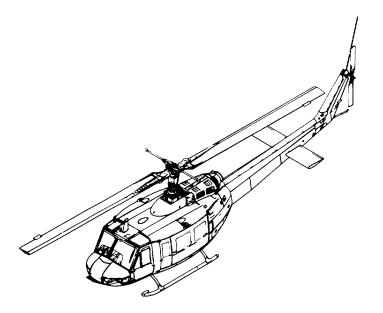
TECHNICAL MANUAL

OPERATOR'S MANUAL

FOR

ARMY EH-1H/X

HELICOPTER



HEADQUARTERS DEPARTMENT
OF THE ARMY
5 NOVEMBER 1983

WARNING DATA

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CHANGE NO. 6

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DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 6 February 1989

Operator's Manual for Army

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To be distributed in accordance with DA Form 12-31, Operator Maintenance requirements for UH-1D/H, EH-1H aircraft.

WARNING

Personnel performing operations, procedures and practices which are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury or loss of life.

STARTING ENGINE

Coordinate all cockpit actions with ground observer. Ensure that rotors and blast areas are clear and fire guard is posted.

FIRE EXTINGUISHER

Exposure to high concentrations of monobromotrifluoromethane (CF³Br) extinguishing agent or toxic fumes produced by the agent should be avoided. The liquid should not be allowed to come in contact with the skin, as it may cause frostbite or low temperature burns.

GROUND OPERATION

Engine shall be started and operated only by authorized personnel. Reference AR 95-1.

ARMAMENT

Loaded weapons, or weapons being loaded or unloaded, shall be pointed in a direction which offers the least exposure to personnel or property in the event of accidental firing. Personnel should remain clear of hazardous area of all loaded weapons. Upon landing, immediately alert personnel to probable presence of live rounds in the gun. Summon armament repairman to clear weapon.

ELECTROLYTE

Battery electrolyte is harmful to the skin and clothing. If potassium hydroxide is spilled on clothing, or other material wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue until medical assistance arrives.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of anoxia exist, the crew should immediately ventilate cabin and shut off heater.

HANDLING FUEL AND OILS

Turbine fuels and lubricating oil contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary.

RADIOACTIVE MATERIALS

Self-luminous dials and ignition units contain radioactive materials. If such an instrument or unit is broken or becomes unsealed, avoid personal contact.

BATTERY

If battery overheats, do not open battery compartment. Battery fluid will cause burns, and overheated battery could cause thermal burns and may explode.

NOISE

Sound pressure levels in this helicopter during some operating conditions exceed the Surgeon General's hearing conservation criteria as defined in TB MED 501. Hearing protection devices, such as the aviator helmet or ear plugs are required to be worn by all personnel in and around the helicopter during its operation.

HANDLING HYDRAULIC FLUID (MIL-H-83282)

Prolonged contact with liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

ELECTRICAL

Serious electrical burns could result from contact with wiring and connectors when systems are energized from running aircraft or from Ground Power Units.

AVIATION LIFE SUPPORT EQUIPMENT

Aviation life support equipment shall be utilized in accordance with AR 95-1 and FM 1-302. Failure to do so may result in personal injury or loss of life.

OPERATOR'S MANUAL EH-1H/X HELICOPTERS

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Troop Support & Aviation Material Readiness Command, ATTN: DRSTS-MPSD, 4300 Goodfellow Boulevard, St. Louis, MO 63120. A reply will be furnished directly to you.

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CHAPTER 1

INTRODUCTION

1-1. GENERAL.

These instructions are for use by the operator(s). They apply to EH-1H and EH-1X helicopters.

1-2. WARNINGS, CAUTIONS, AND NOTES.

Warnings, Cautions, and Notes are used to emphasize important and critical instructions and are used for the following conditions.

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.



An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment

NOTE

An operating procedure, condition, etc., which it is essential to highlight.

1-3. DESCRIPTION.

This manual contains the best operating instructions and procedures for the EH-1H/X helicopter under most circumstances. The observance of limitations, performance and weight balance data provided is mandatory. The observance of procedure is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. Your flying experience is recognized, and therefore, basic flight

principles are not included. THIS MANUAL SHALL BE CARRIED IN THE HELICOPTER AT ALL TIMES.

1-4. APPENDIX A, REFERENCES.

Appendix A is a listing of official publications cited within the manual applicable to and available for flight crews.

1-5. APPENDIX B, ABBREVIATIONS AND TERMS.

Definitions of all abbreviations and terms used throughout the manual are included in appendix B.

1-6. INDEX.

The index lists, in alphabetical order, every titled paragraph, figure, and table contained in this manual. Chapter 7 performance data has an additional index within the chapter.

1-7. ARMY AVIATION SAFETY PROGRAM.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

For information concerning destruction of Army materiel to prevent enemy use, refer to TM 750-244-1-5.

1-9. FORMS AND RECORDS.

Army aviators flight records and helicopter maintenance records which are to be used by the operators and crewmembers are prescribed in TM 38-750 and TM 55-405-9.

1-10. EXPLANATION OF CHANGE SYMBOLS.

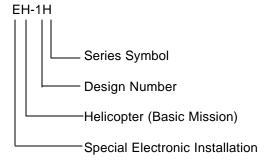
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with emergency markings, which consist of black diagonal lines around three edges, may have the vertical line or change symbol placed along the inner margins. Symbols show current changes only. A miniature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature pointing hands, is utilized when there have been extensive changes made to an illustration. Change symbols are not utilized to indicate changes in the following:

- a. Introductory material.
- **b.** Indexes and tabular data where the change cannot be identified.
- **c.** Blank space resulting from the deletion of text, an illustration, or a table.
- **d.** Correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless such correction changes the meaning of instructive information and procedures.

1-11. HELICOPTER DESIGNATION SYSTEM.

The designation system prescribed by AR 70-50 is used in helicopter designations as follows:



1-12. DESIGNATOR SYMBOLS.

Designator symbols (EH-1H Phase 1A), (EH-1H Phase 1B) and (EH-1X) are used in conjunction with text contents, text headings and illustration titles to show limited effectivity of the material. One or more designator symbols may follow a text heading or illustration title to indicate proper effectivity, unless the material applies to all models and configurations within the manual. If the material applies to all series and configurations, no designator symbols will be used. Where practical, descriptive information shall be condensed and combined for all models to avoid duplication.

1-13. USE OF WORDS SHALL, WILL, SHOULD AND MAY.

Within this technical manual the word "shall" is used to indicate a mandatory requirement. The word "will" is used to express a declaration of purpose. The word "should" is used to indicate a non-mandatory but preferred method of accomplishment. The word "may" is used to indicate an acceptable method of accomplishment.

CHAPTER 2

HELICOPTER AND SYSTEMS DESCRIPTION AND OPERATION

SECTION I. HELICOPTER

2-1. GENERAL DESCRIPTION.

The EH-1H and EH-1X helicopters are essentially all metal helicopters with one main rotor and one tail rotor. Power is provided by a turbine engine. Features include the two-bladed main rotor, low silhouette, wide cabin and skid type landing gear. The EH-1H Phase 1A has both intercept and countermeasure (AN/TLQ-27A) functions. The EH-1H Phase 1B has intercept and countermeasure functions provided by the AN/TLQ-17A system. The EH-1X has intercept, countermeasure (AN/TLQ-17A) and Airborne Direction Finding functions. The EH-1H/X maximum gross weight is 9500 pounds.

2-2. GENERAL ARRANGEMENT.

Figure 2-1 depicts the general arrangement. Indexed items include access openings and most of the items referred to in the exterior check paragraph in Section II of Chapter 8.

2-3. PRINCIPAL DIMENSIONS.

Figure 2-2 depicts the principal dimensions.

2-4. TURNING RADIUS.

Figure 2-3 depicts the minimum turning radius.

2-5. FUSELAGE.

The fuselage is the forward section of the airframe extending from the nose to the forward end of the tailboom. The fuselage consists primarily of two longitudinal beams with transverse bulkheads and metal covering. The main beams are the supporting structure for the cabin, landing gear, fuel tanks, transmission, engine, and tailboom. The external cargo suspension unit is attached to the main beams near the center of gravity of the helicopter.

2-6. TAILBOOM.

The tailboom section is bolted to the aft end of the

fuselage and extends to the aft end of the helicopter. It is a tapered, semi-monocoque structure comprised of skins, longerons, and stringers. The tailboom supports the tail rotor, vertical fin, and synchronized elevator. It houses the tail rotor driveshaft and some electronic equipment.

2-7. LANDING GEAR SYSTEM.

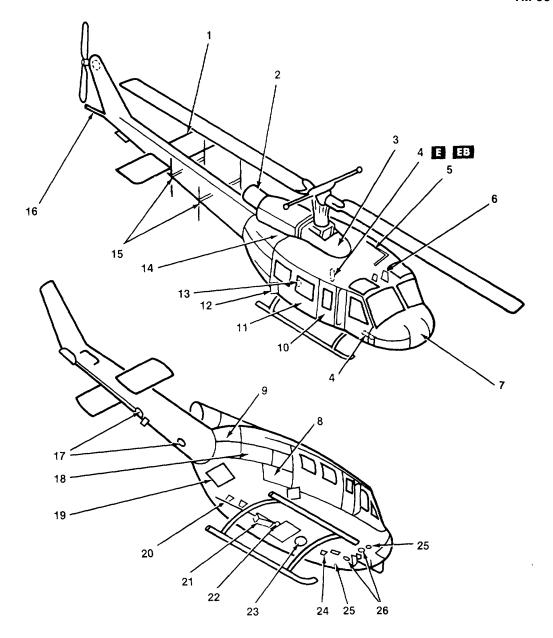
- a. Main Landing Gear. The main landing gear consists of two aluminum arched crosstubes mounted laterally on the fuselage with two longitudinal skid tubes attached to the crosstubes. The skid tubes are made of aluminum and have steel skid shoes attached to the bottom to minimize skid wear.
- **b.** Tail Skid. A tubular steel tail skid is installed on the aft end of the tailboom. It acts as a warning to the pilot upon an inadvertent tail-low landing and aids in protecting the tail rotor from damage.

2-8. CREW COMPARTMENT DIAGRAM.

The crew compartment is depicted in figure 2-7.

2-9. COCKPIT AND CABIN DOORS.

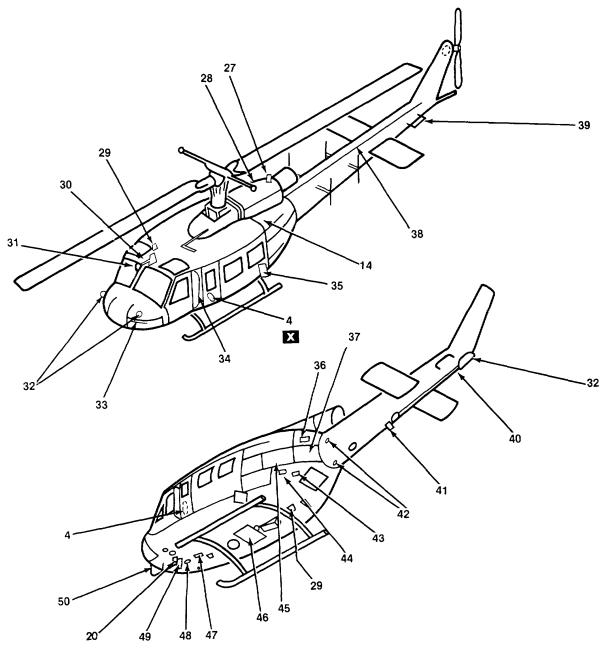
- a. Cockpit Doors. The cockpit doors are formed aluminum frames with transparent plastic windows in the upper section (figure 2-1). Ventilation is supplied by the sliding panels in the windows. Cam-type door latches are used and doors are equipped with jettisonable door releases.
- **b. Cabin Doors.** The two cabin doors are formed aluminum frames with transparent plastic windows in the upper section (figure 2-1). These doors are on rollers and slide aft to the open position allowing full access to the cargo area. Hinged doorpost panels are forward of the cabin doom. They provide a larger entrance to the cargo area. An open door lock is provided to hold the door in the aft position to prevent door separation in flight (figure 2-4).



- 1. Synchronized elevator
- 2. Engine exhaust IR suppressor3. Transmission cowling
- 4. Fire extinguisher
- 5. VHF-FM communication antenna
- 6. VHF-UHF antenna
- 7. Radio compartment and fwd battery access door
- 8. Heater compartment access door
- 9. Tail rotor driveshaft coupling access door
- 10. Cabin panel door
- 11. Cabin cargo door
- 12. Chaff & flare dispenser EB X
- 13. Transm. fluid sight gage

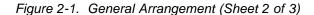
- 14. Engine deck access door
- 15. DF antennas X
- 16. Tail skid
- 17. Radar altimeter antennas No. 2 E EB
- 18. Oil cooler fan access door
- 19. IR oil cooler shield EB X
- 20. TACO communication antenna X
- 21. Intercept antenna E EB
- 22. Position light (white)
- 23. Landing light
- 24. Radar warning blade antenna
- 25. Radar warning SAM antenna EB X
- 26. Radar altimeter antennas No. 1 X

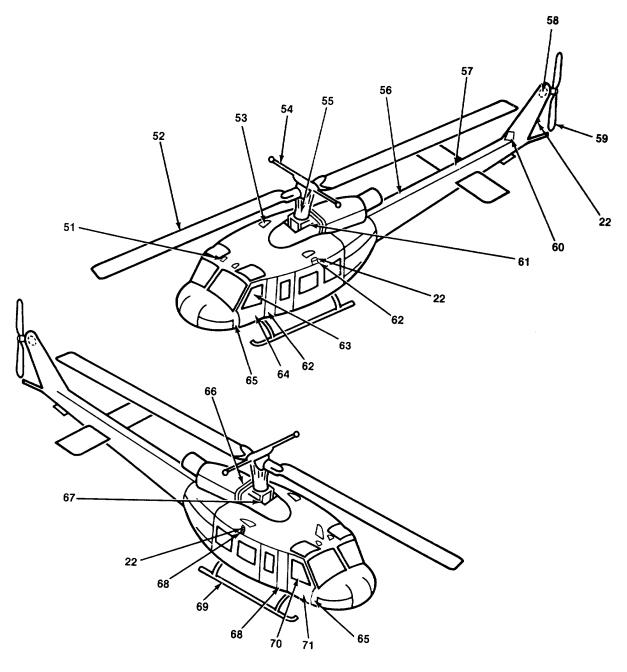
Figure 2-1. General Arrangement (Sheet 1 of 3)



- 27. Anti-collision light
- 28. Engine cowling
- 29. TACAN navigation antenna X
- 30. Pitot Tube
- 31. FAT probe
- 32. Radar warning spiral antennas
- 33. Glideslope antenna X
- 34. FM homing antenna
- 35. Chaff dispenser EB X
- 36. Tail rotor driveshaft access door
- 37. Electrical compartment access door
- 38. Driveshaft cover

- 39. VHF navigation omni antenna
- 40. ECM antenna
- 41. BITE antenna X
- 42. Tailboom attachment bolts
- 43. DC external power receptacle
- 44. AC external power receptacle EB X
- 45. Aft radio compartment access doors
- 46. ADF sense antenna
- 47. Marker beacon antenna
- 48. Searchlight
- 49. IFF antenna
- 50. FM communication antenna E EB





- 51. Forward ventilator
- 52. Main rotor blade
- 53. Aft ventilator
- 54. Stabilizer bar
- 55. Main rotor system
- 56. Fwd tail rotor driveshaft access door
- 57. Aft tail rotor driveshaft access door
- 58. 90° tail rotor gearbox
- 59. Tail rotor
- 60. 42° tail rotor gearbox
- 61. Main driveshaft access

- 62. Position light (red)
- 63. Co pilot seat
- 64. Co pilot door
- 65. Static port
- 66. Engine air intake
- 67. Transmission oil & hydraulic reservoir access
- 68. Position light (green)
- 69. Landing gear
- 70. Pilot seat
- 71. Pilot door

Figure 2-1. General Arrangement (Sheet 3 of 3)

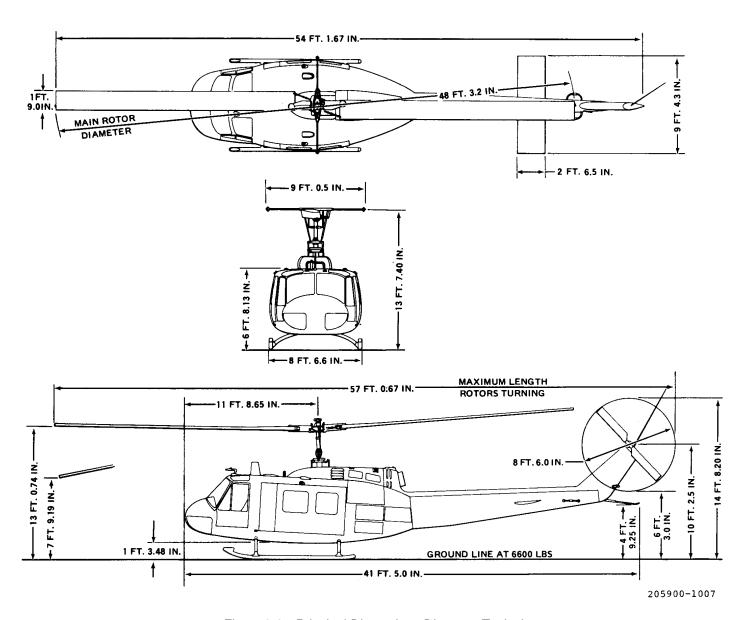


Figure 2-2. Principal Dimensions Diagram -Typical

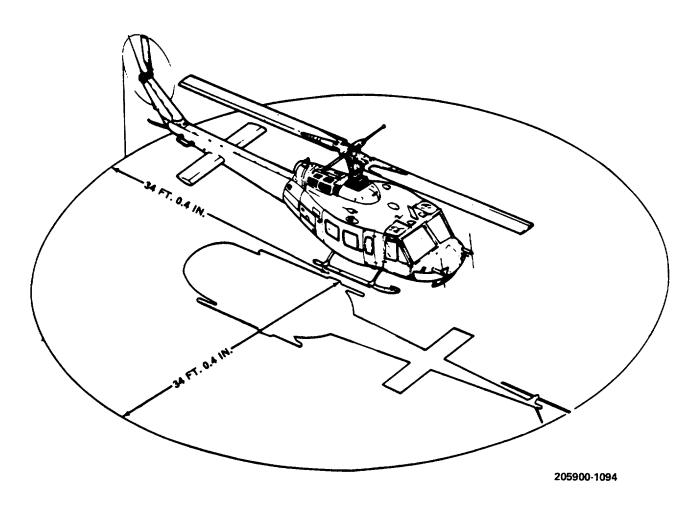


Figure 2-3. Turning Radius - Typical

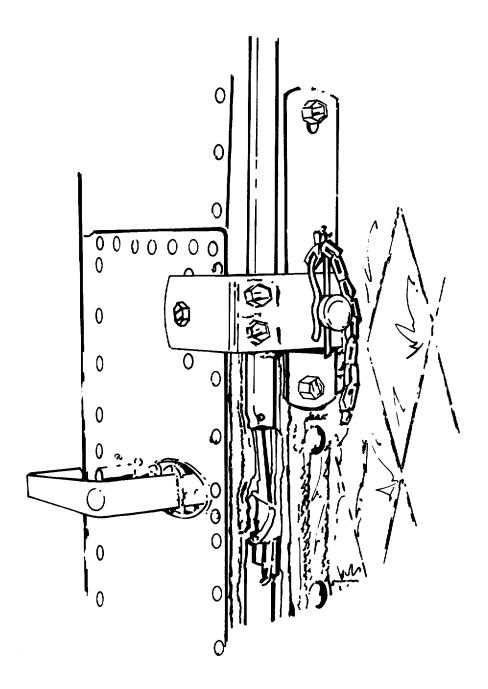


Figure 2-4. Cabin Door Lock - Typical (Sheet 1 of 2)

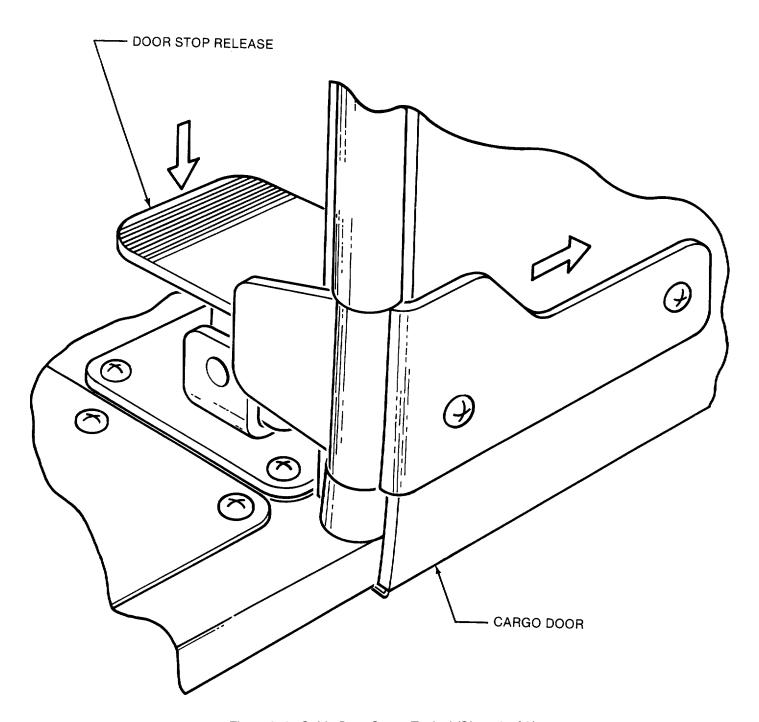
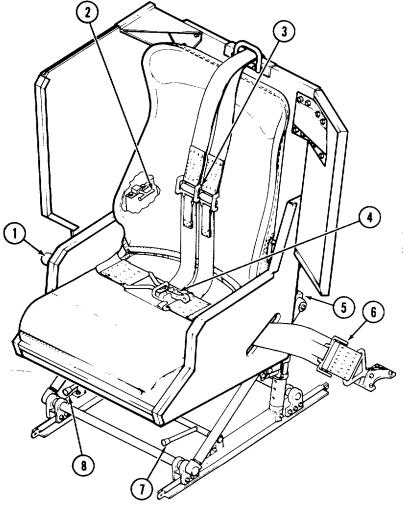


Figure 2-4. Cabin Door Stop - Typical (Sheet 2 of 2)



PILOT/COPILOT

- 1. Shoulder harness lock unlock control
- Armor plate adjustment lock
 Shoulder harness adjuster
- 4. Seat belt latch
- 5. Quick release
- Seat belt adjuster
- 7. Seat adjustment fore and aft8. Seat adjustment vertical

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Figure 2-5. Crew Seats - Typical (Sheet 1 of 3)

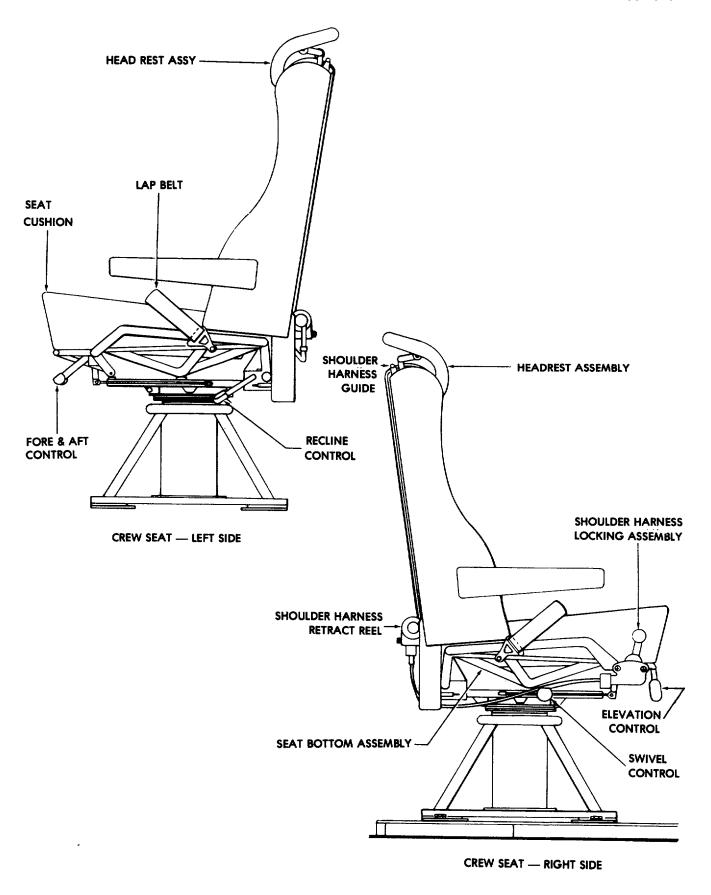
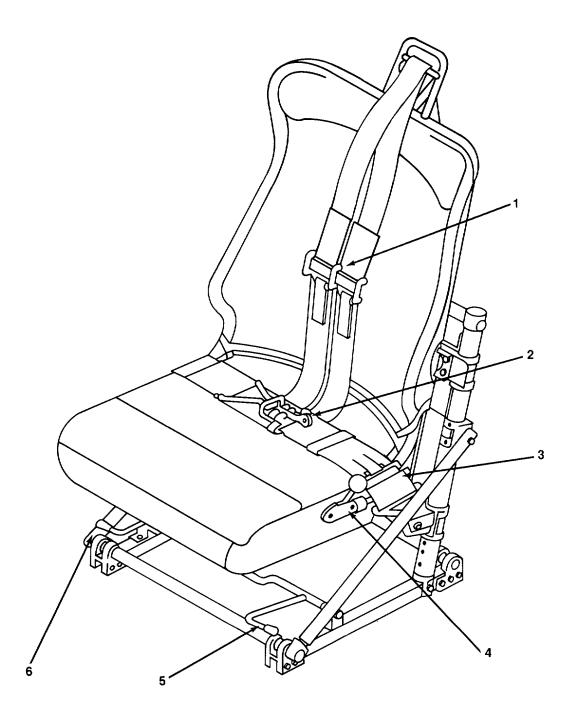


Figure 2-5. EEE Crew Seats - Typical (Sheet 2 of 3)



- Shoulder harness adjuster
 Seat belt latch
 Seat belt adjuster

- 4. Shoulder harness lock/unlock control5. Seat adjustment fore and aft6. Seat adjustment vertical

Figure 2-5. X Crew Seat - Typical (Sheet 3 of 3)

2-10. CREW SEATS.

- a. Pilot and Copilot Seats (figure 2-5). The seats are equipped with lap safety belt and inertia-reel shoulder harness. They are adjustable fore and aft and vertically. The vertical adjustment handle is under the right side of the seat and the fore and aft handle is on the left. The seats are equipped with a quick release, on each side at the back of the seat, for reclining the seat. The seat back, bottom, and sides are protected by ceramic and aluminum armor plate. Hip and shoulder areas are protected by ceramic type armor.
- b. Inertia Reel Shoulder Harness. An inertia reel and shoulder harness is incorporated in the pilot and copilot seats with manual lock-unlock handle located on the right front of the seat (figure 2-5). With the control in the unlocked position (aft) and the shoulder straps properly adjusted, the reel strap will extend to allow the occupant to lean forward; however, the reel automatically locks when the helicopter encounters an impact force of 2 to 3 "G" deceleration. The reel can be locked (handle forward) from any position and will take up slack in the harness. To release the lock, it is necessary to lean back slightly to release tension on the lock and move the control handle to the unlock position. It is possible to have pressure against the seat back whereby no additional movement is possible and the lock cannot be released. If this condition occurs, it will be necessary to loosen the harness. The reel should be manually locked for emergency landing. Straps must be adjusted to fully retract within the inertia reels to prevent rebound overshoot in the event of impact Seat belt must be securely fastened and firmly tightened prior to

adjustment of shoulder harness to prevent submarining in event of impact.

- c. E E Mission Operator Seats (figure 2-5). The two mission operator seats are adjustable, nonreclining, swiveling, and equipped with seat belts and inertia reel shoulder harness.
- d. Mission Operator Seat (figure 2-5). The mission operator seat is vertical and fore-aft adjustable and non-reclining. The vertical height adjustment handle is under the right side of the seat. The fore-aft adjustment is under the left side of the seat. The seat is equipped with seat belts and inertia reel shoulder harness.

2-11. INSTRUMENTS AND CONTROLS.

- **a. Instrument Panel.** The location of all the controls, indicators, instruments, and data placards installed on the instrument panel is depicted in figure 2-6.
- **b. Pedestal Panel.** The panels and controls installed in the pedestal are depicted in figure 2-7.
- **c. Overhead Console.** The location of the controls and circuit breakers installed in the overhead console is depicted in figure 2-7.
 - d. External Stores Jettison Handle. Not used.
- **e.** Other Instruments and Controls. Instruments, controls, or indicators not shown in figures 2-6 or 2-7 are shown in the Chapter/Section which describes their related systems.

SECTION II. EMERGENCY EQUIPMENT

2-12. EMERGENCY EQUIPMENT.

The emergency equipment location, illustration, and emergency procedures are covered in Chapter 9.

2-13. PORTABLE FIRE EXTINGUISHER.

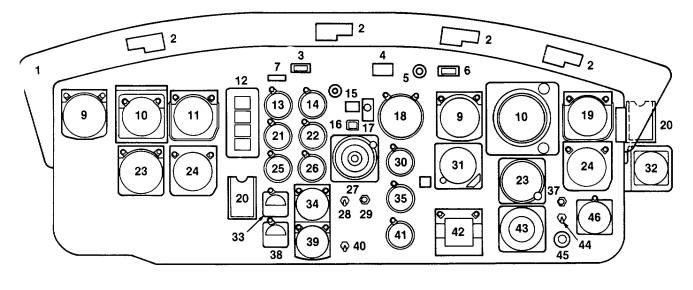
A portable hand-operated fire extinguisher is carried in a bracket at the right side of the pilot seat. It is charged with monobromotrifluoromethane (CF3Br).

a. E E A second portable hand fire extinguisher is carried in a bracket mounted on the mission console, position 2.

b. A second portable fire extinguisher is carried in a bracket mounted on the left side jump door.

2-14. FIRST AID KITS.

- a. E E Four general purpose type first aid kits have been provided in the cabin area (figure 9-1). Two kits are located on the upper area of the aft cabin bulkhead on either side of the rifle rack. Two kits are secured to the upper area of the left and right center door posts.
- **b.** Four general purpose first aid kits have been provided in the cabin area (figure 9-2). Two kits are secured to the right center door post and two are secured to the left center door post.



E EB

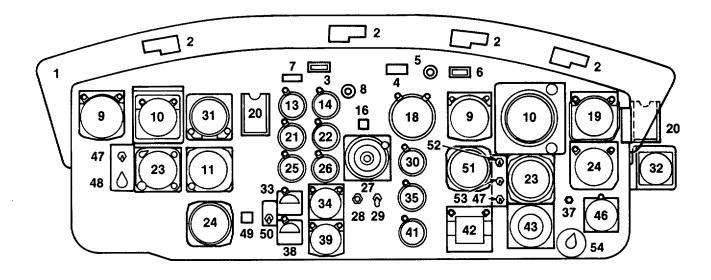
- 1. Glareshield
- 2. Secondary lights
- 3. Master caution
- 4. RPM warning light
- 5. Fire detecter test switch
- 6. Fire warning indicator light
- 7. Radio call designator
- 8. Fuel gage test switch
- 9. Airspeed indicator
- 10. Attitude indicator
- 11. Altimeter indicator (AAU-32/A)
- 12. Mission antenna position indicators
- 13. Fuel pressure indicator
- 14. Fuel quantity indicator
- 15. FM secure-nonsecure indicators
- 16. Radar warning display (AN/APR-44)
- 17. FM secure dimming control **EB**
- 18. Dual tachometer
- 19. Altimeter indicator (AAU-31/A)
- 20. Compass correction card holder
- Engine oil pressure indicator
- 22. Engine oil temperature indicator
- 23. Radio magnetic indicator
- 24. Vertical velocity indicator

- 25. Transmission oil pressure indicator
- 26. Transmission oil temperature indicator
- 27. Radar warning display (AN/APR-39)
- 28. IFF code hold light
- 29. IFF code hold switch
- 30. Torquemeter indicator
- 31. Radar altimeter
- 32. Magnetic compass
- 33. Main generator loadmeter Generator loadmeter EB X
- 34. DC voltmeter
- 35. Gas producer tachometer indicator
- 36. Radar altimeter low limit set indicator
- 37. Marker beacon light **E EB**
- 38. Standby generator loadmeter Converter loadmeter EB X
- 39. AC voltmeter
- 40. Compass slaving switch
- 41. Exhaust gas temperature indicator
- 42. Turn and slip indicator
- 43. Omni indicator
- 44. Marker beacon sensing switch
- 45. Marker beacon volume control



46. Clock

Figure 2-6. Instrument Panel (Sheet 1 of 2)



X

Figure 2-6. Instrument Panel (Sheet 2 of 2)

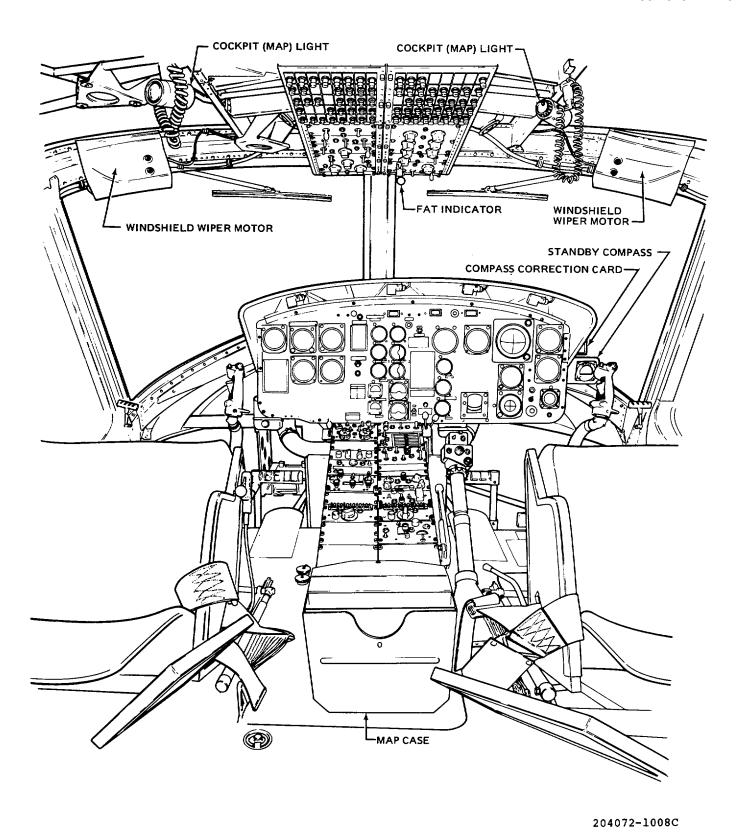
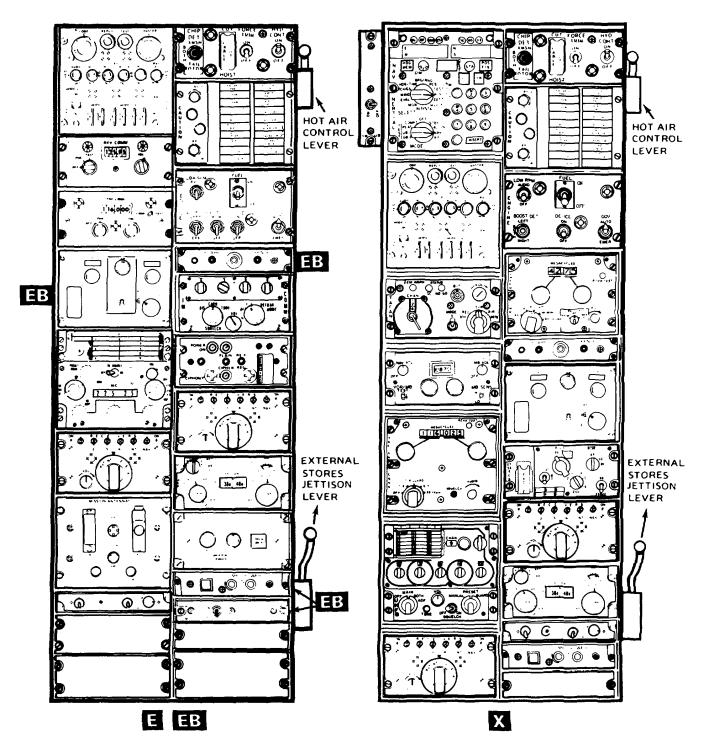


Figure 2-7. Crew Compartment - Typical (Sheet 1 of 4)



PEDESTAL ARRANGEMENT

Figure 2-7. Crew Compartment - Typical (Sheet 2 of 4)

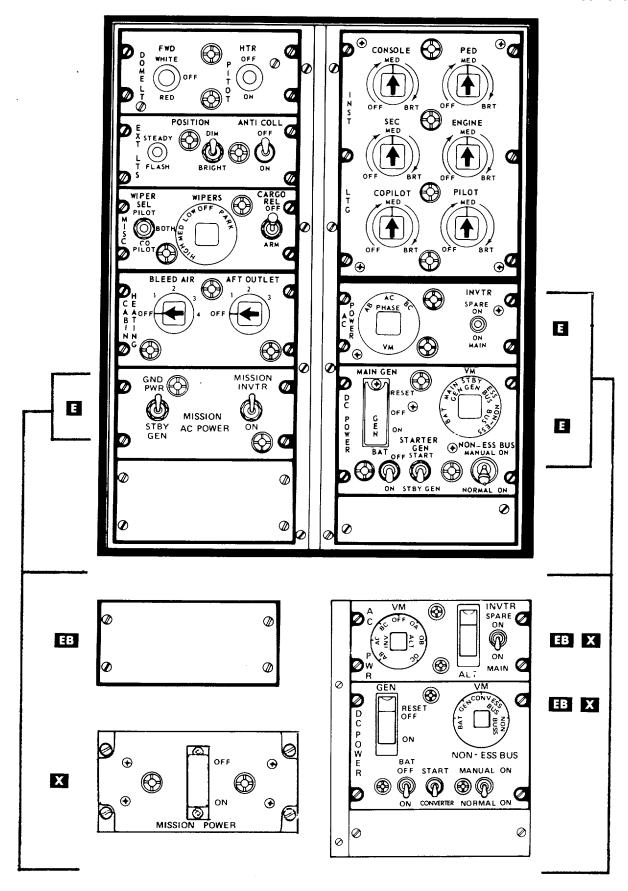


Figure 2-7. Crew Compartment - Typical (Sheet 3 of 4)

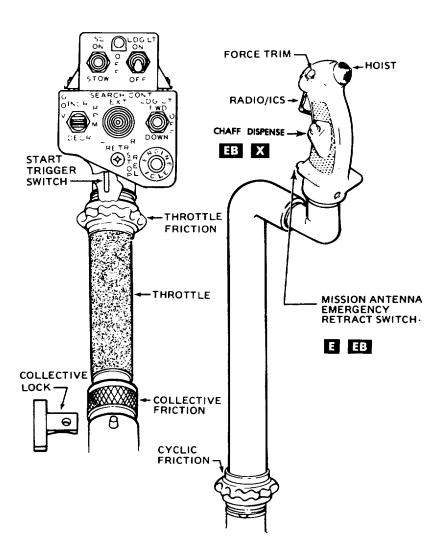


Figure 2-7. Crew Compartment - Typical (Sheet 4 of 4)

SECTION III. ENGINE AND RELATED SYSTEMS

2-15. ENGINE.

The EH-1H and EH-1X helicopters are equipped with T53-L-13 engine (figure 2-8). The engine is rated at 1400 horsepower; however, the helicopter is torque limited by the transmission to 1100 shp at 6600 rpm.

2-16. ENGINE COMPARTMENT COOLING.

The engine compartment is cooled by natural convection through engine compartment screens.

2-17. AIR INDUCTION SYSTEM.

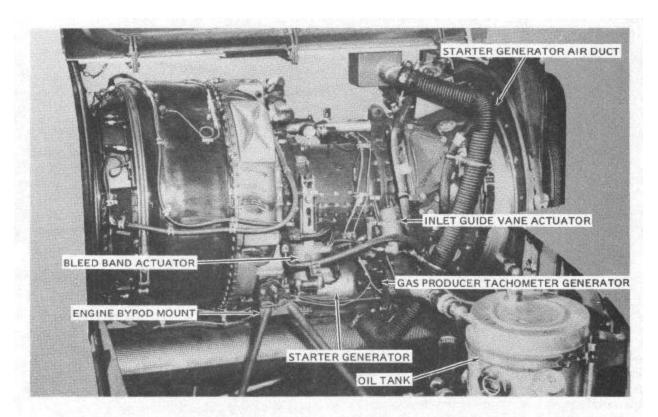
- a. Particle Separator. Helicopters are equipped with a self-purging particle separator. This is an inertial-type separator. Particle-laden air is directed through a large annular chamber and through an air cleaner. A constant supply of bleed air from the engine flows through the venturi-type ejector and carries particles overboard through airframe plumbing.
- **b. Foreign Object Damage Screen.** EH-1H/X helicopters have a Foreign Object Damage (FOD) screen installed. This prevents large particles from entering the engine inlet.
- **c. De-Ice.** Engine de-ice is a bleed air system activated by the DE-ICE switch on the ENGINE panel (figure 2-9). In the ON position bleed air is directed through the engine inlet to provide ice protection. Power losses caused when the system is on are shown in Chapter 7. In the event of DC electrical failure or when the DE-ICE ENG circuit breaker is out, de-ice is automatically on. System power is provided by the DC essential bus and protected by the ANTI-ICE ENG circuit breaker.

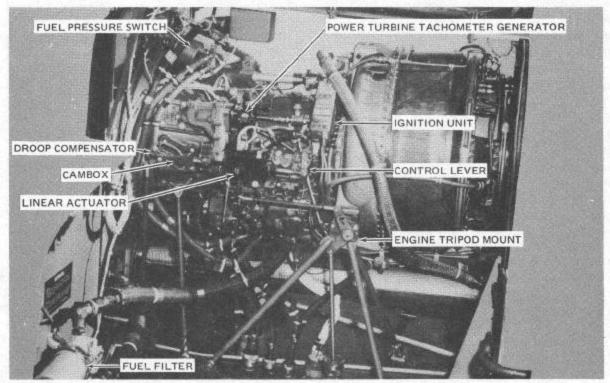
2-18. ENGINE FUEL CONTROL SYSTEM.

- **a. Engine Mounted Components.** The fuel control assembly is mounted on the engine. It consists of a metering section, a computer section and an overspeed governor.
- (1) The metering section is driven at a speed proportional to N1 speed. It pumps fuel to the engine through the main metering valve or, if the main system

fails, through the emergency metering valve which is positioned directly by the twist grip throttle.

- (2) The computer section determines the rate of main fuel delivery by biasing main metering valve opening for N1 speed, inlet air temperature and pressure, and throttle position. It also controls the operation of the compressor air bleed and operation of the variable inlet guide vanes.
- (3) The overspeed governor is driven at a speed proportional to N2 speed. It biases the main metering valve opening to maintain a constant selected N2 rpm.
- b. Starting Fuel Flow. During engine start. energizing the start fuel switch opens the fuel solenoid valve, allowing fuel from the fuel regulator to flow through the starting fuel manifold and into the When N1 reaches sufficient combustion chamber. speed, the start switch is de-energized, causing the solenoid valve to close and stop-starting fuel flow. Starting fuel nozzles are purged by air from the combustion chamber through a check filter valve. Engine starting fuel solenoid valve is controlled by the engine starter switch. The engine solenoid valve (engine starting fuel solenoid valve) cannot be individually controlled during engine starts.
- c. Power Controls (Throttles). Rotating the pilot or copilot twist grip-type throttle (figure 2-7) to the full open position allows the overspeed governor to maintain a constant rpm. Rotating the throttle toward the closed position will cause the rpm to be manually selected instead of automatically selected by the overspeed governor. Rotating the throttle to the fully closed position shuts off the fuel. An idle stop is incorporated in the throttle to prevent inadvertent throttle closure. To bypass the idle detent, press the IDLE REL switch and close the throttle. The IDLE REL switch is a momentary on, solenoid-operated switch. The IDLE REL switch is located on the pilot collective stick switch box. IDLE REL switch receives power from the 28 Vdc bus and is protected by a circuit breaker marked IDLE STOP REL. Friction can be induced in both throttles by rotating the pilot throttle friction ring counterclockwise (figure 2-7). The ring is located on the upper end of the pilot throttle.





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Figure 2-8. Engine - Typical

d. Governor Switch. The GOV switch is located on the ENGINE control panel (figure 2-9). AUTO position permits the overspeed governor to automatically control the engine rpm with the throttle in the full open position. The EMER position permits the pilot or copilot to manually control the rpm. Because automatic acceleration, deceleration, and overspeed control are not provided with the GOV switch in the EMER position, control movements must be smooth to prevent compressor stall, overspeed, overtemperature or engine failure. The governor circuit receives power from the 28 Vdc essential bus and is protected by the GOV CONT circuit breaker.

2-19. ENGINE OIL SUPPLY SYSTEM.

a. Description. The dry sump pressure type oil system is entirely automatic in its operation. The system consists of an engine oil tank with de-aeration provisions, thermostatically controlled oil cooler with bypass valve, pressure transmitter and pressure indicator, low pressure warning switch and indicator, sight gages, and oil supply return vent, and breather lines. Drain valves have been provided for draining the oil tank and cooler. Pressure for engine lubrication and scavenging of return oil are provided by the enginemounted and engine-driven oil pump. The tank capacity, oil specification and grade are specified in the Servicing Table 2-1.

b. Oil Cooler. Engine oil cooling is accomplished by an oil cooler. The cooler is housed within the fuselage area under the engine deck (figure 2-1). Air circulation for oil cooling is supplied by a turbine fan which operates from turbine bleed air. The fan is powered at all times when the engine is operating and no control is required except the bleed air limiting orifice.

2-20. IGNITION - STARTER SYSTEM.

The starter-ignition switch is mounted on the underside of the pilot collective pitch control lever switch box. An additional switch may be installed on the copilot stick. The switch is a trigger switch, spring-loaded to the off position (figure 2-7). The starter and ignition unit circuits are both connected to the trigger switches. The circuits receive power from the 28 Vdc essential bus and are protected by circuit breakers marked STARTER RELAY and IGNITION SYSTEM IGNITER SOL. The starter

circuit is energized when the STARTER/GEN switch or START/CONVERTER switch is in the START position and the trigger switch is pulled (figure 2-7). The starter is automatically energized when the starter ignition switch is pulled. The ignition circuit is energized when the FUEL ON/OFF switch on the engine control panel is in the ON position and the trigger switch is pulled. The ignition keylock is located by the AC circuit breaker panel. The OFF position deactivates the igniters and start fuel to prevent engine starting. The ON position allows engine starting (figure 2-17).

2-21. GOVERNOR RPM SWITCH.

The pilot and copilot GOV RPM INCR/DECR switches are mounted on a switch box attached to the end of the collective pitch control lever (figure 2-7). The switches are a three-position momentary type and are held in INCR (up) position to increase the power turbine (N2) speed or down to DECR position to decrease the power turbine (N2) speed. Electrical power for the circuit is supplied from the 28 Vdc essential bus and is protected by a circuit breaker marked GOV CONT.

2-22. DROOP COMPENSATOR.

A droop compensator maintains engine rpm (N2) as power demand is increased by the pilot. compensator is a direct mechanical linkage between the collective stick and the speed selector lever on the N2 governor. No crew controls are provided or required. The compensator will hold N2 rpm to \pm 40 rpm when properly rigged. Droop is defined as the speed change in engine rpm (N2) as power is increased from a no-load condition. It is an inherent characteristic designed into the governor system. Without this characteristic, instability would develop as engine output is increased resulting in N1 speed overshooting or hunting the value necessary to satisfy the new power condition. If N2 power were allowed to droop, other than momentarily, the reduction in rotor speed could become critical.

2-23. ENGINE INSTRUMENTS AND INDICATORS.

All engine instruments and indicators are mounted in the instrument panel and the pedestal (figure 2-6, and figure 2-7).

- a. Torquemeter Indicator. The torquemeter indicator is located in the center area of the instrument panel and is marked TORQUE PRESS (figure 2-6). The indicator is connected to a transmitter which is part of the engine oil system. The torquemeter indicates torque in pounds per square inch (psi) of torque imposed upon the engine output shaft. The torquemeter receives power from the 28 Vac bus and is protected by a circuit breaker marked TORQUE in the ac circuit breaker panel.
- b. Exhaust Gas Temperature Indicator. The exhaust gas temperature indicator is located in the center area of the instrument panel and is marked EXH TEMP (figure 2-6). The indicator receives temperature indications from the thermocouple probes mounted in the engine exhaust diffuser section. The temperature indications are in degrees Celsius. The system is electrically self-generating.
- c. Dual Tachometer. The dual tachometer is located in the center area of the instrument panel and indicates both the engine and main rotor rpm (figure 2-6). The tachometer inner scale is marked ROTOR and the outer scale is marked ENGINE. Synchronization of the ENGINE and ROTOR needles indicates normal operation of helicopter. The indicator receives power from the tachometer generators mounted on the engine and transmission. Connection to the helicopter electrical system is not required.
- d. Gas Producer Tachometer. The gas producer indicator is located in the right center area of the instrument panel and is marked PERCENT (figure 2-6). The indicator displays the rpm of the gas producer turbine speed in percent. This system receives power from a tachometer generator which is geared to the engine compressor. A connection to the helicopter electrical system is not required.
- **e. Oil Temperature Indicator.** The engine oil temperature indicator is located in the center area of the instrument panel and is marked OIL °C (figure 2-6). The indicator is connected to an electrical resistance-type thermocouple. The temperature of the engine oil at the engine oil inlet is indicated in degrees Celsius. Power to operate the circuit is supplied from the 28 Vdc essential bus. Circuit protection is provided by the TEMP IND ENG & XMSN circuit breaker.

- f. Oil Pressure Indicator. The engine oil pressure indicator is located in the center area of the instrument panel and is marked OIL PRESS (figure 2-6). The indicator receives pressure indications from the engine oil pressure transmitter and provides readings in pounds per square inch (psi). The circuit receives electrical power from the 28 Vac bus and circuit protection is provided by the ENG circuit breaker in the ac circuit breaker panel.
- g. Oil Pressure Caution Light. The ENGINE OIL PRESS caution light is located in the pedestal mounted CAUTION panel. The light is connected to a low pressure switch. When pressure drops below approximately 25 psi, the switch closes an electrical circuit, causing the caution light to illuminate. The circuit receives power from the 28 Vdc essential bus and is protected by the circuit breaker marked CAUTION LIGHTS.
- h. Engine Chip Detector Caution Light. A magnetic plug is installed in the engine. When sufficient metal particles accumulate on the magnetic plug to complete the circuit, the ENGINE CHIP DET segment illuminates. The circuit receives power from the 28 Vdc essential bus and is protected by the circuit breaker marked CAUTION LIGHTS.
- i. Engine Ice Detector. The ice detector system (ENGINE ICE DET caution light) is not connected.
- j. **E** Engine Icing Caution Light. The ENGINE ICING segment of the caution panel is not connected.
- **k.** Engine Inlet Air Caution Light. The ENGINE INLET AIR segment of the caution panel will illuminate when the inlet air filter becomes clogged. Power is supplied from the 28 Vdc bus and protection is provided by the CAUTION LIGHT circuit breaker.
- I. Engine Fuel Pump Caution Light. The ENGINE FUEL PUMP caution light is located in the pedestal-mounted caution panel. Failure of either fuel pump element will close an electrical circuit illuminating the caution light. The system receives power from the 28 Vdc essential bus and is protected by a circuit breaker marked CAUTION LIGHTS. One type of switch used on some aircraft will illuminate the caution light until normal operating pressure is reached. This momentary lighting does not indicate a pump element failure.

- m. Emergency Fuel Control Caution Light. The emergency fuel control caution light is located in the pedestal-mounted caution panel. The illumination of the worded segment GOV EMER is a reminder to the pilot that the GOV switch is in the EMER position. Electrical power for the circuit is supplied from the 28 Vdc bus and is protected by a circuit breaker marked CAUTION LIGHTS.
- n. Fuel Filter Caution Light. The FUEL FILTER caution light is located in the pedestal-mounted caution

panel or a press to test light is located on the instrument panel. A differential pressure switch is mounted in the fuel line across the filter. When the filter becomes clogged, the pressure switch senses this and closes contacts to energize the caution light circuit. If clogging continues, the fuel bypass opens to allow fuel to flow around the filter. The circuit receives power from the 28 Vdc essential bus and is protected by a circuit breaker marked CAUTION LIGHTS.

SECTION IV. HELICOPTER FUEL SYSTEM

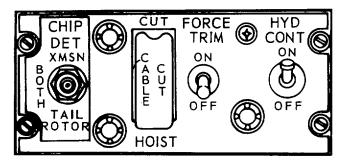
2-24. FUEL SUPPLY SYSTEM.

- a. Crashworthy Fuel System. The crashworthy fuel system consists of five interconnected cells all filled from a single fitting on the right side of the helicopter. The two forward cells each contain an electrically driven submerged boost pump. The boost pumps provide fuel pressure to prime the fuel line to the engine driven fuel pump. The pumps provide adequate fuel pressure when the aircraft is operating above 4600 feet pressure altitude. Each forward fuel cell is divided into two compartments by a lateral baffle fitted with a flapper valve to allow fuel flow from front to rear. submerged boost pump is mounted on a sump assembly near the aft end of each forward cell and is connected by a hose to the pressure line outlet to the engine. Part of the pump output is diverted forward through a flow switch and hose to an ejector pump at front of cell. Induced flow of the ejector pump sends fuel through a hose over the baffle into the rear part of the cell, so that no significant quantity of fuel will be unusable in any flight attitude. The crashworthy system is designed to contain fuel during a severe, but survivable, crash impact to reduce the possibility of fire. Frangible fittings used to secure the fuel cells in the airframe are designed to fail and permit relative movement of the cells, without rupture, in event of a crash; self-sealing break-away valves are installed in the fuel lines at the fuel cell outlets and certain other locations. The break-away valves are designed to permit complete separation of components without loss of fuel. Rollover vent valves are installed on the aft fuel cells to provide protection in the event of a helicopter rollover during a crash. The system has a .50 caliber ballistic protection level.
- **b. Closed Circuit Refueling System.** EH-1H/X helicopters serial number 69-15292 and subsequent and modified helicopters provide a closed circuit refueling system when used with the mating nozzle. This system is capable of automatic shutoff of fuel flow when full.

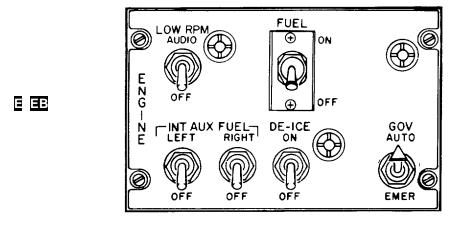
c. Gravity Refueling. If fuel servicing vehicle is not equipped with related nozzle for closed circuit refueling, a gravity system may be used.

2-25. CONTROLS AND INDICATORS.

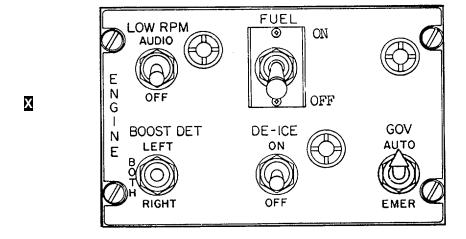
- a. Fuel Switches. The fuel system switches consist of a FUEL switch, and E INT AUX FUEL switches (figure 2-9).
- (1) Fuel Switch. The FUEL ON/OFF switch is located on the pedestal-mounted ENGINE panel (figure 2-9). The switch is protected from accidental operation by a spring-loaded toggle head that must be pulled up before switch movement can be accomplished. When the switch is in the ON position, the fuel valve opens, the electric boost pump(s) are energized and fuel flows to the engine. When the switch is in the OFF position the fuel valve closes and the electric boost pump(s) are de-energized. Electrical power for circuit operation is supplied by the 28 Vdc essential bus and is protected by circuit breakers FUEL VALVES, LH BOOST PUMP and RH BOOST PUMP.
- (2) Fuel Control Switches. Fuel flow and mode of operation is controlled by switches on the pedestal-mounted engine control panel (figure 2-9). The panel contains the FUEL ON/OFF switch, two INT AUX FUEL switches, a BOOST DET switch, and GOV AUTO/EMER switch. The switchover to emergency mode is accomplished by retarding the throttle to idle or off position and positioning the GOV AUTO/EMER switch to the EMER position. In the EMER position fuel is manually metered to the engine, with no automatic control features, by rotating the collective twist grip.



MISCELLANEOUS CONTROL PANEL



ENGINE CONTROL PANEL



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Figure 2-9. Engine/Miscellaneous Control Panel

- **b. Fuel Quantity Indicator.** The fuel quantity indicator is located in the upper center area of the instrument panel (figure 2-6). This instrument is a transistorized electrical receiver which continuously indicates the quantity of fuel in pounds. The indicator is connected to three fuel transmitters mounted in the fuel cells. Two are mounted in the right forward cell and one in the center aft cell. Indicator readings shall be multiplied by 100 to obtain fuel quantity in pounds. Electrical power for operation is supplied from the 115 Vac system and is protected by circuit breaker FUEL QTY in the ac circuit breaker panel.
- **c.** Fuel Gage Test Switch. The FUEL GAGE TEST switch is used to test the fuel quantity indicator operation (figure 2-6). Pressing the switch will cause the indicator pointer to move from the actual reading to a lesser reading. Releasing the switch will cause the pointer to return to the actual reading. The circuit receives power from the 115 Vac system and is protected by a circuit breaker marked FUEL QTY in the ac circuit breaker panel.
- **d. Fuel Pressure Indicator.** The fuel pressure indicator displays the psi pressure of the fuel being delivered by the boost pumps from the fuel cells to the

- engine (figure 2-6). The circuit receives power from the 28 Vac bus and is protected by the FUEL PRESSURE circuit breaker in the ac circuit breaker panel.
- e. Fuel Quantity Low Caution Light. The 20 MINUTE FUEL caution light will illuminate when there is approximately 180 pounds remaining. Electrical power is supplied from the 28 Vdc essential bus. The CAUTION LIGHTS circuit breaker protects the circuit.
- f. Fuel Boot Pump Caution Lights. The LEFT FUEL BOOST and RIGHT FUEL BOOST caution lights will illuminate when the left/right fuel boost pumps fail. Failure of one or both of the fuel boost pumps will cause the FUEL BOOST segment panel to illuminate. In order to determine which pump has failed, it is necessary to set the BOOST DET switch (figure 2-9) in first the LEFT then the RIGHT position. The lamp will illuminate when the switch is set to the failed pump side. Circuit protection is provided by the CAUTION LIGHTS, RH FUEL BOOST PUMP and LH FUEL BOOST PUMP circuit breakers. On helicopters prior to Serial No. 69-15292 a FUEL TANK SUMP PUMP circuit breaker is used instead of RH and LH BOOST PUMP circuit breakers.

SECTION V. FLIGHT CONTROL SYSTEM

2-26. DESCRIPTION.

The flight control system is a hydraulic assisted positive mechanical type, actuated by conventional helicopter controls. Complete controls are provided for both pilot and copilot The system includes a cyclic system, collective control system, tail rotor system, force trim system, synchronized elevator, and a stabilizer bar.

2-27. CYCLIC CONTROL SYSTEM.

The system is operated by the cyclic stick movement (figure 2-7). Moving the stick in any direction will produce a corresponding movement of the helicopter which is a result of a change in the plane of rotation of the main rotor. The pilot cyclic contains the switch, radio ICS switch, chaff dispense switch, hoist switch (not used) and force trim switch. Desired operating friction can be induced -into the control stick by hand tightening the friction adjuster.

- a. Synchronized Elevator. The synchronized elevator (figure 2-1) is located on the tailboom. It is connected by control tubes and mechanical linkage to the fore and aft cyclic system. Fore and aft movement of the cyclic control stick will produce a change in the synchronized elevator attitude. This improves controllability within the cg range.
- b. Stabilizer Bar. The stabilizer bar is mounted on the main rotor hub trunnion assembly in a parallel plane, above and at 90 degrees to the main rotor blades (figure 2-1). The gyroscopic and inertial effect of the stabilizer bar will produce a damping force in the rotor rotating control system and thus the rotor. When an angular displacement of the helicopter/mast occurs the bar tends to remain in its trim plane. The rate at which the bar rotational plane tends to return to a position perpendicular to the mast is controlled by the hydraulic dampers. By adjusting the dampers, positive dynamic stability can be achieved, and still allow the pilot complete responsive control of the helicopter.

2-28. COLLECTIVE CONTROL SYSTEM.

The collective pitch control lever controls vertical flight (figure 2-7). When the lever is in full down position, the main rotor is at minimum pitch. When the lever is in the full UP position, the main rotor is at maximum pitch. The amount of lever movement determines the angle of attack and lift developed by the main rotor, and results in ascent or descent of the helicopter. Desired operating friction can be induced into the control lever by handtightening the friction adjuster (figure 2-7). A griptype throttle and a switch box assembly are located on the upper end of the collective pitch control lever. The pilot switch box contains the starter switch, governor rpm switch, engine idle stop release switch, and landing light/searchlight switches. A collective lever down lock is located on the floor below the collective lever. The copilot collective lever contains only the grip-type throttle, governor rpm switch, and starter switch when installed. The collective pitch control system has a builtin breakaway (friction) force to move the stick up from the neutral (center of travel) position of eight to ten pounds with hydraulic boost ON.

2-29. TAIL ROTOR CONTROL SYSTEM.

The system is operated by pilot/copilot anti-torque pedals (figure 2-7). Pushing a pedal will change the pitch of the tail rotor blades resulting in directional control. Pedal adjusters are provided to adjust the pedal distance for individual comfort. A force trim system is connected to the directional controls.

2-30. FORCE TRIM SYSTEM.

Force centering devices are incorporated in the cyclic controls and directional pedal controls. These devices are installed between the cyclic stick and the hydraulic servo cylinders, and between the anti-torque pedals and the hydraulic servo cylinder. The devices furnish a force gradient or "feel" to the cyclic control stick and anti-torque pedals. A FORCE TRIM ON/OFF switch is installed on the miscellaneous control panel to turn the system on or off (figure 2-7). These forces can be reduced to zero by pressing and holding the force trim pushbutton switch on the cyclic stick grip or moving the force trim switch to off.

SECTION VI. HYDRAULIC SYSTEM

2-31. DESCRIPTION.

The hydraulic system is used to minimize the force required by the pilot to move the cyclic, collective and pedal controls. A hydraulic pump, mounted on and driven by the transmission supplies pressure to the hydraulic servos. The hydraulic servos are connected into the mechanical linkage of the helicopter flight control system. Movement of the controls in any direction causes a valve, in the appropriate system, to open and admit hydraulic pressure which actuates the cylinder, thereby reducing the force-load required for control movement. Irreversible valves are installed on the cyclic and collective hydraulic servo cylinders to prevent main rotor feedback to the cyclic and collective in the event of hydraulic system malfunction.

2-32. CONTROL SWITCH.

The hydraulic control switch is located on the miscellaneous panel (figure 2-9). The switch is a two-position toggle type labeled HYD CONT ON/OFF. When the switch is in the ON position, pressure is supplied to the servo system. When switch is in the OFF

position the solenoid valve is closed and no pressure is supplied to the system. The switch is a fail-safe type. Electrical power is required to turn the switch off.

2-33. RESERVOIR AND SIGHT GLASS.

The hydraulic reservoir is a gravity feed type and is located at the right aft edge of the cabin roof (figure 2-15). The reservoir and sight gage are visible for inspection through a plastic window in the transmission fairing.

2-34. HYDRAULIC FILTER.

A filter is installed to clean the oil. When the filter is clogged it will give a visual warning by raising a red indicator button. The red button pops out when a set differential pressure across the element is exceeded. Once actuated, the indicator will remain extended until reset manually. When the indicator is in reset position it will be hidden from view. An inspection window may be provided to permit ready visual access to the filter indicator. The transparent window is located on forward face of the transmission bulkhead.

2-35. HYDRAULIC PRESSURE CAUTION LIGHT.

Low hydraulic system pressure will be indicated by the illumination of HYD PRESSURE segment on the CAUTION panel. Moderate feedback forces will be noticed in the controls when moved.

2-36. ELECTRICAL CIRCUIT.

Electrical power for hydraulic system control is supplied by the 28 Vdc essential bus. The circuit is protected by the HYD CONT circuit breaker.

SECTION VII. POWER TRAIN SYSTEM

2-37. TRANSMISSION.

The transmission is mounted forward of the engine and coupled to the power turbine shaft at the cool end of the engine by the main driveshaft. The transmission is basically a reduction gearbox, used to transmit engine power at a reduced rpm to the rotor system. A freewheeling unit is incorporated in the transmission to provide a quick-disconnect from the engine if a power failure occurs. This permits the main rotor and tail rotor to rotate in order to accomplish a safe autorotational landing. The tail rotor drive is on the lower aft section of the transmission. Power is transmitted to the tail rotor through a series of driveshafts and gearboxes. The rotor tachometer generator, hydraulic pump, and main dc generator are mounted on and driven by the transmission. A self-contained pressure oil system is incorporated in the transmission. The oil is cooled by an oil cooler and turbine fan. The engine and transmission oil coolers use the same fan. The oil system has a thermal bypass valve which causes the oil to bypass the cooler when the oil is below 79°C (175°F). An oil level sight glass, vented filler cap, and magnetic chip detector are provided. A transmission oil filter is mounted in a pocket in upper right aft corner of sump case, with inlet and outlet ports through internal passages. The filter incorporates a bypass valve for continued oil flow if screens become clogged. The transmission external oil filter is located in the cargo-sling compartment on right side wall, and is connected into the external oil line. A bypass valve is incorporated, set to open at 18 to 22 psi differential pressure to assure oil flow if filter element should become clogged. A bypass condition will be indicated by extension of a red indicator on the filter head.

2-38. GEARBOXES.

a. Intermediate Gearbox - 42 Degree. The 42 degree gearbox is located at the base of the vertical fin.

It provides 42 degree change of direction of the tail rotor driveshaft. The gearbox has a self-contained wet sump oil system. An oil level sight glass, filler cap, vent (figure 2-15) and magnetic chip detector are provided.

b. Tail Rotor Gearbox - 90 Degree. The 90 degree gearbox is located at the top of the vertical fin. It provides a 90 degree change of direction and gear reduction of the tail rotor driveshaft. The gearbox has a self-contained wet sump oil system. An oil level sight glass, vented filler cap (figure 2-15) and magnetic chip detector are provided.

2-39. DRIVESHAFTS.

- **a. Main Driveshaft.** The main driveshaft connects the engine output shaft to the transmission input drive quill. A standard driveshaft or an improved (KAFLEX) type driveshaft, which incorporates a fail-safe feature may be installed.
- **b. Tail Rotor Driveshaft.** The tail rotor driveshaft consists of six driveshaft and four hanger bearing assemblies. The assemblies and the 42 degree and 90 degree gearboxes connect the transmission tail rotor drive quill to the tail rotor.

2-40. INDICATORS AND CAUTION LIGHTS.

a. Transmission Oil Pressure Indicator. The TRANS OIL pressure indicator is located in the center area of the instrument panel (figure 2-6). It displays the transmission oil system oil pressure in psi. Electrical power for the circuit is supplied from the 28 Vac bus and is protected by the XMSN circuit breaker in the ac circuit breaker panel.

- b. Transmission Oil Pressure Low Caution Light. The XMSN OIL PRESS segment in the CAUTION panel will illuminate when the transmission oil pressure drops below 28 to 32 psi. The circuit receives power from the 28 Vdc essential bus. Circuit protection is supplied by the CAUTION LIGHTS circuit breaker.
- c. Transmission Oil Temperature Indicator. The transmission oil temperature indicator is located in the center area of the instrument panel. The indicator displays the temperature of the transmission oil in degrees Celsius. The electrical circuit receives power from the 28 Vdc essential bus and is protected by the TEMP IND ENG & XMSN circuit breaker in the dc circuit breaker panel. This is a wet bulb system dependent on fluid for valid indication.
- **d.** Transmission Oil Hot Caution Light. The XMSN OIL HOT segment in the CAUTION panel will illuminate when the transmission oil temperature is above 110°C (230°F). The circuit receives power from the 28 Vdc essential bus and is protected by the CAUTION LIGHTS circuit breaker. This is a wet bulb system dependent on fluid for valid indication.

e. Transmission and Gearbox Chip Detector.

- (1) Chip Detector Caution Light. Magnetic inserts are installed in the drain plugs of the transmission sump, 42 degree gearbox, and the 90 degree gearbox. When sufficient metal particles collect on the plugs to close the electrical circuit the CHIP DETECTOR segment in the CAUTION panel will illuminate. A self-closing, spring-loaded valve in the drain plug permits the magnetic plugs to be removed without the loss of oil. The circuit is powered by 28 Vdc essential bus and protected by the CAUTION LIGHTS circuit breaker.
- (2) Chip Detector Switch. A CHIP DET switch (fig 2-9) is installed on a pedestal-mounted panel. The switch is labeled BOTH, XMSN, and TAIL ROTOR and is spring loaded to the BOTH position. When the CHIP DETECTOR segment in the CAUTION panel illuminates, position the switch to XMSN, then TAIL ROTOR, to determine the trouble area. CHIP DET caution light will remain on when contaminated component is selected. The light will go out if the noncontaminated component is selected.

SECTION VIII. ROTORS

2-41. MAIN ROTOR.

- a. Description. The main rotor is a two bladed, semi-rigid, seesaw type. The two all metal blades are connected to a common yoke by blade grips and pitch change bearings with tension straps to carry centrifugal forces. The rotor assembly is connected to the mast with a nut. The nut has provisions for hoisting the helicopter. A stabilizer bar is mounted on the trunnion 90 degrees to the main rotor. Blade pitch change is accomplished by movements of the collective and cyclic controls. The main rotor is driven by the mast through the transmission. The mast is tilted 5 degrees forward.
- **a1. Hub Spring.** As on aid in controlling rotor flapping, a hub spring kit has been installed in the rotor system for those helicopters modified by MWO 55-1520-242-50-1. Two nonlinear elastomeric springs are attached to a support affixed to the most. The hub springs provide an additional margin of safety in the

event of an inadvertent excursion of the helicopter beyond the approved flight envelope.

b. RPM Indicator. The rpm indicator is part of the dual tachometer (figure 2-6). The tachometer inner scale displays the rotor rpm. The inner scale pointer is marked with an R.

2-42. TAIL ROTOR.

The tail rotor is a two-bladed, semi-rigid delta-hinge type. Each blade is connected to a common yoke by a grip and pitch change bearings. The hub and blade assembly is mounted on the tail rotor shaft with a delta-hinge trunnion and a static stop to minimize rotor flapping. Blade pitch change is accomplished by movement of the anti-torque pedals which are connected to a pitch control system through the tail rotor (90 degree) gearbox. Blade pitch change serves to offset torque and provide heading control.

SECTION IX. UTILITY SYSTEMS

2-43. PITOT HEATER.

The pitot tube is equipped with an electrical heater (figure 2-1). The PITOT HTR switch is on the overhead console panel (figure 2-7). ON position activates the heater in the tube and prevents ice from forming in the pitot tube. OFF position de-activates the heater. The electrical circuit for the system receives power from the 28 Vdc essential bus and is protected by the PITOT TUBE HTR circuit breaker.

2-44. HEATED BLANKET RECEPTACLES.

Two or six electrical receptacles are provided to supply 28 Vdc for heated blankets. They are mounted on the inside cabin roof structure aligned with the forward edge of the transmission support structure. The electrical circuit for the receptacles receive power from the 28 Vdc nonessential bus. Circuit protection is provided by the HEATED BLANKET circuit breakers.

2-45. DATA CASE.

A data case for maps, flight reports, etc., has been provided and is located at the aft end of the pedestal.

2-46. BLACKOUT CURTAINS.

Provisions have been made for installing blackout curtains behind pilot and copilot seats and between forward and aft cabin sections. Other blackout curtains

may be installed over both cabin door windows and window in removable doorpost.

2-47. WINDSHIELD WIPER.



Do not operate the wiper on a dry or dirty windshield.

- **a.** Two windshield wipers are provided, one for the right section of the windshield and one for the left section of the windshield.
- **b.** The wipers are driven by electric motors with electric power supplied by the dc electrical system. Circuit protection is provided by WINDSHIELD WIPER PILOT and WINDSHIELD WIPER COPILOT circuit breakers on the dc circuit breaker panel (figure 2-12).
- **c.** The windshield wiper switches on the overhead console mounted MISC panel (figure 2-7) have five positions: HIGH, MED, LOW, OFF, and PARK.
- **d.** The panel also has a selector which permits the operation of windshield wiper for pilot, copilot or both as desired.

SECTION X. HEATING AND VENTILATION

2-48. VENTILATING SYSTEM.

- **a. Description.** The ventilating system consists of four independently controlled exterior air scoop ventilators (figure 2-1). Two single orifice air scoops are located on top of the cockpit section, and two double orifice air scoops are on top of the cabin. The amount of air entering the cabin through the ventilators is regulated by the butterfly valve control.
- **b. Operation.** Rotate butterfly valve control to desired position to provide outside air for flight.

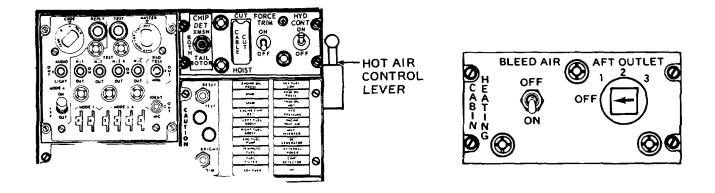
2-49. HEATING AND DEFROSTING SYSTEM.

Three different types of heating and defrosting system may be used on these helicopters. They are the bleed air heater, combustion heater, and the auxiliary exhaust heat exchanger. Each system is described separately in the following paragraphs.

a. Bleed Air Heating and Defrosting System. Heat is supplied to the bleed air heater by the compressor bleed air system. Electric power for operation of the controls is supplied from the 28 Vdc essential bus and is protected by the CABIN HEATER CONT circuit breaker. On helicopters Serial No. 66-16868 through 70-16518, temperature is controlled by a thermostat located on the right doorpost. Helicopters Serial No. 71-20000 and subsequent are protected by two circuit breakers marked CABIN HEATER OUTLET

VALVE and CABIN HEATER AIR VALVE. Refer to figure 2-10 for controls and their function.

- b. Combustion Heating and Defrosting System. With the combustion heater installed, a combination of bleed air heat and combustion heat is available for Bleed air may be used for defrosting and combustion heat for heating, or combustion heat may be used for defrosting only with bleed air heat off. The FUEL switch must be ON, actuating the right boost pump, before fuel is available for combustion heater operation (figure 2-9). A purge switch keeps the blowers operating after shutdown to prevent residual heat If blower air pressure drops too low the buildup. combustion heater will stop automatically. An overheat switch also automatically turns the heater off in the event of malfunction. The starting cycle has to be repeated to start the combustion heater. Electric power to operate the heater controls is supplied from the 28 Vdc essential bus and is protected by the CABIN HEATER CONT circuit breaker. Refer to figure 2-10 for controls and their function.
- c. Auxiliary Exhaust Heater System. The auxiliary exhaust heater system consists of an exhaust gas exchanger, and a bleed air driven fan for circulating ambient air through the heat exchanger. A mixing valve controls air to maintain the desired outlet temperature. The exhaust heater system controls consist of the cabin heating panel (figure 2-10), a thermostat dial on the right doorpost and the air directing lever on the pedestal.



SWITCH/CONTROL	POSITION	FUNCTION
BLEED AIR (ON/OFF)	ON OFF	Turns bleed air heat on. Turns bleed air heat off.
AFT OUTLET	Clockwise Rotation	Increases amount of air to doorpost
	OFF	outlets. Doorpost are closed, all air is direct to pedestal outlets.
Pedestal Lever	Full Forward Full Aft	All heated air to defrost nozzles. All heated air to cockpit and cabin.
:	Intermediate	Partial defrost and partial cockpit and cabin heat.

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Figure 2-10. Heating and Defrosting System

SECTION XI. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

2-50. DC AND AC POWER DISTRIBUTION.

Figure 2-11 depicts the general schematic of the dc and ac power distribution system. The dc power is supplied by the battery, main generator, standby startergenerator, or the external power receptacle. The 115 Vac power is supplied by the main or spare inverters. The 28 Vac power is supplied by a transformer which is powered by the inverter.

2-51. ■ DC AND AC POWER DISTRIBUTION.

Figure 2-11 depicts the general schematic of the dc and ac power distribution system. The dc is supplied by the battery, generator, alternator/converter, or the external dc power receptacle. AC power for all the aircraft 115 Vac systems is supplied from the main or standby inverters. The 28 Vac power is supplied by a transformer which is powered by the inverters.

2-52. DC POWER SUPPLY SYSTEM.

The dc power supply system is a 28 volt, single conductor system with the negative leads of the generator grounded in the helicopter fuselage structure. The main generator voltage will vary from 27 to 28.5 depending on the average ambient temperature. In the event of a generator failure the nonessential bus is automatically de-energized. The pilot may override the automatic action by positioning the NON-ESS BUS switch on the DC POWER control panel to MANUAL ON.

2-53. EXTERNAL POWER RECEPTACLE.

The external power receptacle transmits the ground power unit 28 Vdc power to the power distribution system (figure 2-1). A 7.5 KW GPU is recommended for external starts.

2-54. EXTERNAL AC MISSION POWER RECEPTACLE.

The external ac power receptacle transmits the ground power unit three phase, 400 HZ 115 Vac to the converter for mission equipment. DC voltage from the converter is

supplied to the aircraft essential bus. To obtain 28 Vdc on the nonessential bus the NON-ESS bus switch must be set to MANUAL ON. The aircraft cannot be started on external ac power.

2-55. BATTERY.

WARNING

If battery overheats, do not open battery compartment. Battery fluid will cause burns and overheated battery could cause thermal burns and may explode.

The battery supplies 24 Vdc power to the power distribution system when the generators and external power receptacle are not in operation (figure 2-1).

2-56. MAIN AND STANDBY STARTER-GENERATOR.

The 30 volt 300 ampere main generator is mounted on and driven by the transmission. A standby starter-generator, rated at 300 amperes is mounted on the engine accessory drive section. The standby generator furnishes DC power for the mission equipment during normal operations and to aircraft systems in the event of a main generator failure.

2-57. **EE** X STARTER-GENERATOR AND ALTERNATOR.

A 28 volt, 300 amperes starter/generator is mounted on and driven by the engine. When the starter switch is pressed and the START CONVERTER switch is in the START position, the generator acts as the starter. A 30 KVA alternator mounted on the transmission and a 29 volt, 200 amperes converter, mounted in the left avionics compartment, furnishes dc power in the event of a generator failure. The alternator/converter combination automatically picks up the load if the generator fails. The aircraft battery is not charged when essential bus dc power is furnished by the converter.

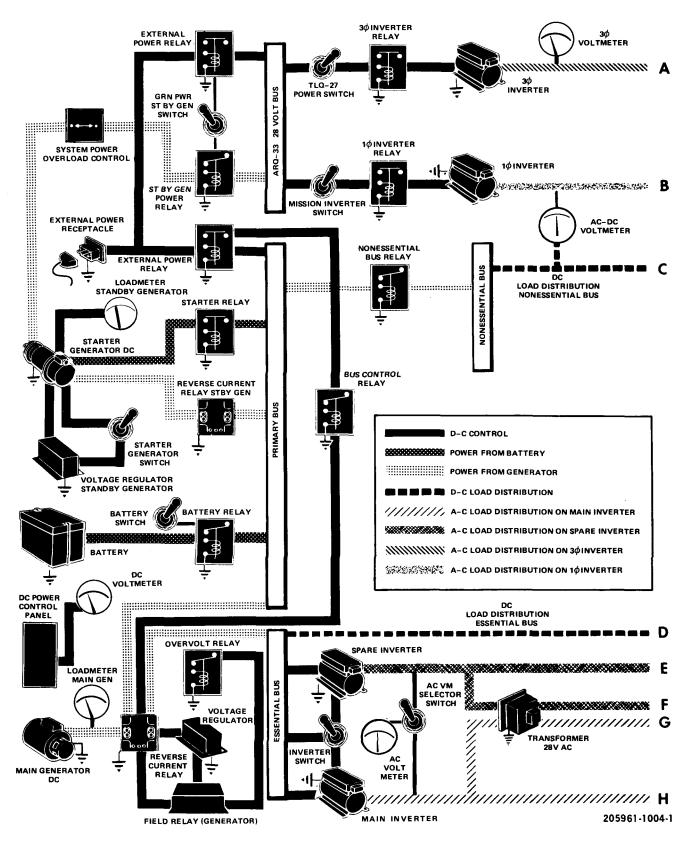


Figure 2-11. E Electrical System Schematic Diagram - Typical (Sheet 1 of 6)

Idle stop release 115-VOLT AC 30 INVERTER Governor control Fire detection Countermeasures set AN/TLQ-27 Pilots windshield wiper Copilots windshield wiper 115-VOLT AC 10 INVERTER Engine anti-ice **Utility lights** Radar altimeter AN/APN-171 Dome lights Countermeasures receiver AN/GLR-9 Force trim 28-VOLT DC NONESSENTIAL BUS Armament circuit RPM limit warning Nonessential bus voltmeter Hydraulic control Instrument secondary lights Heated blankets Crew lights Turn and slip indicator Casi ARQ-33 mission ac power Instrument panel lights Radar detection set AN/APR-39 Temperature indicator — engine and transmission Mission FM radio set AN/ARC-131 Console and pedestal lights Mission KY-28 **Navigation lights** Cigarette lighters Fuselage lights Radar altimeter AN/APN-171 Caution lights ARQ-33 mission dc power Anti-collision light Landing light power 28-VOLT DC ESSENTIAL BUS Searchlight power Landing and searchlight control Generator and bus reset UHF transceiver AN/ARC-51BX Main inverter power J-2 compass Inverter control Heater control Des Spare inverter power Intercom C-1611D/AIC copilot and crew-L Starter relay Intercom C-1611D/AIC pilot and crew-R Ignition system and igniter solenoid Direction finder AN/ARN-83 Fuel valve Omni receiver AN/ARN-82 Fuel transfer pump VHF transmitter T-366/ARC Fuel tank sump pump Pitot tube heater FM radio set AN/ARC-131 115-VOLT AC SPARE INVERTER Forward and aft mission antenna retract system AC failure relay Fuel quantity indicator and tank unit E 8XXXX Attitude indicator - pilot Attitude indicator - copilot J-2 compass IFF transponder AN/APX-72 28-VOLT AC Course indicator F *** Torque pressure instruments G/// Transmission oil pressure transmitter and indicator Engine oil pressure transmitter and indicator Fuel pressure transmitter and indicator 115-VOLT AC MAIN INVERTER AC failure relay Fuel quantity indicator and tank unit Attitude indicator - pilot Attitude indicator - copilot J-2 compass IFF transponder AN/APX-72 205961-1004-2

Figure 2-11. E Electrical System Schematic Diagram - Typical (Sheet 2 of 6)

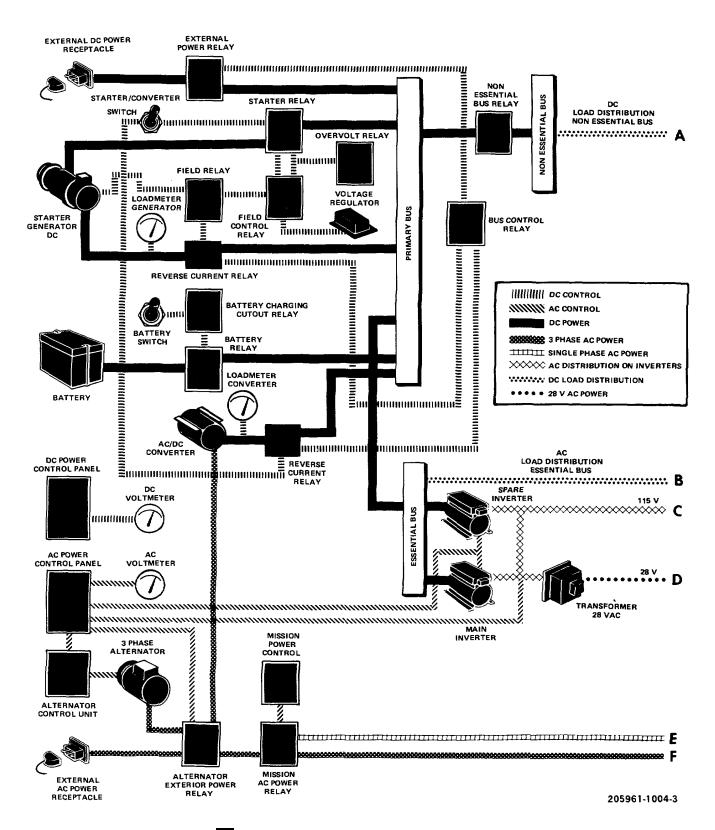


Figure 2-11. EB Electrical System Schematic Diagram - Typical (Sheet 3 of 6)

205961-1004-4

28-VOLT DC NONESSENTIAL BUS Dome lights Force trim Armament circuit Nonessential bus voltmeter **RPM** limit warning Heated blankets A ::::: Crew lights Hydraulic control Mission FM radio set AN/ARC-131 Instrument secondary lights Mission KY-28/KY-58 Turn and slip indicator Instrument panel lights ARQ-33 mission dc power Temperature indicator — engine and transmission 28-VOLT DC ESSENTIAL BUS Console and pedestal lights **Navigation lights** Generator and bus reset **Fuselage lights Caution lights** Main inverter power Anti-collision light Inverter control Landing light power Spare inverter power Searchlight power Starter relay Ignition system and igniter solenoid Landing and searchlight control VHF receiver/transmitter AN/ARC-134 Fuel valve B∵∷: Fuel transfer pump UHF transceiver AN/ARC-51BX Fuel tank sump pump **Heater control** Intercom C-1611D/AIC copilot and crew-L Idle stop release Governor control Intercom C-1611D/AIC pilot and crew-R Fire detection Direction finder AN/ARN-83 Pilots windshield wiper Omni receiver AN/ARN-82 Copilots windshield wiper Pitot tube heater Engine anti-ice IFF transponder AN/APX-72 **Utility lights** FM radio set AN/ARC-131 Forward and aft mission antenna retract system Mission antenna lights **INVERTER, 115-VOLT AC** Radar detection AN/APR-39 Radar detection AN/APR-44 AC failure relay Radar altimeter AN/APN-171 Fuel quantity indicator and tank unit Chaff/flare dispenser M-130 Attitude indicator — pilot Radar jamming AN/ALQ-144 Attitude indicator — copilot Compass AN/ASN-43 IFF transponder AN/APX-72 Radar altimeter AN/APN-171 28-VOLT AC Course indicator Torque pressure instruments Transmission oil pressure transmitter and indicator Engine oil pressure transmitter and indicator Fuel pressure transmitter and indicator ALTERNATOR, 115-VOLT AC 1 PHASE Countermeasures receiver AN/GLR-9 ALTERNATOR, 115-VOLT AC 3 PHASE AC/DC converter Countermeasures set AN/TLQ-17A

Figure 2-11. EB Electrical System Schematic Diagram - Typical (Sheet 4 of 6)

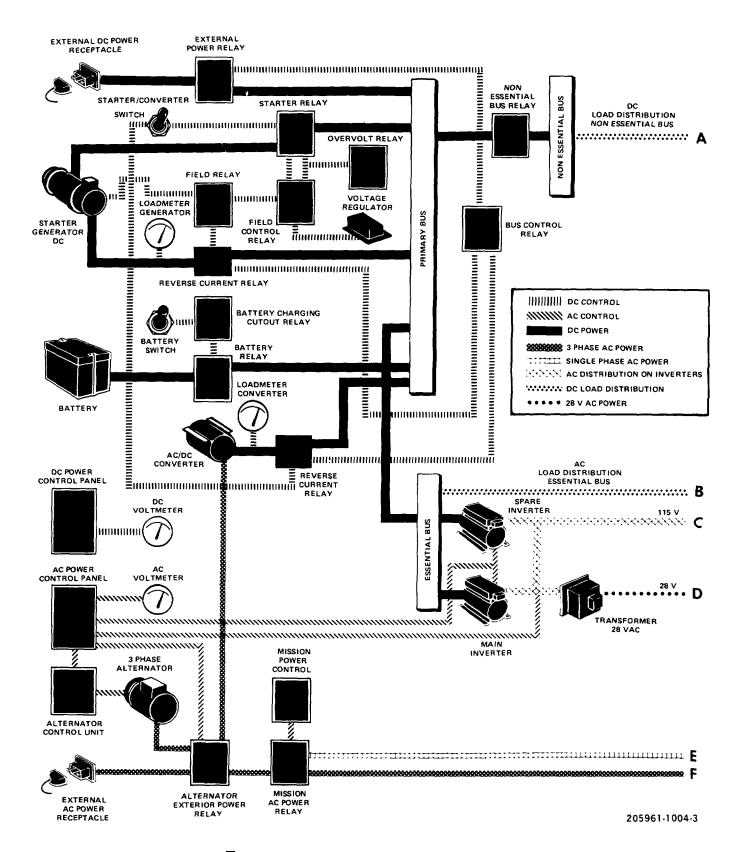


Figure 2-11. X Electrical System Schematic Diagram - Typical (Sheet 5 of 6)

28-VOLT DC NONESSENTIAL BUS Dome lights Force trim Nonessential bus voltmeter Armament circuit Heated blankets RPM limit warning Hydraulic control 28-VOLT DC ESSENTIAL BUS Instrument secondary lights Turn and slip indicator Generator and bus reset Instrument panel lights Main inverter power Temperature indicator - engine and transmission Inverter control Console and pedestal lights Spare inverter power Navigation lights Starter relay Ignition system and igniter solenoid Fuselage lights Fuel valve Caution lights Fuel transfer pump Anti-collision light Landing light power Fuel tank sump pump Searchlight power Idle stop release Landing and searchlight control Governor control VHF receiver/transmitter AN/ARC-115 Fire detection UHF transceiver AN/ARC-164 Pilots windshield wiper Heater control Copilots windshield wiper IntercomC-1611D/AIC copilot and crew-L Engine anti-ice Intercom C-1611D/AIC pilot and crew-R Utility lights Direction finder AN/ARN-83 Engine air filter (if installed) Nav receiver AN/ARN-123 INVERTER 115-VOLT AC Pitot tube heater IFF transponder AN/APX-72 AC failure relay FM radio set AN/ARC-114A Fuel quantity indicator and tank unit Mission antenna retract system Radar detection AN/APR-39 Attitude indicator-pilot Radar detection AN/APR-44 Attitude indicator-copilot Radar altimeter AN/APN-209 Compass AN/ASN-43 Chaff/flare dispenser M-130 Radar jamming AN/ALQ-144 28-VOLT AC Course indicator Torque pressure instruments Transmission oil pressure transmitter and indicator Engine oil pressure transmitter and indicator Fuel pressure transmitter and indicator ALTERNATOR, 115-VOLT AC POWER TACAN AN/ARN-103 E commo Inertial navigation system AN/ASN-86 Special purpose countermeasures system AN/ALQ-151 AC-DC converter Countermeasures set AN/TLQ-17A 28 VOLT DC MISSION POWER UHF transceiver AN/ARC-164 TACAN AN/ARN-103 Inertial navigation system AN/ASN-86 Special purpose countermeasures system AN/ALQ-151

Figure 2-11. X Electrical System Schematic Diagram - Typical (Sheet 6 of 6)

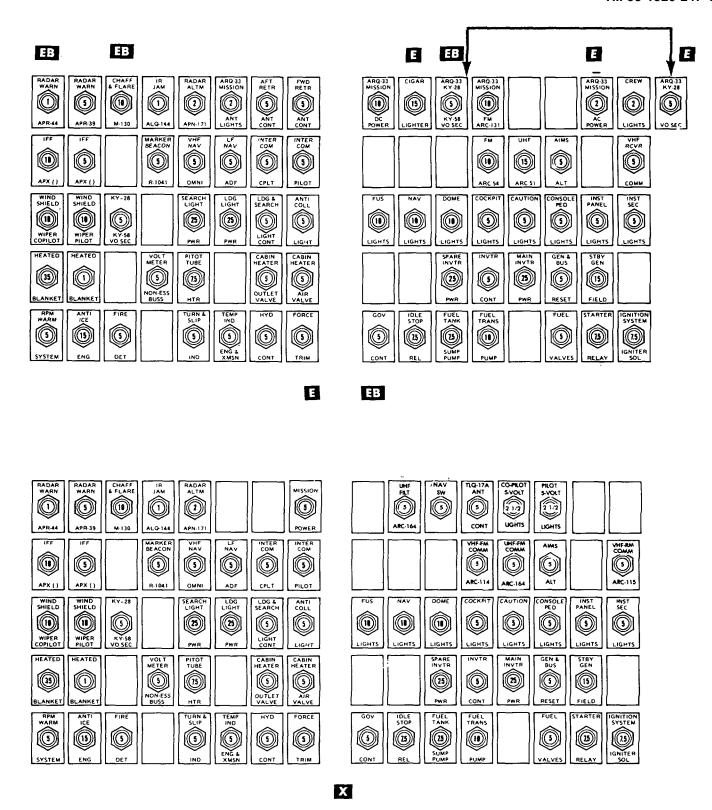


Figure 2-12. DC Circuit Breaker Panel - Typical

2-58. DC POWER INDICATORS AND CONTROLS.

- a. Voltage Regulator. The solid state voltage regulator is protected from over voltage and over current by a manually reset relay on the voltage regulator. When either condition trips the relay, the affected generator cannot be reset from the cockpit. The reset can be accomplished when the aircraft is on the ground with access to the voltage regulators.
- b. Main Generator Switch. The MAIN GEN or GEN switch (figure 2-7) is on the overhead console DC POWER panel. In the ON position the generator supplies power to the distribution system. The RESET position is spring-loaded to the OFF position. Momentarily holding the switch to RESET position will reset the generator. The OFF position isolates the generator from the system. The circuit is protected by the GEN & BUS RESET in the dc circuit breaker panel.
- **c. Battery Switch**. The BAT switch is located on the DC POWER control panel (figure 2-7). ON position permits the battery to supply 24 Vdc to the power distribution system. ON position also permits the battery to be charged by the generator. The OFF position isolates the battery from the system.
- **d.** Starter-Generator Switch. The STARTER GEN switch is located on the DC POWER control panel (figure 2-7). The START position permits the starter generator to function as a starter. The STBY GEN position permits the starter generator to function as a generator.
- e. Starter-Converter Switch. EE The START CONVERTER switch is located on the DC POWER control panel (figure 2-7). The START position permits the starter generator to function as a starter. In the CONVERTER position, the converter function as a secondary 28 vdc supply to the distribution system in case of generator failure.
- **f. Nonessential Bus Switch**. The NON-ESS BUS switch is located on the DC POWER control panel (figure 2-7). In the NORMAL ON position, the nonessential bus receives 28 vdc power only from the generator. In the MANUAL ON position, the nonessential bus receives DC power regardless of the power source.
- **g. DC Voltmeter Selector Switch**. The VM switch is located on the DC POWER control panel (figure 2-7).

The switch permits monitoring of voltage being delivered from any of the following; BAT, MAIN GEN, STBY GEN, ESS BUS, and NON-ESS BUS, BAT, GEN, CONV, ESS BUS and NON-ESS BUS.

- h. DC Voltmeter. The dc voltmeter is located in the center area of the instrument panel and is labeled VOLT DC (figure 2-6). Direct current voltage is indicated on the voltmeter as selected by the VM switch in the overhead console.
- i. DC Loadmeters Main and Standby. Two direct current loadmeters are mounted in the lower center area of the instrument panel (figure 2-6). The MAIN GEN loadmeter indicates the percentage of main generator rated capacity being used. The STBY GEN loadmeter indicates the percentage of standby generator rated capacity being used. The loadmeters will not indicate percentage when the generators are not operating.
- j. EB X DC Loadmeters Generator and Converter. Two direct current loadmeters are mounted on the lower center area of the instrument panel (figure 2-6). The GEN loadmeter indicates the percentage of generator rated capacity being used. The CONV loadmeter indicates the percentage of converter rated capacity being used.

2-59. E ELECTRONIC COUNTER - MEASURES DC ELECTRICAL POWER SYSTEM.

- **a.** The ground power/standby generator switch (GND/STBY GEN) is relay actuated to the GND PWR position whenever the standby generator fails or is applying its output to the helicopter primary bus due to main generator failure. Should this occur, (NON-ESS BUS switch in NORMAL ON position) power to all mission equipment will be lost except for the antenna retract system, interphone and crew call circuits.
- **b.** The 28 Vdc essential bus supplies power to the AN/ARQ-33 antenna circuits, antenna emergency retract circuit, C-1611D/AIC interphone circuits, and crew call circuits through circuit breakers on the overhead console.
- **c.** The 28 Vdc nonessential bus supplies power to the aft AN/ARC-131, AN/APR-39(V) 1, TSEC/KY-28, AN/APN-171A(V) 1, mission power control circuits, and the ac power control circuits through circuit breakers in the overhead console (figure 2-12).

2-60. EE ELECTRONIC COUNTER - MEASURES DC ELECTRICAL POWER SYSTEM.

- **a.** The 28 vdc essential bus supplies power to the ECM (AN/ARQ-33A) antenna circuits, intercom (C-1611D/AIC), radar warning (AN/APR-39(V)2), pilot voice security (TSEC/KY-28/58), radar warning (AN/APR-44), IR jammer (AN/ALQ-144), radar altimeter (AN/APR-171A(V)1) and crew call circuits through circuit breakers in the overhead console (figure 2-12).
- **b.** The 28 Vdc nonessential bus supplies power to the aft FM communications (AN/ARC-131), mission voice security (TSEC/KY-28), mission power control circuits and the ac power control circuits through circuit breakers in the overhead console.

2-61. ELECTRONIC COUNTER - MEASURES DC ELECTRICAL POWER SYSTEM.

- **a.** The 28 vdc essential bus supplies power to the ECM (AN/ALQ-151) antenna circuits, intercom (C-1611D/AIC) crew call circuits through circuit breakers in the overhead console (figure 2-12).
- **b.** The 28 vdc nonessential bus supplies power to the radar warning (AN/APR-39(V) 2), voice security (TSEC/KY-58), radar altimeter (AN/APN-209), UHF communications (AN/ARC-164), mission power control circuits and the ac power control circuits in the overhead console.

2-62. DC CIRCUIT BREAKER PANEL.

The dc circuit breaker panel is located in the overhead console (figure 2-12). In the "pushed in" position the circuit breakers provide circuit protection for the 28 Vdc equipment. In the "pulled out" position the circuit breakers de-energize the circuit. In the event of an overload the circuit breaker protecting that circuit will "pop out". Each breaker is labeled for the particular circuit it protects. Each applicable breaker is listed in the paragraph describing the equipment it protects.

2-63. AC POWER SUPPLY SYSTEM.

- **a**. Alternating current is supplied by two inverters (figure 2-11). They receive power from the 28 Vdc essential bus and are controlled from the AC POWER control panel (figure 2-7).
- **b. EB** X AC power for use by mission equipment and to provide standby power to the aircraft is supplied by a 30 KVA alternator which is controlled by the ALT switch on the AC PWR panel on the overhead console (figure 2-7).

2-64. INVERTERS.

- a. Main and Spare. Either the main or spare inverter (at the pilots option) will supply the necessary 115 Vac to the distribution system. The inverters also supply 115 Vac to the 28 volt ac transformer which in turn supplies 28 Vac to the necessary equipment. Circuit protection for the inverters is provided by the MAIN INVTR PWR and SPARE INVTR PWR circuit breakers.
- **b.** Mission AC Power. The inverter switch labeled MISSION INVTR is located in the mission ac power control panel in the overhead console (figure 2-7). This is a two position switch labeled MISSION INVTR in the aft (OFF) position and ON in the forward position.

2-65. E B MISSION POWER CONTROL PANEL.

- **a.** The MISSION POWER control panel is located on the pedestal (figure 2-7).
- **b.** This panel is labeled MISSION POWER and contains the MISSION POWER ON-OFF switch and the CREW CALL switch.
- **c.** The MISSION POWER switch is a two position switch which is OFF in the aft position and ON in the forward position.
- **d.** The CREW CALL switch is a momentary contact switch.

2-66. X MISSION POWER CONTROL PANEL.

- **a.** The mission power control panel is located in the overhead console (figure 2-7).
- **b.** The panel is labeled MISSION POWER and contains a guarded MISSION ON-OFF switch.

2-67. AC POWER INDICATORS AND CONTROLS.

- a. Inverter Switch. The INVTR switch is located on the AC POWER control panel in the overhead console (figure 2-7). The switch is normally in the MAIN ON position, to energize the main inverter. In the event of a main inverter failure the switch can be positioned to SPARE ON to energize the spare inverter. Electrical power to the INVTR switch is supplied from the 28 Vdc essential bus. Circuit protection is provided by the INVTR CONT circuit breaker.
- **b.** AC Failure Caution Light. The INST INVERTER caution light will illuminate when the inverter in use fails or when the INV switch is in the OFF position.
- c. EE X Alternator and Converter Caution Lights. The CONVERTER caution light will illuminate when the converter fails or the alternator is not running. The ALTERNATOR caution light will illuminate (along with the CONVERTER light) if the alternator fails or is not running.
- d. AC Voltmeter Selector Switch. The AC PHASE VM switch is located on the AC POWER control panel (figure 2-7). The switch is used to select any one of the three phases of the 115 Vac three-phase, current for monitoring on the ac voltmeter. The three positions on the switch are: AB, AC and BC. Each position indicates that respective phase of the 115 Vac on the ac voltmeter.
- e. AC Voltmeter. The ac voltmeter is mounted on center area of the instrument panel (figure 2-6). The ac voltage output from the inverter (main or spare) is indicated on this instrument. The voltage indicated on any of the three selected positions should be 115 plus or minus 3.0 Vac. IT In this configuration the AC VM also monitors the alternator voltage. The voltage indicated on ØA, ØB, or ØC should be 118 to 122 Vac.

- f. EE X AC VM SEL Switch. The AC VM SEL switch is located on the AC PWR panel on the overhead console (figure 2-7). The switch is used to select any one of the three phases on the 115 Vac three phase inverter current for monitoring on the voltmeter. These positions are marked AB, AC and BC. In addition this switch also selects each of the three phases of the alternator voltage for monitoring on the voltmeter. These positions are marked ØA, ØB, and ØC.
- g. EE X ALT Switch. The ALT switch is located on the AC PWR on the overhead console (figure 2-7). The switch turns the alternator on and off. Additionally, moving the switch to RES OFF resets the alternator when the switch is returned to the ON position.

2-68. E ELECTRONIC COUNTER - MEASURES AC ELECTRICAL POWER SYSTEM.

115 vac power for the ECM system is supplied by two inverters. The single phase ac system is powered by the mission bus through a switch marked MISSION INVTR on the overhead console. The 115 volt single phase ac voltmeter is on operator console position 2. The three phase ac system is powered by the mission bus through a switch marked TLQ-27 POWER at operator console position 3. Circuit protection is provided by a 5 amp circuit breaker. The 115 volt three phase ac voltmeters are on operator console position 3.

2-69. ELECTRONIC COUNTER-MEASURES AC ELECTRICAL POWER SYSTEM.

115 vac power for the ECM system is supplied by one 30 KVA three phase alternator. The ECM system requires both three phase and single phase ac. The single phase ac is used to power the intercept (AN/GLR-9(V) 11) functions on position 2. The three phase ac is used to power the countermeasures (AN/TLQ-17A) functions in mission console position 1. Power control and circuit protection is provided by relays and circuit breakers. The single phase ac is monitored by a VM on mission console position no. 2.

2-70. MELECTRONIC COUNTERMEASURES AC ELECTRICAL POWER SYSTEM.

115 vac for the ECM system is supplied by one 30 KVA three phase alternator. The ECM system requires both three phase and single phase ac. The three phase ac is used to power the countermeasures (AN/TLQ-17A) functions. Single phase current is used for the navigation (AN/ASN-86) system. Power control and circuit protection is provided by relays and circuit breakers.

2-71. AC CIRCUIT BREAKER PANEL.

The ac circuit breaker panel is located on the right side of the pedestal base (figure 2-13) and (figure 2-7). The circuit breakers in the "pushed in" position provide circuit protection for the 26 Vac and 115 Vac operated equipment. The breakers in the "pulled out" position deenergize the circuit. The breakers will "pop out" automatically in the event of a circuit overload. Each breaker is labeled for the particular circuit it protects. Each applicable breaker is listed in the paragraph describing the equipment it protects.

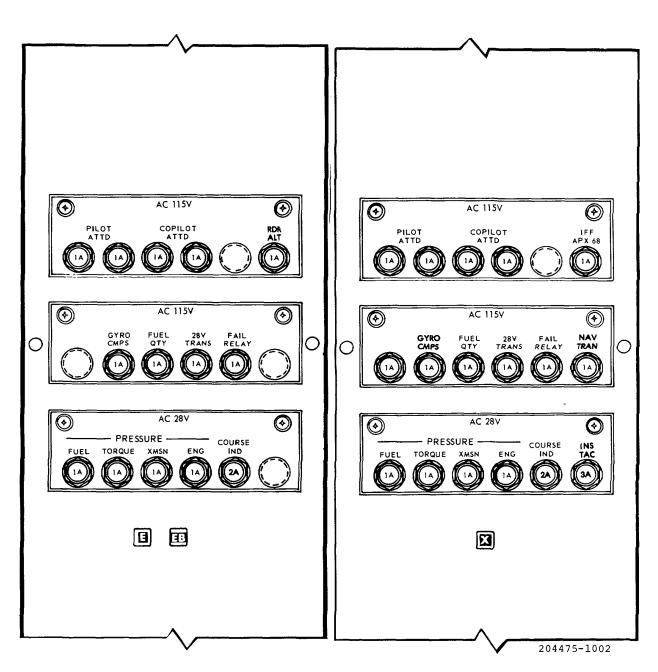


Figure 2-13. AC Circuit Breaker Panel - Typical

SECTION XII. LIGHTING

2-72. POSITION LIGHTS.

- a. General. The position lights consist of eight lights (figure 2-1). Two red lights are mounted on the left side of the fuselage, one above and one below the cabin door. Two green lights are mounted on the right side of the fuselage, one above and one below the cabin door. Two white lights are mounted on top of the fuselage, just inboard of the red and green lights. One white light is mounted on the bottom center of the fuselage, and one white light is mounted on the tailboom vertical fin. Electric power to operate the lights is supplied from the 28 Vdc essential bus. Circuit protection is provided by the NAV LIGHTS circuit breaker in the dc circuit breaker panel. The position lights may be protected by the FUS LIGHTS circuit breaker.
- **b.** Operation. The position lights are controlled by the POSITION switches on the EXT LTS panel on the overhead console (figure 2-7). A three position switch permits selection of STEADY, OFF, or FLASH. Another two-position switch controls brilliance and is marked DIM and BRIGHT. When the three-position switch is in STEADY position, all eight navigation lights are illuminated. In the FLASH position, the colored lights and the aft white light flash.

2-73. ANTI-COLLISION LIGHT.

- **a. General.** The anti-collision light is located on the top aft fuselage area (figure 2-1). Electric power to operate the light is supplied from the 28 Vdc essential bus. Circuit protection is provided by the ANTI COLL LIGHT circuit breaker.
- **b. Operation**. The ON position of the ANTI COLL light switch illuminates the anti-collision light and starts rotation of the light (figure 2-7). OFF position deenergizes the light.

2-74. LANDING LIGHT.

a. General. The landing light is flush-mounted to the underside of the fuselage (figure 2-1). It may be extended or retracted to improve forward illumination. Electric power to operate the system is supplied from the 28 Vdc essential bus. Circuit protection is provided by the LDG LIGHT PWR and LDG SEARCH LIGHT CONT circuit breakers.

b. Operation. Landing light switches are on the pilot collective lever switch box (figure 2-7). The ON position of the LDG LT switch causes the landing light to illuminate; OFF turns the light off. On helicopters with pilot and copilot switches, the landing light can be extinguished only when the switch used to turn the light on is moved to OFF. The EXT position of the LDG LT EXT OFF RETR extend the landing light to the desired position; RETR position retracts the light. The OFF position stops the light during extension or retraction. The light automatically stops at the full extend/retract position. On helicopters with pilot and copilot switches, the LDG LT EXT OFF RETR switch is spring loaded to the OFF position.

2-75. SEARCHLIGHT.

a. General. The searchlight is flush-mounted to the underside of the fuselage (figure 2-1). The light can be extended and retracted for search illumination. At any desired position in the extend or retract arc, the light may be stopped and rotated to the left or right. Electric power to operate the light is supplied from the 28 Vdc essential bus. Circuit protection is provided by the SEARCHLIGHT PWR LDG & SEARCHLIGHT CONT circuit breakers.

b. Operation.

- (1) Searchlight Switch. The pilot SL switch ON position illuminates the light (figure 2-7). The OFF position deactivates the light. The STOW position retracts the light into the fuselage well.
- **(2)** Searchlight Control Switch. The pilot SEARCH CONT switch EXT position extends the light from the fuselage well and moves it forward (figure 2-7). RETR position moves the light aft. The L and R position rotates the light left and right.

2-76. DOME LIGHTS.

a. General. The dome lights provide overhead lighting for the cabin area. The forward light is controlled by the FWD switch on the DOME LT panel on the overhead console. The aft dome lights are controlled by the switch on the AFT DOME LTS panel on the roof. Electric power to operate the dome light is supplied from the 28 Vdc essential bus. Circuit protection is provided by the DOME LIGHTS circuit breaker.

b. Operation. To operate the FWD dome light, position the FWD switch to WHITE for white light, RED for red light and OFF to turn light off. The aft dome lights panel has two switches. The WHITE/OFF/RED switch functions are the same as the FWD switch. Rotation of the rheostat marked OFF/MED/BRT increases or decreases the brightness of the aft dome lights.

2-77. E E MISSION OPERATOR UTILITY LIGHTS.

The utility crew lights are roof panel mounted and have three position switches to provide WHITE/OFF/RED, thus permitting a choice as to the type of illumination or lights OFF. A switch type rheostat permits the operator to increase or decrease the light intensity. The lights are detachable and equipped with flexible stretch power cords.

2-78. COCKPIT LIGHTS.

- **a. General.** Two cockpit lights (figure 2-7) are provided; one above the pilot and one above the copilot. Each light is controlled individually. The lights receive power from the essential bus and are protected by the COCKPIT LIGHTS circuit breaker.
- **b. Operation.** Rheostat switches are part of each light assembly. Brightness is increased by turning the rheostat clockwise or dimmed by turning counterclockwise. Clockwise rotation of the lens provides red lighting.

2-79. INSTRUMENT LIGHTS.

The instrument lights control panel is located in the overhead console (figure 2-7). The panel contains six switch/rheostats for activating and controlling the brightness of the various instrument lights. Each switch/rheostat functions the same. OFF position deenergizes the circuit, clockwise rotation increases brightness of the lights, and counterclockwise rotation decreases brightness. The instrument lights all receive electric power from the 28 Vdc essential bus. The radiomagnetic indicator (ID-998/ASN) and radar altimeter receive electric power from a 5 Vdc power supply.

a. Pilot Instrument Lights. The pilot instrument lights furnish illumination for the following instruments: gas producer tachometer, torquemeter, exhaust temperature indicator, dual tachometer, airspeed indicator, clock, vertical velocity indicator, turn and slip indicator, altimeter, attitude indicator, radio magnetic

indicator, CDI indicator, standby compass, pilot collective switch box, radar altimeter and ☑ ID-663 BDHI indicator. These lights are all on one circuit and are controlled by the switch/rheostat marked PILOT on the INST LTG control panel. Circuit protection is provided by the INST PANEL LIGHTS circuit breaker and ☑ PILOT 5 VOLT LIGHTS circuit breaker.

- b. ☑ Pilot Instrument Lights Rheostat. Turning the rheostat marked PILOT (located on the INST LTG control panel) to OFF trips a relay, providing full illumination to the digital readout and HI-LO warning lights on the co-pilots AN/APN-209 radar altimeter. This feature allows the pilot and co-pilot to read the displays during daytime operation.
- c. Copilot Instrument Lights. The copilot instrument lights furnish illumination for the instruments on the copilot section of the instrument panel. These instruments consist of an airspeed indicator, attitude indicator, altimeter, vertical velocity indicator, radio magnetic indicator, radar altimeter indicator, I altimeter encoder (AAV-32/A) and radar altimeter (AN/APN-209). The copilot instrument lights are all on one circuit, and are controlled by the switch/rheostat marked COPILOT on the INST LTG control panel. Circuit protection is provided by INST PANEL LIGHTS circuit breaker and I PILOT 5 VOLT LIGHTS circuit breaker.
- d. Engine Instrument Lights. The engine instrument lights furnish illumination for the following instruments: transmission oil temperature, fuel quantity, transmission oil pressure, engine oil pressure, loadmeters, ac voltmeter, fuel pressure indicator, engine oil temperature gage, and dc voltmeter. Each instrument is individually illuminated and control is accomplished by the switch/rheostat marked ENGINE on the INST LTG control panel. Circuit protection is provided by the INST PANEL LIGHTS circuit breaker.
- e. Secondary Instrument Lights. The four secondary instrument lights are spaced across the top of the instrument panel shield (figure 2-6). These lights furnish secondary illumination for the instrument panel face. The lights are activated and controlled by the switch/rheostat marked SEC on the INST LTG control panel. Circuit protection is provided by the INST SEC LIGHTS circuit breaker.
- f. E FM Secure Dim Control. The FM SEC/NON SEC dimmer is located adjacent to the light near the center of the instrument panel (figure 2-6) and is used to adjust the brightness of the light.

2-80. OVERHEAD CONSOLE PANEL LIGHTS.

The overhead console panel lights furnish illumination for all overhead panels (figure 2-7). Each panel is individually illuminated and control is accomplished by the switch/rheostat, marked CONSOLE on the INST LTG control panel. Circuit protection is provided by the CONSOLE PED LIGHTS circuit breaker.

2-81. PEDESTAL LIGHTS.

The pedestal lights furnish illumination for the control panels on the pedestal (figure 2-7). Each panel is individually illuminated and control is accomplished by the switch/rheostat marked PED on the INST LTG control panel. Circuit protection is provided by the CONSOLE PED LIGHTS circuit breaker.

2-82. TRANSMISSION OIL LEVEL LIGHT.

A transmission oil level light is installed to provide illumination to check the transmission oil sight gage. The circuit is activated by a button-type switch marked XMSN OIL LEVEL LT SWITCH and is located on the right side of the transmission forward bulkhead. Electric power for the transmission oil level light circuit is supplied by the 24 Vdc battery. Circuit protection is provided by the battery voltmeter circuit breaker located in the oil cooler compartment or forward radio compartment.

2-83. SPARE LAMP KIT.

The spare lamp kit is located on the left side of the overhead console. The kit contains spare light bulb for the segment panel lights, the instrument lights, pedestal and overhead console lights, master caution and segment caution lights, all press-to-test lights, the rpm and fire warning lights, and the dome lights. All bulbs except the dome light bulb may be replaced without the use of tools.

SECTION XIII. FLIGHT INSTRUMENTS

2-84. AIRSPEED INDICATORS.

The pilot and copilot airspeed indicators display the helicopter indicated airspeed (IAS) in knots (figure 2-6). The IAS is obtained by measuring the difference between impact air pressure from the pitot tube and the static air pressure from the static ports (figure 2-1). IAS is inaccurate due to instrument and installation errors.

2-85. TURN AND SLIP INDICATOR.

The turn and slip indicator (4 MIN TURN) displays the helicopter slip condition, direction of turn and rate of turn (figure 2-6). The ball displays the slip condition. The pointer displays the direction and rate of the turn. The circuit receives power from the 28 Vdc essential bus and is protected by the TURN & SLIP IND circuit breaker.

2-86. VERTICAL VELOCITY INDICATOR

The vertical velocity indicator displays the helicopter ascent and descent speed in feet per minute (figure 2-6). The indicator is actuated by the rate of atmospheric pressure change.

2-87. PRESSURE ALTIMETER.

- a. Pressure Altimeter. The pressure altimeter (ALT) furnishes direct readings of height above sea level and is actuated by the pitot static system (figure 2-6). Two altimeters are provided, one for the pilot and one for the copilot. (Refer to Chapter 3 for operation.)
- b. E Radar Altimeter AN/APN-171. The radar altimeter provides continuous indication of height (terrain clearance) from 0 to 5000 feet. Altitude in feet is indicated by the indicator on the pilots instrument panel. It contains a pointer that indicates altitude on a linear scale from 0 to 100 feet in 2 foot increments, 100 to 200 feet in 10 foot increments, 200 to 1000 feet in 50 foot increments, and 1000 to 5000 feet in 200 foot increments. Integral lighting operated by the 28 Vdc essential bus is incorporated in the indicator. A black and yellow striped flag is located in the lower center of the indicator. When power is turned on, the flag disappears from view. (Refer to Chapter 3 for operation.)
- c. Radar Altimeter AN/APN-209. The radar altimeter provides continuous indication of height (terrain clearance) from 0 to 1500 feet. Altitude in feet is indicated by the indicator on the copilot's instrument panel (Figure 2-6).

2-88. ATTITUDE INDICATORS.

a. Pilot Attitude Indicator. The pilot attitude indicator is located on the pilot section of the instrument panel (figure 2-6). The indicator displays the pitch and roll attitude of the helicopter. An OFF warning flag in the indicator is exposed when electrical power to the system is removed. However, the OFF flag will not indicate internal system failure. The attitude indicator has an electrical trim in the roll axis in addition to the standard pitch trim. The attitude indicator is operated by 115 Vac power, supplied by the inverter. Circuit protection is provided by the PILOT ATTD circuit breakers in the ac circuit breaker panel.

CAUTION

The copilot attitude indicator shall be caged only in a straight and level attitude. The caging knob shall never be pulled violently.

b. Copilot Attitude Indicator. The copilot attitude indicator is located in the copilot section of the instrument panel (figure 2-6). It is operated by 115 Vac power supplied by the inverter. Circuit protection is provided by the COPILOT ATTD circuit breakers in the ac circuit breaker panel. In a climb or dive exceeding 27 degrees of pitch the horizontal bar will stop at the top or bottom of the case and the sphere then becomes the reference. The copilot attitude indicator may be caged manually by pulling the PULL TO CAGE knob smoothly away from the face of the instrument to the limit of its travel and then releasing quickly.

2-89. FREE - AIR TEMPERATURE INDICATOR (FAT).

The free-air temperature indicator is located at the top center area of the windshield (figure 2-7). The indicator displays the free air temperature in degrees Celsius.

2-90. STANDBY COMPASS.



The magnetic compass will become erratic during transmission of the countermeasures transmitter.

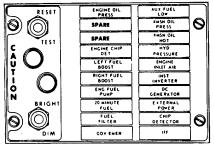
The standby (magnetic) compass is mounted in a bracket at the center right edge of the instrument panel (figure 2-6). A compass correction card is located in the card holder above the compass. A deviation in magnetic compass indications will occur when the landing and/or searchlights are turned on.

2-91. FIRE DETECTOR WARNING SYSTEM.

A FIRE WARNING light is located in the upper right section of the instrument panel (figure 2-6). The press-to-test (FIRE DETECTOR TEST) test switch is located to the left of the fire warning light. Excessive heat in the engine compartment causes the FIRE light to illuminate. Pressing the press-to-test switch also causes the light to illuminate for testing. Electric power for the circuit is supplied from the 28 Vdc essential bus and is protected by the FIRE DET circuit breaker.

2-92. MASTER CAUTION SYSTEM.

- a. Master Caution Indicator. The master caution indicator light on the instrument panel will illuminate when fault conditions occur (figure 2-6). This illumination alerts the pilot and copilot to check the caution panel for the specific fault condition.
- b. Caution Panel. The CAUTION panel is located on the pilot side of the pedestal (figures 2-14 and 2-15). Worded segments illuminate to identify specific fault conditions. The worded segments are readable only when the light illuminates. When a light illuminates, indicating a fault condition, it will remain illuminated until the fault condition is corrected. Refer to figures 2-14 and 2-15 for explanation of the fault conditions.
- (1) Bright-Dim Switch. The BRIGHT-DIM switch on the CAUTION panel permits the pilot to manually select a bright or dimmed condition for all the individual worded segments and the master caution indicator. The dimming switch position will work only when the pilot instrument lights are on. The master caution system lights will be in bright illumination after each initial application of electrical power; when the pilot instrument lights are turned OFF, or a loss of power from the dc essential bus occurs.

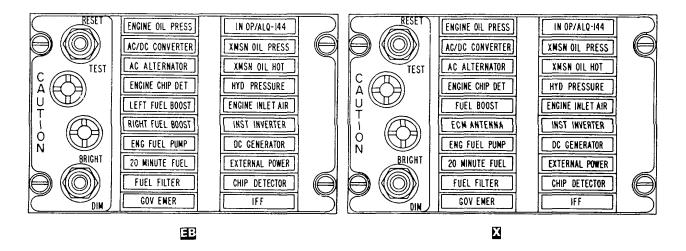


CAUTION PAN	EL	
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CAUTION PANEL WORDING	FAULT CONDITION	
ENGINE OIL PRESS	Engine oil pressure low	
SPARE	Engine icing detected	
SPARE	Engine ice detector disarmed	
ENGINE CHIP DET	Metal particles in engine	
LEFT FUEL BOOST	Left fuel boost pump inoperative	
RIGHT FUEL BOOST	Right fuel boost pump inoperative	
ENG FUEL PUMP	Engine fuel pump inoperative	
20 MINUTE FUEL	Fuel quantity low	
FUEL FILTER	Fuel filter clogged	
GOV EMER	Emergency fuel control	
AUX FUEL LOW	Auxiliary fuel tank empty	
XMSN OIL PRESS	Transmission oil pressure low	
XMSN OIL HOT	Transmission oil temperature high	
HYD PRESSURE	Hydraulic pressure low	
ENGINE INLET AIR	ILET AIR Engine air filter clogged	
INST INVERTER	AC Bus failure (inverter failure)	
DC GENERATOR	DC Generator failure	
EXTERNAL POWER	External power connected or receptacle door open	
CHIP DETECTOR	Metal particles present in 42° or 90° gearbox or main transmission	
IFF	IFF System inoperative	

205075-1005B

Figure 2-14. E Caution Panel - Typical



CAUTION PANEL WORDING	FAULT CONDITION
WORDING ENGINE OIL PRESS AC/DC CONVERTER AC ALTERNATOR ENGINE CHIP DET LEFT FUEL BOOST EB RIGHT FUEL BOOST EB FUEL BOOST LE ECM ANTENNA LE ENG FUEL PUMP 20 MINUTE FUEL FUEL FILTER GOV EMER IN OP/ALQ-144 XMSN OIL PRESS XMSN OIL HOT HYD PRESSURE ENGINE INLET AIR	CONDITION Engine oil pressure low AC/DC Converter failure AC Alternator failure Metal particles in engine Left fuel boost pump inoperative Right fuel boost pump inoperative Left or right fuel boost pump inoperative ECM Antenna not stowed Engine fuel pump inoperative Fuel quantity low Fuel filter clogged Emergency fuel control ALQ-144 System inoperative Transmission oil pressure low Transmission oil temperature high Hydraulic pressure low Engine air filter clogged
INST INVERTER	AC Bus failure (inverter failure)
DC GENERATOR EXTERNAL POWER	DC Generator failure External power connected or receptacle door open
CHIP DETECTOR	Metal particles present in 42° or 90° gearbox or main transmission.
IFF	IFF System inoperative

Figure 2-15. EB X Caution Panel

- (2) Reset-Test Switch. The RESET-TEST switch on the CAUTION panel enables the pilot to manually reset and test the master caution system. Momentarily placing the switch in the RESET position, extinguishes and resets the master caution indicator light so it will again illuminate should another fault condition occur. Momentarily placing the switch in TEST position will cause the illumination of all the individually worded segments and the master caution indicator. Only the lamp circuitry is tested; the condition circuitry is not. Testing of the system will not change any particular combination of fault indications which might exist prior to testing. The worded segments will remain illuminated as long as fault condition or conditions exist unless the segment is rotated.
- **c. Electrical Power.** Electric power for the master caution system is supplied from the 28 Vdc essential bus. Circuit protection is provided by the CAUTION LIGHTS circuit breaker.

2-93. RPM HIGH-LOW LIMIT WARNING SYSTEM.

The rpm high-low limit warning system provides the pilot with an immediate warning of high and low rotor or engine rpm. Main components of the system are a detector unit, warning light and audio signal circuit, low RPM AUDIO/OFF switch, and electrical wiring and connectors. The warning light and audio warning signal systems are activated when the following rpm conditions exist:

Warning light only

- 1. For rotor rpm of 334 (± 5) (High Warning).
- 2. For rotor rpm of 305 (± 5)(Low Warning).
- 3. For engine rpm of 6200 (± 100)(Low Warning).
- 4. Loss of signal (circuit failure) from either rotor tachometer generator or power turbine tachometer generator.

Warning light and audio warning signal combination

- 1. For rotor rpm of 305 (± 5) and engine rpm of 6200 (± 100)(Low Warning).
- Loss of signal (circuit failure) from both rotor tachometer generator and power turbine tachometer generator.

NOTE

The audio warning signal will be heard in the headsets. The signal is a varying, oscillating frequency; starting low and building up to a high pitch. Signal alternates on for 0.85 second: then off for one second.

- a. Rotor Tachometer Generator and Power Turbine Tachometer Generator. The rotor tachometer generator and power turbine tachometer generator both send signals to the high-low rpm warning light and audio warning circuits. When the warning light only is energized, determine the cause of indication by checking the torquemeter and cross referencing other engine instruments. A normal indication signifies that the engine is functioning properly, and that there is a tachometer generator failure or an open circuit to the warning system rather than an actual engine failure. Electrical power for system operation is supplied by the 28 vdc essential bus.
- **b.** Light High Low Limit RPM Warning. The high low warning light (figure 2-6) is located on the instrument panel. This light illuminates to provide a visual warning of low rotor rpm, low engine rpm, or high rotor rpm.
- c. Switch Low RPM Audio/Off. The LOW RPM AUDIO/OFF switch is on the engine control panel (figure 2-9). When in OFF position, the switch prevents the audio warning signal from functioning during engine starting. This eliminates use of the circuit breaker as a switch and increases safety by having warning light working at all times.
- d. Switch -Low RPM Audio/Off (Modified). The LOW RPM AUDIO/OFF switch is on the engine control panel (figure 2-9). When in OFF position, the switch prevents the audio warning signal from functioning during engine starting. Current production helicopters (and those so modified) use a spring-loaded switch. When the switch has been manually turned off for engine starting, it will automatically return to the AUDIO position when normal operating range is reached.

SECTION XIV. SERVICING PARKING AND MOORING

2-94. SERVICING.

- a. Servicing Diagram. Refer to figure 2-16.
- b. Approved Military Fuels, Oils, Fluids, and Unit Capacities. Refer to table 2-1.
- **c. Fuel Sample.** Settling time for AVGAS is 15 minutes per foot of tank depth and one hour per foot depth for jet (JP) fuels. Allow the fuel to settle for the prescribed period before any fuel samples are taken.

2-95. FUEL SYSTEM SERVICING.

WARNING

Servicing personnel shall comply with all safety precautions and procedures specified in FM 10-68, Aircraft Refueling Field Manual.

- **a.** Refer to table 2-1 for fuel tank capacities.
- **b.** Refer to table 2-1 for approved fuel.
- **c.** The helicopter may be serviced by any of the methods described as follows:
 - (1) Closed Circuit Refueling (Power Off).
- (a) Refer to figure 2-16 for fuel filler location.
- **(b)** Assure that fire guard is in position with fire extinguisher.
 - (c) Ground servicing unit to ground stake.
 - (d) Ground helicopter to ground stake.
- **(e)** Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.



Ensure that servicing unit pressure is not above 125 psi while refueling.

- **(f)** Remove fuel filler cap, and assure that refueling module is in locked position. Refer to figure 2-16.
- **(g)** Remove nozzle cap and insert nozzle into fuel receptacle and lock into position.
- **(h)** Activate flow control handle to ON or FLOW position. Fuel flow will automatically shut off when fuel cell is full. Just prior to normal shut off, fuel flow may cycle several times as maximum fuel level is reached.
- (i) Assure that flow control handle is in OFF or NO FLOW position and remove nozzle.
 - (j) Replace fuel nozzle cap.
 - (k) Replace fuel filler cap.
 - (I) Disconnect fuel nozzle ground.
- **(m)** Disconnect ground from helicopter to servicing unit.
- **(n)** Disconnect servicing unit ground from ground stake.
- **(o)** Return fire extinguisher to designated location.
 - (2) Gravity or Open-Port Refueling (Power Off).
- (a) Refer to figure 2-16 for fuel filler location.
- **(b)** Assure that fire guard is in position with fire extinguisher.
 - **(c)** Ground servicing unit to ground stake.
 - (d) Ground helicopter to ground stake.
- **(e)** Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.
 - (f) Remove fuel filler cap.
- **(g)** Using latch tool, attached to filler cap cable, open refueling module. Refer to figure 2-16.

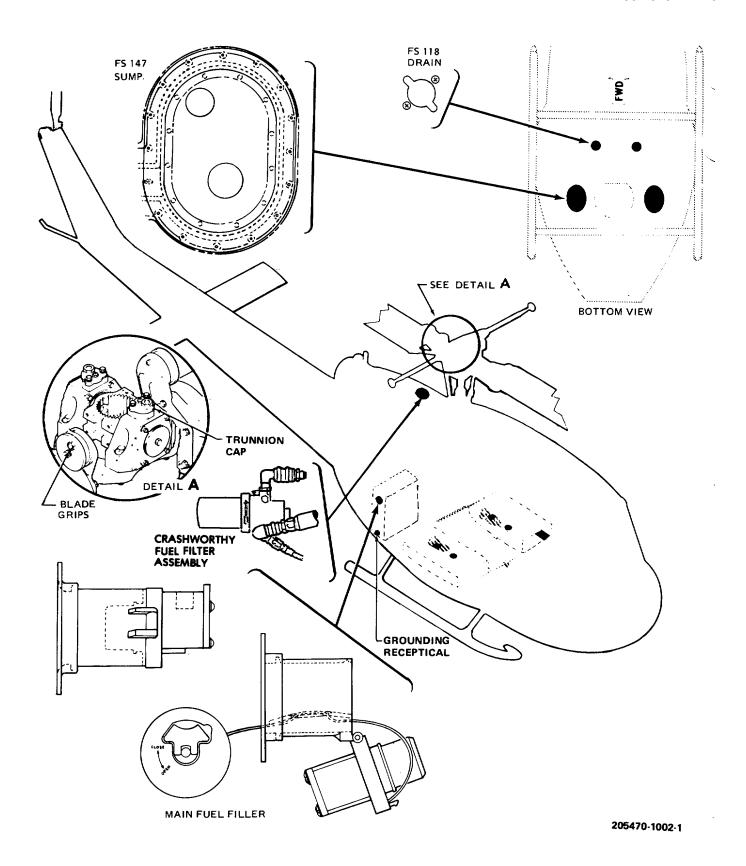


Figure 2-16. Servicing Diagram - Typical (Sheet 1 of 2)

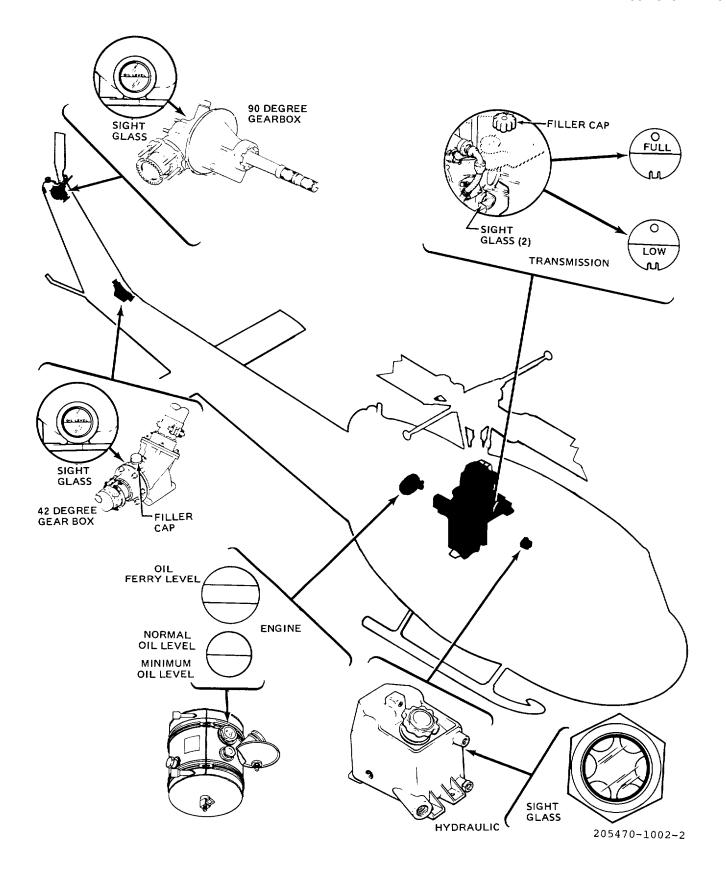


Figure 2-16. Servicing Diagram - Typical (Sheet 2 of 2)

- **(h)** Remove nozzle cap and insert nozzle into fuel receptacle.
 - (i) Fill to specified level.
 - (j) Remove nozzle.
 - (k) Replace fuel nozzle cap.
- (I) Close refueling module by pulling cable until latch is in locked position. Refer to figure 2-16.
 - (m) Replace fuel filler cap.
 - (n) Disconnect fuel nozzle ground.
- **(o)** Disconnect ground from helicopter to servicing unit.
- **(p)** Disconnect servicing unit ground from ground stake.
- (q) Return fire extinguisher to designated location.
 - (3) Rapid (Hot) Refueling (Closed Circuit).
 - (a) Before rapid refueling.
 - 1 Throttle Idle.
- **2** FORCE TRIM switch ON or controls frictioned.
 - 3 E MISSION INVERTER switch-OFF.

WARNING

In case of helicopter fire, observe fire emergency procedures in Chapter 9.

- **(b)** During rapid refueling. A crewmember should observe the refueling operation (performed by authorized refueling personnel) and stand fire guard as required. One crewmember shall remain in the helicopter to monitor controls. Only emergency radio transmission should be made during rapid refueling.
- **(c)** Refer to figure 2-16 for fuel filler location.
- $\begin{tabular}{ll} \begin{tabular}{ll} \beg$
 - **(e)** Ground servicing unit to ground stake.

- (f) Ground helicopter to ground stake.
- **(g)** Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.

CAUTION

Ensure that servicing unit pressure is not above 125 psi while refueling.

- **(h)** Remove fuel filler cap, and assure that refueling module is in closed position. Refer to figure 2-16.
- (i) Remove nozzle cap and insert nozzle into fuel receptacle and lock into position.
- **(j)** Activate flow control handle to ON or FLOW position. Fuel flow will automatically shut off when fuel cell is full. Just prior to normal shut off, fuel flow may cycle several times, as maximum fuel level is reached.
- **(k)** Assure that flow control handle is in OFF or NO FLOW position and remove nozzle.
 - (I) Replace fuel nozzle cap.
 - (m) Replace fuel filler cap.
 - (n) Disconnect fuel nozzle ground.
- **(o)** Disconnect ground from helicopter to servicing unit. After rapid refueling, the pilot shall be advised by the refueling crew that fuel cap is secure and grounding cables have been removed.
- **(p)** Disconnect servicing unit ground from ground stake.
- (q) Return fire extinguisher to designated location.
 - (r) MISSION INVERTER switch ON.
 - (4) Rapid Hot Gravity Refueling.
 - (a) Before rapid refueling.
 - 1 Throttle Idle.
- **2** FORCE TRIM switch ON or controls frictioned.
- 3 MISSION INVERTER switch OFF.

WARNING

In case of helicopter fire, observe fire emergency procedures in Chapter 9.

- **(b)** During rapid refueling. A crewmember should observe the refueling operation (performed by authorized refueling personnel) and stand fire guard as required. One crewmember shall remain in the helicopter to monitor controls. Only emergency radio transmission should be made during rapid refueling.
- **(c)** Refer to figure 2-16 for fuel filler location.
- **(d)** Assure that fire guard is in position with fire extinguisher.
 - **(e)** Ground servicing unit to ground stake.
 - (f) Ground helicopter to ground stake.
- **(g)** Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.
 - (h) Remove fuel filler cap.
- (i) Using latch tool, attached to filler cap cable, open refueling module. Refer to figure 2-16.
- **(j)** Remove nozzle cap and insert nozzle into fuel receptacle.
 - (k) Fill to specified level.
 - (I) Remove nozzle.
- (m) Close refueling module by pulling cable until latch is in locked position.
 - (n) Replace fuel nozzle cap.
 - (o) Replace fuel filler cap.
 - (p) Disconnect fuel nozzle ground.
- (q) Disconnect ground from helicopter to servicing unit. After rapid refueling, the pilot shall be advised by the refueling crew that fuel cap is secure and grounding cables have been removed.

- **(r)** Disconnect servicing unit ground from ground stake.
- **(s)** Return fire extinguisher to designated location.
 - (t) MISSION INVERTER switch -ON.

2-96. APPROVED COMMERCIAL FUEL, OILS, FLUIDS.

- a. Fuels. Refer to table 2-1.
- b. Oils. Refer to table 2-1.
- c. Fluids. Refer to table 2-1.

2-97. TYPES AND USE OF FUELS.

- **a.** Fuel Types. Refer to TB 55-9150-200-24.
- (1) Army Standard Fuels. These are the Armydesignated primary fuels adopted for worldwide use, and are the only fuels available in the Army supply system (table 2-1).
- **(2)** Alternate Fuels. These are fuels which can be used continuously when Army standard fuel is not available, without reduction of power output.
- (3) Emergency Fuels. These are fuels which can be used if Army standard and alternate fuels are not available. Their use is subject to a specific time unit (table 2-1).

b. Use of Fuels.

- (1) There are no special limitations on the use of Army standard or alternate fuels, but certain limitations are imposed when emergency fuels are used. A fuel mixture which contains over 10 percent leaded gasoline shall be recorded as all leaded gasoline. The use of emergency fuels shall be recorded in the FAULT/REMARKS column of DA Form 2408-13, Aircraft Maintenance and Inspection Record, noting the type of fuel, additives, and duration of operation.
- (2) When mixing of fuel in helicopter tanks or changing from one type of authorized fuel to another, for example JP-4 to JP-5, it is not necessary to drain the helicopter fuel system before adding the new fuel.

(3) Fuels having the same NATO code number are interchangeable. Jet fuels conforming to ASTM D-1655 specification may be used when MIL-T-5624 fuels are not available. This usually occurs during cross country flights where helicopters using NATO F-44 (JP-5) are refueled with NATO F-40 (JP-4) or commercial ASTM type B fuels. Engine will operate satisfactorily on either JP-4 or JP-5 type fuel.

2-98. GROUND HANDLING EQUIPMENT, COVERS, ROTOR TIEDOWNS, AND MOORING DIAGRAM.

Refer to figure 2-17.

NOTE All tiedowns shall be tight.

Table 2-1. Servicing Table of Approved Fuels, Oils, Fluids, and Unit Capacities

			TOTAL SYSTI	EM
SYSTEM	SPECIFICATION	NOTE	U.S.	METRIC
Fuel	MIL-T-5624 (JP-4)	1	Crashworthy System Total: 208.5 U.S. Gallons Usable: 206.5 U.S. Gallons	(789.2 Liters) (781.6 Liters)
Oil Engine	MIL-L-23699 *MIL-L-7808	3, 4 2, 4	3.3 U.S. Gallon	(12.5 Liters)
Transmission	MIL-L-23699 *MIL-L-7808	3, 4 2, 4	2.8 U.S. Gallon	(10.6 Liters)
42° Gearbox	MIL-L-23699 *MIL-L-7808	3, 4 2, 4	0.4 U.S. Pint	(0.2 Liters)
90° Gearbox	MIL-L-23699 *MIL-L-7808	3, 4 2, 4	0.5 U.S. Pint	(0.2 Liters)
Hydraulic System	MIL-H-5606 MIL-H-83282	5, 7 6, 7	10.0 U.S. Pint	(4.7 Liters)
Main Rotor Grip	MIL-L-23699 MIL-L-7808 MIL-L-2104 MIL-L-46152 MIL-L-46167	3, 4, 8 2, 4, 8 8 8	2 U.S. Quarts Each Side	(1.9 Liters)
Pillow Block Oil	MIL-L-23699 MIL-L-7808 MIL-L-2104 MIL-L-46152 MIL-L-46167	3, 4, 8 2, 4, 8 8 8	0.3 U.S. Pint	(0.1 Liters)

NOTE:

Army Standard fuel is MIL-T-5624 (JP-4) NATO code is F-40.
 Alternate fuels are MIL-T-5624 (JP-5) (NATO F-44) and MIL-T-83133 (JP-8)(NATO F-34).
 Emergency fuel is MIL-G-5572 (any AV gas) (NATO F-12, F-18, F-22).

 Refer to TM 55-9150-200-24. The use of emergency fuel for a maximum operating time of 50 hours (25 hours when TCP is used in fuel) will require a scheduled (hot end) inspection.

Table 2-1. Servicing Table of Approved Fuels, Oils, Fluids, and Unit Capacities (Cont)

SYSTEM SPECIFICATION NOTE U.S. TOTAL SYSTEM METRIC

CAUTION

Lubrication oil made to MIL-L-7808 by Shell Oil Company under their part number 307, qualification number 7D-1 shall not be used in the engine or aircraft systems. It contains additives which are harmful to seals in the systems.

2. MIL-L-7808 NATO code is 0-148 (Not for use in main rotor hub, P/N 204-212-101-31). For use in ambient temperatures below minus 32°C/25°F.

May be used when MIL-L-23699 oil is not available.



Under no circumstances shall MIL-L-23699 oil be used in ambient temperatures below minus 32°C/25°F.

- 3. MIL-L-23699 NATO code is 0-156 (Not for use in main rotor hub, P/N 204-012-101-31). For use in ambient temperatures above minus 32°C/25°F.
- 4. It is not advisable to mix MIL-L-7808 and MIL-L-23699 oils, except during an emergency. If the oils are mixed, the system shall be flushed within six hours and filled with the proper oil. An entry on DA Form 2408-13 is required when the oils are mixed.
- 5. MIL-H-5606 NATO code is H-515. For use in ambient temperatures below minus 35°C/30°F. (Refer to TB 55-1500-334-25.)
- 6. For use in ambient temperatures above minus 35°C/30°F.



Prolonged contact with hydraulic fluid (MIL-H-83282) liquid or mist can irritate eyes and skin. After any prolonged contact with skin immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber glove when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

Table 2-1. Servicing Table of Approved Fuels, Oils, Fluids and Unit Capacities (Cont)

				TOTAL SYSTEM
SYSTEM	SPECIFICATION	NOTE	U.S.	METRIC

7. It is not advisable to mix MIL-H-5606 and MIL-H-83282 fluids, except during an emergency. An entry on DA Form 2408-13 is required when the fluids are mixed. When changing from MIL-H-5606 to MIL-H-83282, not more than two percent of MIL-H-5606 may be present in the system.



Do not mix MIL-L-2104, MIL-L-46152, or MIL-L-46167 oils. In cases of emergency, these oils may be mixed in any combination. If this becomes necessary, drain the system within 6 hours of operation and refill with correct oil. An entry on DA Form 2408-13 is required when oils are mixed. Do not mix MIL-L-2104, MIL-L-46152, or MIL-L-46167 with MIL-L-23699 or MIL-L-7808.

Main Rotor Hub (P/N 204-012-101-31 only)

Average Temp Range		Specifications
+40 and Above °F(5°C)		MIL-L-2104, Grade 50, NATO Code 0-230
0° to +40°F(-18°C)		MIL-L-2104, Grade 30, NATO Code 0-230
	OR	MIL-L-46152, Grade 30
-20° to 0°F(-29°C)		MIL-L-2104, Grade 10, NATO Code 0430
	OR	MIL-L-46152, Grade 10W30
-65° to -20°F(-54°C)		MIL-L-46167, Dexron II Automatic Transmission Fluid

8. Refer to stencil on grip assembly to determine proper lubrication requirements.

Table 2-1. Servicing Table of Approved Fuels, Oils, Fluids, and Unit Capacities (Cont)

APPROVED DOMESTIC COMMERCIAL FUELS (SPEC. ASTM-D-1655-70)				
	MA	MANUFACTURERS DESIGNATION		
MANUFACTURERS NAME	JET B - JP4 TYPE	JET A - JP5 TYPE	JET A - 1 - JP8 TYPE	
American Oil Co.	American JP-4	American Type A		
Atlantic Richfield	Aerojet B	Aerojet A	Aerojet A-1	
Richfield Div		Richfield A	Richfield A-1	
H.P. Trading	B.P.A.T.G.		B.P.A.T.K.	
Caltex Petroleum Corp.	Caltex Jet B		Caltex Jet A-1	
Cities Service Co.		CITGO A		
Continental Oil Co.	Conoco JP-4	Conoco Jet-50	Conoco Jet-60	
Gulf Oil	Gulf Jet B	Gulf Jet A	Gulf Jet A-1	
EXXON Co. USA	EXXON Turbo Fuel B	EXXON A	EXXON A-1	
Mobil Oil	Mobil Jet B	Mobil Jet A	Mobil Jet A-1	
Phillips Petroleum	Philjet JP-4	Philjet A-50		
Shell Oil	Aeroshell JP-4	Aeroshell 640	Aeroshell 650	
Sinclair		Superjet A	Superjet A-1	
Standard Oil Co		Jet A Kerosine	Jet A-1 Kerosine	
Chevron	Chevron B	Chevron A-50	Chevron A-1	
Техасо	Texaco Avjet B	Avjet A	Avjet A-1	
Union Oil	Union JP-4	76 Turbine Fuel		
	APPROVED FOREIGN COM	MMERCIAL FUELS		
COUNTRY	F-40	F-44		
Belgium	BA-PF-2B			
Canada	3GP-22F	3-6P-24e		

Table 2-1. Servicing Table of Approved Fuels, Oils, Fluids and Unit Capacities (Cont)

APPROVED FOREIGN COMMERCIAL FUELS (CONT)

COUNTRY	F-40	F-44
Denmark	JP-4 MIL-T-5624	
France	Air 3407A	
Germany (West)	VTL-9130-006	UTL 9130-007/UTL 9130-010
Greece	JP-4 MIL-T-5624	
Italy	AA-M-C-1421	AMC-143
Netherlands	JP-4 MIL-T-5624	D. Eng Rd 2493
Norway	JP-4 MIL-T-5624	
Portugal	JP-4 MIL-T-5624	
Turkey	JP-4 MIL-T-5624	
United Kingdom (Britain)	D. Eng RD 2454	E. Eng RD 2498

NOTE:

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel - The fuel system icing inhibitor shall conform to MIL-L-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in helicopter fuel systems. Icing inhibitor conforming to MIL-I-27686 shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted commercial procedures. Commercial product "PRIST" conforms to MIL-I-27686.

APPROVED DOMESTIC COMMERCIAL OILS FOR MIL-L-7808

MANUFACTURERS NAME	MANUFACTURERS DESIGNATION	
American Oil and Supply Co.	PQ Turbine Oil 8365	
Humble Oil and Refining Co.	ESSO/ENCO Turbo Oil 2389	
Mobile Oil Corp.	RM-184A/RM-201A	



Do not use Shell Oil Co., par No. 307, qualification No. 7D-1 oil (MIL-L-7808). It can be harmful to seals made of silicone.

Table 2-1. Servicing Table of Approved Fuels, Oils, Fluids, and Unit Capacities (Cont)

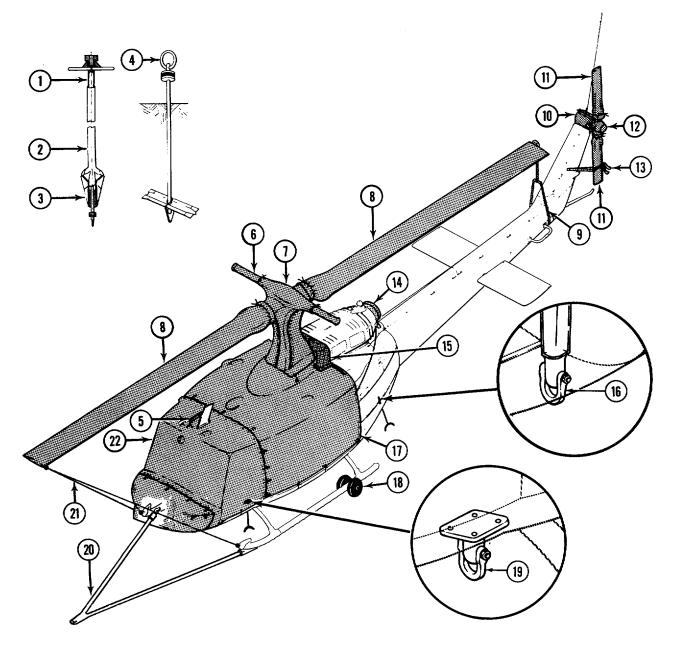
APPROVED DOMESTIC COMMERCIAL OILS FOR MIL-L-23699

MANUFACTURERS NAME	MANUFACTURERS DESIGNATION
American Oil and Supply Co.	PQ Turbine Lubricant 5247/6423/6700/7731/8878/9595
Bray Oil Co.	Brayco 899/899-G/899-S
Castrol Oil Co.	Castrol 205
Chevron International Oil Co., Inc.	Jet Engine Oil 5
Crew Chemical Corp.	STO-21919/STO-21919A/STD-6530
W.R. Grace and Co. (Hatco Chemical Div.)	HATCOL 3211/3611
Humble Oil and Refining Co.	Turbo Oil 2380 (WS-6000) /2395 (WS-6459) /2392/2393
Mobile Oil Corp.	RM-139A/RM-147A/Avrex S Turbo 260/Avrex S Turbo 265
Royal Lubricants Co.	Royco 899 (C-915) /899SC/Stauffer Jet II
Shell Oil Co., Inc.	Aeroshell Turbine Oil 500
Shell International Petroleum Co., Ltd.	Aeroshell Turbine Oil 550
Standard Oil Co., of California	Chevron Jet Engine Oil 5
Stauffer Chemical Co.	Stauffer 6924/Jet II
Texaco, Inc.	SATO 7377/7730, TL-8090

Table 2-1. Servicing Table of Approved Fuels, Oils, Fluids, and Unit Capacities (Cont)

APPROVED DOMESTIC COMMERCIAL OILS FOR MIL-H-5606

MANUFACTURERS NAME	MANUFACTURERS DESIGNATION			
American Oil and Supply Co.	"PO" 4226			
Bray Oil Co.	Brayco 757B Brayco 756C Brayco 7561D			
Castrol Oils, Inc.	Hyspin A			
Humble Oil and Refining Co.	Univis J41			
Mobile Oil Corp.	Aero HFB			
Pennsylvania Refining Co.	Petrofluid 5606B Petrofluid 4607			
Royal Lubricants Co. DS-437	Royco 756C/D			
Shell Oil Co.	XSL 7828			
Standard Oil Co., of California	PED 3565 PED 3337			
Texaco, Inc.	TL-5874			
Stauffer Chemical Co.	Aero Hydroil 500			
Union Carbide Chemical Co.	YT-283			
Union Carbide Corp.	FP-221	FP-221		



205470-1003

- 1. Anchor rod
- 2. Driving rod
- 3. Arrow
- 4. Eye
- 5. Pitot tube cover
- 6. Stabilizer bar cover
- 7. Pylon cover
- 8. Main rotor blade cover
- 9. Main rotor tiedown (aft)
- 10. 90° gearbox cover
- 11. Tail rotor blade cover
- 12. Tee head cover
- 13. Tail rotor tiedown
- 14. Exhaust cover
- 15. Intake cover

- 16. Aft mooring fitting (2)
- 17. Main cabin cover
- 18. Ground handling wheels
- 19. Forward mooring fitting (2)
- 20. Tow bar
- 21. Main rotor tiedown (forward)
- 22. Forward cabin cover

Figure 2-17. Ground Handling Equipment, Covers, Rotor Tiedowns, and Mooring Diagram

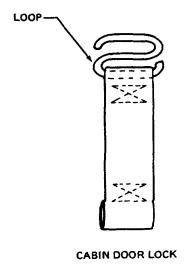
SECTION XV. HELICOPTER SECURITY SYSTEM

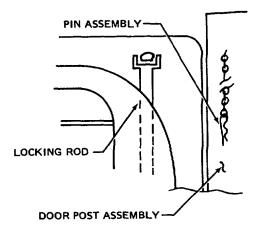
2-99. HELICOPTER SECURITY.

Door locking devices and an ignition keylock switch are installed to prevent unauthorized use of the helicopter (figure 2-18).

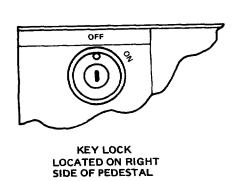
- a. Cabin Door Locking Devices. The cabin doors are locked by use of a cable assembly. One end of the cable assembly is looped over the cabin door latch handle, with the other end attached to the lower crossmember of the crew seat. The seat is then adjusted forward to tighten the cable.
- **b. Pilot Door Locking Device.** The pilot door is locked from the inside by inserting a pin through a hole in the door locking rod and door structure. The hole is located in the aft upper corner of the door. The pin is attached to a chain on the doorpost. A streamer marked REMOVE BEFORE FLIGHT is attached to the pin.

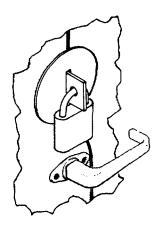
- **c. Window Locking Devices.** Pilot and copilot door windows have a clear plastic block bonded to the window. The block is located approximately one inch from the bottom and prevents the windows being opened.
- **d. Copilot Door Locking Device.** The copilot door is locked from the outside with a hasp and padlock. The hasp is riveted to the doorpost and inserted through a hole in the edge of the doorframe. A padlock is inserted in the hasp.
- **e. Ignition Keylock Switch.** An ignition keylock switch is installed on the right side of the pedestal. When the switch is in the OFF position, the ignition and start fuel circuits cannot be energized. In the ON position, it allows normal operation of ignition and start fuel circuits.





PILOT DOOR LOCK





COPILOT DOOR LOCK

205900-1056C

Figure 2-18. Helicopter Security System - Typical

CHAPTER 3

AVIONICS

SECTION I. GENERAL

3-1. GENERAL.

This chapter covers the avionics equipment configuration installed in Army EH-1H/X helicopters. It includes a brief description of the avionics equipment, its technical characteristics, capabilities, and location. The chapter also contains complete operating instructions for all avionics equipment installed. For mission avionics equipment, refer to Chapter 4, Mission Equipment.

3-2. AVIONICS EQUIPMENT CONFIGURATION.

The configuration consists of headset cordage, keying switches, and the equipment listed in figure 3-1.

a. Headset Cordage. The pilot and copilot cordage connectors are located at their respective sides near the aft portion of the overhead console. The crew cordage connectors are located near the overhead mounted control intercommunications set (figure 3-2) at each crew station.

- b. Keying Switches. A trigger type keying switch is located on each (pilot and copilot) cyclic control stick grip. The half depressed (first detent) position of the trigger switch is used for keying the interphone. The fully depressed (second detent) position of the trigger switch keys the radio selected with the transmitinterphone selector switch on the intercommunications set. A foot-operated type keying switch (pilot and copilot) is located at each side of the center console, between the center console and cyclic control stick, and on the cabin floor at each crew station. The depressed position of the foot-operated switch keys the radio or interphone selected with the rotary selector switch at the appropriate control intercommunications set.
- **c. Power Supply and Circuit Breakers.** Refer to figure 2-11 and 2-12.
- **d. Operation.** The operation of the avionics equipment in this helicopter is dependent on the operation of the interphone system (figure 3-2). Do not turn interphone system off until the end of flight day.

Nomenclature	Common Name	Use	Range
Control Intercommunications Set C-1611D/AIC	Signal Distribution Panel	Integrate interphone and all communications equipment.	Stations within helicopter.
X Radio Set AN/ARC-114A	FM Radio Set	Two-way voice communications.	Line-of-sight.
Ē ĒĒ Radio Set AN/ARC-131	FM Command Radio	Two-way voice communication.	Line-of-sight.
Ē ĒĒ Radio Set AN/ARC-51BX	UHF Radio Set	Two-way voice communications.	Line-of-sight.
X AN/ARC-164	UHF Command Set	Two-way communications	Line-of-sight (50 miles average)
E EE Radio Set AN/ARC-134	VHF Command Set	Two-way voice communications.	Line-of-sight (50 miles average).
X Radio Set AN/ARC- 115	VHF Radio Set	Two-way voice Line communications. (50 r	
EEE Gyromagnetic Compass Set AN/ASN-43	Gyromagnetic Compass	Navigational aid.	N/A
Navigation Set AN/ARN-103	TACAN	Navigational Line- Aid	
X Navigation Set AN/ASN-86	Inertial Navigation Set	Navigational Internal Aid Navigat Position	
EE Radio Receiving Set AN/ARN-82	VHF Navigation Set	VHF navigational aid and Line VHF audio reception	
Direction Finder Set AN/ARN-83	Direction Finder Set	Radio range 150 to 2 navigation. miles a	
X AN/ARN-123	VHF Navigation Glide Scope and Marker Beacon	Navigational Line-of and Landing Aid	
Transponder Set AN/APX-72	Transponder Set	Navigational aid.	Line-of-sight.
E EB TSEC/KY28	Voice Security Equipment	Secure two-way voice N/A communication.	
▼ TSEC/KY-58 Voice Security Equipment		Secure Two- way Voice Communication	N/A

Figure 3-1. Avionics Equipment Configuration - Typical

SECTION II. COMMUNICATIONS

3-3. CONTROL INTERCOMMUNICATIONS SET C-1611D/AIC.

- a. Description. The Control Intercommunications Set amplifies and controls the distribution of audio signals applied to or from each headset-microphone, to or from communication receivers and transmitters, from navigation receivers, intercommunication between crewmembers, and for monitoring the communication and navigation receivers singly or in combination. In addition the C-1611D/AIC set permits the operator to control four receiver-transmitters. A private interphone line is also provided. When the selector switch is in the PVT position it provides a hot line (no external switch is used) to any station in the helicopter which also has PVT selected. C-1611D/A/C units are installed for the pilot and copilot and in the cabin compartment for the mission operation. All four of the C-1611D/AIC units are wired to provide interphone operations for the crew. Full transmit and receive facilities for communication equipment are available for the pilot and copilot.
 - b. Controls and Functions. Refer to figure 3-2.
 - c. Operation.
- (1) Transmit interphone selector switch As desired.
 - (2) RECEIVERS switches As desired.
 - (3) Microphone switches As desired.
 - (4) VOL control Adjust.

3-4. E E UHF RADIO SET AN/ARC-51BX.

- a. Description. The radio set provides two-way communications in the UHF (225.0 to 399.0 MHz) band, located at the left side of the pedestal. The set tunes in 0.05 MHz increments and provides 3500 channels. The set also permits 20 preset channels and monitoring of the guard channel. Transmission and reception are conducted on the same frequency.
 - b. Controls and Functions. Refer to figure 3-3.

c. Operation.

- (1) UHF function select switch T/R (T/R + G as desired).
- (2) UHF mode selector switch PRESET CHAN.
 - (3) RECEIVERS switch No. 2 ON.
 - (4) Channel Select.

NOTE

An 800-cps audio tone should be heard during channel changing cycle.

- (5) SQ DISABLE switch OFF.
- (6) VOL Adjust.
- **(7)** Transmit-interphone selector switch No. 2 position.
 - d. Emergency Operation.
 - (1) UHF mode switch GD XMIT.
 - (2) UHF function switch T/R+G.

3-5. X UHF COMMAND SET AN/ARC-164.

a. Description. The UHF command set provides amplitude modulated two-wav (MA) voice communication within the frequency range of 225.000 to 399.975 MHz for a distance range of approximately 50 miles line-of-sight. Channel selection is spaced at 0.025 MHz intervals. Additionally, a separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). The audio output of the UHF set is applied to the audio control panel where it is made available to the headsets. The UHF command set is protected by the 15 ampere UHF circuit breaker on the overhead circuit breaker panel. Figure 3-4 illustrates the UHF command set control panel. The associated blade type antenna is shown in Figure 4-1.

- **b.** Controls and Functions. Refer to Figure 3-4.
- c. Operating Procedures.
 - (1) Receiver operating procedure.
 - (a) Function selector switch As required.
- **(b)** Frequency Select required frequency using either preset channel control or manual frequency selector controls.

NOTE

The PRESET channel selector and manual frequency selectors are inoperative when the MANUAL-PRESET-GUARD switch is set to GUARD.

- (c) Volume Adjust.
- (d) Squelch As required.

(2) Transmitter operating procedure:

- (a) Transmitter-Interphone selector (ICS, figure 3-2) No. 2 position.
 - (b) Microphone switches Press.
- (3) Shutdown procedure: Function selector switch (UHF control panel) OFF.
- d. UHF Command Set and Voice Security System Operation.

NOTE

Disregard the operating procedures involving the voice security (KY-58) control-indicator if this unit is not installed.

NOTE

The voice security relays will automatically interrupt the UHF receiver audio at a given position whenever the FM or VHF transmitter is keyed from that position.

(1) Turn-on procedure:

- (a) POWER ON switch (KY-58 control-indicator, figure 3-10) ON.
 - (b) Mode switch OP
- (c) Function switch (UHF control panel) BOTH

(2) Receiver Operating Procedure:

- (a) Mode selector As required.
- **(b)** Frequency Select required frequency using either preset channel control or manual frequency selector.

NOTE

The PRESET CHAN selector and manual frequency selectors are inoperative when the mode selector is set to GUARD position.

(c) Volume - Adjust.

NOTE

To adjust volume when audio is not being received, turn SQUELCH switch OFF, adjust volume for comfortable noise level, then turn squelch disable switch ON.

- (d) Squelch As required.
- (3) Transmitter Operating Procedure (PLAIN):
- (a) Transmitter-interphone selector (ICS, figure 3-2) No. 2 position.
- **(b)** PLAIN/C/RAD switch (KY-58 control-indicator) PLAIN.
 - (c) Microphone switch Press.
- (4) Transmitter Operating Procedure (C/RAD):
- (a) Transmitter-interphone selector (ICS) No. 2 position.

- **(b)** PLAIN/C/RAD switch (KY-58 control-indicator) C/RAD.
- **c.** Microphone switch Press momentarily (interrupted tone from voice security unit should no longer be heard).

NOTE

No traffic will be passed if the interrupted tone is still heard after pressing and releasing the microphone switch.

(d) Microphone switch - press (do not talk). Wait until beep is heard, then speak into microphone.

(5) Shutdown Procedure:

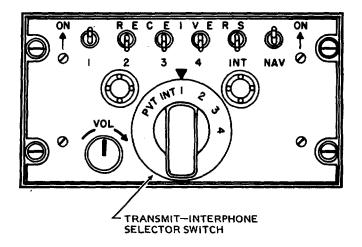
- (a) Function switch OFF.
- **(b)** POWER ON switch (KY-58 control-indicator) OFF.
 - e. UHF Command Set Emergency operation.

NOTE

Transmission on emergency frequency (243.0) MHz guard channel) shall be restricted to emergencies only. An emergency frequency of 121.500 MHz is also available on the VHF command radio set.

- (1) Transmitter-interphone selector (ICS, figure 3-2) No. 2 position.
- (2) Mode selector switch (UHF control panel) GUARD.
 - (3) Microphone switch Press.

- a. Description. The VHF Radio Set provides amplitude-modulated, narrow band voice communications within the frequency range of 116.000 to 149.975 MHz on 1360 channels for a distance of approximately 50 miles line of sight. A guard receiver is incorporated and fixed tuned to 121.50 MHz. The panel is labeled VHF AM COMM and mounted on the left side of the pedestal.
 - b. Controls and Functions. Refer to figure 3-5.
 - c. Operation.
 - (1) Function selector As desired.
 - (2) Frequency Select
 - (3) RCVR TEST Press to test.
 - (4) AUDIO Adjust.

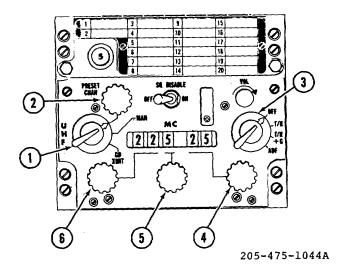


CONTROL	FUNCTION
RECEIVERS switches 1 (FM), 2 (UHF), 3 (VHF), and 4 (Turns audio from associated receiver ON or OFF.
■ M not used). INT switch	ON position enables operator to hear audio from the interphone.
NAV switch	ON position enables operator to monitor audio from the navigation receiver.
VOL control	Adjusts audio on receivers except NAV receivers.
Transmit- interphone selector switch	Positions 1 (FM), 2 (UHF), 3 (VHF), 4 (not used) and INT permits INT or selected receiver-transmitter to transmit and receive. The cyclic stick switch or foot switch must be used to transmit. PVT position keys interphone for transmission.

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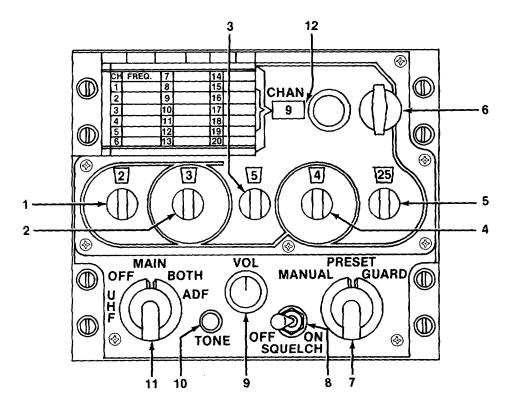
Figure 3-2. Signal Distribution Panel C-1611D/AIC

- 1. Mode selector
- 2. Preset channel control
- 3. Function select switch
- 4. 0.05 megahertz control
- 5. 1 megahertz control
- 6. 10 megahertz control



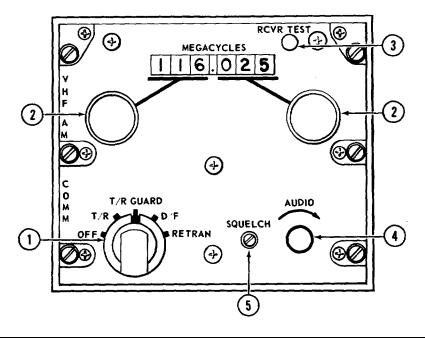
CONTROL/INDICATOR	FUNCTION
Function select switch	Applies power to radio set and selects type of operation as follows:
	OFF position - Removes operating power from the set.
	T/R position - Transmitter and main receiver ON.
	T/R + G position - Transmitter, main receiver and guard receiver ON.
	ADF position - Energizes, UHF-DF system when installed.
VOL control	Controls the receiver audio volume.
SQ DISABLE switch	In the ON position squelch is disabled. In the OFF position, the squelch is operative.
Mode selector	Determines the manner in which the frequencies are selected as follows:
	PRESET CHAN position - Permits selection of one of 20 preset channels by means of preset channel control.
	MAN position - Permits frequency selection by mean of megacycle controls.
	GD XMIT position - Receiver-transmitter automatically tunes to guard channel frequency (243.00 MHz).
PRESET CHANnel	Permits selection of any one of 20 preset channels.
Preset channel indicator	Indicate the preset channel selected by the preset channel control.
Ten megahertz control	Selects the first two digits (or ten-megahertz number).
One megahertz control	Selects the third digit (or one-megahertz number).
Five-hundredths megahertz control	Selects the fourth and fifth digits (or 0.05 megahertz number).

Figure 3-3. E EB UHF Control Panel C-6287/ARC-51BX



C	CONTROL/INDICATOR	FUNCTION	CONTROL/INDICATOR	FUNCTION
1.	Manual Frequency Selector Switch (hundreds)	Selects hundreds digit of frequency (either 2 or 3) in MHz.	PRESET	Frequency is selected using the preset channel selector switch for selecting any one of 20 preset channels.
2.	Manual Frequency Selector Switch (tens)	Selects tens digit of frequency (0 through 9) in MHz.	GUARD	The main receiver and transmitter are automatically tuned to the guard frequency and the guard receiver is disabled.
3.	Manual Frequency Selector Switch (units)	Selects units digit of frequency (0 through 9) in MHz.	8. SQUELCH ON-OFF switch	Turns on or off squelch circuit of main receiver.
1	Manual Frequency	Selects tenths digit of frequency (0	9. VOL Control	Adjusts volume.
4.	Selector Switch (tenths)	through 9) in MHz.	10. TONE SWITCH	Selects transmission of a 1,020 Hz tone on the selected frequency.
5.	Manual Frequency Selector Switch	Selects hundredths and thousandths digits of frequency (00, 25, 50, or	11. Function switch	Selects operating function:
	(hundredths and thousandths)	75) in MHz.	OFF	Shuts down equipment.
6.	Preset Channel Selector Switch	Selects one of 20 preset channels.	MAIN	Selects main receiver and transmitter.
7.	MANUAL-PRESET GUARD SWITCH	Selects method of frequency selection.	вотн	Selects main receiver, transmitter, and guard receiver.
	COARD OWNOR		ADF	Selects ADF or homing system (if installed) and main receiver
	MANUAL	Any one of 7,000 frequencies is manually selected using the five frequency selector switches.	12. CHAN Indicator	Indicates the operating channel, in preset mode only.

Figure 3-4. X UHF Command Set AN/ARC-164



CONTROL/INDICATOR	FUNCTION
Function Selector	
OFF	Power off.
T/R	Receiver - On; Transmitter - Standby.
T/R GUARD	Receiver - On; Transmitter - Standby; Guard Receiver - On.
	NOTE
	Reception on guard frequency is unaffected by frequencies selected for normal communications.
D/F	Not used.
RETRAN	Not used.
2. Frequency Selectors	
Left	Selects first three digits of desired frequency.
Right	Selects fourth, fifth and sixth digits of desired frequency.
3. RCVR TEST switch	When pressed, audible signal indicates proper receiver performance.
4. AUDIO control	Adjusts receiver volume.
5. SQUELCH control	Squelch control adjusted by maintenance personnel only.

205075-1001A

Figure 3-5. Control Panel, AN/ARC-115

- **(5)** Transmit-interphone selector switch No. 3 position.
 - (6) RADIO transmit switch Press.
- **d. Emergency Operation.** Select guard frequency 121.50 MHz.

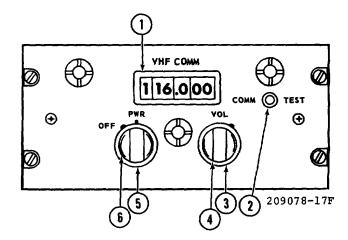
3-7. E E VHF RADIO SET - AN/ARC-134.

- **a. Description.** The set transmits and receives the same frequency. The panel (VHF COMM) is located on the left side of the pedestal. The set provides voice communications in the VHF range of 116.000 through 149.975 MHz on 1360 channels spaced 25 kHz apart.
 - **b.** Controls and functions. (Refer to figure 3-6.)
 - c. Operation.
- (1) OFF/PWR switch PWR. Allow set to warm up.
 - (2) Frequency Select
 - 1. Frequency indicator
 - 2. Communication test switch
 - 3. Volume control
 - 4. Kilohertz selector
 - 5. Off/power switch
 - 6. Megahertz selector

- (3) RECEIVERS switch No. 3 -ON.
- **(4)** Volume Adjust. If signal is not audible with VOL control fully clockwise, press COMM TEST switch to unsquelch circuits.
- **(5)** Transmit-interphone selector switch No. 3 position.
 - (6) OFF/PWR switch OFF.
- **d. Emergency Operation.** Select guard frequency 121.500 MHz.

3-8. X FM RADIO SET - AN/ARC-114A.

a. **Description.** The FM Radio Set provides two-way frequency modulated (FM) narrow band voice communications and homing capability within the frequency range of 30.00 to 75.95 MHz on 920 channels for a distance range limited to line of sight. A guard receiver is incorporated in the set and is fixed tuned to 40.50 MHz. The radio set is



CONTROL/INDICATOR	FUNCTION
OFF-PWR switch	Turns power to the set ON-OFF.
VOL control	Controls the receiver audio volume.
COMM-TEST switch	Turns squelch on or off.
Megahertz control	Selects whole number part of operating frequency.
Kilohertz control	Selects the decimal number part of the operating frequency

Figure 3-6. E EB VHF Control Panel C-7197/ARC-134

marked VHF FM COMM and is mounted on the center console.

- b. Controls and Functions. Refer to figure 3-7.
- c. Operation.
 - (1) Function selector As desired.
 - (2) Frequency Select
 - (3) RCVR TEST Press to test.
 - (4) AUDIO Adjust.
- **(5)** Transmit-interphone selector No. 1 position.
- **d. Emergency Operation.** Select guard frequency 40.50 MHz.

3-9. **E E FM** RADIO SET - AN/ARC-131.

a. Description. The FM Radio Set consists of a receiver-transmitter, remote control panel communication antenna and a homing antenna. radio set provides 920 channels spaced 50 kHz apart within the frequency range of 30.00 to 75.95 MHz. Circuits are included to provide transmission sidetone monitoring. One control panel is located on the pedestal and one is located on console position #2. Homing data is displayed by the course indicator (figure 3-13) on the instrument panel. A channel changing tone should be heard in the headset while radio set is tuning. When the tone stops, the radio set is tuned. Operation in DIS position is possible; however flags on course indicator will be inoperative. When the first FM radio set is in the homing mode, the homing indicator may deflect left or right of on course indication while the second FM radio set is keyed.

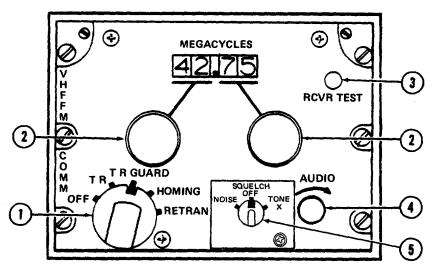
- b. Controls and Functions. Refer to figure 3-8.
- **c. Operation.** Depending on the settings of the control panel controls, the radio set can be used for the following types of operation: Two way voice communication and homing (figure 3-8).

(1) Two-Way Voice Communication.

- (a) Mode control switch T/R (allow two minute warm up).
 - (b) Frequency Select.
 - (c) RECEIVERS No. 1 switch ON.
 - (d) VOL control Adjust.
- **(e)** SQUELCH control Set for desired squelch mode.
 - (f) TRANS selector switch No. 1.

(2) Homing Operation.

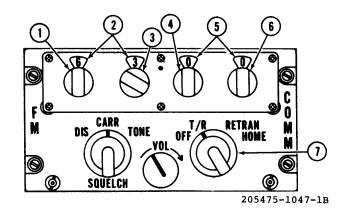
- (a) Mode control switch HOME.
- **(b)** Frequency Adjust to frequency of selected homing station.
- **(c)** SQUELCH control may be set to CARR or TONE, however, the carrier squelch is automatically selected by an internal contact arrangement on HOME position.
- (d) Fly helicopter toward the homing station by heading in direction that causes homing indicator right-left vertical pointer to position itself in the center of indicator scale. To ensure that helicopter is not heading away from homing station, change the heading slightly and note that the homing indicator vertical pointer deflects in direction opposite that of the turn.



CO	NTROL/INDICATOR	FUNCTION
1.	Function Selector	
	OFF	Power off.
	T/R	Receiver - On; Transmitter - Standby.
	T/R GUARD	Receiver - On; Transmitter - Standby; Guard Receiver - On.
		NOTE
		Reception on guard frequency is unaffected by frequencies selected for normal communications.
	HOMING RETRAN	Not used. Not used.
2.	Frequency Selectors	
	Left Selector	Selects first two digits of desired frequency.
	Right Selector	Selects third and fourth digits of desired frequency.
3.	RCVR TEST	When pressed, audible signal indicates proper receiver performance.
4.	AUDIO	Adjusts receiver volume.
5.	SQUELCH	
	OFF	Disables squelch.
	NOISE	Enables noise squelch.
	TONE X	Enables tone squelch.

Figure 3-7. X Control Panel AN/ARC-114A

- 1. Tens megahertz digit frequency selector
- 2. Frequency indicators
- 3. Units megahertz digit frequency selector
- 4. Tenths megahertz digit frequency selector
- Frequency indicators
- 6. Hundredths megahertz digit frequency selector
- 7. Mode control switch



CONTROL/INDICATOR	FUNCTION
Mode control switch	
(four-position switch) OFF	Turns off primary power.
	Tamo on primary power.
T/R	Radio set operates in normal communication mode (reception).
(transmit/receive)	(Aircraft transmit switch must be depressed to transmit.)
RETRAN	Not Used.
НОМЕ	Radio set operates as a homing facility.
VOL control	Adjusts the audio output level of the radio set.
SQUELCH switch (three-position rotary switch)	
DIS (disable)	Squelch circuits are disabled.
CARR (carrier)	Squelch circuits operate normally in presence of any carrier.
TONE	Squelch opens (unsquelches) only on selected signals (signals containing a 150-cps tone modulation).
Frequency indicator	
Tens megahertz frequency selector	Selects the tens megahertz digit of the operating frequency.
Units megahertz frequency selector	Selects the units megahertz digit of the operating frequency.
Tenths megahertz frequency selector	Select the tenths megahertz digit of the operating frequency.
Hundredths megahertz frequency selector	Selects the hundredths megahertz digit of the operating frequency.
Frequency indicator	Displays the operating frequency of the radio set.

Figure 3-8. E EE FM Radio Set Control Panel AN/ARC-131

(3) Stopping Procedure. Mode control switch - OFF.

3-10. E E VOICE SECURITY EQUIPMENT, TSEC/KY28.

a. Description. The voice security equipment is used with the FM Command Radio to provide secure two-way communication (figure 3-8). The equipment is controlled by the control-indicator mounted in the pilot right console. The POWER switch must be in the ON position, regardless of the mode of operation, whenever the equipment is installed.

b. Controls and Functions. Refer to figure 3-9.

c. Operation. Normal operation will exist without its encoder/decoder and control indication being installed in the helicopter. However, two operating modes are available when they are installed. PLAIN mode for unciphered radio transmission or reception and CIPHER mode for ciphered radio transmission or reception. Both modes may be operated with or without retransmission units.

(1) Preliminary.

- (a) Set the control indicator POWER switch to ON.
 - **(b)** Apply power to FM radio set.
- **(c)** When power is initially applied, an automatic alarm procedure is initiated.
- $\underline{\mathbf{1}}$ A constant tone is heard in the headset and after approximately two seconds the constant tone will change to an interrupted tone.

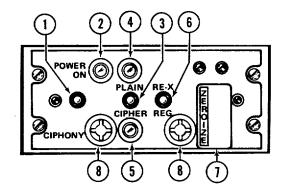
- **2** To clear the interrupted tone, press and release the press to talk switch, the interrupted tone will no longer be heard, and the circuit will be in a standby condition ready for either transmission or reception. No traffic will be passed if the interrupted tone is still heard after pressing and releasing the press to talk switch.
- **(d)** Set control unit function switch for desired type of operation (2 and 3 below).

(2) Plain Mode.

- (a) Set the control indicator POWER switch to ON.
- **(b)** Set the PLAIN-CIPHER switch to PLAIN (indicated by red light).
- **(c)** Set the RE-X-REG switch to REG except when operating with retransmission units, at which time switch will be placed in the RE-X position.
- **(d)** Press the press to talk switch and speak into the microphone to transmit. Release the press to talk switch for reception.

(3) Cipher Mode.

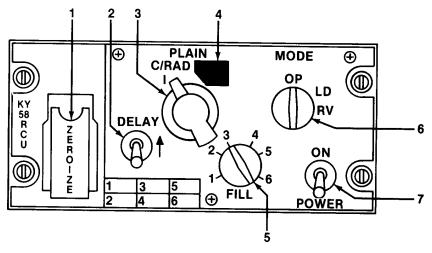
- (a) Set the PLAIN-CIPHER switch to CIPHER (indicated by a green light).
- **(b)** Place the RE-X-REG switch to REG, except when operating with retransmission units, at which time the switch will be placed in RE-X position.
- **(c)** To transmit, press the press to talk switch. Do not talk; in approximately one-half second, a beep will be heard. This indicates the receiving station is now capable of receiving your message. Transmission can now commence. Only one voice security system can transmit on a given frequency. Always listen before attempting to transmit to assure that no one else is transmitting.



206075-44C

		206075-44C
	CONTROL/INDICATOR	FUNCTION
1.	POWER ON Switch (Two-Position Circuit Breaker)	Connects power to the associated TSEC/KY-28 cipher equipment in the ON (forward) position, and disconnects power from the equipment in the OFF (aft) position.
		NOTE
		Switch must be in the ON (forward) position for operation in the PLAIN or CIPHER mode.
2.	POWER ON (Amber) Indicator (with Dimmer Switch)	Lights when the associated POWER ON switch is placed in the ON (forward) position.
3.	PLAIN CIPHER Switch (Two-Position Locking Toggle)	In the PLAIN position, permits normal (unciphered) communications on the associated FM radio set. In the CIPHER position, permits ciphered communications on the associated radio set.
4.	PLAIN (Red) Indicator (with Dimmer Switch)	Lights when the associated PLAIN-CIPHER switch is in the PLAIN position.
5.	CIPHER (Green) Indicator (with Dimmer Switch)	Lights when the associated PLAIN-CIPHER switch is in the CIPHER position.
6.	RE-X-REG Switch (Two-Position Locking Toggle)	In the RE-X position, permits ciphered communications through a retransmission unit (at a distant location). In the REG position, permits normal ciphered communications or clear text.
7.	ZEROIZE Switch (Two-Position Locking Toggle, Under Spring-Loaded Cover)	CAUTION Do not place the ZEROIZE switch in the ON (forward) position unless a crash or capture is imminent. Normally in OFF (aft) position. Placed in ON (forward) position during emergency situations to neutralize and make inoperative the associated TSEC/KY-28 cipher equipment.
8.	Panel Lights	Illuminate the control-indicator (controlled by aircraft panel lights).

Figure 3-9. E EE Voice Security Equipment TSEC/KY28



СС	NTROL/INDICATOR	FUNCTION	
1.	ZEROIZE switch (two-position momentary toggle, under spring loaded cover	Zeroizes the KY-58; clears any encoding in the system.	
2.	DELAY switch 2 position toggle	Used when signal is to be retransmitted.	
3.	PLAIN-C/RAD Switch rotary 2 posi- tion selector switch	In the PLAIN position, permits normal (unciphered) communications on the associated FM radio set. In the C/RAD position, permits ciphered communications on the associated radio set.	
4.	C/RAD2 Switch stop	Location of stop for C/RAD2 on front Panel.	
5.	FILL switch 6 position ro- tary switch	Permits pilot to select one of 6 storage registers for filling.	
6.	MODE Switch three position rotary	In the OP position KY-58 normal operating. In the LD position for filling. In the RV position KY-58 in Receive-Variable. Filed from another external source.	
7.	POWER ON switch two position toggle	Connects power to the associated TSEC/KY-58 cipher equipment in the ON (forward) position, and disconnects power from the equipment in the OFF (aft) position. Turns on power to TSEC/KY-58.	

Figure 3-10. ■ Voice Security Equipment T/SEC KY-58

- **(d)** When transmission is completed, release the press to talk switch. This will return equipment to the standby condition.
- **(e)** To receive, it is necessary for another station to send you a signal first. Upon receipt of a signal the cipher equipment will be switched automatically to the receive condition, which will be indicated by a short beep heard in the headset Reception will then be possible. Upon loss of the signal, the cipher equipment will be automatically returned to the standby condition.

3-11. ■ VOICE SECURITY EQUIPMENT TSEC/KY-58.

- a. Description. The voice security equipment is used with the FM Command Radio to provide secure two way communication (Figures ☒ 3-7 and ☒ 3-8). The equipment is controlled by the control-Indicator (Z-AHP) mounted in the right pedestal panel. The POWER switch must be in the ON position, regardless of the mode of operation, whenever the equipment is installed.
 - b. Controls and Functions. Refer to Figure 3-10.
 - c. Operating Procedures.
 - (1) Operating procedures for secure voice.

NOTE

To talk in secure voice, the KY-58 must be "Loading" with any number of desired variables.

- (a) Set to MODE switch to OP.
- **(b)** Set the FILL switch to the storage register which contains the crypto-net variable (CNV) you desire.
 - (c) Set the POWER switch to ON.
 - (d) Set the PLAIN C/RAD switch to C/RAD.
- **(e)** If the signal is to be retransmitted, set the DELAY switch to (ON).
- **(f)** At this time a crypto alarm, and background noise, in the aircraft audio intercom system should be heard. To clear this alarm, press and release PT in the aircraft audio/intercom system. Secure voice communication is now possible.

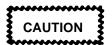
NOTE

When operating in either secure or clear (plain) voice operations, the VOLUME must be adjusted on the aircraft radio and intercom equipment to a comfortable operating level.

(2) Clear Voice Procedures:

To operate in clear voice (plain text) simply:

- (a) Set the Z-AHP(RCU) PLAIN-C/RAD switch to PLAIN.
 - **(b)** Operate the equipment.
 - (3) Zeroizing Procedures.



Instructions should originate from the Net Controller or Commander as to when to zeroize the equipment.

To zeroize the KY-58: (Power must be on).

- (a) Lift the red ZEROIZE switch cover on the RCU.
- **(b)** Lift the spring-loaded ZEROIZE switch. This will zeroize positions 1-6.
 - (c) Close the red cover.

The equipment is now zeroized and secure voice communications are no longer possible.

(4) Automatic Remote Keying Procedures.

NOTE

Automatic Remote Keying (AK) causes an "old" crypto-net variable (CNV) to be replaced by a "new" CNV. Net Controller simply transmits the "new" CNV to your KY-58.

- (a) The Net Controller will use a secure voice channel, with directions to stand by for an AK transmission. Calls should not be made during this stand by action.
- **(b)** Several beeps should now be heard in your headset. This means that the "old" CNV is being replaced by a "new" CNV.
- **(c)** Using this "new" CNV, the Net Controller will ask you for a "radio check."
- **(d)** After the "radio check" is completed, the Net Controller instructions will be to resume normal communications. No action should be taken until the net controller requests a "radio check."
- (5) MANUAL REMOTE KEYING PROCEDURES. The Net Controller will make contact on a secure voice channel with instructions to stand by for a new crypto-net variable (CNV) by a Manual Remote Keying (MK) action. Upon instructions from the Net Controller:
- (a) Set the Z-AHP FILL switch to position 6. Notify the Net Controller by radio, and stand by.
- **(b)** When notified by the Net Controller, set the Z-AHP MODE switch to RV (receive variable). Notify the Net Controller, and stand by.
- **(c)** When notified by the Net Controller, set the Z-AHP FILL switch to any storage position selected to receive the new CNV (may be unused or may contain the variable being replaced). Notify the Net Controller, and stand by.

NOTE

When performing Step 3, the storage position (1 through 6) selected to receive the new CNV may be unused, or it may contain the variable which is being replaced.

- **(d)** Upon instructions from the Net Controller
 - 1. Listen for a beep on your headset.
 - 2. Wait two seconds.
 - 3. Set the RCU MODE switch to OP.

4. Confirm.

- **(e)** If the MK operation was successful, the Net Controller will now contact you via the new CNV.
- **(f)** If the MK operation was not successful, the Net Controller will contact you via clear voice (plain) transmission; with instructions to set your Z-AHP FILL selector switch to position 6, and stand by while the MK operation is repeated.
- **(6)** It is important to be familiar with certain KY-58 audio tones. Some tones indicate normal operation, while others indicate equipment malfunction. These tones are:
- (a) Continuous beeping, with background noise, is cryptoalarm. This occurs when power is first applied to the KY-58, or when the KY-58 is zeroized. This beeping is part of normal KY-58 operation. To clear this tone, press and release the PTT button on the Z-AHQ (after the Z-AHQ LOCAL switch has been pressed). Also the PTT can be pressed in the cockpit.
- **(b)** Background noise indicates that the KY-58 is working properly. This noise should occur at TURN ON of the KY-58, and also when the KY-58 is generating a cryptovariable. If the background noise is not heard at TURN ON, the equipment must be checked out by maintenance personnel.
- **(c)** Continuous tone, could indicate a "parity alarm." This will occur whenever an empty storage register is-selected while holding the PTT button in. This tone can mean any of three conditions:
 - 1. Selection of an empty storage register.
 - 2. A "bad" cryptovariable is present.
- 3. Equipment failure has occurred. To clear this tone, follow the "Loading Procedures" IN TM 11-5810-262-OP. If this tone continues, have the equipment checked out by maintenance personnel.
- **(d)** Continuous tone could also indicate a crypotoalarm. If this tone occurs at any time other than in (c) above, equipment failure may have occurred. To

clear this tone, repeat the "Loading Procedures" in TM 11-5810-262-OP. If this tone continues, have the equipment checked out by maintenance personnel.

- **(e)** Single beep, when RCU is not in TD (Time Delay), can indicate any of three normal conditions:
- <u>1</u> Each time the PTT button is pressed when the KY-58 is in C (cipher) and a filled storage register is selected, this tone will be heard. Normal use (speaking) of the KY-58 is possible.
- <u>2</u> When the KY-58 bas successfully received a cryptovariable, this tone indicates that a "good" cryptovariable is present in the selected register.

- <u>3</u> When you begin to receive a ciphered message, this tone indicates that the cryptovariable has passed the "parity" check, and that it is a good variable.
- **(f)** A single beep, when the RCU is in TD (Time Delay) occuring after the "preamble" is sent, indicates that you may begin speaking.
- (g) A single beep, followed by a burst of noise after which exists a seemingly "dead" condition indicates that your receiver is on a different variable than the distant transmitter. If this tone occurs when in cipher text mode: Turn RCU FILL switch to the CNV and contact the transmitter in PLAIN text and agree to meet on a particular variable.

SECTION III. NAVIGATION

3-12. ADF SET AN/ARN-83.

- a. Description. The Automatic Direction Finder set provides radio aid to navigation within the 190 to 1750 KHz frequency range. In automatic operation, the set presents continuous bearing information to any selected radio station and simultaneously provides aural reception of the stations transmission. In manual operation, the operator determines the bearing to any selected radio station by controlling the aural null of the directional antenna. The set may also be operated as a receiver.
 - **b.** Controls and Function. (Refer to figure 3-11).
 - c. Operation.
 - (1) Automatic Operation.
 - (a) RECEIVERS NAV switch ON.
 - (b) Mode selector switch ADF.
 - (c) Frequency Select.
 - (d) Volume Adjust.
 - (2) Manual Operation.
 - (a) Mode selector switch LOOP.
 - (b) BFO switch BFO.
- (c) LOOP L/R switch Press right or left and rotate loop for null.

3-13. E B VHF NAVIGATION SET AN/ARN-82.

a. Description. The Navigation Receiver set provides reception on 200 channels, with 50 KHz spacing. This permits reception of the VHF omnidirectional range (VOR) and localizer signals. The localizers are received on odd-tenth MHz, between 108.0 and 122.0 MHz and energized as selected. Both VOR and localizer are received aurally through the interphone system. The VOR is presented visually by the course indicator and the number 2 pointer on the bearing indicator and the localizer is presented visually by the vertical needle on the course deviation indicator (CD1) (figure 3-13).

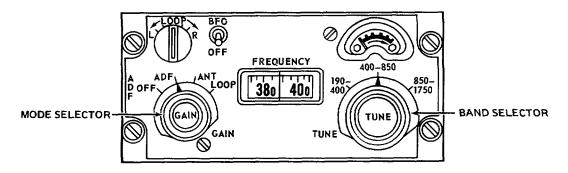
- **b.** Controls and Functions. Refer to figure 3-12.
- c. Operation.
 - (1) Function switch PWR.
 - (2) Frequency Select.
 - (3) NAV switch on C-1611D/AIC panel ON.
 - (4) VOL Adjust.

3-14. E TOURSE DEVIATION INDICATOR ID-1347/ARN.

- **a. Description.** The Course Deviation Indicator, used with the VHF Navigation Receiver system, is installed in the instrument panel. (figure 3-12). The purpose of the indicator is to depict bearing and deviation of the helicopter from the selected station. Also, information is presented from the FM Receiver when the mode selector switch is in HOME position. (figure 3-8).
 - **b.** Controls and Functions. Refer to figure 3-13.
- **c. Operation.** Refer to the applicable VHF Navigation Receiver and/or FM Radio set operating procedures.

3-15. X NAVIGATION SET AN/ARN-123.

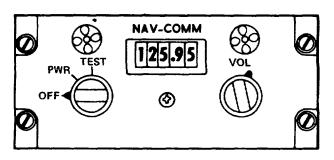
- **a. Description.** The navigation receiver contains a VOR/LOC, glideslope and marker beacon receiver.
- (1) VHF Omnirange (VOR) Localizer (LOC) Receiver. The VOR/LOC receiver section receives and processes VOR and LOC signals over the frequency range 108.0 to 117.95 MHz, 200 channels (160 VOR channels and 40 LOC channels), with a channel spacing of 50 KHz. Both VOR and LOC are received aurally through the interphone system. The VOR is presented visually by the course indicator and the pointer on the RMI. The localizer is presented visually by the vertical needle on the CDI.



CONTROL/ INDICATOR	FUNCTION
Band selector switch	Selects the desired frequency band.
TUNE control	Selects the desired frequency.
Tuning meter	Facilitates accurate tuning of the receiver.
GAIN control	Controls receiver audio volume.
Mode selector switch	Turns set OFF and select ADF, ANT and LOOP modes of operation.
LOOP L-R switch	Controls rotation of loop left or right.
BFO switch	Turns BFO, on or off.

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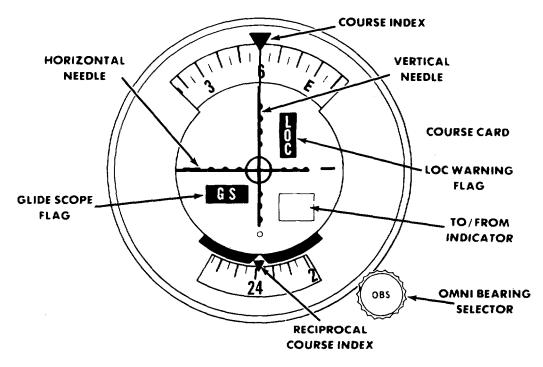
Figure 3-11. Direction Finder Control Panel ARN-83



CONTROL/INDICATOR	FUNCTION	
VOL control	Controls receiver audio volume	
Power switch	Turns primary power to the radio set. Allows for test of accuracy of Course Deviation Indicators.	
Whole megahertz channel selector knob	This is the control knob on the left side. It is used to select the whole megahertz number of the desired frequency.	
Fractional megahertz channel selector knob	This is the control knob on the right side. It is used to select the fractional megahertz, number of the desired frequency.	

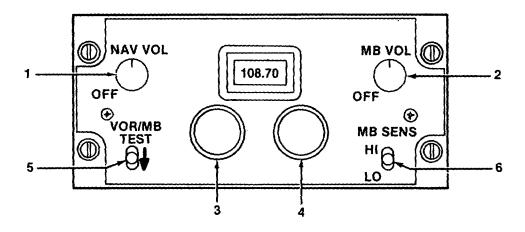
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Figure 3-12. E B Navigation Control Panel ARN-82



CONTROL/INDICATOR	FUNCTION
Omni Bearing Selector (OBS)	Drives course card for course selection.
Course Index	indicates selected radial.
Reciprocal Course Index	Indicates radial 180° from selected radial.
Course Card	Manually rotated cord, driven by OBS control so that desired radial is directly beneath course index.
To/From Indicator	Indicates whether flying selected radial would direct plane toward (TO) or away from (FR) VOR station.
Vertical Needle	Indicates direction of deviation from selected VOR radial or localizer path. Needle also indicates, during FM homing, direction to station.
LOC Warning Flag	Red LOC warning flag appears when VOR or localizer signal is unreliably weak or when there is a malfunction in receiver. Flag also disappears when FM homing is functioning properly.
Horizontal Needle	Indicates direction of deviation and approximate degree of deviation from glidepath. Indicates strength of FM homing signal being received. The needle will deflect downward as signal strength decreases.
Glide Scope Flag (GS)	Red GS flag appears when glide slope signal is unreliably weak or when there is a malfunction is glide slope receiver. Flag also disappears when FM homing is functioning properly.

Figure 3-13. Course Deviation Indicator ID-1347() /ARN



	CONTROL/INDICATOR	FUNCTION
1.	NAV VOL-OFF Control	Turns VOR/ILS receiver on and off, adjusts volume.
2.	MB VOL-OFF Control	Turns marker beacon receiver on and off; adjusts volume.
3.	Megahertz tune Control	Tunes VOR/ILS receiver in MHz as indicated on frequency indicator.
4.	Hundredths Megahertz Tune Control	Tunes VOR/ILS receiver in hundredths MHz as indicated on frequency indicator.
5.	VOR/MB Test Control	Activates VOR test circuit and MB receiver lamp self-test circuits.
6.	MB SENS HI-LO Control	For controlling MB sensitivity.
	LO	Decreases receiver sensitivity by shortening time transmitted signal will be received.
	HI	Increases receiver sensitivity by lengthening time transmitted signal will be received.

Figure 3-14. X Radio Receiving Set AN/ARN-123(V)

- (2) Glideslope (G) Receiver. The GS receiver section receives and processes glideslope signals over the frequency range of 329.15 to 335.0 MHz, 40 channels, with a channel spacing of 150 KHz. The GS is presented visually by the course indicator.
- (3) Marker Beacon (MB) Receiver. The MB receiver section receives and processes 75 MHz marker beacon signals and provides the pilot with aural and visual information.
 - **b.** Controls and Functions. Refer to figure 3-14.
 - c. Operating Procedures.
 - (1) NAV VOL switch Clockwise as desired.
 - (2) Frequency Select, as desired.
 - (3) MB VOL Clockwise, as desired.
 - (4) MB SENS As desired.

3-16. E EE GYROMAGNETIC COMPASS SET, AN/ASN-43.

a. Description.

- (1) The gyromagnetic compass set is a direction sensing system which provides a visual indication of the magnetic heading (MAG) of the helicopter. The information which the system supplies may be used for navigation and to control flight path o the helicopter. The system may also be used as a free gyro (DG) in areas where the magnetic reference is unreliable.
- (2) A radio magnetic indicator is installed in the pilot instrument panel. A second radio magnetic indicator (not shown) is installed in the copilots instrument panel. The copilot indicator is a repeater type instrument similar to the pilot indicator except that it has no control knobs. The moving compass card on both indicators displays the gyromagnetic compass heading.
 - **b.** Controls and Functions. Refer to figure 3-15.
 - c. Operation.
 - (1) INV switch MAIN or STBY.

- **(2)** Radio magnetic indicator (pilot only) Check power indicator is not in view.
 - (a) Slaved gyro mode (figure 2-6).
 - 1 COMPASS switch MAG.
- **2** Synchronizing knob Center (Null) annunciator.

NOTE

The system does not have a "fast-slewing" feature. If the compass is 180° off the correct helicopter heading when the system is energized it will take approximately 1 hour and 30 minutes (2° per minute) for the compass to slave to the correct headings.

- <u>3</u> Magnetic heading Check.
- **(b)** Free gyro mode.
 - 1 COMPASS switch DG.
 - 2 Synchronizing knob Set heading.
- <u>3</u> Annunciator Center position and then does not change (annunciator is de-energized in the free gyro (DG) mode).
 - (c) Inflight operation.
- <u>1</u> Set the COMPASS switch to DG or MAG as desired for magnetically slaved or free gyro mode of operation. Free gyro (DG) mode is recommended when flying in latitudes higher than 70°.
- <u>2</u> When operated in the slaved (MAG) mode, the system will remain synchronized during normal flight maneuvers. During violent maneuvers the system may become unsynchronized, as indicated by the annunciator moving off center. The system will slowly remove all errors in synchronization; however, if fast synchronization is desired turn the synchronizing knob in the direction indicated by the annunciator until the annunciator is centered again.
- <u>3</u> When operating in the free gyro (DG) mode, periodically update the heading to a known reference by rotating the synchronizing knob.

3-17. X TACAN RADIO SET AN/ARN-103.

a. Description. The TACAN radio set is on airborne navigational set that operates in conjunction with selected TACAN ground stations or other TACAN equipped aircraft to provide course deviation, bearing and distance to selected destination. The TACAN radio set operates on one of 252 preselected frequencies: 962 to 1024 MHz (channels 1X through 63X), 1151 to 1213 MHz (channels 64X through 126X), 1088 to 1150 MHz (channels 1Y through 63Y), or 1025 to 1057 MHz (channels 64Y through 126Y). Visual indications of course deviation are displayed on the course deviation indicator (Figure 3-13). Visual indications of bearing to station are displayed on the BDHI (figure 3-18) and RMI (figure 3-19). Distance to destination information is displayed on the BDHI. Application of power, channel and mode selection is provided by the TACAN control panel (Figure 3-16). The TACAN radio set has a maximum distance range of approximately 300 miles, which is dependent upon the aircraft altitude, terrain, and power of the ground station. The TACAN radio set is protected by the 3-ampere TAC circuit breaker on the AC circuit breaker panel. The associated antenna is illustrated in Figure 4-1.

b. Controls and Functions.

- (1) TACAN Control Panel C-8968/ARN-103: Refer to Figure 3-16.
- (2) INS/TAC Switch; refer to Figures 3-20 and 3-21.
 - (3) Mode Select Switch; refer to Figure 3-22.

c. Operating Procedures.

- (1) Turn-on Procedure.
 - (a) Mode Selector REC
 - **(b)** VOL control as required.

WARNING

Verify that the TACAN CHAN is not tuned to a station within the range of reception before attempting the BITE test or the test will fail.

- **(c)** BIT pushbutton Press (and release) GO indicator should illuminate after 10 seconds. If NO-GO indicator illuminates, have system checked by maintenance personnel. The double-needle pointer on the RMI should point north, the DME reads zero, and course indicator centered with 0° (360°) dialed in.
- **(2)** To determine course only to a selected ground station:
 - (a) CHAN selector-As required.
 - **(b)** Mode selector REC.
- **(c)** INS/TAC switch Figures 3-20 and 3-21 (instrument panel, figure 2-6) TAC if required.
- (d) Double needle on BDHI and RMI (pilot's ID-663 and copilot's ID-99) read course.
- **(3)** To determine course and range to a selected ground station:
- (a) CHAN selector As required Station channel numbers 127, 128 and 129 are not used.
 - (b) Mode selector T/R
 - **(c)** Mode switch X or Y as required.
 - (d) INS/TAC switch (instrument panel) -

TAC

- (e) Needle on BDHI and RMI read course.
- **(f)** MILES indicator on BDHI read slant range.
 - (4) To select course:
- (a) TACAN controls SET-UP (2) or (3) above.

- **(b)** INS/TAC switches (instrument panel) TAC.
- **(c)** OBS control (course deviation indicator, figure 3-13) As required.
- **(d)** Course deviation indicator Steer toward needle.
- **(e)** Heading pointer Read deviation from selected course. This pointer will show the crab angle, if any, when the course deviation indicator is centered.
 - **(5)** To determine course to the TACAN station:
- (a) SET control (pilot's course indicatorselector) - Rotate until course deviation indicator is centered and TO-FROM flag reads TO.
- **(b)** COURSE indicator Read course to station.
 - **(6)** To determine bearing from TACAN station:
- (a) SET control (pilot's course indicatorselector) - Rotate until course deviation indicator is centered and TO-FROM flag reads FROM.
- **(b)** COURSE indicator Read bearing from station.
 - (7) To operate for air-to-air range tracking.
 - (a) Mode selector-A/A.
- **(b)** CHAN selector Set 63 channels difference from master aircraft channel selector.
- **(c)** MILES indicator (TACAN distance indicator) Read range to aircraft being tracked.
 - (8) Shutdown procedure: Mode selector OFF.

3-18. ☑ INERTIAL NAVIGATION SYSTEM (INS) AN/ASN-86.

a. Description. The INS system is a selfcontained navigation system that is totally independent of aircraft maneuvers, conditions, and terrain. The INS, in conjunction with aircraft equipment interface, permits operations instruments under Instrument on Meteorological Conditions (IMC). The INS provides visual display of preset position data in Universal Transverse Mercator (UTM) coordinates or conventional latitude-longitude coordinates during all phases of the When a selected position is approached flight.

overflown, the INS will display and or freeze the geographic coordinates of the aircraft's position a, provide approach and DEST warning light indications the pilot. The INS system is protected by the 3-ampere INS circuit breaker on the pilot's AC circuit break panel. The INS control-indicator (figure 3-17) provide controls for power application; mode selection; data memory insertion and display; destination selection, insertion, and display; position update; and display clearings. Indicators are provided for navigation mode status, destination, arrival, malfunctions, data display and directional displays.

- **b.** Controls and Functions. Refer to Figure 3-17.
- c. Operating Procedures.

NOTE

The following data will be required prior to operating the INS: Local magnetic variation, latitude and longitude or Universal Transverse Mercator (UTM) coordinates of the aircraft during INS alignment. This information is necessary to program the INS computer during alignment procedure.

NOTE

When inserting data into the INS computer, always start at the left and work to the right. The first digit inserted will appear in the right position of the applicable display. It will step to the left as each subsequent digit is entered. The degree sign, decimal point, and colon (if applicable) will appear automatically.

(1) Turn-on procedure:

NOTE

The aircraft must be connected to a ground power unit if INS alignment is performed prior to engine starting. In this event the engines must not be stared until after the IN is placed in the HDG MEM mode and then turned off. The HDG MEM alignment will then be accomplished with aircraft power. The aircraft must not move until the INS is placed in the NAV mode.

- (a) MODE selector STBY.
- **(b)** DIM pushbutton Press. Assure that MAL, RDY, MEM, DEST, TAC, INS, AD, STA, POS, FIX and INSERT indicators are on. Assure that all 8's appear in left and right displays. Assure that E, W, N, S, degree, colon and decimal point lights come on.
- **(c)** DIM pushbutton Rotate to adjust light intensity. If the AD legend is flashing press DIM pushbutton again to extinguish.

NOTE

If MEM indicator remains on when the DIM pushbutton is released, the INS had been placed in the heading memory before last shutdown. If the aircraft has not been moved since the last shutdown then a heading memory alignment can be performed by proceeding to step (2)(h).

NOTE

Mistakes in the data being inserted into the computer can be corrected in the following manner: (1) If the mistake is detected prior to pressing the INSERT pushbutton, press the SL or SR pushbutton, as applicable twice, and repeat the data entry procedure. (2) If the mistake is detected after INSERT pushbutton has been pressed, press the SL or SR pushbutton, as applicable, and repeat the data entry procedure.

NOTE

If longitude and latitude coordinates are being used, skip step (2)(d) and proceed with step (2)(e).

NOTE

To insert UTM data to 10 meter accuracy or L/L data to one-hundredth of a minute accuracy, refer to (2)(k) below.

- (2) To insert UTM coordinates of aircraft position:
 - (a) SELECT switch -POS-UTM.
 - (b) DEST thumbwheel-"O".
- **(c)** STA pushbutton Press (if STA indicator is on). Note that STA indicator dims.

- **(d)** SL pushbutton Press. Note that INSERT indicator brightens.
- **(e)** Data entry pushbutton E/6 Press. E (for easting) will appear in left display.
- **(f)** Applicable data entry pushbutton Press. Insert easing zone number and distance in kilometers and tenths of kilometers. Data will appear on left display.
- **(g)** INSERT pushbutton Press. Note that INSERT indicator dims and information on left display is correct.
- **(h)** SR pushbutton Press. Note that right display clears and INSERT indicator brightens.
- (i) Data entry pushbutton N/ 2 or S/ 8 Press applicable pushbutton, N for northing, or S for southing, will appear in right display.
- **(j)** Applicable data entry pushbutton Press. Insert northing or southing distance in kilometers and tenths of kilometers. Data will appear in right display.
- **(k)** INSERT pushbutton Press. Note that INSERT indicator dims and information on right display is correct. Proceed to step (2) (i).
- **(3)** To insert latitude-longitude coordinates of aircraft position:
 - (a) SELECT switch- POS-L/L.
 - (b) DEST thumbwheel "O".
- **(c)** STA pushbutton Press (if STA indicator is on). Note that STA indicator dims.
- **(d)** SL pushbutton Press. Note that left display clears and INSERT indicator brightens.
- **(e)** Data entry pushbutton E/6 or W/4-Press applicable pushbutton. E for east, or W for west, longitude will appear in left display.
- **(f)** Applicable data entry pushbutton Press. Insert longitude in degrees, minutes, and tenths of minutes. Data will appear in left display.
- **(g)** INSERT pushbutton Press. Note that INSERT indicator dims and information on left display is correct.
- **(h)** SR pushbutton Press. Note that right display clears and INSERT indicator brightens.

- (i) Data entry pushbutton N/ 2 or S/ 8 Press. N or S for the hemisphere will appear in the right display.
- **(j)** Applicable data entry pushbuttons Press. Insert latitude in degrees, minutes, and tenths of minutes. Data will appear in right display.
- **(k)** INSERT pushbutton Press. Note that INSERT indicator dims and information on the right display is correct.
 - **(4)** To insert local magnet variation:
 - (a) SELECT switch MV/CS.
- **(b)** SL pushbutton Press. Note that left display clears and INSERT indicator brightens.
- **(c)** Data entry pushbutton E/ 6 or W/ 4 Press applicable pushbutton. E or W for direction of variation will appear in left display.
- **(d)** Applicable data entry pushbuttons Press. Insert local magnetic variation in degrees and tenths of a degree. Data will appear in left display.
- **(e)** INSERT pushbutton Press. Note that INSERT indicator dims and information on left display is correct.
 - **(5)** To insert aircraft altitude:
 - (a) Set SELECT switch to ALT/STA.
- **(b)** Off STA indicator is bright, press STA pushbutton. Make sure the STA indicator dims.
- **(c)** Press SL pushbutton. Make sure the left display clears and INSERT indicator brightens.
- **(d)** Press applicable data entry pushbutton to insert altitude above sea level in thousands of feet to nearest one hundred feet.
- **(e)** INSERT pushbutton PRESS. Note INSERT indicator dims and information in the left display is correct.

Before operating in NAV mode it is necessary that the present aircraft altitude (or field elevation) is inserted in the INS. This is to minimize erroneous. TACAN slant range calculations by the INS while on the ground.

(6) MODE selector - ALIGN.

NOTE

Do not move the aircraft while the MODE selector is in the ALIGN position. Do not start the engines until the full alignment has been completed, HDG MEM selected and the NS turned off. During INS alignment other programming can be performed.

(7) RDY indicator - Indicator should flash in approximately 12 minutes, if a full alignment was performed, or 4 minutes if the heading memory alignment method was used.

NOTE

The longer the MODE selector is in the ALIGN position with the RDY indicator flashing, the more accurate the alignment will be.

NOTE

Before operating in NAV mode it is necessary that the present aircraft altitude (or field elevation) is inserted in the INS (8) MODE selector - NAV.

NOTE

The NAV position of the MODE selector is detented. To switch from the NAV position, pull up and turn the MODE selector. If the MAL indicator comes on when the MODE elector is set to NAV, set the SELECT switch to MON and thumbwheel DEST ZERO. The numeral 1 or 3 will appear in the left display to indicate a computer malfunction. Appearance of the numeral 4 or 5 will indicate a platform malfunction.

(9) INS indicator - ON. The INS is ready for flight.

NOTE

The following programming steps may be accomplished after takeoff if required.

(10) To program destinations or TACAN coordinates:

If latitude and longitude coordinates are being used, skip step (10(a) and proceed with step (10)(b).

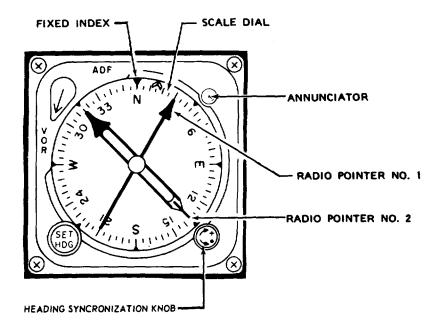
(a) To insert UTM, coordinates:

NOTE

To insert UTM data to 10 meter accuracy and L/L data to one-hundredth of a minute accuracy, see paragraph c(3) above.

- 1 SELECT switch DEST-UTM.
- **2** DEST thumbwheel Select number representing the desired destination or TACAN.
- <u>3</u> STA pushbutton Select STA indicator IN (bright) program TACAN data select STA indicator OUT (program destination data).
- 4 SL pushbutton Press. Note that left display clears and INSERT indicator brightens.
- $\underline{\mathbf{5}}$ Data entry pushbutton E/6 Press. E appears in left display.
- **6** Applicable data entry pushbuttons Press. Insert easting zone number and distance in kilometers and tenths kilometers. Data will appear in left display.
- $\underline{\textbf{7}}$ INSERT pushbutton Press. Note that INSERT indicator dims and information in left display is correct.
- **8** SR pushbutton Press. Note that right display clears and INSERT indicator brightens.
- **9** Data entry pushbutton N/2 or S/8 Press applicable pushbutton. N for northing or S or southing will appear in right display.
- **10** Applicable data entry pushbutton Press. Insert distance in kilometers and tenths of a kilometer. Data will appear in right display.
- <u>11</u> INSERT pushbutton Press. Note that INSERT indicator dims and information in right display is correct.
- $\underline{12}$ DEST thumbwheel select next desired destination number. Repeat steps $\underline{3}$ through $\underline{11}$ for up to a total of ten destinations, plus 10 TACAN locations.

- **(b)** To insert latitude-longitude coordinates of destinations:
 - 1 SELECT switch DEST L/L.
- **2** DEST thumbwheel Select desired destination number.
- **3** STA pushbutton Select STA indicator IN (bright) program TACAN data. Select STA indicator out (program destination data).
- **4** SL pushbutton Press. Note that left display clears and INSERT indicator dims.
- **5** Data entry pushbutton E/6 or W/4 Press applicable button. E or W will appear in left display.
- <u>6</u> Applicable data entry pushbuttons Press. Insert longitude in degrees, minutes, and tenths of a minute. Data will appear in left display.
- 7 INSERT pushbutton Press. Note that INSERT indicator dims and information in left display is correct.
- **8** SR pushbutton Press. Note that right display clears and INSERT indicator brightens.
- $\underline{\textbf{9}}$ Data entry pushbutton N/2 or S/8 Press applicable button. N or S will appear in right display.
- <u>10</u> Applicable data entry pushbuttons Press. Insert latitude in degrees, minutes, and tenths of a minute. Data will appear in right display.
- <u>11</u> INSERT pushbutton Press. Note that INSERT indicator dims and information in right display is correct.
- $\underline{\mathbf{12}}$ DEST thumbwheel Select next desired destination number. Repeat steps 3 through 11 for up to a total of 10 destinations, plus 10 TACAN locations.
- **(11)** To program true course angles and TACAN station local magnetic variation:
 - (a) SELECT switch MV/CS.
- **(b)** DEST thumbwheel Select desired number.
- **(c)** STA pushbutton Select STA indicator IN (bright) program TACAN data. Select STA indicator out (program destination data).



CONTROL/INDICATOR	FUNCTION
Pointer No. 1	Indicates course to ADF or VOR radio station.
Pointer No. 2	Indicates course to VOR station.
Synchronizing control	Is manually rotated to null annunciator and synchronize compass system.
SET HDG control	Moves the heading select cursor to desired heading.
Heading select Cursor	Indicate desired heading.
ADF/VOR control	Selects ADF or VOR. Selects ADF or VOR for pointer No. 1
Fixed index	Provides reference mark for rotating compass card.
Rotating compass card	Rotates under fixed index to indicate helicopter magnetic heading.
Annunciator	Show dot (•) or cross (+) to indicate misalignment (nonsynchronization) of compass system.
Power failure indicator (OFF)(flag)	Shows to indications loss of power to compass system.
Compass switch (located on pilots instrument panel)	MAG position slaved gyro mode DG position free gyro mode.

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Figure 3-15. E EE Gyromagnetic Compass Indicator (RMI) ID-998

- **(d)** SR pushbutton Press if a course angle is to be programmed. Note right display clears and INSERT indicator brightens.
- $\underline{\mathbf{1}}$ Data entry pushbuttons press to insert desired course angle in degrees and tenths of a degree.
- **2** INSERT pushbutton Press. Note the INSERT indicator dims and the information in the right display is
- **(e)** SL pushbutton Press if TACAN station local magnetic variation is to be programmed. Note left display clears and INSERT indicator brightens.
- $\underline{\mathbf{1}}$ Data entry pushbutton Press to insert TACAN station local magnetic variation in degrees and tenths of a degree.
- **2** INSERT pushbutton Press. Note the INSERT indicator dims and the information in the left display is correct.
- (12) To program TACAN station tower altitude and channel number.
 - (a) SELECT switch ALT/STA
- **(b)** DEST thumbwheel Select desired number.
- **(c)** STA pushbutton If STA indicator is dim, press STA pushbutton and make sure STA indicator brightens.
- **(d)** SL pushbutton press if tower altitude is to be programmed. Left display clears and INSERT indicator brightens.
- 1 Data entry pushbutton Press to insert tower altitude in-thousands of feet to the nearest hundred feet
- $\underline{\textbf{2}}$ INSERT pushbutton Press. Note the INSERT indicator dims and the information in the left display is correct.
- **(e)** SR pushbutton Press if TACAN channel number is to be programmed.
- $\underline{\textbf{1}}$ Data entry pushbuttons Press to insert TACAN channel number.
- **2** INSERT pushbutton Press. Note the INSERT indicator dims and the information in the right display is correct.

- (13) Designating fly-to-destinations or TACAN:
- (a) DEST thumbwheel Select desired number.
- **(b)** STA pushbutton Select bright or dim as appropriate to represent desired destination or TACAN.
- **(c)** SELECT switch BRG/RNG. Insert indicator should brighten. If not, then the selected destination or TACAN is presently designated.
- **(d)** INSERT pushbutton Press. Note that INSERT indicator dims.

Navigation information is now available from the INS for display on the BDHI and RMI and on the course deviation indicator as determined by the mode select switch (figure 3-22).

- (14) To fly the selected INS course:
- (a) Pilot's mode select switch (instrument panel) INS.
- **(b)** Course deviation indicator Steer toward needle.
- **(c)** DEST INDICATOR Indicator will illuminate when the aircraft is within two-minutes flying time of the destination. Indicator flashes when distance to destination begins to increase (station overflown).
- (d) INS/TAC switch (instrument panel) INS (if required).
 - (e) INS/MD-1 switch (instrument panel) INS.



Align the RMI (ID-998) compass card with the known magnetic heading using synchronization control. This should be made immediately following alignment prior to taxi and should be repeated any time switching occurs from Gyro to INS. The RMI must be manually adjusted to the heading indicated on the mission BDHI (ID-2091) whenever switching from MAG or GYRO to INS while in the NAV mode.

(f) Double-needle pointer (copilot's) RMI ID-998/ASN - Pointer will remain on-course during an INS direct course.

(15) To obtain readouts from the INS:

NOTE

To read out UTM and EVAL DATA TO 10 meter accuracy and L/L data to one-hundredth of a minute accuracy, refer to step (19) below.

NOTE

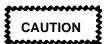
Refer to table 3-1 for the values and units of measurement of the display readouts.

- (a) To read bearing and range to destinations or TACAN:
- <u>1</u> DEST thumbwheel Select desired destination number.
- **2** STA pushbutton Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).
 - 3 SELECT switch BRG/RNG.
- <u>4</u> Left display Read bearing to destination.
- $\underline{\mathbf{5}}$ Right display Read range to destination.
- **(b)** To read present position in UTM coordinates:
 - 1 SELECT switch POS-UTM.
- $\underline{\textbf{2}}$ Left display Read easting zone number and aircraft easing.
- $\underline{\textbf{3}}$ Right display Read aircraft northing or southing.
- **(c)** To read present position in longitude and latitude:
 - 1 SELECT switch POS-L/L.
- **2** Left display Read aircraft longitude (east or west).
- $\underline{\mathbf{3}}$ Right display Read aircraft latitude and hemisphere.
- **(d)** To read destination or TACAN UTM coordinates:

- 1 DEST thumbwheel Select desired
- **2** STA pushbutton Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).

number.

- 3 SELECT switch DEST-UTM.
- **<u>4</u>** Left display Read destination easting.
- $\underline{\mathbf{5}}$ Right display Read destination northing or southing.
- (e) To read destination or TACAN longitude and latitude coordinates:
- <u>1</u> DEST thumbwheel Select desired number.
- **2** STA pushbutton Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).
 - 3 SELECT switch DEST-L/L.
- **4** Left display Read destination longitude.
- $\underline{\mathbf{5}}$ Right display Read destination latitude.
- **(f)** To read local magnetic variation and course select angle:
- <u>1</u> DEST thumbwheel -Select desired number.
- **2** STA pushbutton Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).
 - 3 SELECT switch MV/CS.
- 4 Left display STA button out (dim) NAV mode read only calculated magnetic variation at aircraft position. Other modes read or insert value of magnetic variation at aircraft position STA button in (bright) all modes read or insert value of magnetic variation for TACAN station location.
- $\underline{\bf 5}$ Right display Read course select angle for destination (referenced to true north).
 - (g) To read wind direction and velocity:



WIND readout in NAV mode is not mechanized.

Table 3-1. INS Control - Indicator Display Readouts

SELECT SWITCH POSITION	MAXIMUM VALUE OF VARIABLE - LEFT DISPLAY	UNIT OF VARIABLE - LEFT DISPLAY	MAXIMUM VALUE VARIABLE - RIGHT DISPLAY	UNITS OF VARI- ABLE - RIGHT DISPLAY
BRG/RNG	0359.9	Degrees (true)	9999.9	Kilometers
POS-UTM*	E 60:999.9	Kilometers	N/S 9999.9	Kilometers
DEST-UTM*	E 60:999.9	Kilometers	N/S 9999.9	Kilometers
POS-L/L*	E/W 179°59.9	Degrees & Minutes	N/S 89°59.9	Degrees & Minutes
DEST-L/L*	E/W 179°59.9	Degrees & Minutes	N/S 89°59.9	Degrees & Minutes
MV/CS	E/W 00179.9	Degrees	359.9	Degrees (true)
ALT/STA	99999.9	Feet (1000's)	00126	No Units
MON	E/W 99999.9	Variable	N/S 9999.9	Variable
EVAL*	E/W 09999.9	Kilometers	N/S 9999.9	Kilometers
WIND	00359.9	Degrees (true)	0600.0	Knots
TCK/GS	00359.9	Degrees (true)	0600.0	Knot
HDG/TIME	00359.9	Degrees (true)	9999.9	Minutes

^{*}When X10 mode has been selected, all digits will shift one place to the left so that the last digit on the right will represent 10 meters (UTM and EVAL) or one-hundredth of a minute (L/L).

- 1 SELECT switch WIND
- 2 Left display Read wind direction.
- 3 Right display Read wind velocity.
- (h) To read track and ground speed:
 - **1** SELECT switch -TCK/GS.
- **2** Left display Read aircraft ground track angle (referenced to true north).
- 3 Right display Read aircraft ground speed.
- (i) To read aircraft heading and time to destination or TACAN:

1 DEST thumbwheel - Select desired

number.

- **2** STA pushbutton Select STA indicator in (bright) program TACAN data. Select STA indicator out (program destination data).
 - 3 SELECT switch HDG/TIME.
- **<u>4</u>** Left display Read aircraft heading. Reading is angle relative to true north.
- $\underline{\textbf{5}}$ Right display Read time to destination or TACAN.
 - (16) Manual INS update:

Manual INS update should be used only when automatic TACAN updating is unreliable.

(a) Visual landmark INS update.

NOTE

Visual landmark update should be used only when navigation radio INS update cannot be accomplished. It should be performed at the lowest safe altitude.

1 Fly the aircraft directly over a location of known coordinates and press the POS FIX pushbutton at the exact instant that the aircraft is over the known location. Note that the POS FIX Indicator brightens.

NOTE

The POS FIX pushbutton may be pressed with the SELECT switch in any position. In the POS-UTM or POS-L/L positions, the displays indicate the coordinate information at the instant the POS FIX pushbutton was pressed. In the EVAL position, the difference between known and computer coordinates will be indicated.

- **2** DEST thumbwheel Select destination used as fix position.
- $\underline{\textbf{3}}$ STA pushbutton Press if STA indicator is bright.
- **4** SELECT switch EVAL. Read difference between known coordinates and computed coordinates of selected destination. Note that INSERT pushbutton brightens.
- **<u>5</u>** INSERT pushbutton Press only if visual update is needed. Not that INSERT and POS FIX indicators dim.
- $\underline{\textbf{6}}$ POS FIX pushbutton Press if indicator is bright.
 - (b) Navigation radio INS update.



The following method is not accurate and should not be used except in extreme cases.

NOTE

- It is essential that the exact coordinates of the VOR, ADF, or TACAN station be programmed into the INS prior to update. Follow procedures outlined in subparagraph (16) above for inserting position update coordinates into the INS.
- 1 East-West manual INS update using VOR, ADF, or TACAN stations can be accomplished by flying the aircraft so that it will cross the true 0° or 180° bearing to the station. The magnetic bearing representing the true bearing can be observed on the appropriate RMI by including the local magnetic variation. For VOR and TACAN, the course indicator can also be used by selecting the magnetic course which represents the true course. For example, with an easterly magnetic variation of 9.5°, the indicated magnetic bearing or selected magnetic course would be 350.5° or 170.5°.
- \underline{a} POS FIX pushbutton Press when the bearing pointer indicates the magnetic bearing that corresponds to a true bearing of 0° or 180° to the station. Note that the POS FIX indicator brightens.
- $\underline{\textbf{b}} \ \ \text{DEST} \ \ \text{thumbwheel} \ \ \textbf{-} \ \ \text{Select}$ number representing the station used for update.
- **c** STA pushbutton must agree with ground fix. If fix is a TACAN station being overflown STA button must be in (bright); if a destination stored in TW locations 0 to 9 then STA button must be out (dim).
- $\underline{\textbf{d}}$ SELECT switch EVAL. Read difference between known coordinates and computed coordinates of selected destination. Note that INSERT pushbutton brightens.

- f INSERT pushbutton Press. Note that INSERT and POS FIX indicators dim.
- **2** North-South manual INS update using VOR, ADF, or TACAN stations can be accomplished by flying the aircraft so that it will cross the true 90° or 270° bearing to the station. The magnetic bearing representing the true bearing can be observed on the appropriate RMI (ID-998 or ID-250) by including the local magnetic variation. For VOR and TACAN, the course indicator-selector can also be used by selecting the magnetic course which represents the true course. For example, with a westerly magnetic variation of 14.5°, the indicator magnetic bearing or selected magnetic course would be 104.5° or 284.5°.
- \underline{a} POS FIX pushbutton Press when the bearing pointer indicates the magnetic bearing that corresponds to a true bearing of 90° or 270° to the station. Note that the POS FIX indicator brightens.
- **<u>b</u>** DEST thumbwheel Select number representing the station used for update.
- **<u>c</u>** STA pushbutton Select STA indicator in (bright) program TACAN data. Select STA indicator out (dim) program destination data.
- **<u>d</u>** SELECT switch EVAL. Read difference between known coordinates and computed coordinates of selected destination.
- $\underline{\underline{\textbf{e}}}$ SL pushbutton Press. Note that left display clears and INSERT pushbutton brightens.
- $\underline{\mathbf{f}}$ INSERT pushbutton Press. Note that INSERT and POS FIX indicators dim.
- (17) TACAN update of INS. Updating of the INS can be automatically accomplished by the TACAN in the following manner

When operating in the NAV position the air craft's actual altitude must be programmed as often as practical (during climbs and descents altitude differential should not exceed 500 ft.) to provide the most accurate updating capability.

(a) With the INS aligned and in the NAV position and the TACAN control panel switch in the T/R position, the INS will be automatically updated by valid

- TACAN data from the channel selected on the TACAN control panel.
- **(b)** With the INS aligned and in the NAV position and the TACAN control panel switch in the AUTO position, the INS will be automatically updated by valid TACAN data from any TACAN station whose coordinates, altitude, mag variation and station into the INS computer.
 - (18) To operate in the air data mode:

NOTE

The INS automatically switches to the air data mode when the INS platform malfunctions. This condition is indicated when the MAL and AD indicators illuminate. The air data mode may also be selected manually if the true airspeed transducer is installed.

- (a) MODE selector AD
- (b) Update local magnetic variation, if required.
 - (c) To update wind velocity and direction:
 - 1 SELECT switch WIND.
- **2** STA pushbutton switch Press if STA indicator is on. Note that STA indicator dims.
- **3** SL pushbutton switch Press. Note that INSERT indicator brightens and left display clears.
- 4 Applicable data entry pushbuttons Press. Insert wind direction in degrees and tenths of a degree referenced to true north. Data will appear in left display.
- **<u>5</u>** INSERT pushbutton Press. Note that INSERT indicator dims and information in left display is correct.
- **6** SR pushbutton Press. Note that INSERT indicator brightens and right display clears.
- $\underline{\textbf{7}}$ Applicable data entry pushbuttons Press. Insert wind velocity in knots. Data will appear in right display.
- **8** INSERT pushbutton Press. Note that INSERT indicator dims and information in right display is correct.

- (19) X10 Mode Procedure.
- (a) To add 10 meter accuracy to UTM coordinates.
- $\underline{\mathbf{1}}$ SELECT switch DEST-UTM or POS- UTM.
- **2** DEST thumbwheel Select number representing the desired destination or TACAN.
- 3 STA pushbutton Select STA indicator in (bright) to program TACAN data. Select STA indicator out (dim) to program destination data. Note that left and right displays readout the coordinates of the desired destination or TACAN.
- **4** DIM pushbutton Press. Note AD indicator flashes and information in both displays has shifted one position to the left.
- <u>5</u> SL pushbutton Press. Note that left display clears and INSERT indicator brightens.
- **6** Keyboard pushbuttons Press E/6 and the pushbutton representing the desired 10 meter number. Note that E and the 10 meter digit appear in the left display.
- 7 INSERT pushbutton Press. Note that INSERT indicator dims and that easing coordinates are on the left display but are shifted one position to the left.
- **8** SR pushbutton Press. Note that right display clears and INSERT indicator brightens.
- $\underline{\textbf{9}}$ Keyboard pushbutton Press N/2 for northing or S/8 for southing and the pushbutton representing the desired 10 meter number. Note that N or S and the 10 meter digit appear in the right display.
- **10** INSERT pushbutton Press. Note that INSERT indicator dims and that easing coordinates are on-the right display but are shifted one position to the left.
- <u>11</u> DIM pushbutton Press. Note AD indicator stops flashing and the information on both displays has shifted back to normal display.
- **(b)** To add ten one-hundredth minute accuracy to L/L.
- $\underline{\textbf{1}}$ SELECT switch DEST L/L or POS- L/L.
- $\underline{\textbf{2}}$ DEST thumbwheel Select number representing the desired destination or TACAN.

- 3 STA pushbutton Select STA indicator in (bright) to program TACAN data. Select STA indicator out (dim) to program destination data. Note the left and right displays readout the coordinates of the desired destination or TACAN.
- **4** DIM pushbutton Press. Note AD indicator flashes and information in both displays has shifted one position to the left.
- $\underline{\mathbf{5}}$ SL pushbutton Press. Note that left display clears and INSERT indicator brightens.
- **6** Keyboard pushbuttons Press E/6 or W/4 and the pushbutton representing the desired 1/10 of a minute of longitude. Note that E or W and the digit representing 1/10 minute appear in left display.
- 7 INSERT pushbutton Press. Note that INSERT indicator dims and that longitude coordinates are on left display but are shifted one position to the left.
- **8** SR pushbutton Press. Note that right display clears and INSERT indicator brightens.
- **9** Keyboard pushbuttons Press N/2 or S/8 and the pushbutton representing the desired 1/10 of a minute of latitude.
- 10 INSERT pushbutton Press. Note that INSERT indicator dims and that latitude coordinates are on right display but are shifted one position to the left.
- <u>11</u> DIM pushbutton Press. Note AD indicator stops flashing and the information on both displays has shifted back to normal display.
 - **(c)** To obtain X10 readouts from the INS:
- **1** SELECT switch DEST-UTM, POS-UTM, DEST -L/L or EVAL as desired.
- **2** DEST thumbwheel Select number representing the desired destination or TACAN.
- **3** STA pushbutton Select STA indicator in (bright) to display TACAN data. Select STA indicator out (dim) to display destination data. Note that left and right displays readout the coordinates of the desired destination or TACAN.
- $\underline{\textbf{4}}$ DIM pushbutton Press. Note AD indicator flashes and information in both displays has shifted one position to the left. The right digit in both displays represents the 10 meter (UTM, EVAL) or 1/10 minute (V) data of the desired coordinate data.

 $\underline{\bf 5}$ DIM pushbutton - Press. Note AD indicator stops flashing and the information on both displays has shifted back to normal display.

(20) Shutdown procedure:

- (a) Aircraft Ensure that aircraft is parked in a fixed position.
- **(b)** INS data Record as required (time in NAV, velocity errors, terminal error, etc.).
- **(c)** HDG MEM Press. Hold pushbutton until MEM indicator brightens.
 - (d) MODE selector-OFF.

3-19. BEARING DISTANCE HEADING INDICATOR (BDHI) ID- 663/ASN.

- **a. Description.** The ID-663 is the pilot's BDHI. It is capable of displaying the following information:
 - (1) Bearing
 - (2) Distance on Digital Readout.
 - (3) Heading
 - b. Controls and Functions. Refer to Figure 3-18.
- (1) As used on the EH-1X, the magnetic heading display on the pilot's ID-663 is selected by the switch (Figure 3-23) located on the far left side of the instrument panel.
- (2) The two pointers on the pilot's ID-663 are controlled by the two toggle switches on the VOR/ADF switch and the INS/TAC switch (Figure 3-21). These switches are located to the immediate left or the ID-663.

3-20. RADIO MAGNETIC INDICATOR (RMI) ID-998/ASN.

- **a. Description.** The radio magnetic indicator (RMI) provides aircraft magnetic or directional gyro heading, mission target heading, TACAN magnetic bearing, and INS, VOR, or ADF bearing information. The RMI is protected by the one ampere GYRO CMPS circuit breaker on the AC circuit breaker panel. Figure 3-19 illustrates the RMI.
 - b. Controls and Functions. Refer to Figure 3-19.
- **c. Operating Procedures.** See AN/ARN-123 (paragraph 3-15) TACAN (paragraph 3-17) and AN/ASN-86 (paragraph 3-18) for further information.

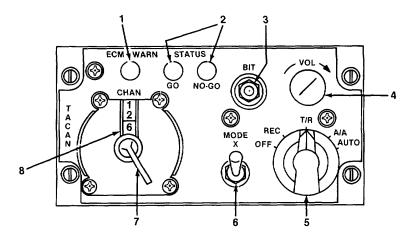
CAUTION

The VOR indicator will become erratic during use of the AN/TLQ-17A countermeasures equipment.

- (1) X The single needle displays either bearing data from the AN/ARN-123 (VOR) or the ARN-83 (ADF).
- (2) The magnetic heading display is selected (for the co-pilot's ID-998) by use of the switch (Figure 3-20) located on the far left side of the instrument panel.

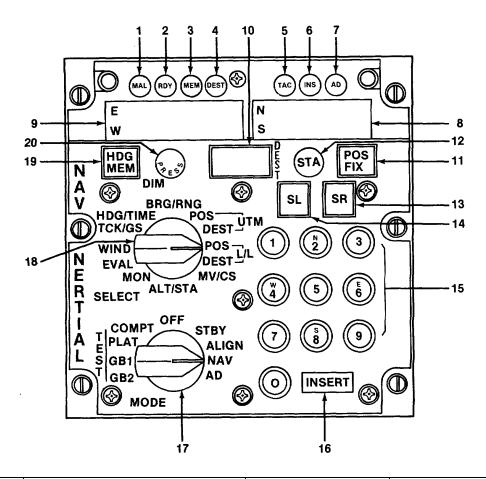
NOTE

When switching from the INS to MAG or DG Mode of operation, the pilot must synchronize the compass card to the mag compass. If the aircraft is run up with the Compass switch in the MAG position, and the switch is changed to the INS position, the pilot must sync the cord to the magnetic compass.



CONTROL/INDICATOR	FUNCTION
ECM WARN Indicator	Indicates when enemy countermeasure signal is trying to jam the TACAN system. May also illuminate when in the immediate vicinity of RF radiation devices, i.e., GCA radar and when an unreliable signal is received.
2. STATUS Indicator	Indicates a system GO or NO-GO (fault) during self test.
3. BIT Pushbutton	Initiates a self test sequence and result is displayed by STATUS GO/NO-GO indicators. Also illuminates the ECM WARN and STATUS GO/NO-GO indicators as long as the pushbutton is pressed thereby providing a lamp test feature.
4. VOL Control	Adjusts volume.
5. Mode Selector	Determines operating mode:
OFF	Turns set off.
REC	Selects receive portion of receiver-transmitter for course and bearing information and beacon identification tone.
T/R	Selects transmit and receive function of receiver- transmitter for course and distance information and provides beacon identification tone.
A/A	Selects air-to-air transmit and receive function for range information to a cooperating aircraft
AUTO	INS computer selects the channel.
6. MODE Switch	Selects X or Y beacon channels.
7. CHAN Selector	Provides selection of one of 126 TACAN channels in either X or Y mode for receiving and transmitting. Station channel numbers 127, 128, and 129 are not used.
8. CHAN Indicator	Indicates the operating channel.

Figure 3-16. X TACAN Control Panel AN/ARN-103



CONTROL/INDICATOR	FUNCTION	CONTROL/INDICATOR	FUNCTION
MAL Indicator	Illuminates when any component in the navigation set malfunctions.	7. AD indicator	Illuminates when GSPU of the INS malfunctions or when MODE selector is set to AD. Flashes when X10 mode has
2. RDY indicator	Illuminates by flashing when INS is ready for NAV mode.		been selected for insertion or display of POS, DEST and EVAL data.
3. MEM indicator	Illuminates when heading memory alignment is in progress, or when the heading memory mode is initiated.	8. NS (right) display	Indicates direction, north or south, of data displayed on INS control-indicator.
4. DEST indicator	Illuminates when aircraft is within two minutes of destination. Flashes when distance to destination is increasing.	9. EW (left) display	Indicates direction, east or west, of data displayed on INS control-indicator.
5. TAC indicator	Illuminates when the INS is using TACAN data for automatic updating of present position.	10. DEST Thumbwheel	Allows insertion or display of any core storage location as defined by the position of select switch. With SELECT switch set to MON, decimal quantities are
6. INS indicator	Illuminates when INS is operating in the navigation mode.		displayed on the right and left displays as follows:

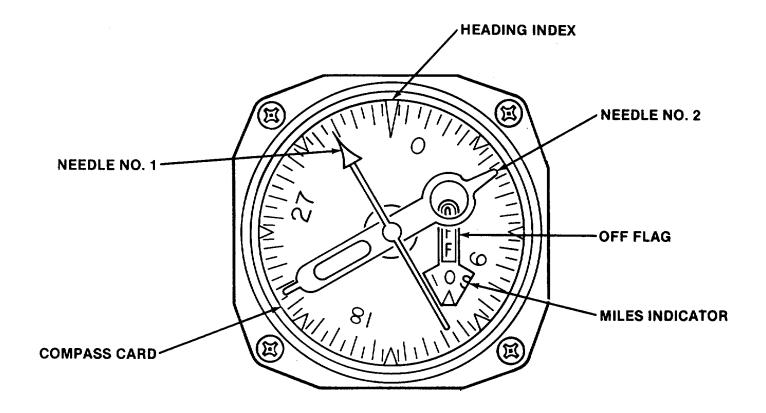
Figure 3-17. X INS Control Indicator AN/ASN-86 (sheet 1 of 3)

CONTROL/INDICATOR	FUN	NCTION	CONT	ROL/INDICATOR	FUNCTION
10. DEST Thumbwheel (cont)	Left display	Right display	13.	SR Pushbutton	When pressed, clears right display and causes INSERT indictor to brighten. When pressed a second time will bring back display and dim the insert light.
0	Number indi- cates test failure.	Code number of destination being flown.	14.	SL Pushbutton	When pressed, clears left display and causes INSERT indicator to brighten.
1	Y-gyro bias	Z-gyro bias			When pressed a second time will bring back display and dim the insert light.
2	X-gyro bias	Z-gyro bias			
3	East velocity error	North velocity error	15.	Keyboard Push- buttons	Keys are pressed in conjunction with SELECT switch. DEST thumbwheel, SL, SR, STA and INSERT pushbutton to load left and right displays.
4	All I's indi- cate comple- tion of self- test	Align status	16.	INSERT Pushbutton	Used in conjunction with SELECT switch, DEST thumbwheel, SL, SR, and keyboard, to load left and right displays for display and storage in computer.
5	% of spec	Time in selected mode.	17	MODE	Selects mode of operation as follows:
6	Instrumentation Spheroid select Selector entry/enable				
7	Initial	Running		OFF	Turns set off
8	Greenwich time % spore duty cycle	Greenwich time Allows selection of any core stor-		STBY	Applies primary power to computer and control-indicator, and heater power to platform.
9	Displays octal value of con-	age location. Displays octal value of con-		ALIGN	Allows platform stable element to be leveled with respect to local vertical and aligned to true north.
	tents in se- lected core storage location	tents in se- lected core tent in se- lected core		NAV	Normal mode for flight or when air-craft is moved on ground when navigation set is on.
11. POS FIX Push- button	UTM POS, or L/L I displays will be from pushbutton is pres- ition update. If no	zen when POS FIX sed. Used for pos-		AD	Initiates air data mode of operation which is used when platform malfunctions during fight. INS will automatically switch to AD if the platform fails.
12. STA Pushbutton				TEST-COMPT TEST-PLAT TEST-GB-1	Initiates built-in test of computer. Initiates built-in test of platform. Initiates gyro bias 1 test.
	TACAN data. With	STA pushbutton OUT DEST thumbwheel		TEST-GB 2	Initiates gyro bias 2 test.
	number pertains to (0 through 9) set for data. With STA inc the selected DEST	the ten locations or destination dicator IN (bright) thumbwheel number	18.	SELECT	Selects data to be read into memory and displayed control-indicator displays as follows:
	pertains to the ten thru 19) set up for locations can be us tional destination d	TACAN data. These sed for addi-		BRG/RNG	Displays bearing-to-destination in degrees and tenths of a degree on.

Figure 3-17. X INS Control Indicator AN/ASN-86 (sheet 2 of 3)

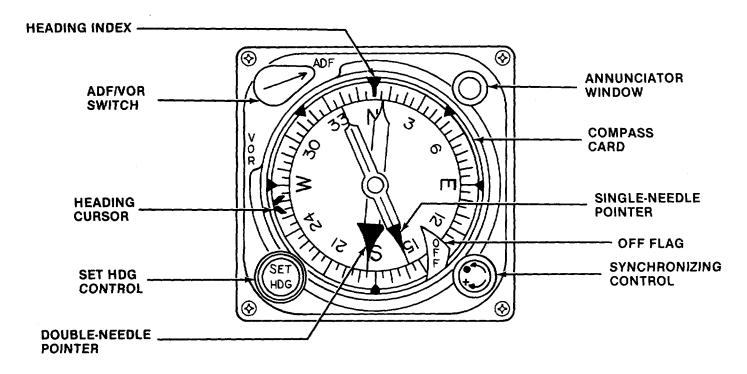
CONTROL/INDICATOR	FUNCTION	CONTROL/INDICATOR	FUNCTION
18. SELECT (cont) BRG/RNG	left display and range-to-destination in kilometers and tenths of kilometers on right display for destination or TACAN selected by STA pushbutton and DEST thumbwheel. RMI, range indicator and course indicator selector will indicate course deviation bearing and range to destination.	ALT/STA	Allows insertion or readout (left display) of altitude above sea level of the TACAN station and insertion or readout (right display) of the selected TACAN station channel number as selected by the DEST thumbwheel with STA pushbutton IN (or indicator is bright).
	destination or TACAN with STA pushbutton and DEST thumbwheel and pressing the INSERT pushbutton. The insert light will go out; but illuminate for	MON	Allows display and selection of any computer core storage location.
	all other positions of the DEST thumbwheel.	EVAL	Allows updating and display of difference between present position and destination number selected with STA pushbutton and
UTM POS	Allows insertion or display of present position zone number and easting distance in kilometers and tenths of a kilometer on left display and northing or southing distance in kilometers and tenths of a kilometer on right display. Information is automatically inserted into DEST "O" during STBY or ALIGN mode.		DEST thumbwheel. The north- south difference in kilometers and tenths appears on the right display; the east-west difference in kilometers and tenths appears on the left display.
		WIND	Allows display of wind direction angle in degrees and tenths of a degree relative to
UTM DEST	Allows insertion or display of destination zone number and easting distance in kilometers and tenths of kilometer on left display and northing or southing distance in kilometers and tenths of a kilometer on right display for destination or TACAN selected by STA pushbutton and DEST thumbwheel.		true north on left display and wind speed in knots and tenths of a knot on right display during navigate mode. During air data mode allows insertion of wind speed and direction. The WIND function is not mechanized.
L/L POS	Allows insertion or display of present position longitude in degrees and minutes on left display and latitude in degrees and minutes on right display. Information is automatically inserted into	TCK/GS	Allows display of ground track angle in degrees and tenths of a degree relative to true north on left display and ground speed in knots and tents of a knot on right display.
	DEST "O" during STBY or ALIGN mode.	HDG/TIME	Allows display of aircraft heading angle in degrees and tenths of a degree relative to
L/L DEST	Allows insertion or display of destination position longitude in degrees and minutes on left display and latitude in degrees and minutes on right display for destination or TACAN selected by STA pushbutton and DEST thumbwheel.		true north on left display and time-to destination in minutes and tenths of a minute on right as defined by destination number selected on DEST thumb-wheel and position of STA pushbutton.
MV/CS	Allows insertion or display of magnetic variation angle in degrees and tenths of a degree on left display and course	19. HDG MEM Pushbutton	Used to retain platform alignment after landing. Permits another flight to be made without performing another complete platform alignment.
	select angle in degrees and tenths of a degree on right display relative to true north.	20. DIM Pushbutton	When rotated it adjusts light intensities when pressed, illuminates the E, W, N S, and degree colon, and decimal points, and all other lights except the data entry indicators and SL and SR indicators. The
ALT/STA	Allows insertion or readout of insertion of required aircraft altitude above sea level on left display when STA pushbutton is out (or indicator is dim).		display readout will show all 8's. It will also place the INS in X10 mode, for insertion or display of UTM, L/L and EVAL data. Press again to cancel X10 mode.

Figure 3-17. X INS Control Indicator AN/ASN-86 (sheet 3 of 3)



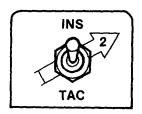
CONTROL/INDICATOR	FUNCTION
Heading Index	Provides compass card reference mark.
Compass Card	Rotating card. Number under heading index indicates magnetic heading of aircraft.
Needle No. 1	Indicates selected VOR or ADF course.
Needle No. 2	Indicates selected INS or TACAN course.
Miles Indicator	Indicates nautical miles to or from destination or station.
OFF Flag	Indicates when miles indicator information is unreliable.

Figure 3-18. X Bearing Distance Heading Indicator (BDHI) ID-663/ASN



CONTROL/INDICATOR	FUNCTION	CONTROL/INDICATOR	FUNCTION
Single-needle Pointer	Indicates ADF bearing or VOR magnetic bearing, depending on position of ADF/VOR switch.	, ,	Synchronizes compass, card with the gyro magnetic compass. When operating in the INS mode the + and ball will not oscillate in the window.
2. Double-needle Pointer	Indicates INS or TACAN bearing as appropriate, depending on No. 2 needle select switch position.	9. OFF flag	Indicates equipment failure.
3. Heading Cursor	Provides visual indication of heading selected by SET HDG control.	10. Heading Index	Provides reference mark for rotating compass card.
4. SET HDG Control	Sets heading cursor.	NOTE:	
5. ADF/VOR Switch	Selects and applies ADF or VOR signal to single-needle pointer	When switching from t	he INS to MAG or DG mode of t synchronize the compass card to
6. Compass Card	Indicates aircraft compass magnetic or directional gyro heading or INS heading at top of dial.	the magnetic compass. compass switch in the	If the aircraft is run up with the MAG position, and the switch is tion, the pilot must synchronize the
7. Annunciator Window	Indicates gyro magnetic compass synchronization in slaved mode when the gyro compass is operated in the MAG mode.		,

Figure 3-19. X Copilots Radio Magnetic Indicator (RMI) ID-998/ASN



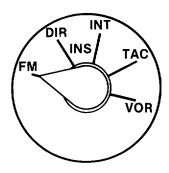
CONTROL/INDICATOR	FUNCTION
INS/TAC switch	Selects bearing from either the ASN-86 inertial navigation set (INS) or the ARN-103 TACAN system (TAC) for display on the double needle of ID-998.

Figure 3-20. X INS/TAC Switch



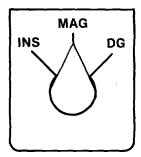
CONTROL/INDICATOR	FUNCTION
VOR/ADF switch	Selects either the ARN-123 (VOR) or the ARN-83 (ADF) as the driving source for the number 1 (single) needle on the ID-663.
INS/TAC switch	Selects either the ASN-86 (INS) or the ARN-103 TACAN (TAC) as the driving source for the number 2 (double) needle and the distance readout on the ID-663.

Figure 3-21. X VOR/ADF: INS/TAC Switches



CONTROL/INDICATOR	FUNCTION
Select switch	Selects the source of navigation data to be displayed on the course deviation indicator.
FM	Selects the ARC-114, UHF-FM receiver
DIR	Selects the ASN-86 (INS) in the direct mode.
INT	Selects the ASN-86 (INS) in the intercept mode.
TAC	Selects the ARN-103 TACAN system.
VOR	Selects the ARN-123 system.

Figure 3-22. X Mode Select Switch



CONTROL/INDICATOR	FUNCTION
Select switch	Selects the source of magnetic heading information displayed on the ID-663 and ID-998. The data is displayed by the compass card.
INS	Selects the ASN-86 system.
MAG	Selects the ASN-43 compass in the magnetic mode.
DG	Selects the ASN-43 compass in the directional gyro mode.

Figure 3-23. X Magnetic Heading Select Switch



CONTROL/INDICATOR	FUNCTION
INS/MD-1 switch	Selects either the ASN-86 (INS) or the MD-1 attitude gyro (MD-1) as the driving source for the pilot's attitude indicator ID-4005G.

Figure 3-24. X Attitude Indicator Switch

SECTION IV. TRANSPONDER AND RADAR

3-21. TRANSPONDER SET AN/APX-72.

- a. Description. The APX-72 provides radar identification capability. Five independent coding modes are available. The first three modes may be used independently or in combination. Mode 1 provides 32 possible code combinations, any one of which may be selected in flight. Mode 2 provides 4,096 possible code combinations but only one is available since the selection dial is not available in flight and must be press before flight. Mode 3/A provides 4,096 possible codes, any of which may be selected in flight. Mode C is used with the AAU-32/A Encoding Altimeter (AIMS). Mode 4, which is connected to an external computer, can be programmed prior to flight to display any one of many classified operational codes for security identification. The effective range depends on the capability of interrogating radar and line of sight. The transponder set is mounted on the right side of the pedestal. The IFF CODE HOLD switch interfaces with MODE (figure 2-6). This allows the crew to hold the classified operational code that has been programmed. The CODE HOLD switch must be momentarily held in the ON position prior to turning the CODE control knob to HOLD and the CODE control knob must be in HOLD a minimum of 15 seconds prior to turning MASTER control OFF.
 - b. Controls and Functions. Refer to figure 3-25.
 - c. Operation.
- (1) MASTER control STBY. Allow approximately 2 minutes for warmup.
 - (2) Mode and code Select as required.
 - (3) Test as required.
 - (4) MASTER control NORM.
 - (5) IDENT As required.
- **d. Emergency Operation**. MASTER control EMER.
 - e. Mode 4 Transponder Operation.

(1) Prior to Starting Engine: Set the controls on the C-6280A(P) APX, Transponder Set as follows:

CONTROL/POSITION

- (a) MASTER/OFF.
- (b) TEST M-1 (OUT) /OUT.
- (c) TEST M-2 (OUT) /OUT.
- (d) TEST M-3 (OUT/OUT.
- (e) TEST MC (OUT/OUT.
- (f) AUDIO (OUT/LIGHT) /AUDIO.
- (g) CODE/A.
- (h) MODE 4 (ON/OUT) /OUT.
- (i) Start aircraft engine at this time...
- (2) Transponder Starting Operation (Unkeyed Equipment).
- (a) Turn transponder MASTER control to STBY position.
- **(b)** Allow to warm up in the STBY position for a minimum of two minutes.
- **(c)** The IFF caution light should be ON at this time.
- **(d)** Key the KIT-1A and close the access door; this will cause the IFF light to go OUT.
- **(e)** Place the MASTER control switch in NORM/LOW position as desired.
- $% \left(\mathbf{f}\right) =\mathbf{f}$ (f) Place the MODE 4 switch to the ON position.
- (g) Place the audio/LIGHT switch as desired. (AUDIO position allows monitoring of MODE 4 replies visually and aurally.) LIGHT position monitors replies visually only. OUT position disables the monitoring circuit.

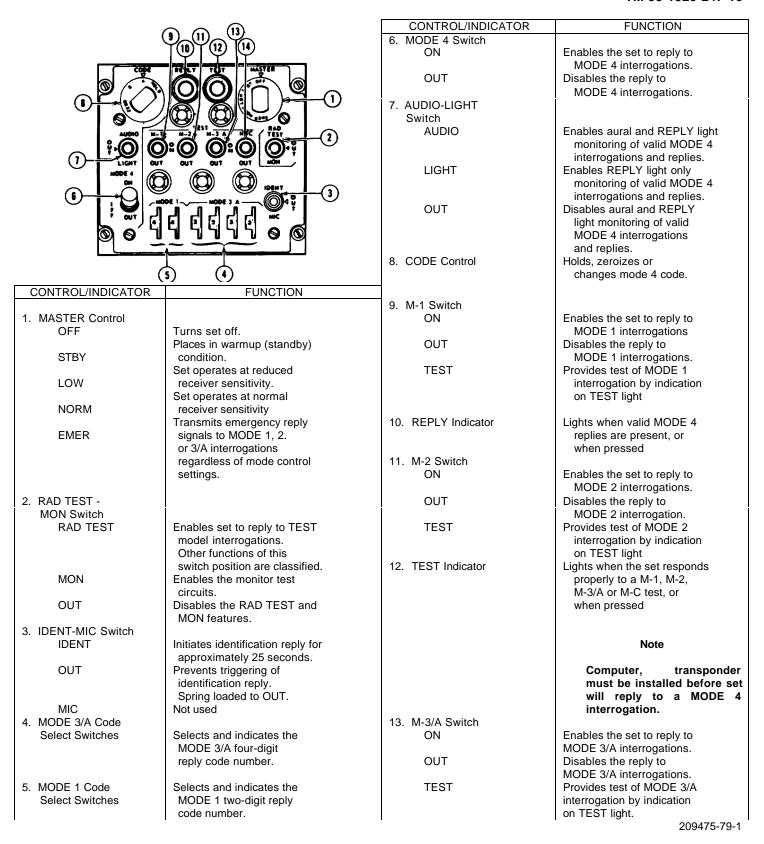


Figure 3-25. Transponder Set AN/APX-72 (Sheet 1 of 2)

CONTROL/INDICATOR	FUNCTION
14. M-C Switch	Used with AIMS altimeter.
ON	Enables set to reply to MODE C interrogation.
OUT	Disables reply to MODE C interrogation.
TEST	Enables TS-1843/APX to locally interrogate set.

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Figure 3-25. Transponder Set AN/APX-72 (Sheet 2 of 2)

- **(3)** Transponder Stopping Procedure Retaining Equipment In The Keyed Condition.
- (a) Prior to engine shutdown, place IFF CODE HOLD switch to the HOLD position. IFF CODE HOLD LIGHT on instrument panel should light.
- **(b)** Rotate spring-loaded CODE CONTROL switch to HOLD position momentarily and allow to return to A position.
 - (c) Wait at least 15 seconds.
 - (d) Turn MASTER switch to OFF position.
 - (e) Complete normal A/C shutdown.
 - (f) Guard keyed equipment.
 - (4) Restart Operation With Keyed Equipment
- (a) Prior to turning battery switch on or applying external power to A/C, ensure IFF CODE HOLD switch is in the HOLD position.
- **(b)** Start A/C engine, turn MASTER control switch to STBY position. Allow A/C to warm up in STBY for a minimum of two minutes.
- **(c)** Place MASTER control to NORM/LOW position as desired.
 - (d) Place MODE 4 switch to ON.

- (e) Place AUDIO/LIGHT switch as desired.
- (f) Place IFF CODE HOLD switch to OFF.
- (5) Transponder Stopping Procedure Code Not Desired.
- (a) Rotate CODE control switch to ZERO position. IFF CAUTION LIGHT should light indicating loss of code.
- $\begin{tabular}{ll} \textbf{(b)} & Turn all switches to OFF/OUT/ZERO as appropriate. \end{tabular}$
- f. Short Operating Instructions For Restart In Keved Condition.
 - (1) CODE HOLD switch ON.
 - (2) TRANSPONDER SWITCH/STBY.
- (3) TRANSPONDER CODE HOLD/POSITION A.
 - (4) M-1, M-2, M-3/A, M-C and MODE 4/ON.
- **(5)** Check proper MODE 1 and 3/A codes select codes as necessary.
- **(6)** TRANSPONDER SWITCH/NORMAL (after 2 minutes).
 - (7) CODE HOLD switch/OFF.

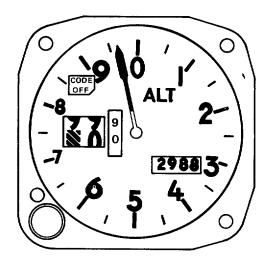
g. Shutdown Procedure Holding Equipment In Keyed Condition.

- (1) CODE HOLD switch/ON.
- (2) TRANSPONDER switch momentarily/HOLD.
- (3) MODE switch/OFF.
- (4) TRANSPONDER POWER/OFF.

3-22. AAU-32/A ALTITUDE ENCODER/PNEU-MATIC ALTIMETER.

a. Description. The AAU-32/A pneumatic counter-drum-pointer altimeter is a self-contained unit which consists of a precision pressure altimeter combined with an altitude encoder (figure 3-26). The indicates and the encoder transmits. simultaneously, pressure altitude reporting. Altitude is displayed on the altimeter by a 10,000 foot counter, a 1000 foot counter and a 100 foot drum. A single pointer indicates hundreds of feet on a circular scale, with 50 foot center markings. Below an altitude of 10,000 foot a diagonal warning symbol will appear on the 10,000 foot counter. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches of Hg. A DC powered vibrator operates inside the altimeter whenever aircraft power is on. If DC power to the altitude encoder is lost, a warning flag placarded CODE OFF will appear in the upper left portion of the instrument face indicating that the altitude encoder is inoperative and that the system is not reporting altitude to ground stations. The CODE OFF flag monitors only the encoder function of the altimeter. It does not indicate The AIMS altitude reporting transponder condition. function may be inoperative without the AAU-32/A CODE OFF flag showing, in case of transponder failure or improper control settings.

It is also possible to get a "good" MODE C test on the transponder control with the CODE OFF flag showing. Display of the CODE OFF flag only indicates an encoder power failure or a CODE OFF flag failure. In this event check that DC power is available and that the circuit breakers are in. If the flag is still visible, radio contact should be made with a ground radar site to determine whether the AIMS altitude reporting function is operative, and the remainder of the flight should be conducted accordingly.



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Figure 3-26. AAU-32/A Altitude Encoder/Pneumatic
Altimeter

b. Operation.

(1) Normal Operation. The AIMS altimeter circuit breaker should be closed prior to flight. The Mode C switch (M-C) on the transponder control should be switched to "on" for altitude reporting during flight. The AAU-32/A altimeter indicates pneumatic altitude reference to the barometric pressure level as selected by the pilot. At ambient pressure, altimeters should agree within \pm 70 feet of the field elevation when the proper barometric pressure setting is set in the altimeter. If there is an error of greater than ±70 feet, do not use the altimeter for IFR flight. A red flag marked CODE OFF is located in the upper left portion of the altimeters face. In order to supply Mode C information to the IFF transponder, the CODE OFF flag must not be visible. A vibrator, powered by the DC essential bus, is contained in the altimeter and requires a minimum of one minute warmup prior to checking or setting the altimeter.

(2) Abnormal Operation.

(a) If the altimeters internal vibrator becomes inoperative due to internal failure or DC power failure, the pointer and drum may momentarily hang up when passing from "9" through "0" (climbing) or from "0" through ""9" (descending). This hang-up will cause lag, the magnitude of which will depend on the vertical velocity of the aircraft and the friction in the altimeter. Pilots should be especially watchful for this type failure when the minimum approach altitude lies within the "8" - "1" part of the scale (800 to 1100, 1800 to 2100, etc).

- **(b)** If the "CODE OFF" flag is visible, the DC power is not available, the circuit breaker is not in, or there is an internal altimeter encoder failure.
- **(c)** If the altimeter indicator does not correspond within 70 feet of the field elevation (with proper local barometric setting) the altimeter needs rezeroing or there has been an internal failure.
- (d) If the baroset knob binds or sticks, abnormal force should not be used to make the setting as this may cause internal gear failure resulting in altitude errors. Settings can sometimes be made by backing off and turning at a slower rate.

3-23. E E ALTIMETER SET, ELECTRONIC AN/APN-171A(V)1.

a. Description.

- (1) The radar altimeter is an airborne, low altitude, terrain-tracking and altitude sensing radar system. The Height Indicator ID-1345A/APN-171(B)(figure 3-27) indicates low altitude absolute height of the helicopter above terrain. It's primary purpose is to automatically retract mission antenna when the helicopter descends below the reset altitude.
- (2) Fluctuations of \pm 1.5 feet can be anticipated while hovering over smooth surfaces at altitudes under 100 feet. During normal flight operation above 5000 feet, the altimeter will indicate an unreliable condition.

CAUTION

After turning on, allow approximately three minutes for the system to reach operating temperature. To avoid damage to system components, do not return system to operation until three minutes have elapsed since system was turned OFF.

b. Controls and Functions. Refer to figure 3-27.

c. Operation.

(1) PUSH TO TEST, OFF, SET control-ON. Allow three minutes for system warm-up. The NO TRACK flag should remain visible and the dial pointer should remain behind the NO TRACK mask for 2 to 3 minutes after power is turned on. The pointer will then

rotate to the 0 \pm 5 foot graduation on the dial and the flag will disappear from view.

- **(2)** Low Warning Index-Set to 50 feet. The LOW warning light should illuminate.
- (3) PUSH TO TEST switch-Press. The height indicator pointer should indicate 100 \pm 15 feet. The LOW warning light should go out.
- (4) PUSH TO TEST switch-Release. The pointer should return to zero and the LOW warning light illuminate. The SET ALTM INDEX light will illuminate due to control action of a holding relay. This occurs on the initial extension of either mission antenna if the radar altimeter is not on. After initial antenna extension, the SET ALTM INDEX light will illuminate whenever the radar altimeter is secured, regardless of mission antenna position.
- **d. Stopping**. PUSH TO TEST, OFF, SET control-OFF.

3-24. X RADAR ALTIMETER - AN/APN-209.

a. Description. The radar altimeter set is a high resolution pulse radar that provides an indication of absolute clearance over all types of terrain. The set consists of the following: a panel mounted height indicator receiver transmitter (located on copilot instrument panel); a panel mounted remote height indicator (located on pilot instrument panel); and two flush mounted antennas on the underside of the helicopter. The controls and displays of the height indicator receiver-transmitter (IRT) and the remote height indicator (RI) are identical (see figure 3-28). Absolute altitude is displayed by a pointer and a digital readout. The pointer operates against a fixed dial and indicates tens of feet between 0 to 200 feet, and hundreds of feet between 200 to 1500 feet. Above 1500 feet the pointer is driven behind a mask. The digital display has a four digit readout. The readout is displayed in one foot increments up to 255 feet. At 256 feet the display is rounded up to 260 feet. Between 260 and 1500 feet the readout is displayed in tens of feet. The LO SET control knob functions as the on-off switch and is the low altitude trip point adjustment. Clockwise rotation turns the set on. Continuing a clockwise rotation provides for the setting of the low altitude bug. The HI SET control knob provides for the setting of the high altitude bug. Depressing the HI SET control knob places the altimeter set in the self-test mode. The IRT sends a simulated signal of 1000 feet to both indicators.

The indicators display the information via the pointer and digital readout. Whenever the indicated altitude drops below the low altitude bug setting the LO altitude warning lamp is activated. Whenever the indicated altitude goes above the high altitude bug setting, the HI altitude warning lamp is activated. When the LO SET control knob is turned to OFF, or during periods of unreliable operation, the OFF flag comes into view.

- **b. Operating Procedures.** The following procedures apply to both indicators (IRT on copilot instrument panel, and RI on pilot instrument panel). Accomplish procedures using controls on each indicator.
- (1) Initial Operation. Turn the IRT and RI on by turning the LO SET control knob clockwise. Set the low altitude warning bug to 80 feet by turning LO SET control knob clockwise. Set the high altitude warning bug to 800 feet by turning the HI SET control knob clockwise.

NOTE

The indicators should display a track condition within two minutes of the time the indicator was turned on. The OFF flag should disappear from view; the pointer read 0 ± 3 feet; the digital display - 0 to +3 feet; and the LO warning lamp illuminate.

Press and hold the HI SET control knob (push-to-test operation). The indicator pointer should read 1000 \pm

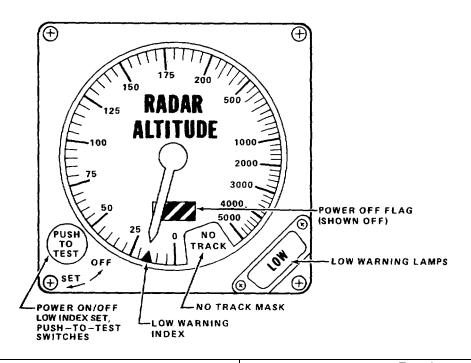
175 feet; the digital display 1,000 \pm 100 feet; the LO warning lamp should be off and the HI warning lamp on.

(2) Normal operation. LO SET control knob to desired setting for low altitude warning bug. The LO warning lamp will illuminate when indicated altitude drops below this setting. Adjust HI SET control knob to desired setting for high altitude warning bug. The HI warning lamp will illuminate when indicated altitude goes above the high altitude warning bug setting. For daylight operations, set the pilot's instrument lighting control (overhead console) to OFF. This setting provides lighting at full brightness to the warning lamps and digital displays on both indicators. Turning the instrument lighting controls (pilot and copilot) controls clockwise dims the indicator lighting.

NOTE

In the event of loss of track due to helicopter attitude (30 degrees pitch or 45° roll) or to operation beyond the range of the altimeter, the altitude pointer swings behind the no-track mask and the digital readout is totally blanked. In addition, the OFF flag comes into view.

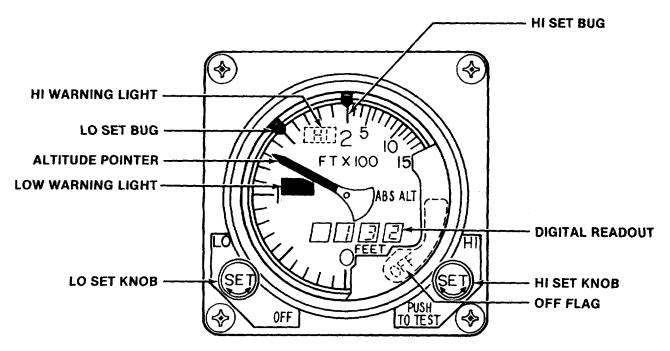
(3) Stopping Procedure. Turn LO SET control knob (on each indicator) fully counter clockwise.



Control/Indicator	Function	
PUSH TO TEST, OFF, SET control.	Applies 115 Vac power to height indicator and receiver-transmitter. Clockwise rotation is ON. Counterclockwise rotation is OFF.	
Low Index SET control.	Positions the low altitude warning index on the height indicator to the desired altitude. Clockwise rotation increases altitude setting.	
PUSH TO TEST switch.	Energizes the push-to-test circuit (self test) in the receiver-transmitter.	
Indicators		
Power OFF-NO TRACK flag.	When yellow-black striped flag is visible on the height indicator dial (other than during preflight warmup), power is off or track has been lost. When the flag is solid black, power is applied and track is maintained.	
LOW warning light.	When illuminated, the helicopter is at or below the altitude set by the low index SET control.	
NO TRACK mask.	When the dial pointer is behind the mask, it indicates that helicopter altitude is above 5,000 feet or the system has lost tracking.	
SET ALTM INDEX light.	Illuminate when either mission antenna is extended with radar altimeter off. Light is extinguished when radar altimeter is turned on, regardless of altitude which LOW INDEX SET control is set.	

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Figure 3-27. E EE Height Indicator ID-1345/APN-171(V)1



Control/Indicator	Function
1. LO SET Knob	Power control turned counterclockwise to OFF clockwise to on.
2. LO SET Bug	Sets altitude trip point of LO warning light.
3. HI SET Bug	Sets altitude trip point of HI warning light.
4. HI SET Knob	Pushing knob actuates built-in test system to self-test altimeter.
5. Altitude pointer	Provides an analog indication of absolute altitude from zero to 1500 feet.
6. Digital readout	Provides a direct-reading four digit indication of absolute altitude from zero to 1500 feet.
7. LO Warning light	Lights whenever dial point goes below L altitude bug setting.
8. Hi Warning light	Lights whenever dial pointer goes above H altitude bug setting.
9. OFF Flag	Moves into view whenever altimeter loses track while power is applied.

Figure 3-28. X Copilots Radar Altimeter Indicator RT-1115/AN/APN-209

CHAPTER 4

MISSION EQUIPMENT

SECTION I. MISSION AVIONICS

4-1. ANTENNA INSTALLATION.

Refer to figures 2-1 and 4-1.

4-2. E E CONSOLE GROUP AN/ ARQ-33/33A.

- **a.** The console group contains the electronic countermeasure system. It is an airborne radio frequency intercept, identification, and recording system designed to cover the frequency range from 2 to 100 MHz utilizing 4 RF tuning units for the intercept phase.
- **b.** It has the capability to initiate countermeasures against an RF emitter within its frequency range.
- c. There are three positions manned by two operators (two positions for search, one position for counter measures). Positions I and II use the AN/GLR-9(V)II for the search function. The two search consoles provide for reception of amplitude modulated (AM), frequency modulated (FM), continuous wave (CW) and pulse type emissions. Position III is the countermeasure console which is manned by the search operator of Position II when required. The AN/TLQ-27A is used for the countermeasures function.
- d. EE There are two positions manned by two operators. Position I is the countermeasures position which may also be used as a search position. The AN/TLQ-17A is used for the countermeasures function. Position II uses the AN/GLR-9(V)II for its search function (AM, FM, CW, or pulsed type emissions).

4-3. X CONSOLE GROUP AN/ALQ-151.

a. The console group contains a computer controlled system that is able to detect, locate, produce geographical fix data, and jam selected target emitters. The system may be operated independently as a single platform helicopter in the LOCAL mode, or a number of

systems in separate helicopters may be operated as a multiplatform in the NET mode.

- **b.** It has the capacity to initiate countermeasures against an RF emitter within its frequency range.
- **c.** There are two positions manned by one operator. One position contains the countermeasures system which uses the TLQ-17A, and the other position is an airborne radio frequency intercept, identification and direction finding system.

4-4. CONTROL INTERCOMMUNICATIONS SET C-1611D/AIC.

a. Description.

- (1) Intercommunications between the pilots and mission operator(s) is provided by the C- 1611D/AIC (figures 4-2, 4-3 and 4-4) when the transmit-interphone selector switch is set to INT. A CREW CALL button on the Emission power control panel or instrument panel is provided to permit the pilot or copilot to signal mission operator(s) who have selected PVT operation of the interphone.
- **(2)** Mission operators can key the selected transmitter by using a foot switch or by using the switch on the microphone cord.
- **b. Controls and Functions.** Refer to figures 4-2, 4-3 and 4-4.
 - **c. Operation**. Refer to chapter 3.

4-5. The second set is a second set is a second set in the second set is a second set in the second set in the second set is a second set in the second second set in the second se

Two AN/ARC-131 sets are installed. One is located forward for the pilot and copilot. The other is located in mission console 2. Refer to Chapter 3 for description and operation.

Table 4-1. Communications and Associated Electronic Equipment

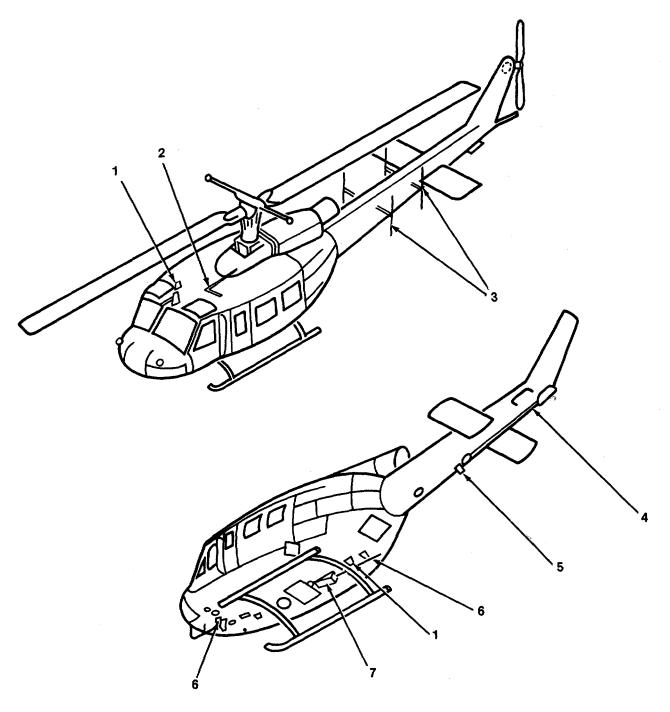
Nomenclature	Common Name	Use	Range
E EB Console Group AN/ARQ-33(A)	Special Purpose countermeasures system	Detects and jams target emitters	*Line-of-sight
X Console Group AN/ALQ-151(V)	Special Purpose countermeasures system	Detects, locates, fixes, and jams target emitters	*Line-of-sight
Radio Set AN/ARC-131	FM Receiver Transmitter	Two way voice communications.	*Line-of-sight
Control Intercommunications Set C-1611D/AIC	Signal Distribution Panel	Integrate inter- phone and all communications equipment.	N/A
Radar Altimeter AN/APN-171A(V)1	Radar Altimeter	Altitude sensing and terrain tracking.	5000 feet.
Countermeasures transmitter AN/TLQ-27A	ECM Transmitter	Electronic emission against unfriendly signals.	*Line-of-sight
Countermeasures transmitter EB X AN/TLQ-17A	ECM Transmitter	Surveillance and identification of R.F. signals and electronic emission against unfriendly signals.	*Line of sight.
Recorder-Reproducer, Sound AN/UNH-16A	Recorder	Record and play back of mission operator C-1611D/ AIC/audio and radar/radio signals.	N/A
Countermeasures reception AN/GLR-9(V)11	ECM Receiver	Surveillance and identification of R.F. signals.	*Line-of-sight

^{*}Range of transmission and reception is dependent upon a number of variables including weather conditions, time of day, operating frequency, power of transmitter, and altitude of helicopter.

Table 4-1. Communications and Associated Electronic Equipment (Cont)

Nomenclature	Common Name	Use	Range
X Radio Set AN/ARC-164	UHF Command Set	Two-way com- munications	Line-of-sight (50 miles average
Radar Altimeter AN/APN-209	Radar Altimeter	Altitude Sensing and Terrain Tracking	1500 feet
Radar Warning E AN/APR-39(V)1 EB X AN/APR-39(V)2	Radar Warning	Both visual and audible warning in radar environ-ment	*Line-of-sight
Radar Warning EB X Receiver AN/APR-44	Radar Warning	Both visual and audible warning in radar environ-ment	*Line-of-sight
EB X Countermeasures Set AN/ALQ-144	Countermeasure Jammer	IR Jammer	N/A
X Bearing Distance Heading Indicator ID-2091/ASN	BDHI	Indicates bearing and distance to selected target	N/A

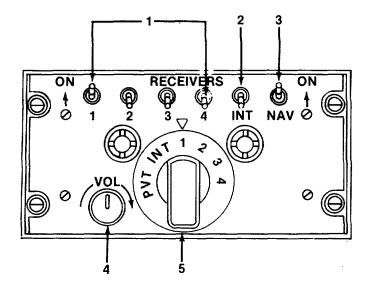
^{*}Range of transmission and reception is dependent upon a number of variables including weather conditions, time of day, operating frequency, power of transmitter, and altitude of helicopter.



- TACAN Navigation Antenna X
 VHF-FM Communication Antenna
- 3. DF Antennas X

- 4. ECM Antenna
 5. BITE Antenna X
 6. TACO Communication Antenna X
 7. Intercept Antenna EEE

Figure 4-1. Mission Antenna Installation



MISSION OPERATOR POSITION 1

	CONTROL/INDICATOR	FUNCTION
1.	RECEIVERS	
	Switch 1	Permits monitoring of FM ARC-131 air-to-ground communications link audio.
	Switch 2	Permits monitoring of R-1634/TLQ-27 audio.
	Switch 3	Permits monitoring of GLR-9 (Pos I) audio.
	Switch 4	Permits monitoring of UNH-16 (Pos I). Channel 1 Playback audio.
2.	INT switch	Permits monitoring of Interphone Audio.
3.	NAV switch	Permits monitoring of GLR-9 (Pos I) audio.
4.	VOL control	Adjusts earphone volume of any audio being monitored.
5.	Transmit-interphone	
	selector switch	
	PVT	Permits intercommunication between Positions I, II and III only.
	INT	Permits intercommunication between Positions I, II and III and pilot and copilot.
	1	Permits transmission over FM ARC-131 air-to-ground communications link.
	2 3	Not used
		Not used
	4	Permits Position I Operator to Record MIC Audio On Channel 2 of UNH-16 Recorder.

Figure 4-2. E Intercommunication Control Set (C-1611D/AIC)(Sheet 1 of 3)

MISSION OPERATOR POSITION II

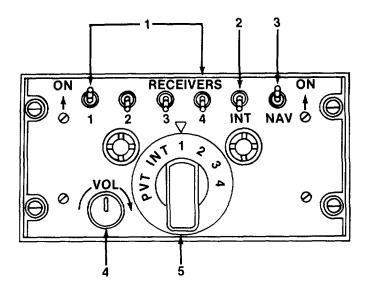
	CONTROL/INDICATOR	FUNCTION
1.	RECEIVERS Switch 1 Switch 2 Switch 3 Switch 4	Permits monitoring of FM ARC-131 air-to-ground communications link audio. Permits monitoring of R-1634/TLQ-27 audio. Permits monitoring of GLR-9 (Pos II) audio. Permits monitoring of AN/UNH-16 (Pos II Channel 1 playback audio.)
2.	INT switch	Permits monitoring of Interphone audio.
3.	NAV switch	Permits monitoring of GLR-9 (Pos I) audio.
4.	VOL control	Adjusts earphone volume of any audio being monitored.
5.	Transmit-interphone selector switch PVT INT 1 2 3 4	Permits intercommunication between Positions I, II and III only. Permits intercommunication between Positions I, II and III with pilot and copilot Permits transmission over FM ARC-131 air-to ground communications link. Not Used Not Used Permits Position II Operator to Record Mic Audio on Channel 2 of UNH-1 6 Recorder.

Figure 4-2. E Intercommunication Control Set (C-1611D/AIC) (Sheet 2 of 3)

MISSION OPERATOR POSITION III

CONTROL/INDICATOR	FUNCTION	
RECEIVERS Switch 1	Permits monitoring of FM ARC-131 air-to-	
Switch 1	ground communications link audio.	
Switch 2	Permits monitoring of R-1634/TLQ-27 audio.	
Switch 3	Permits monitoring of GLR-9 (Pos II) audio.	
Switch 4	Permits monitoring of UNH-16 (Pos II) Channel 1 Playback audio.	
2. INT switch	Permits monitoring of Interphone audio.	
3. NAV switch	Permits monitoring of GLR-9 (Pos I) audio.	
4. VOL switch	Adjusts earphone volume of any audio being monitored.	
Transmit-interphone selector switch		
PVT	Permits intercommunication between Positions I, II and III only.	
INT	Permits intercommunication between Positions I, II, and III and pilot and copilot.	
1	Permits transmission over FM ARC-131 air-to- ground communications link.	
2	Not Used.	
3	Not Used.	
4	Not Used.	
		j

Figure 4-2. ■ Intercommunication Control Set (C-1611D/AIC) (Sheet 3 of 3)



MISSION OPERATOR POSITION 1

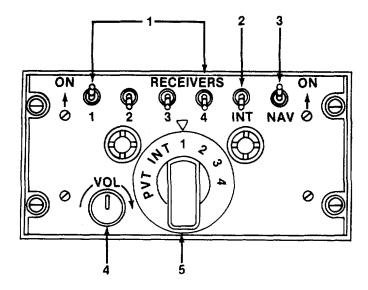
CONTROL/INDICATOR	FUNCTION
1. RECEIVERS	
Switch 1	Permits monitoring of FM ARC-131 air-to- ground communications link audio.
Switch 2	Permits monitoring of UNH-16 (Pos I) Channel 1 Playback audio.
Switch 3	Permits monitoring of TLQ-17A audio.
Switch 4	Permits monitoring of UNH-16 (Pos I) Channel 2 side tone.
2. INT switch	Permits monitoring of Interphone Audio.
3. NAV switch	Permits monitoring of GLR-9 (Pos II) audio.
4. VOL control	Adjusts earphone volume of any audio being monitored.
Transmit-interphone selector switch	
PVT	Permits intercommunication between Positions I and II only.
INT	Permits intercommunication between positions I and II and pilot and copilot.
1	Permits Transmission over FM ARC-131 air-to- ground communications link.
2	Not Used.
3	Not Used.
4	Permits Position I Operator to Record Mic audio on Channel 2 of UNH-16 Recorder.

Figure 4-3. El Intercommunication Control Set (C-1611D/AIC) (Sheet 1 of 2)

MISSION OPERATOR POSITION II

CONTROL/INDICATOR	FUNCTION
1. RECEIVERS	
	Demails association of FM ADO 404 sin to
Switch 1	Permits monitoring of FM ARC-131 air-to- ground communications link audio.
Switch 2	Permits monitoring of UNH-16 (Pos II) Channel 1 Playback audio.
Switch 3	Permits monitoring of GLR-9 (Pos II) audio.
Switch 4	Permits monitoring of UNH-16 (Pos II) Channel 2 side tone.
2. INT switch	Permits monitoring of interphone audio.
3. NAV switch	Permits monitoring of TLQ-17 audio.
4. VOL control	Adjusts earphone volume of any audio being monitored.
Transmit-interphone selector switch	
PVT	Permits intercommunication between Positions I and II only.
INT	Permits intercommunication between Positions I and II and pilot and copilot.
1	Permits Transmission over FM ARC-131 air-to- ground communications link.
2	Not Used.
3	Not Used.
4	Permits Position II Operator to Record Mic Audio on Channel 2 of UNH-16 Recorder.

Figure 4-3. EEE Intercommunication Control Set (C-1611D/AIC)(Sheet 2 of 2)



MISSION OPERATOR POSITION 1

CONTROL/INDICATOR	FUNCTION
1. RECEIVERS	
Switch 1	Pormits manifering of APC 164 air to ground
Switch	Permits monitoring of ARC-164 air-to-ground and air-to-air communications link audio.
Switch 2	Permits monitoring of UNH-16A Channel I
	playback audio.
Switch 3	Permits monitoring of ARC-114 air-to-ground communications audio.
Switch 4	Permits monitoring of intercept/DF audio.
2. INT switch	Permits monitoring of interphone audio.
3. NAV switch	Permits monitoring of TLQ-17A receiver audio.
4. VOL control	Adjusts earphone volume of any audio being monitored.
5. Transmit-interphone	
select switch	
PVT	Permits intercommunication between crew and pilot and copilot.
INT	Permits intercommunication between crew and pilot and copilot.
1	Permits Transmission over UHF ARC-164 air-to- ground communications link.
2	Permits operator to record Mic audio on Channel 2 of UNH-16 Recorder.
3	Permits Transmission over FM ARC-114 air-to- ground communications link.
4	Not Used.

Figure 4-4.

▼ Intercommunication Control Set (C-1611D/AIC)

4-6. E MISSION AC POWER CONTROL PANEL SA-1843/ARQ-33.

- **a.** Description. The MISSION AC power control panel is located on the overhead console. Switches on the panel provide control of dc power to the 115 volt single phase inverter which supplies power to the radar altimeter and countermeasures receivers.
 - **b.** Controls and Function. Refer to figure 4-5.
 - c. Operation.
- (1) GND PWR/STBY GEN switch STBY GEN (GND PWR if GPU utilized).
 - (2) MISSION INVTR switch ON.

4-7. E II A MISSION POWER CONTROL PANEL C-8983/ARQ-33.

- a. Description.
- (1) The mission power control is located on the pedestal and controls the 28 Vdc power to crew position cigarette lighters, dc voltmeter, antenna coupler, and mission power to mission consoles when pressed.
- (2) A CREW CALL switch is located on the panel and flashes CREW CALL indicators on consoles when pressed.
 - **b.** Controls and Functions. Refer to figure 4-6.
 - **c.** Operation.
- (1) MISSION POWER switch ON. (Power to mission console 2 MAIN POWER switch).
- (2) CREW CALL switch Press and hold. CREW CALL illuminates on each mission console and on pedestal.
- (3) CREW CALL switch Release. CREW CALL light should extinguish.
- **d.** Stopping Procedure. MISSION POWER switch OFF.

4-8. X MISSION POWER CONTROL PANEL.

- **a.** Description. The mission power control is located on the overhead console. The switch on the panel provides power for the mission equipment.
 - **b.** Controls and Functions. Refer to figure 4-7.

- c. Operation.
 - (1) MISSION POWER circuit breaker IN.
 - (2) MISSION POWER switch ON.

4-9. E E MISSION ANTENNA CONTROL PANEL, SA-1823/ARQ-33.

- **a.** Description. The mission antenna control panel is located on the pedestal and controls antenna extension and retraction.
 - **b.** Controls and Function. Refer to figure 4-8.
 - **c.** Operation.

CAUTION

The FWD RETR ANT CONT and AFT RETR ANT CONT circuit breakers must be out during ground and hover operation. Inadvertent antenna extension, which results in ground contact, will damage the antennas.



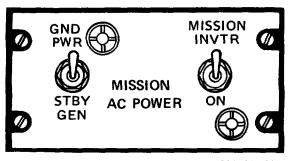
Do not extend mission antennas with helicopters on the ground or in a low hover.

- (1) Ground Check.
- **(a)** TEST switch Press. (all sections of the mission antenna position indicator should illuminate).
- **(b)** DIM control Adjust brightness as required.
 - (2) In Flight.

NOTE

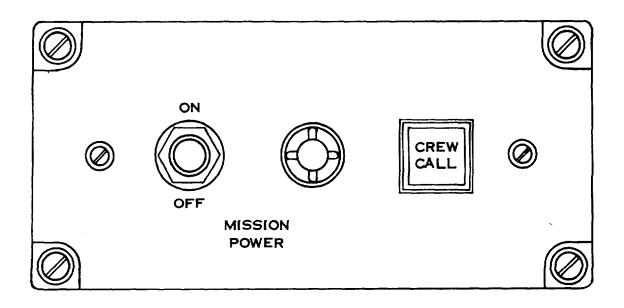
The mission antennas may be raised by pressing the antenna emergency retract switch on the pilot/copilot cyclic stick.

FWD and/or AFT MISSION ANTENNA EXTEND - RETRACT switches - EXTEND.



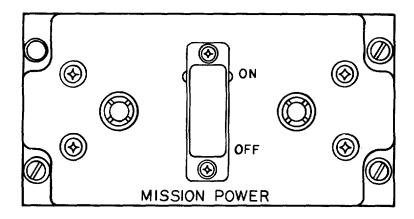
CONTROL	FUNCTION
GND/PWR - STBY GEN switch	Selects 28 V dc power source for ARQ-33 bus.
MISSION INVTR switch	Controls dc power to inverter control relay which controls inverter supplying power to radar altimeter and countermeasures receivers.

Figure 4-5. E Mission AC Power Control Panel, SA-1843/ARQ-33



CONTROL	FUNCTION
ON-OFF switch	Applies the 28 Vdc to AN/ARQ-33 system.
CREW CALL	Allows pilot to alert crew for ICS operation if CREW ICS is on PVT position.

Figure 4-6. EEE Mission Power Control Panel, C-8983/ARQ-33



CONTROL/INDICATOR	FUNCTION
ON/OFF Switch	Turns mission power on or off.

Figure 4-7. X Mission Power Control Panel

- **a.** Description. The mission antenna control switch is located on the instrument panel and controls AN/TLQ-17A (ECM) antenna extension and retraction.
 - **b.** Controls and Functions. Refer to figure 4-9.
 - **c.** Operation.
 - (1) Operation (AN/APN-209 radar altimeter on).
- (a) ECM ANTENNA switch EXTEND or RETRACT as required. (No action will occur if EXTEND is chosen and antenna is already fully extended. If RETRACT is chosen, no action will occur if antenna is already fully retracted).
- **(b)** If antenna is extended when the aircraft is below the present altitude on the APN-209 radar altimeter, the antenna will automatically retract. Extension is prevented as long as aircraft altitude remains below the preset limit.
- **(2)** Operation (AN/APN-209 radar altimeter off or disconnected).

NOTE

While the aircraft is on the ground, the AN/TLQ-17A antenna may be extended only by pulling the AN/APN-209 circuit breaker out and holding ECM ANTENNA switch in EXTEND position. Antenna may be stopped in transit by pulling ECM ANT circuit breaker out.

- **(a)** ECM ANTENNA switch EXTEND. Hold until antenna is fully extended.
- **(b)** If ECM antenna switch is released before antenna is fully extended, the antenna will automatically return to the fully retracted position.

4-11. E E MISSION ANTENNA POSITION INDICATOR.

a. Description. The mission antenna position indicator is located on the instrument panel. The purpose of the indicator is to show the condition status of the forward and aft mission antennas.

b. Controls and Functions. Refer to figure 4-10.

4-12 E E COMMUNICATIONS SECURE - NONSECURE INDICATOR.

a. Description. (Refer to figure 4-11). There are four three indicators installed. One indicator is located on the instrument panel and one is located on each mission console. Each indicator displays the operating mode of the AN/ARC-51BX, the AN/ARC-134 and both AN/ARC-131 radio sets.

NOTE

The AN/ARC-51BX and AN/ARC-134 do not have voice security.

- **b.** Each indicator is white when not illuminated. The black legends are visible only when the background color is illuminated.
- **c.** The indicator displays operational modes as follows:
- (1) FWD and/or AFT FM operating in secure mode: FWD FM and/or AFT FM steady green (dimmable). Indicator is dimmable but cannot be extinguished.

NOTE

The appropriate section of the indicator will automatically become flashing bright green if either AN/ARC-131 is operated nonsecure and the NON SEC indicator will illuminate bright red.

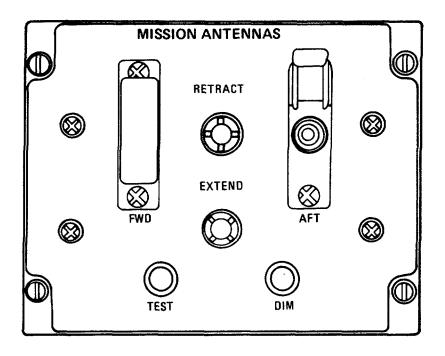
(2) AN/ARC-51 and or AN/ARC-134 transmission: NON SEC indicator steady red (dimmable) one mission consoles. This mode is used to alert the crew not to use the intercom during AN/ARC-51 or AN/ARC-134 transmission.

4-13. UHF COMMAND SET AN/ARC-164.

Refer to Chapter 3 for description and operation.

4-14. ☐ RADAR ALTIMETER AN/APN-209.

Refer to Chapter 3 for description and operation.



Control	FUNCTION
FWD EXTEND/RETRACT switch	To raise or lower intercept antenna.
AFT EXTEND/RETRACT switch	To raise or lower aft countermeasures antenna.
TEST switch	A press-to-test switch to check all antenna position indicator lamps, on the instrument panel
DIM control	To control intensity of mission antenna position indicator.

Figure 4-8. E EE Mission Antenna Control Panel, SA-1823/ARQ-33



CONTROL/INDICATOR	FUNCTION
RETRACT/EXTEND Switch	To raise or lower countermeasures antenna.

Figure 4-9. X Mission Antenna Control Switch

4-15. RADAR WARNING RECEIVER AN/APR-39.

- **a.** Description. The radar warning receiver AN/APR-39 (figure 4-12) provides the pilot with visual and audible warning when a hostile fire-control threat is encountered. The equipment respond to hostile fire-control radars but nonthreat radars are generally excluded. The equipment also receives missile guidance radar signals and, when the signals are time-coincident with a radar tracking signal, the equipment identifies the combination as an activated hostile surface to air (SAM) radar system. The visual and aural displays warn the pilot of potential threat so that evasive maneuvers can be initiated.
 - **b.** Controls and Functions. Refer to figure 4-13.
 - c. Operations.
 - (1) System Operation.
 - (a) PWR switch ON.
 - (b) AUDIO control Adjust.
 - (c) Intensity control Adjust.
 - (d) NIGHT DAY control Adjust.
 - (2) Self-Test Operation.
 - (a) DSCRM switch ON.
- **(b)** Press SELF TEST switch, verify that within approximately three seconds the indicator displays a forward (0 degrees) or aft (180 degrees) strobe and an audio tone is heard.
- **(c)** Approximately three seconds later, the opposite strobe should appear and the audio tone becomes stronger.
 - (3) Stopping Procedure. PWR switch OFF.

4-16. **■ NAPR** 4-16. **■ ANAPR** 44.

- **a.** Description. The AN/APR-44 radar warning system (figure 4-14) indicates the presence of certain types of search radar signals. The radar warning system consists of two antennas, a receiver, a control (figure 4-15) and a remote indicator on the center of the instrument panel. The system is protected by a 5-ampere circuit breaker on the overhead circuit breaker panel.
 - **b.** Controls and Functions. Refer to figure 4-15.

- c. Operating Procedures.
 - (1) POWER switch ON.
 - (2) VOLUME control Adjust, as desired.

4-17. ■ COUNTERMEASURES SET AN/ALQ-144.

- **a.** Description. The AN/ALQ-144 IR Countermeasures Set (Figure 4-16) consists of a transmitter (not installed at this time), control panel (Figure 4-16) and associated cables including a 100 ampere converter. The converter (Figure 4-16) is used to supply dc power for this system. The control panel is located on the pedestal. The system is protected by a one ampere circuit breaker on the overhead circuit breaker panel.
 - **b.** Controls and Functions. Refer to Figure 4-17.
 - **c.** Operating Procedure.

WARNING

Do not expose skin or eyes to infrared radiation for longer than 10 seconds at distances less than 4 inches.

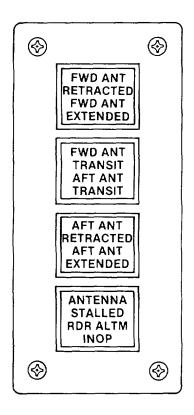
NOTE

ALQ-144 INOP indicator on Master Caution Panel should not illuminate.

- **1.** ON-OFF switch ON momentarily, then release (switch will return to center position when released).
- **2.** Stopping Procedure. ON-OFF switch OFF. The transmitter will continue to operate for about 60 seconds during the cool-down cycle.

4-18. BEARING DISTANCE HEADING INDICATOR (BDHI) ID-2091/ASN.

- **a.** Description. This BDHI displays mission data. The compass card is driven by the ASN-86. The needle and distance readout (in statute miles) indicate respectively bearing and distance to a target selected by the mission operator. It is located on the pilot's instrument panel to the left of his BDHI.
 - **b.** Controls and Functions. Refer to Figure 4-18.



MISSION OPERATOR POSITION I

CONTROL/INDICATOR	FUNCTION
(1) FWD ANT RETRACTED.	Illuminates when forward antenna is stowed in fully retracted position.
(2) FWD ANT EXTENDED	Illuminates when forward antenna is fully extended.
(3) FWD ANT TRANSIT	Illuminates when forward antenna is in transit.
(4) AFT ANT TRANSIT	Illuminates when aft antenna is in transit.
(5) AFT ANT RETRACTED	Illuminates when aft antenna is stowed in fully retracted position.
(6) AFT ANT EXTENDED	Illuminates when aft antenna is fully extended.
(7) ANT STALLED.	Illuminates when either antenna jams in an intermediate position.
(8) RDR ALTM INOP	Illuminates if radar altimeter is disabled.

Figure 4-10. E E Mission Antenna Position Indicator

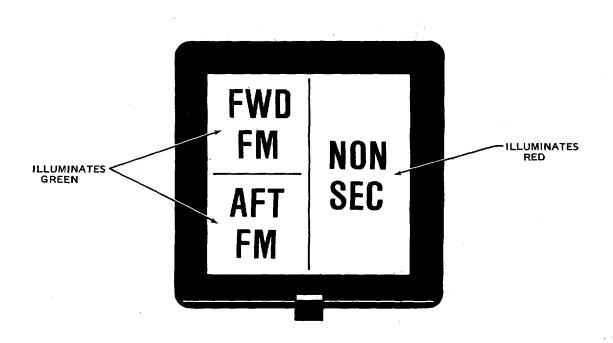


Figure 4-11. E E Communications Secure-Nonsecure Indicator

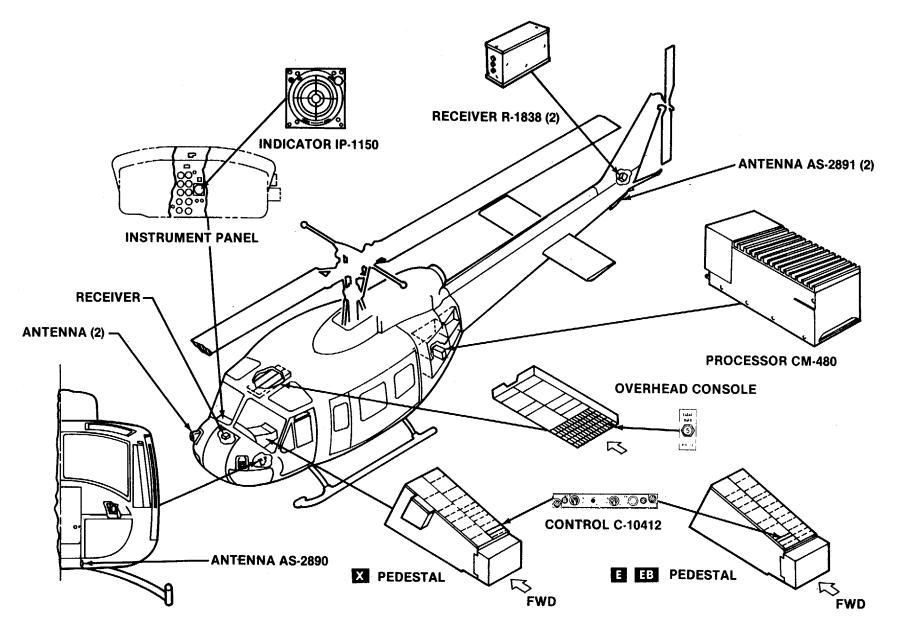
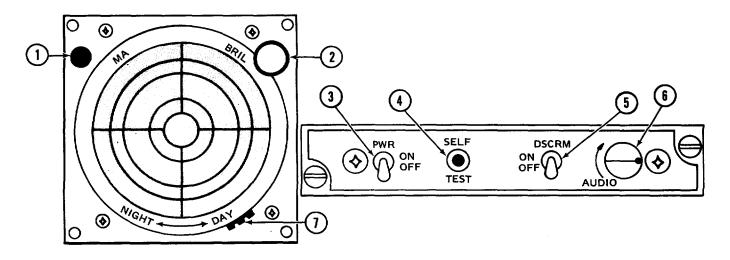


Figure 4-12. Radar Warning System AN/APR-39



CONTROL/INDICATOR	FUNCTION
1. MA Indicator	Flashing indicates high radar missile threat with DSCRM switch in ON.
2. BRIL Control	Adjusts indicator illumination.
3. PWR Switch: ON	Applies power to radar set
OFF	De-energizes radar set.
SELF-TEST Switch: With DSCRM Switch OFF	No indications.
With DSCRM Switch ON	One strobe appears at a cardinal point and primary (normal) audio tone is heard. After short delay, a second strobe will appear 180 degrees from the initial strobe. After another short delay, MA light will start flashing and audio warning (whaling) tone is heard.
5. DSCRM Switch: OFF	Without missile activity - Provides strobe lines for ground radar and normal audio indications.
	With missile activity - Provides strobe lines for ground radar, flashing strobe line(s) for missile activity, and flashing MA (missile alert) light.
ON	Without missile activity - No indications.
	With missile activity - Flashing strobe lines for missile activity (no strobe lines for ground radar), flashing MA light, and audio warning (whaling) tone.
6. AUDIO Control	Adjusts radar warning audio volume.
7. NIGHT-DAY Control	Adjust indicator intensity.

Figure 4-13. Radar Warning System AN/APR-39

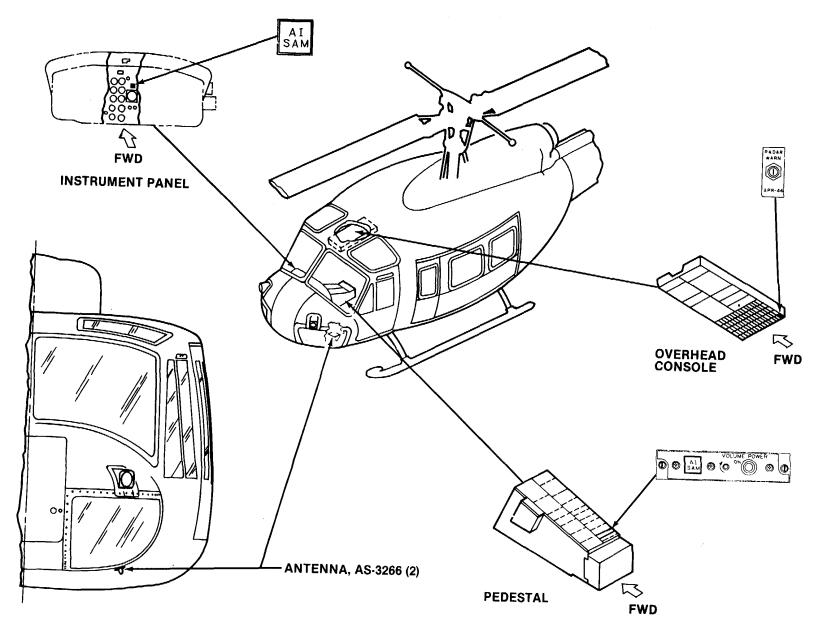
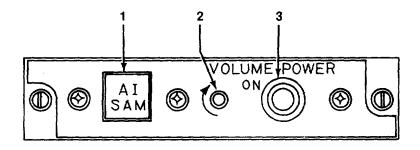


Figure 4-14. EE X Radar Warning System AN/APR-44



CONTROL/INDICATOR	FUNCTION
Radar Warning Indicator	Illuminates to indicate the presence of an AI or SAM threat.
2. VOLUME Control	Adjusts volume.
3. POWER Switch	Turns set on or off.

Figure 4-15. EE X Radar Warning Receiver Control Panel (AN/APR-44(V) 3)

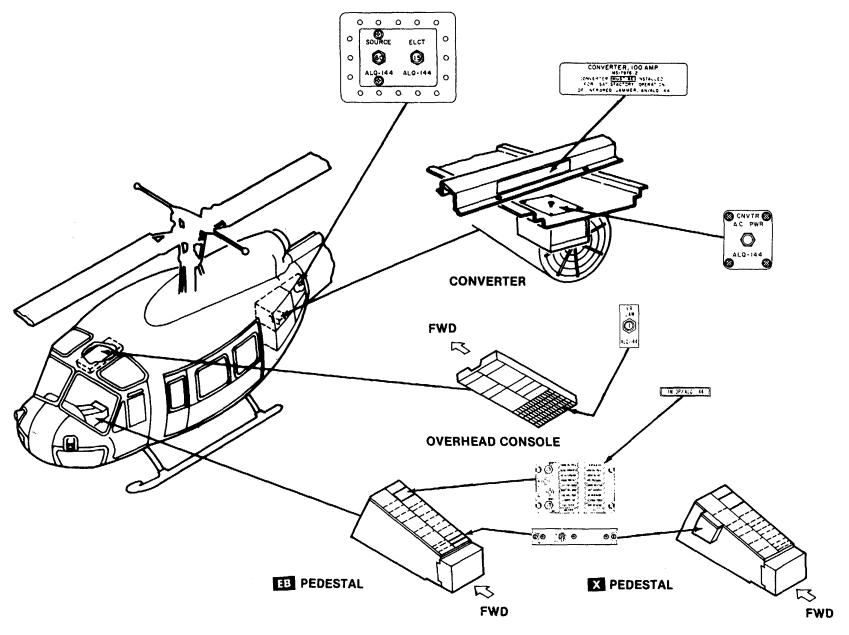
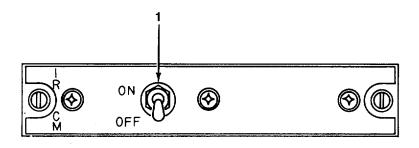
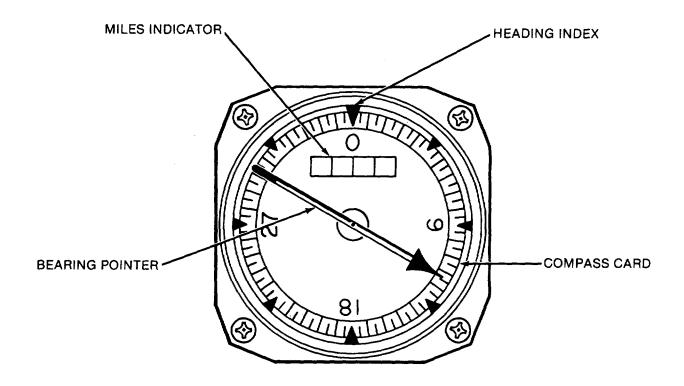


Figure 4-16. EE X Countermeasures System AN/ALQ-144



CONTROL/INDICATOR	FUNCTION
1. ON/OFF Switch	Turns set on or off.

Figure 4-17. **EE** X Countermeasures Control Panel (AN/ALQ-144)



CONTROL/INDICATOR	FUNCTION		
Heading Index	Provides compass card reference mark.		
Compass Card	Rotating card. Number under heading index indicates magnetic heading of helicopter.		
Bearing Pointer	Indicates bearing to RF emitter or station.		
Miles Indicator	Indicates nautical miles to or from destination or station.		

Figure 4-18. Mission Bearing Distance Heading Indicator (ID-2091)

Section II. ARMAMENT

4-19. **■** M-130 FLARE AND CHAFF DISPENSING SYSTEM.

a. Description. The M-130 flare and chaff dispensing system provides effective survival countermeasures against radar guided weapons systems and infrared seeking missile threats. The systems consists of two dispenser assemblies with payload module assemblies, a dispenser control panel, chaff dispense switches, a flare dispense switch with an electronic module assembly. The system is powered by the 28VDC mission essential bus and is protected by a circuit breaker labeled CHAFF/FLARE M130 on the DC circuit breaker panel.

WARNING

Flares shall be installed only on the right side with the dispenser in the AFT facing position.

- (1) Dispenser Assemblies. Two interchangeable dispenser assemblies are mounted on the aircraft (figures 4-19 and 4-20). One is located on the left-hand aft external stores fittings, (figure 4-21) and the other is mounted on the right-hand aft external stores fittings (figure 4-21). On this aircraft the dispenser on the left side will be used for chaff only, (Primary) while the dispenser on the right side can be used for either chaff, (Secondary) or flares. In the chaff mode, the right side will not be effective until the left side has been ejected (30 rounds). The selector switch (placarded C-F) on the dispenser can be set for either chaff or flares. The unit also contains the sensor for the flare detector. The dispenser assembly breech plate has the electrical contact pins which fire the impulse cartridges. The unit also contains the sequencing mechanism.
- (2) Payload Module Assemblies. A removable payload module assembly is provided for each dispenser assembly. Each payload module has 30 chambers which will accept either flares or chaff. Flares or chaff are loaded into the rear end (studded of the payload module and secured in place by a retaining plate).
- (3) Electronic Module Assembly. The electronic module assembly contains the programmer and the flare detector (figures 4-19 and 4-20). The unit is located in the aft radio compartment.

NOTE

Safety pin is not used in the electronic module assembly when installed in aircraft.

- (a) Flare Detector. The flare detector is provided to insure that a flare is burning when it is ejected from the payload module. If the initial flare fails to ignite, the detector automatically ejects another flare within 75 milliseconds. If the second flare fails to ignite, the detector will eject a third flare. If the third flare ignition is not detected, the detector will not eject another flare until the system is activated again by pressing the FLARE DISPENSE switch.
- **(b)** Programmer. The programmer is used for the chaff mode only. It has four switches labeled SALVO, BURST, COUNT & INTERVAL. Refer to TM 9-1095-206-13 and P for a description of the switch functions.
- **(4)** Flare Dispense Switch (figure 4-22). A single pushbutton switch placarded FLARE DISPENSE, located on the control pedestal (figures 4-19 and 4-20) will eject a flare from the dispenser payload module each time it is pressed.
- (5) Dispenser Bracket Mounted Safety Switch. A dispenser bracket mounted safety switch (with safety pin and flag) located on the edge of each bracket (figure 4-21) prevents the ejecting of chaff or flares when the pin is inserted. This safety pin shall be inserted while the aircraft is on the ground and removed prior to flight or during system tests. Both safety pins with their red flags should be stowed upon the EE forward transmission bulkhead, X the left hand door post (figures 4-19 and 4-20) prior to flight.

NOTE

When a safety pin had been removed from either side of the aircraft and aircraft power has been supplied to the DCP, the ARM lamp will light and both counters will count. However, there will be no power to the dispenser with the safety pin installed.

(6) Chaff Dispenser Switches. The weapon fire switches located on the pilot and co-pilot cyclic control (figures 4-19 and 4-20) will eject chaff cartridges as programmed or singly depending on control panel setting. The number of burst/salvo and number of salvo/program and their intervals will be set into the programmer prior to take-off (refer to TM 9-1095-206-13 and P for information on setting programmer). If desired, the operator may override the programmed operational mode and fire chaff countermeasures manually by moving the dispenser function selector switch to MANUAL and pressing the dispenser switch.

- (7) Dispenser Control Panel (figure 4-22). The dispenser control panel (DCP) (figures 4-19 and 4-20) is mounted on the control pedestal. Control/Indicator functions are described in figure 4-22.
- **(8)** Ammunition for Dispenser. Ammunition for the system consists of countermeasures chaff M1, countermeasures flares M206, and impulse cartridges M796

4-20. PREFLIGHT PROCEDURES - M-130 FLARE AND CHAFF DISPENSING SYSTEM.

- a. Dispenser covers Remove.
- **b.** Safety pins Installed.
- **c.** Dispensers Check condition and security;

Payload modules installed as required;

C-F Switch - set as required.

- d. Electronic module switches set as required
- e. ARM-SAFE switch SAFE.
- f. RIPPLE-FIRE switch cover down.
- **g.** Safety pins Remove.

4-21. BEFORE TAKEOFF PROCEDURES - M-130 FLARE AND CHAFF DISPENSING SYSTEM.

- a. Counters Sets required.
- **b.** ARM light Press to test.

4-22. INFLIGHT PROCEDURES - M-130 FLARE AND CHAFF DISPENSING SYSTEM.

- a. ARM-SAFE switch ARM
- b. CHAFF selector switch as required.
- c. CHAFF dispense switch Press as required.
- d. FLARE dispense switch Press as required.

4-23. BEFORE LANDING PROCEDURES - M-130 FLARE AND CHAFF DISPENSING SYSTEM.

ARM-SAFE switch - SAFE

4-24. BEFORE LEAVING HELICOPTER PROCEDURES - M-130 FLARE AND CHAFF DISPENSING SYSTEM.

- a. Safety pins Install.
- b. Dispenser covers Secure.

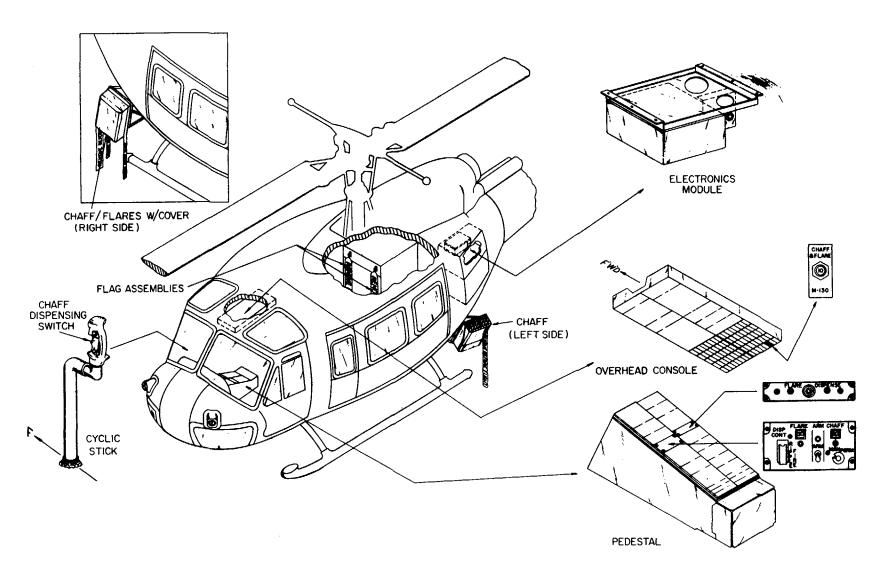


Figure 4-19. EB MI30 Flare/Chaff Dispensing System

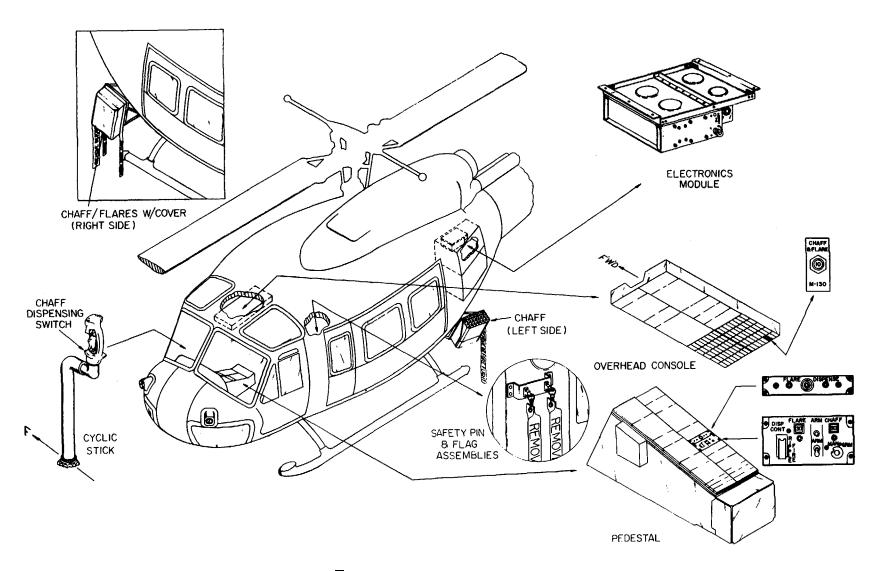
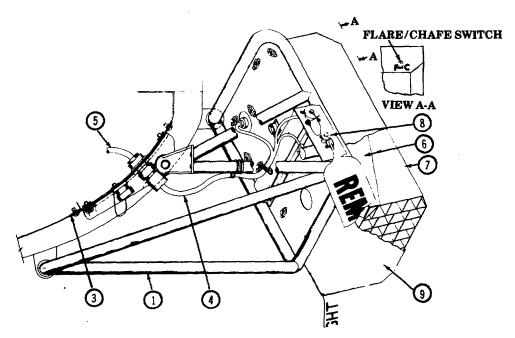
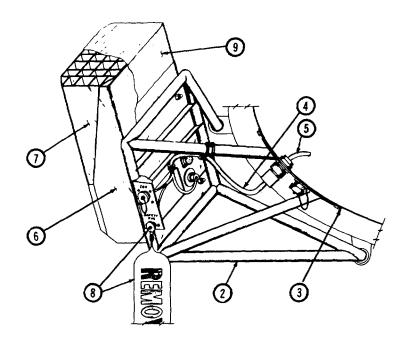


Figure 4-20. X MI30 Flare/Chaff Dispensing System



VIEW LOOKING FORWARD - RIGHT SIDE

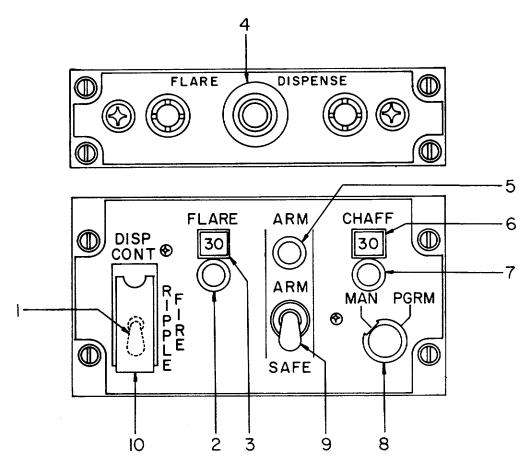


VIEW LOOKING FORWARD - LEFT SIDE

- 1. Support assembly right
- 2. Support assembly left
- 3. Access panel assembly
- 4. Cable assembly external
- 5. Cable assembly internal

- 6. Dispenser assembly
- 7. Payload module
- 8. Safety pin and flag
- 9. Cover

Figure 4-21. EB X Flare/Chaff Dispenser Installation



CONTROL/INDICATOR

light.

FUNCTION

1.	RIPPLE FIRE switch	A guarded switch placarded RIPPLE FIRE fires all remaining flares when moved to the up position. It is used	6.	CHAFF counter	Indicates the number of chaffs remaining in the payload module.
		in the event of an inflight emergency to dispense all flares from the dispenser payload module.	7.	CHAFF counter setting knob	Facilitates setting CHAFF counter to the number of chaffs in the payload module before flight.
2.	FLARE counter setting knob	Facilitates setting FLARE counter to the number of flares in the payload module before flight.	8.	CHAFF SELECTOR switch	र
3.	FLARE counter	Indicates the number of flares remaining in the dispenser payload module.		MAN	Bypasses the programmer and fires one chaff each time one of the chaff dispense switches is pressed.
4.	FLARE DISPENSE switch	Fires one flare each time the FLARE DISPENSE switch is pressed.		PRGM	Chaff is fired in accordance with the preset chaff program as set into the electronic module (count and interval of bursts and salvo).
5.	ARM light	An amber press to test indicator light placarded ARM illuminates when the ARM-SAFE switch is in the ARM position, when the safety pins are removed from the electronic module and the wing safety switch. Clock-	9.	ARM-SAFE switch	When in the SAFE position, power is removed from the M-130 system. When in the ARM position, power is applied to the M-130 system.
		wise rotation will dim the indicator	10.	RIPPLE FIRE	Guards against firing of remaining

Figure 4-22. EE X Flare/Chaff Dispenser Control Panel

switch cover

flares except in an emergency.

CHAPTER 5

OPERATING LIMITS AND RESTRICTIONS

SECTION I. GENERAL

5-1. PURPOSE.

This chapter identifies or refers to all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. GENERAL.

The operating limitations set forth in this chapter are the direct results of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the helicopter.

5-3. EXCEEDING OPERATIONAL LIMITS.

Anytime an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required.

5-4. MINIMUM CREW REQUIREMENTS.

The minimum crew required to fly the helicopter is one pilot. During single pilot operations, the pilot's station is in the right seat. Additional crewmembers, as required, may be added at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

SECTION II. SYSTEM LIMITS

5-5. INSTRUMENT MARKINGS. (FIGURE 5-1.)

- a. Instrument Marking Color Codes. Operating limitations and ranges are illustrated by the colored markings which appear on the dial faces of engine, flight, and utility system instruments. RED markings on the dial faces of these instruments indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings on instruments indicate the safe or normal range of operation. The YELLOW markings on instruments indicate the range when special attention should be given to the operation covered by the instrument.
- **b. Instrument Glass Alignment Marks.** Limitation markings consist of strips of semitransparent color tape which adhere to the glass outside of an indicator dial. Each tape strip aligns to increment marks

on the dial face so correct operating limits are portrayed. The pilot should occasionally verify alignment of the glass to the dial face. For this purpose, all instruments that have range markings have short, vertical white alignment marks extending from the bottom part of the dial glass onto the fixed base of the indicator. These slippage marks appear as a single vertical line when limitation markings on the glass properly align with reading increments on the dial face. However, the slippage marks appear as separate radial lines when a dial glass has rotated.

5-6. ROTOR LIMITATIONS.

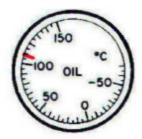
- a. Refer to figure 5-1.
- **b.** Restrict rotor speed to 319 to 324 RPM (6500 to 6600 RPM) during cruise flight





ENGINE OIL PRESSURE

- 25 PSI Minimum Engine Idle 80 to 100 PSI Continuous Operation
- 100 PSI Maximum



TRANSMISSION OIL TEMPERATURE

110°C Maximum



AIRSPEED NOSE MOUNTED PITOT TUBE

112 Knots Maximum

Refer to Figure 5-3, Airspeed Operating
Limits for Additional Limitations.



ENGINE OIL TEMPERATURE

93°C Maximum Below 30°C FAT 100°C Maximum At 30°C FAT and Above

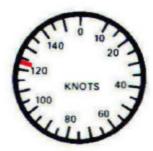
NOTE

Operating Time, Engine Oil Temperature and Ambient Air Temperature Shall Be Logged On DA Form 2408-13, When Engine Oil Temperature Exceeds 93 C.



TRANSMISSION OIL PRESSURE

- 30 PSI Minimum
- 40 to 60 PSI Continuous Operation
- 70 PSI Maximum



AIRSPEED ROOF MOUNTED PITOT TUBE

124 Knots Maximum

Refer to Figure 5-3, Airspeed Operating Limits for Additional Limitations

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GAS PRODUCER TACHOMETER (N1)

= 101.5 Percent Maximum



TORQUE PRESSURE

Meter is marked with the maximum torque limit for each engine as reflected by the individual engine Data Plate Torque. Refer to Torque Available Chart, Chapter 7.

NOTE

Red line at 50 PSI shown on dial face is for illustration only. Actual location will vary.



EXHAUST TEMPERATURE

- 400°C to 610°C Continuous Operation
- 610°C to 625°C 30 Minute Limit
 - 625°C Maximum 30 Minutes Operation
- 625°C to 675°C 10 Second Limit for Starting and Acceleration
 - 675°C to 760°C 5 Second Limit for Starting and Acceleration
- 760°C Maximum

NOTE

The term acceleration as applied here means any engine acceleration to include throttle application (N2 RPM), collective application (N1 RPM), or a combination of both.



ROTOR TACHOMETER

- 294 to 324 Continuous Operation
- 339 RPM Maximum for Autorotation

ENGINE TACHOMETER (N2)

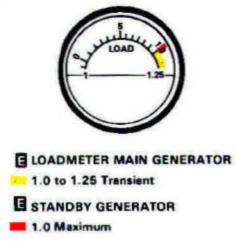
- 6000 to 6400 RPM Transient
- 6400 to 6600 RPM Continuous Operation
- 6700 RPM Maximum Continuous Above 15 PSI Torque
 - 6700 to 6900 RPM Maximum Continuous at 15 PSI Torque or Less
 - 6700 to 6900 RPM Maximum Transient (3 Seconds) Above 15 PSI Torque
- 6900 RPM Maximum

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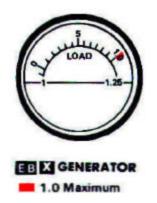


Figure 5-1. Instrument Markings (Sheet 2 of 3)











205070-1012-4



Figure 5-1. Instrument Markings (Sheet 3 of 3)

SECTION III. POWER LIMITS

5-7. ENGINE LIMITATIONS.

- **a.** Refer to figure 5-1.
- **b.** Maximum oil consumption is 0.3 gallons (2.4 pints) per hour.
- **c.** Maximum starter energize time is 40 seconds with a three-minute cooling time between start attempts with three attempts in any one hour.
- **d.** Health Indicator Test. When a difference between a recorded EGT (TGT) and the baseline EGT (TGT) is plus or minus 20°C, the Aviator will make an entry on DA Form 2408-13 to notify the Maintenance Officer. A difference of 30°C or greater is cause for grounding the aircraft.

5-8. HOVERING LIMITATIONS/DIRECTIONAL CONTROL.

Ten percent pedal margin is considered adequate for Directional Control when hovering. Figure 7-5 depicts wind azimuth and relative speed where at least ten percent pedal margin can be maintained for a given pressure altitude, temperature, and gross weight. The yellow area on figure 7-5 (sheet 1 of 2) indicates conditions where the control margin may be less than ten percent in zero wind hover. The red area on sheet 2 of 2 indicates maximum airspeed/wind speed limits. The yellow area on sheet 2 of 2 indicates conditions where the Directional Control Margin may be less than ten percent for gross weights and altitudes determined from sheet 1 of 2. Use of the Charts is explained in the example on sheet 1 of 2.

SECTION IV. LOADING LIMITS

5-9. CENTER OF GRAVITY LIMITATIONS.

- **a.** Center of gravity limits for the helicopter to which this manual applies and instructions for computation of the center of gravity are contained in Chapter 6.
- **b.** When flying at an aft cg (station 140 to 144) terminate an approach at a minimum of five-foot hover prior to landing to prevent striking the tail on the ground.

5-10. WEIGHT LIMITATIONS.

- **a. Maximum Gross Weight.** The maximum gross weight for the helicopter is 9500 pounds. The maximum gross weights for varying conditions of temperature altitude, wind velocity, and skid height are shown in Chapter 7.
- **b. Maximum Gross Weight for Towing.** The maximum gross weight for towing is 9500 pounds.

SECTION V. AIRSPEED LIMITS

5-11. AIRSPEED LIMITATIONS.

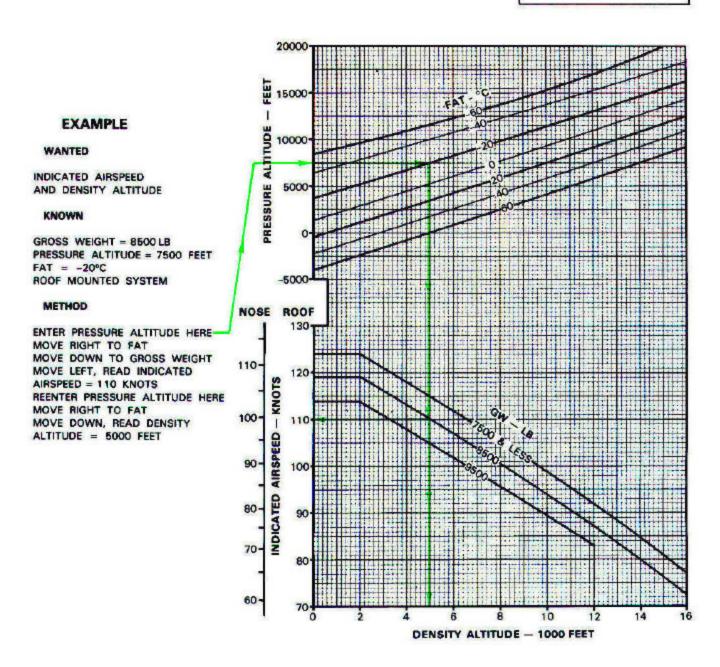
- a. Refer to figure 5-2 for forward airspeed limits.
- **b.** Sideward flight limits are 30 knots.
- c. Rearward flight limit is 30 knots.
- **d.** The helicopter can be flown up to Vne with the cabin doors locked in the full open position only if the appropriate modifications have been made to the cabin

doors and airframe (figure 2-4). Do not fly with open doors during mission operations to insure against loss of classified data.

e. If a cabin door comes open from closed position while in flight, reduce airspeed below approximately 50 KIAS and secure door. If not possible to secure in closed position, the door must be fully opened and secured by the open door latch. When securing the cabin door in flight, the crewmembers shall be fastened to the helicopter by seat belts or other safety devices.

AIRSPEED OPERATING LIMITS

AIRSPEED OPERATING LIMITS EH-1H T53-L-13B



DATA BASIS: DERIVED FROM FLIGHT TEST

SECTION VI. MANEUVERING LIMITS

5-12. PROHIBITED MANEUVERS.

- **a.** ABRUPT INPUTS OF FLIGHT CONTROLS CAUSE EXCESSIVE MAIN ROTOR FLAPPING, WHICH MAY RESULT IN MAST BUMPING AND MUST BE AVOIDED.
 - **b.** No aerobatic maneuvers permitted.

- **c.** Intentional flight below +0.5G is prohibited. Refer to low G maneuvers paragraph 8-60.
- **d.** The speed for any and all maneuvers shall not exceed the level flight velocities as stated on the airspeed operating limits chart (figure 5-2).
- **e.** This helicopter is prohibited from practice touchdown autorotation maneuvers and practice running landings.

SECTION VII. ENVIRONMENTAL RESTRICTIONS

5-13. ENVIRONMENTAL RESTRICTIONS.

- **a.** This helicopter is qualified for flight under instrument meteorological conditions.
- **b.** Intentional flight into known moderate icing condition is prohibited.
 - c. Wind Limitation.
 - (1) Maximum cross wind for hover is 30 knots.

- (2) Maximum tail wind for hover is 30 knots.
- **d. Wind Limitation for Starting.** Helicopter can be started in a maximum wind velocity of 30 knots and a maximum gust spread of 15 knots.

NOTE

Gust spreads are not normally reported. To obtain spread, compare minimum and maximum wind velocity.

SECTION VIII. HEIGHT VELOCITY

5-14. HEIGHT VELOCITY.

The Height Velocity diagram (figure 9-3) is based on an extrapolation of test data. The chart is applicable for all gross weights up to and including 9500 pounds.

SECTION IX. OTHER LIMITATIONS

5-15. **TOWING**.

The helicopter should not be towed for 25 minutes after the battery and inverter switches have been turned off to prevent damage to attitude and directional gyros. If the helicopter must be towed prior to the 25 minute limit, the battery and inverter switches shall be turned on. Wait five minutes after the switches are on before moving the helicopter.

CHAPTER 6

WEIGHT/BALANCE AND LOADING

SECTION I. GENERAL

6-1. GENERAL.

Chapter 6 contains sufficient instructions and data so that an aviator knowing the basic weight and moment of the helicopter can compute any combination of weight and balance.

6-2. Class.

Army Models EH-1H/X are in Class 1. Additional directives governing weight and balance of Class 1 aircraft forms and records are contained in AR 95-16 and DA PAM 738-751.

6-3. HELICOPTER STATION DIAGRAM.

Figure 6-1 shows the helicopter reference datum lines, fuselage stations, butt lines, and water lines. The primary purpose of the figure is to aid personnel in the computation of helicopter weight/balance and loading.

SECTION II. WEIGHT AND BALANCE

6-4. LOADING CHARTS.

- **a. Information.** The loading data contained in this chapter is intended to provide information necessary to work a loading problem for the helicopters to which this manual is applicable.
- **b.** Use. From the figures contained in this chapter, weight and moment are obtained for all variable load items and are added to the current basic weight and moment (DD Form 365C) to obtain the gross weight and moment.
- (1) The gross weight and moment are checked on DD Form 365F to determine the approximate center of gravity (cg). Figure 6-3 shows a sample form.
- (2) The effect on cg by the expenditures in flight of such items as fuel, ammunition, etc., maybe checked by subtracting the weights and moments of such items from the takeoff weight and moment and checking the new weight and moment on the CG Limits Chart.

6-5. DD FORM 365A - BASIC WEIGHT CHECKLIST.

The form is initially prepared by the manufacturer before the helicopter is delivered. The form is a tabulation of equipment that is, or may be, installed and for which provision for fixed stowage has been made in a definite location. The form gives the weight, arm, and moment/100 of individual items for use in correcting the basic weight and moment on DD Form 365C as changes are made in this equipment.

6-6. DD FORM 365C - BASIC WEIGHT AND BALANCE RECORD.

The form is initially prepared by the manufacturer at time of delivery of the helicopter. The form is a continuous history of the basic weight and moment resulting from structural and equipment changes. At all times the last entry is considered current basic weight and balance status of the helicopter. Figure 6-2 shows a sample DD Form 365C.

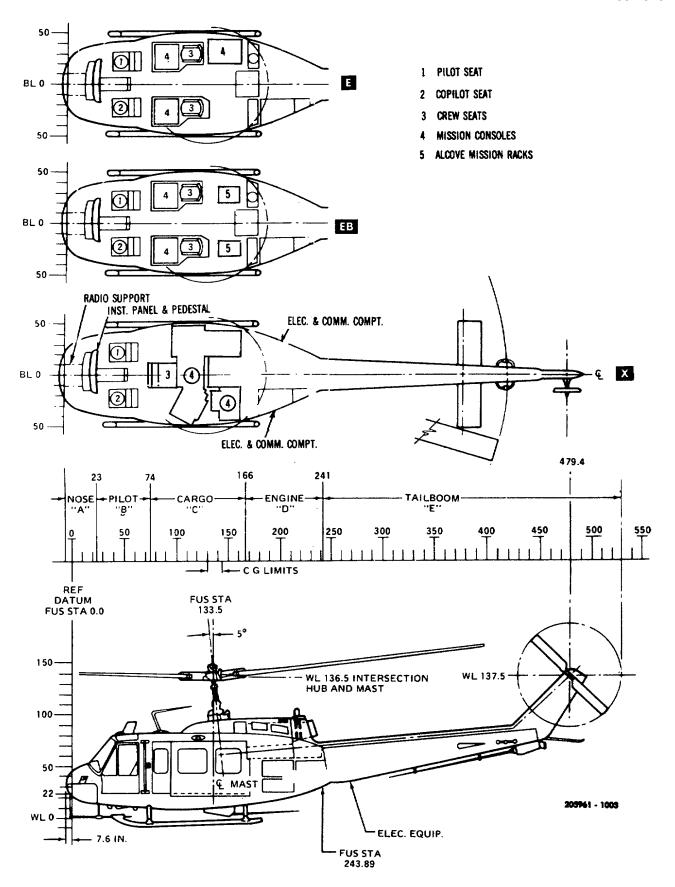


Figure 6-1. Helicopter Station Diagram

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Figure 6-2. DD Form 365C

6-7. DD FORM 365F - WEIGHT AND BALANCE CLEARANCE FORM F.

- **a. General.** The form is a summary of actual disposition of the load in the helicopter. It records the balance status of the helicopter, step-by-step. It serves as a worksheet on which to record weight and balance calculations, and any corrections that must be made to ensure that the helicopter will be within weight and cg limits. Refer to figure 6-3 for sample DD Form 365F.
- **b. Form Preparation.** Specific instructions for filling out the form are given in the following paragraphs. Figure 6-3 shows the results of the instructions.

NOTE

Reference 1, 2, etc., are references to items 1, 2, etc., on DD Form 365F.

- (1) Insert the necessary identifying information at the top of the form. $\label{eq:continuous}$
- **(2)** Reference 1 Enter the helicopter basic weight and moment from the last entry on Chart C -Basic Weight and Balance Record.

NOTE

Enter moment/100 values throughout the form. Obtain these values from this chapter.

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Figure 6-3. DD Form 365F

- (3) Reference 2 Not applicable.
- **(4)** Reference 3 Enter the number and weight of CREW. Use actual crew weight, if available (figure 6-5).
- **(5)** Reference 4 Enter the weight of the CREWS BAGGAGE, if applicable.
 - (6) Reference 5 Not applicable.
- **(7)** Reference 6 Enter the weight of EMERGENCY EQUIPMENT, if applicable.
- **(8)** Reference 7 Enter the weight of any EXTRA EQUIPMENT, if applicable.
- **(9)** Reference 8 Enter the sum of the weights of reference 1 through 7 inclusive to obtain OPERATING WEIGHT.
- (10) Reference 9 Enter the number of gallons and weight of TAKEOFF FUEL (figure 6-4).
 - (11) Reference 10 Not applicable.
- (12) Reference 11 Enter the sum of the weights for reference 8 through 10 inclusive to obtain TOTAL AIRCRAFT WEIGHT.
- (13) Reference 12 Using the same compartment letter designation as shown on helicopter diagram (figure 6-1) enter the number and weight of passengers and the weight of cargo (baggage) (figure 6-7). Use actual passenger weight, if available. Enter the total for each compartment in the weight column.
- (14) Reference 13 Enter the sum of reference 11 and the compartment totals from reference 12 opposite TAKEOFF CONDITION (uncorrected). At this point, if not already done, calculate the moment/100 for reference 1 through 13 inclusive.
- (15) Check the weight and moment/100 figure opposite reference 13 on the center of gravity limits chart (figure 6-9) to ascertain that the indicated cg is within allowable limits.
- (16) Reference 14 If changes in amount or distribution of load are required, indicate necessary adjustments by proper entries in the CORRECTIONS table in lower left-hand corner of the form, as follows:

- (a) Enter a brief description of the adjustment made in the column marked ITEM.
- **(b)** Add all the weight and moment decreases and insert the totals in the space opposite TOTAL WEIGHT REMOVED.
- **(c)** Add all the weight and moment increases and insert the total in space opposite TOTAL WEIGHT ADDED.
- **(d)** Subtract the smaller from the larger of the two totals and enter the difference (with applicable plus or minus sign) opposite NET DIFFERENCE.
- **(e)** Transfer these NET DIFFERENCE figures to the space opposite reference 14.
- (17) Reference 15 Enter the sum of the difference between reference 13 and reference 14. Recheck to see that these figures do not exceed allowable limits.
- (18) Reference 16 Determine the takeoff cg position by referring to the Center of Gravity Limits chart (Figure 6-9). Enter this figure in the space provided opposite Takeoff CG.
- (19) Reference 17 Estimate and enter weight of fuel which will be expended before landing in reference 17.
- (a) Determine moment for estimated fuel on board at landing.
- **(b)** Subtract this amount from moment established for TAKEOFF FUEL in reference 9.
- **(c)** Enter the difference as moment in reference 17.

NOTE

Do not consider reserve fuel as expended when determining ESTIMATED LANDING CONDITION.

(20) Reference 18 - Enter the weight of AIR SUPPLY LOAD to be dropped before landing with moment/100, if applicable.

- (21) Reference 19 Not applicable.
- (22) Reference 20 Enter the difference in weight and moment/100 between reference 15 and the sum of the reference 17 and reference 18.
- (23) Reference 21 Check the weight and moment/100 figures on the Center of Gravity Limits chart

(figure 6-9) to ascertain that the cg is within the allowable limits. If it is not, make necessary changes in (16) above and recalculate (17) through (23) (figure 6-9). Determine estimated landing CG position using figure 6-9. Enter this figure opposite ESTIMATED LANDING CG.

SECTION III. FUEL/OIL

6-8. FUEL.

6-9. OIL.

Refer to figure 6-4.

For weight and balance purposes, engine oil is a part of basic weight.

SECTION IV. PERSONNEL

6-10. PERSONNEL COMPARTMENT.

6-11. PERSONNEL MOMENTS.

Refer to figure 6-5.

Refer to figure 6-5.

SECTION V. MISSION EQUIPMENT

6-12. WEIGHT AND BALANCE LOADING DATA.

6-13. TIEDOWN DEVICES.

Refer to figure 6-6.

Refer to figures 6-7 and 6-8.

SECTION VI. CENTER OF GRAVITY LIMITS

6-14. CENTER OF GRAVITY LIMITS.

Refer to figure 6-9.

FUEL LOADING



CRASHWORTHY SYSTEM TANKS

EXAMPLE

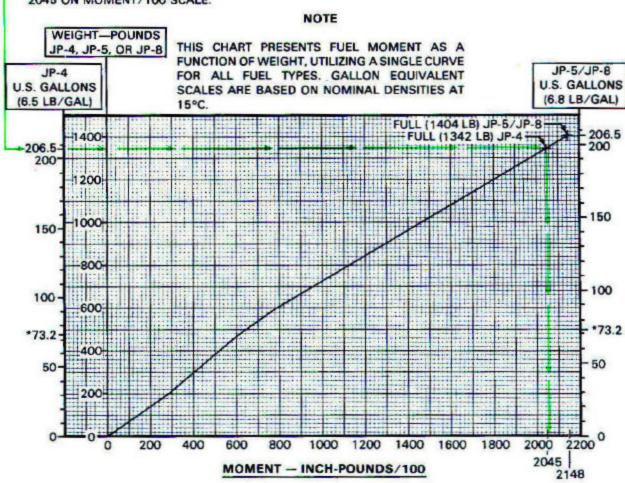
WANTED

WEIGHT AND MOMENT FOR A GIVEN QUANTITY OF USABLE FUEL IN CRASHWORTHY FUEL SYSTEM.

KNOWN

206.5 U.S. GALLONS OF JP-4 FUEL.

METHOD ENTER AT 206.5 GALLONS ON JP-4 SCALE. MOVE RIGHT TO READ WEIGHT 1342 POUNDS. CONTINUE RIGHT TO INTERSECT DIAGONAL LINE, THEN PROJECT DOWN TO READ 2045 ON MOMENT/100 SCALE. WEIGHT-POUNDS



*MOST FORWARD FUEL CG AT 73.2 GALLONS

205900-2005-1

Figure 6-4. Fuel Data

6

PERSONNEL LOADING CHART

MOMENT FOR PERSONNEL

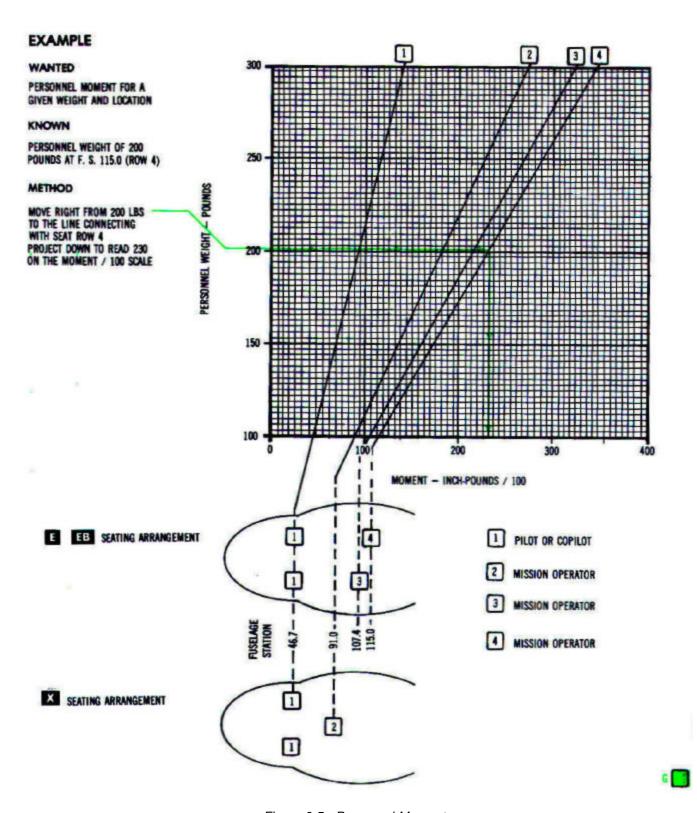
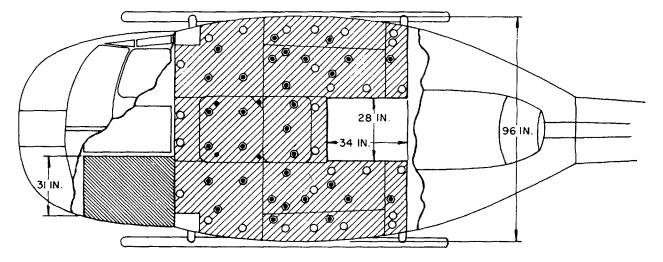


Figure 6-5. Personnel Moment

SUB-SYSTEM	ITEM	WEIGHT - LBS	ARM	MOMENT/100
M-130 CHAFF DISPENSER	DISPENSER/ PAYLOAD MODULE	9.1	163	1483
	CONTROL PANEL	1.4	43	60
	ELECTRONIC MODULE	4.8	192	922
	RETROFIT PROVISIONS	9.7	139.7	1355
	CHAFF CARTRIDGES (30)	9.9	163	1614
M-130 CHAFF/FLARE DISPENSER	DISPENSER/ PAYLOAD MODULE	9.1	163	1483
	SUPPORT ASSEMBLY	4.0	161	644
	FLARE DISPENSE SWITCH	0.7	41.8	29.3
	FLARE/CHAFF CARTRIDGES	9.9	163	1614

Figure 6-6. EE X System Weight and Balance Data



CODE

- Ring & Stud Tiedown
- O Ring Tiedown
- Stanchion Stud
- Stud

Cargo Area, Max. Loading Dimensions

Optional Load'g Area, Left Seat Removed

Interior Clearance
Above Max. Package
at Centerline of Cabin

NOTES

- Floor tiedown fittings, strength 1350 pounds vertical, 500 pounds horizontal load per fitting. Each aft bulkhead tiedown fitting is capable of the following loads: 1250 pounds, parallel to the bulkhead.
- 2. Bulkhead tiedown fittings are good for 1250 pounds maximum per fitting perpendicular to the bulkhead.
- Tiedown fittings on the side of the beams are good for 1250 pounds maximum per fitting perpendicular to the beams.
- 4. Two fittings at station 129.0 are good for 1250 pounds maximum per fitting perpendicular to bulkhead.

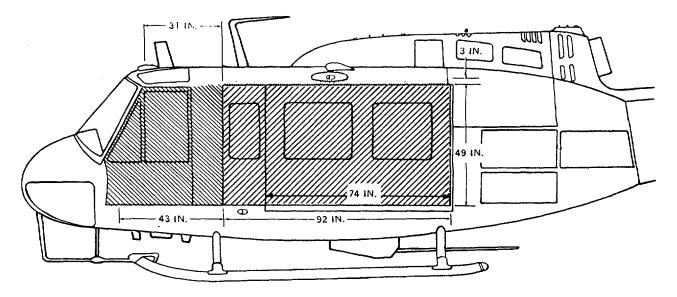
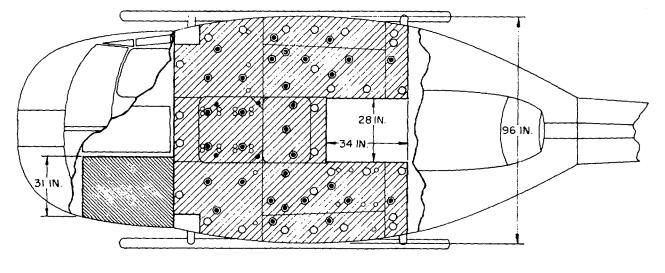


Figure 6-7. EEE Cargo Compartment (Sheet 1 of 2)



CODE

- Ring & Stud Tiedown
- O Ring Tiedown
- Stanchion Stud
- Stud
- O Threaded Insert

Cargo Area, Max. Loading Dimensions

Optional Load'g Area, Left Seat Removed

Interior Clearance
Above Max. Package
at Centerline of Cabin

NOTES

- Floor tiedown fittings, strength 1350 pounds vertical, 500 pounds horizontal load per fitting. Each aft bulkhead tiedown fitting is capable of the following loads: 1250 pounds, parallel to the bulkhead.
- Bulkhead tiedown fittings are good for 1250 pounds maximum per fitting perpendicular to the bulkhead.
- Tiedown fittings on the side of the beams are good for 1250 pounds maximum per fitting perpendicular to the beams.
- Two fittings at station 129.0 are good for 1250 pounds maximum per fitting perpendicular to bulkhead.

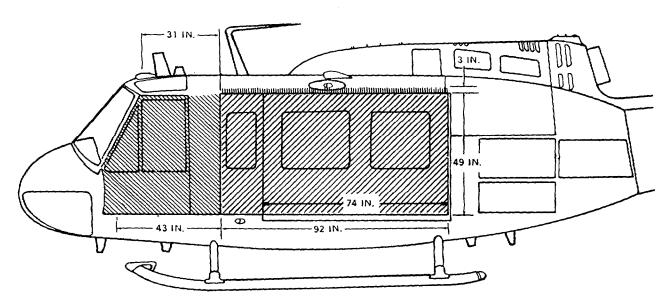


Figure 6-7. X Cargo Compartment (Sheet 2 of 2)

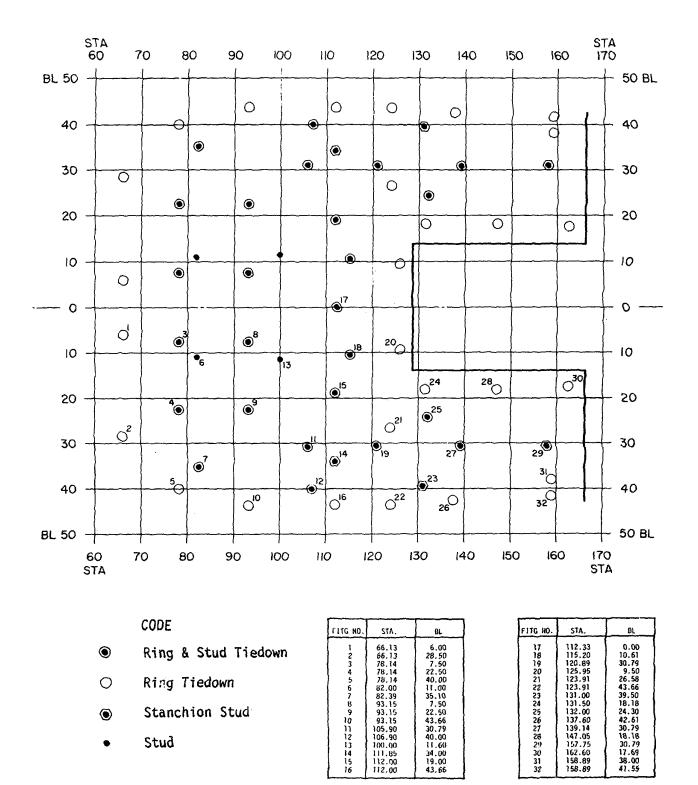


Figure 6-8. E EE Cargo Tiedown Fitting Data (Sheet 1 of 2)

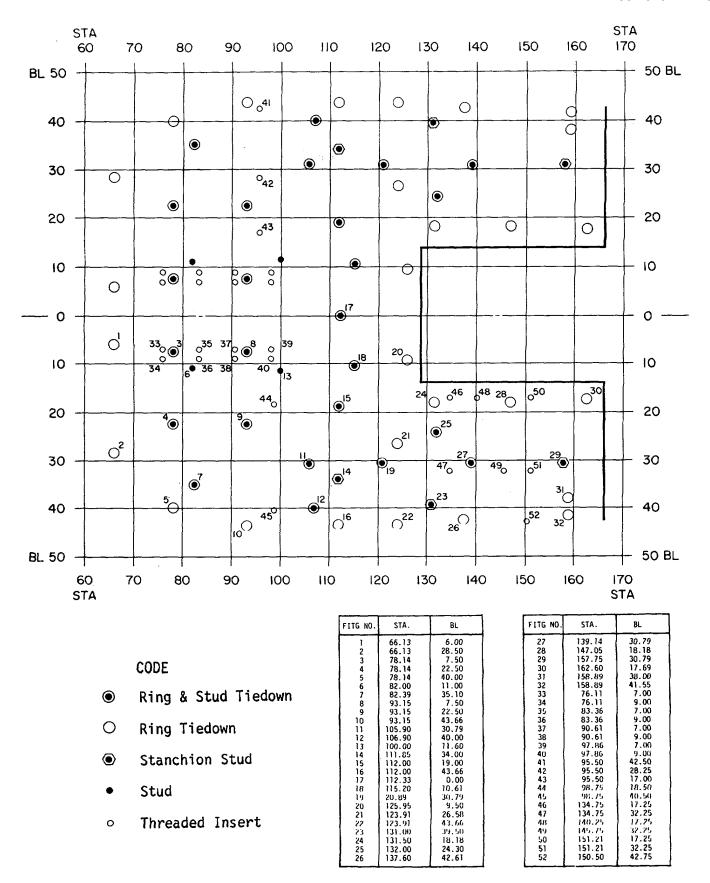


Figure 6-8. X Cargo Tiedown Fitting Data (Sheet 2 of 2)

205900-2001-1

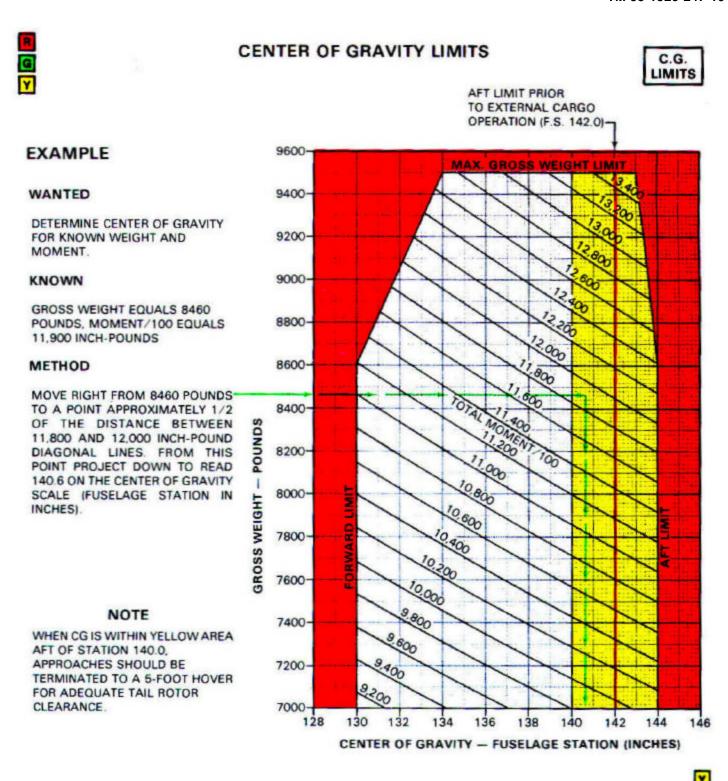


Figure 6-9. Center of Gravity Limits (Sheet 1 of 2)



CENTER OF GRAVITY LIMITS



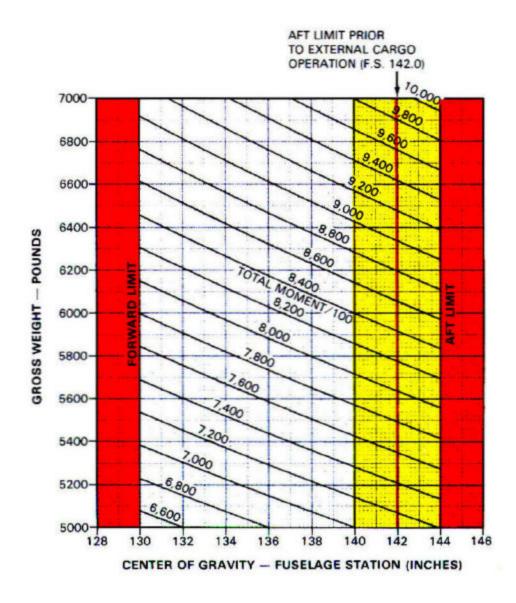




Figure 6-9. Center of Gravity Limits (Sheet 2 of 2)

CHAPTER 7

PERFORMANCE DATA

Section I. INTRODUCTION

7-1. PURPOSE.

The purpose of this chapter is to provide the best available performance data for the EH-1H helicopter. Regular use of this information will enable you to receive maximum safe utilization from the helicopter. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons:

- **a.** Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.
- **b.** Situations requiring maximum performance will be more readily recognized.
- **c.** Familiarity with the data will allow performance to be computed more easily and quickly.
- **d.** Experience will be gained in accurately estimating the effects of variables for which data-are not presented.

NOTE

The information provided in this chapter is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used inflight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-2. CHAPTER 7 INDEX.

The following index contains a list of the sections and their titles, the figure numbers, subjects and page numbers of each performance data chart contained in this chapter.

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INDEX (Cont)

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7-3. GENERAL.

The data presented covers the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgment and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However NO GENERAL CONSERVATISM HAS BEEN APPLIED. All performance data presented are within the applicable limits of the helicopter.

7-4. LIMITS.

Applicable limits are shown on the charts as red lines. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13 so proper maintenance action can be taken.

7-5. USE OF CHARTS.

- **a. Chart Explanation.** The first page of each section describes the chart(s) and explains its uses.
- **b. Color Coding.** Chart color codes are used as follows:
 - (1) Green is used for example guidelines.
 - (2) Red is used for limit lines.
- (3) Yellow is used for precautionary or timelimited operation.
- c. Reading the Charts. The primary use of each chart is given in an example and a green guideline is provided to help you follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, reflect down at right angles to the third variable, reflect left at right angles to the fourth variable, reflect down, etc. until the final variable is read out at the final scale. In addition to the primary use, other uses of each chart are

explained in the text accompanying each set of performance charts. Colored registration blocks located at the bottom and top of each chart are used to determine if slippage has occurred during printing. If slippage has occurred, refer to chapter 5 for correct operating limits.

NOTE

An example of an auxiliary use of the charts referenced above is as follows: Although the hover chart is primarily arranged to find torque required to hover, by entering torque available as required, maximum skid height for hover can also be found. In general, any single variable can be found if all others are known. Also, the tradeoffs between two variables can be found. For example, at a given density altitude and pressure altitude, you can find the maximum gross weight capability as free air temperature changes.

d. Dashed Line Data. Data beyond conditions for which tests were conducted are shown as dashed lines.

7-6. DATA BASIS.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date of the data are also given. The data provided generally is based on one of four categories:

- **a.** Flight Test Data. Data obtained by flight test of the aircraft by experienced flight test personnel at precise conditions using sensitive calibrated instruments.
- **b. Derived From Flight Test.** Flight test data obtained on a similar rather than the same aircraft and series. Generally small corrections will have been made.
- **c. Calculated Data.** Data based on tests, but not on flight test of the complete aircraft.
- **d. Estimated Data.** Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-7. SPECIFIC CONDITIONS.

The data presented are accurate only for specific conditions listed under the title of each chart. Variables for which data are not presented, but which may affect that phase of performance, are discussed in the text. Where data are available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-8. GENERAL CONDITIONS.

In addition to the specific conditions, the following general conditions are applicable to the performance data.

- **a. Rigging.** All airframe and engine controls are assumed to be rigged within allowable tolerances.
- **b. Pilot Technique.** Normal pilot technique is assumed. Control movements should be smooth and continuous.
- **c. Helicopter Variation.** Variations in performance between individual helicopters are known to exist; however, they are considered to be small and cannot be individually accounted for.
- **d. Instrument Variation.** The data shown in the performance charts do not account for instrument inaccuracies or malfunctions.

7-9. PERFORMANCE DISCREPANCIES.

Regular use of this chapter will allow you to monitor instruments and other helicopter systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data are not provided, thereby increasing the accuracy of performance predictions.

7-10. DEFINITIONS OF ABBREVIATIONS.

a. Unless otherwise indicated in the following list of abbreviations, abbreviations and symbols used in this manual conform to those established in Military Standard MIL-STD-12, which is periodically revised to reflect current changes in abbreviations usage.

Accordingly, it may be noted that certain previously established definitions have been replaced by more current abbreviations and symbols.

b. Capitalization and punctuation of abbreviations varies, depending upon the context in which they are used. In general, lower case abbreviations are used in text material, whereas abbreviations used in charts and illustrations appear in full capital letters. Periods do not

usually follow abbreviations; however, periods are used with abbreviations that could be mistaken for whole words if the period were omitted.

c. The following list provides definitions for abbreviations used in this manual. The same abbreviation applies for either singular or plural applications.

LIST OF ABBREVIATIONS

Abbreviation	Definition	Abbreviation	Definition
AGL	Above ground level	F	Fahrenheit
ALT	Altitude	FAT	Free air temperature
AVAIL	Available	FLT	Flight
С	Celsius	FT	Foot
CAS	Calibrated airspeed	FT/MIN	Feet per minute
CL	Centerline .	FWD	Forward
CONT	Continuous	Δ F	Increment of equivalent flat plate
		244	drag area
END	Endurance	GAL	Gallon
GAL/HR	Gallons per hour	NO.	Number
GRWT	Gross weight	NM	Nautical mile
GW	Gross weight	PSI	Pounds per square inch
HP	Horsepower	PRESS	Pressure
HR	Hour	R/C	Rate of climb
IAS	Indicated airspeed	R/D	Rate of descent
IGE	In ground effect	RPM	Revolutions per minute
IN IN IIO	Inch	SHP	Shaft horsepower
IN HG	Inches of mercury	SPEC	Specifications
IR	Infrared	STA	Station
KCAS	Knots calibrated airspeed	SQ FT	Square feet
KIAS	Knots indicated airspeed	TAS	True airspeed
KTAS	Knots true airspeed	TRQ	Torque
KN 。	Knot Degree		
OGE	Out of ground effect	USAASTA	United States Army Aviation
LB	Pound		Systems Test Activity
LB/HR	Pounds per hour	VDC	Volts, direct current
LIM	Limit	VNE	Velocity, never exceed (airspeed
MAX	Maximum		limitation)
MIN	Minute	XMSN	Transmission
MIN	Minimum		
MM	Millimeter		

Section II. PERFORMANCE PLANNING

7-11. PURPOSE.

This section of the manual contains a performance planning card, a temperature conversion chart, and

information needed for use of the performance planning card.

7-12. PERFORMANCE PLANNING CARD.

This card (figure 7-1) is provided to assist you in recording data applicable to the mission and may be reproduced at the local level.

7-13. PERFORMANCE PLANNING SEQUENCE.

The following sequence is provided to aid you in preparing the performance planning card.

- a. Pressure Altitudes. Obtain departure point pressure altitude by setting 29.92 in. hg at the altimeter barometric pressure scale and reading pressure altitude from outer scale pointers. Record in space provided under departure heading. Estimate pressure altitude increase above departure elevation; (if destination is below departure elevation, subtract difference in elevation). Record pressure altitudes in space provided under climb, cruise and arrival headings.
- **b.** Fee Air Temperature. Obtain the local free air temperature and record in space provided under departure heading. Estimate FAT for climb, cruise, and arrival by subtracting 2 degrees C for each 1000 feet altitude increase above departure point; (if destination is below departure elevation, add 2°C for each 1000 feet difference in elevation). Record temperature in space provided under climb, cruise and arrival headings.

NOTE

If required, see figure 7-2 for temperature conversion chart (Fahrenheit to Celsius, or vice versa).

c. Departure.

- (1) Calculate and record the departure gross weight. Refer to chapter 6.
- **(2)** Determine and record torque available. See figure 7-3.
- (3) Determine and record torque required at five feet.
- **(4)** Determine and record torque required to hover at desired skid height. See figure 7-4.
- (5) Determine if takeoff to hover can be made by comparing torque required for desired skid height with

maximum torque available. For takeoff, torque available must be greater than torque required.

- (6) Determine and record obstacle height.
- (7) Determine and record distance to obstacle.
- **(8)** Select and record the airspeed that will allow the helicopter to safely clear obstacle. See figure 7-6.

d. Climb.

- (1) Conservatively, using departure gross weight, determine and record speed for maximum rate of climb, IAS and the torque pressure for cruise at this speed. See figure 7-7 (sheets 1 through 24) using pressure altitude and FAT previously determined.
- (2) Record maximum torque pressure available and maximum fuel flow. See figure 7-7 (sheets 1 through 24).
- **(3)** Subtract level flight torque required from maximum torque available to obtain change in excess torque for climb. Record this value.
 - (4) Determine rate of climb from figure 7-9.

e. Cruise.

- (1) Select and record cruise speed (TAS).
- **(2)** Calculate and record gross weight at beginning of cruise segment or average weight during cruise segment.
- **(3)** Using pressure altitude and FAT previously determined from figure 7-7 (sheets 1 through 24) determined and record the following:
 - (a) Cruise speed (IAS)
 - **(b)** Cruise torque pressure.
 - (c) Cruise fuel flow.

f. Arrival.

- (1) Calculate and record gross weight.
- (2) Select and record approach airspeed (IAS).

	PEI	RFORMANO	CE PLANNING		
		DEPAR	RTURE		
PRESS. ALT MAX TORQUE AVAILABI TORQUE REQUIRED TO	LE	PSI	°C		LB
	O	BSTACLE (CLEARANCE		
OBSTACLE HEIGHT CLIMBOUT IAS				DISTANCE	FT
		CLI	МВ		
PRESS. ALT MAX R/C IAS LEVEL FLIGHT TORQUE CHANGE IN TORQUE FO RATE OF CLIMB	KNOTS AT R/C IAS OR CLIMB	P:	MAX TORQUE A SI IAX TORQUE AVA	VAILABLE	PSI
		CRU	IISE		
PRESS. ALT	KNOTS		CRUISE S	GW PEED, IAS EL FLOW	
CRUISE SPEED, TAS			IVAI		
		ARRI			

Figure 7-1. Performance planning card

(3) Using the method described for departure in steps c (2), (3) and (4) above, determine whether a hovering approach to landing can be accomplished. Torque available for landing must exceed torque required. See figures 7-3 and 7-6.

NOTE

Performance information obtained may make it necessary to alter gross

weight, airspeed, altitude, or other variables in order to safely operate the helicopter. If any of these variables are changed on one chart, corresponding changes will be necessary on all other charts where that information is used.

TEMPERATURE CONVERSION CHART

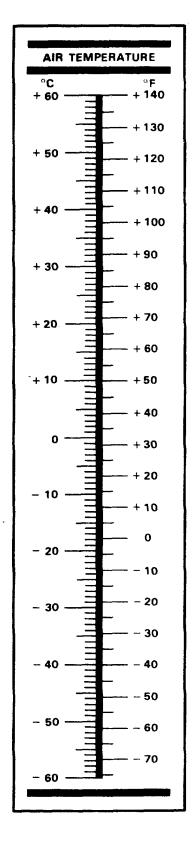


Figure 7-2. Temperature conversion chart

Section III. TORQUE AVAILABLE

7-14. DESCRIPTION.

The torque available charts show the effects of altitude and temperature on engine torque.

7-15. CHART DIFFERENCES.

Both pressure altitude and FAT affect engine power production. Figure 7-3 shows power available data at 30 minute power ratings in terms of the allowable torque as recorded by the torquemeter (PSI). Note that the power output capability of the T53-L-13 engine can exceed the transmission structural limit (50 PSI) under certain conditions.

- **a.** Figure 7-3 (sheet 1) is applicable for maximum power, 30 minute operation at 324 rotor/6600 engine rpm.
- **b.** Figure 7-3 (sheet 2) is applicable for maximum power, 30 minute operation at 324 rotor/6600 engine rpm with Hot Metal Plus Plume IR Suppressor Installed.
- **c.** Prolonged IGE hover may increase engine inlet temperature as much as 10°C, therefore a 10° higher FAT must be used to correct for this condition.

7-16. USE OF CHARTS.

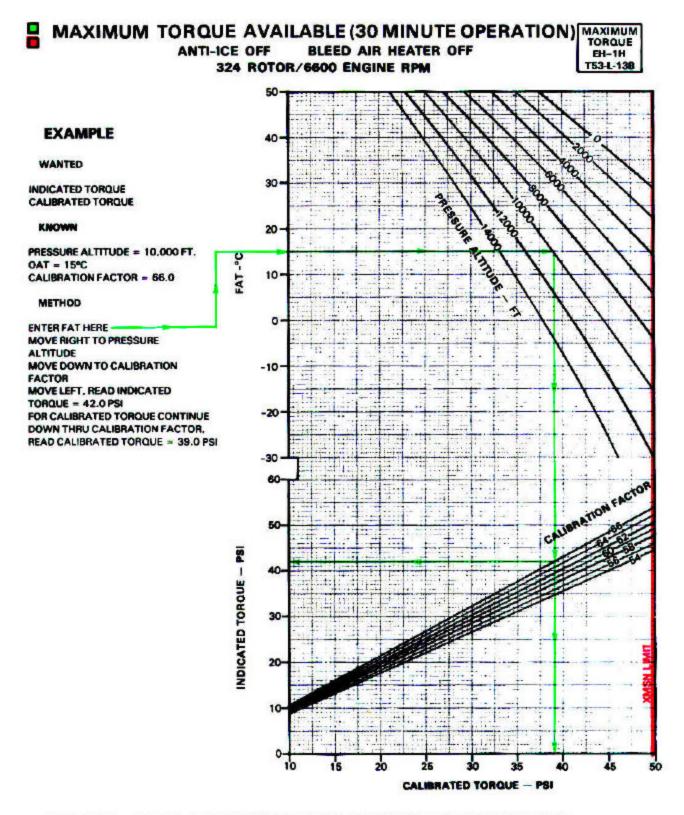


Engine torque available values in figure 7-3 are in error. Decrease engine torque available by 3 PSI. Omit this correction for transmission limited conditions.

The primary use of the charts is illustrated by the examples. In general, to determine the maximum power available, it is necessary to know the pressure altitude and temperature. The calibration factor (Data Plate Torque), obtained from the engine data plate or from the engine acceptance records, is the indicated torque pressure at 1125 ft-lbs actual output shaft torque, and is used to correct the error of individual engine torque indicating system.

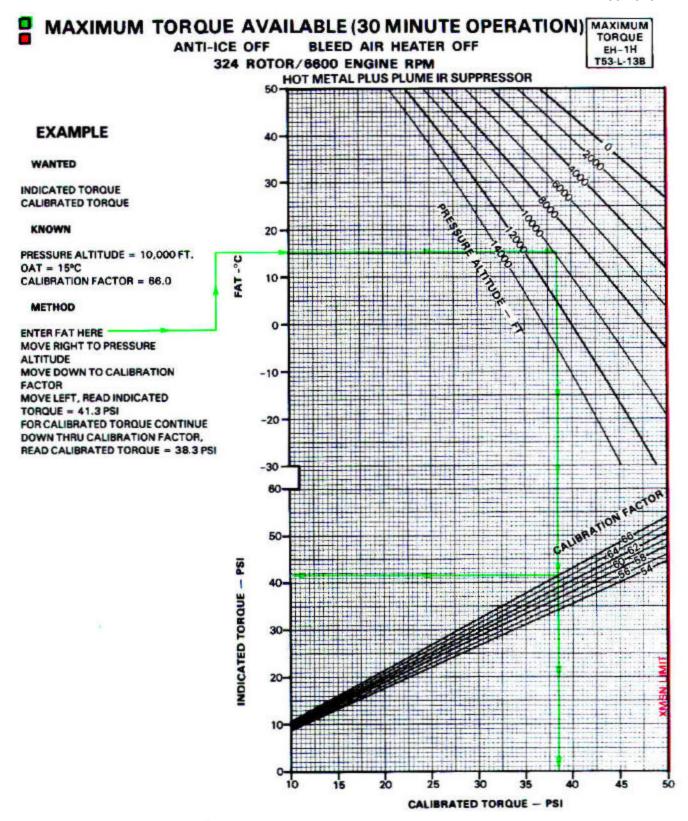
7-17. CONDITIONS.

Chart (figure 7-3) is based upon speeds of 324 rotor/6600 engine rpm grade J-4 fuel. The use of aviation gasoline will not influence engine power. Fuel grade of JP-5 will yield the same nautical miles per pound of fuel and being 6.8 pounds per gallon will only result in increase fuel weight. All torque available are presented for bleed air heater and deice off. Decrease power available 1.4 PSI for heater on and 2.1 PSI for deice on; decrease torque available 3.5 PSI if both bleed air heater and deice are operating.



DATA BASIS: CALCULATED FROM MODEL SPEC 104.33, 6 MAY 1966, CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST, ASTA 66-04, NOVEMBER 1970.

Figure 7-3. Maximum torque available (30 minute operation) chart (Sheet 1 of 2)



DATA BASIS: CALCULATED FROM MODEL SPEC 104.33, 6 MAY 1966, CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST, ASTA 66-04, NOVEMBER 1970.

Figure 7-3. Maximum toque available (30 minute operation) chart (Sheet 2 of 2)

Section IV. HOVER

7-18. DESCRIPTION.

- **a.** The hover charts (figure 7-4, sheets 1 and 2) show the hover ceiling and the torque required to hover respectively at various pressure altitudes, ambient temperatures, gross weights, and skid heights. Maximum skid height for hover con also be obtained by using the torque available from figure 7-3.
- **b.** Sheet 1 of the control margin charts (figure 7-5) shows the maximum right crosswind which one can achieve and still maintain directional control as a function of pressure altitude, temperature, and gross weight. Sheet 2 of the control margine chart (figure 7-5) shows the combinations of relative wind velocity and azimuth which may result in marginal directional or longitudinal control.

7-19. USE OF CHART.

- a. The primary use of the hover charts is illustrated by the charts examples. In general, to determine the hover ceiling or the torque required to hover, it is necessary to know the pressure altitude, temperature, gross weight and the desired skid height. In addition to its primary use, the hover chart (sheet 2) can also be used to determine the predicted maximum hover height, which is needed for use of the takeoff chart (figure 7-6). To determine maximum hover height, proceed as follows:
 - (1) Enter chart at appropriate pressure altitude.
 - (2) Move right to FAT.
 - (3) Move down to gross weight.
- (4) Move left to intersection with maximum power available (obtained from figure 7-3).
- (5) Read predicted maximum skid height. This height is the maximum hover height. The hover charts are based on torque required only. To determine if adequate control margin is available see figure 7-5.

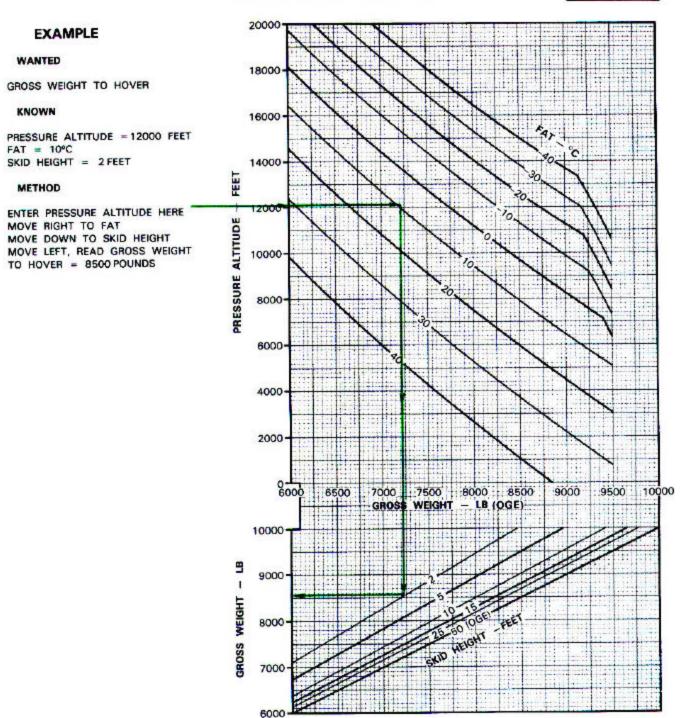
b. Use of the control margin charts is illustrated by the example on sheet 1. Ten percent pedal margin, full right to full left is considered adequate for directional control when hovering. The vellow area on sheet 1 indicates conditions where the directional control margin may be less than ten percent in zero wind hover. The red area on sheet 2 indicates maximum airspeed/windspeed limits. The yellow area on sheet 2 labeled "DIRECTIONAL" indicates conditions where directional control margin may be less than ten percent for crosswind components in excess of those determined from sheet 1. The yellow area on sheet 2 labeled "LONGITUDINAL" indicates wind conditions where longitudinal control may be less than ten percent. These charts are based on control margin only. To determine if adequate torque is available for hover see figure 7-4.

7-20. CONDITIONS.

- a. The hover charts are based upon calm wind conditions, a level ground surface, the use of 324 rotor RPM and do not account for the effect of IR suppressor The Bell Scoop IR Suppressor creates a devices. download of approximately 140 pounds. determine hover torque required with the Bell Scoop installed enter the hover chart at a gross weight 140 pounds heavier than the actual gross weight. In like manner to determine maximum hover gross weight for this configuration decrease weight determined from the hover chart by 140 pounds. To determine hover performance with the Hot Metal Plus Plume IR Suppressor installed use figure 7-3 sheet 2 and figure 7-4 sheet 2.
- **b.** The control margin charts are based on test of in ground effect (IGE) translational flight over a level surface at 324 rotor RPM. Use of these charts to determine if adequate control margin will be available for IGE and OGE hover in winds or low speed translational flight is recommended.

HOVER CEILING MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION) 324 ROTOR/6600 ENGINE RPM

HOVER CEILING EH-1H T53-L-138



DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-4. Hover (ceiling) chart (Sheet 1 of 2)

EXAMPLE

WANTED

MAXIMUM SKID HEIGHT CAPABILITY

KNOWN

PRESSURE ALTITUDE = 11000 FEET, FAT = 0°C GROSS WEIGHT = 8500 POUNDS 30 MINUTE CALIBRATED TORQUE AVAILABLE AT 324 ROTOR/6600 ENGINE RPM = 42.6 PSI (REFERENCE FIGURE 7-3, SHEET 1)

METHOD

REENTER PRESSURE ALTITUDE HERE—
MOVE RIGHT TO 0°C FAT
MOVE DOWN TO 8500 POUNDS GROSS WEIGHT
MOVE LEFT TO CALIBRATED TORQUE LINE OF 42.6 PSI—
AT INTERSECTION INTERPOLATE FOR MAXIMUM SKID
HEIGHT = 10 FEET

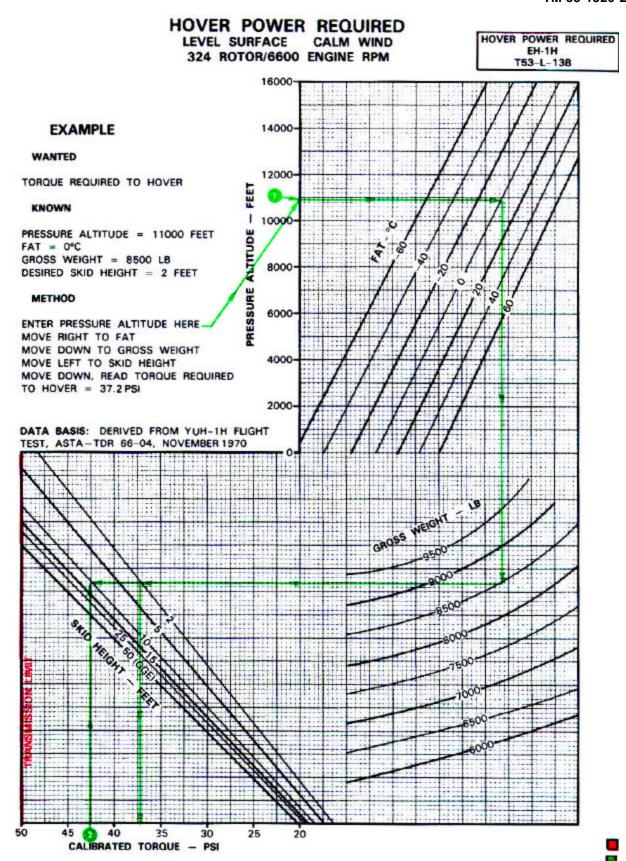
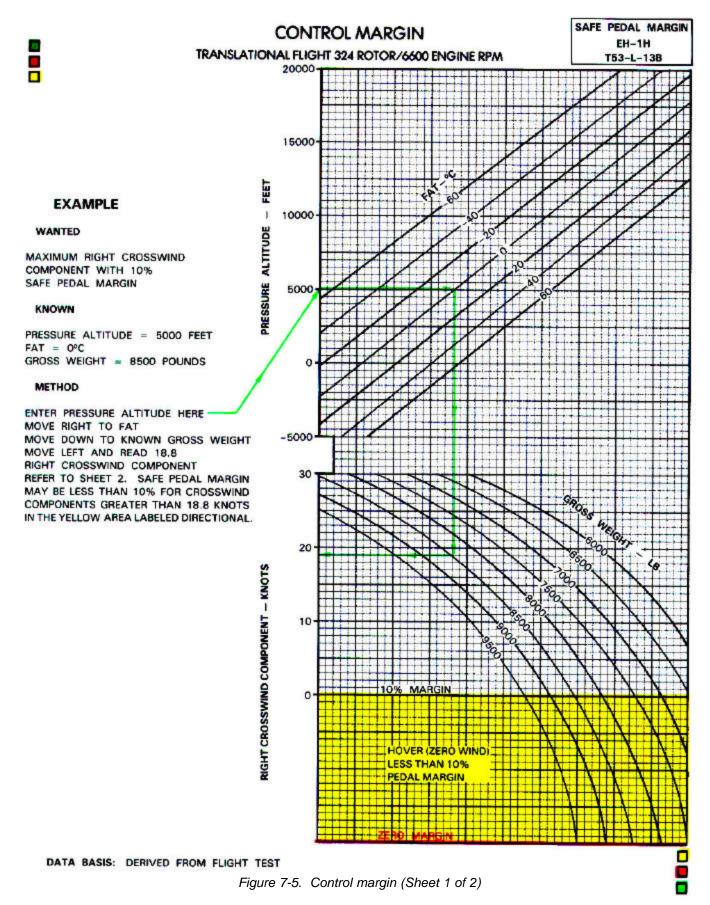


Figure 7-4. Hover (power required) chart (Sheet 2 of 2)



7-18

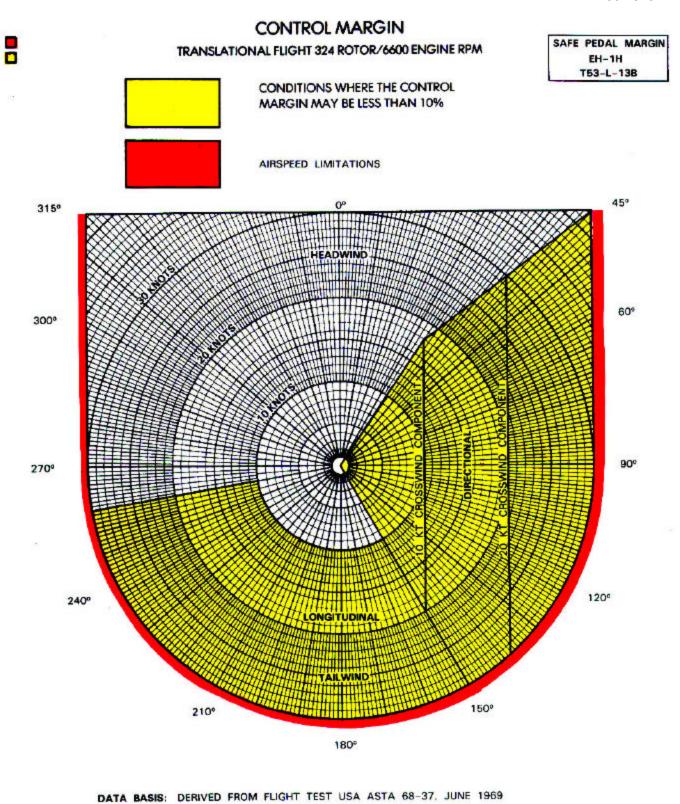


Figure 7-5. Control margin (Sheet 2 of 2)

Section V. TAKEOFF

7-21. DESCRIPTION.

The takeoff chart (figure 7-6) shows the distances to clear various obstacle heights, based upon several hover height capabilities The upper chart grid presents data for climbout at a constant INDICATED airspeed. The two lower grids present data for climbouts at various TRUE airspeeds. Figure 7-6, sheet 1, is based upon level acceleration technique, sheet 2 is based upon a climb and acceleration from a 3 foot skid height and sheet 3 is based upon a climb and acceleration from a 15 foot skid height.

NOTE

The hover heights shown on the chart are only a measure of the aircraft's climb capability and do not imply that a higher than normal hover height should be used during the actual takeoff.

7-22. USE OF CHARTS.

The primary use of these charts are illustrated by the charts examples. The main consideration for takeoff performance is the hovering skid height capability, which includes the effects of pressure altitude, free air temperature, gross weight, and torque. Hover height

capability is determined by use of the hover chart, figure 7-4. A hover check can be made to verify the hover capability. If winds are present, the hover check may disclose that the helicopter can actually hover at a greater skid height than the calculated value, since the hover chart is based upon calm wind conditions.

7-23. CONDITIONS.

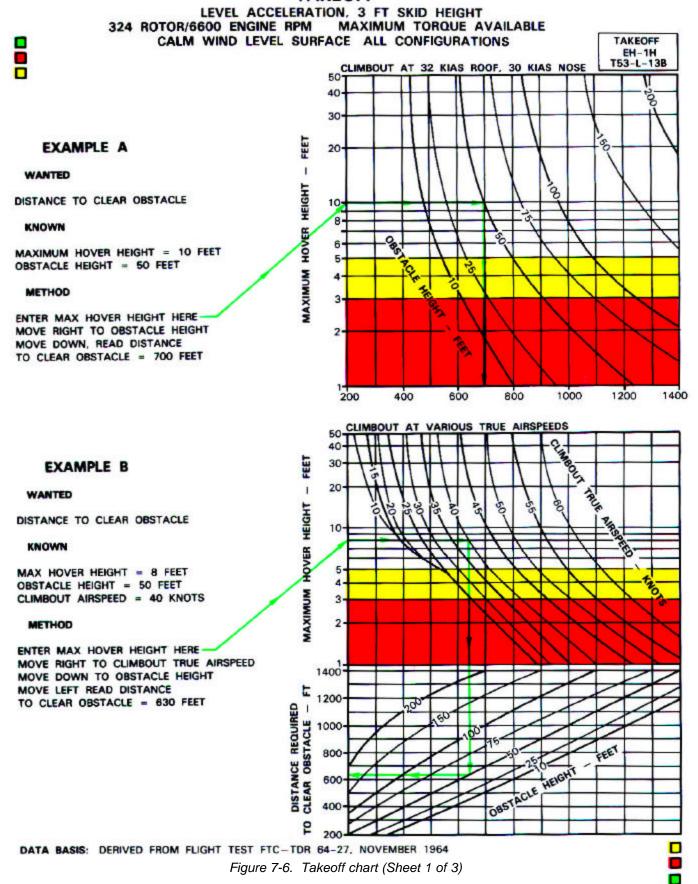
a. Wind. The takeoff chart is based upon calm wind conditions. Since surface wind velocity and direction cannot be accurately predicted, all takeoff planning should be based upon calm wind conditions. Takeoff into any prevailing wind will improve the takeoff performance.

WARNING

A tailwind during takeoff and climbout will increase the obstacle clearance distance and could prevent a successful takeoff.

b. Power Settings. All takeoff performance data are based upon the torque used in determining the hover capabilities in figure 7-4.

TAKEOFF



TAKEOFF CLIMB AND ACCELERATION, 3 FT SKID HEIGHT 324 ROTOR/6600 ENGINE RPM MAXIMUM TORQUE AVAILABLE EH-1H CALM WIND LEVEL SURFACE ALL CONFIGURATIONS CLIMBOUT AT 32 KIAS ROOF, 30 KIAS NOSE HEIGHT **EXAMPLE A** MAXIMUM HOVER WANTED DISTANCE TO CLEAR OBSTACLE KNOWN MAX HOVER HEIGHT = 17 FEET 100 300 500 700 900 1100 1300 1500 1700 1900 2100 OBSTACLE HEIGHT = 120 FEET DISTANCE REQUIRED TO CLEAR OBSTACLE - FT METHOD ENTER MAX HOVER HEIGHT HERE CLIMBOUT AT VARIOUS TRUE AIRSPEEDS MOVE RIGHT TO OBSTACLE HEIGHT HEIGHT MOVE DOWN, READ DISTANCE TO CLEAR OBSTACLE = 1420 FEET HOVER **EXAMPLE B** WANTED MAXIMUM 3 DISTANCE TO CLEAR OBSTACLE KNOWN MAX HOVER HEIGHT - 17 FEET 2100 OBSTACLE HEIGHT = 120 FEET CLIMBOUT AIRSPEED = 50 KTAS 1900 METHOD ENTER MAX HOVER HEIGHT HERE OBSTACLE 1700 MORE RIGHT TO AIRSPEED MOVE DOWN TO OBSTACLE HEIGHT MOVE LEFT, READ DISTANCE 1500 TO CLEAR OBSTACLE = 1610 FEET CLEAR 1300 DISTANCE REQUIRED TO 1100 900 700 500 DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Takeoff chart (Sheet 2 of 3)

TAKEOFF

LEVEL ACCELERATION, 15 FT SKID HEIGHT 324 ROTOR/6600 ENGINE RPM MAXIMUM TORQUE AVAILABLE CALM WIND LEVEL SURFACE ALL CONFIGURATIONS

TAKEOFF EH-1H T53-L-13B



WANTED

DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 17 FEET OBSTACLE HEIGHT = 120 FEET

METHOD

ENTER MAX HOVER HEIGHT HERE— MOVE RIGHT TO OBSTACLE HEIGHT MOVE DOWN, READ DISTANCE TO CLEAR OBSTACLE = 1125 FEET

EXAMPLE B

WANTED

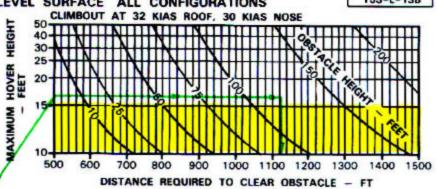
DISTANCE TO CLEAR OBSTACLE

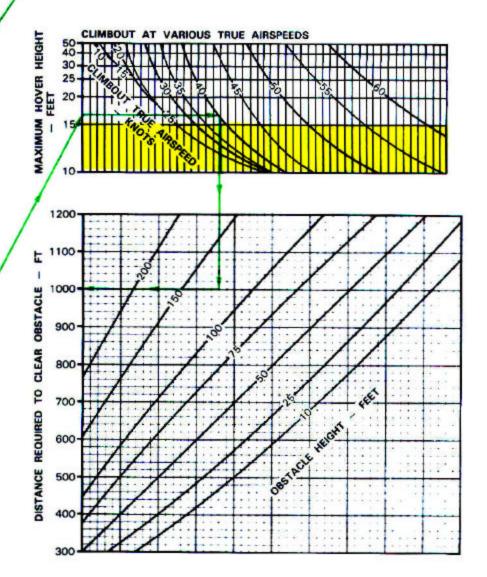
KNOWN

MAX HOVER HEIGHT = 17 FEET OBSTACLE HEIGHT = 120 FEET CLIMBOUT AIRSPEED = 40 KTAS

METHOD

ENTER MAX HOVER HEIGHT HEREMOVE RIGHT TO CLIMBOUT
TRUE AIRSPEED
MOVE DOWN TO OBSTACLE HEIGHT
MOVE LEFT, READ DISTANCE
TO CLEAR OBSTACLE = 1000 FEET





DATA BASIS: DERIVED FROM YUH-1H FLIGHT TEST, ASTA-TDR 66-04, NOVEMBER 1970

Figure 7-6. Takeoff chart (Sheet 3 of 3)

Section VI. CRUISE

7-24. DESCRIPTION.

The cruise charts (figure 7-7, sheets 1 through 24) show the torque pressure and engine rpm required for level flight at various pressure altitudes, airspeeds, gross weights and fuel flows for the clean configuration. The cruise charts are basically arranged by FAT groupings. Each chart has a dashed line that represents a ten square foot equivalent flat plate drag area. This allows quick determination of Delta PSI for other than clean configuration.

NOTE

Clean configuration is EH-1X antennae configuration, with Hot Meal Plug Plume IR Suppressor, ALQ-144 IR Jammer, M-130 Chaff Dispenser and M130 Flare Dispenser. See section VI for corrections for other configurations.

7-25. USE OF CHARTS.

CAUTION

Engine torque available values in figure 7-7 are in error. Decrease engine torque available by 3 PSI. Omit this correction for transmission limited conditions.

CAUTION

Cruise flight is restricted to 319 to 324 Rotor RPM (6500 to 6600 Engine Cruise at 324 Rotor/6600 Engine RPM is recommended. The cruise chart data for true airspeeds above 40 KTAS is based on 314 Rotor/6400 Engine RPM. Until the revised. cruise charts are shall performance planning accomplished using the procedures and torque corrections from Table 7-1.

The primary use of the charts is illustrated by the examples provided in figure 7-7. The first step for chart use is to select the proper chart, based upon the planned drag configuration, pressure altitude and anticipated free air temperature; refer to chapter 7 index (paragraph 7-2). Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and FAT, or the next higher altitude and

- FAT. If greater accuracy is required, interpolation between altitudes and/or temperatures will be required (see example on page 7-26). You may enter the charts on any side: TAS, IAS, torque pressure, or fuel flow, and then move vertically or horizontally to the gross weight, then to the other three parameters. Maximum performance conditions are determined by entering the chart where the maximum range or maximum endurance and rate of climb lines intersect the appropriate gross weight; then read airspeed, fuel flow and PSI torque pressure. For conservatism, use the gross weight at the beginning of cruise flight. For greater accuracy on long flights, it is preferable to determine cruise information for several flight segments in order to allow for decreasing fuel weights (reduced gross weight). The following parameters contained in each chart are further explained as follows:
- **a. Airspeed.** True and indicated airspeeds are presented at opposite sides of each chart. On any chart, indicated airspeed can be directly converted to true airspeed (or vice versa) by reading directly across the chart without regard for other chart information. Maximum permissible airspeed (V_{NE}) limits appear as red lines on some charts. If no red line appears, V_{NE} is above the limits of the chart.
- **b. Torque Pressure (PSI).** Since pressure altitude and temperature are fixed for each chart, torque pressures vary according to gross weight, airspeed and bleed air on or off. See page 7-10 for effect of bleed air heater and deice installed.
- c. Fuel Flow. Fuel flow scales are provided opposite the torque pressure scales. On any chart, torque pressure may be converted directly to fuel flow without regard for other chart information. All fuel flows are presented for bleed air heated and deice off. Add two percent fuel flow (about 14 lb/hr) for heater on and increase fuel flow three percent (approximately 21 lb/hr) for deice on. If both are operating, add five percent fuel flow (about 35 lb/hr) to chart values.
- **d. Maximum Range.** The maximum range lines indicate the combinations of weight and airspeed that will produce the greatest flight range per gallon of fuel under zero wind conditions. When a maximum range condition does not appear on a chart it is because the maximum range speed is beyond the maximum permissible speed (V_{NE}); in such cases, use V_{NE} cruising speed to obtain maximum range.
- e. Maximum Endurance and Rate of Climb. The maximum endurance and rate of climb lines indicate

the airspeed for minimum torque pressure required to maintain level flight for each gross weight, FAT and pressure altitude. Since minimum torque pressure will provide minimum fuel flow, maximum flight endurance will be obtained at the airspeeds indicated.

7-26. CONDITIONS.

The cruise charts are based upon operation at 324 rotor/6600 engine rpm below 40 KTAS and 314 rotor/6400 engine rpm for true airspeeds above 40 knots.

Table 7-1. TORQUE CORRECTION (Sheet 1 of 4)

To determine cruise performance data for 324 Rotor/6600 Engine RPM at speeds above 40 KTAS follow the instructions in paragraph 7-25 except:

- a. Add appropriate torque correction from this table to the calibrated torque required values determined from the intersection of the airspeed and gross weight lines on the upper (6400 Engine RPM) portion of the cruise chart.
- b. Determine fuel flow corresponding to the corrected torque required from the lower (6600 Engine RPM) portion of the cruise chart.
- c. Determine continuous torque available (CONT TRQ AVAIL) and 30 minute torque available (30 MIN TRQ AVAIL) from the lower (6600 Engine RPM) portion of the cruise chart. Decrease torque available read from chart by 3 psi.

EXAMPLE

WANTED

Speed for Maximum Range Calibrated Torque Required and Fuel Flow at Maximum Range Speed

KNOWN

324 Rotor/6600 Engine RPM Clean Configuration FAT = -30°C Pressure Altitude = 8000 Feet Gross Weight = 8500 Pounds Roof Mounted System

METHOD

Locate (-30°C FAT, 8000 Feet) Chart (Figure 7-7 Sheet 3 of 24) Find Intersection of 8500 Lb Gr Wt Line with the Max Range Line To Read Speed for Maximum Range: Move Right, Read TAS = 98.7 Knots Move Left, Read IAS = 96.2 Knots To Read Calibrated Torque Required @ 314 Rotor/6400 Engine RPM: Move Down, Read Torque = 41.8 PSI To Correct Torque Required for 6600 Engine RPM From Table for Sheet 3 (8000 Ft, -30°C) @ 8500 Gross Weight For 90 KTAS, Torque Correction = 3.5 PSI For 110 KTAS, Torque Correction = 5.7 PSI Interpolate for 98.7 KTAS Torque Correction = 4.5 PSI Corrected Torque Required = 41.8 PSI + 4.5 PSI = 46.3 PSI To Determine Fuel Flow Enter Figure 7-6 Sheet 3 of 24 at 46.3 PSI Torque Move Down Read Fuel Flow = 613 Lbs/hr

TABLE 7-1. TORQUE CORRECTION (Sheet 2 of 4)

=					E CORREC				
(-30°C F	,		ET 1	SHE			ET 3		EET 4
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	NA	NA	2.4	2.2	2.1	1.9	1.8
	70	NA	NA	NA	2.8	2.6	2.4	2.2	2.2
	90	NA	NA	NA	3.5	3.4	3.2	3.0	2.9
	110	NA	NA	NA	5.9	5.5	5.2	4.9	4.5
6500	50	3.0	2.8	2.6	2.4	2.2	2.2	2.1	1.9
	70	3.3	3.2	3.1	2.9	2.6	2.5	2.4	2.3
	90	4.3	4.1	3.9	3.7	3.5	3.4	2.9	2.9
	110	7.3	6.9	6.4	6.1	5.6	5.3	4.5	4.6
500	50	3.1	2.9	2.6	2.5	2.3	2.3.	1.7	1.4
	70	3.5	3.3	3.0	3.0	2.8	2.7	2.2	2.2
	90	4.5	4.3	4.1	3.9	3.4	3.3	2.9	2.7
	110	7.4	7.0	6.5	6.2	5.3	5.3	4.7	4.7
3500	50	3.0	2.9	2.7	2.6	2.3	1.8	1.1	0.8
	70	3.5	3.4	3.3	3.1	2.8	2.6	1.8	1.1
	90	4.6	4.4	4.0	3.7	3.5	3.2	1.9	8.0
	110	7.5	7.1	6.4	6.0	5.7	5.5	2.6	0.6
500	50	3.1	3.0	2.9	2.1	1.7	1.1	0.1	-1.8
	70	3.8	3.5	3.4	2.8	2.8	1.9	-0.6	-2.3
	90	4.9	4.2	4.2	3.5	3.5	2.0	-2.4	-1.5
	110	7.7	6.6	6.7	6.0	5.9	2.5	-4.8	1.4
-15°C F			ET 5	SHE			ET 7		ET 8
W-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	NA	1.3	1.2	1.1	1.0	1.0	1.0
	70	NA	NA	1.9	1.7	1.7	1.5	1.5	1.3
	90	NA	NA	2.6	2.5	2.3	2.2	2.1	1.9
	110	NA	NA	3.0	2.9	2.6	2.4	2.3	2.0
6500	50	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.5
	70	2.2	2.1	1.9	1.7	1.7	1.6	1.5	1.3
	90	3.0	2.9	2.7	2.5	2.4	2.2	2.1	1.8
	110	3.5	3.3	3.1	2.8	2.7	2.3	2.2	1.8
7500	50	1.6	1.4	1.3	1.3	1.2	0.7	0.7	0.3
7000	70	2.2	2.0	2.0	1.9	1.8	1.6	1.6	0.6
	90	3.2	2.9	2.8	2.6	2.4	2.1	2.0	0.9
	110	3.6	3.3	3.2	2.7	2.4	2.1	2.0	-0.5
	110	3.0	5.5	ა.∠	۷.1	2.0	۷.۷	۷.۱	-0.5
8500	50 70	1.6	1.5	1.4	1.1	0.7	0.5	0.5	-0.9
	70	2.3	2.2	2.1	1.9	1.7	1.2	0.8	-1.4
	90	3.3	3.1	2.8	2.6	2.2	1.6	1.3	-3.2
	110	3.6	3.3	2.8	2.7	2.3	0.8	-0.2	-7.5
500	50	1.6	1.4	0.8	0.9	0.4	-0.1	-0.8	-7.5
	70	2.3	2.3	2.0	2.0	8.0	-0.2	-1.2	-6.6
	90	3.2	3.1	2.6	2.6	1.2	-0.8	-2.9	-6.8
	110	3.2	3.1	2.7	2.7	-0.7	3.8	-7.2	-6.9

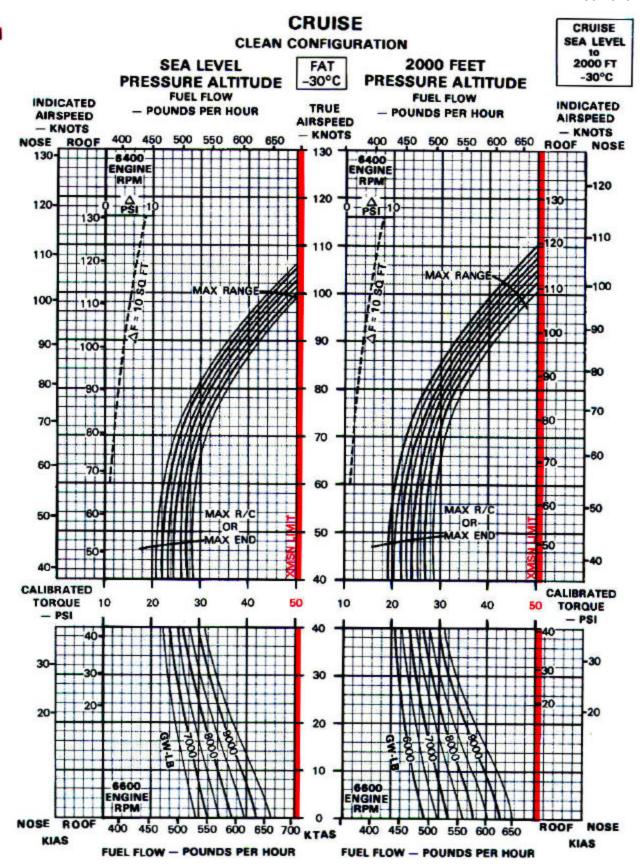
TABLE 7-1. TORQUE CORRECTION (Sheet 3 of 4)

				TORQUI	E CORREC	TION - PSI			
[0°C FAT] SHEET 9			ET 10	SHEE	T 11	SHE	SHEET 12		
GW-LB	-								
	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	NA	1.1	1.1	1.0	0.9	0.9	0.8
	70	NA	NA	1.2	1.1	1.1	1.0	0.9	0.8
	90	NA	NA	1.4	1.3	1.2	1.1	1.1	1.0
	110	NA	NA	2.5	2.3	2.1	2.0	1.9	1.6
	-			-					
6500	50	1.4	1.3	1.1	1.2	1.1	0.9	0.7	0.6
	70	1.4	1.3	1.2	1.2	1.1	0.9	0.8	8.0
	90	1.6	1.5	1.4	1.4	1.2	1.2	0.9	0.9
	110	2.9	2.7	2.5	2.4	2.1	2.0	1.8	1.6
	110	2.0	2.1	2.0	2.4	2.1	2.0	1.0	1.0
7500	50	1.3	1.3	1.2	1.1	0.9	0.7	0.4	0.4
	70	1.4	1.4	1.3	1.1	1.0	8.0	0.2	0.0
	90	1.6	1.6	1.4	1.3	1.2	0.9	0.3	0.0
	110	3.0	2.7	2.5	2.3	2.1	1.9	0.5	-0.1
	110	3.0	2.1	2.5	2.3	2.1	1.9	0.5	-0.1
8500	50	1.4	1.3	1.1	0.7	0.7	0.4	-0.5	-3.0
	70	1.5	1.3	1.2	0.9	0.8	0.1	-1.5	-3.8
	90	1.7	1.5	1.5	1.0	0.8	0.1	-3.8	-5.9
	110	3.0	2.5	2.5	2.1	1.8	0.0	-4.9	-8.8
9500	50	1.3	1.0	0.8	0.5	0.4	-0.8	-6.9	NA
0000	70	1.4	1.2	1.1	0.3	0.0	-2.0	-7.3	NA
	90	1.6	1.3	1.2	0.3	-0.3	-5.3	-8.5	NA
//=== = .	110	2.8	2.6	2.4	0.4	-0.4	-6.3	-15.4	NA
(15°C FA		SHEE			ET 14	SHEE			ET 16
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000
5500	50	NA	0.7	0.7	0.6	0.6	0.7	0.6	0.5
	70	NA	0.9	0.9	0.8	0.7	0.7	0.6	0.5
	90	NA	1.0	1.1	0.9	0.9	0.8	0.8	0.7
	110	NA	0.9	0.9	0.9	0.8	0.8	0.8	0.8
	110	14/3	0.5	0.5	0.5	0.0	0.0	0.0	0.0
6500	50	0.8	0.7	0.7	8.0	0.7	0.6	0.4	0.2
	70	1.0	1.0	0.9	0.9	0.6	0.5	0.4	0.1
	90	1.2	1.1	1.0	0.9	0.9	0.8	0.6	0.3
	110	1.1	1.0	1.0	0.9	0.8	0.8	0.6	-0.3
	110	1.1	1.0	1.0	0.9	0.0	0.0	0.0	-0.3
7500	50	0.9	0.9	0.8	0.7	0.4	0.4	0.1	-1.0
	70	1.1	1.0	0.7	0.7	0.5	0.2	-0.2	-1.7
	90	1.2	1.1	1.0	1.0	0.6	0.5	-0.1	-4.2
	110	1.1	1.0	0.9	1.1	0.7	0.1	-1.2	-6.7
8500	50	0.9	0.8	0.6	0.5	0.0	-0.5	-1.3	-7.3
5555	70	0.9	0.8	0.6	0.5	-0.3	-0.9	-2.0	-7.3 -7.1
	90	1.1	1.2	0.8	8.0	-0.1	-2.0	-5.0	-7.9
	110	1.0	1.1	8.0	8.0	-1.5	-4.0	-8.2	-19.6
9500	50	0.8	0.6	0.4	0.0	-1.4	-4.9	NA	NA
5500									
	70	0.7	0.6	0.2	-0.2	-2.2	-5.2	NA NA	NA
	90	1.2	8.0	0.4	0.0	-5.4	-7.3	NA	NA
	110	1.2	0.9	-0.2	-1.5	-8.7	-15.2	NA	NA

Change 4 7.24.4

TABLE 7-1. TORQUE CORRECTION (Sheet 4 of 4)

					E CORREC					
[30°C F/			ET 17		ET 18		ET 19		ET 20	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000	
5500	50	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.3	
	70	8.0	0.7	0.7	0.6	0.6	0.5	0.3	0.3	
	90	0.5	0.5	0.4	0.3	0.3	0.2	0.3	0.1	
	110	8.0	8.0	8.0	0.7	0.7	0.7	0.7	0.6	
6500	50	0.6	0.6	0.7	0.5	0.5	0.3	0.4	0.0	
	70	0.7	0.7	0.6	0.5	0.4	0.4	0.3	-0.2	
	90	0.6	0.4	0.3	0.3	0.4	0.1	0.1	-0.6	
	110	1.0	0.9	8.0	8.0	1.0	0.6	0.5	-0.9	
7500	50	0.9	0.7	0.6	0.5	0.4	-0.1	-0.6	-1.6	
	70	0.8	0.5	0.5	0.4	0.3	-0.3	-0.9	-2.0	
	90	0.3	0.3	0.4	0.1	0.2	-0.7	-2.7	-5.1	
	110	0.9	1.0	1.0	0.8	0.7	-1.1	-2.8	-7.4	
8500	50	0.7	0.6	0.5	0.1	0.0	-1.6	-6.3	NA	
	70	0.5	0.4	0.4	0.0	-0.1	-2.1	-6.0	NA	
	90	0.4	0.3	0.2	-0.4	-0.7	-5.7	-7.9	NA	
	110	1.2	1.0	0.7	-0.6	-1.1	-8.0	-16.3	NA	
		1.2		0.7	0.0		0.0			
9500	50	0.5	0.5	-0.1	-1.0	-2.2	-8.3	NA	NA	
	70	0.4	0.5	-0.3	-1.3	-2.7	-7.7	NA	NA	
	90	0.1	0.2	-0.8	-3.9	-6.6	-9.3	NA	NA	
	110	8.0	8.0	-1.3	-5.4	-9.7	-21.5	NA	NA	
[45°C F/	AT]	SHE	ET 21	SHE	ET 22	SHEI	ET 23	SHE	ET 24	
GW-LB	KTAS	SL	2000	4000	6000	8000	10000	12000	14000	
5500	50	0.5	0.5	0.5	0.6	0.5	0.4	0.3	0.2	
	70	0.4	0.5	0.4	0.3	0.3	0.1	0.2	0.1	
	90	0.5	0.5	0.3	0.2	0.2	0.3	0.3	0.1	
	110	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.0	
6500	50	0.6	0.6	0.5	0.4	0.3	0.2	-0.1	-0.3	
	70	0.5	0.4	0.3	0.2	0.2	0.1	-0.3	-0.6	
	90	0.3	0.2	0.2	0.4	0.3	0.1	-0.4	-1.3	
	110	0.3	0.4	0.4	0.4	0.3	0.0	-1.1	-2.5	
7500	50	0.6	0.4	0.4	0.3	0.0	-0.1	-1.5	-5.9	
	70	0.3	0.2	0.3	0.2	-0.2	-0.2	-2.1	-5.7	
	90	0.3	0.4	0.4	0.1	-0.4	-0.6	-5.0	-6.9	
	110	0.4	0.5	0.3	0.0	-0.9	-1.5	-7.9	-14.7	
8500	50	0.5	0.3	0.2	-0.2	-1.4	-3.6	7.2	NA	
0000	70		0.3						NA NA	
		0.3		0.1	-0.3	-1.9	-3.9	8.0		
	90	0.5	0.1	0.0	-0.8	-4.4	-6.4	11.0	NA	
	110	0.6	0.0	-0.3	-1.8	-7.2	-11.7	NA	NA	
9500	50	0.4	-0.1	-0.4	-1.9	-7.7	NA	NA	NA	
	70	0.2	-0.4	-0.6	-2.6	-7.5	NA	NA	NA	
	90	0.3	-0.7	-1.4	-6.3	-8.8	NA	NA	NA	
	110	0.1	-1.6	-2.8	-10.0	-18.8	NA	NA	NA	



EXAMPLE

WANTED

CALIBRATED TORQUE REQUIRED FOR LEVEL FLIGHT, FUEL FLOW, INDICATED AIRSPEED

KNOWN

CLEAN CONFIGURATION
GROSS WEIGHT = 9000 LB
PRESSURE ALTITUDE = 5000 FEET
FAT -30°C
DESIRED TRUE AIRSPEED = 100 KNOTS ROOF MOUNTED
SYSTEM

METHOD (INTERPOLATE)

ENTER TRUE AIRSPEED HERE
READ CALIBRATED TORQUE, FUEL FLOW, AND IAS ON EACH
ADJACENT ALTITUDE AND/OR FAT, THEN INTERPOLATE
BETWEEN ALTITUDE AND/OR FAT

ALTITUDE, FEET	4000 FEET	6000 FEET	5000 FEET
FAT, °C	-30	-30	-30
CALIBRATED TORQUE, PSI	46.4	45.2	45.8
FUEL FLOW, LB/HR	628	602	615
IAS, KNOTS	104.5	100.7	102 6

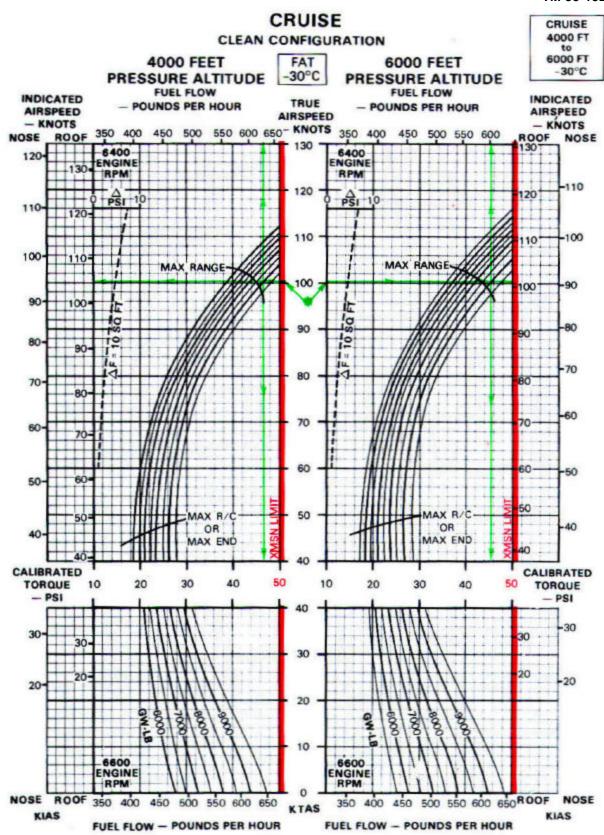


Figure 7-7. Cruise chart (Sheet 2 of 24)

EXAMPLE

WANTED

SPEED FOR MAXIMUM RANGE
CALIBRATED TORQUE REQUIRED AND FUEL FLOW AT
MAXIMUM RANGE SPEED AND FOR MAXIMUM ENDURANCE

KNOWN

CLEAN CONFIGURATION, FAT = -30°C PRESSURE ALTITUDE = 8000 FEET. AND GROSS WEIGHT = 8500 POUNDS ROOF MOUNTED SYSTEM

METHOD

LOCATE (-30°C FAT, 8000 FEET) CHART

FIND INTERSECTION OF 8500 LB GROSS WEIGHT LINE WITH THE

MAXIMUM RANGE LINE

TO READ SPEED FOR MAXIMUM RANGE:

MOVE RIGHT, READ TAS = 98.7 KNOTS AND MOVE LEFT,

READ IAS = 96.2 KNOTS

TO READ FUEL FLOW REQUIRED:

MOVE UP, READ FUEL FLOW = 559 LB/HR

TO READ CALIBRATED TORQUE REQUIRED:

MOVE DOWN, READ TORQUE = 41.8 PSI

FIND INTERSECTION OF 8500 LB GROSS WEIGHT LINE WITH THE

MAXIMUM ENDURANCE LINE

TO READ SPEED FOR MAXIMUM ENDURANCE:

MOVE RIGHT, READ TAS = 52.5 KNOTS AND MOVE LEFT,

READ IAS = 49.0 KNOTS

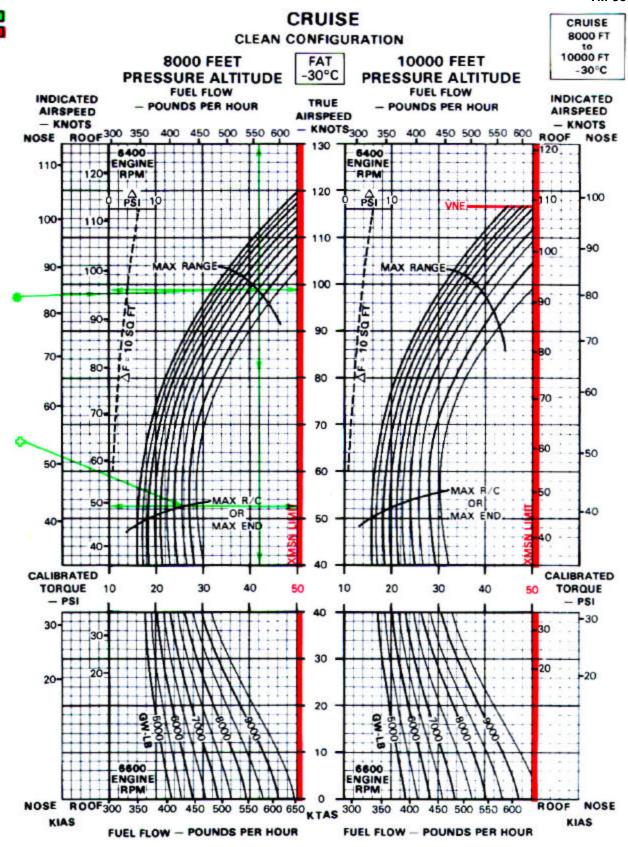


Figure 7-7. Cruise chart (Sheet 3 of 24)

EXAMPLE

WANTED

ADDITIONAL CALIBRATED TORQUE REQUIRED AND FUEL FLOW FOR EXTERNAL DRAG CONFIGURATION

KNOWN

∆F FOR EXTERNAL DRAG CONFIGURATION (FROM FIGURE 7-8, EXAMPLE B) = 4 SQUARE FEET GROSS WEIGHT = 7000 POUNDS FAT = -30°C PRESSURE ALTITUDE = 12000 FEET TRUE AIRSPEED = 105 KNOTS

METHOD

ENTER TRUE AIRSPEED AT 105 KNOTS (**) AND MOVE LEFT TO 7000 POUND GROSS WEIGHT LINE. MOVE UP TO FUEL FLOW SCALE AND READ 509 LB/HR. MOVE DOWN TO CALIBRATED TORQUE SCALE AND READ 39.0 PSI. MOVE LEFT (AT 105 KNOTS) TO 10 SQ. FT. Δ F LINE, MOVE UP AND READ 4.0 Δ PSI. DIVIDE 4 SQ. FT. BY 10 SQ. FT. = 40%. 40% OF 4.0 Δ PSI = 1.6 Δ PSI. ADD 1.6 AND 39.0 = 40.6 PSI. MOVE UP FROM TORQUE SCALE AT THIS POINT TO FUEL FLOW SCALE AND READ 522 LB/HR.

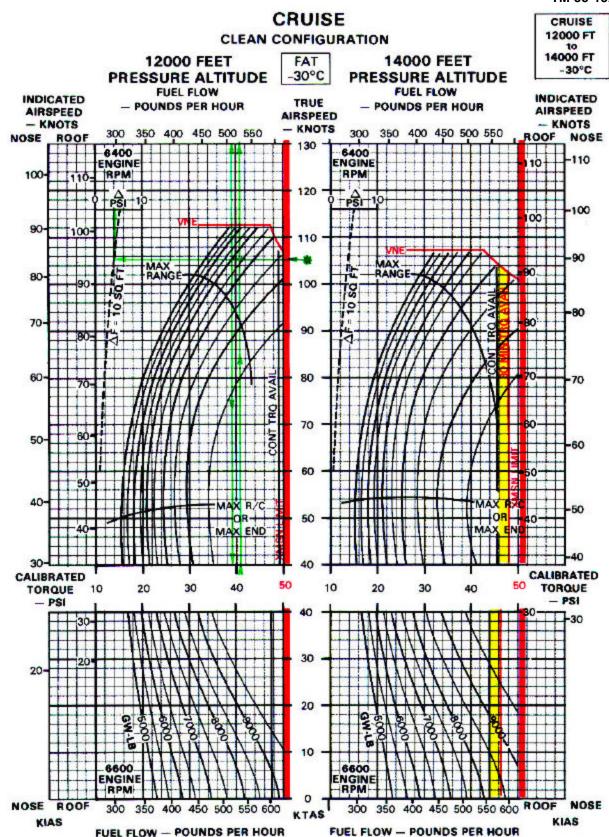


Figure 7-7. Cruise chart (Sheet 4 of 24)

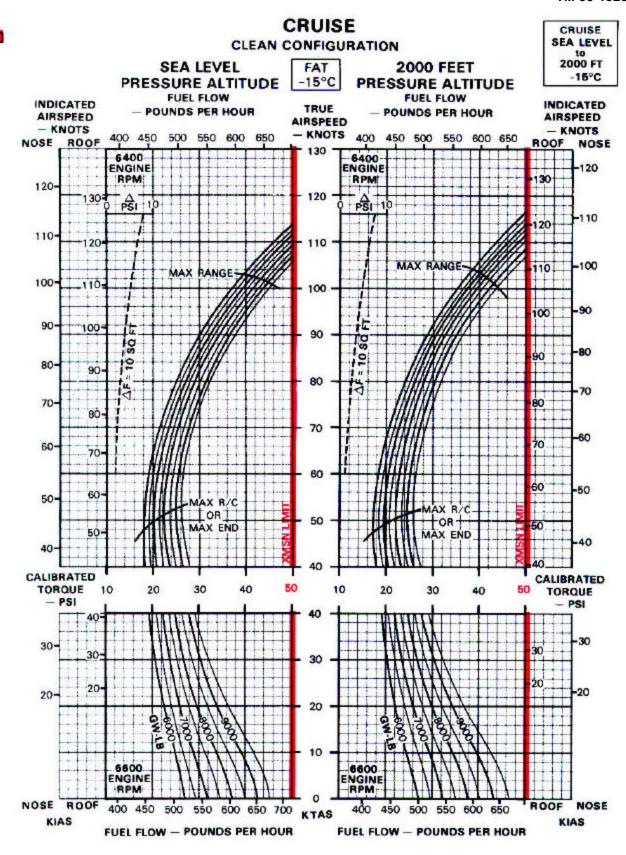


Figure 7-7. Cruise chart (Sheet 5 of 24)

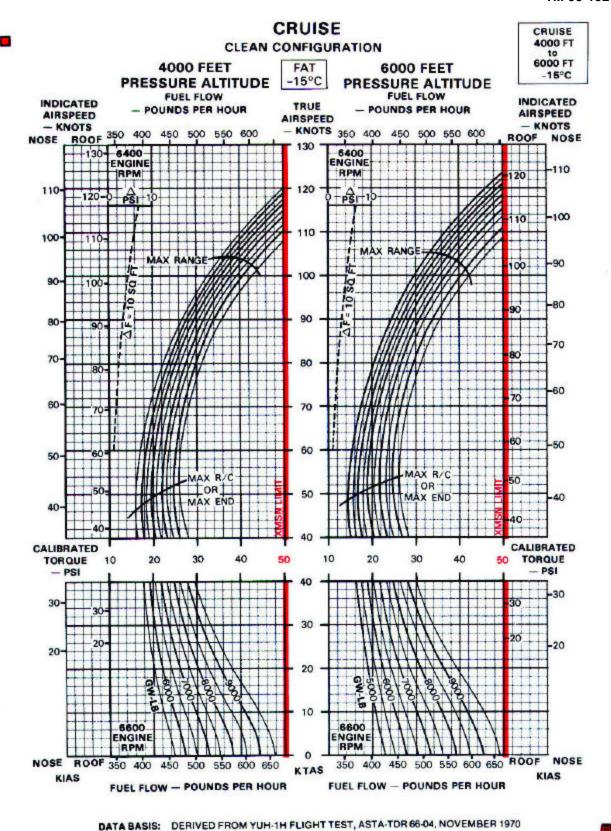


Figure 7-7. Cruise chart (Sheet 6 of 24)

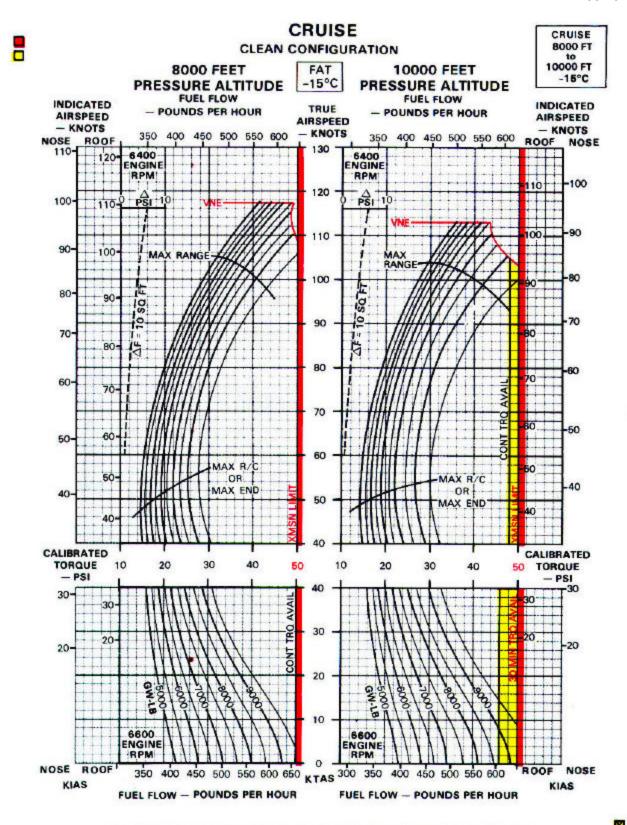


Figure 7-7. Cruise chart (Sheet 7 of 24)

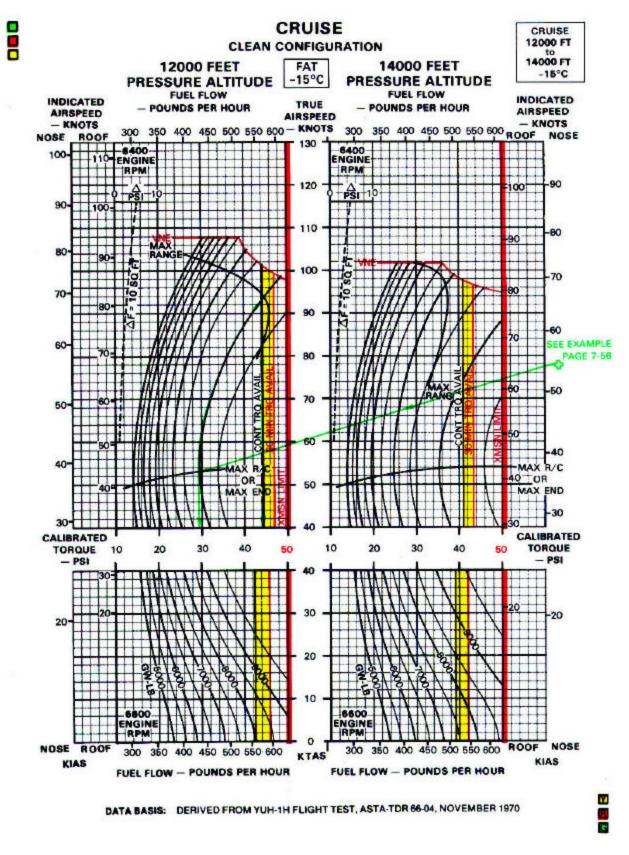


Figure 7-7. Cruise chart (Sheet 8 of 24)

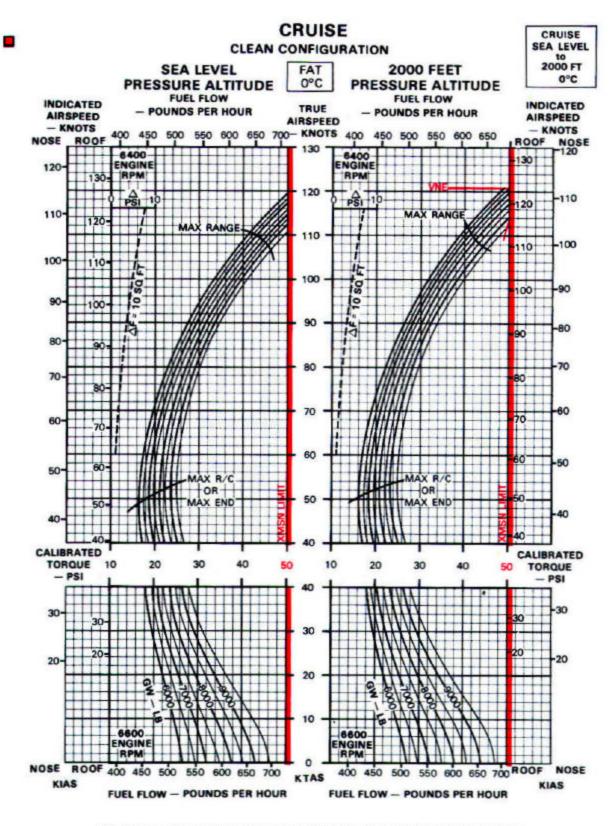


Figure 7-7. Cruise chart (Sheet 9 of 24)

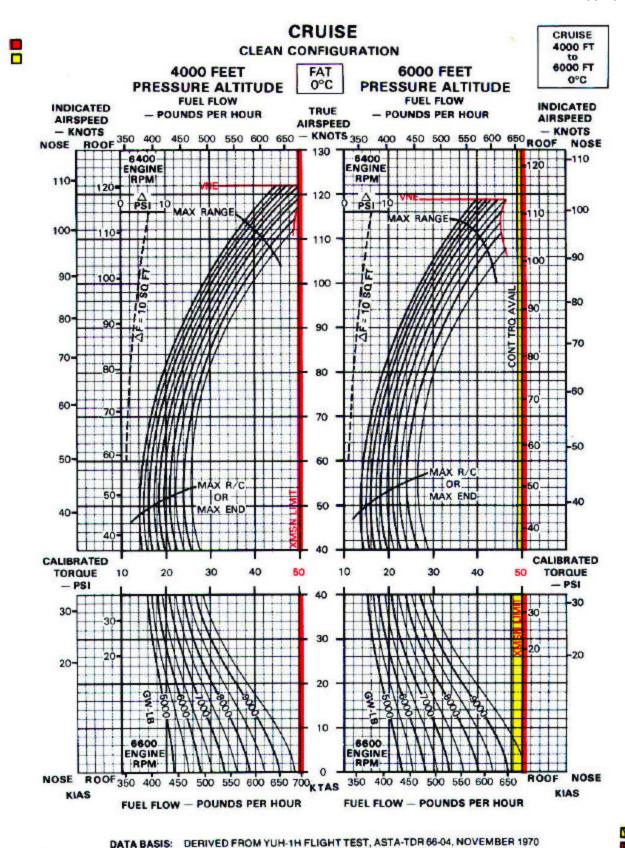


Figure 7-7. Cruise chart (Sheet 10 of 24)

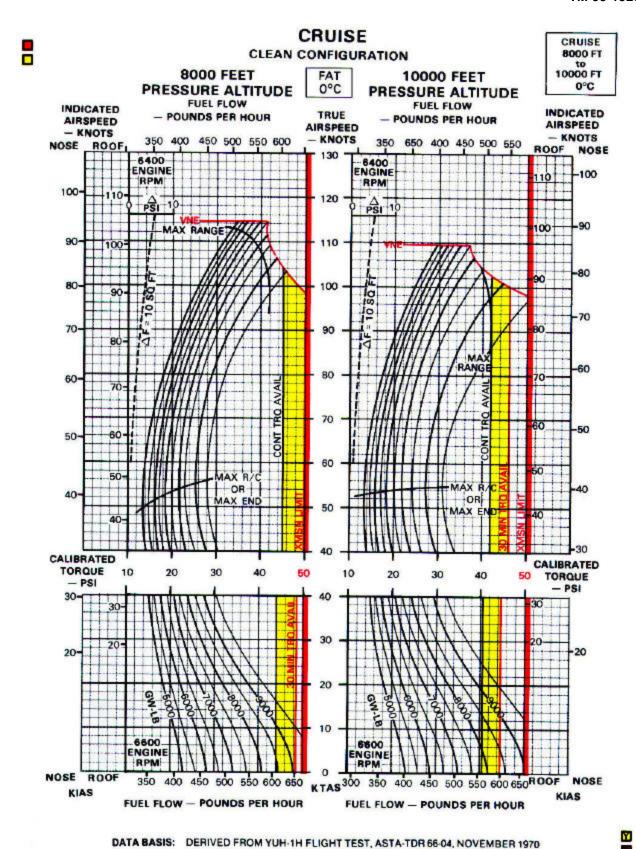


Figure 7-7. Cruise chart (Sheet 11 of 24)

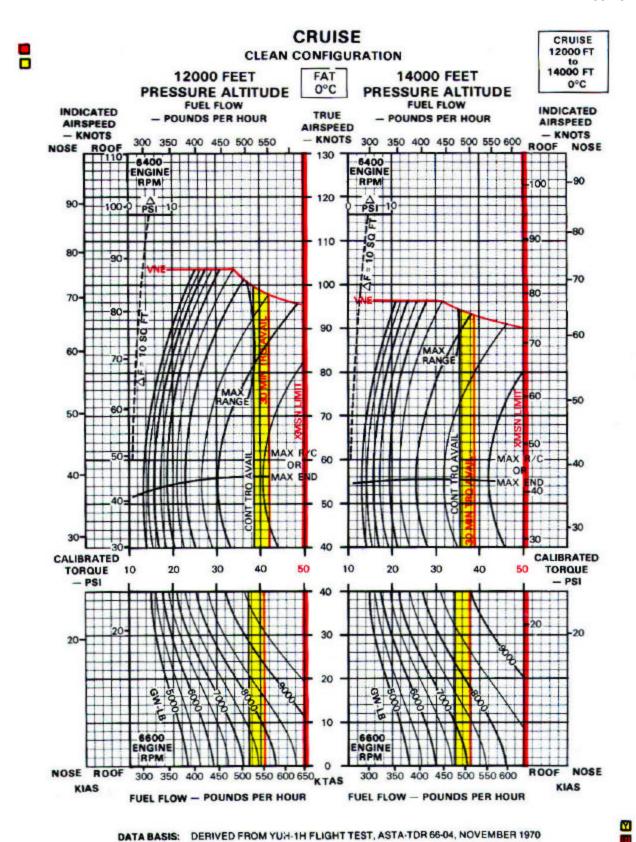


Figure 7-7. Cruise chart (Sheet 12 of 24)

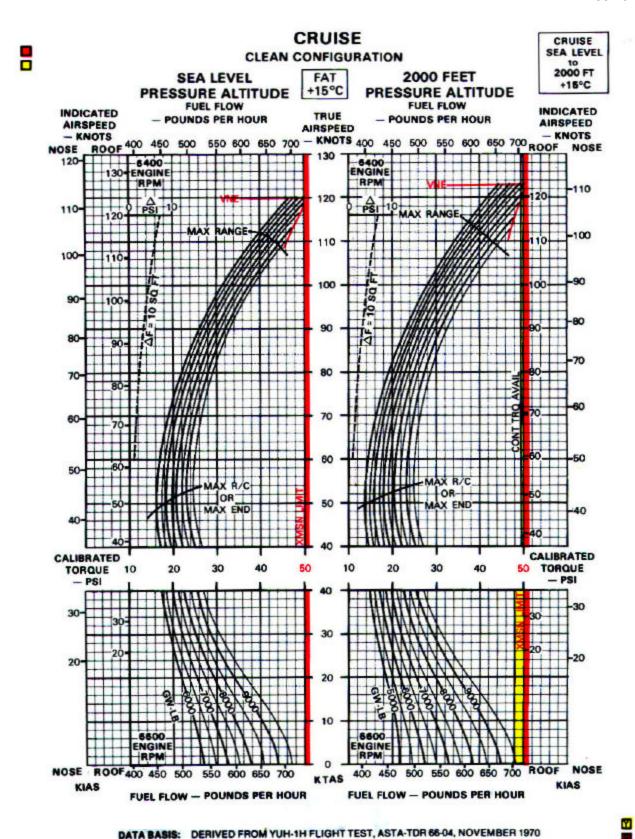


Figure 7-7. Cruise chart (Sheet 13 of 24)

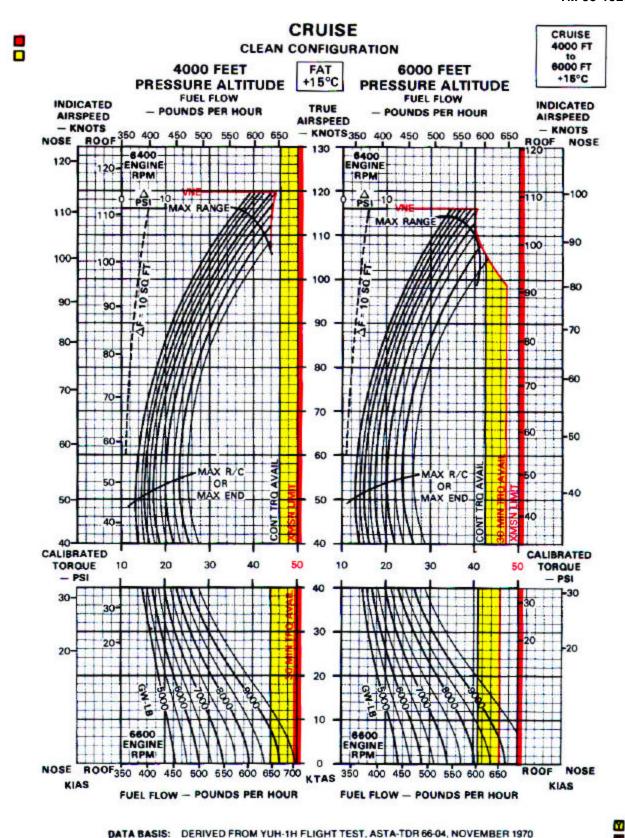


Figure 7-7. Cruise chart (Sheet 14 of 24)

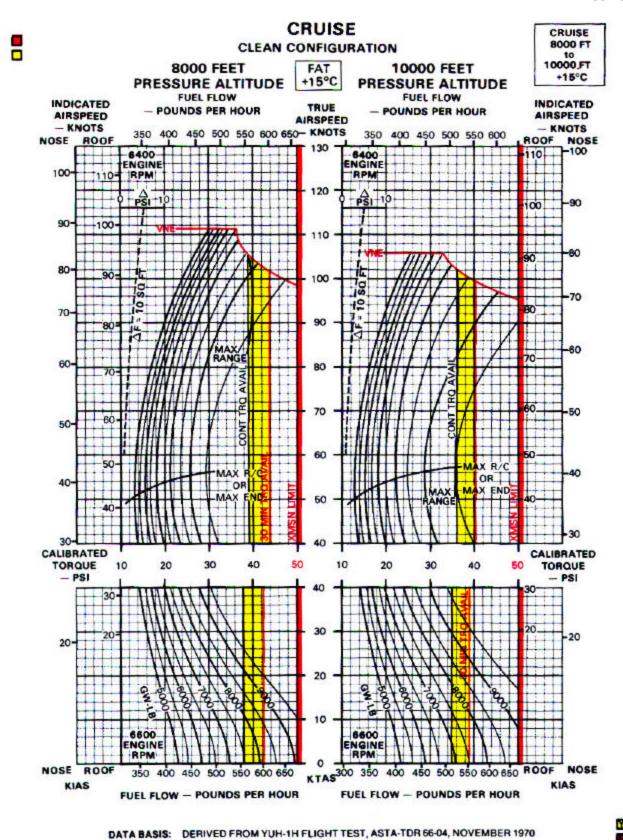


Figure 7-7. Cruise chart (Sheet 15 of 24)

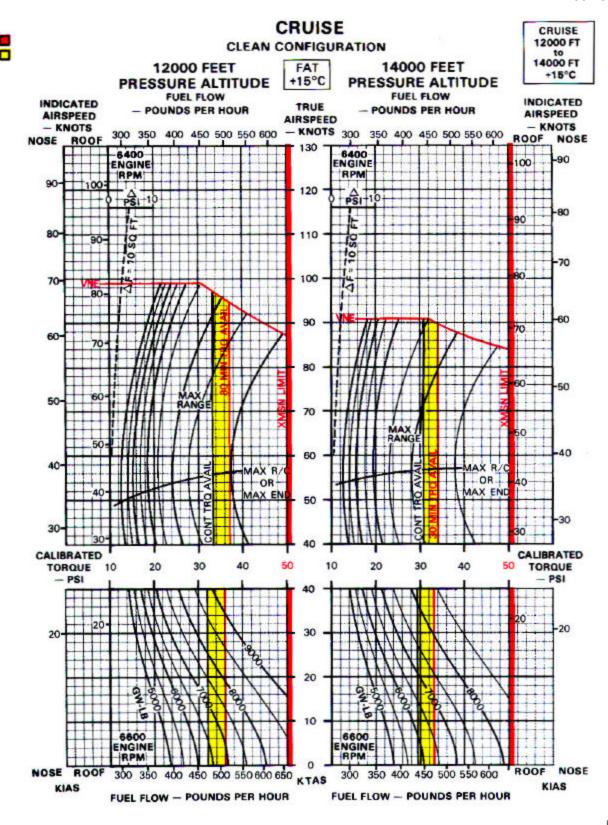


Figure 7-7. Cruise chart (Sheet 16 of 24)

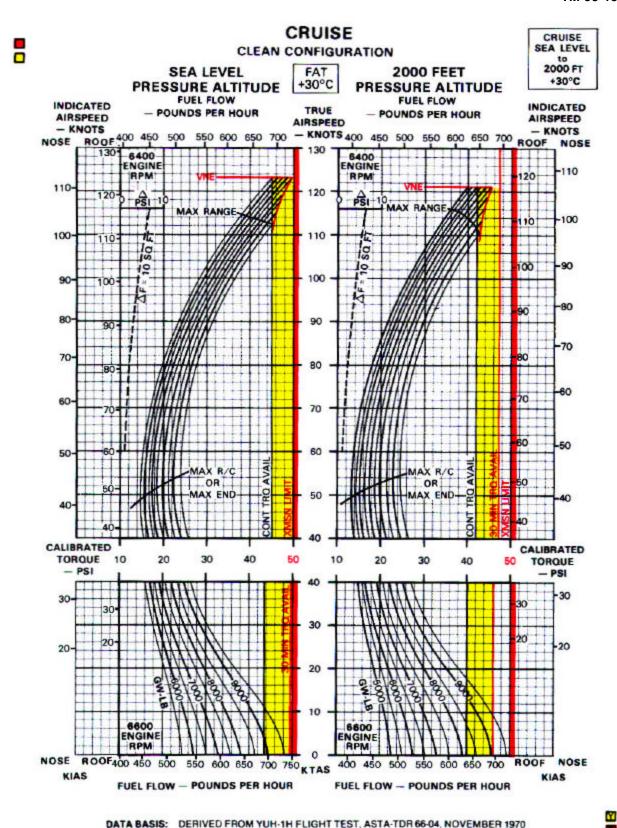


Figure 7-7. Cruise chart (Sheet 17 of 24)

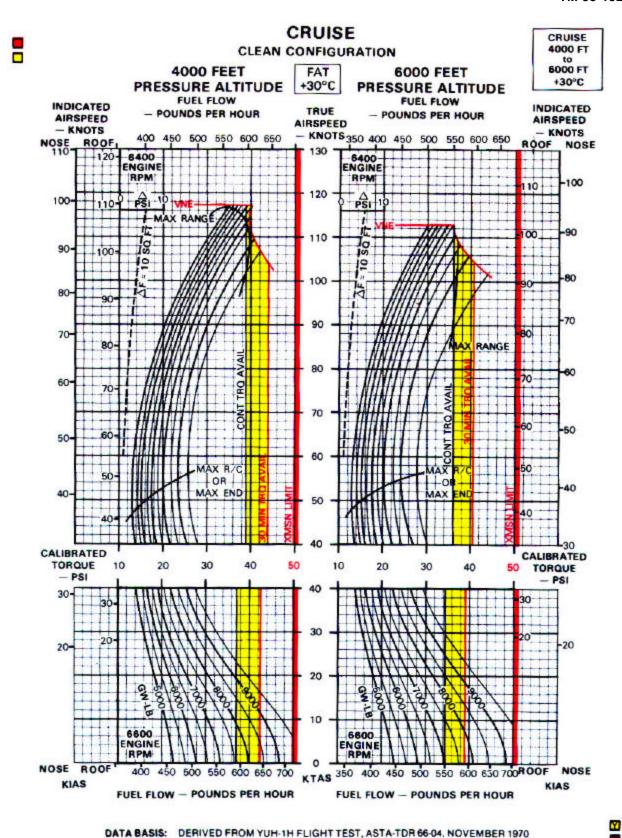


Figure 7-7. Cruise chart (Sheet 18 of 24)

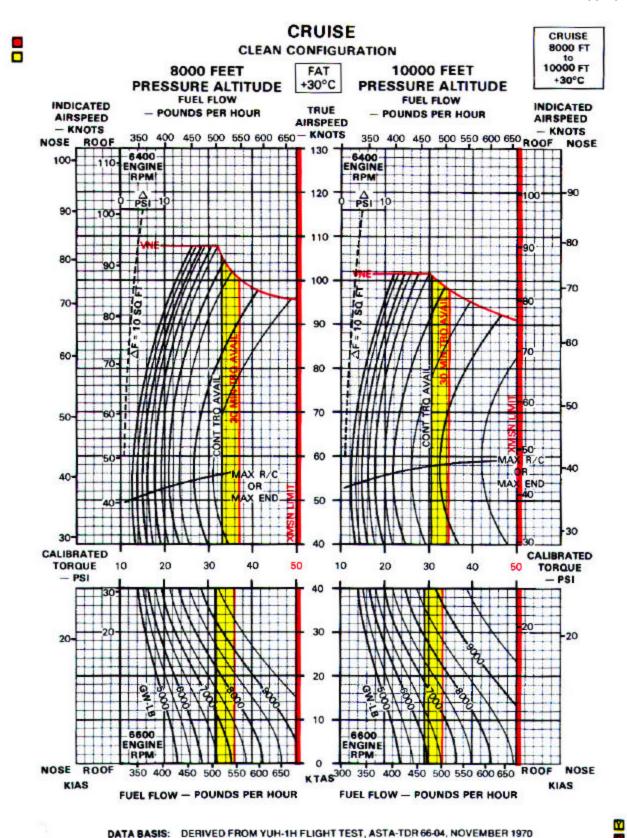


Figure 7-7. Cruise chart (Sheet 19 of 24)

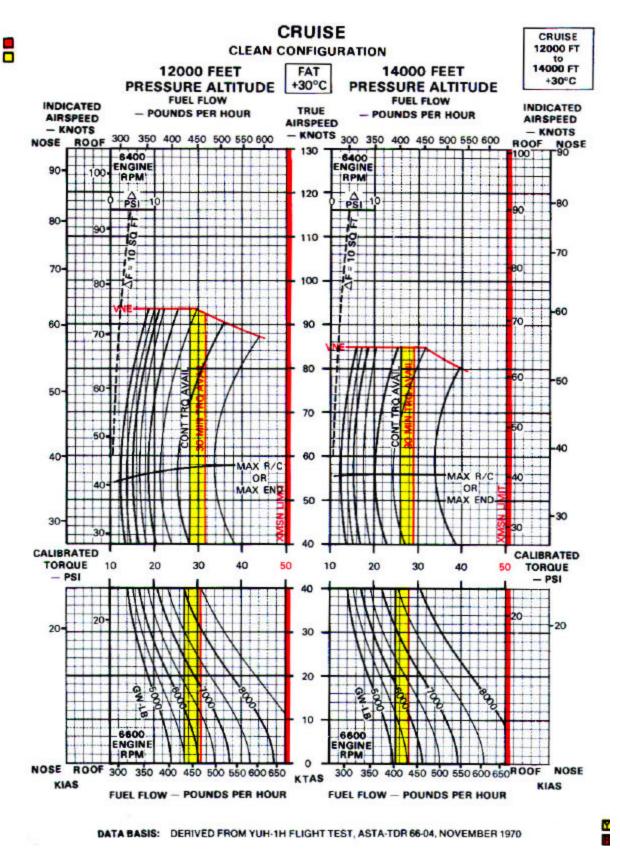


Figure 7-7. Cruise chart (Sheet 20 of 24)

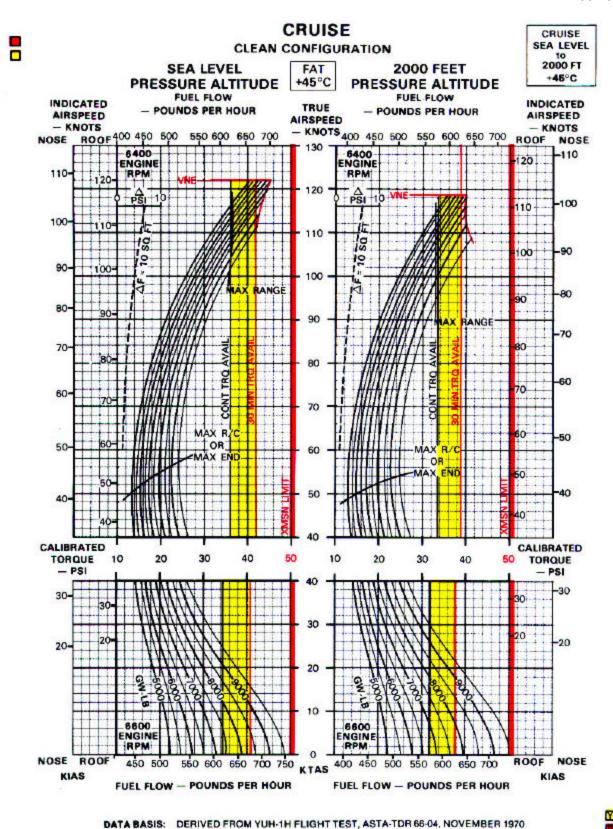


Figure 7-7. Cruise chart (Sheet 21 of 24)

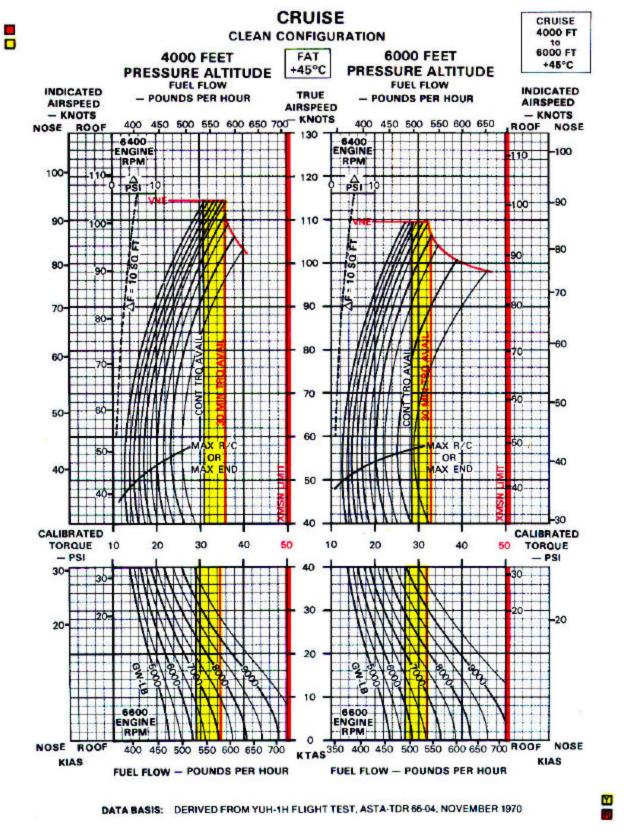


Figure 7-7. Cruise chart (Sheet 22 of 24)

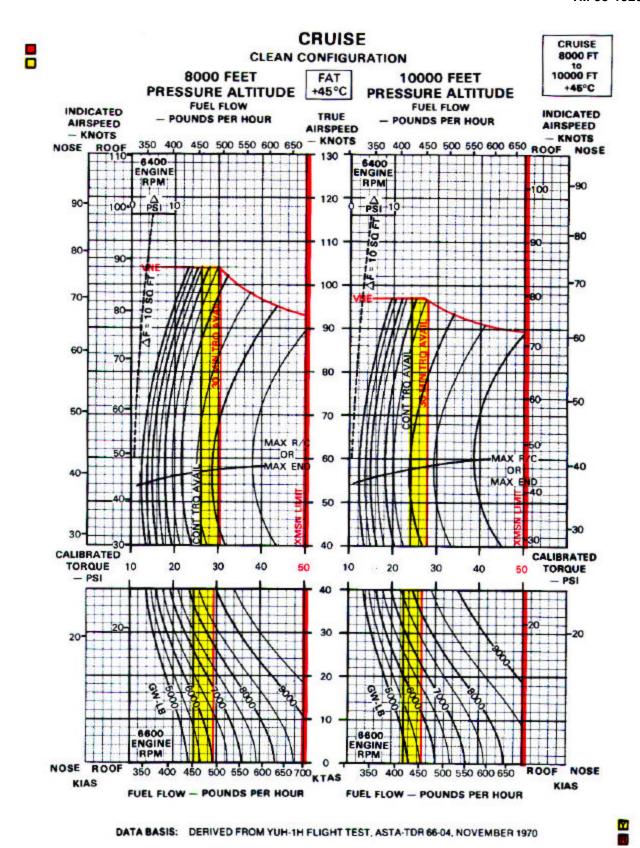


Figure 7-7. Cruise chart (Sheet 23 of 24)

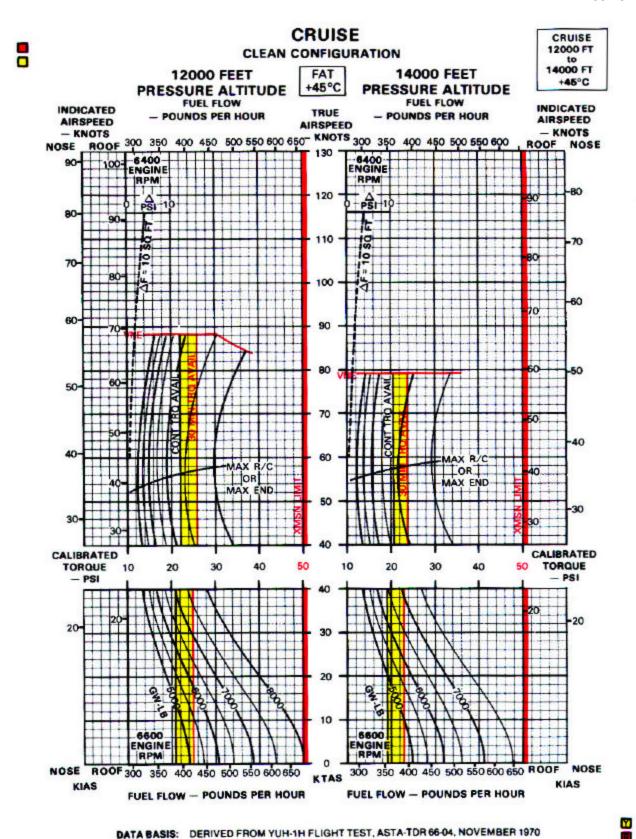


Figure 7-7. Cruise chart (Sheet 24 of 24)

Section VII. DRAG

7-27. DESCRIPTION.

The drag chart (figure 7-8, sheet 1 of 2) shows the authorized configuration or the equivalent flat plate drag area changes for additional aircraft modifications. There is no increase in drag with cargo doors fully open.

The upper left hand portion of figure 7-8, sheet 2 of 2, presents drag areas of typical external loads as a function of the load frontal area. The balance of the charts shows the additional torque required in level flight due to the increase in drag caused by external loads, aircraft modifications or authorized configurations.

7-28. USE OF CHART.

The primary use of the chart is illustrated by the example. To determine the change in torque it is

necessary to know the drag area change, the true airspeed, the pressure altitude and the fee air temperature. Enter at the known drag area change, move right to TAS, move down to pressure altitude, move left to FAT, then move down and read change in torque. In addition, by entering the chart in the opposite direction, drag area change may be found from a known torque change.

This chart is used to adjust cruise charts for appropriate torque and fuel flow due to equivalent flat plate drag area change (ΔF).

7-29. CONDITIONS.

The drag chart is based upon 314 rotor/6400 engine rpm.

DRAG

DRAG EH-1H T53-L-13B

ITEM	EQUIVALENT DRAG AREA CHANGE (f±2)
EH-1H MISSION ANTENNAE	2.2
EH-1X MISSION ANTENNAE	4.0
M-130 CHAFF DISPENSER	2.3
M-130 FLARE DISPENSER	2.2
BELL I.R. SCOOP	2.0
HOT METEL & PLUME I.R. SUPPRESSOR	2.0
ALQ-144 I.R. JAMMER	0.5
CARGO MIRROR	6.0

NOTE

Cruise chart "clean Configuration" is EH-1X antennae, with Hot Metal Plus Plume IR Suppressor, ALQ-144 I.R. Jammer, M-130 Chaff Dispenser, and M-130 Flare Dispenser.

Figure 7-8. Drag chart (Sheet 1 of 2)

EXAMPLE A

WANTED

INCREASE IN DRAG AREA DUE TO EXTERNAL CARGO

KNOWN

SHAPE OF EXTERNAL LOAD = CYLINDER FRONTAL AREA OF EXTERNAL LOAD = 6.8 SQ FT

METHOD

ENTER CHART AT SYMBOL FOR CYLINDER _______
MOVE DOWN TO 6.8 SQ FT
MOVE RIGHT AND READ INCREASED DRAG
AREA = 4.0 SQ FT

EXAMPLE B

WANTED

CHANGE IN TORQUE REQUIRED DUE TO EQUIVALENT FLAT PLATE DRAG AREA CHANGE (△F) FROM CLEAN (BASELINE) CONFIGURATION TO AN EXTERNAL LOAD CONFIGURATION

KNOWN (FROM EXAMPLE A)

AF DRAG AREA CHANGE = 4.0 SQ FT TRUE AIRSPEED = 110 KNOTS PRESSURE ALTITUDE - SEA LEVEL FAT = 0°C

METHOD

ENTER DRAG AREA CHANGE HERE
MOVE RIGHT TO TRUE AIRSPEED
MOVE DOWN TO PRESSURE ALTITUDE
MOVE LEFT TO FREE AIR TEMPERATURE
MOVE DOWN, READ CHANGE IN
TORQUE = 2.6 PSI

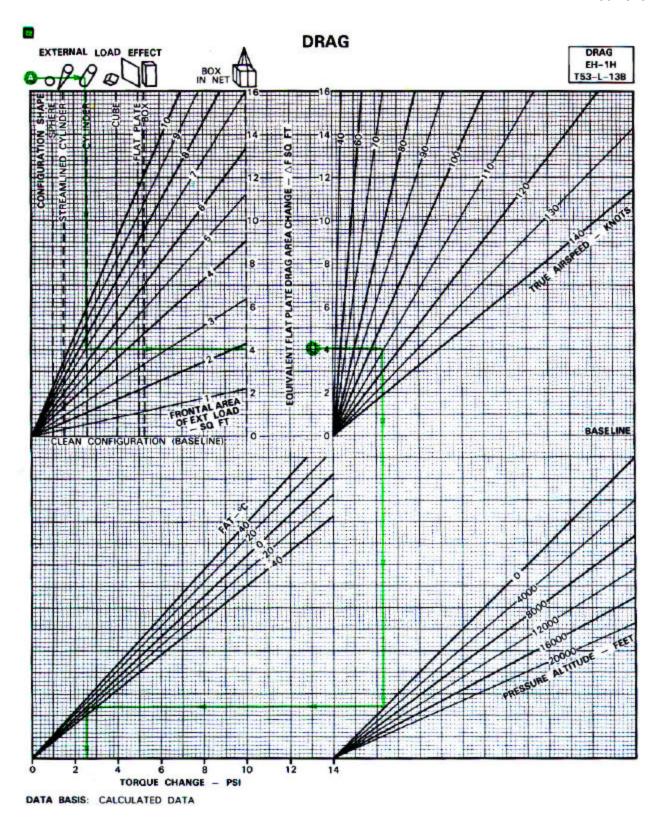


Figure 7-8. Drag chart (Sheet 2 of 2)

Section VIII. CLIMB - DESCENT

7-30. DESCRIPTION.

The climb descent chart (figure 7-9) shows the change in torque (above or below torque required for level flight under the same gross weight and atmospheric conditions) to obtain a given rate of climb or descent.

7-31. USE OF CHART.

The primary uses of the chart are illustrated by the chart examples.

- a. The torque change obtained from the grid scale must be added to the torque required for level flight (for climb) or subtracted from the torque required for level flight (for descent) obtained from the appropriate cruise chart in order to obtain a total climb or descent torque.
- **b.** By entering the bottom of the grid with a known torque change, moving upward to the gross weight, and left to the corresponding rate of climb or descent may also be obtained.

7-32. CONDITIONS.

The climb-descent chart is based on the use of constant rotor or engine rpm. The rate of climb (descent) presented is for steady state conditions and rpm bleed could increase (decrease) the rate of climb (descent) shown.

EXAMPLE

WANTED

MAXIMUM RATE OF CLIMB AT MAXIMUM CONTINUOUS POWER

KNOWN

CLEAN CONFIGURATION
GROSS WEIGHT = 9000 LB
PRESSURE ALTITUDE = 12000 FEET
FAT = -15°C

METHOD

LOCATE APPROPRIATE CRUISE CHART (FIGURE 7-7, PAGE 7-35)
FIND INTERSECTION OF 9000 LB GROSS WEIGHT LINE WITH THE
MAXIMUM RATE OF CLIMB LINE
MOVE DOWN, READ TORQUE REQUIRED = 29.5 PSI
MOVE RIGHT, DETERMINE CONTINUOUS TORQUE IS LIMITED BY
THE TORQUE LIMIT

MOVE DOWN, READ TORQUE AVAILABLE = 44.2 PSI EXCESS TORQUE AVAILABLE = 44.2-29.5 = 14.7 PSI

ENTER CALIBRATED TORQUE SCALE OF CLIMB DESCENT
CHART HERE
MOVE UP TO GROSS WEIGHT
MOVE LEFT TO RATE OF CLIMB OR DESCENT SCALE, READ RATE
OF CLIMB = 950 FT/MIN

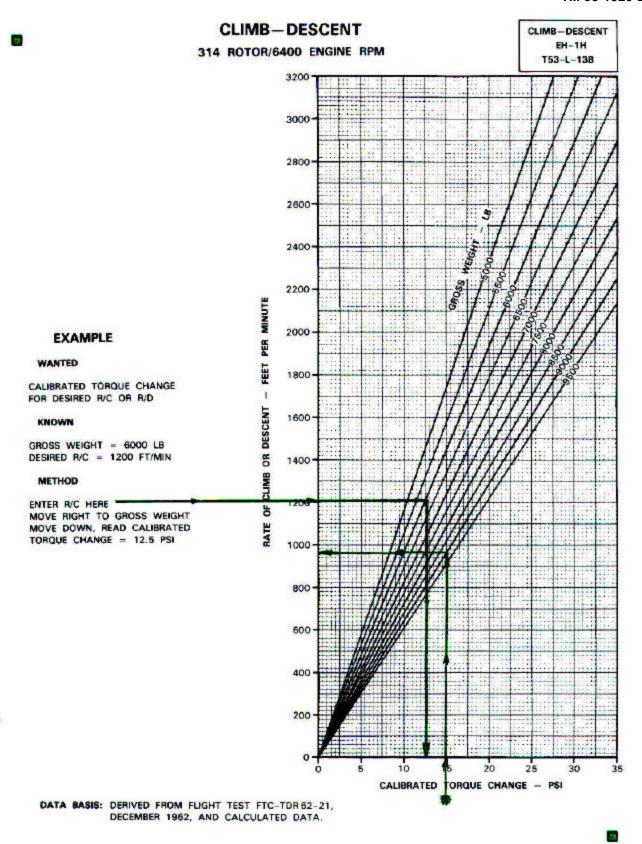


Figure 7-9. Climb-descent chart

7-33. DESCRIPTION.

The climb performance chart (figure 7-10) represent a synthesis of the cruise charts to ease estimation of the climb portion of the flight plan. The charts show relationships between gross weight, initial and final altitude and temperatures, and time to climb, distance covered while climbing, and fuel expended while climbing. The chart (figure 7-10) is presented for continuous power and may be used for all drag configurations.

7-34. USE OF CHART.



Increase climb time, fuel and distance obtained from figure 7-10 by an amount commensurate with a 250 feet per minute decrease in rate of climb. Omit this correction for transmission limited conditions.

Enter at the top left at the known gross weight, move right to the initial altitude, move down to the free air temperature at that altitude, and move left and record time, distance, and fuel consumed for that altitude. Enter again at the gross weight, move right to the final altitude, move down to the free air temperature at that altitude, and move right and record the time, distance, and fuel for that altitude. Subtract the time, distance, and fuel values of the initial altitude-temperature condition from those of the final altitude-temperature condition to find the time to climb, distance covered and fuel used while climbing.

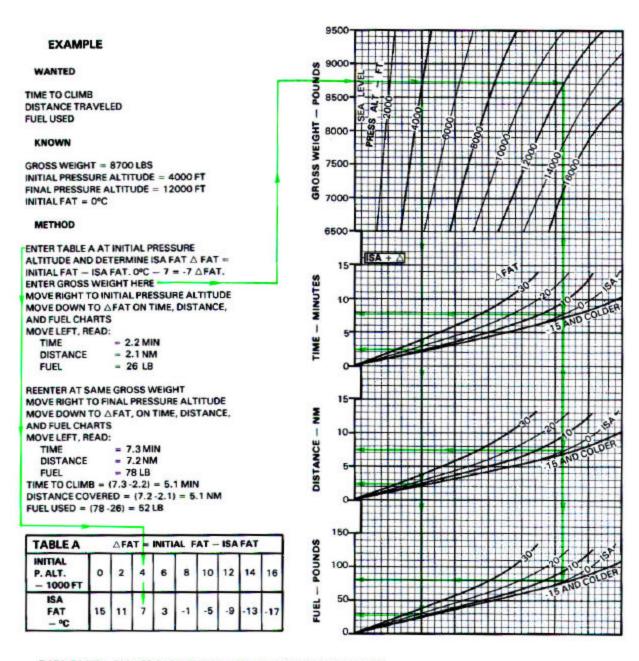
7-35. CONDITIONS.

The charts represent climb at optimum condition, that is minimum power required and stated torque available. Climb is assumed to be at 60 knots indicated airspeed with a roof pitot system and 65 knots indicated airspeed with a nose pitot system as this is near the airspeed for maximum rate of climb at most atmospheric conditions. Warmup and taxi fuel are not included in fuel flow calculations. Climb performance is calculated for 314 rotor/6400 engine rpm. The charts are based upon a nowind condition, therefore, distance traveled will not be valid when winds are present.

U.S. GPO: 1985-481-622

CLIMB PERFORMANCE (CONTINUOUS OPERATION)

314 ROTOR/6400 ENGINE RPM CLIMB AT 60 KIAS ROOF, 65 KIAS NOSE CLIMB EH-1H T53-L-13B



DATA BASIS: DERIVED FROM FLIGHT TEST USA ASTA 66-06, APRIL 1970

Figure 7-10. Climb performance chart

Section IX. IDLE FUEL FLOW

7-36. DESCRIPTION.

The idle fuel flow chart (figure 7-11) shows the fuel flow at idle with flat pitch and 324 rotor/6600 engine rpm.

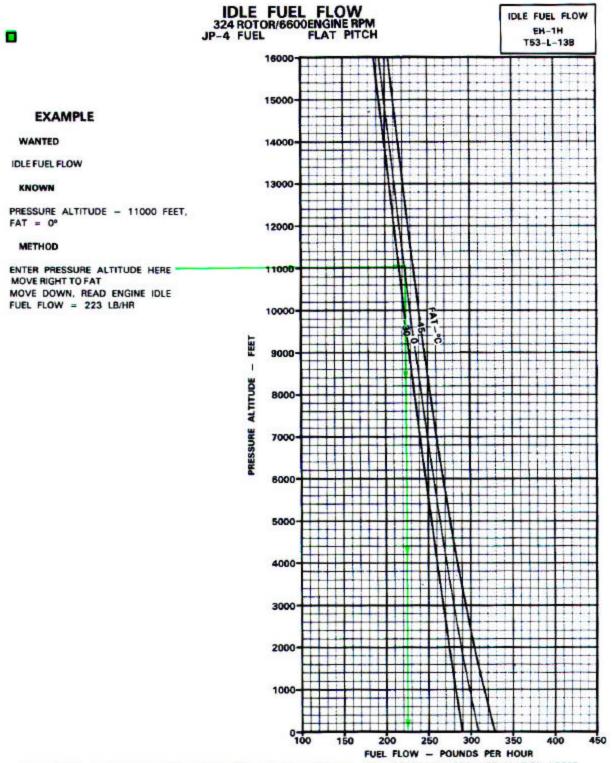
7-37. USE OF CHART.

The primary use of the chart is illustrated by the example. To determine the idle fuel flow, it is necessary to know the idle condition, pressure altitude, and free air

temperature. Enter at the pressure altitude, move right to FAT is appropriate grid, then move down and read fuel flow on the scale corresponding to the condition. Refer to the cruise charts to obtain fuel flow for cruise power conditions.

7-38. CONDITIONS.

This chart is based upon the use of JP-4 fuel.



DATA BASIS: CALCULATED FROM MODEL SPEC 104.33, SEPTEMBER 1964; CORRECTED FOR INSTALLATION LOSES BASED ON FLIGHT TEST FTC-TDR 64-27, NOVEMBER 1964.

Figure 7-11. Idle fuel flow chart

7-39. DESCRIPTION.

The fuel flow for this aircraft (Hot Metal Plus Plume IR Suppressor installed) is presented in figure 7-12. Fuel flow vs torque shows fuel flow in pounds-per-hour versus torquemeter PSI for pressure altitudes from sea level to 14000 feet and for 0°C free air temperature.

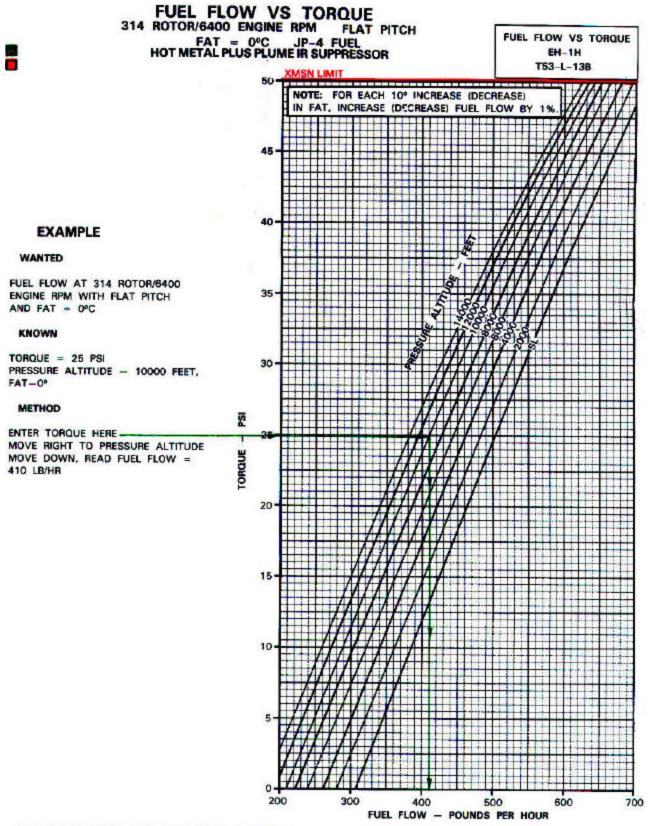
7-40. USE OF CHART.

The primary use of this chart is illustrated by the examples to determine fuel flow. It is necessary to know the condition or torquemeter pressure (PSI) and the FAT as well as the pressure attitude. Fuel flow will increase

about two percent with the bleed air heater on and three percent with deice on. When both systems are on, increase fuel flow five percent. Also a range or endurance penalty should be accounted for when working cruise chart data. A fairly accurate rule-of-thumb to correct fuel flow for temperatures other than 0°C FAT is to increase (decrease) fuel flow 1% for each 10°C increase (decrease) in FAT.

7-41. CONDITIONS.

This chart is based on JP-4 or JP-5 fuel, 314 rotor/6400 engine rpm and bleed air heater and deice off.



DATA BASIS: CALCULATED FROM MODEL SPEC 104,33, SEPTEMBER 1964; CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST FTC-TDR 64-27, NOVEMBER 1964.

Figure 7-12. Fuel flow vs torque chart

CHAPTER 8

NORMAL PROCEDURES

SECTION I. MISSION PLANNING

8-1. MISSION PLANNING.

Mission planning begins when the mission is assigned and extends to the preflight check of the helicopter. It includes, but is not limited to checks of operating limits and restrictions; weight balance and loading; performance; publications; flight plan and crew and passenger briefings. The pilot in command shall ensure compliance with the contents of this manual that are applicable to the mission.

8-2. OPERATING LIMITS AND RESTRICTIONS.

The minimum, maximum, normal and cautionary operational ranges represent careful aerodynamic and structural calculation, substantiated by flight test data. These limitations shall be adhered to during all phases of the mission. Refer to Chapter 5, OPERATING LIMITS AND RESTRICTIONS, for detailed information.

8-3. WEIGHT BALANCE AND LOADING.

The helicopter shall be loaded, cargo and passengers secured, and weight and balance verified in accordance with Chapter 6, WEIGHT, BALANCE AND LOADING. This helicopter requires a weight and balance clearance in accordance with AR 95-16. The helicopter weight and center-of-gravity conditions shall be within the limits prescribed in Chapter 5, OPERATING LIMITS AND RESTRICTIONS.

8-4. PERFORMANCE.

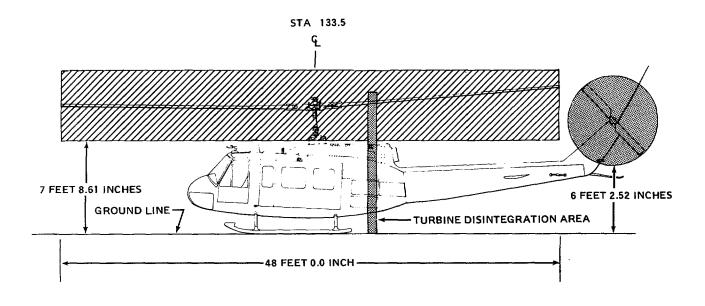
Refer to Chapter 7, PERFORMANCE DATA, to determine the capability of the helicopter for the entire mission. Consideration shall be given to changes in performance resulting from variation in loads temperatures, and pressure altitudes. Record the data on the Performance Panning Card for use in completing the flight plan and for reference throughout the mission.

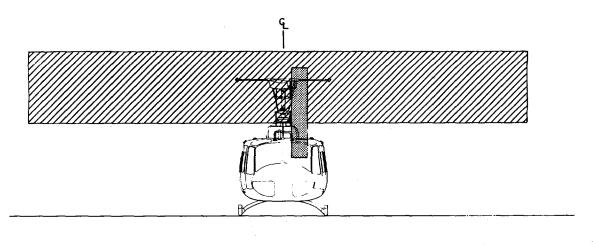
8-5. CREW BRIEFINGS.

A crew briefing shall be conducted to ensure a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to copilot, crew chief, mission equipment operator, and ground crew responsibilities and the coordination necessary to complete the mission in the most efficient manner. A review of visual signals is desirable when ground guides do not have direct voice communications link with the crew.

8-6. DANGER AREAS.

Refer to figure 8-1.





DANGER AREA

205900-1049A

Figure 8-1. Danger Area

SECTION II. OPERATING PROCEDURES AND MANEUVERS

8-7. OPERATING PROCEDURES AND MANEUVERS.

This section deals with normal procedures, and includes all steps necessary to ensure safe and efficient operating of the helicopter from the time a preflight begins until the flight is completed and the helicopter is parked and secured. Unique feel, characteristics and reaction of the helicopter during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described including precautions to be observed. Your flying experience is recognized; therefore, basic flight principles are avoided. Only the duties of the minimum crew necessary for the actual operation of the helicopter are included.

8-8. ADDITIONAL CREW.

Additional crew duties are covered as necessary in Section VI, CREW DUTIES. Mission equipment checks are contained in Chapter 4, MISSION EQUIPMENT Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV, FLIGHT CHARACTERISTICS, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions, such as desert and cold weather operations, supplement normal procedures checks in this section and are covered in Section V, ADVERSE ENVIRONMENTAL CONDITIONS.

8-9. CHECKLIST.

Normal procedures are given primarily in checklist form, and amplified as necessary in accompanying paragraph form, when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operators and Crewmembers Checklist, TM 55-1520-247-CL. To provide for easier cross-referencing, the procedural steps are numbered to coincide with the corresponding numbered steps in TM 55-1520-247-CL.

8-10. CHECKS.

The checklist includes items for day, night, and instrument flight with annotative indicators immediately preceding the check to which they are pertinent; (N) for night operation only; (I) for instrument operations only; and (O) to indicate a requirement if the equipment is installed. The symbol ★ preceding steps of the checklist indicates that detailed procedures for those checks are included in the performance checks section located at the back of the condensed checklist (TM 55-1520-247-CL). When a helicopter is flown by the same flight crew on a mission requiring intermediate stops, it is not necessary to perform all of the normal checks. The steps that are essential for safe helicopter operations on intermediate stops are designated as "thru-flight" checks. An asterisk (*) indicates that performance of steps is mandatory for all "thru-flights". The asterisk applies only to checks performed prior to takeoff.

WARNING

Do not preflight until armament systems are safe.

8-11. BEFORE EXTERIOR CHECK.

- Publications Check DA Forms 2408-12, -13, -14, and -18; DD Form 1896; DD Form 365F; locally required forms and publications, and availability of Operators Manual (-10), and Checklist (-CL).
- *2. Ignition keylock switch ON.
- 3. AC circuit breakers Check in.
- Mission avionics switches and circuit breakers -Set as follows:
 - a. **E** EMISSION INVTR switch MISSION INVTR.
 - b. SPARE INVTR PWR and MAIN INVTR PWR circuit breakers In.

- c. MISSION POWER switch OFF.
- d. FWD RETR ANT CONT and AFT RETR ANT CONT circuit breakers Out.
- BAT switch ON. Check battery voltage. A minimum of 24 volts should be indicated on the DC voltmeter for a battery start.
- Lights On. Check landing, search, anticollision, position, and interior lights for condition and operation as required; position landing and searchlights as desired; then off.
- *7. Fuel Check quantity. Caps secure.
- 8. Fuel sample Check for contamination before first flight of the day. If the fuel sumps, and filter have not been drained by maintenance personnel, drain a sample as follows:
 - a. Sumps Drain sample and check.
 - b. FUEL switch ON.
 - c. Filter Drain sample and check.
- 9. BAT switch OFF.
- *10. Helicopter covers, locking devices, tiedowns, and grounding cables Removed and secured.

8-12. EXTERIOR CHECK. (FIGURE 8-2.)

8-13. AREA 1.

- *1. Main rotor blade Check condition.
- 2. Fuselage Check as follows:
 - a. Cabin top Check windshields, wipers, and FAT probe for condition.
 - Radio compartment Check security of all equipment. Check battery if installed. Secure door.

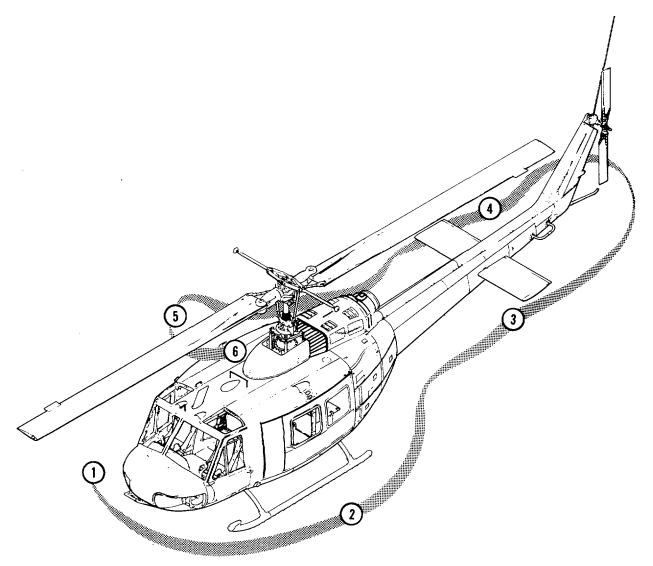
- c. Antennas Check condition and security.
- d. Cabin lower area Check condition of windshield, antennas, and fuselage. Check for loose objects inside which might jam controls.

8-14. AREA 2.

- 1. Fuselage Check as follows:
 - a. Copilot seat, seat belt and shoulder harness
 Check condition and security; secure belt and harness if seat is not used during flight.
 - b. Copilot door Check condition and security.
 - c. Cabin doors Check condition and security.
 - d. Landing gear Check condition and security; ground handling wheels removed.
 - e. Radio and electrical compartments Check condition, circuit breakers in and components secure. Secure access doors.
- 2. Engine compartment Check fluid lines and connections for condition and security. Check general condition. Cowling secure.
- O 3. M-130 Chaff dispenser Check. Refer to Chapter 4.

8-15. AREA 3.

- 1. Tailboom Check as follows:
 - a. Skin Check condition.
 - b. Driveshaft cover Check secure.
 - c. Synchronized elevator Check condition and security.
 - d. Antennas Check condition and security.
 - e. Tail skid Check condition and security.



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Figure 8-2. Exterior Check Diagram

- *2. Main rotor blade Check, condition, rotate in normal direction 90 degrees to fuselage, tiedown removed.
- *3. Tail rotor Check condition and free movement on flapping axis. The tail rotor blades should be checked as the main rotor blade is rotated. Visually check all components for security.

8-16. AREA 4.

*1. Tail rotor gearboxes (90 and 42 degrees) - Check general condition, oil levels, filler caps secure.

- 2. Tailboom Check as follows;
 - a. Skin Check condition.
 - b. Antennas Check condition and security.
 - c. Synchronized elevator Check condition and security.
- 3. Engine exhaust Check condition.
- 4. Oil cooling fan and heater compartments Check, condition of fan, flight control and cables, tail rotor servo for leaks and security and

battery if installed; check for installation of structural support check tailboom attachment bolts; check heater for condition and security if installed; check area clear of obstructions; secure doors.

5. M-130 Flare/chaff dispenser - Check. Refer to Chapter 4.

8-17. AREA 5.

- Engine compartment Check, fluid lines and connections for condition and security. Check fluid levels and general condition; cowling secure.
- *2. Hydraulic fluid sight gage -Check, full of fluid.
- *3. Fuselage -Check as follows:
 - a. Cabin doors Check condition and security.
 - b. Landing gear Check condition and security; ground handling wheels removed.
 - c. Pilot door Check condition, security, and operation.
 - d. Pilot seat, seat belt and shoulder harness Check condition and security.
 - e. Fire extinguisher Check secure.

8-18. AREA 6.

- *1. Main rotor system Check condition and security; check level of fluid in dampers, blade grips, and pillow blocks.
- 2. Transmission area Check as follows:
 - Transmission and hydraulic filler caps -Secure.
 - b. Main driveshaft Check condition and security.
 - c. Engine air intake Check unobstructed.

- d. Engine and transmission cowling Check condition and security.
- e. Antennas Check condition and security.
- f. Pitot static tube Check security and unobstructed.

8-19. INTERIOR CHECK - CABIN.

- *1. Transmission oil level Check.
- *2. Cabin area Check as follows:
 - a. Loose equipment Stow rotor blade tiedown, pitot tube cover, tailpipe cover and other equipment.
 - b. Mission equipment Check condition and security. Refer to Chapter 4 MISSION EQUIPMENT, for equipment checks.
 - c. Crew seats and belts Check condition and security.
 - d. First aid kits Check secure.
 - e. Fire extinguisher Check secure.
- 3. Crew briefing Complete as required.

8-20. BEFORE STARTING ENGINE.

- ★ *1. Overhead switches and circuit breakers Set as follows:
 - a. DC circuit breakers In, except for FWD RETR ANT CONT and AFT RETR ANT CONT.
 - b. DOME LT switch As required.
 - c. PITOT HTR switch OFF.
 - *d. EXT LTS switches Set as follows:
 - (1) ANTI COLL switch ON.
 - (2) POSITION lights switches As required; STEADY/FLASH for night OFF for day.

- e. WIPERS switch OFF.
- f. CABIN HEATING switches OFF.
- g. MISSION AC PWR switches Set as follows:
 - (1) GND PWR/STBY GEN switch GND PWR.
 - (2) MISSION INVTR switch MISSION INVTR.
- h. INST LTG switches As required.
- i. AC POWER switches Set as follows:
 - (1) PHASE switch AC.
 - (2) **EB** X ALT switch ON.
 - (3) INVTR switch MAIN.
- j. DC POWER switches Set as follows:
 - MAIN GEN switch ON and cover down.
 - (2) VM selector ESS BUS.
 - (3) NON-ESS BUS switch MANUAL ON.
 - (4) **E** STARTER GEN switch START.
 - (5) **EE** X START/CONVERTER switch START.
 - *(6) BAT switch ON.

NOTE

The copilot attitude indicator must be caged and held momentarily as the BAT switch is turned on and inverter power is applied.

- *2. Ground power unit Connect for GPU start. GPU is the preferred method for starting whenever possible.
- 3. FIRE warning indicator light Test.
- Press to test caution/warning lights Check as required.

- 5. Flight instruments Check and set as required.
- Systems instruments Check engine and transmission systems for static indications, slippage marks, and ranges. Check fuel gage for quantity.
- 7. COMPASS switch As required.
- ★ *8. Pedestal switches Set as follows:
 - a. Avionics equipment Off; set as desired.
 - b. MISSION POWER switch OFF.
 - c. External stores jettison handle -Check safetied.
 - d. GOV switch AUTO.
 - e. DE-ICE switch OFF.
 - *f. FUEL switch ON.
 - g. Caution panel lights TEST and RESET.
 - h. HYD CONT switch ON.
 - i. FORCE TRIM switch ON.
 - j. CHIP DET switch BOTH.
 - Flight controls Check freedom of movement through full travel; center cyclic and pedals; collective pitch full down.
 - 10. Altimeters Set to field elevation.

★ *8-21. STARTING ENGINE.

- Rotor blades Check clear untied and Fireguard posted.
- 2. Engine Start.
 - a. Throttle Set for start Check full travel and return to engine idle stop. Check operation of the engine idle stop, then close the throttle; position the throttle as near as possible (on decrease side) to the engine idle stop.

- b. Start switch Press and hold; start time. Note DC voltmeter indication. A minimum of 24 volts should be indicated on the DC voltmeter before attempting start. Battery starts can be made when voltages less than 24 volts are indicated, provided the voltage does not drop below 14 volts when cranking through 10 percent N1 speed.
- Main rotor Check that the main rotor is turning as N1 reaches 15 percent. If the rotor is not turning, abort the start.
- d. Start switch Release at 40 percent N1 or after 40 seconds, whichever occurs first. Refer to Chapter 5 for starter limitations.
- e. Throttle Slowly advance past the engine idle stop to the engine idle position.
 Manually check the engine idle stop by attempting to close the throttle.
- f. N1 68 to 72 percent Hold a very slight pressure against the engine idle stop during the check. A slight rise in N1 may be anticipated after releasing pressure on throttle.
- 3. Engine and transmission oil pressures Check.
- 4. GPU Disconnect.

8-22. ENGINE RUNUP.

- * 1. Avionics On Check as required.
- * 2. ESTARTER GEN switch STBY GEN.
- * 3. EE X START/CONVERTER switch CONVERTER.
- * 4. Systems Check as follows:
 - a. Engine.
 - b. Transmission.
- * 5. RPM 6600. As throttle is increased, the low rpm audio and warning light should be off at 6100 to 6300 rpm.
- * 6. Mission switches Set as follows:

- a. GND PWR/STBY GEN switch STBY GEN.
- b. **MISSION INVTR switch ON.**
- c. MISSION POWER switch ON.
- 7. Electrical systems Check as follows:
 - (1) AC 112 to 118 volts.
 - (2) **EB** X AC VM SEL switch ØA, ØB and ØC. Check AC voltmeter for 118 122 volts in each position. Return to AC phase.
 - (3) DC 27 volts at 26°C and above. 28 volts from 0°C to 26°C. 28.5 volts below 0°C.
- 8. Health Indicator Tests (HIT) check Perform as required.

8-23. TAKEOFF TO HOVER.

With the cyclic control in a neutral position, increase collective pitch with a smooth, positive pressure until the desired hovering altitude is reached. Apply tail rotor pedal pressures to maintain heading as collective pitch control is increased. As the helicopter leaves the ground, make minor corrections with cyclic control to ensure a vertical ascent and apply pedal pressures as necessary to maintain directional control. As the desired hover height is reached, adjust the flight controls as necessary to stabilize the helicopter at that height.

8-24. HOVERING TURNS.

Apply pressure on the desired tail rotor pedal to begin the turn, using pressure and counter-pressure on pedals as necessary to maintain constant rate of turn. Coordinate cyclic control to maintain the desired position over the selected point on the ground while maintaining altitude with collective pitch control.

8-25. SIDEWARD AND REARWARD HOVERING FLIGHT.

From a stabilized hover, apply cyclic control pressure in the desired direction of flight to begin sideward or rearward movement. Maintain the desired heading with pedals and altitude with collective pitch. To return to a stationary hover, apply cyclic pressure opposite the direction of movement while coordinating collective pitch and pedals to maintain the desired altitude and heading.

8-26. HOVER/TAXI.

From a stabilized hover, apply forward cyclic pressure to begin forward movement of the helicopter. Maintain the desired heading with pedals and altitude with collective pitch. Changes in direction should be made primarily with pedal control to avoid excessive bank angles. To stop the forward movement, apply aft cyclic pressure while coordinating collective pitch and pedals to maintain the desired altitude and heading.

* 8-27. HOVER/TAXI CHECK.

Perform the following checks at a hover:

- 1. Flight controls Check flight controls for correct responses.
- 2. Engine and transmission instruments Check.
- 3. Flight instruments Check as required.
 - a. VSI and altimeter Check for indication of climb and descent.
 - b. Slip indicator Check ball free in race. .
 - Turn needle, heading indicator, and magnetic compass - Check for turn indication left and right.
 - d. Attitude indicator Check for indication of nose high and low and banks left and right.
 - e. Airspeed indicator Check airspeed.
- 4. Power check as required. The power check will determine if sufficient power is available for the mission and is performed by comparing the indicated torque required to hover at five feet with the predicted values from performance charts in Chapter 7.

8-28. LANDING FROM A HOVER.

From a stabilized hover, decrease collective pitch control to begin a gradual descent to touchdown, making necessary corrections with pedals and cyclic control to prevent movement over the ground. Upon contact with the ground, continue to decrease collective pitch control smoothly and steadily until the entire weight of the helicopter is on the ground. Apply cyclic control as necessary to level rotor system.

* 8-29. BEFORE TAKEOFF.

Immediately prior to takeoff, the following checks shall be accomplished.

- 1. RPM 6600.
- 2. Systems Check engine, transmission, electrical and fuel systems indications.
- 3. Avionics As required.
- 4. Crew and mission equipment Check.

8-30. TAKEOFF.

8-31. NORMAL.

- a. Align the helicopter with the desired takeoff course at a stabilized hover of approximately 3 feet (skid height) or an altitude permitting safe obstacle and terrain clearance. Smoothly apply forward cyclic pressure to begin acceleration into effective translational lift. As the helicopter begins its forward movement, additional collective pitch will be required to maintain altitude. Simultaneously adjust pedal pressure as necessary to maintain the desired heading. Control rate of acceleration and direction of flight with cyclic and altitude with collective. Continue to accelerate at the required altitude until effective translational lift has been attained. then begin a climb. Establish climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path airspeed, rate of climb.
- **b.** Refer to the height-velocity diagram, Chapter 9, for avoid areas The height-velocity diagram assumes the availability of a suitable landing area in the event of engine failure. Since suitable landing areas are often

not available, operating outside the avoid areas during takeoff and climb will provide the highest margin of safety. Additionally, autorotational landings can be made at minimum sink rate and low or zero forward speed, thereby minimizing damage and injuries, regardless of terrain.

c. A normal takeoff may be made from the ground by aligning the helicopter with the desired takeoff course on the ground and positioning the cyclic control slightly forward of neutral. Smoothly increase collective pitch to begin a climb to an altitude of approximately three feet (or an altitude permitting safe obstacle and terrain clearance), while simultaneously accelerating the helicopter. Continue takeoff as above.

8-32. MAXIMUM PERFORMANCE.

A takeoff that demands maximum performance from the helicopter is necessary because of various combinations of heavy helicopter loads, limited power and restricted performance due to high density altitudes, barriers that must be cleared and other terrain features. The decision to use either of the following takeoff techniques must be based on an evaluation of the conditions and helicopter performance. The copilot (when available) can assist the pilot in maintaining proper rpm by calling out rpm and torque as power changes are made, thereby allowing the pilot more attention outside the cockpit.

a. Coordinated Climb. Align the helicopter with the desired takeoff course at a stabilized hover of approximately three feet (skid height) Apply forward cyclic pressure smoothly and gradually while simultaneously increasing collective pitch to begin a coordinated acceleration and climb. Adjust pedal pressure as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding helicopter limits) as the helicopter attitude is established that will permit safe obstacle clearance. The climbout is continued at that attitude and power setting until the obstacle is cleared. After the obstacle is cleared, adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. This technique is desirable when OGE hover capability exists. Takeoff may be made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

b. Level Acceleration. Align the helicopter with the desired takeoff course at a stabilized hover of approximately three feet (skid height). Apply forward cyclic pressure smoothly and gradually while simultaneously increasing collective pitch to begin an acceleration at approximately 3 to 5 feet skid height. Adjust pedal pressure as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding helicopter limits) prior to accelerating through effective translational Additional forward cyclic pressure will be necessary to allow for level acceleration to the desired climb airspeed. Approximately five knots prior to reaching the desired climb airspeed, gradually release forward cyclic pressure and allow the helicopter to begin a constant airspeed climb to clear the obstacle. Care must be taken not to decrease airspeed during the climbout since this may result in the helicopter descending. After the obstacle is cleared, adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. Takeoff maybe made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

c. Power Application.



Do not exceed helicopter limits during power application.

During takeoffs where maximum engine performance is demanded and the maximum torque limit cannot be reached, it will be necessary to press the GOV INCR switch (increase "beep") to prevent drooping the engine rpm below 6600. As the GOV INCR switch is pressed, collective pitch must be increased simultaneously to prevent engine overspeed. As the takeoff is completed and power requirements are reduced, a coordinated reduction is collective pitch and GOV DECR (decrease "beep") are required to maintain 6600 rpm.

The copilot (when available) can assist the pilot in maintaining proper rpm by calling out rpm and torque as power changes are made, thereby allowing the pilot more attention outside the cockpit.

d. Comparison of Techniques. Refer to Chapter 7, Performance Data, for a comparison of takeoff distances. Where the two techniques yield the same distance over a fifty-foot obstacle, the coordinated climb technique will give a shorter distance over lower obstacles and the level acceleration technique will give a shorter distance over obstacles higher than fifty feet. The two techniques give approximately the same distance over a fifty-foot obstacle when the helicopter can barely hover OGE. As hover capability is decreased the level acceleration technique gives increasingly shorter distances than the coordinated climb technique. In addition to the distance comparison, the main advantages of the level acceleration technique are: (1) it requires less or no time in the avoid area of the height velocity diagram; (2) performance is more repeatable since reference to attitude which changes with loading and airspeed is not required: (3) at the higher climbout airspeeds (30 knots or greater), reliable indicated airspeeds are available for accurate airspeed reference from the beginning of the climbout, therefore minimizing the possibility of descent. The main advantage of the coordinated climb technique is that the climb angle is established early in the takeoff and more distance and time are available to abort the takeoff if the obstacle cannot be cleared. Additionally, large attitude changes are not required to establish climb airspeed.

8-33. CROSSWIND TAKEOFF.

A crosswind takeoff does not require a significantly different technique than a takeoff into the wind. The primary difference is the requirement to hold the lateral cyclic into the wind to prevent drift. For right crosswinds additional power is required because of more left pedal being applied to maintain the desired heading.

8-34. CLIMB.

After takeoff, select the airspeed necessary to clear obstacles. When obstacles are cleared, adjust the airspeed as desired at or above the maximum rate of climb airspeed. Refer to Chapter 7 for recommended airspeeds.

8-35. CRUISE.

When the desired cruise altitude is reached, adjust power as necessary to maintain the required airspeed. Refer to Chapter 7 for recommended airspeeds, power settings, and fuel flow.

8-36. DESCENT.

Adjust power and attitude as necessary to attain and maintain the desired speed and rate during descent. Refer to Chapter 7 for power requirements at selected airspeeds and rates of descent. All checks of mission equipment that must be made in preparation for landing should be accomplished during descent.

8-37. BEFORE LANDING.

Prior to landing the following checks shall be accomplished:

- 1. Crew and mission equipment Check.
- 2. MISSION ANTENNAS switch RETRACT.

8-38. **LANDING.**

- a. Approach. The approach begins upon interception of an approach angle which allow safe obstacle clearance to touchdown at the intended point of landing. Once this approach angle (0 to 90 degrees) is intercepted, adjust power to establish and maintain the entry airspeed until the apparent ground speed and rate of closure appear to be increasing. From this point, progressively decrease the rate of descent and forward speed to stop all forward movement about at a 3-foot hover (or continue to the ground). As forward speed decreases below effective translational lift it will be necessary to gradually and smoothly increase collective pitch to terminate the approach. Refer to paragraph 8-28, landing from a hover. Refer to Chapter 7 for airspeed rates of descent and power requirements. Refer to the Height Velocity Diagram. Figure 9-2, for avoid area during the approach.
- b. Running Landing. A running landing is used during emergency conditions of hydraulic power failure and some flight control malfunctions. The approach is shallow and flown at an airspeed that provides safe helicopter control. Airspeed is maintained as for a normal approach except that touchdown is made at an airspeed above effective translational lift. After ground contact is made, slowly decrease collective pitch to minimize forward speed. If braking action is necessary, the collective pitch may be lowered as required for quicker stopping.

8-39. AFTER LANDING.

- 1. Landing light As required.
- 2. Avionics As required.

8-40. ENGINE SHUTDOWN.



If throttle is inadvertently rolled to the OFF position, do not attempt to roll it back on.

- 1. Throttle Engine idle for two minutes.
- 2. FORCE TRIM switch ON.
- 3. Mission switches Set as follows:
 - a. MISSION POWER switch OFF.
 - b. MISSION INVTR switch MISSION INVTR.
 - c. GND PWR/STBY GEN switch GND PWR.

NOTE

Steps 4 through 10 are for the last flight of the day.

- PITOT HTR Check. Place the PITOT HTR switch in the ON position. Note loadmeter increase - then OFF.
- BLEED AIR switch ON; set for maximum; check for EGT increase, then OFF, EGT should decrease.
- *6. EE X DE-ICE switch ON. Check for EGT increase, then OFF. EGT should decrease.
- 7. INVTR switch OFF. Check INST --INVERTER caution light on, then SPARE. INST INVERTER caution light should be out.
- 8. AC voltmeter Check 112 to 118 volts.

9. MAIN GEN switch - OFF. Check dc voltmeter as follows:

27 volts +26°C and above 28 volts from 0°C to +26°C 28.5 volts below 0°C

The DC GENERATOR caution light should Illuminate and the standby loadmeter should indicate a load.

- 10. E NON-ESS BUS Check as follows:
 - a. VM switch NON-ESS BUS.
 - b. DC voltmeter Check for the same dc volts as in step 9 above.
 - MAIN GEN switch ON. Check dc voltmeter for an indication of one volt above voltage in step 9 above.
 - d. VM switch ESS BUS.
- 11. E STARTER GEN switch START.
- 12. EB X START/CONVERTER switch START.
- 13. Throttle OFF.
- 14. Pedestal switches Off as follows:
 - a. FUEL
 - b. Avionics equipment.
- Overhead switches and circuit breakers Set as follows:
 - a. PITOT HTR OFF.
 - b. EXT LTS OFF.
 - c. MISC OFF.
 - d. CABIN HEATING OFF.
 - e. INST LTG OFF.
 - f. INVTR OFF.
 - g. BAT OFF.
- 16. Ignition lock switch Remove key as required.

8-41. BEFORE LEAVING THE HELICOPTER.

- Walk-around -Complete, checking for damage, fluid leaks and levels.
- 2. Mission equipment -Secure.
- Complete DA Forms 2408-12 and -13. An entry in DA Form 2408-13 is required if any of the following conditions were experienced:

- a. Flown in a loose grass environment.
- b. Subjected to saltwater or saltwater spray.
- c. Exposed to radioactivity.
- d. Operated in rain, ice, or heavy snow.
- 4. Secure helicopter.

SECTION III. INSTRUMENT FLIGHT

8-42. INSTRUMENT FLIGHT - GENERAL.

This helicopter is qualified for operation in instrument meteorological conditions. Flight handling qualities, ability characteristics, and range are the same during instrument flight as for visual flight. Navigation and communication equipment are adequate for instrument flight.

8-43. INSTRUMENT FLIGHT PROCEDURES.

Refer to FM 1-5, FM 1-30 FLIP, AR 95-1, FAR Pan 91, and procedures described in this manual.

a. Instrument Takeoff. Complete the normal checks prescribed in this chapter, to include a power check. An instrument takeoff should not be attempted with less than a hover out-of-ground effect capability. When ready for takeoff, align the helicopter with the takeoff course and set the RMI index to the takeoff heading. Set the attitude indicator miniature aircraft on the horizon. Using outside references to prevent movement of the helicopter, increase collective pitch sufficiently to get the helicopter light on the skids. Then, while referring to the helicopter instruments, continue to increase collective pitch smoothly and steadily until takeoff power is reached. Gradually adjust helicopter attitude to place the attitude indicator miniature aircraft no more than two bar-widths below the horizon, while maintaining a wings-level attitude. As the desired climb airspeed is reached, adjust helicopter attitude and power to maintain the desired airspeed and recommended rate The radar altimeter will provide ground of climb.

separation altitude information and relative rate of climb over known terrain.

- **b. Instrument Climb.** Refer to Chapter 7 for speeds, power required, rates-of-climb and fuel consumption.
- **c. Instrument Cruise.** There are no unusual flight characteristics during cruise in instrument meteorological conditions. Refer to Chapter 7 for airspeed, power required and fuel consumption.
- **d. Speed Envelope.** Stability and handling characteristics are normal from maximum rate of climb airspeed throughout the entire speed envelope during instrument flight Power settings during instrument flight should be in accordance with the cruise charts in Chapter 7.
- **e.** Communication and Navigation Equipment. No special techniques in the use of avionics are required for instrument flight.
- f. Instrument Descent. When a descent at slower than cruise speed is desired, slow the helicopter to the desired speed before initiating the descent. Normal descent or radar controlled descent to traffic pattern altitude can be made using cruise airspeed. Normally, descent will be made at cruise speed by reducing power as required.
- **g. Holding.** Holding enroute may be accomplished at cruise speed. For extended holding patterns

at maximum endurance airspeeds, consult the appropriate cruise chart in Chapter 7. For descent in the holding pattern, decrease power and maintain the holding pattern airspeed.

WARNING

Below 20 knots IAS the airspeed, vertical speed and altimeter indicators are not completely reliable because of rotor downwash on the pitot static probe.

h. Instrument Approaches. Establish airspeed as required at or below Vne. Continue with approach as depicted in instrument approach charts, or as instructed by the controller. Perform the before-landing check prior to beginning final descent. The helicopter may be decelerated during the approach, but should not be

flown at airspeeds below 60 KIAS while in instrument flight conditions. The radar altimeter may be utilized for terrain separation information.

8-44. NIGHT FLYING.

Night flying is very closely related to instrument flying and may often be conducted almost entirely under instrument conditions. Before takeoff, it is imperative to ensure that all lighting, instruments, and avionics equipment required for night flight shall be operational prior to flight. Generally, interior lighting should be kept to the minimum amount which will still allow complete visibility of all instruments and gages. Excessive cockpit lighting decreases outside visibility. Avoid using landing lights when in dust, thick haze, smoke, or fog, as reflected light will reduce visibility and may affect depth perception. During ground operations, the helicopter should be hovered/taxied slowly, because it is difficult to judge actual ground speed and excessive speeds may be developed without realizing it.

SECTION IV. FLIGHT CHARACTERISTICS

8-45. FLIGHT CHARACTERISTICS.

8-46. OPERATING CHARACTERISTICS.

The flight characteristics of this helicopter in general are similar to other single rotor helicopters.

8-47. MAST BUMPING.

WARNING

ABRUPT INPUTS OF FLIGHT CONTROLS CAUSE EXCESSIVE MAIN ROTOR FLAPPING, WHICH MAY RESULT IN MAST BUMPING AND MUST BE AVOIDED.

Mast bumping (flapping-stop contact) is the main yoke contacting the mast. It may occur during slope landings, rotor startup/coastdown, or when the flight envelope is exceeded. Table 8-1 represents a matrix of flight maneuvers which produce high flopping and the flight conditions which amplify flopping. For example, because of mission requirements, it may be necessary to rapidly lower the nose of the helicopter with cyclic input or make a rapid collective reduction. At moderate to high airspeeds it becomes increasingly easy to approach less than +0.5G by abrupt forward cyclic

inputs. Variance, in such things as sideslip, airspeed, gross weight, density altitude, center of gravity and rotor speed, may increase main rotor flapping and increase the probability of mast bumping. Rotor flapping is a normal part of maneuvering and excessive flapping con occur at greater than one G flight but, flopping becomes more excessive for any given maneuver at progressively lower load factors.

- **a.** If bumping occurs during a slope landing, reposition the cyclic to stop the bumping and re-establish a hover.
- **b.** If bumping occurs during startup or shutdown, move cyclic to minimize or eliminate bumping.
- **c.** As collective pitch is reduced after engine failure or loss of tail rotor thrust, cyclic must be positioned to maintain positive "G" forces during autorotation. Touchdown should be accomplished prior to excessive rotor rpm decay.

8-48. COLLECTIVE BOUNCE.

Collective bounce is a pilot induced vertical oscillation of the collective control system when an absolute friction (either pilot applied or control rigged) is less than seven pounds. It may be encountered in any flight condition by a rapid buildup of vertical bounce at approximately three cycles per second. The severity of the oscillation is such that effective control of the helicopter may become difficult to maintain.

The pilot should apply and maintain adequate collective friction in all flight conditions.

8-49. BLADE STALL.

a. Blade stall is caused by a high angle of attack on the retreating blade.

		Amplify Flapping						
		o do moy	Mess C. S.	Migh Grass	(4)00 Paris	High Dense:	Lincopolity, Allinos	Moju Light
Produce High Flapping	High Speed Flight	х	X	Х	Х	x	X	
	Reduced "G" Flight				Х		Х	
	Roll Reversal		х	х	х		х	
	Sideward & Rearward Flight		х		х			
	Slope Landings	х		х	х	×		
	Contour Flight	х		Х		Х		

Table 8-1. Factors Causing High Flapping Angle Which May Result in Mast Bumping

- (1) Blade stall is the result of numerous contributing factors such as gross weight, rotor rpm, airspeed, acceleration, and altitude.
- (2) The condition is most likely to occur at higher airspeeds and low operating rpm; it also follows that the condition will occur sooner with higher values of altitude and gross weight.
- (3) One of the more important features of the two-bladed semi-rigid rotor system is its warning to the pilot of impending blade stall.
- (4) Prior to progressing fully into the stall region, the pilot will feel a marked increase in airframe vibration. Consequently, corrective action can be taken before the stall condition becomes severe. When rotor stall progresses into a severe state, feedback may occur, primarily in the cyclic controls.
- **b. Blade Stall Corrective Action.** When blade stall is evident, the condition may be eliminated by accomplishing one or a combination of the following corrective actions:
 - (1) Reduce collective.
 - (2) Reduce airspeed.
 - (3) Increase operating rpm.
 - (4) Descent to lower altitude.
 - **(5)** Decrease the severity of the maneuver.

8-50. SETTLING WITH POWER.

Settling with power is a transient condition of downward flight (descending through air which has just previously been accelerated downward by the rotor) during which an appreciable portion of the main rotor system is being forced to operate at angles of attack above maximum. Blade stall starts in near the hub and progresses outward along the blade as the rate of descent increases. The application of collective pitch results only in stalling more of the blade area and producing an even more rapid descent rate. Since inboard portions of the blades are stalled, cyclic control response will be reduced accordingly. Rates of descent exceeding 2200 feet/minute have been recorded during this state of flight. Roughness in the airframe and controls and some

loss of control effectiveness will be experienced. Recovery is accomplished by lowering the nose and accelerating into forward flight. Recovery can also be made by reducing collective to the minimum. This procedure, however, results in considerable altitude loss.

8-51. MANEUVERING FLIGHT.

Action and response of the controls during maneuvering flight are normal at all times when the helicopter is operated within the limitations set forth in this manual.

8-52. HOVERING CAPABILITIES.

Refer to Chapter 7 for hover performance. Chapter 5 contains information on hover limitations.

8-53. TYPES OF VIBRATION.

- **a.** The source of vibrations of various frequencies are the rotating and moving components on the helicopter; other components vibrate in response to an existing vibration.
- **b.** Rotor vibrations felt during in-flight or ground operations are divided in general frequencies as follows:
- (1) Extreme low frequency Less than one per revolution (pylon rock).
 - (2) Low frequency One or two per revolution.
- **(3)** Medium frequency Generally, four, five, or six per revolution.
- (4) High frequency Tail rotor frequency or higher.
- **c.** Most vibrations are always present at low magnitudes. The main problem is deciding when a vibration level has reached the point of being excessive.
- **d.** Extreme low, and most medium frequency vibrations are caused by the rotor or dynamic controls. Various malfunctions in stationary components can affect the absorption or damping of the existing vibrations and increase the overall level.
- **e.** A number of vibrations are present which are considered a normal characteristic. Two per revolution

is the most prominent of these, with four or six per revolution the next most prominent. There is always a small amount of high-frequency vibration present that may be detectable. Experience is necessary to learn the normal vibration levels. Sometimes the mistake is made of concentrating on feeling one specific vibration and concluding that the level is higher than normal.

8-54. EXTREME LOW FREQUENCY VIBRATIONS.

- **a.** Extreme low-frequency vibration is usually limited to pylon rock. Pylon rocking, two to three cycles per second is inherent with the rotor, mast, and transmission system. To keep the vibration from reaching noticeable levels, transmission mount dampers are incorporated to absorb the rocking. Malfunctions in the damper system will allow rocking to start.
- **b.** Pylon rock may be aggravated when maximum power is reached, depending on condition of transmission dampers, engine and flight conditions. As much as plus or minus 5 psi torque oscillation may be observed. This condition may be corrected by reducing power approximately 1 percent N1.

8-55. LOW FREQUENCY VIBRATIONS.

- **a.** Low frequency vibrations are caused by the rotor. One per revolution vibrations are of two basic types, vertical or lateral. A one per revolution (1/rev) vertical is caused by one blade developing more lift at a given point than the other blade. A lateral vibration is caused by a spanwise or chordwise unbalance of the rotor due to a difference of weight between the blades.
- **b.** Generally, verticals felt predominantly in low power descent at moderate airspeeds (60 to 70 knots) are caused by a basic difference in blade lift and can be corrected by rolling the grip slightly out of track. Vertical vibrations felt in forward flight, increasing as airspeed increases, are usually due to one blade developing more lift with increased speed than the other (a climbing blade). This condition is corrected by adjustment of the trim tabs.

8-56. LOW FREQUENCY VIBRATION - VERTICAL.

a. Associated with one per revolution vertical vibration is the intermittent one per revolution vertical.

Essentially, this is a vibration initiated by a gust causing a momentary increase of lift in one blade giving a one per revolution vibration.

- **b.** The momentary vibration is normal; but if picked up by the rotating collective controls and fed back to the rotor causing several cycles of one per revolution, it becomes undesirable. Sometimes during steep turns one blade will "pop" out of track and cause a hard one per revolution vertical.
- **c.** This condition is usually caused by too much differential tab in the blades and can be corrected by rolling one blade at the grip and removing some of the tab (as much as can be done without affecting the ride in normal flight).

8-57. LOW FREQUENCY VIBRATION - LATERAL.

- **a.** Should a rotor, or rotor component, be out of balance, a one per revolution lateral vibration will be present. This vibration is usually felt as a vertical due to the rolling motion it imparts to the helicopter, causing the pilot seats to bounce up and down out of phase; that is, the pilot goes up while the copilot goes down. An unusually severe lateral vibration can be felt as a definite sideward motion as well as a vertical motion.
- **b.** Lateral vibrations existing due to an unbalance in the rotor are of two types: spanwise and chordwise.
- **c.** Spanwise unbalance is caused simply by one blade and hub being heavier than the other (i.e., an unbalance along the rotor span).
- **d.** A chordwise unbalance means there is more weight toward the trailing edge of one blade than the other. Both types of unbalance can be caused by the hub as well as the blades.
- **e.** Lateral vibrations are usually felt in a hover and in descending moderate airspeed turns and tend to disappear in forward flight. However, many times a lateral can manifest itself as a vertical in forward flight.
- **f.** Two per revolution vibrations are inherent with two-bladed rotor systems and a low level of vibration is present.

8-58. MEDIUM FREQUENCY VIBRATIONS.

- **a.** Medium frequency vibrations at frequencies of four or six per revolution are another inherent vibration associated with most rotors. An increase in the level of these vibrations is caused by a change in the capability of the fuselage to absorb vibration, or a loose airframe component, such as the skids, vibrating at that frequency.
- **b.** Changes in the fuselage vibration absorption can be caused by such things as fuel level, external sores, structural damage, structural repairs, internal loading, or gross weight.
- **c.** Abnormal vibration levels of this range are nearly always caused by something loose; either a regular part of the helicopter or part of the cargo or external sores. The vibration is felt as a rattling in the helicopter structure. The most common cause is loose skids.

8-59. HIGH FREQUENCY VIBRATIONS.

- **a.** High frequency vibrations can be caused by anything in the helicopter that rotates or vibrates at a speed equal to or greater than that of the tail rotor.
- **b.** The most common and obvious causes are tail rotor balance and track. Pilot experience can help greatly in troubleshooting the cause of a high frequency vibration, as a pilot who has experienced a vibration can often recognize the cause the next time he feels the same vibration.
- **c.** A comparison between the feel of the helicopter without excessive vibration and the helicopter with the vibration is helpful in precluding erroneous conclusions.

8-60. LOW G MANEUVERS.

WARNING

INTENTIONAL FLIGHT BELOW +0.5G IS PROHIBITED.

WARNING

ABRUPT INPUTS OF FLIGHT CONTROL CAUSE EXCESSIVE MAIN ROTOR FLAPPING, WHICH MAY RESULT IN MAST BUMPING AND MUST BE AVOIDED.

a. Because of minion requirements, it may be necessary to rapidly lower the nose of the helicopter. At moderate to high airspeeds, it becomes increasingly easier to approach zero or negative load factors by abrupt forward cyclic inputs. The helicopter may exhibit a tendency to roll to the right simultaneously with the forward cyclic input.

WARNING

If an abrupt right roll should occur when rapidly lowering the nose, apply aft cyclic to stop the rate and effect recovery. Left lateral cyclic will not effect recovery from a well developed right roll during flight at less than one "g" and it may cause severe main rotor flapping. Do not move collective or directional controls.

- **b.** Such things as sideslip, weight and location of external stores and airspeed will affect the severity of the right roll. Variances in gross weight, longitudinal cg, and rotor rpm may affect the roll characteristics. The right roll occurs throughout the normal operating airspeed range and becomes more violent at progressively lower load factors. When it is necessary to rapidly lower the nose of the helicopter, it is essential that the pilot monitor changes in roll attitude as the cyclic is moved forward.
- **c.** If the flight envelope is inadvertently exceeded, causing a low "G" condition and right roll, move cyclic aft to return rotor to a positive thrust condition, then roll level, continuing flight if mast bumping has not occurred.

8-61. ROLLOVER CHARACTERISTICS.

a. During normal or slope takeoffs and landings with some bank angle or side drift with one skid on the ground, the bank angle or side drift can cause the helicopter to get into the situation where it is pivoting about a skid. When this happens, lateral cyclic control response is more sluggish and less effective than for the free hovering helicopter. Consequently, if a roll rate develops, a critical bank angle (the angle between the helicopter

and the horizon) may be reached where roll cannot be corrected with full lateral cyclic and the helicopter can roll over on its side. As the roll rate increases, the angle at which recovery is still possible is significantly reduced. The critical rollover angle is also reduced for a right side down condition, crosswinds, lateral center of gravity offset, main rotor thrust almost equal to helicopter weight, and left pedal inputs. When these items are all in their most critical condition, high gross weight, right lateral center of gravity crosswind from the left, hovering on the right skid with thrust (lift) approximately equal to the weight, very little right roll rate is correctable for any bank angle. Refer to figure 8-3.

- b. When performing maneuvers with one skid on the ground, care must be taken to keep the helicopter trimmed, especially laterally. For example, if a slow takeoff is attempted and the tail rotor thrust contribution to rolling moment is not trimmed out with cyclic, the critical recovery angle may be exceeded in less than two seconds. Control can be maintained if the pilot maintains trim, does not allow helicopter rates to become large, and keeps the bank angle from getting too large. The pilot must fly the helicopter into the air smoothly keeping excursions in pitch, roll and yaw low and not allowing any untrimmed moment.
- **c.** When performing takeoffs and landings on relatively level ground with one skid on the ground and thrust (lift) approximately equal to the weight, carefully maintain the helicopter position relative to the ground with the flight controls. Perform maneuvers smoothly and keep the helicopter trimmed so that no helicopter rates build up, especially roll rate. If the bank angle starts to increase to a large angle (5 to 8 degrees) and full corrective cyclic does not reduce the angle, reduce collective to reduce the unstable rolling condition.
- **d.** When performing slope takeoff and landing maneuver follow the published procedures, being careful to keep roll rates small. Slowly raise the downslope skid

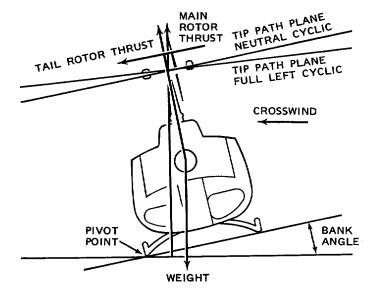
to bring the helicopter level and then lift off (if landing, land on one skid and slowly lower the down-slope skid). If the helicopter rolls to the upslope side (5 to 8 degrees), reduce collective to correct the bank angle and return to level attitude and then start the takeoff procedure again.

e. Collective is much more effective in controlling the rolling motion than lateral cyclic because it reduces the main rotor thrust (lift). A smooth, moderate collective reduction is adequate to stop the rolling motion with about two degrees bank angle overshoot from where down collective is applied. Care must be taken to not dump collective at too high a rate as to cause fuselage -rotor blade contact. Additionally, if the helicopter is on a slope and the roll starts to the up-slope side, reducing collective too fast creates a high rate in the opposite direction. When the down slope skid hits the ground, the dynamics of the motion can cause the helicopter to bounce off the upslope skid and the inertia can cause the helicopter to roll about down-slope skid and over on its side. Do not pull collective suddenly to get airborne as a large and abrupt rolling movement in the opposite direction will result. This movement may be uncontrollable.

WARNING

If the helicopter develops a roll rate with one skid on the ground and thrust (lift) approximately equal to the weight, the helicopter can roll over on its side.

f. When landing or taking off, with thrust (lift) approximately equal to the weight and one skid on the ground, keep the helicopter trimmed and do not allow helicopter rates to build up. Fly the helicopter smoothly off (or onto) the ground, carefully maintaining trim.

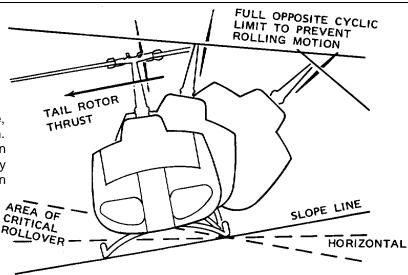


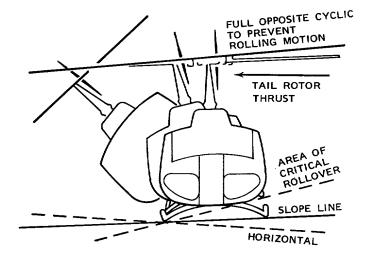
EXAMPLE OF FORCES ACTING ON A HELICOPTER WITH RIGHT SKID ON THE GROUND

During normal takeoffs to a hover and landings from a hover, cross slope takeoffs and landings, and takeoffs from the ground with bank angle or side drift, a situation can exist where the helicopter will pivot about the skid/wheel which remains on the ground and enter a rolling motion that cannot be corrected with full lateral cyclic input.

UPSLOPE ROLLING MOTION

Excessive application of cyclic into the slope, in coordination with collective pitch application. During landings or takeoffs, this condition results in the downslope skid rising sufficiently to exceed lateral cyclic control limits and an upslope rolling motion occurs.





DOWNSLOPE ROLLING MOTION

Excessive application of collective pitch in coordination with cyclic application into the slope. When the downslope skid is on the slope, excessive application of collective may result in the upslope skid rising sufficiently to exceed lateral cyclic limits and induce a downslope rolling motion.

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Figure 8-3. Forces Acting Upon a Helicopter

SECTION V. ADVERSE ENVIRONMENTAL CONDITIONS

8-62. GENERAL.

This section provides information relative to operation under adverse environmental conditions (snow, ice and rain, turbulent air, extreme cold and hot weather, desert operations, mountainous and altitude operation) at maximum gross weight. Section II check list provides for operational requirements of this section.

8-63. COLD WEATHER OPERATIONS.

Operation of the helicopter in cold weather or an arctic environment presents no unusual problems if the operators are aware of those changes that do take place and conditions that may exist because of the lower temperatures and freezing moisture.

a. Inspection. The pilot must be more thorough in the preflight check when temperatures have been at or below 0°C (32°F) Water and snow may have entered many parts during operations or in periods when the helicopter was parked unsheltered. This moisture often remains to form ice which will immobilize moving parts or damage structure by expansion and will occasionally foul electric circuitry. Protective covers afford protection against rain, freezing rain, sleet, and snow when installed on a dry helicopter prior to the precipitation. Since it is not practicable to completely cover an unsheltered helicopter, those parts not protected by covers and those adjacent to cover overlap and joints require closer attention, especially after blowing snow or freezing rain. Remove accumulation of snow and ice prior to flight. Failure to do so can result in hazardous flight due to aerodynamic and center of gravity disturbances as well as the introduction of snow, water and ice into internal moving parts and electrical systems. The pilot should be particularly attentive to the main and tail rotor systems and their exposed control linkages.

CAUTION

At temperatures of -35°C (-31°F) and lower, the grease in the spherical couplings of the main transmission driveshaft may congeal to a point that the couplings cannot operate properly.

b. Transmission. Check for proper operation by turning the main rotor opposite to the direction of rotation while observer watches the driveshaft to see there is no tendency for the transmission to "wobble" while the driveshaft is turning. If found frozen, apply heat (do not use open flame, avoid overheating boot) to thaw the spherical couplings before attempting to start engine.

c. Checks.

- (1) Before exterior check 0°C (32°F) and lower. Perform check as specified in Section II.
- (2) Exterior check O'C (32°F) to -54°C (-65°F). Perform exterior check as outlined in Section II, plus the following checks. Check that all surfaces and controls are free of ice and snow. Contraction of the fluids in the helicopter system at extreme low temperatures causes indication of low levels. A check made just after the previous shutdown and carried forward to the walk around check is satisfactory if no leaks are in evidence. Filling when the system is cold-soaked will reveal an overfull condition immediately after flight, with the possibility of forced leaks at seals.
- (a) Main rotor Check free of ice, frost, and snow.
- **(b)** Main driveshaft Check for freedom of movement.
- **(c)** Engine air inlet and screens Remove all loose snow that could be pulled into and block the engine intake during starting.
- (d) Oil cooling fan compartment Check oil cooling fan blades for ice.
- (3) Interior check All flights 0°C (32°F) to 54°C (-65°F). Perform check as specified in Section II.
- **(4)** Interior check Night flights O'C (32°F) to -54°C (-65°F). External power connected. Perform check as specified in Section II.
- (5) Engine starting check O'C (32°F) to -54°C (-65°F). Determine that the compressor rotor turns freely. As the engine cools to an ambient temperature below 0°C (32°F) after engine shutdown condensed

moisture may freeze engine seals. Ducting hot air from an external source through the air inlet housing will free a frozen rotor. Perform check as outlined in Section II. If temperature is -44°C (-47°F) or below the pilot must be particularly careful to monitor engine and transmission instruments for high oil pressure. During cold weather starting the engine oil pressure gage will indicate maximum (100 psi). The engine should be warmed up at engine idle until the engine oil pressure indication is below 100 psi. The time required for warmup is entirely dependent on the starting temperature of the engine and lubrication system.

(6) Engine runup check. Perform the check as outlined in Section II.

WARNING

Control system checks should be performed with extreme caution when helicopter is parked on snow and ice. There is reduction in ground friction holding the helicopter stationary, controls are sensitive and response is immediate.

d. Engine Stating Without External Power Supply. If a battery start must be attempted when the helicopter and battery have been cold-soaked at temperatures between -26°C to -37°C (-15°F to -35°F), preheat the engine and battery if equipment is available and time permits. Preheating will result in a faster starter cranking speed which tends to reduce the hot start hazard by assisting the engine to reach a self-sustaining speed (40 percent N1) in the least possible time.

8-64. BEFORE LEAVING THE HELICOPTER.

Open vents to permit free circulation of air. Install protective covers as required.

8-65. SNOW.

- **a. Takeoff.** Snow takeoff may be considered normal except for the following precautions that should be observed.
 - (1) Loose or powdery snow will restrict visibility.

- **(2)** Ground operation time should be minimized to reduce the possibility of engine air TM 55-1520-247-10 starvation due to snow and ice accumulation. Ground operation time should be minimized and FOD screen and particle separator must be inspected prior to takeoff.
- (3) Before attempting to takeoff make sure the landing gear skids are free and not frozen to the surface.
- (4) The first takeoff after a cold start should include a visual check of the ground surface for evidence of hydraulic leaks. This should be done under hovering power conditions. If hydraulic leaks are present, abort the mission.
- **b. Landing Snow.** Snow landing may be considered normal except for the following precautions that should be observed:
- (1) If possible, select an area free of loose or powdery snow so that visibility will not be restricted by blowing snow.
- **(2)** Accomplish a landing to the ground. Limited visibility will result from swirling snow, when hovering is attempted before making a touchdown.
- **(3)** Anticipate loose powdery snow and crusts on all landings on snow.
- **(4)** During landing, the reference point should be keep forward and to the right so that it will be visible to the pilot at all times.
- (5) When making an approach and landing on snow it should be one continuous operation without extended hover in order to reduce the white-out condition. This white-out will usually occur on loose snow and can cause the pilot to lose all reference with the ground or any object he is approaching. If the object being used as reference should become completely obscured, accomplish a go-around.

8-66. DESERT AND HOT WEATHER OPERATION.

Problems encountered in desert operation are blowing dust/sand and high ambient temperature.

a. Blowing dust and sand obscure vision. Takeoffs and landings should not be made to or from a hover.

b. High ambient temperature affects helicopters performance. Refer to Chapter 7.

8-67. TURBULENCE AND THUNDERSTORMS.

8-68. TURBULENCE.

- **a.** Intentional flight into known or forecast moderate turbulence is not recommended when the report or forecast is based on transport type aircraft.
- **b.** Intentional flight into known or forecast moderate turbulence is permitted when the report or forecast is based on helicopters or light airplanes under 12,500 pounds gross weight.
- **c.** To minimize the effects of turbulence encountered in flight the helicopter should be flown at an airspeed corresponding to minimum torque required; maximum endurance airspeed. There will be a corresponding increase in control movements at the reduced airspeed.
- **d.** Helicopter controllability is the primary consideration; therefore, if control becomes marginal, exit the turbulence as soon as possible.
- **e.** In turbulence, check that all occupants are seated with seat belts and harnesses tightened.

8-69. THUNDERSTORMS.

- **a.** To minimize the effects of thunderstorms encountered in flight perform the following:
- **(1)** Adjust torque to maintain maximum endurance airspeed.
- (2) Check that all occupants are seated with seat belts and harnesses tightened.
 - (3) PITOT HTR switch ON.
- **(4)** Avionics Reduce volume on any equipment affected by static.

(5) Interior lights - Adjust to full bright at night to minimize blinding effect of lightning.

b. In The Storm.

- (1) Maintain a level attitude and constant power setting. Airspeed fluctuations should be expected and disregarded.
- **(2)** Maintain original heading, turning only when necessary.
- (3) The altimeter is unreliable due to differential barometric pressures within the storm. An indicated gain or loss of several hundred feet is not uncommon and should be allowed for in determining minimum safe altitude.

8-70. LIGHTNING STRIKES.

WARNING

Avoid flight in or near thunderstorms especially in areas of observed or anticipated lightning discharges.

- **a.** Although the possibility of a lightning strike is remote, with increasing use of all-weather capabilities the helicopter could inadvertently be exposed to lightning damage. Therefore static tests have been conducted to determine lightning strike effects on rotors.
- **b.** Simulated lightning tests indicate that lightning strikes may damage helicopter rotors. The degree of damage will depend on the magnitude of the charge and the point of contact. Catastrophic structural failure is not anticipated. However, lightning damage to hub bearings, blade aft section, trim tabs, and blade tips was Also, adhesive bond separations demonstrated. occurred between the blade spar and aft section between the spar and leading edge abrasion strip. Some portions of blade aft sections deformed to the extent that partial or complete separation of the damaged section could be expected. Such damage can aerodynamically produce severe structural vibration and serious control problems which, if prolonged, could endanger the helicopter and crew.

c. If lightning damage occurs, indications such as control problems or vibration changes, especially abnormal noise may or may not be evident.

NOTE

Abnormal operating noises almost always accompany rotor damage, but loudness or pitch are not valid indications of the degree of damage sustained.

- **d.** If lightning strike occurs or is suspected, the following precautions are recommended to minimize further risk.
- (1) Reduce airspeed as much as practical to maintain safe flight.
 - (2) Avoid abrupt control inputs.

8-71. ICE AND RAIN.

a. In heavy rain, a properly adjusted wiper can be expected to clear the windshield adequately throughout the entire speed range. However, when poor visibility is encountered while cruising in rain, it is recommended that the pilot fly by reference to the flight instruments and the copilot attempt to maintain visual reference. Rain has no noticeable effect on handling or performance of the helicopter.

NOTE

If the windshield wiper does not start in LOW or MED position, turn the control to HIGH. After the wiper starts, the control may be set at the desired position.

b. Continuous flight in light icing conditions is not recommended because the ice shedding induces rotor blade vibrations, adding greatly to the pilots work load. If icing conditions are encountered during flight every effort should be made to vacate the icing environment.



When operating at outside air temperatures of 40°F (5°C) or below, icing of the engine air inlet screens can be expected. Ice accumulation on inlet screens can be detected by illumination of the ENGINE INLET AIR caution liaht. Continued accumulation of ice will result in partial or complete power loss. It should be noted that illumination of the ENGINE INLET AIR caution light indicates blockage at the inlet screen only and does not reveal icing conditions in the particle separator or on the FOD screen.

To preclude the possibility of icing, it is recommended that the right and left engine air inlet filters be removed from the cowling when it is anticipated that the helicopter will be flown under atmospheric conditions conducive to icing. (Do not remove the top filter.)

- **c.** If icing conditions become unavoidable the pilot should actuate the pitot heat windshield defroster and de-icer switches.
- **d.** Flight tests in closely controlled icing conditions have indicated that the pilot can expect one or all of the following to occur:
- (1) Obscured forward field of view due to ice accumulation on the windscreens and chin bubbles If the windshield defrosters fail to keep the windshield clear of ice, the side windows may be used for visual reference during landing.
- (2) One-per-rotor-revolution vibrations ranging from mild to severe caused by asymmetrical ice shedding from the main rotor system. The severity of the vibration will depend upon the temperatures and the amount of ice accumulation on the blades when the ice shed occurs. Flight test experience has shown that the possibility of an asymmetric ice shed occurring increases as the outside air temperature decreases.
- (3) An increase in torque required to maintain a constant airspeed and altitude due to ice accumulation on the rotor system.

- **(4)** Possible degradation of the ability to maintain autorotational rotor speed within operating limits.
- **e.** Severe vibrations may occur as a result of main rotor asymmetrical ice shedding. If icing conditions are encountered while in flight land as soon as practical. All ice should be removed from the rotor system before attempting further flight.
- f. Control activity cannot be depended upon to remove ice from the main rotor system. Vigorous control movements should not be made in an attempt to reduce low frequency vibrations caused by asymmetrical shedding of ice from the main rotor blades. These movements may induce a more asymmetrical shedding of ice, further aggravating helicopter vibration levels.
- **g.** If a 5 psi (or greater) torque pressure increase is required above the cruise torque setting used prior to entering icing conditions, it may not be possible to maintain autorotational rotor speed within operational limits, should an engine failure occur.

h. Ice shed from the rotor blades and/or other rotating components presents a hazard to personnel during landing and shutdown. Ground personnel should remain well clear of the helicopter during landing and shutdown, and passengers and crewmembers should not exit the helicopter until the rotor has stopped turning.

8-72. HIGH OR GUSTY WIND.

- **a.** High or gusty wind operations require no special procedures or techniques while in flight however, special parking precautions are necessary to ensure that the main rotor blades do not flex downward contacting the tail rotor driveshaft during rotor coast down.
- **b.** To reduce the possibility of main rotor/tailboom contact during engine shutdown, land the helicopter on an upwind heading. During engine shutdown, displace cyclic into the wind, adding cyclic as necessary as rotor rpm decreases.

SECTION VI. CREW DUTIES

8-73. RESPONSIBILITIES.

The minimum crew required to fly the helicopter is a pilot. Additional crewmembers, as required, may be added at the discretion of the commander. The manner in which each crewmember performs his related duties is the responsibility of the pilot in command.

8-74. PILOT.

The pilot in command is responsible for all aspects of mission planning, preflight and operation of the helicopter. He will assign duties and functions to all other crewmembers as required. Prior to or during preflight the pilot will brief the crew on the mission, performance data, monitoring of instruments, communications, emergency procedures, taxi, and load operations.

8-75. COPILOT (WHEN ASSIGNED).

The copilot must be familiar with the pilots duties and the duties of the other crew positions. The copilot will assist the pilot as directed.

8-76. CREW CHIEF (WHEN ASSIGNED).

The crew chief will perform all duties as assigned by the pilot, in addition to the following specific duties:

- **a.** Maintenance, servicing, inspection, loading, and security of the helicopter.
- **b.** Completes the daily inspection prior to the arrival of pilot for preflight. Helicopter will be serviced, log book current and correct, and equipment secured.
- **c.** Accompanies pilot during preflight inspection, performs the inspection with the pilot.
 - **d.** Checks the security of each area inspected.
- **e.** Ensures the helicopter is clear during starting procedures.

CHAPTER 9 EMERGENCY PROCEDURES SECTION I. HELICOPTER SYSTEMS

9-1. HELICOPTER SYSTEMS.

This section describes the helicopter systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the Operators and Crewmembers Checklist, TM 55-1520-247-CL. Emergency procedures involving mission equipment are covered in Section II, Mission Equipment, and are repeated in this section only as safety of flight is affected. Emergency operations of avionics equipment are covered when appropriate in Chapter 3, Avionics.

9-2. IMMEDIATE ACTION EMERGENCY CHECKS.

Those checks that must be performed immediately in an emergency procedure are underlined. These immediate action emergency checks shall be committed to memory.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is helicopter control. All procedures are subordinate to this requirement.

9-3. DEFINITION OF LANDING TERMS.

For the purpose of standardization the following definitions shall apply:

The term <u>LAND AS SOON AS POSSIBLE</u> is defined as executing a landing to the nearest suitable landing area without delay. The primary consideration is to assure the survival of occupants.

The term <u>LAND AS SOON AS PRACTICABLE</u> is defined as executing a landing to the nearest suitable airfield/heliport.

9-4. AFTER EMERGENCY ACTION.

After a malfunction of equipment has occurred, appropriate emergency actions have been taken and the

helicopter is on the ground, an entry must be made in the Remarks Section of DA Form 2408-13 describing the malfunction.

9-5. EMERGENCY EXITS.

Emergency exits are shown in figure 9-1. Emergency exit release handles are yellow and black striped.

a. Removal - Crew Exit Doom.

- (1) Pull handle.
- (2) Push door outward by pushing on the bottom third of the door.

b. Removal - Passenger Exit Windows.

- (1) Pull handle.
- (2) Lift window inward.

c. X Opening - Crew Exit Doors.

- (1) Pull handle, at center of door edge, aft while grasping egress handle at top of door.
 - (2) Slide cargo door aft.
 - (3) Open hinged door post panel as required.

9-6. EMERGENCY ENTRANCE.

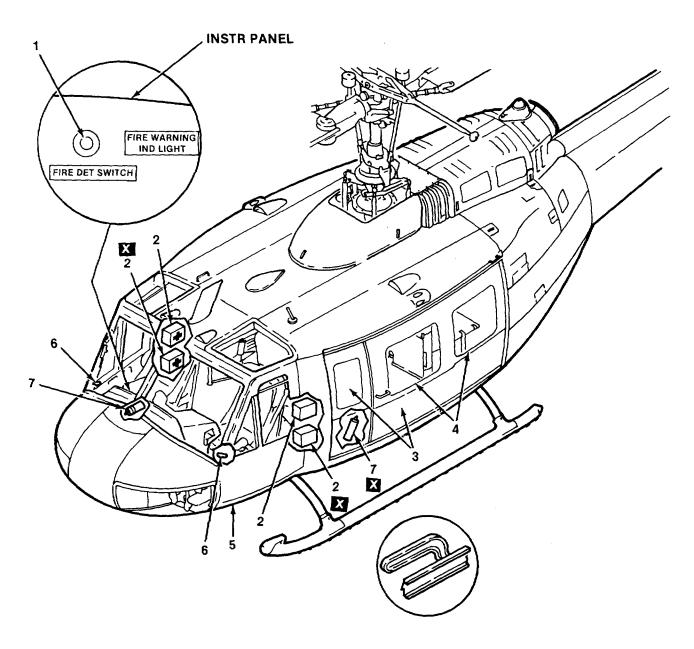
Crew/passenger removal is accomplished through the crew/cargo doors or through the windows with crash rescue equipment.

9-7. EMERGENCY EQUIPMENT.

WARNING

Use fire extinguishers only in well ventilated areas because the toxic fumes of the extinguishing agent may cause injury.

One fire extinguisher (figure 9-1) is mounted to the right of the pilot seat and one is mounted on E E mission console II, I left-hand hinged door post panel.



- 1. Fire Detector Test Switch and Indicator Light
- 2. First Aid Kit (4)
- 3. Cabin Exit (4)
- 4. Cabin Door Window Emergency Release Handle (4)
- 5. Cockpit Exit (2)
- 6. Cockpit Jettisonable Door Release (2)
- 7. Fire Extinguisher (2)

Figure 9-1. Emergency Exits and Equipment (Sheet 1 of 3)

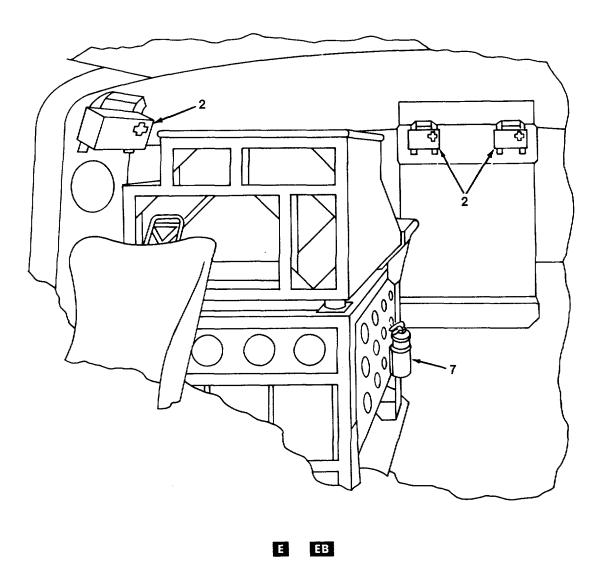
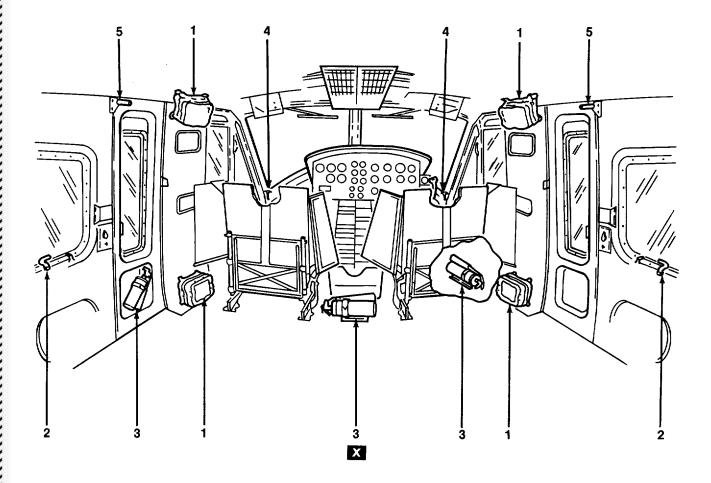


Figure 9-1. Emergency Exits and Equipment (Sheet 2 of 3)



- 1. First aid kit (4)
- 2. Crew door jettison handle
- 3. Fire extinguisher (2)
- Cabin door window emergency release handle (left side not shown)
- 5. Crew door auxiliary handle

Figure 9-1. Emergency Exits and Equipments (Sheet 3 of 3)

9-8. **ENGINE.**

9-9. FLIGHT CHARACTERISTICS.

Control response in this helicopter in an autorotational descent with an engine inoperable is similar to that of a descent with power. Full control can be maintained with the helicopter in autorotational descent.

9-10. ENGINE FAILURE.

The indications of an engine failure, either a partial power loss or a complete power loss are:

- **a.** Left yaw. This is caused by the drop in torque applied to the main rotor.
 - **b.** Drop in engine rpm.
 - **c.** Drop in rotor rpm.
 - **d.** Low rpm audio alarm.
 - e. Illumination of the low rpm light.
 - f. Change in engine noise.

WARNING

Do not close the throttle. Do not respond to the rpm audio and/or warning light illumination without first confirming engine failure by one or more of the other indications. Normal indications signify that the engine is functioning properly and that there is a tachometer generator failure or an open circuit to the warning system rather than an actual engine failure.

Under partial power conditions the engine may operate relatively smoothly at reduced power or it may operate roughly and erratically with intermittent surges of power. In instances where a power loss is experienced without accompanying engine roughness or surging, the helicopter may sometimes be flown at reduced power to a favorable landing area; however, under these conditions the pilot should always be prepared for a complete power failure. In the event that a partial power condition is accompanied by engine roughness, erratic

operation or power surging, the GOV switch may be moved to the EMER position (after throttle reduction to engine idle) in an attempt to correct the rough running engine. If altitude and time do not permit moving the GOV switch to the EMER position, close the throttle completely and perform an autorotational descent and landing.

Procedures to be followed after an engine failure are governed by the altitude and airspeed available to establish an autorotational glide, control the aircraft and maintain sufficient rotor rpm for successful landing.

Decrease in collective pitch after engine failure will vary with altitude and airspeed at the time of the occurrence. For example, collective pitch must not be decreased when an engine failure occurs at a hover-in-ground effect; whereas, during cruise flight conditions altitude and airspeed are sufficient for a significant reduction in collective pitch, thereby allowing rotor speed to be maintained in the safe operating range during autorotational descent. Should the engine fail during a left bank maneuver, right cyclic input to level the aircraft must be made simultaneously with collective pitch adjustment. If the collective pitch is decreased without a corresponding right cyclic input the helicopter will pitch down and the left roll rate will increase rapidly resulting in a significant loss of altitude.

Cyclic control is adjusted as necessary to remain over the desired point after engine failure at a hover or to control airspeed and flight path after engine failure occurs in forward flight.

Pedal pressure is applied as necessary to control aircraft trim and varies with airspeed and the amount of collective pitch applied at the time of engine failure.

Airspeed should be maintained at the optimum (figure 9-2) if conditions permit. As airspeed increases above minimum rate of descent airspeed, there is a corresponding increase in rate of descent. Airspeed up to maximum distance airspeed will increase glide distance but should be avoided at low altitude because the time available to decelerate is critical. At airspeeds below minimum rate of descent airspeed, rate of descent increases and glide distance decreases. Gliding the helicopter in autorotation out-of-trim will also increase rate of descent and decrease glide distance; therefore, tail rotor pedal control immediately after engine failure and during descent is important. If time

permits during the autorotational descent transmit a "May Day" call, set transponder to the appropriate emergency mode and code and lock shoulder harness.

9-11. MINIMUM RATE OF DESCENT - POWER OFF.

Refer to figure 9-2.

9-12. MAXIMUM GLIDE DISTANCE - POWER OFF.

Refer to figure 9-2.

9-13. ENGINE FAILURE - LOW ALTITUDE/LOW

The height velocity diagram (figure 9-3) depicts combinations of airspeed and height above the ground where a successful straight in autorotation may be made from level or hovering flight in the event of an engine failure. It is imperative that the techniques described in the subparagraphs be followed to achieve the capability shown by the height-velocity diagram. Delay in recognition of the failure, improper technique or excessive maneuvering to reach a suitable landing area reduces the probability of a safe touchdown. Flight conducted within the caution area of the height-velocity diagram exposes the helicopter to a high probability of damage despite the best efforts of the pilot. The following procedures must be observed when an engine failure occurs:

- a. Area A. Forward cyclic should be applied in conjunction with lowering of collective to establish a nose-down pitch attitude of 25 degrees in order to reach and stabilize on the minimum rate of descent airspeed. The helicopter may tend to roll right upon sudden forward cyclic application.
- **b.** Area B. Forward cyclic should be applied as necessary in conjunction with lowering of collective to establish a nose-down pitch attitude of 20 degrees at 40 KIAS varying to no forward cyclic at 70 KIAS, in order to reach and stabilize on the minimum rate of descent airspeed.
- c. Area C. From conditions of low airspeed and low altitude, the deceleration capability is limited, and caution should be used to avoid striking the ground with

the tail rotor. Initial collective reduction will vary from no reduction at zero airspeed and 15 feet to full down at 70 KIAS and 125 feet. Intermediate altitudes and airspeeds will require a partial reduction of collective in order to reach the termination prior to excessive rotor speed decay. Touchdown should be made in a slightly nosehigh attitude to reduce the ground run as much as possible.

- **d.** When engine failure occurs, proceed as follows:
 - 1. <u>Collective pitch Adjust</u> as required, establish autorotational glide.
 - GOV switch EMER. If engine power is regained when the GOV switch is moved to the EMER position, the pilot must be prepared to immediately reduce throttle to prevent engine overspeed/overtemperature.
 - 3. <u>Throttle Adjust</u> as necessary to control rpm.

If engine power is not regained.

- Mission antennas emergency retract switch -Press.
- 5. Land.

9-14. ENGINE FAILURE - TAKEOFF.

Refer to ENGINE FAILURE - LOW ALTITUDE/LOW AIRSPEED (paragraph 9-13).

9-15. ENGINE FAILURE - CRUISE.

In cruise flight at airspeeds up to Vne reduce collective pitch immediately to the full down position in order to regain the rotor rpm, and apply right pedal pressure to trim helicopter. Adjust cyclic pressure as necessary to attain and maintain the required airspeed. A landing area shall be selected as soon as the engine failure is recognized and control movements made as necessary to fly to the intended site. Throughout the descent adjust collective pitch as necessary to maintain the rotor rpm in the normal operating range. At high gross weights the rotor may tend to overspeed and require collective pitch application to maintain the rpm below the upper limit.

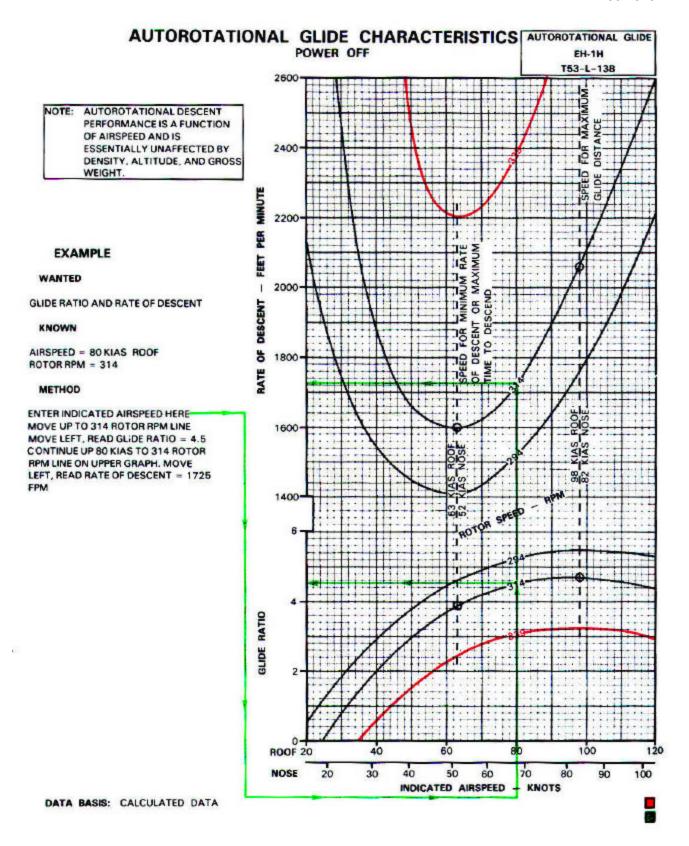


Figure 9-2. Autorotational glide characteristics chart



HEIGHT VELOCITY DIAGRAM 324 ROTOR RPM

HEIGHT VELOCITY EH-1H T53-L-13B

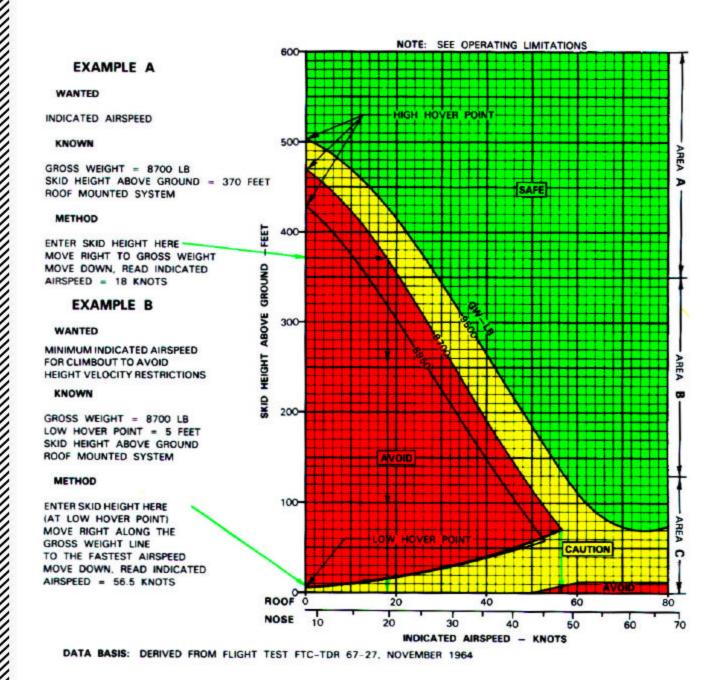


Figure 9-3. Height Velocity Diagram

Collective pitch should never be applied to reduce rpm below normal limits for extending glide distance because of the reduction in rpm available for use during touchdown. Additional airspeed above the recommended minimum rate of descent airspeed increases rate of descent and should only be used as necessary to extend glide distance. Touchdown speed should be adjusted as necessary depending on touchdown area. When engine failure occurs during cruise flight, proceed as follows:

- 1. <u>Collective pitch Down</u>. Establish autorotational glide.
- Mission antennas emergency retract switch -Press.
- 3. Land.

9-16. MAIN DRIVESHAFT/CLUTCH FAILURE.

A failure of the main driveshaft/ clutch will result in complete loss of power to the rotor and a possible engine overspeed. Supporting indications are as follows

- **a.** Left Yaw. This is caused by the drop in torque applied to the main rotor.
 - **b.** Increase in engine rpm.
 - **c.** Decrease in rotor rpm.
- **d.** Low rpm audio alarm (unmodified rpm warning system only).
 - **e.** Illumination of the low rpm light.

If failure occurs:

INFLIGHT

- 1. <u>Collective pitch Adjust</u> as required: establish autorotational glide.
- 2. Throttle Off.
- Mission antennas emergency retract switch -Press.
- 4. Land.

ON THE GROUND

- 1. Throttle Off.
- 2. Complete shutdown.

9-17. CLUTCH FAILS TO DISENGAGE.

A clutch failing to disengage in flight will be indicated by the rotor rpm decaying with engine rpm as the throttle is reduced to the engine idle position when entering autorotational descent. This condition results in total loss of autorotational capability therefore, the throttle must be returned to the full open position immediately. If a failure occurs, do the following:

- 1. Throttle Open.
- 2. Land as soon as possible.

9-18. ENGINE GROUND OPERATIONS.

9-19. FLOODED ENGINE.

In the event the engine has been motored with the throttle open and the ignition key lock switch OFF or there is any reason to suspect the engine may be flooded with fuel, do the following:

- 1. Ignition keylock switch OFF.
- 2. FUEL switch OFF.
- 3. Throttle Off.

Prior to attempting another start, wait 3 minutes for excess fuel to drain, then do the following:

- 1. Ignition key lock switch ON.
- 2. FUEL switch ON.
- 3. Throttle Set for start.

9-20. EMERGENCY START.

An emergency start may be attempted if the engine fails to start normally and starting the engine is necessary because of an emergency situation. Normal

before-starting checks must be completed prior to beginning the following procedure:

- 1. Throttle Off.
- 2. GOV switch EMER.
- 3. Starter switch Press.

CAUTION

Advance and reduce throttle slowly and monitor EGT closely when the GOV switch is in the EMER position in order to avoid exceeding EGT limits or flameout.

- 4. Throttle Open slowly to the engine idle position as N1 passes through 8 percent.
- 5. Starter switch Release at 40 percent N1.
- 6. <u>Throttle Open</u> slowly to 80 percent N1, then decrease slowly to engine idle.
- 7. GOV switch AUTO as N1 decreases from 80 percent to engine idle. Engine rpm may surge as the GOV switch is placed in the AUTO position, however, this is normal.

9-21. ENGINE RESTART - DURING FLIGHT.

After an engine failure in flight, resulting from a malfunction of the fuel control unit, an engine start may be attempted. Because the exact cause of engine failure cannot be determined in flight, the decision to attempt the start will depend on the altitude and time available, rate of descent, potential landing areas, and crew assistance available. Under ideal conditions approximately one minute is required to regain powered flight from time the attempted start is begun. If the decision is made to attempt an in-flight start, proceed as follows:

- 1. Throttle Off.
- 2. **STARTER GEN E X START/CON- VERTER switch START.**
- 3. GOV switch EMER.
- 4. Attempt start.

- a. Starter switch Press.
- Throttle-Open slowly to 6400 to 6600 rpm as N1 passes through 8 percent.
 Control rate of throttle application as necessary to prevent exceeding EGT limits.
- c. Starter switch Release as N1 passes through 40 percent. After the engine is started and powered flight is reestablished continue with manual throttle control. Return the STARTER GEN switch to STANDBY; the START /CONVERTER switch to CONVERTER.
- 5. Land as soon as possible.

9-22. ENGINE COMPRESSOR STALL.

Engine compressor stall (surge) is characterized by a sharp rumble or a series of loud sharp reports, severe engine vibration and a rapid rise in exhaust gas temperature (EGT) depending on the severity of the surge. Maneuvers requiring rapid or maximum power applications should be avoided. Should this occur the following steps should be accomplished:

- 1. Reduce power.
- 2. DE-ICE switch OFF.
- 3. BLEED AIR switch OFF.
- Land as soon as possible.

9-23. PARTIAL POWER.

a. Inlet Guide Vane Actuator Failure.

(1) If the guide vanes fail in the closed position a maximum of 20 to 25 psi of torque will be available although N1 may indicate normally. Power applications above 20 to 25 psi will result in deterioration of N2 and rotor rpm while increasing N1. Placing the GOV switch in the EMER position will not provide any increased power capability and increases the possibility of an N1 overspeed and an engine overtemperature. Should a failure occur, accomplish an approach and landing to the ground with torque not exceeding the maximum available. If possible, a running landing is recommended.

- (2) If the inlet guide vanes fail in the open position during normal flight it is likely that no indications will be evidenced. In this situation increased acceleration times will be experienced. As power applications are made from increasingly lower N1s, acceleration times will correspondingly increase.
- **b. Droop Compensator Failure**. Droop compensator failure will be indicated when engine rpm is no longer controlled by application of collective pitch. The engine will tend to overspeed as collective pitch is decreased and will underspeed as collective pitch is increased. If the droop compensator fails, make minimum collective movements and execute a shallow approach to the landing area. If unable to maintain the operating rpm within limits, proceed as follows:
 - Collective pitch Down; establish autorotational glide.
 - 2. Throttle Engine idle.
 - 3. GOV switch EMER.
 - 4. <u>Throttle Open</u> slowly to normal operating rpm and continue flight with manual throttle control.
 - 5. Land as soon as possible.
- c. Governor Control Failure. Failure of the GOV RPM switch or linear actuator results in the inability to control N2 rpm. Failure at normal operating rpm does not require action by the pilot. Should the failure occur below normal operating rpm and due to an emergency situation a takeoff must be made; proceed as follows:
 - 1. Throttle Engine idle.
 - 2. GOV switch EMER.
 - 3. <u>Throttle Open</u> slowly to normal operating rpm and continue with manual throttle control.
 - 4. Land as soon as possible.

9-24. ENGINE OVERSPEED.

An engine overspeed may be caused by a malfunctioning N2 governor or fuel control. Although the initial indications of high N2 rpm and rotor rpm are the same in each case, actions that must be taken to control

rpm are distinctly different. If the N2 governor malfunctions, throttle reduction will result in a corresponding decrease in N2 rpm. In the event of a fuel control malfunction, throttle reduction will have no effect on N2 rpm. If an overspeed is experienced, do the following:

- Collective pitch Increase to load the rotor in an attempt to maintain rpm below the maximum operating limit.
- Throttle Reduce until normal operating rpm is attained. Continue with manual throttle control.

If reduction of throttle does not reduce rpm as required:

- 3. GOV switch EMER.
- 4. <u>Throttle Adjust</u> as required to maintain normal operating rpm.
- 5. Land as soon as possible.

9-25. ENGINE UNDERSPEED.

An engine underspeed is caused by a malfunctioning N2 governor or fuel control. Due to the very limited response time at low altitude/low airspeed, the malfunction must be treated differently than at a cruise altitude airspeed. If an engine underspeed occurs do this:

a. Engine Underspeed - Low Altitude/Low Airspeed.

- 1. Collective pitch Adjust as required.
- 2. GOV switch EMER.
- 3. <u>Throttle Adjust as required</u> to maintain engine/rotor rpm. Continue with manual throttle control.
- 4. Land as soon as possible.

b. Engine Underspeed - Cruise.

- 1. <u>Collective pitch Down;</u> establish autorotational glide.
- 2. N1 Check to ensure engine has not failed.

- Throttle Engine idle.
- GOV switch EMER.
- Throttle Open slowly to normal engine/rotor rpm and continue with manual throttle control.
- 6. Land as soon as possible.

9-26. ENGINE CHIP DET CAUTION LIGHT ILLUMINATION.

If the ENGINE CHIP DET caution light illuminates, <u>Land</u> as soon as possible.

9-27. ENGINE OIL - HOT OR LOW PRESSURE.

If the ENG OIL PRESS caution light illuminates; limits of the engine oil pressure gage, or limits on the engine oil temperature gage are exceeded, <u>Land as soon as possible</u>.

9-28. ENGINE INLET FILTER CLOGGED/ENGINE INLET AIR CAUTION LIGHT ILLUMINATION.

If the ENGINE INLET FILTER CLOGGED/ENGINE INLET AIR CAUTION LIGHT illuminates; <u>Land as soon</u> as possible.

9-29. ROTORS, TRANSMISSIONS, AND DRIVE SYSTEMS.

9-30. MAIN ROTOR SYSTEM MALFUNCTION.

Imminent failure of main rotor components may be indicated by a sudden increase in main rotor vibration and/or unusual noise. Severe changes in lift characteristics and/or balance condition can occur due to blade strikes, skin separation, shift or loss of balance weights or other material. Malfunctions may result in severe main rotor flapping. In the event of a main rotor system malfunction, proceed as follows:

WARNING

Danger exists that the main rotor system could collapse or separate

from the aircraft after landing. A decision must be made whether occupant egress occurs before or after the rotor has stopped.

- 1. Perform an approach and <u>landing</u> with power <u>as soon as possible</u>.
- 2. Throttle OFF as soon as the helicopter is on the ground.
- 3. FUEL Switch OFF.
- 4. BAT Switch OFF.

9-31. TAIL ROTOR MALFUNCTIONS.

Because of the many different malfunctions that can occur it is not possible to provide a solution for every emergency. The success in coping with the emergency depends on quick analysis of the condition and selection of the proper emergency procedure. The following is a discussion of some types of malfunctions, probable effects, and corrective actions.

- a. Complete Loss of Tail Rotor Thrust. This is a situation involving a break in the drive system such as severed driveshaft, wherein the tail rotor stops turning or tail rotor controls fail with the tail rotor in a zero pitch condition, and no thrust whatsoever is delivered by the tail rotor. A failure of this type will always result in the nose of the helicopter turning to the right (left sideslip) and a left roll of the fuselage along the horizontal axis.
- (1) In powered flight, the degree of sideslip and the degree of roll may be varied by changing airspeed and by varying power (throttle or pitch), but neither can be eliminated. Below an airspeed of approximately 30 to 40 knots, the sideslip angle may become uncontrollable, and the helicopter begins to revolve on its vertical axis.
- (2) In power-off flight (autorotation), the sideslip angle and the roll angle can be almost completely eliminated by maintaining an airspeed of 40 to 70 knots. When airspeed is decreased below approximately 20 to 40 knots, the fin stabilizing becomes negligible and the sideslip angle may become large. Upon pitch application at touchdown, the fuselage will tend to turn in the same direction the main rotor is turning (left) due to an increase of friction in the transmission system.
- **b. Fixed Pitch Setting.** This is a malfunction involving a loss of control resulting in a fixed pitch setting. Whether the nose of helicopter yaws left or right is dependent upon the amount of pedal (which is related

to power) applied at the time of the - malfunction. Regardless of pedal setting at the time of malfunction, a varying amount of tail rotor thrust will be delivered at all times during flight.

- (1) If the tail rotor pitch becomes fixed during an approach or other reduced power situation (right pedal applied), the nose of helicopter will turn right when power is applied, possibly to an even greater degree than would be experienced with complete loss of tail rotor thrust, and the overall situation may be even more hazardous. The best solution may be to maintain control with partial power as required and accomplish a run-on landing. Whether a successful autorotation could be accomplished is not certain, and is dependent upon the amount of pitch applied at the time of malfunction. A shallow approach and running landing may be advisable if helicopter trim can be maintained in powered flight.
- (2) If the tail rotor pitch becomes fixed during a takeoff or other increased power situation (left pedal applied), the nose of helicopter will turn left when power is reduced as in leveling off with cruise power). This turn to the left upon power reduction will probably be to a greater degree than the left turn encountered in a lower powered situation. Under these circumstances, it appears that powered flight to an airfield and powered landing could be accomplished with little difficulty since the sideslip angle will probably be corrected when power is applied for touchdown. However, upon decreasing power to initiate the approach at destination the sideslip angle will increase and remain so increased during the approach, but should be corrected when touchdown power is applied. Due to sideslip increase upon reduction of power to initiate the approach, a higher than normal approach speed may be beneficial. In this instance, powered landing may be the best solution as it is unlikely that autorotation could be accomplished at all.
- (3) If the tail rotor pitch becomes fixed during normal cruise power settings, the helicopter reaction should not be so violent as in the previously described situations and, at speeds from 40 to 70 knots, the tail pylon should streamline with very little, if any, sideslip or roll angle. In this instance, autorotation may aggravate the situation because a reduction of power (torque) may then result in a right sideslip. It must be considered, however, that an increase in power at touchdown will result in a left sideslip if powered approach is used, although this sideslip should not be of a hazardous magnitude for touchdown.

c. Loss of Tail Rotor Components. The gravity of this situation is dependent upon the amount of weight lost. If the loss is small, such as "aft of the ninety degree gearbox", the situation should be quite similar to "complete loss of tail rotor thrust." If more than that is lost, immediate autorotation may be the only solution of possible value. Any loss of this nature will result in a forward center of gravity shift, requiring aft cyclic control correction.

9-32. EMERGENCY PROCEDURES -IN FLIGHT.

When an anti-torque malfunction occurs, attempt to regain helicopter control in cruise flight. Retract antennas as soon as possible. It the situation permits, a change in collective pitch (power) may be attempted as an aid in gaining maximum possible control (trim) of the helicopter under existing circumstances. An increase in collective pitch turns the nose right; decrease turns it left. Rolling off power (throttle) will turn the nose left. The courses of action available will normally be:

- **a.** An autorotational descent and landing should be accomplished when possible under conditions when complete thrust is lost to the tail rotor. The autorotational technique to be used is described in paragraph b. below.
- b. If a safe landing area is not immediately available, continue powered flight to a suitable landing area with an airspeed dictated by the limitations of the emergency condition. This airspeed should be that which provides best control (between 40 and 70 KIAS). When the landing area is reached, make a full autorotative landing. During the descent, an airspeed above minimum rate of descent airspeed should be maintained and turns kept to an absolute minimum. If the landing area is a level, paved surface a run-on landing with a touchdown airspeed between 15 and 25 knots should be accomplished. If the field is unprepared, start to decelerate from about 75 feet altitude, so that forward groundspeed is at a minimum when the helicopter reaches 10 to 20 feet; execute the touchdown with a rapid collective pull just prior to touchdown in a level attitude with minimum ground roll (zero if possible).
- **c.** If the tail rotor pitch is fixed in a left pedal applied position, autorotative landing must not be attempted. The pilot should return to powered level flight at an airspeed which will be dictated by the degree of sideslip and roll; continue powered flight to the nearest improved landing area, and execute a run-on landing

with power that provides the best helicopter control. Under most conditions, an approach to hover is impossible. Prior to final approach the throttle may be reduced to maintain engine rpm above 6000 manually (GOV switch -AUTO). Upon decreasing power to begin the approach to the landing area, the sideslip angle will increase for the duration of the approach, but should be corrected when touchdown power is applied.

9-33. EMERGENCY PROCEDURES - HOVER.

- **a.** If the tail rotor pitch is fixed in a left pedal applied position, simultaneously reduce throttle and increase collective pitch to land the helicopter.
- **b.** If total loss of tail rotor thrust is experienced, close the throttle immediately and accomplish an autorotational landing.

9-34. LOSS OF TAIL ROTOR EFFECTIVENESS.

The tail rotor exhibits a tendency to lose effectiveness under various combinations of relatively high gross weight, high density altitude, marginal-power conditions and low airspeed (generally below effective translational lift). The condition is characterized by the helicopter turning right at high power settings and as left pedal approaches the forward limit. Contributing factors may be tail winds or inadvertent right pedal pressure during right turns at low airspeed. As the left pedal travel reaches the forward limit and the helicopter continues its right turn, continued left pedal pressure will have no effect on stopping the turn. If corrective action is not taken immediately, the helicopter will continue in a right spin which, if uncorrected, can lead to total loss of control. Corrective action depends on the height above the terrain and altitude available at the time of the occurrence. If loss of tail rotor effectiveness is experienced, reduce collective (as altitude permits) to decrease the torque effect of the main rotor and simultaneously reduce left pedal input. Apply forward cyclic to accelerate through effective translational lift. Simultaneously increase collective pitch and apply pedal as required for control and trim. If the spin cannot be corrected, an autorotation may be the only solution.

9-35. TRANSMISSION OIL - HOT OR LOW PRESSURE.

If the transmission oil temperature XMSN OIL HOT caution light illuminates; limits on the transmission oil

temperature gage are exceeded; XMSN OIL PRESS caution light illuminates; or limits on the transmission oil pressure gage are exceeded (low or high):

WARNING

Engine power must be maintained throughout the approach and landing to aid in preventing seizure of gears in the transmission.

Land as soon as possible.

Should transmission oil pressure drop to zero psi, a valid cross reference cannot be made with the oil temperature indicators. The oil temperature gage and transmission oil hot warning lights are dependent on fluid for valid indications.

9-36. CHIP DETECTORS.

If the CHIP DETECTOR caution light for the main transmission, forty two degree or ninety degree gearboxes illuminates:

Land as soon as possible.

9-37. FIRE.

The safety of helicopter occupants is the primary consideration when a fire occurs; therefore, it is imperative that every effort be made by the flight crew to put the fire out. On the ground it is essential that the engine be shut down, crew and passengers evacuated and fire fighting begun immediately. If time permits a "MAYDAY" radio call should be made before the electrical power is OFF to expedite assistance from fire fighting equipment and personnel. If the helicopter is airborne when a fire occurs the most important single action that can be taken by the pilot is to land the helicopter.

9-38. ENGINE FIRE.

9-39. HOT START - EMERGENCY SHUTDOWN.

The following procedure is applicable during engine starting if flames are emitted from the tail pipe, EGT limits listed in Chapter 5 are exceeded, or it becomes apparent that it will be exceeded.

- Starter switch Press. The starter switch must be held until EGT is in the normal operating range.
- 2. <u>Throttle Off.</u> The throttle must be closed immediately as the starter switch is pressed.
- 3. FUEL switch OFF.

NOTE

Flames emitting from the tailpipe are acceptable if the EGT limits are not exceeded.

9-40. FUSELAGE FIRE - GROUND.

If fire is observed in any part of the helicopter during ground operations proceed as follows:

- 1. Throttle Off.
- 2. FUEL switch OFF.
- 3. BAT switch OFF.
- 4. Clear the helicopter of crew immediately.

9-41. FUSELAGE FIRE - FLIGHT.

If fire is observed in any part of the helicopter during flight proceed as follows:

- 1. Land as soon as possible.
- 2. Throttle Off as soon as the helicopter is on the ground.
- 3. FUEL switch OFF.
- 4. BAT switch OFF.
- 5. <u>Clear the helicopter of crew immediately.</u>

9-42. ENGINE FIRE -FLIGHT.

9-43. LOW ALTITUDE.

If the fire light illuminates or fire is observed in or around the engine compartment during flight at low altitude, proceed as follows:

- 1. Land as soon as possible.
- 2. Throttle Off as soon as the helicopter is on the ground.

- 3. FUEL switch OFF.
- 4. BAT switch OFF.
- 5. Clear the helicopter of crew immediately.

9-44. CRUISE ALTITUDE.

Prevailing circumstances, such as altitude and landing areas available, must be considered in order to determine whether to execute a powered approach or a power-off autorotational descent to the ground. If the FIRE light illuminates and/or fire is observed in or around the engine during cruise flight and the pilot decides to execute a power-off descent, proceed as follows:

- 1. Collective pitch Down, autorotate.
- Mission antennas emergency retract switch Press.
- 3. Throttle Off.
- 4. FUEL switch OFF.
- 5. BAT switch OFF.
- 6. <u>Land</u> Accomplish an autorotational descent and landing.
- 7. Clear the helicopter of crew immediately.

9-45. ELECTRICAL FIRE.

9-46. ELECTRICAL FIRE -FLIGHT.

Prior to shutting off all electrical power, the pilot must consider the equipment that is essential to a particular flight environment that will be encountered, e.g., flight instruments, and fuel boost pumps.

In the event of electrical fire or suspected electrical fire in flight, proceed as follows:

- 1. BAT switch OFF.
- 2. <u>E STARTER GEN <u>EB</u> <u>X</u> START CONVERTER switch START.</u>
- 3. EMAIN GEN EB X GEN switch OFF.
- 4. MISSION POWER switch OFF.

5. <u>MISSION INVTR switch - MISSION INVTR.</u>

- 6. Land as soon as possible.
- Engine shutdown After landing complete as follows:
 - a. BAT switch ON.
 - b. Throttle Off.
 - c. FUEL switch OFF.
 - d. BAT switch OFF.

9-47. ELECTRICAL FIRE - FLIGHT CONTINUED.

If landing cannot be made and flight must be continued, the defective circuits may be identified and isolated as follows:

- 1. Complete steps 1 through 5 above.
- 2. Circuit breakers Out.

As each of the following steps are accomplished, check for indications of the source of the fire.

- 3. EMAIN GEN EB X GEN switch ON.
- 4. STARTER GEN switch STBY GEN.
- 5. EB X START/CONVERTER switch CONVERTER.
- 6. BAT switch ON.
- 7. <u>Circuit breakers In</u> one at a time in the priority required GEN & BUS RESET first. When malfunctioning circuit is identified, pull the applicable circuit breaker out.

9-48. ELECTRICAL FIRE - GROUND.

In the event of electrical fire or suspected electrical fire during ground operations, proceed as follows:

- 1. Throttle Off.
- 2. FUEL switch OFF.
- 3. BAT switch OFF.
- 4. STARTER GEN ES X START/
 CONVERTER switch START.

- 5. E MAIN GEN/EB X GEN switch OFF.
- 6. Clear the helicopter of crew immediately.

9-49. SMOKE AND FUME ELIMINATION.

Smoke and/or toxic fumes entering the cockpit and cabin can be exhausted as follows:

CAUTION

Do not jettison doors.

Doors, windows, and vents - Open.

- 9-50. FUEL SYSTEM.
- 9-51. FUEL BOOST CAUTION LIGHT ILLUMINATED.
- **a. One Boost Pump.** If the fuel pressure gage indicates a drop in pressure and/or one FUEL BOOST caution light illuminates:

Land as soon as practicable.

- **b. Two Boost Pumps.** If the fuel pressure gage indicates zero pressure and/or both FUEL BOOST caution lights illuminate, proceed as follows:
 - 1. FUEL switch Check ON.
 - 2. Descend to a pressure altitude of 4600 feet or less if possible.
 - 3. Land as soon as practicable.

No attempt should be made to troubleshoot the system while in flight.

9-52. FUEL FILTER CAUTION LIGHT ILLUMINATED.

If the FUEL FILTER caution light illuminates:

Land as soon as possible.

9-53. ENGINE FUEL PUMP CAUTION LIGHT ILLUMINATED.

If the ENGINE FUEL PUMP caution light illuminates:

Land as soon as possible.

Table 9-1. Emergency Procedures for Caution Segments			
Light	Corrective Action		
MASTER CAUTION	Check the CAUTION panel for the condition. If master caution only (no segment light). land as soon as possible.		
AUX FUEL LOW DC GENERATOR	INT AUX FUEL transfer switches - OFF. Check GEN AND BUS RESET circuit breaker in MAIN GEN switch RESET then ON. Switch to STBY GEN.		
INST INVERTER EXTERNAL POWER XMSM OIL PRESS XMSM OIL HOT ENGINE INLET AIR CHIP DETECTOR LEFT FUEL BOOST	Switch to other inverter. Close door. Land as soon as possible. Land as soon as possible. Land as soon as practicable. Land as soon as possible. Land as soon as possible. Land as soon as practicable.		
RIGHT FUEL BOOST	Land as soon as practicable.		
20 MINUTE FUEL IFF ENGINE OIL PRESS ENGINE CHIP DET GOV EMER ENGINE ICE DET ENGINE FUEL PUMP ENGINE ICING FUEL FILTER HYD PRESSURE SPARE	Information/System Status Information/System Status Land as soon as possible. Land as soon as possible. Information/System Status Land as soon as possible. Land as soon as possible. Land as soon as possible. Land as soon as possible. Land as soon as practicable. Land as soon as practicable. Land as soon as possible.		

9-54. THROTTLE FAILURE - EMERGENCY SHUTDOWN.

If the throttle cannot be closed, engine shutdown can be accomplished as follows: FUEL switch - OFF. The engine may continue to run for about 2 minutes after the switch is off.

9-55. ELECTRICAL SYSTEM.

9-56. OVERHEATED BATTERY.

WARNING

Do not open battery compartment. Battery fluid will cause burns and overheated battery will cause thermal burns and may explode.

If an overheated battery is suspected or detected, proceed as follows:

- 1. BAT switch OFF.
- Land as soon as possible. If condition is corrected, flight may be resumed with battery switch OFF.
- 3. Engine shutdown.
 - a. Rapid If battery is in forward location.
 - (1) Throttle Off.
 - (2) FUEL switch OFF.
 - b. Normal If battery is in aft location, perform a normal shutdown.
- 4. Clear the helicopter of crew immediately.

9-57. SPARE CAUTION LIGHT ILLUMINATION.

If a SPARE caution light illuminates:

Land as soon as possible.

9-58. MASTER CAUTION LIGHT ILLUMINATION.

If a master caution light illuminates with no segment panel light illumination:

Land as soon as possible.

9-59. **E** GENERATOR MALFUNCTION.

A malfunction of the generator will be indicated by a zero indication on the Generator Loadmeter and DC GENERATOR caution light illumination. An attempt may be made to put back on line by accomplishing the following:

- 1. MISSION POWER switch OFF.
- MISSION INVTR switch MISSION INVTR.
- MAIN GEN & BUS RESET circuit breaker -In.
- MAIN GEN switch RESET then ON. Do not hold the switch in the RESET position.

If the generator is not restored or if it goes off the line again.

5. MAIN GEN switch - OFF.

NOTE

Check that the standby generator loadmeter is indicating a load. Flight may be continued using the standby generator.

9-60. EB X ALTERNATOR MALFUNCTION.

A malfunction of the alternator will be indicated by illumination of the AC ALTERNATOR and the AC/DC CONVERTER segments of the master caution panel. An attempt may be made to put back on line by accomplishing the following:

- 1. MISSION POWER switch OFF.
- 2. START/CONVERTER switch START.
- 3. <u>ALT switch OFF. RESET then ON.</u> Do not hold the switch in the RESET position.

If the alternator is not restored or if it goes off the line again.

4. ALT switch - OFF.

If the alternator is restored.

5. <u>START/CONVERTER</u> <u>switch</u> CONVERTER.

9-61. HYDRAULIC.

WARNING

During hydraulic failure, do not return the HYD CONT switch to the ON position during takeoff, nap of the earth flying, approach and landing. This prevents any possibility of a surge in hydraulic pressure and the resulting loss of control.

9-62. HYDRAULIC POWER FAILURE.

Hydraulic power failure will be evident when the force required for control movement increases; a moderate feedback in the controls when moved, is felt and the HYD PRESSURE caution light illuminates. Control movements will result in normal helicopter response in every respect In the event of hydraulic power failure, proceed as follows:

- Airspeed Adjust as necessary to attain the most comfortable level of control movements.
- 2. <u>HYD CONT circuit breaker Out;</u> check for restoration of hydraulic power.
- 3. <u>HYD CONT circuit breaker In,</u> if hydraulic power is not restored.
- 4. HYD CONT switch OFF.
- Mission antennas emergency retract switch -Press.
- 6. <u>Land as soon as practicable</u> at an area that will permit a run-on landing with power. Maintain airspeed at or above effective translational lift until touchdown.

9-63. CONTROL STIFFNESS.

Under certain conditions a failure within an irreversible valve within the boost system may cause extreme stiffness in the flight controls to the extent that controls are extremely hard to move. Should control stiffness occur proceed as follows:

- HYD CONT switch OFF then ON. Check for restoration of normal flight control movements. Repeat as necessary if control response is not restored.
- 2. <u>HYD CONT switch OFF</u> if cycling the switch fails to restore controls to normal operation.

- Mission antennas emergency retract switch -Press.
- 4. <u>Land as soon as possible</u> at an area that will permit a run-on landing with power. Maintain airspeed at or above effective translational lift until touchdown.

9-64. CYCLIC HARDOVER.

Cyclic hardover is any erratic movement of the cyclic stick not induced by turbulence or by crew input. In the event of an irreversible valve failure (hardover), with hydraulics off, the cyclic stick will move either left rear, right rear, left forward, or right forward, depending on which irreversible fails. In flight with hydraulics ON when a hardover occurs, the cyclic stick will move left rear, right rear, left forward, or right forward. In flight, with hydraulics OFF (when a hardover occurs), the cyclic will tend to move either right rear or left rear. The cyclic moves toward the rear quadrants due to the main rotor exerting extension forces on the hydraulic servos. A failure in either mode may render the helicopter uncontrollable unless the following corrective action is taken:

- a. On the ground HYD CONT switch ON.
 - 1. HYD CONT switch OFF.
 - 2. Complete a normal engine shutdown.
- **b**. On the ground HYD CONT switch OFF.
 - 1. HYD CONT switch ON.
 - 2. Complete a normal engine shutdown.
- c. In flight HYD CONT switch ON.
 - 1. HYD CONT switch OFF then ON.
 - 2. Land as soon as practicable.

If malfunction is not corrected:

- 3. HYD CONT switch OFF.
- 4. <u>Mission antennas emergency retract switch Press.</u>
- Land as soon as practicable at an area that will permit a run-on landing with power. Maintain airspeed at or above effective translational lift at touchdown.

- d. In flight HYD CONT switch OFF.
 - 1. HYD CONT switch ON.
 - Mission antennas emergency retract switch -Press.
 - Land as soon as practicable at an area that will permit a run-on landing with power. Maintain airspeed at or above effective translational lift at touchdown.

9-65. LANDING AND DITCHING.

9-66. LANDING IN TREES.

A landing in trees should be made when no other landing area is available. In addition to accomplishing engine failure emergency procedures, select a landing area containing the least number of trees of minimum height Decelerate to a zero ground speed at tree-top level and descend into the trees vertically applying collective pitch as necessary for minimum rate of descent. Prior to the main rotor blades entering the trees, apply all of the remaining collective pitch.

9-67. DITCHING - POWER ON.

If it becomes necessary to ditch the helicopter accomplish an approach to an approximate 3-foot hover above the water and proceed as follows:

- Mission antennas emergency retract switch -Press.
- 2. Cockpit doors Jettison.
- 3. Cabin doors Open.
- 4. Crew (except pilot) Exit.
- 5. Hover a safe distance away from personnel.
- Throttle Close and execute an autorotation into the water. Apply full collective pitch prior to the main rotor blades entering the water. Maintain a level attitude as the helicopter sinks and until it begins to roll, then apply cyclic in direction of the roll.
- 7. Pilot Exit when the main rotor is stopped.

9-68. DITCHING - POWER OFF.

If an engine failure occurs over water and ditching is imminent accomplish engine failure emergency procedures and proceed as follows:

- 1. Cockpit doors Jettison.
- 2. Cabin doors Open.
- 3. <u>Land</u>. Accomplish autorotational descent, decelerating to zero forward speed as the helicopter nears the water. Apply all of the collective pitch as the helicopter enters the water. Maintain a level attitude as the helicopter sinks and until it begins to roll, then apply cyclic in the direction of the roll.
- 4. Crew Exit when the main rotor is stopped.

9-69. MAST BUMPING.

If mast bumping occurs:

- 1. Reduce severity of maneuver.
- 2. Land as soon as possible.

9-70. COLLECTIVE BOUNCE.

Collective bounce is a pilot induced vertical oscillation of the collective control system when an absolute friction (either pilot applied or control rigged) is less than seven pounds.

It may be encountered in any flight condition by a rapid buildup of vertical bounce at approximately three cycles per second. The severity of the oscillation is such that effective control of the helicopter may become difficult to maintain.

The pilot should apply and maintain adequate collective friction in all flight conditions.

Should collective bounce be encountered:

- Relax pressure on collective pitch control. (Do not "stiff arm" the collective.)
- 2. <u>Make a significant pitch application</u>, either up or down.
- 3. Increase collective pitch friction.
- 4. Land as soon as practicable.

9-71. FLIGHT CONTROL MALFUNCTIONS.

Failure of components within the flight control system may be indicated through varying degrees of feedback, binding, resistance, or sloppiness. These conditions should not be mistaken for hydraulic power failure. In the event of a flight control malfunction:

- 1. Land as soon as possible.
- 2. Throttle OFF.
- FUEL switches OFF.
- BAT switch OFF.

9-72. LIGHTNING STRIKE.

If lightning strike occurs:

Land as soon as possible.

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APPENDIX A

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APPENDIX B

ABBREVIATIONS AND TERMS

AC	Alternating Current	CNVTR	Converter
ADF	Automatic Direction Finder	COLL	Collision
Al	Attack Imminent	COMM	Communication
ALT	Alternator	COMPT	Compartment
ALT	Altitude/Altimeter	CONV	Converter
ALTM	Altimeter	CW	Clockwise
AM	Amplitude Modulation	DC	Direct Current
AMP	Ampere	DCP	Dispenser Control Panel
ANT	Antenna	DF	Direction Finding
ATTD	Attitude	DECR	Decrease
AUTO	Automatic	DELTA Δ	Incremental Change
AUX	Auxiliary	DET	Detector
AVGAS	Aviation Gasoline	DG	Directional Gyro
BAT	Battery	DIS	Disable
BDHI	Bearing Distance Heading Indicator	DISP	Dispense
BFO	Beat Frequency Oscillator	DSCRM	Discriminator
BL	Butt Line	ECM	Electronic Countermeasures
BRIL	Brilliance	EGT	Exhaust Gas Temperature
BRT	Bright	ELEC	Electrical
С	Celsius	EMER	Emergency
CARR	Carrier	ENG	Engine
CAS	Calibrated Airspeed	ESS	Essential
CCW	Counter Clockwise	EXH	Exhaust
CDI	Course Deviation Indicator	EXT	Extend
CG	Center of Gravity	EXT	Exterior
CL	Centerline	F	Fahrenheit
CMPS	Compass	FAT	Free Air Temperature
JIVII J	Compass		

FITG	Fitting	IGE	In Ground Effect
FM	Frequency Modulation	IN	Inch
FOD	Foreign Object Damage	INCR	Increase
FPS	Feet Per Second	IND	Indication/Indicator
FREQ	Frequency	INOP	Inoperative
FS	Fuselage Station	INST	Instrument
FT	Foot	INT	Internal
FT/MIN	Feet Per Minute	INT	Interphone
FUS	Fuselage	INV	Inverter
EWD	Forward	INVTR	Inverter
FWD	Polward	IR	Infrared
ΔΕ	Increment of Equivalent Flat Plate Drag Area	IRT kHz	Indicator Receiver Transmitter Kilohertz
G	Gravity	KIVC	Knote Indicated Airanced
G	Guard	KIAS	Knots Indicated Airspeed
GAL	Gallon	km KTA C	Kilometer
GD	Guard	KTAS	Knots True Airspeed
GEN	Generator	KN	Knots
GND	Ground	kva	Kilovolt-Ampere
GOV	Governor	kw	Kilowatt
GPU	Ground Power Unit	L	Left
HDG	Heading	LB	Pounds
HF	High Frequency	LDG	Landing
HIT	Health Indicator Test	LH	Left Hand
HTR	Heater	LSB	Lower Sideband
HYD	Hydraulic	LT	Lights
IAS	Indicated Airspeed	LTG	Lighting
ICS	Interphone Control Station	LTS	Lights
IDENT	Identification	MAG	Magnetic
IFF	Identification Friend or Foe	MAN	Manual

MAX	Maximum	% Q	Percent Torque
MED	Medium	R	Right
MHF	Medium - High Frequency	RCVR	Receiver
MHz	Megahertz	RDR	Radar
MIC	Microphone	RDS	Rounds
MIN	Minimum	REL	Release
MIN	Minute	REM	Remote
MISC	Miscellaneous	RETR	Retract
mm	Millimeter	RETRAN	Retransmission
MON	Monitor	RF	Radio Frequency
MWO	Modification Work Order	RH	Right Hand
NAV	Navigation	RI	Remote Height Indicator
NET	Network	RPM	Revolutions Per Minute
NO	Number	SAM	Surface to Air Missile
NM	Nautical Mile	SEC	Secondary
NON-ESS	Non-Essential	SEC	Secure
NON-SEC	Non-Secure	SEL	Select
NORM	Normal	SENS	Sensitivity
N1	Gas Turbine Speed	SL	Searchlight
N2	Power Turbine Speed	SOL	Solenoid
OGE	Out of Ground Effect	SQ	Squelch
PED	Pedestal	SSB	Single Sideband
PLT	Pilot	STA	Station
PRESS	Pressure	STBY	Standby
PRGM	Program	SQ FT	Square Feet
PSI	Pounds Per Square Inch	TAS	True Airspeed
PVT	Private	TEMP	Temperature
PWR	Power	TGT	Turbine Gas Temperature
QTY	Quantity	T/R	Transmit-Receive

TRANS	Transfer	VOL	Volume
TRANS	Transformer	VOR	Visual Omni Range
TRANS	Transmitter	V_{NE}	Velocity, Never Exceed (Airspeed Limitation)
TRQ	Torque	WL	Water Line
UHF	Ultra-High Frequency	WPN	Weapon
USB	Upper Sideband	XCVR	Transceiver
VAC	Volts, Alternating Current	XMIT	Transmit
VDC	Volts, Direct Current	XMTR	Transmitter
VHF	Very High Frequency	XMSN	Transmission
VM	Volt Meter		

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch 1 decimeter = 10 centimeters = 3.94 inches 1 meter = 10 decimeters = 39.37 inches 1 dekameter = 10 meters = 32.8 feet 1 hectometer = 10 dekameters = 328.08 feet 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain 1 decigram = 10 centigrams = 1.54 grains 1 gram = 10 decigram = .035 ounce 1 dekagram = 10 grams = .35 ounce 1 hectogram = 10 dekagrams = 3.52 ounces 1 kilogram = 10 hectograms = 2.2 pounds 1 quintal = 100 kilograms = 220.46 pounds 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce 1 deciliter = 10 centiliters = 3.38 fl. ounces 1 liter = 10 deciliters = 33.81 fl. ounces 1 dekaliter = 10 liters = 2.64 gallons 1 hectoliter = 10 dekaliters = 26.42 gallons 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

٥F	Fahrenheit	5/9 (after	Celsius	°C
	temperature	subtracting 32)	temperature	

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