CHAPTER 10

INSTRUMENTS

SECTION I SCOPE

10-1. PURPOSE.

10-2. This chapter provides the instructions and information required by organizational maintenance personnel to perform maintenance on UH-1D/H helicopter instruments. All flight, navigation, engine and miscellaneous instruments are mounted in a panel attached to the top forward side of pedestal.

Note

Additional illustrations, pertaining to the information found in the following sections, are contained in TM 55-1520-210-10.

Note

For compartment location see figure 12-1. For equipment location see figure 12-2. See figures 13-10 through 13-39 for systems diagrams, Tables 13-1 through 13-4 for equipment listing, Table 13-5 for connector replacement chart, and figures 13-40 through 13-49 for wiring diagrams of ships prior to 65-9565.

10-3. INSTRUMENT PANEL.

10-4. The instrument panel is mounted on the top forward section of the pedestal and contains all instruments for the pilot and copilot.

10-5. ADJUSTMENT—INSTRUMENT PANEL. Instrument panel vibration may be eliminated or minimized by adjusting the tube and brace assemblies provided for this purpose. The tube assemblies are attached to the helicopter structure by means of a pin, washer, and cotter pin. They are equipped with a clevis and check nut for adjustment. The brace assemblies are attached to the pedestal and may be adjusted by turnbuckles incorporated in the brace assemblies. Inspect for cracks and loose, missing or improperly installed hardware. Inspect compass correction cards, placards, and decals for legibility. Inspect shock mounts and vibration dampers for sagging, deterioration, cracks and permanent set. Inspect rheostats and switches for missing and loose knobs.

10-6. INSTRUMENTS.

10-7. REMOVAL — INSTRUMENTS. Remove any instrument from panel, by the following general procedure:

a. Be sure all electrical power is OFF.

b. Disconnect electrical leads or instrument piping from back of panel. Necessary access may be through pedestal, through back of cabin mounting holes in panel after instrument is detached.

c. Protect ends of electrical leads, and cap open piping and openings on instrument.

Note

On UH-1D/H Helicopters, serial No. 66-746 and subsequent; the MS28042 clamp will be used to mount certain round instruments. In order to remove this clamp it will be necessary to hold the clamp from the aft side while removing the screw from the front of the panel.

d. Remove mounting screws or loosen mounting clamp screw. Remove instrument.

10-8. CLEANING — INSTRUMENTS. Clean panel and instrument cover glasses with a suitable soft, lint-free cloth.

10-9. INSPECTION — INSTRUMENTS.

a. Inspect for loose, missing or improperly installed hardware. Inspect gage lens for cleanliness, looseness, cracked glass and slippage.

b. Inspect for legibility of range markings.

c. Inspect for faulty decals.

10-10. REPAIR OR REPLACEMENT — INSTRUMENTS. Replace any missing or damaged limits or index markings on cover glasses of instruments. Also replace any required decals which are not clearly legible. Replace any instrument if cover glass is loose or broken, or when found to be unserviceable.

10-11. INSTALLATION — INSTRUMENTS. Install any instrument in panel by the following general procedure:

a. Check instrument for correct markings on cover glass.

Note

On UH-1D/H Helicopters, serial No. 66-746 and subsequent; the MS28042 clamp will be used to mount certain round instruments. The installation technique required to insure instrument security is that the clamp must be held in place from the aft side while tightened by a screw visible on the front side of the panel. A gap between the head of the screw and the face of the instrument panel may exist. Do not attempt to overtorque the screw to eliminate the clearance since the scissors mechanism of the clamp will be damaged.

b. Position instrument in panel. Install mounting screws or tighten screw of mounting clamp.

c. Remove protective caps or covers as necesary. Connect electrical leads and instrument piping.

d. Check operation of instrument.

10-12. OPERATIONAL CHECK — ELECTRICAL. Wiring diagrams and schematics shall be utilized in accomplishing the functional tests of electrical circuits and components. Tests shall be conducted after installation, repair or replacement of equipment.

SECTION II FLIGHT INSTRUMENTS

10-13. DESCRIPTION.

10-14. The flight instruments include altimeter airspeed indicator, pitot system, turn and slip indicator, attitude indicators (pilot and co-pilot), vertical velocity indicator, and clock.

10-15. ALTIMETER.

10-16. The altimeter is vented through piping to static pressure ports of pitot-atmospheric pressure. An external adjustment knob is provided to make compensation for variations of prevailing barometric pressure. See figure 10-1.

10-17. TROUBLESHOOTING — ALTIMETER. Perform necessary checks to isolate trouble.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Incorrect reading	Leak in static pressure line	Correct leak
	Clogged static vent port or piping	Clean vent port or piping
	Instrument defective	Replace instrument

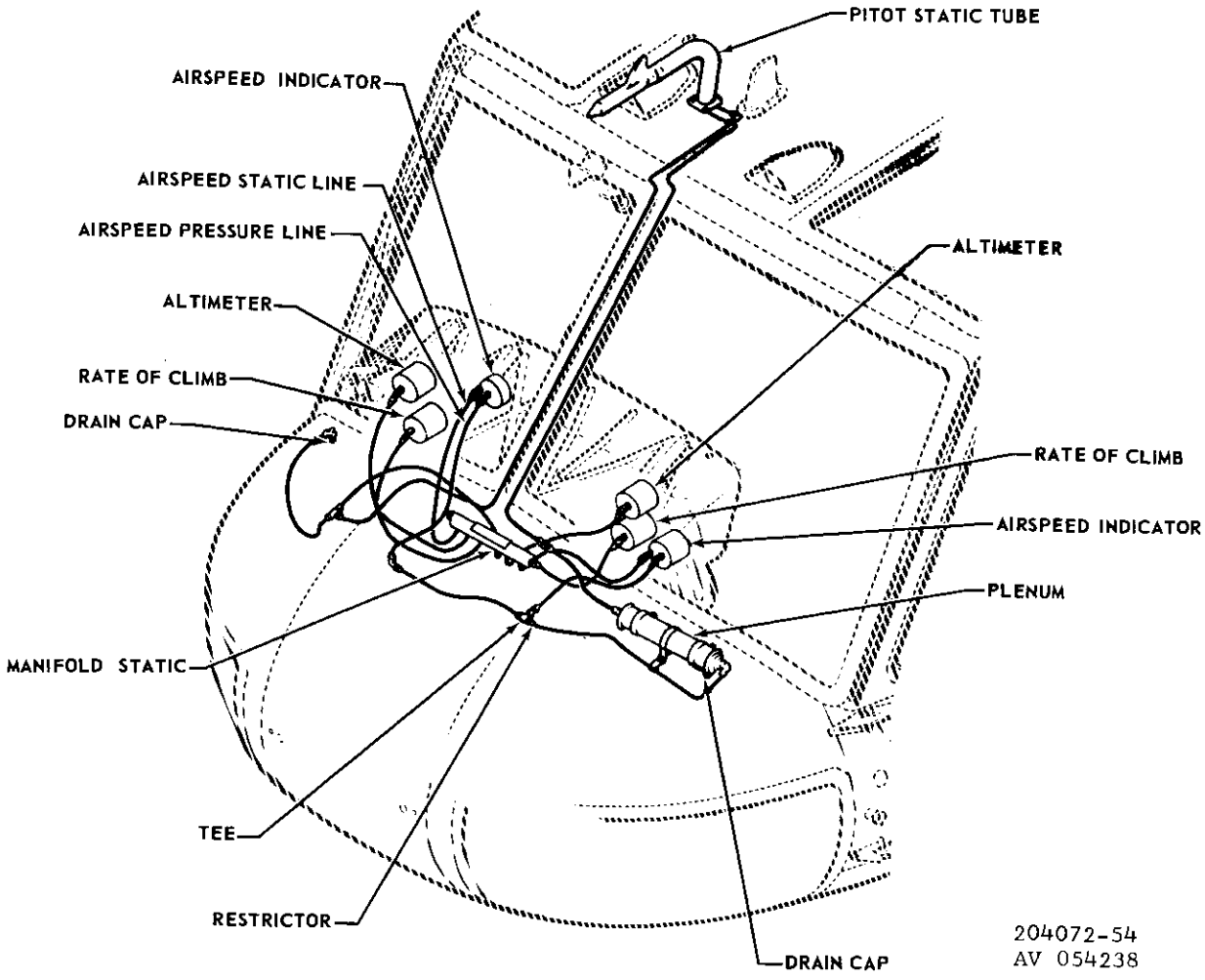

Figure 10-1. Instrument piping (typical)

10-18. MAINTENANCE — ALTIMETER. (Refer to paragraphs 10-7 through 10-11.)

10-19. AIRSPEED INDICATOR.

10-20. The airspeed indicator is a standard pitot-static instrument. The single-scale indicator provides airspeed indication in knots by measuring differences between impact air pressure from pitot tube and pressure from static vents. Pitot tube, which has a heating element for icing conditions, is located on forward left side of cabin nose, or top right hand side of cabin roof. Static air pressure vents are located just forward of each crew door, with piping to altimeters, vertical velocity indicators, and airspeed indicators. See figure 10-1.

Note

Pitot tube mounted on cabin roof effective on UH-1D/H helicopters Serial No. 66-746 through 66-1210, 66-16000 through 66-17144 and 66-8574 through 66-8577, 67-17145 through 67-17312.

10-21. TROUBLESHOOTING — AIRSPEED INDICATOR. Perform checks as necessary to isolate trouble.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Pointer fails to respond	Pressure line not connected	Connect line
	Lines clogged by water or dirt	Disconnect and blow lines clear
Pointer indicates incorrectly	Defective or leaking indicator	Replace indicator
	Leak in line	Repair or replace line

10-22. MAINTENANCE — AIRSPEED INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-23. PITOT SYSTEM.

10-24. The pitot system consists of the electrically heated pitot tube, two static air pressure vents, and necessary piping to connect these units to altimeters, vertical velocity indicators, and airspeed indicators. The pitot tube is located on the forward left-hand side of the cabin nose, or on top right-hand side of cabin roof. Static air pressure vents are located just forward of each crew door. Helicopters having pitot tube installed in roof have static port incorporated into pitot head. (See figure 10-1.)

10-25. CLEANING — PITOT SYSTEM.

a. Disconnect pitot tube pressure lines from airspeed indicators. Cap openings in indicators to prevent entrance of foreign material.

b. Disconnect static vent lines from altimeters and vertical velocity indicators. Cap openings in altimeters and indicators to prevent entrance of foreign material.

c. Blow all lines clean with filtered, compressed air.

d. Uncap openings in instruments and reconnect lines.

10-26. INSPECTION — PITOT SYSTEM.

a. Inspect pitot tube for clogged drain hole on bottom of tube.

b. Inspect pitot tube and static vents for corrosion, dents, or other visible damage.

c. Inspect pitot tube electrical receptacle, pins and sockets for damage.

d. Inspect for loose, missing or improperly installed hardware. Inspect pitot and static lines for leaks, anchoring and chaffing. Check lines from manifold to instruments for interference with shock mount movement.

10-27. OPERATIONAL CHECK—PITOT HEATER

a. Close PITOT TUBE HEATER circuit breaker.

b. Position pitot heater switch S9 to ON and check that pitot tube heating element is energized. Return switch S9 to OFF. (See figure 13-10.)

10-28. TURN AND SLIP INDICATOR.

10-29. This instrument has a needle (turn indicator), controlled by an electrically activated gyro, and a ball (slip indicator). Although 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 helicopter is in directional balance, either in a turn or in straight and level flight. If helicopter is yawing or slipping, ball will be off center. Needle indicates in which direction and at what rate helicopter is turning.

Note

Mark "DC ELECT" on instrument face or directly below Turn and Slip Indicator on flight instrument panel.

10-30. TROUBLESHOOTING — TURN AND SLIP INDICATOR. Perform checks as necessary to isolate trouble. (See figure 13-11.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Pointer remains centered, either constantly or intermittently	Sticky gyro	Replace indicator
	No electrical power to indicator	Check circuit connections; replace wiring
Ball too sensitive	Dampening fluid leaked out	Replace indicator

10-31. OPERATIONAL CHECK – TURN AND SLIP INDICATOR.

a. Open all circuit breakers. Close TURN SLIP IND circuit breaker.

b. Check that indicator gyro is running.

10-32. MAINTENANCE – TURN AND SLIP INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-33. ATTITUDE INDICATOR SYSTEM.

10-34. This system displays flight attitude of the helicopter relative to the earth. The complete system includes a roll and pitch gyro, rate switching gyro, pilot's and copilot's indicator, and an amplifier located in the nose compartment. Power for these units is supplied by the 115 volt ac bus. On model UH-1D/H Serial No. 65-9565 and subsequent, the pilot's attitude indicator is a one-piece unit containing both the indicator and the amplifier.

10-35. TROUBLESHOOTING – ATTITUDE INDICATOR (PILOT). Perform checks as necessary to isolate trouble. See figure 13-12.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator does not operate but roll and pitch gyro has indications of operating	Plug loose at indicator	Check for proper plug installation
Indicator does not operate	One unit of system defective	Replace defective unit
System functions properly but power failure flag does not lift.	Defective indicator	Replace indicator

10-36. OPERATIONAL CHECK – ATTITUDE INDICATOR – PILOT (TYPE IND-A5-UH1). Open both pilot attitude indicator circuit breakers on the pedestal panel. Energize the main inverter and perform the following steps:

a. Close both pilot attitude indicator circuit breakers. Check that display erects to within ±1 degree in pitch and roll and the power warning flag disappears within one minute.

b. Rotate the roll trim knob to the extreme clockwise position and check that bank index is at 8 to 20 degrees left bank.

c. Rotate the roll trim knob to extreme counterclockwise position and check that bank index is at 8 to 20 degrees right bank.

d. Rotate the pitch trim knob fully clockwise and check that deflection of the horizon line is a minimum of 16 degrees downward.

e. Rotate pitch trim knob fully counterclockwise and check that horizon line deflects upward a minimum of 8 degrees.

f. Turn off the main inverter and, after a few seconds delay, turn on the spare inverter. Check that pitch and bank axis remain level within ±1 degree.

10-37. MAINTENANCE ATTITUDE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-38. TROUBLESHOOTING – ATTITUDE INDICATOR (COPILOT). Perform checks as necessary to isolate trouble. See figure 13-12.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator does not operate	Power failure	Check wiring and plugs
	Defective indicator	Replace indicator

10-39. OPERATIONAL CHECK – ATTITUDE INDICATOR – COPILOT (TYPE J-8).

a. Open both copilot attitude indicator circuit breakers. Energize the main inverter.

b. Close both copilot attitude indicator circuit breakers. After fifteen seconds, pull out and then release the PULL TO CAGE knob. The gyro should cage and release. Within three minutes the indicator should settle to its zero position within ±1 degree in bank and pitch.

10-40. MAINTENANCE – ATTITUDE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

Note

One and two-piece attitude and indicators are interchangeable for all members.

prior to Serial No. 65-9565; however, when installing one-piece attitude indicators in helicopters prior to Serial No. 65-9565, cannon plugs of amplifier must be stowed when amplifier is removed. Connect remaining cannon plug to receptacle on one-piece attitude indicator.

10-41. VERTICAL VELOCITY INDICATOR.

10-42. The vertical velocity indicator is vented to the static air system to sense the rate of atmospheric pressure change. The indicator registers ascent or descent in feet. See figure 10-1.

10-43. TROUBLESHOOTING – VERTICAL VELOCITY INDICATOR. Perform checks as necessary to isolate trouble. (See figure 10-1.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Pointer off zero	Mechanism shifted	Return pointer to zero by turning adjustment knob; tap face of indicator lightly while adjusting
Inaccurate readings	Defective indicator	Replace indicator
	Loose connections in static line	Tighten connections
	Indicator case leaks	Replace indicator
Excessive pointer oscillation	Leak in static line	Tighten connections; replace leaky lines
	Defective indicator	Replace indicator

10-44. MAINTENANCE – VERTICAL VELOCITY INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-45. CLOCK.

10-46. Clock has a sweep-second pointer and a minute totalizer hand to indicate elapsed time. A control knob on case stops both pointers when pressed and returns pointers when pressed again.

10-47. MAINTENANCE – CLOCK. (Refer to paragraphs 10-7 through 10-11.)

SECTION III NAVIGATION INSTRUMENTS

10-48. DESCRIPTION.

10-49. Navigation instrument includes Course Indicator, Bearing Heading Indicator, Radio Compass, AN/ASN-43 Gyro Magnetic Compass, and standby Compass.

10-50. COURSE INDICATOR.

10-51. The ID-453/ARN course indicator functions to furnish the pilot visual bearing from or to the station being received. A knob is provided on the instrument for selection or adjustment of the bearing indicator needle to set up a desired omni course or to change course 180 degrees on the indicator, thereby reversing the TO-FROM meter. Operating in conjunction with the course selector is the cross pointer meter. The pilot, by means of the omni system, can set up any bearing to or from a station when he knows his general geographical location and he can determine that location by obtaining a position fix on two omni stations. The cross pointer will deflect right or left depending upon the relative bearing of the helicopter to the station.

10-52. MAINTENANCE – COURSE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-53. BEARING – HEADING INDICATOR.

10-54. The ID-998 ( )/ASN (C-6H) and ID-250 ( )/ARN indicators are dual pointer, moving type instruments. The ID-998 ( )/ASN provides additional isolated heading output by means of an external servo amplifier. The ID-250 ( )/ARN is a repeater type instrument. The dial on each instrument displays heading from the J-2 compass system. Pointer number one of each indicator displays magnetic bearing received by the ARN-59 Direction Finder Set. Pointer number two of each indicator displays omni bearing received by the ARN-30( ) Radio Receiving Set. (Refer to TM 11-1520-210-20 for description, installation, and maintenance of the System Components.)

10-55. MAINTENANCE – BEARING HEADING INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-56. RADIO COMPASS.

10-57. Pilot and copilot are both provided with a radio compass which is a part of the J-2 radio compass system. (Refer to TM 11-1520-210-20.)

10-58. AN/ASN-43 GYRO MAGNETIC COMPASS.

10-59. The UH-1D/H helicopter serial No. 66-8574 through 66-8577 and 66-16307 through 66-17144 are equipped with the AN/ASN-43 Gyro Magnetic Compass system. This system replaces the J-2 radio compass system. (Refer to TM 11-1520-210-20 for description, installation, and maintenance of the system components.)

10-60. STANDBY COMPASS.

10-61. One standby compass, of standard magnetic type, is provided for navigational use. This unit is to be used in conjunction with the compass correction card, which is located adjacent to the compass.

10-62. TROUBLESHOOTING — STANDBY COMPASS. Perform checks as necessary to isolate trouble.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive card error	Improper compensation	Compensate compass
Excessive card oscillation	External magnetic interference	Locate magnetic interference and eliminate if possible
Card element not level	Insufficient liquid in bowl	Replace compass
Card sluggish	Leaking float chamber	Replace compass
	Card magnets detached	Replace compass
	Dirty jewels on pivots restricting rotation	Replace compass

10-63. MAINTENANCE — STANDBY COMPASS. (Refer to paragraphs 10-7 through 10-11.)

10-64. CALIBRATION — STANDBY COMPASS.

a. Check condition of compass before positioning helicopter on compass rose. (Refer to paragraph 10-9.)

b. Position helicopter on compass rose. Observe the following precautions prior to start of swinging procedure:

(1) Make sure that all magnetic material and equipment in helicopter is secured in normal flight position.

(2) Check that all controls and levers are set in normal position. (Refer to TM 55-1520-210-10.)

(3) Check all observers or personnel near or in the helicopters to insure they have no metals on their person that have magnetic properties that could cause compass deviation.

(4) Check that all magnetic objects, such as trucks, automobiles or other aircraft, are removed from the compass rose swing area to a distance at which they will have no magnetic effect on the compass.

c. Position helicopter on compass rose turntable and radial lines. Secure helicopter right-hand skid to compass rose holding fixture. Use helicopter ground handling wheels, or equivalent, to support helicopter when rotating to different headings.

Note

If compass rose is not available, use master compass to align helicopter on each of the 4 cardinal headings.

d. Start helicopter power plant according to standard procedures. (Refer to TM 55-1520-210-10.) Turn on power to all equipment, including compass system, except landing light, searchlight and windshield wipers. Allow helicopter to rest, facing east, for approximately three minutes to permit equipment functions to stabilize.

Note

Rotate helicopter under engine power to accomplish steps e. through i.

Note

Use non-magnetic screwdriver to adjust "N-S" and "E-W" degree compensators on face of compass. Purpose of compensators is to adjust standby compass indicator, as nearly as possible, to agree with helicopter heading on compass rose. The standby compass reading should also agree with the compass reading. (For compass calibration, refer to TM 11-1520-210-20.)

e. Rotate helicopter to south magnetic heading and observe compass indication. Adjust "N-S" compensator as necessary.

f. Rotate helicopter to west magnetic heading and observe compass indication. Adjust "E-W" compensator as necessary.

g. Rotate helicopter to north magnetic heading and observe compass indication. Adjust "N-S" compensator as necessary.

h. Rotate helicopter to east magnetic heading and observe compass indication. Adjust "E-W" compensator as necessary.

i. Repeat steps e. through h. two times to establish closest possible degree of compensation.

j. Record S, W, N and E degree deviations on standby compass correction card. Secure compass compensator screws with sealing compound (item 201, table 1-2).

k. Shut down helicopter power plant and electrical power. Remove helicopter from compass rose.

Note

Standby compass may be calibrated against previously calibrated compass system while in flight by accomplishing steps e. through j. Make certain power to all equipment is turned on except landing light, searchlight, and windshield wipers. Standby compass may also be calibrated with a master compass, utilizing the procedures outlined in TM 55-403.

SECTION IV ENGINE INSTRUMENTS

10-65. DESCRIPTION.

10-66. Engine instruments include Dual Tachometer (rotor and turbine), Gas Producer Tachometer, Engine oil pressure, Torque Pressure, Fuel Pressure, Engine Oil Temperature, Exhaust Temperature, and Fuel Quantity Indicators.

10-67. DUAL TACHOMETER SYSTEM.

10-68. Dual tachometer indicates both main rotor rpm and engine output shaft rpm. Each tachometer has a synchronous motor connected electrically to a separate tachometer generator. The system operates independently of helicopter electrical power systems. Rotor rpm pointer indicates on inner scale of instrument, by connection to a generator mounted on right side of transmission sump case. Engine rpm pointer indicates on outer scale, by connection to a generator on upper left side of engine inlet housing. Pointers will be aligned when engine and rotor speeds are synchronized in normal operation.

10-69. TROUBLESHOOTING — DUAL TACHOMETER SYSTEM. Perform checks as necessary to isolate trouble. See figure 13-13.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive scale error	Weak magnet in tachometer generator	Replace tachometer generator
Pointer moves backward	Leads reversed at generator	Change leads in generator plug
Indication only half actual speed	Leads connected to wrong terminal in indicator	Refer to wiring diagram and install wires in indicator plug correctly.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No reading on instrument, either constant or intermittent	Break or short circuit in leads	Repair or replace leads
	Poor connections at indicator or generator plugs	Clean or tighten connections
	Break in unit circuit	Replace defective unit (generator) or (indicator)
	Poor connection at indicator or generator	Clean and tighten connections
Low reading or indicator, either constant or intermittent	Indicator resistance out of adjustment	Replace indicator
High reading on indicator, either constant or intermittent	Indicator resistance out of adjustment	Replace indicator

10-70. MAINTENANCE — DUAL TACHOMETER. (Refer to paragraphs 10-7 through 10-11.)

10-71. ROTOR TACHOMETER GENERATOR.

10-72. The rotor tachometer generator is located on the lower right hand side of the transmission. It is mounted on the hydraulic pump and tachometer drive quill assembly. It is connected to the dual tachometer indicator on the instrument panel.

10-73. REMOVAL — ROTOR TACHOMETER GENERATOR. Remove cowling from right-hand side of transmission. Disconnect electrical receptacle, remove mounting nuts and washers and lift tachometer generator from helicopter.

10-74. INSPECTION — ROTOR TACHOMETER GENERATOR. Inspect generator case for cracks, excessive wear, or any visible damage. Check connector for damaged or bent pins and cracked inserts. Check that rotor turns freely and there is no visible indication of excessive wear to bearings.

10-75. REPAIR OR REPLACEMENT — ROTOR TACHOMETER GENERATOR. Replace item if inspection requirements are not met.

10-76. INSTALLATION — ROTOR TACHOMETER GENERATOR. Position generator on mounting studs and install mounting washers and nuts. Connect electrical receptacle and install cowling.

10-77. POWER TURBINE TACHOMETER GENERATOR.

10-78. The engine tachometer generator is mounted on the governor and tachometer drive gear box on the left upper side of the engine and is connected to the dual tachometer indicator on the instrument panel.

10-79. REMOVAL — POWER TURBINE TACHOMETER GENERATOR.

a. Remove cowling from left-hand side of engine.

b. Disconnect electrical receptacle, remove mounting nuts and washers and lift tachometer from engine.

10-80. INSPECTION — POWER TURBINE TACHOMETER GENERATOR. (Refer to paragraph 10-74; procedure is the same.)

10-81. REPAIR OR REPLACEMENT — POWER TURBINE TACHOMETER GENERATOR. Replace item if inspection requirements are not met.

10-82. INSTALLATION—POWER TURBINE TACHOMETER GENERATOR. Position generator and gasket on studs and install nuts. Connect electrical receptacle and install cowling.

10-83. GAS PRODUCER TACHOMETER SYSTEM.

10-84. Gas producer tachometer indicator provides indication in percentage rpm of engine gas producer

(first-stage on nI turbine and compressor) by connection to a synchronous generator mounted on engine accessory drive section. Indicator and generator circuit is independent of helicopter electrical power system.

10-85. TROUBLESHOOTING – GAS PRODUCER TACHOMETER SYSTEM. (Refer to paragraph 10-69; procedure is the same.)

10-86. MAINTENANCE – GAS PRODUCER TACHOMETER. (Refer to paragraphs 10-7 through 10-11.)

10-87. GAS PRODUCER TACHOMETER GENERATOR.

10-88. The gas producer tachometer generator, located on the right hand side of the engine on the accessory gear box, registers the rpm of the gas producer turbine. This instrument is used in conjunction with the gas producer tachometer indicator on the instrument panel.

10-89. REMOVAL – GAS PRODUCER TACHOMETER GENERATOR. (Refer to paragraph 10-79; procedure is the same.)

10-90. INSPECTION – GAS PRODUCER TACHOMETER GENERATOR. (Refer to paragraph 10-74; procedure is the same.)

10-91. REPAIR OR REPLACEMENT – GAS PRODUCER TACHOMETER GENERATOR. Replace item if inspection requirements are not met. (Refer to paragraph 10-74.)

10-92. INSTALLATION – GAS PRODUCER TACHOMETER GENERATOR. (Refer to paragraph 10-82; procedure is the same.)

10-93. ENGINE OIL PRESSURE INDICATOR SYSTEM.

10-94. Engine oil pressure indicator provides continuous readings of engine oil pump pressure in psi, by means of an electrical transmitter mounted on top of engine inlet section. Transmitter is connected to 28-volt ac electrical power, and by a hose to a pressure tap on engine oil filter housing.

10-95. TROUBLESHOOTING – ENGINE OIL PRESSURE INDICATOR SYSTEM. Perform checks as necessary to isolate trouble. See figure 13-14.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Low reading on oil pressure indicator	Kinked or obstructed oil pressure line	Replace or clean line
Inaccurate or sticking pressure indicator	Defective indicator	Replace indicator
Sluggish oil pressure reading or fluctuating oil pressure	Sludge in oil pressure line	Bleed line
No reading on indicator	Defective transmitter	Replace transmitter
	Open circuit between transmitter and indicator	Make continuity check and replace or repair leads
Fluctuating oil pressure indicator	Loose electrical connection	Check connections

10-96. OPERATIONAL CHECK — AC PRESSURE INSTRUMENTS. To perform functional test of the torque transmitter, transmission oil pressure transmitter, engine oil pressure transmitter or fuel pressure transmitter, proceed as follows:

a. Energize main inverter.

b. Close TORQUE PRESS circuit breaker.

c. Disconnect the pressure line from the torque transmitter and apply pressure while monitoring the torque indicator. For helicopters prior to S/N 66-16459, indicated pressure shall be 50 psi when applied pressure is 50 ±7 psi, and for helicopters S/N 66-16459 and subsequent indicated pressure shall be 100 psi when applied pressure is 100 ±10 psi.

d. Open TORQUE PRESS circuit breaker and reconnect pressure line.

e. Close XMSN OIL PRESS circuit breaker and repeat Steps c and d for transmission oil pressure transmitter and indicator, except indicated pressure shall be 50 psi when applied pressure is 50 ±7 psi.

f. Close ENG OIL PRESS circuit breaker and repeat Steps c and d for engine oil pressure transmitter and indicator, except indicated pressure shall be 50 psi when applied pressure is 50 ±7 psi.

g. Close FUEL PRESS circuit breaker and repeat Steps c and d for the fuel pressure transmitter and indicator, except that the indicated pressure shall be 50 psi when applied pressure is 50 ±7 psi.

Note

Pressure caution lights test may also be performed at this time. (Refer to paragraph 12-182.)

10-97. MAINTENANCE — ENGINE OIL PRESSURE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-98. ENGINE OIL PRESSURE TRANSMITTER.

10-99. The engine oil pressure transmitter is mounted on a bracket on top of the engine and is connected to the engine oil pressure indicator on the instrument panel.

10-100. REMOVAL — ENGINE OIL PRESSURE TRANSMITTER.

a. Remove cowling from engine.

b. Disconnect electrical connector. Disconnect oil line. Place cover over connector and oil line.

c. Remove lockwire and mounting screws and lift transmitter from mounting bracket.

10-101. INSPECTION — ENGINE OIL PRESSURE TRANSMITTER. (Refer to paragraph 10-110; procedure is the same.)

10-102. REPAIR OR REPLACEMENT — ENGINE OIL PRESSURE TRANSMITTER. Repair connectors, tighten pressure fitting and replace item if inspection requirements are not met.

10-103. INSTALLATION — ENGINE OIL PRESSURE TRANSMITTER.

a. Position transmitter on bracket and install mounting screws. Install lockwire.

b. Remove cover and connect electrical receptacle and oil line. Install cowling.

10-104. TORQUE PRESSURE INDICATOR SYSTEM.

10-105. Torquemeter indicator is a pressure indicator type instrument for continuous readings of engine output shaft torque, supplied by an electrical transmitter mounted at top of engine inlet section. Transmitter is connected by hoses to a specialized oil pressure tap on right side of engine inlet housing, and to a vent connection on front of accessory drive gear box. Electrical circuit is operated by 28-volt ac power.

10-106. MAINTENANCE — TORQUEMETER INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-107. TORQUE PRESSURE TRANSMITTER.

10-108. The torque pressure transmitter is mounted on a bracket on top of the engine and is connected to the torquemeter on the instrument panel.

10-109. REMOVAL—TORQUE PRESSURE TRANSMITTER.

a. Remove cowling from engine.

b. Disconnect electrical connector and oil line and connector.

c. Cover openings of oil line and protect electrical connector.

d. Cut lockwire, remove mounting screws and washers and lift transmitter from helicopter.

10-110. INSPECTION — TORQUE PRESSURE TRANSMITTER.

a. Visually inspect case for damage or cracks, check for proper security of unit on mounting bracket and tightness of all pressure fittings.

b. Check connectors for security, bent or damaged pins, broken or cracked inserts and check operation of unit.

10-111. REPAIR OR REPLACEMENT – TORQUE PRESSURE TRANSMITTER. Repair connectors, tighten pressure fitting and replace item if other inspection requirements are not met.

10-112. INSTALLATION – TORQUE PRESSURE TRANSMITTER.

a. Position transmitter on bracket and install mounting screws.

b. Remove cover from openings and connect oil line and electrical connector to transmitter. Install cowling.

10-113. FUEL PRESSURE INDICATOR.

10-114. A fuel pressure indicator provides reading in psi of pressure in main fuel supply line from boost pumps in tanks, by means of an electrical transmitter mounted at engine deck level just ahead of forward firewall at right side. Electrical circuit is operated by 28-volt ac power.

10-115. TROUBLESHOOTING – FUEL PRESSURE INDICATOR. Perform checks as necessary to isolate trouble. (See figure 13-14.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator sticks or hand does not return to zero	Defective indicator	Replace indicator
No reading, either constant or intermittent	Defective indicator	Replace indicator
	Break or grounded circuit in leads	Repair or replace leads
	Poor connection at indicator	Clean and tighten electrical connection
	Defective transmitter	Replace transmitter
Low reading on fuel pressure indicator	Kinked or obstructed transmitter pressure line	Clean or replace pressure line

10-116. MAINTENANCE – FUEL PRESSURE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-117. ENGINE OIL TEMPERATURE INDICATOR.

10-118. The engine oil temperature indicator is electrically connected to 28-volt dc essential bus. The electrical resistance type thermobulb installed in engine oil pump housing measures temperature of the oil entering that unit.

10-119. TROUBLESHOOTING–ENGINE OIL TEMPERATURE INDICATOR. Perform checks as necessary to isolate trouble. See figure 13-11.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Oil temperature reading off scale at low end, or low reading either constant or intermittent	Defective indicator	Replace indicator
	Short circuit in leads from resistance bulb to indicator	Make continuity check and repair or replace leads
	Short circuit in bulb	Replace bulb
Oil temperature reading off scale at high temperature end, either constant or intermittent	Resistance bulb circuit open	Check continuity and repair wiring or replace defective bulb
	Defective indicator	Replace indicator
No reading on indicator	Defective circuit breaker	Replace circuit breaker
	Defective indicator	Replace indicator
	Break in leads	Repair wiring

10-120. OPERATIONAL CHECK—TEMPERATURE INDICATORS.

a. Open all circuit breakers and close TEMP IND ENG & XMSN circuit breakers.

b. Check that engine oil temperature and transmission oil temperature instruments read approximately ambient temperature.

10-121. MAINTENANCE—ENGINE OIL TEMPERATURE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-122. EXHAUST GAS TEMPERATURE INDICATOR.

10-123. Exhaust gas temperature indicator operates on electrical potential from an engine thermocouple harness with probes mounted in aft section of engine exhaust diffuser. Indicator circuit is entirely independent of any other electrical power source, and includes a coil resistor which provides a means of instrument calibration. (See figure 13-15.)

10-124. TROUBLESHOOTING — EXHAUST GAS TEMPERATURE INDICATOR. In event of malfunction, check and tighten circuit connections. Any further repair will require use of a testing unit to check and calibrate instrument circuit.

10-125. OPERATIONAL CHECK — EXHAUST TEMPERATURE.

a. Connect and operate the "Jetcal" analyzer in accordance with the instructions for "Functional Check of Aircraft E.G.T. (Exhaust Gas Temperature) Circuit" which is attached to the analyzer cover.

b. Set the heater probes to an outlet temperature of 500°C by adjustment of the TEMP REGULATOR. The helicopter's exhaust temperature indicator (Type MJ-2) should read 500 ±10°C.

10-126. MAINTENANCE — EXHAUST GAS TEMPERATURE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-127. THERMOCOUPLE LEAD SPOOL RESISTOR.

10-128. The thermocouple lead spool resistor is located inside the cabin roof at approximately station 104.20 and buttock line 30.0. Sections of alumel and chromel are used to connect the thermocouple with an indicator by way of the spool resistor. The resistor acts as a matching device between indicator and thermocouple.

10-129. INSPECTION — THERMOCOUPLE LEAD SPOOL RESISTOR. Inspect resistor for loose connections, corrosion, broken wires, broken terminals and damage to cover or cover fasteners.

10-130. FUEL QUANTITY INDICATOR.

10-131. Fuel quantity indicator provides readings of fuel supply in tank system. The indicator is connected to capacitor-type probes mounted in upper and lower fuel cells and requires a 115-volt ac power source.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator reads low.	System out of adjustment.	Perform adjustment procedure. Change tank unit.
Indicator reads high.	Tank unit has low capacitance.	Change tank unit.
Indicator remains at one point on scale.	Compensator capacitance too high.	Perform adjustment procedure. Change tank unit.
	System out of adjustment.	Check wiring terminals for security.
	Tank unit has high capacitance.	Change tank unit.
	Open lead on compensator circuit. Compensator section of tank unit open.	
	No power.	Check 115 volts, 400 hertz power supply.
	Defective indicator.	Replace indicator.
	Coaxial lead grounded.	Check wiring and/or replace indicator assembly.
	400 hertz lead grounded.	
	Prolonged existence of this condition will burn out fire hazard resistor in indicator.	
Indicator remains at zero or below.	Open wiring.	Check wiring.
Indicator operation sluggish.	Low insulation resistance of the circuit.	Check wiring and tank unit.

10-132. TROUBLESHOOTING — FUEL QUANTITY INDICATOR. Perform checks as necessary to isolate trouble. (See figure 13-16.)

10-133. OPERATIONAL TEST — FUEL QUANTITY SYSTEM. The fuel quantity system shall be functionally tested and calibrated at higher maintenance level.

10-134. MAINTENANCE — FUEL QUANTITY INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

SECTION V MISCELLANEOUS INSTRUMENTS

10-135. DESCRIPTION.

10-136. Miscellaneous Instruments include transmission oil pressure indicator, transmission oil temperature indicator, alternating current voltmeter, direct current voltmeter, direct current loadmeter, and free air temperature gage.

10-137. TRANSMISSION OIL PRESSURE INDICATOR.

10-138. Transmission oil pressure indicator provides continuous readings in psi by means of an electrical transmitter mounted directly into an oil manifold at right aft on transmission top case. Electrical circuit is operated by 28-volt ac power.

10-139. TROUBLESHOOTING — TRANSMISSION OIL PRESSURE INDICATOR SYSTEM. (Refer to paragraph 10-95; procedure is the same.)

10-140. MAINTENANCE — TRANSMISSION OIL PRESSURE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-141. TRANSMISSION OIL PRESSURE TRANSMITTER.

10-142. The transmission oil pressure transmitter is located on the right hand side of the transmission. It is connected to the transmission oil pressure indicator on the instrument panel.

10-143. REMOVAL — TRANSMISSION OIL PRESSURE TRANSMITTER.

a. Disconnect electrical connector.

b. Remove lockwire and unscrew transmitter from manifold.

10-144. INSPECTION — TRANSMISSION OIL PRESSURE TRANSMITTER. (Refer to paragraph 10-110.)

10-145. REPAIR OR REPLACEMENT — TRANSMISSION OIL PRESSURE TRANSMITTER. (Refer to paragraph 10-111; procedure is the same.)

10-146. INSTALLATION — TRANSMISSION OIL PRESSURE TRANSMITTER.

a. Screw transmitter into manifold.

b. Connect electrical connector and install lockwire.

10-147. TRANSMISSION OIL TEMPERATURE INDICATOR.

10-148. The transmission oil temperature indicator is electrically connected to the 28-volt dc essential bus. The electrical resistance type thermobulb installed in the transmission oil manifold measures temperature of the oil entering that unit.

10-149. TROUBLESHOOTING — TRANSMISSION OIL TEMPERATURE INDICATOR. (Refer to paragraph 10-119; procedure is the same.)

10-150. OPERATIONAL CHECK — TRANSMISSION OIL TEMPERATURE INDICATOR. (Refer to paragraph 10-120.)

10-151. MAINTENANCE — TRANSMISSION OIL TEMPERATURE INDICATOR. (Refer to paragraphs 10-7 through 10-11.)

10-152. AC VOLTMETER.

10-153. The AC voltmeter will indicate voltage of the main or spare inverter for AB, AC, or BC phases, according to position of VM selector switch on AC power panel in overhead console.

10-154. MAINTENANCE — AC VOLTMETER. (Refer to paragraphs 10-7 through 10-11.)

10-155. DC VOLTMETER.

10-156. A DC voltmeter is provided to indicate the voltage of the main generator, standby generator, essential bus, non-essential bus, or battery. These sources are selected by the VM selector on the DC power panel in the overhead console.

10-157. TROUBLESHOOTING — DC VOLTMETER. Perform checks as necessary to isolate trouble. (See figure 13-17.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No reading or erratic reading	Open or short circuit in instrument	Replace instrument
	Dirty or worn mechanism in instrument	Replace instrument

10-158. MAINTENANCE — DC VOLTMETER. (Refer to paragraphs 10-7 through 10-11.)

10-159. LOADMETER.

10-160. Two DC loadmeters are provided for main and standby DC generators to indicate output or load of each generator as percent of total capacity.

10-161. MAINTENANCE — LOADMETER. (Refer to paragraphs 10-7 through 10-11.)

10-162. FREE AIR TEMPERATURE GAGE.

10-163. The free air temperature gage is installed through the upper left corner of the pilot's windshield and measure the outside air temperature.

10-164. REMOVAL — FREE AIR TEMPERATURE GAGE.

a. Screw retainer off probe outside of the windshield.

b. Remove seal from probe and pull assembly out of windshield.

10-165. INSPECTION—FREE AIR TEMPERATURE GAGE.

a. Inspect assembly for corrosion.

b. Inspect for discoloration.

c. Inspect for leaking seal.

d. Check for proper temperature indication.

10-166. REPAIR OR REPLACEMENT — FREE AIR TEMPERATURE GAGE.

a. Replace assembly if unserviceable or damaged.

b. Replace seal if leaking or damage.

c. Replace assembly if it fails to register proper temperature indication.

10-167. INSTALLATION — FREE AIR TEMPERATURE GAGE.

a. Insert probe through windshield.

b. Position seal around probe against windshield.

c. Secure assembly to windshield by screwing retainer on probe.

CHAPTER 11

UTILITY SYSTEMS

SECTION I SCOPE

11-1. PURPOSE.

11-2. The purpose of this chapter is to provide information for maintenance personnel to accomplish organizational maintenance on the utility systems.

SECTION II HEATING AND VENTILATING SYSTEMS

11-3. HEATING AND VENTILATING.

11-4. CABIN HEATING - DEFROSTING SYSTEMS.

11-5. Basic helicopter has a defroster-heater system (see figure 11-1) using engine compressor bleed air, blended with outside air and routed through ducts under left side of cabin floor to registers under pilot seats and to nozzles at windshields and lower nose windows. Another duct system, extending under right side of cabin floor and connected through valves to defrost nozzles as well as to additional heat outlets, is not operational without installation of a combustion type heater kit but can be used for heating while on ground by connection of external heater duct at capped inlet provided on right side aft of cargo door. In this configuration all mechanical and electrical controls are complete for bleed air heat system. Electrical circuits for combustion heater are installed but stowed, ready for final connection during kit installation. Aft heat outlet ducts and heater fuel line are installed and capped.

11-6. WINTERIZATION EQUIPMENT.

11-7. For operation in cold weather conditions, an auxiliary combustion-type heater (see figure 11-2) may be installed in fuselage compartment at right side of fuselage, operating on fuel pumped from supply tanks through a fuel train assembly installed under left side of cabin floor.

11-8. BLEED AIR HEAT SYSTEM.

11-9. Bleed air heat-defrost system includes a five-position control valve, an air mixing valve, two noise suppressors, a four-position distribution valve, ducts, underseat registers, defrost nozzles, a heat selector valve with manual control, and electrical circuits with two rotary selector switches on BLEED AIR section of CABIN HEAT overhead control panel. (See figure 11-1.) Heat source is engine compressor bleed air, taken off from centrifugal compressor housing on T53-L-9 engine or from diffuser housing on T53-L-9A, -11, -11B, and -13 engine.

11-10. INSPECTION - BLEED AIR HEAT SYSTEM.

a. Check heater ducts for cracks, fraying and wear.

b. Check clamps for security and condition

c. Check defrost nozzles and underseat registers for cleanliness and freedom from obstructions.

d. Check manual control levers on pedestal for operation and freedom of movement.

e. Check electrical connections on all switches and circuit breakers for security. Check continuity of circuits. (Refer to Chapter 13.)

f. Check bleed air control valve for operation and security of attachment.

g. Check bleed air hose for security of attachment to bleed air control valve.

h. Check bleed air mixing valve for operation and security of attachment.

i. Check heat distribution valve for operation and security of attachment.

11-11. TROUBLE SHOOTING - BLEED AIR HEAT SYSTEM.

Note

Trouble shoot bleed air heat system in accordance with the following chart.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No heated air from nozzles or registers	Manual HEAT SELECTOR control at wrong position	Place control at BLEED AIR ON (or CLOSE ON YUH-1D)
	Faulty limit switch at manual control	Replace switch
	Open or faulty BLEED AIR circuit breaker	Reset or replace circuit breaker
	Faulty AIR control switch CABIN HEATING panel	Replace switch
	Faulty connection on bleed air valve	Repair electrical circuit to valve
Restricted warm air supply at nozzles and registers	Wrong reducer fitting at bleed air valve outlet (with T53-L-9 engine)	Install correct fitting for engine model
	Faulty bleed air valve operation	Repair control circuit or replace valve.
	Faulty air mixing valve	Replace valve
	Faulty BLEED AIR DEFROST circuit or distribution valve operation	Repair control circuit, or replace valve or actuator
	Leaks or obstruction in ducts.	Repair or replace ducts
	Air leaking through valve to right-hand (auxiliary heater) duct system	Repair or replace selector valve in pedestal
Excessive hot air	Wrong reducer fitting at bleed air valve outlet (with T53-L-9A, -11 series, and -13 engines)	Install correct fitting for engine model
	Faulty air mixing valve	Replace valve

BLEED AIR HEAT SYSTEM:

1. Engine Bleed Air Hose
2. Bleed Air Control Valve
3. Air Mixing Valve
4. Noise Suppressors
5. Bleed Air Heat Distribution Valve
6. Under-Seat Registers
7. Windshield Nozzles
8. Heat Selector Valve
9. Lower Window Nozzle
10. Heat Selector Control

AUXILIARY HEATING PROVISIONS:

11. Lower Right Outlet Control
12. Lower Left Outlet Control
13. Iris Valves
14. Auxiliary Heat Duct
15. Thermostat Dial
16. Door Post Outlets
17. Distribution Valve
18. Capped Fuel Line
19. Capped Aft Outlets
20. Spot Heating Connection

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Figure 11-1. Heat-defrost air system without auxiliary heater (Sheet 1 of 2)

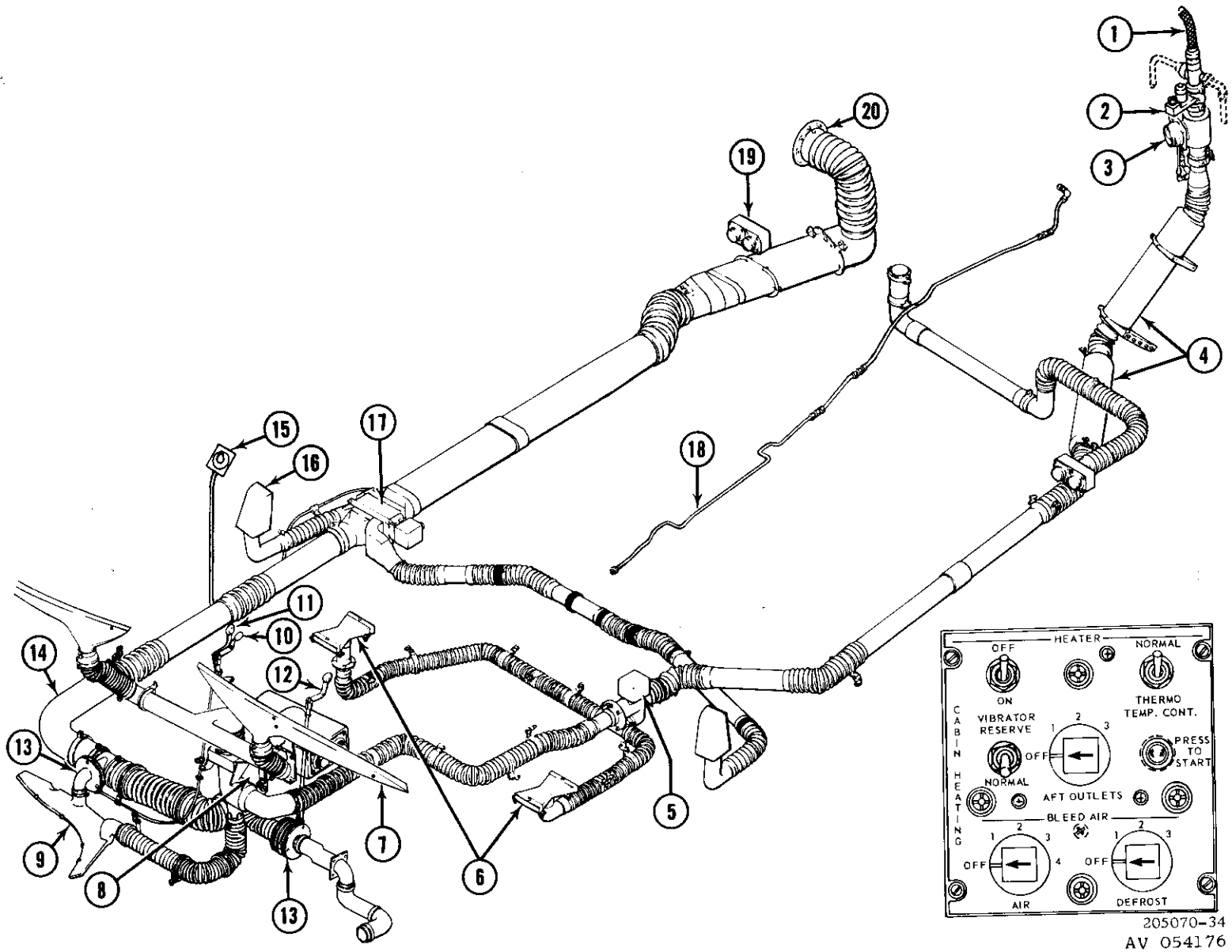


Figure 11-1. Heat-defrost air system without auxiliary heater (Sheet 2 of 2)

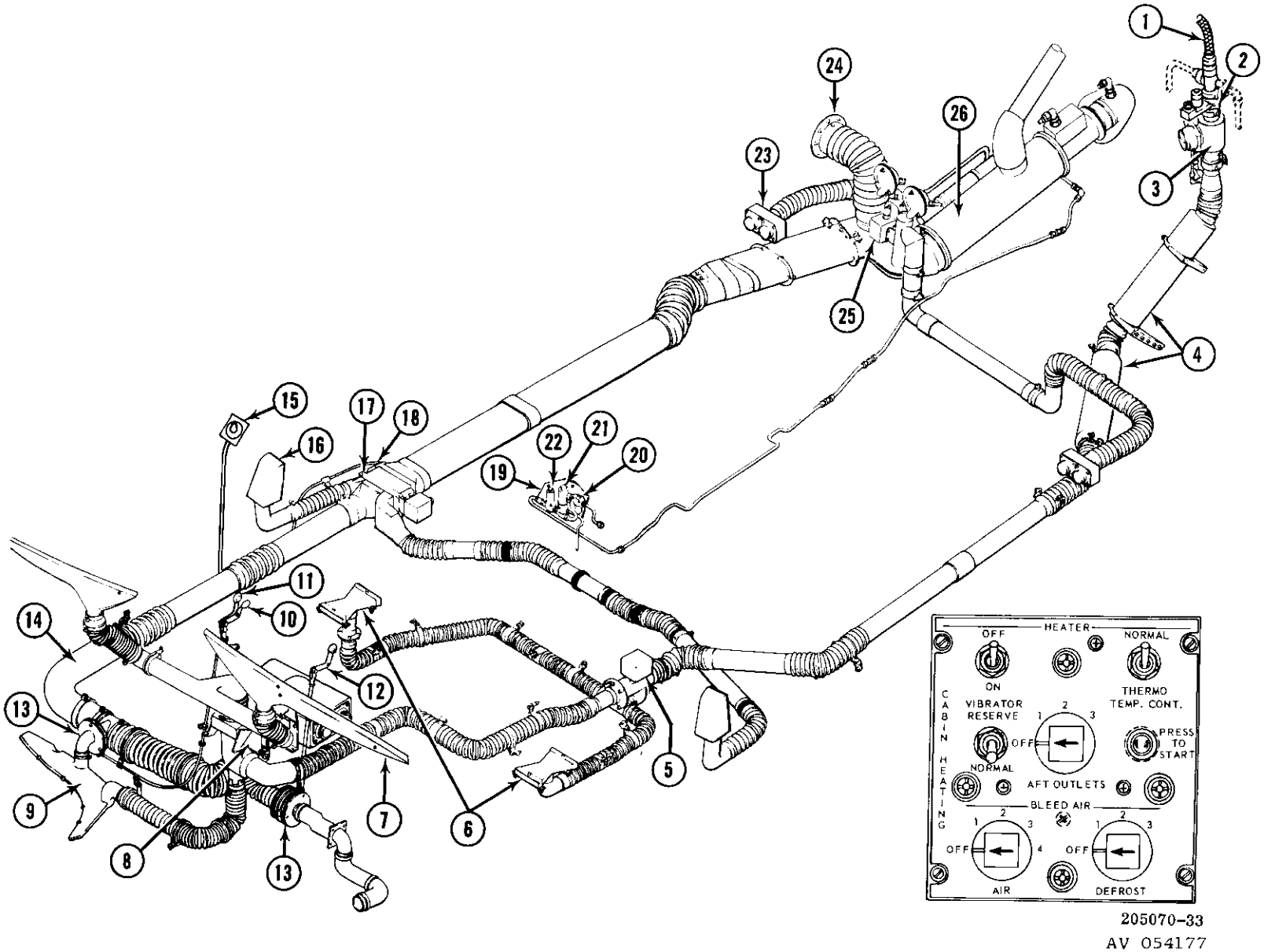


Figure 11-2. Heat-defrost air system with auxiliary heater (Sheet 1 of 2)

BLEED AIR HEAT SYSTEM:

1. Engine Bleed Air Hose
2. Bleed Air Control Valve
3. Air Mixing Valve
4. Noise Suppressors
5. Bleed Air Heat Distribution Valve
6. Under-Seat Registers
7. Windshield Nozzles
8. Heat Selector Valve
9. Lower Window Nozzle
10. Heat Selector Control

AUXILIARY HEATING SYSTEM:

11. Lower Right Outlet Control
12. Lower Left Outlet Control
13. Iris Valves
14. Auxiliary Heat Duct
15. Thermostat Dial
16. Door Post Outlets
17. Distribution Valve
18. Thermostat
19. Heater Fuel Train Assembly
20. Fuel Filter
21. Fuel Pump
22. Fuel Solenoid Valve
23. Aft Heat Outlets
24. Spot Heating Connection
25. Aft Outlets Valve
26. Auxiliary Combustion Heater

205070-33

Figure 11-2. Heat-defrost air system with auxiliary heater (Sheet 2 of 2)

11-12. BLEED AIR CONTROL VALVE.

11-13. Bleed air for heating is shut off or admitted in controlled amounts by a five-position electrically actuated butterfly valve, located on left side of engine compartment deck aft of the forward firewall. Inlet fitting above valve has a coupling for engine bleed air hose, and two noncontrolled connections for air lines to oil cooling blower and left fuel boost pump. Valve outlet is connected by fitting to air mixing valve. Valve automatically returns to OFF (closed) position if not electrically energized, as in event of circuit failure or if upper microswitch on right side of cabin pedestal is not held closed by manual HEAT SELECTOR lever.

11-14. INSPECTION - BLEED AIR CONTROL VALVE. Refer to paragraph 11-10.

11-15. AIR MIXING VALVE.

11-16. A temperature-operated hot air mixing valve is incorporated in bleed air heating system to regulate temperature of air used for cabin heating. Valve is located under left side of engine deck and is connected to bleed air control valve outlet. Operation of valve is automatic, admitting outside air through its butterfly, as required, to maintain an outlet air mixture within a predetermined temperature range.

11-17. INSPECTION - AIR MIXING VALVE. Refer to paragraph 11-10.

11-18. BLEED AIR HEAT DISTRIBUTION VALVE.

11-19. Bleed air heat is distributed to defrost nozzles or to under-seat registers by a butterfly type valve assembly, located under left side of cabin floor, inboard and aft of door post. Valve is operated by an electrical solenoid which is controlled by DEFROST switch on overhead panel.

11-20. INSPECTION - BLEED AIR HEAT DISTRIBUTION VALVE. Refer to paragraph 11-10.

11-21. AUXILIARY COMBUSTION HEAT SYSTEM.

11-22. Cabin heat-defrost auxiliary system for cold weather operation (see figures 11-2 and 11-3) includes a combustion type heater, with intake blowers for combustion air and for ventilation air, a fuel train to deliver fuel from supply tanks, an outlet plenum assembly, ducts, a distributor valve, heat outlets at aft wall of cabin and at door posts, manually controlled iris valves to lower nose window nozzle and outlet, rear part of HEAT SELECTOR valve in pedestal, and electrical power and control circuits. Electrical controls include switches on HEATER portion of CABIN HEATING overhead panel, circuit breakers for HEATER CONT. and HEATER POWER, a thermostat which senses heat in distributor valve and has a control dial on right door post, actuators on two distribution valves, three thermal switches in heater plenum, two air pressure switches connected to blowers, and two relays on inner wall of heater compartment. Operating instructions will be found in TM 55-1520-210-10.

11-23. TROUBLE SHOOTING - COMBUSTION HEATER.

Note

A general method and specific procedures are outlined below for isolating troubles which may occur in operation of the auxiliary combustion heater installation.

a. Check heater operation by starting in accordance with operating instructions. (Refer to TM 55-1520-210-10.)

(1) External power connected or BATTERY switch ON.

(2) HEATER POWER and HEATER CONTROL circuit breakers closed.

(3) HEATER switch ON.

(4) VIBRATOR switch NORMAL.

(5) PRESS TO START switch, hold 3 to 4 seconds, then release.

b. If heater starts, quickly check air distribution controls by use of manual levers and AFT OUTLETS rotary selector switch. During shutdown, check for proper operation of purging switch. (Refer to paragraph 11-24.)

c. If heater fails to start, determine whether trouble is in air, fuel, or ignition system of heater.

(1) Air System: Check whether both blowers on heater are operating. If not, proceed to paragraph 11-24.

(2) Fuel System: Check whether fuel is reaching inlet fitting of heater, by loosening fuel line connection enough to determine that there is flow. If not, proceed to paragraph 11-25.

Caution

Take precautions to avoid fire hazards.

(3) Ignition System: Verify ignition power to ignitor plug. If there is not ignition with VIBRATOR switch at NORMAL, place switch at RESERVE to try for proper operation through the alternate vibrator circuit provided in the heater ignition unit. If not, proceed to paragraph 11-26.

Caution

Heater ignition used 30,000 volts.

d. When checking functional systems of heater, follow indicated steps in order listed.

e. Check electrical circuits as required, using standard test voltmeters and continuity test equipment. (Refer to Chapter 13, for schematic and detailed wiring diagrams.) If a no-voltage condition is found at any point in a circuit, verify continuity of wiring back to last voltage point before replacing a component.

11-24. TROUBLE SHOOTING - HEATER AIR SYSTEM. Components involved in air system of combustion heater are:

Combustion Air Blower

Vent Air Blower

Purging Switch

HEATER POWER Circuit Breaker

HEATER ON/OFF Switch

Purging Relay

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No voltage at purging relay terminal X1	Broken wire	Repair or replace wire
	Faulty HEATER POWER circuit breaker	Replace breaker
No voltage at purging relay terminal A2	Faulty relay	Replace relay
	Broken wire between terminal X2 and HEATER ON/OFF switch	Repair or replace wire
	Faulty ON/OFF switch	Replace switch
Combustion blower not running	Faulty blower motor	Replace blower
Vent air blower not running	Faulty blower motor	Replace blower
Blowers do not continue running to cool heater plenum when HEATER switch is turned OFF after operation	Faulty purging switch	Replace purging switch

11-25. TROUBLE SHOOTING - HEATER FUEL SYSTEM. If combustion heater is still inoperative after check of air system, check for trouble in heater fuel system. All of the following units must function for heater to have fuel:

1. HEATER CONTROL Circuit Breaker
2. HEATER ON/OFF switch
3. Heater Blowers (Combustion and Vent Air)
4. Air Pressure Switches (Both)
5. Heater Lockout Relay
6. Overheat Switch
7. Heater START Switch
8. Heater Fuel Filter
9. Heater Fuel Pump
10. Heater Cycling Switch
11. TEMP. CONT. Switch
12. Cabin Thermostat
13. Heater Fuel Solenoid Valve

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No voltage at lockout relay terminal B1	Faulty HEATER CONTROL circuit breaker	Replace breaker
	Faulty HEATER ON/OFF switch	Replace switch
No voltage at lockout relay terminal A2	Faulty combustion or vent air pressure switch	Replace faulty pressure switch
No voltage at lockout relay terminals A1, B2, and X1	Relay not energized	
(1) No voltage on X1 with START switch pressed	Faulty START switch	Replace switch
(2) No voltage on B2 with START switch pressed	Faulty relay Faulty overheat switch	Replace relay Replace switch

Note

Trouble shooting to this stage also applies to heater ignition, which depends on proper functioning of all components, items 1 through 7, above.

Heater fuel pump motor not running	Broken wire to pump connector Pin A	Repair or replace wire
	Faulty pump motor	Replace pump
No fuel to pump inlet connection	Clogged fuel filter	Clean or replace filter
No voltage at TEMP. CONT. switch center terminal	Faulty cycling switch	Replace cycling switch
No voltage at heater fuel solenoid connector Pin B		
(1) With TEMP. CONT. switch at NORMAL (manual)	Faulty TEMP. CONT. switch	Replace switch

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
(2) With TEMP. CONT. switch at THERMO (auto)	Faulty TEMP. CONT. switch	Replace switch
	Cabin thermostat set above ambient temperature	Adjust thermostat
	Faulty thermostat	Replace thermostat
No fuel to inlet connection on heater	Faulty fuel solenoid valve	Replace valve

11-26. TROUBLE SHOOTING - HEATER IGNITION SYSTEM. If a combustion heater fails to operate after it has been determined that its air and fuel systems will function properly, look for cause of trouble in ignition. In addition to units in electrical circuits which are listed in fuel system trouble shooting procedure, ignition system components include ground electrode, ignitor plugs, high tension lead and ignition unit on heater, and a VIBRATOR selector switch with connecting wires.

Caution

Ignition unit output is 30,000 volts.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No voltage at ignition unit input connector Pin A	Broken wire	Repair or replace wire
No voltage at ignition unit input connector Pin B with VIBRATOR switch on RESERVE	Faulty VIBRATOR switch	Replace switch
No voltage at ignition unit output connector (lead disconnected)	Faulty ignition unit	Replace ignition unit
No voltage at end of high tension lead disconnected from plug	Faulty lead	Replace lead
Fuel does not ignite	Faulty ignitor plug	Replace plug

11-27. INSPECTION - COMBUSTION HEATER ASSEMBLY.

a. Inspect all parts for damage.

Note

Slight scaling and discoloration of radiator and jacket assembly is a normal condition for heaters that have been in service. The scale will be mottled, and a blue-gray powder is sometimes present. This condition is not cause for rejection of the unit, unless severe overheating has produced soft spots in metal.

b. Damage to radiator and jacket assembly can be classified as follows:

(1) Soft and spongy metal as a result of overheating. Can be detected by tapping lightly with a hammer. Soft spots will produce a dull sound in contrast to the solid ringing obtained when tapping on live metal. Soft spots will usually occur opposite the crossover passages.

(2) Deformation as a result of overheating can be detected by distortion of radiator wall near cross-over passages and by presence of extreme oxidation.

(3) Deformation as a result of backfiring. Backfiring usually pushes inner wall of the radiator in toward the combustion chamber. This condition may be present in a relatively new heater and is not considered serious unless it causes an increase of more than 10 per cent in the ventilating air pressure drop across the heater.

11-28. HEATER COMBUSTION BLOWER.

11-29. An electrically driven blower (5, figure 11-3) is connected to an inlet on right side of heater assembly.

11-30. INSPECTION - COMBUSTION AIR BLOWER.

a. Inspect brushes for damage and wear.

b. Inspect commutator for nicks, scratches, burned bars, visible grooving or visible wear in the brush track. If any bar or bars are visibly raised above the adjacent surface of the commutator, the armature should be discarded.

c. Inspect bearings for wear and rough spots.

d. Check commutator diameter for minimum diameter of 0.6719 inch.

11-31. VENTILATING AIR BLOWER.

11-32. The ventilating air blower (see figure 11-3) is an electrically driven, axial flow type blower with a multi-vane impeller. A radio noise filter is included as part of the component.

11-33. INSPECTION - VENTILATING AIR BLOWER.

a. Check commutator diameter for a minimum diameter of 0.9687.

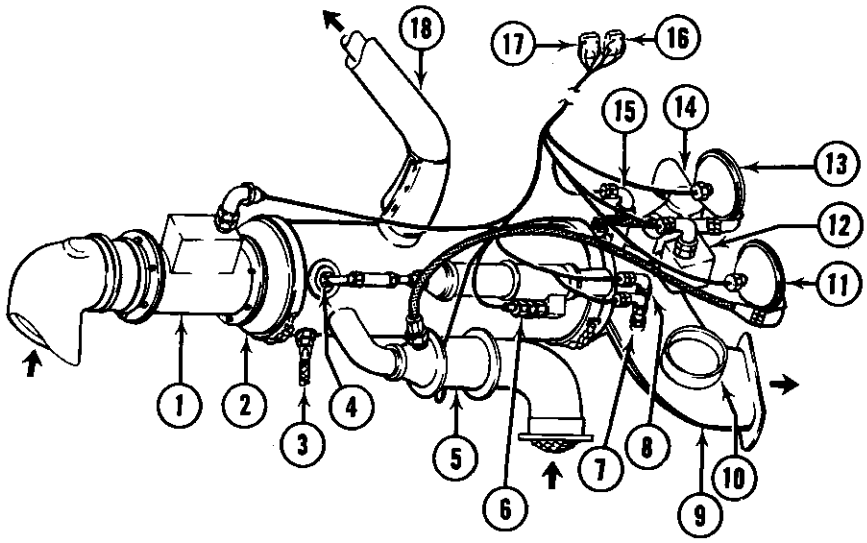
b. Check bearings for wear and rough spots.

c. Inspect brushes for damage and wear.

d. Inspect leads for damage.

11-34. HEATER AIR PRESSURE SWITCHES.

11-35. Two air pressure actuated switches (11 and 13, figure 11-3) are mounted in brackets on front



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1. Vent Air Blower
2. Combustion Heater
3. Fuel Inlet Hose
4. Ignitor Plug
5. Combustion Air Blower
6. Ignition Unit
7. Cycling Switch
8. Overheat Switch
9. Plenum
10. Spot Heating Duct Connection
11. Combustion Air Pressure Switch
12. Aft Outlets Selector
13. Vent Air Pressure Switch
14. Aft Outlets Valve
15. Purge Switch
16. Purging Relay
17. Heater Lockout Relay
18. Heater Exhaust

Figure 11-3. Auxiliary combustion heater

wall of heater compartment and connected by air hoses to combustion air blower and to heater plenum. Electrical circuits to heater lockout relay are such that power to heater ignition and fuel train will be shut off if either blower fails.

11-36. INSPECTION - HEATER AIR PRESSURE SWITCHES.

a. Check switches for operation and security of mounting.

b. Check security of electrical connections and security and condition of air hoses.

11-37. REMOVAL - AIR PRESSURE SWITCH.

a. Open heater compartment doors.

b. Be sure electrical power is off. Disconnect electrical connector from pressure switch being removed.

c. Disconnect air hose from fitting at bottom of switch assembly.

d. Remove mounting nuts to detach switch from bracket.

11-38. INSTALLATION - AIR PRESSURE SWITCH.

a. Assemble fittings from removed switch on replacement switch assembly, using new gasket.

b. Install switch assembly, with ports down for self draining, on mounting bracket.

c. Connect air hose to switch fitting.

d. Connect and lock-wire electrical connector.

e. Close compartment after operational check.

11-39. HEATER THERMAL SWITCHES.

11-40. Three temperature-actuated switches are mounted in heater outlet plenum and connected into electrical circuits. (See figure 11-3.) Cycling switch maintains a constant temperature range in duct, and is normally-closed type which closes on falling temperature, being set at 200°F (250°F on YUH-1D). Overheat switch is a safety feature to prevent excessive temperature in duct, and is normally-closed type which closes on falling temperature, being set at 300°F (350°F on YUH-1D). Purge switch keeps blowers running after heater shutoff until plenum has cooled down, and is a normally-open type closing on rising temperature, being set at 115°F. Temperature settings on all switches have a tolerance of plus or minus six degrees.

11-41. REMOVAL - THERMAL SWITCH.

a. Open heater compartment door at right side of fuselage.

b. Be sure electrical power is off. Disconnect electrical wiring connector from thermal switch to be replaced.

c. Remove thermal switch, with gasket, from plenum.

11-42. INSPECTION - HEATER THERMAL SWITCHES.

a. Check switches for operation and security of mounting.

b. Check electrical connections for security.

11-43. INSTALLATION - THERMAL SWITCH.

a. Install replacement switch, with gasket.

b. Connect and lock-wire electrical connector to thermal switch.

c. Close heater compartment door after operational check.

11-44. HEATER IGNITION.

11-45. Ignition to heater combustion chamber is provided by means of an ignition unit mounted on heater, a high voltage lead, an ignitor plug, and a ground electrode. (See figure 11-3.) Ignition unit is a vibrator type, energized by 28-volt DC to produce a high voltage oscillating current output for a continuous spark at gap between plug and electrode in combustion head. A spare set of vibrator points in ignition unit can be actuated by VIBRATOR switch on control panel when required.

11-46. REMOVAL - IGNITOR PLUG.

a. Open heater compartment doors.

b. Be sure electrical power is off. Disconnect electrical input connector from ignition unit.

c. Disconnect high voltage lead from ignitor plug. Remove plug.

d. Before cleaning, examine ignitor plug for evidence of cracked porcelain, arcing or carbon tracks in well of plug.

(1) If cracks are found, discard plug.

(2) Arcing or carbon tracks may be caused by shorting of plug or by dirt on spring connector that seats in well of plug. Faults must be corrected before reinstalling or replacing plug.

e. Wipe out grease or carbon deposits in well of plug with a clean cloth dampened with carbon tetrachloride.

11-47. CLEANING - IGNITOR PLUG. Clean ignitor plug by sand-blasting. Close well of plug with stopper to keep out dirt during cleaning.

11-48. INSPECTION - HEATER IGNITION.

a. Check ignition system for operation.

b. Check ignitor plug for condition and security.

c. Check vibrator unit for condition and security of mounting.

d. Check electrical lead for condition and security of connections.

11-49. INSTALLATION - IGNITOR PLUG.

a. Install ignitor plug and gasket, with 28 foot-pounds torque.

b. Connect high voltage lead to plug, and electrical wiring connector to input receptacles of ignition unit.

c. Close compartment door after operational check.

11-50. ADJUSTING - IGNITOR PLUG. If plug is replaced, be sure new plug is correct type with same length to maintain proper spark gap with ground electrode. If gap is believed incorrect, partial disassembly of heater and check of spark gap will be required, to be accomplished by qualified personnel in accordance with TM 1-15H1-2-10-3.

11-51. REMOVAL - HEATER IGNITION UNIT.

a. Be sure electrical power is off. Disconnect input and output leads from ignition unit on heater.

b. Remove nuts from clamps and lift off ignition unit.

11-52. INSTALLATION - HEATER IGNITION UNIT.

a. Position replacement ignition unit on heater and secure clamps.

b. Connect high voltage lead. Connect and lockwire input wiring connector to ignition unit.

c. Check for proper operation.

11-53. HEATER FUEL TRAIN.

11-54. Fuel train assembly for combustion heater consists of a filter, an electric pump, and a solenoid type fuel valve connected in series and mounted on a panel. (See figure 11-2.) Assembly is installed under cabin floor at right side, on front of bulkhead at fuselage station 102. In operation, pump draws fuel through filter from crossfeed line at front of right forward fuel cell and delivers it through valve to heater inlet line.

11-55. REMOVAL - HEATER FUEL TRAIN.

a. Remove floor plates as necessary for access to fuel train assembly.

b. Be sure electrical power is off. Disconnect electrical connectors from solenoid valve and pump.

c. Place suitable vessel to catch spilled fuel. Disconnect fuel lines from filter inlet and valve outlet, and disconnect drain line from pump. Cap open fittings and lines.

d. Detach panel from bulkhead by removing three mounting screws with spacers, washers, and nuts. Remove fuel train assembly.

11-56. INSPECTION - HEATER FUEL TRAIN.

a. Check heater fuel system for leaks.

b. Check filter for contamination.

c. Check fuel pump, fuel valve and filter for security of mounting.

d. Check electrical leads for condition and security of connections.

11-57. REPAIR OR REPLACEMENT - HEATER FUEL TRAIN.

a. Repair any fuel leaks in connections between units by replacing unserviceable gaskets, fittings, or lines.

b. Replace valve, pump, or filter in event of malfunction.

c. Replace filter element if clogged by fuel contamination. In normal service, element will be changed at heater overhaul.

11-58. INSTALLATION - HEATER FUEL TRAIN.

a. Insert three mounting screws through fuel train panel from front. Place a spacer on each screw at back of panel.

b. Position assembly to mounting holes at front of station 102 bulkhead, with pump 27.5 inches to right of cabin center line. Secure to bulkhead with washers and nuts.

c. Connect pump seal drain line. Connect heater fuel supply line to outlet fitting on solenoid valve. Connect fuel line from tank crossfeed tee fitting to filter inlet fitting.

d. Connect and lock-wire electrical connectors to pump and valve solenoid.

e. After operational check for leaks and proper function, reinstall floor plates over access opening.

11-59. CABIN THERMOSTAT.

11-60. A thermostat which controls output of combustion heater when TEMP. CONT. switch is at THERMO position, is mounted on outboard side of distribution valve below cabin floor near right door post. A control dial on door post changes setting of thermostat by means of a flexible cable.

11-61. REMOVAL - CABIN THERMOSTAT.

a. Remove floor panel at right side of cabin behind door post for access to distribution valve and thermostat.

b. Be sure electrical power is off. Disconnect electrical connector from thermostat.

c. Disconnect flexible control cable from thermostat.

d. Remove mounting screws to detach thermostat from mounting pad on valve assembly.

11-62. INSPECTION - CABIN THERMOSTAT.

a. Check thermostat for operation.

b. Check thermostat and thermostat dial for security of mounting.

c. Check electrical leads on thermostat for security.

11-63. INSTALLATION - CABIN THERMOSTAT.

a. Position replacement thermostat on side of valve and secure with mounting screws.

b. Connect control cable and electrical connector to thermostat.

c. Make operational check before reinstalling floor plate.

11-64. VENTILATION SYSTEM.

11-65. Volume and directional flow of air into cabin is controlled by one valve in each of two forward scoops and two valves in each of two aft scoops. The air scoops are located in cabin roof. Each scoop pan is vented by a tube to an opening in roof skin to prevent excessive moisture in the scoop.

Note

With the combustion (auxiliary) heater installed, cabin air may be changed by turning on the blowers without lighting the heater.

11-66. REMOVAL - AIR SCOOP ASSEMBLIES.

a. Remove screws from scoop assemblies on top of cabin roof and remove scoop.

b. Use a sharp non-metallic instrument for separating pan of either forward assembly from top cabin skin.

Note

Pan sections of air scoop assemblies are riveted to roof section and are not removable.

c. Pull drain tube assembly from pan assembly nipple inside cabin roof.

d. Remove the screws attaching air control valve to the pan and remove the valve from the assembly.

Note

The air control valve may be removed as a unit from inside the cabin without removing either the pan or air scoop.

11-67. INSPECTION - VENTILATION SYSTEM.

a. Check air scoops and valves for security of mounting and condition.

b. Check air valves for freedom of operation.

c. Inspect ventilation system and drain tubes for obstructions.

11-68. INSTALLATION - AIR SCOOP ASSEMBLY.

a. Position control fitting on pan assembly, align holes and install attaching screws.

b. Place a bead of zinc chromate putty (item 200, table 1-2) on mating sections of roof skin (forward scoops only), position pan and align screw holes.

c. Position scoop assembly on pan assembly, align holes and install screws.

11-69. AUXILIARY EXHAUST HEATER INSTALLATION.

11-70. The auxiliary exhaust heater system (see figure 11-4) consists of a heat exchanger on the exhaust tailpipe, a blower for circulating air through the heat exchanger, a mixing valve to control the air to maintain the desired temperature, a plenum assembly which controls the aft cabin outlet ducts, and connect ducts.

11-71. INSPECTION - AUXILIARY EXHAUST HEATER.

a. Check heater ducts for cracks, fraying and wear.

b. Check clamps for security and condition.

c. Check hot air mixing valve for security of mounting.

d. Check temperature control valve for security of mounting.

e. Check plenum for damage and security of mounting.

11-72. HEAT EXCHANGER - UH-1D/H (SERIAL NO. 60-6028 THROUGH 65-12895).

11-73. The heat exchanger (1, figure 11-4) is mounted on the tail pipe of the engine and serves to heat the air as it is distributed through the heat-defrost system. Air is circulated through heat exchanger by the blower fan (4).

11-74. BLOWER.

11-75. An air-driven blower (7, figure 11-4) is connected to the inlet port of the heat exchanger (1).

11-76. INSPECTION - AIR BLOWER.

a. Check blower for damage.

b. Check blower for security of mounting and security of attachment of bleed air hose and ducts.

11-77. HOT AIR MIXING VALVE ASSEMBLY.

11-78. The hot air mixing valve (14, figure 11-4) controls the air to maintain the desired temperature of air routed to the cabin. The valve assumes its position as a result of increasing or decreasing pressures, as dictated by the remote sensor, using bleed air through the actuator to drive the butterfly to the correct position.

11-79. INSPECTION - HOT AIR MIXING VALVE ASSEMBLY. Refer to paragraph 11-71.

11-80. TEMPERATURE CONTROL VALVE.

11-81. The temperature control valve (24, figure 11-4) senses the air temperature in the distribution ducts and controls the hot air mixing valve by increasing or decreasing bleed air pressure by positioning the flapper valve to maintain the selected temperature.

11-82. REMOVAL - TEMPERATURE CONTROL VALVE. (See 24, figure 11-4.)

a. Disconnect tube (18, figure 11-4) from distribution valve (19) and tube (17).

b. Remove brackets that attach tubing (11) to lower end of bulkhead fitting. Disconnect tubing (11) from reducing adapter (12) in bleed air line and remove.

c. Disconnect tubing (11) from temperature control valve (24).

d. Remove tubing (17) from bulkhead fitting and disconnect from temperature control valve (24).

e. Remove clamp that secures duct (25) to elbow (26).

f. Remove elbow (26) and gasket from temperature control valve (24).

g. Remove clamp that secures duct (8) to temperature control valve (24).

h. Remove clamp that secures duct (22) to temperature control valve (24).

i. Remove bolts that secure temperature control valve (24) to cabin deck and remove temperature control valve.

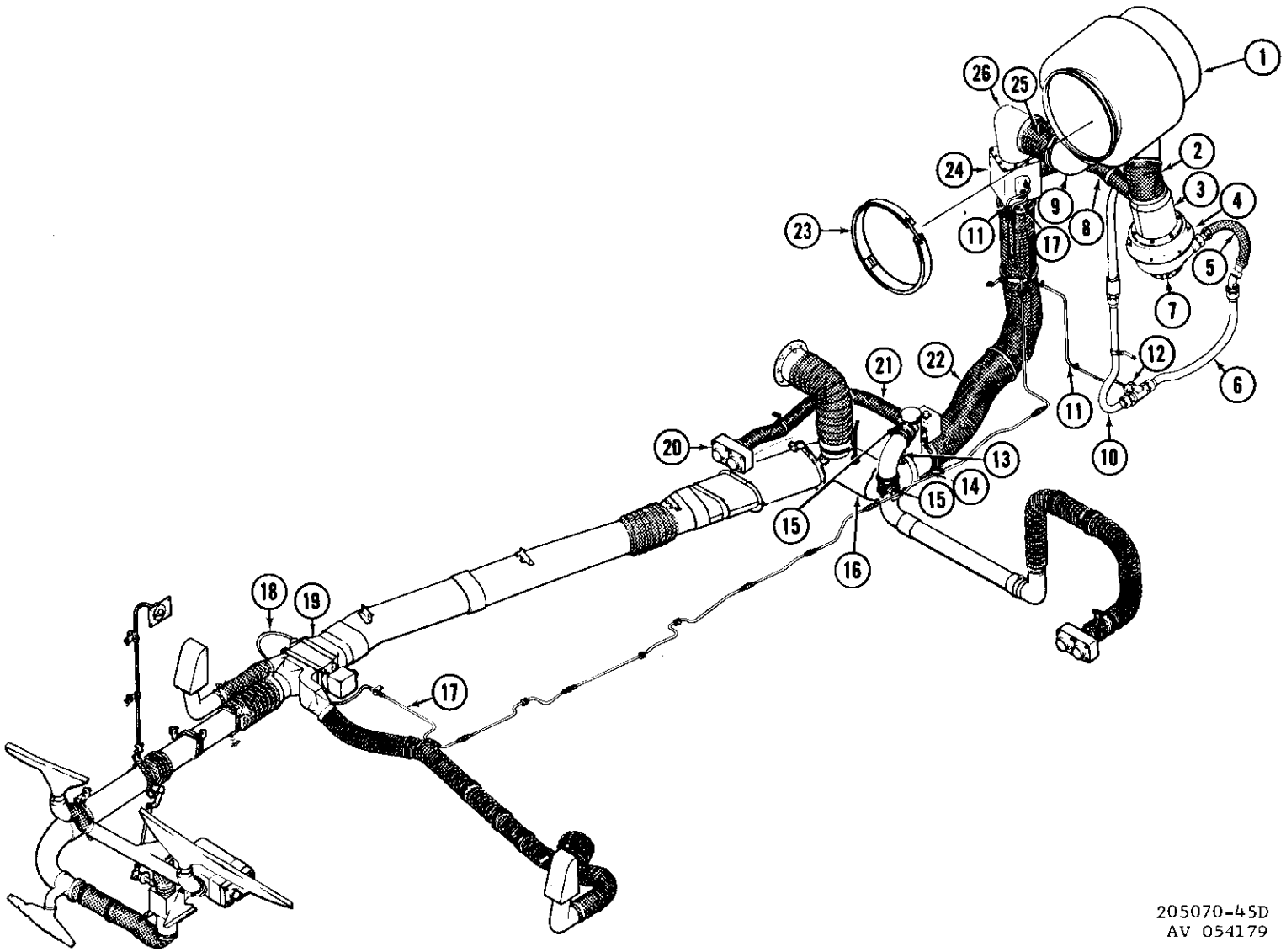
11-83. INSPECTION - TEMPERATURE CONTROL VALVE. Refer to paragraph 11-71.

11-84. INSTALLATION - TEMPERATURE CONTROL VALVE.

a. Remove cover on right side of deck.

b. Position temperature control valve (24, figure 11-4) through hole in cabin deck and secure with bolts.

c. Position duct (8) on aft port of temperature control valve (24) and secure duct to temperature control valve with clamp, screw, washer, and nut.



1. Heater Exchange
2. Duct
3. Tee
4. Fan
5. Hot Air Bleed Line
6. Tube
7. Blower
8. Duct
9. Elbow
10. Drain Line
11. Tubing
12. Reducer
13. Elbow
14. Hot Air Mixing Valve
15. Flexible Coupling
16. Plenum
17. Tube
18. Tube
19. Distribution Valve
20. Capped Air Outlets
21. Duct
22. Duct
23. "V" Clamp
24. Temperature Control Valve
25. Duct
26. Elbow

Figure 11-4. Exhaust heater installation

d. Position gasket on top flange of temperature control valve (24). Position elbow (26) on temperature control valve (24) and secure with screws.

e. Position duct (25) on elbow (26) and secure with clamp, screw, washer, and nut.

f. Position temperature control valve (24) on duct (22) and secure with clamp.

g. Remove cap from existing bulkhead fitting at right hand forward side of deck. Install tubing (17) from bulkhead fitting to inboard connection of temperature control valve (24).

h. Remove plug from deck and install bulkhead fitting and jam nut.

i. Install tubing (11) from bulkhead fitting to fitting on temperature control valve (24).

j. Attach tubing (11) to lower end of bulkhead fitting, previously installed and route and attach to reducing adapter (12) in hot air bleed line (5) on left side of fuselage. Secure tubing to bulkhead with brackets, screws, washers, and nuts.

k. Remove cap from tube (17) and attach flexible tube (18). Route tube (18) beneath distribution valve (19) and connect to sensor switch.

l. Unstow electrical plug near hot air mixing valve (14) and attach sensor on aft side of hot air mixing valve.

11-85. PLENUM ASSEMBLY.

11-86. The plenum assembly controls the flow of air to the aft cabin.

11-87. REMOVAL - PLENUM ASSEMBLY.

a. Remove clamps and ducts from valve assembly.

b. Remove cable assembly from plenum.

c. Disconnect electrical wiring.

d. Remove mounting screws and washers, and lift assembly from helicopter.

11-88. INSPECTION - PLENUM ASSEMBLY. Refer to paragraph 11-71.

11-89. INSTALLATION - PLENUM ASSEMBLY.

a. Position plenum assembly in place and install mounting screws and washers.

b. Install ducts and clamps.

c. Connect cable assembly and electrical wiring.

11-90. DUCTS, NOZZLES, REGISTERS, GASKETS AND MISCELLANEOUS VALVES.

11-91. Maintain heater miscellaneous components (see figures 11-1, 11-2 and 11-4) in accordance with the following paragraphs.

11-92. REMOVAL - DUCTS, NOZZLES, REGISTERS, GASKETS AND MISCELLANEOUS VALVES. Remove attaching hardware and/or clamps and remove component.

11-93. INSPECTION - DUCTS, NOZZLES, REGISTERS, GASKETS AND MISCELLANEOUS VALVES.

a. Inspect hoses for cracks, corrosion, wear and deterioration.

b. Inspect nozzles, registers and valves for damage and serviceability.

c. Inspect gaskets for damage.

d. Inspect duct screens for obstructions, cuts and cleanliness.

e. Inspect flexible air ducts as follows:

(1) Silicone damage not in excess of 3.00 inches in length and 1.50 inches wide.

(2) Maximum of two repairs per foot of duct.

(3) No more than 3% of surface area may be repaired.

11-94. REPAIR OR REPLACEMENT - DUCTS, NOZZLES, REGISTERS, GASKETS AND MISCELLANEOUS VALVES.

a. Replace damaged or unserviceable hoses.

b. Replace nozzles, registers, valves and gaskets which do not meet inspection requirements.

c. If necessary, clean and remove obstructions from duct screens. Replace screens if cut or damaged.

d. Repair flexible air ducts as follows:

(1) Clean damaged area with Xylene (item 321, table 1-2) or Toluene (item 322, table 1-2). Allow cleaned area to air dry a minimum of 30 minutes.

(2) Apply a brush coat of adhesive (item 214, table 1-2) on damaged area with a 0.500 inch overlap from edge of damaged area.

(3) Smooth and cure by air drying a minimum of two hours at room temperature or until it is dry to the touch.

Note

For repair of damage to the fiber glass cloth, the limitation is no more than 10% of surface area after completion of repair.

(4) Clean the complete circumference of the air duct in the vicinity of damaged area with Xylene (item 321, table 1-2) or Toluene (item 322, table 1-2). Allow cleaned area to air dry a minimum of 30 minutes.

(5) Use brush to apply a thin coat of adhesive (item 214, table 1-2) to the complete circumference of the duct in the damaged area and smooth out adhesive.

(6) Cut a piece of fiber glass cloth (item 511, table 1-2) of sufficient size to cover the complete circumference of the duct, with a one inch overlap of the damaged area.

(7) Wrap fiber glass cloth around duct and smooth out.

(8) Allow to air dry a minimum of two hours or until dry to touch before handling.

11-95. INSTALLATION - DUCTS, NOZZLES, REGISTERS, GASKETS AND MISCELLANEOUS VALVES. Install component and secure with attaching hardware and/or clamps.

SECTION III ANTI-ICING AND DEICING SYSTEM

(Not Applicable)

SECTION IV OXYGEN SYSTEM

(Not Applicable)

SECTION V FIRE DETECTOR SYSTEM

11-96. FIRE DETECTION SYSTEM - ENGINE.

11-97. The engine fire detection system (see figure 11-5) consists of a fire detector unit, FIRE WARNING caution light, and FIRE DETECTOR TEST pushbutton switch. The fire detector unit consists of two heat sensitive wires (2) one on inside of each engine cowl in the engine compartment. The wires are mounted in spring support brackets (3). The caution light and test switch are located on the instrument panel.

11-98. TROUBLE SHOOTING - FIRE DETECTOR. The following is a list of indications of trouble, probable causes and corrective action.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator light inoperative	Burnt out bulb	Replace bulb
	Defective test switch	Replace switch
	Loose electrical connections	Tighten connections
	Broken or disconnected detector wire	Replace or connect detector wire

11-99. TESTING - FIRE DETECTOR.

a. Disconnect electrical plug located in work deck directly under power plant on left-hand side of helicopter at station 184.41.

b. Short receptable pins "C" and "F" together, depress the "Push-to-Test" switch. Fire warning light should come on.

Note

This test assures that the test and control circuit is operable.

c. Remove the jumper wire from pins "C" and "F" and use it to short either receptacle pin "C" or "F" to ground.

d. Fire warning light should come on.

Note

This test assures that the alarm circuit is operable.

e. Use an ohmmeter to check conductivity between pins "C" and "F" at plug side of harness.

Note

Maximum resistance should not exceed 20 ohms. If higher value registers, check all connectors for tightness.

f. Use an ohmmeter to check either pin "C" or "F" to ground at plug side of harness.

Note

Value register should always be a minimum of 200,000 ohms at an ambient temperature of 72°F. As the ambient temperature rises, the resistance value of pin "C" or "F" to ground will decrease. At 100°F this resistance should be a minimum of 100,000 ohms.

g. If the above values are not obtained, it will be necessary to check each cable for resistance from center pin of cable to ground. At 72°F, the minimum value of each cable is one megohm. Resistance below this value will indicate a faulty cable which should be replaced.

h. Re-connect main firewall cannon plug.

i. Depress "Push-to-Test" switch to assure that system is properly assembled.

j. Install a Jet-Cal Tester Unit to area of cable that assures a good fit for the temperature probe.

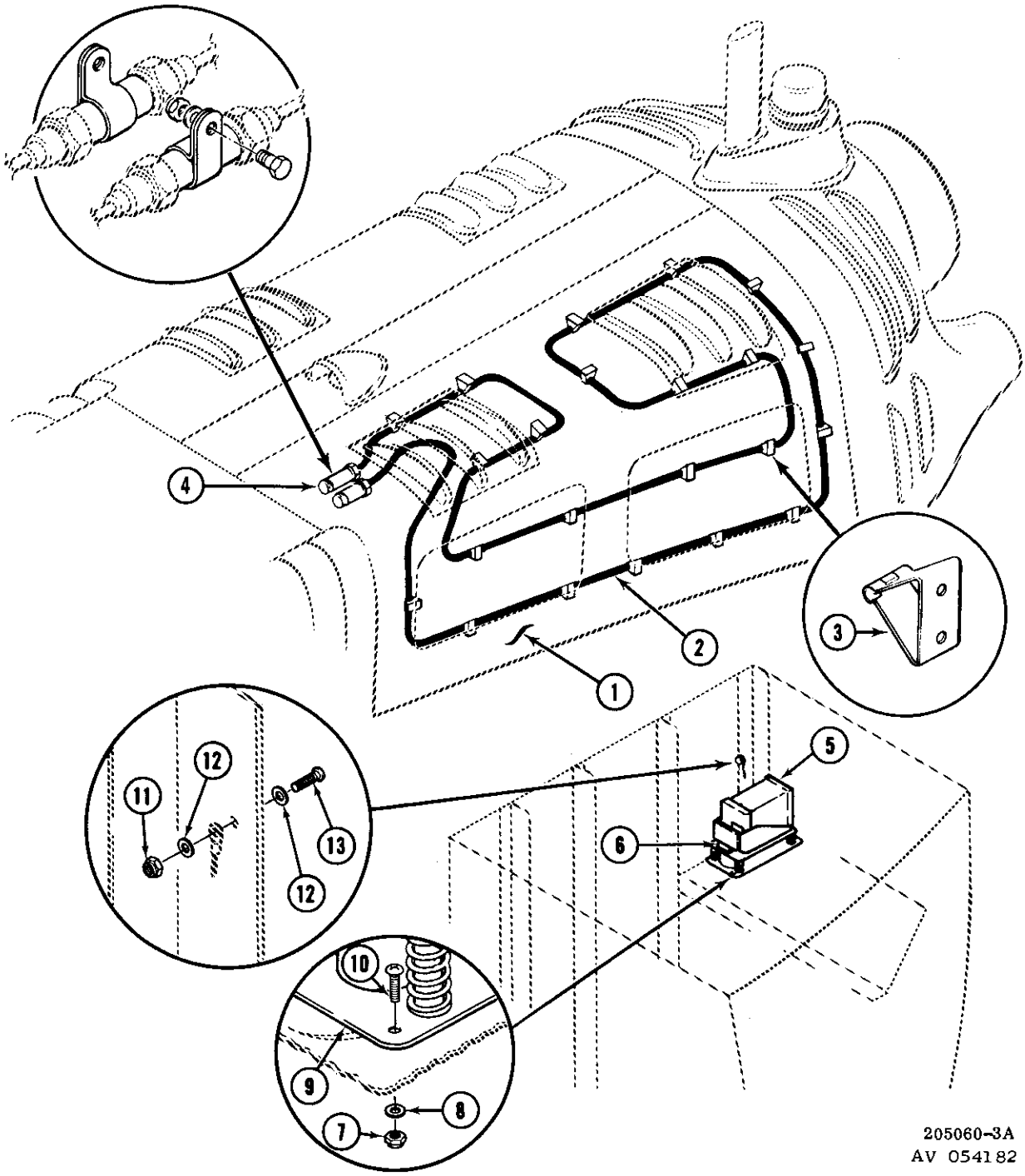
Note

Make sure that temperature probe is contacting nothing but the cable. It is easy to "heat-sink" the probe if contact is made with helicopter structure.

k. When alarm light comes on, check indicator on Jet-Cal Tester Unit. Value should be 429°F plus or minus 111°F.

Note

The Jet-Cal Tester Unit is only a check system under heated condition. The temperature warning light comes on is not a good indication of system operation temperature.



1. Engine Cowl (LH)
2. Fire Detector Wire
3. Support Bracket
4. Receptacle
5. Fire Detector Control Box
6. Resistor
7. Nut
8. Washer
9. Mount
10. Screw
11. Nut
12. Washer
13. Screw

Figure 11-5. Engine fire detector

l. Remove test equipment and safety wire all electrical connectors and cannon plugs.

11-100. REMOVAL - FIRE DETECTOR.

a. Make sure battery switch is in "OFF" position.

b. Disconnect electrical wiring from detector wire receptacles and cover wire ends with insulating tape.

c. Remove bolts, washers, and nuts attaching detector wire receptacles to engine cowl.

d. Apply pressure on each side of detector wire retaining clips and remove detector wire from cowl.

e. Remove safety wire from retaining nuts on each end of detector wire receptacles. Remove top nut on each receptacle and remove detector wire ends.

f. Remove fire detector control unit located in electrical and radio compartment, station 178.00 on left hand side of helicopter, as follows: (see figure 11-5).

(1) Make sure that battery switch is in "OFF" position.

(2) Disconnect cable connector from the fire detector control box (5).

(3) Remove screw (13), two washers (12), and nut (11) securing ground cable to bulkhead.

(4) Remove four screws (10), four washers (8), and four nuts (7), securing fire detector control box (5) to shelf of electrical and radio compartment.

(5) Remove fire detector control box (5).

11-101. INSPECTION - FIRE DETECTOR.

a. Inspect wires for damage and wear.

b. Inspect wire retention clips for cracks and serviceability.

c. Inspect fire detector control box for security of mounting.

11-102. REPAIR OR REPLACEMENT - FIRE DETECTOR.

a. Replace wires if damaged or worn.

b. Replace clips if broken, cracked, or unserviceable.

c. Replace fire detector control box if unserviceable.

11-103. INSTALLATION - FIRE DETECTOR.

a. Insert detector wire ends into receptacle and tighten retaining nuts. Safety wire top and bottom retaining nuts together, on each receptacle.

b. Position detector wire receptacles on engine cowl and install attaching units, washers, and bolts.

c. Position and route detector wire through spring retention clips.

d. Remove insulating tape from wire ends and connect electrical wiring to detector wire receptacles.

e. Install fire detector control box in electrical and radio compartment, station 178.00 on left hand side of helicopter as follows: (see figure 11-5).

Note

Before installation, check resistor (6) for continuity and security on face of fire detector control box.

(1) Secure fire detector control box (5) to shelf of electrical and radio compartment using four screws (10), four washers (8), and four nuts (7).

(2) Attach ground cable to bulkhead with screw (13), two washers (12), and nut (11).

(3) Reconnect battery.

SECTION VI FIRE EXTINGUISHER SYSTEM

(Not Applicable)

SECTION VII DEFROSTER SYSTEM

(Refer to Section II)

SECTION VIII WINDSHIELD WIPER SYSTEM

11-104. WINDSHIELD WIPER.

11-105. Model UH-1D/H helicopters are equipped with a windshield wiper for both pilot and copilot. Circuit breakers in the overhead console panel protect these installations in case of malfunction. A five position rotary switch on the miscellaneous panel of the overhead console permits operation of the wipers at low, medium or high speed. A selector switch permits operation of pilot and copilot windshield wipers separately or simultaneously. Special tools required to perform the following maintenance functions on the windshield wiper system are listed below in Table 11-1.

TABLE 11-1. SPECIAL TOOLS

PART NUMBER	NOMENCLATURE
XW 20509	Wrench

11-106. REMOVAL - WINDSHIELD WIPER AND MOTOR-CONVERTER.

a. Turn battery to OFF position.

Caution

Install 3/32 cotter key in stand-off holes prior to removal of windshield wipers.

b. Remove windshield wiper blade and universal arm from motor shaft. Disconnect electrical receptacle.

c. Remove bolts which attach head guard bracket and windshield wiper support to cabin. Lift brackets, and motor-converter from cabin.

d. Remove four nuts, washers, and bolts which attach motor-converter to bracket support.

11-107. INSPECTION - WINDSHIELD WIPER BLADE. Inspect blade for deterioration and serviceability. Check continuity of electrical circuits. (Refer to Chapter 13.)

11-108. REPAIR OR REPLACEMENT - WINDSHIELD WIPER BLADE. Replace unserviceable blade.

11-109. INSTALLATION - WINDSHIELD WIPER AND MOTOR-CONVERTER.

a. Position motor-converter in support and install mounting bolts, washers, and nuts.

b. Place converter shaft through hole in cabin and position head guard assembly over motor-converter. Align holes in head assembly and windshield wiper support with holes in cabin, and install mounting screws and connect electrical receptacle.

c. Operate the motor-converter so that wiper shaft is stopped in the PARK position.

d. Install wiper arm and blade assembly on serrated shaft so that blade will be parallel to and 5.0 to 5.5 inches below the windshield wiper stop, with a slight upward pressure being applied to arm.

e. Tighten Allen head screw clamping wiper arm to shaft, install washer and mounting bolt. Safety the Allen screw to mounting bolt.

f. Using wrench No. XW20509, adjust pressure of blade on windshield to 4.5 to 5 pounds measured at intersection of wiper blade and wiper arm.

Caution

Do not operate wiper on dry windshields. Install 3/32 inch cotter key in standoff holes before operating.

g. With battery switch ON and wiper circuit breaker IN, using wiper control switch, operate the wiper through all speeds, and return to the PARK position.

Caution

Testing of the windshield wiper with blade raised clear of windshield should be done in small increments. Do not allow blade to operate fast enough to cause whipping, this can bend wiper arm.

h. Remove 3/32 inch cotter key from standoff holes and carefully lower blade onto windshield.

SECTION IX AUXILIARY POWER UNIT

(Not Applicable)

SECTION X VACUUM SYSTEM

(Not Applicable)

SECTION XI AUXILIARY FUEL SYSTEM

11-110. 300 GALLON FUEL SYSTEM - AUXILIARY.

11-111. Two 150 U.S. gallon capacity auxiliary fuel cells (see figure 11-6) may be installed in the passenger-cargo compartment of the YUH-1D and UH-1D/H helicopters for extended distance and ferry missions. The cells are located at the intersection of the aft cabin bulkhead and the transmission support structure, one on each side of cabin. Each cell is equipped with an electrically operated fuel transfer pump, a fuel low-level switch for controlling CAUTION panel indicator AUX FUEL LOW circuit, fittings and flexible hoses with quick-disconnect couplings. The fuel cell hoses connect to lines under the cabin floor which are a permanent part of the main fuel system. The auxiliary transfer pump circuit relay is controlled by float switches in the main fuel cells. (Refer to TM 55-1520-210-10 for operating instructions and general information.)

11-112. REMOVAL - AUXILIARY FUEL CELLS.

Note

Procedure is the same for both tanks.

Note

Drain fuel from auxiliary cells before removing from helicopter.

a. Disconnect four fuel lines (fuel discharge, cell vent, seal drain, and cell drain) and electrical connector at cabin floor.

b. Install protective devices, over ends of all lines and plugs, under deck and on cell.

c. Install cover plate over fuel line access hole on cabin floor.

d. Disconnect auxiliary cell holding straps from studs (18 points) at aft cabin bulkhead and transmission support structure.

e. Unhook two nylon cord loops on top of cell.

f. Carefully remove cell from helicopter.

Note

For repair, handling, and storage instructions of fuel cell, refer to TM55-405-3.

g. If auxiliary cell is to remain out of the helicopter, remove all fuel cell equipment kit items from aft cabin bulkhead and transmission support structure and place in storage compartment in door post. Reinstall all troop seats and litter fittings along sides of aft cabin bulkhead and transmission support structure.

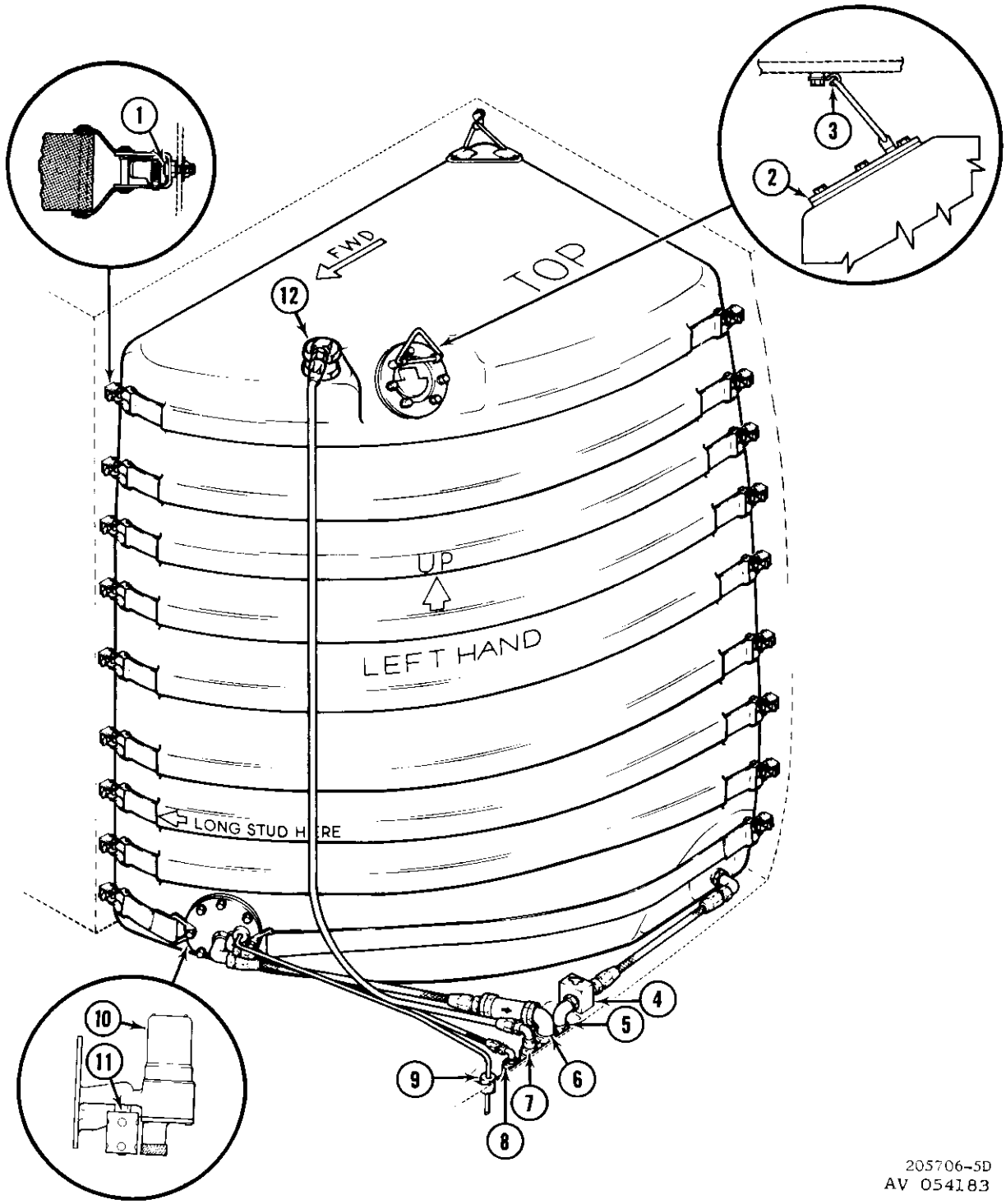
11-113. FUEL PUMP - AUXILIARY FUEL CELL.

11-114. The electrically operated fuel pump is capable of pumping approximately 600 pounds of fuel per hour at sea level. The auxiliary fuel cell incorporates a float switch to give CAUTION panel (AUX FUEL LOW) indication to the pilot when fuel level is low.

11-115. REMOVAL - FUEL PUMP - AUXILIARY FUEL CELL.

Note

Turn battery switch to OFF. Drain all fuel from cell.



1. Stud
2. Fuel Tank Cap and Adapter Assembly
3. Hook
4. Valve
5. Tank Drain Line
6. Fuel Discharge Line
7. Tank Vent Line
8. Pump Seal Drain Line
9. Electrical Connector
10. Pump Assembly
11. Float Switch
12. Vent Valve

Figure 11-6. Auxiliary fuel cell installation - typical

a. Disconnect electrical connector and two fuel lines (fuel discharge and seal drain) at access port in cabin floor.

b. Remove seven bolts and washers holding fuel pump and holding-strap fittings to fuel cell.

c. Carefully withdraw pump and O-ring from fuel cell by pulling outward and upward on fuel pump base. Upward movement is required in order to clear pump body through opening in cell.

11-116. INSTALLATION - FUEL PUMP - AUXILIARY FUEL CELL.

a. Install fuel pump and O-ring into cell with flat section of mounting flange down, using reverse procedure to that noted in step c., above.

b. Install seven bolts and washers, two passing through the fittings of cell holding strap.

c. Tighten bolts to a torque of 50 to 70 inch-pounds.

d. Connect electrical connector and two fuel lines in access port in cabin floor.

e. Check installation for leaks.

Note

Fuel cell installation to be pressure tested with fuel discharge lines, sump drain lines, vent lines, and seal drain lines capped. Pressurize cells to 2.5 psig and shut off air source. Cells shall retain 2.5 psig pressure for 15 minutes.

11-117. INSTALLATION - AUXILIARY FUEL CELLS.

a. Remove troop seats and litter fittings from aft cabin bulkhead and sides of transmission support structure.

b. Remove auxiliary fuel cell equipment kit items from stowage in doorpost. Install 18 studs and washers into cap plate nuts on aft cabin bulkhead and transmission support structure. Tighten studs to a torque of 50 to 70 inch-pounds.

Note

The long stud is used in third plate nut from bottom of transmission support structure.

c. Install spacer, hook, washer, and bolt into plate nut at top of transmission support structure. Install like items in plate nut at top of aft cabin bulkhead. Tighten bolts to a torque of 50 to 70 inch-pounds.

d. Carefully lift cell into helicopter.

e. Thread 0.187 inch nylon cord through two aft cell hangers and through hook on upper transmission support structure. Tighten and tie cord in such a manner as to retain fuel cell to support structure. Repeat process to secure forward end of fuel cell to aft cabin bulkhead, using cord through delta ring hanger and hook on cabin bulkhead.

f. Snap cell-holding straps to studs on aft cabin bulkhead and transmission support structure. (See figure 11-6.)

g. Remove cover over fuel lines access on top of cabin floor; remove caps from all lines and plugs.

h. Connect electrical connector and four lines from cell.

i. Repeat above procedure for other fuel cell and service cells as required; check operation. (Refer to TM 55-1520-210-10.)

CHAPTER 12

ELECTRICAL SYSTEMS

SECTION I SCOPE

12-1. PURPOSE.

12-2. This chapter provides the instructions and information required by organizational maintenance personnel to perform maintenance on the UH-1D/H electrical system.

12-3. GENERAL.

12-4. All DC electrical power in the helicopter during flight is supplied by a 24 volt battery or by either of two 28 volt dc generators. The main DC generator is mounted on and driven by the main rotor transmission. The stand-by generator is a combination starter-generator which is mounted on and driven directly by the helicopter engine. Control panels for the AC and DC electrical systems are located on the overhead console between the pilot and copilot. Control relays, power relays, voltage regulators, and other equipment required to control and regulate, and to effect power transfer and malfunction monitoring are located in the upper (aft) electrical compartment on left side of fuselage. On YUH-1D and UH-1D/H through 62-12376 a lower (aft) electrical compartment is utilized. On UH-1D/H 63-8739 and subsequent, the inverters and associated equipment, formerly located in the aft electrical compartment, are relocated to the nose compartment just forward of the pedestal. For compartment location, see figure 12-1. For equipment location, see figure 12-2. See tables 13-1 through 13-4 for equipment listing; table 13-5 for connector replacement chart. See figures 13-3 through 13-9 for load analysis charts; figures 13-10 through 13-39 for systems wiring diagrams; figures 13-40 and 13-41 for armament wiring diagrams, and figures 13-42 through 13-49 for wiring diagrams of helicopters prior to 65-9565.

Note

1. Illustrations pertaining to circuit breakers, control panel arrangement and face identification are contained in TM 55-1520-210-10.

2. Throughout this chapter when performing operational checks external power should be utilized whenever possible. Perform operational checks to make certain that circuits are free of possible potential malfunction when equipment is replaced or airframe wiring is repaired or replaced.

3. Words "cycles" or "hertz" are used to designate frequency; either word has the same meaning. The abbreviation "cps" carries the same meaning as "Hz".

12-5. OPERATIONAL CHECKS – ELECTRICAL. Systems diagrams, wiring diagrams and schematics shall be utilized in accomplishing functional tests of electrical circuits and components. Tests shall be conducted after installation, repair or replacement of equipment.

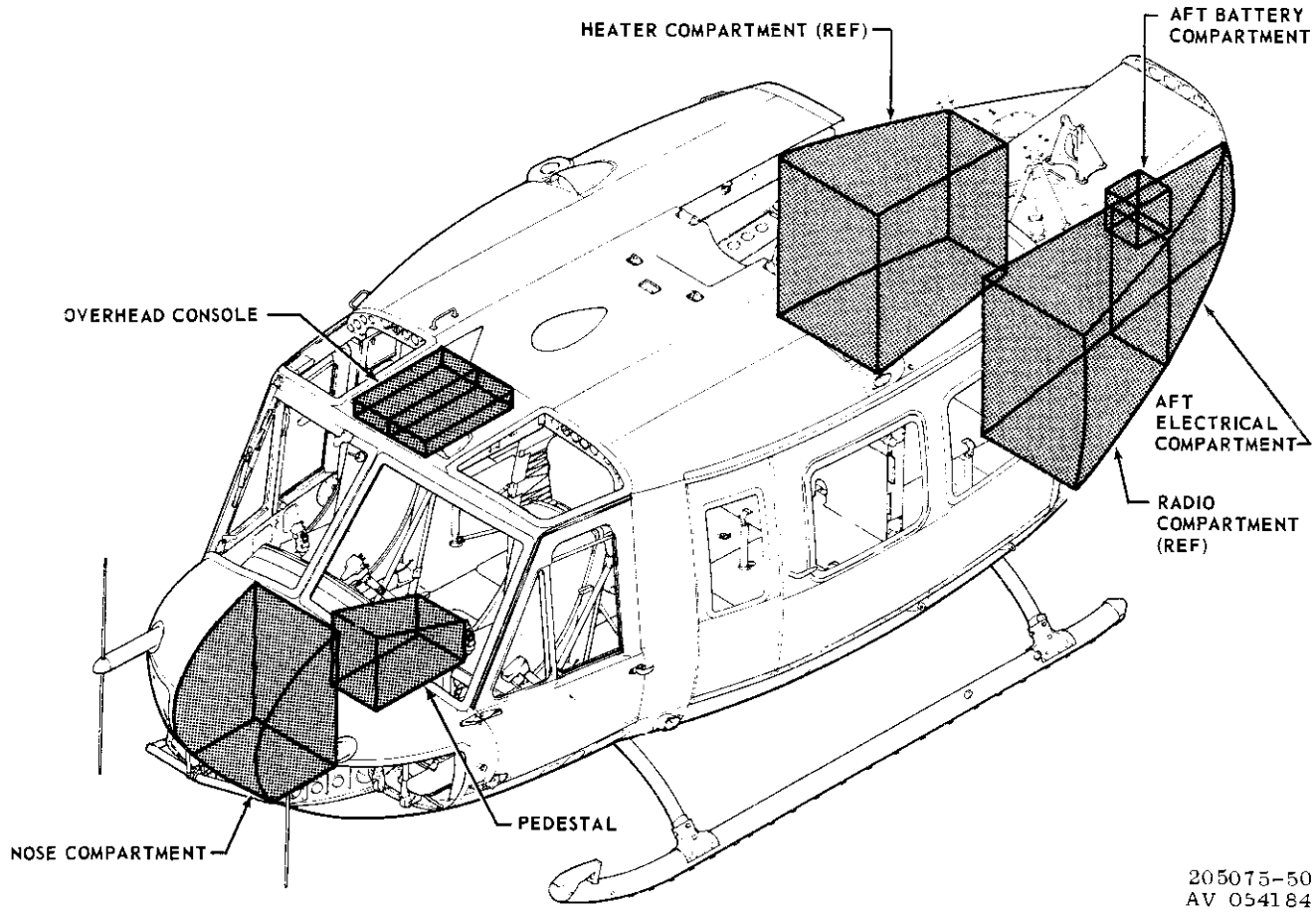


Figure 12-1. Compartment location - electrical

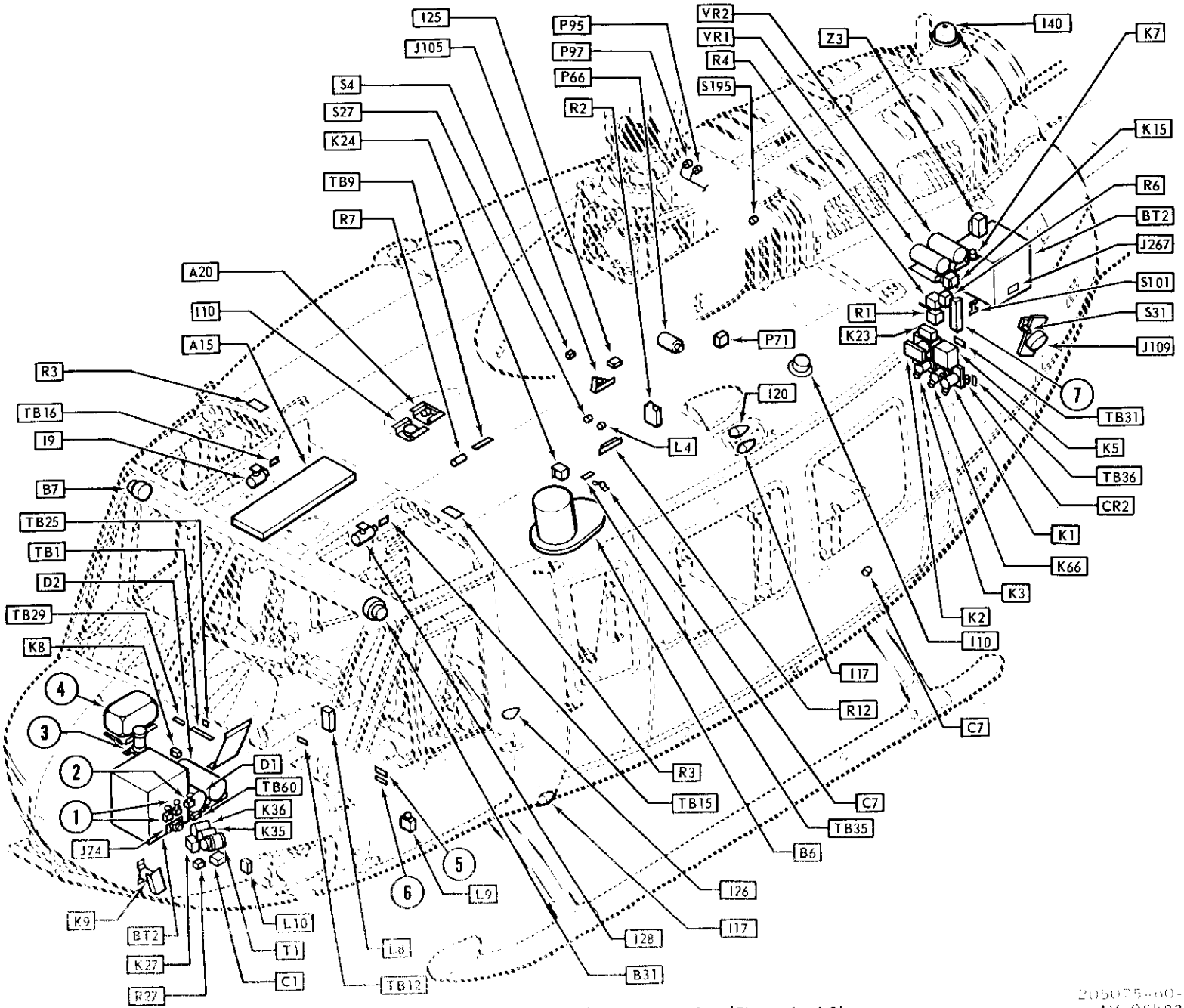


Figure 12-2. Electrical equipment location (Sheet 1 of 3)

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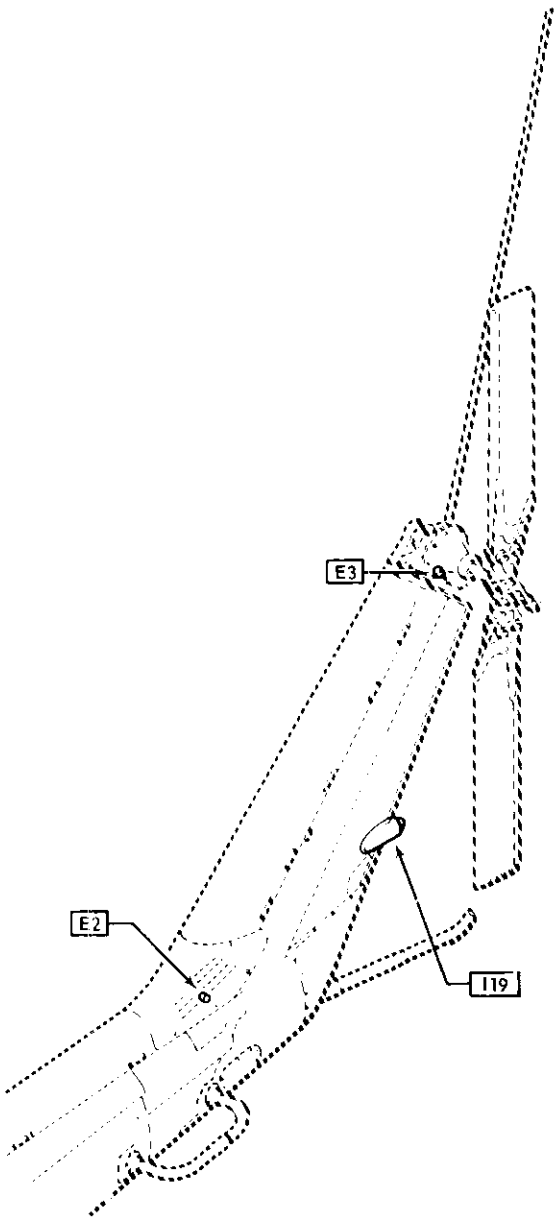

CODE ITEM	DESCRIPTION
A15	Overhead Console Panel
A20	Aft Dome Lights Panel
B6	Fuel Boost Pump Motor
B7	Windshield Wiper Motor - Pilot
B31	Windshield Wiper Motor - Copilot
BT2	Battery
C1	Capacitor, Power Factor Correction
C7	Capacitor, Noise Filter
CR2	Diode, External Power Relay
D1	Inverter - Main
D2	Inverter - Spare
E2	Magnetic Chip Detector - 42° Gearbox
E3	Magnetic Chip Detector - 90° Gearbox
I 9	Utility Light - Pilot
I 10	Dome Light
I 17	Navigation Light - Left
I 19	Tail Light
I 20	Fuselage Light - Top
I 25	Transmission Sump Inspection Light
I 26	Fuselage Light - Bottom
I 28	Utility Light - Copilot
I 20	Anti-Collision Light
J74	Receptacle, Battery Disconnect - Forward
J105	Receptacle, Heated Blanket - Left-hand
J109	Receptacle, External Power
J267	Receptacle, Battery Disconnect - Aft
K1	Relay, External Power
K2	Relay, Non-Essential Bus
K3	Relay, Starter
K4	Relay, Bus Control - Generator Fail
K5	Relay, Reverse Current - Main Generator
K7	Relay, Generator Field
K8	Relay, A.C. Failure
K9	Relay, Battery - Forward
K10	Relay, Fuel Transfer
K15	Relay, Standby Generator Field
K23	Relay, Standby Generator Reverse Current
K24	Relay, Cargo Hook Release
K27	Relay, Inverter
K35	Relay, Main Inverter Power
K36	Relay, Spare Inverter Power
K66	Relay, Battery Feeder

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Figure 12-2. Electrical equipment location (Sheet 2 of 3)

CODE ITEM	DESCRIPTION
L4	Solenoid, Hydraulic Bypass
L8	Magnetic Brake, Anti-Torque Force Trim
L9	Magnetic Brake, Fore & Aft Force Trim
L10	Magnetic Brake, Lateral Force Trim
P66	Plug, Fuel Pressure Mixture
P71	Plug, Fuel Valve Shut-Off
P95	Plug, Fire Detector Element - Left-hand
P97	Plug, Fire Detector Element - Left-hand
R1	Shunt-Ammeter - Standby Generator
R2	Shunt-Ammeter - Main Generator
R3	Resistor, Windshield Wiper
R7	Resistor, Navigation Lights - Dim
R12	Resistor, Spool Thermocouple
R27	Resistor, A.C. Load Balancing
S4	Switch, Transmission Sump Inspection Light
S27	Switch, Hydraulic Pressure
S31	Switch, Limit-External Power Door
S101	Switch, Differential Pressure
T1	Transformer, 115/28 Volt
TB1	Terminal Board, Forward Instrument Panel
TB9	Terminal Board, Top & Dome Lights
TB12	Terminal Board, Pedestal Panel Edge Lights
TB15	Terminal Board, Cockpit Lights - Left-hand
TB16	Terminal Board, Cockpit Lights - Right-hand
TB25	Terminal Board, Thermocouple - Indicator
TB29	Terminal Board, Instrument Ground
TB35	Terminal Board, Right-hand Fuel Cell
TB36	Terminal Board, External Power Diode
TB39	Terminal Board, Electrical Compartment - Aft
TB60	Terminal Board, Battery Voltage - Forward
VR 1	Voltage Regulator - Main Generator
VR2	Voltage Regulator - Standby Generator
Z3	Flasher Unit, Navigation Lights
1.	Power Factor Correction Circuit Breakers
2.	Battery Voltmeter Circuit Breaker
3.	AM-3209( )/ASN Amplifier, Electronics Control
4.	Vertical Gyro - Type MD-1
5.	Junction Box - Upper, BJ-4-F
6.	Junction Box - Lower, BJ-4-A
7.	Circuit Breakers
	a. Main Generator Voltmeter
	b. Standby Generator Loadmeter Voltmeter
	c. Standby Generator Loadmeter
	d. Main Generator Field

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Figure 12-2. Electrical equipment location (Sheet 3 of 3)

SECTION II DIRECT CURRENT POWER DISTRIBUTION SYSTEM

12-6. DESCRIPTION.

12-7. The Direct Current Power System provides all basic power for operation of electrical components installed in the UH-1D/H Helicopter.

12-8. MISCELLANEOUS ELECTRICAL COMPONENTS.

12-9. Included in this category are relays, rheostats, switches, circuit breakers, plugs, leads, connectors, wiring, conduits, receptacles, shunts and shock mounts.

12-10. REMOVAL – MISCELLANEOUS ELECTRICAL COMPONENTS. Remove attaching hardware, clamps and/or connectors and remove component.

Note

Before attempting to remove or adjust any electrical component, disconnect battery.

12-11. INSPECTION – MISCELLANEOUS ELECTRICAL COMPONENTS.

a. Inspect rheostats for security, corrosion, burned element, damaged wiper, cracks and correct resistance.

b. Inspect switches for weak detents, security, corrosion, continuity in ON and OFF position.

c. Inspect circuit breakers for security, corrosion, actuation for circuit power on and power off and reset retentions.

d. Inspect plugs, connectors and receptacles for security, contact corrosion, damaged contacts, broken wires, faulty contacts, insert cracks and faulty insulation.

e. Inspect leads and wiring for loose terminals, chaffing, corrosion or deteriorated conditions, faulty or damaged insulation, excessive mechanical stress, broken strands, damaged shielding, shorted shielding, routing and mounting conditions.

f. Inspect conduits for security, surface damage, cracks, corrosion and deterioration.

g. Inspect shunts for corrosion, security, deep scratches, physical damage and discoloration (indicating excessive overloading).

h. Inspect shockmounts for retention, security, cracks, distortion, corrosion and bonding.

i. Inspect relays for loose connections, damaged or broken contact pins or terminals, damage to case or insulation between contact pins, and evidence of corrosion, pits or discoloration (indicating arcing due to loose connections, internal shorting or excessive overload.)

12-12. REPAIR OR REPLACEMENT – MISCELLANEOUS ELECTRICAL COMPONENTS.

a. Tighten loose terminal connectors, mounting and attachments of electrical components.

b. Replace miscellaneous electrical components that fail to meet inspection requirements.

12-13. INSTALLATION – MISCELLANEOUS ELECTRICAL COMPONENTS.

a. Install component and secure with attaching hardware or clamps.

b. Attach terminals and/or connectors.

12-14. CONTROL PANELS.

12-15. The control panels on the overhead console are as follows: DOME LT-PITOT, EXT LTS, CABIN HEATING, MISC, DC POWER, INST LTG, and AC POWER. The control panels on the pedestal are as follows: ENGINE, FORCE TRIM-HYD CONTROL, and CAUTION.

12-16. REMOVAL – CONTROL PANELS. Remove control panels as follows:

Note

The removal procedure for all panels is relatively the same. A single removal procedure may be used for any panel.

a. Be sure all electrical power is OFF.

b. Disengage fasteners holding panel to pedestal or overhead console. Carefully lift panel from mount and disconnect electrical connector.

12-17. INSPECTION – CONTROL PANELS. Visually inspect for scratched, chipped, or broken edge lit panels, loose wiring connections, damaged or faulty switches, damaged connectors and broken or missing mounting fasteners.

12-18. REPAIR OR REPLACEMENT – CONTROL PANELS. Replace items that fail to meet inspection requirements.

12-19. INSTALLATION – CONTROL PANELS. Connect electrical connector. Position panel in mount being careful not to damage wiring. Engage fasteners.

12-20. DC CIRCUIT BREAKERS.

12-21. The DC circuit breakers are mounted on the overhead console. DC circuits can be opened and closed by operating these trip-free, push-pull circuit breakers.

12-22. REMOVAL – DC CIRCUIT BREAKERS.

a. Be sure all electrical power is OFF.

b. Disengage fasteners and open appropriate panel assembly of overhead console.

c. Disconnect wiring to appropriate breaker and cover wire ends.

d. Remove mounting screws and lift breaker from panel assembly.

12-23. INSPECTION – DC CIRCUIT BREAKERS. (Refer to paragraph 12-11.)

12-24. REPAIR OR REPLACEMENT – DC CIRCUIT BREAKERS. Replace item if inspection requirements are not met.

12-25. INSTALLATION–DC CIRCUIT BREAKERS.

a. Position breaker in panel assembly and install mounting screws.

b. Remove cover from wire ends and connect to breaker.

c. Close panel assembly and engage fasteners.

12-26. EXTERNAL POWER SYSTEM.

12-27. For ground checks of the aircraft's electrical systems, power may be supplied from an external power supply. This is accomplished by use of an external power receptacle on the side of the aircraft. Applying external power to the receptacle results in an external power relay automatically connecting power to all DC buses if the polarity of the external power supply is correct. If polarity is reversed the external relay will not close due to a diode in its coil circuit. All circuits in the helicopter function the same on external power as on power from the main generator system. Circuit breakers in the individual systems will protect the aircraft circuit from too much current should overvoltage be applied to the aircraft from the external power supply.

12-28. TROUBLESHOOTING–EXTERNAL POWER SYSTEM. Perform checks as necessary to isolate trouble. See figure 13-18.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Lack of power when external power plug is inserted.	Reverse polarity in plug.	Rework plug to correct polarity.
	Relay points corroded or pitted.	Replace points or relay.
	Power supply from external source too low.	Increase output of external power.

12-29. OPERATIONAL CHECK – EXTERNAL POWER CIRCUITRY. Place battery switch in OFF position and non-essential bus switch in the manual position. Connect 28 volt external power supply to the external power receptacle. Move voltmeter selector switch (S2) to all positions and observe voltmeter indications. Voltmeter should indicate 28 volts in the essential bus and non-essential bus positions. Zero volts should be the indication in all other positions.

a. Place non-essential switch (S62) in the manual position. Voltmeter indications should be the same as above.

b. Place the battery switch in the "ON" position with battery connected. Voltmeter should indicate 28 volts in the BATT, non-essential bus, and Essential bus position and zero voltage in all other positions.

c. Insure that battery switch is OFF and battery is disconnected. Jumper from the 28 volt external power sources negative (-) terminal to the small short pin of the external power receptacle. Jumper the large pin furtherest from the small short pin in the external power receptacle to the external powers positive (+) terminal. Check to insure that external power relay is not closing when

reverse polarity power is applied from the external power source.

12-30. EXTERNAL POWER RECEPTACLE.

12-31. The external power receptacle is mounted just below the aft electrical compartment access door. The receptacle is covered by an access door. (See figures 12-1 and 12-2.)

Note

External power is not required but is recommended for starting the aircraft.

12-32. REMOVAL—EXTERNAL POWER RECEPTACLE.

a. Be sure all electrical power is OFF.

b. Remove nuts and washers from terminal posts of receptacle and remove wires to receptacle. Cover wire ends.

c. Remove mounting screws and lift receptacle from bracket.

12-33. INSPECTION—EXTERNAL POWER RECEPTACLE. (Refer to paragraph 12-11.)

12-34. REPAIR OR REPLACEMENT—EXTERNAL POWER RECEPTACLE. Replace item if inspection requirements are not met.

12-35. INSTALLATION—EXTERNAL POWER RECEPTACLE.

a. Position receptacle on bracket and install mounting screws.

b. Remove cover on wire ends and install on terminal posts of receptacle.

12-36. EXTERNAL POWER RELAY.

12-37. The external power relay is located in the aft electrical compartment. This relay connects an external source of power, through the external power receptacle, to the electrical system of the helicopter.

12-38. INSPECTION — EXTERNAL POWER RELAY. (Refer to paragraph 12-11.)

12-39. REPAIR OR REPLACEMENT — EXTERNAL POWER RELAY. Replace item if inspection requirements are not met.

12-40. GENERATOR AND BUS SYSTEM.

12-41. The self-excited main generator normally supplies electrical power to the main bus when its output voltage is approximately 1/2 volt above that existing at the bus. Mechanical power is not supplied to the main generator until the engine starts driving the main rotor transmission. The voltage of the main generator at which it starts supplying power to bus system will vary according to the voltage applied to the main bus from other source (other sources may be battery of approximately 24 volts, standby generator of approximately 26.5 volts, or external power supply of varying voltages). If no other voltage source is connected to the bus, the main generator will be connected to the main bus when its output is 22 to 24 volts with main generator switch on. The main generator's reverse current relay automatically closes and opens the circuit between the generator and the main bus. The voltage regulator provides for proper generator voltage output during normal operating speeds and average draw. A field control relay operating in conjunction with the overvoltage relay protects the DC powered components on the aircraft from overvoltage from the main generator. A generator switch is provided on the overhead panel to provide manual control of the reverse current relay. A warning light is provided on the caution panel to indicate when the main generator's reverse current relay is not closed. The warning light is provided with DC power from the battery or stand by generator through the contacts of the bus control relay. The main generator supplies power to the bus control relay coil through the IND terminal on the reverse current relay when it closes and connects the main generator to the main bus.

12-42. The standby generator develops voltage whenever it is being driven by the engine. The voltage regulator in the standby system is adjusted so the voltage output of the standby generator is approximately one volt below that of the main generators normal output. A reverse current relay is also provided for the standby system. Control of the reverse current relay is provided for by the standby position of the standby generator switch and the bus control relay. During normal operation the main generator reverse current relay energizes the bus control relay when the main generator is connected to the bus. The bus control relay then performs three functions: (1) Opens the circuit between the standby position of the standby generator switch and the standby reverse current relay preventing the relay from automatically connecting the standby generator to the main bus. (2) Opens the circuit to the DC generator light, turning the caution light off. (3) Complete a circuit from the essential bus through the "normal on" position of the non-essential bus switch to the non-essential bus relay, energizing the non-essential bus. If the main generator fails or is disconnected from the main bus by its reverse current relay for any reason the bus control relay also becomes de-energized. The bus control relay then closes the circuit to illuminate the DC generator caution