Pilot's airspeed indicator
- 2. Common static system
- 3. True airspeed transducer
- 4. Copilot's airspeed indicator

- A. 1 and 2 only
- B. 3 and 4 only
- C. 1 and 3 only
- D. 2, 3, and 4

8. The compass control panel is located on the _____

- A. pilot's console
- B. copilot's console
- C. instrument panel
- D. lower center console

9. The nose wheel can swivel a MAXIMUM of _____ degrees.

- A. 70
- B. 90
- C. 180
- D. 360

10. The light in the landing gear control handle will be illuminated when the gear is _____

- A. up and locked
- B. down and locked
- C. up and the throttle is retarded
- D. in any intermediate position between full up or down



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11. In an emergency, the main landing gear is extended by _____

- A. an electric motor
- B. air pressure
- C. trapped hydraulic pressure
- D. a mechanical jackscrew

12. Which statement concerning ramp operation is TRUE?

- A. The forward ramp can be opened in flight
- B. The aft ramp can be opened on the water.
- C. The forward ramp must be unlocked before the aft ramp can be opened
- D. The forward ramp can be opened on the water

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ANSWERS TO SELF-QUIZ #4

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	D	4-3
2	B	4-2
3	A	4-3
4	B	4-4
5	B	4-4
6	C	4-5
7	C	4-6
8	A	4-7
9	D	4-9
10	D	4-10
11	B	4-11
12	B	4-11

HH-3F SYSTEMS

Reading Assignment:
Pages 5-1 through 5-11

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the basic operation and characteristics of the:

1. Heating system.
2. Anti-icing systems.
3. Lighting equipment systems.
4. Auxiliary power unit.

HEATING SYSTEM

The heating system (figure 5-1) consists of a blower, air internal combustion heater, a plenum chamber, an ducts which run along the left and right sides of the cabin and into the cockpit. The heater has a 200,000 BTU output. The heater unit, located overhead in the aft end of the cabin above the aft ramp, operates on fuel pumped from the forward main tank to the heater fuel pump and cycling valve to the heater fuel pump and cycling valve to the heater unit, where it is ignited by an ignitor plug. The ignitor plug operates electrically on current from the DC primary bus, boosted by the heater ignition unit mounted in the heater intake port, located aft of the aft ramp on the bottom of the tail pylon, and then through a heat exchanger surrounding the combustion unit. Heated air is then forced into the plenum chamber and the heater ducts. The blower also supplies air to the heater combustion chamber. The heating system is energized by the DC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked CABIN HEAT CONT under the general headings DC PRI.

Fuel consumption of the heater unit, when operating continuously in the HIGH position, is 1.2 gallons (8 pounds) per hour.

HEATER SWITCH

The heating system is operated by a switch on the overhead switch panel. The switch is marked CABIN HEATER and has marked positions LOW, OFF, and HIGH. The heater switch controls the heater fuel pump and cycling valve and the ignition unit. When the switch is in the LOW position, the heater will automatically maintain a temperature of approximately 65.6° C. in the ducts. When the switch is in the HIGH position, the heater will automatically maintain a temperature of approximately 140.6° C. in the ducts. An overheat switch will shut off the heater if for any reason the heat in the plenum chamber rises to 176.7° C. The heater amber caution light, marked HEATER HOT, located on the caution-advisory panel, will illuminate and the heater will automatically shut off if the heater blower should fail, if there is no ignition 45 seconds after the heater has been turned on, if the heater flame goes out after ignition, or if an overheat condition occurs. The caution light will flash momentarily when the heater is turned on.

HEATER BLOWER SWITCH

The heater blower switch is located on the overhead switch panel. The switch is marked CABIN HEATER and has marked positions NORM and VENT. The switch controls a relay connecting power from the No. 2 AC primary bus to the heater blower in the heater air intake duct. The switch and

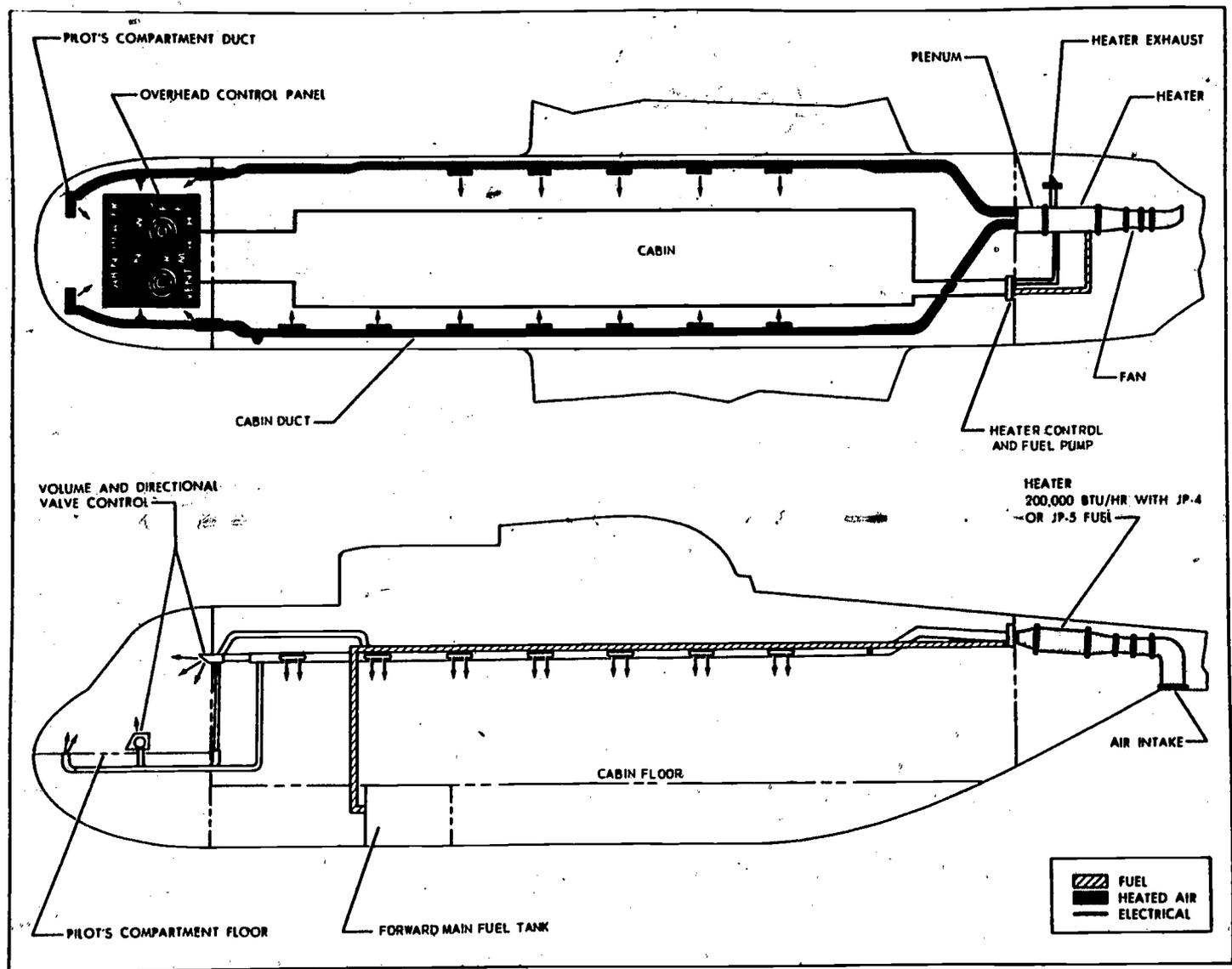


Figure 5-1. - Heating system.

blower control circuit is energized by the DC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked CABIN HEAT VENT under the general heading PRI and DC. The blower is protected by circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked CABIN HEATER BLOWER under the general heading No. 2 AC PRI. When the heater switch is in the NORM position, the blower operates in conjunction with the heating system. Placing the heater blower switch in the VENT position will operate the heater blower continuously.

VENTILATING SYSTEM

Placing the heater blower switch in the VENT position, without operating the heater, will draw outside air into the heater system and ventilate the cockpit and cabin.

HEATING AND VENTILATING DIFFUSERS

Heating and ventilating diffusers and registers are located in each of the heater ducts that extend along the sides of the cabin and into the cockpit. The cockpit has six diffusers. Two are located above and behind the pilot and copilot, and two are located on each side of the cockpit near the floor. These four diffusers are of the round, adjustable nozzle, air vent type. The open end of the nozzle has a knurled ring which can be turned to control the flow of air from full open to closed. The two remaining diffusers are of the register type and are located on the cockpit floor below the tail rotor pedals. There are twelve diffusers in the cabin, seven in the left-hand duct and five in the right-hand duct. Knobs, marked OPEN, are used to regulate the flow of air through the diffusers. The ducts are stenciled with operation instructions above each diffuser: TURN KNOB FOR VOLUME CONTROL, and PULL CENTER VANE DOWN FOR DIRECTIONAL CONTROL.

ANTI-ICING SYSTEMS

There are four anti-icing systems: (1) engine air inlet anti-icing system, (2) engine inlet guide vane (IGV) anti-icing system, (3) windshield anti-icing system, and (4) pitot head anti-icing system.

ENGINE AIR INLET AND IGV ANTI-ICING SYSTEMS

The engine air inlet and IGV anti-icing systems are designed to prevent ice from forming and

subsequently being ingested into the engine. Both systems are operated by the same control switches.

NOTE

If the engine anti-ice advisory light on the caution-advisory panel illuminates during flight when the engine anti-ice switches are in the OFF position this indicates that the engine anti-ice solenoid valve has opened (de-energized) due to electrical failure, and that a loss of approximately 50 horsepower at maximum power, will occur. With complete DC primary bus failure, the solenoid valve will open, but the advisory panel light will not illuminate.

Engine Air Inlet Anti-Icing System

The engine air inlet ducts are anti-iced by thermal electrical resistance elements embedded in the epoxy glass intake ducts. The oil tank mounting ring is anti-iced by a thermal electric boot that is interconnected with the inlet duct heating elements. Electrical current is applied to the heating elements to raise the temperature of the affected areas higher than the temperature at which ice will form. The electrical heating elements for the No. 1 engine air inlet duct and oil tank mounting ring receive operating power from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked NO 1 ENG INLET ANTI-ICE under the general heading NO 1 AC PRI. Operating power for the No. 2 engine air inlet duct and oil tank mounting comes from the No. 2 AC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked NO 2 ENG INLET ANTI-ICE under the general heading NO 2 AC PRI.

Engine IGV Anti-Icing System

The engine starter fairing, the inlet guide vanes, and the top (12 o'clock), right (3 o'clock), and left (9 o'clock) struts of the front frames of each engine are anti-iced by diverting engine tenth-stage compressor air to heat them. The bottom (6 o'clock) strut is continuously heated by scavenge oil from the No. 1 bearing area. Actuating the engine anti-ice switches deenergizes the engine mounted solenoid valve to the open position, allowing hot compressor air to flow through the front frame of the engines to the inside of the starter fairing and the inlet guide vanes.

WINDSHIELD ANTI-ICING SYSTEM

The pilot's and copilot's windshields are anti-iced by electric current which passes through a transparent electrically resistant film on the inner surface of the outer pane of the windshield. The windshield

anti-icing system consists of a special windshield, a windshield anti-ice controller, transformers, and a switch located on the overhead switch panel. The windshield anti-icing system also de-fogs the windshield.

The copilot's windshield anti-icing system operates from the No. 1 AC primary bus and is protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked WSHLD ANTI-ICE COPILOT under the general heading NO 1 AC PRI. The pilot's windshield anti-icing system operates from the No 2 AC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked WSHLD ANTI-ICE PILOT under the general heading NO 2 AC PRI. The control circuits use both AC and DC power. The AC control circuit uses 0A from the No. 2 AC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked WSHLD under the general headings ANTI-ICE and NO 2 AC PRI. The DC control circuit operates from the DC primary bus and is protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked WSHLD ANTI-ICE under the general heading ICE PROTECTION and DC PRI BUS.

PITOT HEATERS

A pitot heater switch, marked PITOT HEAT with marked positions ON and OFF, is located on the overhead switch panel. When the switch is placed in the ON position, an electric heater in each pitot head is turned on to prevent ice formation in the pitot head. The pitot heaters operate from the primary DC bus and are protected by two circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked PITOT HEAT 1 and 2 under the general headings ICE PROTECTION and DC PRI BUS.

LIGHTING EQUIPMENT

INTERIOR LIGHTS

Pilot's and Copilot's Flight Instrument Panel Lights

The pilot's and copilot's flight instrument panel lights and VOR-TACAN selector lights are individually controlled by rheostats are marked PILOT FLT INST and COPILOT FLT INST. With the PILOT FLT INST or COPILOT FLT INST rheostats in the OFF position, the VOR-TACAN lights will operate with a bright, fixed intensity. The VOR-TACAN

switch turns the appropriate VOR or TACAN light on. The intensity of the flight instrument lights may be varied by rotating each rheostat.

The copilot's flight instrument lights operate from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked CO-PLT FLT INST under the general headings CKPT LTS and NO 1 AC PRI. The pilot's flight instrument lights operate from the No. 2 AC primary bus and are protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked PILOT FLT INST under the general headings CKPT LTS and NO 2 AC PRI.

Non-Flight Instrument Lights

The non-flight instrument panel lights are controlled by a rheostat, marked NON-FLT INST, on the overhead switch panel. The intensity of the engine and transmission instrument lights, the hydraulic pressure gage lights, the fuel management backlighting, and fuel-quantity lights may be varied by rotating the rheostat. The non-flight instrument lights operate from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked NON-FLT INST under the general heading CKPT LTS and NO 1 AC PRI.

Console and Overhead Panel Lights

The white lights on the center console, the overhead switch panel, the pilot's side console, the copilot's side console, and the MARKER BEACON/RAWS control panel are controlled by rheostats on the overhead switch panel. The rheostats are under the heading CONSOLES LOWER and OVHD. An additional rheostat for red lighting on the lower center console, pilot's side console, and copilot's side console is on the overhead switch panel under the headings LOWER CONSOLE RED LIGHTS. The center console lights operate from the No. 2 AC primary bus and are protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked CSL LOWER under the general headings CKPT LTS and NO 2 AC PRI. The cockpit overhead panel lights operate from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked CSL OVHD under the general headings CKPT LTS and NO 1 AC PRI.

Cockpit Dome Lights and Secondary Instrument Light

There is one red and one white dome light on the cockpit overhead dome light panel. These lights are

controlled by a guarded switch on the dome light panel. The switch is marked DOME LIGHTS - CKPT with the marked positions RED, OFF and WHT. This switch will supply white light of a fixed intensity. In addition, the red dome light may be used as a secondary instrument light. When the red dome light is used as an instrument light, it should be turned on and its intensity adjusted with the rheostat, marked SECONDARY INST, on the overhead switch panel. These lights are powered by the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked COCKPIT DOME under the general headings INT LTS and DC PRI BUS.

Cockpit Utility Lights

Two portable utility lights with coiled cords are secured, one on each outboard side of the cockpit above the sliding windows. The lights may be adjusted on their mountings to direct the light beams, or they may be removed and used as portable lights. The utility lights are each controlled by a rheostat or a pushbutton, located on the end of each light casing. The lens casing of the light may be rotated to position a red filter converting the white light to a red light. The cockpit utility lights operate from the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked COCKPIT DOME under the general headings INT LTS and DC PRI BUS.

Scroll Check List Light

The scroll checklist light is controlled by an on-off rheostat switch mounted on the left side of the checklist container. The scroll checklist light operates from the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked CHECK LIST under the general headings INT LTS and DC PRI BUS.

Avionicsman's Panel Light Control

The avionicsman's panel light control rheostat, marked PNL LTS, is located on the radio rack in front of the avionicsman's table and controls light intensity of the LORAN control panel. The night lighting for the HF head, INTER ICS panel, and RADIO panel is controlled by the LOWER CONSOLE RED LIGHTS rheostat on the overhead switch panel in the cockpit. The avionicsman's panel lights operate from the No. 2 AC primary bus and are protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked NAV under the general headings CREW LTS and NO 2 AC PRI.

Avionicsman's Utility Light

A portable utility light, with coiled cord and mounting base, is secured to the left side of the cabin beside the avionicsman's table. The light is controlled by a rheostat on the mounting base. The light may be adjusted on its mounting base to direct the light beam, or it may be removed and used as a portable light. The utility light can be adjusted to operate as a red or white light. The avionicsman's utility light operates from the No. 2 AC primary bus and is protected by a circuit breaker on the pilot's overhead circuit breaker panel. The circuit breaker is marked MAP LT under the general heading NO 2 AC PRI.

Cabin Dome Lights

The four cabin dome lights (9, figure 5-2) are controlled by a guarded switch on the cockpit dome light panel. The switch is marked CABIN under the general heading DOME LIGHTS, with marked positions RED, OFF, and WHT. The cargo compartment dome lights are equipped with a red and a white lamp. The red or white light may be turned on at any time DC power is available at the DC monitor bus. The white light may be turned on only if the guard is lifted. The cabin dome lights operate from the DC monitor bus and are protected by a circuit breaker located on the pilot's circuit breaker panel. The circuit breaker is marked CABIN DOME LTS under the general headings DC MON.

Loading Lights

Two loading lights (10 and 14, figure 5-2), one in the ceiling of the cabin above the ramp and one in the bottom of the tail pylon, provide illumination for the ramp loading area. The lights are controlled by a two-position switch, marked LOADING LTS, ON, OFF, located on the overhead switch panel. The loading lights receive power from the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked LOADING under the general headings EXTERIOR LTS and DC PRI BUS.

EXTERIOR LIGHTS

Controllable Searchlight

The forward facing searchlight located in the nose of the helicopter can move on its hinged mounting bracket forward and down through a 120° arc. In addition, the searchlight can rotate 360° in either direction on its axis. However, it is restricted to 45° left or right until the unit has extended forward and down 110° to 120°, at which time the light will rotate 360°. The extend motor, rotate motor, limit switches and lamp are enclosed in



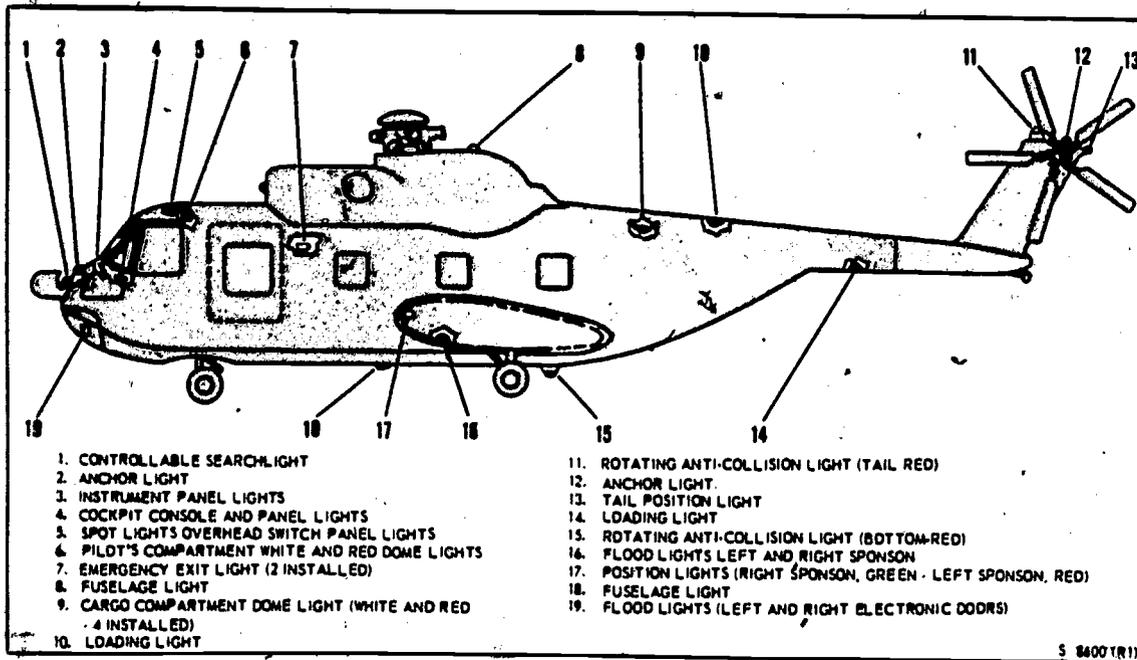


Figure 5-2. - Lighting system.

waterproof housings. There are three searchlight position control switches, one located on each collective pitch grip, marked SLT TRAIN, and the third on the copilot's searchlight and ICS switch panel. The illumination switch is on the overhead switch panel. The switch is labeled SEARCH, with marked positions STOW, OFF, and ON, and is under the general heading EXTERIOR LTS. The SLT TRAIN switch is a spring-loaded, four-position, thumb switch, center position OFF, with marked positions, FWD, AFT, L and R. Placing the SEARCH switch in the ON position lights the controllable spotlight and furnishes power to the SLT TRAIN switch to control the searchlight movement. When the SLT TRAIN switch is placed in the FWD position, the controllable searchlight extends by revolving forward and down a maximum of 120° from its stowed position, and it may be stopped at any intermediate position by releasing the switch. Placing the switch in the AFT position retracts the light until the searchlight is in the fully stowed position. When the switch is placed in the L or R position, the searchlight will rotate to the left or right. The searchlight position control switch mounted on the copilot's landing light and ICS switch panel operates in the same manner, and is marked LDG LTS with the marked positions FWD, AFT, L and R. If the SEARCH switch is placed in the STOW position while the controllable searchlight is extended, the searchlight will automatically go out and then retract

to the stowed position. The switch is then placed in the OFF position. The controllable searchlight operates from the DC primary bus and is protected by circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked SEARCH LIGHT, PWR, and CONT under the general heading EXTERIOR LTS.

Hover Lights

Four hover lights, one located on each side of the electronics compartment door and one located on the lower leading edge of each sponson, are controlled by a pushbutton switch, marked FLOOD HOVER, on the overhead switch panel. The button portion of the switch is a green lens that illuminates when the switch is pressed to illuminate the hover lights, and goes out when the button is pressed to turn off the hover lights. The hover lights illuminate an area forward and below the helicopter. The hover lights operate from the DC monitor bus and are protected by three circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked CONT, LH, and RH under the general headings FLOOD LTS, and DC MON.

CAUTION

The hover lights should not be left illuminated for more than 15 minutes at a time, to prevent overheating. The length of time while illuminated and the OAT will determine the cooling off period.

Position Lights

The position lights (17, figure 5-2), located on the sponsons and pylon, are controlled by two switches on the overhead switch panel. The switches are marked POSITION under the general heading EXTERIOR LTS. One switch will turn the lights on in a STEADY or FLASH configuration or turn the lights OFF. The other switch, marked DIM and BRT, will adjust the intensity of the lights accordingly when they are in the STEADY or FLASH configuration. The position lights operate from the DC primary bus and are protected by a circuit breaker on the overhead breaker panel. The circuit breaker is marked POS under the general headings EXTERIOR LTS and DC PRI BUS.

Fuselage Lights

Two fuselage lights (8 and 18, figure 5-2) are installed on the helicopter. One light is located on the top rear side of the transmission compartment and the other on the bottom of the hull. Both lights are controlled by a three-position switch on the overhead switch panel. The switch is marked FUSELAGE under the general heading EXTERIOR LTS, with marked positions DIM, OFF, and BRIGHT. The lights receive power from the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked FUS under the general heading EXTERIOR LTS.

Anchor Lights

Two anchor lights (2 and 12, figure 5-2), one located on the nose and the other on the pylon, are controlled by a two-position switch on the overhead switch panel. The switch is marked ANCHOR under the general heading EXTERIOR LTS, with marked positions ON and OFF. The anchor lights receive power from the battery bus and are protected by a circuit breaker, marked ANCHOR LTS. The circuit breaker is on the battery bus circuit breaker panel on the center console.

Rotating Anti-collision Lights

Two rotating anti-collision lights (11 and 15, figure 5-2), one located on the top of the tail pylon and the other on the bottom of the fuselage, are controlled by two switches on the overhead switch panel, under the general headings EXTERIOR LTS and ANTI-COLLISION. The left-hand switch, under the heading FWD with marked positions ON and OFF, controls the forward anti-collision light. The right-hand switch, under the heading AFT with marked positions AFT, ON and OFF controls the aft rotating anti-collision light. The rotating anti-

collision lights operate from the DC primary bus and are protected by two circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked FWD and AFT under the general headings ANTI-COLL and EXTERIOR LTS.

AUXILIARY POWER UNIT

The auxiliary power unit (APU) (figure 5-3), located to the rear of the main gear box, enables ground starting of the engines and ground operation of the electrical and hydraulic systems. The APU system consists of a control panel, and accumulator assembly, a hydraulic starter motor, a turbine engine, a fuel system, a self-contained oil system, and a mechanical drive. Starting power for the APU is furnished by means of an accumulator system mounted on the transmission deck. The accumulator carries an initial air charge of 1,600 psi and is hydraulically charged to 3,000 psi by the utility hydraulic pump. In addition, the system has provisions for hand pumping and may be charged in this manner with a hand pump, located on the right side of the cabin interior. When starting circuitry is energized, the start valve is opened, and hydraulic pressure from the accumulator is dumped into the APU starter. As soon as the turbine reaches operating speed and is driving the main gear box accessory section, the utility pump pressure recharges the accumulator with 3,000 psi pressure. The turbine engine has a self-contained oil system.

Electrical power for the control circuit is supplied from the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked CONT under the general headings APU and DC PRI BUS. This control circuit operates the automatic control system and the automatic emergency shutdown operation of the APU. The electrical power may be supplied from the battery or from an external power source. Fuel is supplied from the aft main tank. A fuel pressure switch actuates at approximately 110 psi to supply fuel to the combustion chamber through both the start fuel nozzle and main fuel ejectors and to commence ignition. At 90 percent speed, the start fuel nozzle and ignition are turned off by the speed switch and burning is self-sustaining as long as there is a flow of fuel through the APU main fuel valve. Fuel is consumed at 73 pounds (maximum) per hour. A mechanical drive with an automatic clutch is provided to drive the main gear box accessories section. The automatic clutch contains a freewheel unit that

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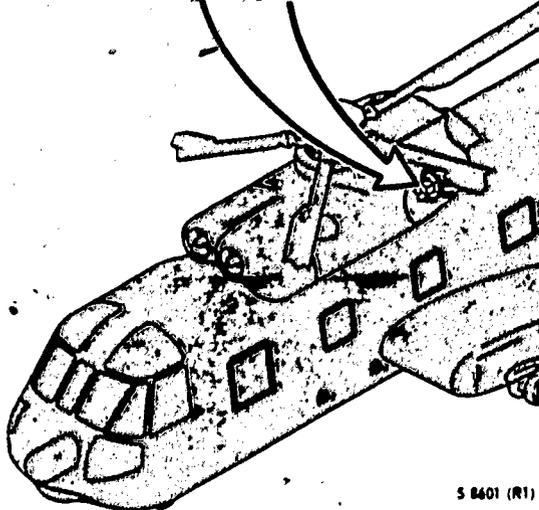
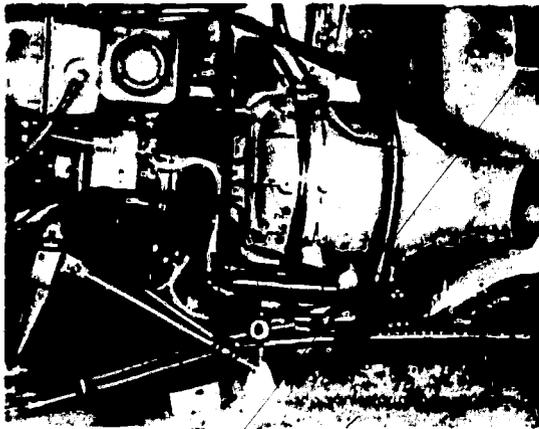


Figure 5-3. - Auxiliary power unit.

enables shutdown of the APU when the rotor head is engaged. Low oil pressure, high exhaust temperature or overspeed will cause the APU to shut down automatically.

APU CONTROL PANEL

The APU control panel (figure 5-4) located on the pilot's side console contains a master switch, a tachometer, an emergency panel and the following amber caution lights: prime-pump pressure, low oil pressure, high exhaust temperature and overspeed. The emergency panel contains a red fire warning light and fuel shutoff and fire extinguisher switches. During starts, the hydraulic start valve opens to motorize the engine. The prime pump also comes on for 20 seconds, then automatically goes off.

APU Function Switch

The APU master switch, with marked positions START, RUN, and OFF, controls operation of the

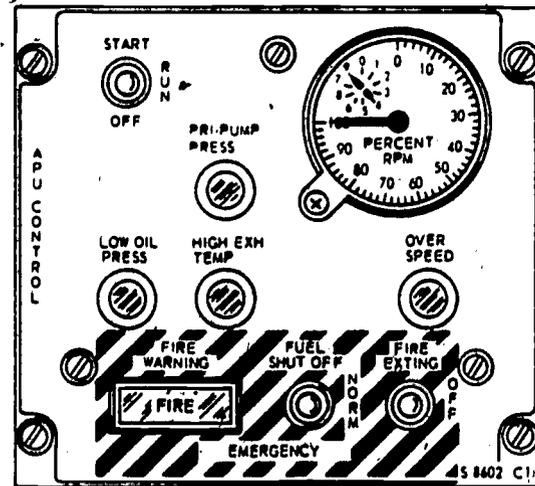


Figure 5-4. - Auxiliary power control panel.

APU. The switch must be held in the START position as it is spring-loaded to the RUN position. Holding the switch in the START position energizes the components of the automatic starting system and starts the APU. When the switch is released and returns to the RUN position, the APU will run normally and drive the accessory section of the main gear box. The switch is placed in the OFF position to close the main fuel valve and shut down the APU. The APU master switch is energized by the DC primary bus and is protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked CONT under the general headings APU and DC PRI BUS.

APU Tachometer

The tachometer indicates the percentage of APU engine rpm. The tachometer receives power from an APU-driven tachometer generator.

APU Low Oil Pressure Caution Light

An amber low oil pressure caution light, marked LOW OIL PRESS, will illuminate to indicate the APU has been automatically shut down because of low oil pressure.

APU High Exhaust Temperature Caution Light

An amber exhaust temperature caution light, marked HIGH EXH TEMP, will illuminate to indicate the APU has been automatically shut down because of abnormally high exhaust temperatures.

APU Overspeed Caution Light

An amber overspeed caution light, marked OVERSPEED, will illuminate to indicate the APU has been automatically shut down because its speed reached 110% rpm.

APU Prime Pump Press Caution Light

An amber prime fuel pump pressure caution light, marked PRI-PUMP PRESS, will illuminate whenever the prime pump is not delivering enough fuel pressure to open the pressure switch. A prime pump failure would be indicated by the illumination of the PR PUMP caution light for 20 seconds, upon initiating starting procedures.

APU Emergency Fuel Shutoff Switch

The emergency fuel shutoff switch, with marked positions FUEL SHUTOFF and NORM, is used to shut the APU down in an emergency. When the switch is in the NORM position, the APU performs normally and the APU fire extinguisher circuit is de-energized. Placing the switch in the FUEL SHUTOFF position closes the main fuel valve and allows the APU fire extinguisher circuit to be energized. The emergency fuel shutoff switch is energized from the DC primary bus, through the CONT circuit breaker.

APU Fire Extinguisher Switch

The APU fire extinguisher switch, with marked positions FIRE EXTING and OFF, discharges the APU fire extinguishing agent to the APU. The switch receives power from the DC primary bus, through the FUEL SHUTOFF position of the APU emergency fuel shutoff switch, through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked EXT under the general headings FIRE, APU, and DC PRI BUS.

APU Fire Warning Lights

Two red press-to-test APU fire warning lights, marked FIRE WARNING on the APU control panel, the APU FIRE on the caution advisory panel, provides an indication of fire in the APU. The light receives electrical power from the DC primary bus through the APU fire detection system through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked DET under the general headings FIRE, APU, and DC PRI BUS.

APU Advisory Light

A green light on the caution-advisory panel, marked APU, comes on whenever the main fuel valve opens (at approximately 30% APU speed) just before lite-off and will stay on until the APU is shut down.

APU HAND PUMP AND ACCUMULATOR GAGE

The hand pump and gage are located in the cabin forward of the last window on the right-hand side.

The hand pump (figure 5-5) is used before starting the turbine if the 3,000 psi pressure from the accumulator is not available or is insufficient. At -54° C, a pressure of approximately 4,000 psi is required to start the turbine. A visual indication of pressure can be observed on the hand pump gage during pumping operations.

APU STARTING PROCEDURE
APU START/RUN CHECKLIST

- MINIMUM CREW TO RUN APU -**
1 FIREGUARD.
1 COCKPIT OPERATOR.

PREFLIGHT

1. SIGHT CHECK APU COMP., INTAKE & EXHAUST.
2. APU WORK PLATFORM - closed.
3. APU ACCESS DOORS - closed.

MINIMUM CREW TO COMPLETE CHECKLIST - TWO.

FIREGUARD MAY READ ALL ITEMS UP TO #33, THEN ASSUME FIREGUARD POSITION.

STARTING CHECKLIST (#1-3 FOR NIGHT ONLY)

1. BATTERY SWITCH - on.
2. COCKPIT LIGHTING CONTROL - 7 rheostats full.
3. PILOTS OVERHEAD MAP LIGHT - on & positioned.

NORMAL DAYTIME PROCEDURES

4. OVERHEAD CIRCUIT BREAKERS - set.
5. ENG ANTI-ICE - off.
6. WINDSHIELD ANTI-ICE - off.
7. SEARCH LIGHT - off.
8. ANCHOR LIGHT - off.
9. FUSELAGE LIGHT - off.
10. ANTI-COLLISION LIGHTS - off (2).
11. POSITION LIGHTS - off.
12. CABIN HEATER - normal & off.
13. PITOT HEAT - off.
14. WINDSHIELD WIPERS - off.
15. WINDSHIELD WASHERS - off.
16. LOADING LIGHTS - off.
17. EMERG LIGHT - arm.
18. NOSE GEAR - normal.
19. HOIST MASTER - off.
20. CARGO HOOK - off.



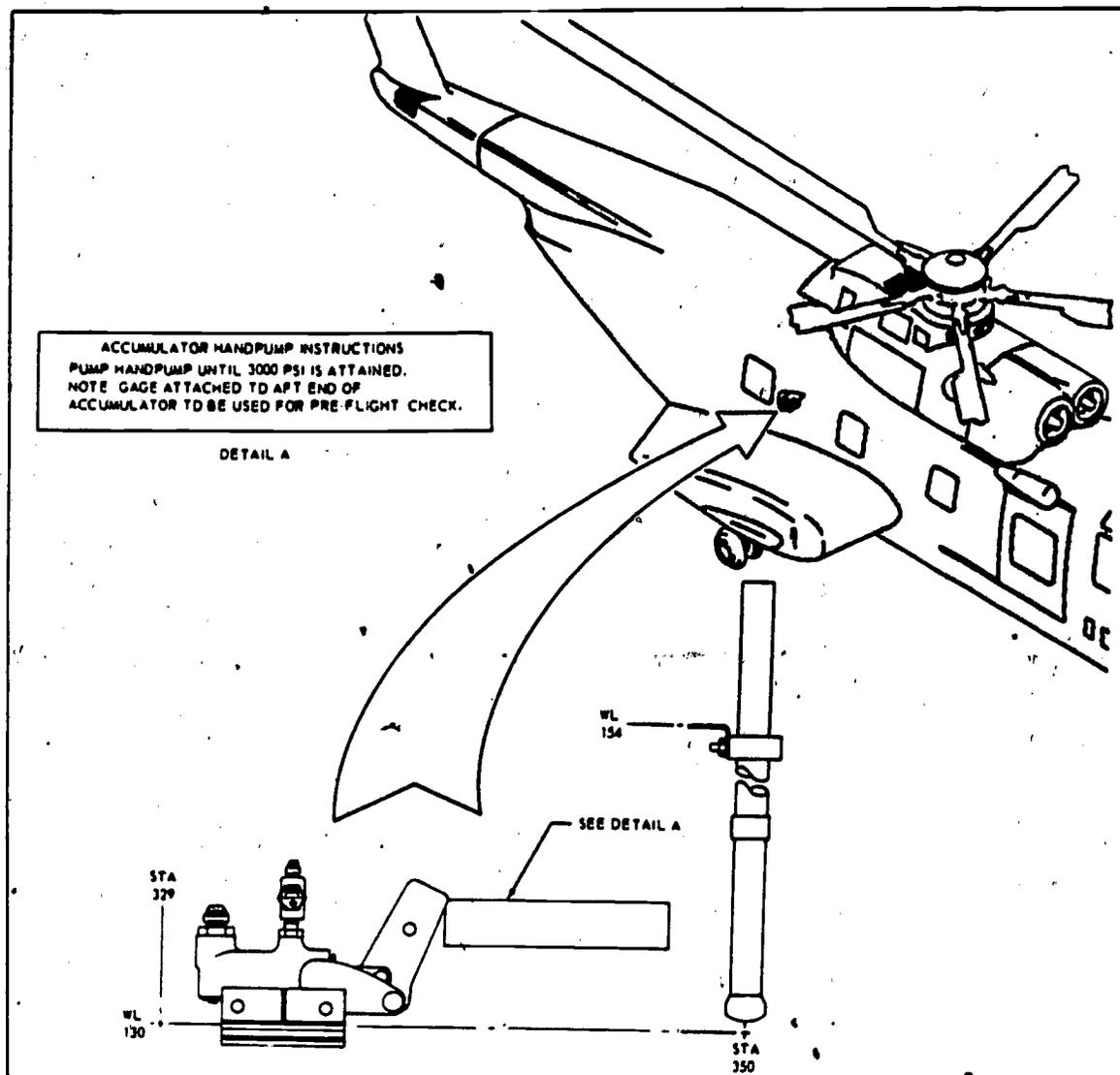


Figure 5-5. - APU accumulator hand pump.

- | | |
|--|--|
| <ul style="list-style-type: none"> 21. STICK TRIM MASTER - on. 22. CHANNEL MONITOR - off. 23. CONVERTERS (2) - on. 24. EXT PWR - off. 25. BATTERY - on. 26. GENERATOR SWITCHES (2) - on. 27. ROTOR BRAKE - on press min 320 psi. 28. GEAR HANDLE - down/green lights. 29. PARKING BRAKE - set. 30. RAMP MASTER - off. 31. APU FUEL SHUTOFF - normal. 32. APU FIRE EXTINGUISHER - off. 33. APU START/RUN SWITCH - run. | <ul style="list-style-type: none"> a. CK FOLLOWING LIGHTS ON - high
exch temp & overspeed. b. PRESS TO TEST - prime pump press/
low oil press. c. ENG FIRE WARNING TEST SWITCH
TO #2 ENG/APU FIRE LIGHT ONLY
<ul style="list-style-type: none"> 34. FIREGUARD - in position. 35. APU START/RUN SWITCH - start
position until Ng passes 45%, then release to run. 36. APU CLUTCH ENGAGEMENT - 76 to
80% Ng. 37. HYDRAULIC PRESS GAGES (3) - press up. |
|--|--|

38. WARNING PANEL LIGHTS - tested.

Following lights on warning panel must be out: CONVS 1-2, GENS 1-2, PRI-HYD PRESS, AUX-HYD PRESS, XMISSN OIL PRESS, & XMISSN CHIP DET.

39. BATTERY - off.

SECURE CHECKLIST

1. BATTERY - on.
2. EMERG LIGHT - disarm.
3. APU START/RUN SWITCH - off.
4. COCKPIT LIGHTING CONTROL - 7 rheostats closed.
5. STICK TRIM MASTER - off.
6. CONVERTERS (2) - off.
7. GENERATORS (2) - off.
8. PILOT'S OVERHEAD MAP LIGHT - off.
9. COCKPIT DOME LIGHT - off.
10. BATTERY SWITCH - off.

APU FIRE FIGHTING PROCEDURES - (obtain positive indication of fire before firing EXTING)

1. APU EMERG FUEL SHUTOFF - shut off.
2. APU FIRE EXTING - fire exting.

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3. APU MASTER SWITCH - off.
 4. EXIT A/C ASSIST FIGHTING FIRE

APU LIMITATIONS

1. CLUTCH ENGAGEMENT - 4-6 seconds.
2. Ng TOPPING - 99% - plus or minus 1%.
3. MOMENTARY OVERSHOOT - 110% Ng.
4. TOTAL TIME FOR START - approx 10 sec (never exceed 18 sec).
5. ABORT START IF -
 - a. No Ng indication
 - b. Warning light on APU panel lit
 - c. Warning lights cited in #38 lit
 - d. APU limitation exceeded
6. APU ADVISORY LIGHT ON WARNING PANEL - on above 30% Ng.

APU EMERGENCY STARTING PROCEDURE

The 3,000-psi pressure from the accumulator has a two time starting capability. However, if the pressure in the accumulator becomes depleted, the manual hydraulic pumping system can be used to replenish pressure in the accumulator.

SELF QUIZ #5

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOC T, you must study all the course material.

1. Heater fuel is taken from the _____ fuel tank.

- A. forward main
- B. forward aux
- C. aft main
- D. aft aux

2. Which of the following are anti-iced by thermal electric boots?

- 1. Oil tank mounting ring
- 2. Engine air intake duct
- 3. Inlet guide vanes
- 4. Starter cover

- A. 1 and 2 only
- B. 2 and 3 only
- C. 3 and 4 only
- D. 1, 2, and 3

3. The pilot's windshield anti-icing system operates from the _____ bus.

- A. DC primary
- B. No. 1 AC primary
- C. No. 2 AC primary
- D. No. 1 AC start

4. The cabin dome light guard is lifted to turn _____

- A. the red light on
- B. the white light on
- C. both lights on
- D. both lights off

5. To prevent overheating, the hover lights are limited to _____ minutes of operation.

- A. 5
- B. 10
- C. 15
- D. 20

6. The APU is started by a/an _____

- A. electric motor
- B. air turbine starter
- C. electric motor
- D. hydraulic motor

7. Fuel to operate the APU is taken from the _____ fuel tank.

- A. forward main
- B. forward aux
- C. aft main
- D. aft aux

8. The APU start fuel valve is energized until the unit reaches _____ percent of its rated speed.

- A. 50
- B. 75
- C. 90
- D. 100

9. The APU will automatically shut down when the speed reaches an rpm of _____ percent.

- A. 104
- B. 106
- C. 108
- D. 110

10. The APU START/RUN switch is released to the RUN position from the start position as Ng passes _____ percent.

- A. 45
- B. 56
- C. 76
- D. 80



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ANSWERS TO SELF-QUIZ #5

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	A	5-1
2	A	5-3
3	C	5-4
4	B	5-5
5	C	5-6
6	D	5-7
7	C	5-7
8	C	5-7
9	D	5-8
10	A	5-10

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COMMUNICATION SYSTEMS

Reading Assignment:
Pages 6-1 through 6-19

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the following HH-3F systems:

1. AN/AIC-18 ICS
2. AN/ARC-51A UHF

Since some communication and navigation systems are interrelated, the first part of this section will deal briefly with both systems. The remainder of the section explains the communication system in detail. We will discuss the navigation system in detail in another section.

COMMUNICATION AND NAVIGATION SYSTEMS

Electronic systems permit communication, navigation, and intercommunication between crew members. The systems also provide sensor inputs to the automatic flight control system (AFCS) and the attitude indicating system. The communication and navigation systems installed in the helicopter are listed in figure 6-5 and figure 6-6.

COMPONENT LOCATIONS

(See figures 6-2, 6-3, 6-4.)

Most communications and navigation system components are located in the electronics compartment below the cockpit, on the forward and aft cabin electronic racks, in the Doppler bay, and in the cockpit. Component locations for each system are shown in separate location diagrams contained in this pamphlet. Detail locations for system control panels are shown in figure 6-2, 6-3, 6-4.

COMPONENT REMOVAL/INSTALLATION

WARNING

To prevent injury to personnel and damage to equipment, turn off electrical power before performing any maintenance on electronic or electrical equipment.

Bow Electronics Compartment

Navigation system components secured on their respective mountings are removed either by releasing the nut-locking devices at the front of the mounting and sliding the component out of its mounting and off the shelf, or by disconnecting the particular cable connector, releasing the nut-locking devices at the front of the mounting, and sliding the component out of its mounting and off the shelf. Navigation system components not secured on mountings are removed by removing the attaching screws, bolts, or other securing devices, and lifting the component from the shelf. Install navigation system components by sliding the component into its mounting, ensuring proper mating of component receptacle and mounting plug, and by either tightening the nut-locking devices at the front of the mounting, or by tightening the nut-locking devices at the front of the mounting, and connecting the cable connector. Navigation system components not installed on mountings are secured in their respective places with screws, bolts, or other securing devices. Fasteners and electrical connectors of hard mounted components shall be safety wired.

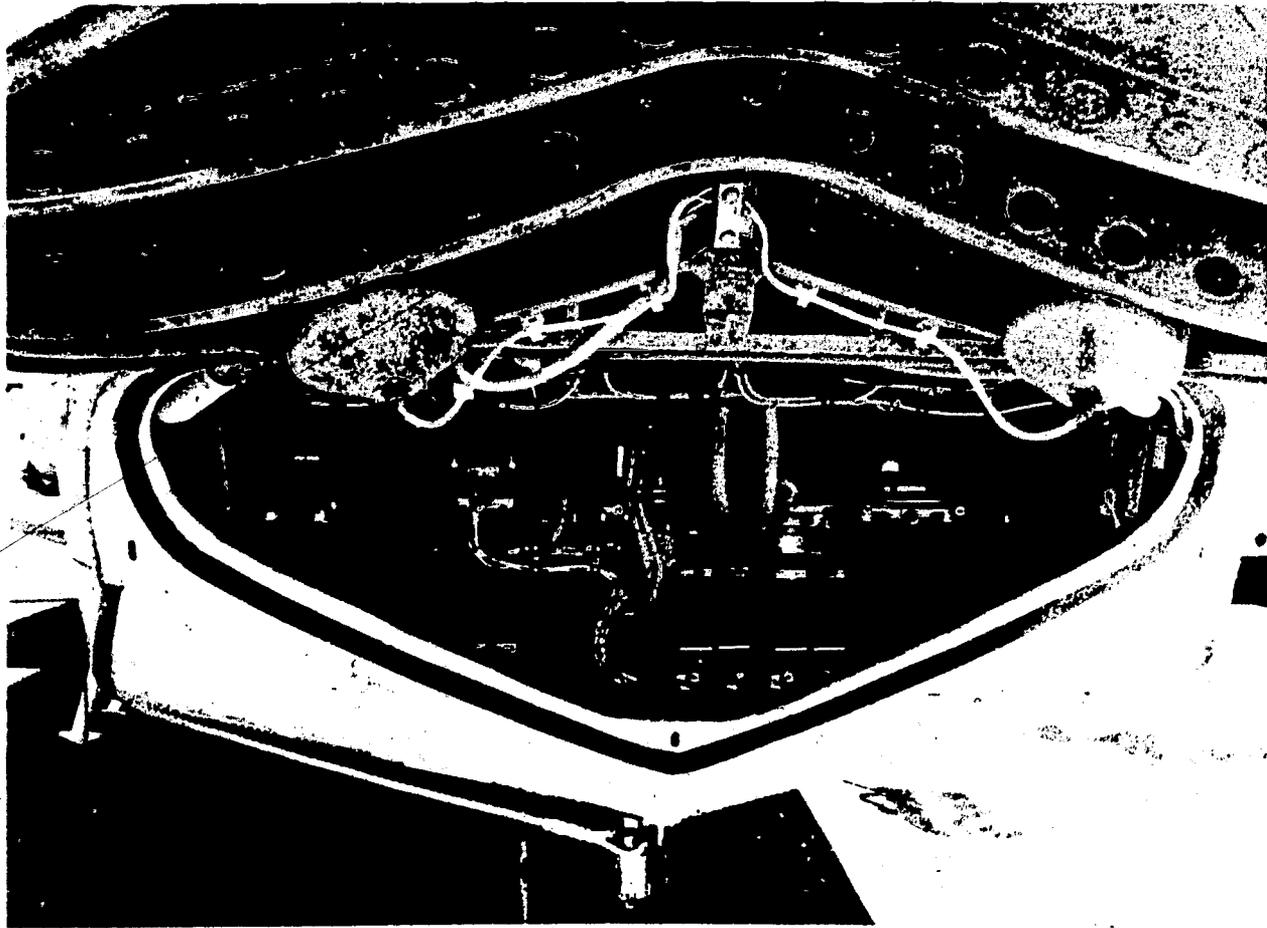


Figure 6-1. - Bow electronics compartment.

Cabin Electronic Mounting Racks

The aft cabin rack has removable side panels for accessibility. The majority of communication system components secured on their respective mountings are removed by disconnecting the appropriate cable connectors, releasing the nut-locking devices at the front of the mounting and sliding the component out of its mounting and off the shelf. Communication system components not secured on mountings are removed by removing the attaching screws, bolts, or other securing devices, and lifting the component from the shelf. Install communication system components by sliding the component into its mounting, ensuring proper mating of component receptacle and mounting plug, and by tightening the nut-locking devices at the mounting, and connecting the cable connector. Communication system components not installed on mountings are secured in their respective places with screws, bolts, or other securing devices. Fasteners and electrical connectors of hard mounted components shall be safety wired.

Instrument Panel

The instrument panel contains the pilot's and copilot's navigation instruments and search radar control unit. A navigation instrument is removed from the instrument panel by loosening the fasteners, carefully lifting the instrument sufficiently from the panel recess to gain access to the rear disconnect plug, and disconnecting the plug.

Consoles

Remove a control panel from a console by loosening the fasteners, lifting the control panel sufficiently from the console recess to gain access to the rear disconnect plug, and disconnecting the plug.

GROUNDING PRACTICES

An adequate ground must be provided for all communication and navigation components.

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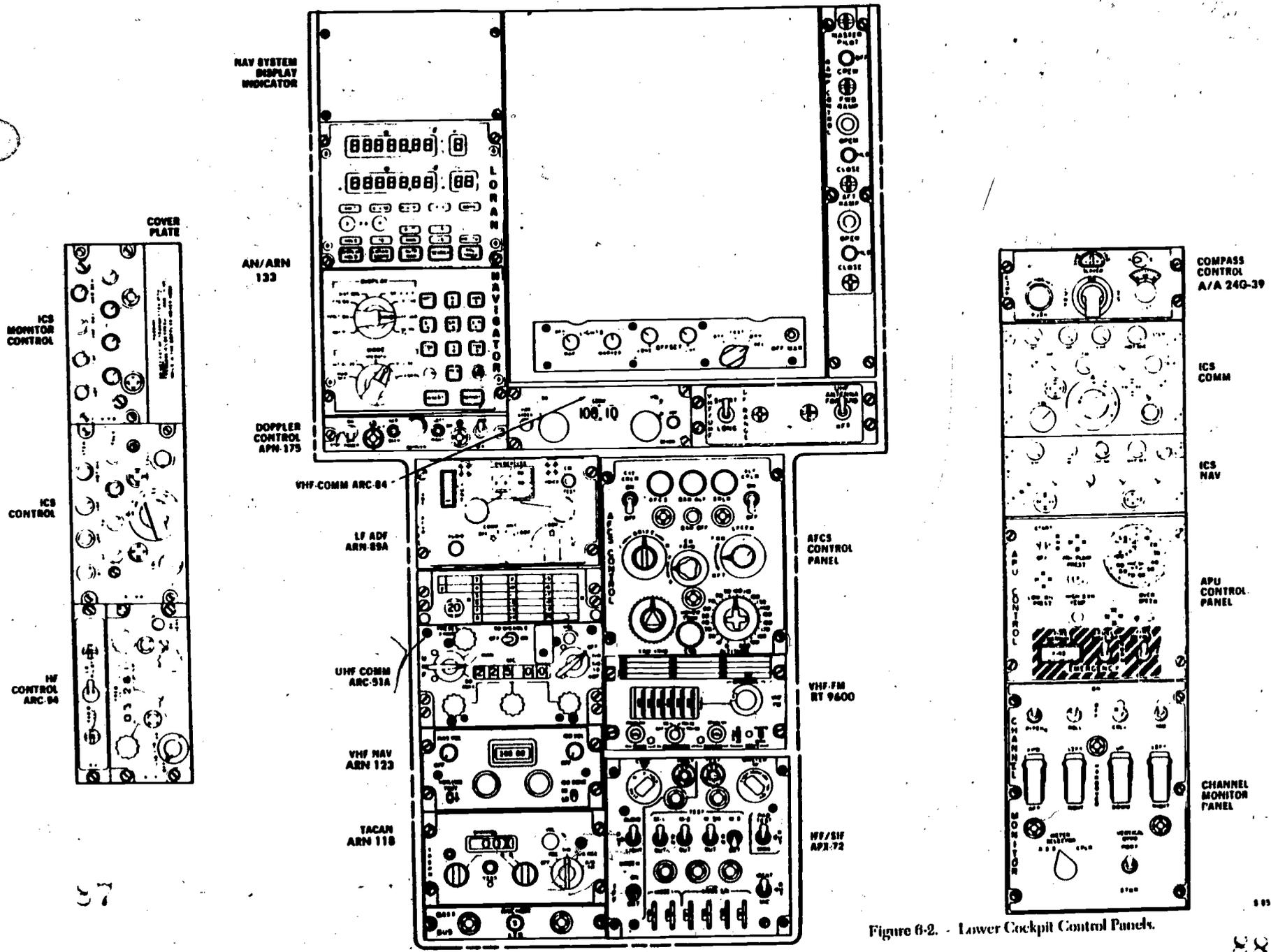


Figure 6-2. - Lower Cockpit Control Panels.

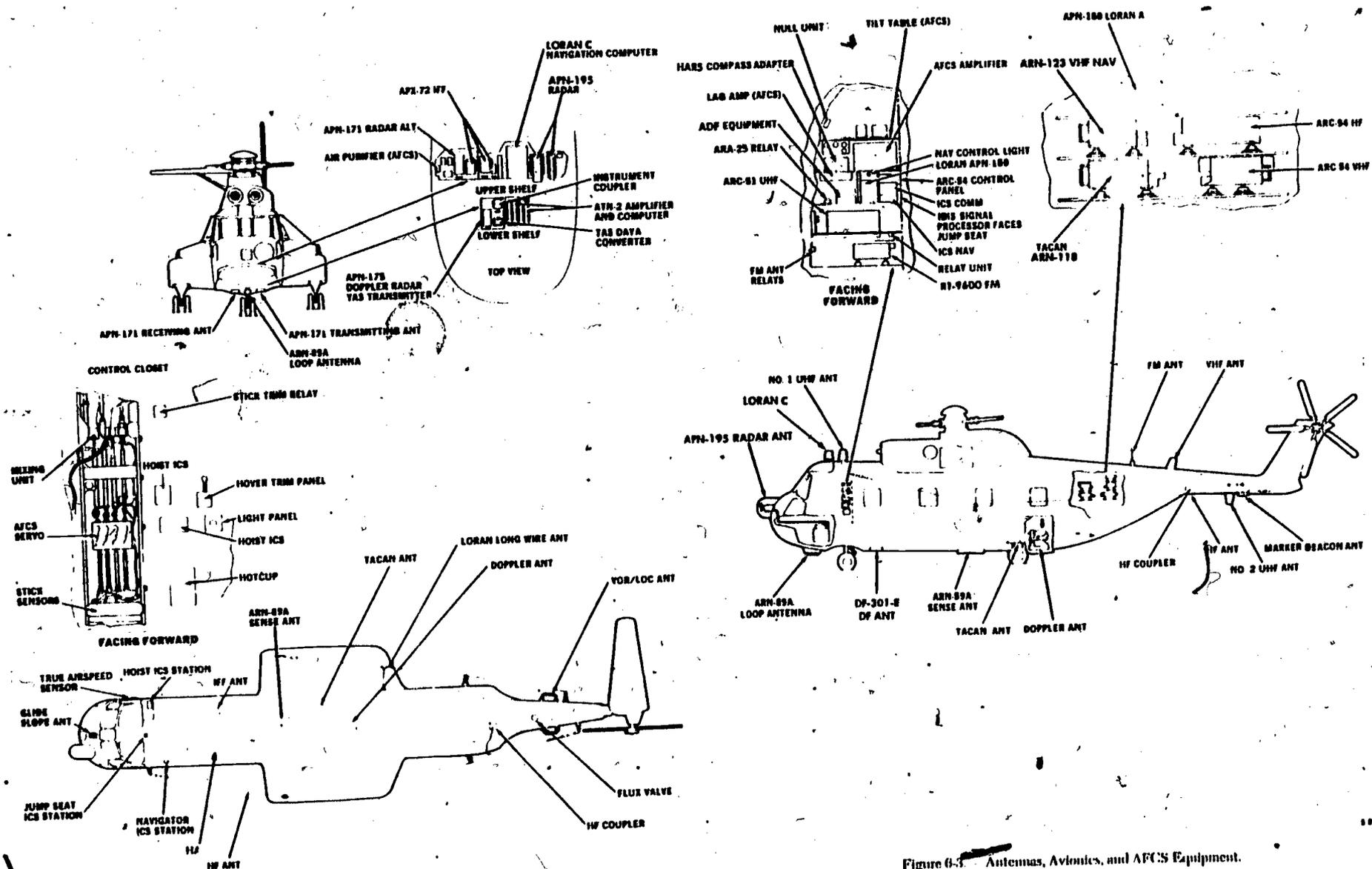


Figure 6-3. Antennas, Avionics, and AFCS Equipment.

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6-5

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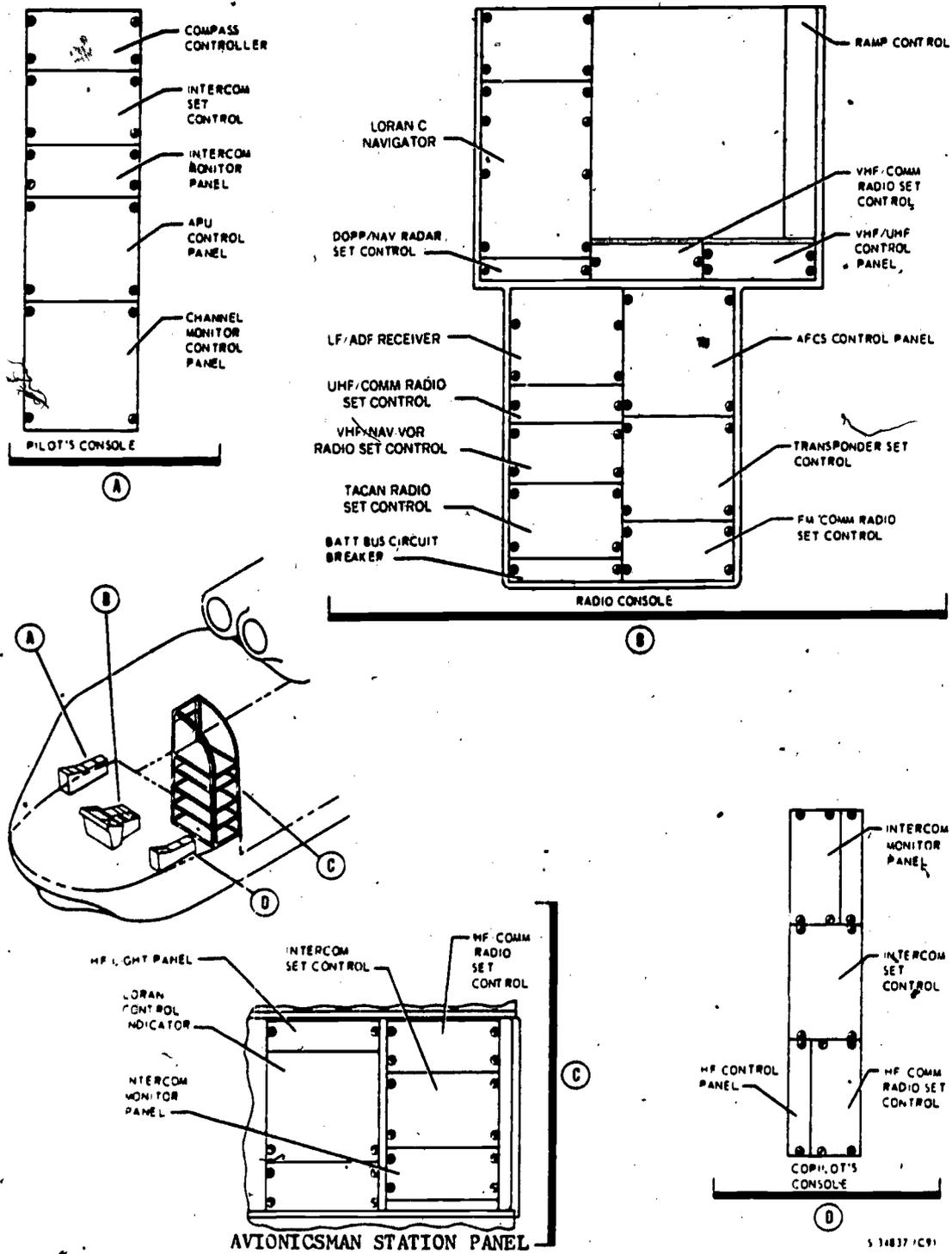


Figure 6-4. - Consoles and control panels - location diagram.

Communication and Navigation Systems

<u>SYSTEM NOMENCLATURE AND DESIGNATION</u>	<u>SYSTEM COMMON NOMENCLATURE</u>	<u>PURPOSE OF SYSTEM</u>
Intercommunication Set AN/AIC-18	INTERCOM	Provides intercommunication between stations within helicopter. Also provides selection, control, audio, and monitoring of communication and navigation systems.
Radio Set AN/ARC-51A	UHF/COMM	Provides short-range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.
Radio Set AN/ARC-94	HF/COMM	Provides long-range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.
Radio Set AN/ARC-84	VHF/COMM	Provides medium-range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.
Transponder AN/APX-72(V)	IFF	Provides coded reply in response to interrogation for identification and navigation.
Heading Attitude Reference System AN/A24(G-39)	Heading attitude reference system	Provides attitude and heading information in the form of continuous signal outputs representing displacement of helicopter about pitch, roll, and yaw axes.
Direction Finder DF-301	UHF-VHF-FM/ADF	Provides pointer indication of relative bearing to UHF, VHF and FM radio transmitter sources for homing.
Direction Finder Set AN/ARN-59A	LF/ADF	Provides visual indication of relative bearing to LF transmitter signal source for navigation and homing.
Tacan Navigational Set AN/ARN-118	TACAN	Provides bearing and distance information with respect to geographical location of TACAN ground beacon. Also air-to-air ranging between helicopters and beacon identity information.

Figure 6-5. - Communication and Navigation Systems.

SYSTEM
NOMENCLATURE AND
DESIGNATION

SYSTEM COMMON
NOMENCLATURE

PURPOSE OF SYSTEM

Navigation Set
AN/ARN-123(V)

VHF/NAV-VOR

Provides course deviation with respect to localizer beam. Also provides course deviation and ambiguity information to VOR station.

Glide-slope

Provides course deviation with respect to glide-slope beam.

Marker beacon

Indicates that helicopter has passed over airway fan markers, station location Z markers, or approach markers of instrument landing system.

Radar Altimeter
Set AN/APN-171

Altimeter

Provides visual indication of terrain clearance from 0 to 5,000 feet.

Radar Navigation
Set AN/APN-175(V)-1

DOPP/NAV

Provides visual indication of true ground speed, drift speed, and vertical velocity.

Radar Set
AN/APN-195

Search radar

Provides accurate and continuous picture of weather conditions (weather map) in general sky area ahead of helicopter. Also used for navigation and search aid.

Loran C Navigator

LORAN C

Provides continuous navigation information and steering in LORAN C coverage areas.

Loran-A Navigation
System AN/APN-180

Loran

Provides Loran chart navigation data to COMPUTER/NAV system or Loran lines of position fix when used independently.

Navigation Computer
Set AN/AYN-2

FLIGHT/NAV

Provides an easily interpreted pictorial display of helicopter navigation situation and automatically computes required action necessary to obtain desired radio track or heading.

Radio Set
RT-9600

VHF-FM/COMM

Provides medium range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.

Figure 6-5. - (Continued).

<u>TYPE</u>	<u>DESIGNATION</u>	<u>FUNCTION</u>	<u>RANGE</u>	<u>LOCATION OF CONTROL</u>
Intercommuni- cation System	AN/AIC-18	Interphone and ra- dio communication	Internal	At the following sta- tions: pilot, copilot, avionicsman; jump seat, hoist operator and aft cabin station
UHF/COMM	AN/ARC-51A	Two-way voice communication-	Line of sight	Cockpit console
VHF/COMM	AN/ARC-84	Two-way voice communication	Line of sight	Cockpit console
HF/COMM	AN/ARC-94	Two-way voice communication	Long range	Copilot console, avionicsman's, console
IFF Trans- ponder	AN/APX-72	Identification azimuth, and range	Line of sight	Cockpit console
UHF-VHF/ ADF	DF-301	Automatic direc- tion finding	Line of sight	Cockpit console
VHF/FM	RT-9600	VHF/FM transceiver in 150.000 to 173.995 MHz frequency range	Line of sight	Cockpit console
VHF/NAV	AN/ARN-123	ILS, VOR, Glide Slope and Marker Beacon receiver	Line of sight	Cockpit console
TACAN	AN/ARN-118	Tactical air navigation	Line of sight	Cockpit console
LF/ADF	AN/ARN-89A	Automatic direc- tion finding	Long range	Cockpit console

Figure 6-6. - Electronic equipment (HH-3F).

<u>TYPE</u>	<u>DESIGNATION</u>	<u>FUNCTION</u>	<u>RANGE</u>	<u>LOCATION OF CONTROL</u>
Radar Altimeter	AN/APN-171(V)	Measure absolute altitude	5,000 feet	Instrument panel
Radar	AN/APN-195	Weather search and navigation	60 miles	Instrument panel
X Doppler	AN/APN-175(V) -1	Doppler sensor	N/A	Cockpit console
LORAN A	AN/APN-180	Long range navigation	Long range	Avionicsman station
LORAN C Navigator	AN/ARN-133(V)	Loran C Navigation computer	N/A	Cockpit console
Flight Director	AN/AYN-2	Present visual readout of navigation radio aid receivers	N/A	Instrument panel

Figure 6-6. - Electronic equipment (HH-3F) (Continued).

INTERCOMMUNICATION SYSTEM (ICS)
AN/AIC-18

The AN/AIC-18 intercommunication system (ICS) provides communication between the various crewmembers. The ICS also links the audio channels of the communication and associated electronic equipment to provide simplified control and simultaneous operation. The system is controlled through identical ICS control and monitor panels provided for the pilot, copilot, and avionicsman (figures 6-7 and 6-9). In addition, the copilot has a remote ICS switch. The hoist station is equipped with a monitor panel, ICS station, and a hot mike switch (figure 6-11). The cabin aircrewman's station (jump seat) is equipped with an ICS station and a monitor panel (figure 6-8). The aft cabin station is equipped with an ICS station and a hot mike switch (figure 6-8).

The ICS circuits for the pilot, copilot, avionicsman, and crewman are powered by the DC primary bus. The forward and aft exterior ICS receptacles are on the crewman's ICS circuit (figure 6-10). When the aft external ICS receptacle is in use, the

aft cabin ICS station is inoperative. The pilot's and avionicsman's ICS circuits are protected by circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked PILOT and NAV under the general headings DC, PRI, and ICS. The copilot's and crewman's ICS circuits are protected by circuit breakers on the copilot's circuit breaker panel. The circuit breakers are marked CO-PLT and CREW under the general headings DC, PRI, and ICS.

NOTE

If any of the ICS circuit breakers pop, complete communication capability (ICS, CALL, RADIOS, and HOT MIKE) is lost to the respective position.

ICS CONTROL

The ICS control, marked INTER, is a panel mounted assembly on the pilot's, copilot's and avionicsman's console. All switches and control are front mounted except the external talk switch. Seven separate combination monitor selector-volume controls enable monitoring and individual listening level adjustment of the seven audio lines. The associated

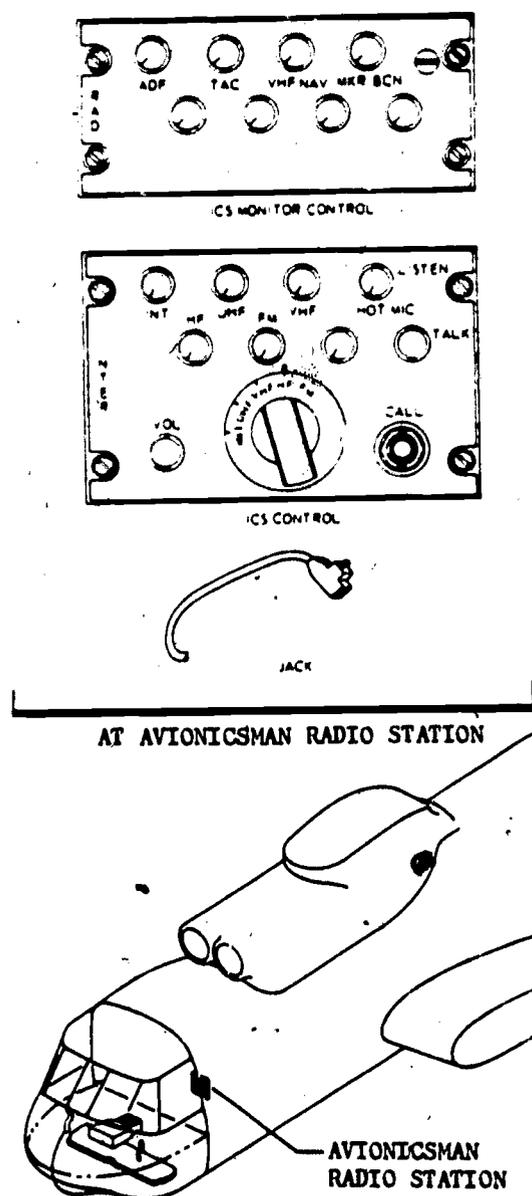


Figure 6-7. - ICS system avionicsman AN/AIC-18,

monitor switches are pulled out to monitor the desired audio lines. The level of the individual audio line is adjusted by rotating the associated monitor volume control. The six-monitor selector/volume controls used are marked: INT, UHF, VHF, HOT MIC LISTEN, HF, and FM. A HOT MIC TALK switch is also on this panel. A rotary selector switch enables transmission and reception on ICS or selected radio communications systems. The switch is marked INT, UHF, VHF, HF, and FM. The external talk switches control operation of the selected transmitter. The ICS control panel also contains a VOL control to adjust the signal level to the associated headphones, a HOT MIC TALK on-off switch, and a CALL button for emergency call operation.

The ICS controls provide four modes of microphone operation: one button, two button, HOT MIC, and CALL. The avionicsman has one-button operation, which provides a capability to talk on the interphone line or a radio transmitter, as selected by the rotary selector switch. Two-button operation is a mode whereby the pilot and copilot may talk on the interphone line or a selected radio transmitter without the need for operating the selector switch on the ICS control panel. The capability is provided by rocker switches on the pilot's and copilot's cyclitic pitch stick. In addition, the copilot may talk on interphone or a selected radio by using the copilot's remote ICS switch. HOT MIC operation provides hand-free intercommunication. Call operation provides exalted intercommunication for high-priority or emergency messages. The call signal is heard at least six decibels louder than any other signal present.

ICS STATION

The ICS station is a bulkhead-mounted assembly with two controls mounted on the front panel. The VOLUME control adjusts the signal level to the headphones. The CALL button, which has a cap guard and chain, provides for emergency call operation on the interphone line. A plug connector and associated cable is used to connect the headset-microphone to the ICS station. The plug connector is a telephone jack with a push-to-talk switch and clip. (See figures 6-14 and 6-15.)

ICS MONITOR CONTROL

The monitor panel, marked RAD, is a panel mounted assembly with eight combination monitor selector/volume controls. At the pilot's, copilot's and avionicsman's consoles, only four are used, and they are marked ADF, TAC, VHF NAV, and MKR BCN. These monitor switch-volume controls permit monitoring of navigational systems which have output signals in the audio range. The hoist operator's and cabin aircrewman's stations are equipped with a monitor panel, marked RAD and HOSIT OPERATOR, and seven of the eight monitor selector/volume controls are used. They are marked INT, UHF, HF, HOT MIC LISTEN, VHF, FM, and ADF. These controls permit monitoring and individual listening level adjustment.

HOT MIKE SWITCH

The hoist operator and aft cabin stations are equipped with a two-position HOT MIKE switch with the marked positions ON and OFF. This switch permits hands-free intercommunication. (See figure 6-11.)

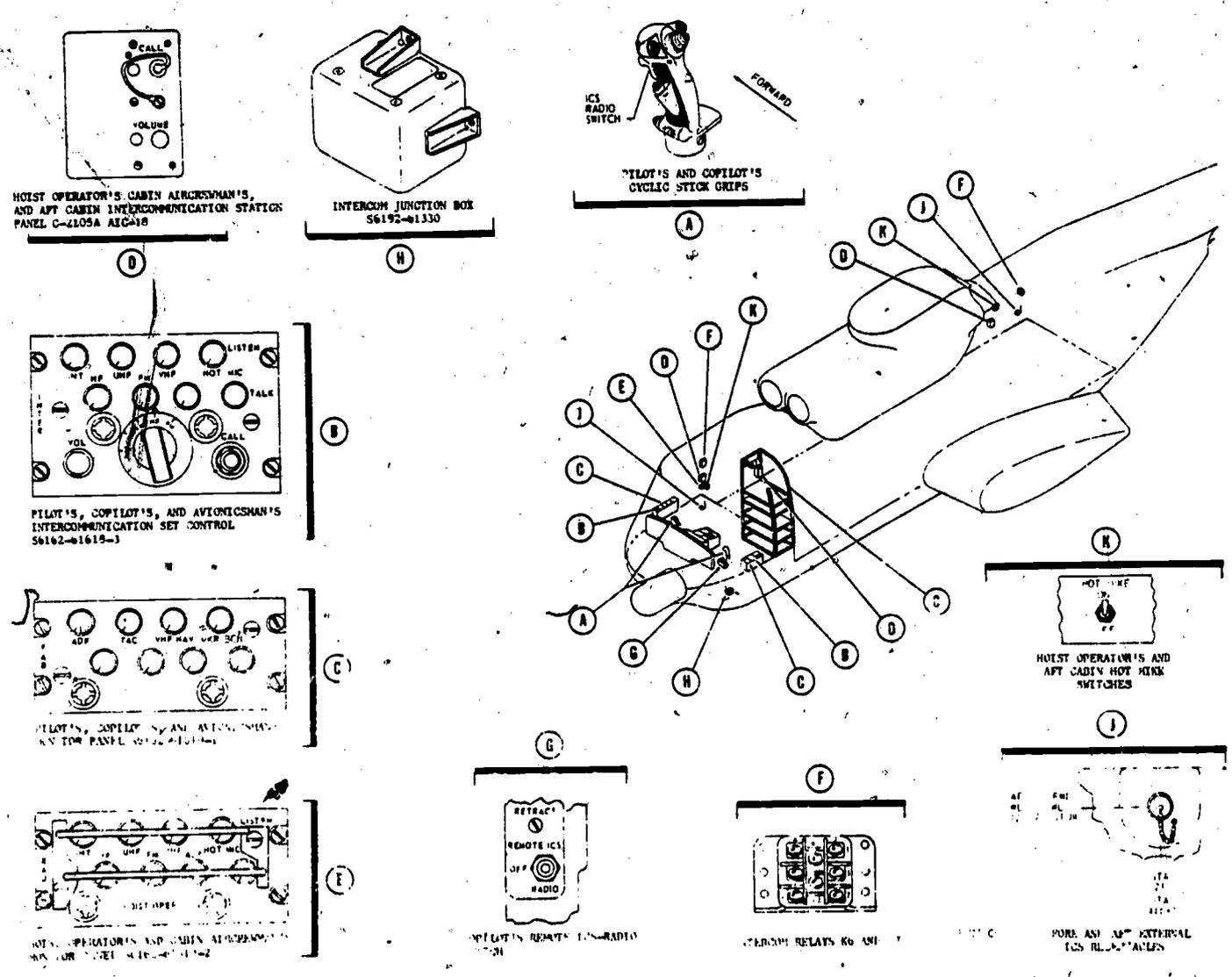
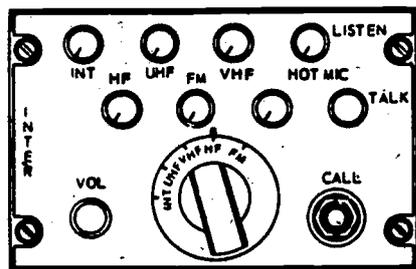
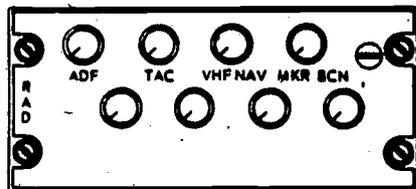


Figure 6-8. - INTERCOM system components - location diagram.

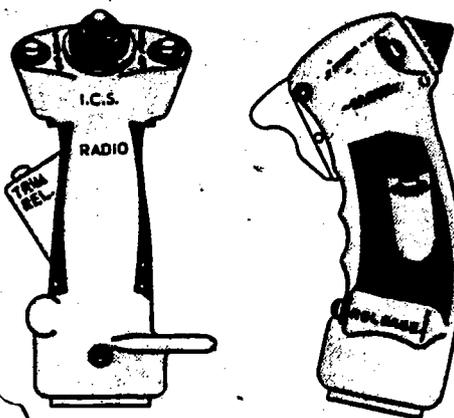




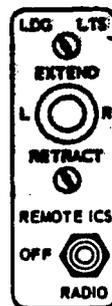
DETAIL A



DETAIL B



ICS ROCKER SWITCH, PILOT'S AND COPILOT'S
DETAIL C



ICS SWITCH PANEL, REMOTE, COPILOT'S
DETAIL D

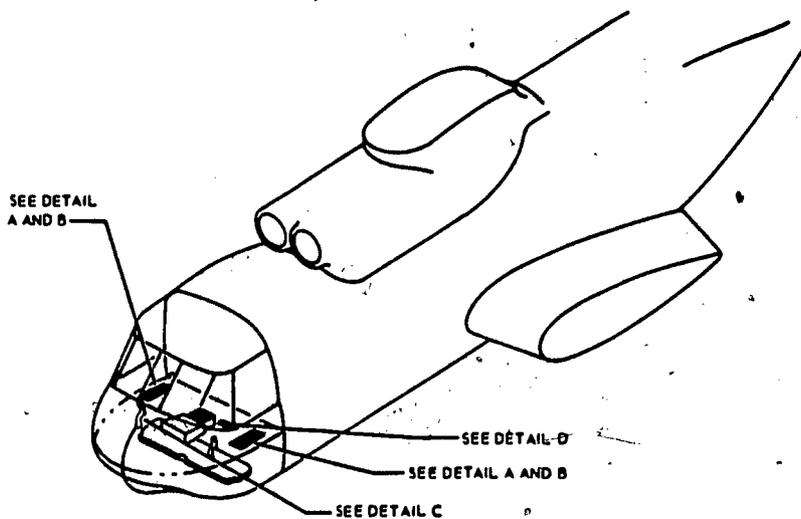


Figure 6-9. - ICS system pilot and copilot AN/AIC-18.

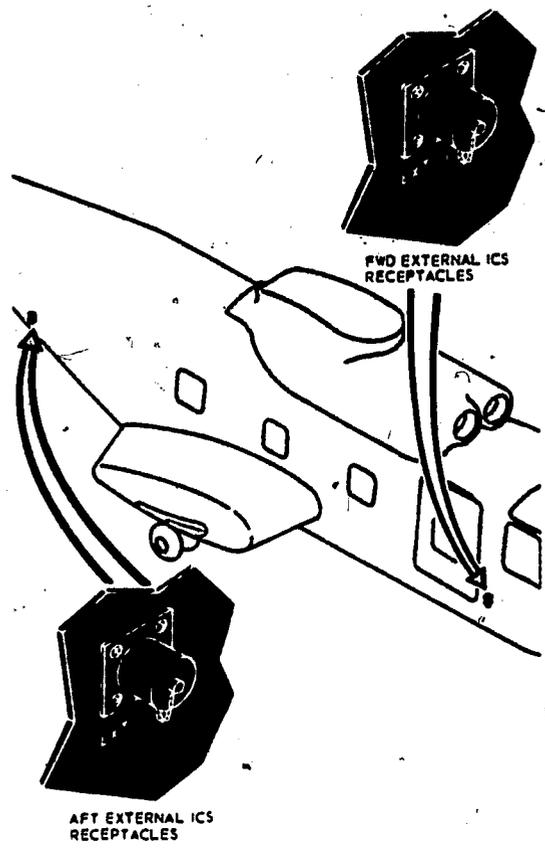


Figure 6-10. - ICS External stations AN/AIC-18.

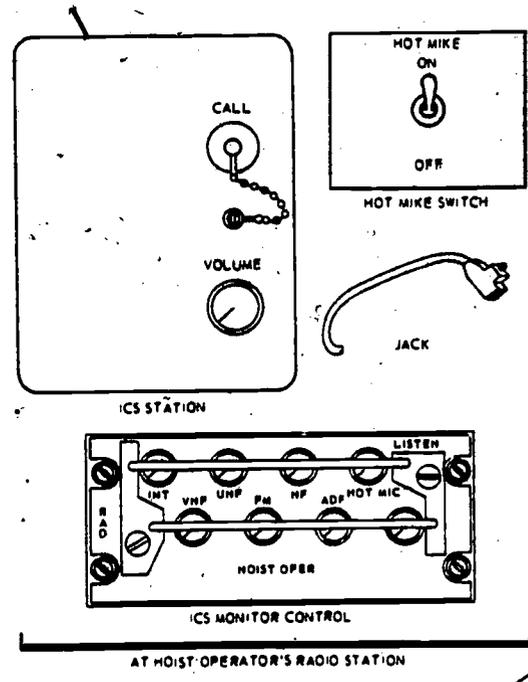
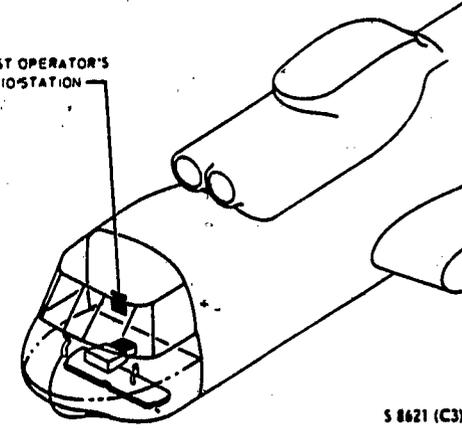


Figure 6-11. - ICS system hoist operator AN/AIC-18.



<u>COMPONENT</u>	<u>FUNCTION</u>
Intercommunication Set Controls	Provides selection of communications reception-transmission and intercommunication control to pilot, copilot, and avionicsman stations.
Intercommunication Station Panels	Provides intercommunications for hoist operator, cabin aircrewman, and aft cabin stations. Cabin aircrewman and aft cabin stations are electrically connected to fore-and-aft external ICS receptacles.
Monitor Panels	Provides additional monitoring circuits for pilot, copilot, avionicsman, cabin aircrewman, and hoist operator stations.

Figure 6-12A. - Intercom Equipment Components - Leading Particulars.

<u>COMPONENT</u>	<u>FUNCTION</u>
INTERCOM Junction Box	Provides load for and distributes intercommunication, communication, and navigation audio input and output signals.
ICS-RADIO Switches	Allows pilot and copilot to key INTERCOM system or selected communication system. Provides ground path when pressed to ICS or RADIO.
Microphone Switch Cord Assembly	Allows avionicsman to key selected INTERCOM or communication systems. Allows crewman to key INTERCOM system.
Headset Microphone Copilot REMOTE ICS-RADIO Switch	Provides means of communication. When positioned to ICS, allows copilot hands-off INTERCOM key operation. Spring-loaded RADIO position returns to OFF when released.
External fore-and-aft ICS receptacles	Provides electrical connection to cabin aircrewman and aft cabin stations for outside helicopter communications.
Hot Mike Switches	Allows hoist operator and aft cabin stations to transmit on hot mike.
Junction Box	Provides electrical connection for crewman's microphone switch cord assembly.

Figure 6-12B. - Associated Equipment Components.

<u>STATION</u>	<u>NORMAL INTERCOM</u>	<u>CALL INTERCOM</u>	<u>HOT MIKE INTERCOM</u>	<u>COMM/NAV RECEPTION</u>	<u>COMM TRANSMISSION</u>
Pilot	X	X	X	X	X
Copilot	X	X	X	X	X
Avionicsman	X	X	X	X	X
Hoist	X	X	X	X	
Operator					
Aft Cabin	X	X	X		
Cabin Air Crewman	X	X		X	

Figure 6-13. - Station Modes of Operation.

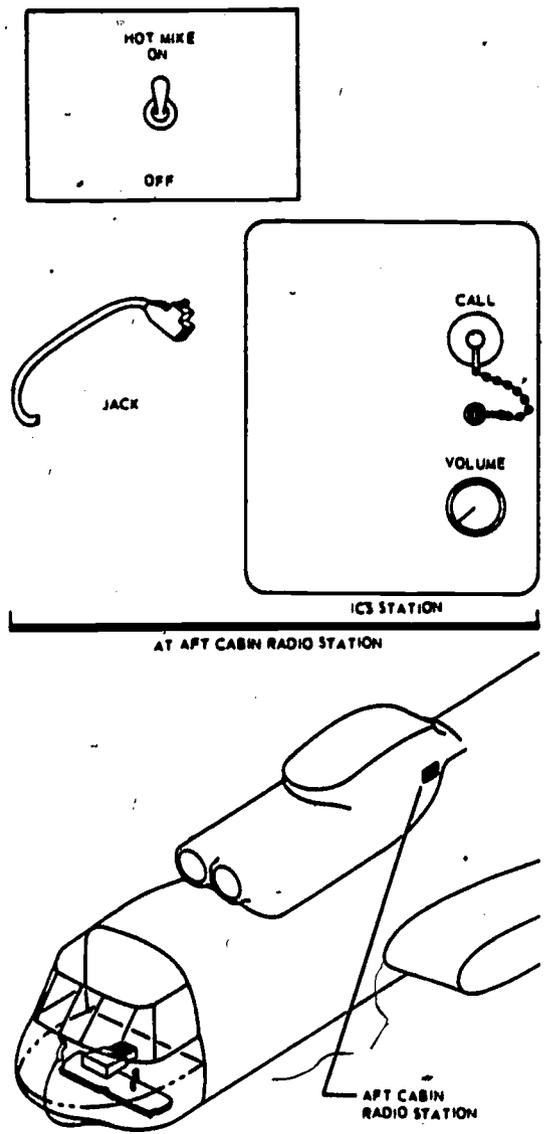


Figure 6-14. - ICS system aft cabin station AN/AIC-18.

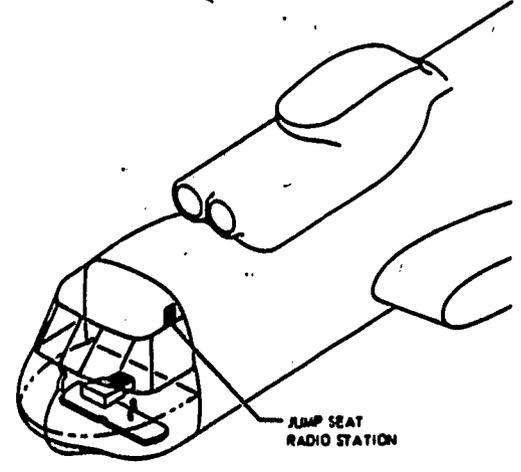
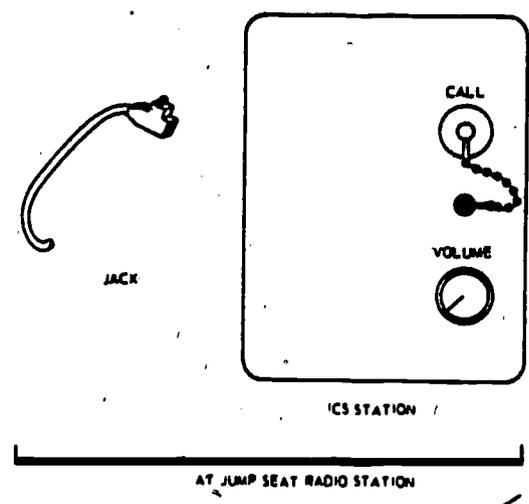


Figure 6-15. - ICS system jump seat AN/AIC-18. (Radio monitor panel not shown)

UHF/COMM RADIO SET AN/ARC-51A

The UHF/COMM system AN/ARC-51A is composed of a receiver-transmitter and a control panel. The set provides two-way voice communication between land-based, seaborne, or airborne stations. This can be accomplished on any one of 20 preset frequencies, or by manually selecting any one of 3,500 channels spaced at 50 KHz intervals within the equipment's frequency range of 225.0 through 399.95 MHz. The radio set includes a guard receiver which permits continuous monitoring of the guard frequency at the same time the main transmitter

receiver is tuned to a tactical frequency. In addition, the radio set provides automatic direction finding (ADF) in conjunction with the direction finding group DF-301. Magnetic bearing will be displayed by the NO. 1 pointer on both RMI's.

The UHF/COMM system is equipped with two antennas. The antenna normally used is located above the cockpit, and the alternate antenna is located aft on the bottom of the pylon. The alternate antenna is used to eliminate UHF transmission and reception dead spots. The An/ARC-51A UHF radio set is powered from the No. 2 AC primary bus and the DC primary bus. The circuits are protected by circuit breakers on the pilot's circuit breaker panel. The AC circuit breaker is marked UHF under the general heading NO. 2 AC PRI. The DC circuit breaker is marked UHF under the general headings DC and PRI.

UHF/COMM CONTROL PANEL

The operating controls on the AN/ARC-51A radio control panel (figure 6-16) are the function selector, the mode selector, the preset channel control, the preset channel indicator, the frequency selectors, the frequency display window, the volume control, and the squelch disable switch.

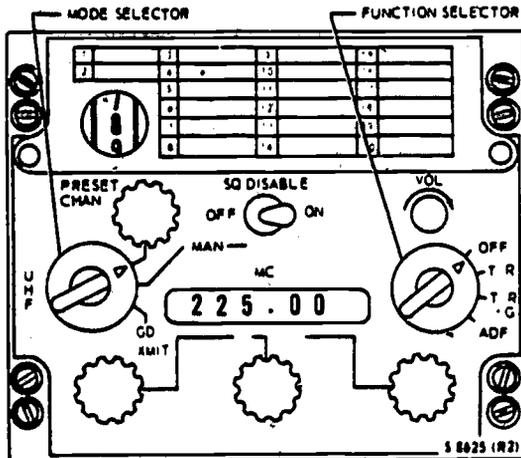


Figure 6-16. - UHF/COMM radio AN/ARC-51A.

Function Selector

The function selector has four positions: OFF, T/R, T/R+G, and ADF. In the OFF position, all power is removed from the equipment. The T/R position energizes the receiver-transmitter, and the T/R+G energizes the receiver-transmitter and guard receiver. In the ADF position, the DF-301 is energized to provide automatic direction finding operation.

Mode Selector

The mode selector has three positions: PRESET CHAN, MAN, and GD XMIT. The PRESET CHAN position permits selection of one of 20 preset channels by means of a preset channel control. In the MAN positions, 3,500 frequency channels may be selected by use of the manual frequency selectors. The GD XMIT position selects the preset guard frequency for the transmitter and receiver, with the function selector set at T/R. Setting the function selector to T/R+G, with the mode selector set at GD XMIT, turns the guard receiver on and places the transmitter, guard receiver, and main receiver on the guard frequency.

Preset Channel Control

The preset channel control selects any one of the 20 preset channels. The preset channel indicator displays the preset channel.

Frequency Selectors

Frequency selectors provide manual frequency selection when the mode selector is set at MAN.

VOL control

The VOL control adjusts the audio level of the receiver.

SQ Disable Switch

The SQ DISABLE switch has two positions. In the ON position, the receiver squelch is disabled. In the OFF position, the receiver squelch circuit is unaffected.

Antenna Selector Switch

The antenna selector switch, marked FORWARD and AFT, is on the UHF ANTENNA switch panel (figure 6-17) located on the center console.

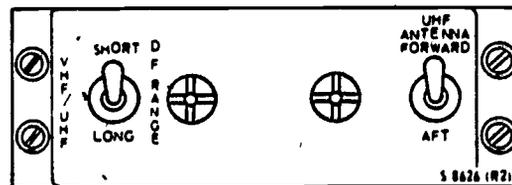


Figure 6-17. - UHF switch panel.

UHF/COMM OPERATION

To Turn Set On:

1. Function Switch (UHF/COMM Control Panel) - AS REQUIRED.
2. Antenna Switch (UHF ANTENNA Switch Panel) - AS REQUIRED. (See figure 6-17.)
3. ICS Monitor Selector/Volume Control - UHF.
4. ICS Transmit Selector Switch - UHF.
5. Squelch Disable Switch - OFF.
6. Volume Control Knob (UHF/COMM Control Panel) - AS REQUIRED.
7. Mode Selector (UHF/COMM Control Panel) - AS REQUIRED.
8. Preset Channel Control (UHF/COMM Control Panel) - AS REQUIRED.
9. To Transmit - DEPRESS THE MICROPHONE TRIGGER SWITCH ON THE CYCLIC STICK GRIP TO THE RADIO POSITION, AND SPEAK INTO THE MICROPHONE.

To Secure Set

1. Function Switch (UHF/COMM Control Panel) - OFF.

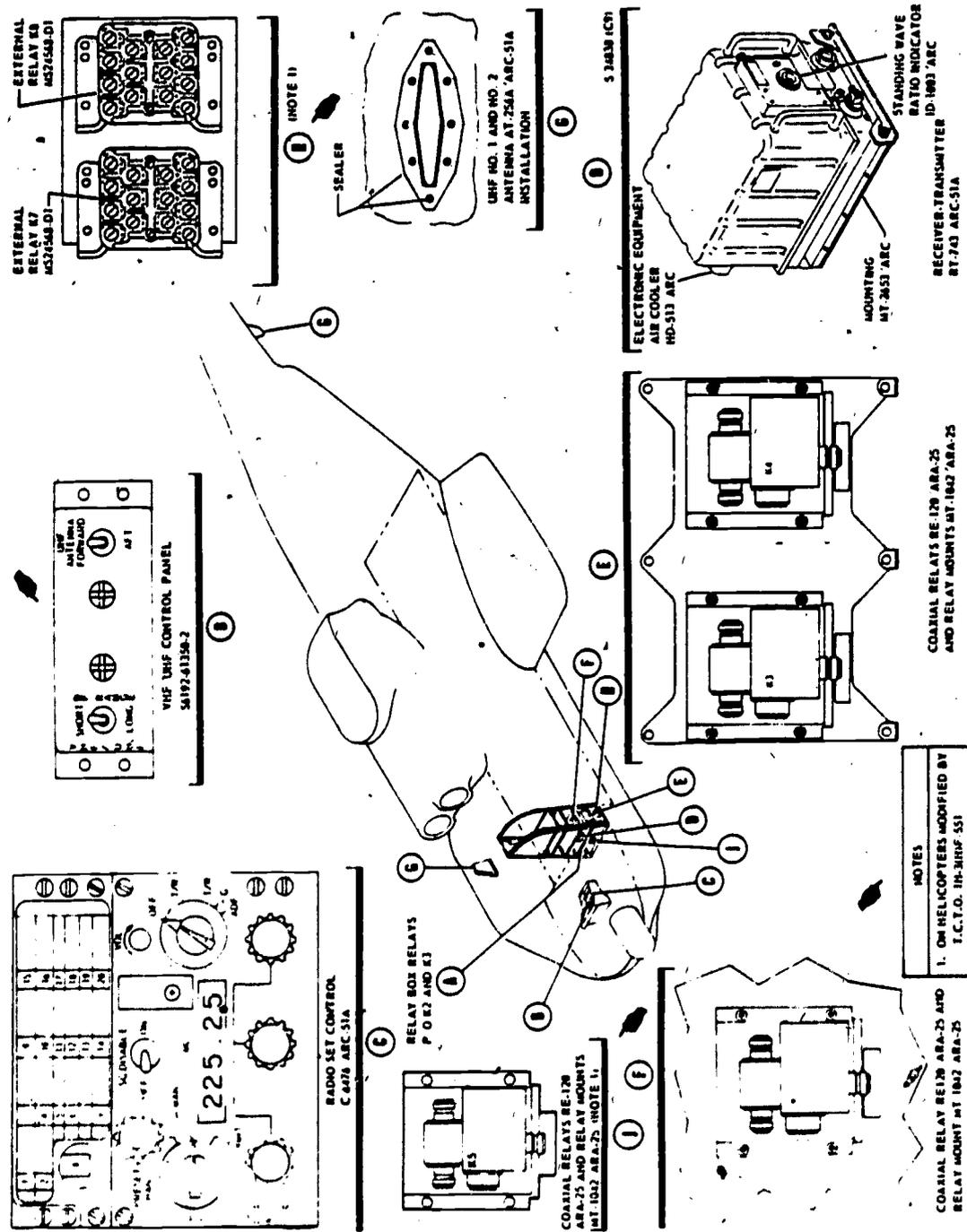


Figure 6-18. - UHF/COMM system components - location diagram.

SELF-QUIZ #6

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The HH-3F has a TOTAL of _____ ICS stations.

- A. two
- B. four
- C. six
- D. eight

2. Two-button operation is a mode of microphone operation provided by the ICS controls. By selecting this mode, the pilot has _____

- A. the capability to talk on the interphone line as selected by the rotary selector switch
- B. the capability to talk on the interphone line without operating the selector switch on the ICS control panel
- C. free-hand intercommunications
- D. exalted intercommunication for high-priority messages

3. Which stations are equipped with a "Hot-Mike" two-position toggle switch?

- 1. Pilot
 - 2. Copilot
 - 3. Avionicsman
 - 4. Hoist operator
 - 5. Aft cabin
- A. 1 and 3 only
 - B. 4 and 5 only
 - C. 1, 2, and 4 only
 - D. 1, 2, 4, and 5

4. The antenna normally used for the UHF/COMM system is located _____

- A. above the cockpit
- B. on the right side of the fuselage
- C. aft on top of the pylon
- D. aft on the bottom of the pylon

5. The AN/ARN-51A UHF radio set gets its power from _____

- A. 28V DC and No. 2 AC radio bus
- B. 26V DC and No. 1 AC radio bus
- C. No. 1 AC primary bus and DC primary bus
- D. No. 2 AC primary bus and DC primary bus

6. The UHF antenna selector switch is located on the _____

- A. instrument panel
- B. overhead switch panel
- C. center console
- D. radio control panel

ANSWERS TO SELF-QUIZ #6

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	6-10
2	B	6-12
3	B	6-12
4	A	6-19
5	D	6-17
6	C	6-18

COMMUNICATION SYSTEMS (cont)

Reading Assignment:
Pages 7-1 through 7-8

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the following HH-3F systems:

1. RT-9600 VHF-FM
2. AN/ARC-84 VHF
3. AN/ARC-94 HF
4. AN/APX-72 IFF

VHF-FM/COMM RADIO SET RT-9600

The VHF-FM-COMM System RT-9600 is composed of a receiver-transmitter and a control panel. The set provides two-way voice communications between land based, seaborne, or airborne stations. The communications may be on any one of 9600 manually selected channels spaced at 2.5 kHz increments in the 150.000 to 173.9975 MHz frequency range. The set includes a two channel guard receiver with a priority interrupt function. These guard channels can be set to any frequency in the 150.000 to 173.9975 MHz range. The international VHF-FM guard frequency is 156.800 MHz. The RT-9600 is used in conjunction with the DF-301 Homer. It is powered by the DC Primary Bus and is protected by a circuit breaker marked FM on the pilot's overhead circuit breaker panel under the general headings DC, PRI, and VHF.

VHF-FM/COMM CONTROL PANEL

(See figure 7-1.)

The C-961 used with the RT-9600 has 11 preset and 9600 manual channels. The preset channels are programmed in the C-961 by the placement of diodes in the printed circuit boards. The frequency information is sent over 17 wires in binary form (BCD) Binary Coded Decimal, to the RT-9600.

The 11 preset channels in the C-961 can be operated simplex or duplex, with or without tone squelch by the placement of diodes on the channel cards with no limitations on the transmit to receiver frequency spacing.

VHF-FM/COMM OPERATION

To Turn Set ON

1. Function selector switch (VHF-FM/COMM control panel) - AS REQUIRED.
2. ICS receiver select switch - FM - ON.
3. ICS transmit select switch - FM.
4. Frequency selector switches (VHF-FM/COMM control panel) - AS REQUIRED.
5. HI LOW PWR switch (VHF-FM/COMM control panel) - AS REQUIRED.
6. VOL control knobs (VHF-FM/COMM control panel) - AS-DESIRED.
7. Squelch control knobs (VHF-FM/COMM control panel) - AS REQUIRED.

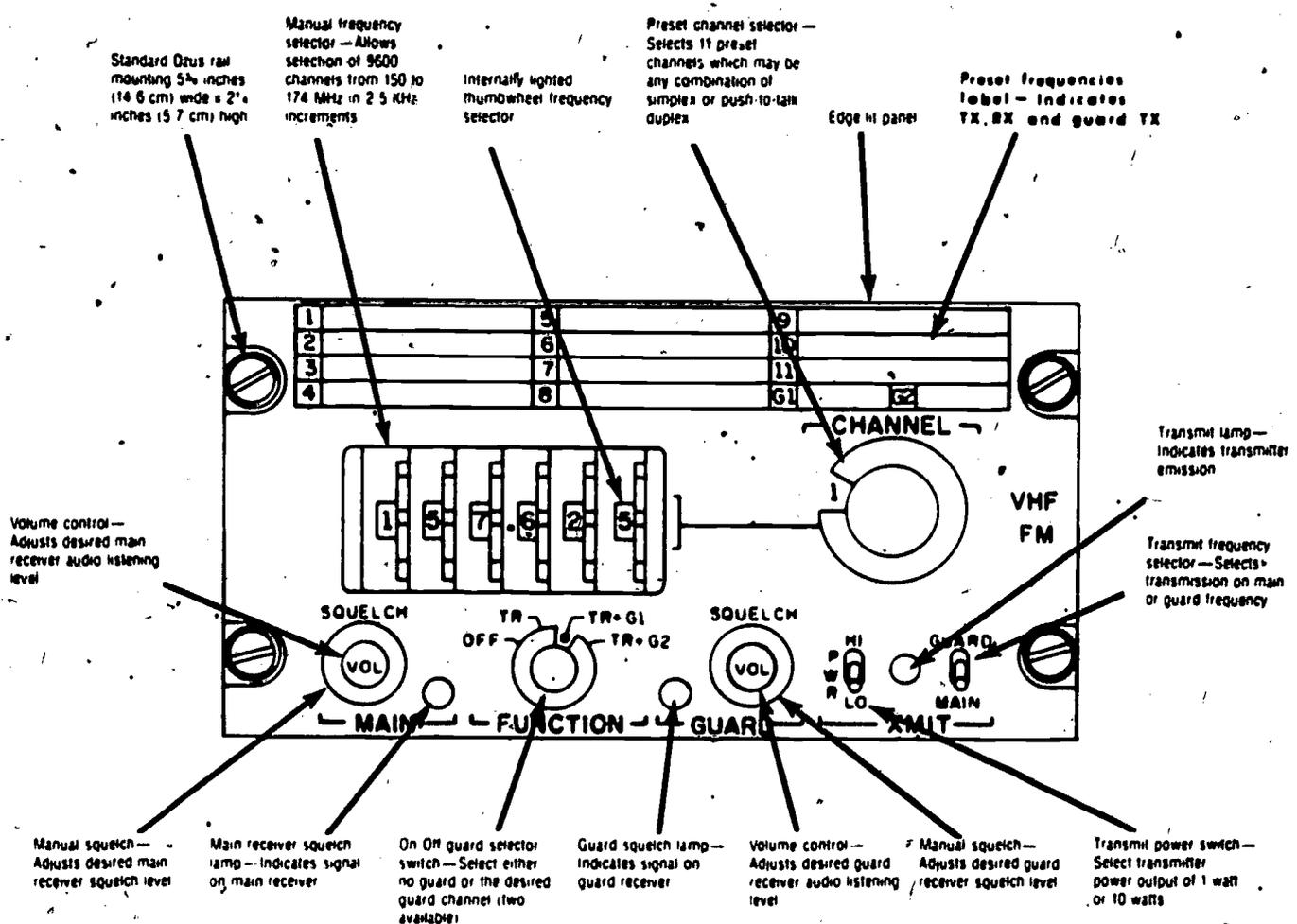


Figure 7-1.

VHF/COMM RADIO SET AN/ARC-84

The VHF/COMM system AN/ARC-84 is composed of a receiver, a transmitter, and a control panel. The set provides two-way voice communication between land based, seaborne and airborne stations. The transmitter and receiver are designed to operate on crystal controlled channels spaced 50 kHz apart. The range of the transmitter is 118.0 through 135.95 MHz, and the range of the receiver is 108.0 through 135.95 MHz. In addition, the receiver is designed to operate in conjunction with the DF-301 direction finder to allow VHF-ADF homing. Magnetic bearing will be displayed by the No. 1 pointer of both RMI's. The VHF receiver and transmitter are powered by the DC primary bus. The receiver and transmitter are protected by circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked RCVR and XMTR, respectively, under the general headings DC, PRI, and VHF.

VHF/COMM CONTROL PANEL

The operating controls are provided by a control panel (figure 7-3), marked COMM, located on the cockpit center console. The panel consists of two frequency selectors, the frequency display window, the off-on/volume control, a squelch control, a momentary VHF-ADF homing select switch, a VOR momentary check switch, and a mode selector switch.

Frequency Selectors

The frequency selectors mechanically select and display frequencies spaced 50 kHz apart over the 108.00 through 135.95 MHz range.

VOL OFF Switch

The VOL OFF switch provides power control to the radio set and adjusts the audio level of the receiver.

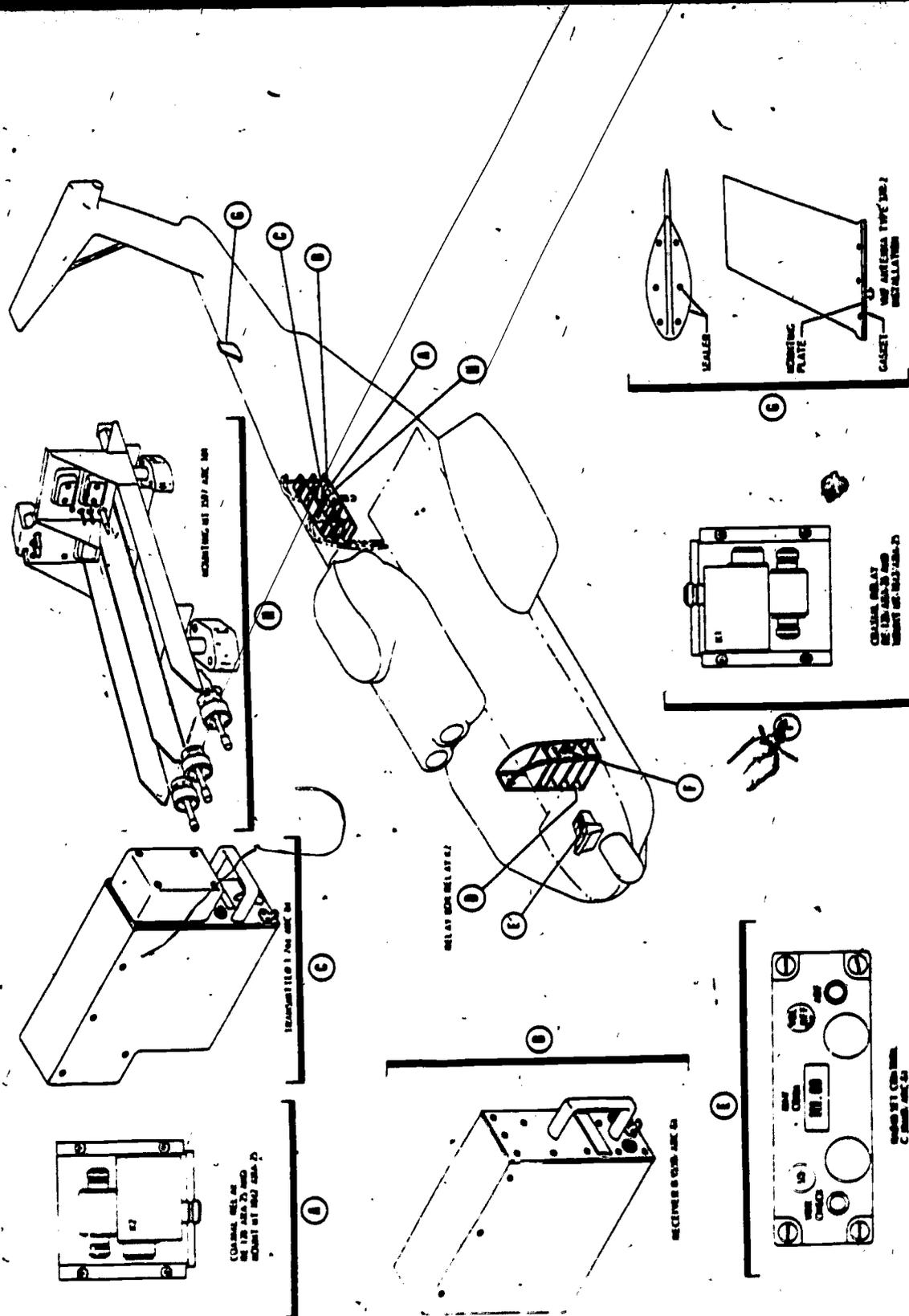


Figure 7-2. - VHF/COMM system components - location diagram.

94

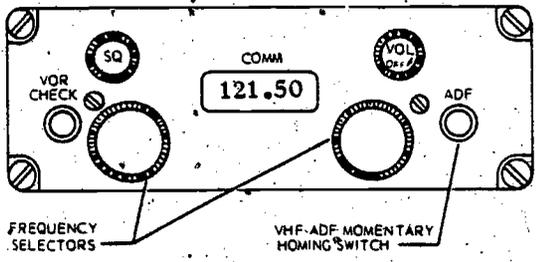


Figure 7-3. - VHF/COMM radio AN/ARC-84.

SQ Control

The SQ control eliminates receiver background noise.

ADF Switch

The momentary ADF homing select switch displays magnetic bearing with the No. 1 pointer of each RMI, as long as the switch is held down.

VOR Check Switch

The VOR momentary check switch is inoperative on the VHF/COMM control panel.

VHF/COMM OPERATION

To Turn Set On:

1. VOL OFF Switch (VHF/COMM Selector Panel) - ON.
2. ICS Monitor Selector/Volume Control - VHF.
3. ICS Transmit Select Switch - VHF.
4. Frequency Selectors (VHF/COMM Control Panel) - AS REQUIRED.
5. SQ Control (VHF/COMM Control Panel) - AS REQUIRED.
6. To transmit - DEPRESS THE MICROPHONE TRIGGER SWITCH ON THE CYCLIC STICK GRIP TO THE RADIO POSITION, AND SPEAK INTO THE MICROPHONE.

To Secure Set:

1. VOL OFF Switch (VHF/COMM Control Panel) - OFF.

HF/COMM RADIO SET AN/ARC-94

The HF/COMM system AN/ARC-94 consists of a receiver-transmitter, two control panels, an

antenna, a coupler and a coupler blower. The system provides two-way voice communication between land-based, seaborne and airborne stations. The operating frequency range is from 2.0 to 29.999 MHz, divided into 28,000 discrete channels in one KHz increments. The HF/COMM system receives and transmits on either single sideband (USB or LSB) or amplitude modulated equivalent (AM). The receiver transmitter and the coupler blower are both powered by the No. 2 AC primary bus. The radio set uses 400-Hz three-phase 115-volt AC, and the coupler blower uses 400-Hz single-phase 115-volt AC power. Each unit is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is under the general heading NO. 2 AC PRI. The receiver and transmitter circuit breaker is marked HF, and the coupler blower circuit breaker is marked HF COUPLER BLOW 0B. The control circuit illuminates the avionicsman's HF (figure 7-7) control light and is powered by the DC primary bus. This circuit is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is under the general headings DC PRI and is marked HF. (See figure 7-4.)

HF/COMM OPERATING CONTROLS

The system is remotely controlled by either one of two control panels (figure 7-5) marked HF. One control panel is located on the copilot's console and the other on the avionicsman's console. In addition, the copilot's console contains an HF/COMM switch panel (figure 7-6), with marked positions RADIO NAV and COPILOT. This switch permits the copilot to transfer control to or remove control from the avionicsman's control panel. The COPILOT position gives control of the set to the copilot, and the RADIO NAV position gives control of the set to the avionicsman. An advisory light (figure 7-7), marked HF CTR, is illuminated on the avionicsman's console above the HF/COMM control panel when the avionicsman has control. Both HF control panels contain a mode selector, four frequency selector knobs and associated display window, and an RF sensitivity control.

Mode Selector

The mode selector has four marked positions: OFF, USB, LSB, and AM. The OFF position removes aircraft power from the set. The USB position selects upper sideband operation, and the LSB position selects lower sideband operation. The AM position provides amplitude modulation operation of the radio.



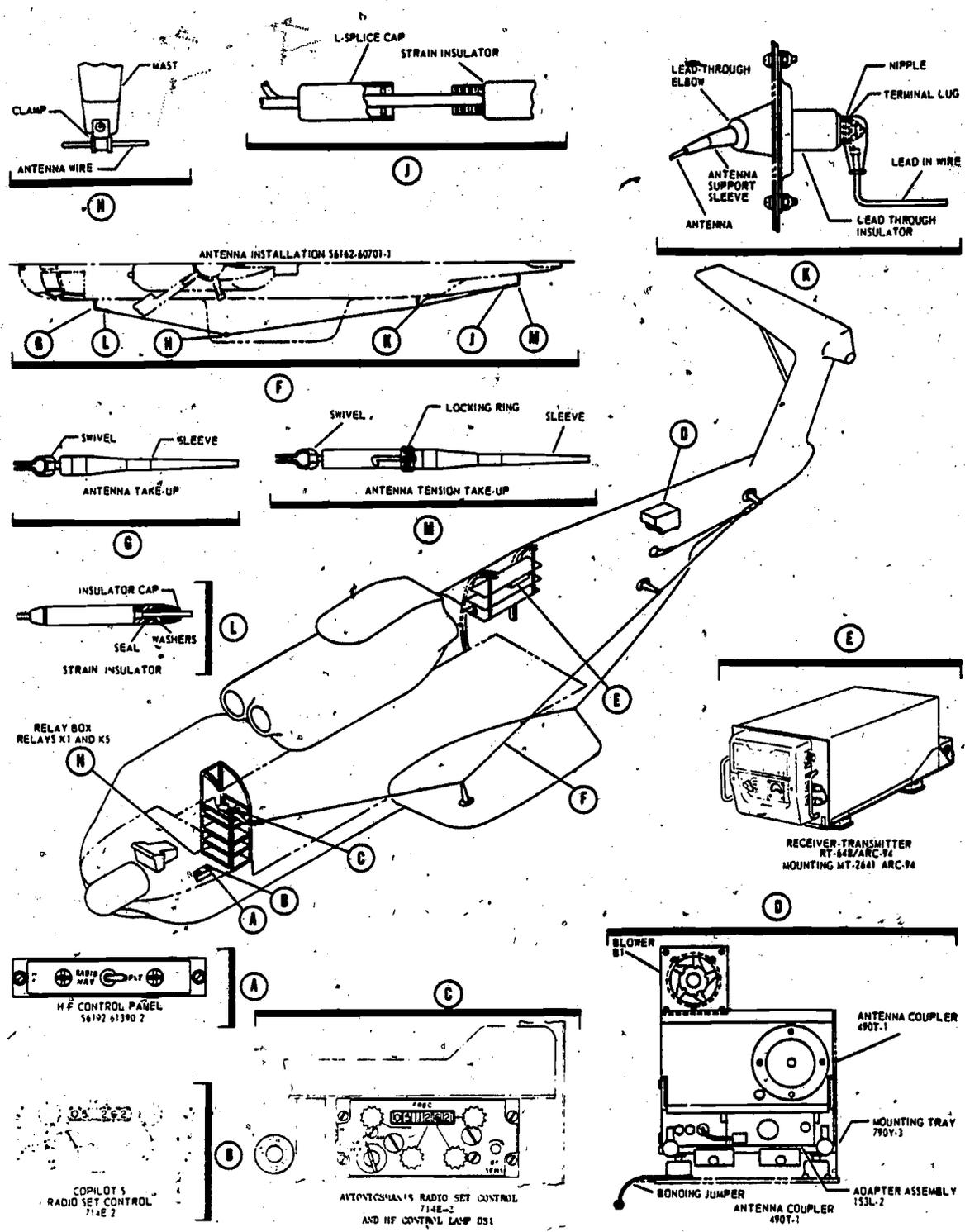


Figure 7-4. HF/COMM system components - location diagram.

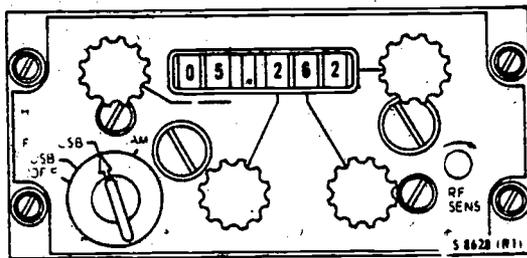


Figure 7-5. - HF/COMM radio AN/ARC-94.



Figure 7-6. - HF/COMM switch panel.

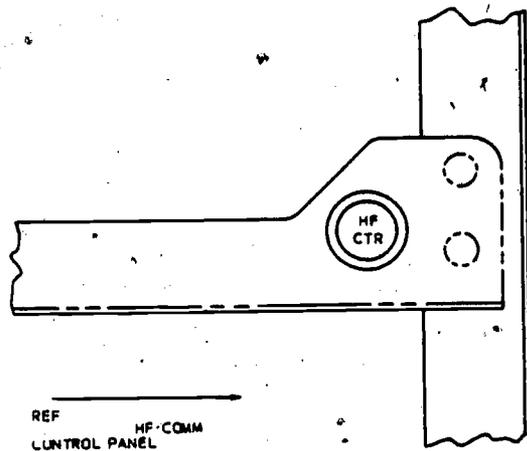


Figure 7-7. - HF/COMM control advisory light.

Frequency Control
(See figure 7-5.)

The control panels each have a frequency display window that reads in megahertz and four frequency selector knobs to select operating frequencies.

RF Sensitivity Control

AN RF sensitivity control marked RF SENS adjusts the receiver sensitivity of the receiver-transmitter.

WARNING.

During ground operation of the AN/ARC-94, ensure that personnel are clear of the antenna. Serious burns may result if bodily contact is made with the antenna during ground operation.

WARNING

Do not transmit in 3.0 and 3.6 MHz range during doppler or coupler hover operation. Transmission in this range will result in erratic aircraft attitude.

HF/COMM RADIO SET AN/ARC-94 OPERATION

To Put The Equipment Into Operation:

1. HF/COMM Control Selector Switch (HF/COMM Switch Panel) - AS REQUIRED. (See figure 7-6.)
2. Mode Selector (HF/COMM Control Panel) - AS REQUIRED.
3. ICS Monitor Selector/Volume Control - HF.
4. ICS Transmit Selector Switch - HF.
5. Frequency Selector (HF/COMM Control Panel) - AS REQUIRED.

NOTE

While set is channeling, no background noise will be heard in the headset. The channeling cycle is complete when background noise is heard.

6. Microphone Switch - DEPRESS, MOMENTARILY.

NOTE

When microphone switch is depressed, a one kHz tone will be heard in the headset. When the tone stops, antenna loading is complete and the set is ready for operation.

7. To Transmit - DEPRESS MICROPHONE

To Secure Equipment:

1. Function Selector Switch (HF/COMM Control Panel) - OFF.

AIMS/IFF TRANSPONDER AN/APX-72

The AN/APX-72 AIMS/IFF transponder is composed of a receiver-transmitter, a transponder set control, a transponder inflight test set, an altimeter

encoder, and an antenna. The transponder provides IFF identification in response to coded interrogations from ground, seaborne, or airborne stations. In addition, the signals returned from the IFF transponder can be used by the interrogating station to determine range and azimuth information. The IFF transponder is powered by the DC primary bus and the NO. 2 AC primary bus. These circuits are protected by circuit breakers on the pilot's circuit breaker panel. There are two DC circuit breakers, marked PWR and TEST under the general headings DC, PRI, and IFF. The AC circuit breaker is marked IFF 0A under the general heading NO. 2 AC PRI.

AIMS/IFF TRANSPONDER CONTROL PANEL

The transponder control panel (figure 7-8), marked IFF, is located on the cockpit console. The panel contains a master switch, mode enable toggle switches, code setting dials, an identification position (IDENT) toggle switch, mode 2 code setting dials, a RAD TEST-OUT-MON switch, and mode 4 controls.

Master Switch

The MASTER switch selects five conditions of operation: OFF, STBY, LOW, NORM, and EMER. In OFF, power is not applied to the set components. In STBY (standby), power is applied to components, the transponder is warmed up ready to respond, but no signals will be transmitted. In LOW, receiver

sensitivity is reduced by a preset amount such that only higher energy signals will trigger the transponder. In NORM, the transponder will operate at normal sensitivity and respond to interrogations in accordance with settings of other controls. In EMER (emergency), emergency signal responses will be transmitted in modes 1, 2, or 3/A regardless of the settings of the mode control toggle switches. A detent prevents accidental selection of the EMER position. To bypass the detent, raise the center cap on the switch.

Mode Enable Toggle Switches

Four toggle switches, marked M-1, M-2, M-/A, and M-C, have three marked positions OUT, ON, and TEST. The OUT (down) position prevents responses in each mode. The ON (center) position permits responses in each mode. The TEST (up) position will illuminate the TEST light in the upper section of the control box if the transponder is replying.

NOTE

Mode C, when selected, operates in conjunction with the pilots AAU-21/A or AAU-32/A pressure altimeter-encoder to automatically provide encoded pressure altitude information from the helicopter to interrogating ground stations with Mode C decoding capability. Mode C operates independently of the other modes selected.

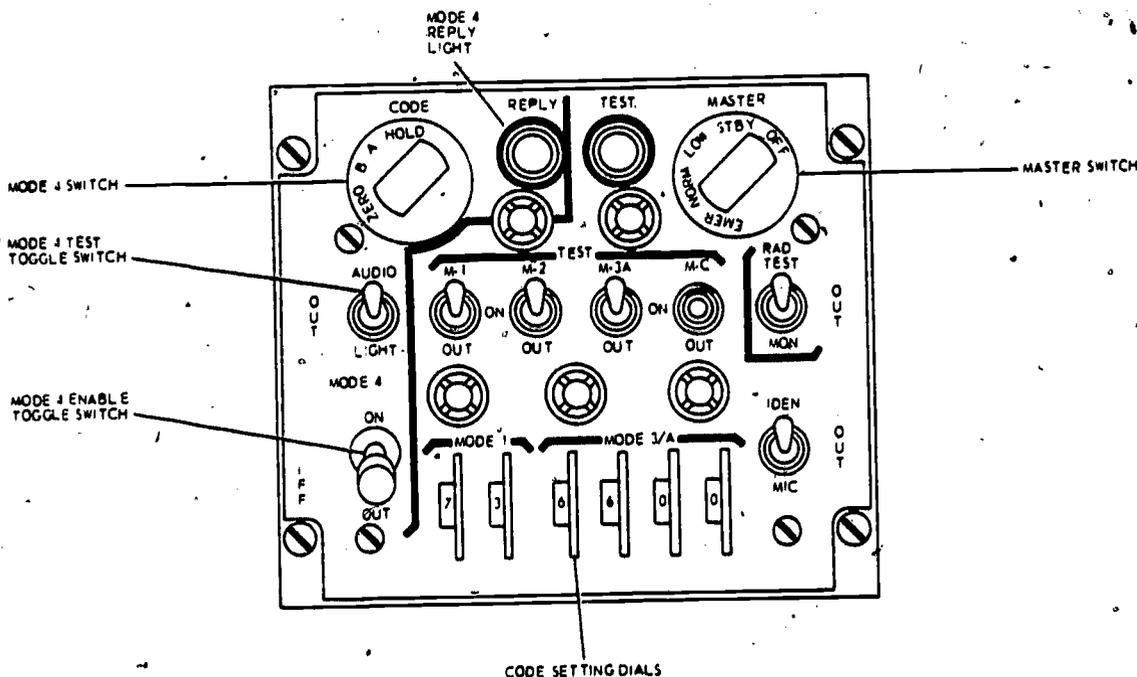


Figure 7-8. - AIMS/IFF Transponder AN/APX-72.

Code Setting Dials

Make desired mode 1 settings on the two numeral wheels marked MODE 1. MODE 1 selects a desired code from 00 through 73. Make the desired mode 3/A settings on the four numeral wheels marked MODE 3/A. MODE 3/A selects a desired code from 0000 through 7777. On the right side of each numeral, in the windows along the lower edge of the control box, is a protruding blunted spike. Light finger pressure on the spikes, either up or down, will rotate the numeral wheels.

Identification Position (IDENT) Toggle Switch

At the lower right of the control unit is a three-position toggle switch with the marked positions IDENT, OUT, and MIC. To provide approximately 20 seconds of IDENT signals on modes 1, 2, or 3/A, press this toggle switch momentarily upward to the IDENT position. A spring-load will return the switch to OUT or center position. To provide approximately 20 seconds of IDENT signals on those modes each time the UHF radio is keyed, set the toggle switch to MIC.

Mode 2 Code Setting Dials

Mode 2 settings must be made on the transponder front panel, marked MODE 2. Four numeral

windows display the selected codes. Light finger pressure either up or down on the blunted spikes at the right of each numeral will rotate the numeral wheels. MODE 2 selects a desired code from 0000 through 7777.

NOTE

The transponder is located in the electronics compartment; therefore, MODE 2 settings must be made before flight.

RAD Test-Out-MON Switch

This switch is on the right center of the control unit. The RAD TEST position is used for maintenance test only. OFF disables the switch, and MON enables monitoring of the transponder replies to external interrogations. The TEST light will illuminate if the transponder is replying.

Mode 4 Controls

The mode 4 controls on the left side of the panel are inoperative in this installation.

SELF-QUIZ #7

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The VHF-FM guard frequency is _____ MHz.
 - A. 158.800
 - B. 156.900
 - C. 158.800
 - D. 159.800
2. The main receiver squelch lamp on the C-961 illuminates when _____.
 - A. the RT-9600 is transmitting
 - B. the receiver squelch circuit fails
 - C. a signal is received in the main receiver
 - D. it is not safe to transmit
3. The frequency range of the AN/ARC-84 receiver is _____ MHz.
 - A. 108.0 - 135.95
 - B. 108.0 - 139.55
 - C. 118.0 - 135.95
 - D. 118.0 - 139.95
4. Which operative controls does the VHF/COMM control panel contain?
 1. OFF-ON/volume control
 2. Squelch control
 3. Half duplex switch
 4. VOR momentary check switch.
 - A. 1 and 2 only
 - B. 3 and 4 only
 - C. 2, 3, and 4 only
 - D. 1, 2, 3, and 4
5. Which of the below is NOT a position on the HF/COMM mode selector?
 - A. AM
 - B. USB
 - C. LSB
 - D. ON
6. After the frequency selector on the AN/ARC-94 control is shifted to a new frequency, the equipment is ready for two-way communications when _____.
 - A. a frequency is selected
 - B. the tone stops
 - C. the channeling cycle is complete
 - D. a background noise is heard
7. The AN/APX-72 IFF transponder is capable of transmitting emergency signal responses in which mode(s)?
 - A. 1 only
 - B. 2 only
 - C. 3/A only
 - D. All of the above

ANSWERS TO SELF-QUIZ #7

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	A	7-1
2	C	7-2
3	A	7-2
4	A	7-4
5	D	7-4
6	B	7-6
7	D	7-7

NAVIGATION SYSTEMS

Reading Assignment:
Pages 8-1 through 8-9

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the following HH-3F systems:

1. DF-301E Automatic Direction Finder
2. AN/ARN-123 OMNI, ILS, Marker Beacon receiver
3. AN/ARN-118 TACAN
4. AN/ARN-89 ADF

DIRECTION FINDER GROUP DF-301 (UHF/VHF/VHF-FM/ADF) SYSTEM

The direction finder indicates the relative bearing of, and homes on, signals received by the UHF, VHF and VHF-FM Communications systems. The DF-301 Direction Finder receives RF signals through its antenna and sends them to the associated UHF, VHF, or VHF-FM system which in turn sends back an audio signal to the DF-301. This audio is processed and changed into relative bearing information and fed to indicators in the cockpit. (See figure 8-1.) The relative bearing information is read as a continuous magnetic bearing by the No. 1 pointer of both pilot's RMI's.

The RF system is broadband from 100 to 400 MHz, therefore frequency selectivity must be accomplished by the associated communication receivers.

The DF-301E is comprised of two sections housed in a single unit: a solid-state UHF/VHF antenna, and switching control, filter/detector, servomotor control and power supplies. The cardioid pattern of the antenna is electronically rotated by a 5.68 KHz signal which reverses direction of rotation

every 20 cycles. The DF-301E requires 27.5 VDC primary power and 26VAC 400 Hz indicator power.

AMPLIFIER AM-3969/AR

The radio frequency amplifier AM-3969/AR is used in conjunction with the DF-301E to amplify signals from a distant source. It is controlled by a panel located in the center console. (Figure 6-2.) When the switch is in the long position, the amplifier is turned on. When the switch is in the short position the amplifier is turned off.

NOTE

DO NOT USE the amplifier when homing on a signal source at close range, since the excessive RF strength may cause saturation of the system and loss of homing ability. Ensure that the switch is in the **SHORT** position.

RMI SELECTOR

An RMI selector switch is located on the instrument panel. (Figure 8-2.) It is marked NO. 1 LF/ADF and UHF/UHF DF. Ensure that this switch is in the UHF/VHF DF position when homing. This connects the NO. 1 needle on the RMI to the DF-301E.



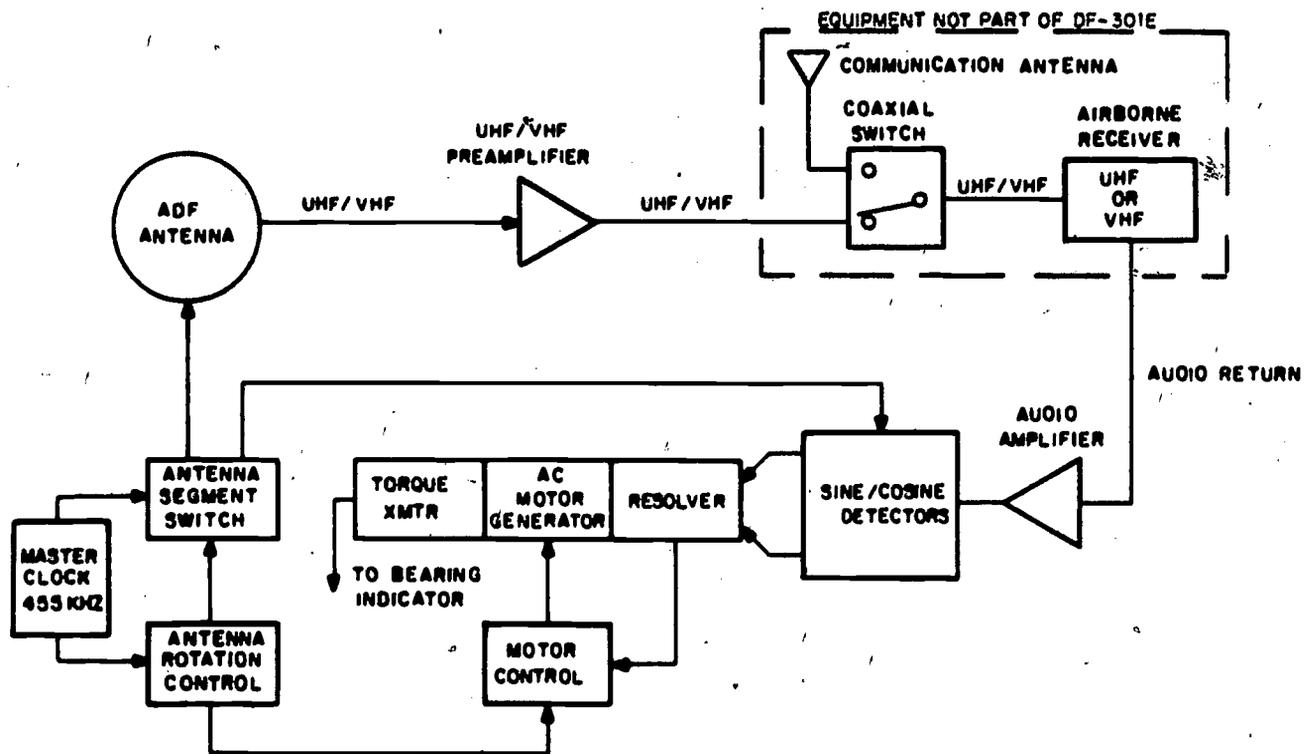


Figure 8-1. - ADF Functional Block Diagram.

DIRECTION FINDER OPERATION

To Turn Set On Using UHF/COMM System:

1. Function Switch (UHF/COMM Control Panel) - ADF.
2. ICS Monitor Selector/Volume Control - UHF.
3. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.
4. Mode Selector (UHF/COMM Control Panel) - AS REQUIRED.
5. Frequency Selector (UHF/COMM Control Panel) - AS REQUIRED.
6. Volume Knob (UHF/COMM Control Panel) - AS REQUIRED.
7. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.

To Secure UHF/COMM Homing Feature:

1. Function Switch (UHF/COMM Control Panel) - AS REQUIRED.

2. RMI Pointer Selector (Instrument Panel) - LF/ADF.

To Turn Set On Using VHF/COMM System:

1. ICS monitor Selector/Volume Control - VHF.
2. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.
3. VOL OFF Switch (VHF/COMM Control Panel) - ON.
4. Frequency Selectors (VHF/COMM Control Panel) - AS REQUIRED.
5. Squelch Control (VHF/COMM Control Panel) - AS REQUIRED.
6. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.
7. Momentary ADF Switch (VHF/COMM Control Panel) - DEPRESS.

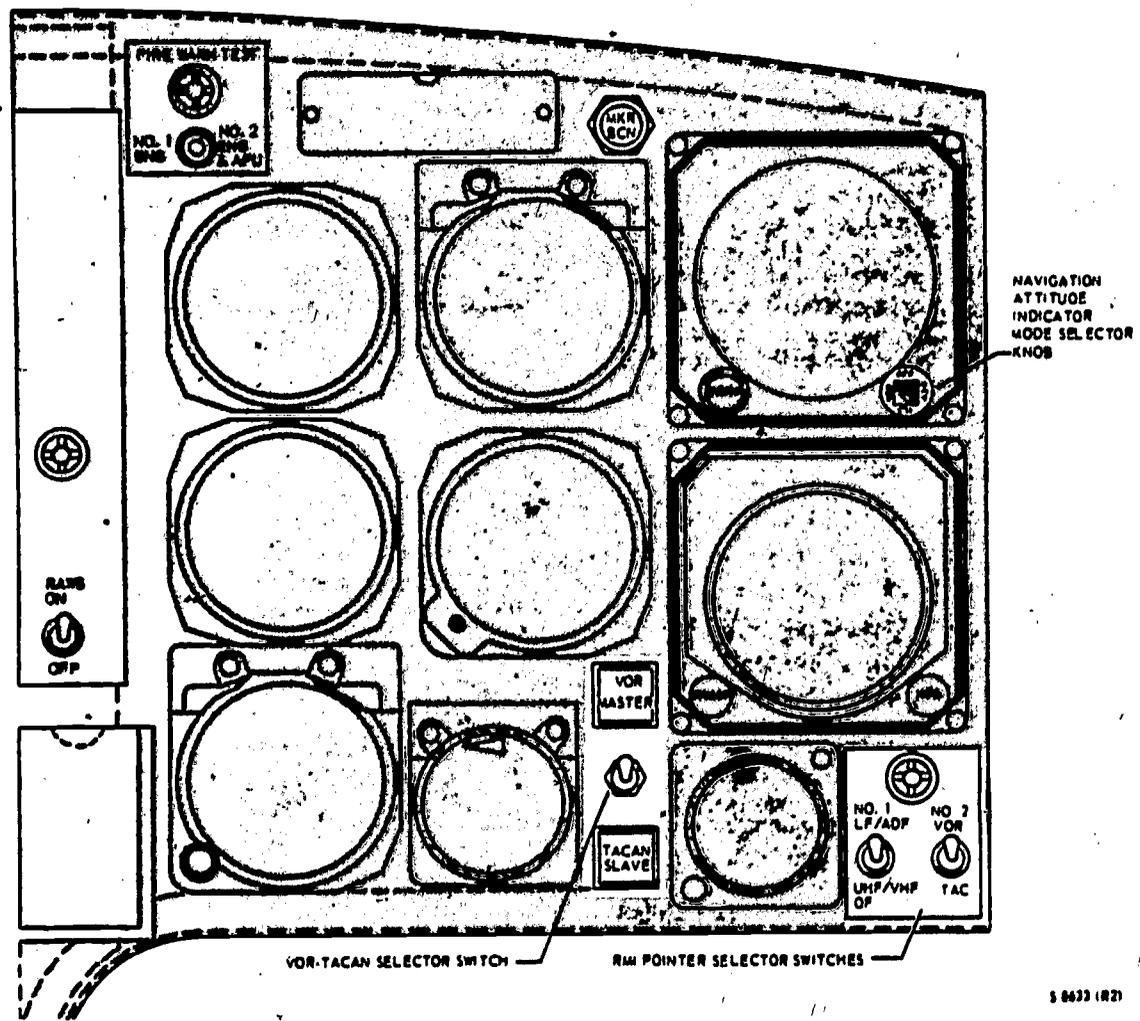


Figure 8-2. - Nav aid auxiliary controls for VOR, ILS, TACAN and ADF.

To Secure VHF/COMM Homing Feature:

- 1. Momentary ADF Switch (VHF/COMM Control Panel) - RELEASE.

To Turn Set On Using VHF/COMM System:

- 1. ICS Monitor Selector/Volume Control - FM.
- 2. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.
- 3. Frequency Selector Switches (VHF-FM Control Panel) - AS REQUIRED.
- 4. Volume Control (VHF-FM Control Panel) - AS REQUIRED.
- 5. Squelch Control (VHF-FM Control Panel) - AS REQUIRED.

- 6. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.

- 7. Function Selector Switch (VHF-FM Control Panel) - ADF.

To Secure VHF-FM/COMM Homing Feature:

- 1. Function Selector Switch (VHF-FM Control Panel) - AS REQUIRED.
- 2. RMI Pointer Selector (Instrument Panel) - LF/ADF.

VHF/NAV RADIO SET AN/ARN-123

The AN/ARN-123 receiver is a remotely located, integrated navigation package which contains a 200

channel VOR/LOC receiver, a 40 channel glide slope receiver, and a marker beacon receiver. The three receivers perform the intended mission of the unit without depending on each other.

Visual presentation of the localizer course, VOR (manual) course, and the glide slope is made on both the pilot's and copilot's attitude indicator and course indicators on the AN/AYN-2 flight director. Ambiguity in omni bearing information of a VOR (manual) course is resolved by the to/from arrow. Visual presentation of heading-sensitive (automatic) VOR bearing is made with the No. 2 pointer of the RMI's:

VHF OMNIRANGE (VOR)/LOCALIZER (LOC) RECEIVER SECTION

The VOR/LOC receiver section receives and processes VOR and localizer signals over a frequency range of 108.00 to 117.95 MHz, with a channel spacing of 50 KHz. Of the 200 channels available, 160 are for VOR operation and 40 are for LOC operation.

NOTE

Reverse sensing will be displayed on the OMNI Course Indicator and Flight Directors when inbound on a localizer back course approach.

GLIDE SLOPE (GS) RECEIVER SECTION

The GS receiver section processes glide slope signals over a frequency range of 329.15 to 335.00 MHz with a channel spacing of 150 KHz. Whenever one of the 40 localizer frequencies is selected the appropriate GS frequency is tuned on the GS receiver. Glide slope information is fed to the OMNI Course Indicator and the Flight Directors.

MARKER BEACON (MB) RECEIVER SECTION

The MB receiver section processes 75 MHz signals and converts them into an output that drives the marker beacon lights on the OMNI and TACAN Course Indicators and provides audio signals to the pilot's and copilot's ICS Control Panel, NAV switch.

VHF NAV RADIO CONTROL PANEL

The VHF NAV Radio control panel (figure 8-3) on the upper radio console (figure 8-4), contains a NAV VOL-OFF control, frequency indicator, frequency selector knobs, MB VOL-OFF control, MB Sensitivity switch (HI/LO), and a VOR/MB test switch.

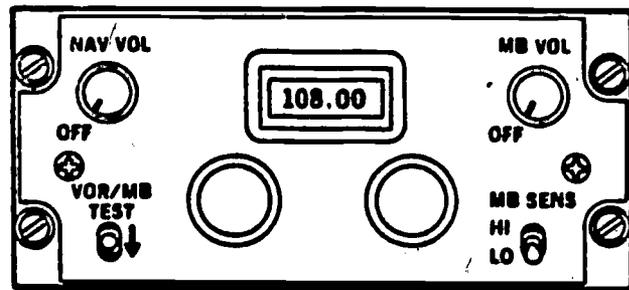


Figure 8-3. - AN/ARN-123 NAV Radio Control Panel.

VHF NAV RADIO OPERATION

To Turn The Set ON:

1. Radio master - ON.
2. NAV VOL-OFF control - ON, VOLUME AS DESIRED.
3. MB VOL-OFF control - ON, VOLUME AS DESIRED.
4. MB Sensitivity - HI.
5. Frequency selector knobs - AS DESIRED.

To Turn Set Off:

1. NAV VOL-OFF control - OFF.

NOTE

The NAV VOL-OFF control is the master power switch for the entire radio.

NOTE

If you lose AC power to the set, VOR course information will be lost. Localizer, glide slope, and marker beacon information will continue to be provided.

VOR/MB CHECK

1. Tune in a nearby VOR station.
2. OMNI course selector - 315 RADIAL.
3. VOR/MB test switch - HOLD IN TEST POSITION.
4. CDI needle - CENTERED PLUS OR MINUS 2 DOTS.

- 5. #2 needle (VOR selected) - 315 RADIAL PLUS OR MINUS 5.
- 6. Both marker beacon lights - ON.
- 7. VOR/MB test switch - RELEASE.

provides a marker beacon output capable of driving a standard one-lamp system or, optionally, a three-lamp system. An audio output is provided for identification purposes. Three separate antenna jacks (glideslope, vhf NAV, and marker) are provided to accept the rf inputs for each of the corresponding receivers.

**SYSTEM APPLICATION
(SEE FIGURE 8-4.)**

The airborne receiver basically consists of several operational sections. The glideslope receiver section provides the up/down deviation and flag alarm information to drive the glideslope loads of the VOR/ILS indicator (CDI) and the flight guidance systems. A VOR/LOC receiver section provides the left/right deviation, flag alarm and to/from information to drive the VOR/LOC loads of the VOR/ILS indicator (CDI) and the flight guidance systems.

In addition, automatic conversion of the VOR bearing provides relative bearing for driving the pointer of a Radio Magnetic Indicator (RMI). An audio output is also provided for voice and identification purposes. Finally, the marker receiver section

**TACAN RADIO SET AN/ARN-118 (V)
(TACTICAL AIR NAVIGATION)**

The TACAN navigation system, AN/ARN-118(V), is a polar coordinate navigation system that is used to determine the relative bearing and line of sight distance from the aircraft to a selected TACAN station. The selected TACAN station can be ground, shipboard, or airborne. The ground and shipboard TACAN stations are considered surface stations and supply both bearing and line of sight distance to the helicopter. An airborne station only supplies line of sight distance information, unless the aircraft is especially equipped with a bearing transmitter.

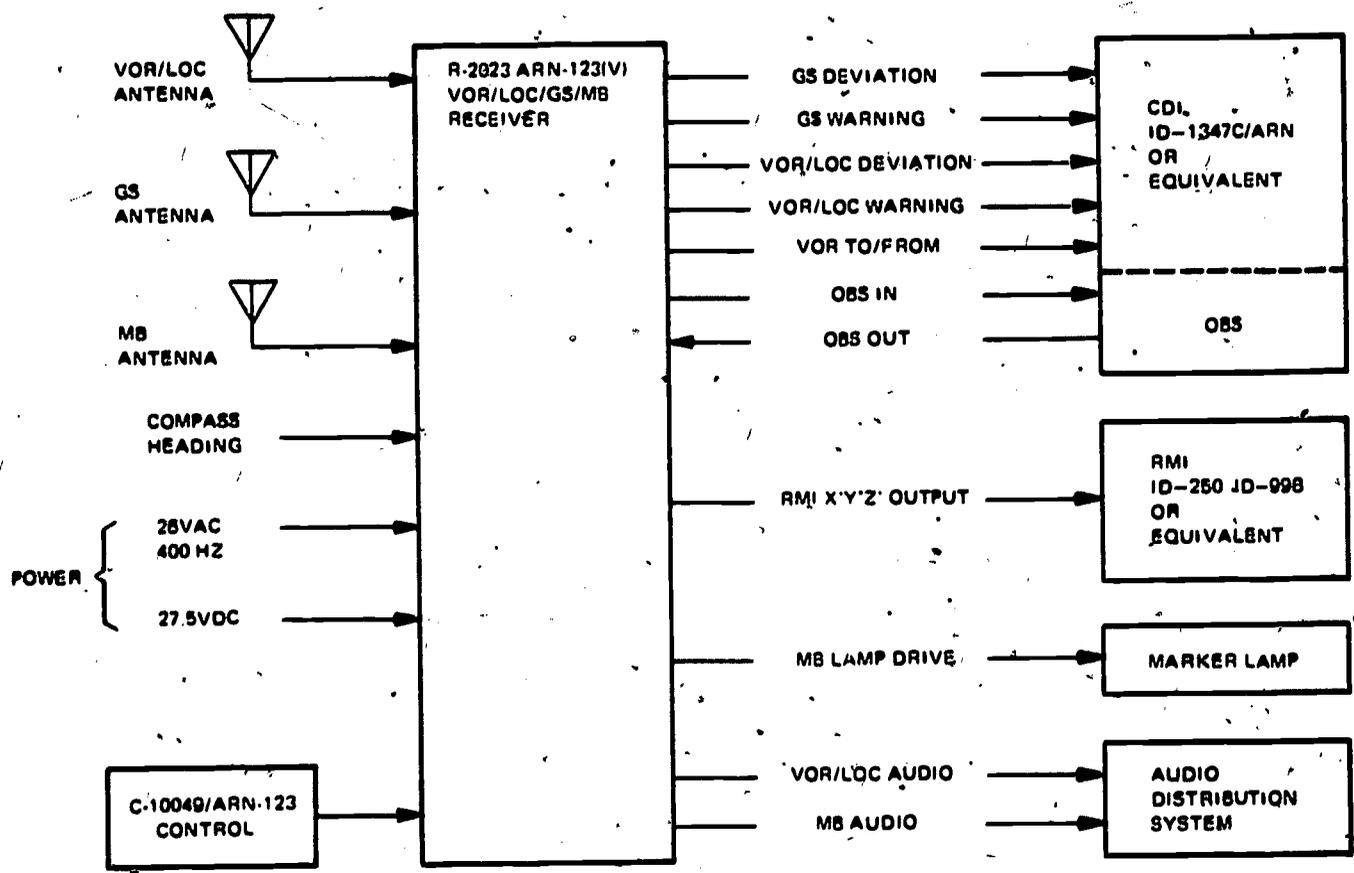


Figure 8-4. - System Application:

TACAN navigation set AN/ARN-118(V) is not capable of transmitting bearing information but does supply line of sight distance information when interrogated. The maximum range of station reception is governed by line of sight considerations. The maximum operating range of the set is 390 nautical miles when the selected station is a surface station, and 200 nautical miles when A/A operation is selected. The distance display on the course indicator is only capable of displaying a range up to 299 nautical miles. The TACAN navigation set has provisions for 126 X channels and 126 Y channels. The X channels are those presently in use by surface stations. The Y channels differ from the X channels in frequency assignment and pulse spacing.

NOTE

The Y channels were developed to alleviate congestion of the X channels, but have not been implemented in ground stations. They are, however, available for use in the A/A modes. Use of the Y channels in the A/A mode is encouraged to eliminate possible interference with ground stations.

Visual presentation of the TACAN course is made on the pilot's and copilot's course indicator of the AN/AYN-2 flight director and the RMIs. Ambiguity in TACAN bearing information of a TACAN (manual set) course is resolved by the to/from arrow. Visual presentation of (automatic) TACAN bearing is presented with the No. 2 pointer of both RMIs. The distance to a TACAN or VORTAC station or a cooperating aircraft is displayed in the distance display window of the course indicator. The distance is read in nautical miles.

The TACAN is powered by the DC primary bus, the No. 1 AC primary bus, and 26 volts AC from the radio autotransformer. The TACAN is protected by two circuit breakers on the copilot's circuit breaker panel. The TACAN's DC primary circuit is protected by a circuit breaker marked TACAN, under the general heading DC PRI. The TACAN's No. 1 AC primary circuit is protected by a circuit breaker marked TACAN AC, under the general heading NO. 1 AC PRI.

TACAN OPERATING CONTROLS

Controls for the TACAN system are located on the TACAN control panel on the center console (figure 8-5). These controls include a function selector switch, tens channel selector switch, units channel selector switch, X/Y channel selector, volume control knob, and self-test button. The control panel also contains a test indicator light and a channel digital display.

Function Selector Switch

A five-position (OFF, REC, T/R, A/A REC, A/A T/R) function selector switch selects the mode of operation. OFF removes power from the set. The REC position allows only bearing information to be received from a surface station. The T/R position allows both bearing information and line of sight distance data to be received from a surface station. The A/A REC position allows only bearing information to be received from a suitably equipped cooperating aircraft.

NOTE

The HH-3E helicopter and other Coast Guard aircraft are not suitably equipped to transmit bearing information to other aircraft. This does not prevent reception of bearing information by the helicopter from a suitably equipped aircraft of another service.

In the A/A T/R position both bearing and line of sight distance information are received from another aircraft. If the cooperating aircraft is not equipped to transmit bearing signals, only the line of sight distance will be received in this mode.

NOTE

Operation in the air-to-air mode requires prearrangement with a cooperating aircraft. The second aircraft must be equipped with an air-to-air TACAN which is set to the air-to-air mode of operation and is set 63 channels away from the channel setting of the TACAN in the first aircraft. One aircraft may reply to as many as five others, but it will only display the distance to the nearest aircraft.

The TACAN navigation set requires a 90-second warm-up period regardless of the position selected by the function selector switch.

Channel Selector Switches

The tens channel selector and units channel selector are rotary switches that tune the TACAN navigation set to any of 126 TACAN channels. The X/Y channel selector selects either the X set of 126 channels or the Y set of 126 channels.

CAUTION

The units channel selector switch contains a built-in mechanical stop to prevent rotation past the nine (9) position. Do not attempt to override this mechanical stop. Direction of switch rotation must be reversed when the stop is reached.

Volume Control Knob

The volume control knob, marked VOL, varies the volume of the audio signals received from the selected surface station and heard through the helicopter intercommunication system when the appropriate monitor button is pulled out.

Self-Test Button

The manual self-test button, marked TEST, provides a test of a complete TACAN system, except for the antennas, when pressed.

Manual Self-Test of TACAN System

To initiate the self-test, select TACAN on the VOR-TACAN selector switches, select TAC on the RMI No. 2 pointer selector switches, select a course of 180 degrees in the copilot's course display window, place the TACAN function switch in the T/R position, and allow 90 seconds for warm-up. Depress the TEST button and observe that the test indicator light illuminates for about one second, the distance shutter and VOR-LOC flags come into view, for approximately seven seconds, and the No. 2 pointers of the RMI's indicate 270 degrees. For the next fifteen seconds, the flags go out of view, the distance displays indicate 000.0 (± 0.5), the No. 2 pointers indicate 180 (± 3) degrees, the course deviation bar centers to within 1/2 dot and the to/from arrow indicates TO.

When the self-test is complete, all indicators return to the indications displayed prior to the self-test. A failure is recorded if the test indicator light remains on during the test and/or the indicators are out of limits. The test can be performed again in the REC mode, and if the indicator light does not come on, the malfunction is isolated to the transmitter section and the bearing information is valid.

Automatic Self-Test of TACAN System

An automatic self-test occurs when the receiver signal becomes unreliable or the signal is lost, to ensure that the TACAN system is operating properly. The results of the automatic self-test are the same as for the manual self-test except that the distance shutters and VOR-LOC flags remain in view throughout the test.

CAUTION

Bearing and/or distance indications may still be present when the TEST lamp is on. Such indications could be either partially usable or grossly inaccurate. They should be cross-checked, using every available means. Be prepared for the possibility of TACAN

equipment failure if the test indicator light illuminates.

TACAN OPERATION

To Turn Set On:

1. Function Selector Switch (TACAN control panel) - AS REQUIRED.
2. ICS Monitor Selector/Volume Control - pull TAC.
3. VOR-TACAN Selector Switch (Instrument Panel) - TACAN.
4. RMI No. 2 Pointer Selector Switch (Instrument Panel) - TAC.
5. Channel Selector Knob (TACAN Control Panel) - AS REQUIRED.
6. Volume Control (TACAN Control Panel) - AS REQUIRED.
7. Attitude Indicator Mode Selector Knob (Instrument Panel) - AS REQUIRED.

To Turn Set Off:

1. Function Selector Switch (TACAN Control Panel) - OFF.

LF AUTOMATIC DIRECTION FINDER SET (LF/ADF) AN/ARN-89

The LF/ADF set AN/ARN-89 (figure 8-5) provides automatic or manual compass bearings with the No. 1 pointer of the RMI on any radio signal between 100 and 3,000 MHz. The tuning range is continuous between these frequencies. The LF-ADF also may function as a low-frequency communications receiver.

The LF/ADF set is powered by the DC primary bus and 26 volts AC from the radio autotransformer. The LF/ADF set's DC primary circuit is protected by a circuit breaker on the pilot's circuit breaker panel marked LF ADF.

LF/ADF CONTROL PANEL

The LF/ADF control panel contains the OFF-COMP-AND-LOOP switch, CW-VOICE-TEST switch, coarse and fine frequency controls, kilohertz indicator, tuning indicator, audio control, and LOOP B-R control.

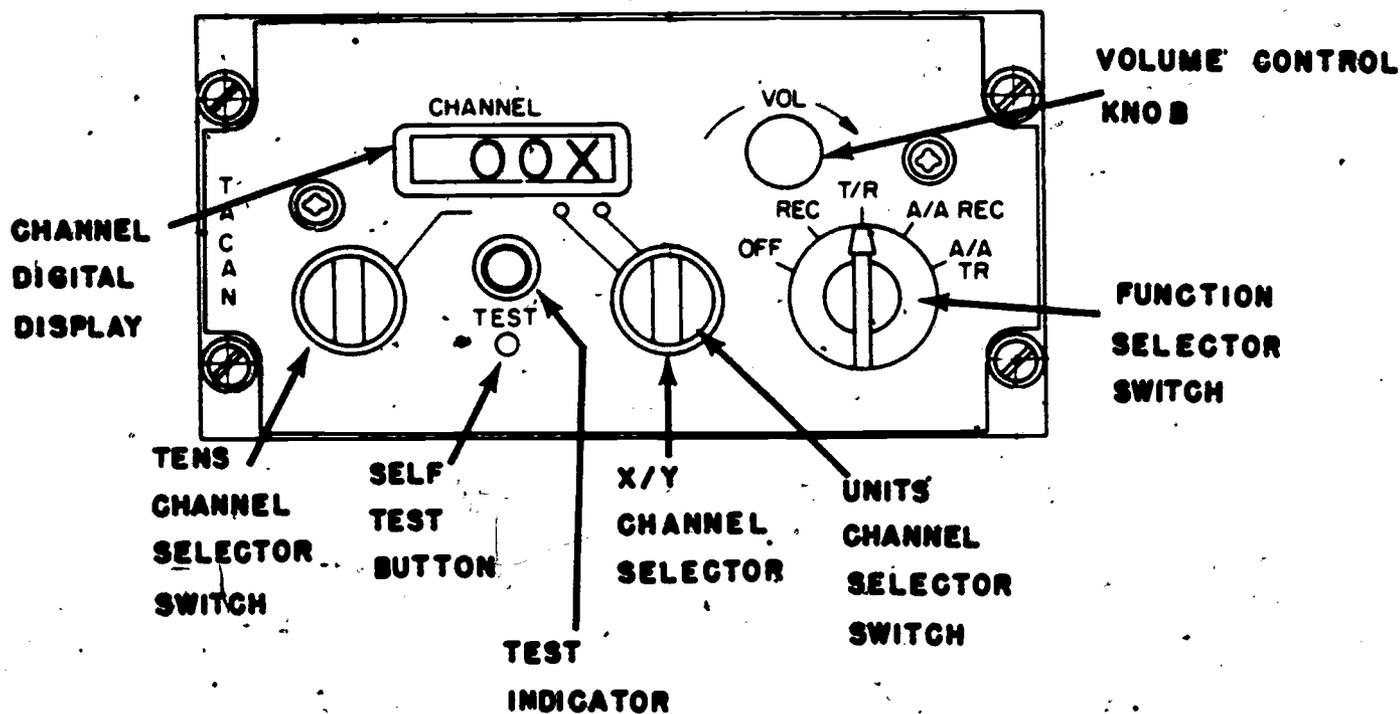


Figure 8-5.

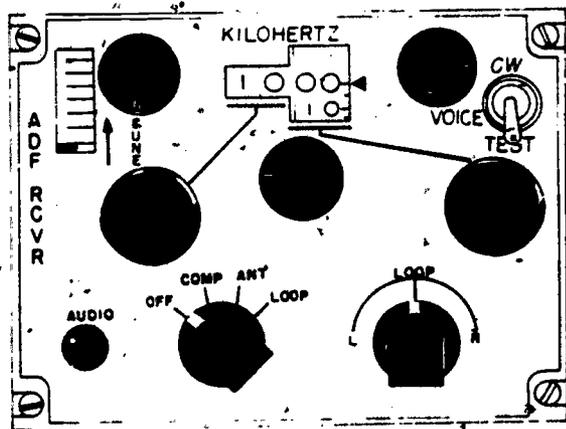


Figure 8-6. - LF/ADF radio AN/ARN-89.

OFF-COMP-ANT-LOOP Switch

The OFF-COMP-ANT-LOOP switch has four positions. In the OFF position, power is removed from the set. The COMP position connects both the loop and sense antennas, and the LF/ADF functions as an ADF. In the ANT position, only the sense antenna is connected, and the LF/ADF functions as a standard low-frequency receiver. In the LOOP position, only the loop antenna is connected, and the LF/ADF may be used for manual direction finding.

CW-VOICE-TEST Switch

The CW-VOICE-TEST switch is a three-position toggle switch, spring loaded away from the TEST position. In the CW position, the receiver's beat frequency oscillator is activated to identify CW signals. In the VOICE position, the receiver functions as a normal AM receiver. In the TEST position, the indicated bearing is automatically slewed to provide a check on ADF operation.

COARSE and FINE Frequency Controls

The COARSE tuning control tunes the receiver in 100-kHz steps as indicated by the first two digits of the kilohertz indicator. The FINE tuning control tunes the receiver through 10-kHz marked increments (continuous tuning) as indicated by the last two digits of the kilohertz indicator.

KILOHERTZ Indicator

The kilohertz indicator indicates the operating frequency to which the receiver is tuned.

TUNING Indicator

The tuning indicator indicates relative signal strength while the receiver is being tuned to a specific radio signal.

AUDIO Control

The audio control controls the RF gain of the receiver while the ADF is operating in the ANT or LOOP mode. When the ADF is operating in the COMP mode, the audio control controls the audio output gain.

LOOP L-R Control

The loop L-R control provides for manual positioning of the loop antenna when the ADF is operating in the manual direction-finding mode.

LF/ADF OPERATING PROCEDURES

AM Receiver Mode of Operation

1. Select ADF on the ICS Monitor Selector/Volume Control.
2. Set the CW-VOICE-TEST switch to the VOICE position.
3. Set the OFF-COMP-ANT-LOOP switch to the ANT position.
4. Adjust the coarse and fine frequency controls to the desired frequency.
5. Adjust the audio control to a comfortable listening level in the headset.
6. Adjust the fine frequency control to obtain a maximum (upward) indication on the tuning indicator.

Compass Mode of Operation

1. Perform the steps of operation for the AM receiver mode of operation.
2. Set the OFF-COMP-ANT-LOOP switch to the COMP position.

NOTE

The #1 needle on the remote indicator should display the relative bearing of the received ground station in relation to the aircraft.

OPERATING LIMITATIONS AND PRECAUTIONS

The LF/ADF set is subject to the following operating limitations, which are imposed by terrain, weather, and general operating conditions.

Night Effect

At night, radio waves reflected by the ionosphere return to the earth at some point 30 to 60 miles from the station. This night effect may cause the pointer to fluctuate. The effect is most prevalent during the period just before and after sunrise and sunset. Generally, the greater the distance from the station, the greater the effect. The effect can be minimized by averaging the fluctuations, by flying at a higher altitude, or by selecting a lower-frequency station. Maximum night effect will be preset with stations operating in frequency ranges above 1,000 kHz. Frequencies below 1,000 kHz are generally less subject to night effect.

Mountain Effect

Bearings taken in the vicinity of mountainous terrain may be erroneous, and the pointer may fluctuate due to magnetic deposits or radio wave reflection.

Shoreline Effect

As radio waves pass from land to water, their direction of travel is changed. Because of shoreline effect, a bearing taken on an inland station from an aircraft over water is inaccurate if the bearing makes an angle of less than 30° with the shoreline. At greater angles, bending is negligible. When taking bearings over water, therefore, choose stations which are either right on the shore, or so located that bearings to them make angles greater than 30° with the shoreline.

General Operating Procedures

Use the following general procedures when operating the LF-ADF set. Only heading bearings are entirely dependable. Keep the helicopter in a level attitude when taking side bearings; accurate bearings cannot be taken with the aircraft in a steep bank, especially when close to a station. For manual direction finding, place the OFF-COMP-ANT-LOOP switch in the LOOP position and slew the LOOP control for an aural null. When you are using the aural null method for taking bearings, the 180° ambiguity must be resolved.



SELF-QUIZ #8

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. When DF-301 equipment is used, the relative bearing to a signal source is read as a continuous magnetic bearing by the _____

- A. No. 2 pointer of the pilot's RMI
- B. No. 1 pointer of both pilots' RMIs
- C. No. 1 pointer of the copilot's RMI only
- D. No. 2 pointer of both pilots' RMIs

2. When homing with the DF-301 on a very strong UHF signal, the DF range switch should be in the _____ position.

- A. FORWARD
- B. AFT
- C. LONG
- D. SHORT

3. The LOCALIZER receiver section of the AN/ARN-123 uses _____ of the 200 channels available.

- A. 200
- B. 160
- C. 100
- D. 40

4. The navaid selector switch with the marked positions VOR and TAC is located on the _____

- A. instrument panel
- B. console control panel
- C. VHF/NAV control panel
- D. overhead radio control panel

5. The glide slope receiver is a _____ receiver.

- A. VHF
- B. UHF
- C. ADF
- D. HF

6. The MARKER BEACON operates on a frequency of _____

- A. 90 Hz
- B. 50 KHz
- C. 75 MHz
- D. 90 MHz

7. The TACAN distance display on the indicator goes up to _____ nautical miles.

- A. 126
- B. 200
- C. 299
- D. 390

8. Operation of the air-to-air mode of TACAN requires that the second aircraft have a channel difference of _____ channels.

- A. 60
- B. 61
- C. 63
- D. 65

9. Your aircraft should have the Y channels of the AN/ARN-118 selected when _____

- A. using A/A with an aircraft using X channels
- B. navigating on-ground stations
- C. all X channels are inoperative
- D. using A/A with an aircraft using Y channels

10. The frequency range of the AN/ARN-89 LF ADF is _____

- A. 100 to 1,000 KHz
- B. 100 to 2,000 KHz
- C. 100 to 3,000 KHz
- D. 100 to 4,000 KHz

11. The FINE tuning control tunes the LF ADF receiver through _____ marked increments.

- A. 5 KHz
- B. 10 KHz
- C. 15 KHz
- D. 20 KHz

111

ANSWERS TO SELF-QUIZ #8

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	8-1
2	D	8-1
3	D	8-4
4	A	8-3
5	B	8-4
6	C	8-4
7	C	8-6
8	C	8-6
9	B	8-6
10	C	8-7
11	B	8-8

HH-3F LORAN C NAVIGATOR

Reading Assignment:
Pages 9-1 through 9-18.

OBJECTIVES .

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the AN/ARN-133 LORAN C NAVIGATOR.

LORAN C NAVIGATOR AN/ARN-133

The AN/ARN-133 LORAN Navigator is a microcomputerized LORAN-C and D navigator capable of providing continuous navigation information anywhere LORAN C or D coverage exists. LORAN signals are received via the antenna located overhead the cockpit, sent to the antenna coupler in the forward electronics compartment and then processed by the navigator located on the copilot's side of the center console. Automatic initialization procedures commence when the MODE switch is turned to initialize. The Navigator is protected by a circuit breaker on the copilot's overhead circuit breaker panel under the general heating DC PRI and marked LORAN C.

CONTROLS, INDICATORS, AND DISPLAYS

The Navigator front panel is divided into five groups: displays, switches and indicators, keyboard, DISPLAY switch and MODE switch. Figures 9-1 through 9-2 illustrate each of these groups.

General Keyboard Information

The keyboard is used to enter information into the navigator. The circular and rectangular keys have essentially a single function, while the square keys have dual functions. The normal entry sequence consists of a clear, function, number, and insert. Specific entry sequences for all navigator functions are discussed in the following pages. Some special keyboard features are:

1. Any entry sequence may be terminated prior to the final INSERT by depressing CLR. This returns the displays to the original condition.

2. After the final INSERT, the only way to change entered data is to perform the entire procedure again, replacing incorrect data with the correct.

3. To correct an error in a number entry as it is made, depress the LEG CHG key, which backs out the last-entered digit from the display. Successive depressions of the LEG CHG key continue to back out successive digits.

Mode Switch

The five position rotor MODE switch has built-in detents protecting the INITIALIZE and EMERG positions. One is between INITIALIZE and OPERATE, and the other between ADVISE and EMERG. To cross either of these detents, push the knob into the panel and turn. These detents prevent inadvertent movement to the INITIALIZE and EMERG positions, thereby losing track of LORAN signals. Switch positions are as follows:

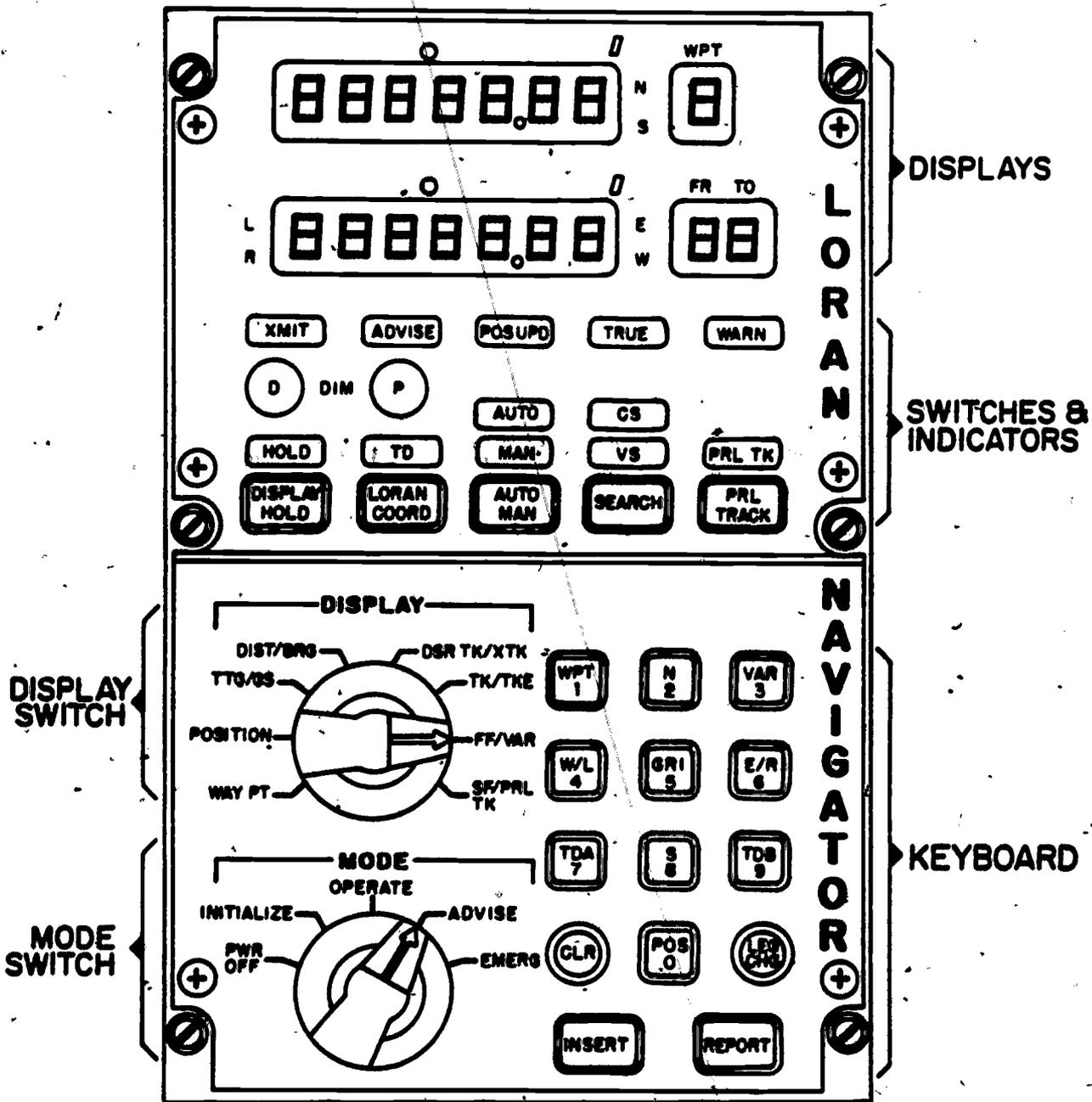
1. PWR OFF - Removes all external system power.

CAUTION

During engine start or other conditions that may produce DC power fluctuations, the MODE switch should be in the PWR OFF-position. In case of extreme fluctuation: i.e., shipboard power starts, the LORAN-C circuit breaker should be pulled.

2. INITIALIZE - Allows all initial data to be entered.

(Detent) The LORAN receiver is held in search.



SWITCHES ARE SHOWN IN LAMP TEST POSITION.
 ALL INDICATORS AND DISPLAY SEGMENTS, EXCEPT
 XMIT, ARE ILLUMINATED.

Figure 9-1. - AN/ARN-133 Front Panel.

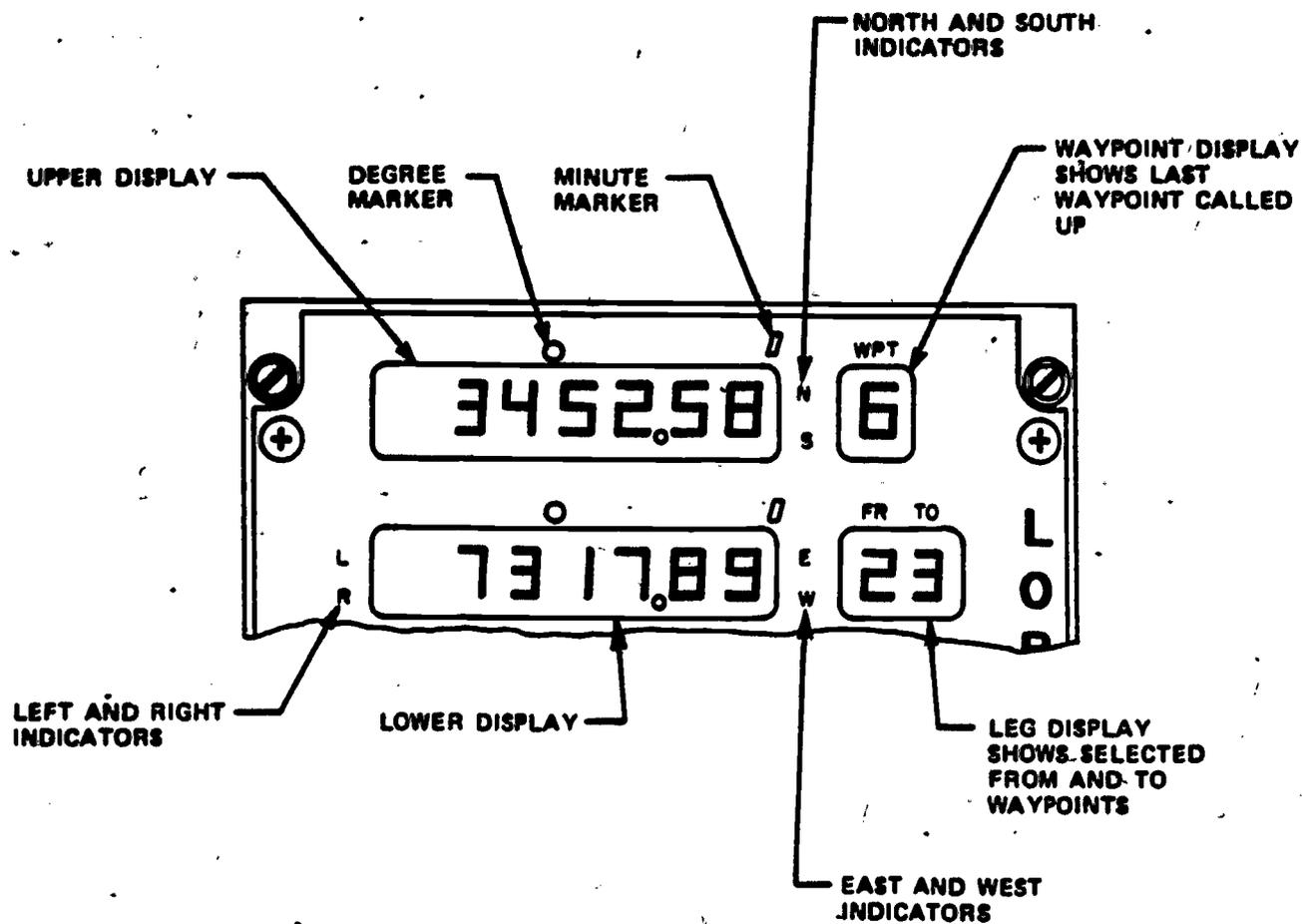


Figure 9-2. - Displays.

NOTE

When turning the navigator on, care should be taken to pause momentarily in the INITIALIZE position. Failure to pause in this position will result in non-retrieval of the stored chain and positional data, and possible freeze-up of the navigator.

Display Switch

The eight position rotary DISPLAY switch (figure 9-1) allows information to be entered or displayed with the MODE switch in the OPERATE position as follows:

NOTE

The positions have different functions with the MODE switch in the ADVISE position. Refer to ADVISE and WARN functions section.

3. OPERATE - This is the normal operating mode. The receiver is freed to acquire and track signals, and the navigation function and displays are activated.

4. ADVISE (Detent) - Used to determine why ADVISE and WARN indicators are illuminated or flashing. Also used in conjunction with DISPLAY switch positions to provide signal and system status and analysis. Allows some pilot control over receiver functions.

5. EMERG - Transmits aircraft position via data link with emergency-report code(7) included. The EMERG position is not used in this installation.

1. WAY PT - Allows entry or display of selected waypoint coordinates in lat/long or time differences (TDA and TDB) in the upper and lower displays respectively for any selected waypoint appearing in the WPT display.

2. POSITION - Allows present POSITION display and entry in lat/long or time differences (TDA and TDB) in the upper and lower displays respectively. The navigator continuously computes POSITION during the display hold, and when the display is released, shows correct present POSITION.

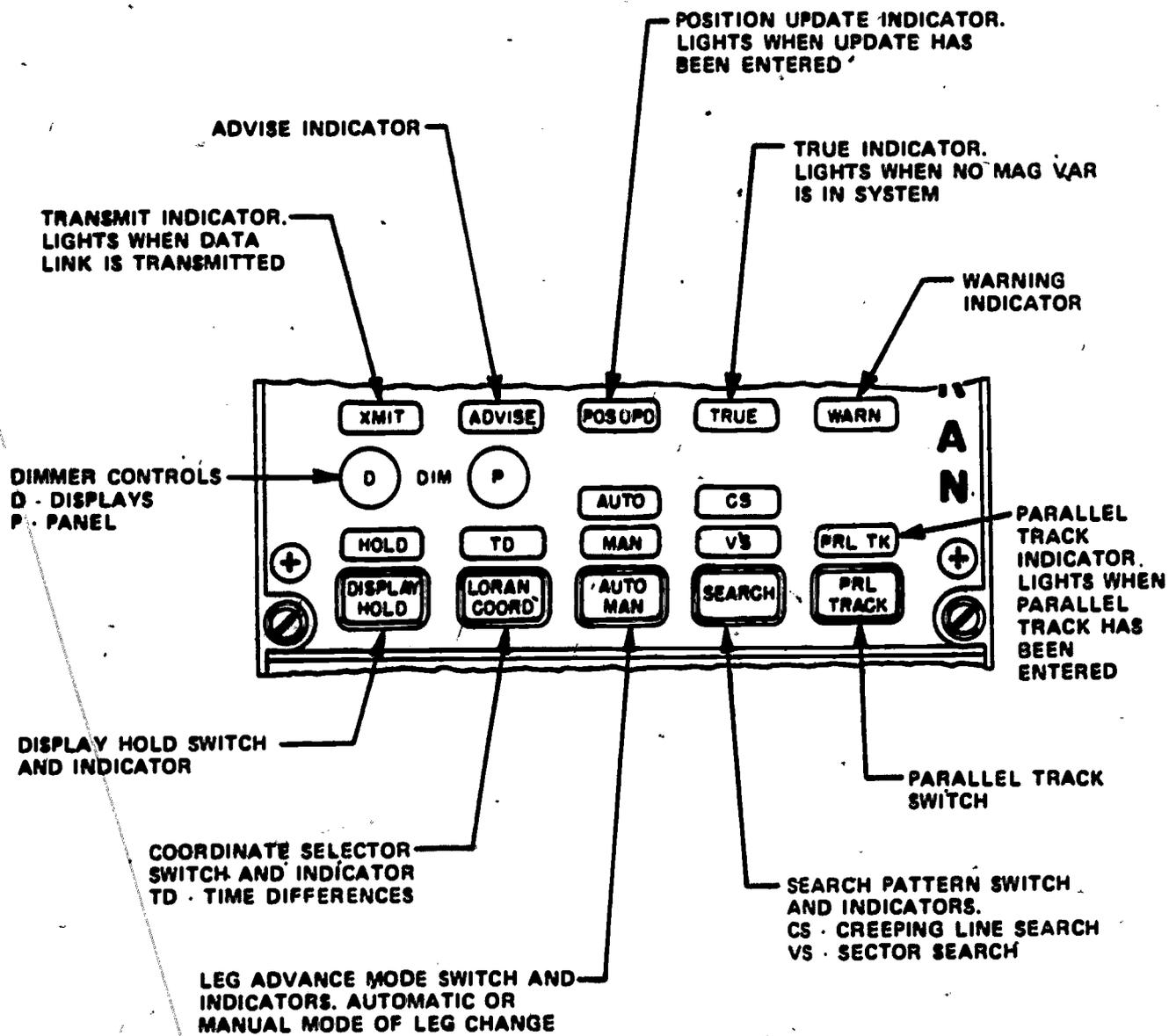


Figure 9-3. - Switches and Indicators.

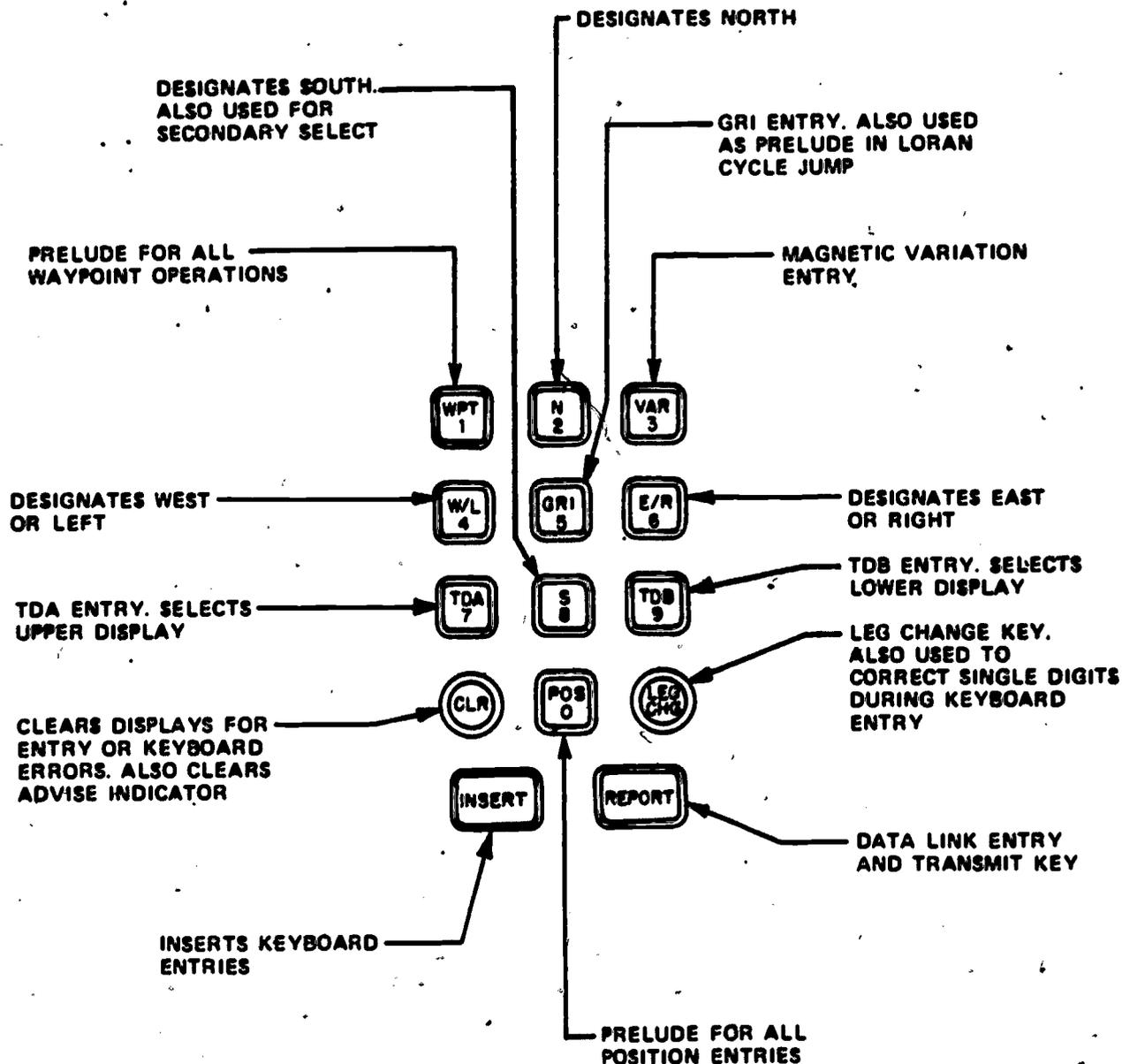


Figure 9-4. - Keyboard.

3. TTG/GS - Presents time to go (TTG) from present position to the TO waypoint in the upper display and ground speed (GS) in the lower display. Time to go is blanked when ground speed is 9 knots or less.

4. DIST/BRG - Presents range (DIST) to the selected TO waypoint in the upper display. Bearing angle (BRG) to the TO waypoint appears in the lower display and is with respect to north (true north if no magnetic variation has been entered). When the interwaypoint range and bearing procedure is used, the following information is displayed:

- a. Upper Display - Distance between waypoints.
- b. Lower Display, Left Side - Bearing on the requested leg.
- c. Lower Display, Right Side - FROM and TO waypoints requested.

This information is presented for ten seconds after which the display reverts back to normal.

5. DSR TK/XTK - Presents the desired track angle (DSR TK) to the nearest degree in the upper display with respect to the selected waypoints. Crosstrack distance (XTK), either left or right, is measured to hundredths of a nautical mile and shown in the lower display.

6. TK/TKE - Presents track angle (TK) with respect to north (true north if no magnetic variation has been entered) in the upper display and track angle error (TKE) in the lower display. Illumination of the R or L indicates present track angle error is to the right or left of the desired track angle. Display of these functions is blanked below 10 knots.

7. FF/VAR - Presents data link information for flight following (FF) consisting of the aircraft identification number (preset by technician prior to flight) from 00 to 99 presented in the upper left display and the single digit report code in the upper right. Entered magnetic variation (VAR) in degrees EAST or WEST appears in the lower display.

8. SF/PRL TK - Presents data associated with CS or VS search patterns (Special Function) in the upper display. The associated information (ie letter) appears in the WPT display. In the lower display parallel track offset distance (PRL TK) is

presented to tenths of a nautical mile either right (R) or left (L) of course.

Advise and Warn Functions

The ADVISE and WARN indicators may be illuminated by any of the following conditions. To determine the cause of ADVISE and WARN indications, set the MODE switch to ADVISE and the DISPLAY switch to DSR TK/XTK. A "1" appearing in any digit position in the upper or lower display signifies the condition listed in figure 9-5.

NOTE

More than one cause may be indicated for any given ADVISE or WARN.

Advise Indications

The ADVISE indicator illuminates or flashes and the corresponding display digit is set to "1" when any of the following conditions occur:

1. MISSED WAYPOINT ARRIVE - The navigator continually monitors the distance-to-go to the selected waypoint. If this changes from a decreasing to an increasing value and the arrival

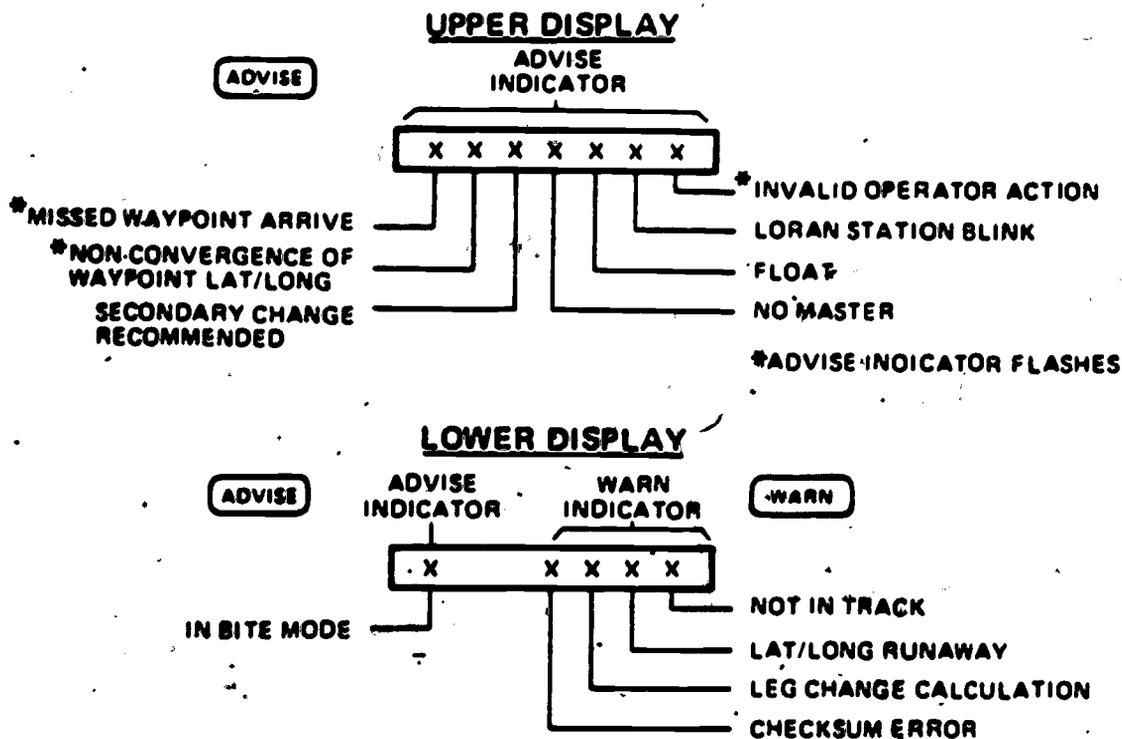


Figure 9-5. - Interpretation of ADVISE and WARN indications.

criteria were not met, signifying a missed-waypoint condition. ADVISE flashes to allow manual selection of the NEXT leg.

2. NON-CONVERGENCY OF WAYPOINT LAT/LOG - ADVISE flashes when the navigator tries to perform a lat/long conversion of a waypoint entered in time differences but cannot due to signals being out of range, poor station geometry, etc.

3. SECONDARY CHANGE RECOMMENDED - ADVISE illuminates when the secondary pair in use is not the secondary pair recommended by the navigator. The navigator compares the signal to noise ratios and relative positions of the LORAN secondaries and recommends the best pair selection that results in the smallest navigation error.

Stations not currently being tracked and stations less than 38 miles from the receiver are not considered. This function is inoperative during master independent operation. Use the automatic secondary advisory function to determine which is the recommended pair.

4. INVALID OPERATOR ACTION - The following erroneous actions may illuminate the ADVISE indicator: incorrect switch/key combinations; certain incorrect values; invalid GRI (one not stored in memory) and certain invalid input coordinate values.

5. LORAN STATION BLINK - ADVISE illuminates when one of the selected LORAN secondary stations blinks. The LORAN control station causes the LORAN signal to blink whenever the time delay is not within tolerance. During blink, portions of the LORAN signal are alternately turned on and off. Blinking stations should not be used.

6. FLOAT - ADVISE illuminates if any signal in use (master, A, or B) goes into float. Float mode indicates that the signal has been lost and the navigator is temporarily dead reckoning using last-known velocity and direction.

- 7. NO MASTER** - 1 = System does not have the real master.
0 = System has the real master.
8 = Master independence has been overridden (inoperative).

8. IN BITE MODE - ADVISE illuminates when the navigator is operating on the Built In Test Equipment (BITE) chain of 5100.

Warn Indicators

WARNING

Whenever the WARN indicator is illuminated, regardless of cause, do not use the system for navigation.

The WARN indicator illuminates and the corresponding lower display digit is set to "1" when any of the following conditions occur:

1. NOT IN TRACK - WARN illuminates when any of the three signals being used is not in track. The WARN indicator stays on for 20 seconds after the navigator goes back into track to allow the TDs to stabilize.

2. LAT/LONG RUNAWAY - The navigator continually monitors the rate of change of lat/long and checks it for reasonableness. If the rate of change is unreasonable or excessive, WARN illuminates.

3. LEG CHANGE CALCULATION - When marking an automatic or manual leg change, the navigator calculates new navigation data. During this brief calculation period, the navigator illuminates the WARN indicator, advising that data is unreliable.

4. CHECKSUM ERROR - WARN illuminates if the navigator has failed self test (checksum). This usually indicates hardware failure.

Advise Functions

The ADVISE position of the MODE switch also provides a readout and navigator status and is used in conjunction with other DISPLAY switch positions to check on a number of system parameters and other data. The data in each of the eight DISPLAY switch positions is listed and described in figure 9-6.

PREFLIGHT PROCEDURES

The preflight procedures depend on whether the aircraft will be flying in the same or different area as before, and whether maintenance action has erased initialization data. When power is applied, the navigator is automatically initialized to the last-computed present position, last-entered LORAN chain, magnetic variation, waypoints, and other previously entered data. This data is held in temporary memory when power is removed from the navigator. When flying in the same general area and temporary memory is intact, set the MODE switch to OPERATE, pausing momentarily in initialize.

Display Switch Position	Function	Upper and Lower Display Data
WAY PT	TD1	X X X X X X Microseconds
	TD2	X X X X X X Microseconds
POSITION	TD3	X X X X X X Microseconds
	TD4	X X X X X X Microseconds
TTG/GS	Velocity	Master Oscillator X X X - X X X
	Envelope Counter	M 1 2 X X - X X X X
DIST/BRG	Loran Status	M 1 2 3 4 ↓ ↓ ↓ ↓ ↓ X X X X X - - 0 - Search 4 - Fine env 2 1 - Coarse env 7 - Track 2 - Coarse env 8 - Float 3 - Fine env 1
	SNR	M 1 2 3 4 ↓ ↓ ↓ ↓ ↓ X X X X X - X Secondary number of designated master (master independent operation). Normal operation (real master) = 0 Master independent = 1 - 4 Poor SNR Good SNR 0 - 0 - 19 7 - 80 - 89 1 - 20 - 29 8 - 90 - 99 2 - 30 - 39 9 - Equal to or greater than 100 3 - 40 - 49 Fair SNR 4 - 50 - 59 5 - 60 - 69 6 - 70 - 79

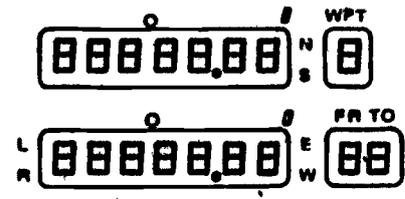
Display Switch Position	Function	Upper and Lower Display Data
DSR TK/XTK	Interpretation of ADVISE and WARN	See previous two pages for complete breakdown of ADVISE and WARN indications.
TK/TKE	GRI (Normal entry)	X X X X - - -
	GRI (Manual chain entry)	X X X X X X
	Secondaries	Recommended X X - - - X X In Use
FF/VAR	Lamp Test	
SF/PRL TK	Memory Address	- - X X X X X (octal)
	Memory Data	- X X X X X X (octal)
		This function reads TDY-52B computer RAM and ROM memories.

Figure 9-6. - Advise Functions.

NOTE

When turning the navigator on, pause momentarily in the INITIALIZE position. Failure to pause in this position will result in non-retrieval of stored chain and positional data, and possible freeze-up of the navigator.

If complete reinitialization is necessary after maintenance of transfer to a different LORAN coverage area, perform the following first:

1. Self test (BITE).

NOTE

Self test (BITE) should be accomplished any time a problem is suspected in the system. After self test is used it will be necessary to enter desired chain GRI, secondary pair, and present position, since these are changed in the test.

2. Initial present position entry.
3. Loran chain GI selection.
4. Secondary pair selection.

This is the minimum information required to go into OPERATE, enabling the navigator to function. Enter the following, as applicable, in any sequence:

1. Waypoints in lat/long of TD's.
2. Magnetic variation.
3. FROM-TO selection for initial leg.

Self Test (BITE)

NOTE

Self test requires going into INITIALIZE mode, which terminates all nav functions and loss of signal track.

Self test exercises all primary functions of the navigator less the antenna, antenna coupler, and associated cabling. It uses an internally simulated LORAN signal, and is initiated in the same manner as selecting a new GRI, using a pseudo chain rate of 51,000 microseconds.

1. Perform lamp test by setting MODE switch to ADVISE and DISPLAY switch to FF/VAR. All displays and indicators except XMIT should illuminate.

2. MODE switch to INITIALIZE and DISPLAY to TK/TKE. Depress LORAN COORD switch to illuminate the TD indicator.

3. Adjust dim knobs as required. Panel lighting indicators and displays should vary accordingly.

4. Depress CLR key. Displays should blank.

5. Depress GRI key.

6. Insert 5100 into keyboard. Number should appear in lower display.

7. Depress INSERT. 5100 should jump to the upper display. ADVISE indicator should illuminate, indicating BITE mode is enabled. WARN indicator should illuminate. Secondaries 1 and 2 are automatically selected and the initial present position of 24° N, 164° W is automatically entered.

8. Set MODE switch to OPERATE and DISPLAY switch to POSITION. The navigator should now search and settle on the simulated chain. When the WARN indicator goes out, the displayed time differences should be: TDA = 16000.00 ± 0.2 in the upper display. TDB 36000.00 ± 0.2 in the lower.

9. Depress LORAN COORD switch to extinguish the TD indicator. Displayed lat/long should be N 23° 52.82' ± 0.05 in the upper display and W, 164° 22.04' ± 0.05 in the lower. Self test is satisfactory if time differences in step 8 and lat/long in this step are as indicated.

10. To terminate self test, set MODE switch to INITIALIZE and enter initial present positions and desired GRI and secondaries.

Initial Present Position Entry

Since two geographic positions are defined by any pair of LORAN-C time delays, the navigator must have an initial estimate of present position. Enter present position as accurately as it is known.

NOTE

Initial present position must be entered in lat/long.



Present position entry is not always required since the last known position is stored at shutdown. Use the following procedure to enter initial present position. To change only one coordinate, omit steps 3, 4, 5 and 6 or 3, 7, 8, and 9 as applicable.

1. MODE switch to INITIALIZE and DISPLAY to POSITION.
2. Depress CLR key. Displays should blank.
3. Depress POS key.
4. Depress N or S latitude key. Appropriate indicator should illuminate.
5. Enter into the keyboard the latitude, using zeros (0) as required. Number should appear in upper display.
6. Depress INSERT.

7. Depress E or W longitude key. Appropriate indicator should illuminate.

8. Enter into keyboard the longitude. Enter zeros (0) as required. Number should appear in lower display.

9. Depress INSERT. Displays should return to normal.

GRI SELECTION

This time that elapses between the initiating pulse from the master and the next initiating pulse from the same master is known as the group repetition interval (GRI).

The following procedure is used to select a LORAN chain GRI. When changing a LORAN chain GRI during flight, allow time for the navigator to acquire and track the new signals (WARN indicator extinguished). Any GRI's not listed in figure 9-7 must first be stored using the manual chain storage procedure.

Chain Rates	Secondaries			
	1	2	3	4
Central European 3970 (L3)	X	Y		
Central Pacific 4990 (S1)	X	Y		
Canadian East Coast 5930 (SH7)	X	Y	Z	
Canadian West Coast 5990 (SH1)	X	Y	Z	
North Atlantic 7930 (SL7)	W	X	Z	
Gulf of Alaska 7960 (SL4)	X	Y		
Norwegian Sea 7970 (SL3)	X	W	Y	Z
Southeast U. S. 7980 (SL2)	W	X	Y	Z
Mediterranean Sea 7990 (SL1)	X	Y	Z	
Great Lakes 8970 -	W	X	Y	
U. S. West Coast 9940 (SS6)	W	X	Y	
Northeast U. S. 9960 (SS4)	W	X	Y	Z
Northwest Pacific 9970 (SS3)	W	X	Y	Z
North Pacific 9990 (SSI)	X	Y	Z	

Figure 9-7. - Secondary Pair Identification Scheme.

1. MODE switch to INITIALIZE and DISPLAY switch to TK/TKE.

2. Depress CLR key. Displays should blank.

3. Depress GRI key to activate GRI function.

4. Enter desired chain rate (four most significant digits) into keyboard. Number should appear in lower display.

4. Enter the two-digit number representing secondary pair desired as shown in figure 9-6. For example, to use the X and Y secondaries of the 9960 chain, enter 23. Entered number should appear in lower display.

5. Depress INSERT. Newly selected secondary pair should appear in right-most two digits of lower display; recommended pair should appear in left-most two digits. GRI should appear in the upper display. If the selected secondary pair does not match the secondaries available in the selected chain, the ADVISE indicator will illuminate. Check secondary number and reenter.

NOTE

If manually stored chain is to be selected enter the same seven digit number stored in Step 1 of the manual chain storage procedure.

5. Depress INSERT. GRI should jump to upper display. If selected GRI is not stored in permanent memory or programmed in temporary memory, the ADVISE indicator will flash. Depress CLR key to remove keyboard error ADVISE light and then reenter correct GRI.

Automatic Secondary Pair Advisory

Once a LORAN chain GRI and secondary pair have been selected the navigator automatically acquires and tracks all receivable secondaries (up to four). The navigator continually determines the optimum secondary pair to be used and the ADVISE indicator illuminates each time a change is recommended. The operator may enter the recommended secondary pair, ignore it and clear the ADVISE by depressing CLR, or enter another choice. To determine the navigator's recommendation for optimum secondary pair:

Secondary Pair Selection

Secondary pair selection may be made in either INITIALIZE or ADVISE modes. Current LORAN chain GRI and secondary pair are normally stored in temporary memory. Making a secondary selection in ADVISE mode may be done without signal loss which would occur if INITIALIZE is selected when making the change. Use the ADVISE position for in-flight changes. When a secondary pair change is made in flight, the TD readout will jump to the new values.

1. Set MODE switch to ADVISE and DISPLAY switch to TK/TKE. Upper display should show selected GRI. The two left-most digits in the lower display show the recommended secondary pair; the two right-most digits show the secondary pair actually in use according to figure 9-7.

NOTE

Repeated attempts at selection of a poor secondary pair will result in a navigator freeze-up. No more than two attempts should be made at selection of a secondary pair that the navigator initially refuses.

WAYPOINT NAVIGATION

A waypoint is a numbered position to be used in navigating or any point for which navigational data is desired. Waypoint numbers appear in two locations on the front panel; the WPT display and the FR TO (leg) display. Control of the WPT display is by the WPT key and the FR TO display is by the LEG CHG key. Use the WPT key and display to enter or display a single waypoint. Use the LEG CHG key and FR TO display to initiate the AUTO navigation sequence or to manually specify a new leg. The number appearing in the waypoint is automatically set to 1 at power-on.

Use the following procedure to select a secondary pair.

1. Set MODE switch to INITIALIZE if selection is to be made during initialization; set to ADVISE if selection is to be made in flight. Set DISPLAY switch to TK/TKE.

2. Depress CLR key. Displays should blank.

3. Depress S key for secondary select.

NOTE

Prior to commencing a leg change, allow the navigator to settle after initial lock-on. Correct (± 10 knots) ground speed is indicative that settling has



occurred. Failure to allow the equipment to stabilize, prior to assigning it a navigation task, will result in non-convergence, possible lat/long runaway and memory saturation accompanied by loss of track and/or navigator freeze-up.

A maximum of nine waypoints in either lat/long or time differences may be entered. When calling up a FROM and TO leg enter the number of the two desired waypoints. Navigational data with respect to a course is defined by those two points. If a 0 and a TO waypoint are called up, navigational data will be from the aircraft present position at the time the INSERT key is pressed to the selected TO point. The 0 tells the navigator that information from present position is desired (figure 9-8).

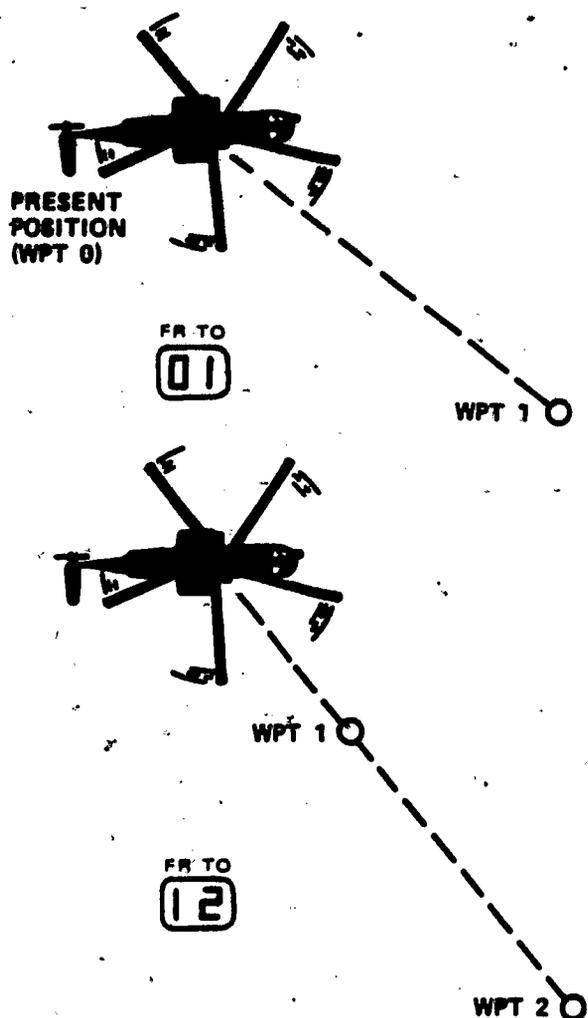


Figure 9-8. - Waypoint Navigation.

The waypoints entered are stored in memory. To clear a waypoint enter a new set of coordinates over the old.

Auto/Manual Leg Chg Selection

The AN/ARN-133 permits automatic or manual LEG CHG selection. In MAN mode, the operator makes the selection. The operator must call up one leg at a time. Navigation with respect to that leg will continue until a new leg change is completed, even if arriving at or passing the desired waypoint. In AUTO mode, the navigator sequences legs automatically, selecting the next leg in numerical sequence each time arrival at a waypoint is completed. If leg changes are entered where the TO waypoint number is greater than the FROM number, the advance of legs, in either AUTO or MAN, will increment: 12, 23, 34, 45, 56, 67, 78, 89. When the limit, 89, is reached, the next leg will be 91; then back to 12, 23, 34, etc. If leg changes are entered where the FROM waypoint number is greater than the TO, the sequence of legs will decrement: 65, 54, 43, 32, 21. When the limit, 21, is reached, the next leg will be 19; then 98, etc. To manually activate a leg change, press CLEAR, LEG CHG, INSERT.

EXAMPLE:

If the navigator is initialized by entering lat/longs for seven consecutive waypoints, when ready for takeoff, set the MODE switch to OPERATE and select AUTO. The AUTO indicator illuminates and the operator calls up the first leg. The navigator must see an initial LEG CHG entry before it will call up the waypoint table, even in AUTO mode. Use the sequence shown in figure 9-9 to call up the first leg.

Subsequent leg changes are automatic. Navigation information is provided from present position (0) to waypoint 1. Arriving over 1, the navigator will automatically switch to leg 12, giving navigation information from 1 to 2. When arriving over 2, the navigator switches to leg 23, etc. If in AUTO, manual leg changes may still be accomplished to manually increment to the next leg by depressing CLR, LEG CHG, INSERT.

When arriving at the TO waypoint, the next waypoint in numerical sequence will be used. If FR TO leg change (flashing ADVISE indicator) is missed, it is not necessary to fly back over the waypoint to enable the navigator to acquire it. Manually select the next leg using the above procedure. If the coordinates of the current TO waypoint are changed, the navigator will automatically calculate data for the new position.

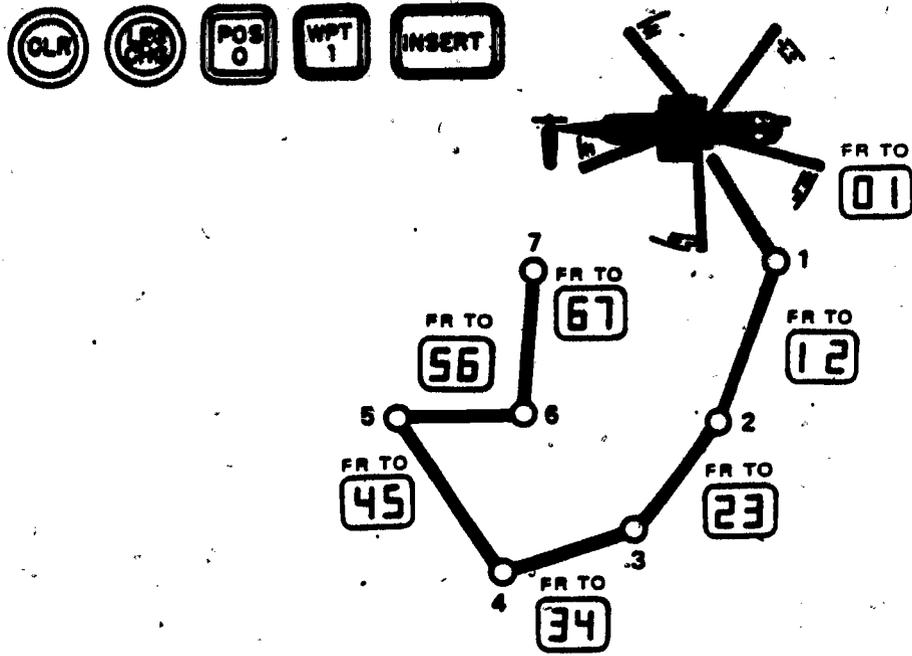


Figure 9-9. - Waypoint Selection.

Waypoint Call Up

Use the following procedure to call up any waypoint for display, entry, or modification. The last waypoint called up appears in the WPT display in most DISPLAY switch positions.

1. Set MODE switch to INITIALIZE or OPERATE and DISPLAY switch to WAY RT. Previously stored coordinates of the waypoint appearing in WPT display, if any, should appear in upper and lower displays.

2. Depress CLR key. Displays should blank.

3. Depress WPT key.

4. Enter single digit into keyboard (1-9) of desired waypoint. Number should appear in lower display.

5. Depress INSERT. Entered number should jump to WPT display. Previously stored coordinates, if any, should appear in upper and lower displays.

Waypoint Entry In Time Differences

Time differences are directly relatable to position for a specified LORAN chain. Although lat/long is used as the primary reference system, waypoints may be entered in TD's.

EXAMPLE:

If a report of a target at a certain TD fix is received without regard to lat/long, enter those TDs as a waypoint, then enter a leg change of 01. Navigation from present position (0) to that fix (1) is provided. See figure 9-10.

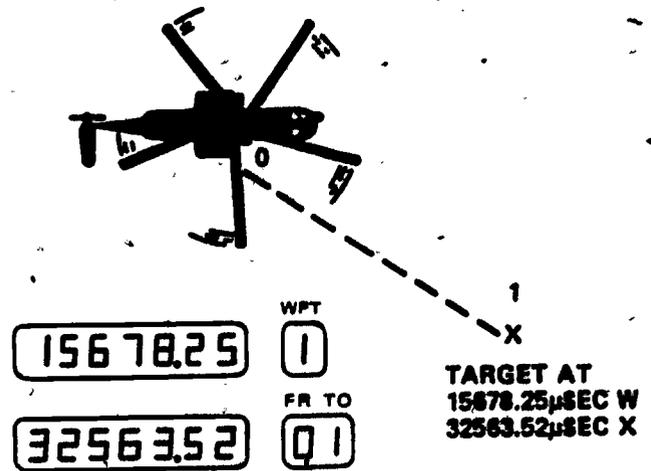


Figure 9-10. - Waypoint Entry in Time Differences.

NOTE

TD's are not related to a geodetic frame of reference, but only relate to the chain from which they were derived. The navigator must be operating on that chain, using those secondaries. When waypoints are entered in TDs depending on distance and geometry, the navigator may not be able to do an ambiguous lat/long conversion until closer to the fix.

Use the following procedure to entry waypoints in time differences. To change only one coordinate, omit steps 4, 5 and 6 or 4, 7 and 8, as applicable.

1. Call up the desired waypoint number using the waypoint call up procedure.
2. Depress LORAN COORD switch to illuminate TD indicator.
3. Depress CLR key. Displays should blank.
4. Depress POS key.
5. Depress TDA key and enter into keyboard the seven digit time difference for TDA to hundredths of a microsecond. The new TDA should appear in upper display.
6. Depress INSERT. New TDA momentarily flashes.
7. Depress TDB key and enter into keyboard the seven digit time difference for TDB to hundredths of a microsecond. The new TDB should appear in lower display.
8. Depress INSERT. New coordinates should remain in upper and lower displays.
9. Repeat steps 1 through 8 for each of the remaining waypoints to be entered. Successive depressions of INSERT will increment the WPT display to the desired waypoint number.

Waypoint Entry In Lat/Long

Use the following procedure to enter waypoints in lat/long. To change only one coordinate, omit steps 4, 5, 6 and 7 or 4, 8, 9 and 10, as applicable.

1. Call up the desired waypoint number using the waypoint call up procedure.
2. Depress LORAN COORD switch to extinguish TD indicator.

3. Depress CLR key. Displays should blank.
4. Depress POS key.
5. Depress N or S latitude key. Appropriate indicator should illuminate.
6. Enter the latitude from keyboard. Number should appear in upper display.
7. Depress INSERT.
8. Depress E or W longitude key. Appropriate indicator should illuminate.
9. Enter the longitude from keyboard. Number should appear in lower display.
10. Depress INSERT. New coordinates should remain in upper and lower displays.
11. Repeat steps 1 through 10 for each of the remaining waypoints to be entered. Successive depressions of INSERT will increment the WPT display to the desired waypoint number.

REPORT CODE ENTRY**NOTE**

Although the report code entry procedures may be accomplished, compatible ground/ship equipment must be available to permit use.

Use the following procedure when a date link report code number is to be selected or changed.

1. MODE switch to OPERATE.
2. Depress CLR key. Displays should blank.
3. Depress REPORT key.
4. Enter into keyboard the desired report code number. (Any digit from 1 through 6 for manual reporting and any digit from 01 through 06 for automatic.) Number should appear in lower display.
5. Depress INSERT. Displays should return to selected function.
6. To set the report code to 0 (which turns on automatic reporting of present position), depress CLR, REPORT, and INSERT.

SEARCH PATTERNS

Two search patterns may be stored in the Navigator: one creeping line (CS) and one sector (VS). Either of these may be called up using the SEARCH function to obtain navigational data to execute the pattern. Once the search patterns are stored, various parameters of either pattern may be individually changed. Search patterns are entered by following cue letters appearing in the WPT display.

Creeping Line Search (CS)

Commence Search Point (CSP) is located one-half search track spacing inside the corner of the search area. Leg length is search area width minus one track spacing (figure 9-11).

Sector Search (VS)

Commence Search Point (CSP) is at datum. Leg length is equal to circle radius. Track spacing is measured at the half-radius point. No entry is made for pattern length (figure 9-12).

Search Pattern Entry

Use this procedure to enter a CS or VS search pattern. Letters A through E appear in the WPT display, cuing the type of data to be entered next. By depressing INSERT a second time at the end of any

sequence, the next step (A through E) may be left with data unchanged from a previous entry.

1. Set MODE switch to OPERATE and DISPLAY switch to SF/PRL TK. Lower display should show previous parallel track offset, if any.
2. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH pushbutton again for VS indicator to illuminate. Cue letter A should appear in WPT display. Previously selected waypoint used for CSP, if any, should appear in upper display.

Enter Commence Search Waypoint

1. Depress CLR key. Display should blank.
2. Enter into keyboard Commence Search Point waypoint number. This number should appear in lower display.
3. Depress INSERT. Cue letter b should appear in WPT display. Last entered leg length, if any, should appear in upper display.

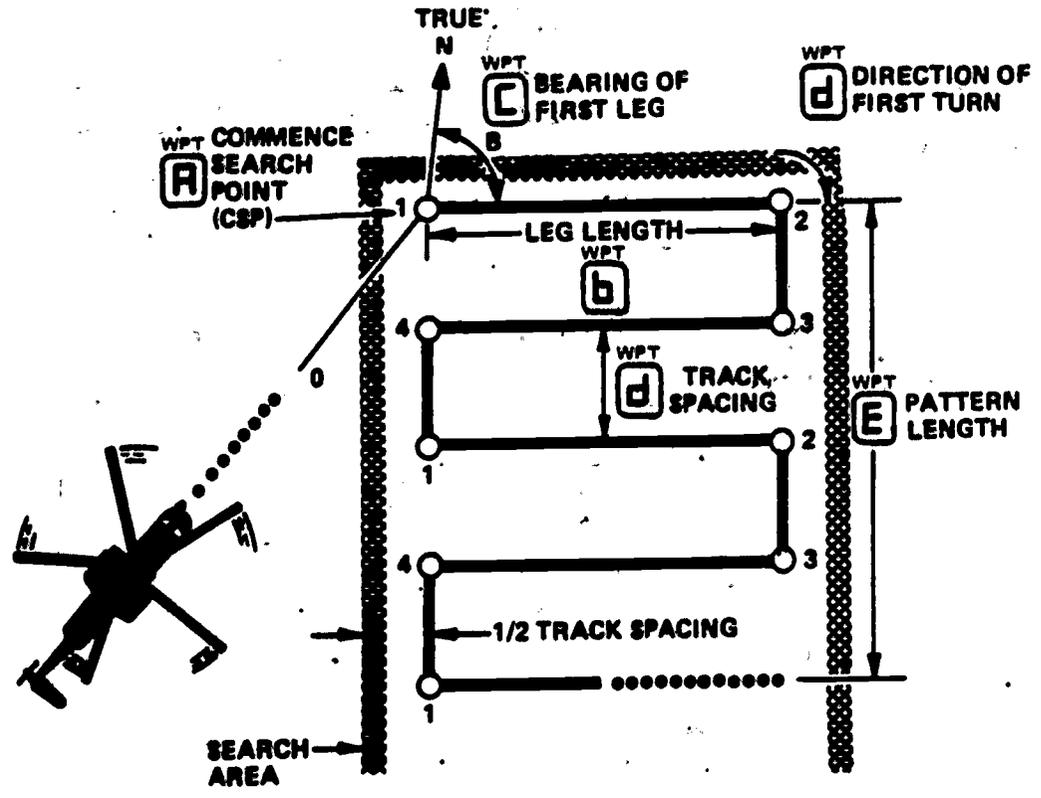


Figure 9-11. - Creeping line search.

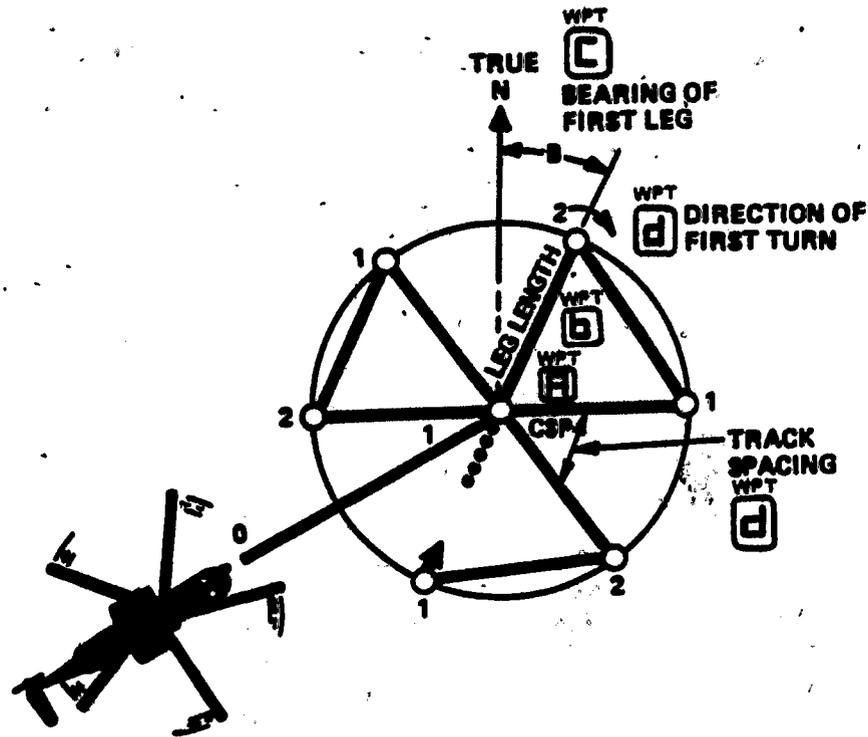


Figure 9-12. - Sector Search.

Enter Leg Length

1. Depress CLR key. Displays should blank.
2. Enter length of search leg in nautical miles and tenths (0.1-99.9). For VS patterns, this is the circle radius. This number should appear in lower display.
3. Depress INSERT. Cue letter C should appear in WPT display. Last entered bearing for first leg should appear in upper display.

Enter Bearing of First Leg

1. Depress CLR key. Displays should blank.
2. Enter into keyboard bearing of first leg in degrees. This number should appear in lower display.
3. Depress INSERT. Cue letter d should appear in WPT display. Last entered direction of first turn should be indicated on L or R indicator. Last entered track spacing should appear in upper display.

Enter Direction of First Turn, and Track Spacing

1. Depress CLR key. Displays should blank.
2. Depress L or R key to select left or right direction of first turn. Appropriate L or R indicator should illuminate.
3. Enter desired track spacing into keyboard (0.1-99.9). For VS patterns, this is measured at the half-radius points. This number should appear in lower display.
4. Depress INSERT. R or L indicator should extinguish. Cue letter E should appear in WPT display. Last entered pattern length for CS pattern, if any, should appear in upper display, cueing next CS entry. Disregard this cue for VS patterns.
5. For VS patterns, depress INSERT again. VS indicator should extinguish signifying VS search pattern entry sequence is complete.

Enter Pattern Length for CS Patterns

1. Depress CLR key. Displays should blank.
2. Enter into keyboard CS pattern length in nautical miles (1 through 99). This number should appear in lower display.
3. Depress INSERT. Number should disappear from lower display. CS indicator should extinguish signifying CS search pattern entry sequence is complete.

EXAMPLE OF CS PATTERN ENTRY (Refer to figure 9-13).

CSP is at waypoint 1.

Leg length is 5.5 nautical miles.

Bearing of first leg is 43° TRUE.

Direction of first turn is right; track spacing is 0.8 nautical miles.

Pattern length is 12 nautical miles.

Search Pattern Readout

Use this procedure to display search patterns previously entered into the navigator.

1. MODE switch to OPERATE. DISPLAY switch to SF/PRL TK. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH again. Cue letter A should appear in WPT display. Waypoint previously entered as Commence Search Waypoint should appear in upper display.

2. Depress INSERT to obtain next cue letter and associated search pattern data. Continue depressing INSERT until desired data is obtained.

3. Continue depressing INSERT until VS or CS indicator extinguishes.

Search Pattern Modification

Use this procedure to modify any portion of an existing search pattern.

1. MODE switch to OPERATE. DISPLAY switch to SF/PRL TK. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH again. Cue letter A should appear in WPT display. Waypoint previously entered as Commence Search Waypoint should appear in upper display.

2. If Commence Search Waypoint number is to be changed, proceed as follows:

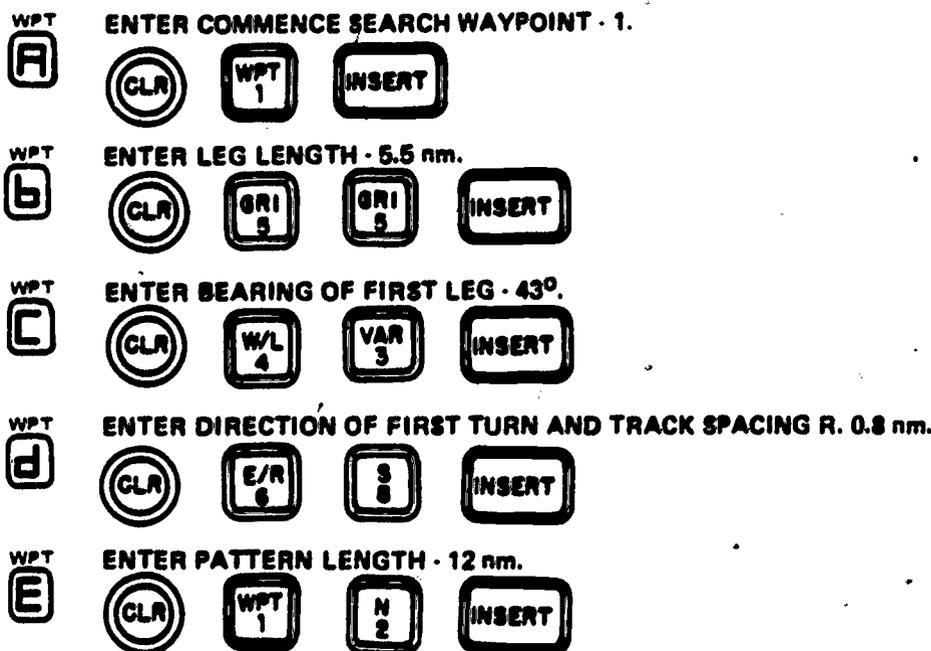


Figure 9-13. - CS Pattern Entry.

a. Depress CLR key. Displays should blank.

b. Enter into keyboard new commence search waypoint number. This number should appear in lower display.

c. Depress INSERT. Cue letter b should appear in WPT display, cuing next entry.

d. If any other pattern data is to be changed, depress INSERT until desired cue letter appears in WPT display. Enter new data as though making an original entry, using CS or VS search pattern input procedure.

3. If no other change is to be made in the pattern, continue depressing INSERT until the last cue (E) is removed and CS or VS indicator is extinguished.

SELF-QUIZ #9

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. When turning the ARN-133 on, you should pause in the INITIALIZE position to prevent _____

- A. power fluctuations
- B. transmitting a false emergency signal
- C. freeze-up of the navigator
- D. signal time warp

2. Self test (BITE) tests all the primary functions of the _____

- A. navigator
- B. antenna
- C. antenna coupler
- D. antenna cable

3. GRI is the abbreviation for _____

- A. ground reflection inversion
- B. group repetition interval
- C. ground speed insertion
- D. intermediate gain regulation

4. When changing from one GBI to another during flight you should _____

- A. turn the mode switch to pwr off and back to operate
- B. wait ten minutes for the signal to track properly
- C. make no more than four attempts to select a secondary pair
- D. wait till the warn indicator is extinguished

5. The LORAN C Navigator tracks up to _____ secondary pairs.

- A. one
- B. two
- C. three
- D. four

6. In order to display, enter, or modify a waypoint, the display switch should be in the _____ position.

- A. POSITION
- B. WAY PT
- C. DSR/TK
- D. FF/VAR

7. Before entering the latitude of a waypoint located in Cleveland, Ohio the _____ key should be pushed.

- A. N
- B. S
- C. E/R
- D. W/L

8. While entering a CS search pattern, the cue letter b appears in the WPT display. You should enter _____

- A. leg length
- B. bearing of first leg
- C. direction of first turn
- D. track spacing

9. After depressing INSERT key, the cue letter C appears. If you have no changes to the information already entered, you should depress the _____ key.

- A. CLR
- B. SEARCH
- C. INSERT
- D. DISPLAY HOLD



ANSWERS TO SELF-QUIZ #9

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	9-3
2	A	9-9
3	B	9-10
4	D	9-10
5	D	9-11
6	B	9-3
7	A	9-14
8	A	9-15
9	C	9-15

HH-3F LORAN C NAVIGATOR (cont)

Reading Assignment:
Pages 10-1 through 10-17.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Explain the preflight procedures of the navigator.
2. Explain the inflight procedures of the navigator.

LORAN C NAVIGATOR AN/ARN-133 (cont)

NAVIGATOR PREFLIGHT
NOTE

The following procedures are the minimum that should be accomplished by the copilot prior to takeoff when cockpit workload permits.

Procedures

1. MODE switch - Initialize.
2. DISPLAY switch - Position. Check/Insert lat/long of present position.
3. DISPLAY switch - TK/TKE. Check/Insert Loran C GRI and secondary pair selection. It is recommended that each unit establish a policy of inserting a standard Loran GRI and secondary pair for their home unit.
4. DISPLAY switch - FF/VAR - Check/Insert correct present position variation. It is recommended that each unit establish a policy of inserting a standard variation for their home unit.
5. DISPLAY switch - WAY PT. Depress CLR, WPT, 1, INSERT. Check/Insert lat/long of WPT 1. It is recommended that each unit establish a policy of always utilizing the lat/long of their home unit in position 1. If some other lat/long and variation are utilized in 1 during flight, the preflight lat/long and variation should be entered in 1 before the aircraft is secured.

6. Taxi clear of large buildings, hangars, or other obstacles.

WARNING

Loran C signal distortion may cause erroneous lock-ons near large metal objects.

7. MODE switch - OPERATE.
8. When WARN light extinguishes DISPLAY switch - POSITION.
9. Depress LORAN COORD key. TD indicator should illuminate. Check displayed TDA and TDB. Displayed information should be within 4.50 microseconds of that predetermined for the selected geographic location, GRI and specific secondary pair. Differences in excess of 4.50 microseconds indicate probable erroneous lockon. Reacquisition should be considered.
10. Depress LORAN COORD key - TD light should extinguish. Check displayed lat/long. Displayed information should be within 0.25 minutes of the lat/long represented by the TDA and TDB displayed in step 9. If differences in excess of 0.25 minutes are observed the Navigator is not converting TD's to lat/long correctly and should not be used for navigation. Perform the self test (BITE) to confirm Navigator performance.
11. Compare the displayed lat/long in step 10 to the predetermined lat/long for the selected geographic location. If not within 0.25 minutes of that predetermined lat/long perform update procedures.

NOTE

Regardless of error, correct position updating against a known geographical reference with known good LORAN-C reception will always provide more accurate navigation information.

INFLIGHT PROCEDURES**Leg Change Entry**

Use the following procedure to define or redefine a flight leg, in either AUTO or MANUAL modes.

1. Set MODE switch to OPERATE.
2. Depress CLR Key. Displays should blank.
3. Depress LEG CHG key.
4. Enter into the keyboard the numbers of the new FROM waypoint and the number of the new TO waypoint, in that order. The new waypoints should appear in the lower display.
5. Depress INSERT. New waypoints should jump to the FR TO display. The WARN indicator will illuminate momentarily while the Navigator is calculating data for the new leg.

NOTE

If 0 was selected as the from waypoint, it will automatically become the present position displayed at the time the INSERT switch was depressed.

6. To advance to the next consecutive leg, depress CLR, LEG CHG, and INSERT. The next leg in numerical sequence should appear in the leg display.

Interwaypoint Range and Bearing

The navigator calculates distance and bearing from the designated FROM waypoint to the designated TO waypoint and displays this data for ten seconds. These computations are performed in lat/long, thus prohibiting interwaypoint range and bearing information for waypoints when either or both are stored in time differences. This is a remote function and does not affect navigation. Use the following procedure to obtain range and bearing from aircraft present position to any waypoint or from any waypoint to any other waypoint.

1. Verify that MODE switch is set to OPERATE. Set DISPLAY switch to DIST/BRG.

2. Depress CLR key. Displays should blank.

3. Depress WPT key.

4. Enter into keyboard the FROM and TO waypoints for which the range and bearing are desired. If range and bearing from aircraft present position to a waypoint are desired, enter 0 and the waypoint number. Numbers should appear in lower display.

5. Depress INSERT. Upper display should show distance; lower display should show bearing. The FROM TO waypoint numbers should appear in the FROM TO readout of the lower display. After ten seconds displays should revert to normal DIST/BRG display. If required longer, depress DISPLAY HOLD.

Converting Present Position Into A Waypoint

Present position can be frozen by depressing DISPLAY HOLD and then transferred to any waypoint by using the waypoint call up procedure. As many as nine points may be stored for reporting, etc. Use of this function does not interrupt normal navigational information to other waypoints.

1. Verify that MODE switch is set to OPERATE. DISPLAY switch may be in any position.

2. Select type of coordinates desired to store the present position, if time differences, depress LORAN COORD to illuminate the TD indicator; if lat/long, TD indicator must be extinguished.

3. When directly over the position, depress and release DISPLAY HOLD pushbutton. HOLD indicator should illuminate, aircraft present position is stored, and the displays are frozen.

4. Depress CLR key. Displays should blank.

5. Depress WPT key.

6. Enter into keyboard the number of the waypoint into which the desired position is to be stored. The selected waypoint number should appear in the lower display.

7. Depress INSERT. Stored values of the held position (whether lat/long or TD) become coordinates for the selected waypoint. HOLD indicator should extinguish and displays revert back to normal.

Position Updating

Position may be updated at any time. It is possible to compensate for propagation anomalies or map error by using position fixes of known accuracy. This is accomplished by entering the known fix in either TD's or lat/long, or by using coordinates previously stored in a waypoint. When the POS update function has been selected and the calibration coordinates have been entered, the INSERT key is depressed when directly over the selected calibration point (figure 10-1). At the instant of switch depression, the coordinates of that present position are measured and compared with the stored coordinates of the calibration point. The difference between the two positions is then used as a correction factor. The correction will be applied to all subsequent measurements until changed, deleted, or a change of secondaries is made. Normal data display is resumed with the proper correction added.

NOTE

Ensure the system is in track and stabilized by verifying that the WARN indicator is extinguished and the CS is settled before doing a POS update. This will ensure that the measured TD's have stabilized.

Time Difference Position Update

Use the following procedure to update system position against a known calibration point using manually entered time differences.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Verify that system is in track (WARN indicator extinguished). To observe the update, verify that TD indicator is illuminated.
2. Depress CLR key. Displays should blank.
3. Depress POS key for position update.
4. Depress TDA key to select time difference A.
5. Enter into keyboard seven digits representing time difference A to hundredths of microseconds. Numbers should appear in upper display.
6. Depress INSERT.
7. Depress TDB key to select time difference B.

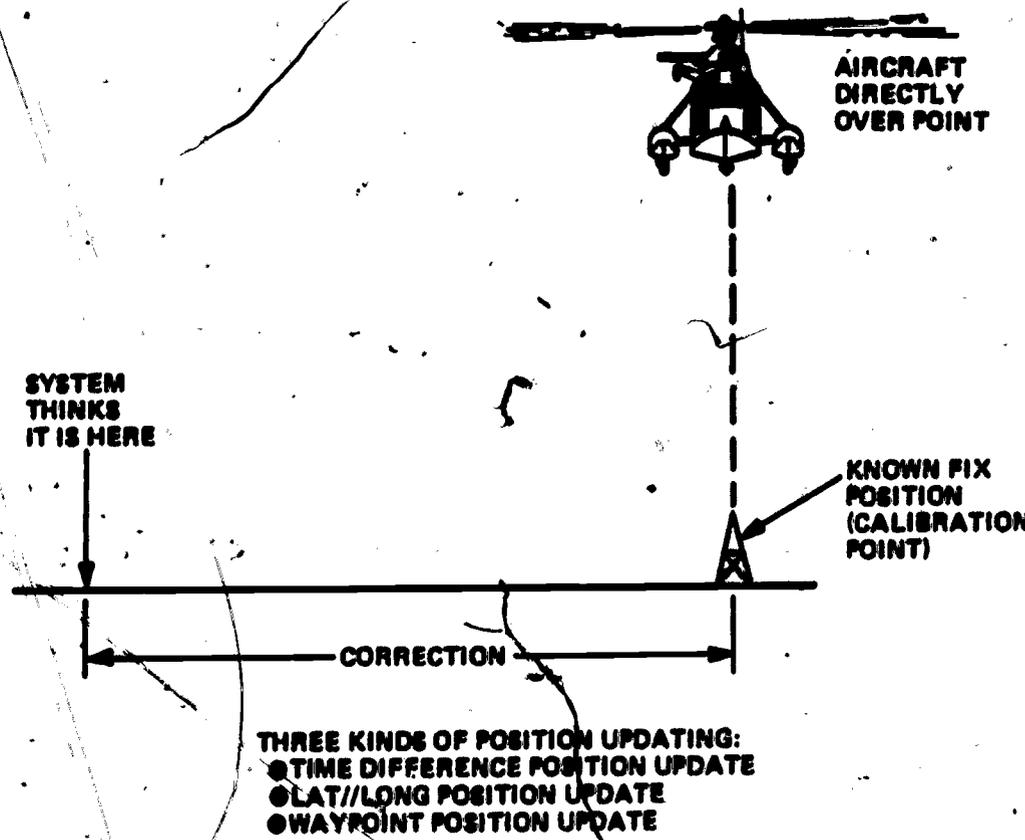


Figure 10-1. - Position Updating.

8. Enter into keyboard seven digits representing time difference B to hundredths of microseconds. Numbers should appear in lower display.

9. Depress INSERT key when directly over calibration point. Displays should return to normal. POS UPD indicator should illuminate, indicating correction factor is active.

10. To clear POS update, depress CLR, POS, and INSERT. POS UPD indicator should extinguish indicating correction is removed.

Lat/Long Position Update

Use the following procedure to update system position against a known calibration point using manually entered latitude and longitude coordinates.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Verify that system is in track (WARN indicator extinguished). To observe the update ensure that TD indicator is extinguished.

2. Depress CLR key. Displays should blank.

3. Depress POS key for position update.

4. Depress N (or S) latitude key. N (or S) indicator should illuminate.

5. Enter latitude into keyboard. Numbers should appear in upper display.

6. Depress INSERT.

7. Depress W (or E) longitude key. W (or E) indicator should illuminate.

8. Enter longitude into keyboard. Number should appear in lower display.

9. Depress INSERT key when directly over calibration point. Displays should return to normal. POS UPD indicator should illuminate, indicating correction factor is active.

10. To clear POS update, depress CLR, POS, and INSERT. POS UPD indicator should extinguish, indicating correction is removed.

Waypoint Position Update

Use the following procedure to update system position against a known calibration point using coordinates stored in a waypoint. Coordinates stored

in the selected waypoint in either TD's or lat/long become the corrected position.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Verify the navigator is in track (WARN indicator extinguished).

2. Depress CLR key. Displays should blank.

3. Depress POS key for position update.

4. Depress WPT key for waypoint position update.

5. Enter into keyboard the waypoint number in which the coordinates have been stored for the calibration point. Selected waypoint number should appear in lower display.

6. Depress INSERT key when directly over calibration point. Displays return to normal. POS UPD indicator should illuminate, indicating correction factor is active.

7. To clear POS update, depress CLR, POS, and INSERT. POS UPD indicator should extinguish, indicating correction is removed.

Magnetic Variation Entry

Use the following procedure to enter or update the angle of magnetic variation. The TRUE indicator is illuminated when there is no magnetic variation inserted in the navigator.

1. MODE switch to INITIALIZE or OPERATE. To observe, set DISPLAY switch to FF/VAR. Magnetic variation may be entered in any position.

2. Depress CLR key. Displays should blank.

3. Depress VAR key.

4. Depress E (or W) key to select direction of variation. E (or W) indicator should illuminate.

5. Enter correct magnetic variation into keyboard to the nearest degree. Number should appear in upper display.

6. Depress INSERT. New variation is accepted and displays return to normal.

7. To clear the system of any magnetic variation, depress CLR, VAR, and INSERT. TRUE

indicator should illuminate, indicating bearing and course angle are with respect to true north.

8. To check entry, set DISPLAY switch to FF/VAR. New variation and direction should appear in lower display.

NOTE

Magnetic variation must be updated in 1° increments during flight progression for accurate navigation.

Parallel Track Navigation

Parallel track navigation facilitates flying parallel to a given course at a selected distance from it. The offset distance may be from 0.1 to 99.9 nautical miles. A series of such offset legs may be flown as determined by the number of waypoints entered in the system. Distance may be changed in mid-leg. The navigator completes this by projecting an artificial destination based on the nominal course coordinates and the offset distance entered. Figure 10-2 illustrates that in order for the navigator to compute the artificial destination 3', the coordinates of waypoints 2, 3, and 4 plus the offset distance, D, are necessary.

In manual mode, and in automatic when no subsequent waypoint coordinates have been entered, the offset destination is projected perpendicularly to the nominal course. In automatic mode, the offset destination is projected on the bisector of an angle between consecutive legs. Once the offset distance

is entered, all navigation data is calculated with reference to the artificial destination. Original waypoint defined course is not lost, but held in storage until parallel track navigation is deselected. The following limitations apply.

- 1. Use of parallel track navigation at latitudes approaching the poles ($\pm 80^\circ$ or more), is unreliable.
- 2. Since parallel track computations are performed in lat/long coordinates, use of parallel track navigation while a waypoint is stored as a TD pair is not possible.
- 3. Waypoint course should not contain any 180° turns.

Use the following procedure to obtain parallel track navigation:

- 1. MODE switch to OPERATE. To observe entry, set DISPLAY switch to SF/PRL TK.
- 2. Depress CLR key. Displays should blank.
- 3. Depress PRL TRACK key.
- 4. Depress L or R key to select either left or right of nominal course. L or R indicator should illuminate.
- 5. Enter into keyboard the desired offset distance to tenths of a nautical mile. (0.1 through 99.9 nautical miles). Selected offset distance should appear in lower display.

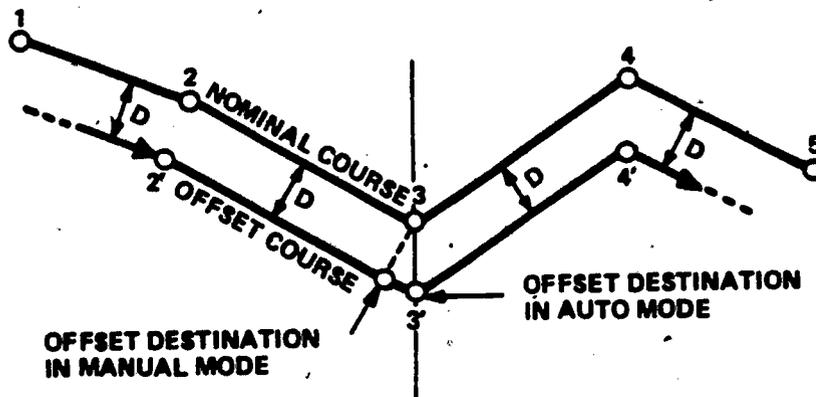


Figure 10-2. - Parallel Track Navigation.

6. Depress INSERT. PRL TRACK indicator should illuminate and displays should revert to selected function. Navigation is for the offset track.

7. To deselect parallel track navigation, depress CLR, PRL TRACK, and INSERT. PRL TRACK indicator should extinguish. Navigation should revert to normal.

Search Operation Using Prestored Patterns

Once any search pattern has been stored it may be called up and used in flight. The following procedures describe how to commence search on a prestored pattern, perform an optional manual leg advance during search, depart from and resume search, and terminate search.

NOTE

Prior to commencing a search, time should be allowed for the navigator to settle after initial lock-on. Correct (± 10 knots) ground-speed is indicative that settling has occurred. Failure to allow the equipment to stabilize, prior to assigning it a navigation task, will result in a non-convergence, possible lat-long runaway and memory saturation accompanied by loss of track and/or navigator.

Commence Search Pattern

To commence search use the following procedure.

1. MODE switch to OPERATE position. To observe, set DISPLAY switch to SF/PRL TK.
2. Depress CLR key. Displays should blank.
3. Depress LEG CHG key to initiate leg change.
4. Enter into the keyboard the single digit representing the approach leg FROM point. This is usually 0, representing aircraft present position. The TO point is the waypoint previously specified during search pattern storage as the Commence Search Point and need not be entered. Number should appear in lower display.
5. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH again: VS indicator should illuminate.

6. Depress INSERT. Leg display should show leg selected in step 4. AUTO MAN indication is set

to AUTO. Upper display left-most three digits show number of legs to be flown in the search pattern; right-most three digits show number of legs completed. Lower display shows direction of next turn and course of next search leg. To manually advance legs while flying a search pattern, depress CLR, LEG CHG, and INSERT. Each time this is accomplished, the Navigator will advance navigation to the next leg and change the displays accordingly.

A commence search pattern example is illustrated in figure 10-3.

Depart from Search Pattern, Return, and Resume Search

To leave the scheduled search pattern and investigate a target, and then return to the point of departure to take up search where it was left off, use the following procedure:

1. During search, depress SEARCH key at the point where the pattern is departed. The active CS or VS indicator should flash on and off. The leg display should blank. The Navigator stores the aircraft position at the time of switch depression.
2. To resume the search pattern at the departure point depress SEARCH again. Active CS or VS indicator stops blinking and remains illuminated. Leg display shows OE (E signifying point or exit), and navigation is not provided from present position to point where the search pattern was left (step 1). Search pattern resumes where it left off.

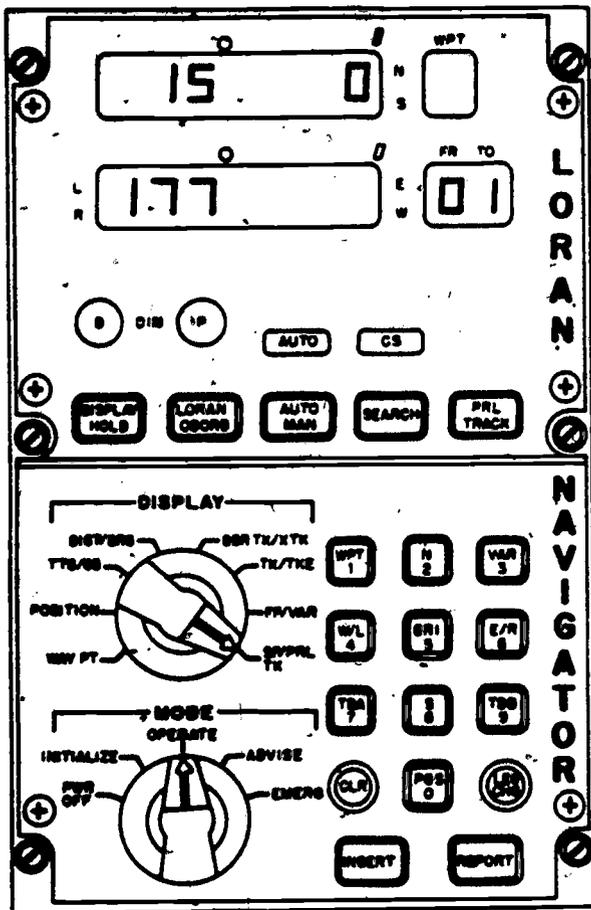
Terminating Search

Use the following procedure to terminate the stored search pattern.

1. Depress CLR key. Displays should blank.
2. Depress SEARCH key. Active search indicator should blink.
3. Depress INSERT. Leg display is blanked.

NOTE

Initiating a standard leg change will also terminate search and activate navigation to the designated waypoint.



EXAMPLE:

COMMENCE SEARCH ON PRESTORED CS PATTERN USING WAYPOINT 1 AS STARTING WAYPOINT.

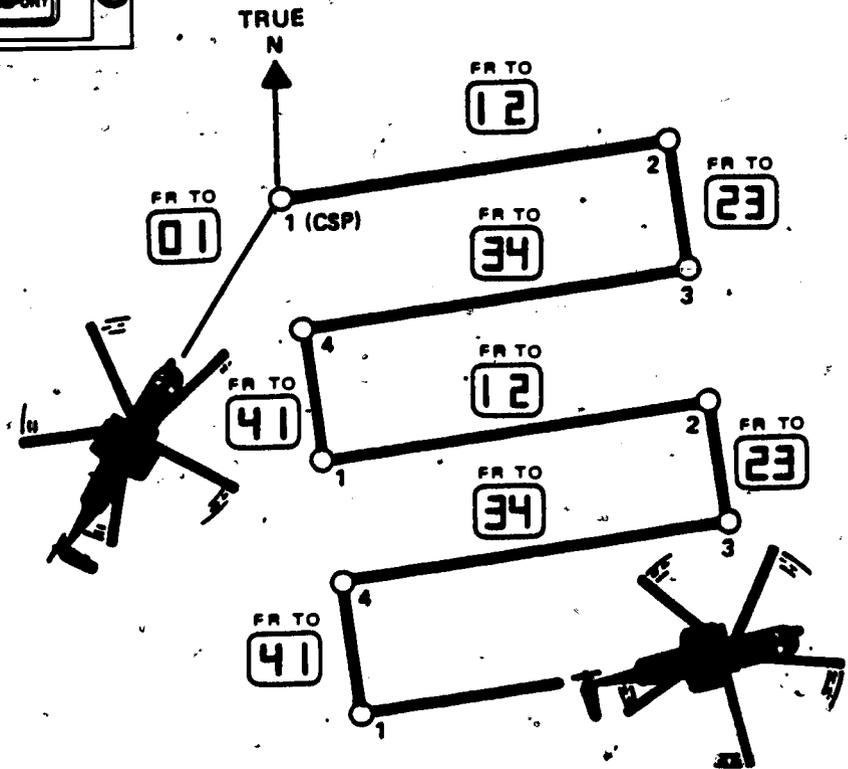


Figure 10-3. - Commence Search Pattern.

Rho-Theta Navigation

The rho-theta navigation function (figure 10-4) calculates the latitude and longitude of a waypoint that lies at a given distance (rho), and bearing (theta) from a given waypoint or present position. This function may be used in two ways:

1. To have the navigator calculate lat/long of the projected point and store it in a specified waypoint for future use.
2. To have the navigator calculate the lat/long of the projected point, store it, and automatically initiate a leg change to provide navigation to that point.

NOTE

The navigator will not accept entries of rho distances over 250 nautical miles.

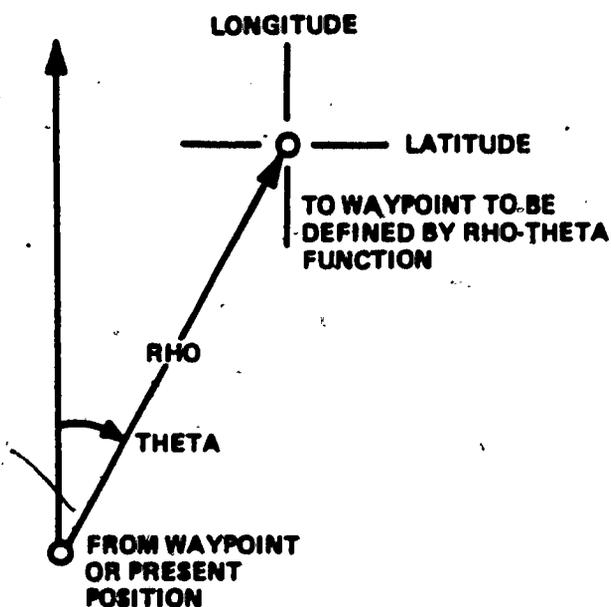


Figure 10-4. - Rho-Theta Navigation.

Use the following procedure to obtain rho-theta navigation.

1. MODE switch to OPERATE and DISPLAY switch to DIST/BRG.
2. Depress CLR key. Displays should blank.
3. Depress WPT and LEG CHG keys to initiate the function.

4. To store the projected point as a waypoint without obtaining navigation to it, enter the single digit of the FROM waypoint from which rho and theta are to be calculated. To obtain navigation information to the projected point, enter 0 for the FROM waypoint. Entering 0 designates present position. Number should appear in lower display.

5. Enter the single digit of the TO waypoint to be defined by the rho-theta function. Number should appear in lower display.

6. Depress INSERT.

7. Enter up to four digits of range (rho) in nautical miles and tenths, up to 250 nautical miles maximum. Range should appear in upper display.

8. Depress INSERT.

9. Enter up to three digits of bearing (theta) in degrees. Bearing should appear in lower display.

10. Depress INSERT. The navigator will calculate the lat/long of the projected point and store this in the selected TO waypoint. If a FROM waypoint of 0 was entered, a leg change will be automatically initiated and navigation to the calculated point will be provided. DIST/BRG will be displayed.

SPECIAL PROCEDURES

Master Independence

NOTE

Master independent operation is not obtainable when using a manually stored chain for navigation.

The AN/ARN-133 is designed to operate without the master Loran signal when at least three secondaries are available and can be adequately received. This allows operation in cases where the master signal is not initially receivable or is lost after navigation has begun. In such cases, the Navigator designates a secondary as master and new LOP's are calculated. When the master signal becomes receivable again, it is picked up and treated as another secondary. This feature operates automatically without operator action, but may be overridden (master independence override). The ADVISE indicator illuminates when master independence is enabled. And when the MODE switch is set to ADVISE and the DISPLAY switch to DIST/BRG, the right-most digit in the lower display indicates which secondary is designated as the master. When this digit is 0, the

navigator has the real master and is operating normally: when this digit is 1, 2, 3, or 4, it identifies which secondary is being used as the master. With the DISPLAY switch at DSR TK/XTK, a "1" in the "No Master" digit of the upper display (middle digit) indicates the Navigator does not have a master. This may also indicate master independence, but not decisively. When master independence is operative, the position update function (POS UPD) is inoperative as the position update capability is based on the real master-referenced system. Master independence also disables the automatic secondary change advise function.

Master Independence Override

To override master independence (deactivate the function) in cases where it is known the navigator will take longer than usual to find the master, use the following procedure:

1. Set MODE switch to ADVISE and DISPLAY switch to DSR TK/XTK.
2. Depress CLR key. Displays should blank.
3. Depress 4 key to identify master override function.
4. Enter number 8 into keyboard. 8 should appear in lower display (and in proper ADVISE work digit), indicating override.
5. Depress INSERT. Displays should return to normal: master independent override is in effect.

To remove master independence override (allow master independence operation), use the following procedure:

1. MODE switch to ADVISE and DISPLAY switch to DSR TK/XTK.
2. Depress CLR key. Displays should blank.
3. Depress 4 key to identify master override function.
4. Enter number 0 into keyboard. 0 should appear in lower display (and in proper ADVISE work digit), indicating normal operation of master independence.
5. Depress INSERT. Displays should return to normal: master independence operation is not permitted to function normally.

Loran Cycle Jump

This procedure permits changing the cycle being tracked by the navigator. The tracking point can be moved either one cycle ahead or behind the cycle currently being tracked. This should be done when the navigator locks on 10 usecs off.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Depress LORAN COORD switch as necessary so TD indicator illuminates.

2. Depress CLR key. Displays should blank.

3. Depress GRI key.

4. To move the master tracking point, proceed to step five. To move the A secondary, depress TDA key; to move the B secondary, depress TDB key. N and S indicators should illuminate with TDA selection; E and W indicators should illuminate for TDB selection.

5. If jump is to be made to the left (-), depress L key; if jump is to be made to the right (+), depress R key. Appropriate L or R indicator should illuminate.

6. Depress INSERT. For secondary A or B (-) jumps, the time difference should decrease by ten microseconds. For (+) jumps, the time difference should increase by ten microseconds. For master jumps, the shift will be + or - five microseconds, but there is no visible display indication of this.

Manual Chain Storage

The AN/ARN-133 stores the required data for 14 LORAN chains. All of these, plus the 5100 BITE chain used for self test, are permanently stored in memory and can be selected by using the GRI selection procedure. The navigator allows for manual storage of one additional chain, providing versatility for storing every aspect of any LORAN C or D chain. As a guide through the storage procedure, step numbers appear in the FR-TO display, and sub-step numbers appear when applicable in the lower display. In addition, data from any previously stored manual chain appears in upper and lower displays, cueing the type of entry to be made. To correct errors after any INSERT, it is necessary to display the step number in which the mistake was made. To accomplish this, either move the MODE switch out of INITIALIZE momentarily and then back, resetting the step to 01, or depress INSERT as necessary to step to the end of the cue sequence and back to the



desired step. To correct data entered in any step, reenter the correct data over the incorrect.

Use the manual chain storage procedure for any chain not listed in figure 10-7.

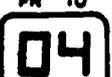
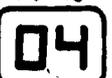
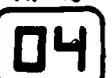
MANUAL CHAIN STORAGE PROCEDURE

Display Counters	Operator Action	System Response
	<ol style="list-style-type: none"> 1. Set MODE switch to INITIALIZE and DISPLAY switch to SF/PRL TK. 	Upper display shows previous manual chain GRI. FR TO counter is set to 01.
 <p>FR TO 01</p> <p>Enter GRI</p>	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Enter into keyboard seven-digit GRI, using zeros if necessary. Enter only in increments of 2.5 microseconds, entering a trailing zero after the sixth digit. 3. Depress INSERT. <p>Note: The TDL-424 will only track real-world GRI's in increments of 2.5 microseconds (far greater resolution than required for any foreseeable chain), even though any GRI number can be entered.</p>	<p>Displays should blank.</p> <p>GRI should appear in upper display.</p> <p>FR TO counter advances to 02; previous number of secondaries should appear in upper display.</p>
 <p>FR TO 02</p> <p>Specify no. of secondaries</p>	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Enter 2, 3, or 4, specifying number of secondaries in chain. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Number appears in upper display.</p> <p>Counter advances to 03. Previous Loran C or D selection is displayed.</p>
 <p>FR TO 03</p> <p>Specify Loran C or D</p>	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Enter 1 or 2, specifying Loran C or D. 1 = C; 2 = D. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Number appears in upper display.</p> <p>Counter advances to 04. Previous phase code type is displayed.</p>

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
<p>FR TO</p>  <p>Specify type of phase code</p>	<ol style="list-style-type: none"> Depress CLR key. Enter N or S, specifying new or standard phase code. (For definition of standard phase code, see new phase code preparation procedure.) <p style="text-align: center;">NOTE</p> <p>All active Coast Guard Loran C chains use standard phase coding.</p> <ol style="list-style-type: none"> Depress INSERT. <p>If standard phase code (S) was selected, proceed to 05 instruction, below.</p>	<p>Displays should blank.</p> <p>Appropriate N or S indicator should light.</p> <p>If S was selected counter advances to 05. If N was selected, counter remains at 04 and lower display reads 01, indicating substep; previous phase code value is displayed.</p>
 <p>FR TO</p>  <p>Master interval A</p>	<ol style="list-style-type: none"> Depress CLR key. Enter six-digit octal phase code for master, interval A. (Obtain this and subsequent numbers by performing new phase code preparation procedure.) Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 02. Previous master interval B code is displayed.</p>
 <p>FR TO</p>  <p>Master interval B</p>	<ol style="list-style-type: none"> Depress CLR key. Enter six-digit octal phase code for master, interval B. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 03. Previous master interval C code is displayed.</p>
 <p>FR TO</p>  <p>Master interval C</p>	<ol style="list-style-type: none"> Depress CLR Key. Enter six-digit octal phase code for master interval C. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 04. Previous master interval D code is displayed.</p>

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
 FR TO  Master interval D	<ol style="list-style-type: none"> 1. Depress CLR. 2. Enter six-digit octal phase code for master interval D. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 05. Previous secondary 1 interval A code is displayed.</p>
 FR TO  Secondary 1, interval A	<ol style="list-style-type: none"> 1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval A. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 06. Previous secondary 1 interval B code is displayed.</p>
 FR TO  Secondary 1, interval B	<ol style="list-style-type: none"> 1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval B. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 07. Previous secondary 1 interval C code is displayed.</p>
 FR TO  Secondary 1, interval C	<ol style="list-style-type: none"> 1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval C. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 08. Previous secondary 1 interval D code is displayed.</p>
 FR TO  Secondary 1, interval D	<ol style="list-style-type: none"> 1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval D. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 09. Previous secondary 2 interval A code is displayed.</p>
 FR TO  Secondary 2, interval A	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Enter six-digit octal phase code for secondary 2 interval A. 3. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 10. Previous secondary 2 interval B code is displayed.</p>

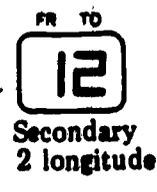
MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
  Secondary 2, interval B	<ol style="list-style-type: none"> Depress CLR key. Enter six-digit octal phase code for secondary 2, interval B. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 11. Previous secondary 2 interval C code is displayed.</p>
  Secondary 2, interval C	<ol style="list-style-type: none"> Depress CLR key. Enter six-digit octal phase code for secondary 2, interval C. Depress INSERT. 	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>Substep counter advances to 12. Previous secondary 2 interval D code is displayed.</p>
  Secondary 2, interval D	<ol style="list-style-type: none"> Depress CLR key. Enter six-digit octal phase code for secondary 2, interval D. Depress INSERT. <p>Note: Steps 13 through 16 are for entering octal phase codes for intervals A through D of secondary 3. Steps 17 through 20 are for entering octal phase codes for intervals A through D of secondary 4. If a 3 was entered in step 02, perform steps 13 - 16; if a 4 was entered, perform steps 17 - 20.</p>	<p>Displays should blank.</p> <p>Code should appear in upper display.</p> <p>If a 2 was entered in step 02, signifying two secondaries, lower display should blank and FR TO counter should advance to 05 with previous master latitude shown in upper display. If a 3 or 4 was entered in step 02, lower display counter will advance to 13.</p>
 Master latitude	<ol style="list-style-type: none"> Depress CLR key. Depress N or S key to designate latitude of master. Enter latitude of master. Depress INSERT. 	<p>Displays should blank.</p> <p>N or S indicator should light.</p> <p>Latitude should appear in upper display.</p> <p>Counter advances to 06. Previous longitude of master is displayed.</p>

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
FR TO  Master longitude	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Depress E or W key to designate longitude of master. 3. Enter longitude of master. 4. Depress INSERT. 	Displays should blank. E or W indicator should light. Longitude should appear in lower display. Counter advances to 07. Previous secondary 1 emission delay is displayed.
FR TO  Secondary 1 emission delay	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Enter seven-digit emission delay for secondary 1 (coding delay + baseline in microseconds). 3. Depress INSERT. 	Displays should blank. Emission delay should appear in upper display. Counter advances to 08. Previous secondary 1 latitude is displayed.
FR TO  Secondary 1 latitude	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Depress N or S key to designate latitude of secondary 1. 3. Enter six-digit latitude of secondary 1. 4. Depress INSERT. 	Displays should blank. N or S indicator should light. Latitude should appear in upper display. Counter advances to 09. Previous secondary 1 longitude is displayed.
FR TO  Secondary 1 longitude	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Depress E or W key to designate secondary 1 longitude. 3. Enter six or seven-digit longitude for secondary 1. 4. Depress INSERT. 	Displays should blank. E or W indicator should light. Longitude should appear in lower display. Counter advances to 10. Previous secondary 2 emission delay is displayed.
FR TO  Secondary 2 emission delay	<ol style="list-style-type: none"> 1. Depress CLR key. 2. Enter seven-digit emission delay for secondary 2. 3. Depress INSERT. 	Displays should blank. Emission delay should appear in upper display. Counter advances to 11. Previous secondary 2 latitude is displayed.

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
	<ol style="list-style-type: none"> Depress CLR key. Depress N or S key to designate latitude of secondary 2. Enter six-digit secondary 2 latitude. Depress INSERT. 	<p>Displays should blank.</p> <p>N or S indicator should light.</p> <p>Latitude should appear in upper display.</p> <p>Counter advances to 12. Previous secondary 2 longitude is displayed.</p>
	<ol style="list-style-type: none"> Depress CLR key. Depress E or W key to designate secondary 2 longitude. Enter seven-digit longitude of secondary 2, using zeros where applicable. Depress INSERT. <p>Note: Steps 13 - 15 are for secondary 3 emission delay, latitude and longitude; steps 16 - 18 are for secondary 4 emission delay, latitude and longitude. If applicable, perform these steps using same format as for secondaries 1 and 2.</p>	<p>Displays should blank.</p> <p>E or W indicator should light.</p> <p>Longitude should appear in lower display.</p> <p>Counter will reset to 01 if two secondaries were specified, indicating entry is complete. Counter will advance to 13 if three or four secondaries were specified.</p>

NLW PHASE CODE PREPARATION PROCEDURE

Standard phase codes are defined below. If the phase code to be used in manual chain entry deviates from this standard by as much as one bit, it is considered a new (N) phase code, and the following phase code preparation procedure must be followed.

LORAN-C Standard Phase Code

(1 = + or in phase; 0 = - or 180° out of phase)

Time →

- 1 1 0 0 1 0 1 0 Master, interval A (and C)
- 1 0 0 1 1 1 1 1 Master, interval B (and D)
- 1 1 1 1 1 0 0 1 Each secondary interval A (and C)
- 1 0 1 0 1 1 0 0 Each secondary interval B (and D)

LORAN-D Standard Phase Code (Air Force Definition)

Time →

- 1 1 1 1 0 1 0 0 1 1 0 1 1 0 0 1 Master Interval A
- 1 1 0 1 0 1 1 0 1 0 1 0 1 1 1 0 Master Interval B
- 1 0 1 0 0 0 0 1 1 0 0 0 1 1 0 0 Master Interval C
- 1 0 0 0 0 0 1 1 1 1 1 1 1 0 1 1 Master Interval D

- 1 1 1 0 1 1 1 1 1 0 0 1 0 1 1 1 Secondary 1,3,4 Int.A
- 1 0 0 1 1 0 0 0 1 0 1 1 0 1 0 1 Secondary 1,3,4 Int.B
- 1 0 1 1 1 0 1 0 1 1 0 0 0 0 1 0 Secondary 1,3,4 Int.C
- 1 1 0 0 1 1 0 1 1 1 1 0 0 0 0 0 Secondary 1,3,4 Int.D

- 1 1 1 0 1 1 1 1 1 1 0 0 0 0 1 0 Secondary 2 Int. A
- 1 1 0 0 1 1 0 1 1 0 1 1 0 1 0 1 Secondary 2 Int. B
- 1 0 1 1 1 0 1 0 1 0 0 1 0 1 1 1 Secondary 2 Int. C
- 1 0 0 1 1 0 0 0 1 1 1 0 0 0 0 0 Secondary 2 Int. D

EXAMPLE:

PROBLEM: To make secondary 2 phase codes the same as secondary 1, 3, and 4 for LORAN-D. Since this is a deviation from standard, it is necessary to start at the beginning and enter all phase codes. Begin by entering the master codes, even though they do not change.

a. Start by writing down the Master interval A phase code with time flow from left to right:

Time →
1111010011011001

b. Then write the data from right to left:

← Time
1001101100101111

c. Add two leading zeros and group the data bits in groups of three:

001001101100101111

d. Assign a binary value for each bit as shown below. This puts the data in binary coded octal format for entry into the computer.

4	2	1	4	2	1	4	2	1	4	2	1	4	2	1	Binary value
0	0	1	0	0	1	1	0	1	1	0	0	1	0	1	Data

e. Determine the numeric value of each group of three bits as shown below, and write each number below its respective group.

4	2	1	4	2	1	4	2	1	4	2	1	4	2	1	Binary value
0	0	1	0	0	1	1	0	1	1	0	0	1	0	1	Data
1	1	5	4	6	7										Octal value

Example: $4 + 2 + 1 = 7$

f. This six-digit octal number is the octal phase code to be entered in manual chain entry sub-step 01.

01. 115457

g. Repeat this procedure for master interval B as follows:

Time →
1101011010101110.

Reversed:

← Time
0111010101101011

Grouped, two leading zeros added, and converted:

4	2	1	4	2	1	4	2	1	4	2	1	4	2	1	Binary value
0	0	0	1	1	1	0	1	0	1	1	0	1	0	1	Data
0	7	2	5	5	3										Octal value

h. Enter on worksheet for substep 02:

02. 072553

i. Repeat this procedure until all phase codes for the master and each secondary are defined for all four intervals. To complete this example, the numbers to be entered for master interval C and D would be, respectively.

03. 030605 and 04. 157701

j. Calculate all four secondaries (or as many as there are in the chain) in a similar manner. Since, for this example, we are making secondary 2 phase codes the same as secondaries 1, 3, and 4, the four phase code entries would be as follows:

05. 164767 Interval A

09.
13.
17.

06. 126431 Interval B

10.
14.
18.

07. 041535 Interval C

11.
15.
19.



08. 003663 Interval D
12.
16.
20.

Grouped and converted:

4	2	1	4	2	1	4	2	1	4	2	1	4	2	1	Binary value	
0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	Data
0	1	0	4	0	5											Octal value

k. If the new phase codes are for a LORAN-C chain (eight pulses per group instead of 16), the 16 pulse format must still be followed. To do this, insert a zero between each bit of the LORAN-C phase codes, and after reversal, add three leading zeros. This maintains the proper pulse spacing in the computer. As an example, the two master interval phase codes would be calculated as follows:

This data must not be entered for substeps 01 and 03, since the LORAN-C phase codes repeat every two intervals, rather than every four:

01. 010405 03. 010405

Similarly, substeps 02 and 04 would calculate out as follows:

Time →

11001010

Reversed: ←

01010011

10011111

Reversed:

11111001

Zeros added, grouped, and converted:

Inserting zero between bits and adding three leading zeros (as underlined):

000001000100000101

4	2	1	4	2	1	4	2	1	4	2	1	4	2	1	Binary value	
0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1	Data
0	5	2	5	0	1											Octal value

Calculate the secondaries in a similar fashion.

SELF-QUIZ # 10

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

- 1. During preflight, erroneous lockon is indicated by a _____
 - A. TDA 2.50 microseconds different than predetermined selection
 - B. TDB 5.50 microseconds different than a predetermined selection
 - C. flashing CS indicator
 - D. flashing WARN indicator

- 2. The three kinds of position updating are _____
 - A. TIME DIFFERENCE, LAT/LONG, WAYPOINT
 - B. TIME DIFFERENCE, LEG CHG, WAYPOINT
 - C. TIME DIFFERENCE, LEG CHG, LAT/LONG
 - D. WAYPOINT, LEG CHG, LAT/LONG

- 3. Parallel Track Navigation is used to _____
 - A. follow a course previously flown by another aircraft
 - B. fly above the 80° latitude range (North Pole)
 - C. make turns that are greater than 180°
 - D. fly an offset course to that already programmed

- 4. The LORAN C navigator will not accept rho distances over _____ nautical miles.
 - A. 150
 - B. 175
 - C. 200
 - D. 250

- 5. The ARN-133 will operate properly _____
 - A. when no master signal is received by using a secondary station as master
 - B. when only the master signal is received by assuming secondary positions
 - C. when only one secondary station is received and no master by assuming master position
 - D. when, after lockon, all signals are lost, by operating in the memory mode

- 6. The ARN-133 stores data for _____ LORAN chains.
 - A. 10 GRI and 2 manual
 - B. 12 GRI and 4 manual
 - C. 14 GRI and 1 manual
 - D. 16 GRI and 3 manual

- 7. 03 appears in the Display Counters when entering a manual LORAN chain GRI. You enter a 1 to indicate that the GRI is LORAN _____.
 - A. A
 - B. B
 - C. C
 - D. D

- 8. Add two zeros to the front of the LORAN D PHASE CODE 1011101011000010. When converted to actual octal for entry in the manual chain entry substep, this number should read _____.
 - A. 135302
 - B. 146402
 - C. 565410
 - D. 676510



ANSWERS TO SELF-QUIZ #10

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	10-1
2	A	10-3
3	D	10-5
4	D	10-8
5	A	10-8
6	C	10-9
7	C	10-10
8	A	10-16

FLIGHT DIRECTOR SYSTEMS

Reading Assignment:
Pages 11-1 through 11-10.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the AN/AYN-2 system and its components.
2. Summarize the flight director modes of operation.
3. Explain the preflight procedures for the flight director system.

FLIGHT DIRECTOR AN/AYN-2

Each pilot is provided with a complete flight director system (figure 11-1). The flight director system provides an easily interpreted pictorial display of the helicopter navigation situation, and it automatically computes the required action to obtain a desired radio track or heading. The information is displayed continuously, and any system failure is normally indicated by means of flag circuitry. The copilot's flight director requires attitude and azimuth inputs from the AN/ASN-50. The pilot's flight director requires azimuth inputs from the AN/ASN-50 and attitude inputs from the 1080Y vertical gyro.

The flight director is powered by the No. 1 AC primary bus and is protected by three circuit breakers on the copilot's circuit breaker panel. Two of the circuit breakers, under the general heading NO 1 AC PRI FLT DIR and HEADING, are marked PILOT \emptyset B and CO-PILOT \emptyset B respectively. The third circuit breaker is under the general heading NO 1 AC PRI and is marked ATTITUDE CO-PILOT \emptyset B.

Power for the AN/ASN-50 system is supplied from the No. 1 AC primary bus, the DC primary bus, and the two autotransformers that operate from the No. 1 AC primary bus. The system is protected by circuit breakers on the copilot's overhead circuit breaker panel. One circuit breaker, under the general heading No. 1 AC PRI, is marked GYRO COMPASS, the other, under the general heading DC PRI, is marked GYRO COMPASS.

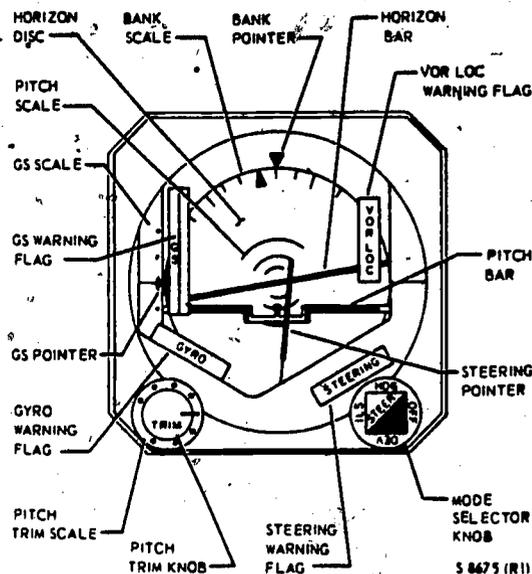


Figure 11-1. - Flight director set AN/AYN-2 attitude indicator.

The flight director system consists of four components: steering computer, attitude indicator, course indicator, and instrument amplifier.

WARNING

If the radio transformer fails and the pilot is using TACAN inputs to the AYN-2, no visual warning will be displayed on the flight director or any other flight instrument to indicate system failure.

STEERING COMPUTER

The steering computer provides the pilot with steering information via the attitude indicator. The steering computer computes a horizontal guidance signal from TACAN/VOR or localizer, heading, error, and bank angle data. The horizontal guidance signal is displayed on the attitude indicator by means of the steering pointer. Necessary corrective measures to the approach, selected heading, and radio path are thus provided to the pilot. A steering warning service is provided by flag circuits.

ATTITUDE INDICATOR

The steering and glide slope pointers of the attitude indicator (figure 11-2) provide guidance in intercepting and following localizer and glide slope beams or for maintaining a selected heading or course. Warning flags indicate any malfunction in the glide slope, localizer, VOR, TACAN, attitude display, or steering signal system. The steering computer horizontal guidance signal is displayed by means of the steering pointer. Precise lateral control may be achieved by maneuvering the helicopter to maintain the steering pointer in the centered position. The glide slope pointer indicates displacement of the helicopter from the glide slope path. The position of the glide slope pointer, relative to the pitch indicator, indicates the flight correction required to achieve a smooth approach. The horizontal and vertical guidance indicators described above are superimposed on an artificial horizon. The artificial horizon consists of pitch and bank indicators and provides continuous monitoring of the flight attitude.

Steering Flag

Depending on the position of the mode selector switch, failure of the A/A24G-39 vertical gyro or directional gyro, remote indicating compass, or radio inputs causes the STEERING flag to be displayed. Loss of steering computer primary power would cause the flag to be displayed regardless of the mode switch position.

Gyro Flag

Failure of the A/A24G-39 vertical gyro driving the copilot's attitude display, or the 1080Y vertical gyro driving the pilot's attitude display, causes the appropriate GYRO flag to appear. Failure of the A/A24G-39 vertical gyro also affects the pilot's and copilot's steering circuitry. Set the mode selector to the DEV position and use the pilot's approach indicator as the primary attitude indicator.

VOR LOC Flag

The VOR LOC flag is in view when the signal from the helicopter TACAN/VOR or localizer receiver is inadequate. The flag will be in view when the receiver is malfunctioning, turned off, or not tuned to a sufficiently strong TACAN, VOR, or localizer frequency.

GS Flag

The GS flag appears when signals from the glide slope receiver are inadequate for driving the glide slope pointer.

Pitch Bar

The pitch bar (A, figure 11-2) represents imaginary wings and moves up and down as helicopter pitch changes. The level flight position of the bar may be changed, for reference during cruise, by rotating the TRIM knob. The pitch bar trim is preset when the mode selector is in the ILS position.

Steering Pointer

Deflections of the steering pointer (B, figure 11-2) are commands to establish a selected course or heading. The pilot always flies the helicopter to bank toward the pointer. Proper bank angle is established when the steering pointer centers. When on course, keeping the steering pointer centered will establish the crab angle required to correct for possible crosswind conditions in the ILS and DEV modes. With the mode switch in DEV position, steering pointer deflections are no longer bank commands. The pointer shows the direction to turn to attain the selected course. Degree of bank is not included in this command since the pointer will center only when the helicopter is actually on the selected course. DEV mode may be used as backup in the event of steering computer failure.

Horizon Bar

As seen by the pilot, the horizon bar (C, figure 11-2) tilts in the same sense the real horizon tilts as helicopter bank changes. A pointer at the top of the attitude indicator and index marks on the horizon disc indicate aircraft bank in graduations of 10, 20, 30 and 45 degrees.

Glide Slope Pointer

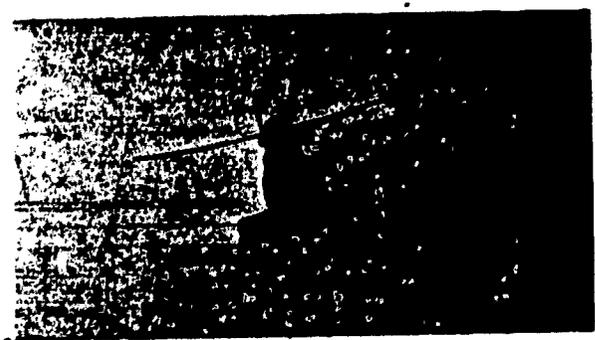
The displacement from the glide path is shown by the glide slope pointer (D, figure 11-2). The glide slope is flown by adjusting power to keep the glide slope pointer and the pitch bar aligned while desired airspeed is maintained.



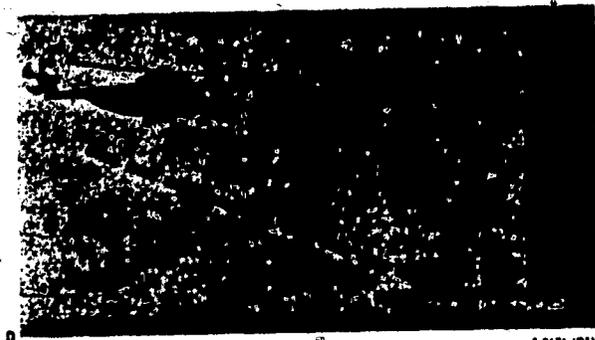
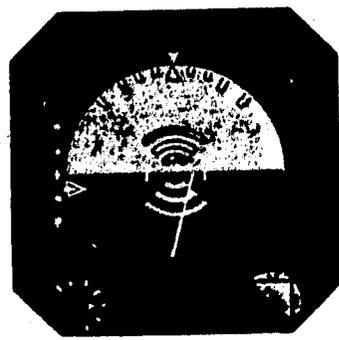
A
PITCH BAR DISPLAY



B
STEERING POINTER



C
HORIZON DISC



D
GLIDE SLOPE POINTER

5 8678 (R1)

Figure 11-2. - Attitude indicator AN/AYN-2.

11-3

COURSE INDICATOR

The course indicator (figure 11-3) displays a pictorial plan view of the helicopter with respect to magnetic north, selected course, and selected heading. Heading, heading deviation, selected heading, selected course, and crab angle are read against a servo-driven azimuth card. The selected TACAN, VOR, and localizer course is displayed pictorially and by means of a digital COURSE counter. A digital distance display is also provided on the course indicator. Meter movements not only display course deviation, to-from indication, and glide slope location, but also operate warning flags. The warning flags monitor heading, display, and radio signals. A stationary symbolic aircraft, located in front of the course deviation pointer, provides the pictorial presentation of helicopter position and heading. The course indicator requires a remote amplifier for the azimuth servo system. Selected course and heading may be set manually.

VOR LOC Flag

See ATTITUDE INDICATOR, VOR LOC Flag.

GS Flag

See ATTITUDE INDICATOR, GS Flag.

HDG Card Flag

A malfunction in the A/A24G-39 system will bring the HDG CARD flag into view. The heading circuits also supply data to the steering pointer circuits. Set the mode selector to the DEV position. The steering pointer will show deviation from the selected course. Readings of all other parts of the displays are correct regardless of the condition of the heading circuitry.

Symbolic Aircraft

The aircraft outline fixed behind the instrument face is symbolic of the helicopter (A, figure 11-4). Moving portions of the course indicator relate to the symbolic aircraft to provide a map-like display of the actual flight situation.

Azimuth Card and Lubber Line

The azimuth card turns as the helicopter turns; the symbolic aircraft is always pointed toward the actual helicopter heading as read on the azimuth card (B, figure 11-4). The helicopter heading may be read accurately under the lubber line at the top of the instrument. A series of index marks are inscribed around the azimuth card for reference at the start of turns.

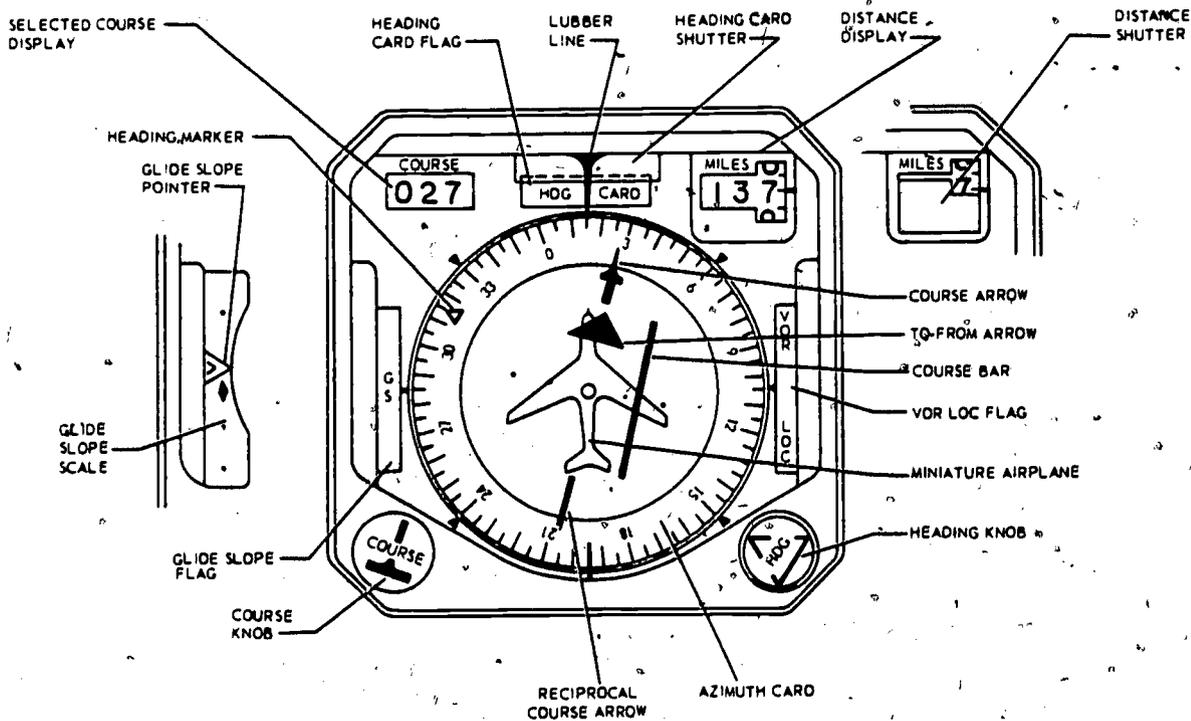
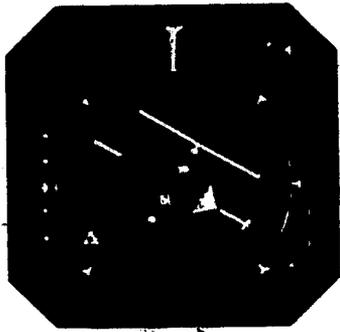
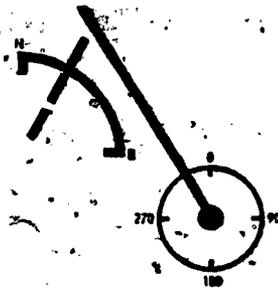


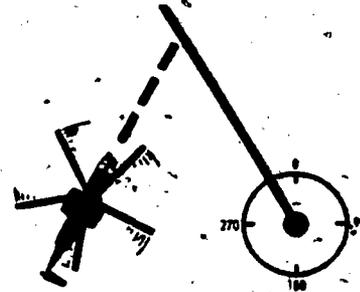
Figure 11-3. - AN/AYN-2 course indicator.



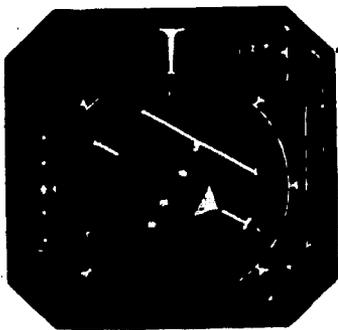
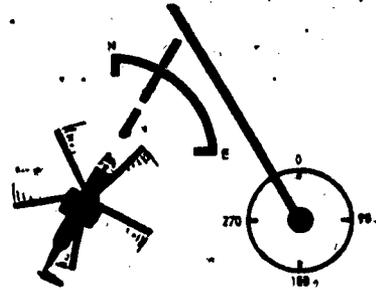
A SYMBOLIC AIRCRAFT



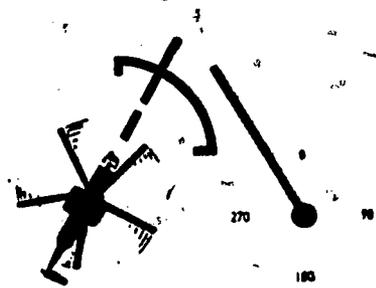
B AZIMUTH CARD AND LUBBER LINE



C COURSE ARROW KNOB AND COUNTER



D COURSE BAR



5 8478 (R1)

Figure 11-4. - Course indicator AN/AYN-2.

Course Arrow, Knob, and Counter

The TACAN/VOR or localizer course is selected by positioning the course arrow (C, figure 11-4). The course arrow is positioned by the COURSE knob. The arrow setting is read against the azimuth card or on the COURSE counter. The course arrow is always set to the inbound localizer front course even if a back course approach is being flown.

VOR-TACAN Selector Switches

A VOR-TACAN selector switch is located in front of each pilot on the instrument panel. The switches select the associated navigation receiver that will supply inputs to the particular pilot's flight director system. The pilot's switch has the marked positions VOR MASTER and TACAN SLAVE. The copilot's switch has marked positions VOR SLAVE and TACAN MASTER. The MASTER/SLAVE marking remind both pilots that only the pilot's course knob controls both flight director system displays when the VOR or localizer receiver is being used. In addition, only the copilot's course knob controls both flight director displays when the TACAN receiver-transmitter is being used.

WARNING

Power failure to the VHF NAV receiver will cause TACAN information to be automatically displayed on the copilot's flight director system regardless of the VOR-TACAN selector switch position.

NOTE

When either the pilot's or copilot's VOR-TACAN selector switch is in the MASTER position, steering pointer information (ILS mode) is valid for that particular flight director. If the VOR-TACAN SELECTOR switch is in the SLAVE position, steering pointer information (ILS mode) will not be valid unless the course selected is the same as that course which has been selected on the course indicator of the pilot who controls the flight director display (MASTER position). If the reciprocal of the course is selected, steering pointer information will be invalid.

NOTE

It is possible for both pilot and copilot to receive DME information via their respective course indicators whenever the TACAN function switch is in the T-R position, regardless of the position of either VOR/TACAN-SELECTOR switch.

Course Bar

The course bar (D, figure 11-4) is symbolic of a segment of the selected TACAN/VOR radial or localizer course. The position of the symbolic aircraft with respect to the course bar is always the same as the position of the pilot's helicopter with respect to the selected course.

To/From Arrow

Ambiguity in omni bearing information is resolved by the to/from arrow (E, figure 11-5). The arrow will indicate the direction TO the station along the course line selected with the course arrow.

Miles Counter

The distance to a VORTAC or TACAN station, measured by the aircraft DME equipment, is displayed by the MILES counter (F, figure 11-5). The distance is read in nautical miles.

Glide Slope Pointer

Both the course indicator and the attitude indicator of the AN/ATN-2 have glide slope pointers (G, figure 11-5).

The glide slope pointer on the course indicator also is useful for quick reference when the aircraft is inbound on the localizer to the outer marker; interception of the glide path is readily seen.

HEADING MARKER

The steering pointer guides the pilot to establish the heading read by the heading marker when the mode selector on the attitude indicator is set to the HDG position (H, figure 11-5). The heading marker is read against the azimuth card and is positioned on the card by rotating the HDG knob.

INSTRUMENT AMPLIFIER

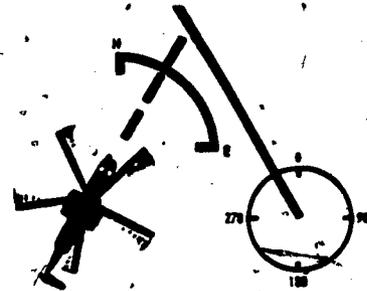
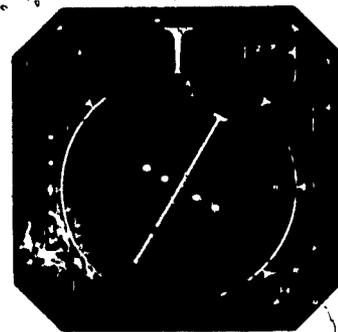
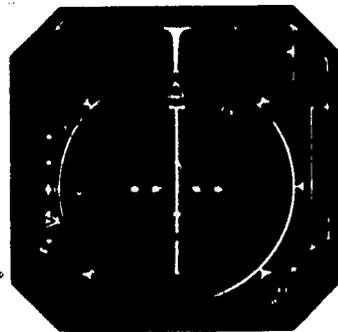
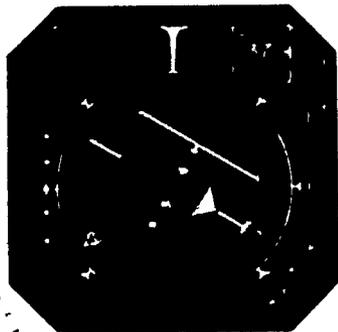
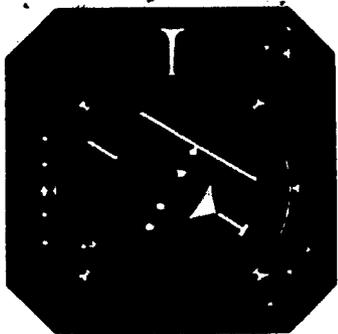
Compass and gyro warning flag circuitry and servo amplifiers for the approach horizon and the course indicator are contained within the instrument amplifier.

FLIGHT DIRECTOR SPECIFICATIONS

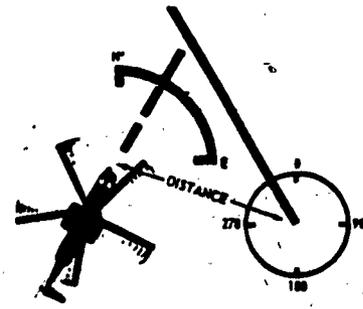
The following ratios have been established for the flight director.

GLIDE SLOPE POINTER

A full scale deflection of the glide slope pointer on the vertical glide slope scale corresponds to an aircraft deviation of 0.5 degree from the glide path.



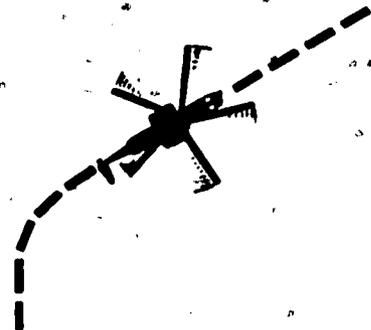
E TO/FROM ARROW



F MILES COUNTER



G GLIDE SLOPE POINTER



H HEADING MARKER

5 8678 (R1)

Figure 11-5.7 - An/AYN-2 course indicator.

PITCH BAR

A one-dot deflection of the pitch bar, measured on the pitch scale, corresponds to an aircraft pitch angle of 5 degrees.

COURSE BAR

When the receiver is tuned to a TACAN/VOR radial, a two-dot deflection of the course bar corresponds to an aircraft deviation of 10 degrees. When the receiver is tuned to a localizer course, a two-dot deflection of the course bar corresponds to an aircraft deviation of 2.5 degrees. The course bar deflection is nonlinear beyond two dots.

HORIZON DISC

The aircraft bank angle divisions on the horizon disc represent 10, 20, 30 and 45 degrees of bank.

PITCH TRIM

One division on the pitch TRIM knob represents five degrees of pitch.

STEERING POINTER

The steering pointer will not direct banks in excess of 15 degrees in any mode.

HDG Mode of Operations

A selected heading error of 10 degrees is equivalent to a bank error of 15 degrees.

ILS (TACAN/VOR And Localizer)**Mode Of Operation**

A bank angle of 2.2 degrees is equivalent to one degree of course datum.

DEV Mode Of Operation

The steering pointer indicates which way to bank in order to intercept or track a selected course.

FLIGHT DIRECTOR MODES**HDG MODE OF OPERATION**

The HDG mode of operation is obtained by setting the attitude indicator mode selector knob to the HDG position. A magnetic heading is selected by rotating the course indicator HDG knob until the heading marker is set to the desired magnetic heading as read on the azimuth card. Helicopter bank attitude, with respect to the horizon, is displayed by the horizon disc. Helicopter magnetic heading is displayed by the position of the azimuth card with respect to the lubber line. Helicopter position, with respect to the selected heading, is given by the

position of the heading marker (representing selected heading) with respect to the lubber line (representing the actual helicopter magnetic heading).

Horizontal guidance steering information is displayed by the steering pointer. The steering pointer deflection indicates the amount and direction of bank required to obtain a selected heading. When the helicopter is banked in the proper direction to center the steering pointer and sufficient rudder is applied for a coordinated turn, a smooth entry will be made into the magnetic heading. Once the helicopter is on the magnetic heading, minor changes in magnetic heading cause the pointer to deflect in the direction which the helicopter must be turned to correct the error.

ILS MODE OF OPERATION

An ILS, TACAN, or VOR mode of operation is obtained by setting the mode selector knob to the ILS position. Align the VOR-TACAN selector switches to desired MASTER/SLAVE positions.

When the navigation receiver is tuned to a localizer frequency, the reference pitch attitude (the pitch attitude required to maintain descent on the glide path) is preset by an adjustment made during test bench adjustments. The pitch bar will be automatically positioned with respect to this reference each time the mode selector knob is set to ILS. The inbound localizer course is obtained by tuning the VOR receiver to the proper localizer frequency. The COURSE knob is rotated until the course counter indicates the heading of the inbound localizer course. Helicopter position, with respect to the localizer course, is presented by the course bar.

The GS warning flags will unmask the glide slope pointers when the glide slope receiver is tuned to a signal of sufficient strength and the glide slope signal is presented. Helicopter position, with respect to the glide path, is presented by the attitude indicator and course indicator glide slope pointers. A TACAN or VOR radial may be selected for use with the course indicator by tuning the associated navigation receiver to the desired TACAN or VOR facility and rotating the COURSE knob until the COURSE counter indicates the desired radial on the azimuth card. The pilot should make the TACAN or VOR course intercept in the HDG mode, switching to the ILS mode once the course has been intercepted. Helicopter position, with respect to the selected TACAN or VOR radial, is presented by the course bar. Helicopter pitch attitude is displayed by the

pitch bar. Helicopter bank attitude is displayed by the horizon disc as in the HDG mode of operation. The horizontal guidance steering signal, with crosswind correction, is displayed by the pointer. The steering pointer deflection indicates the amount and direction of bank required to fly a localizer heading. When the helicopter is banked in the proper direction to center the steering pointer and sufficient rudder is applied for a coordinated turn, a smooth entry will be made onto the localizer or selected course. Once the helicopter has obtained the localizer or selected course, minor changes cause the steering pointer to deflect in the direction in which the aircraft must be banked to correct the error.

NOTE

Steering pointer commands, in the ILS mode, are at times erratic, overly sensitive and contradictory to the information displayed by the course indicator. This phenomenon is most prevalent when the system is used in proximity to the radio navigational aid. The flight director steering pointer should not be used in the ILS mode during an instrument approach, departure, or other conditions of instrument flight requiring high levels of pilot concentration.

NOTE

The VOR/TACAN selector switches must be aligned to desired MASTER/SLAVE positions before the desired navigational aid is used. In the ILS mode, in order for the pilot to interpret a selected TACAN course with the steering pointer and to provide a correct pictorial plan view, the pilot's and copilot's course counters must display the same selected course.

DEV MODE OF OPERATION

The DEV mode of operation is obtained by setting the attitude indicator mode selector knob to the DEV position. A reference pitch attitude is obtained by setting the pitch TRIM knob to the desired pitch attitude. A TACAN or VOR radial is selected by tuning the associated navigation receiver to the desired TACAN or VOR facility, aligning the VOR-TACAN selector switches to desired MASTER/SLAVE positions, and rotating the COURSE knob until the COURSE counter indicates the desired course.

Helicopter pitch attitude, with respect to the reference pitch attitude, is displayed by the pitch bar.

Helicopter bank attitude, with respect to the horizon, is displayed by the horizon disc. Helicopter magnetic heading is displayed by the position of the azimuth card with respect to the lubber line. A display of helicopter position, with respect to the selected TACAN or VOR course selected, is presented by the course bar. While the flight director is in the DEV mode of operation, the steering pointer receives information directly from the selected navigation receiver and indicates which way to turn in order to intercept or track a selected course. The steering pointer does not indicate the amount of bank required. Warning flag services are provided as in the HDG mode of operation.

OFF MODE OF OPERATION

When the flight director is in the OFF mode, the steering computer is deactivated, and the steering pointer and steering flag on the attitude indicator is biased out of view. In all other respects, the OFF mode operates the same as the DEV mode.

FLIGHT DIRECTOR OPERATION

PREFLIGHT CHECKLIST

1. Adjust the pitch trim knob to the center index on the pitch trim scale; then check to see that the positions of the pitch bar and horizon bar correspond to the actual attitude of the helicopter.
2. Check to see that the helicopter heading corresponds to the heading read on the azimuth card.
3. Tune the helicopter TACAN or VOR receiver to a TACAN or VOR station. Set the mode selector to the DEV position. Set the course arrow to the radial on which the aircraft is located. The course bar and the steering pointer should center.
4. Move the course arrow 10° to the right or left. The course bar and steering pointer should both be deflected in appropriate directions. The course bar should be deflected to the outer dot.
5. Set the mode selector to the ILS position. The steering pointer should call for a bank toward the selected course.
6. Move the course arrow to a position which centers the course bar. The steering pointer should come to rest centered.

7. Tune the helicopter VOR receiver to the localizer. Set the course arrow to the inbound localizer front course. The course bar should be deflected in a direction appropriate to the location of the localizer. The steering pointer should call for a bank toward the localizer.

8. Set the mode selector to the OFF position. The STEERING flag and the steering pointer should both be hidden from view.

9. Set the mode selector to the HDG position. Set the heading marker under the lubber line. The steering pointer should come to rest centered.

10. Move the heading marker to the left. The steering pointer should be deflected to the left.

AFCS ACCELEROMETER CHECK

This check should be accomplished if usage of the AFCS coupler is anticipated.

1. Place the meter selector on the CHANNEL MONITOR panel to the CPLR position.

2. Set the MODE selector on the AFCS indicator to the A MODE.

3. Place the DOPPLER in STANDBY.

4. Put the Altitude Set Pot on the AFCS CONTROL PANEL to 0. (zero)

5. Push the AFCS Button on the AFCS Control Panel to engage the AFCS.

Locate the deadbank/null area on the drift pot by setting the knob to the full counterclockwise position. Slowly rotate the drift pot clockwise, noting that the roll bar on the AFCS indicator will follow the movement of the drift pot until the dead/bank null area is reached. The roll bar and the drift pot should both be centered. If the roll bar is not centered within the donut, adjust the associated accelerometer null set screws to obtain proper alignment within the donut. Repeat the same procedure for the speed pot.

Check the vertical accelerometer by noting the position of the vertical pointer. Alignment should be within $\pm .25$ of a division from the center. If it is not, adjust the appropriate accelerometer null set screw to obtain proper alignment.

If the altitude or cyclic coupler checks are not going to be accomplished, place the meter selector switch to ASE and disengage the AFCS.

SELF-QUIZ # 11

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The horizontal guidance signal is displayed on the attitude indicator of the flight director system by means of the _____

- A. horizon disc
- B. steering pointer
- C. pitch bar display
- D. glide slope pointer

2. Any malfunction in the glide slope system is indicated by a/an _____

- A. amber light
- B. green light
- C. buzzing signal
- D. warning flag

3. The AN/AYN-2 steering flag is displayed, regardless of the mode switch position, when the _____ fails.

- A. radio input
- B. directional gyro
- C. remote indicating compass
- D. steering computer primary power

4. The pitch bar trim is preset when the mode selector is in the _____ position.

- A. OFF
- B. ILS
- C. HDG
- D. DEV

5. The helicopter heading will be accurately shown under the _____ on the AN/AYN-2 course indicator.

- A. lubber line
- B. azimuth card
- C. course arrow
- D. heading marker

6. TACAN information will automatically be displayed on the copilot's flight director system when there is a power failure to the _____ receiver.

- A. DF-301
- B. UHF COMM
- C. VHF NAV
- D. LF/ADF

7. The heading marker is read against the azimuth card and is positioned on the card by rotating the _____

- A. course knob
- B. heading knob
- C. heading marker
- D. glide slope pointer

8. When the receiver is tuned to a localizer course, a two-dot deflection of the flight director course bar corresponds to an aircraft deviation of _____ degrees.

- A. 1.5
- B. 2.0
- C. 2.5
- D. 3.0

9. An ILS, TACAN, or VOR mode of operation is obtained by setting the mode selector knob to the _____ position.

- A. ILS
- B. VOR
- C. TACAN
- D. MASTER

10. During an instrument approach, the flight director steering pointer should not be used in the _____ mode.

- A. OVR
- B. ILS
- C. DEV
- D. ADF

ANSWERS TO SELF-QUIZ #11

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	11-2
2	D	11-2
3	D	11-2
4	B	11-2
5	A	11-4
6	C	11-6
7	B	11-6
8	C	11-8
9	A	11-8
10	B	11-9

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ELECTRONIC FLIGHT AIDS

Reading Assignment:
Pages 12-1 through 12-9.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the radar altimeter system.
2. Summarize the operation of the radar set.
3. Explain the Doppler radar system.

RADAR ALTIMETER AN/APN-171(V)

Radar altimeter set AN/APN-171(V) consists of a receiver-transmitter, two indicators, and two antennas. The set provides instantaneous indication of actual clearance between the helicopter and terrain from 0 to 5,000 feet with the following accuracies:

Altitude (ft)	Accuracies
0-200	$\pm(3\text{ft.} + 2\% \text{ of altitude})$
200-1000	$\pm(7\text{ft.} + 2\% \text{ of altitude})$
1000-5000	$\pm(25\text{ft.} + 2\% \text{ of altitude})$

Altitude, in feet, is indicated by the radar altimeter indicators (figure 12-1) located on the pilot's and copilot's instrument panel. The radar altimeter is powered by the DC primary bus and the No. 1 AC primary bus. Both the DC and AC circuits are protected by circuit breakers on the copilot's circuit breaker panel. One circuit breaker is marked RDR ALTM under the general heading DC PRI. The other circuit breaker is marked RDR ALTM OA under the general heading NO. 1 AC PRI.

RADAR ALTIMETER OPERATION

A control knob, located on the lower left corner of the indicator, combines functions to serve as a test switch, a low level warning index set control, and an on/off power switch. The system is turned on by rotating the control knob, marked PUSH-TO-TEST, clockwise from the OFF position and is the only control necessary for equipment operation.

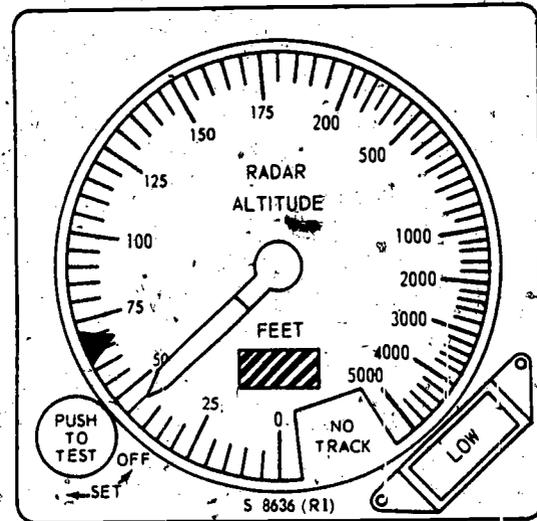


Figure 12-1. - Radar altimeter AN/APN-171(V).

Three minutes must be allowed for system warmup. Both control knobs must be in the OFF position to secure the set. Continued clockwise rotation of the control knob toward the SET position will permit each pilot to select any desired low-altitude limit, which will be indicated by the low-level warning index marker (bug) on the indicator. A low-level warning light, located on the lower right-hand corner of the indicator, will illuminate and show the marking LOW any time the helicopter is at or below the low-altitude limit that has been selected. On helicopters modified by T.O. 1H-3(H)f-570, the low limit warning light can be dimmed by using the dimming switch for the Caution/Advisory panel.

NOTE

Rheostat marked PILOT FLT INST on the overhead switch panel must be ON to use the bright/dim switch.

Depressing the PUSH-TO-TEST control switch provides a testing feature of the system at any time and altitude, provided the RAD ALT mode of the AFCS is disengaged. When the PUSH-TO-TEST control knob is depressed, a visual indication of 100 ± 15 feet on the indicator is indicative of satisfactory system operation. Releasing the PUSH-TO-TEST control knob restores the system to normal operation. In addition to altitude measurement, the altimeter provides outputs to the coupler for RADALT HOLD operation.

RADAR ALTIMETER WARNING SYSTEM (RAWS)

Three audio warning signals are developed by the altimeter and are fed into the pilot's and copilot's headsets. The first is a 1,000-Hz steady tone which sounds when the altimeter is unreliable. At approximately 200 feet, a 1,000-Hz tone is switched on for 3 seconds and is pulsed at a rate of two pulses per second. At 50 feet, this tone is again switched on for 3 seconds but is pulsed at a rate of four pulses per second. A two-position switch on the instrument panel, marked ON and OFF, under the heading RAWS (figure 12-2) turns the RAWS system on and off. When the switch is in the OFF position, an amber light on the caution advisory panel, marked RAWS OFF, is illuminated.

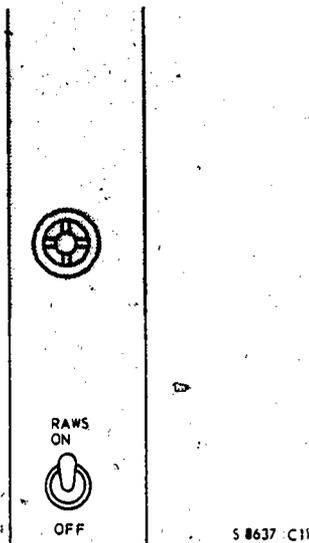


Figure 12-2. - Radar altimeter warning system (RAWS) selector switch.

Failure Indications

Loss of system power or tracking condition will be indicated by a black and yellow striped flag which appears in the indicator window on the lower center portion of the indicator. If the system should become unreliable, the black and yellow striped flag will appear, the indicator pointer will go behind a mask, marked NO TRACK, to prevent erroneous readings, and a 1,000 Hz audio tone will sound in both pilot's ICS. If the coupler RAD ALT hold mode is engaged at this time, it will disengage. During normal flight operations, it is not necessary to turn the system off when the aircraft is operating above 5,000 feet.

NOTE

IF AC power is lost, the pointers freeze in position. An audio warning will be heard on the ICS if AC power is lost and the RAWS switch is ON.

RADAR SET AN/APN-195

The AN/APN-195 radar set is a lightweight, pulse-modulated radar system consisting of a receiver-transmitter, synchronizer, control panel, indicator, and antenna. This set provides an accurate and continuous picture of weather conditions (weather map) in the general sky area ahead of the helicopter and is used as a navigation and search aid to extend the vision of the pilot. The AN/APN-195 is powered by the No. 1 AC primary bus and is protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked SEARCH RADAR under the general heading NO. 1 AC PRI. In addition, pitch and roll inputs from the AN/ASN-50 are necessary to stabilize the antenna.

RADAR SET CONTROL PANEL

The control panel and azimuth range indicator (figure 12-3) are centrally located on the instrument panel and are accessible to both pilots. The control panel contains three controls: a mode selector switch, a receiver gain control, and an antenna tilt control.

Mode Selector

The mode selector switch is a rotary four-position switch marked OFF-STBY-OPR-CTR. The OFF position disconnects power from the radar set. The STBY position applies voltage to tube filaments and initiates an approximate four-minute time delay for

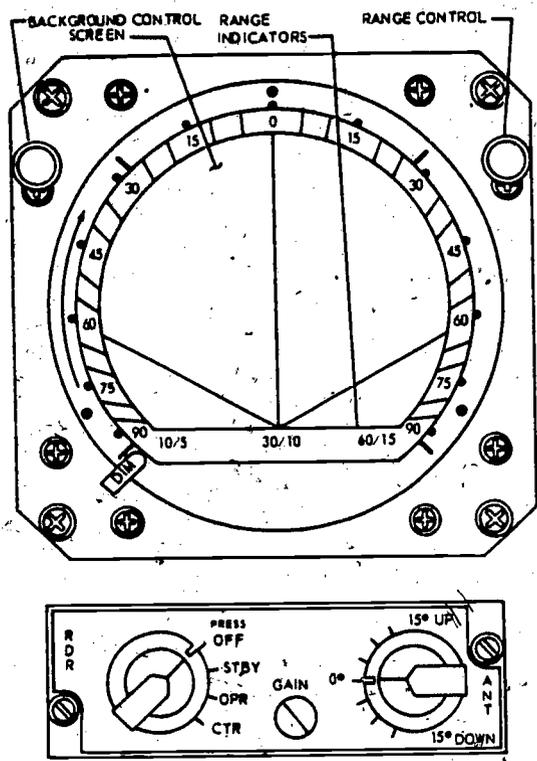


Figure 12-3. - Radar set AN/APN-195.

warm-up. It also holds the equipment in standby condition after the four-minute time delay expires. The OPR position applies voltage to all circuits (after elapse of four-minute time delay) for normal operation. The radar echo from the target area is displayed on the azimuth-range indicator screen as bright spots or areas. The contour circuit is inoperative. When the switch is in the CTR position, areas of heavy rainfall are displayed on the azimuth range indicator screen as dark areas or black holes surrounded by bright rings which represent areas of lighter rainfall.

CAUTION

There is a detent between the OFF and STBY positions to prevent accidental shutdown of the radar with a subsequent recycled four-minute delay. To overcome this when shutting off the system, depress the mode selector switch (pushed into the control panel) when going from the STBY to the OFF position. Deviation from this procedure will result in a broken switch which will indicate OFF when actually in the STBY position, STBY when in the OPR position, the OPR in the CTR position.

Receiver Gain Control

The receiver gain control, marked RECEIVER GAIN, controls the amplification of the radar echo received.

Antenna Tilt Control

The antenna tilt control, marked ANT, is a synchro control marked UP and DOWN at 5° intervals. The control varies the tilt of the antenna reflector between 15 degrees above (UP) and 15 degrees below (DOWN) the horizontal reference plane of the helicopter.

Azimuth-Range Indicator

The azimuth-range indicator contains a screen that displays target echoes, a range switch, a background control, and a dimming control. The screen indicates the range and azimuth of targets.

The unmarked range switch is located in the upper right side of the indicator and is a three-position rotary switch. The range switch, when rotated fully counterclockwise to the first position, will illuminate an indicator, marked 10/5 at the base of the screen. This position provides a 10-mile sweep trace and two 5-mile range circles on the screen. The second clockwise position on the rotary switch will illuminate an indicator, marked 30/10 at the base of the screen. This position provides a 30-mile sweep trace and three 10-mile range circles on the screen. The third clockwise position on the rotary switch will illuminate an indicator at the base of the screen, marked 60/15. This position provides a 60-mile sweep trace and four 15-mile range circles on the screen. All distance references are in nautical miles. The unmarked background control located in the upper left side of the indicator is in the minimum intensity position when rotated fully counterclockwise. The background control adjusts the level of background noise to permit very weak echoes to be viewed on the screen. The dimming control, marked DIM, revolves on the periphery of the screen and is used to dim the display for best viewing. The dimming control is off when revolved fully counterclockwise (down).

RADAR OPERATION

Preliminary Operating Procedures:

1. Mode Selector Switch - OFF.
2. Antenna Tilt Control - CENTERED (0).
3. Receiver Gain Control - FULLY COUNTERCLOCKWISE.



4. Range Switch - 60/15.
5. Background Control - FULLY COUNTERCLOCKWISE.
6. Dim Control - FULLY COUNTERCLOCKWISE (down).

STARTING

1. Mode Selector Switch - OPR.

NOTE

The equipment will not function for 4 minutes because of a built-in automatic time delay.

2. Range Switch - 30/10.
3. Background Control - AS REQUIRED.

Adjust background control until scope becomes green. Then turn counterclockwise until green just disappears (range marks will still be visible).

4. Receiver Gain Control - AS REQUIRED.
5. Background Control - AS REQUIRED.
6. Dim Control - AS REQUIRED.
7. Range Switch - AS REQUIRED.
8. Antenna Tilt Control - ADJUST FOR TARGETS.

Turn the tilt control slowly (approximately 1° per second) when adjusting for small targets, such as ships.

Weather Observations

(See figures 12-4 and 12-5.)

Perform the preliminary operating procedures:

1. Antenna Tilt Control - AS REQUIRED.
2. Mode Selector Switch - OPR.
3. Receiver Gain Control - AS REQUIRED.
4. Range Switch - AS REQUIRED.
5. Mode Selector Switch - OPR/CTR AS REQUIRED.

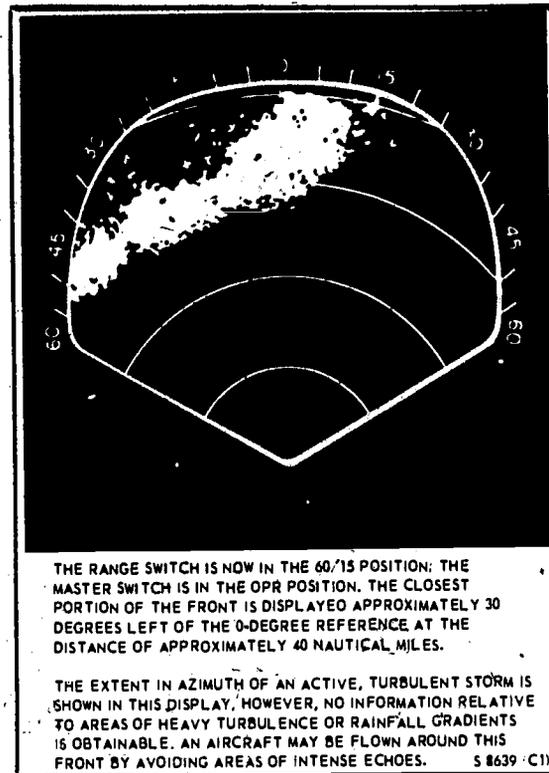


Figure 12-4. - Weather interpretation (OPR) position.

DOPPLER RADAR AN/APN-175(V) (SEE FIGURE 12-8.)

The Doppler radar is a navigation system using the Doppler effect to determine drift and ground speed. Four beams of pulsed microwave energy are beamed toward the earth along the corners of an imaginary pyramid whose peak is at the helicopter. Echoes from the front pointing beams undergo upward Doppler shift, whereas echoes from the rearward beams undergo downward Doppler shift. Similarly, drift causes Doppler shift of echoes from beams on one side with respect to beams on the other side of the helicopter. The Doppler effect is the change in the observed frequency of a wave due to relative motion of source and observer. When the distance between the source and observer is decreasing, the observed frequency is higher than the source frequency. When the distance is increasing, the observed frequency is lower. The Doppler shift is the amount of the change in the observed frequency of a wave due to Doppler effect, expressed in hertz, also called Doppler frequency. In addition, the hover indicator in D mode is used to display fore and aft, left and right, and vertical velocity. (See figure 12-7.)

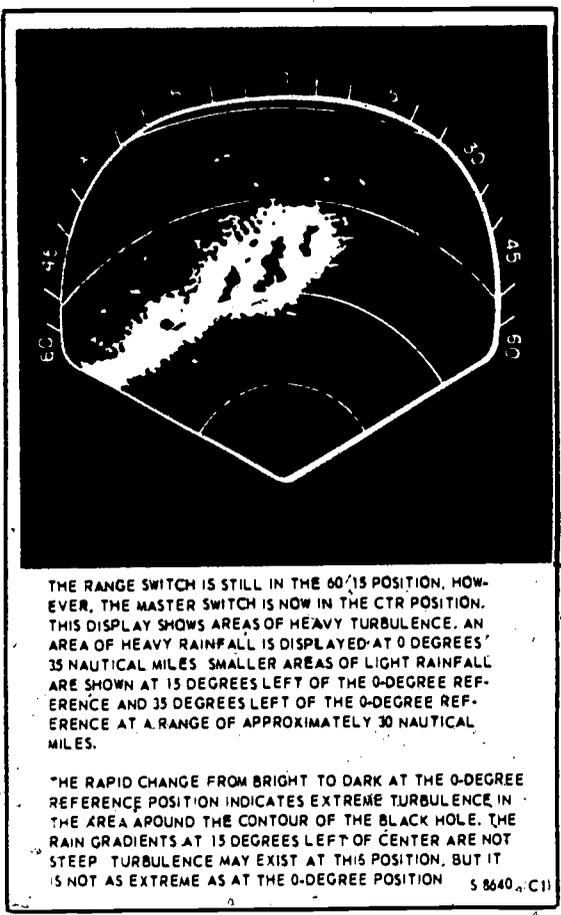


Figure 12-5. - Weather interpretation (CTR) position.

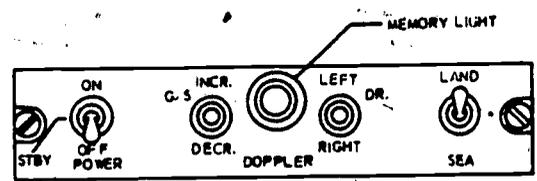


Figure 12-6. - Doppler controls AN/APN-175(V)-1.

DOPPLER SENSOR GROUP

The Doppler sensor group operates at a frequency of 13325 MHz through an altitude range of 15 to 30,000 feet. The group consists of a receiver-transmitter, a frequency tracker, an antenna, and a control panel. A blower is provided to cool the operating components and to eliminate fumes in the Doppler compartment. The transistorized receiver-transmitter produces a frequency-modulated signal

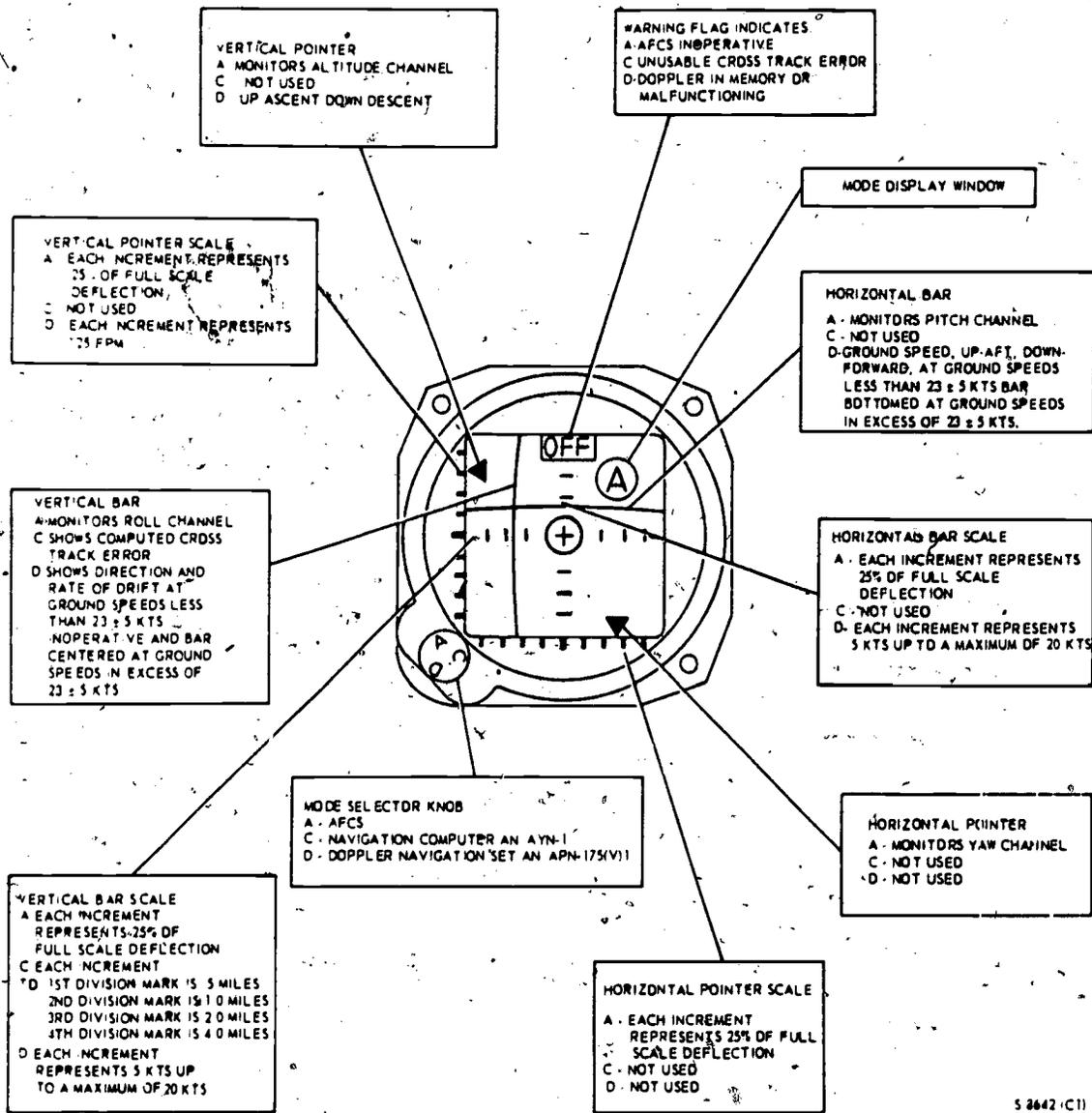
of 13325 MHz to the antenna, which transmits and receives four beams in a square pattern to the land or water below. There are two forward and two backward beams. The signals returned to the antenna by the reflecting surface are received by the frequency-tracker as forward and backward Doppler signals from the receiver-transmitter. The receiver-transmitter produces a single frequency equal of the center frequency of the summed totals of the forward and backward signals, and provides error voltages to align the antenna with the ground track. The horn excited wave-guide-type antenna is mounted on the bottom of the fuelage. The antenna contains one transmitting and two receiving waveguide assemblies. The antenna will rotate with drift angle changes of the helicopter up to a maximum of 90 degrees, left or right, at a minimum rate of 6 degrees per second. The antenna receives pitch and roll information from A/A24G-39 inputs and maintains a level attitude by movement of the antenna up to limits of 45° of roll (left or right) and 25° of pitch (up or down). The set provides reliable ground-speeds, from -50 to +390 knots, and left and right drift angles, up to 90 degrees, over all reflective surfaces. The groundspeed and drift angle outputs are then fed to the navigation computer AN/AYN-1 for computation of present position.

The Doppler sensor group is operated from the Doppler switch panel (figure 12-8). The set will detect any loss of Doppler signal and send an input to the navigation computer. The navigation computer will then use the last reliable wind solution from the Doppler sensor group, use true airspeed and heading inputs to solve groundspeed and track, and furnish groundspeed and drift angle memory signals to the Doppler sensor group until the Doppler signal returns. The Doppler sensor and the Doppler compartment blower are powered by the No. 1 AC primary bus. The sensor group circuit breaker is marked RDR 0B, and the compartment blower is marked COMPT BLO 0C. Both circuit breakers are on the copilot's circuit breaker panel, under the general headings DOPPLER and NO. 1 AC PRI. The doppler sensor also receives 26 volt AC power from the radio auto transformer.

HOVER INDICATOR

The hover indicator (figure 12-7) in D mode displays information developed by the Doppler navigation set, AN/APN-175(V)-1. In D mode, the horizontal pointer and scale are not used. At ground speeds in excess of 23 ± 5 knots, the horizontal bar is bottomed. At ground speeds less than 23 ± 5 knots, the horizontal bar indicates ground speed in 5-knot increments and shows whether the direction

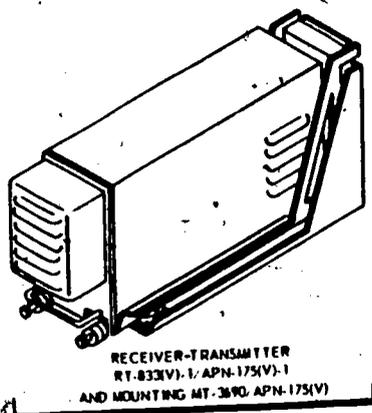




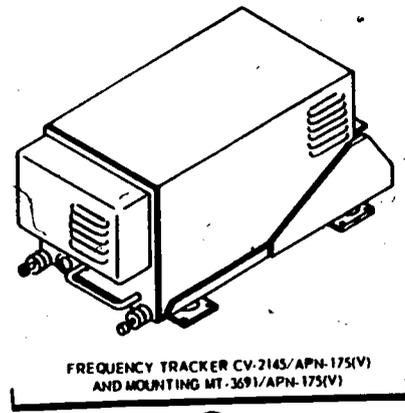
5 8642 (C1)

Figure 12-7. - Hover indicator.

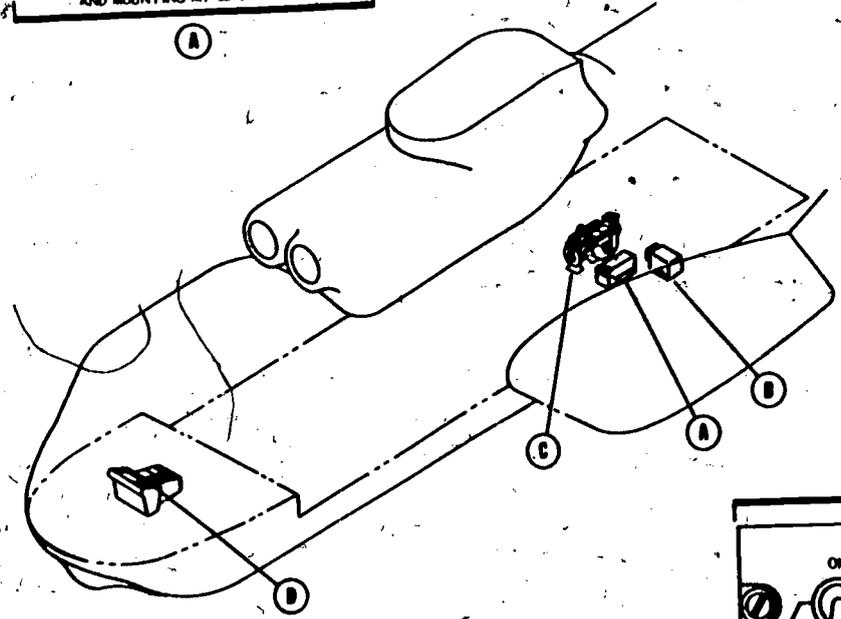
169



A



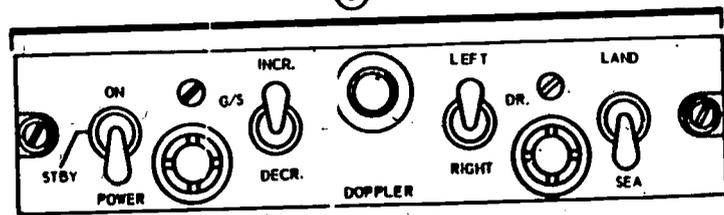
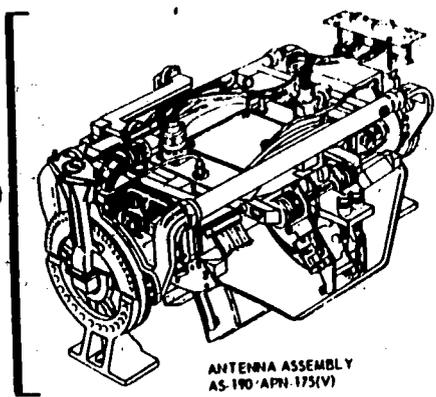
B



C

D

D



DOPPLER RADAR CONTROL CMC336-106

Figure 12-8. - DOPP/NAV system components - location diagram.

being traveled is either forward or aft. If the horizontal bar is above the centerline, the aircraft is moving aft; if the bar is below the center, the aircraft is moving forward. Each increment of the horizontal bar scale represents 5 knots up to a maximum of 20 knots. At ground speeds in excess of 23 ± 5 knots, the vertical bar remains centered. At ground speeds less than 23 ± 5 knots, the vertical bar will show lateral drift and rate of drift. Each increment of the vertical bar scale represents 5 knots up to a maximum of 20 knots. The vertical pointer above its centerline shows ascent and below descent. Each increment of the vertical pointer scale represents 125-feet-per-minute up to a 500-foot-per-minute maximum.

DOPPLER CONTROL PANEL

The doppler control panel, marked DOPPLER, (figure 12-8) consists of four toggle switches and a

memory light. The panel is located on the center console aft of the navigation computer controller. The POWER switch, with marked positions OFF, STBY, and ON, will remove power in the OFF position. The STBY position permits the sensor group to warm up and to be held in a standby status. The ON position places the sensor group in operation. The G/S (ground speed) switch, with marked positions INCR (increase) and DECR (decrease), is used only for test. The memory light is on during a loss of doppler signal. The memory light is also on when the POWER switch is in the STBY position. The DR. (drift) switch, with the marked positions LEFT and RIGHT, is used only for preflight and test. The LAND-SEA switch is used in the LAND position over land and in the SEA position over water. When the Beaufort sea state is 3 or greater, more accurate doppler sensing is obtained with the LAND-SEA switch in the LAND position.

DOPPLER RADAR SYSTEM COMPONENTS - LEADING PARTICULARS

<u>COMPONENT</u>	<u>FUNCTION</u>
Receiver-transmitter	Transmits FM/CW signals of $13,325 \pm 25$ megahertz, and receives doppler spectra from outputs of antenna forward and aft mixers. Provides IF amplification of spectra for application to frequency tracker.
Mounting	Secures receiver-transmitter to electronics mounting rack in lower fuselage.
Antenna Assembly	Radiates transmitted frequency of $13,325 \pm$ megahertz and receives doppler spectra. Extracts modulation side bands from earth reflected beam for application to receiver-transmitter IF amplifiers.
Frequency Tracker	Produces frequency equal to center frequency of summed forward and aft doppler spectra, and provides error voltages to align antenna assembly with helicopter ground track. Also provides V_h , V_u , V_r , and flag outputs to pilot's and copilot's AFCS indicators and to AFCS amplifier during coupler operation. Also applies ground speed analog and memory flag signals to COMPUTER/NAV system.
Mounting	Secures frequency tracker to electronics mounting rack in lower fuselage.
Doppler Radar Control	Provides switches and controls for operation and testing of DOPP/NAV system.

ASSOCIATED EQUIPMENT COMPONENTS

<u>COMPONENT</u>	<u>FUNCTION</u>
Navigation Computer	Receives ground speed analog data from frequency tracker, and drift angle data from antenna unit.
Drift Angle Repeater	Converts antenna drift position to drift angle voltage.
Attitude Heading Reference System Displacement Gyro	Stabilizes antenna horizontally with terrain.
Pilot's and Copilot's AFCS Indicators	Display velocity heading, velocity drift, and vertical velocity (V_h , V_d , and V_v) when in D mode.

DOPPLER PREFLIGHT

1. Doppler POWER Switch (Doppler Control Panel) - STBY.
2. ON-STBY-OFF Switch (AN/AYN-1 Navigation Computer Controller) - STBY THEN ON.
3. SENSOR Rotary Switch (AN/AYN-1 Navigation Computer Controller) - DOPP.
4. INSERT/DISPLAY Key (Navigation Computer Controller Keyboard) - DISPLAY.
5. E4/GS-TR Key (Navigation Computer Controller Keyboard) - GS-TR.
6. DR. Switch (Doppler Control Panel) - AS REQUIRED.

Observe the heading of the helicopter on RMI or standby compass. Check antenna travel by turning the antenna 90° left or right of the centerline of the helicopter by holding the DR switch left or right approximately 15 seconds. Full antenna deflection can be detected by observing the bottom register of the navigation computer display.

7. ON-STBY-OFF Switch (Doppler Control Panel) - ON.

Observe ground speed lock-on and memory light goes out in a maximum of 30 seconds. Preflight complete.

8. ON-STBY-OFF Switch (AN/AYN-1 Navigation Computer Controller) - AS REQUIRED.
9. Doppler POWER Switch (Doppler Control Panel) - STANDBY.

DOPPLER SENSOR OPERATION

To turn sensor on:

1. POWER Switch (Doppler Control Panel) - STBY.
2. POWER Switch (After 1-Minute Warmup in STBY) - ON.

CAUTION

Place the doppler power switch in STBY just before landing on the water.

3. LAND-SEA Switch (Doppler Control Panel) - AS REQUIRED.



SELF-QUIZ # 12

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. At an altitude of 200 to 1,000 feet, the accuracy of the radar altimeter is _____ of indicated altitude.

- A. ± 3 ft. + 2%
- B. ± 3 ft. - 2%
- C. ± 7 ft. + 2%
- D. ± 7 ft. - 2%

2. The radar altimeter warning system will produce a 1,000-Hz steady tone when the _____

- A. aircraft is at 200 ft.
- B. altimeter is unreliable
- C. aircraft is at 50 ft.
- D. RAWS system is first turned on

3. What is the approximate warm-up time delay for the AN/APN-195 radar set?

- A. 30 seconds
- B. 90 seconds
- C. 2 minutes
- D. 4 minutes

4. The range switch in the azimuth-range indicator is located in the _____ side of the indicator.

- A. upper right
- B. upper left
- C. lower right
- D. lower left

5. The Doppler antenna is mounted on the _____

- A. bottom of the pylon
- B. bottom of the fuselage
- C. right side of the fuselage
- D. left side of the fuselage

6. One function of the Doppler radar frequency tracker is to _____

- A. radiate transmitted frequency of $13,325 \pm 25$ megahertz
- B. receive ground speed analog data and drift angle data
- C. receive Doppler spectra from outputs of antenna forward mixers
- D. apply memory flag signals to the COMPUTER/NAV system

7. The hover indicator vertical bar will show lateral drift and rate of drift at MAXIMUM ground speeds of _____ knots.

- A. 23 ± 3
- B. 23 ± 5
- C. 25 ± 3
- D. 25 ± 5

ANSWERS TO SELF-QUIZ #12

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	12-1
2	B	12-2
3	D	12-2
4	A	12-3
5	B	12-8
6	D	12-7
7	B	12-6



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AVIONICSMAN'S DUTIES

Reading Assignment:
Pages 13-1 through 13-6.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the procedures for establishing and maintaining airborne communications.
2. Explain the radio frequency procedures used to establish contact with a surface or air unit.
3. Summarize the procedures for sending aircraft message reports.
4. Describe the aircraft communications equipment used in aircraft, small boats, and sea going vessels.

AIRCRAFT COMMUNICATIONS IN ACCORDANCE WITH COMMUNICATIONS MANUAL (CG-233)

ESTABLISHING COMMUNICATIONS

Aircraft normally establish communication on a prearranged frequency with their aeronautical station within 5 minutes after takeoff. The aeronautical station so contacted will then be responsible for the radio guard of the aircraft until it returns or until another station has established communications with the aircraft and has assumed radio guard responsibility.

NOTE

An aeronautical station is a land station in the aeronautical mobile service which includes a communication/radio station with an air-ground position. In certain instances an aeronautical station may be placed on board a ship.

IN FLIGHT COMMUNICATIONS

Operations permitting, all Coast Guard aircraft will guard the emergency frequencies 121.5, 156.8, and 243.0 MHz. Appropriate VHF/UHF frequencies are used for all normal communications, and use of 121.5, 156.8 and 243.0 MHz is restricted to emergency communications or circumstances where other frequencies will not suffice.

Aircraft in flight must establish communication contact with an aeronautical station at least every 30 minutes. If an aeronautical station loses contact with an aircraft, the station reestablishes communication with the aircraft directly or through another station or initiates an alert. (Any communications with an aircraft will begin a new 30-minute period for making an "operations normal" report.) When operating under the conditions specified below, aircraft in flight are specifically exempted from establishing communication contact with an aeronautical station.

1. When the pilot in command is maintaining communications with ATC facilities, he makes the required position reports to the ARTC OR OATC with which he holds communication contact. He should shift his communication guard to the appropriate ATC facility.

2. When the pilot in command is maintaining communications with an on-scene commander (OCS) in conjunction with a mission, the pilot makes the required position reports to the OSC. An aircraft engaged in a SAR mission and reporting to an on-scene commander should shift its communication guard from the aeronautical station to the OSC until released from the SAR mission for return to base. In flight, SAR communications are conducted in accordance with section 1830, CG-233.

3. When the proper authority has instructed the pilot in command to maintain radio silence, the requirement for communication contact with an aeronautical radio station is waived. In any case of contemplated radio silence, the radio station is so advised and radio contact reestablished as soon as practicable thereafter.

As a general rule, the primary channel for operation communications between the operational commander and his aircraft is through Coast Guard facilities. Relay through the facilities of other agencies is authorized when operationally necessary.

Contact Frequencies

UHF air/surface frequencies are used to the fullest extent possible for short range communications. Aircraft may use Coast Guard VHF/FM maritime mobile frequencies when operating with Coast Guard small boats or group commanders. HF air/surface frequencies are used when line-of-sight communications are not possible. Air station operation/communication centers can be contacted on one or the other of the Coast Guard UHF common frequencies 381.8 or 383.9 MHz during hours of air station operations. In addition to the above UHF frequencies, air stations can be contacted during times of operation on the appropriate HF air/surface frequencies listed under circuits E1 or E2 in CG-233-1. When required, HF air/surface frequencies can be remoted to the air station operations center. Coast Guard air traffic control towers guard the frequencies listed under circuit E5 in CG-233-1. The frequencies actually guarded by a particular air station may be determined by referring to the DOD Flight Information Publication Enroute Supplements.

When an aircraft is communicating with a district radio station that is maintaining radio guard for an air station, the frequencies used are those from circuits E1, E2, and J1.2 in CG-233-1 which are appropriate. In such cases, the district radio station is called by its own radio call sign and not that of the air station. Traffic so passed to a radio station for delivery to an air station will contain proper routing instructions in the transmission instructions.

Communications required for Oceanic Air Traffic Control (OATC) clearance normally will be conducted between aircraft and the ICAO aeronautical station serving the oceanic area control center on the voice or CW frequencies provided for this purpose.

CG aircraft may use any aeronautical mobile (R) band frequency for communications with aeronautical stations regularly serving the routes or areas to which these frequencies are allotted. In certain areas Aeronautical Radio Incorporated (ARINC) operates the ICAO aeronautical stations. In these areas, aircraft should make every effort to use government facilities rather than those of ARINC, provided government facilities can serve the air traffic control requirements.

Call Signs

Call signs for aircraft will be in accordance with ACP 125 and its supplements for voice and USN Suppl-1 to ACP 110 for CW. For training, logistic flights, and peacetime operational missions, use the international call signs. Use the entire aircraft number in forming the call sign. After the initial call-up, the voice call sign may be abbreviated. Examples of international call signs are shown below:

<u>Aircraft</u>	<u>Voice Call Sign</u>	<u>CW Call Sign</u>
HU-65A 1242	Coast Guard 1242	Not applicable
HC-130B 1340	Coast Guard 1340	NC 1340
HH-3F 1469	Coast Guard Cop- ter 1469	Not applicable

All aircraft on search and rescue missions will insert the word "RESCUE" in the call sign after COAST GUARD when using voice procedure.

PROCEDURE FOR CALLING SHORE STATIONS

Aircraft and units afloat may call aeronautical stations or shore facilities by using the station or field name followed by AIR, TOWER, RADIO, COMSTA, or other appropriate voice procedures.

Examples: KODIAK AIR - ELIZABETH CITY
TOWER - MIAMI RADIO - HONOLULU
COMSTA

AIRCRAFT MESSAGE REPORTS

General

Types of aircraft message reports:

1. Departure
2. Arrival
3. Weather
4. Rendezvous with ship
5. SITREP
6. Prospective flight notices



- 7. Remaining overnight
- 8. Accident
- 9. Ferry movement
- 10. Pollution reports
- 11. Fisheries patrol reports

2. Training flights which involve a remaining overnight report (RON).

3. Training flights where stops are made and the locations and/or circumstances indicate that the district commander should be informed.

Aircraft message reports may be via the following communication services:

- a. Coast Guard
- b. Navy
- c. Air Force
- d. Army
- e. Federal Aviation Administration
- f. ICAO
- g. Commercial

Examples:

AIRCRAFT MOVEMENT

0 181328Z AUG 80
 FM COGARD AIRSTA NEW ORLEANS LA
 TO COGARD AIRSTA MIAMI FL
 INFO CCGD EIGHT NEW ORLEANS LA
 BT
 UNCLAS
 AIRCRAFT MOVEMENT
 1. HH-3F CG 1433 LCDR CARTER NEW ORLEANS FOR MIAMI.
 2. ETA 2250Z
 BT

Air traffic control communications will be handled in accordance with procedures set forth by the FAA and ICAO where applicable.

Procedure

Normally aircraft movement message reports are sent IMMEDIATE precedence (O) to action addressees. Reports to information addressees, in most cases, may be sent with a lower precedence.

LOGISTICS

0 200249Z AUG 80
 FM COGARD ONE FOUR THREE THREE
 TO COGARD AIRSTA NEW ORLEANS LA
 INFO CCGD EIGHT NEW ORLEANS LA
 COGARD AIRSTA HOUSTON TX
 BT
 UNCLAS
 HOUSTON LOGISTICS
 1. HH-3F CG 1433 LCDR ANGUS HOUSTON FOR NEW ORLEANS 0244Z.
 2. ETA 0705Z
 3. RADM STARBOARD PLUS TWO
 4. REQUEST TRANSPORTATION
 BT

Responsibility For Filing

Responsibility for filing departure and arrival reports rests solely with the pilot in command, except when the point of departure or arrival is a unit under Coast Guard jurisdiction. In this case the responsibility rests with the commanding officer of the unit. In the latter event, the pilot in command ensures that the commanding officer of such ship or station is properly notified as to the movement, departure, or arrival.

TRAINING

0 031433Z SEP 80.
 FM COGARD AIRSTA NEW ORLEANS LA
 TO USCGC PREVELANT
 INFO CCGD EIGHT NEW ORLEANS LA
 BT
 UNCLAS
 SAREX USCGC PREVELANT
 A. CCGD EIGHT 020905Z SEP 80
 1. HH-3F CG 1433 LT LOCKNESS DEPT 1401Z.
 2. ETA USCGC PREVELANT, POSIT 30-51N 91-12W 1452Z.
 BT

Departure Reports

On certain flights, message reports are required to keep appropriate commands informed of the type and Coast Guard number of the aircraft, pilot's name, names and titles of passengers of high rank, point of departure, destination, ETA, and nature of mission. The pilot in command files messages giving pertinent information concerning these flights in accordance with existing area and district directives.

When flights are made outside the home district, district commanders (and other appropriate commands) concerned are included as information addressees. Flights of this type are:

- 1. Operational flights (except ferry).



Arrival Reports

After completing a flight on which a departure report was sent, an aircraft or unit will make an arrival report. It should be addressed to the controlling Coast Guard activity and the addressees of the departure message.

Weather Reports

Aircraft make weather reports as directed by the officer authorizing the flight. When the officer ordering the flight so directs, or authorizes, position reports and weather reports may be combined in one report.

Rendezvous With A Coast Guard Or Navy Ship

Before departing from a shore station or as soon thereafter as practicable, an aircraft sends a message to the ship of destination as follows:

Action addressee:

1. Ship of destination

Information addressees:

1. District Commander
2. Other activities assisting in the operation
3. Appropriate addressees

Contents:

1. Model designation and Coast Guard number of aircraft
2. Aircraft commander's name and rank
3. Estimated time of departure
4. Estimated time of arrival at ship
5. True airspeed and altitude
6. Aircraft/ship calling frequency
7. Special requests, such as for weather

Operations Normal Report

Aircraft in flight make communication contact with an aeronautical station at least every 30 minutes.

Situation Reports (SITREP)

The operational commander specifies the form, content, and requirements for situation reports.

Example Format:

SITREP

```

0 150147Z SEP 80
FM COGARD ONE FOUR THREE THREE
TO NEW ORLEANS SARCOORD NEW OR-
LEANS LA
INFO COGARD AIRSTA NEW ORLEANS LA
BT
UNCLAS
SITREP TWO F/V DRIFTER OVERDUE
1. SITUATION:
  A. 0105Z HH-3F CG 1433 ON SCENE
  B. WEATHER CAVU SEAS 3 TO 5 WIND
    240/12
2. ACTION:
  A. CONDUCTING SHORE LINE SEARCH
    PT. CHEVREUIL TO NORTH PT.
3. PLANS:
  A. PLAN SEARCH OF POINT AU FAR IS-
    LAND ON RETURN NEW ORLEANS
4. RECOMMENDATIONS:
  A. REQUEST HARBOR CHECK OF
    WEEKS BAY BY LOCAL AUTHORITIES
*5. CASE PENDS:
BT
  
```

*SAR Coordinators assign the CASE STATUS. CASE CLOSED can only be sent by the SAR Coordinator.

Prospective Flight Notices

Prospective flight notices are sent only when it is necessary to make prior arrangements, request special services, or inform aeronautical stations of frequency plan and/or aircraft calls. Prospective flight reports carry precedence and classification according to the requirements.

RON Reports

Remaining overnight (RON) reports may be filed as an additional group of the contents of an arrived report. Include only the abbreviation RON.

Accident Reports

The U.S. Coast Guard Safety Manual (CG-405) contains instructions for message reports of aircraft or ground accidents and for preliminary reports of aircraft accidents.

Ferry Movement Reports

These reports are sent in accordance with the Air Operations Manual, CG-233.

TYPICAL RADIO COMMUNICATIONS
APPLICABLE TO THE HH-3F

Before flight, an aircraft normally makes an initial radio communications check on HF (high frequency) equipment with the aeronautical station responsible for the aircraft radio guard. At this time, the aeronautical station provides the aircraft with the correct time of day and the quality of the aircraft HF transmission. Primary and secondary frequencies to be used during the flight are passed to the aircraft at this time also.

NOTE

The secondary frequency assigned is used if communications between the aircraft and the aeronautical station are lost at any time during the flight.

Any difficulty in obtaining this initial contact with the aeronautical station should be brought to the attention of the aircraft commander immediately for possible corrective action before flight.

After takeoff, the aircraft passes the airborne time to the aeronautical station, along with the number of persons on board (POB) and the purpose or destination of the flight.

At the nearest quarter hour, the aircraft passes a "flight operations" report to the aeronautical station. This report informs the aeronautical station of in-flight aircraft and aeronautical station. At the next quarter hour, the aircraft gives a position report along with the "flight operations" report. From this time until the end of the flight, a "flight operations" report is given every 15 minutes along with a position report every 30 minutes.

Before securing at the end of the flight, the aircraft must inform the aeronautical station of flight termination. The aeronautical station then terminates radio guard with the aircraft without further effort to contact the aircraft.

COMMUNICATION LOGS

Three significant terms used in this discussion are defined below:

1. **RADIO LOG:** An official record of signals transmitted and received by a radio-equipped unit.
2. **COMPLETE RADIO LOG:** A complete and continuous record of all signals transmitted and received.
3. **ABBREVIATED RADIO LOG:** A complete record of all transmitted and received signals that pertain to the unit such as incoming messages, weather, radio checks, etc.

Radio logs provide a record of radio transmissions and receptions to aid units in recounting past actions. All radio transmissions pertaining to a unit's operations should be logged. However, keeping radio logs aboard some type of Coast Guard units is impractical; such logs may be inaccurate or incomplete and thus of questionable benefit. Tape recordings of radio circuits are considered to be a substitute for a written log.

Radio logs are not required on HH-3F aircraft except when the aircraft are serving as "on-scene-commanders." When serving in this capacity, an abbreviated radio log will be maintained.

A typical abbreviated radio log includes the following:

1. Aircraft model and number.
2. Aircraft crew list.
3. Date.
4. Complete record of messages sent and received.
5. Time of each entry. (GMT or local time may be used)
6. Transmission frequency.
7. Rate and signature of person keeping log.

A new log book page will be used for each flight. All entries will be made in ink. Errors will be corrected by drawing a straight line through the entry and initialing the error.

The completeness of coverage and degree of radio log detail will vary with the type of unit, availability of personnel, and the type of information passing through the unit. The ultimate decisions as to the completeness of the abbreviated radio log rests with the commanding officer.

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SAMPLE ABBREVIATED LOG

CDR TIFFT
LT BUMPS

HH-3F 1433
1 JAN 1981
LOCAL TRAINING

AE1 FLINT

AT1 AARON

1602Z
09
30
1701Z
29
57
1805Z
1807Z
2.0

NEW ORLEANS COMSTA TI 1433 RDO CK/LOUD AND CLR
NO TI 33 ABNE 08 LOCAL TRAINING/R PRI 56 SEC 89
NO TI 33 OPS NORM/R
NO TI 33 OPS NORM POSIT SLIDELL/R
NO TI 33 OPS NORM/R
NO TI 33 LANDING NEW ORLEANS IN 5/R
NO TI 33 ON DECK SECURING/R,
(CHOX)
T.F.T (total flight time)

5898
5898
5898
5898
5898
5898

AT1 ARRON
(signature)

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SELF-QUIZ # 13

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. After takeoff, aircraft should contact their aeronautical station within _____ minutes.

- A. 1
- B. 2
- C. 3
- D. 5

2. What is one of the emergency communications frequencies?

- A. 121.5 MHz
- B. 218.2 MHz
- C. 256.0 MHz
- D. 381.8 MHz

3. When an aircraft is maintaining communications with an on-scene-commander (OSC), the aircraft makes the required position reports to _____

- A. the station to which the aircraft is attached
- B. the on-scene-commander
- C. any unit with which contact can be established
- D. the aeronautical station with which the aircraft is maintaining communications

4. The frequencies actually guarded by a particular air station may be determined by referring to _____

- A. ACP-125
- B. CG-233-1
- C. the USN/ACP 110 SUPPLEMENT-1
- D. the DOD Flight Enroute-Supplement

5. Aircraft movement message reports are normally sent to action addressees with a/an _____ precedence.

- A. URGENT
- B. ROUTINE
- C. PRIORITY
- D. IMMEDIATE

6. When an aircraft is sending a message report for rendezvous with a ship, what is contained in the message?

- 1. True airspeed
- 2. Estimated time of departure
- 3. Estimated time of arrival
- 4. Number of persons on board
- 5. Estimated time on scene

- A. 1, 2, and 4 only
- B. 1, 3, and 5 only
- C. 1, 2, and 3 only
- D. 2, 3, 4, and 5

7. When an aircraft is serving as an "on-scene-commander," what type of radio log should you maintain?

- A. Coded
- B. Formal
- C. Complete
- D. Abbreviated



ANSWERS TO SELF-QUIZ #13

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.



QUESTION	ANSWER	REF.
1	D	13-1
2	A	13-1
3	B	13-1
4	D	13-2
5	D	13-3
6	C	13-4
7	D	13-6



DEPARTMENT OF TRANSPORTATION -
U. S. Coast Guard (11/80)

U. S. Coast Guard Institute
PAMPHLET NO. 657

This pamphlet contains original material developed at the Coast Guard Institute and also excerpts from:

- HH-3F Flight Manual T.O.1H-3(H)F-1
- HH-3F Maintenance Manual T.O. 1H-3(H)F-2-2

IMPORTANT NOTE: In November, 1980, the information contained in this pamphlet was current according to the latest updates of those Directives/Publications listed. This pamphlet was compiled for training **ONLY**. It should **NOT** be used in lieu of official Directives or publications. It is always **YOUR** responsibility to keep abreast of the latest professional information available for your rate.

The personnel responsible for the latest review and update of the material in this component during November 1980 are:

- ATCS B. L. Ely (Subject Matter Specialist)
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Questions about the text should be addressed to your Subject Matter Specialist.

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HH-3F FLIGHT PREP

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INTRODUCTION

This pamphlet is designed to acquaint you with the procedures used in preparing for a SAR mission and other flights. As you read the material, you should memorize some of the items. These items are pointed out in the pamphlet.

Hoisting procedures and terminology have been covered in detail. Also covered are procedures for using the rescue platform, the cargo sling, and the high-intensity searchlight.

When you complete this pamphlet, you should be prepared for your flight syllabus. You should also have the information needed to become a competent SAR mission qualified aircrewmember.

NOTICE TO STUDENT

This pamphlet contains lesson quizzes. Correct answers and text references are printed in the right-hand column of each quiz page. Cover the answers in the right-hand column. After you answer the questions, remove the cover to check your answer with the printed answer. Try to answer the questions in each quiz before looking back at the text.

FLIGHT PREPARATION

OBJECTIVES

When you complete this section, you will be able to:

1. Summarize the crew assignments on the HH-3F.
2. Explain the duties required of an HH-3F SAR aircrewman in preparation for a flight.
3. Describe the HH-3F SAR aircrewman inspection.
4. Outline a complete passenger briefing.

NORMAL CREW ASSIGNMENTS

Although the helicopter can be safely flown by a crew of only two pilots, the minimum crew under normal conditions will consist of a pilot, copilot, flight mechanic, and avionicsman.

CREW DUTIES

Flight Mechanic

The duties of the flight mechanic normally include but are not limited to the following:

1. Routine mechanic duties such as servicing and maintenance when away from home base.
2. Supervising all activities in the cabin.
3. Operating the rescue hoist and platform.
4. Supervising cargo loading and off-loading.
5. Operating the manual fuel dump valves and actuating the auxiliary flotation equipment as directed.
6. Searching.
7. Performing the duties of the avionicsman, as required, when one is not assigned.
8. Conduct safety check after takeoff and every 30 minutes. Prior to conducting a safety check the flight mechanic shall either close the cargo door, or, with the seat in the forward locked position, swivel the seat inboard before releasing the shoulder harness. This check includes but is not limited to the following items:

- a. Engine and transmission gages - check for normal indication.
- b. Cockpit overhead circuit breaker panels - check for popped circuit breakers.
- c. AUX servo broom closet - check for leaks and for security of servount, control rods and mixing unit.
- d. Helicopter exterior - check for leaks, loose cowling, and for security of long wire antennas.
- e. Deck fittings and outboard deck channels - check for evidence of leaks.
- f. Engine and transmission deck drain lines - check for leaks.
- g. Airframe fuel filter inlets and outlets - check for leaks.
- h. Radio rack - check for overheating.
- i. Heater fuel control - check for leaks.
- j. General cabin area - check for leaks and security of equipment.
- k. Advise pilot to cross check compasses and check fuel quantity.
9. Remove landing gear pins during preflight.

Avionicsman

The duties and responsibilities of the avionicsman include but are not limited to the following:

1. Operating all communication and navigation equipment at his position.
2. Maintaining in-flight logs, records, and navigation plots as required.

1 . . .

3. Searching.
4. Maintaining hover position when directed through use of the hover trim stick.
5. Assisting the flight mechanic as required.
6. Operating the hoist as required.

CREW BRIEFING GUIDE

The following briefing guides assist the pilot in conducting briefings, as applicable to the type of mission assigned. The aircrewmember should be familiar with these briefing guides.

1. Mission requirements.
2. Flight plan.
3. Fuel load.
4. Emergency - survival equipment.
5. Weather.
6. Crew duties and responsibilities.

CREW COORDINATION

Safe and efficient operation of the helicopter requires precise crew coordination and discipline due to the helicopter's performance capabilities, the type and quantity of equipment installed, the size and location of exits and the cargo and passenger capacity of the cabin.

Safety Belts

During routine landings and takeoffs and when directed, the flight mechanic and avionics man will be seated with seat belts and harnesses fastened and seats facing forward. During flight, each crewmember and passenger must be seated

with belt fastened except when necessary to move about or when the pilot has granted permission. Whenever either the cargo door or ramp is open in flight, all persons not strapped in a seat must be securely fastened in a crewmember's safety harness. Secure the cargo door safety strap across the door opening whenever the door is open in flight except when operational necessity dictates otherwise, such as during hoist or platform operations.

ICS Coordination

A crewmember must inform the pilot before disconnecting from the ICS.

MISCELLANEOUS EQUIPMENT

We have already discussed some of the crew duties concerning safety belts. In the following paragraphs, we will expand on these duties and discuss the equipment, including passenger seats, in more detail.

Passenger Seats

Passenger seats (figure 1) equipped with seat belts may be installed in the cabin to accommodate six people. The seats are distributed evenly, three on each side. Four seats are located between the second and third windows and two are between the third and fourth windows. Modified helicopters are equipped with provisions for 14 additional seats, 9 on the left side and 5 on the right for a total of 20 passenger seats. The seat legs are attached to the cargo tiedown studs in the cabin floor at the front of the seat assemblies. The seats are folded by disconnecting the front legs from the floor and securing the front of the seats against the upper back support with the straps provided.

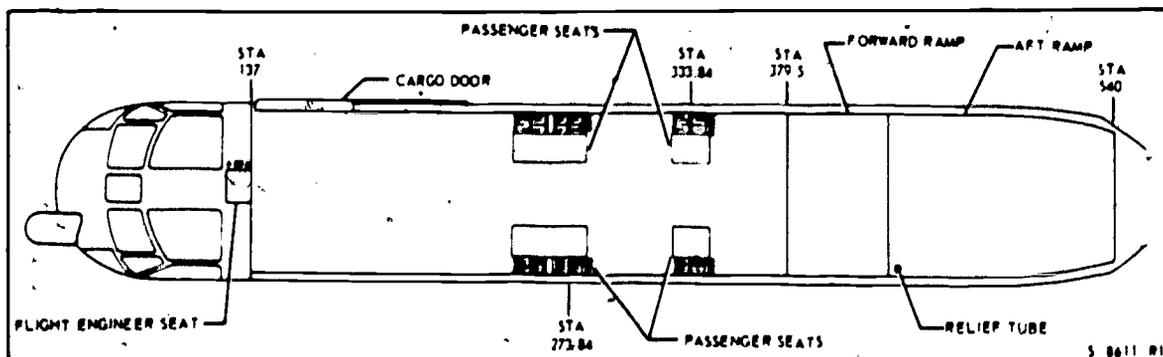


Figure 1. - Seats, passenger.

NOTE

During search operations, when maximum visibility from the cabin is necessary for scanning, the seat backs blocking windows should be stowed. The seat backs should also be stowed during water operations to permit quick access to the windows in event of an emergency.

Crewmember's Safety Harness

The harness may be attached to any tiedown fitting on the cargo floor or overhead fitting behind the avionicsman's seat. The harness is worn during hoist operation and/or any time the cargo door is open in flight and personnel are using this position for other activities. The aircrewmember may attach his safety harness strap to a jumpseat seat belt ring to enable him to reach the outboard edge of the rescue platform.

Cargo Door Safety Strap

The helicopter is equipped with a safety strap (figure 2) installed in the cargo door opening to restrain personnel. The safety strap is a fixed-length, nonadjustable strap. The forward end is permanently attached to an eyebolt and ring assembly on the cargo door forward frame (station 137). The right end of the safety strap has a quick release snap that attaches to a ring and eyebolt assembly on the cargo door rear frame. During loading, or whenever the safety strap is not required, it is stowed by attaching the right end snap to the ring on the forward door frame.

WARNING

The cargo door safety strap must be attached whenever the helicopter is

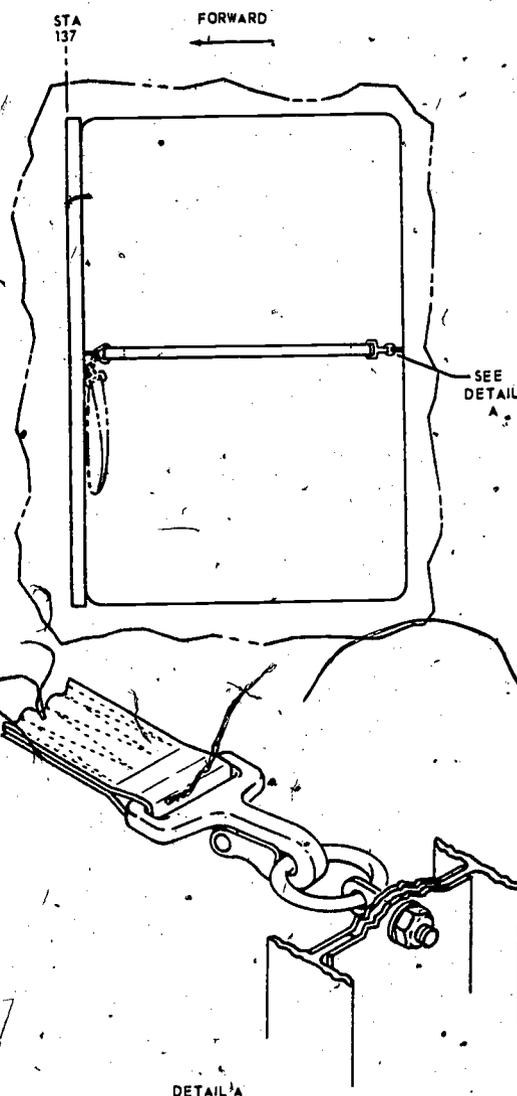


Figure 2. - Safety strap, cargo door.

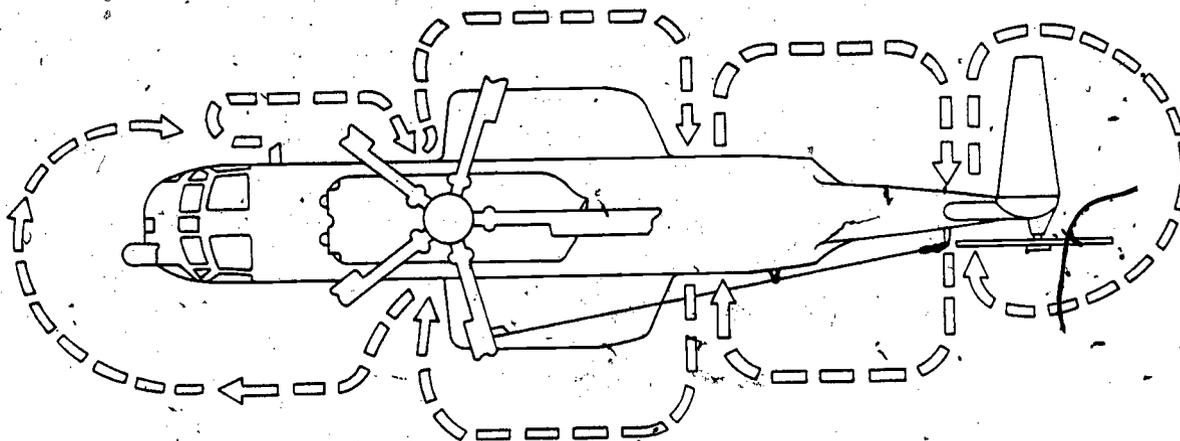


Figure 3. - Exterior inspection.

in motion, except when operational necessity dictates otherwise, such as hoist or platform operations.

AIRCRAFT AND EQUIPMENT INSPECTIONS

PREFLIGHT CHECK

The flight mechanic will perform an inspection of the aircraft before each flight. The pilot's preflight will be the final inspection before the flight. The purpose of this inspection is to visually inspect the aircraft before the flight,

to ensure removal of any protective covers/devices, and to detect damage or discrepancies which have developed since completion of the maintenance preflight inspection. The inspection will include, but is not limited to, the following items: (See figure 5.)

Aircraft general - CHECKED. A qualified aircrewmember will make a walkaround inspection, checking for visible fuel and oil leaks, security of inspection panels and doors, and presence of foreign matter such as ice, snow, and frost.

See figure 3 for a typical walk-around pattern.

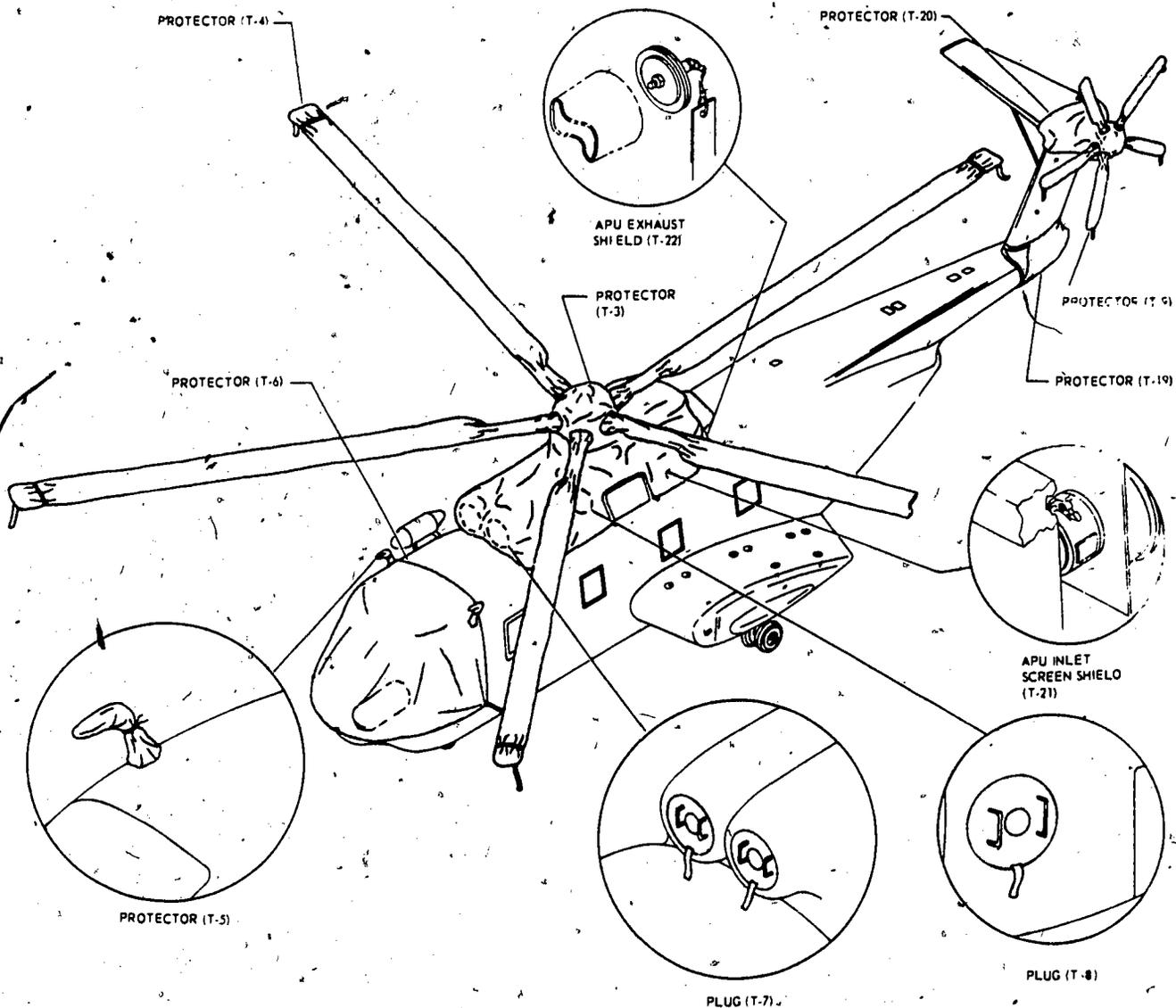


Figure 4. - Protective covers.

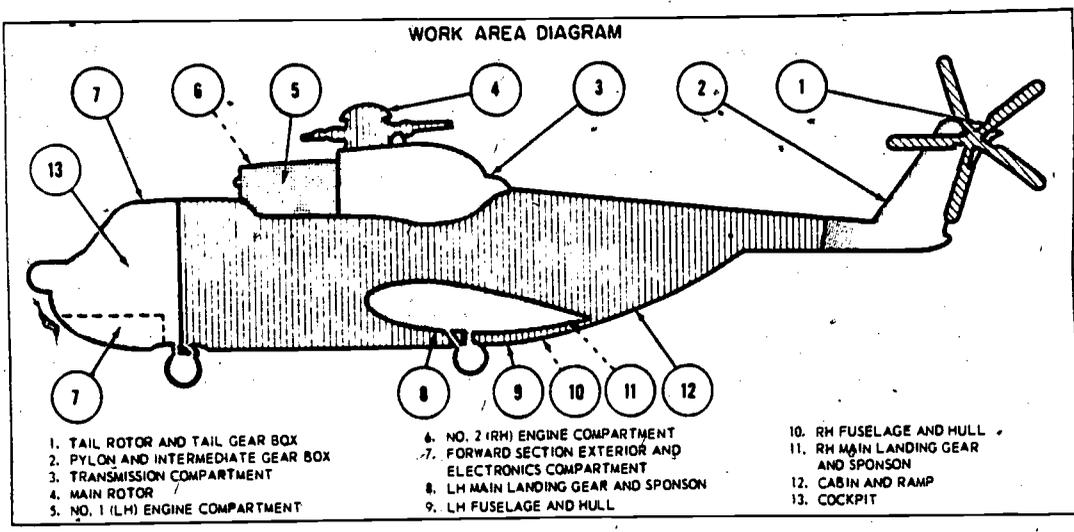


Figure 5. - Work area diagram.

- 1. Main and tail rotor blades - CHECKED.
- 2. Main landing gear pins - REMOVED, and chocks - IN PLACE.
- 3. Protective covers and tiedown equipment - REMOVED. (See figure 4.)
- 4. SAF
- 5. Cargo door safety strap for general condition.
- 6. Seat belts and seats for general condition and security.
- 7. SAR mission equipment (check for minimum quantities and general condition.

WARNING

The transmission work platform and latch handle can be placed in the stowed position without positive locking action, allowing the transmission platform to open in flight. A visual inspection between the aircraft frame and work platform should be made to ensure positive locking action of platform latch tangs.

INTERIOR INSPECTION

- 1. Cargo, seats, miscellaneous equipment - SECURED.
- 2. Ramp cables - ATTACHED PRIOR TO TAKE-OFF.
- 3. All visible control cables.
- 4. Aircrewmember's safety harness for condition and personalized adjustment.
- a. Hoist operators gloves
- b. Cable cutter and flashlight
- c. Rescue platform
- d. Rescue basket
- e. Rescue sling
- f. Litter
- g. Boat hook
- h. SAR board equipment, including pyrotechnics.
- i. Rafts
- j. Crew survival items.
- k. Emergency exits for unobstructed passage and release handles for proper positioning and safety wiring.

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PASSENGER BRIEFING

The SAR aircrewman must ensure that all passengers embarked receive an adequate briefing. This briefing must encompass at least the following:

1. Use of parachutes (if carried).
2. Use of life jackets (if flight overwater).
3. Applicable alerting signals in event of an emergency.
4. Action required in case of ditching or crash landing.
5. Emergency exits.
6. Use of other emergency equipment.
7. No smoking and seat belt rules.
8. Movement within the helicopter.

REVIEW

In this section you have studied material describing the duties of an HH-3F SAR aircrewman. Even when your aircraft has been preflighted, you should still give it a good visual inspection. You will also have to inspect the rescue equipment that should be on the aircraft.

Now that you have completed this section, you should be able to prepare the aircraft for flight. Also you should be able to complete a SAR aircrewman inspection and a passenger briefing.

(Now answer the following review questions.)

1. Which of the following is/are required of a SAR aircrewman?
 - A. Complete the SAR aircrewman's pre-flight inspection only
 - B. Complete a passenger briefing only
 - C. Perform the SAR aircrew inspection only
 - D. All of the above
2. When performing a SAR aircrewman's pre-flight inspection, what should you look for?
 1. Removal of protective covers and devices
 2. Damage or discrepancies that have developed since completion of the maintenance pre-flight
 3. Positive locking of platform latch handles
 - A. 1 only
 - B. 2 only
 - C. 2 and 3 only
 - D. 1, 2, and 3
3. Which item is listed under a SAR aircrew inspection?
 - A. Boat hook
 - B. Life jacket
 - C. Emergency exit
 - D. Fire axe
4. When crewmembers are working near an open hatch while airborne, which item(s) must they wear?
 - A. Seat belt only
 - B. Shoulder harness only
 - C. Safety harness only
 - D. All of the above
1. D The SAR aircrewman assigned to the flight must perform all the duties mentioned (Refer to pages 4, 5 and 6)
2. D There are many items an aircrewman must inspect. Those listed here are some of the typical items. (Refer to pages 4 and 5)
3. A The boat hook is part of the rescue equipment and is listed under the SAR aircrewman inspection. (Refer to page 5)
4. C The cabin doorway on the HH-3F is a large opening, and a crewman could easily fall out of the aircraft. (Refer to page 3)



EMERGENCY PROCEDURES AND EQUIPMENT

OBJECTIVES

When you complete this section, you will be able to:

1. Explain the procedures used during an in-flight emergency in the HH-3F (fire, auto., ditch, etc.).
2. State the location of the emergency exits on the HH-3F and their use.
3. Explain correct procedures used during cold weather operations of the HH-3F.
4. Describe the techniques used during helicopter operations in hot weather.

GENERAL

As a SAR aircrewman on the HH-3F, you will be required to perform emergency duties if the occasion arises. These are in addition to your regular duties. The following information will acquaint you with these emergency duties and situations.

CAUTION

Severity of the fire and actual flight conditions (night or instrument) will dictate the immediate procedure to be followed. It may be more advisable to let the fire burn, if it is isolated, than to secure all electrical power and lose AFCS and flight instruments before achieving VFR conditions.

AUTOROTATION

When an autorotation is evident during flight, you must make sure that all loose gear is stowed or secured. The cabin door should be opened if time permits. Make sure that all passengers are briefed and are secure in their seats. Finally, you must be seated and strapped in. Report "all secure" to the pilot.

SMOKE AND FUME ELIMINATION

After a fire or if fumes are detected in the helicopter open the cargo door and the pilot's compartment windows for the elimination of smoke and/or fumes. Flight tests indicated these two openings are the most effective for smoke and fume elimination.

IN-FLIGHT CABIN/COCKPIT FIRE

If a cabin or cockpit fire occurs in flight, you must ensure that all helicopter doors and windows are closed. The next step is to man the fire extinguisher, proceed to the scene of the fire, and fight the fire. Keep the pilot advised of the status of the fire and damage. Standby for emergency landing. (These procedures are general and might not serve every need.)

WARNING

Do not open the cockpit windows if the cargo door is not open.

CAUTION

Do not jettison any windows, the door, or the left search windows while the helicopter is in forward flight, to avoid the possibility of their being carried into the rotor blades.

Normally no toxic quantities of carbon monoxide gas or other gases are present from the engine exhaust. Objectionable odors of the engine exhaust gases are sometimes encountered in the helicopter during ground run-up, taxiing, slow speed flight, or single-engine flight with one engine in ground idle. These odors may be avoided by heading the helicopter into the wind and/or closing the pilot's compartment window and the cargo door. Opening the cargo door and the pilot's compartment windows in flight will assist in removing objectionable fumes and odors.

WARNING

Do not open the cockpit windows if the cargo door is not open.

BAIL OUT

Bail out is recommended only if it is impossible to make a safe emergency landing. Bail out is possible either in level flight or autorotation.

WARNING

To avoid contacting sponsors during bail out, the pilot will limit aircraft speeds to; 140 KNOTS MAXIMUM POWERED FLIGHT - 125 KNOTS MAXIMUM AUTOROTATIVE.

Bail out procedures are:

1. Airspeed - 70 KNOTS.
2. Attitude - LEVEL.
3. Wheels-UP.
4. Cargo compartment occupants - ALERTED.
5. Cargo door - OPEN (If cargo door will not open, pull emergency handle and jettison door).

The pilot may, at his discretion, open the rear ramp in flight and have personnel bail out through the ramp exit. However, do not allow more than one person on the ramp at a time, to avoid a CG problem. Minimum bail out altitude should be 1,000 feet above the surface.

6. Cargo compartment occupants - BAIL OUT. Cargo compartment occupants dive down and out of the cargo door exit, arms close to body, and head down. Wait until clear of the helicopter before pulling the rip-cord to avoid fouling the parachute.
7. Pilot's compartment sliding window - JETTISON.
8. Pilot and copilot - BAIL OUT (The pilot should trim the helicopter for level flight).
 - a. Copilot exit through cargo door.
 - b. Pilot may exit through the pilot's window or the cargo door, as circumstances dictate. If exit is through window, proceed as follows:
 - (1) Place both feet in seat, hands on either side of window frame.
 - (2) Dive out and down.
9. Open parachute when clear of aircraft.

EMERGENCY WATER LANDING OR DITCHING

During an emergency water landing or ditching, you as a crewmember will actuate the flotation bag system when directed by the pilot. You may be directed to launch the sea drogue or anchor. (See figure 7.) If it becomes necessary to abandon the aircraft, the flight mechanic will direct the evacuation of the cabin and provide the raft, and any other gear that might be needed. (See figure 8.)

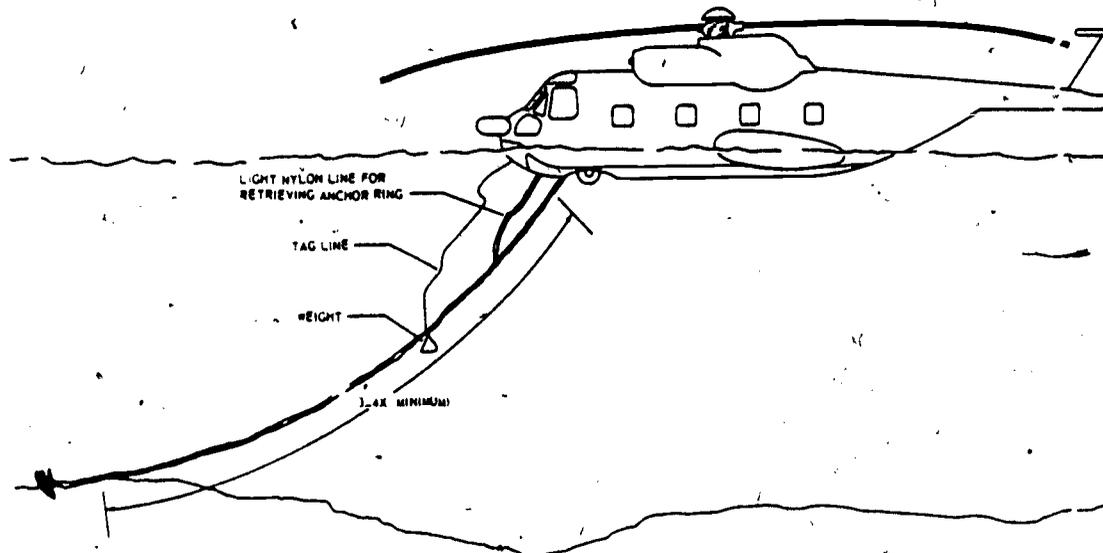


Figure 7.- Anchoring the helicopter.

GROUND LANDING EMERGENCIES

A successful landing with the landing gear retracted, or improperly lowered, is not as difficult to make with a helicopter as with a fixed-wing aircraft. Proper selection of a landing site, and care during hovering or touchdown, will permit a landing with a minimum of danger to personnel and damage to the helicopter. If attempts to lower the landing gear by the alternate system are unsuccessful, it may be possible to jar the landing gear loose by an abrupt increase in collective pitch after a shallow dive. However, since the helicopter has water landing capabilities, a water landing may be made if facilities are available. Landings with all wheels retracted, or with any one or any two wheels down, may be made by placing soft objects, such as mattresses, under the malfunctioning landing gear (or gears) and the bottom of the fuselage. Ground personnel should place the soft objects before touchdown and then direct the pilot from a hover to a vertical landing on the objects.

After aircraft motion has ceased and the rotors have stopped turning, the flight mechanic will direct the evacuation of the cabin. Disconnect the battery if time permits.

EMERGENCY EGRESS PROCEDURES

Because of the high probability of spatial disorientation due to aircraft attitude, damage,

and/or environmental factors (night, water), it is imperative that all crew members become familiar with normal/emergency aircraft, escape routes and the egress procedures. The importance of the use of reference points cannot be overstressed.

1. Reference Point - Locate and remain calm.
2. Mike Cord - Disconnect.
3. Emergency Exits - Locate Emergency Release Handles - Pull and Jettison.
4. Reference Point - Relocate and hold.

WARNING

Land - Wait until all buffeting stops (recommended 5 - 8 seconds).

Water - Take normal breath and wait until completely immersed (recommended 5 - 8 seconds).

5. Seatbelt Harness - Release.
6. Egress - Holding Reference Points, exit at right angles to the aircraft.

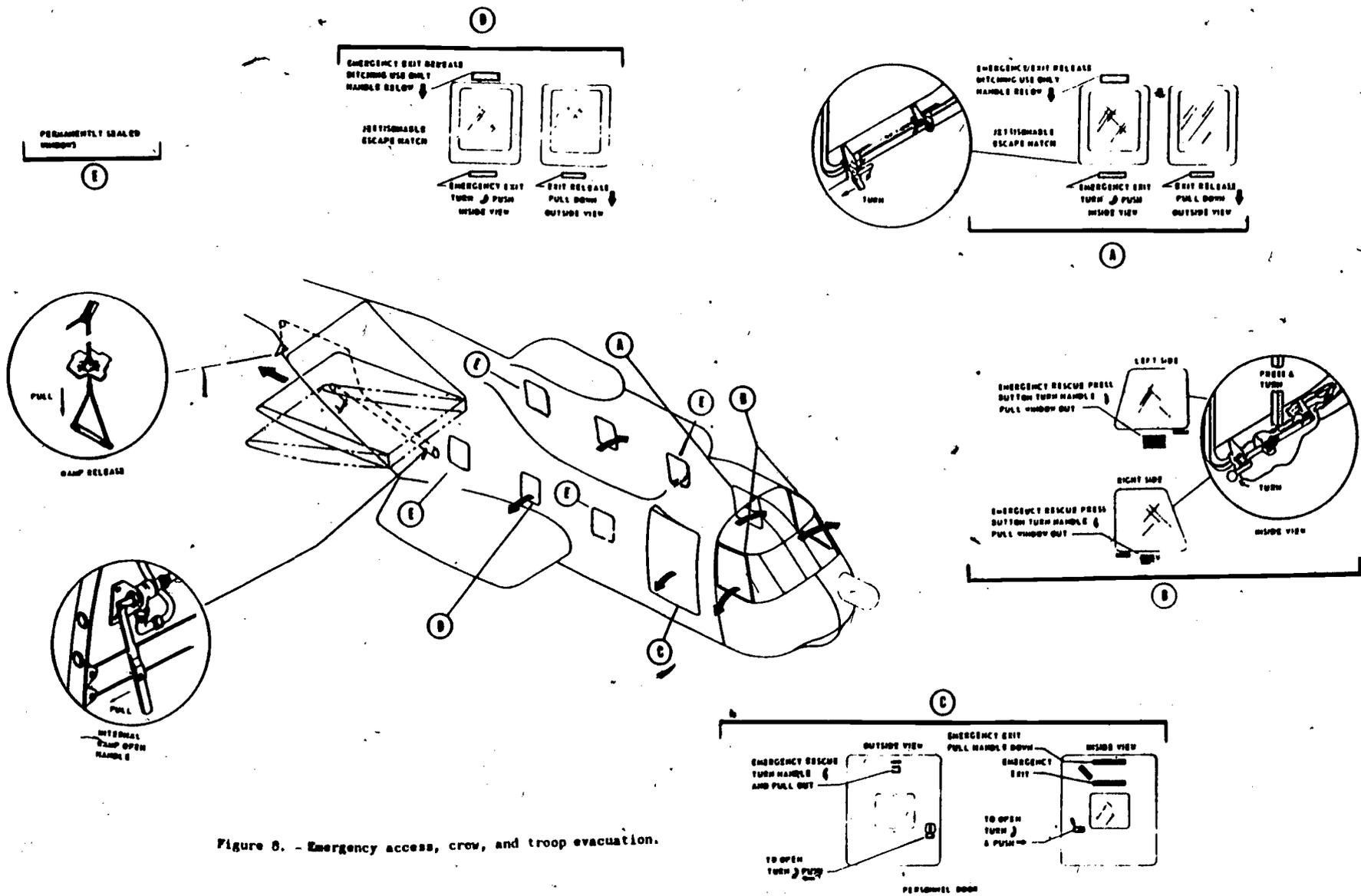


Figure 8. - Emergency access, crew, and troop evacuation.

CARGO COMPARTMENT WINDOWS
(See figures 8 and 9)

marked EMER EXIT, TURN, PUSH. The window must then be pushed out. The modified windows may be opened from the outside by pulling down on the handle below the window marked: EXIT RELEASE PULL DOWN, and pulling the window out.

A jettisonable window is located over each sponson. To open, turn handle below window,

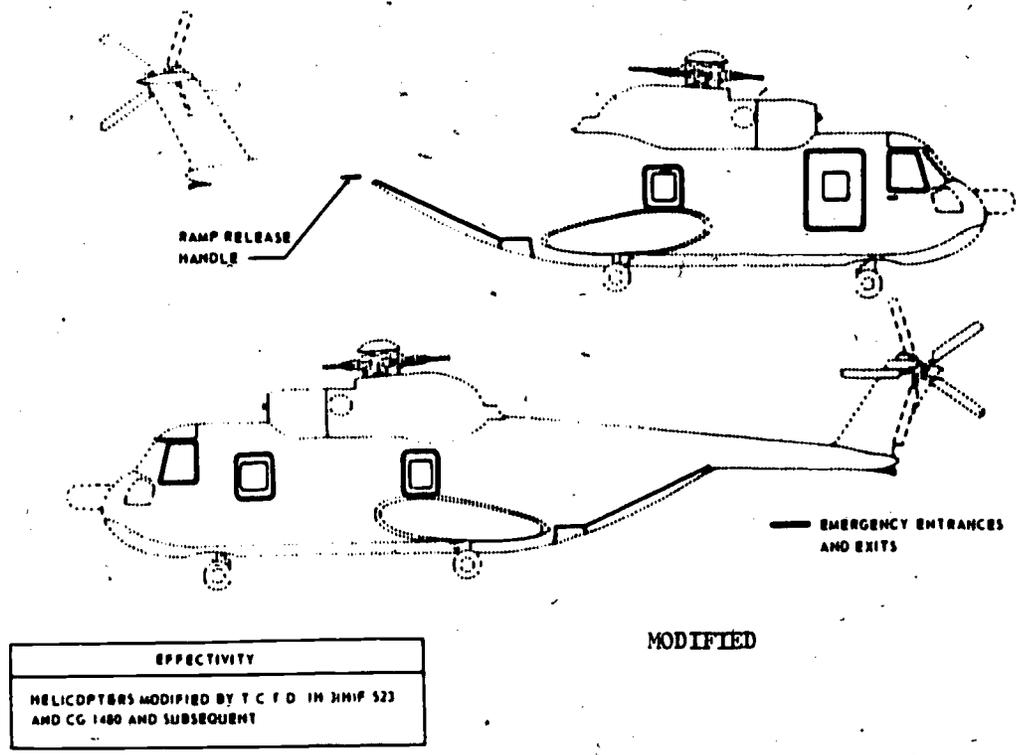


Figure 9. - Emergency entrances and exits.

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RAMP (See figure 8.)

Emergency exit can be accomplished through the aft ramp by pulling the handle marked: EMERGENCY EXIT RELEASE HANDLE, on the starboard aft wall of the cargo compartment. The ramp may be lowered from the outside by pulling a handle, located below the tail pylon under a cover beside which is marked RAMP RELEASE HANDLE PULL. When the handle is pulled and held in the down position, the ramp hydraulic cylinder moves to the open position and the aft ramp unlatches. With the handle held in the down position, the ramp will then open by its own weight, permitting entrance to the cargo compartment.

EMERGENCY EXIT LIGHTS

The two removable emergency exit lights, installed in the cabin above each emergency exit, have a self-contained battery that will cause the light to illuminate whenever DC power to the light is interrupted. The lights may be removed from the helicopter in the event of an emergency evacuation by pulling on the handle, marked PULL, located at the top of each light. When the light is removed, a switch on the light housing is actuated, causing the light to operate on battery power. Once the light is removed, it may be turned off by pushing the handle in and turned on again by pulling the handle out. The emergency exit lights are controlled by a switch on the overhead switch panel. The switch is marked EMER EXIT LTS, with marked positions ARM, TEST, and DISARM. Placing the switch in the ARM position arms and provides electrical power to charge the self-contained battery. The lights are tested by moving the switch to the TEST position, which interrupts power to

the lights causing them to illuminate. The lights are turned off by placing the switch in the DISARM position. The emergency exit lights receive power from the DC monitor bus through a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked EMER EXIT LTS ARM under the general headings DC MON.

NOTE

The emergency exit lights will operate if submerged in water.

EMERGENCY EQUIPMENT

PORTABLE FIRE EXTINGUISHERS

One hand-operated (CO2) fire extinguishers (6, figure 10) is located in the cockpit on the bulkhead behind the pilot's seat. A second (CO2) fire extinguisher (13, figure 10) is located on the right side above the ramp. The extinguishers are held in place by a bracket with a tight fitting quick release spring.

FIRST AID KITS

One first aid kit (5, figure 10) is mounted in the cockpit, on the bulkhead behind the pilot's seat. Five additional kits are installed in the cabin, one on the left (3, figure 10) and four on the right side (8, 9, 10, 11, figure 10). Each kit is held in place by a metal frame and supporting clips.

CRASH AXE

One crash axe (4, figure 10) is installed below the step at the cockpit entrance. The axe is secured by a bracket and strap.

LIFE RAFTS

There are provisions for stowage of two MK-7 life rafts on the aft cargo ramp (1 and 14, figure 10).

PARACHUTE AND LIFE JACKET STOWAGE

There are provisions for the stowage of twelve QAC parachutes, six on each side of the cargo compartment. Twenty-four hangers are located below the aft radio rack for stowage of parachute harnesses and life jackets. The cockpit seats are designed to accommodate back pack parachutes.

UNDERWATER ACOUSTIC LOCATOR BEACON (PINGER)

Each helicopter has installed a Dukane Model N15F210B "pinger" on the left side of the cabin at station 198. This battery operated underwater acoustic beacon is a highly reliable, impact-resistant, water-activated, lightweight unit that will enhance locating crashed aircraft in a water environment of any depth to 20,000 feet.

This unit has an operating life of thirty (30) days after-actuation by immersion in fresh or salt water and has a detection range of 2,000 to 4,000 yards, depending upon exposure and sea state.

Special receiving equipment is necessary to locate signals from an activated "pinger".

WATER CONTAINER

The 2-gallon drinking water container is located next to the relief tube on the left side of the forward ramp and is held in place by two quick disconnect straps (2, figure 10).

AUXILIARY FLOTATION SYSTEM

The auxiliary flotation system (figure 11) gives the helicopter additional stability while on water with the rotor system stopped. The system consists of two inflatable bags, two compressed air cylinders, and a manual release. A bag is located

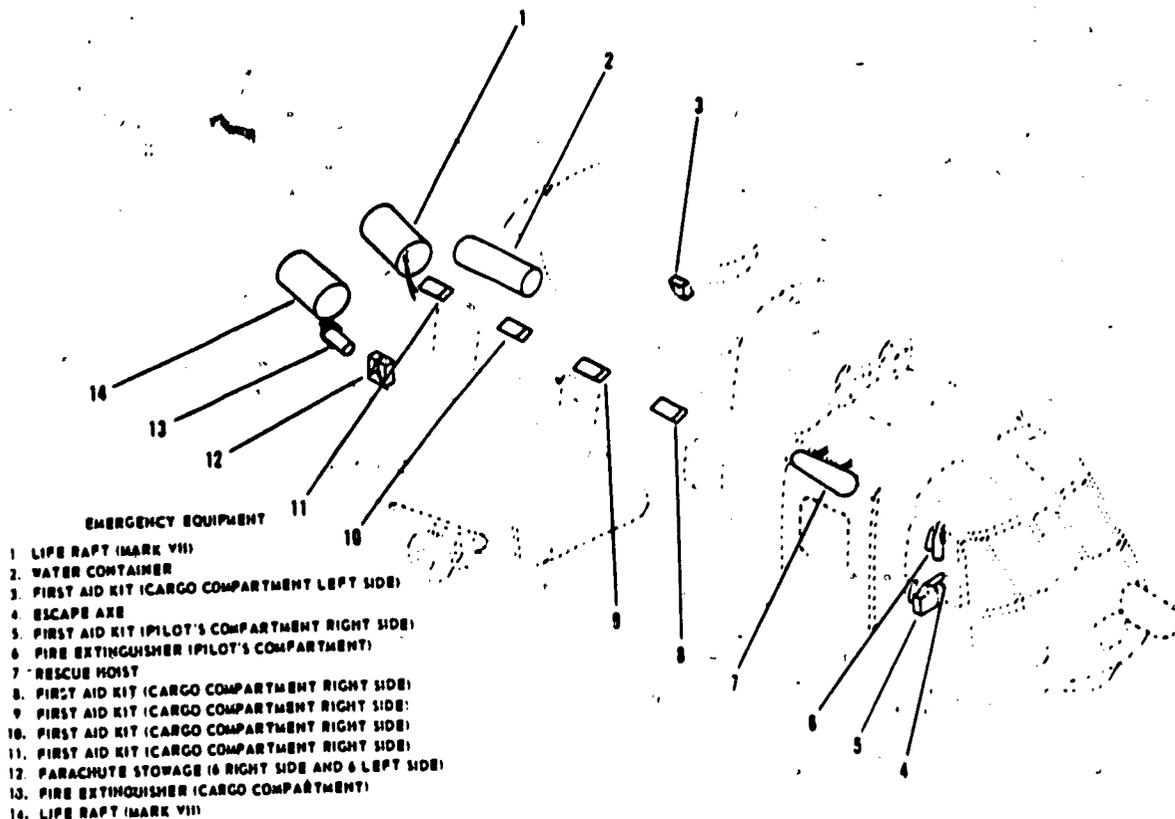


Figure 10. - Emergency equipment.

on the outboard chine of each sponson, and is stowed in a fabric enclosure. The bags are inflated by two cylinders located in the leading edge of the left sponson. Each bag is divided into two compartments, fore and aft. The forward compartments of the bags are inflated by the bottom air cylinder, and the aft compartments are inflated by the top cylinder. The two air cylinders are connected to their respective bag compartments by separate air lines. This system of inflation ensures a symmetric configuration of the pop-out bags in the event of damage to any component. The system is activated by pulling the AUX FLOAT handle down. The handles are located on the left side of the cabin between and above the

second and third windows and above the co-pilot's seat. Pressure gages are provided for both air pressure cylinders and can be viewed through a window in the left sponson. The cylinders are fully serviced if the gages indicate between 2,650 and 3,000 psi.

AUXILIARY FLOTATION COLLARS

The auxiliary flotation collar system provides increased lateral stability while the helicopter is on the water with the rotor system stopped. All helicopters will be modified by TCTO 1H-3(H)F-574, which

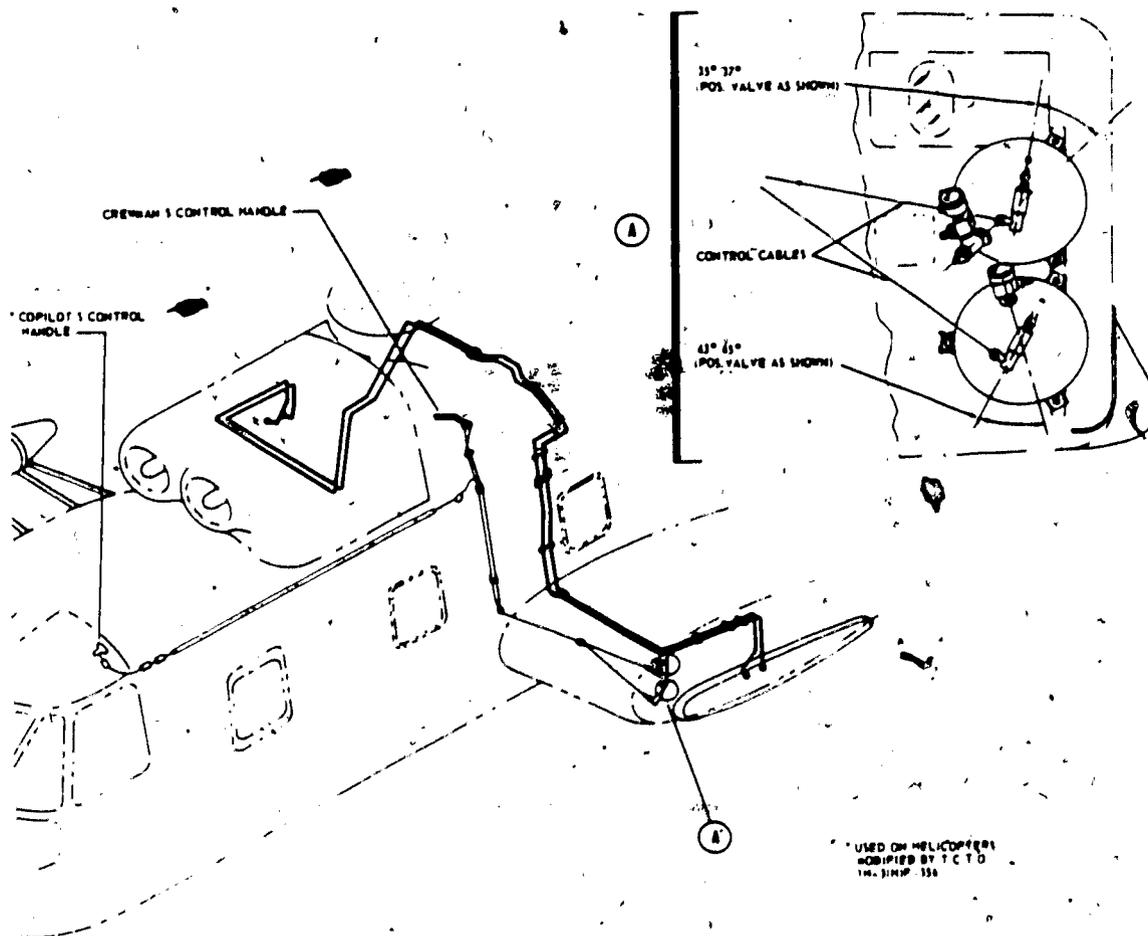


Figure 11. - Auxiliary flotation system - component location.



Figure 12. - HH-3F with auxiliary flotation collars deployed.

directs the installation of sponson hardpoints to which the auxiliary flotation collars will be attached. The auxiliary flotation collar system consists of two collars: one for attachment to the left sponson (container identified by LEFT HAND and has a RED STRIPE), and one for attachment to the right sponson (container identified by RIGHT HAND and has a GREEN STRIPE). Each collar is packed in a modified MARK-7 life raft container, and each weighs approximately 60 pounds.

The collar system can be installed from the sponsons once the helicopter is on the water. Detailed installation instructions are located in the salvage portion of the HH-3F Maintenance Manual (T.O. 1H-3(H)F-2-2). When both collars have been attached, they should be inflated simultaneously. The collars are made of raft fabric and contain primary and secondary inflation chambers. The inflation chambers are not interconnected and are inflated by separate self-contained CO₂ bottles. The secondary chamber should be used only when the primary chamber is malfunctioning. (See figure 12.)

CAUTION

Inflation of both chambers at the same time will cause overinflation and possible rupture of the collar.

The crewmember should follow the brief checklist below when installing auxiliary flotation collars:

1. Remove and stow over the sponson emergency exit windows.
2. Adjust crewmember's safety harness to be able to reach all portions of the sponson.
3. Secure power to HF and LORAN.
4. Crewmember with crewmember's safety harness moves out onto sponson, and second crewmember passes appropriate collar out window.
5. If required, remove HF and LORAN antennas.
6. Connect flotation collars to sponson hardpoints in numerical sequence. (See figure 13.)
7. Inflate both collars simultaneously by using the yellow lanyards.
8. Rig secondary inflation system. Lanyards for secondary system are green.



(This checklist is explained in detail under INSTRUCTIONS FOR ATTACHING FLOTATION COLLAR TO HH-3F, discussed later in this section.)

CAUTION

Do not inflate secondary unless primary compartment is completely deflated. If primary compartment deflation is imminent, carefully rupture outside skin and then inflate secondary compartment.

NOTE

Since initial purchase of auxiliary flotation collars does not provide a set for each helicopter, the collars may have to be delivered to the downed helicopter.

A helicopter may takeoff from the water with the auxiliary flotation collars attached, but airspeed must be limited to 70 knots. Tow speeds of up to four knots may be used with the auxiliary flotation collars attached, depending on sea conditions.

INSTRUCTIONS FOR ATTACHING FLOTATION COLLAR TO HH-3F

1. Move collar to sponson emergency exit, making sure the correct bags are positioned for each side. Remove nylon retainer line and attach to tiedown ring beneath window.
2. Remove and stow sponson emergency exit window. One crewmember should exit through window and onto sponson, assuring crewmember's safety harness is properly worn and attached as close as possible to emergency exit. (See figure-14.)
3. Second crewmember pass collar through window and onto sponson with retainer line inboard. Place on sponson and unwrap cover completely.
4. Unfold collar, keeping retainer line near to side of aircraft to prevent fouling.

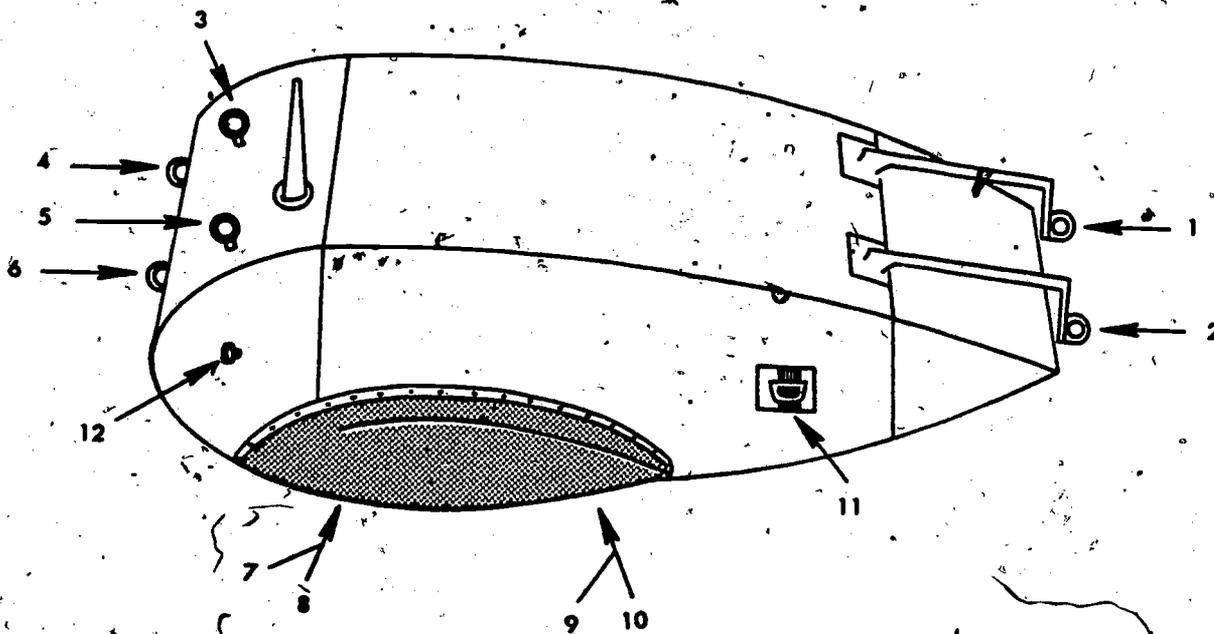


Figure 13. - Hardpoint location numbers.



Figure 14. - Auxiliary flotation collar installation.

- 5. Move to attachment points 1 and 2 at trailing edge of sponson and attach collar. Remove yellow lanyard from snap enclosure on primary bottle and return to line tender at emergency exit.
- 6. Arrange collar around outer perimeter of sponson to attachment points 3 and 4 at forward inboard edge of sponson. Attach top strap #3 and reach under bag and attach #4. Check to see that chafing packs are toward sponson and that collar is not twisted.
- 7. Move to attachment points 5 and 6 at forward outboard edge of sponson. Attach top strap to #5. Reach under bag and attach #6.

8. Move to attachment points 7 and 8, which are the forward "Y" straps. Pull straps around forward end of aircraft float bag and attach short strap #7 collar; then connect #8 and push strap back down under bag.
9. Move to attachment points 9 and 10, which are the aft "Y" straps. Pull straps around aft cover of float bag and attach. Push straps back down under bag as far as possible.
10. Attach point 11 to collar just aft of 9 and 10.
11. Move to #12 at forward outboard side of sponson and attach.
12. Recheck collar for twisting or abnormalities.

When collars are fully attached on both sides, pull yellow inflation lanyards to inflate both sides simultaneously. After inflation, recheck both sides and bring secondary lanyard (green) to exit for standby emergency use.

COLD WEATHER PROCEDURES

The major problems in cold weather operations are the preparation for flight, restricted visibility from blowing snow, and the adverse effects on helicopter materials. Moisture, usually from condensation or melted ice, may freeze in critical areas. Tire, landing gear strut, fire extinguisher bottle, and accumulator air pressures will decrease as the temperatures decrease. Extreme diligence on the part of both ground and flight crews is required to ensure successful cold weather operation. Flight control hardovers have been induced on the HH-3F aircraft by the freezing of condensate in the primary servos. If this condition exists and the APU is started, the flight controls may be in a hardover condition and remain there until the hydraulic system attains normal operating temperatures. Do not attempt to engage the rotor system if the above condition is suspected to exist.

Pilots should be aware of the fact that the horizon may be lost when flying

over large unbroken expanses of snow. If such a situation exists, the helicopter should be flown entirely by instruments at a safe instrument altitude. Colored glasses should be worn in snow areas to prevent snow blindness. The problems that pilots encounter when operating from snow covered surfaces are compounded when operating from other than an operational base. When the aircraft is hovering in loose or powdery conditions, all ground references may be lost due to blowing snow. Smoke markers will assist in providing reference and determining wind.

WARNING

When the helicopter lands on snow, the main and tail rotor ground clearances are reduced with the helicopter resting on the fuselage. Therefore, personnel entering or leaving the helicopter should exercise extreme caution to preclude being struck by the blades.

WARNING

Make sure static electricity generated by the helicopter is dissipated before attempting a sling or hoist pickup, particularly in colder dry climatic conditions when static electricity buildups are large. To dissipate this static charge, allow the sling or hoist to touch the ground, or use a conductor to make contact between the helicopter and the ground. Use care not to break contact as the static charge will rebuild immediately.

NOTE

Rotor wash or wind will have a supercooling effect, which may reduce the efficiency of exposed personnel. Consequently, the time that survivors and/or ground personnel are exposed to rotor wash should be held to a minimum.

PREPARATION FOR FLIGHT

In addition to accomplishing a normal exterior inspection, thoroughly inspect engine inlets, rotor head, main rotor blades, tail rotor, and flight controls and make sure they are free of all ice and snow. Failure to remove snow and ice accumulations while on the ground can result in serious aerodynamic and structural effects when flight is attempted. Ice chocks should be used.

CAUTION

Do not attempt to chip or scrape snow and ice from any surface or controls. Portable ground heaters or de-icing fluid may be used to remove any accumulation that cannot be swept off.

Check to see that fuel tank vents, battery compartment vent tube, and pitot tubes (including static ports) are free of snow and ice; that landing gear struts and tires are properly inflated; and that a warm well-charged battery has been installed, if practicable. Check the engines for ice and snow. If ice or snow is found, thaw out the engine with hot air before attempting to start.

STARTING APU

The lower the temperatures, the greater will be the amount of accumulator pressure required for a start. At -54°C. (-65°F.) a pressure of approximately 4,000 psi is required to start the APU.

WARMUP AND GROUND TESTS

At temperatures below freezing, immediately after APU start, turn on the cabin heater, and windshield anti-ice system, close the cargo door and remove the rubber transmission access panel. Check the transmission oil pressure and temperature. When engaging the rotor head, be careful not to exceed the transmission oil pressure limitations.

CAUTION

A longer warm-up period during cold weather is required to bring engine and transmission oil temperatures up to desired operating range. When ambient temperature is below -6.7°C. (20°F.), operate the APU until the main transmission oil temperature gage indicates -6.7°C. (20°F.) before rotor engagement is accomplished. If a rotor brake fails, do not start engines until this warm-up period is completed to prevent damage to the main transmission.

CAUTION

When starting the APU with low ambient temperature, clutch engagement time will increase due to greater breakaway torque levels among the accessories. The APU should be shut down if acceleration between 76% and 80% hangs up more than 6 seconds.

ENGINE STARTING

At extremely low temperatures, it is possible that the engine oil pressure will go to a maximum value during an engine start. Ensure that ground heater ducts have been removed; then accomplish normal engine start. If there is no indication of oil pressure after 30 seconds of engine operation at ground idle, or if oil pressure drops to zero after a few minutes of ground operation, stop engines and investigate.

Alternate Engine Starting/Rotor Engagement With APU Inoperative

If the APU is inoperative, the number one engine should be started and the rotors engaged by using the procedures outlined in Section IX of the Flight Manual (T.O. 1H-3(H)F-1).

TAXIING INSTRUCTIONS

The helicopter can be taxied in snow. Increased collective pitch may improve steering. Snow-covered surfaces may contain hidden obstructions or hazards. A lower pitch and higher ground speed, to get ahead of the blowing snow, may improve visibility. At temperatures below -0°C. (32°F.) wheel braking action is fair to good. However, as temperatures rise, increased caution must be used.

WARNING

In cold weather, make sure all instruments have warmed up sufficiently to ensure normal operation. Check for sluggish instruments during taxiing.

TAKEOFF

Select an area devoid of loose or powdery snow to minimize the restriction to visibility from blowing snow, and make sure the wheels are not frozen to the snow or ice.

DURING FLIGHT

During flight, use the cabin heater, engine inlet antiicing, and windshield anti-ice protective systems, as required. The horizon may be lost during flights over large unbroken expanses of snow. If such a situation exists, the helicopter should be flown entirely by instruments at a safe instrument altitude. After takeoff from water, wet snow, or slush-covered field, operate the landing gear through several completed cycles to preclude their freezing in the retracted position. (Expect slower operation of the landing gear in cold weather due to thickening of all lubricants.)

HOT WEATHER PROCEDURES

Hot weather operation, as distinguished from desert operation, generally means operation in a hot, humid atmosphere. High humidity usually results in the condensation of moisture throughout the helicopter. Possible results include malfunctioning of electrical equipment, fogging of instruments, rusting of metal parts, and the growth of fungi in vital areas of the helicopter. Further results may be pollution of lubricants and fluids and the deterioration of nonmetallic materials. Normal procedures will be followed for all phases of operation, with emphasis placed on the data contained herein. More power will be required to hover during hot weather than on a standard day. Hovering ceilings will be lower for the same gross weight and power settings on a hot day. Check for the presence of corrosion or fungus at joints, hinge points, and similar locations. Any fungus or corrosion found must be removed. If instruments, equipment, and controls are moisture coated, wipe them dry with a clean, soft cloth.

NOTE

As fuel density decreases with a rise in ambient temperature, total usable fuel quantities will be reduced, thus resulting in a decrease in normal operating range.

AFTER LANDING

When the helicopter is parked, the doors and windows, except the cockpit windows, should be opened if weather permits. The cockpit windows should remain closed to prevent unexpected rain showers from pooling water on control panels, which could create short circuits.

DESERT PROCEDURES

Desert operation generally means operation in a very hot, dry, dusty, often-windy atmosphere. Under such conditions sand and dust will often be found in vital areas of the helicopter. Sand and dust may cause severe damage to the affected parts. The helicopter should be towed into takeoff position, which if possible should be on a hard, clear surface, free from sand and dust.

PREPARATION FOR FLIGHT

Check for the presence of sand and dust in control hinges and actuating linkages, and inspect the tires for proper inflation. High temperatures may cause over-inflation. The oleo struts should be checked for sand and dust, especially in the area next to the cylinder seal, and any accumulation removed with a clean, dry cloth. Inspect for, and have removed, any sand or dust deposits on instrument panel and switches, and on and around flight and engine controls.

ENGINE STARTING, WARM-UP,
AND GROUND TESTS

If possible, engine starting and ground operation should be accomplished from a hard clean surface. Complete the normal

engine start, warm-up, and ground tests, but limit ground operation to a minimum, because the downwash from the main rotor may stir up clouds of sand. Make every effort to minimize the amount of sand being blown up around the main rotor and engines.

BEFORE LEAVING THE HELICOPTER

Install all protective covers and shields. Leave windows and doors open to ventilate the helicopter except when sand and dust are blowing.

STOPPING ENGINES

Shutdown the engine as soon as practical after landing to minimize the ingestion of sand and dust.

In this section we have discussed emergency in-flight procedures for the HH-3F. You should now be familiar with the emergency exits on the HH-3F. You have learned what to do in case of an in-flight fire or fuel fumes in the aircraft. You have also learned how extreme environmental conditions can affect any system on an aircraft. Also discussed was the auxiliary flotation collar.

(Now answer the following review questions.)

5. What is one of a crewmember's duties during a helicopter autorotation?
 - A. Jettison all loose gear
 - B. Close cabin door
 - C. Brief passengers
 - D. Jettison cabin door
6. What is the FIRST step in fighting a cabin or cockpit fire?
 - A. Advise the pilot of the status of the fire
 - B. Make sure that all doors and windows are closed
 - C. Stand by for emergency landing
 - D. Man the fire extinguisher and proceed to fight the fire
7. Which openings on the HH-3F are the MOST effective for smoke and fume elimination?
 - A. Ramp and the radioman's window
 - B. Cargo door and the ramp
 - C. Ramp and cockpit sliding windows
 - D. Cargo door and the cockpit sliding windows
8. The MINIMUM altitude at which a crewman should bail out of an HH-3F is _____ feet.
 - A. 1,000
 - B. 1,200
 - C. 1,500
 - D. 2,000
9. The cabin on an HH-3F modified by TCTO 1H-3(H)F-523 has a total of _____ emergency exits.
 - A. four
 - B. five
 - C. six
 - D. seven
5. C The briefing will make the passengers aware of what is taking place and will also make sure that they know what to do (Refer to page 9)
6. B You must get rid of air drafts as much as possible because they feed the fire (Refer to page 9)
7. ~~B~~ These openings bring in slipstream air to carry smoke and fumes out of the aircraft (Refer to page 9)
8. A (Refer to page 10)
9. B There are two on the starboard side and two on the port side and the ramp (Refer to page 15)

10. The ramp external release handle is located _____.

- A. below the tail pylon
- B. on the fuselage lower half
- C. on the right side of the aft fuselage
- D. on the left side of the aft fuselage

11. What is the total number of hand-operated CO₂ fire extinguishers on the HH-3F?

- A. One
- B. Two
- C. Three
- D. Four

12. The flotation system bottles are fully serviced at which of the following?

- A. 2,650 psi only
- B. 2,800 psi only
- C. 3,000 psi only
- D. All of the above

13. The main transmission oil must be preheated before rotor engagement if the oil temperature is below _____.

- A. 35° F
- B. 30° F
- C. 25° F
- D. 20° F

14. As fuel density decreases with a rise in ambient temperature, total usable fuel quantities will _____.

- A. increase
- B. reduce
- C. stay the same
- D. fluctuate

10. A This is for easy access to the aircraft (Refer to page 16)

11. B One is located on the right side by the ramp and one in the cockpit behind the pilot's seat. (Refer to page 16)

12. D The bottles are considered to be fully serviced between 2,650 and 3,000 psi. (Refer to page 18)

13. D The oil, being cold congealed, could cause damage to the main gear box (Refer to page 23)

14. B (Refer to page 24)

HOISTING, RESCUE PLATFORM, AND CARGO SLING PROCEDURES

OBJECTIVES

When you complete this section, you will be able to:

1. Outline correct procedures used in performing a hoist.
2. Use the correct terminology when making a hoist.
3. State the correct procedures used in a rescue platform recovery.
4. Explain the correct techniques used in a cargo sling operation.

WATER RESCUE PROCEDURES

The equipment required for a rescue platform recovery or hoist should be rigged before beginning the approach or when established in a stable hover. If possible, the crewmen should be seated with seat belts and harnesses fastened and seats facing forward during the approach to a hover. At the direction of the pilot the crewman will complete the Rescue Checklist. The Rescue Checklist shall be posted in the helicopter at the Hoist Operator's Station.

The Rescue Checklist consists of, but is not limited to:

1. Aircrewmember's rescue harness on and adjusted.
2. Check rescue rig (basket, sling, platform) for condition and rigging.
3. Check hot mike (pilot and copilot response); request hoist power.
4. Roll and pitch bias centered.
5. Request permission to open up.
6. Rig rescue gear.
7. Conduct Crew briefing.
8. Report ready to pilot.

CAUTION

Operation of the hoist at airspeeds above 80 KIAS will result in possible airframe/hoist damage.

HOISTING PROCEDURES

GENERAL

Most SAR hoists will be made from a boat or a ship. Although the procedures below cover

this type of hoist, they are adaptable to land and water hoists. The pilot will brief the crew after evaluating the situation and prior to commencing the hoist. The quality of this briefing will determine how efficient and safe the hoist will be.

To make a successful rescue by hoisting requires close coordination and cooperation between the pilots and the crew. The use of standard rescue procedures will improve crew coordination by ensuring that pilots and crewmembers are using proven procedures and voice reports to make a rescue.

The hoist operator will wear a heavy work type glove on the hand used to guide the hoist cable and whenever possible will have his helmet visor down.

Extreme care should be used when hoisting the rescue device. If pendulum action and rotation of the rescue device are not quickly stopped, the rotations may increase to unmanageable proportions. The pendulum action may be dampened by moving the cable in the opposite direction of the movement of the rescue device. Rotation of the rescue device can be stopped, if detected early, by rotating the hoist cable in a one or two foot diameter circle in the opposite direction of rotation of the rescue device.

When pulling the survivor into the helicopter, the easiest method is to turn his back to the helicopter and pull him in. This procedure will reduce the possibility of a semi-conscious or injured survivor fighting the hoist operator. The rescue device should never be removed from the hoist cable or the survivor until he is safely inside the helicopter and clear of the door.

STANDARD HOIST

When the helicopter is established in a hover, the pilot will adjust his altitude to maintain

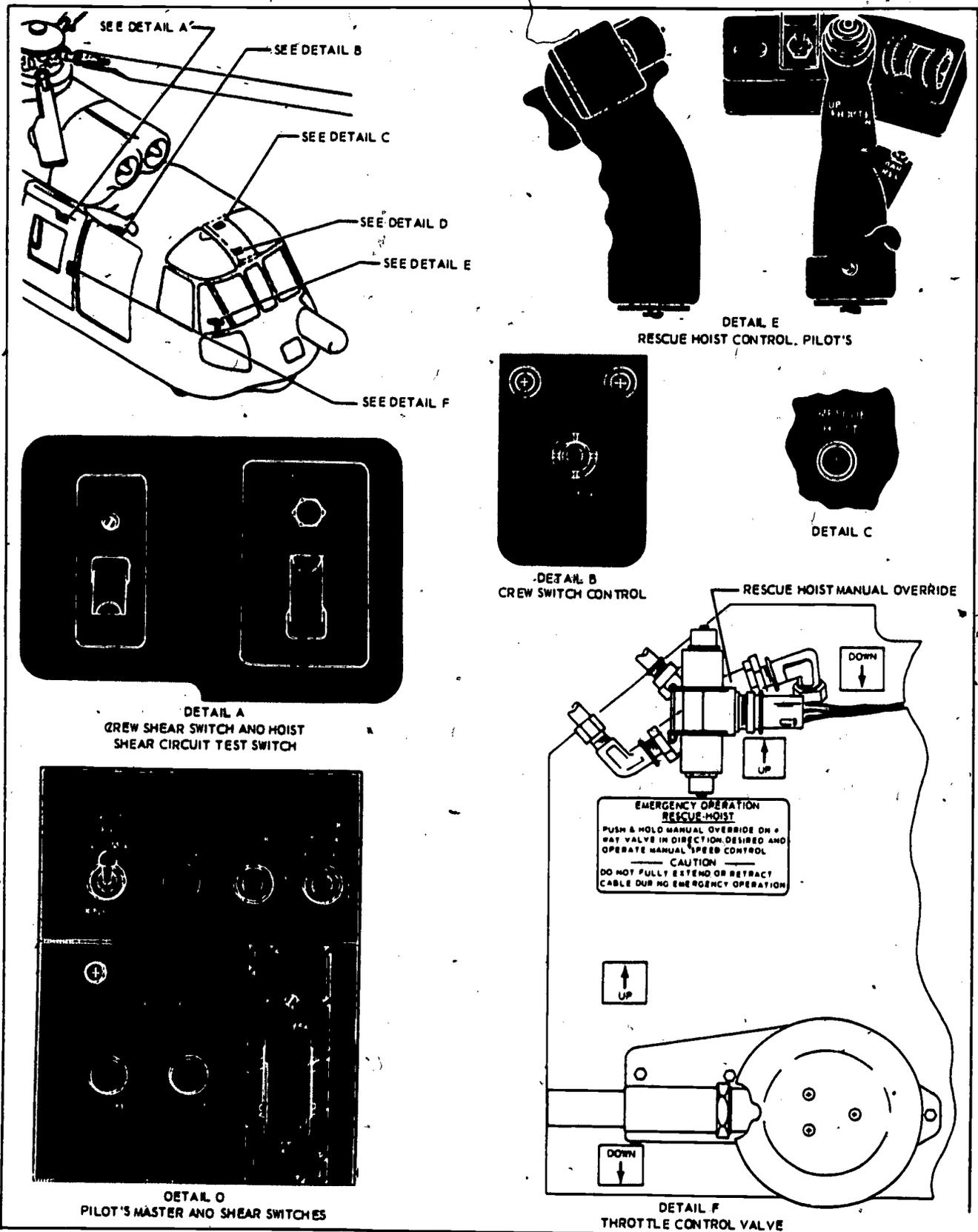


Figure 15. - Rescue hoist controls.

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obstruction clearance, check his torque/T5, give last minute instructions to the copilot and hoist operator.

When the pilot is satisfied that all is ready, he will direct the crewman, "go on hot mike." At this time, the crewman should go on the hot mike, start the hoisting rig down, and begin normal hoisting ADVISORY REPORTS.

When the pilot directs the crewman to "conn me in," the crewman should begin giving the pilot directional COMMANDS to position the helicopter over the hoisting area.

NOTE

COMMANDS are given in reference to the fore and aft axis of the helicopter to direct the pilot to move the helicopter in that direction. ADVISORY REPORTS keep the pilot informed of everything else that is occurring during the rescue.

After the basket, litter, or sling is on deck, the pilot must hold a steady position. When the person being hoisted is safely in the rescue device, and the helicopter is in a steady hover directly over the rescue device, the crewman will raise the hoist. During the hoist evolution, continuous COMMANDS will be necessary to keep the pilot exactly over the hoisting area.

Once the rescue device is clear of the deck and all obstructions, the crewman will notify the pilot with the appropriate ADVISORY REPORT and continue to give COMMANDS moving the helicopter clear of the vessel until the pilot reports "Cease commands".

After reporting "Cease commands" the pilot will continue to move off on his own until he is well clear of the vessel and in a safe, stable hover.

When the rescue equipment is safely in the cabin, the hoist operator should report; "Basket in cabin." After all hoist equipment is secured and the survivor(s) are securely placed in seats, the hoist operator reports; "Going off hot mike, ready for forward flight."

BOAT HOIST

Communications should be established with the vessel as soon as possible, prior to arriving on scene, to expedite the rendezvous and the hoist. The vessel should be briefed as follows:

1. The desired course and speed of the vessel (course 35° to 45° to right of wind line and underway).

2. The method of retrieval (basket, litter) to be provided by the helicopter.

WARNING

Do not use vessel's equipment except as a last resort. Aircraft litters are specially stressed and rigged for hoist operations and must be used for maximum safety of the patient.

3. To discharge the static electricity prior to handling the hoisting rig.
4. If hoisting rig is to be moved from the hoist location, to have the vessel's personnel disconnect the hoist cable.
5. To ensure that hoist cable is not secured to any part of the vessel.
6. To have vessel lower and/or stow all antennas, booms, rigging, flagstaffs, loose gear, etc., from the hoist area.
7. Additional information to be passed as required.

NOTE

During hoisting operations, advise the vessel of the number of persons on board. In the event of a mishap to the helicopter, the crew of the vessel will know how many persons to rescue from the helicopter. It may also be helpful to know the number of persons on the vessel.

If voice communications cannot be established, the pilot, upon arriving on scene may direct the crewmember to drop message blocks, use hand signals, chalkboards, loud-hailers, or he may just have to move into position and commence the hoist. The rescue checklist should be completed prior to commencing the approach or when established in a stable hover.

WARNING

Extreme caution must be exercised when hoisting from small boats and rafts, particularly if unable to maintain way, due to the danger of capsizing them with



Figure 16. - Hoist, with basket going down.





rotor downwash. If the boat can maintain way which when combined with relative wind exceeds 15 knots, a successful hoist can generally be performed; however, broadside approaches can result in the vessel capsizing.

The helicopter should be brought to a hover about 15 to 20 yards short of the vessel. The pilot will direct the hoist operator to go on HOT MIC and conn the pilot into position. The hoisting rig should be started down as early as possible to limit the hoist time over the vessel. The helicopter will be positioned over the vessel at as low an altitude as safely practicable. It is desirable to have the vessel underway or maintaining steerageway with the wind over her port bow. The hoist operator must keep the pilot informed at all times.

As the basket clears the deck and obstructions, the pilot will move the helicopter clear of the vessel. This is advisable for two reasons:

1. To prevent serious injury to personnel or damage to the vessel if an engine failure occurs, and
2. To let the pilot see the vessel, so that he can maintain a more stable hover. When clear of the vessel, the pilot may slowly lower the helicopter to a safe hovering altitude as the hoisting rig is raised.

When the hoist operator has the rescue device inside the cabin, he should report, "Basket in cabin." When certain other tasks have been performed (SEE HOISTING PHRASEOLOGY SECTION), he should report "Going off hot mike, ready for forward flight." The helicopter should not be transitioned to forward flight until the hoist operator reports: READY FOR FORWARD FLIGHT.

WARNING

Discharge static electricity prior to attempting a hoist. Breaking contact will result in an immediate rebuilding of the electrical charge. DO NOT ground the hoist near spilled fuel.

WARNING

In the event of electrical failure to the hoist, attempt to determine the cause (bent cable, fouled cable, etc.), visually check the hoist, and secure the Hoist Master Switch prior to using manual hydraulic override. Use of override with fouled reel or cable can cause damage and possible parting of cable. If resistance is met when using override, operation should be stopped immediately to prevent further damage. The hoist master switch must be placed in the OFF position when using the manual hydraulic override to prevent injury to personnel or equipment, should electrical power suddenly be restored. The intermediate limit switch and the up and down limit switches are inoperative with electrical power loss and the hoist is capable of operating in excess of 100 ipm in this configuration. Therefore exercise caution when operating near cable extremities, and adjust cable speed accordingly.



Figure 19. — Hoist from water.

CAUTION

Before the rescue device is raised from the deck, the helicopter should be in a stable hover directly over the rescue device.



Figure 20. Basket directly over boat.



Figure 21. - Vertical sling hoist.

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CAUTION

The hoist operator must never allow the hoist cable or hook to be secured to any part of the vessel. If this should happen, the hoist operator should immediately run out slack cable, advise the pilot, and then attempt to have the boat personnel assist in releasing it. If the attempt to free the cable or hook is unsuccessful, the hoist shear may have to be used.

CAUTION

The AFCS heading retention feature should be used to prevent inadvertent heading change.

NOTE

Use of an altitude coupled hover may be desirable during hoist operations.

TRAIL LINE HOIST**Purpose of the Trail Line**

The combination of boat size, mast or antenna obstructions, rigging obstructions, and little or no relative wind may result in a hoist during which the pilot will be unable to see the vessel. Weather conditions might also prevent the pilot from maintaining a high, no-reference hover for any length of time. In these situations the trail line hoist can be used to simplify the hoist operation. The use of a trail line reduces the time the pilot is required to maintain a precise, perfectly stable hover, without a reference. The trail line also prevents wide swinging during a high hoist or when a rescue device must be lowered to a restricted location on deck.

A weight should be attached to the end of the trail line that does not have a weak link. (The weak link is a safety device which protects the helicopter by NOT allowing more than 300 pounds of force to be applied to the trail line. If more is applied, the weak link will part.)

The weak link end of the trail line may be fastened to either the hoist hook small eye or the rescue device.

CAUTION

During a hoisting evolution the trail line is snapped to the hoist hook or the hoisting device by the weak link, **JUST BEFORE** the device goes out the door. Until then the trail line must be **HAND HELD**.

Procedures for a Trail Line Hoist

The procedures for a trail line hoist are exactly the same as for a boat hoist through the approach and hover astern of the vessel. The weighted trail line is passed to the vessel using standard hoist procedures.

CAUTION

The hoist operator must use extreme care when handling the trail line to prevent getting it fouled in the helicopter rotor system.

CAUTION

The pilot will normally lose sight of the vessel during this phase of the operation and will have to rely entirely on the hoist operator for position information.

Once the trail line is on the vessel and the boat crew is tending it, the hoist operator will report, "Trail line on deck," and then give **COMMANDS** to the pilot directing him clear of the vessel while paying out slack in the trail line. When the pilot can again see the vessel and has reported "Cease commands", the hoist operator will begin to lower the hoist and continue to give **ADVISORY REPORTS**.

Shipboard personnel then use the trail line to guide the rescue device into the desired location.

When the rescue device is on the vessel's deck and the survivor is ready for hoisting, the pilot will direct the hoist operator to "conn me in," at which time the hoist operator will give the pilot **COMMANDS** to get the helicopter back to a position directly over the hoisting rig and hoist



vertically from the deck. Retrieving the rescue device vertically may not always be possible. Be aware of this and be prepared to recover the rescue device at an angle. However, when conditions permit, always recover the rescue device vertically.

As soon as the survivor is clear of the deck and all obstructions, the hoist operator will give the pilot **COMMANDS** to clear the helicopter away from the vessel, usually left but sometimes back until the pilot reports "Cease commands." This position should be maintained until the survivor is in the cabin and the trail line is either retrieved or discarded and the hoist operator has reported ready for forward flight.

Once clear of the vessel the pilot will continue to move off on his own until he is well clear of the vessel and in a safe, stable hover.

HOISTS FROM WATER

As the helicopter approaches a hover, the hoist operator should be directed to put the hoisting rig over the side. The helicopter should be brought to a hover, over the survivor, with assistance of the hoist operator's **COMMANDS** and **ADVISORY REPORTS**. It may be necessary to drop charts, floats, smoke markers, etc., upwind to give the pilot some reference points during the hoist. Other aids that may be used for reference are water foam, debris and rotorwash patterns.

WARNING

Rotor downwash may cause difficulty in breathing and could result in the drowning of the survivor. Consideration should be given to the utilization of trail line procedures for a conscious survivor.

DEWATERING PUMP DELIVERY

Because of a dewatering pump's size and weight, the pump could easily cause injury to personnel and damage to the vessel to which it is being delivered. This is particularly true if the vessel is pitching and rolling in a rough sea.

The indirect method of delivery is to deliver a weighted trail line to the vessel. Then the helicopter moves off and establishes a low hover clear of the vessel. The trail line is securely attached to the "D" ring on the pump bridle (without a weak link) and the pump is put into the water.

The vessel's crew can pull the pump to them through the water. The trail line is delivered to the vessel in the standard manner, and then the hoist operator gives the pilot **COMMANDS** to move the

helicopter until the pilot can see the vessel. The pilot will then continue to move **LEFT** or **LEFT** and **AFT** of the vessel until the vessel is well clear of the rotor downwash and the rotor blades. The pilot will then begin a descent to a low hover over the water after which the hoist operator will connect the trail line to the D-ring on the drop pump bridle. When the hoist operator receives the command from the pilot to put the pump into the water, he will simply push the drop pump out of the door, taking care that the pump does not become fouled in the line that is connected to it. He will also make sure that when the pump goes out, the line cannot foul on the helicopter.

The boat must be dead in the water to deliver the dewatering pump this way, and there must be sufficient personnel aboard the vessel to lift the pump aboard.

If there is some reason why the previous procedures cannot be used, the drop pump can be safely delivered directly to the deck of the vessel, but extreme care must be taken to avoid damage to the vessel or injury to personnel on deck. This can be done by using the trail line first, remembering that this is a hoist and the weak link should be attached as described under **TRAIL LINE HOISTS**. Instead of a trail line hoist using a rescue device, the hoist will be made using a pump. In this type of hoisting, try to remain over the vessel during the hoist. Moving left will make it very difficult for deck personnel to retrieve the pump. Once the trail line is delivered, personnel on deck can steady the pump and guide it directly to a spot on deck. This is a variation of the standard hoist, which works equally well with a basket, litter or pump.

HOISTING PHRASEOLOGY

The effectiveness of a hoist operation depends upon the ability of the pilot and crewmember to act and communicate as a team. Standard voice procedures reduce the chance of misunderstanding. The crewmember should tell the pilot what the helicopter is to do, not what the helicopter is doing.

NOTE

COMMANDS are given in reference to the for and aft axis of the helicopter, to

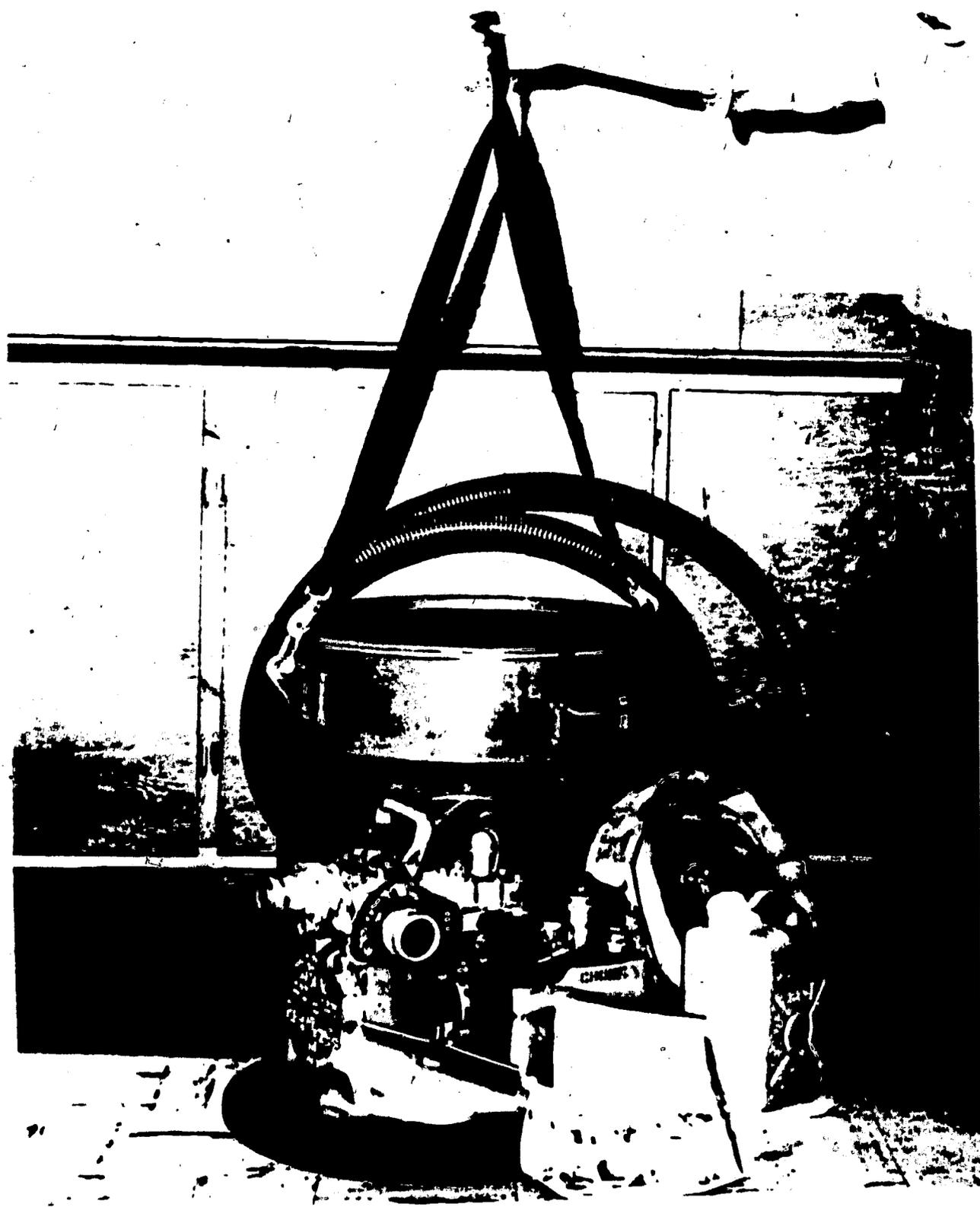


Figure 23. - Dewatering pump rigged with harness.

direct the pilot to move the helicopter in that direction. ADVISORY REPORTS keep the pilot informed of everything else that is occurring during the rescue.

NOTE

Combination COMMANDS, such as "FORWARD AND RIGHT 5" are

permissible in horizontal directions. At certain times when you are trying to hoist or maneuver in a restricted area, a COMMAND of "FORWARD 5," followed by "RIGHT 5," will not work. The only way is to move on a diagonal. Under these circumstances, combination COMMANDS are authorized.

HOISTING AND RESCUE PLATFORM COMMANDS

COMMAND

MEANING

FORWARD 5

Move helicopter forward 5 feet.

BACK 5

Move helicopter backward 5 feet.

LEFT 5

Move helicopter left 5 feet.

RIGHT 5

Move helicopter right 5 feet.

UP

Increase helicopter altitude. Do not use a distance with this command.

DOWN

Lower helicopter altitude. Do not use a distance with this command.

HOLD

Hold helicopter in a position relative to the target.

EASY

(left, right, forward, back)

Move helicopter very slowly in the direction indicated, a very small distance.

FORWARD AND RIGHT 5

Combination COMMAND as discussed above.

GO ON HOT MIC

The hoist operator begins giving ADVISORY REPORTS.

CONN ME IN

The hoist operator begins giving directional COMMANDS and continues giving ADVISORY REPORTS.

CEASE COMMANDS

Pilot no longer requires COMMANDS to maneuver.

SHEAR! SHEAR! SHEAR!

The hoist operator and copilot should activate their respective shear switches.

HOISTING ADVISORY REPORTS

(Example of Basket Hoist)

ADVISORY REPORTS

MEANING

ON HOT MIKE, HAVE TARGET IN SIGHT, BASKET GOING OUT THE DOOR.

Hoist operator is commencing the hoist.

BASKET BELOW AIRCRAFT

Basket is below the hull of the helicopter.

BASKET HALFWAY DOWN/UP

Basket is halfway between the helicopter and the surface.

HOISTING ADVISORY REPORTS - Continued

ADVISORY REPORTS

MEANING

BASKET HOLDING _____ FEET OFF THE WATER

The basket has been lowered to a safe distance from the water and will not be lowered any further until over the hoist area.

BASKET ON DECK

The basket is on the deck of the vessel.

MAN GETTING IN THE BASKET

Self-explanatory.

MAN IN THE BASKET

The man is in the basket and ready to be hoisted.

PREPARE TO TAKE THE LOAD

Hoist operator is taking in the slack of the hoist cable and preparing to lift the basket clear of the deck.

TAKING THE LOAD

The hoist operator is lifting the basket with the hydraulic hoist.

BASKET CLEAR OF VESSEL, CLEAR TO MOVE LEFT

The basket is well clear of the deck of the vessel and not in danger of fouling in the vessel's rigging. Copilot should clear area to the left. Move the helicopter left so pilot can again see the vessel. COMMANDS are required until the pilot reports "Cease commands."

BASKET CLEAR OF VESSEL, TRAIL LINE STILL ON DECK, CLEAR TO MOVE LEFT _____ FEET

If a trail line was used, this modification of the previous similar report reminds the pilot that the trail line is still on deck and to exercise caution when moving left.

BASKET OUTSIDE DOOR

Basket is level with the door and is being brought into the helicopter.

BASKET IN CABIN

Basket is in the cabin and being disconnected from the hoist cable.

BASKET IN CABIN, RETRIEVING TRAIL LINE

The basket is in the cabin and now the hoist operator is concentrating on getting the trail line aboard. Under adverse conditions, do not hesitate to cut the trail line or disconnect the trail line from the hook and throw it overboard. It may be safer not to try to get it back.

CABLE FOULED

The hoist cable has become fouled on the vessel.

BASKET FOULED

The basket has become fouled on the vessel.

GOING OFF HOT MIKE, READY FOR FORWARD FLIGHT

Basket is disconnected from the hoist cable; the hoist cable has been run up to the limit stop. The door has been closed, and the hoist operator is going off hot mike. All passengers and crewmen should be strapped in except for those required to be up and about the cabin in the performance of their duties.

HOISTING ADVISORY REPORTS - ContinuedADVISORY REPORTS

CABIN SECURED

MEANING

All rescue equipment has been stowed; all passengers and crewmen should be strapped in except for those required to be up and about the cabin in the performance of their duties.

LOST TARGET

Pilot has lost sight of the hoisting reference.*

TARGET

Pilot can again see the hoisting reference.*

*Hoisting Reference-A visual reference such as a portion of the boat, runway, or platform that will allow the pilot to maintain a stable hover to complete the hoist. It is normal not possible to maintain visual reference with the actual position from which the hoist is to be made.

HOISTING ADVICE

If the following points are kept in mind, an EMERGENCY situation can often be avoided:

that is necessary to solve the problem. Do not hesitate to retrieve the basket; move off, relax, discuss the situation, and then try again.

1. Evaluate each hoist before starting. Look the vessel over. Do not allow yourself to be rushed in for a hoist. Check and make a mental note of all obstructions, and do not forget to keep watch on them during the hoist. Check the deck area for obstructions or loose gear. Loose gear could become airborne and injure someone. Observe the vessel's motion, particularly pitch and roll. Make a determination if any nonstandard procedures will be required, and if so, talk them over with the pilot BEFORE the hoist.
2. Make sure you receive a complete briefing from the pilot before starting the hoist. He should tell you exactly what equipment you should use and how you will accomplish the hoist. There should be no doubt in either the pilot's or hoist operator's mind as to HOW the hoist is to be accomplished.
3. Take corrective action early. Do not allow a potentially bad situation to get out of hand. If the hoist is not going well, report it to the pilot before damage or injury occurs. The two of you can work out a solution much better than if only one of you knows there is a problem. A small change in delivery technique may be all
4. Anticipate. Do not wait for something to happen or allow yourself to "get behind the aircraft." Allow a lead time on COMMANDS. Do not wait for the aircraft to arrive where you want it before you say "HOLD." If you do, and you have not anticipated the rate of aircraft movement, by the time the pilot brings the aircraft to a stop, you will be well beyond where the aircraft should be. Try to ANTICIPATE!
5. Keep the pilot informed. Clear, timely, voice reports on the hoist progress enables the pilot to stay abreast of your activities. The pilot cannot see anything of the hoist operation, except possibly a very small section of the vessel's bow. The less you tell the pilot, the HARDER the hoist will be for the hoist operator.
6. Do not rush. Work slowly and deliberately.
7. Do not raise your voice. Maintain a low monotone, NO MATTER WHAT!
8. Always keep the vessel in sight. If you allow the pilot to move

the aircraft in such a manner that you lose sight of the vessel, you are asking for very serious problems. If your visual contact is lost, immediately inform the pilot and give him your best estimate of corrective action.

- 9. Use the weak link. ALWAYS use a weak link when attaching a trail line to the hoist hook. The only time a weak link is not used is for a pump delivery where the pump is to be put into the water with the trail line on the vessel. The hoist would not be used. Review pump deliveries in the previous text.



REVIEW

So far in this section, you have studied correct hoisting procedures, as well as the terminology you should use when making a hoist. This section was designed to help you become a well-qualified hoist operator. During your training as a SAR aircrewman, you will have to memorize much of the terminology and many of the advisory reports used in hoisting operations.

(Now answer the following review questions.)

15. Which of the following are included on the rescue checklist?
1. Check hot mike
 2. Check rescue rig
 3. Rig rescue gear
 4. Request hoist power
- A. 1 and 2 only
 B. 3 and 4 only
 C. 1, 2, and 4 only
 D. 1, 2, 3, and 4
16. If, during the hoist, the cable gets fouled or secured to the boat, which of the following should you do FIRST?
- A. Advise the pilot you are going to shear the cable
 - B. Attempt to have the boat crew release the cable
 - C. Shear the cable using the hoist shear switch
 - D. Run out slack on the hoist cable
17. When the hoist operator has the basket inside the cabin, he should report, _____.
- A. "Cabin secured, going off hot mike"
 - B. "Basket in cabin"
 - C. "Cleared for forward flight"
 - D. "Cabin secured, ready for forward flight"
18. When should the crewman give the pilot commands and advisory reports.
- A. Throughout the entire operation, until the pilot reports: "CEASE COMMANDS"
 - B. Only when the crewman feels that they are needed
 - C. Only at the beginning and end of the hoist operation
15. D The items in the rescue checklist must be checked before the hoist can be started. (Refer to page 29)
16. D Running out slack on the cable will give you and the pilot time and room to free the cable or decide whether or not to shear the cable. (Refer to page 38)
17. B This means that the crewman has the basket in the cabin and is securing the cabin. (Refer to page 35)
18. A The pilot needs ADVISORY REPORTS during the entire hoist operation. COMMANDS may be discontinued when the pilot has regained visual contact with the hoist sight and reports: CEASE COMMANDS. (Refer to page 31)



19. During a pump delivery, the hoist operator will hook the trail line to the

- A. pump can handle
- B. dewatering pump bridle
- C. pump weak link
- D. dewatering pump float

20. What is the meaning of the command, "Hold"?

- A. Stop helicopter in a specified direction
- B. Stop helicopter motion, UP or DOWN
- C. Hold helicopter in a position relative to the target
- D. Hold helicopter heading

21. Which of the following means, "Hoist operator is taking in the slack of the hoist cable and is preparing to lift the basket clear of the deck."

- A. Taking the load
- B. Basket clear of vessel
- C. Prepare to take a strain
- D. Prepare to take the load

19. B The trail line is hooked to a "D" ring attached to the bridle. This makes it easier for a crew to recover the pump. (Refer to page 40)

20. C If the target is a boat under way, this command means that the helicopter is moving with the boat. (Refer to page 42)

21. D This means that the pilot should be prepared for an additional weight load on the helicopter. (Refer to page 43)

SEA RESCUE PLATFORM

RESCUE PLATFORM RECOVERY
IN CALM WATER

The rescue platform will normally be used to rescue survivors from sheltered water or relatively calm open sea conditions. The rescue platform is particularly effective to recover personnel from the water or from a small boat or raft where hoisting without good visual references would be difficult or the rotor downwash would swamp the boat.

The rescue platform should be rigged and the Rescue Checklist completed at the direction of the pilot. These operations are normally done before the aircraft begins

the approach, but they may be done after the aircraft is established in a hover. For actual pickups, the platform should be rigged in the LOWER position.

Rescue Checklist

The Rescue Checklist consists of:

1. Aircrewmember's safety harness on and adjusted.
2. Check rescue rig (basket, sling, platform) for condition and rigging.
3. Check hot mike (pilot and copilot response)
4. Roll and pitch bias centered.
5. Request permission to open up.
6. Rig rescue gear. (See figure 24.)
7. Conduct crew briefing.
8. Report ready to pilot.

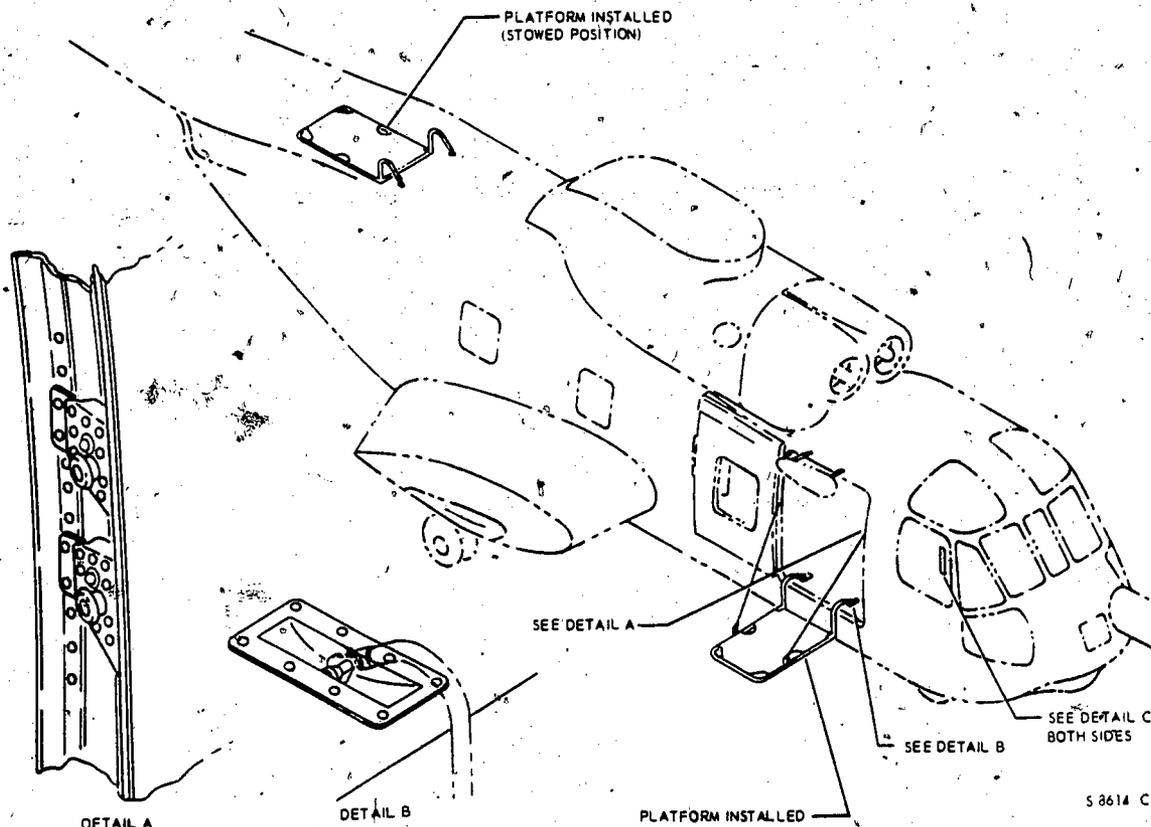


Figure 24. - Rescue platform.

Voice Procedures

The voice procedures should be as follows: (Memorize)

- Pilot: Perform rescue checklist for rescue platform pick-up.
- SAR Aircrew: Roger.
- SAR Aircrew: On hot mike, how do you read?
- Pilot: Loud and clear, how me?
- SAR Aircrew: Loud and clear, going off hot mike.
- SAR Aircrew: Checklist complete, request permission to open up.
- Pilot: Open up (or "Standby", as the situation dictates; the command "open up" includes permission to lower the platform.
- Pilot: (When ready) If you have the target in sight, go on hot mike and conn me in.
- SAR Aircrew: On hot mike, I have the target in sight, forward _____ feet.

Recovery Procedures

The pilot will normally land the helicopter with the survivor just outside the rotor downwash at about the one o'clock position and direct the crewman to go on hot mike and conn him in. The crewman should then position himself on one or both knees on the outboard edge of the platform with the aircrewman's safety harness adjusted and holding him securely at this position. The crewman should then supplement the pilot's picture with continuous COMMANDS and ADVISORY REPORTS until the rescue is complete or the pilot directs "CEASE COMMANDS". (See figure 25).

NOTE

The aircrewmember may attach his safety harness strap to a jump seat belt ring to enable him to reach the outboard edge of the platform.

The avionicsman will be outfitted in an aircrewmember's safety harness during any platform or hoist evolution.

CAUTION

Once touchdown on the water is made, the closure rate should be SLOW, and it must be closely controlled to stop all drift as the platform approaches the survivor or to avoid running over the survivor or to prevent the survivor from drifting under the sponson or hull. The helicopter must be brought to a stop in the water as the survivor arrives alongside the platform. If you feel the closure rate is too rapid, immediately advise the pilot. Slower than necessary is better than just a little bit too fast. If the survivor becomes endangered by the aircraft, use the COMMAND "UP," meaning for the pilot to immediately establish a hover. (See figure 27.)

Normally, the crewmember will use the boat hook to help retrieve the survivor.

WARNING

To prevent rotor blade contact, the boat hook must not be raised above the cargo door.

When the crewmember has the survivor aboard the helicopter, the crewmember will report "Man in cabin, going off hot mike," then complete the secure checklist.

The secure checklist consists of:

1. Strap across the door.
2. Platform in the aircraft and stowed.
3. Survivors strapped in.
4. Crew strapped in.

Once the secure checklist has been completed the crewmember should report "Cabin secured, ready for forward flight."



Figure 25. - Rescue platform rigged.



Figure 26. - Aircrewman's safety harness on and adjusted.

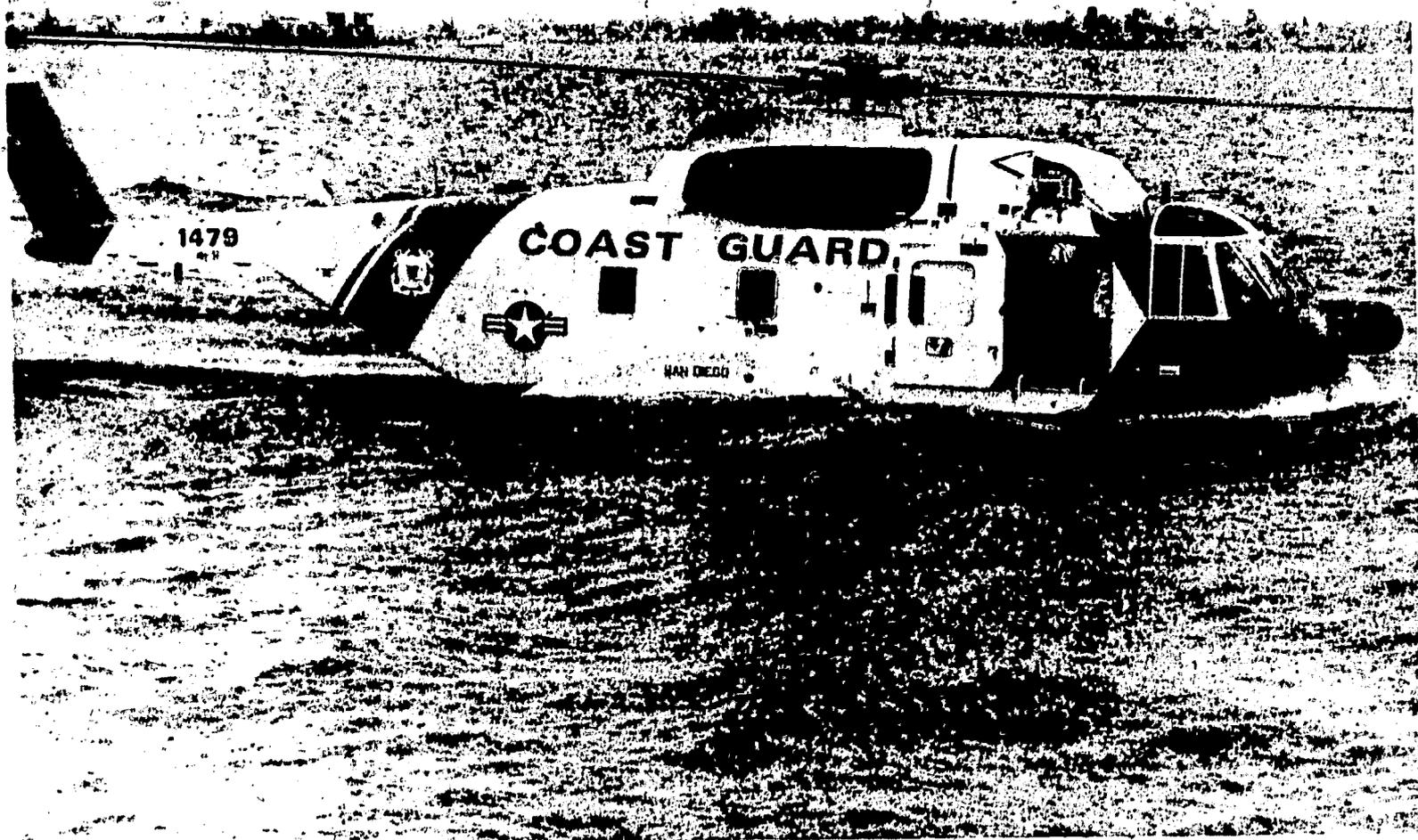


Figure 27. - Conning the pilot into position.

NOTE

Upon completion of platform operations, when stowing the platform, the cables shall be secured with bungee to prevent them from entering the tail rotor drive shaft housing. Proper stowage instructions are contained in the Maintenance Manual, TO 1H-3(H)F-2-2.

If conditions permit, complete the entire secure checklist before forward flight.

Dangers Encountered During Recovery

It is dangerous to air taxi close to small boats or life rafts because the rotor downwash could capsize the raft or boat and possibly cause contact with the rotor blades. It is normally best to land short and, using minimum collective, water taxi for the recovery.

Use extreme care in approaching parachutes in the water. AVOID this if at all possible. When recovering an immobile survivor attached to a parachute, the aircraft is landed clear to one side and you will swim or use a raft to aid the survivor and free him of the parachute. You should be attached to a safety line and don a life vest before attempting such a rescue.

When being approached by a small boat, the pilot and crew must be alert to take corrective action if it appears that persons in the boat may stand up, raise oars, or in any way jeopardize themselves or the helicopter. Signal the people to keep low with a palms down motion with both hands.

RESCUE PLATFORM RECOVERY IN
ROUGH WATER

Some sea conditions preclude a safe landing and rescue platform recovery. Therefore, a hoist will be required. When in doubt, the pilot will hoist. If you have any doubts about the safety of the aircraft in a rough sea landing, SAY SO! Remember, however, that the final decision rests with the aircraft commander.

If the pilot has elected to make a platform recovery, the approach and preparation for landing will be the same as

for a calm water pickup. After transitioning to a hover, the crewmember will be instructed to open the door and lower the rescue platform. The pilot will turn the helicopter to place the major swell on the port bow to the port beam, holding the survivor in about the one o'clock position well outside the rotor wash. While maintaining this general relationship, evaluate the sea. The pilot will instruct the crewmember to "Go on hot mike" and establish ICS communications. When the pilot directs the crewmember to "Conn me in", the crewmember should begin giving the pilot continuous COMMANDS and ADVISORY REPORTS to supplement the pilot's picture. The pilot will close on the survivor, and when the sea conditions permit, land with the survivor just inside the rotor wash. The COMMANDS and ADVISORY REPORTS should continue until the rescue is complete or the pilot directs "CEASE COMMANDS".

Once touchdown on the water is made, the closure rate must be closely controlled to stop the aircraft and all drift as the platform approaches the survivor. (See figure 28.) When the crewmember has the survivor aboard the aircraft, he will report, "Man on platform, cleared to hover." (See figure 29.) When the crewmember has the cabin equipment secured and all hands are strapped in their seats, the crewmember will report, "Cabin secured, ready for forward flight," and not before!

RESCUE PLATFORM RECOVERY
VOICE PROCEDURES

The pilot and crewmember must perform as a team to make a safe recovery. To prevent confusion and misunderstanding, the crewmember uses COMMANDS and ADVISORY REPORTS in directing the pilot to position the helicopter during the rescue. A COMMAND is given in reference to the fore and aft axis of the helicopter to direct the pilot to move the helicopter in that direction. All distances given with COMMANDS will be in feet -- no other types of measurement. ADVISORY REPORTS keep the pilot informed of everything else that is occurring during the rescue. They are information, not COMMANDS. (See tables 5 and 6.)

Use the COMMANDS and ADVISORY REPORTS in table 5.

Table 5. - Rescue Platform Commands.

COMMAND	MEANING
FORWARD 5	Move helicopter forward 5 feet.
BACK 5	Move helicopter backward 5 feet.
RIGHT 5	Move helicopter right 5 feet.
LEFT 5	Move helicopter left 5 feet.

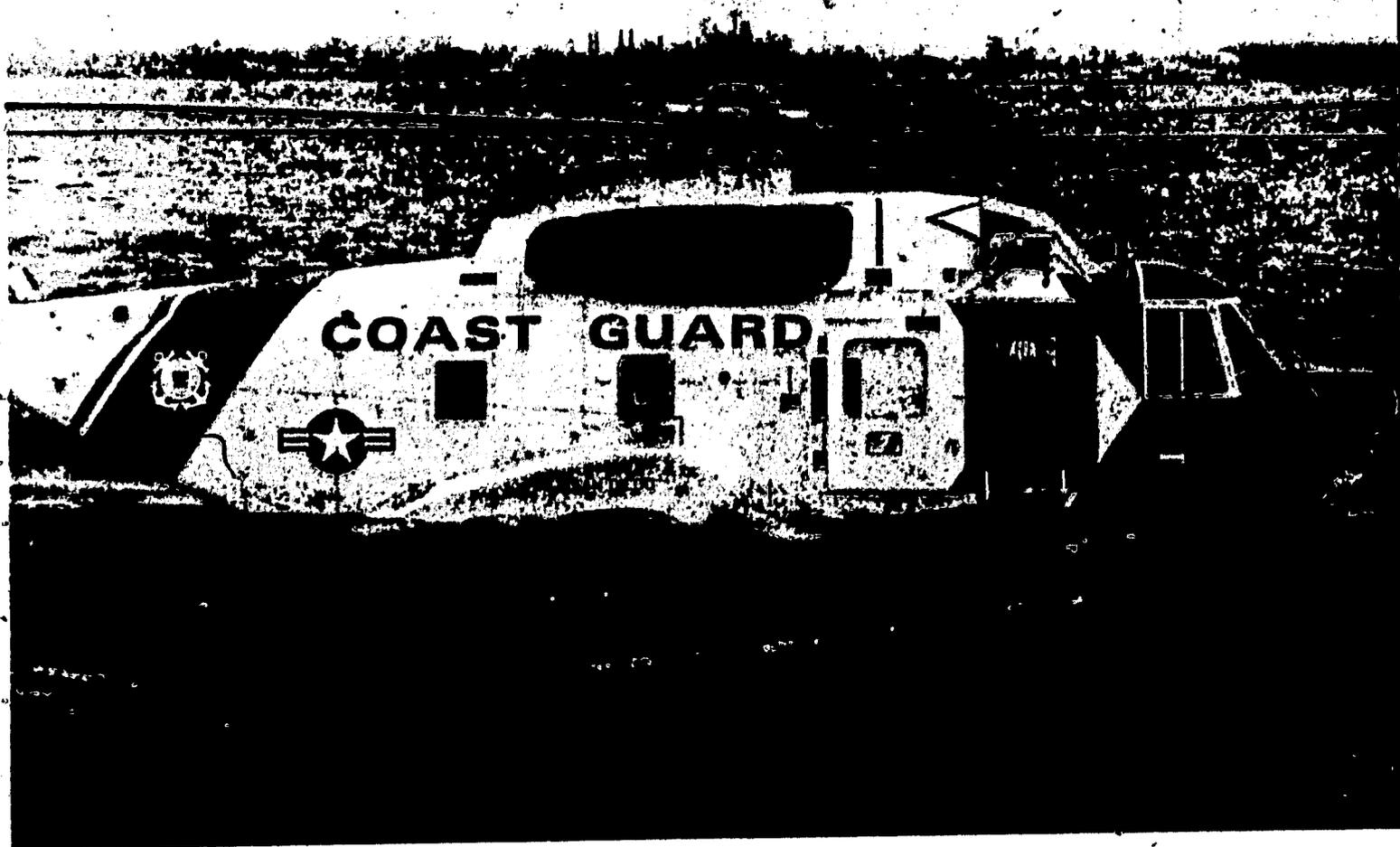


Figure 28. - MH-3F approach for a
platform pickup.



Table 5 (Cont'd.) - Rescue Platform Commands.

<u>COMMAND</u>	<u>MEANING</u>
EASY (right, left, forward, backward)	Precedes the direction of movement desired and requests a very slow rate of movement in the direction indicated.
HOLD UP	Hold aircraft in a position relative to the target. Danger to the survivor or to the aircraft. Immediately establish a hover. May be given by the copilot if something is endangering the aircraft from port side.

To reemphasize, when you give the pilot a COMMAND requesting a direction of movement, also include the approximate distance that you desire the helicopter to move in that direction. Example: FORWARD 50. All directions are given with reference to the fore and aft axis of the helicopter. Do not use distances with the COMMANDS of EASY, HOLD or UP.

As mentioned before, during a rescue platform recovery, there are additional reports that are advisory to the pilot and keep him up to date on the progress of the rescue. These ADVISORY REPORTS are listed in table 6.

Table 6. - Advisory Reports (rescue platform).

<u>ADVISORY REPORT</u>	<u>MEANING</u>
MAN APPROACHING PLATFORM	The survivor is close to the platform, and the distance between the survivor and the platform is closing.
MAN AT PLATFORM	Self-explanatory.
MAN ON PLATFORM	Self-explanatory.
CLEARED TO HOVER	
MAN IN CABIN, GOING OFF HOT MIKE	The hoist operator is going off the hot mike and will be assisting the survivor and stowing equipment.
CABIN SECURED, READY FOR FORWARD FLIGHT	Self-explanatory.
PICK UP INTO HOVER, MAN DRIFTING	This is very important. If the man being rescued drifts into an area that would endanger him, such as too far aft, under the sponson or the hull of the aircraft, immediately lift the aircraft into a hover. This advisory report informs the pilot of a potentially serious situation. "UP" is a COMMAND and differs in that it represents an IMMEDIATE EMERGENCY!

The ADVISORY REPORTS in table 6 should be supplemented by other clearly understood advisories, as necessary. Basically, the pilot wants you talking to him all the time. If a COMMAND is not necessary, then give him progress information on how you are

doing; in other words, give the pilot ADVISORY REPORTS.

Remember, you will be on the hot mike, and all noises will be transmitted through the ICS to the pilot's headphones. Keep

your mike right on your lips to eliminate wind noise and to prevent your being difficult to hear. If the pilot is having difficulty hearing you, he may do something which is entirely different from what you really want done.

NOTE

Upon completion of platform operations when stowing the platform, the cables shall be secured with bungee to prevent them from entering the tail rotor drive shaft housing. Proper stowage instructions are contained in the Maintenance Manual T.O. 1H-3(H)F-2-2.

PERSONNEL LADDER

Although the personnel ladder was not originally designed for use as rescue equipment, experience has shown that the ladder has very positive advantages over the rescue platform under certain situations. When you are recovering a survivor who is mobile, the personnel ladder acts very much like the ladder in a swimming pool. It permits a person in the water to grab onto something and to climb out of the water into the aircraft with crewmember's assistance. The crewmember, with aircrewmember's safety harness adjusted, may climb down several steps into the water and give the survivor considerably more assistance than he could operating from the rescue platform. When you are recovering a body or an object, the rescue platform is recommended. The decision of which piece of equipment to use, rescue platform or personnel ladder, is the aircraft commander's, based on his evaluation of the situation, safety, and your recommendations as crewmember. Checklist and voice procedures are the same for either piece of equipment. (See figure 30.)

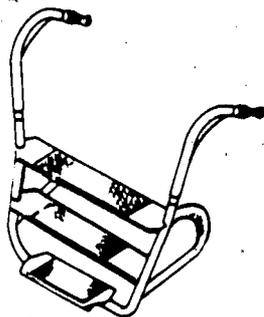


Figure 30. - Personnel ladder.

LOW RESPONSE EXTERNAL CARGO SLING

The low response external cargo sling (figure 31) permits carrying loads up to 8,000 pounds beneath the helicopter. The sling is made up of universal sling fittings, cables, cargo hook, pulleys, and a suspension frame. The sling is attached to four hard points on the bottom of the helicopter by four universal sling fittings. The fittings, in turn, are attached to a suspension frame, which contains a pulley in each corner. Two cables are threaded through the pulleys which support the cargo hook. Each cable picks up a suspension ring on the cargo hook, is threaded through a pulley, passed diagonally below the tub and threaded through the opposite pulley, and then attached to the opposite suspension ring. This suspension permits the hook to swing independently of the helicopter in any direction. The path of the hook during its swing is elliptical; therefore, the line of reaction of the load is perpendicular to a tangent on the elliptical path. This line of reaction passes through the helicopter between the floor and the center of gravity and eliminates undesirable aircraft responses.

The cargo release circuit operates on current from the DC primary bus and is protected by a circuit breaker, marked CARGO HOOK PWR, located on the overhead circuit breaker panel. Ground personnel may open the hook by actuating the manual release lever located on the side of the cargo hook. The load beam for the cargo hook will automatically return to the normally closed position after the load is released. For a pickup, the helicopter can be hovered over the load and the load attached to the hook from outside the helicopter, or be hooked to a preset ring by the pilot flying the hook into the ring.

When the cargo sling is attached, but not in use, it is stowed under the fuselage by means of a nylon stowage line. A light, marked CARGO HOOK, on the pilot's advisory panel will illuminate any time the cargo hook is open. The light receives electrical power from the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked CARGO HOOK WARN under the general headings INDICATOR LTS. and DC PRI BUS.

NOTE

With external loads, radio communication and navigation systems may be unreliable.

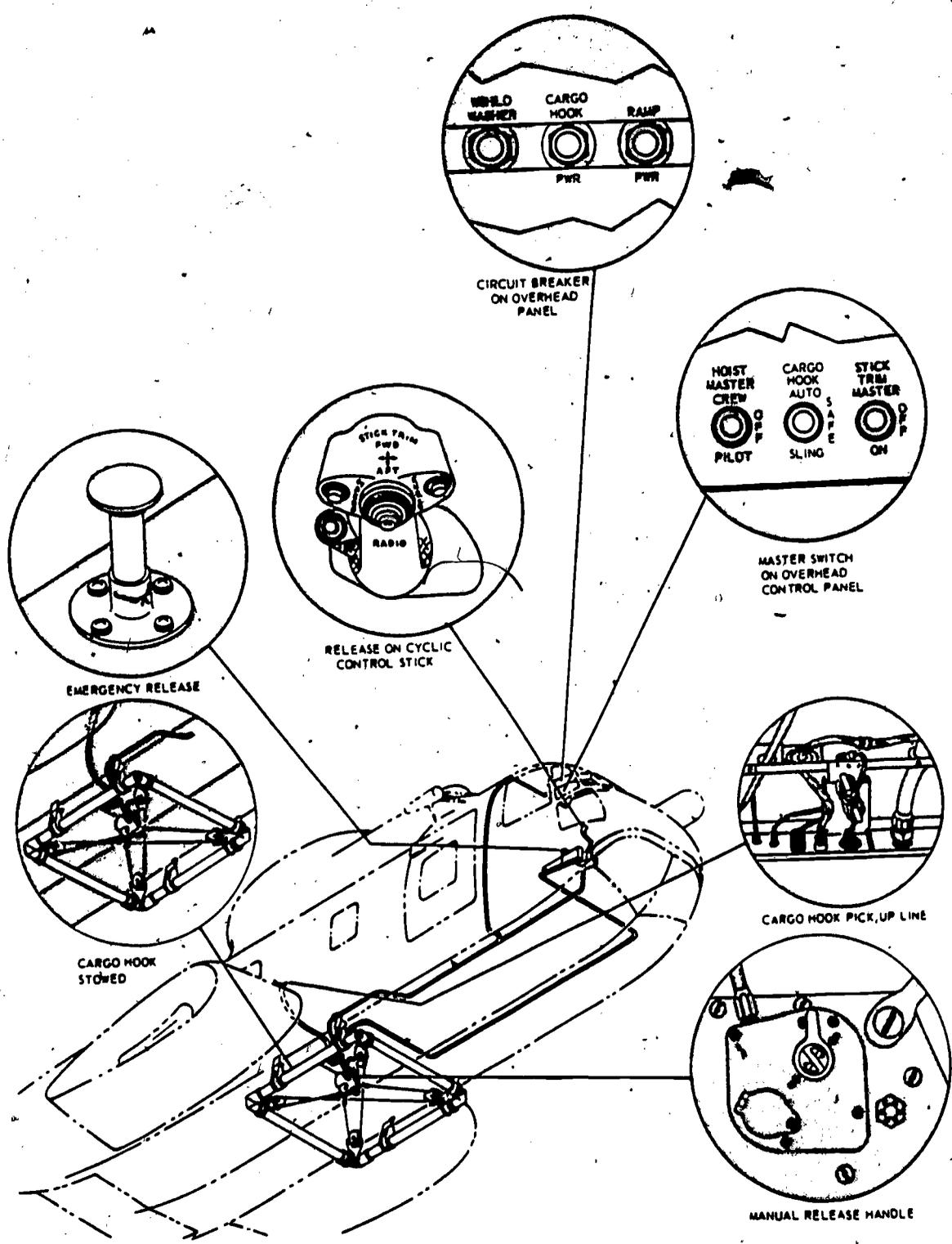


Figure 31. - Cargo sling system, low response.

CARGO SLING OPERATION

Cargo Sling Master Switch

A switch, marked CARGO HOOK, located on the overhead switch panel (figure 31) controls the operation of the cargo sling hook. The switch has marked positions AUTO, SAFE, and SLING, and should be kept in the SAFE position during flight to prevent accidental discharge of the cargo by gusts or conditions that would lighten the load force. The SLING position energizes the thumb switches on the pilot's and copilot's cyclic stick grips, marked CARGO. This enables the pilot or copilot to electrically release the load on the sling. The cargo sling master switch should be in the SLING position during cargo hookups and until a safe altitude and airspeed are reached, to allow for quick release of the external load in the event of an emergency. The AUTO position energizes the cargo release switches and also a touchdown switch on the cargo hook. The touchdown switch, activated by load tensions greater than 125 ± 10 pounds, will automatically release the load when the load touches the ground and the load tension on the hook becomes less than 100 pounds. After an AUTO cargo release, the CARGO HOOK OPEN light will blink continuously until the switch is positioned to SAFE. Although the automatic touchdown release is set to actuate at 100 pounds or less, it should not be used with loads less than 200 pounds. The master switch should always be returned to the SAFE position and sling stowed after the load has been released. The master switch receives electrical power from the DC primary bus through a circuit breaker, marked CARGO HOOK PWR, located on the overhead circuit breaker panel.

CAUTION

When you are carrying loads of less than 200 pounds, the cargo sling master switch should never be in the AUTO position during flight. The cargo sling hook would open immediately if a gust of air momentarily lightened the load. The AUTO position should be used just before touchdown to avoid an inadvertent release of cargo.

Cargo Release Buttons

A cargo release button, marked CARGO, is located on the pilot's and copilot's stick grips. Either cargo release button may be depressed to open the cargo sling

hook when the cargo sling master switch is in either AUTO or SLING position.

Cargo Release Pedal

A cargo release pedal, located on the pilot's side of the cockpit, is connected mechanically by cable to the manual release lever on the cargo hook. The pedal may be depressed to mechanically open the cargo sling hook when the electrical release circuit is inoperative. The load will be released in the air or on the ground regardless of the position of the cargo sling master switch.

Cargo Hook Open Advisory Light

The cargo hook open advisory light is actuated by a microswitch on the cargo hook. A green advisory light, marked CARGO HOOK, located on the caution-advisory, will come on whenever the cargo hook load beam is open.

Cargo Hook Manual Release Arm

The cargo hook may be manually released by ground personnel by operating the manual release arm on the cargo hook. A force of 15 to 22 pounds is required to move the release arm in an upward direction to release a load of 8,000 pounds. With no load, 10 pounds force is the maximum required to open the load beam.

Cargo Hook Stowage Line

The cargo hook stowage line runs from the cargo hook into the fuselage to a cleat close to the deck on the right-hand compartment side panel just aft of the cargo door. The cargo hook is stowed by lifting the cargo hook by the nylon line and tying the line to the tiedown cleat inside the cargo compartment. To release the cargo hook from the stowed position, untie the nylon line and slowly lower the cargo hook. A bungee cord, attached from the cargo hook cables to the fuselage, removes the slack from the cables when the hook is stowed.

WARNING

Any static electricity that may have been generated by the helicopter should be dissipated before you attempt a hook-up, by allowing the sling to touch the ground or through a conductor that can make contact between the sling and the ground.

WARNING

External loads may cause oscillations to the extent that the load may oscillate into the rotor blades and/or fuselage, or that the load may cause a deterioration in the stability of the helicopter. Oscillations can usually be controlled by slowing the forward speed of the helicopter.

CAUTION

The cargo sling should be stowed before landing to prevent the hook from striking the ground. Striking the hook on the ground can cause damage and subsequent failure of the hook. Landing on water with an unstowed hook can cause damage by denting or puncturing the hull. Normally, with the hook installed, running water landings will not be accomplished.

AIRCRAFT OPERATION WITH THE CARGO SLING ATTACHED

Preflight

The most important phase of a cargo sling mission is thorough planning. The operating area should be selected to avoid flight over vehicles, buildings, or congested areas and to provide optimum safety. Areas of dust, mud, snow, or ice should be avoided. All personnel concerned with the mission should be thoroughly briefed on their duties and responsibilities during the operation. Ground crew personnel should wear helmets with visors down and radio cords tucked in. They must exercise sound judgment and common sense in positioning themselves so that if the load should be accidentally dragged or lifted, they can move clear immediately to avoid injury. If an emergency occurs during cargo sling ground operations, the helicopter and ground crew personnel should move in opposite directions to clear each other. The helicopter should move to its left while ground crew personnel move off to the right. Ground crew personnel should make every effort to work at the right side of the load (with respect to the position of the helicopter over the load) so that in an emergency, they can clear from under the helicopter without climbing over or moving around the load.

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Do not consider wind velocity in advance planning except to note that any wind encountered may serve to improve helicopter performance. It is recommended that training loads not exceed 2000 pounds.

Equipment Inspection

Inspect the following items before cargo flight:

1. Cargo sling and attachments for security.
2. Manual release for proper rigging.
3. Cargo hook for security and condition.

In Flight

1. Equipment preparation.
 - a. Ensure sling is fully extended and all cables and lines are clear.
 - b. Pilot's HOT MIC LISTEN - ON.
 - c. Cargo hook switch - SLING. (See figure 31.)
2. Approach and hookup.
 - a. Aircrewmember conn pilot into position directly over cargo, using hoisting voice procedures.
 - b. Ground personnel ENSURE static electricity dissipated.
 - c. Aircrewmember monitor hookup; ground personnel clear of cargo. Ground personnel should enter and depart the cargo sling hookup area from the starboard side of the aircraft.
 - d. Aircrewmember report hookup and ready for lift.
 - e. Pilot smoothly increase power until the cable is under tension and slowly continue power increase to lift off.
 - f. Aircrewmember report cargo clear of deck.

NOTE

For training, a 10- to 15-foot cable should be attached to the selected load. The length of cable will vary in actual operations.

Transition to Forward Flight

Transition to forward flight and establish a positive rate of climb as soon as translational lift has been obtained. Do not descend during transition. Acceleration and maximum airspeed, to prevent oscillation, will be dependent on the type of load carried. Some loads will require airspeeds as low as 10 knots to maintain stability. The helicopter should not be maneuvered abruptly.

NOTE

The aircrewmember should monitor the load for oscillation and other unsatisfactory indications.

Cruise

Cargo master switch -- SAFE (after 500-foot terrain clearance).

CAUTION

When the cargo hook switch is in the SLING position, the pilots should exercise caution to prevent inadvertent release of the load.

CAUTION

Do not fly over populated areas, buildings, or other surface conditions that would be endangered or damaged in inadvertent cargo release. Gusty wind conditions, action of the load, or aircraft equipment malfunction can cause or require unplanned load release.

LOAD STABILITY

Most of the problems encountered in helicopter external lifts concern the instability of loads in flight as the sling load is seldom aerodynamically stable.

Load instability will occur whenever the weight of a suspended load is not sufficient to

hold it down against the drag of the air through which it moves. Such loads will normally turn broadside to the direction of flight, this exposing maximum drag surface. Stabilization of such loads may be assured by one or more of the following means:

1. Reducing airspeed.
2. Make slow control movements.
3. Increasing the weight of the load.
4. Reducing the drag surface by altering the relationship between the center of gravity and the center of pressure of the suspended load in such a way as to assure that the narrowest surface points in the direction of flight.
5. Drag surface reduction can be achieved by adding surface to the rear of the load or adding weight to the front. The general rule is that stability will be assured at practical helicopter speeds when the loads center of gravity is located at the front third of the surface area.

CAUTION

Spinning may result in pendant failure. If conditions permit, a spinning load may be placed on the ground or water to reduce the spin rate. Release uncontrollable loads.

Approach

1. Use a NORMAL APPROACH.
2. HOT MIC - ON.
3. Cargo master switch - AS REQUIRED.
4. Crew report - "CARGO ON DECK."
5. Cargo - RELEASED.
6. Sling - STOWED BEFORE LANDING.

NOTE

Cargo operation without AFCS should be undertaken with caution. Without the stabilization, oscillation of the helicopter and load can endanger ground personnel.

NOTE

The radar altimeter may be unreliable with a load attached.



REVIEW

When it is impractical to use a hoist in rescue operations, you will use a rescue platform. The rescue platform can be used for injured persons, body pickups, and pickups from a raft. The cargo sling is used for bulky cargo that cannot be loaded into the helicopter. You must handle the cargo sling properly to avoid inadvertently dropping the load.

(Now answer the following review questions.)

22. The rescue platform should be rigged and the checklist completed when the
- A. copilot gives the direction
 - B. crewmember is ready
 - C. pilot gives the direction
 - D. crewmember has the target in sight
23. In the rescue platform pickup voice procedures, the command "Open Up" includes permission to _____
- A. go on hot mike
 - B. rig the platform
 - C. complete the checklist
 - D. lower the platform
24. Which command is used if the survivor is in danger from the aircraft?
- A. "Hold"
 - B. "Up"
 - C. "Easy"
 - D. "Slow"
25. Distances are not be used with which commands?
1. "EASY"
 2. "UP"
 3. "HOLD"
- A. 1 only
 - B. 2 only
 - C. 1 and 2 only
 - D. 1, 2, and 3
26. You can use the personnel ladder when recovering a/an _____
- A. body from the water
 - B. immobile survivor
 - C. injured survivor
 - D. mobile survivor
22. C The pilot is in command and is in a better position to decide when this should be done. (Refer to page 49)
23. D This command is given to get the rescue platform out of the cabin and down into position. This is in preparation for making the approach to the pickup. (Refer to page 50)
24. B This command means that the survivor is in immediate danger and that the helicopter should be lifted into a hover. (Refer to pages 50 & 57)
25. D Distances are not needed with these commands. (Refer to page 57)
26. D A mobile survivor will be able to grab the personnel ladder and climb into the helicopter a lot easier than he could using the rescue platform. (Refer to page 58)



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27. Which of the following is not a correct statement?

- A. The crewmember must advise the pilot when cargo is on the deck
- B. The pilot does not have a manual release capability in the cockpit
- C. The crewmember must oversee the cargo hookup and drop
- D. The crewmember must conn the pilot into position over the cargo

28. Ground personnel should enter and depart the cargo sling hookup area from the _____ of the aircraft.

- A. starboard side
- B. front
- C. port side
- D. back

27. B. (Refer to page 60)

28. A. This will enable the crewmember and pilot to see any ground personnel coming in under the rotor disc area. (Refer to page 61)

HIGH-INTENSITY SEARCHLIGHT SYSTEM

OBJECTIVES

When you complete this section, you will be able to:

1. Identify the components of the high-intensity searchlight system.
2. Explain the searchlight operation.
3. Describe the safety precautions for the operation of the searchlight.

HIGH-INTENSITY SEARCHLIGHT SYSTEM

The high-intensity searchlight system (Nightsun) provides a high-intensity light source particularly suited for most night operations, including search operations and examination of rescue locations from a safe altitude. Night photographic missions are possible by using daylight techniques and film.

The searchlight system is comprised of the following components: external mount (gimbal mount and searchlight assembly), junction box, remote control unit, interconnection cables, and mounting hardware. (See figure 32.) The system utilizes the controllable searchlight position control switches for cockpit control of beam direction.

The searchlight system is powered by the DC primary bus. During the start sequence, 30,000 volts are generated within the searchlight assembly, and a high current power surge develops in the junction box.

NOTE: The start sequence may cause considerable interference with radios in the helicopter.

After the start sequence is completed, only 28 VDC are required for the system to sustain illumination.

CAUTION

Do not attempt to operate the searchlight from battery power only.

Now we will discuss the individual components of the high-intensity searchlight system.

EXTERNAL MOUNT

The external mounting consists of three support brackets, the gimbal mount, and the searchlight assembly. (See figure 32.) The assembly is mounted on the port side of the helicopter below the avionicsman's window.

CAUTION

Water landings with the searchlight installed shall be limited to operational necessities. If a water landing is necessary and the searchlight is in use, if possible turn the light off and allow it to cool before landing (3-5 minutes are recommended; however, any cooling period is beneficial). The MASTER switch should also be secured before water contact. Water landings with any forward speed may cause damage to the Nightsun mounting and aircraft mounting points.

Gimbal Mount

The gimbal mounting assembly (figure 32) consists of a yoke and two small DC motor actuators. One motor is mounted at the base of the yoke and rotates the light

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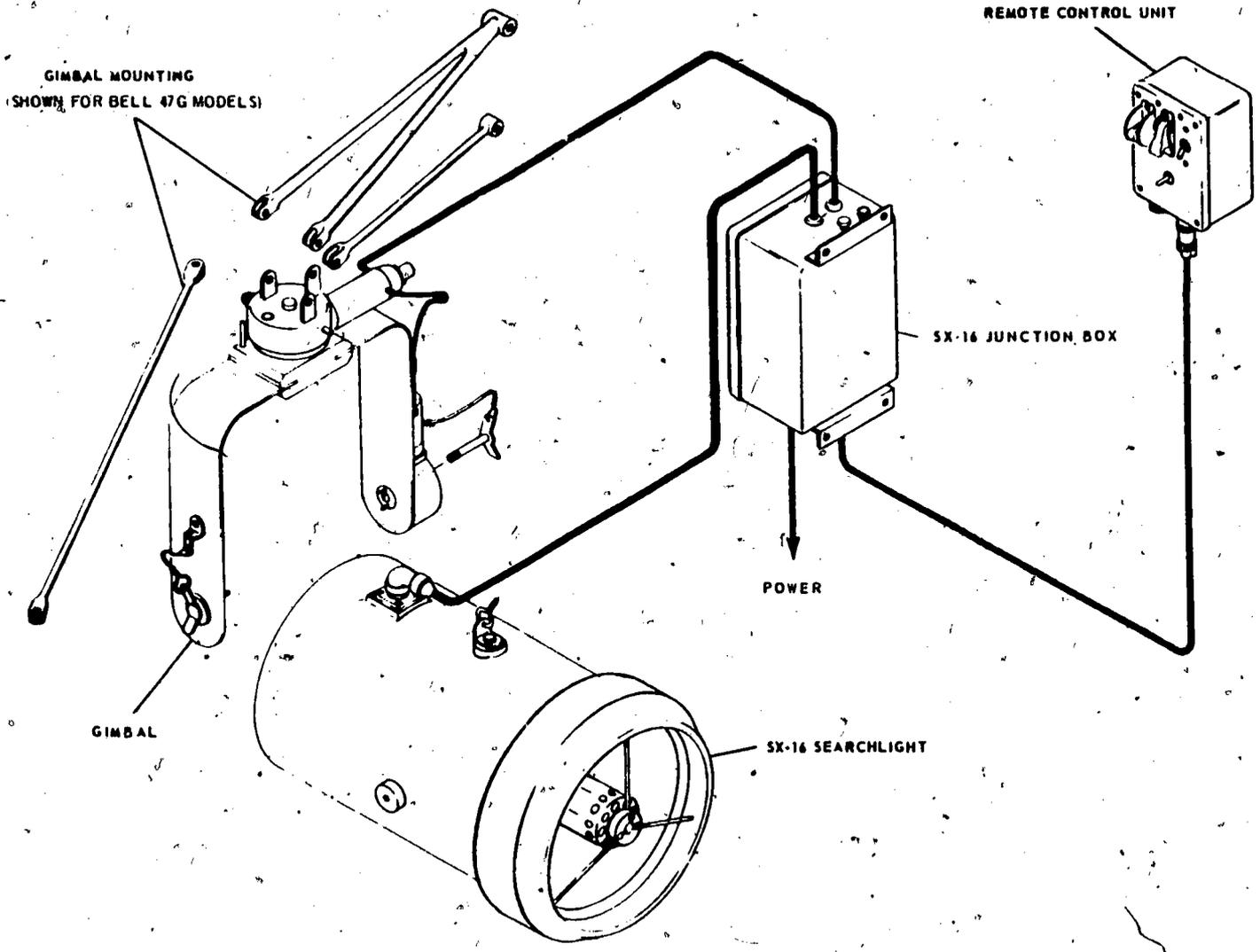


Figure 32.

for azimuth. The second motor is mounted on one leg of the yoke and drives the trunnion mounting for elevation. Stop pins in the yoke bearing housing limit the searchlight rotation in azimuth. A slip clutch on each motor drive absorbs the motor torque when the searchlight is driven against the stop. The stops are adjustable in azimuth and may permit a maximum of 350 degrees of rotation. There are no physical stops for elevation. Normal range of elevation is from 10 degrees above the horizontal to 70 degrees below. The drive motors may cause some radio interference.

NOTE: Manual movement of the searchlight assembly will not damage the actuating mechanism.

WARNING

Avoid training the searchlight on any part of the helicopter. The heat generated is capable of melting a tire or igniting paint or fiberglass. When changing azimuth from side to side, DEPRESS ELEVATION to avoid shining the light inside the helicopter.

Searchlight Assembly

The searchlight assembly (figure 33) consists of a cylindrical housing within which are mounted an arc lamp bulb, a reflector, a cooling fan, a focusing motor, and various electrical components used in the start circuit of the lamp. The lens, made of specially tempered glass, is capable of withstanding both mechanical stresses and high temperatures. The xenon arc lamp contains two tungsten electrodes permanently sealed in a quartz glass bulb filled with xenon gas under pressure. The lamp is capable of 3,800,000 peak beam candle power.

NOTE: Unlighted pressure within the bulb is approximately 75 psi. Lighted, the pressure approaches 300 psi, and the temperature surrounding the arc will range between 300°F. and 2,100°F. Should the bulb explode, it will be contained by the searchlight housing and lens.

The beam is focused by a focusing motor driving the reflector towards or away from

the lens. The motor is nonreversing and continually drives the reflector back and forth through the same cycle. The focus is from a 10 degree beam width (flood) to a 6.5 degree beam width (search). (See figure 34.) The searchlight assembly has a safety cable attached to the yoke.

JUNCTION BOX

The junction box (figure 32) consists of a rectangular metal box containing relay and terminal connections for power distribution to the functional components of the searchlight equipment. The junction box is mounted in the cabin, portside, aft of the radioman's seat. Two circuit breakers are mounted on the bottom of the case (70A and 7A).

REMOTE CONTROL UNIT

The control unit (figure 35) is mounted in the cabin below the rescue hoist throttle control valve on the right side. Two quick-disconnect releases permit moving the unit to the other positions about the cabin for remote use. The control panel contains a circuit breaker type ON-OFF switch marked MASTER. This switch powers the lamp, lamp starter, gimbal drive motors, focusing drive motor, and a cooling fan in the lamphousing assembly. A guarded momentary contact switch marked START controls the start circuit. A third momentary contact toggle switch marked FOCUS controls the motor-driven focus mechanism. A four-way momentary contact toggle switch marked DOWN, UP, LEFT, RIGHT controls the movement of the searchlight in azimuth and elevation. The above four switches are located on the face of the remote control unit. On top of the remote control unit is an unmarked momentary interrupt pushbutton. This extinguishes the lamp but allows the cooling fan to continue running. The cooling fan runs anytime the MASTER switch is ON.

HIGH-INTENSITY SEARCHLIGHT INSTALLATION

Install the searchlight (figure 36) as follows:

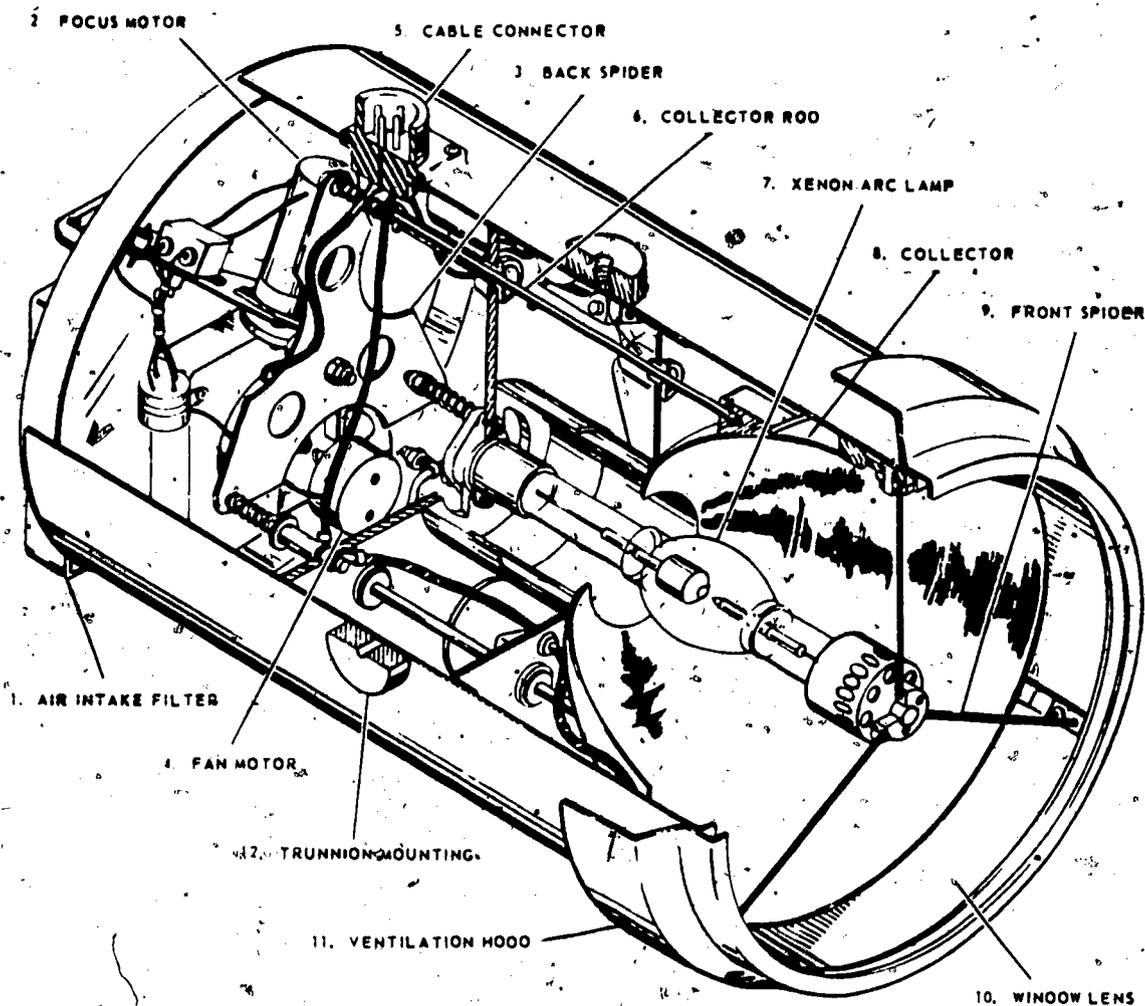


Figure 33. - SX-16 Searchlight assembly.

1. Locate mounting brackets (3 ea on left side of aircraft).
2. Mount the high-intensity searchlight (using 3 mounting bolts and elastic stop nuts).
3. Connect control/power cable (to connector on side of aircraft).
4. Attach two drain tube extenders.
5. Remove searchlight lens cover.

HIGH-INTENSITY SEARCHLIGHT OPERATION

OPERATING PROCEDURES

Preflight

1. Lens clean - CHECKED.

NOTE: Do not touch the lens with your hands; smudges cause an uneven heating of the lens and subsequent cracking.

2. Light - MANUALLY POSITIONED so beam will NOT STRIKE HELICOPTER WHEN ILLUMINATED.

10° BEAM (FLOOD)

135.0

33.0

15.0

8.4

5.4

3.7

2.8

2.1

1.7

1.4

340.0

90.0

40.0

22.5

14.4

10.0

7.4

5.5

4.4

3.6

6° BEAM (SEARCH)

DIAMETER, FEET

288

260

240

220

200

180

160

140

120

100

80

60

40

20

100

200

300

400

500

600

700

800

900

1000

RANGE, FEET

BEAM INTENSITY IN FOOT CANDLES

NIGHTSUN SX-16 SEARCHLIGHT
BEAM SIZE vs. INTENSITY

Figure 34. - Beam width chart.



Figure 35. - Remote control unit.

- 3. MASTER switch - OFF.
- 4. Circuit breakers - CHECKED.

CAUTION

Do not direct light beam onto surface of aircraft due to intense heat.

Starting

- 1. MASTER switch - ON.
- 2. START switch - DEPRESS UNTIL LAMP IGNITES (5-10 seconds), Release immediately

CAUTION

Continuing to depress the switch after ignition may seriously damage the searchlight.

Operation

- 1. FOCUS switch - ADJUSTED TO DESIRED BEAM WIDTH.

- 2. Four-way directional control switch - OPERATE AS DESIRED.

NOTE: When the controllable searchlight is OFF or in STOW, the collective searchlight position control switches and the searchlight position toggle switch, of the copilot's remote ICS panel, controls the Nightsun positioning.

Securing

- 1. Push momentary OFF button. Note: Lamp may be restarted if desired, by pushing start switch.
- 2. Allow 3-5 minutes for cooling.
- 3. MASTER switch - OFF.

OPERATING TECHNIQUES

Techniques for use of the searchlight must vary with the object of the search,

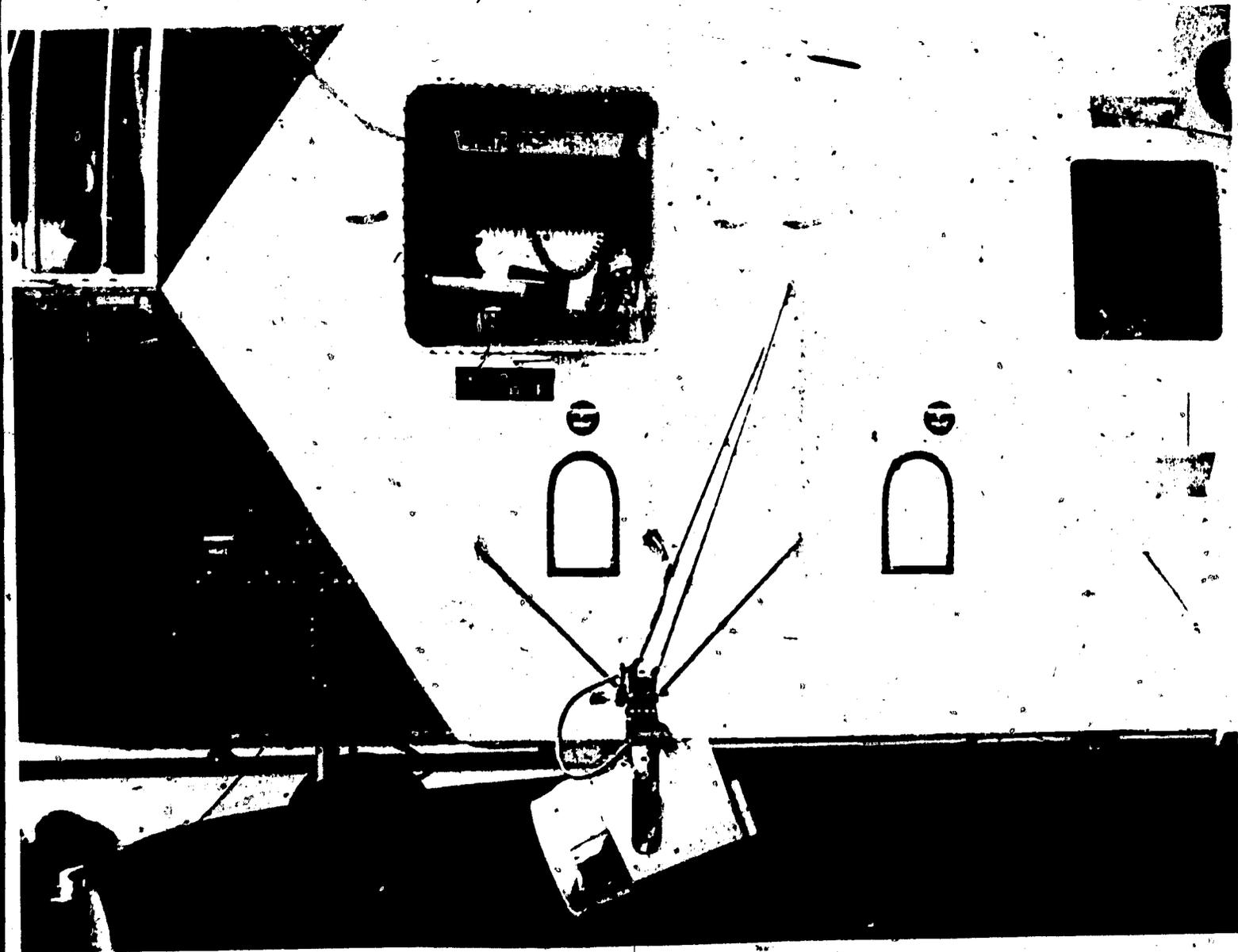


Figure 36. - HH-3F high-intensity searchlight installation.

CAUTION

area being searched, and meteorological conditions. General guidelines for its use are listed below; however, proficiency in its use can be acquired only through actual experience. The following techniques are only general guidelines for good search conditions:

1. Search airspeed - It is recommended that search airspeeds of 50-100 knots be maintained as required for the type of object being searched for and the area to be covered. The Nightsun has been designed to operate at airspeeds corresponding to helicopter limitations.
2. Altitude - proportional to search object's size:
 - a. Vessels or boats 40 feet or over - 1,000 to 1,500 feet.
 - b. Boats less than 40 feet - 300 to 1,000 feet.
 - c. Personnel - 300 to 500 feet (hover search also a satisfactory technique).
3. Beam width - as desired. Midway between narrow and widest points provides a nearly solid beam spot.
4. SEARCH STATIONS. The port side of the helicopter is the recommended search side and can be used efficiently by the copilot and avionicsman. The copilot can maintain directional control of the Nightsun with either the collective searchlight position control switch or the searchlight position toggle switch on the remote ICS panel. The avionicsman can start, focus, change direction, or secure the Nightsun by using the remote control box. The control box, mounted on the starboard side of the helicopter, has enough cable to allow it to be used in the avionics position.

When operating the remote control box from the avionics position, the power extension cable laying across the cabin deck may be a hazard during an emergency exit.

It is recommended that the Nightsun not be used to search on the starboard side of the helicopter due to the possibility of the light striking the helicopter.

WARNING

The heat generated by the light is capable of melting a tire or igniting paint or fiber glass.

SAFETY PRECAUTIONS

Observe the following safety precautions when operating the high-intensity searchlight:

1. Because of high temperatures and high operating pressures, the possibility of an explosion is always present during operation or handling of the bulb. If an explosion should occur, anyone within a radius of 25 feet could be critically injured by flying glass.
2. Avoid training the searchlight on any part of the helicopter. The heat generated is capable of melting a tire or igniting paint or fiberglass. When you are changing azimuth from side to side, avoid shining the light on or inside the helicopter.
3. When operating close to personnel, the light beam should never be directed towards them since the high intensity of the beam may cause burns or eye injuries.

REVIEW

You have now completed the section on the high-intensity searchlight system. You should be thoroughly familiar with the system operation, preflight procedures, starting operation, and safety precautions. You have also learned how to install the light on the aircraft.

(Now answer the following review questions.)

29. The high-intensity searchlight can produce a MAXIMUM of _____ peak beam candle power.

- A. 3,600,000
- B. 3,700,000
- C. 3,800,000
- D. 3,900,000

29. C (Refer to page 67)

30. The lighted pressure inside the searchlight bulb is approximately _____.

- A. 300 psi
- B. 400 psi
- C. 600 psi
- D. 800 psi

30. A (Refer to page 67)

31. Where is the searchlight's remote control unit located in the helicopter cabin?

- A. Aft of the radio rack
- B. Below the variable hoist control
- C. Aft of the radioman's seat
- D. Above the variable hoist control

31. B This position is inside the cabin and on the right side. (Refer to page 67)

32. From what position is the focus of the high-intensity searchlight controlled?

- 1. Cockpit
- 2. Master control unit
- 3. Remote control unit

- A. 2 only.
- B. 3 only.
- C. 1 and 2 only
- D. 1, 2, and 3

32. B The remote control unit in the cabin has the only focus control. (Refer to page 67)

33. On the start cycle, the searchlight lamp will ignite in approximately _____ seconds.

- A. 3 to 5
- B. 3 to 8
- C. 5 to 8
- D. 5 to 10

33. D (Refer to page 70)

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34. Before securing the MASTER switch on the high-intensity searchlight, you should allow a MINIMUM of _____ minutes.

- A. 2
- B. 3
- C. 4
- D. 5

35. The altitude of aircraft searching for boats less than 40 feet long should be _____ feet.

- A. 300 to 500
- B. 300 to 800
- C. 300 to 1,000
- D. 1,000 to 1,500

34. B If the master switch is secured before the 3 minutes are up, the fan in the light assembly will be secured, and the lamp will not be cooled. (Refer to page 70)

35. C This altitude will give the crew a better chance of locating a boat of this size. (Refer to page 72)

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HH - 3F AVIONICSMAN



STANDARDIZED SYLLABUS

DEPARTMENT OF TRANSPORTATION
U. S. Coast Guard (08/81)

U.S. Coast Guard Institute
944421

FOREWORD

Successful rescue missions are accomplished by the coordination of skills between the pilot and SAR aircrewman.

The pilot has a training syllabus that requires him to be skilled in the art of flying.

You, as an avionicsman, must have a working knowledge of the equipment used aboard the helicopter. You must be familiar with and accomplished in the professional skills, techniques, and procedures used on rescue missions.

This syllabus is designed specifically to give you the required training to become a proficient and safety-conscious avionics SAR aircrewman.

A qualified instructor must supervise the student as he completes this booklet. To indicate that the student has satisfactorily demonstrated or explained an item, the instructor will enter his initials and the abbreviated date (1-1-76) in the "S" block. If the student's performance is not satisfactory, the instructor will initial and date the "U" block. He will then indicate in the Instructor's Remarks section the reason for the unsatisfactory mark. If the student is not prepared or fails to satisfactorily complete an item, the instructor should counsel him and indicate what preparation or additional training is required.

This is a composite ground/flight syllabus derived from close examination of the many syllabi in existence at various Air Stations and is designed to meet the needs of all Air Stations. Commanding officers may deviate from this standard as required to meet local mission requirements and operational limitations. In revising this standard syllabus for local use, it should be remembered that a proficient, safe, and standard search and rescue aircrewman is the goal of the program.

Reprinted (06/81)

CREWMAN

INTRODUCTION TO AVIONICSMAN SYLLABUS GROUND PHASE

I. Objectives

- A. After completing this phase, the student will be able to:
1. Perform taxi signalman duties safely, using standard hand signals.
 2. Perform the line duties required of a SAR aircrewman (servicing, etc.)
 3. Tow an aircraft, using the proper equipment and procedures.
 4. Demonstrate emergency egress procedures from Avionicsman and Flight Mechanic positions.
 5. Use the pyrotechnics and SAR equipment safely.
 6. Plot a course, using the proper navigation equipment and procedures.
 7. Perform preflight, thruflight, and post-flight, using the proper guidelines.
 8. Locate and identify the avionics antennas.
 9. Locate the components of the various avionic systems.
 10. Stand radio room watch on air-to-ground frequencies.
- B. The student must accomplish the ground phase to the instructor's satisfaction before it can be signed off.
- C. The student must complete the ground phase before he can begin the flight phase.
- D. Completion of this ground training will give the student the background he needs to be a good line crewman and a good aircrewman.

GROUND 1

I. AIRCRAFT GROUND HANDLING

S	U
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Instructor will have the student accomplish the following:

A. Aircraft start and launch

- Using the proper procedures and safety precautions, stand the fire guard for aircraft start and launch.

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B. Aircraft taxiing

- Demonstrate the proper procedures and hand signals for aircraft taxiing.
- Describe the safety precautions used during acft. taxi evolution.

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C. Aircraft securing

- Demonstrate proper procedures to follow during engine shutdown.
- Use the proper procedures to tie down an aircraft.
- Show how the equipment for securing an aircraft is used.
- Show the location of the main landing gear locking pins and show how they are used.

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- Demonstrate a working knowledge of general line operations.

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II. GENERAL

- Progress
- Knowledge
- Judgment
- Attitude

III. INSTRUCTOR'S REMARKS:

S	U
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Instructor Signature / Date

III. INSTRUCTOR'S REMARKS:

GROUND 2

I. AIRCRAFT TOWING

S	U
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Student will accomplish the following under guidance of the instructor:

A. Complete prestart check of tow tractor (gas, oil, etc.).

--	--

B. Operate tow tractor.

--	--

C. Complete tow bar safety check and hook up to the aircraft.

--	--

D. Hook up tow tractor to tow bar and aircraft.

--	--

E. Ensure that the proper tow crew is in position, and has been briefed on emergency/normal stops.

--	--

F. Tow aircraft.

--	--

G. Demonstrate the aircraft towing safety precautions.

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(Student should go through this lesson as many times as it takes him to complete the lesson to the instructor's satisfaction.)

II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude

Instructor Signature / Date

GROUND 3

S	U
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I. AIRCRAFT SERVICING

S	U
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Instructor will have student accomplish the following:

A. Fueling

1. Complete prestart check of fuel truck.
2. Operate fuel truck, demonstrating proper procedures and safety precautions, including proper static grounding sequence.
3. Demonstrate knowledge of the fueling and defueling operation on the III-3F.
4. Fuel aircraft, including procedures for hydrant and cabinet fueling.

B. Oil and hydraulic fluid

1. Identify the proper oil to be used in the engines, transmission, intermediate gear box, and tail gear box.
2. Using the proper oil, replenish the engines, transmission, intermediate and tail gear boxes.
3. Using the proper hydraulic fluid, replenish the primary, auxiliary, and utility hydraulic systems.

4. Describe the proper procedures to be followed in accomplishing items 2 and 3 in this section.

C. Lubrication

1. Using the proper grease, equipment, and procedures, lubricate the landing gear.

- D. Observe the proper procedures and safety precautions in each of the described operations.

II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude

III. INSTRUCTOR'S REMARKS:

Instructor Signature / Date

E. Emergency items and procedures

Student will show the location of and/or explain the following:

1. Emergency exits
2. Demonstrate emergency egress procedures from Avionicsman and Flight Mechanic positions.
3. Fire extinguishers
4. Emergency exit lights
5. First aid kits
6. In-flight fire
7. Smoke and fume elimination
8. Ditching procedures

S	U
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II. GENERAL:

- A. Progress
- B. SAR/Rescue equipment knowledge
- C. Judgment
- D. Attitude

III. INSTRUCTOR'S REMARKS:

II. GENERAL:

- A. Progress
- B. SAR/Rescue equipment knowledge
- C. Judgment
- D. Attitude

III. INSTRUCTOR'S REMARKS:

Instructor Signature / Date

GROUND 5

I. NAVIGATION

S	U
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Instructor will have student accomplish the following:

A. Interpret charts.

1. Read charts.
2. Identify types of charts.
3. Estimate distances.
4. Identify approach plate.
5. Identify enroute supplements.

B. Use navigation equipment.

1. Compass
2. Plotter
3. Dividers
4. Pilot's computer

C. Plot a given course, giving headings, distance, enroute time, and any other information as desired. (Use 80 kts.)

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D. Show a working knowledge of the following electronic navigation equipment:

1. Direction finders
2. VHF/NAV
3. ADF
4. TACAN

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II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude

S	U
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III. INSTRUCTOR'S REMARKS:

Instructor Signature / Date

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GROUND 6

I. INSPECTIONS

S	U
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Instructor will have the student accomplish the following:

A. Preflight inspection

1. Perform a preflight inspection in accordance with and using as a guide CMS Card #000.4A.

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2. Sign off preflight on CG-4377 using proper procedures (sample).

--	--

B. Thruflight inspection

1. Perform a thruflight inspection in accordance with and using as a guide, CMS Card #000.5A.

--	--

2. Sign off thruflight on CG-4377 using proper procedures (sample).

--	--

C. Postflight inspection

1. Perform a postflight inspection in accordance with and using as a guide, CMS Card #000.6A.

--	--

2. Sign off postflight according to station instructions.

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III. INSTRUCTOR'S REMARKS:

GROUND 8

I. AVIONICS COMPONENTS

S	U
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Instructor will have the student accomplish the following:

A. Locate and identify the following avionic components in the bow compartment:

1. Radar altimeter
2. IFF
3. Glide slope
4. LORAN C Antenna Coupler
5. Radar
6. Flight director

B. Locate and identify the following avionic components on the forward cabin electronics rack:

1. UHF
2. ADF
3. FM

C. Locate and identify the following avionic components on the aft cabin electronics rack:

1. TACAN
2. VHF NAV
3. Marker Beacon

Instructor Signature/Date

S	U
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- 4. HF
- 5. VHF

D. Locate and identify the following avionic components in the doppler bay:

- 1. Doppler
- 2. Gyro

II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude

III. INSTRUCTOR'S REMARKS:

Instructor Signature/Date

GROUND 9

S	U
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I. RADIO ROOM WATCH STANDING (40 hours minimum)

Instructor will have student accomplish the following:

A. Watch standing

- 1. Convert local time to GMT time.
- 2. Stand watch on aircraft frequency.
- 3. Receive and interpret a drill message.
- 4. Maintain an abbreviated radio log.
- 5. Handle outgoing and incoming messages.
- 6. Operate teletype and understand teletype operating procedures.

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II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude

III. INSTRUCTOR'S REMARKS:

Instructor Signature/Date

INTRODUCTION TO AVIONICSMAN SYLLABUS FLIGHT PHASE

This syllabus is designed to help you become a qualified HH-3F avionicsman. This syllabus is also a record of your completed training.

FLIGHT 1

1. Objectives:

- A. After completing this syllabus, the student will be able to:
1. Operate the ICS.
 2. Use proper ICS voice procedures.
 3. Operate the HF transceiver.
 4. Use proper radio voice procedures.
 5. Maintain an abbreviated radio log.
 6. Send and receive messages.
 7. Operate the LORAN navigator
 8. Plot position from Loran readings.

FLIGHT TIME

S	U
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I. COMMUNICATIONS

Instructor will have student monitor the following:

A. ICS

1. Operation of ICS
2. ICS voice procedures
3. Proper ICS responses

B. HF Transceiver

1. Initial setup
2. Frequency changes
3. HF communications

II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude
- E. Crew coordination

III. INSTRUCTOR'S REMARKS:

Instructor Signature/Date

III. INSTRUCTOR'S REMARKS:

FLIGHT 2

FLIGHT TIME

S	U
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I. WATCH STANDING

Instructor will have student perform the following:

A. ICS

1. Operate the ICS
2. Use proper ICS voice procedures
3. Use proper voice responses

B. HF Transceiver

1. Establish communication with aeronautical station.
2. Transmit operation and position reports.
3. Maintain abbreviated radio log.
4. Keep aircraft time sheet.
5. Receive drill message.
6. Transmit drill message.

(Student should go through this lesson as many times as it takes him to complete the lesson to the instructor's satisfaction.)

H. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude
- E. Crew coordination

Instructor Signature/Date

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III. INSTRUCTOR'S REMARKS:

FLIGHT 3

FLIGHT TIME

S	U
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I. NAVIGATION

Instructor will have student perform the following:

A. Loran chart interpretation

- 1. Identify Loran rates in area.
- 2. Obtain approximate Loran fix from chart.

B. LORAN C NAVIGATOR

- 1. Complete initial setup.
- 2. Operate LORAN C NAVIGATOR

C. Plotting

- 1. Plot Loran fix using TD and Lat Long

II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude
- E. Crew coordination

Instructor Signature/Date

FLIGHT 4

FLIGHT TIME

S	U
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I. CHECK FLIGHT

Instructor will observe student for correct operation of the following:

A. ICS

1. Proper operation and voice procedures.

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B. HF Transceiver

1. Proper operation and voice procedures.

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C. LORAN

1. Proper operation.

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II. GENERAL

- A. Progress
- B. Knowledge
- C. Judgment
- D. Attitude
- E. Crew coordination

III. INSTRUCTOR'S REMARKS:

Instructor Signature/Date