TM 55-1520-210-10

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S

MANUAL

ARMY MODEL UH-1D H HELICOPTER

HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1969

WARNING

Personnel performing instructions involving operations, procedures, and practices which are included or implied in this technical manual shall observe the following instructions. Disregard of these warnings and precautionary information can cause serious injury, death, or an aborted mission.

DANGER AREAS AROUND TURBINE ENGINES

The area around the helicopter must be cleared of personnel, other aircraft, and all vehicles before the engine is started because of the high exhaust temperatures and velocities.

DAMGER OF HIGH VOLTAGE CREATED BY STATIC ELECTRICITY IN EXTERNAL CARGO HOOK

A crew member must inform all ground handling personnel of high voltage harzards when making external cargo hookups.

DANGER OF EXPOSURE TO FIRE EXTINGUISHING AGENTS

Exposure to high concentrations of fire extinguishing agents and their decomposition products can cause severe irritation to eyes and nose.

DANGER OF OPERATING ARMAMENT

Do not retract bolt on the M60D machine gun when a hangfire or cook-off is suspected.

DANGER OF VERTIGO FROM LIGHT REFLECTION

Be sure external cargo hook-up mirror is removed and stowed or mirror cover is on before all instrument and night operations. Reflected light from the mirror could cause vertigo.

*TM 55-1520-210-10

TECHNICAL MANUAL
No. 55-1520-210-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *7 May 1969*

Operator's Manual

ARMY MODEL UH-1D/H HELICOPTER

* This manual supersedes TM 55-1520-210-10, 20 November 1967, including all changes.

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CHAPTER I

INTRODUCTION

SECTION I SCOPE

IMPORTANT

In order to obtain complete information and derive maximum benefits from this manual it is necessary to read this chapter carefully and thoroughly.

1-1. This manual, issued expressly for operators, is an official document for Army Models YUH-1D and UH-1D/H helicopters. Serial numbers of the applicable helicopters are as follows:

ARMY MODEL	SERIAL NO.
YUH-1D	60-6028 thru 60-6034
UH-1D/H	62-2106 thru 62-2113
	62-12351 thru 62-12372
	63-8739 thru 63-8859
	63-12956 thru 63-13002
	64-13492 thru 64-13901
	65-9565 thru 65-9767
	65-9770 thru 65-10113
	65-10117 thru 65-10135
	65-12773 thru 65-12776
	65-12847 thru 65-12852
	65-12857 thru 65-12895
	66-746 thru 66-1210
	66-16000 thru 66-17144
	66-8574 thru 66-8577
	67-17145 thru 67-17312
	67-17313 thru 67-17622
	67-17623 thru 67-17777
	67-17778 thru 67-17859
	67-18411 thru 67-18413
	67-18558 thru 67-18577
	67-19475 thru 67-19537
	68-15214 thru 68-15778
	68-16050 thru 68-16628

The purpose of this manual is to supply you with the latest information and performance data derived from flight test programs and operation experience. The study and use of this manual will enable you to perform and assigned duties and missions with maximum efficiency and safety.

1-2. Your ability and experience are recognized. It is not the function of this manual to teach the pilot how to fly; basic flight principles and elementary instructions are not included. The contents of this manual will provide you with a general knowledge of Army Models YUH-1D and UH-1D/H helicopters, their flight characteristics and specific normal and emergency operating procedures.

1-3. Reports necessary to comply with the Army Safety Program are described in detail in AR 385-40.

1-4. DA Forms and procedures used for equipment maintenance will be only those prescribed by TM 38-750.

1-5. Equipment serviceability criteria applicable to Army Models YUH-1D and UH-1D/H helicopters are presented in TM 55-1520-210-ESC.

SECTION II GENERAL

1-6. Notes, Cautions, and Warnings shall be used to emphasize important and critical instructions and shall be used for the following conditions:

Note

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

Caution

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

Warning

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

1-7. Report of errors, omissions, and recommendations improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to: Commanding General, U.S. Army Aviation Systems Command, ATTN: AMSAV-R-M, Box 209, St. Louis, Missouri 63166".

1-8. When information applies to a specific model, a code system has been used and is as follows:

D	UH-1D only	(T53-L-9, T53-L-9A or T53-L-11 series engine)
H	UH-1H only	(T53-L-13 engine)

No code applies to YUH-1D, UH-1D and UH-1H.

S	L-11S	(L-11 series engine)

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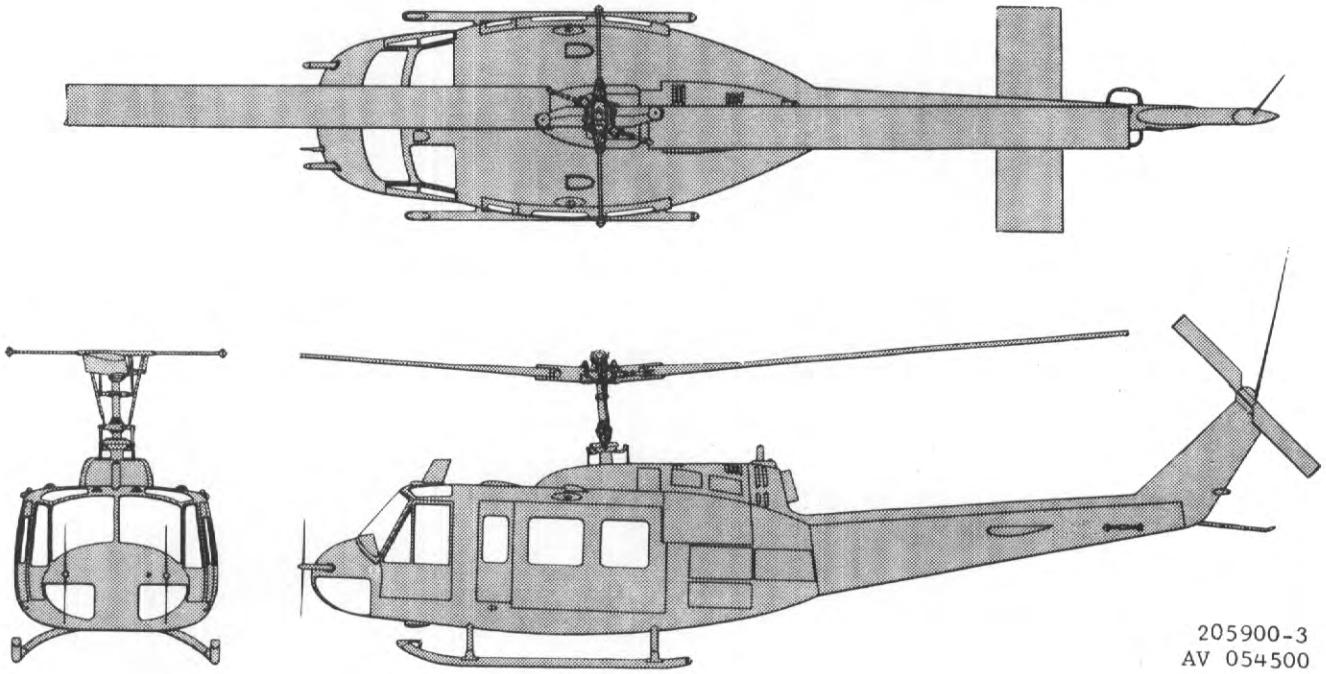

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The Helicopter

CHAPTER 2

DESCRIPTION

SECTION I SCOPE

2-1. SCOPE.

2-2. The function of Chapter 2 is to describe the helicopter and all its systems and controls which contribute to the physical act of flying the helicopter.

2-3. Includes in this chapter is all the emergency equipment that is not part of the auxiliary system. This chapter contains description only. The procedures are covered elsewhere in this manual.

SECTION II AIRCRAFT SYSTEMS AND CONTROLS DESCRIPTION

2-4. THE AIRCRAFT.

2-5. The YUH-1D, UH-1D and UH-1H helicopters, manufactured by Bell Helicopter Company, are military type aircraft of a compact design, featuring a low silhouette and low vulnerability in order to meet combat requirements. A wide cargo-passenger compartment, with large cubic foot volume, permits the helicopter to be used in a variety of services: for transport of personnel, special teams or crews, and equipment and supplies; for medical evacuation and emergency ambulance service and as an instrument trainer. This helicopter is capable of operating from unprepared take-off landing areas, under instrument (IFR) conditions (including light icing), day or night. It can be navigated by dead reckoning or by using radio aids to navigation. Maximum visibility is afforded the pilot and crew by use of transparent plastic panels at the top, front, bottom, and sides of the cabin. The gross weight of the aircraft for take-off on a NASA standard day from a firm dry surface at sea level is 9500 pounds.

2-6. CABIN CONFIGURATION AND ACCESS.

2-7. Entrance is accomplished by means of four doors. Crew entrance is through the two swing-hinged doors located in the forward cabin next to the pilot's and copilot's stations. Entrance to the cargo-passenger area aft of the pilot's and copilot's stations is accomplished by means of two large sliding doors, one on each side of the aft cabin area. The cargo-passenger area provides seating for a maximum of eleven passengers or troops. Removing the passenger seats and the copilot's seat provides an unrestricted loading space for cargo or equipment transportation. For medical evacuation and ambulance service, the area aft of the crew may be utilized to accommodate six litter patients and a medical attendant.

2-8. PROPULSION.

2-9. The propulsion system consists of the engine and drive system and is located aft of the cabin and mounted above the fuselage on a platform which provides footing for maintenance personnel while servicing the helicopter. The engine and drive system are enclosed by cowling that can be quickly opened or removed for easy access. This drive system with its independently mounted units and quick disconnect couplings, allows rapid servicing, and repair or replacement under combat conditions without the use of special tools or ground equipment.

2-10. AIRFRAME.

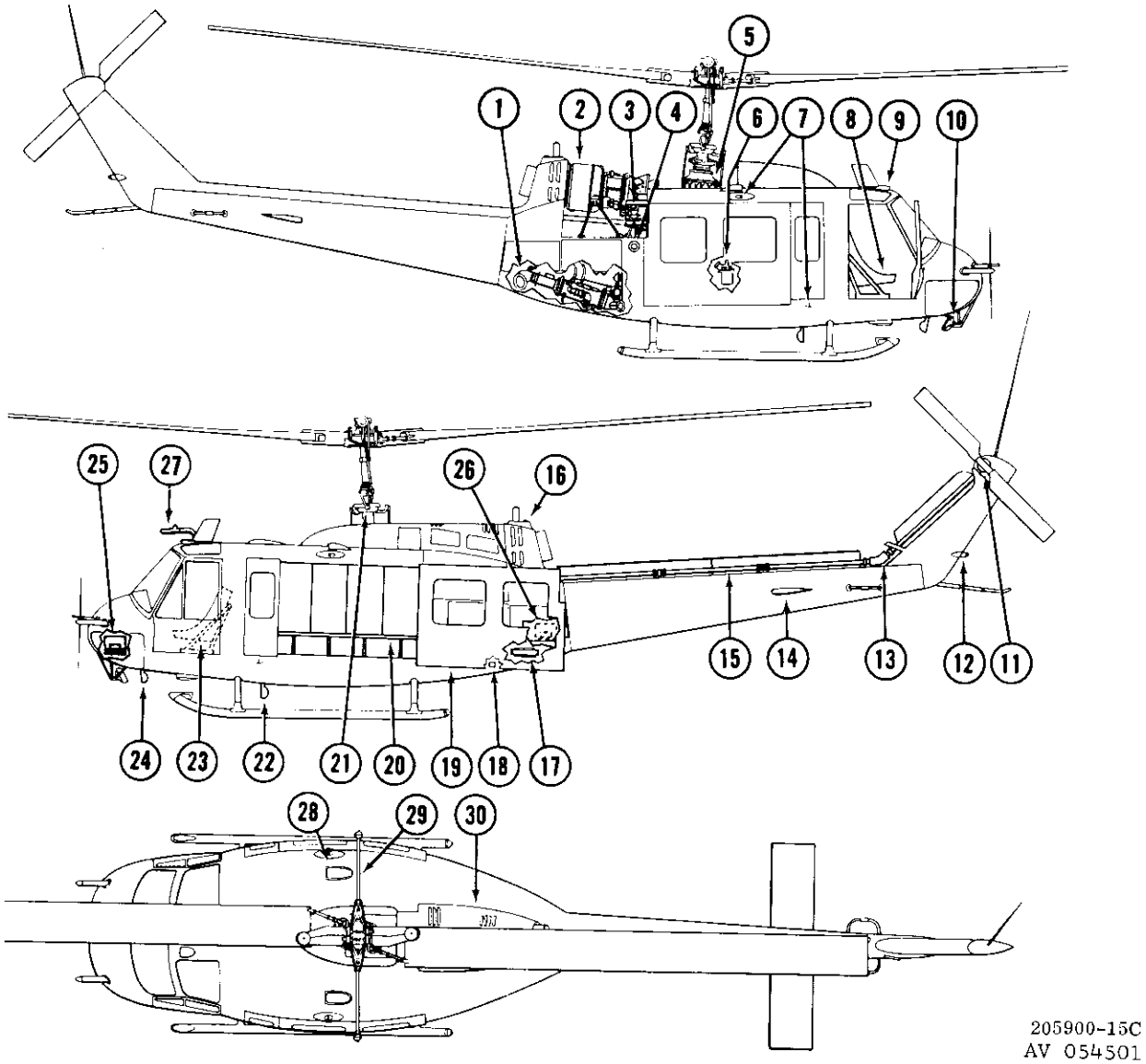
2-11. The fuselage consists of two main sections, the forward (cabin) section, and the aft (tail boom) section. The forward fuselage section consists primarily of two longitudinal beams with transverse bulkheads and metal covering. The beams provide the supporting structure for the cabin sections, landing gear, fuel tanks, transmission, engine, and tail boom and are attaching points for the external cargo suspension unit. The aft (tail boom) section is a semimonocoque structure with metal covering and attaches to the forward fuselage section with bolts to allow easy removal for repair or replacement. The rear of the tail boom supports the tail rotor, vertical fin, and synchronized elevator. The landing gear is of the skid type, attached to the fuselage at four points. Ground handling wheels are provided in the loose equipment and are quickly installed for moving the helicopter on the ground or removed to present a clean configuration for flight.

2-12. CREW CONFIGURATION.

2-13. The crew required for operation of the helicopter consists of the pilot alone, pilot and rescue hoist operator, pilot and medical attendant, or pilot and copilot, depending on the mission assigned.

2-14. PRINCIPAL DIMENSIONS - MAXIMUM.

2-15. Maximum dimensions of the helicopter are as specified in table 2-1.



1. Heating Burner and Blower Unit
2. Engine
3. Oil Tank Filler
4. Fuel Tank Filler
5. Transmission
6. Hydraulic Reservoir
7. Forward Navigation Lights (4)
8. Pilot's Station
9. Forward Cabin Ventilator (2)
10. Cargo Suspension Mirror
11. Tail Rotor (90°) Gear Box
12. Aft Navigation Light
13. Tail Rotor Intermediate (45°) Gear Box
14. Synchronized Elevator
15. Tail Rotor Drive Shaft
16. Anti-Collision Light
17. Oil Cooler
18. External Power Receptacle
19. Cargo-Passenger Door
20. Passenger Seats Installed
21. Swashplate Assembly
22. Landing Light
23. Copilot's Station
24. Search Light
25. Battery
26. Alternate Battery Location (Armor Protection Kit)
27. Pitot Tube
28. Aft Cabin Ventilators (2)
29. Stabilizer Bar
30. Engine Cowling

Figure 2-1. General arrangement diagram

TABLE 2-1. PRINCIPAL DIMENSIONS

LENGTH	
Overall (main rotor fore and aft and tail rotor horizontal)	57 ft. 0.67 in.
Overall (main rotor fore and aft and tail rotor vertical) to aft end of tail skid	54 ft. 1.67 in.
Nose of cabin to aft end of vertical fin (tail rotor vertical)	41 ft. 5.0 in.
Nose of cabin to aft end of tail rotor (tail rotor horizontal)	44 ft. 10.0 in.
Nose of cabin to center line of main rotor	11 ft. 8.65 in.
Skid Gear	12 ft. 2.0 in.
WIDTH	
Synchronized Elevator	9 ft. 4.3 in.
Skid Gear	8 ft. 6.6 in.
Stabilizer Bar	9 ft. 0.5 in.
HEIGHT (to static ground line)	
Tip of main rotor forward blade	
Secured aft	17 ft. 1.49 in.
Pressed down forward	7 ft. 9.19 in.
Top tip of tail rotor vertical	14 ft. 8.20 in.
Top of stabilizer bar	13 ft. 7.40 in.
Top of cabin	6 ft. 8.13 in.
Bottom of cabin	1 ft. 3.48 in.
Tail rotor clearance (ground to tip, rotor turning)	6 ft. 3.0 in.
Tail skid to ground	4 ft. 9.0 in.
DIAMETER (swept circle)	
Main rotor	48 ft. 3.2 in.
Tail rotor	8 ft. 6.0 in.
Stabilizer bar	9 ft. 0.5 in.
Turning radius	34 ft. 0.4 in.

2-16. WEIGHTS.

2-17. Refer to Chapter 12, Weight and Balance Computation.

2-18. ENGINE.

2-19. The helicopter is equipped with one of the following engines: T53-L-9, -9A, -11. -11B, or -13. The engines are similar in design and, except for stated differences (table 2-2), will be treated as one engine in the description. The turbine engine and its accessories are located aft of the cabin and mounted on a platform deck to provide maximum accessibility for servicing and maintenance (figure 2-2). This engine is a free turbine type designed for low fuel consumption, minimum size and weight, and maximum performance.

2-20. The free-power part of the engine eliminates the need for a clutch and provides free, smooth and trouble-free engagement of the helicopter's rotor. The T53-L-9, -9A, and -11 series engines are rated at 900 hp at 6600 rpm for maximum continuous power minus installation losses. The T53-L-13 engine is rated at 1250 hp; however, the engine is torque limited by the pilot to 1100 hp for military and normal power.

2-21. SAND AND DUST SEPARATOR.

2-22. The T53-L-9, -9A, -11 series, and -13 engines are equipped with a unit, mounted on the inlet housing, to separate sand and dust particles from the air entering the engine. This reduces erosion of engine parts. Particles removed from inlet air are held in box assemblies containing porous plastic foam inserts. The box assemblies can be easily removed for inspection and cleaning. Other components used with the sand and dust separator are ENG AIR FILTER CONT circuit breaker on overhead console, an engine air differential pressure switch, and an ENGINE INLET AIR warning light in the instrument panel.

Note

The ice detector system is not applicable on helicopters equipped with the sand and dust separator unit.

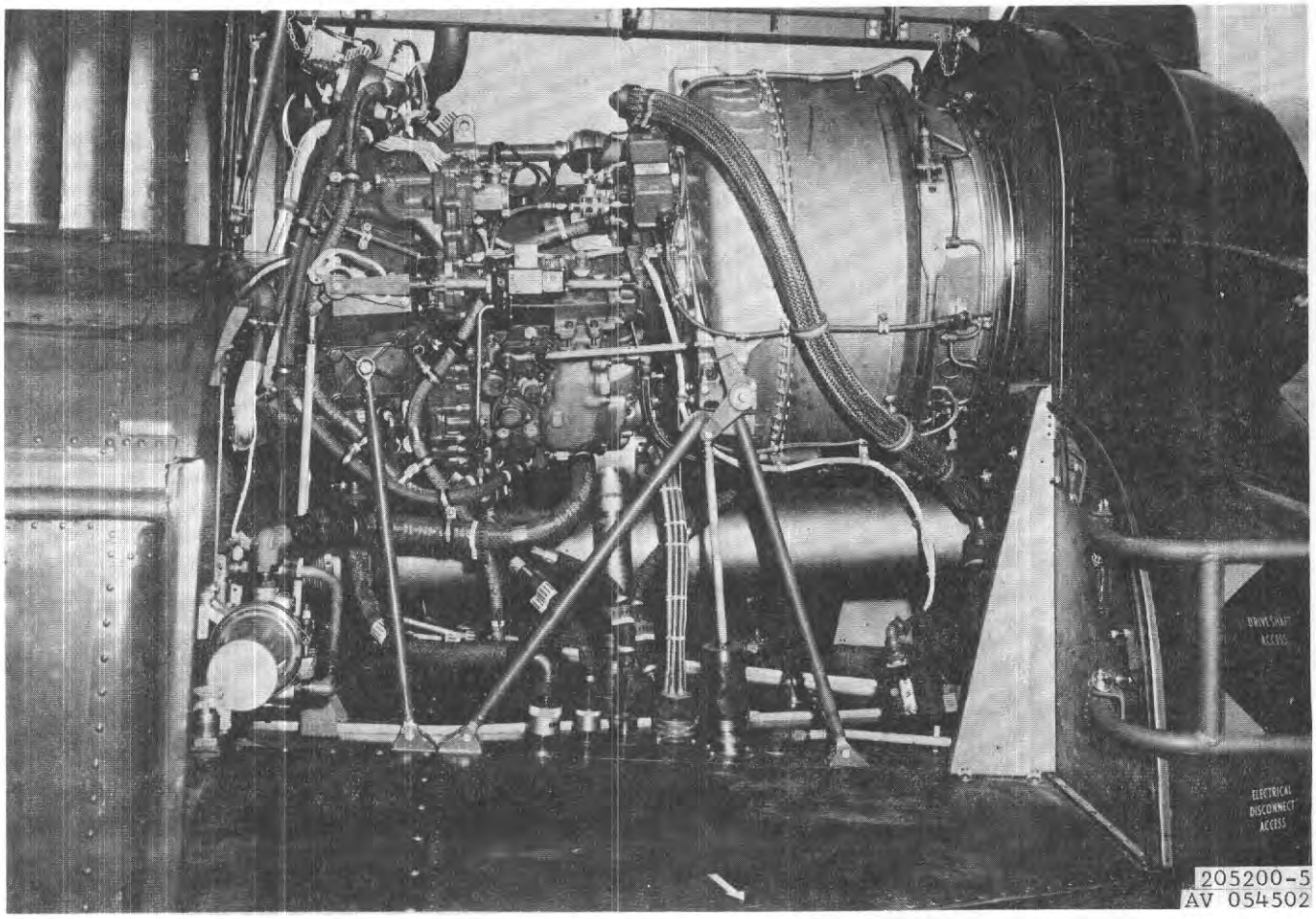


Figure 2-2. Engine Installation

TABLE 2-2. COMPARISON OF T53-L-9, -9A, -11 SERIES AND -13 ENGINES

	T53-L-9	T53-L-9A	T53-L-11/-11B	T53-L-13
*Power Rating in Shaft hp (min)				
Take-off	1100	1100	1100	N/A
Military	1000	1000	1000	1400****
Normal	900	900	900	1250****
75% Normal	675	675	675	938
*Fuel Consumption in lbs/hr				
Take-off	750.2	750.2	750.2	
Military	690	690	690	812
Normal	631.8	631.8	631.8	750
75% Normal	514.4	514.4	514.4	622
JP-5 Fuel Use	***Emergency	***Emergency	Alternate	Alternate
Dry Weight	485 lbs	490 lbs	505 lbs	535 lbs
Ignition Nozzles	5	5	2	4
Combustor	Scoops	Scoops	Scoopless	Scoopless
	Coated	Coated	Uncoated	Uncoated
Bleed Air Extraction Point	Compressor	Diffuser	Diffuser	Diffuser
Fuel Control Assembly (connection to interstage airbleed assembly)	No	No	Yes	Yes
Interstage Airbleed Systes (Acceleration	Yes	Yes	**Yes	**Yes
Acceleration - Flight Idle to Military	4.5 sec (max)	4.5 sec (max)	3.5 sec (max)	3.5 sec (max)

*Horsepower and Fuel Consumption ratings are based on sea level standard day conditions (plus 59°F, 29.92 inches Hg).
**Also responds to transient speed changes in operating range.
***Grade JP-5 as alternate only after incorporation of the Scoopless Combustor.

****This transmission is limited to 1100 hp.

Caution

When operating at outside air temperatures of 40°F or below, icing of the engine air inlet screens can be expected. Ice accumulation on the inlet screens can be detected by illumination of the "Engine Inlet Air" warning light. Continued accumulation of ice will result in partial or complete power loss. It should be noted that illumination of the "Engine Inlet Air" warning light indicates blockage at the inlet screen only and does not reveal icing conditions in the sand and dust separator or on the FOD screen.

2-23. DIFFERENCES.

2-24. The T53-L-9A engine is the same as the T53-L-9, except for relocation of the bleed air take-off point. On the T53-L-9 engine, the bleed air is taken from the inlet side of the impeller and delivered through a port on the top of the compressor housing. On the T53-L-9A, -11 series, and -13 engines, bleed air for driving the oil cooling fan and for heating purposes is taken from the outlet side of the impeller. T53-L-11 engines with serial numbers ending with A, T53-L-11B, and T53-L-13 engines have an improved output reduction gear and gear assembly and are identical except for the power output shaft. The T53-L-11 whose serial numbers end in A have a shaft with 24 teeth while the T53-L-11B and T53-L-13 shafts have 26 teeth.

2-25. ENGINE FUEL CONTROL SYSTEM.

2-26. The engine fuel control system consists of the engine fuel regulator and engine overspeed governor, solenoid valve, starting fuel and main fuel manifolds, igniter nozzles, fuel vaporizers, and igniter plugs. The electrical cable assembly is connected to the fuel system at two points: at the solenoid valve and at the main fuel control assembly. The coil and lead assembly connects to the igniter plugs. From the helicopter fuel tanks, fuel enters and passes through the fuel regulator assembly to the starting and main discharge ports. The starting fuel flows to a solenoid valve which is wired in with the ignition system. Energizing the ignition system actuates the solenoid valve, which allows starting fuel to enter the starting fuel manifold and combustion chamber through igniter nozzle assemblies. The igniter plugs initiate the flame. After combustion occurs and the ignition system is de-energized, the solenoid valve shuts off the starting fuel flow. Main fuel is delivered to the main fuel system when the engine rpm is great enough to deliver minimum fuel pressure. Main fuel flow is maintained as the engine flame is propagated. After an engine shutdown, a pressure-actuated valve automatically drains any remaining unburned fuel from the combustion chamber. Engine fuel control is accomplished by a hydro-mechanical type fuel control system consisting of a fuel regulator assembly and an overspeed governor assembly. An emergency fuel metering system is also provided as an integral part of the fuel control system. The fuel control regulator assembly supplies metered fuel to the solenoid valve and to the engine starting and main fuel manifolds by means of a fuel metering pump. A main governor, incorporated in the regulator assembly, determines the rate at which metered fuel is supplied to the engine in relation to the gas producer turbine speed (nI), altitude, compressor, inlet temperature, and manual throttle selection. The regulator assembly limits engine fuel flow to the maximum permissible rate under all operating conditions. The overspeed governor assembly is mounted on the fuel control regulator assembly and functions to reduce the fuel flow when power turbine speed (nII) exceeds the selected rpm.

2-27. FUEL CONTROL SYSTEM OPERATION. Fuel flow control is accomplished by operation of switches located on the pedestal-mounted ENGINE control panel (figure 2-3). The panel contains two FUEL switches (MAIN ON/OFF and *START ON/OFF), two INT FUEL TRANS PUMP switches (LEFT/OFF and RIGHT/OFF), and a GOV AUTO/EMER switch. The engine fuel and power control system permits the pilot to obtain maximum performance from the engine with a minimum of attention.

***Note**

FUEL START switch not applicable on helicopters serial Nos. 66-8574 through 66-8577, 66-16034 and subsequent, and earlier models so modified.

2-28. EMERGENCY FUEL FLOW. The switchover to emergency fuel flow is accomplished by retarding the power control (throttle), moving the GOV AUTO/EMER switch on the ENGINE panel to EMER. The emergency control manually meters fuel to the engine without the incorporation of any automatic features. It is possible to fly the helicopter by utilizing smooth, coordinated use of the rotating power control.

H Note

During extended operation in the EMERGENCY mode, set the governor INCREASE-DECREASE switch to the minimum position to preclude the possibility of bleed band popping (opening and closing).

2-29. POWER CONTROL (THROTTLE).

2-30. The rotating grip-type power controls (28, figure 2-4) are located on the collective pitch control levers (pilot and copilot). The power control is a simple single throttle grip which is used for starting engine, adjusting to flight idle and full open, autorotational landings, and in full decrease serves as idle cutoff.

The throttle grip is rotated to the left to increase or to the right to decrease power. Friction can be induced into the throttle grip by rotating the ring at the upper end of the throttle grip. Rotating the ring to the left increases friction in the system and prevents grip slippage. A 28-volt DC powered solenoid-operated idle detent is incorporated in the throttle to prevent inadvertent closing of the throttle during flight or ground run. To bypass the idle detent, depress and hold the engine idle release switch and close throttle. The idle detent limits only the decrease rotation of the rotating grip. The gas producer speed governor safeguards the engine against overloading; and on acceleration and deceleration, the control prevent engine damage or combustion blowout due to sudden changes in power selection made at any rate and in any sequence.

2-31. STARTER-IGNITION SYSTEM.

2-32. Combination starter-ignition trigger-actuated snap switches (31, figure 2-4) (pilot and copilot) are mounted on the undersides of the collective pitch control lever switch boxes. Both the starter and ignition unit circuits are wired to these trigger switches, as the engine ignition will only be required while accomplishing engine starts.

2-33. POWER SUPPLY.

2-34. The circuits are supplied power from the 28-volt DC essential bus. The starter circuit is actuated with the STARTER/GEN switch is in START position and the trigger switch (31, figure 2-4) is pulled. The ignition circuit is actuated when the FUEL MAIN ON/OFF switch on the ENGINE control panel is ON and the trigger switch is pulled.

2-35. GOVERNOR RPM SWITCH.

2-36. The GOV RPM INCR/DECR switch is mounted in a switch box attached to the end of the collective pitch control lever (figure 2-4). The switch (30) is a three-position momentary type and is held up in INCR position to increase the power turbine (nII) speed or down to DECR position to decrease the power turbine (nII) speed. Electrical power for circuit operation is supplied by the 28-volt DC essential bus.

2-37. DROOP COMPENSATOR.

2-38. A droop compensator is installed on the governor control to maintain (nII) speed, as power is increased, to the rpm value selected by the pilot. Governor droop should not be confused with rpm variations due to the acceleration-deceleration limiters (transient droop), or exceeding maximum power limits. Rapid movements of the collective control stick may require power changes at a rate in excess of the capabilities of the engine.

2-39. ENGINE IDLE RELEASE SWITCH.

2-40. The ENGINE IDLE REL switch (26, figure 2-4) is a pushbutton momentary-on type switch mounted in a switch box attached to the end of the collective pitch control lever. The pushbutton switch operates an electrical solenoid with a retractable plunger. The solenoid is mounted so that the plunger acts as a stop in the power control system linkage. The stop prevents the pilot from accidentally retarding the power control beyond the flight idle position. This acts as a safety feature by preventing inadvertent engine shutdown. The switch need not be depressed when opening the throttle; however, the switch must be depressed when it is desired to retard the power control below the flight idle position. Electrical power for circuit operation is supplied by the 28-volt DC essential bus. Circuit protection is provided by IDLE STOP REL circuit breaker on the DC circuit breaker panel (figure 2-11).

2-41. ENGINE INSTRUMENTS AND INDICATORS.

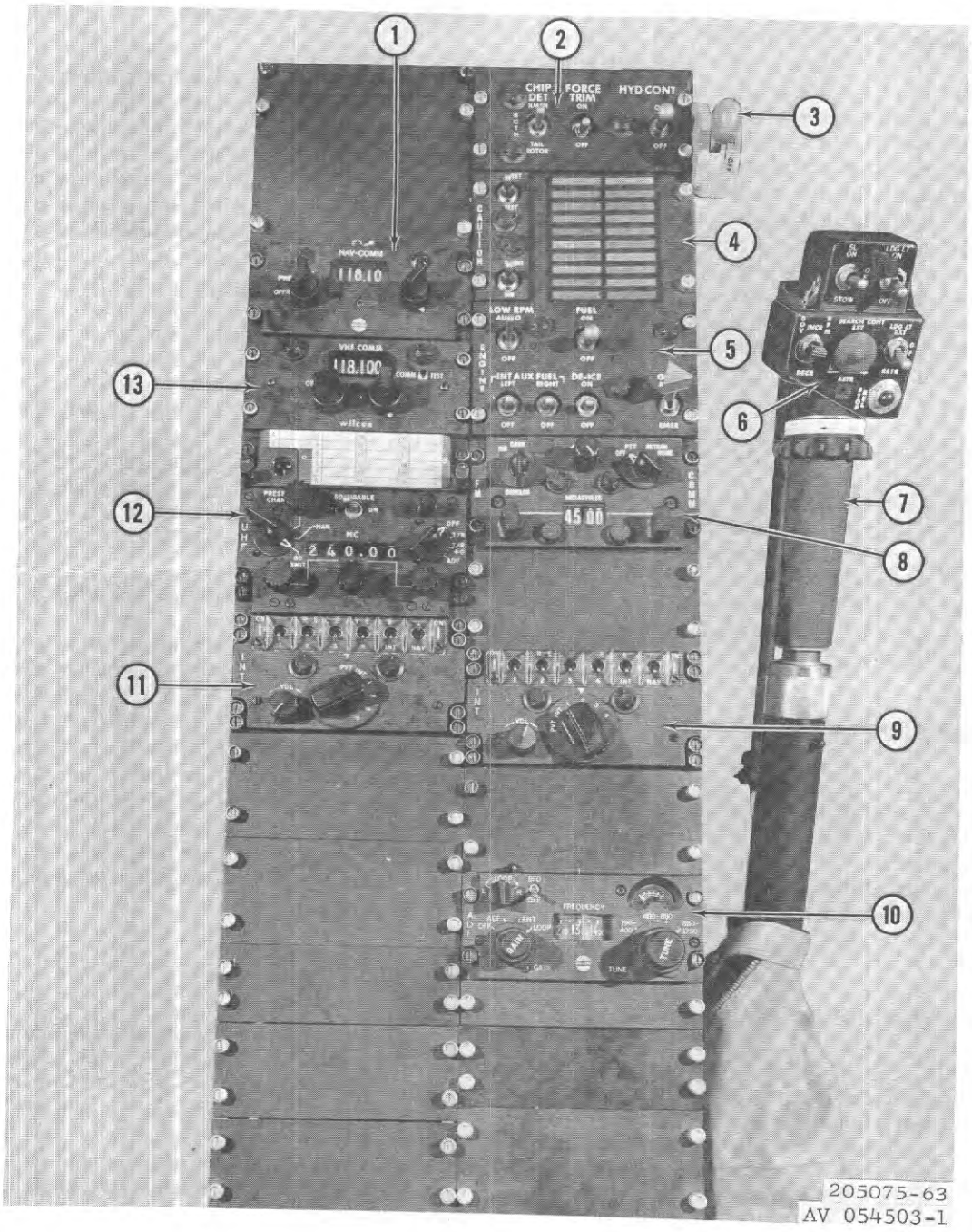
2-42. All engine instruments and indicators are mounted in the instrument panel (figure 2-5) and the pedestal (figure 2-3). The engine instruments and indicators consist of the following: torquemeter, exhaust gas temperature indicator, dual tachometer, gas producer tachometer indicator, engine oil pressure indicator, engine oil pressure low caution light, engine oil temperature indicator, fuel quantity indicator, fuel gage test switch, fuel quantity caution light, fuel pressure indicator, and engine fuel pump caution light.

2-43. TORQUEMETER.

2-44. The pressure torquemeter indicator (24, figure 2-5) is located in the center area of the instrument panel. This indicator is connected to a transmitter which is part of the engine oil system. The torquemeter indicates torque pressure in pounds per square inch readings of torque imposed upon the engine output shaft. The torquemeter electrical circuit is powered by 28-volt AC and is protected by a circuit breaker labeled TORQUE in the AC circuit breaker panel on the right side of the pedestal (figure 2-12).

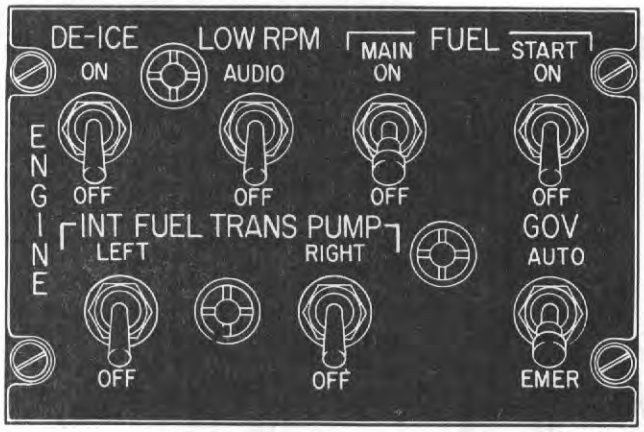
2-45. EXHAUST GAS TEMPERATURE INDICATOR.

2-46. The exhaust gas temperature indicator (see 38, figure 2-5) is located in the center area of the instrument panel. The indicator receives temperature indications from the bayonet-type thermocouples mounted in the engine exhaust diffuser section forward of the tailpipe. The temperature indications are in degrees centigrade multiplied by 100. Electrical power is not required as the system is self-generating.



1. Navigation Control Panel C-6873/ARN-82
2. Hydraulic Control Panel
3. Heating Air Directing Lever
4. Caution Panel
5. Engine Control Panel
6. Switch Box - Collective Pitch Control Lever (Ref)
7. Collective Pitch Control Lever (Ref)
8. FM Control Panel C-3835/ARC-54
9. Signal Distribution Panel C-1611A/AIC
10. Direction Finder Control Panel - C6899/ARN-83
11. Signal Distribution Panel C-1611A/AIC
12. UHF Control Panel C-6287/ARC-51BX
13. VHF Control Panel C-7197/ARC-134

Figure 2-3. Pedestal panel installation - typical (Sheet 1 of 2)



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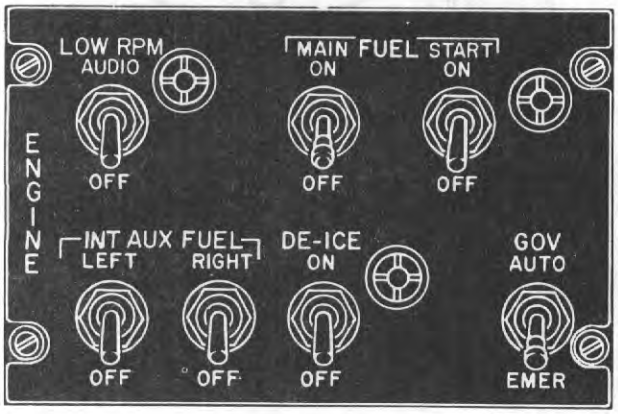

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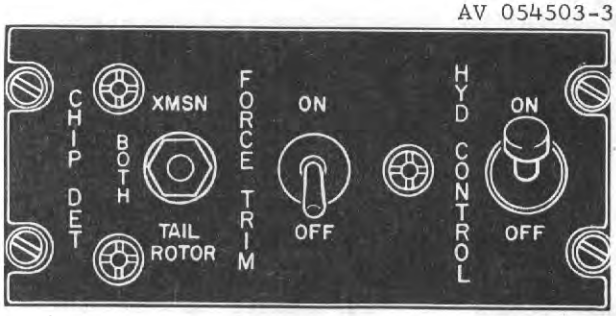

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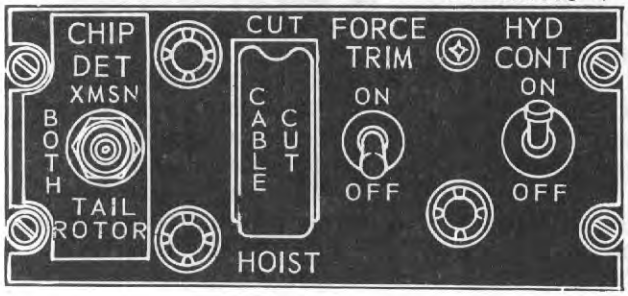

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Figure 2-3. Pedestal panel installation - typical (Sheet 2 of 2)

2-47. DUAL TACHOMETER.

2-48. The dual tachometer is located in the center area of the instrument panel and indicates both the engine and main rotor rpm (figure 2-5). The outer scale of the indicator is for power turbine (engine) rpm. The smaller inner scale is for the main rotor rpm. Power for operation of the indicators is provided by tachometer generators mounted on the engine and transmission. These systems are self-generating; therefore, an electrical connection to the helicopter's electrical system is not required. Normal operation of the helicopter is evident when the power turbine (engine) and rotor rpm indicator needles are in synchronization.

2-49. GAS PRODUCER TACHOMETER INDICATOR.

2-50. The gas producer tachometer indicator is located on the instrument panel in front of the pilot (31, figure 2-5). This indicator registers the rpm of the gas producer turbine and is powered by a tachometer generator which is geared to the engine rotor shaft therefore, a connection to the helicopter's electrical system is not required. The indicator readings are in percent rpm of gas producer turbine speed. The gas producer tachometer, when used in conjunction with the exhaust gas temperature indicator, permits engine power to be accurately set without exceeding engine limitations.

2-51. ENGINE OIL PRESSURE INDICATOR.

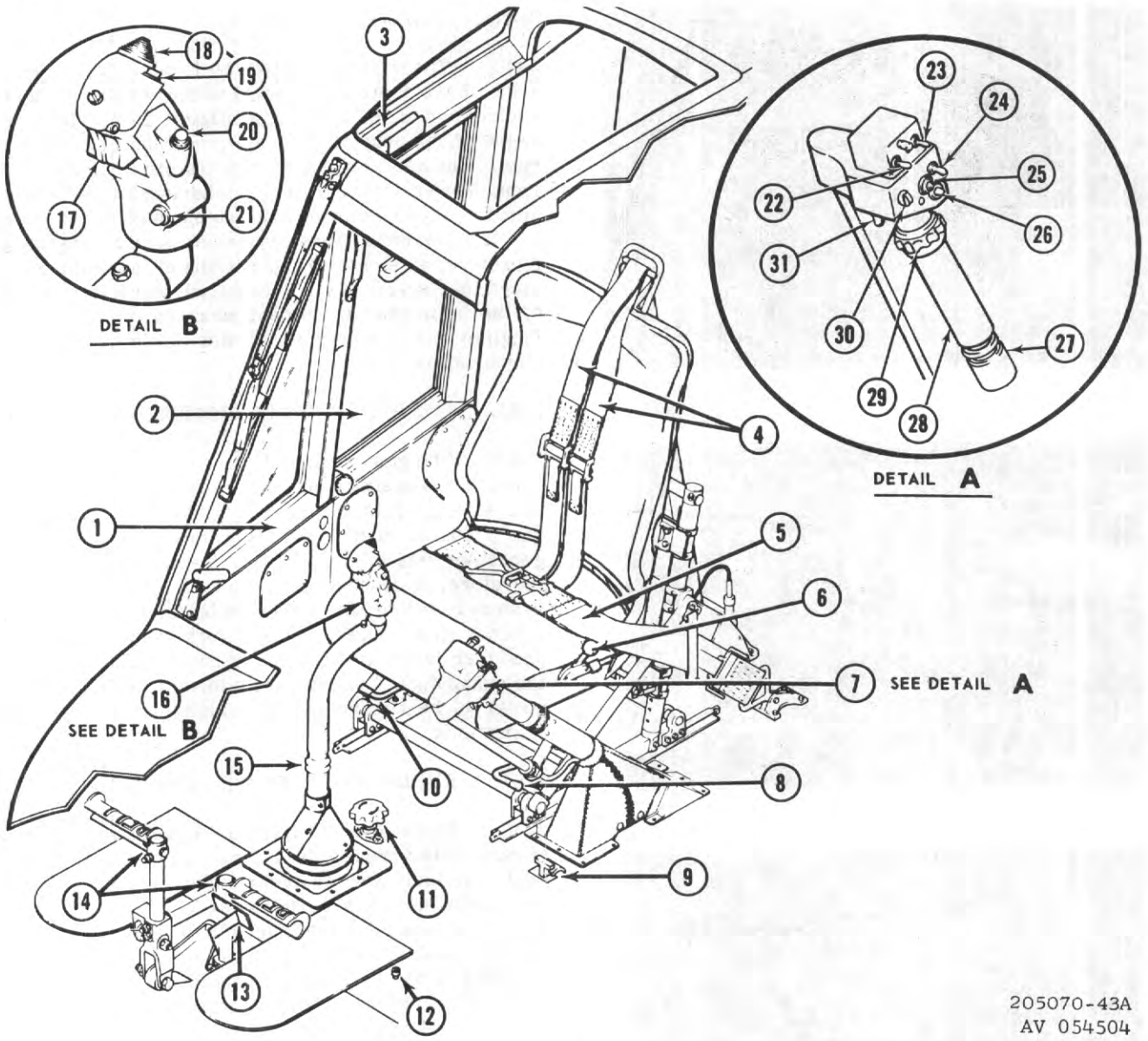
2-52. The engine oil pressure indicator is located in the center area of the instrument panel (16, figure 2-5). The indicator receives pressure indications from the engine oil pressure transmitter and provides readings in pounds per square inch (psi). Electrical power for oil pressure indicator and transmitter operation is supplied by the 28-volt AC system. Circuit protection is provided by the ENG circuit breaker on the AC circuit breaker panel (figure 2-12).

2-53. ENGINE OIL PRESSURE LOW CAUTION LIGHT.

2-54. The ENGINE OIL PRESS caution light is located on the pedestal-mounted CAUTION panel (figure 2-14). The light is connected to a low pressure switch which, when pressure drops below a safe limit, closes an electrical circuit, causing the caution light to illuminate. The circuit is supplied power by the 28-volt DC essential bus.

2-55. ENGINE OIL TEMPERATURE INDICATOR.

2-56. The engine oil temperature indicator is located in the center area of the instrument panel (17, figure 2-5). This indicator is connected to an electrical resistance-type thermocouple and indicates the temperature of the engine oil at the engine oil inlet. Electrical power to operate this circuit is supplied by



1. Pilot's Entrance Door
2. Sliding Window Panel
3. Hand Hold
4. Shoulder Harness
5. Safety Belt
6. Shoulder Harness Lock-Unlock Control
7. Collective Pitch Control Lever
8. Seat Adjustment Fore and Aft
9. Collective Pitch Down Lock
10. Seat Adjustment Vertical
11. Directional control Pedal Adjuster
12. Radio Transmit Foot Switch
13. External Cargo Mechanical Release
14. Directional Control Pedals
15. Cyclic Control Friction Adjuster
16. Cyclic Control Stick
17. Radio Transmit, ICS Trigger Switch
18. ASW-12 Directional Switch
19. Force Trim Switch
20. Armament Fire Control Switch
21. External Cargo Electrical Release Switch
22. Search Light ON-OFF Stow Switch
23. Landing Light ON-OFF Switch
24. Landing Light EXTEND-RETRACT Switch
25. Search Light EXTEND-RETRACT LEFT-RIGHT Control Switch
26. Engine Idle Release Switch
27. Collective Pitch Control Friction Adjuster
28. Throttle Twist Grip
29. Throttle Friction Adjuster
30. Governor RPM INCREASE-DECREASE Switch
31. Starter Ignition Trigger Switch

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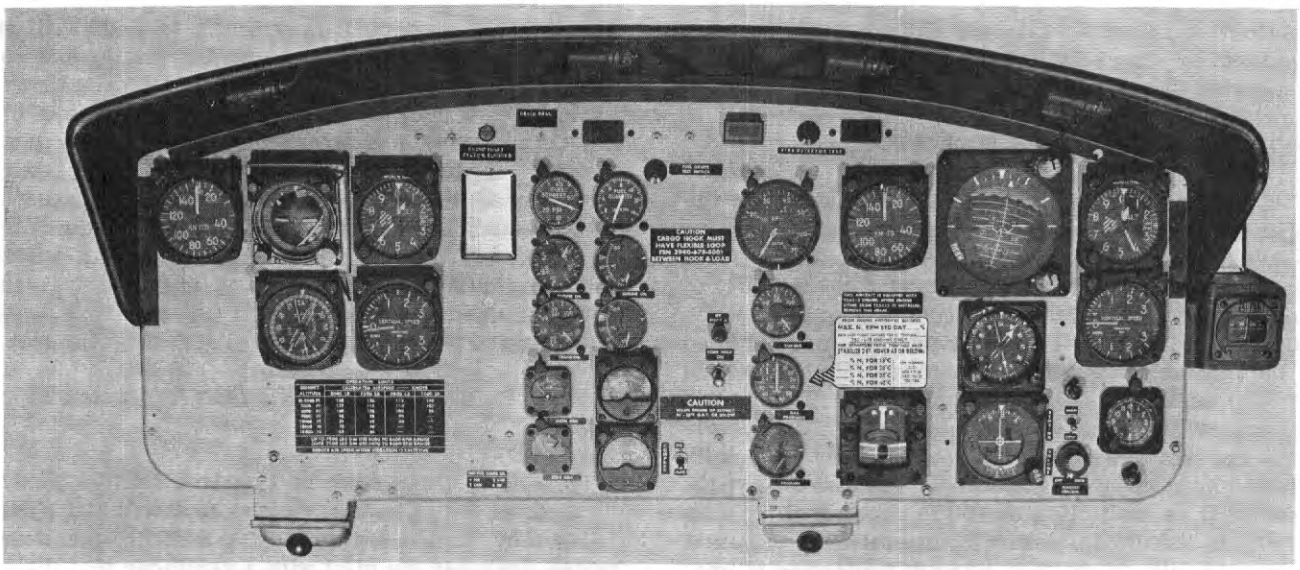
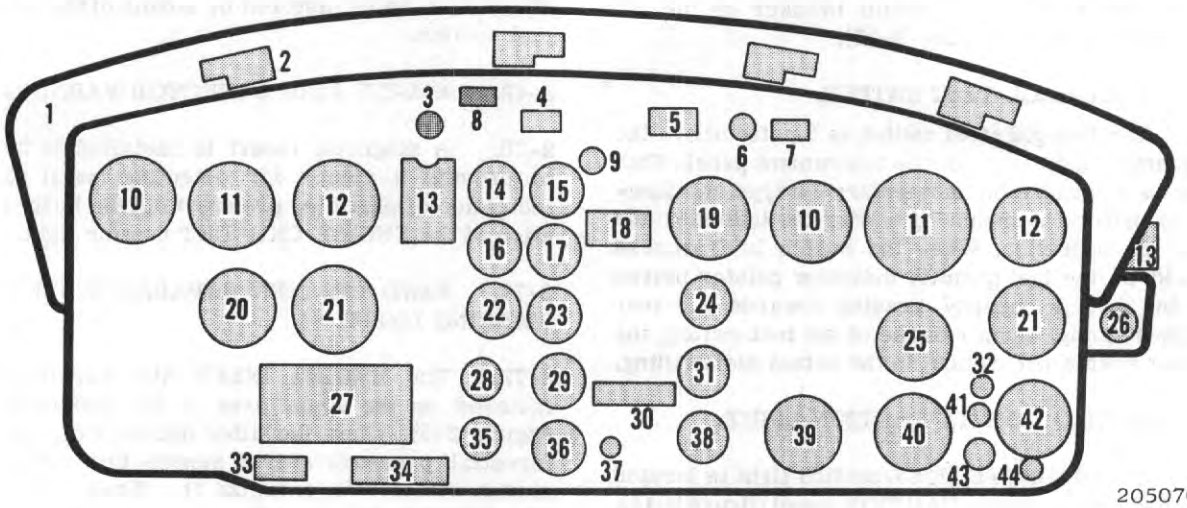
Figure 2-4. Pilot's station - typical





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1. Glare Shield
2. Secondary Lights
3. Engine Air Filter Light
4. Master Caution
5. RPM Warning Light
6. Fire Detector Test Switch
7. Fire Warning Indicator Light
8. Radio Call Designator
9. Fuel Gage Test Switch
10. Airspeed Indicator
11. Attitude Indicator
12. Altimeter Indicator
13. Compass Correction Card Holder
14. Fuel Pressure Indicator
15. Fuel Quantity Indicator
16. Engine Oil Pressure Indicator
17. Engine Oil Temperature Indicator
18. Cargo Caution Decal
19. Dual Tachometer
20. Radio Compass Indicator
21. Vertical Velocity Indicator
22. Transmission Oil Pressure Indicator
23. Transmission Oil Temperature Indicator
24. Torquemeter Indicator
25. Radio Compass Indicator
26. Standby Compass
27. Operating Limits Decal
28. Main Generator Loadmeter
29. DC Voltmeter
30. Engine Caution Decal
31. Gas Producer Tachometer Indicator
32. Marker Beacon Light
33. Engine Installation Decal
34. Transmitter Selector Decal
35. Standby Generator Loadmeter
36. AC Voltmeter
37. Compass Slaving Switch
38. Exhaust Gas Temperature Indicator
39. Turn and Slip Indicator
40. Omni Indicator
41. Marker Beacon Sensing Switch
42. Clock
43. Marker Beacon Volume Control
44. Cargo Release Armed Light

Figure 2-5. Instrument panel - typical

the 28-volt DC essential bus. Circuit protection is provided by the TEMP IND ENG & XMSN circuit breaker on the DC circuit breaker panel (figure 2-11).

2-57. FUEL QUANTITY INDICATOR.

2-58. The fuel quantity indicator is located in the upper center area of the instrument panel (15, figure 2-5). This instrument is a transistorized electrical receiver which continuously indicates the quantity of fuel in pounds. The fuel quantity indicator is connected to two capacitor-type fuel transmitters mounted in the interconnected fuel cells (one in the right-hand forward cell and one in the center aft cell). The advantage of this indicator system is that quantity volumes are more correctly indicated and not materially affected by varying temperatures. The indicator readings shall be multiplied by 100 to obtain fuel quantity in pounds. Electrical power for operation is supplied by the 115-volt AC system. Circuit protection is provided by the FUEL QTY circuit breaker on the AC circuit breaker panel (figure 2-12).

2-59. FUEL GAGE TEST SWITCH.

2-60. The fuel gage test switch is located above the fuel quantity indicator on the instrument panel. This switch is a pushbutton momentary-on type and functions to provide a means of testing the indicator and circuit for operation. When the switch is depressed and held in, the fuel quantity indicator pointer moves from the actual quantity reading towards a lesser quantity reading. Upon release of the test switch, the indicator needle will return to the actual fuel reading.

2-61. FUEL QUANTITY CAUTION LIGHT.

2-62. The 20 MINUTE FUEL caution light is located on the pedestal mounted CAUTION panel (figure 2-14). The light switch assembly is a float switch tupe and is located in the left-hand fuel cell. The switch functions to close the circuit and illuminates the light when there is approximately enough fuel remaining for 20 minutes flight time at cruise power. Electrical power for circuit operation is supplied by the 28-volt DC essential bus.

2-63. FUEL PRESSURE INDICATOR.

2-64. The fuel pressure indicator (14, figure 2-5) is located in the upper center area of the instrument panel. This indicator provides pounds per square inch (psi) readings of the fuel as delivered from the tank-mounted fuel boost pumps to the engine driven pump. The fuel pressure indicator is connected to a pressure transmitter, powered by 28-volt AC, which electrically transmits the actual psi fuel pressure reading to the fuel pressure indicator.

2-65. ENGINE FUEL PUMP CAUTION LIGHT.

2-66. The engine fuel pump caution light is located on the pedestal-mounted CAUTION panel (figure 2-14). The light is connected electrically to a fuel differential pressure switch at the engine driven dual element fuel pump. (See the fuel system schematic diagram, figure 2-8). A failure of either fuel pump element will cause a differential fuel pressure which is at once sensed by the differential pressure switch thus closing the electrical circuit and illuminating the caution light. When illuminated, the caution light segment wording will read ENGINE FUEL PUMP, providing visual indication of an engine driven fuel pump failure. The caution light and pressure switch are supplied power by the 28-volt DC essential bus.

2-67. EMERGENCY FUEL CONTROL CAUTION LIGHT.

2-68. The emergency fuel control caution light is located on the pedestal mounted caution panel (figure 2-14). The worded segment (GOV EMER) when illuminated provides the pilot with a reminder that the engine fuel is being metered by means of the emergency fuel system.

2-69. ENGINE CHIP DETECTOR WARNING LIGHT.

2-70. A magnetic insert is installed in the engine to provide a means for detecting metal particles. Indication of particles present is given by the illumination of the ENGINE CHIP DET caution light.

2-71. SAND AND DUST SEPARATOR FILTER WARNING LIGHT.

2-72. The ENGINE INLET AIR warning light is mounted on the upper area of the instrument panel (figure 2-5). When the filter becomes clogged, a differential pressure switch senses this condition and closes contacts to energize the filter warning light. The ENGINE INLET AIR, warning light illuminates, alterting the pilot to a clogged filter. As conditions permit the pilot shall proceed to the nearest authorized landing area for cleaning of sand and dust separator filters.

2-73. TRANSMISSION SYSTEM.

2-74. The transmission (5, figure 2-1) is mounted forward of the engine and coupled to the power turbine shaft at the cool end of the engine by means of a short drive shaft. The transmission is basically a reduction gearbox functioning to transmit engine power at a reduced rpm to the main rotor and tail rotor. The transmission incorporates a freewheeling unit at the input drive and two-stage plangtary gear train. This freewheeling unit provides a quick-disconnect from the engine if a power failure occurs and permits the main rotor and tail rotor to rotate in order to accomplish safe autorotational landings. The tail rotor is powered by a take-off on the lower aft section of the transmission. Accessory mounting pads and drives are included on the transmission for the rotor tachometer generator, hydraulic pump, and the electrical system

direct current generator. Quick-disconnect couplings are used on the drive shaft and electrical connections which permit rapid removal or replacement of the transmission as an assembly.

2-75. CHIP DETECTOR WARNING LIGHT - TRANSMISSION/GEAR BOX.

2-76. Magnetic inserts are installed in the drain plugs of the transmission sump, the intermediate (42°) tail rotor gearbox and the tail rotor (90°) gearbox. These plugs provide a means of inspection for metal particles. Indication of particles present is given by the illumination of the CHIP DETECTOR caution light. These plugs can be removed without loss of oil by means of a self-closing spring loaded valve in the drain plug which seats when magnetic insert is removed. The CHIP DETECTOR switch on the pedestal mounted hydraulic control panel is labeled BOTH, XMSN and TAIL ROTOR. The switch is normally in BOTH position, if the CHIP DETECTOR caution light illuminates RESET to extinguish and move switch to XMSN and TAIL ROTOR to determine the trouble area.

2-77. TRANSMISSION INDICATORS.

2-78. The transmission indicators provided consist of a transmission oil pressure, transmission oil temperature indicator, and caution light-transmission oil temperature.

2-79. TRANSMISSION OIL PRESSURE INDICATOR.

2-80. The TRANS OIL pressure indicator (22, figure 2-5) is located in the center area of the instrument panel. This instrument receives pressure indications from the transmission oil pressure transmitter. Readings on the indicator are provided in pounds per square inch (psi). Electrical power for the TRANS OIL pressure indicator and transmission oil pressure transmitter operation is supplied by the 28-volt AC circuit, and circuit protection is provided by the XMSN circuit breaker on the AC circuit breaker panel (figure 2-12).

2-81. CAUTION LIGHT - TRANSMISSION OIL PRESSURE.

2-82. A caution light marked XMSN OIL PRESS is located on the pedestal-mounted CAUTION panel (figure 2-14). This caution light is electrically connected to a transmission-mounted pressure switch which is actuated by a drop in the transmission oil pressure. The drop in oil pressure, when below safe operating limits, closes the electrical circuit and illuminates the caution light. The circuit is supplied power by the 28-volt DC essential bus.

2-83. TRANSMISSION OIL TEMPERATURE INDICATOR.

2-84. The transmission oil temperature indicator is located in the center of the instrument panel (23, figure 2-5). This indicator is connected to an electrical resistance-type thermobulb which electrically transmits the oil temperature reading to the indicator. The transmission oil temperature indicator circuit is supplied power by the 28-volt DC essential bus. Circuit protection is provided by the TEMP IND ENG & XMSN circuit breaker on the DC circuit breaker panel (figure 2-11).

2-85. CAUTION LIGHT - TRANSMISSION OIL TEMPERATURE.

2-86. A transmission oil temperature caution light is provided on the pedestal-mounted CAUTION panel (figure 2-14). The light is connected to a transmission-mounted thermoswitch which, when heated by transmission oil to a temperature above safe operating limits, closes an electrical circuit and illuminates the caution light which reads XMSN OIL HOT. The caution light circuit is supplied power by the 28-volt DC essential bus.

2-87. ROTOR SYSTEM.

2-88. The rotor system consist of a main rotor, anti-torque tail rotor and a rotor system indicator.

2-89. MAIN ROTOR.

2-90. The main rotor is a two-blades, semi-rigid see-saw type employing preconing and underslinging to insure smooth operation. The assemblies consist of two all-metal bonded blades with corrosion and scuff resistant leading edges, blade grips, yoke, mast, stabilizer bar, and rotating controls. Each blade is connected to a common yoke by means of blade grip and pitch change bearings with tension straps to carry centrifugal forces. The rotor assembly is attached to the mast with a cardan type universal joint and secured to the mast with a cap fitting which incorporates provisions for attaching a cable hoist to the helicopter. A stabilizer bar, mounted on the mast in a parallel plane above and at 90 degrees to the main rotor blades, provides the helicopter with an additional amount of stability (29, figure 2-1). The stabilizer bar is partially restrained in its movement by hydraulic-type dampers. Blade pitch change is accomplished by movements of the collective pitch control lever (7, figure 2-4) and a series of mixing levers terminating at the blade grip. Movement of the collective control lever UP increases the angle of attack of the rotor blades and causes the helicopter to ascend, and movement of the control lever DOWN decreases the angle of attack of the rotor blades, allowing the helicopter to descend. Tilting of the rotor is accomplished by movement of the cyclic

control stick (16, figure 2-4) which, when moved, results in a corresponding change in the plane of rotation of the rotor. Power to drive the rotor is from the two-stage planetary transmission into which the main rotor is mounted.

2-91. TAIL ROTOR.

2-92. The tail rotor is a two-bladed, semi-rigid delta hinged type employing preconing and underslinging. Each blade is connected to a common yoke by means of a grip and pitch change bearing. The blade and yoke assembly is mounted on the tail rotor shaft by means of a delta hinge trunnion to minimize rotor flapping. Blade pitch change is accomplished by movement of the pilot's or copilot's directional control pedals which are connected to apitch control assembly in the tail rotor (90 degree) gearbox. This blade pitch change provides control of torque and change of directional heading. Power to drive the tail rotor is from a take-off on the lower end of the main rotor transmission.

2-93. OIL SUPPLY SYSTEMS.

2-94. ENGINE OIL SUPPLY SYSTEM.

2-95. 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 by-pass valve, pressure transmitter and pressure indicator, low pressure warning switch and indicator, sight gages, and oil supply return vent, and breather lines. (See figure 2-6.)

2-96. The oil system connecting lines include quick-disconnect fittings to allow rapid removal of the engine or other defective items that require checking or replacement.

2-97. 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 engine-mounted and engine-driven oil pump. The tank capacity, oil specification and grade are specified in the servicing diagram (figure 2-16).

2-98. OIL COOLER. Engine oil cooling is accomplished by an oil cooler with thermostatic valves and bypass provisions. The cooler is housed within the fuselage area under the deck. 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 or provided.

2-99. OIL SYSTEM CONTROLS. The oil system is operative whenever the helicopter's engine is in operation.

2-100. TRANSMISSION OIL SYSTEM.

2-101. Transmission lubrication is accomplished by means of a self-contained pressure oil system, with the oil pump immersed in the wet sump located at the lower end of the transmission unit. Oil specification, grade, and capacity for the transmission are specified in the servicing diagram (figure 2-16).

2-102. TRANSMISSION OIL COOLER. A transmission oil cooler is incorporated in the transmission oil system. The transmission oil cooler is attached to the lower end of the engine oil cooler; and the same turbine fan that cools engine oil also functions to cool the transmission oil. Independent thermostatic valves and bypass provisions are a part of the transmission oil cooling system. (See figure 2-7.)

2-103. TAIL ROTOR INTERMEDIATE GEARBOX OIL SYSTEM.

2-104. The tail rotor intermediate gearbox lubrication is accomplished by a self contained wet sump in the lower area of the gearbox assembly. A visual sight gage is provided on the right side of the gearbox to permit checking oil level. Oil specification, grade and capacity are specified in the servicing diagram (figure 2-16).

2-105. TAIL ROTOR (90°) GEARBOX OIL SYSTEM.

2-106. The tail rotor (90°) gearbox lubrication is accomplished by a self contained wet sump. A visual sight glass gage is provided on the right side of the gearbox to permit checking oil level. Oil specification, grade and capacity are specified in the servicing diagram (figure 2-16).

2-107. FUEL SUPPLY SYSTEM.

2-108. The fuel supply system (figure 2-8) consists of five inter-connected rubber fuel cells with submerged fuel pumps in the forward cells, a bleed air-driven fuel boost pump in the left-hand forward cell and an electrically powered fuel boost pump in the right-hand forward cell; a fuel filter, fuel pressure switches, a fuel quantity system, a notor-operated shutoff valve, pressure transmitter and gage; a fuel low level warning switch, caution lights (ENGINE FUEL PUMP, 20 MINUTE FUEL, LEFT FUEL BOOST and RIGHT FUEL BOOST), drain valves and defuel valves. Provisions for an auxiliary fuel tank installation include permanently installed fuel flow lines, vent lines, drain lines, and electrical connections which terminate beneath the cabin floor and are accessible through a removable panel. A check valve incorporated in the auxiliary fuel tank flow line prevents fuel flow from the main fuel cells to the auxiliary tank and also prevents the fuel from the auxiliary tank overfilling the main fuel cells when transfer pump switch is in the OFF position. The auxiliary fuel equipment kit description and operating procedure

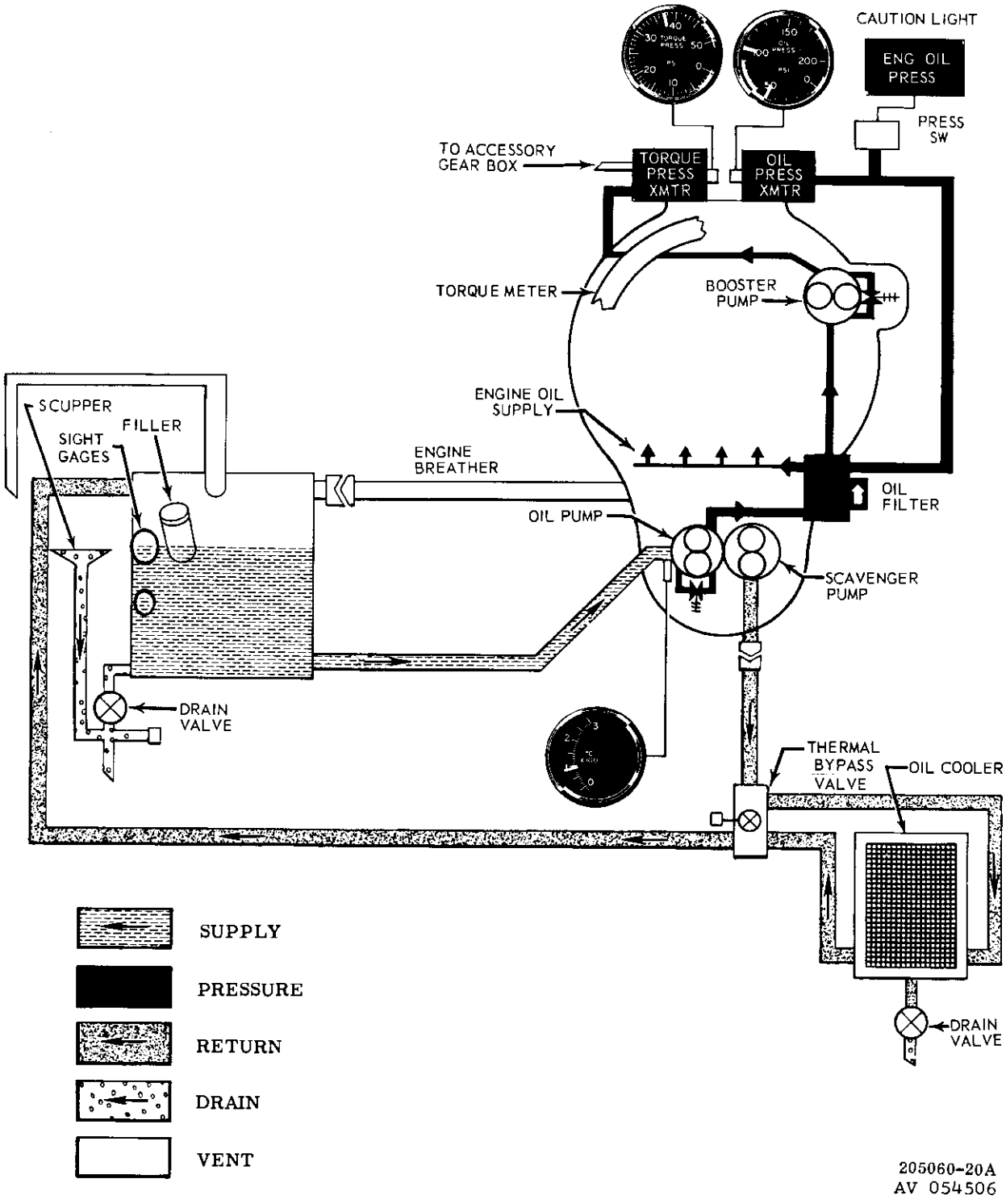

Figure 2-6. Engine oil system schematic diagram

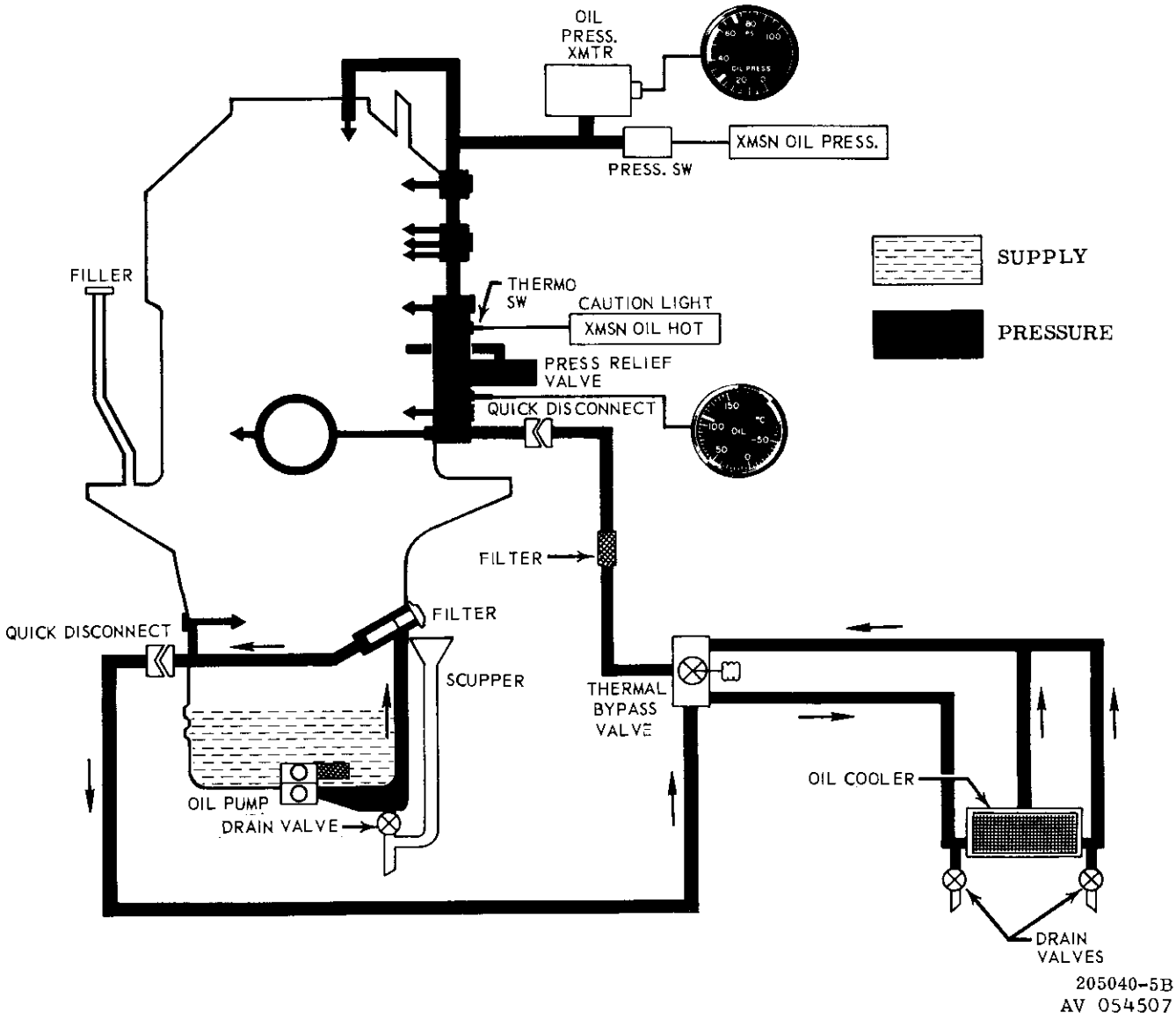

Figure 2-7. Transmission oil system schematic diagram

is set forth in Chapter 6, Auxiliary Equipment. Fuel specification, grade, and capacity are specified in the servicing diagram (figure 2-16, table 2-4, and table 2-5).

Note

On the YUH-1D helicopter, the boost pumps and sumps are located near the front of the forward fuel cells. A fuel quantity gage sensing unit is located in each of the forward cells and in the aft center cell. On the UH-1D/H helicopter, each forward cell is divided into two compartments by a lateral baffle fitted with a flapper valve to allow fuel flow from front to rear. A 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. 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 ejector pump sends fuel through a hose over a baffle into the rear part of the cell, so that no significant quantity of fuell will be unusable in any flight attitude. Two fuel quantity gage sensing units are located in right-hand forward cell and one sensing unit is located in the aft center cell.

2-109. FUEL SYSTEM CONTROLS.

2-110. The fuel system controls consist of a fuel main ON/OFF switch, fuel start ON/OFF switch (not

applicable on helicopters serial Nos. 66-8674 through 66-8577, 66-16034 and subsequent, and earlier models so modified) and fuel transfer pump switches (figures 2-3 and 2-8).

2-111. FUEL MAIN SWITCH. The FUEL MAIN ON/OFF switch is located on the pedestal-mounted ENGINE panel (figure 2-3). This switch is a two-position multiple-contact toggle type, ON in the up position and OFF in the down position. The switch is protected from accidental operation by a spring-loaded toggle head that must be pulled up before switch movement can be accomplished. Positioning of the MAIN ON/OFF switch to ON allows fuel to flow to the engine pump from the fuel cells, completes the circuit to the right-hand fuel cell boost pump, putting the pump into operation; and, when the starter-ignition trigger switch (figure 2-4) is pulled, energizes the ignition circuit. When the toggle head is lifted and the MAIN ON/OFF switch is positioned to OFF, fuel flow stops and the right-hand fuel cell boost pump ceases operation. Electrical power for circuit operation is supplied by the 28-volt DC essential bus. Circuit protection is provided by the FUEL VALVE, FUEL BOOST RIGHT and IGNITION SYSTEM-IGNITER SOL circuit breaker on the DC circuit breaker panel. (See figure 2-11.)

Note

The bleed air fuel pump in the left-hand forward cell operates only when the engine is in operation.

2-112. FUEL START SWITCH. The FUEL START ON/OFF switch is located on the pedestal-mounted ENGINE panel (figure 2-3). With this switch positioned to ON, the starting fuel igniter solenoid valve will be energized when the starter-ignition switch is pulled. When the FUEL START switch is positioned to OFF, the igniter solenoid valve circuit is de-energized. Electrical power for circuit operation is supplied by the 28-volt DC essential bus. Circuit protection is provided by the IGNITION SYSTEM-IGNITER SOL circuit breaker on the DC circuit breaker panel (figure 2-11).

Note

FUEL START switch not applicable on helicopter serial Nos. 66-8574 through 66-8577, 66-16034 and subsequent, and earlier models so modified.

2-113. FUEL TRANSFER PUMP SWITCHES. The INT FUEL TRANS PUMP LEFT/OFF and RIGHT/OFF switches are located on the pedestal-mounted engine panel (figure 2-3). These switches are used only when the auxiliary fuel equipment has been installed and cables for the two electrically operated transfer pump and ferry tank fuel level switches are connected.

2-114. CAUTION LIGHT-RIGHT-AND LEFT-HAND FUEL BOOST PUMP. The right- and left-hand fuel boost pump caution lights are located on the pedestal-mounted CAUTION panel (figure 2-14). These caution lights monitor the operation of their respective pumps. A fuel boost pump failure is sensed by a pressure switch which closes, energizing the caution light circuit for the malfunctioning boost pump. The respective caution lights will illuminate and read LEFT FUEL BOOST or RIGHT FUEL BOOST. The caution lights and pressure switches receive power from the 28-volt DC essential bus.

2-115. FUEL FILTER CAUTION LIGHT. The FUEL FILTER caution light (UH-1D serial No. 63-8739, and subsequent) is located on the pedestal-mounted CAUTION panel (figure 2-14). 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. The FUEL FILTER caution light illuminates, alerting the pilot to a clogged fuel filter and fuel contamination. If clogging continues, the fuel bypass line opens to allow fuel to flow around the filter.

2-116. After the FUEL FILTER caution light illuminates, the pilot has approximately 30 minutes to return to base or locate a substitute landing area. The helicopter shall not be flown until the reason for illumination of the FUEL FILTER caution light has been determined and corrected.

2-117. ELECTRICAL POWER SUPPLY SYSTEMS.

2-118. The electrical power supply systems provide 28-volt direct current, 115-volt alternating current, and 28-volt alternating current as applicable for the electrical equipment installed in the aircraft. See the electrical system schematic diagram, figure 2-9.

2-119. DC POWER SUPPLY.

2-120. The direct current power supply system is a 28-volt, single-conductor system with the negative leads of the generators grounded in the helicopter fuselage structure. Direct current power is supplied by either the main generator, standby generator (starter-generator), battery, or an external power supply. The system consists of the following: primary bus, essential bus, non-essential bus, auxiliary circuit breaker bus, main generator voltage regulator, stand-by generator voltage regulator, main generator over-voltage relay, main generator field relay, main generator reverse current relay, standby generator reverse current relay, bus control relay, battery relay, nonessential bus relay, starter relay, external power relay, and control panel and circuit breakers to furnish protection for the system and equipment operating from the system. In the event of a main generator failure, the nonessential bus is automatically de-energized when circuit is opened by contacts of the bus control relay and the nonessential

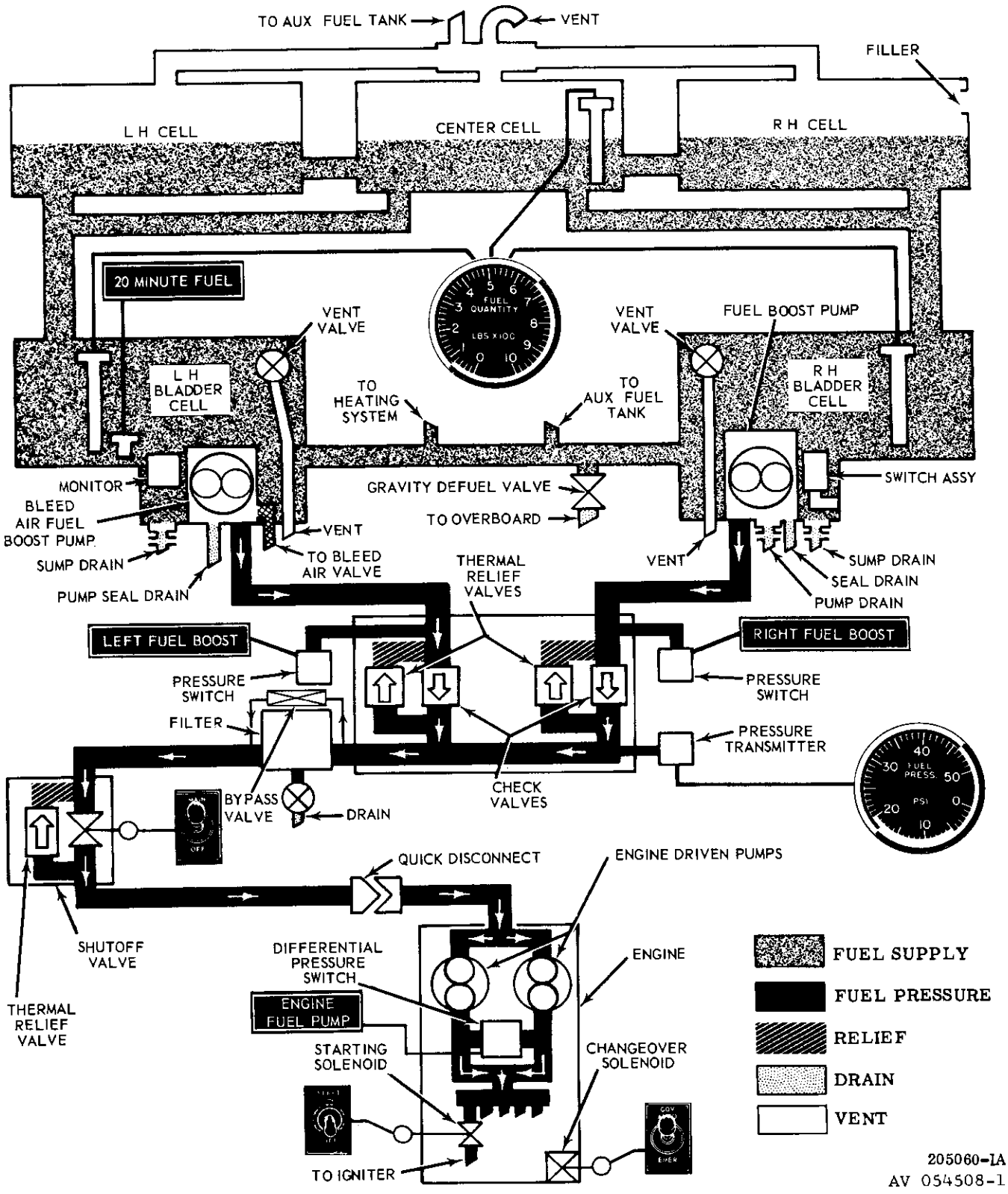

Figure 2-8. Fuel system schematic diagram - YUH-1D (Sheet 1 of 2)

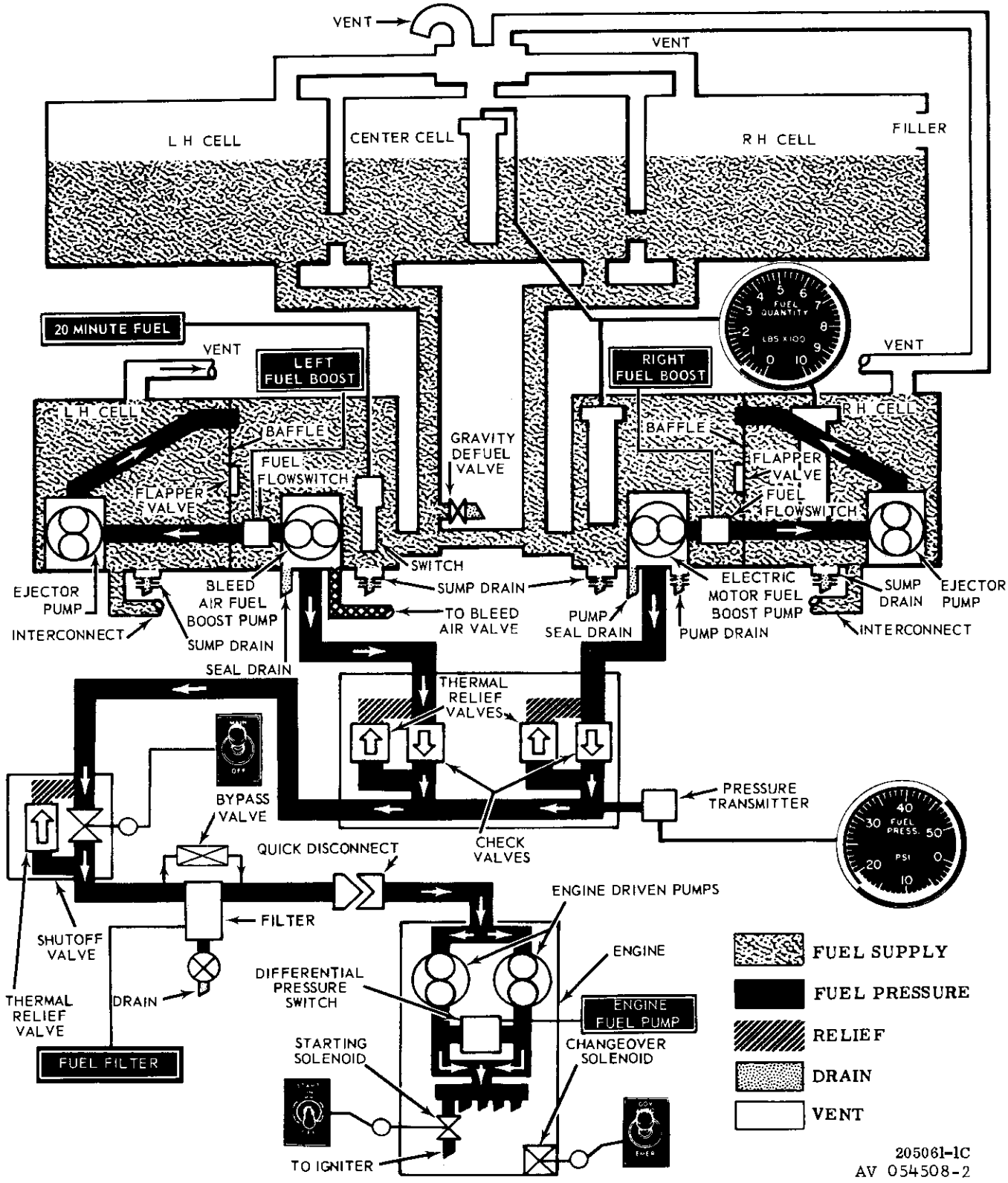

Figure 2-8. Fuel system schematic diagram - UH-1D/H (Sheet 2 of 2)

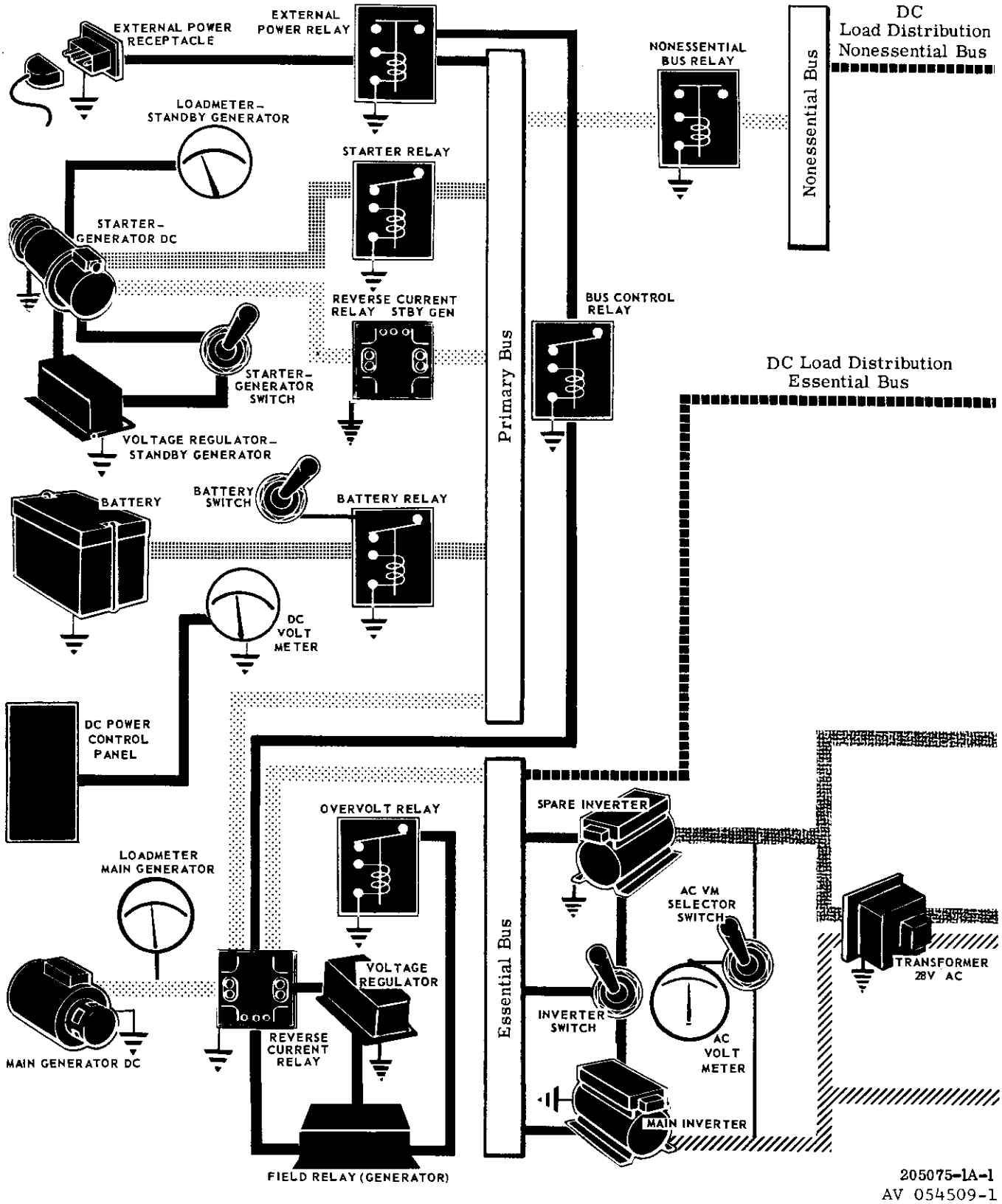

Figure 2-9. Electrical system schematic diagram (Sheet 1 of 2)

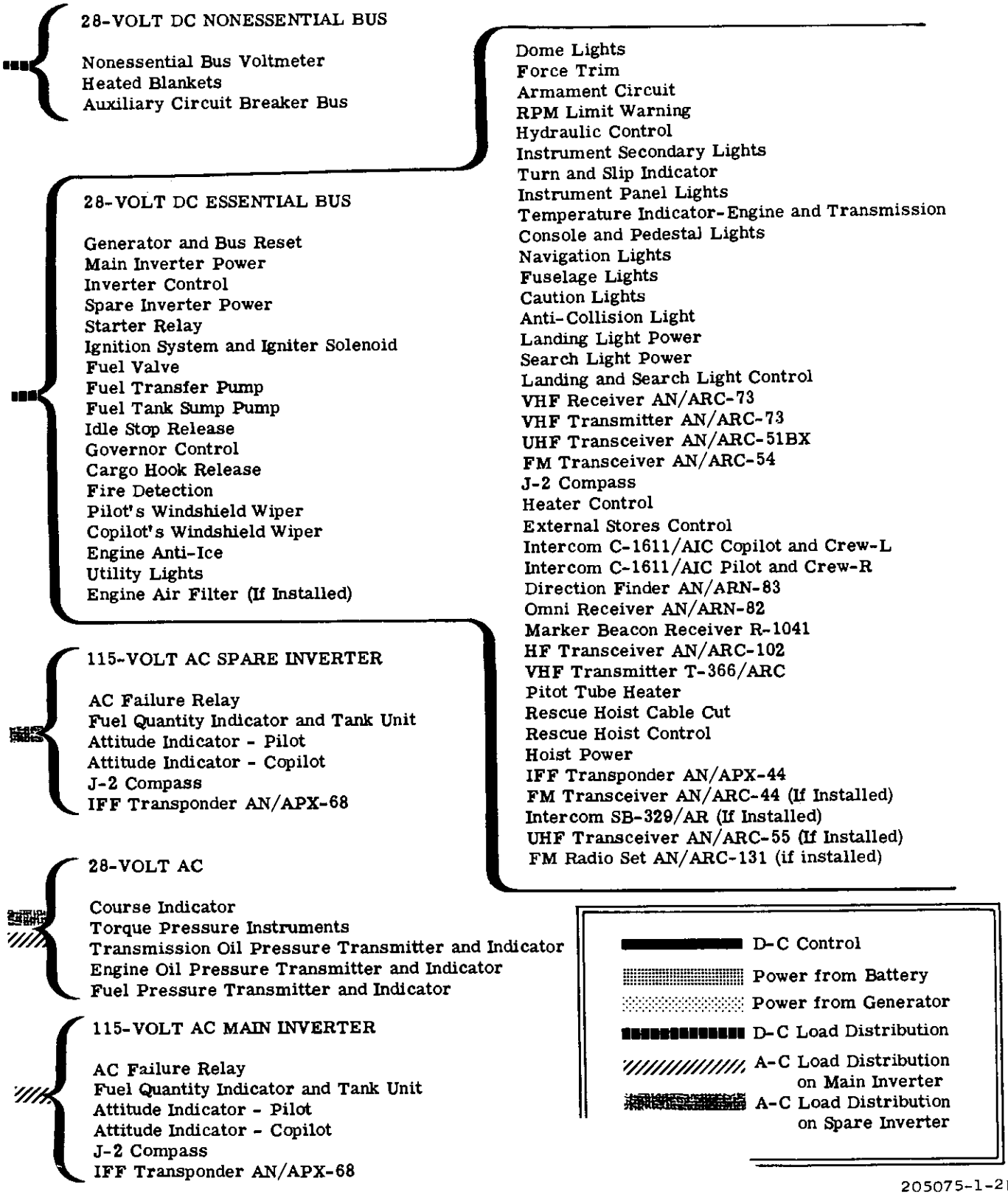

Figure 2-9. Electrical system schematic diagram (Sheet 2 of 2)

bus relay actions. The pilot may override the automatic action by positioning the NON-ESS BUS switch on the DC POWER control panel (figure 2-10) to MANUAL ON.

2-121. MAIN AND STANDBY GENERATORS. The 28-volt main generator is rated at 300 ampere output and is mounted on and driven by the transmission gearing; therefore, generator power is provided and battery drain prevented when autorotational landings are being performed. A standby starter-generator, rated at 200 ampere output and mounted on the helicopter's engine accessory drive section, is provided to furnish 28-volt DC power in the event of a main generator failure.

2-122. BATTERY. The battery (figure 2-1) is located in the nose electrical compartment. The battery is a nickle-cadmium 22 ampere hour, 24-volt and has a high discharge rate for starting turbine engines.

2-123. DIRECT CURRENT POWER CONTROL. Direct current power control is accomplished from the DC POWER control panel on the overhead console (figure 2-10).

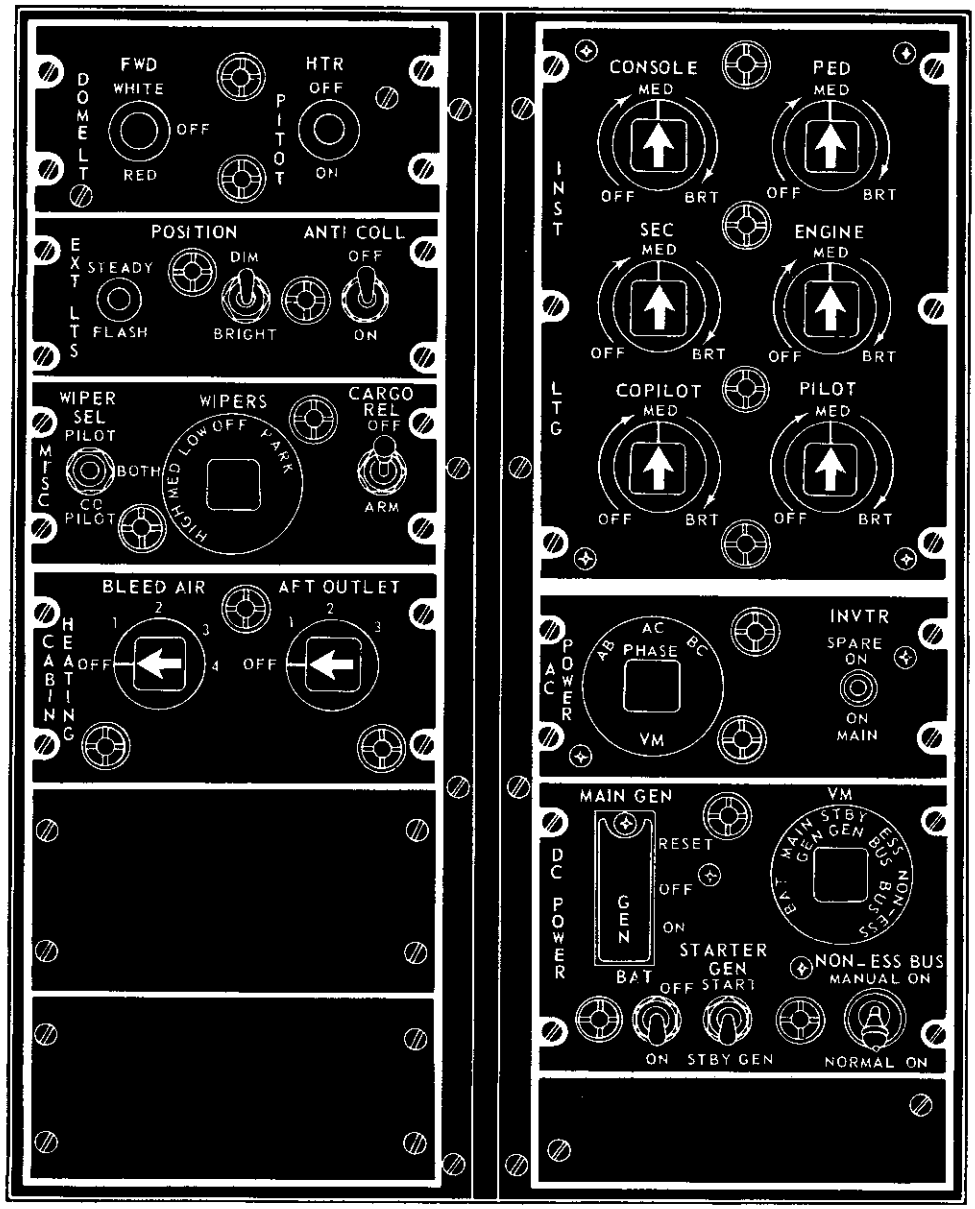

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Figure 2-10. Overhead console typical

2-124. DC POWER CONTROL PANEL. The DC POWER control panel (8, figure 2-10) is located on the overhead console. The DC POWER control panel consists of the MAIN GEN RESET/OFF/ON switch, BAT ON/OFF switch, STARTER GEN START/STBY GEN switch, DC VM (voltmeter) selector switch, and a NON-ESS BUS MANUAL ON/NORMAL ON switch. Panel illumination is provided by three lights controlled by a switch on the instrument lights control panel (figure 2-10).

TABLE 2-3. ENGINE OIL QUANTITY TABLE

U. S. GALLONS			
NO. OF TANKS	TOTAL VOLUME	EXPANSION SPACE	NORMAL USEFUL CAPACITY
1	4.4	1.4	3.0

2-125. MAIN GENERATOR SWITCH. The main generator switch is a three-position type equipped with a guard and is located on the left area of the DC POWER control panel (figure 2-10). This switch is labeled MAIN GEN, RESET in the aft position, OFF in the center position, and ON in the forward position. The RESET position is spring-loaded to return to OFF position when released; therefore, to reset the generator the switch must be held in RESET position momentarily and then moved to the ON position.

2-126. BATTERY SWITCH. The battery switch is located on the lower left area of the DC POWER control panel below the main generator switch. This is a two-position switch labeled BAT OFF in the aft position and ON in the forward position. When the switch is placed in ON position, it closes the circuit to the actuating coil of the battery relay and 24-volt DC is then being delivered from the battery to the primary bus. When the switch is placed in OFF position, it opens the circuit to the actuating coil of the battery relay and no current is delivered from the battery.

2-127. STARTER-GENERATOR SWITCH. The starter-generator switch is located in the center area of the DC POWER control panel. This switch is a two-position type, and is labeled STARTER GEN START in the aft position, and STBY (standby) GEN in the forward position. The START position of the switch actuates the electrical circuits for starter functions of the starter-generator. The STBY GEN position actuates the generator unit of the starter-generator, and 28-volt DC is supplied to the primary bus of the helicopter's electrical system in the event of a main generator failure.

2-128. NONESSENTIAL BUS CONTROL SWITCH. The nonessential bus control switch is located in the lower area of the DC POWER control panel. This is a two-position switch labeled NON-ESS BUS, MANUAL ON in the aft position and NORMAL ON in the forward position. The function of the switch is to permit the pilot, in the event of a generator failure, to override the automatic action when the nonessential bus is dropped by the electrical system's bus control relay and nonessential bus relay. Moving switch to MANUAL ON overrides the action of the bus control relay and nonessential bus. Normally the switch will be positioned forward to NORMAL ON.

2-129. DIRECT CURRENT VOLTMETER SELECTOR SWITCH. The direct current voltmeter selector switch is located in the upper right-hand area of the DC POWER control panel. The switch can be easily identified by the VM label on panel face. This switch functions to monitor voltage being delivered from any

TABLE 2-4. FUEL QUANTITY TABLE

U.S. GALLONS AND POUNDS		
NO. OF TANKS	NORMAL SERVICING	MAXIMUM CAPACITY AND/OR SPILL OVER LEVEL
5	220 Gallons 1430 Pounds	224 Gallons 1455 Pounds

NOTES:
1. To convert gallons of fuel to pounds, multiply gallons by 6.5 (For JP-5, multiply by 6.76)
2. JP-4 fuel density 6.5 pounds/one gallon (JP-5 fuel, 6.76) based on standard day conditions: 59°C (15°C), 29.92 inches Hg, dry air.
3. Gasoline density is 6.0 pounds/one gallon.

of the following: BAT, MAIN GEN, STBY GEN, ESS BUS, and NON-ESS BUS. The switch is actuated by means of a knob permitting the selection of any one of the five positions. Voltage will be indicated on the DC voltmeter.

2-130. DIRECT CURRENT VOLTMETER. The direct current voltmeter (29, figure 2-5) is mounted in the center area of the instrument panel and is labeled VOLT DC. Generator voltage output is indicated by this instrument. Voltage indications will not be shown when the generator is not furnishing electrical power because the direct current voltmeter is connected to the generator side of the reverse current relay.

2-131. DIRECT CURRENT LOADMETERS - MAIN AND STANDBY. Two direct current loadmeters are mounted in the lower center area of the instrument panel (28 and 35, figure 2-5). One is labeled MAIN GEN and indicates the percentage of total electrical system amperage being used by the helicopter's electrical system when main generator is operating The other loadmeter is labeled STBY GEN and indicates the percentage of total electrical system amperage being used by the helicopter's electrical system when standby generator is operating. Loadmeters will not indicate this percentage when the generators are inoperative.

2-132. ALTERNATING CURRENT POWER SUPPLY SYSTEM.

2-133. The alternating current is supplied by two 250 volt-ampere, three-phase inverters (main and spare) which convert the 28-volt DC to 115-volt AC. The main and spare inverters are interchangeable in power output. Selection control, MAIN ON/OFF and SPARE ON, is accomplished from the AC POWER control panel (figure 2-10). Either inverter (at pilot's option) will supply 115-volt AC to attitude indicator system, AC failure relay, fuel quantity indicator and tank units, gyro magnetic compass system, and the 28-volt AC transfomer. The 28-volt AC transformer, in turn, supplied 28-volt AC to the following: torque pressure transmitter and torquemeter, transmission oil pressure transmitter and indicator, engine oil pressure transmitter and indicator, and fuel pressure transmitter and indicator, and the course indicator.

2-134. ALTERNATING CURRENT POWER CONTROL. Alternating current power control is accomplished from the AC POWER control panel (figure 2-10).

2-135. AC POWER CONTROL PANEL. The AC POWER control panel (figure 2-10) is located on the overhead console. This panel is labeled AC POWER and contains the inverter (INVTR MAIN ON/SPARE ON) switch, the AC voltmeter (AC VM) selector switch, and two panel lights.

2-136. INVERTER SWITCH - MAIN AND SPARE. The inverter switch, labeled INVTR, is located on the AC POWER control panel (figure 2-10). This is a three-position switch labeled SPARE ON/OFF/MAIN ON. For normal flight the inverter switch is in the MAIN ON position. The SPARE ON position is used to put the spare inverter into operation in the event of a main inverter failure. Inverter switch is supplied power by the 28-volt DC essential bus. Circuit protection is provided by the INVTR CONT circuit breaker (figure 2-11).

2-137. AC VOLTMETER SELECTOR SWITCH. The AC VM voltmeter selector switch is located on the left half of the AC POWER control panel (figure 2-10). The rotatable switch can easily be identified by the VM label on the round switch dial. The switch is used to monitor voltage between any of the three phases of the 115-volt alternating current electrical system. Actuation of switch is accomplished by a knob which has three (phase monitoring) positions labeled: AB, AC, and BC. When the selector switch is in AB position, the voltage indicated on instrument panel-mounted AC voltmeter is the voltage between phases A and B. In like manner with selector switch in AC position, the voltage indicated on voltmeter is the voltage between phases A and C; with selector switch in BC position, the voltage indicated on voltmeter is the voltage between phases B and C.

2-138. ALTERNATING CURRENT VOLTMETER. The AC voltmeter is mounted in the central area of the instrument panel directly under the DC voltmeter (36, figure 2-5). The alternating current voltage output from the inverter (main or spare) is indicated on this instrument. The voltage indicated between any two of the three selected positions (phases) should be 115 (plus or minus 3.0) volts AC.

2-139. CIRCUIT BREAKER PANELS.

2-140. Two circuit breaker panels are provided consisting of a direct current circuit breaker panel and an alternating current circuit breaker panel.

2-141. DC CIRCUIT BREAKER PANEL. The direct current circuit breaker panel is located on the overhead console within easy reach of the pilot's and co-pilot's positions (figure 2-11). Each individual breaker is clearly labeled for the particular electrical circuit protected. In the event a circuit is overloaded, the circuit breaker protecting that circuit will pop out, de-energizing the circuit. The circuit is reset or actuated by pushing the circuit breaker in.

2-142. AC CIRCUIT BREAKER PANEL. The alternating current circuit breaker panel is located on the right-hand side of the pedestal base, visible and within easy reach of the pilot (figure 2-12). The upper and center panel plate, labeled AC 115V contains the circuit breakers which provide the circuit protection for the 115-volt AC electrical circuits. The lower panel plate, labeled AC 28V, contains the circuit breakers which provide circuit protection for the 28-volt AC

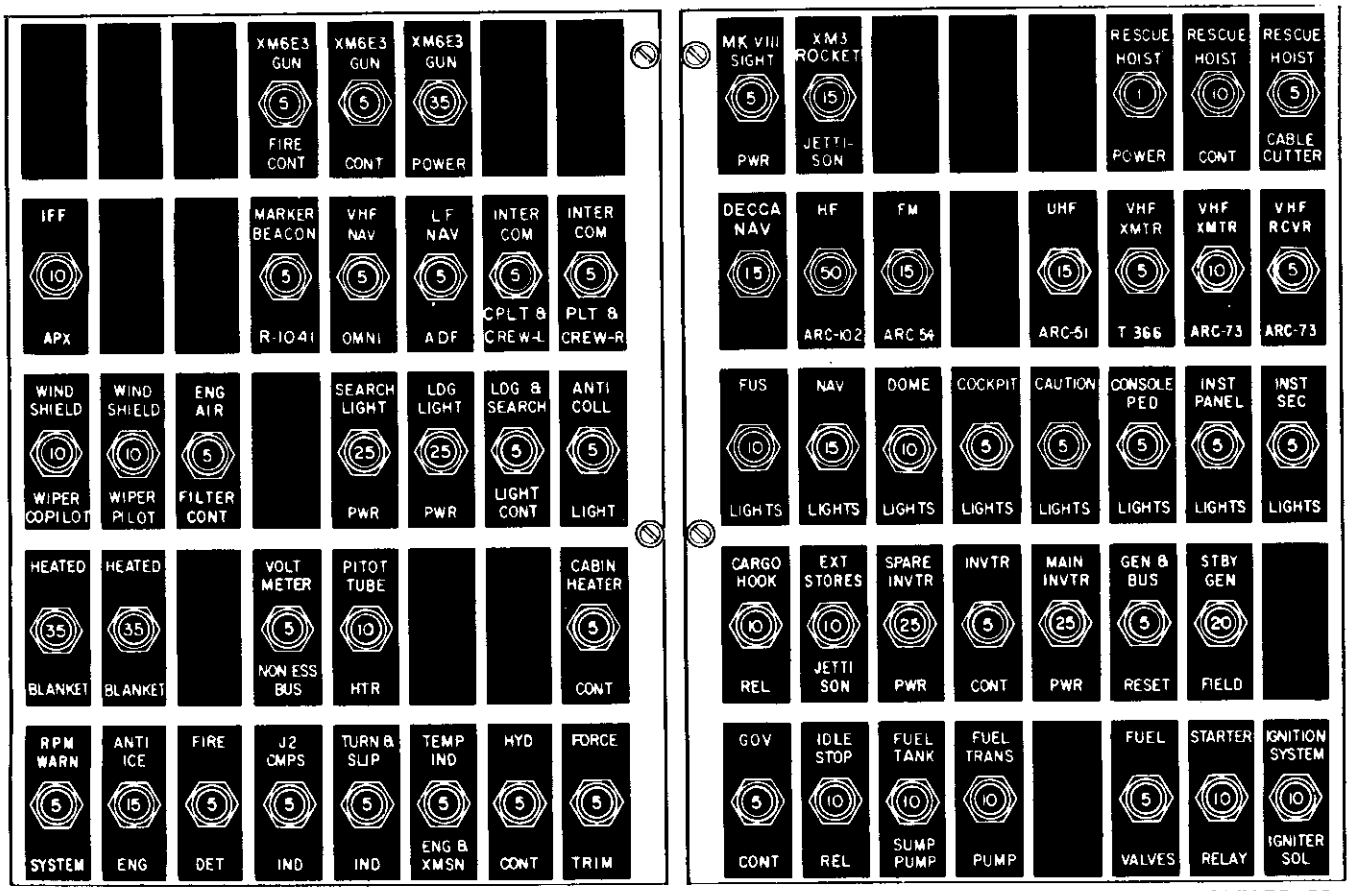

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Figure 2-11. DC circuit breaker panel - typical

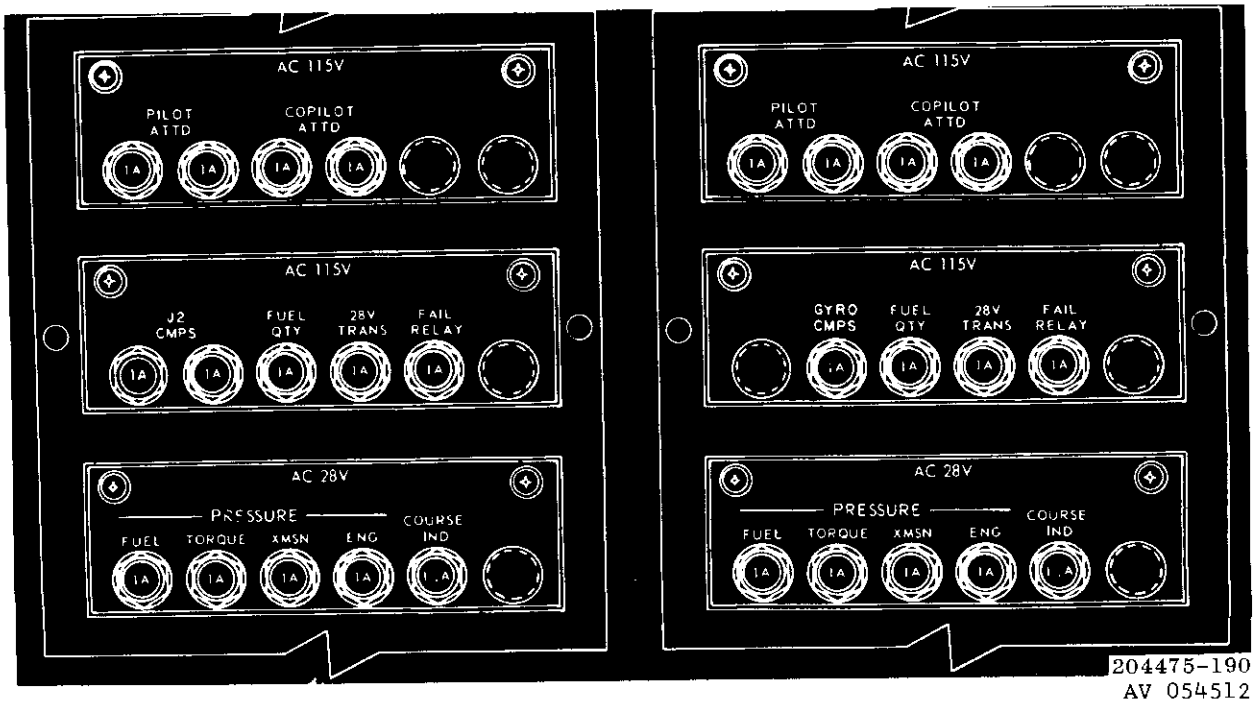

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Figure 2-12. AC circuit breaker panel - typical

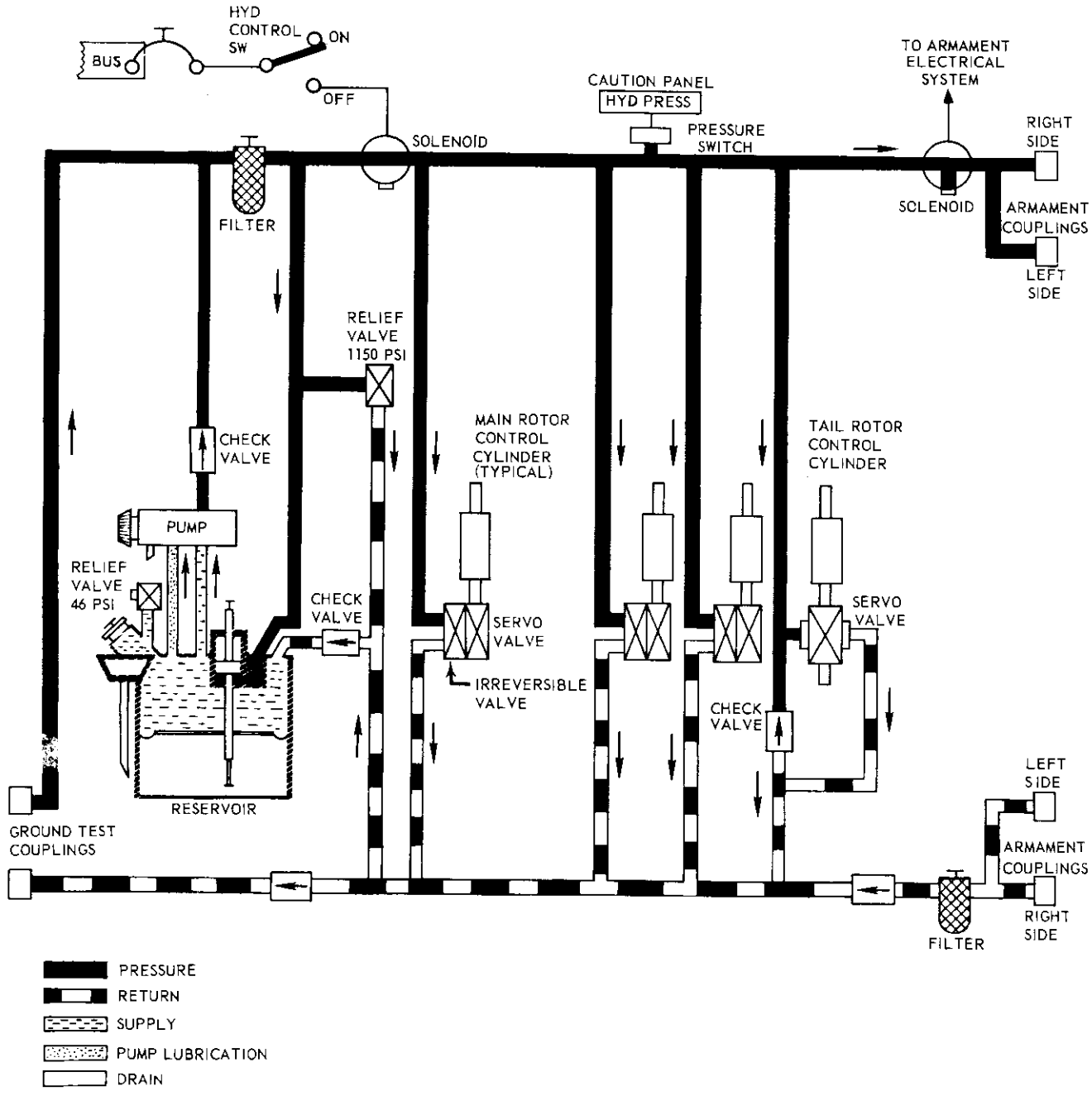

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Figure 2-13. Hydraulic system schematic (Sheet 1 of 2)

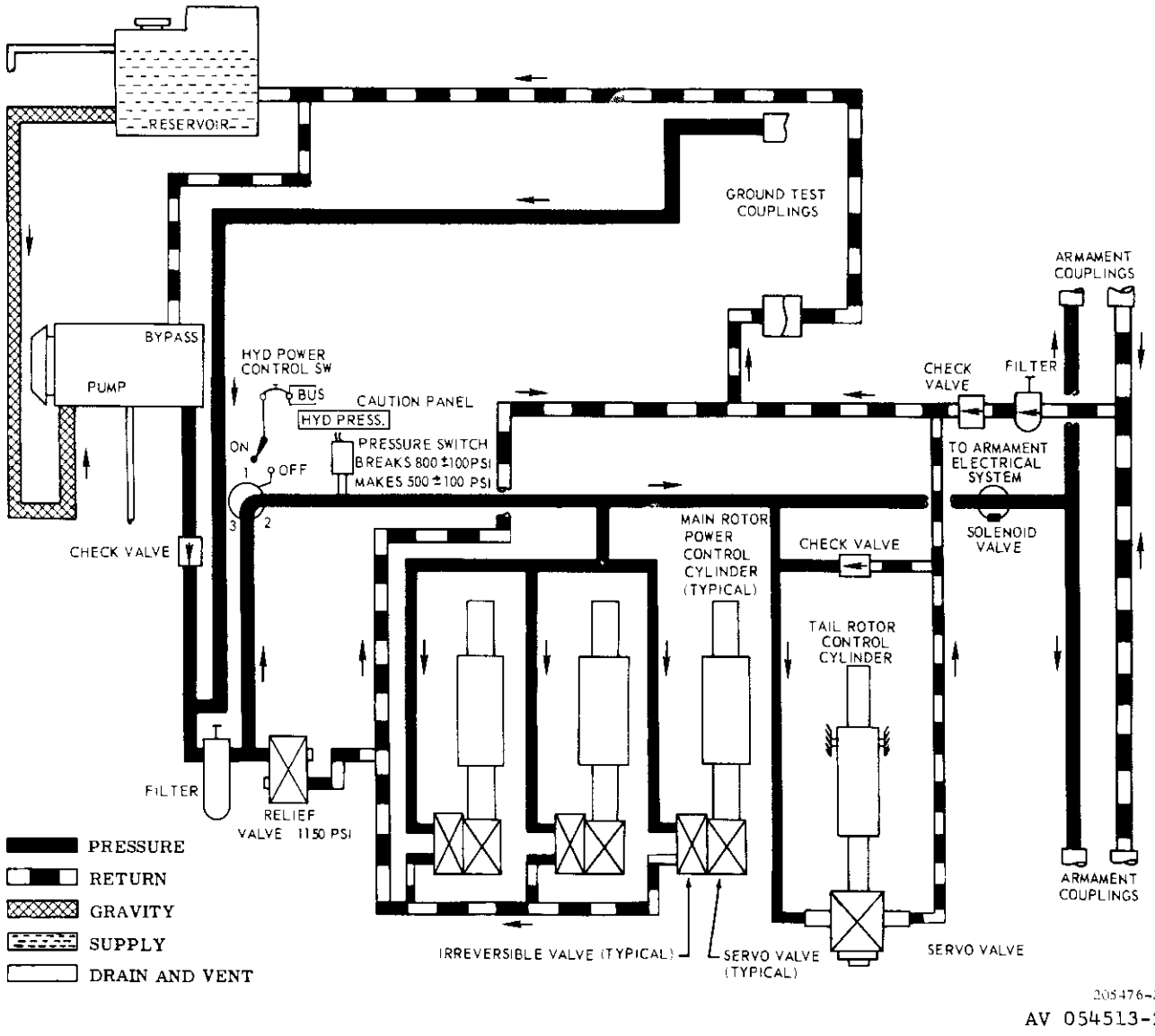


Figure 2-13. Hydraulic system schematic (Sheet 2 of 2)

electrical circuits. In the event a circuit is overloaded, the circuit breaker protecting that particular circuit will pop out, de-energizing the circuit. The circuit is reset or actuated by pushing the circuit breaker in.

2-143. EXTERNAL POWER RECEPTACLE.

2-144. The external power receptacle is located on the left side of the helicopter's fuselage, aft of cabin bulkhead (18, figure 2-1). When the 28-volt DC auxiliary power unit plug is securely inserted in the receptacle, the external power relay in the helicopter's electrical system is energized and 28-volt DC electrical power is supplied to the primary bus for distribution. When external power is connected or the receptacle door is left open, the EXTERNAL POWER caution light on the CAUTION panel will illuminate.

Note

The battery switch shall be in OFF position when APU is being used. Reverse polarity between helicopter's electrical system and APU can occur.

2-145. HYDRAULIC POWER SUPPLY SYSTEM.

2-146. The hydraulic power supply system (figure 2-13) consists of the variable output hydraulic pump, power cylinders, irreversible valves, relief and check valves, a solenoid valve, a system filter, a vent filter,

"boot strap" reservoir, bleed air valve, pressure switch, ground test couplings and connecting hardware. The hydraulic pump is mounted on and driven by the transmission and supplies pressure to the power cylinders and to the boot strap reservoir when this type reservoir is installed.

Note

Helicopters with serial Nos. 65-9565 and subsequent have a gravity feed reservoir which is not under pressure and feeds the hydraulic fluid to pump by gravity.

2-147. The power cylinders in turn are connected into the mechanical linkage of the helicopter's flight control system. The irreversible valves are installed on the cyclic and collective power cylinders to prevent main rotor feedback in the event of a hydraulic system malfunction. The pressure required for system operation is preset to supply demand. This system, for all practical purposes is considered to be a closed type; therefore, a pressure gage is not provided or required. Low hydraulic system pressure will be indicated by the illumination of HYD PRESSURE light on the CAUTION panel (figure 2-14), and moderate feedback forces will be noticed by the pilot as soon as the servo valve is moved off center by the controls.

2-148. HYDRAULIC RESERVOIR.

2-149. The hydraulic reservoir in this installation is a rolling diaphragm type. This reservoir is under pressure when the hydraulic pump is in operation and acts as an accumulator to maintain a constant system pressure to give immediate response to slight control movements. The reservoir is visible for inspection and accessible for refilling by removing a plastic window mounted in the cabin wall (4, figure 2-16).

Note

The hydraulic reservoir installed in helicopters serial Nos. 65-9565 and subsequent is a gravity feed type. The reservoir is located at the right aft edge of the cabin roof. A sight gage on the reservoir can be seen through an opening (indicates "Full and Refill" requirements) in the transmission fairing.

2-150. FLIGHT CONTROL SERVO UNITS.

2-151. The hydraulic servo system reduces the operational loads of the helicopter's cyclic, collective and directional control system (figure 2-13). Movement of the controls in any direction causes a power cylinder valve, in appropriate system, to open and admit hydraulic pressure which actuates the cylinder, thereby reducing the force-load required for control movement.

2-152. HYDRAULIC SYSTEM CONTROL SWITCH.

2-153. The hydraulic control switch is located on a pedestal-mounted panel (figure 2-3). This switch is a two-position toggle type labeled HYD CONTROL ON/OFF. When the switch is in the ON position, the solenoid valve opens and pressure is supplied to the servo system. When switch is in the OFF position, the solenoid valve is closed and hydraulic fluid is circulated between the pump and reservoir; thus no pressure is supplied to the servo system. Electrical power for hydraulic system control is supplied by the 28-volt DC essential bus, and circuit is protected by HYD CONT circuit breaker on the DC circuit breaker panel (figure 2-11).

2-154. HYDRAULIC SYSTEM - INDICATORS.

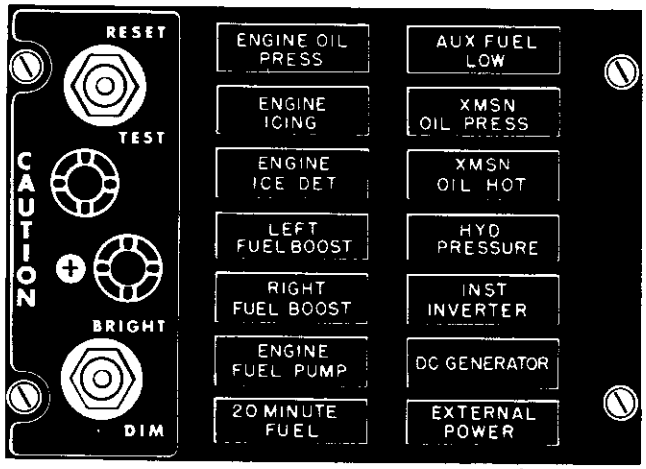
2-155. The hydraulic power supply system is provided with a hydraulic fluid level indicator and a low hydraulic pressure warning light.

2-156. HYDRAULIC FLUID LEVEL INDICATOR. The hydraulic reservoir contains a fluid level indicator rod, easily seen from inside the cabin. The rod is marked REFILL at the point when fluid is low, indicating that the hydraulic reservoir needs refilling.

2-157. LOW HYDRAULIC PRESSURE WARNING LIGHT. The low hydraulic pressure warning light is located on the pedestal-mounted CAUTION panel (figure 2-14). When illuminated, the segment wording reads HYD PRESSURE to provide the pilot with visual indication of a low hydraulic pressure condition. The light is wired in conjunction with the master caution indicator light located on the upper center area of the instrument panel (figure 2-5). Electrical power for the low hydraulic pressure warning light and master caution indicator light is supplied by the 28-volt DC essential bus. Circuit protection is provided by the CAUTION LIGHTS circuit breaker on the DC circuit breaker panel (figure 2-11).

2-158. IMPROVED HYDRAULIC OIL FILTERING SYSTEM - RETROFIT KIT.

2-159. The improved hydraulic oil filtering system eliminates the problem of system contamination once the element becomes clogged. However, the filter assembly incorporates an integral non-electrical device that will give visual warning by raising a red indicator when the differential pressure across the element exceeds 70 plus or minus 10 psi. Once actuated, the indicator will remain extended until reset manually. When the indicator is in reset position, it will be hidden from view. The indicator will not actuate below 35° plus or minus 15°F fluid temperature. An inspection window is provided to permit ready visual access to the filter indicator. The transparent window is located in the sheet metal structure above the access door on forward face of the cabin island.



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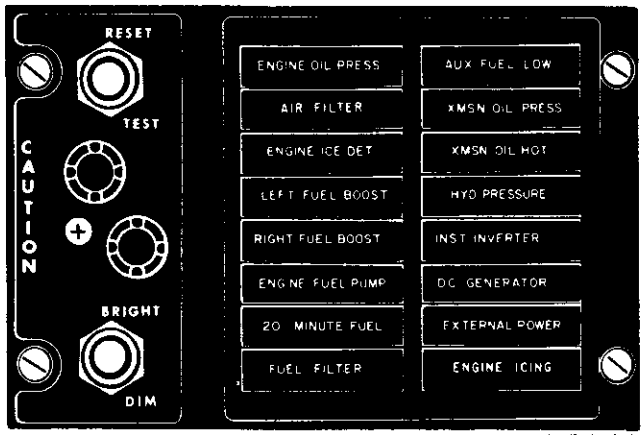

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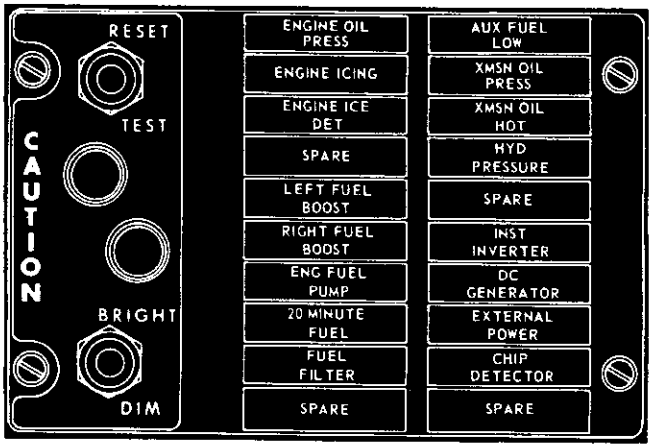

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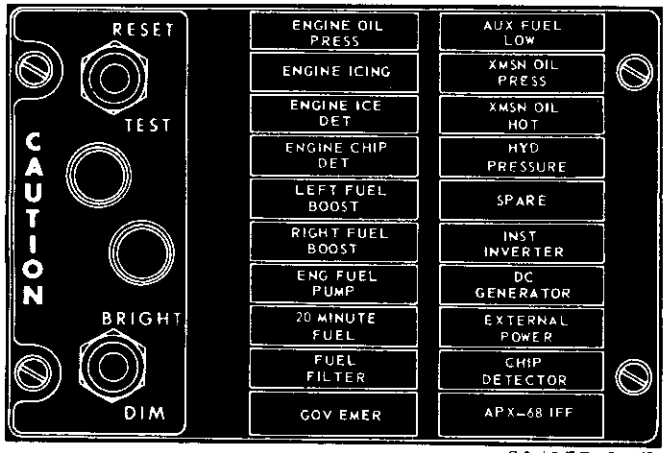

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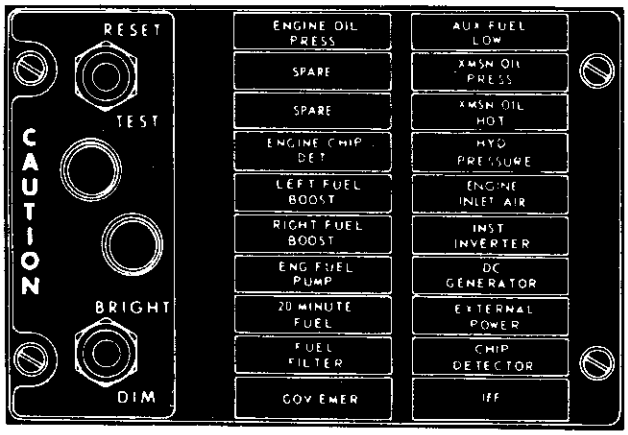

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Figure 2-14. Caution panel - typical

2-160. FLIGHT CONTROL SYSTEM.

2-161. The flight control system is a positive mechanical type, actuated by conventional helicopter controls which, when moved, direct the helicopter in various modes of flight. The system includes a cyclic control stick, used for fore and aft and lateral control; the collective pitch (main rotor) control lever, used for vertical control; tail rotor (directional) control pedals, used for heading control; and a synchronized elevator connected mechanically to the fore and aft cyclic control system to increase controlability and extend cg range.

2-162. The control forces of the flight control system are reduced to a near-zero-pounds force, to lessen pilot fatigue, by hydraulic servo cylinders which are connected to the control system mechanical linkage and powered by the transmission driven hydraulic pump. Force trims (force gradient) connected to the cyclic and directional controls are electrically operated mechanical units used to induce artificial control feeling into cyclic and directional controls and to prevent cyclic stick from moving of its own accord.

Note

Provisions are made for a full dual flight control installation for training missions.

2-163. FORCE TRIMS (FORCE GRADIENT).

2-164. 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 directional control pedals and the hydraulic servo cylinder. The devices act to furnish a force gradient or "feel" to the cyclic control stick and directional control pedals; however, these forces can be reduced to zero by depressing and releasing force trim pushbutton switch (19, figure 2-4) on top of the cyclic control stick. This gradient is accomplished by means of springs and magnetic brake release assemblies which enable the pilot to trim the controls as desired, for any condition of flight. A FORCE TRIM ON/OFF switch is installed on the hydraulic control panel (12, figure 2-3) to deactuate the force trim, if so desired.

2-165. STABILIZER BAR.

2-166. The stabilizer bar is mounted on the main rotor mast in a parallel plane above and at 90 degrees to the main rotor blades (29, figure 2-1). The bar is connected into the main rotor system in such a manner that the inherent inertia and gyroscopic action of the bar is induced into the rotor system and produces a measure of stability for all flight conditions. If while hovering in a level attitude, the helicopter attitude is disturbed, the bar, due to its gyroscopic action tends to remain in its present plane. The relative movement between the bar and mast causes the hub and blade assembly to feather and return the main rotor to its original plane of rotation. Due to a restraining and damping action, the bar posses a mast-following characteristic. The following time is regulated by two hydraulic dampers connected to the bar in such a manner that a movement of the mast is transmitted to the bar through dampers at a rate determined by the adjustment of the dampers. A compromise is met in which the bar provides the desired amount of stability and still allows the pilot complete responsive control of the helicopter. The dampers are cam-actuated to increase damping as the stabilizer bar becomes displaced.

2-167. CYCLIC PITCH CONTROL STICK.

2-168. The cyclic pitch control stick is similar in appearance to the control stick of fixed-wing aircraft (16, figure 2-4). Movement of the stick operates the fore and aft and lateral control systems; therefore, when moved in any direction, will produce a corresponding directional movement of the helicopter which is the result of a change in the plane of rotation of the main rotor. Cyclic stick fore and aft movement changes the synchronized elevator attitude by means of mechanical linkage and connecting control tubes. The pilot's cyclic stick grip contains the cargo release switch, a trigger-type two-position radio transmitter switch, armament fire control switch, and the force trim release switch. The force trim switch is located in the left top-side of the stick grip. Desired operating friction can be induced into the control stick by hand tightening the friction adjuster. The copilot's cyclic control stick, when installed, is the same as the pilot's cyclic control stick.

2-169. COLLECTIVE PITCH CONTROL LEVER.

2-170. The collective pitch control lever (see 7, figure 2-4) is located to the left of the pilot's position and controls the vertical mode of flight. When the lever is in full down position, the main rotor is in minimum pitch. When the lever is in full up position, the main rotor is in 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 hand tightening the friction adjuster (see 27, figure 2-4). A rotating grip-type throttle and a switch box assembly are located on the upper end of the collective pitch control lever. The switch box assembly contains the starter switch, governor rpm increase-decrease switch, engine idle stop release switch, and landing light and searchlight switches. A springloaded pitch lever down lock (see 9, figure 2-4) is located on the floor at the approximate center and inboard of the pitch control lever. The copilot's collective pitch control lever, when installed, contains only the rotating grip-type throttle, starter switch, and governor rpm increase-decrease switch.

Note

The copilot's collective pitch control lever installed in helicopters serial Nos. 68-15214 through 68-15766 have not been provided with a starter switch.

Note

The collective pitch control system has a built-in breakaway force to move the stick up from the neutral (center of travel) position of eight to ten pounds with boost ON.

2-171. TAIL ROTOR PITCH CONTROL PEDALS.

2-172. The directional (tail rotor pitch) control pedals (see 14, figure 2-4) are similar to and react in the same manner as fixed-wing aircraft rudder pedals. The pedals (through push-pull tubes, bellcranks, quadrant, cables and pulleys, and chain and sprocket) alter the pitch of the tail rotor blades; and thereby provide the means of directional control. This literally allows the helicopter to be pivoted about its own vertical axis at slow or zero airspeeds. Pedal adjusters are located below the floor aft of the cyclic control sticks and forward of the pilot and copilot positions. Adjuster knobs (see 11, figure 2-4) extend above the floor to enable adjustment of pedal distance for individual comfort. The force trim system is connected to the directional controls and is operated by the force trim switch on the cyclic control stick grip. The copilot's directional control pedals, when installed, are identical to the pilot's pedals.

2-173. SYNCHRONIZED ELEVATOR.

2-174. The synchronized elevator (see 14, figure 2-1) is located near the aft end of the tail boom and is connected by control tubes and mechanical linkage to the fore and aft cyclic control system. Fore and aft movement of the cyclic control stick produces a change in the synchronized elevator attitude, thus increasing controllability and lengthening cg range.

2-175. LANDING GEAR SYSTEM.

2-176. The helicopter's landing gear system is a skid type consisting of two laterally mounted arched cross-tubes attached to two formed longitudinal skid tubes. The landing gear structure members are made from formed aluminum alloy tubing with full length steel skid shoes to minimize skid wear. The gear assembly is attached with clamps at four points of the fuselage structure; therefore, gear removal for maintenance can be easily accomplished. Two manually retractable and quickly removable wheel assemblies have been provided to facilitate helicopter ground handling operations.

2-177. TAIL SKID.

2-178. A tubular steel tail skid is attached to the lower aft section of the tail boom assembly and acts as a warning to the pilot upon an inadvertent tail-low landing.

2-179. FLIGHT INSTRUMENTS.

2-180. The flight instruments installed in the helicopter consist of the pilot's and copilot's airspeed indicators, turn and slip indicator, vertical velocity indicator, altimeter, and the pilot's and copilot's attitude indicators.

2-181. AIRSPEED INDICATORS.

2-182. Two airspeed indicators (10, figure 2-5) have been provided; one is mounted on the pilot's section of the instrument panel and the other is mounted on the copilot's section of the instrument panel. The single-scale indicators are calibrated in knots and provide an indicated airspeed of the helicopter at any time during flight, by measuring the difference between impact air pressure from the pilot tube and the static vent. The pitot tube is mounted on the left metal nose section of the cabin. Static air pressure for instrument operation is derived from the two static vents located in the side cabin skins near the forward edges of the crew doors.

2-183. TURN AND SLIP INDICATOR.

2-184. The turn and slip indicator (4 MIN TURN) (39, figure 2-5) is controlled by an electrically actuated gyro. The instrument has a needle (turn indicator) and a ball (slip indicator). Although the needle and ball are combined in one instrument and are normally read and interpreted together, each has its own specific function and operates independently of the other. The ball indicates when the helicopter is in directional balance, either in a turn or in straight and level flight. In the event of yawing or slipping by the helicopter, the ball will be off center. The needle indicates in which direction and at what rate the helicopter is turning. The electrical circuit is supplied power by the 28-volt DC essential bus and is protected by TURN & SLIP IND circuit breaker on the DC circuit breaker panel (figure 2-11).

2-185. VERTICAL VELOCITY INDICATOR.

2-186. Two vertical velocity (rate of climb) indicators (21, figure 2-5) (one for pilot and one for copilot) are front-mounted on the instrument panel. These indicators register ascent and descent of the helicopter in feet per minute. The instruments are actuated by the rate of atmospheric pressure change and are vented to the static air system.

2-187. ALTIMETER.

2-188. The altimeter (ALT) furnishes direct readings of height above sea level and is actuated by the pitot static system. Two altimeters are provided, one for the pilot and one for the copilot. Integral lighting, operated by 28-volt DC from the essential bus, is incorporated in the indicator.

2-189. PILOT'S ATTITUDE INDICATOR.

2-190. The pilot's attitude indicator is located on the pilot's section of the instrument panel (see 11, figure 2-5). This indicator provides the pilot with a visual indication of the pitch and roll attitude of the helicopter in relation to the earth's horizontal plane. The attitude indicator system is operated by three-phase 115-volt AC electrical power, supplied by the inverter, and is protected by PILOT ATTD circuit breakers on the AC circuit breaker panel (figure 2-12). Integral lighting, operated by 28-volt DC from the essential bus, is incorporated in the indicator. An OFF warning flag in the indicator is exposed with electrical power is removed from the system; however, the OFF flag will not indicate internal system failure which may occur in the control or indicator. The flag disappears approximately two minutes after electrical power is supplied to the control.

2-191. The attitude indicator has been specifically designed for the flight characteristics of helicopters by incorporating an electrical trim in the roll axis in addition to the standard pitch trim. Degrees of pitch and roll are indicated by a universally mounted sphere. The horizon is represented as a white bar on the sphere; horizontal markings indicate the degree of dive or climb; while bank (roll) angles are read from the semicircular scale located on the upper half of the indicator face.

2-192. The pitch trim knob, located on the lower right corner of the indicator, is adjusted to center the horizon on the indicator sphere with the minature airplane with regard to the normal flight attitude of the helicopter. The roll trim knob, on the indicator case, is adjusted to align the vertical axis of the sphere with the center mark on the roll (bank) indicator in regard to normal flight attitude of the helicopter.

2-193. COPILOT'S ATTITUDE INDICATOR.

2-194. The copilot's attitude indicator(11,figure 2-5) is located on the copilot's section of the instrument panel, and is operated by three-phase 115-volt AC electrical power supplied by the inverter. The gyro is enclosed in a sphere, a portion of which is visible through the opening in the face of the instrument. The indicator provides the copilot with a visual indicator of the pitch and roll flight attitude of the helicopter in relation to the earth's horizontal plane. Relative motion of the helicopter is indicated on the face of the instrument by movement of the horizon bar with relation to the adjustable miniature airplane in the center of the dial. 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's 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.

Caution

Caging of the copilot's (J-8) gyro attitude indicator should be kept to a minimum, and shall never be accomplished in flight, except when the helicopter is in straight and level flight by visual reference to a true horizon. The caging knob shall never be pulled violently.

2-195. STANDBY COMPASS.

2-196. A standard magnetic type compass is mounted in a bracket at the center right-hand edge of the instrument panel (26, figure 2-5). A compass correction card, located in a card holder above the compass, is provided for the pilot's use in conjunction with the magnetic compass (13, figure 2-5).

2-197. MISCELLANEOUS INSTRUMENTS AND INDICATORS.

2-198. Instruments and indicators that are independent or linked with more than one system consist of the freeair temperature indicator, master caution system and rpm high-low limit warning system.

2-199. FREE-AIR TEMPERATURE INDICATOR.

2-200. The bi-metal free-air temperature indicator is located above the instrument panel and in the approximate upper center area of the windshield. The indicator provides a direct reading of the outside air temperature.

2-201. MASTER CAUTION SYSTEM.

2-202. The master caution system consists of a remote master caution indicator light and a warning caution panel. The caution panel, located on the pilot's side of the pedestal, displays condition-indicating lights which caution the pilot of system malfunctions or conditions which require mandatory action. The panel includes the lights and circuits necessary to test, reset, and dim the lamp circuits. The test switch does not test the condition-indicating circuits. When the test switch is held in the TEST position, all lamps should be illuminated, including the master caution light. The panel test switch verifies that the panel lamps are not burned out. The test switch also has a momentary RESET position. This position is used to extinguish the master caution light after a single fault condition (such as AUX FUEL LOW) is noted and the necessary

action is taken. Each additional fault or condition will again illuminate the master caution light, and each time the light may be extinguished or reset to indicate the next condition should another one occur. The reset function does not extinguish the individual caution panel lights. The lights, and the master caution light, may be dimmed, however, by momentarily moving the BRIGHT/DIM switch on the caution panel to DIM. This momentary action energizes a holding relay and dims all lights until one of three actions occurs: The dimming relay will drop out only if (1) the BRIGHT/DIM switch is moved momentarily to BRIGHT (2) the pilot's instrument lights are extinguished by rotating the rheostat to OFF, or (3) a loss of power from the essential DC power bus occurs. The dimming circuit is disabled when the pilot's instrument lights are OFF; however, if all other circuits are in and connected, the caution panel will function normally.

2-203. MASTER CAUTION INDICATOR LIGHT. The master caution indicator light is located at the top center of the instrument panel (4, figure 2-5). When this light illuminates, the pilot is alerted to check the CAUTION panel (figure 2-14) for the fault condition or conditions that have occurred.

2-204. CAUTION PANEL. The CAUTION panel(figure 2-14) is mounted in the instrument pedestal. When illuminated, the worded segment lettering in the panel will be aviation yellow; however, when not illuminated, segment lettering will not be visible. This panel functions to provide the pilot visual indications (day or night) of the fault conditions as follows:

FAULT CONDITION	CAUTION PANEL SEGMENT
Engine Oil Pressure Low	ENGINE OIL PRESS
Metal Particles Present in Engine	ENGINE CHIP DET
Engine Icing Detected	ENGINE ICING
Engine Ice Detector Disarmed	ENGINE ICE DET.
Left Fuel Boost Pump Inoperative	LEFT FUEL BOOST
Right Fuel Boost Pump OFF	RIGHT FUEL BOOST
Engine Fuel Pump Inoperative	ENGINE FUEL PUMP
Fuel Quantity Low	20 MINUTE FUEL
Auxiliary Fuel Tank Empty	AUX FUEL LOW
Transmission Oil Pressure Low	XMSN OIL PRESS
Transmission Oil Temperature High	XMSN OIL HOT
Hydraulic Pressure Low	HYD PRESSURE
AC Bus Failure (Inverter Failure)	INST INVERTER
DC Generator Failure	DC GENERATOR
External Power Connected or Receptical Door Open	EXTERNAL POWER
Fuel Filter Clogged	FUEL FILTER
Engine air Filter Clogged	AIR FILTER
Metal Particles Present in 42° or 90° Gearbox or Main Transmission	CHIP DETECTOR
Emergency Fuel Control	GOV EMER
IFF System Inoperative	AN/APX-68

Note

IFF panel segment is only for the AN/APX-68. Failure of AN/APX-44 system, when installed, will not actuate the light.

2-205. RPM HIGH-LOW LIMIT WARNING SYSTEM.

2-206. The rpm high-low limit warning system provides the pilot with an immediate warning of high or low rotor rpm or low 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 function when the following rpm conditions exist:

Warning light only	For rotor rpm of 335 (plus or minus 5). (High Warning)
Warning light and audio warning signal in combination	For rotor rpm of 295 (plus or minus 5) or engine rpm of 6000 (plus or minus 100) or both. (Low Warning)

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.

The rotor tachometer generator and power turbine tachometer both send signals to the high-low rpm warning light and audio warning circuits. When the combination warning light and audio signals are 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-volt DC essential bus. Circuit protection is provided by a circuit breaker on the auxiliary circuit breaker panel.

2-207. LIGHT - HIGH-LOW LIMIT RPM WARNING. The high-low warning light is located on the upper left-hand area of the instrument panel. This light illuminates to provide a visual warning of low rotor rpm, low engine rpm, or high rotor rpm.

2-208. SWITCH - LOW RPM AUDIO/OFF. The LOW RPM AUDIO/OFF switch is on the engine control panel (5, figure 2-3). When the OFF position, the switch prevents 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. 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 AUTIO position when normal operating range is reached.

2-209. EMERGENCY EQUIPMENT.

2-210. The emergency equipment consists of the fire extinguisher, first aid kits, and fire detector warning system.

2-211. FIRE EXTINGUISHER.

2-212. A portable hand-operated fire extinguisher (Federal Supply Classification No. 4210) is carried in a bracket located at the right side of the pilot's seat. (See figure 4-3.)

2-213. FIRST AID KITS.

2-214. Four aeronautical type first aid kits (Federal Supply Classification No. 6545) have been provided in the cabin area. Two kits are secured to the lower area of the right-hand center door post and the other two kits are secured to the lower area of the left-hand door post. (See figure 4-3.) The first aid kit can be easily removed for immediate use.

2-215. FIRE DETECTOR WARNING SYSTEM.

2-216. The fire detector warning system consists of a right-hand engine cowl fire detection element, a left-hand engine cowl fire detection element, a fire detection control unit, a fire detector test switch, and a fire warning light. The fire detector elements are strategically placed around the engine and attached to the engine cowling. Excessive heat from the engine compartment causes illumination of the FIRE light located on the upper right section of the instrument panel (1, figure 4-3). This light and the other fire detector warning system units are supplied power by the 28-volt DC essential bus. The press-to-test (FIRE DETECTOR TEST) test switch is located to the left of the fire warning light (1, figure 4-3). When the test switch is depressed, the fire detector elements are connected in series and the far end is grounded, causing the fire light to illuminate.

2-217. PILOT'S AND COPILOT'S DOORS.

2-218. The pilot's and copilot's entrance doors (1, figure 2-4) are formed aluminum frames with transparent plastic windows in the upper section. Ventilation is supplied by sliding panels in the windows. Cam-type door latches are used and doors are equipped with jettisonable door releases to allow release in flight.

2-219. CARGO-PASSENGER DOORS.

2-220. The two cargo-passenger doors are formed aluminum frames with transparent plastic windows in the upper section (19, figure 2-1). These doors are on rollers and slide aft to the open position allowing access to the cargo area.

2-221. HINGE DOOR POST PANELS.

2-222. The door post panels forward of the cargo door are hinged to provide a larger entrance to the cargo-passenger area. These panels are formed aluminum frames with transparent plastic windows in the upper panel area. The panels may be quickly removed by removing the special hinge pins.

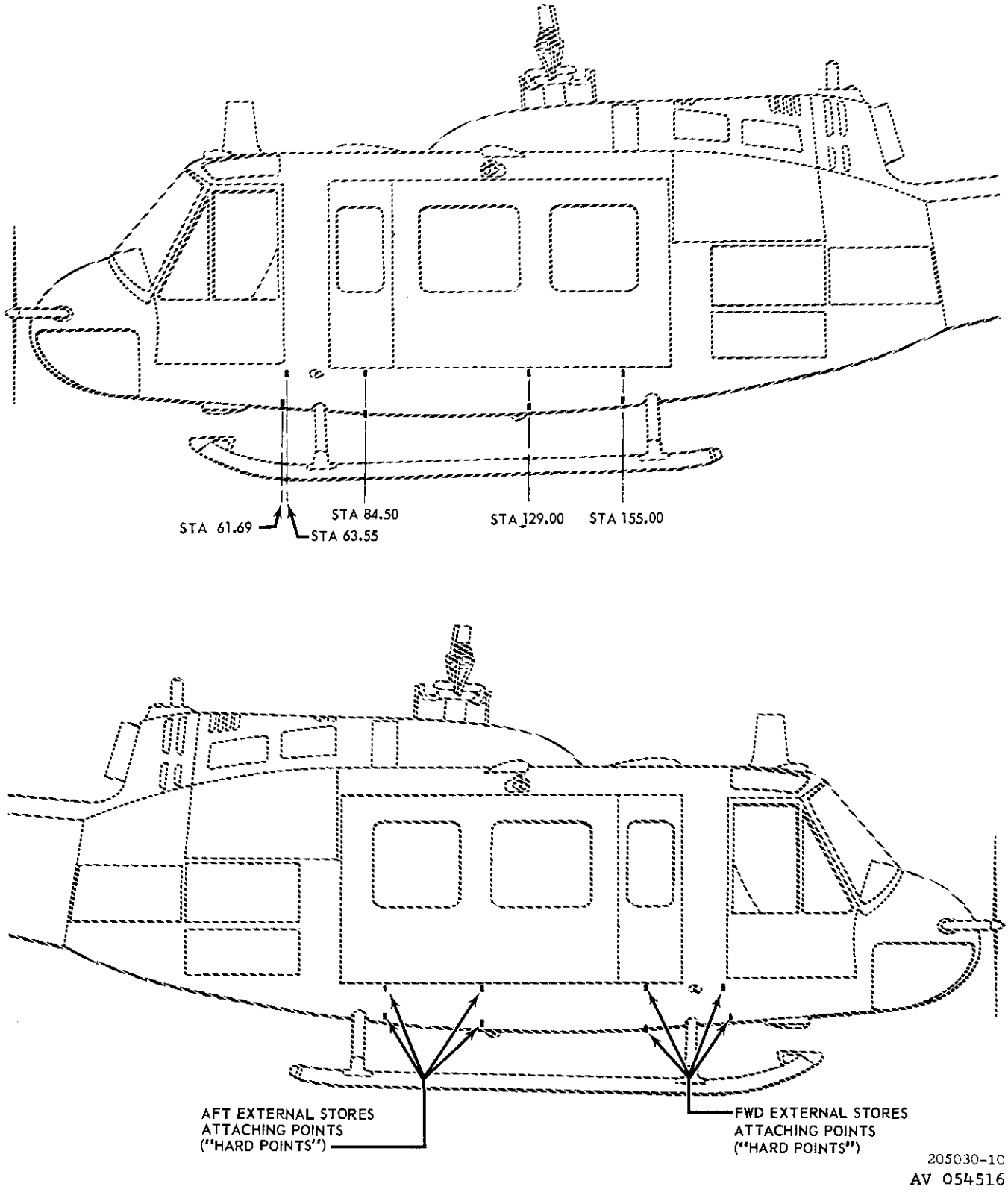
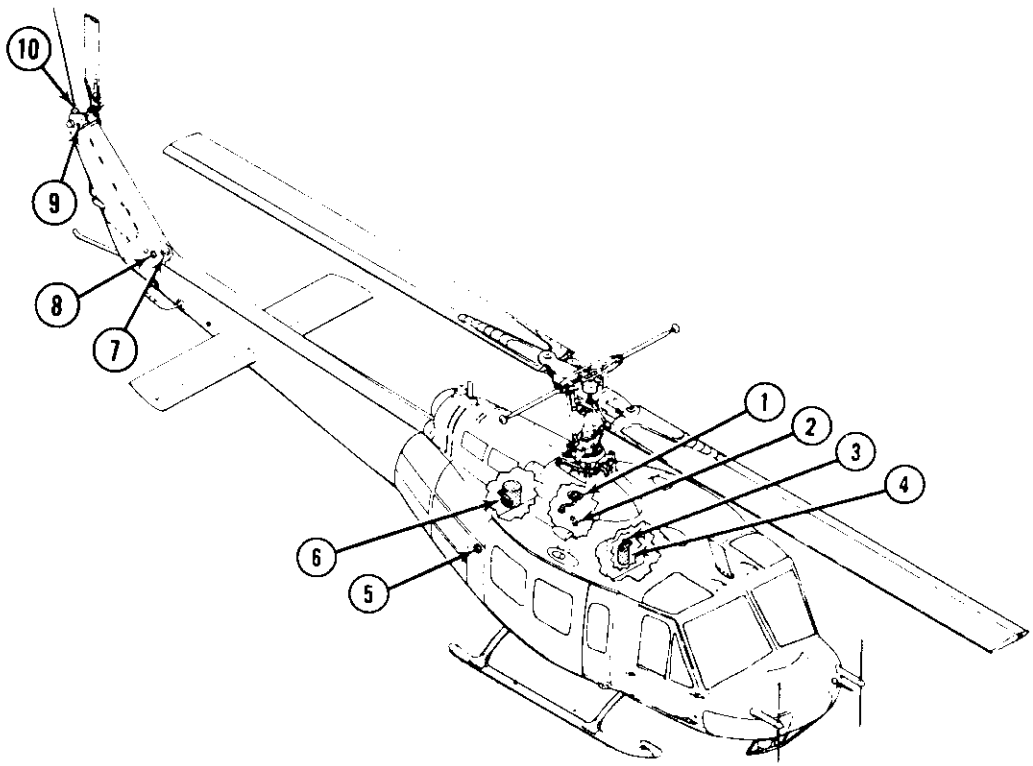


Figure 2-15. Hard point location



1. Transmission Oil Filler
2. Transmission Oil Level Sight Gage
3. Hydraulic Fluid Level Sight Gage
4. Hydraulic Fluid Reservoir
5. Fuel Filler
6. Engine Oil Tank
7. Tail Rotor Intermediate Gear Box Oil Filler
8. Tail Rotor Intermediate Gear Box Oil Level Sight Gage
9. Tail Rotor Gear Box Oil Level Sight Gage
10. Tail Rotor Gear Box Oil Filler

NOTE: Maximum oil consumption for the T53-L-9, -9A, -11 series, -13 engines is 0.3 gallon per hour (2.4 pints).

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Figure 2-16. Servicing diagram (Sheet 1 of 2)

SPECIFICATIONS AND CAPACITIES

ENGINE FUEL -- MIL-J-5624 Grade JP-4
ALTERNATE — Grade JP-5
(T53-L-11 series engines)
Capacity 220 U.S. Gals.

ENGINE OIL — MIL-L-7808 or MIL-L-23699*
Capacity 3.0 U.S. Gals.

The following EMERGENCY fuels may be used in accordance with TB 55-9150-200-25.

(a) Unleaded Gasoline (white gasoline)
(b) MIL-G-5572, Aviation Gasoline (Use lowest grade available)
(c) MIL-G- 3056, Automotive Gasoline (Use lowest grade available)
(d) MIL-J-5624, Grade JP-5 (T53-L-9A)

NOTE: T53-L-13 only

ARMY STANDARD FUEL —
MIL-J-5624 Grade JP-4

ALTERNATE FUEL —
MIL-J-5624 Grade JP-5 and
MIL-F-46005 (CITE)

EMERGENCY FUEL — Gasoline, all types (limited to 10 hours accumulated time between internal inspections)

An entry shall be made in DA Form 2408-13 after use of ALTERNATE or EMERGENCY fuels.

TRANSMISSION — MIL-L-7808 or MIL-L-23699*
Capacity 2.25 U.S. Gals.

TAIL ROTOR INTERMEDIATE GEAR OIL
MIL-L-7808, or MIL-L-23699*
Capacity 0.375 U.S. Pint

TAIL ROTOR GEAR BOX OIL -- MIL-L-7808 or MIL-L-23699*
Capacity 0.50 U.S. Pint

HYDRAULIC FLUID — MIL-H-5606
System Capacity 7.3 U.S. Pints
Reservoir Capacity 1.5 U.S. Pints
Refill Reservoir Capacity 1 U.S. Pint

CAUTION:

Before using anti-icing additive refer to Caution Note in TB 55-9150-200-25

*Note
It is not advisable to mix MIL-L-23699 oil with MIL-L-7808 oil except in cases of emergency. If it becomes necessary to mix the oils it is recommended that the system be flushed within 6 hours.

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AV 054517-2

Figure 2-16. Servicing diagram (Sheet 2 of 2)

2-223. PILOT'S AND COPILOT'S SEATS.

2-224. The pilot's and copilot's seats (figure 2-4) are the adjustable non-reclining type, and each seat is mounted on two fixed tracks. A lever for vertical adjustment is on the right side of each seat and the fore and aft lock is on the left side of each seat. Each seat is equipped with a lap safety belt and inertia-reel shoulder harness. Webbing on the back of the seat can be removed to accept use of a back-pack parachute.

Caution

Upward force of springs located on seats may cause rapid vertical movement.

2-225. SHOULDER HARNESS.

2-226. An inertia-reel and shoulder harness is incorporated in the pilot's and copilot's seat with manual lock-unlock handle (figure 2-4). The control handle may be moved freely from one position to the other. With the control in the unlocked position, the reel cable will extend to allow the pilot to lean forward; however, the reel will automatically lock when helicopter encounters an impact force of 2 or 3 "G" deceleration. Locking of the reel can be accomplished from any position and the reel will automatically take up the 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 can be accomplished and the lock cannot be released; if this condition occurs, it will be necessary to loosen shoulder harness. Manual locking of the reel should be accomplished for emergency landing.

2-227. AUXILIARY EQUIPMENT.

2-228. The following systems and equipment are covered in Chapter 6:

Ventilating System
Heating and Defrosting System
Engine Anti-Icing System
Pitot Heater
Navigation Lights
Anti-Collision Light
Landing Light
Search Light
Dome Lights
Cockpit Lights
Transmission Oil Level Light
Instrument Lights
Armament System Provisions
Windshield Wiper
Casualty Carrying Equipment
Heated Blanket Receptacle
Check List Holder
Data Case
Mooring Fittings
Tow Rings
Ground Handling Wheels
Blackout Curtains
Blood Bottle Hangers
Main and Tail Rotor Tie Downs
Cargo Tie Down Fittings
External Cargo Rear View Mirror
Paratroop Static Line
Electrical Provisions for Engine Vibration Check Equipment
Auxiliary Fuel Equipment
Internal Rescue Hoist

TABLE 2-5. APPROVED SUBSTITUTE FUELS

NOTE: Wide Cut Type Fuels (JP-4 Type). Any of these may be used as Army Standard Fuel when JP-4 is not available.

MILITARY FUELS	
NATO	F-40
Canada	3-GP-22e Amdt 3
Italy	AM-C-142
Belgium	BA-PF-2A Amdt 1
US	MIL-J-5161 Grade 1 (JP-4 Referee)
Britain	D. Eng. R.D. 2486 Iss. 4
Norway	MIL-J-5624F, Am2, GR JP-4
Denmark	MIL-J-5624, Am2, GR JP-4

TABLE 2-5. APPROVED SUBSTITUTE FUELS (CONT)

COMMERCIAL FUELS	
Atlantic	Arcojet-B
B.P. Trading	BP A.T.G.
British American	B-A Jet Fuel JP-4
California Texas	Caltex Jet B
Continental	Conoco JP-4
Esso International	Esso Turbo Fuel B
Gulf	Gulf Jet B
Humble	Esso Turbo Fuel B
	Enco Turbo Fuel B
Phillips	Philjet JP-4
Shell	Aeroshell Turbine Fuel JP-4
Standard of Calif.	Chevron Turbine Fuel B
Standard of Texas	Standard Turbine Fuel B
Standard Oil Co.	Standard Jet B
Texaco	Texaco Avjet B
Union	Union JP-4
NOTE: Kerosene Type Fuels (JP-5 Type). Any of these fuels may be used when JP-5 is not available.	
MILITARY FUELS (Freezing Point - 40°F)	
NATO	F-42
France	AIR 3404A Amdt 1
US	MIL-J-5161, Grade II (JP-5 Referee)
(Freezing Point - 55°F)	
NATO	F-34, F-44
Canada	3-CP-23e, Am. 3
Britain	D. Eng. R.D. 2494, Iss 3
Canada	3-GP-24d, Am. 3
West Germany	VTL-9130/007. Am. 1
	VTL-9130/010
Italy	AM-C-143
US	MIL-F-25524
	MIL-J-25655, JP-6
COMMERCIAL FUELS (Freezing Point - 40°F)	
American	American Jet Fuel Type A
Atlantic	Arcojet-A
British American	B-A Jet Fuel JP-1
Cities Service	Turbine Type A
Continental	Conoco Jet-40
	Conoco Jet-50
Gulf	Gulf Jet A
Humble	Esso Turbo Fuel A
	Enco Turbo Fuel A
Mobil	Mobil Jet A
Phillips	Philjet A-50
Pure	Purejet Turbine Fuel Type A
Richfield	Richfield Turbine Fuel A
Shell	Aeroshell Turbine Fuel 640
Sinclair	Sinclair Superjet Fuel
Standard Oil Co	Standard Jet A
Standard (Ohio)	Jet A Kerosene
Texaco	Texaco Avjet A

TABLE 2-5. APPROVED SUBSTITUTE FUELS (CONT)

(Freezing Point - 55°F)	
American	American Jet Fuel Type A-1
Atlantic	Arcojet A-1
BP Trading	BP A.T.K.
California-Texas	Caltex Jet A-1
Continental	Conoco Jet 60
Esso International	Esso Turbo Fuel A-1
Gulf	Gulf Jet A-1
Humble	Esso Turbo Fuel A-1
	Enco Turbo Fuel A-1
Mobil	Mobil Jet A-1
Pure	Purejet Turbine Fuel Type A-1
Richfield	Richfield Turbine Fuel A-1
Shell	Aeroshell Turbine Fuel 650
Sinclair	Sinclair Super Jet Fuel
Standard of Calif.	Chevron Jet Fuel A-1
Standard of Texas	Standard Turbine Fuel A-1
Standard (Ohio)	Jet A-1 Kerosene
Texaco	Texaco Avjet A-1
Union	76 Turbine Fuel

CHAPTER 3

NORMAL PROCEDURES

SECTION I SCOPE

3-1. PURPOSE.

3-2. Chapter 3 contains instructions and procedures covering flight of the helicopter from the planning stage, through actual flight conditions, to securing the helicopter after landing. Normal and standard conditions are assumed in these procedures. Pertinent data in other chapters is referenced when applicable.

3-3. Normal procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist. Technical Manual TM 55-1520-210-10CL.

3-4. The instructions and procedures contained herein are written for the purpose of standardization and are not applicable to all field situations.

SECTION II FLIGHT PROCEDURES

3-5. PREPARATION FOR FLIGHT.

3-6. This period should be devoted to matters of general mission planning and to a study of special problems involved in operating the helicopter for mission completion.

3-7. FLIGHT RESTRICTIONS.

3-8. The minimum, normal, maximum, and cautionary operation range for the helicopter and the engine are indicated by instrument markings and placards. These instrument markings and placards represent careful aerodynamic calculations, substantiated by flight test data. Refer to Chapter 7, Operating Limitations, for a detailed description of helicopter and engine restrictions.

3-9. FLIGHT PLANNING.

3-10. The safe and efficient planning of the mission to be accomplished will provide the pilot with the data to be used during flight. The information to be used can be compiled from the following sources.

1. Check type of mission to be performed, and destination.

2. Select performance charts to be used from Chapter 14.

3. Record for in-flight use, the information concerning fuel quantity required, airspeed, power settings, take-off, climb, cruise or hovering conditions, landing and fuel consumption for operating gross weight and climatic condition.

3-11. TAKE-OFF AND LANDING DATA.

3-12. Consult chapter 14, Performance Data, for detailed operating information when planning various types of missions that require use of the data.

3-13. WEIGHT AND BALANCE.

3-14. Ascertain proper weight and balance of the helicopter as follows:

1. Consult applicable weight and balance instructions given in Chapter 12, and ascertain that DD Form 365F has been completed properly.

2. Compute take-off and anticipated landing gross weight, checking helicopter CG and location and ascertaining weight of fuel, oil, payload, etc.

3. Check that loading limitations, described in Chapter 7, have not been exceeded.

3-15. PRE-FLIGHT CHECK.

3-16. The amplified preflight check includes the exterior and interior checks as outlined.

Note

(I) Indicates check required for instrument Flight ONLY.

(N) Indicates checks required for Night Flights ONLY.

(O) Indicates checks required if item is installed.

When the aircraft is flown by the same flight crew during tactical or administrative missions requiring intermediate stops, the flight crew need not perform all the pre-flight checks required by the amplified or condensed checklists for beginning flights. Under these conditions, only the starred (*) items in these lists are required checks to assure safe operation.

3-17. BEFORE EXTERIOR CHECK - AREA 1.

1. Publications - Check DA Form 2408-12, 13, and -14, DD Form 365F, locally required forms and publications and availability of Operator's Manual (-10).

2. Battery Switch - OFF.

(N) 3. Searchlight, Landing Light, and Mav Lights - Battery Switch ON, Check lights; Battery switch OFF.

4. Fuel - Check and secure cap.

3-18. EXTERIOR CHECK - FUSELAGE FRONT AREA 2.

1. Rotor Blade - Visually check condition.

2. Cabin Top - Check ventilators and condition.

3. Radio Compartment - Check security of all equipment. (Check battery if armor seats not installed.)

4. Radio Compartment Door - Condition and Secured.

(O) 5. FM Antenna - Check Security and condition.

6. Pitot Tube - Remove cover and check free of obstructions and security.

7. Cabin Lower Area - Check all glass.

(O) 8. Cargo Suspension Mirror - Covered and secured. Uncovered and adjusted if cargo operations are anticipated.

9. Landing and Searchlight - Stowed.

3-19. FUSELAGE - LEFT SIDE AREA 3.

(O) 1. Pitot-Static Port - Free of obstructions.

2. Navigation light - Condition and security.

3. Entrance Doors - Condition and operation.

4. Landing Gear and Skid Shoes - Condition, handling wheels removed.

5. Cargo Suspension Cable - Check centering cables and springs. Check hook if use is anticipated.

3-20. FUSELAGE - AFT CABIN LEFT SIDE AREA 4.

Warning

Visually check security of quick-disconnect fittings by noting lock-pin indications.

1. Engine and Transmission Deck - Check for fuel and oil leaks; secure cowling.

2. Electrical compartment - Check condition, circuit breakers in, and battery connected.

Note

Turn battery and main fuel ON before accomplishing checks 3 through 6, then OFF before continuing checks.

3. Fuel Filter - Drain and check.

4. Right and Left Pumps and Sumps - Drain.

(O) 5. Aux Fuel Tank Filter and Sump - Drain.

6. Access Doors - Secure for flight.

3-21. AFT FUSELAGE (TAIL BOOM) - LEFT SIDE AREA 5.

1. Tail Rotor Drive Shaft Coupling - Check position, security, shut access door.

2. Aft Fuselage - Check general condition.

3. Synchronized Elevator - Condition.

4. Antenna - Condition and security.

5. Main Rotor Blade - Untie, check and ROTATE 90° TO FUSELAGE.

3-22. FUSELAGE - FULL AFT AREA 6.

1. Aft fuselage extension covers - Condition - Secure.

2. Tail Rotor - Check condition and free movement on flapping axis. Visually inspect tail rotor crosshead retaining nut and bolt for installation of cotter pin.

3. Tail Skid - Condition and security.

4. Navigation Lights - Condition and Security.

5. FM Antenna - Condition and security.