

**CHAPTER 11****ENVIRONMENTAL CONTROL**

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## CHAPTER 11

## HEATING , VENTILATION AND AIR CONDITIONING

11.000 Heating and Ventilation11.001 Introduction

This section contains the procedures necessary for replacement of the heater and ventilation systems components.

11.002 Description

The cabin heater system consists of a heat shroud over the muffler, a control valve on the forward side of the firewall, an outlet grill forward of the pilot's tail rotor pedals, and the interconnecting ducts between components. Air is supplied by the engine cooling fan. The push-pull heat control is located on the face of the lower console. The heat control actuates the control valve which directs the air either into the cabin or out an overboard discharge on the underside of the cabin.

Fresh air vents are located in each door and in the nose of the helicopter. A push-pull control for the nose vent is located on the face of the lower console.

11.100 Cabin Heater

Refer to Figure 11-1.

## NOTE

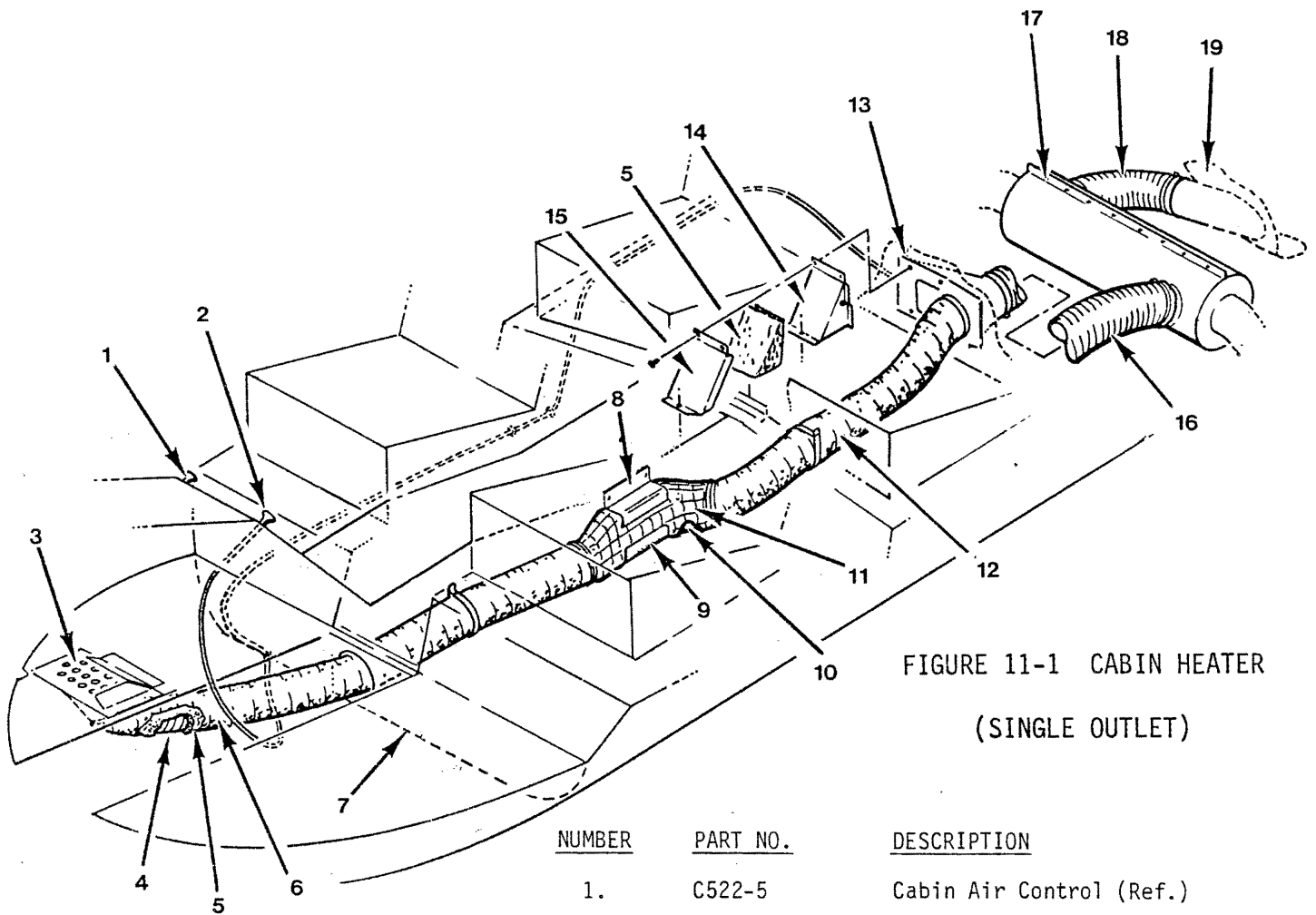
The cabin heater is required to be installed in the R44 helicopter. Air flow through the muffler shroud cools the muffler and engine compartment.

11.110 Control Cable and Valve Replacement

1. Remove the aft tunnel belly panel and engine belly cowling.
2. Remove the three screws holding the C753-1 cover and remove the cover and insulation.
3. Remove four screws holding the C625-1 box and remove the box.
4. Remove the control wire by straightening the end (if applicable) and loosening the A462-1 fitting clamping the wire.
5. To remove the A019-3 valve assembly and A623-1 inlet, remove the two hoses and the remaining four screws through the firewall.
6. To remove the control cable casing, open upper console. Remove the cable jam nut behind the lower console face and the AN742-3 clamp holding the casing to the chin. Inside the right forward baggage compartment, remove the clamp. Outboard of the right aft floor, remove the outboard carpet from the top to access the cable casing. Remove the two clamps under the panel outboard of the right aft seat. Remove the clamp holding the casing to the vertical firewall and pull the casing out through the lower console face.

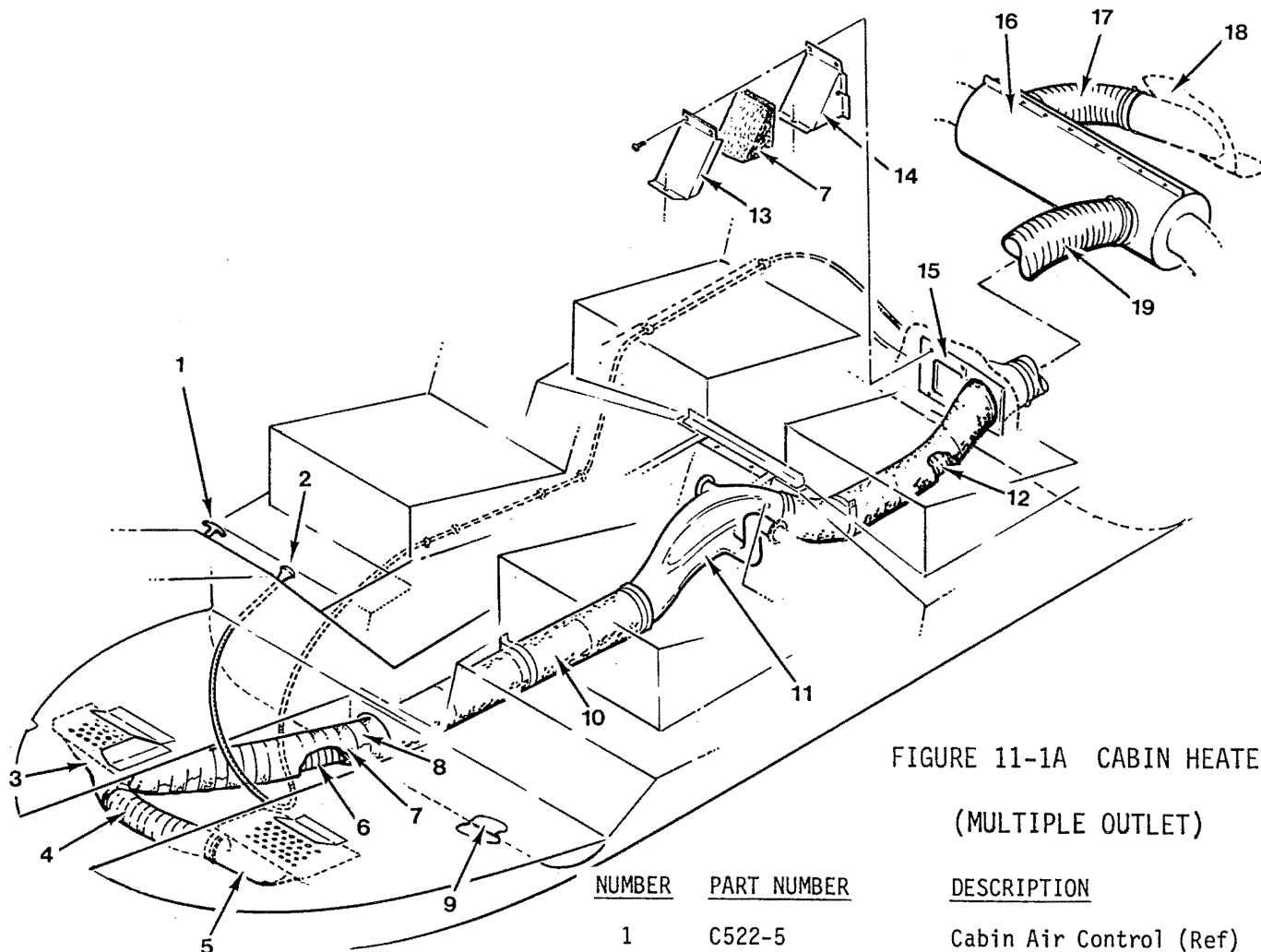
11.110 Control Cable and Valve Replacement (continued)

7. To install the control cable casing, verify that an MS35489-4 or AN931-3-5 grommet is installed in the tunnel wall next to the valve and an NAS557-3A grommet is installed 6 places in holes through which the casing passes (each place except one place through a vertical firewall stiffener and through the bulkhead at the front of the right forward baggage compartment). Install the casing through the lower console face and cable jam nut, through the stiffener on the side of the console, through the right forward baggage compartment, outboard of the right aft floor, through the right aft baggage compartment, through two stiffeners on the vertical firewall, and into the tunnel. Set end of casing approximately 0.8 inches into the tunnel. Fasten casing with AN742-3 clamps five places.
8. To install the valve and inlet, clean off the old sealant and reseal with B270-4 sealant. Install valve and inlet and fasten with screws in four places.
9. Install control cable wire through the A462-1 fitting and adjust to give approximately 0.060 springback at the knob when the valve is fully closed. Verify control operates freely. Cut excess wire approximately 0.01 inch or less from the fitting.
10. Install the C625-1 box and seal with B270-1 sealant. Verify the valve and box are sealed by taping the belly hole closed and applying low air pressure to the inlet. Check for leaks inside the tunnel by using a piece of yarn at the end of a stick.
11. Install one inch thick Microlite AA insulation over the C625-1 box and install the C753-1 cover.
12. Install heater hoses. Install belly cowling, belly cover, and close upper console.



**FIGURE 11-1 CABIN HEATER  
(SINGLE OUTLET)**

<u>NUMBER</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>
1.	C522-5	Cabin Air Control (Ref.)
2.	A522-8	Cabin Heater Control
3.	B164-1	Heater Outlet
4.	A785-15	Hose
5.	R111	Insulation
6.	A701-1	Foil Tape (Forward of item 7)
	A701-2	Foil Tape (Aft of item 7)
7.	D230-1	Bulkhead (Ref.)
8.	C631-2	Clip
9.	C631-1	Clip
10.	D164-1	Duct
11.	C630-1	Insulation
12.	A785-14	Hose
13.	A019-3	Valve Assembly
14.	C625-1	Box
15.	A753-1	Cover
16.	A758-13	Hose
17.	C169-2	Shroud Assembly
18.	A785-12	Hose
19.	C236	Cooling Scroll (Ref.)



**FIGURE 11-1A CABIN HEATER  
(MULTIPLE OUTLET)**

<u>NUMBER</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
1	C522-5	Cabin Air Control (Ref)
2	A522-8	Cabin Heater Control
3	D164-1	Heater Outlet
4	A785-24	Hose
5	D166-1	Outlet (LH)
6	A785-23	Hose
7	R111	Insulation
8	A701-1	Foil Tape (Forward of item 9)
9	D230-1	Bulkhead (Ref)
10	A701-2	Foil Tape (Aft of item 9)
11	D164-2	Duct
12	A785-14	Hose
13	C753-1	Cover
14	C625-1	Box
15	A019-1	Valve Assembly
16	C169-2	Shroud Assembly
17	A785-12	Hose
18	C236	Cooling Scroll
19	A785-13	Hose

### 11.120 Muffler Shroud Replacement

- a) Remove the D040-1 aft engine cowling.
- b) Remove the tail pipe from the exhaust hanger at the engine cooling scroll.
- c) Disconnect the two heater hoses from the shroud.
- d) Remove the screws at the top of the shroud and remove the shroud over the tail pipe.
- e) To install the shroud, reverse steps a through d.

## 11.200 VENTILATION

### 11.210 Cabin Air Vent Cable Removal (See Figure 11-2)

- a) Open upper console.
- b) Remove cotter pin and clevis pin at the forward cabin vent.
- c) Remove attaching clamps.
- d) Remove cable jam nut at lower console face and remove cable.

### 11.220 Cabin Air Vent Cable Installation (See Figure 11-2)

- a) Install or replace the MS3548-4 grommet in the vent box, if required.
- b) Insert the A5225-5 cable through the hole in the lower console and tighten the jam nut.
- c) Secure the control wire to the vent door using one MS20392-2C13 clevis pin and one MS24665-73 cotter pin.
- d) Install the cable clamps. Adjust cable casing for proper operation of vent. Then tighten clamps securely to insure casing does not slide when operating the vent control knob.
- e) Close and secure upper console.

### 11.230 Door Vent (See Figure 11-3)

The door vent hinge is riveted in place and can be replaced, if damaged, by drilling out the rivets and replacing the vent door and/or hinge as required.

The A226-3 seal around the vent door can be replaced if damaged using B270-4 or B270-13 adhesive.

The friction can be adjusted on the door vent by tightening the NAS1291-08 nut holding the knob on the center pivot of the double arm linkage.

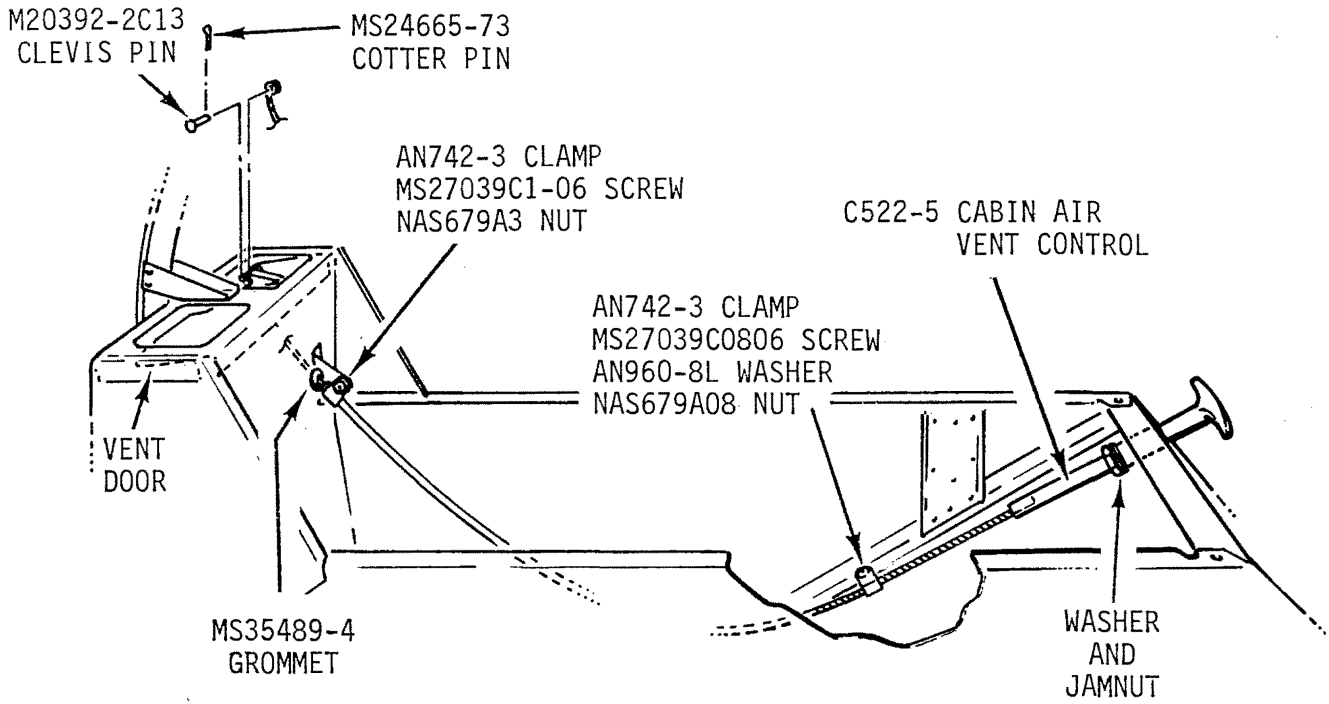


FIGURE 11-2 CABIN AIR VENT INSTALLATION

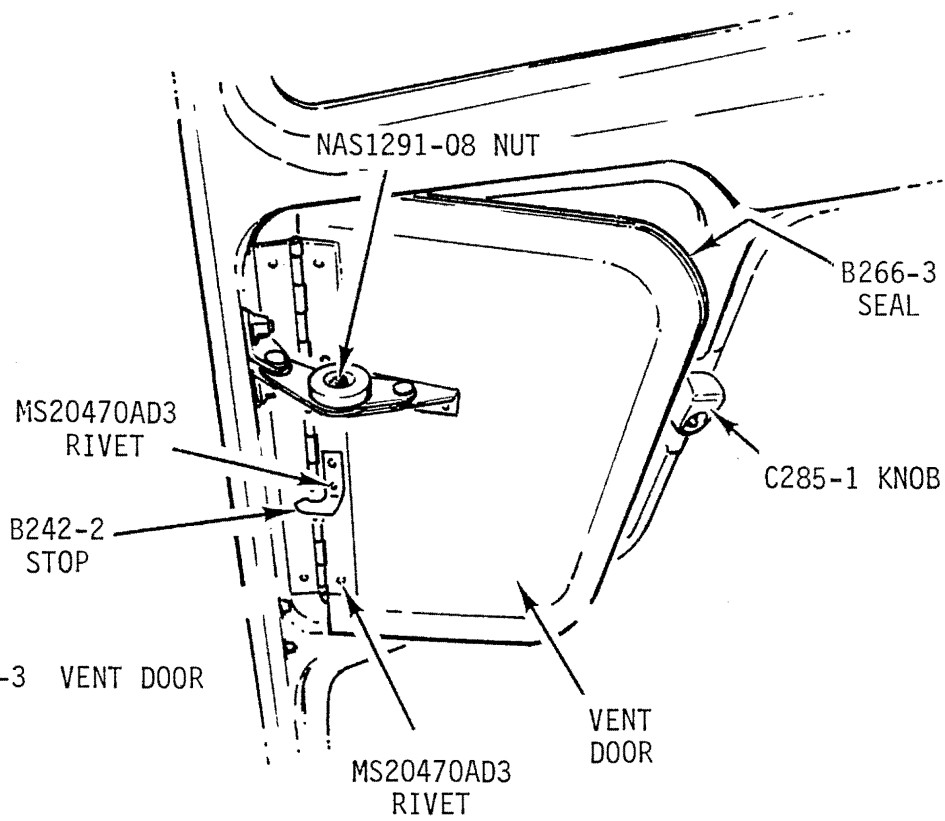


FIGURE 11-3 VENT DOOR



## 11.300 Air Conditioning

### NOTE

Air conditioning service procedures and required equipment are generally similar to those for standard R134a automotive systems. In the United States, only personnel with EPA certification under Section 609 of the Clean Air Act may charge the system with refrigerant or work on the refrigerant system once it has been charged. Different requirements may apply in countries other than the United States.

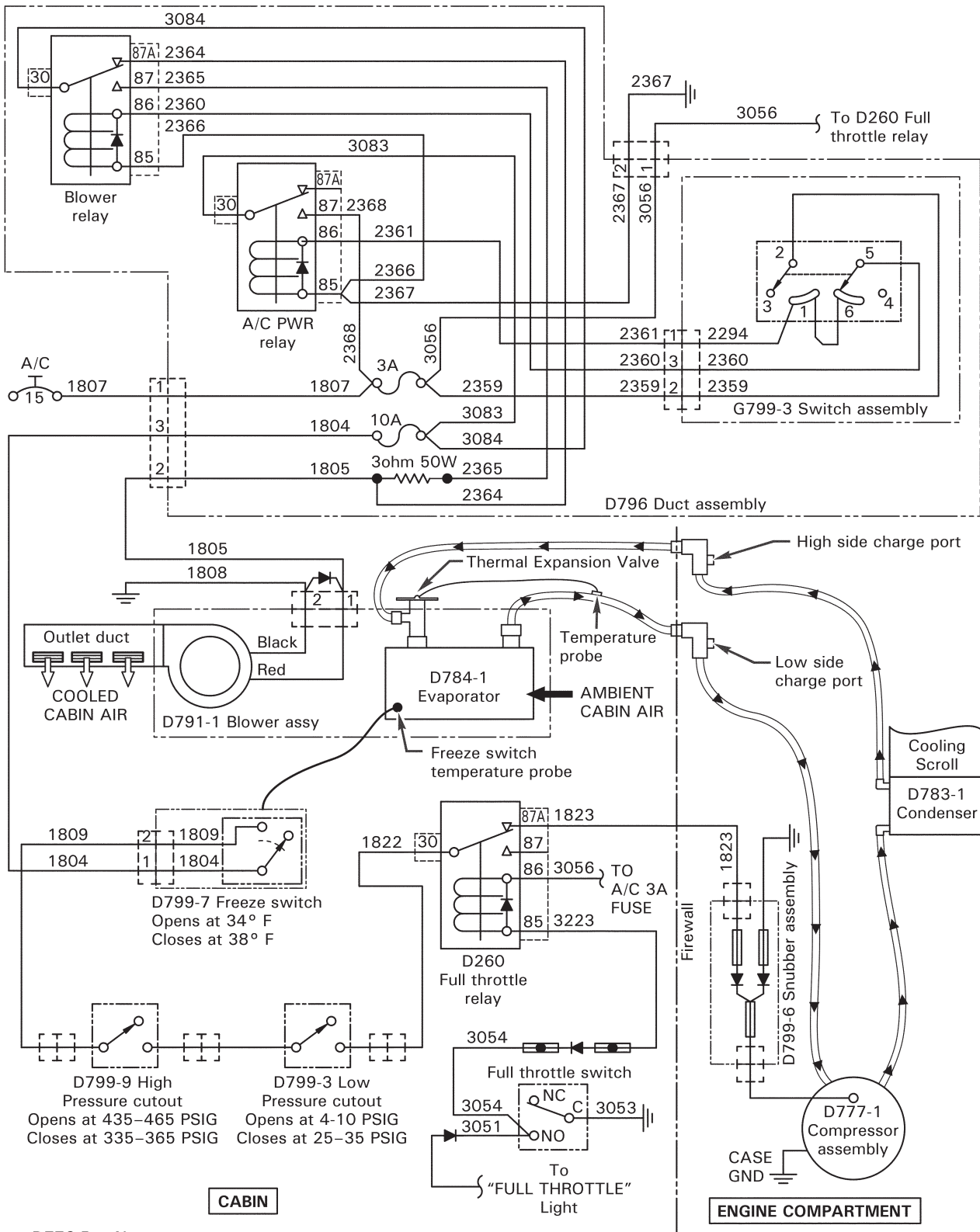
### A. Description

The optional cabin air conditioning system is shown schematically in Figures 11-4 & 11-4A. The system is similar to conventional automotive and light aircraft systems and consists of a compressor accessible through the left engine cowl door, a condenser mounted on the left side of the engine cooling fan scroll, an evaporator and fan assembly mounted to the aft cabin wall, an overhead outlet duct, and interconnecting lines and hoses. The system uses R134a refrigerant.

The compressor is belt-driven from an engine accessory drive cartridge and equipped with an electromagnetic clutch. When the system is off, the compressor clutch is disengaged, allowing the compressor pulley to freewheel.

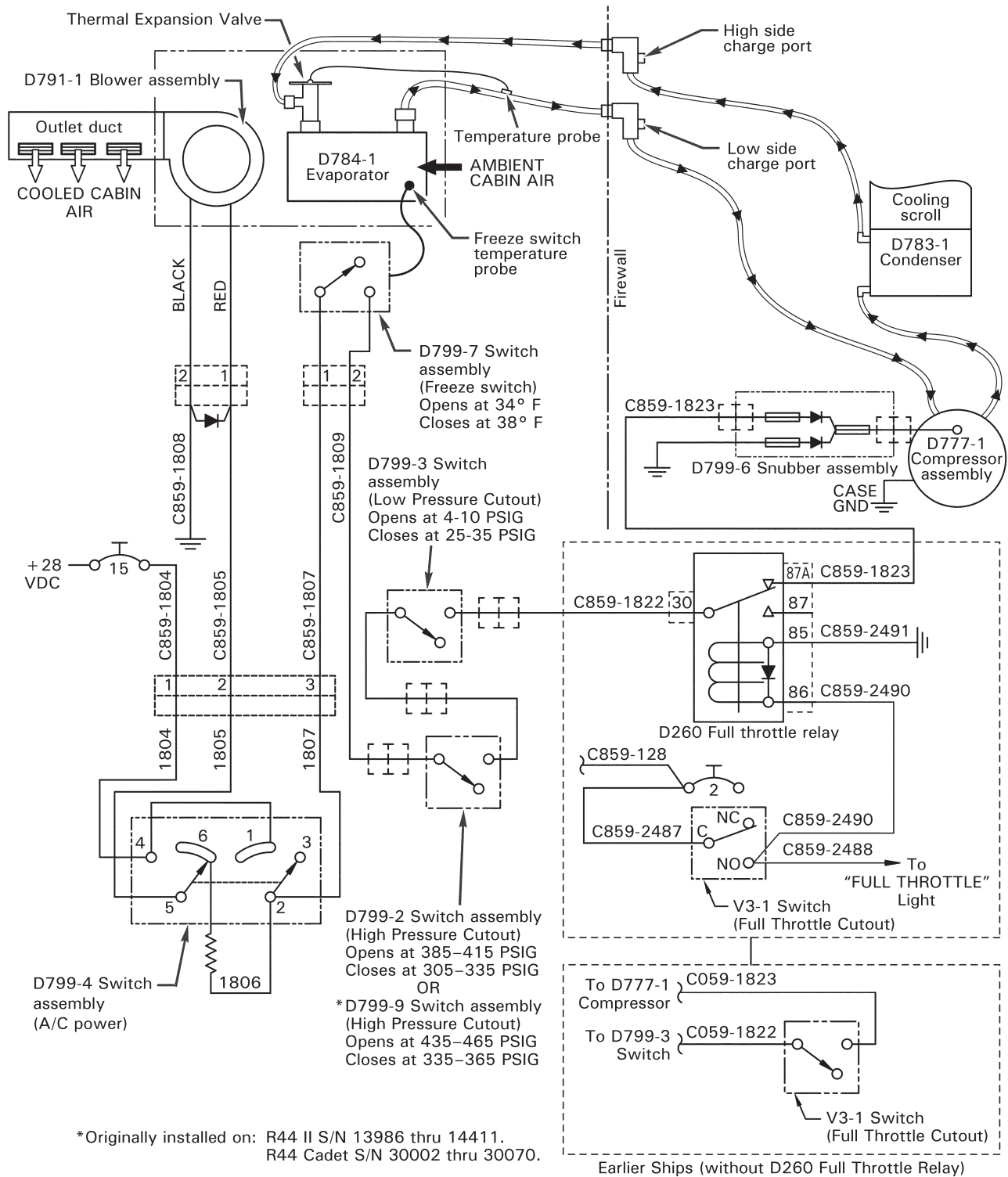
The evaporator fan draws warm cabin air through the evaporator inlet grill and evaporator where it is cooled. Cooled air is drawn through the fan and blown through the overhead duct.

The system is controlled by a toggle switch on the overhead duct which allows selection of off, low, and high fan settings. The compressor is automatically engaged by switching the fan on. A temperature (freeze) switch disengages the compressor when evaporator temperature drops below freezing. Safety (pressure) switches disengage the compressor if excessive refrigerant leakage occurs or if refrigerant pressure is excessive. A full-throttle switch disengages the compressor when the engine is near full throttle to ensure that aircraft performance is not affected. The compressor clutch and fan circuits are protected by the A/C circuit breaker. Later helicopters also have a 3-amp fuse to protect the relays and a 10-amp fuse to protect the compressor circuit.



D776 Rev N

**FIGURE 11-4 AIR CONDITIONING SYSTEM SCHEMATIC**  
 R44 II S/Ns 14412 thru 29999  
 R44 Cadet S/Ns 30071 and subsequent



D776 Rev L

FIGURE 11-4A AIR CONDITIONING SYSTEM SCHEMATIC  
R44 II S/Ns 10001 thru 14411  
R44 Cadet S/Ns 30002 thru 30070

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### 11.310 System Troubleshooting

Two likely system difficulties are:

1. Failure to cool the air flowing through the evaporator and overhead duct.
2. Excessive condensate (water) in the evaporator box area when the system is operating.

Failure to cool is most likely caused by either refrigerant loss or interruption of the compressor clutch power supply (by one of the in-line switches or a wiring fault, see Figure 11-4 schematic). Excessive condensate is most often caused by an improperly assembled or blocked evaporator drain system. Both difficulties can usually be corrected with minimum effort and expense if careful troubleshooting is done prior to major component maintenance. A troubleshooting chart follows.

11.310 System Troubleshooting (cont'd)

PROBLEM	POSSIBLE CAUSE	TROUBLESHOOT/CORRECTIVE ACTION
Air is not cold	Low Refrigerant Charge/ Refrigerant Leak	Recover refrigerant per Section 11.321. System should operate normally on approximately 0.75 to 1.25 lb refrigerant. If less than 0.75 lb refrigerant is recovered, leak test per Section 11.323, repair leaks if any, and recharge per Section 11.322.
	Switch or Wiring Problem Interrupting Compressor Clutch Power	With aircraft not running, turn on Master switch and A/C switch on overhead duct (low or high setting ok). Have observer listen to and observe compressor clutch through left cowl door. Clutch should engage (click and snap against pulley) whenever A/C is switched on. Check wiring at freeze switch (behind D798-1 evaporator assembly), high and low pressure switches (behind left rear seatback), and full-throttle cutout switch (in control tunnel). Repair any damaged wiring or connectors. Verify correct rigging per Section 11.350. Check continuity through each switch. All switches should be closed with a properly charged system and aircraft at rest on ground. Replace any defective switch.
	Failed Compressor Belt	Inspect belt. Replace belt per Section 11.331 as required.
	Insufficient Condenser Airflow	Inspect condenser installation (left side of fan scroll). Verify no blockage and all seals in place. Remove blockage and/or repair seals to ensure airflow through core.
	Extreme Environmental Conditions	Extreme temperature and humidity may result in cooling effect less than a typical automobile. No corrective action available.
Excessive condensate around evaporator assembly and overhead duct	Blocked or Kinked Evaporator Drain Line	Verify system is draining normally. After several minutes ground run in humid conditions with A/C on, water should be seen draining from the drain tube. If water drainage is not observed, inspect drain line (see Section 11.343). Correct any damaged or kinked lines. Clean sediment trap as required. Verify proper function of check ball.
	Damaged Insulation	Verify evaporator assembly and duct insulation are installed correctly and undamaged (see R44 Parts Catalog). Correct any insulation deficiencies.
	Extreme Humidity	Some condensation is unavoidable in extreme humidity. Ensure all fresh air vents closed. Limit opening and closing cabin doors as much as practical to limit humidity entering cabin.

## 11.320 REFRIGERANT

### 11.321 Refrigerant Recovery

If a leak or other service problem is encountered after system is charged with refrigerant, refrigerant must be recovered before work on system can proceed.

Automotive-style air conditioning service equipment is required to recover refrigerant. This equipment is available from many manufacturers in varying levels of automation and complexity. Minimum components include a vacuum pump, storage container, pressure/vacuum gauge, and appropriate lines and fittings. Ensure equipment is compatible with R134a refrigerant and technician is appropriately qualified before attempting refrigerant recovery.

Automotive-style high and low side system service ports are located on the vertical firewall inside the left-hand engine cowl door.

Connect service equipment to system service ports and recover refrigerant per equipment manufacturer's instructions.

### 11.322 Refrigerant Charge

Automotive-style air conditioning service equipment is required to charge system with refrigerant. This equipment is available from many manufacturers in varying levels of automation and complexity. Minimum components include a vacuum pump, pressure pump, refrigerant supply, scale to measure refrigerant charge, pressure/vacuum gauge, and appropriate lines and fittings. Service system only with R134a refrigerant, and ensure technician is appropriately qualified before attempting refrigerant charge.

#### **CAUTION**

Proper lubrication is required to minimize compressor wear. Verify compressor oil level per Section 11.333.5 before beginning charge procedure.

The R44 air conditioning system is not equipped with a traditional receiver-dryer. Ensure system is under full vacuum to eliminate all moisture before charging.

Automotive-style high and low side system service ports are located on the vertical firewall inside the left-hand engine cowl door.

Connect service equipment to system service ports, vacuum system, and charge with R134a refrigerant per equipment manufacturer's instructions. Correct charge is 1.25 lb (1 lb 4 oz, or 0.567 kg) refrigerant.

#### **CAUTION**

Do not overcharge system. If a slow leak is suspected, find and correct per Section 11.323 first, then use correct charge.

### 11.323 Leak Detection

Leaks may be detected using several techniques, depending on equipment available. Leak detection should not be attempted with the aircraft/system running. In addition to safety hazards, leaks are more difficult to detect with the varying pressures and temperatures of an operating system.

An empty system should hold full vacuum (27 to 29 in Hg vacuum at sea level) with no assistance from the vacuum pump for 20 minutes or more. If a vacuumed system creeps up in pressure, a leak may be present. Technician should be thoroughly familiar with vacuum equipment to ensure leak is in aircraft system and not in vacuum equipment or connections.

Leaks in a charged system may be detected using a mild soap and water solution applied to lines and fittings in suspected leak areas (bubbles indicate leaks) or using commercially available electronic refrigerant detectors. Follow detector manufacturer's instructions. Large leaks may be detected audibly if area is quiet or by formation of frost in area of leak.

#### NOTE

Frost does not necessarily indicate a leak. Normal system operation and/or charging procedures can cause frost to accumulate on some components.

#### NOTE

System pressure is not a reliable indicator of charge state or the presence of leaks. Because R134a is a liquid/vapor mixture with the system at rest, pressure will remain constant as more liquid vaporizes until majority of charge is lost.

Very small leaks can be detected by charging the system with helium gas. Helium molecules are smaller than R134a molecules and will leak more quickly. Charge system to 200 psi maximum. Use commercially available electronic helium detector or soap and water solution to locate leaks.

Leaks are most likely to occur at fittings and crimped transitions between hard line and flexible hose. Concentrate initial leak detection efforts in these areas.



### 11.330 COMPRESSOR

#### 11.331 Compressor Belt Replacement

Compressor belt replacement is based on belt condition. Replace any belt exhibiting frayed edges, excessive cracking, heat damage, or rubber deterioration.

To replace belt, loosen NAS6604 bolt through D782-3 adjusting arm slot, and loosen all three NAS6606 bolts through compressor lugs. Rotate compressor up and inboard as required to disengage belt from either compressor or drive pulley, and remove belt.

#### CAUTION

Do not rotate compressor further than necessary to avoid damage to refrigerant lines and fittings. Do not use refrigerant lines or fittings for leverage; handle compressor body or lugs.

Slip new belt over both pulleys, and rotate compressor down and outboard to tension belt. Tension belt such that a 4.5 to 5.5 lb force applied mid-span produces 0.14 inch belt deflection. Tighten compressor mount and adjustment hardware.

#### 11.332 Compressor Removal

1. Remove engine left cowling.
2. Disconnect and remove battery as required for compressor access.
3. Recover refrigerant per Section 11.321.
4. Disconnect compressor clutch wiring from airframe harness.
5. Disconnect refrigerant lines from compressor. Protect all open lines and fittings from contamination.
6. Remove belt from compressor drive pulley per Section 11.331.
7. Remove three compressor lug bolts loosened in step 6, and remove compressor.

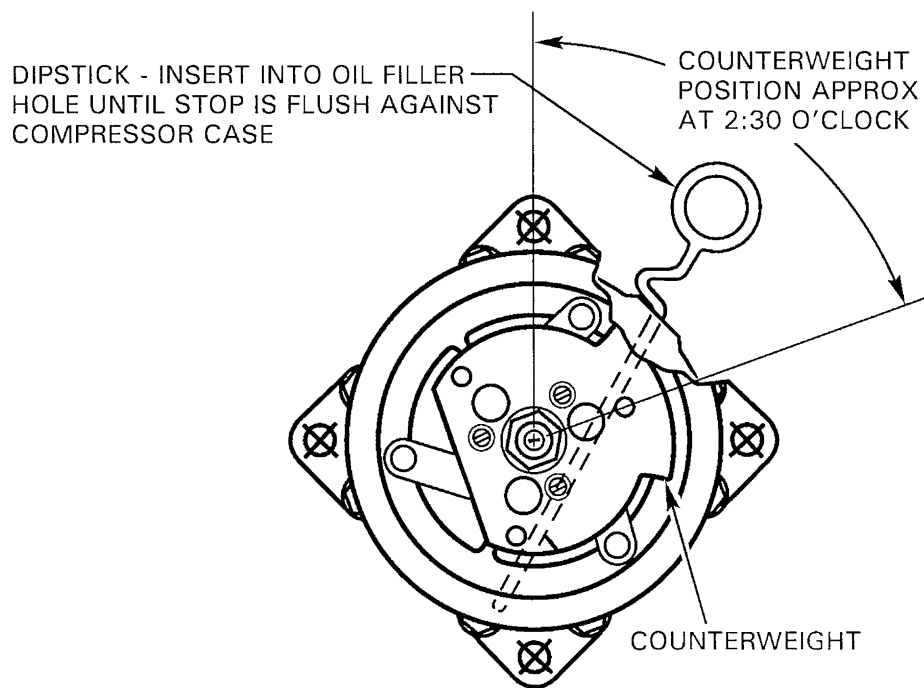
11.333 Compressor Installation

1. Install compressor using three NAS6606 bolts at mount lugs and NAS6604 bolt at D782-3 adjusting arm slot. Refer to R44 Illustrated Parts Catalog for hardware stack up. Leave all hardware loose enough to rotate compressor.
2. Install compressor drive belt, tension per Section 11.331, and tighten mount and adjusting hardware.
3. Connect refrigerant lines to compressor. Torque low-pressure (large) fitting to 300 in.-lb. Torque high-pressure (small) fitting to 210 in.-lb.
4. Connect compressor clutch wiring to airframe harness.
5. Check and adjust compressor oil quantity as follows:

**CAUTION**

Recover refrigerant prior to checking oil level.

- a. Remove compressor oil fill cap (black hex-head cap on upper outboard surface of compressor body behind clutch and pulley).
  - b. Turn compressor shaft clockwise until clutch plate counterweight is positioned per Figure 11-5.
  - c. Insert Airpro P/N 90-3028 or equivalent dipstick per Figure 11-5, and take oil level reading.
  - d. Add A257-20 oil as required to bring dipstick reading to 8 to 10 notches. Approximately 2 to 3 ounces total oil is required for completely empty compressors. Compressors are typically shipped at least partially filled with oil.
  - e. Reinstall fill cap. Torque to 156 in.-lb.
6. Perform vacuum or helium leak check per Section 11.323.
  7. Charge system with refrigerant per Section 11.322.
  8. Install and connect battery (if removed).
  9. Install engine left cowling.



**FIGURE 11-5 COMPRESSOR OIL FILL**

11.340 EVAPORATOR ASSEMBLY11.341 Evaporator Assembly Removal

1. Recover refrigerant per Section 11.321.
2. Remove overhead duct as follows:
  - a. Remove screw aft of rotor brake knob.
  - b. Slide duct forward and down to disengage tabs from evaporator box and windshield frame.
  - c. Push rotor brake knob through slot in duct.
  - d. Disconnect electrical connector.
  - e. Remove duct.
3. Remove screws (4 each side) securing headset jack boxes to evaporator assembly.

**NOTE**

Two different length screws and two different length spacers are used to mate headset jack boxes to evaporator. Use caution to retain spacers during disassembly and note hardware arrangement for re-assembly.

**NOTE**

The entire decorative (headliner) cover is secured to the evaporator box via hook and loop fastening material and may be removed if desired. It is necessary to remove the headset hangers in order to remove the cover. Refer to R44 Illustrated Parts Catalog for details.

4. Remove trim securing headliner between seats, and remove left rear seat back.
5. Remove and discard safety wire, and remove drain tube from drain fitting at base of evaporator box (right side).
6. Disconnect refrigerant lines at vertical connection nuts near upper inboard seat back corner.
7. Push back headliner as required, and remove 6 screws securing evaporator box flanges to aft cabin bulkhead. Tilt top of evaporator box forward and lift up and out.

11.342 Evaporator Assembly Installation

1. Secure evaporator box to aft cabin bulkhead using 6 screws through box flanges.
2. Verify O-rings are clean and undamaged, and connect refrigerant line connection nuts. Torque insulated line to 210 in.-lb and uninsulated line to 150 in.-lb.
3. Connect drain tube to evaporator box drain fitting and secure using 0.032 in diameter safety wire.
4. Secure headset jack boxes to evaporator assembly. Use screw and spacer arrangement retained from Section 11.341 or refer to R44 Illustrated Parts Catalog for hardware details.
5. Install overhead duct as follows:
  - a. Position duct approximately, feed rotor brake knob through slot in duct, and connect electrical connector.
  - b. Slide duct up and aft such that tabs engage evaporator box fan opening and windshield frame.
  - c. Install screw aft of rotor brake knob.
6. Verify no leaks (refer to Section 11.323 as required). Charge system per Section 11.322.
7. Install left rear seat back, and secure headliner between seat backs using trim.

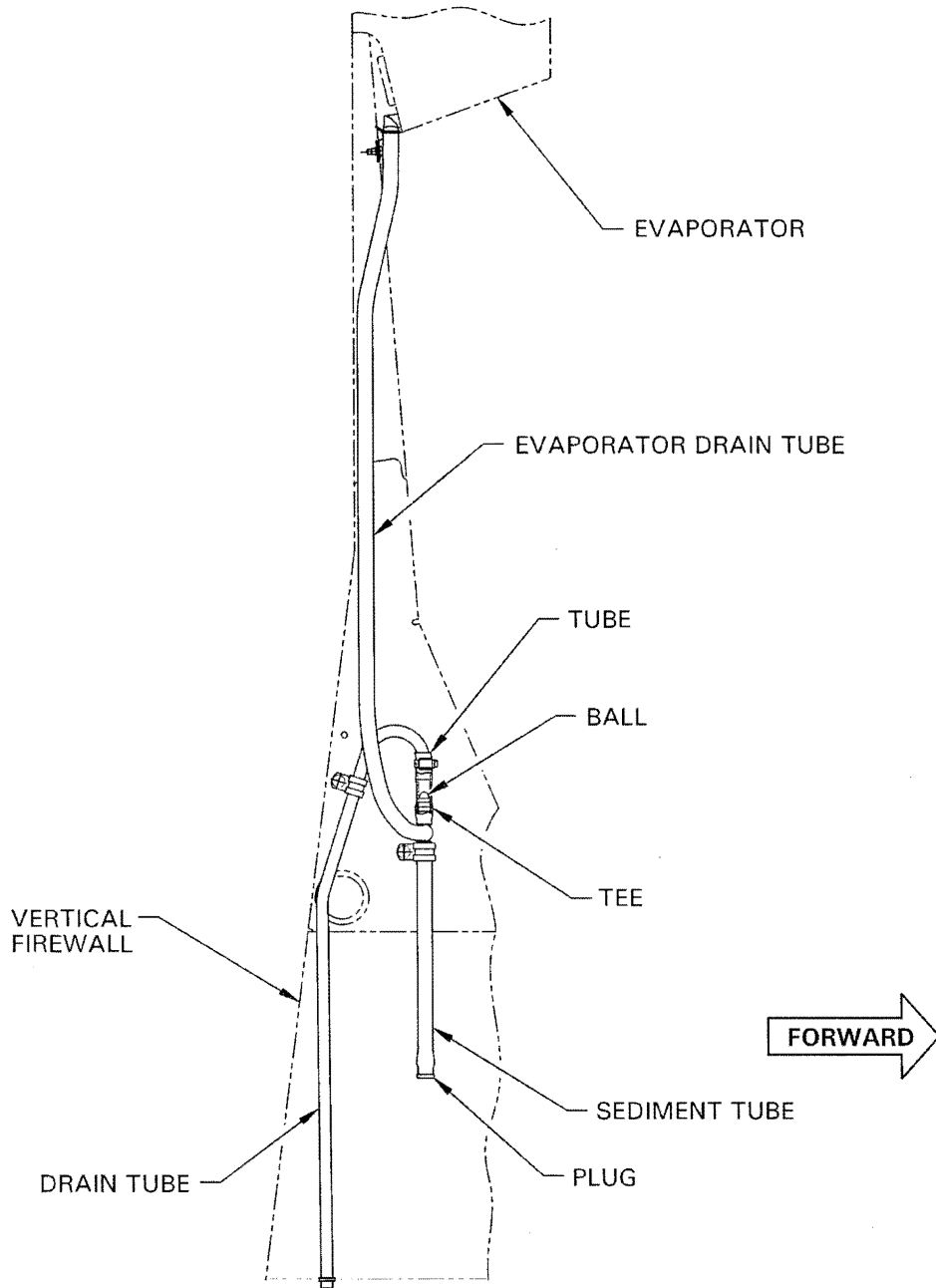
### 11.343 Evaporator Drain System

The evaporator drain system, shown schematically in Figure 11-6, is designed to prevent condensate from backing up in the evaporator box and leaking into the passenger compartment. All components are necessary for proper drainage. Blockage or kinking of a drain line may result in water damage to the cabin interior near the evaporator box.

The flexible tube drains condensate to the tee located behind the right rear seat back. At tee, a sediment-tube extends several inches down to a plug. The sediment-tube is designed to allow contamination to settle out without clogging the main drain system. Inspect tube periodically. Remove plug and clean out tube if sediment build-up nears tee fitting.

Just above tee fitting is a ball retained in upper flex tube. Normally a small amount of water is retained in the loop formed by drain tube and tee fitting. If the system is dry, the ball seats against the tee and prevents the evaporator fan from drawing air up through the drain system until water fills this area.

The hard drain tube runs along the aft, inboard corner of right-rear baggage compartment and out the belly. Normal system operation in humid conditions should result in condensation dripping from the tube. In extremely dry conditions there may be little or no condensation. Periodically inspect evaporator drain assembly to verify it has not been damaged or dislodged.

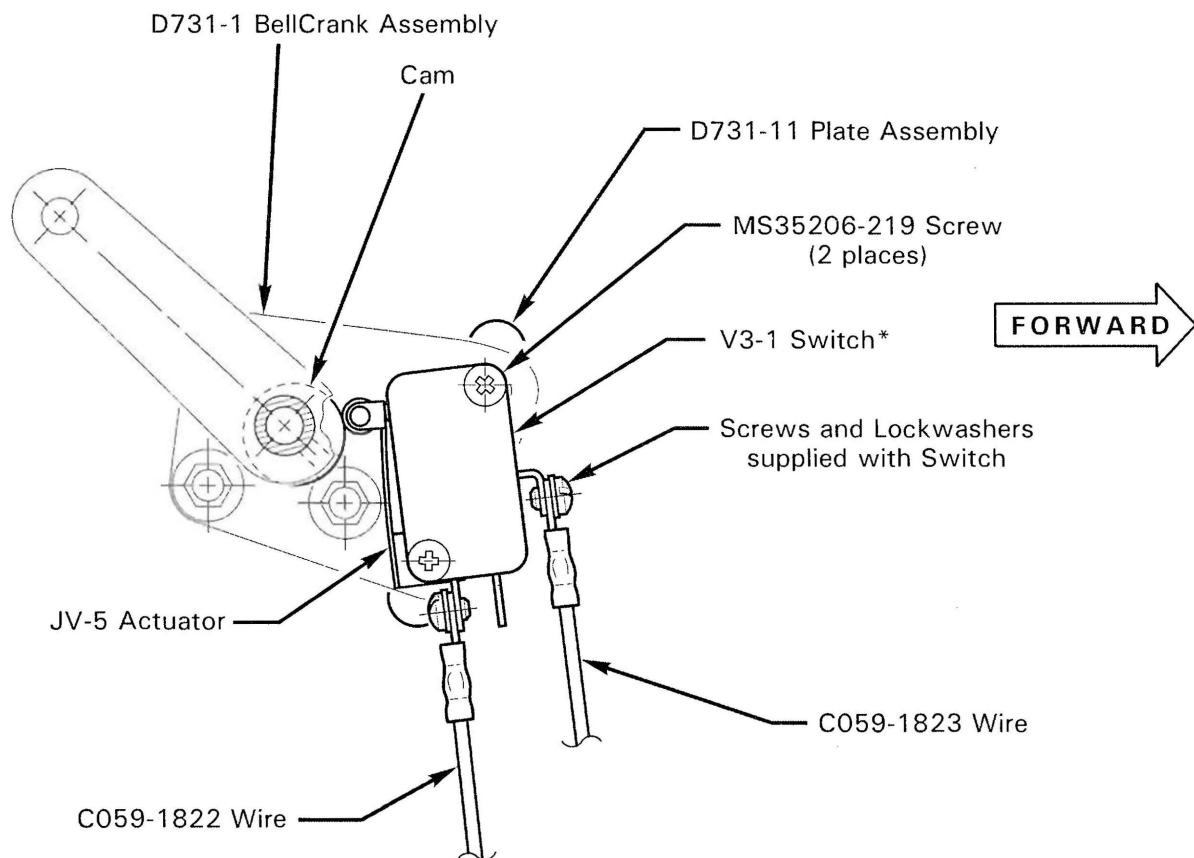


**FIGURE 11-6 EVAPORATOR DRAIN SYSTEM**

11.350 Full Throttle Cut-Out Switch Rigging

A full-throttle cut-out switch is designed to disengage the compressor clutch approximately 1 inch MAP below full throttle. This guarantees that air conditioning operation does not affect aircraft performance at altitude. Full throttle cut-out is controlled via a microswitch located near the bellcrank assembly at the aft end of the throttle push-pull tube in the main control tunnel. The switch is normally closed (allows current flow to the compressor) when its button is not depressed. A cam on the bellcrank assembly depresses the button and opens the switch near full throttle.

Adjust switch so button is depressed by cam when throttle arm at fuel control is 0.15 to 0.20 inch away from full-open throttle stop.



\* Adjust position of V3-1 switch so that switch opens when fuel control throttle arm is 0.15 - 0.20 off full throttle stop.

**FIGURE 11-7 AIR CONDITIONING CUTOFF SWITCH  
(View looking outboard from centerline)**

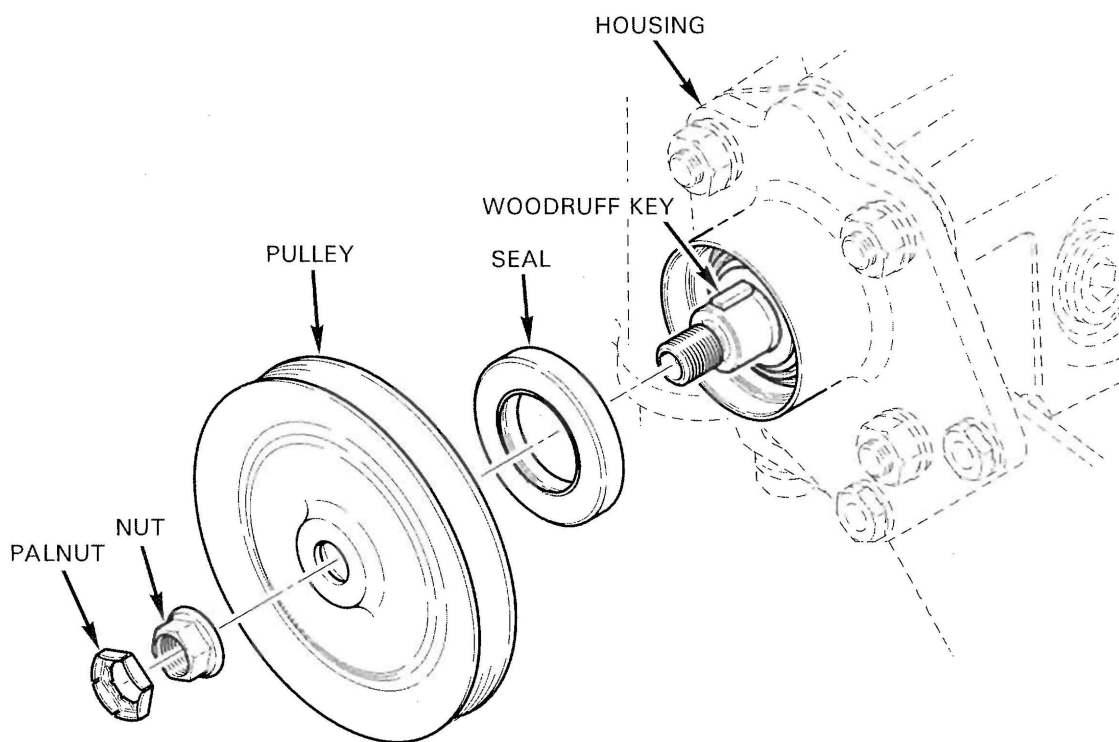


11.400 DRIVE CARTRIDGE11.410 Drive Cartridge Seal Removal

1. Remove engine left cowling.
2. Disconnect and remove battery as required for access.
3. Loosen belt tension and remove belt from pulley.
4. Refer to Figure 11-7. Remove B330-19 palnut and MS21042L6 nut.
5. Remove pulley from shaft to expose A966-5 seal and woodruff key.
6. Remove seal using appropriate tool being careful not to damage housing. Do not remove shims under seal.

11.420 Drive Cartridge Seal Installation

1. Ensure seal recess area is clean and free of debris.
2. Ensure shims are in place, and install A966-5 seal flush with the housing.
3. Install woodruff key and pulley on shaft.
4. Install MS21042L6 nut and special torque per Section 1.330. Install B330-19 palnut and standard torque per Section 1.320. Apply B270-22 protectorant to exposed surfaces of shaft.
5. Install compressor drive belt, tension per Section 11.331, and adjusting hardware.



**FIGURE 11-7 CARTRIDGE ASSEMBLY - COMPRESSOR DRIVE**