Aerolineas Argentinas

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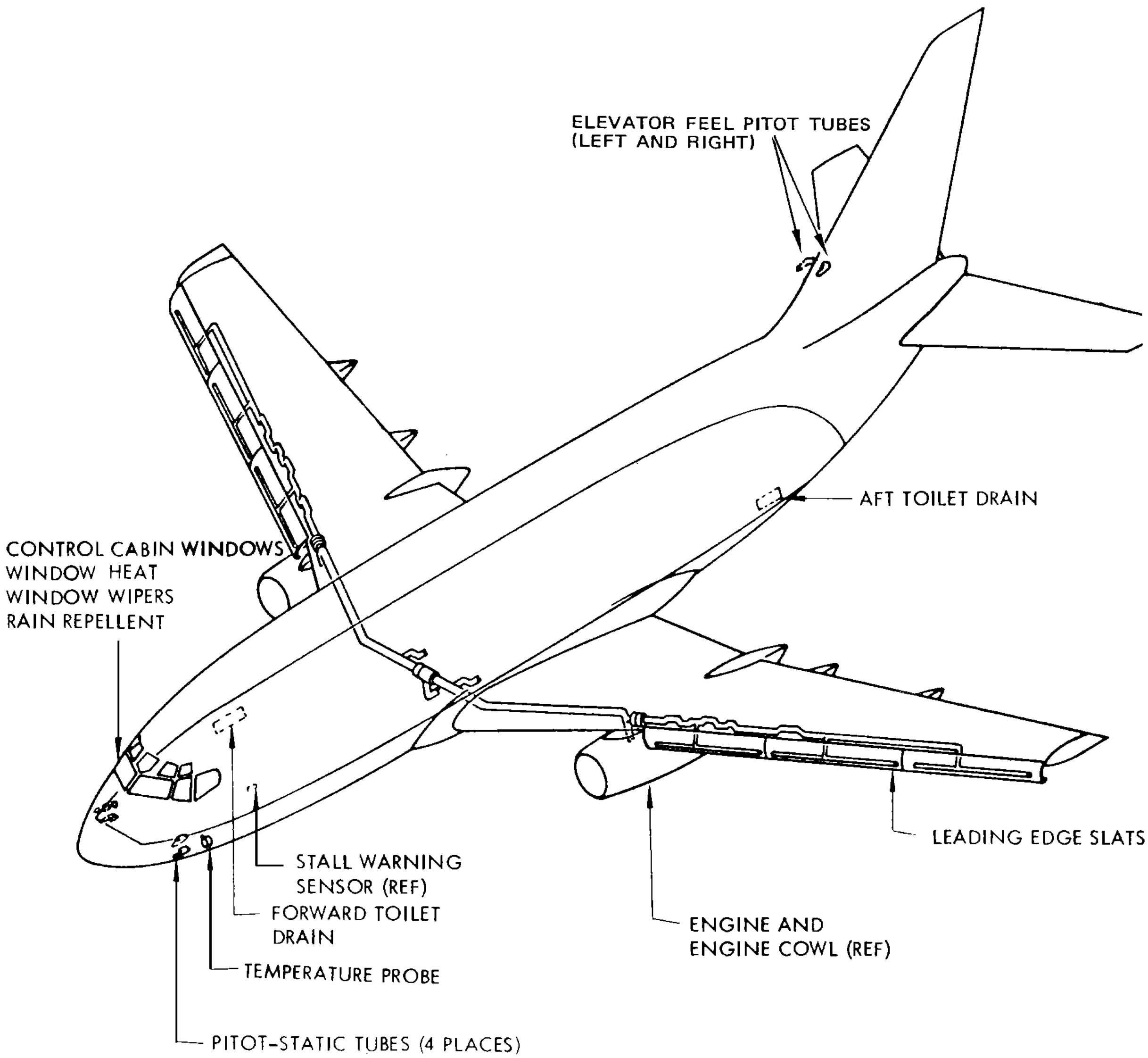
ICE AND RAIN PROTECTION - DESCRIPTION AND OPERATION

1. General
   A. The following systems are used to protect the airplane and aid the pilots when operating under ice and rain conditions.
   B. Thermal anti-icing (TAI) systems using engine bleed air are provided for the wing, engine, and engine cowls (Fig. 1).
   C. Electrical anti-icing systems are provided for the control cabin windows; pitot and temperature probe sensors, stall warning sensor, and the water and toilet drains.
   D. Rain removal is provided for the No. 1 control cabin windows by a windshield wiper system. A rain repellent system is also provided to be used in conjunction with the wiper system.
2. Thermal Anti-Icing Systems
   A. The wing anti-icing system deices the leading edge slats. The TAI air for the system is supplied from engine bleed air (Ref Chapter 36, Engine Bleed Air Distribution System).
   B. The engine anti-ice system deices the engine nose dome, inlet guide vanes, and engine inlet cowl. Engine anti-icing is covered in Chapter 75.
3. Electrical Anti-Icing Systems
   A. The control cabin window anti-icing system deices and provides birdproofing of the No. 1, 2, 4, and 5 control cabin windows on each side of the control cabin. The windows are heated by the use of a transparent electrical resistance coating incorporated as an integral part of the windows.
   B. The pitot-static and temperature probe anti-icing system deices the left and right pitot tubes, the elevator feel left and right pitot tubes and the temperature probe. The sensors are heated by electrical resistance elements installed within the sensing head of the units.
   C. The stall warning sensor is deiced by electrical resistance elements installed within the attitude sensor weathervane The heater is controlled by the stall warning system and is heated whenever that system is in operation (Ref Chapter 27, Stall Warning System).
   D. The water and toilet drain anti-icing system deices the fore and aft toilet drain connectors. The toilet drain connectors are heated by electrical resistance elements installed as an integral part of the connector gasket. The heaters are controlled directly by their respective circuit breaker and are heated whenever the airplane has electrical power.
4. Rain Removal Systems
   A. The windshield wiper system maintains clear areas on the No. 1 control cabin windows during takeoff, approach, and landing in rain or snow. The wipers are driven independently by electric motors, which are controlled by a common switch.

B. The rain repellent system sprays a rain repellent solution on the No. 1 control cabin windows and is used in conjunction with the windshield wiper system to improve visibility during heavy rain. The repellent solution for both windows is supplied from a common pressurized container, but is controlled independently by separate control switches for each window.



Ice and Rain Protection Systems
Figure 1

COMBINED WINDOW AND PITOT HEAT P5-9 MODULE - REMOVAL/INSTALLATION

1. General
   A. The P5-9 Module located in the pilot overhead panel contains all control and test switches and indicating lights for the Pitot-Static and Temperature Probe Anti-Icing System and the Control Cabin Window Anti-Icing System.
2. Prepare for Removal
   A. Open circuit breakers listed below:
      (1) On P6 Generator Bus No. 1 panel, open WINDOW ANTI-ICE circuit breakers:
         (a) L4 & L5
         (b) R SIDE STATIC INDICATION
         (c) L FRONT
         (d) CAPTAIN PITOT STATIC INDICATION
      (2) On P6 Generator Bus No. 2 panel, open WINDOW ANTI-ICE circuit breakers:
         (a) R4 & R5
         (b) R FRONT
         (c) L SIDE
         (d) FIRST OFFICER
         (e) PITOT STATIC INDICATION
         (f) MASTER CAUTION ANTI-ICE
      (3) On P18 Anti-Ice and Rain panel, open PITOT-STATIC and WINDOW HEAT CONTROL circuit breakers:
         (a) CAPT UPPER L
         (b) CAPT LWR R
         (c) F/O UPPER R
         (d) F/O LWR L
         (e) ELEVATOR PITOT R
         (f) ELEVATOR PITOT L
         (g) RIGHT TEMP PROB
         (h) RIGHT FWD AC
         (i) RIGHT FWD DC
         (j) RIGHT SIDE AC
         (k) RIGHT SIDE DC
         (l) LEFT FWD AC
         (m) LEFT FWD DC
         (n) LEFT SIDE AC
         (o) LEFT SIDE DC
         (p) EFT TEMP PROB
         (q) TEMP PROB

3. Remove P5-9 Module
   A. Release four quick-release panel fasteners and lower module.
   B. Disconnect electrical connectors.
4. Install P5-9 Module
   A. Connect electrical connectors.
   B. Place module in position in overhead panel and secure panel fasteners.
   C. Close circuit breakers opened in 2.A. and check module control switches and indicator lights.
      (1) Provide electrical power (Ref 24-22-0, M/P).
      (2) Check each indicator light (Push-to-test).
      (3) Test pitot static and temperature probe anti-icing system (Ref 30-31-0, A/T).
      (4) Position each of the window heat switches to ON individually. Check that the corresponding window increases in temperature and that the amber OFF LIGHT indicator goes out.
      (5) With any window heat switch on, position test switch to PWR. Check that the respective window temperature increases and that the OVERHEAT light illuminates.

      CAUTION: RELEASE TEST SWITCH AS SOON AS THE OVERHEAT LIGHT ILLUMINATES AS WINDOW MAY BE DAMAGED.

      (6) Position test switch to OVHT. Check that all OVERHEAT indicator lights illuminate and that master caution and warning ANTI-ICE indicator light illuminates.
      (7) Return all window heat control switches to OFF. The amber OFF LIGHT for the applicable window will illuminate.
      (8) Remove electrical power if it is no longer required.

WING THERMAL ANTI-ICING SYSTEM - DESCRIPTION AND OPERATION

1. General

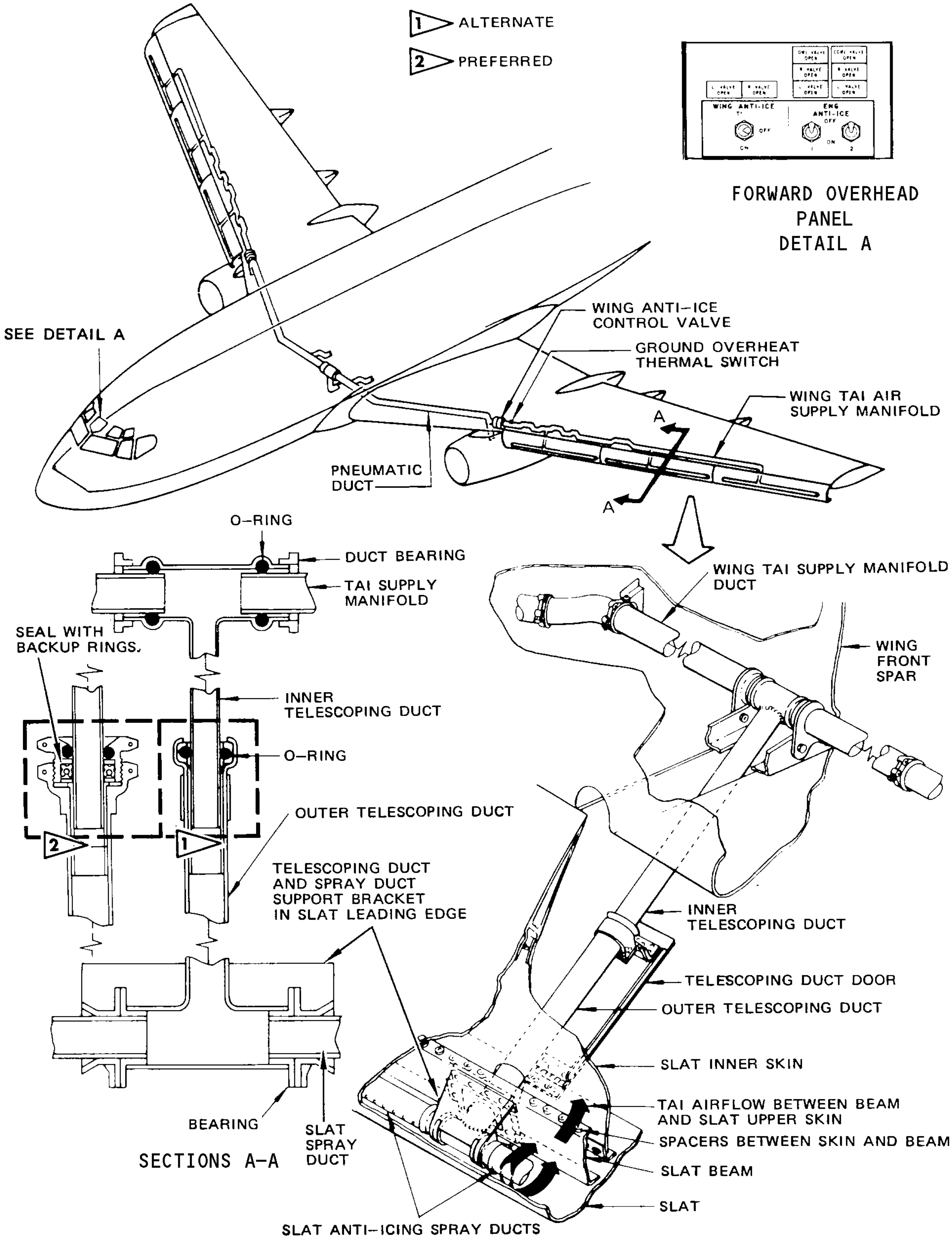
   A. The wing thermal anti-icing (TAI) system prevents the formation of ice on the wing leading edge slats. The system receives regulated hot air (pneumatic air) from the engine bleed air distribution system and is operable only when air is available from that system. Refer to Chapter 36, Engine Bleed Air Distribution System. The flow of pneumatic air is controlled by a shutoff valve for each wing. Both valves are operated by a single control switch on the pilot's overhead panel. When the system is in operation, the valves direct the hot pneumatic air through a distribution system to the wing leading edge slats. The system consists of supply and distribution ducting, two control valves, electrical control components, and indicating components (Fig. 1 and 2).

2. Wing Anti-Ice Ducting

   A. The pneumatic air duct is connected to each of the wing leading edge supply ducts through a control valve located in the wing leading edge just outboard of the engine strut on each side of the airplane (Fig. 1). The wing supply ducts are connected to each of the wing leading edge slats by telescoping ducts. The telescoping ducts consist of two tubes, one of which slides within the other as the slats are extended or retracted, and are sealed by an O-ring between them. The inner telescoping duct is connected to the wing TAI supply manifold ducts by a swivel T-connection to allow rotational movement of the telescoping duct around the wing supply duct. The T-connection is sealed by an O-ring between each end of the T and the supply duct. The outer telescoping duct is connected to a slat anti-icing spray duct by a swivel T-connection to allow rotational movement of the telescoping duct about the slat anti-icing spray duct. A support bracket in the slat leading edge supports the ends of the slat spray ducts and the telescoping duct and prevents the TAI air from flowing back through the telescoping duct cutout in the slat beam. The slat anti-icing spray duct runs the full length of the slat and has perforations to direct the air towards the slat leading edge. The air then flows between the slat upper skin and the slat beam where it is exhausted overboard through openings in the slat inner skin.

   B. To compensate for wing flexing, duct misalignment, and thermal expansion the ducts inboard of approximate wing station 159 are rigidly held and pre-stressed on installation by the use of threaded couplings to stretch the ducting. The ducts outboard of wing station 159 use slip type expansion joints. Duct movement is also absorbed by the swivel joints at each telescoping duct connection and by expansion bends in the duct routing.

3. Wing Anti-Ice Control Valves
   A. The flow of air into the wing TAI system is controlled by a wing TAI shutoff valve for each wing supply duct. The valves are located in the wing leading edge just outboard of each engine strut, (Fig. 1) and are 2-1/2-inch diameter electric motor-driven butterfly valves, which operate on 115-volt ac power. The valves are equipped with limit switches to prevent overrunning of the motor, and valve position indicator switches, which are used in the valve position indicator circuits. Each valve is also equipped with an external valve position indicator to verify valve position. The valves are controlled by the valve control relay.
4. Wing Anti-Ice Control Components
   A. The operation of the wing anti-ice control valves are governed by the following electrical control components; a pair of contacts on the landing gear safety relay, a wing TAI control switch, a valve control relay, two ground overheat thermal switches, and two transistorized circuit cards (Fig. 2).
   B. The safety relay is energized by the main gear safety sensor when the airplane is on the ground. Refer to Chapter 32, Landing Gear Miscellaneous Electrical Components. The relay is used to direct power to the appropriate side of the control switch for operation of the system during testing.
   C. The wing TAI control switch is located on the P5 overhead panel. The switch is a three position six pole toggle switch; two poles are used in the valve control circuit and the other four poles are used in the valve position indicating circuits. It has an ON position, an OFF position and a momentary TEST position. The control switch is used to control the operation of the wing anti-
ice system.
   D. The valve control relay is located behind the P5 overhead panel. The relay directs 115-volt ac power from the WING A/I circuit breakers to open the wing anti-ice control valves when energized and to close the valves when the relay is de-energized. The relay is controlled by the safety relay and the control switch.
   E. The transistorized circuitry is used to control the indicating lights, and in the event a ground overheat condition occurs, it also controls the valve control relay. The system can be tested on the ground and in the air.
   F. The overheat thermal switches are located at the root end of each wing leading edge distribution manifold. The switch is a temperature sensitive bimetallic type switch with normally open contact points, which close at the correct temperature. Thermal switches with part numbers 975-0062-002 or 3000-46-27 close at 125 degrees C (257 degrees F). Thermal switches with part numbers 975-0062-001 or 3000-46-28 close at 93 degrees C (200 degrees F). Actuation of a thermal switch in either wing while the switch is in the TEST or OFF position will complete a circuit to close both wing anti-ice valves.



Wing Thermal Anti-Icing System Equipment Location
Figure 1

5. Wing Anti-Ice Indicating Components

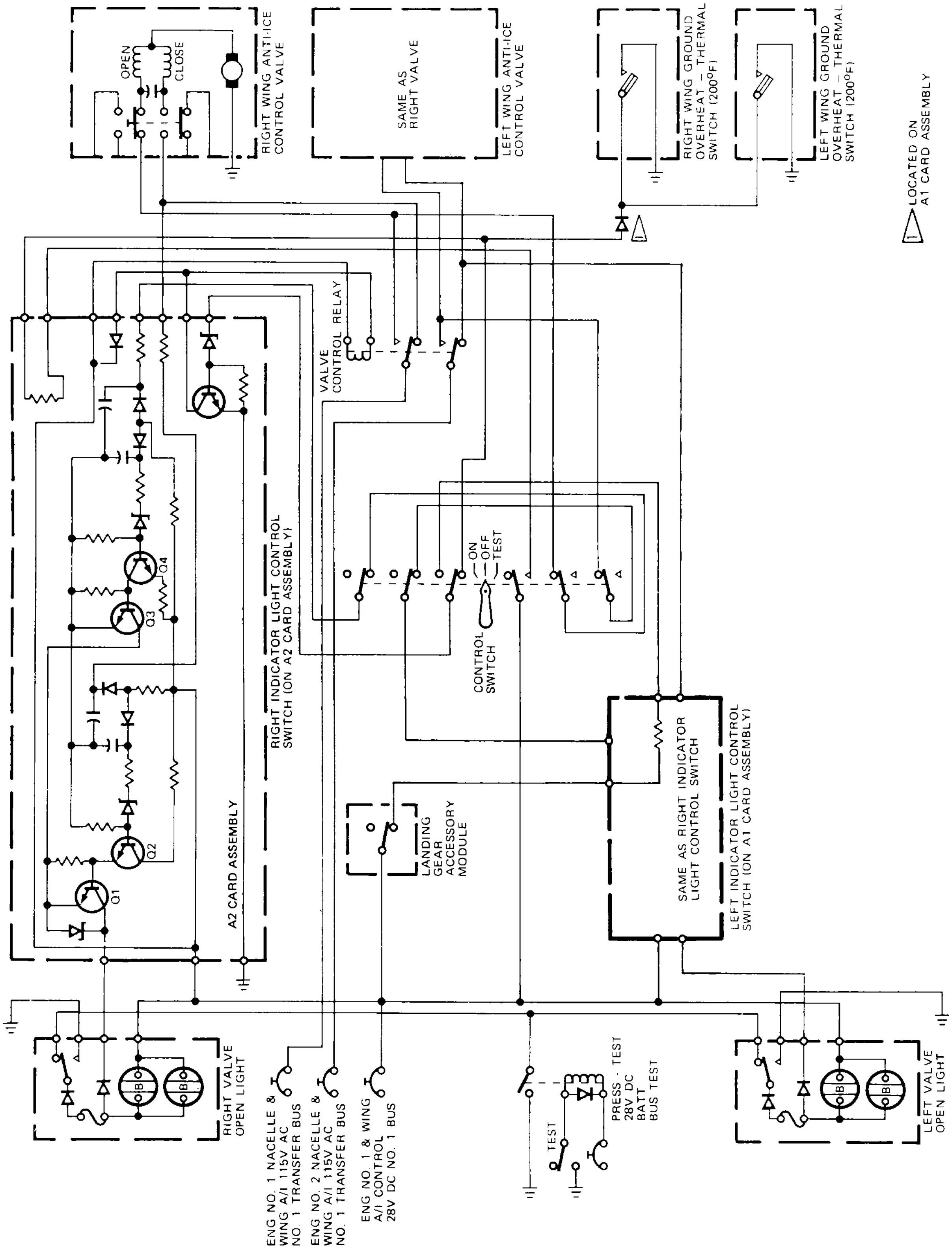
A. The wing anti-ice system is provided with a blue light for each control valve to indicate valve position. The lights are of the press-to-test type and are located on the overhead panel adjacent to the system control switch. The valve open indicating lights are illuminated dimly whenever their respective valve is in the open position, and brightly whenever their respective valve position does not agree with the control switch position due to a system malfunction or during valve transit. The lights may be tested through the use of the master light test switch. Refer to Chapter 33, Control Cabin Lighting, for the master test switch.

B. Each valve indicating light is controlled by a transistorized control switch, two poles of the system control switch, and the valve position limit switches in its respective control valve. The transistorized control switches are on printed circuit cards mounted behind the overhead panel. The transistorized light control switches are supplied 28-volt dc power from the A/I control circuit breaker.

6. Operation

A. The wing anti-icing system is controlled manually by the wing anti-ice control switch on the overhead panel. Actuation of the control switch to the ON position while the airplane is in flight opens the wing TAI control valves and allows pneumatic air to flow through the wing leading edge anti-ice ducts. The landing gear safety relay prevents wing anti-ice operation with the switch in the ON position while the airplane is on the ground. The wing TAI control valves may be operated for testing on the ground or in the air by holding the control switch in the GRD TEST position. Overheating of the ducts by excessive ground testing is prevented by the duct overheat switches, which will automatically cycle the control valves to prevent the pneumatic air from exceeding 200°F.

B. The valve position indicator lights provide an indication of their respective valve position. The light will glow bright if the valve position disagrees with the control switch position. The light will glow dim if the valve is open and the control switch position is in either ON or TEST positions. The light will not illuminate if the valve is closed and the control switch is in the OFF position.



Wing Thermal Anti-Icing System Circuit
Figure 2

WING THERMAL ANTI-ICING SYSTEM - TROUBLESHOOTING

1. General

   A. Before using the following troubleshooting chart prepare to test the wing TAI system in accordance with adjustment test procedure. Proceed with test to extent practical to determine extent of trouble. When checking system for air mode of operation press GRD SENSING TEST switch on landing gear module.

   FL N7370F, N7371F, N7372F, N7378F, N7379F, N7380F;
   TS N73711, N73712, N73715, N73717;
   VP PP-SMA THRU PP-SME;

2. Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
One light does not illuminate on press to test or in any switch position	Defective lamp	Check continuity of lamp. IF -	
		No Continuity -	Replace lamp
		Continuity OK - Check for defective lamp base	
	Defective lamp base	Check for continuity with lamp installed between base terminals 1 and 2, and 1 and 3 with light cover normal and between terminals 1 and 4 with light cover depressed. IF -	
		No Continuity	Replace lamp base
		Continuity OK	Replace P5-11 module
Neither light illuminates on press to test or in valve transit	Defective wiring	Remove receptacle D462 from P5-11 module and check for dc power at pin 18. IF -	
		No Power	Repair wiring between circuit breaker and receptacle
		Power OK - Check for continuity between pin 29 and ground. IF-	
		No Continuity	Repair wiring between receptacle and ground
		Continuity OK	Replace P5-11 module

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
One light does not agree with switch position	Defective valve control circuit	Check if valve position agrees with switch position. IF -	

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
One light does not agree with switch position (Cont)	Defective valve control circuit (Cont)	Valve agrees with switch position check for defective valve position indication circuit	
		Valve does not agree with switch position-remove receptacle D648 from P5-11 module if left valve of D462 if right valve and check for ac power at pins 10 and 11. IF -	
		No Power	Repair wiring between circuit breaker and respective pin of receptacle
		Power OK - Jumper pin 10 on receptacle D648 to pin 10 on P5-11 module if left valve or replace receptacle D462 if right valve and check for ac power at pins 3 and 5 of module receptacle D648 with switch in CLOSE or OFF position and at pins 4 and 6 with switch in GRD-TEST, OPEN or ON position. IF -	
		No Power	Replace P5-11 module
		Power OK - Install receptacle D648 on P5-11 module and remove receptacle to respective valve and check for power at pin 1 for switch in TEST, OPEN or ON position. IF -	

Wing Anti-Icing System - Troubleshooting
Figure 101 (Sheet 1)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
One light does not agree with switch position (Cont)	Defective valve control circuit (Cont)	No Power	Repair wiring between receptacle D648 and respective valve receptacle
		Power OK - Check for continuity between pin 3 of valve receptacle and ground. IF -	
		No Continuity	Repair wiring between valve receptacle and ground
		Continuity OK	Replace valve
Neither light agrees with switch position	Defective valve control circuit	Disconnect receptacle D462 from P5-11 module dc power at pin 24. IF -	
		No Power	Repair wiring between circuit breaker and receptacle (See Landing Gear Miscellaneous Electrical Components - Chapter 32, for operation of safety relay)
		Power OK - Check for continuity between pin 21 and ground. IF -	
		No Continuity	Replace P5-11 module
		Continuity - Disconnect receptacle from both ground overheat thermal switches and check for continuity between pins 1	

Wing Anti-Icing System - Troubleshooting
Figure 101 (Sheet 2)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Neither light agrees with switch position (Cont)	Defective valve control circuit (Cont)	Continuity	Replace defective switch
		No Continuity	Repair wiring between module receptacle and thermal switch receptacles
Overheat protection does not close valves when air temperature exceeds 200°F (thermal switch P/N 975-0062-001 or 3000-46-28) or 257°F (thermal switch P/N 975-0062-002 or 3000-46-27)		Disconnect receptacle D462 from P5-11 module and check for continuity to ground while heating either thermal switch to 200°F (thermal switch P/N 975-0062-001 or 3000-46-28) or 257°F (thermal switch P/N 975-0062-002 or 3000-46-27) in accordance with system adjustment/test procedure. IF -	
		Continuity OK -	Replace P5-11 module
		No Continuity - Remove receptacle from thermal switch and check for continuity across pins 1 and 2 while conducting test. IF -	
		Continuity OK -	Repair wiring between module receptacle and switch receptacle
		No Continuity -	Replace thermal switch

Wing Anti-Icing System - Troubleshooting
Figure 101 (Sheet 3)

WING THERMAL ANTI-ICING SYSTEM - ADJUSTMENT/TEST

1. Wing Thermal Anti-Icing System Test
   A. General
      (1) Testing of the wing TAI system is separated into three parts; an electrical control and indicating system test, a duct pressure and leakage test, and a ground test.
         (a) The electrical control test is effective in establishing correct functioning of the electrical control components, circuit continuity, and valve motor operation.
         (b) The duct leakage test is effective in establishing that all joints are properly made and that allowable leakage is distributed throughout the system. Leakage should not be present in any localized area to an extent capable of creating operating pressure or temperature hazards.
         (c) The ground test is effective as a system confidence check. The test is accomplished with either the engines or the APU running. All functions are performed in the control cabin and requires no access to ducts or system components.
   B. Electrical Control and Indicating System Test
      (1) Equipment and Materials
         (a) Temp-Cal Probe Heater BH3884-40 (attachment to Jet-Cal engine analyzer) or H294 Temp-Cal Thermal Switch Tester or
            H394 Temp Cal Tester with adapter cable BH405
            BH24944 Heater Probe Kit (basic P/N)

            NOTE: This kit is necessary to use the testers listed above. There are different dash number kits for specific airplane model and tester combinations. Please consult with supplier.
            Howell Instruments
            3479 West Vickery Blvd.
            Fort Worth, Texas 76107

      (2) Prepare to Test Control and Indicating System
         (a) Connect external power and energize 115v ac transfer buses No. 1 and 2, and 28v dc T/R bus No. 1.
         (b) Check that the following circuit breakers on the P18-3 anti-ice and rain circuit breaker panel are closed.
            1) ENG 1 & WING VALVE
            2) ENG 2 & WING VALVE
            3) ENG 1 & WING CONTROL

(c) On the pilot's overhead panel (P5) press to test the wing anti-ice left and right valve open lights for operation.

NOTE: Each light will go on when pressed and off when released.

(3) Test Valve Control Circuit

(a) Open ENG 1 & WING VALVE (right wing valve) circuit breaker.

(b) Hold wing TAI control switch in GRD-TEST or TEST position and check that left valve open light glows brightly for 1 to 3 seconds and then continues to glow dim as long as switch is held and left wing anti-ice valve opens.

NOTE: Right valve open light will glow brightly as long as control switch is held.

(c) Release wing TAI control switch and check that switch returns to CLOSED or OFF position, left valve open light glows brightly for 1 to 3 seconds and then goes off and left wing anti-ice valve closes.

NOTE: Right valve open light will go off when control switch is released.

(d) Close ENG 1 & WING VALVE circuit breaker, open ENG 2 & WING VALVE (left wing valve) circuit breaker, and repeat steps (b) and (c) for right valve control circuit.

(e) Close ENG 2 & WING VALVE circuit breaker, place wing anti-ice control switch in ON position, and check that both valve open lights glow brightly and both valves remain closed.

(f) On landing gear module M338, press GRD SENSING TEST switch and check that both valve open lights glow brightly for 1 to 3 seconds and then continue to glow dim as long as test switch is held and both wing anti-ice valves open.

(g) Release GRD SENSING TEST switch and check that both valve open lights continue to glow dim for 1 to 3 seconds and then glow bright and both wing anti-ice valves close.

(h) Return wing anti-ice control switch to the CLOSED or OFF position.

(4) Test Ground Overheat Protection Circuit

(a) Remove wing TAI ground overheat thermal switch from left wing TAI manifold (Ref 30-11-21, R/I). Reconnect electrical connector to thermal switch.

(b) Hold wing anti-ice control switch in GRD-TEST position. After both valve open lights dim indicating both valves open, heat thermal switch to 200 + 10/-0°F (thermal switch P/N 975-0062-001 or 3000-46-28) or 257 + 10/-0°F (thermal switch P/N 975-0062-002 or 3000-46-27) with Temp Cal heater. Allow approximately 2 minutes heating to ensure thermal switch is heat-soaked, and check that both valve open lights go bright after 1 to 3 seconds and both valves close.

(c) Allow thermal switch to cool to ambient temperature then check that both valve open lights return to dim and both valves open.

(d) Release wing anti-ice control switch and reinstall thermal switch (Ref 30-11-21 R/I).

(e) Repeat steps (a) thru (d) for right thermal switch.

(f) Determine if there is any further need for electrical power on the airplane, if not, remove external power.

C. Duct Leakage Test

(1) General

(a) Wing leading edge distribution ducts can be leak tested using either engine bleed, APU, or an external air supply. Air supply above 200°F will cause the ground overheat thermal switch to cycle the wing anti-ice control valve.

(2) Prepare to Test Duct Leakage

(a) Remove wing leading edge lower access panels.

(b) Pressurize pneumatic duct.

1) If APU air is used:

a) Close engine bleed and air conditioning pack valves.

b) Check that manifold isolation valve switch is either in OPEN or AUTO position.

2) If engine bleed air is used, operate engines at idle speed to keep air temperature as low as possible.

3) If external air is used:

a) Connect air supply to ground pneumatic connection. (Air supply should be sufficient to provide a minimum of 7-psi manifold pressure.)

b) Apply external electrical power.

c) Close engine bleed and air conditioning pack valves.

d) Check that manifold isolation valve switch is in either OPEN or AUTO position.

(c) Extend wing leading edge flaps and slats.

1) If APU or external air supply is used, refer to Chapter 27, Wing Leading Edge Flaps and Slats.

(d) Check leading edge manifold and ducts for loose or broken brackets.

(3) Test Duct Leakage

(a) Hold wing anti-ice control switch in GRD TEST or TEST position.

(b) Check distribution manifold and ducts for cracks, holes, and diffused leakage. Diffused leakage is allowable at duct seals and joints. Jet blasts are not permissible. Test for leakage by feeling in near vicinity of area being subjected to test.

WARNING: CARE SHOULD BE EXERCISED NOT TO PLACE HANDS DIRECTLY ON HEATED DUCTS. DUCTS MAY REACH APPROXIMATELY 200°F IN NORMAL OPERATION AND UP TO 450°F IF OVERHEAT PROTECTION FAILS. SERIOUS BURNS CAN RESULT FROM DIRECT CONTACT WITH DUCTS.

(c) Check leading edge flap skins for proper sealing (no leakage) at joints.
(d) Check leading edge flap and slat skin openings for diffused airflow and that openings are free of sealant and foreign matter.

CAUTION: BLOCKED SKIN OPENINGS ALLOW ACCUMULATION OF WATER WHICH ACCELERATES SKIN CORROSION.

(e) Release wing anti-ice control switch.
(4) Restore Airplane to Normal
(a) Retract wing leading edge flaps and slats (Ref Chapter 27, Leading Edge Flaps and Slats)
(b) Remove air supply.
(c) If external air supply was used, determine if there is any further need for electrical power on airplane. If not, remove electrical power.
(d) Install wing leading edge lower access panels.

D. Ground Operational Test with Engine Power

NOTE: You can also do this test with APU power. Paragraph E. provides a procedure, which uses this option.

(1) Prepare to Test Wing TAI System.
(a) Start engines in accordance with engine start procedure. (Ref Chapter 71, Power Plant)
(b) With the engines set idle and power available at 115 volts ac transfer bus No. 1 and No. 2 and 28 volts dc T/R bus No. 1, check that the following circuit breakers are closed:
1) ENG NO. 1 NACELLE & WIND ANTI-ICE
2) ENG NO. 2 NACELLE & WIND ANTI-ICE
3) ENG NO. 1 & WING ANTI-ICE CONTROL

(c) On the pilot's overhead panel P5, press to test the wing anti-ice left- and right-valve open annunciator lights for operation.

NOTE: Each light will go on when pressed and off when released.

(2) Test Wing TAI System
(a) Position left engine bleed valve to open and isolation valve to closed.
(b) Hold wing TAI control switch in GRD-TEST position and check that both valve open lights glow brightly for 1 to 3 seconds and then continue to glow dim.
(c) Increase left engine power slightly until both valve open lights glow brightly (left ground overheat switch actuates).
(d) Reduce left engine power to idle, close left engine bleed valve and check that the valve open lights return to dim after a short interval.
(e) Repeat steps (a), (c) and (d) for right side of system to check operation of right ground overheat switch.
(f) Release wing TAI control switch and check that both valve open lights glow brightly for 1 to 3 seconds and then go off.
(g) Shut down Engine.

E. Ground Operational Test with APU Power (alternative to test with Engine Power).
(1) Provide electrical power (Ref Chapter 24, Electrical Power).
(2) Start the APU (Ref Chapter 49, APU) and allow it to stabilize.
(3) Make sure the VALVE OPEN indicator lights operate:
(a) Push the L and R VALVE OPEN lights on the P5 overhead panel.
(b) Make sure that each light comes on.
(c) Release the VALVE OPEN lights.
(d) Make sure that each light goes off.
(4) Prepare for the test:
(a) Set the BLEED 1 and 2 switches on the P5 panel to OFF.
(b) Set the PACK L and R switches on the P5 panel to OFF.
(c) Set the ISOLATION VALVE switch on the P5 panel to OPEN.
(5) Do this test of the left wing TAI system:
(a) Disconnect electrical connector D736 from the right wing ground thermal switch.
(b) Set the WING ANTI-ICE switch to ON.
1) Make sure that each VALVE OPEN light comes on bright for 1 to 3 seconds (this shows that the valves are in transit).
2) Make sure that each VALVE OPEN light becomes dim after 3 seconds.

(c) Set the APU BLEED switch to ON.

CAUTION: DO NOT LET THE WING TAI VALVE BE OPEN FOR MORE THAN 30 SECONDS. OPERATION FOR MORE THAN 30 SECONDS WITH HEATED AIR CAN CAUSE DAMAGE TO THE WING LEADING EDGE.

1) Make sure that each VALVE OPEN light comes on bright in approximately 10 to 30 seconds.
2) If the lights do not come on in 30 seconds, set the APU BLEED switch to OFF.

(d) Set the APU BLEED switch to OFF.
1) Make sure that both VALVE OPEN lights become dim.

NOTE: It is possible that the lights will not become dim for up to 2 minutes after you set the APU BLEED switch to OFF.

(e) Connect the electrical connector to the right wing ground thermal switch.

(6) Do a test of the right wing TAI system:
(a) Disconnect electrical connector D738 from the left wing ground thermal switch.
(b) Set the APU BLEED switch to ON.

CAUTION: DO NOT LET THE WING TAI VALVE BE OPEN FOR MORE THAN 30 SECONDS. OPERATION FOR MORE THAN 30 SECONDS WITH HEATED AIR CAN CAUSE DAMAGE TO THE WING LEADING EDGE.

1) Make sure that each VALVE OPEN light comes on bright in approximately 10 to 30 seconds.
2) If the lights do not come on in 30 seconds, set the APU BLEED switch to OFF.

(c) Set the APU BLEED switch to OFF.
1) Make sure that each VALVE OPEN light becomes dim.

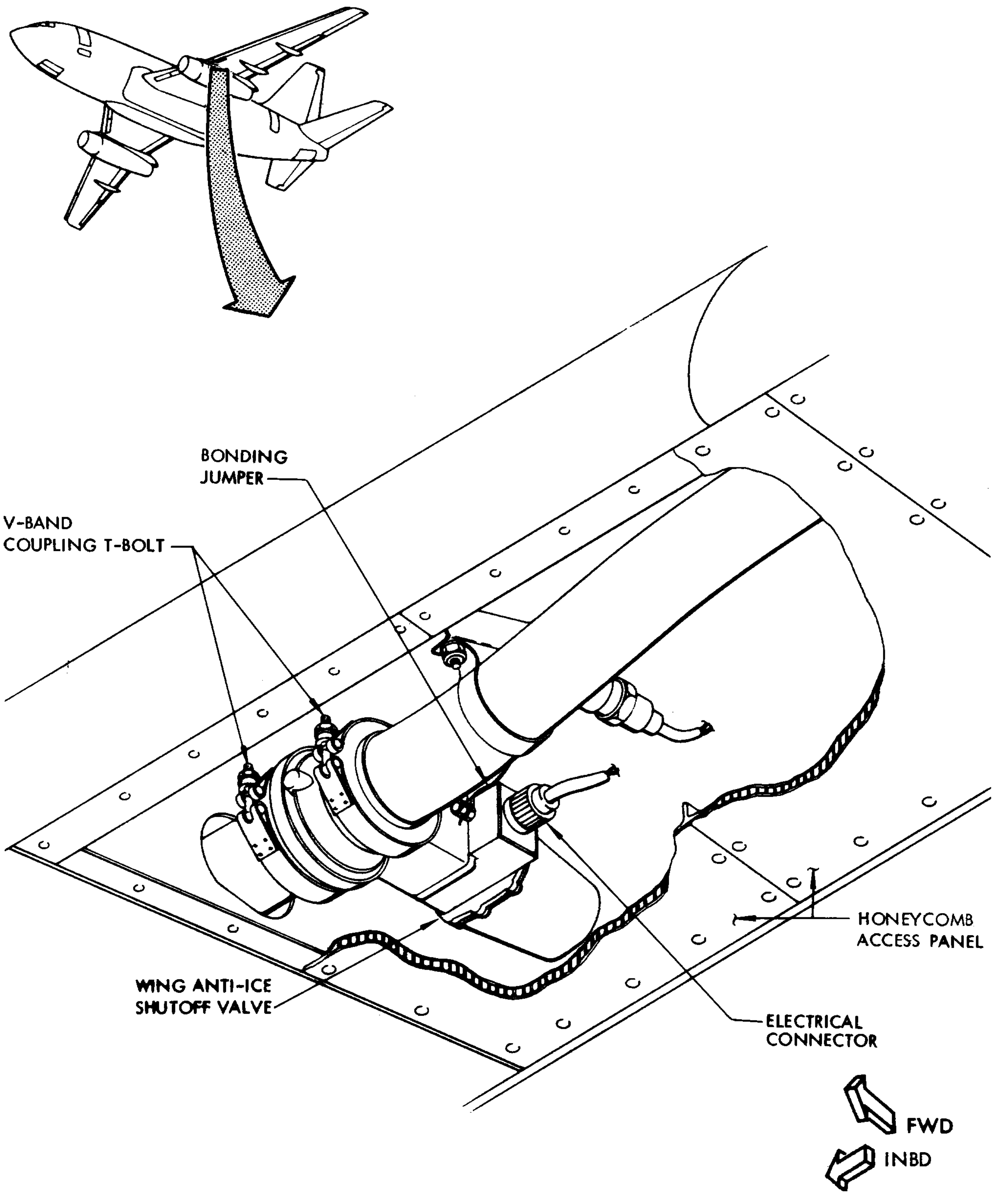
NOTE: It is possible that the lights will not become dim for up to 2 minutes after you set the APU BLEED switch to OFF.

(d) Connect the electrical connector to the left wing ground thermal switch.
(e) Set the WING ANTI-ICE switch to OFF.
1) Make sure that each VALVE OPEN light comes on bright for 1 to 3 seconds.
2) Make sure that each VALVE OPEN light becomes dim after 3 seconds.

(7) Remove electrical power (Ref Chapter 24, Electrical Power).

WING THERMAL ANTI-ICING SHUTOFF VALVE - REMOVAL AND INSTALLATION

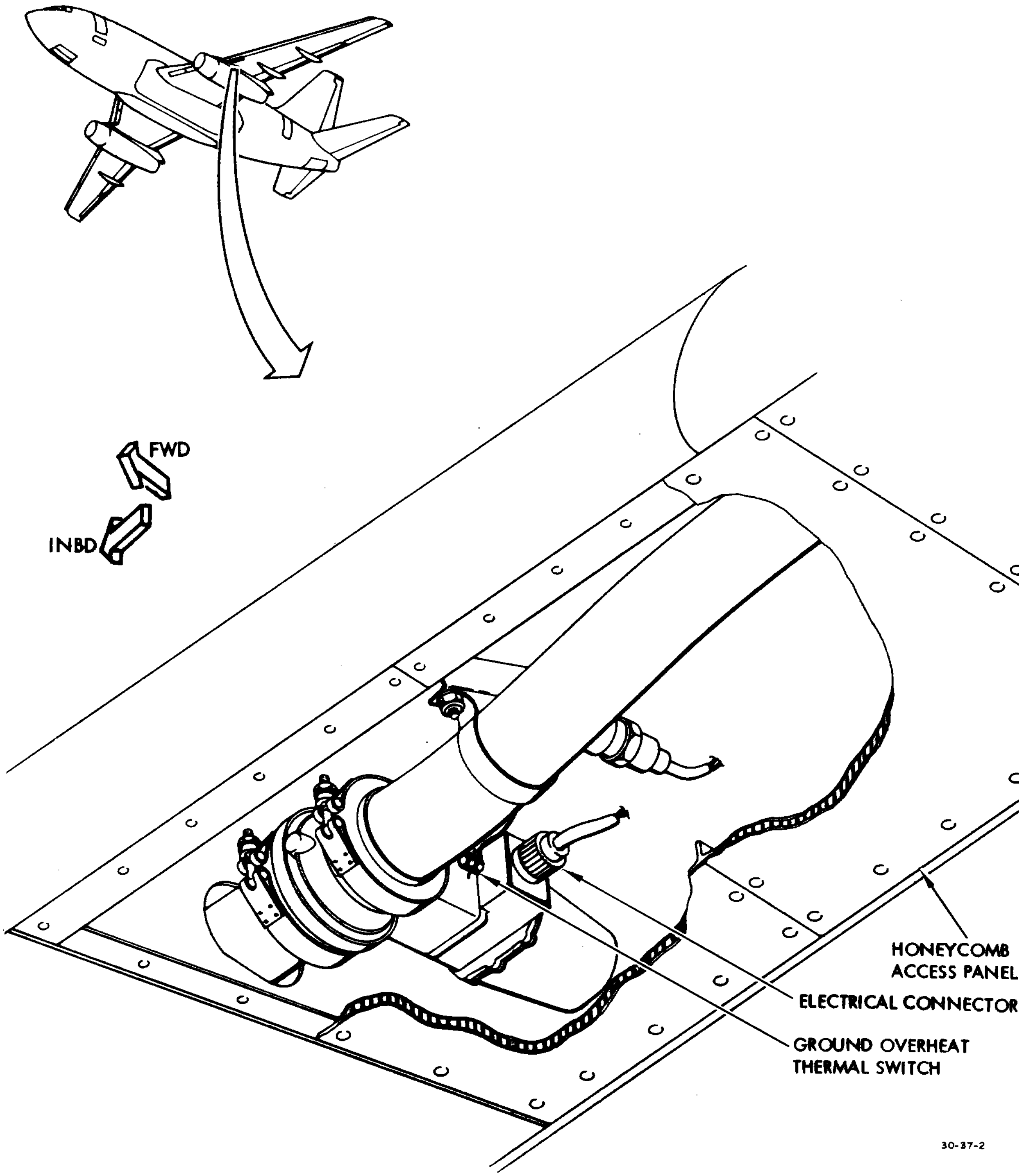
1. General
   A. The wing thermal anti-icing shutoff valves are located outboard of the engines in the leading edge of the wing. Access to the valves is through honeycomb panels in the bottom of the wing leading edge.
2. Remove Wing Anti-Ice Shutoff Valve (Fig. 401)
   A. Open ENG & WING VALVE ANTI-ICE circuit breaker for respective engine on P18 circuit breaker panel.
   B. Remove access panel in bottom of wing leading edge.
   C. Disconnect electrical connector and bonding jumper from shutoff valve.
   D. Support shutoff valve and disconnect V-band coupling T-bolt on each side of shutoff valve.
   E. Slide V-band coupling away from shutoff valve and remove shutoff valve.
3. Install Wing Anti-Ice Shutoff Valve (Fig. 401)
   A. Check that mounting flanges of shutoff valve and duct are clean, free of nicks, gouges, or cracks and in alignment with each other.
   B. Position shutoff valve between duct flanges with airflow directional arrow pointing outboard and motor pointing aft.
   C. Install V-band couplings.
   D. Connect bonding jumper and electrical connector to shutoff valve.
   E. Test Valve Control Circuit (Ref 30-11-0 A/T, airplanes without wing TAI system ground operation capability) or (30-11-01 A/T, airplanes with wing TAI system ground operation capability).
   F. Install access panel.



Wing Thermal Anti-Icing Shutoff Valve
Figure 401

WING ANTI-ICING GROUND OVERHEAT THERMAL SWITCH - REMOVAL AND INSTALLATION

1. General
   A. The wing anti-icing ground overheat thermal switches are located approximately 6 inches outboard from the anti-icing shutoff valve. Access to the overheat thermal switches is through honeycomb panels in the bottom of the wing leading edge.
2. Remove Wing Anti-Icing Ground Overheat Thermal Switch (Fig. 401)
   A. Open ENG 1 & WING ANTI-ICE CONTROL circuit breaker on P18 circuit breaker panel.
   B. Remove access panel in bottom of wing leading edge.
   C. Disconnect electrical connector.
   D. Unscrew switch from duct boss and remove switch and gasket.
3. Install Wing Anti-Icing Ground Overheat Thermal Switch (Fig. 401)
   A. Prior to installation, connect electrical connector and perform Ground Overheat Protection Circuit Test (Ref 30-11-0 A/T, airplanes without wing TAI system ground operation capability) or (30-11-01 A/T, airplanes with wing TAI system ground operation capability). If thermal switch is satisfactory, disconnect electrical lead and install as follows.
   B. Install gasket on switch and screw switch into duct boss.
   C. Connect electrical connector.
   D. Install access panel.



Wing Thermal Anti-Icing Ground Overheat Thermal Switch
Figure 401

WING ANTI-ICE TELESCOPING DUCT - REMOVAL/INSTALLATION

1. General
   A. The wing anti-ice telescoping ducts connect the wing thermal anti-icing manifold to each of the six wing leading edge slat spray ducts. The telescoping duct consists of an inner telescoping duct which is attached to the wing manifold and an outer telescoping duct which is attached to the wing leading edge slat spray duct. When the leading edge slat is removed the two parts disengage and may be removed or installed independent of each other. The following procedure is for use with the slat installed and in extended position. To replace either duct with slat removed, use only that portion of the procedure that is applicable. The procedure is similar for each of the six locations with differences at slats 3 and 4 noted.
2. Equipment and Materials
   A. Primer - BMS 10-11 type 1 (Ref 20-30-41, Finishing Materials)
3. Remove Telescoping Duct at Slats 1, 2, 5 and 6 (Fig. 401)
   A. Lower wing leading edge slats (Ref Chapter 27, Wing Leading Edge Slats).
   B. Remove wing access panels as required to gain access to wing manifold on each side of telescoping duct to be removed (Ref Chapter 12, Wing Lower Surface Access Doors and Panels).
   C. Remove wing TAI supply duct connection and support clamps, as required to remove section of duct, from each side of inner telescoping duct and remove duct section.
   D. Remove duct bearing mounting bolts and bearings on each side of inner telescoping duct.
   E. Lower inner telescoping duct to clear structure and withdraw inner duct from outer telescoping duct.
   F. Remove O-rings from inner duct tee.
   G. Remove applicable slat inner skin panel doubler and outer telescoping duct access door.

      NOTE: Some airplanes have a two piece doubler to facilitate duct removal.

   H. Remove slat access panel on wing at each end of slat and remove spray duct retaining bolts (2 places) from each end of slat.
   I. Withdraw spray duct to clear telescoping duct and spray duct bearing. Remove outer telescoping duct.
   J. Remove bearings.
   K. Remove telescoping duct door and seal from outer telescoping duct.
4. Remove Telescoping Duct at Slats 3 and 4 (Fig. 401)
   A. Lower wing leading edge slats (Ref Chapter 27, Wing Leading Edge Slats).
   B. Remove wing access panels as required to gain access to wing manifold on each side of telescoping duct to be removed (Ref Chapter 12, Wing Lower Surface Access Doors and Panels).

C. Remove forward engine Nacelle Fairing (Ref 54-51-11).
D. Remove applicable slat inner skin panel and outer telescoping duct access door.
E. Remove slat access panel on wing at each end of slat and remove spray duct retaining bolts (2 places) from each end of slat.
F. Withdraw spray duct to clear telescoping duct and spray duct bearing. Remove outer telescoping duct.
G. Remove bearings.
H. Remove telescoping duct door and seal from outer telescoping duct.
I. Remove wing TAI supply duct connection and support clamps, as required to remove section of duct from inboard side of inner telescoping duct and remove duct section.
J. Remove duct mounting bolts and bearings on inboard side of inner telescoping duct.
K. Lower inner telescoping duct to clear structure and withdraw inner duct. If proper clearance to remove duct between leading edge angle details does not exist, modify leading edge angles (Ref 30-11-31, Approved Repairs).

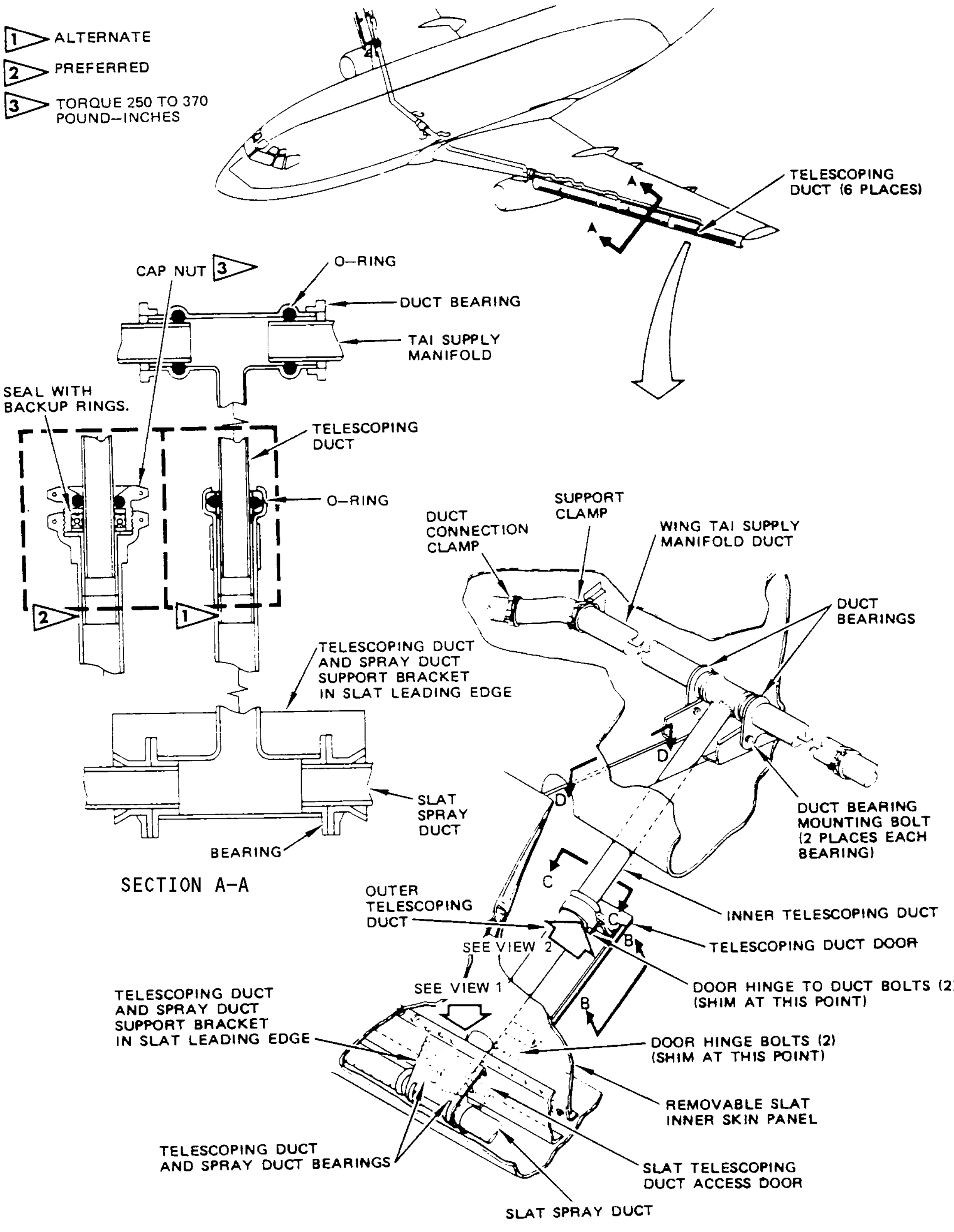
NOTE: Configuration 1 must be modified to configuration 2 to allow removal of duct

L. Remove O-rings from inner duct tee.

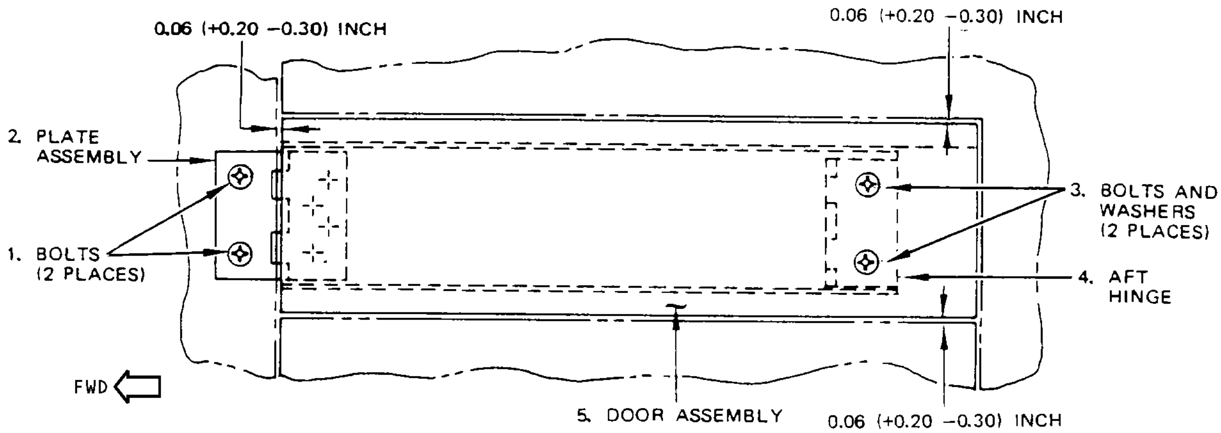
5. Install Telescoping Duct Assembly at Slats 1, 2, 5 and 6 (Fig. 401)
A. Place bearings on each end of tee section of outer telescoping duct and insert assembly into support bracket inside slat. Insert slat spray duct from each end of slat.
B. Install spray duct retaining bolts (2 places) at each end of slat and access panel removed in step 3.H.
C. Install outer telescoping duct access door and slat inner skin doubler.
D. Install seal in end of outer telescoping duct and insert inner telescoping duct.
E. Install wing TAI supply duct O-rings on inner telescoping duct tee.
F. Position inner telescoping duct tee in wing leading edge and install duct bearings.
G. Position wing TAI supply duct section on each side of telescoping duct and install duct connection and support clamps.

CAUTION: TO PREVENT CHAFING, THE SLAT ACTUATOR DOWNLOCK HARNESS AND CLAMPS MUST BE POSITIONED AND INSTALLED TO AVOID INTERFERENCE WITH TELESCOPING DUCT (REF 27-81-21, REMOVAL/INSTALLATION).

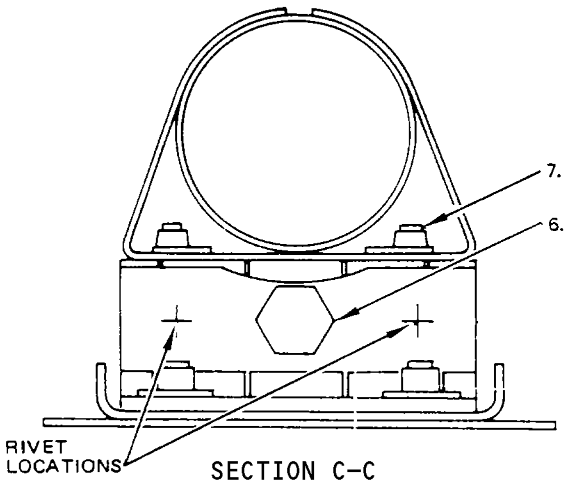
6. Install Telescoping Duct Assembly at Slats 3 and 4 (Fig. 401)
A. Install wing TAI supply duct O-rings on inner telescoping duct tee.
B. Position inner telescoping duct tee in wing leading edge and instal1 duct bearings.



Wing Anti-Icing Telescoping Duct
Figure 401 (Sheet 1)



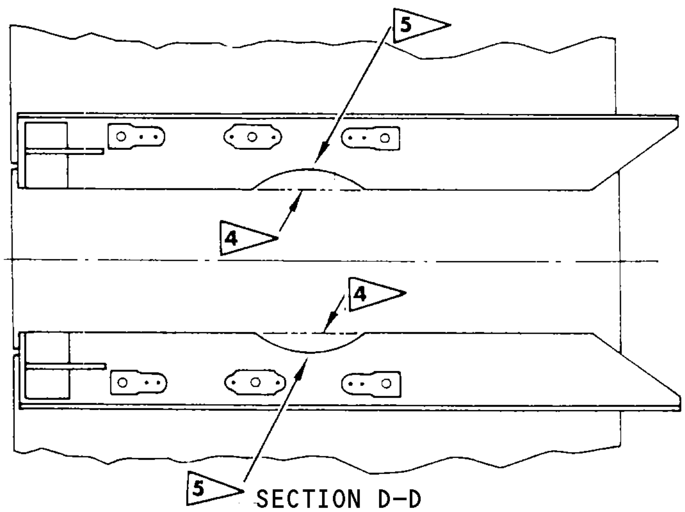
SECTION B-B



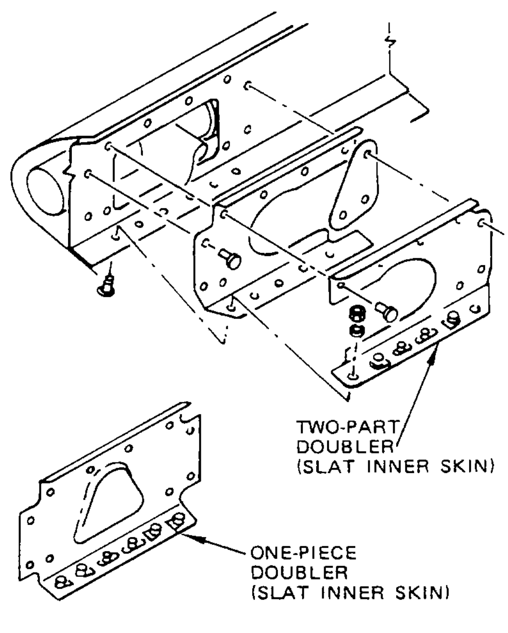
SECTION C-C

4 CONFIGURATION 1

5 CONFIGURATION 2

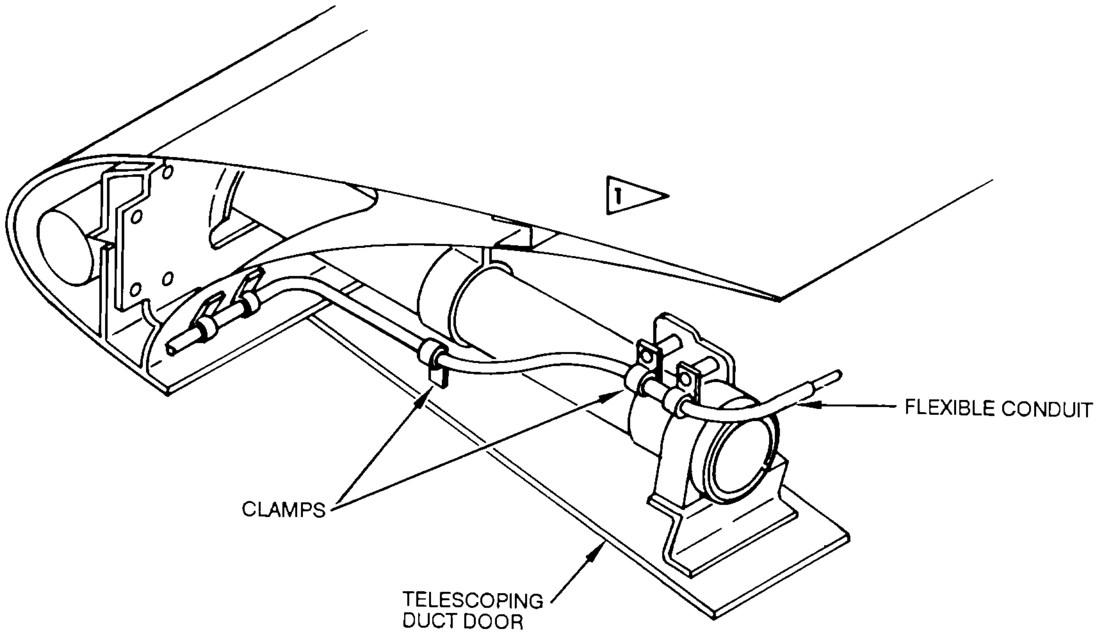


SECTION D-D
(SLAT NO. 3, 4 ONLY)

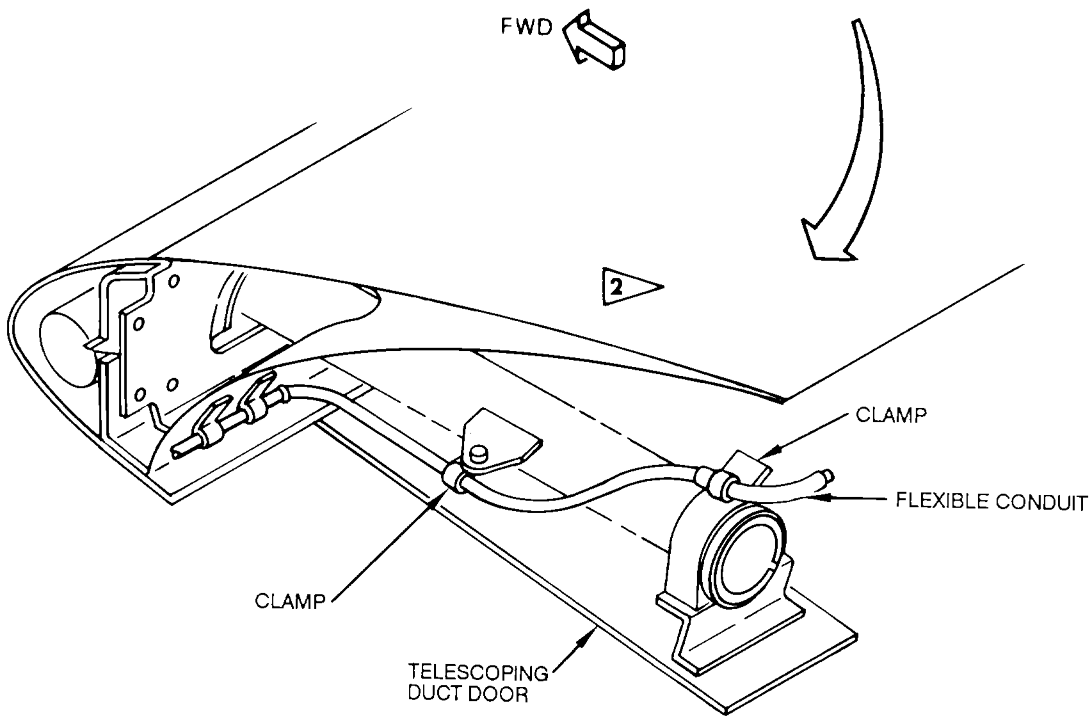


VIEW 1

Wing Anti-Icing Telescoping Duct
Figure 401 (Sheet 2)



VIEW 2



1 ALTERNATE
2 PREFERRED

LEFT SIDE SHOWN,
RIGHT SIDE OPPOSITE

Wing Anti-Icing Telescoping Duct
Figure 401 (Sheet 3)

444221

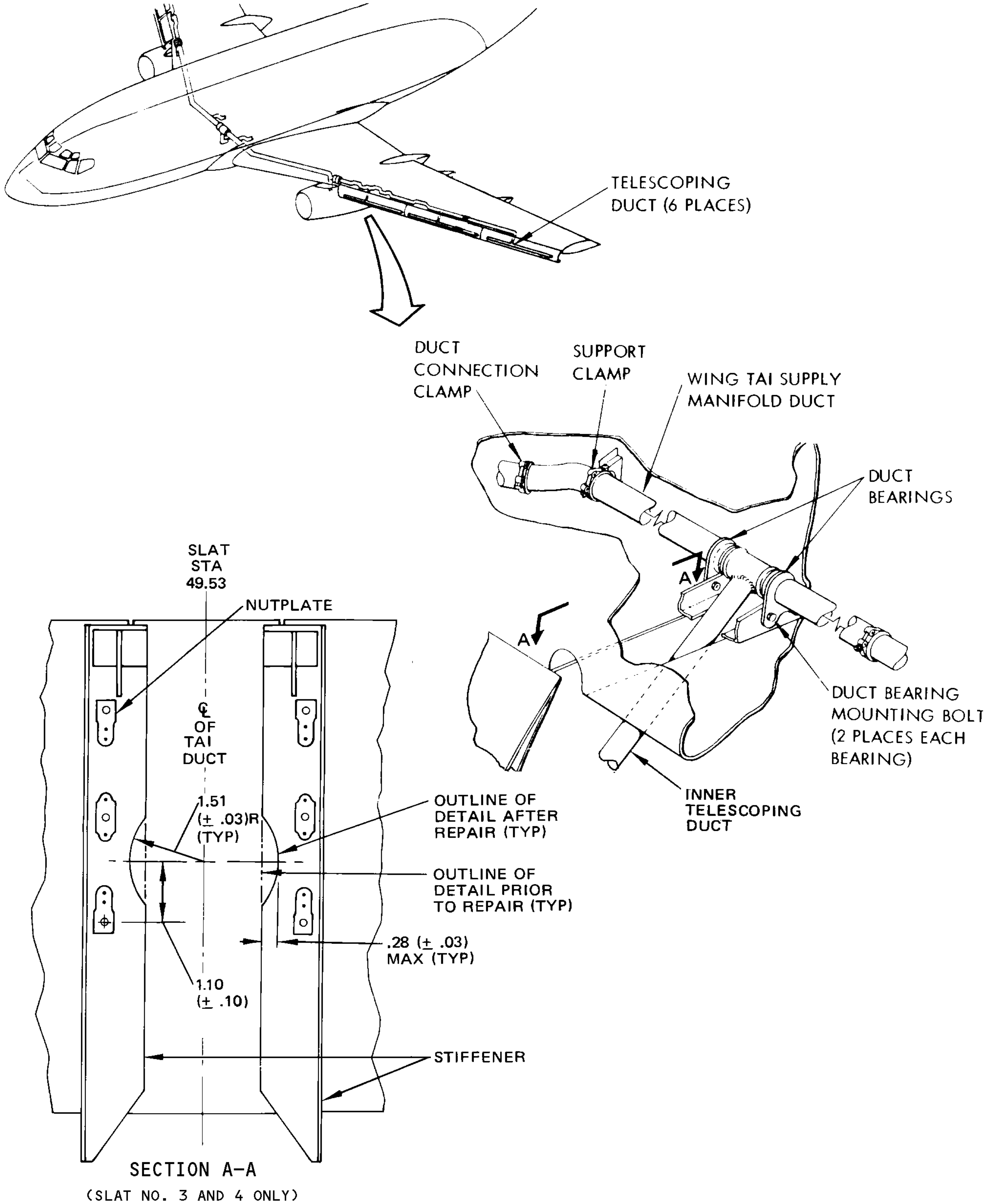
C. Position wing TAI supply duct section on inboard side of telescoping duct and install duct connection and support clamps.
D. Install seal in end of outer telescoping duct and insert over inner telescoping duct. On outer telescoping ducts with cap nuts, torque cap nut to 250-370 pound-inches.
E. Place bearings on each end of tee section of outer telescoping duct and insert assembly into support bracket inside slat. Insert slat spray duct from each end of slat.
F. Install spray duct retaining bolts (2 places) at each end of slat and access panels removed in step 4.E.
G. Install outer telescoping duct access door and slat inner skin.

CAUTION: TO PREVENT CHAFING, THE SLAT ACTUATOR DOWNLOCK HARNESS AND CLAMPS MUST BE POSITIONED AND INSTALLED TO AVOID INTERFERENCE WITH TELESCOPING DUCT (REF 27-81-21, REMOVAL/INSTALLATION).

7. Restore Airplane to Normal
A. Test duct leakage in accordance with system adjustment test procedure.
B. Raise flaps to full up position (Ref Chapter 27, Wing Leading Edge Slats).
C. Shim as required and install telescoping door hinge bolts (1) with BMS 10-11 primer at forward end through wing leading edge and plate assembly (2).
(1) Shim as required and install bolts and washers (3) and (7) at aft end through hinge and duct assembly.
(2) Adjust to make gap equal on all sides (approximately 0.06 inch).
(3) On later airplanes with adjustment bolt:
(a) Tighten adjustment bolt (5) at aft hinge (4) on door assembly (5) to approximately 15 pound-inches.
(b) Retract leading edge slats and adjust trailing edge of door against wing structure.
(c) Extend leading edge slats and center door assembly (5) in door opening.
(d) Tighten adjustment bolt (6) to 20-25 pound-inches.
(e) Install rivets at two locations.
(f) Retract leading edge slats.
D. Install wing access panels removed in step 3.B. and 4.B.
E. Install forward engine nacelle fairing (Ref 54-51-11).

WING ANTI-ICE TELESCOPING DUCT - APPROVED REPAIRS

1. General
   A. This repair is provided to modify leading edge angle details to provide proper access required to allow removal of telescoping duct at slats 3 and 4.
2. Equipment and Materials
   A. Alodine 1000 (Ref 20-30-41)
   B. Primer - BMS 10-11, type 1 (Ref 20-30-41)
3. Prepare for Repair (Fig. 801)
   A. Lower wing leading edge slats (Ref Chapter 27, Wing Leading Edge Slats).
   B. Remove wing access panels to allow complete access to angles at slat sta 49.53.
4. Repair/Modify Leading Edge Angles (Fig. 801)
   A. Trim radius 1.51 + 0.03 inches into angles.
   B. Alodize trimmed edges (Ref 51-21-41, Cleaning/Painting).
   C. Apply primer finish coat (Ref 51-21-171, Cleaning/Painting).
   D. Allow sufficient primer cure time.
5. Restore Airplane to Normal
   A. Reinstall wing access panels.
   B. Move slats back into retracted position.



Wing Anti-Icing Telescoping Duct - Approved Repair
Figure 801

WING ANTI-ICE CONTROL MODULE (P5-11) - REMOVAL AND INSTALLATION

1. General
   A. The P5-11 module located in the pilot's overhead panel contains all control and test switches and indicating lights for the engine and wing thermal anti-icing system.
2. Prepare for Removal
   A. Open circuit breakers listed below on P18 anti-ice and rain panel:
      (1) ENG 1 & WING VALVE
      (2) ENG 2 & WING VALVE
      (3) ENG 1 & WING CONTROL
      (4) ENG 2 CONTROL
3. Remove P5-11 Module
   A. Release four quick-release panel fasteners and lower module.
   B. Disconnect electrical connectors.
4. Install P5-11 Module
   A. Connect electrical connectors.
   B. Place module in position in overhead panel and secure four panel fasteners.
   C. Close circuit breakers opened in 2.A. and test module control switches and indicator lights. See Adjustment/Test.

WING ANTI-ICE CONTROL MODULE (P5-11) - ADJUSTMENT/TEST

1. General
   A. The P5-11 module located in the pilot's overhead panel contains all control and test switches and indicating lights for the engine and wing thermal anti-icing system.
2. Prepare for Test
   A. Check that circuit breakers listed on P18 anti-ice and rain panel are closed:
      (1) ENG 1 & WING VALVE
      (2) ENG 2 & WING VALVE
      (3) ENG 1 & WING CONTROL
      (4) ENG 2 CONTROL
   B. Apply electrical power and energize 115-volt ac transfer buses No. 1 and 2, and 28-volt dc T/R buses No. 1 and 2.
3. Test Module
   A. Check each indicator light (push-to-test).
      (1) Module Test
         (a) Hold wing anti-ice control switch in GRD-TEST or TEST position. Check that both wing anti-ice valves open, L VALVE OPEN and R VALVE OPEN indicator lights glow brightly during valve transient, and that lights change to a dim condition when valves reach full open position.
         (b) Release wing anti-ice control switch. Check that switch returns to OFF position, both wing anti-ice valves close, and that indicator lights glow brightly during valve transient, then go off and remain off when valves are closed.
   B. Place both ENG ANTI-ICE switches to ON position. Check that all valves open and both COWL VALVE OPEN, both R VALVE OPEN, and both L VALVE OPEN indicator lights glow brightly during valve transient, and that lights change to a dim condition when valves reach full open position.
   C. Place both ENG ANTI-ICE switches to OFF position. Check that all valves close, engine valve position indicator lights illuminate bright during valve transient, and then go off and remain off when valves are closed.
   D. Determine if there is any further need for electrical power on airplane. If not, remove electrical power.

PITOT STATIC TUBES AND TEMPERATURE PROBE ANTI-ICING SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The left and right pitot static tubes, the elevator feel left and right pitot tubes, and the temperature probe are heated to prevent the formation of ice, which could affect sensing accuracy (Fig. 1). The heating is accomplished by electrical heaters installed as an integral part of the units. The heaters consist of resistance elements, which operate on 115-volt ac.

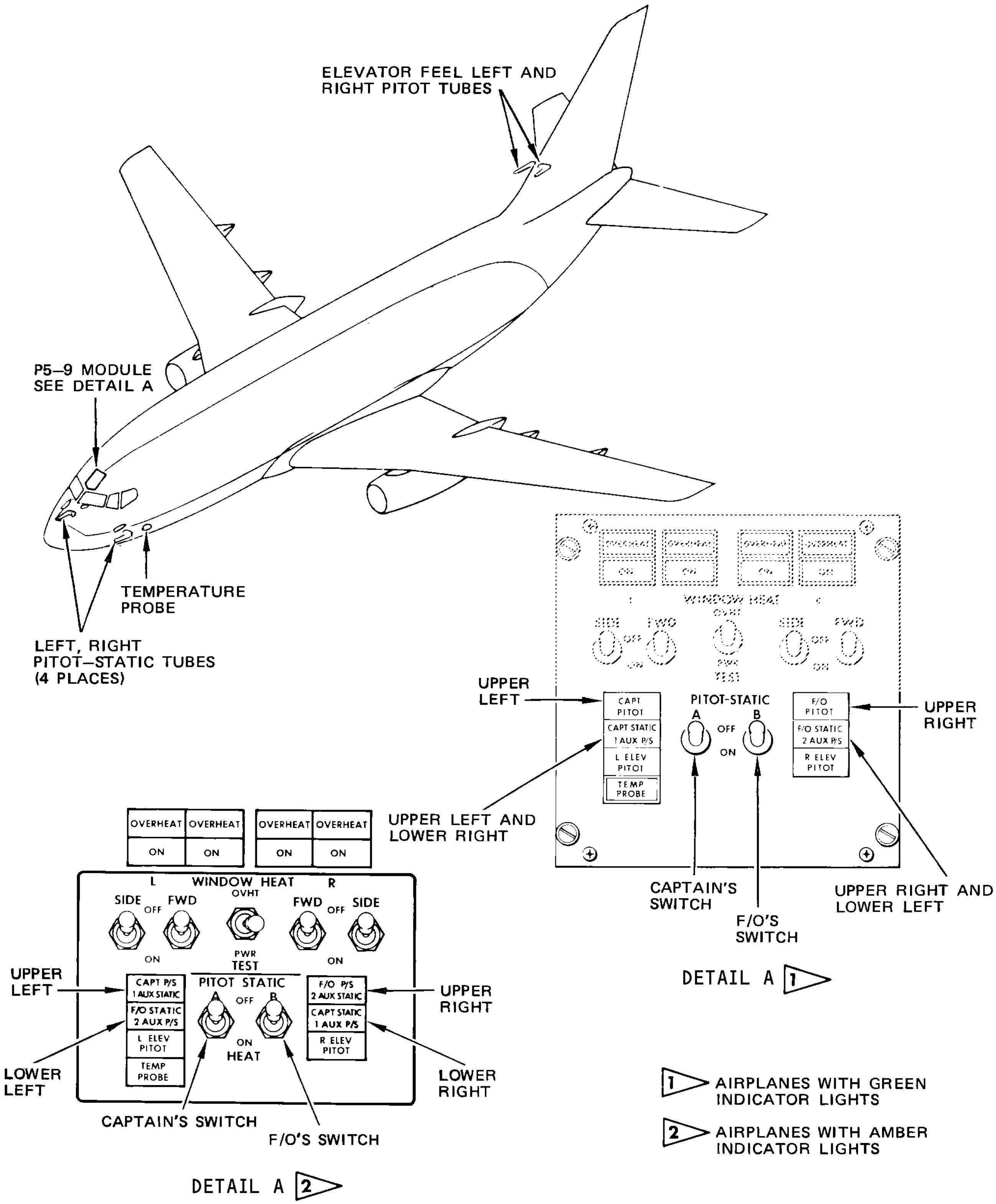
B. The heaters are controlled by two switches on the P5-9 module in the overhead panel. The control switches are four-pole two-position (ON-OFF) toggle switches. The system has an indicating circuit consisting of a current transformer, an electronic switch, and an indicating light for each sensor. The electronic switches and indicating light circuits are installed on printed cards. The transformer is installed in the line to the heater.

C. On airplanes with green indicator lights,
the A switch (pilot) controls the heating of the upper left and lower right pitot static heaters, temperature probe heaters, and the left elevator feel pitot heater. The B switch (F/O) controls the heating of the upper right and lower left pitot static heaters, and the right elevator feel pitot heater. When the transformer senses current flow in the line, it causes the electronic switch to provide a ground for the indicating light. The indicating circuit for the upper left and lower right pitot static heaters is similar except that the electronic switch for the lower right pitot static heater is in series with the upper left pitot static heater switch providing a ground for the lower right indicating light only when current is sensed in the line to both heaters. However, the upper left pitot static heater indicator light circuitry is independent of the lower right pitot static heater indicator light circuit. The circuit for the lower left and the upper right pitot static heaters operate in the same manner as the lower right and upper left pitot static heater circuit.

D. On airplanes with amber indicator lights,
one switch controls the heating of the upper and lower left pitot static heater, left temperature probe heater, and the left elevator feel pitot heater. The other switch controls the heating of the upper and lower right pitot static heaters, and the right elevator feel pitot heater. When the transformer does not sense current flow, the electronic switch provides a ground for the indicating light.

E. The light circuits receive 28-volt dc power through the master dim relay from the INDICATOR DIM BUS NO. 1 DC and NO. 2 DC circuit breakers on the P6 panel. The lights are of the press-
to-test type and may be tested individually or through the use of the master light test switch. The lights may also be dimmed through the use of the master dim switch (Ref Chapter 33, Master Warning and Caution Lights).

F. The P5-9 module located in the pilots' P5 overhead panel contains the control switches, indicating lights, transformers, and printed circuit cards. The P5-9 module also contains the switches and indicating lights for the control cabin window anti-icing system.



Pitot-Static Tubes and Temperature Probe Anti-Icing Equipment Location
Figure 1

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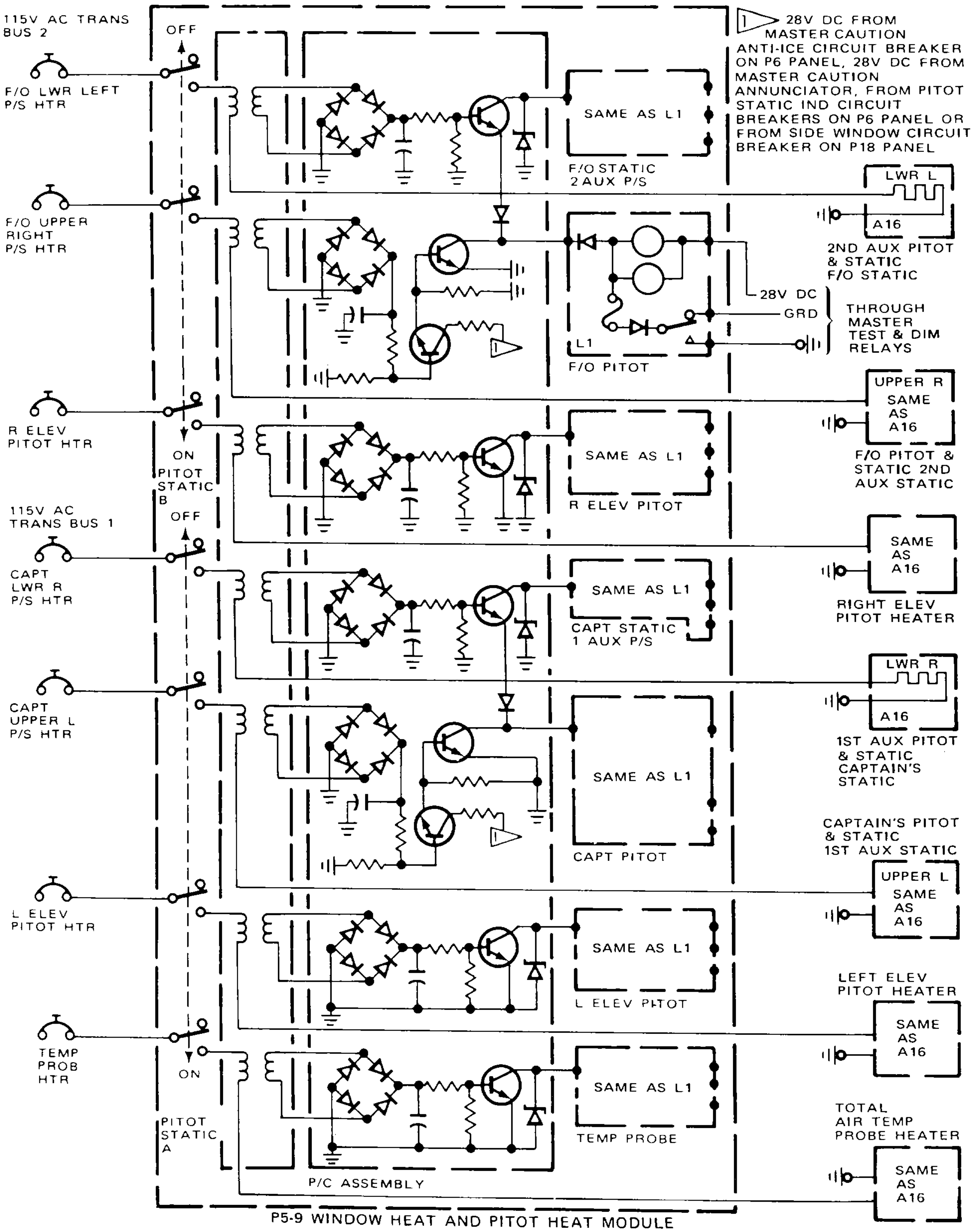


Pitot-Static Probe and Temperature Probe 506
Figure 2

PITOT-STATIC AND TEMPERATURE PROBE ANTI-ICING SYSTEM - TROUBLESHOOTING

1. General
   A. Before using the following troubleshooting chart, prepare to test the pitot static and temperature probe in accordance with adjustment test procedure. Proceed with test to extent practical to determine extent of trouble.
2. Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
With left and right pitot heat switches off, all indicator lights illuminate if green or fail to illuminate if amber.	Defective airplane wiring or P5-9 module.	Remove plug from P5-9 module and check at cable plug terminal for short to ground if -	
		Short circuit exists -	Repair circuit between master indicator light test switch relay and plug terminal.
		No short exists -	Replace P5-9 module
With circuit breaker closed and pitot heat switch on, the probe heater fails to radiate heat.	Defective probe heater, airplane wiring, or P5-9 module.	Check for 115 volts a-c on plug terminal, at P5-9 module. If -	
		No voltage -	Repair circuit between circuit breaker on P18 panel and plug terminal.
		Voltage OK - Check for continuity between pins in P2 receptacle on P5-9 module. If -	
		No continuity -	Replace P5-9 module.
		Continuity OK - Check for continuity between plug terminal and ground at P5-9 module. If -	
		No continuity -	Replace P/S probe.

Pitot-Static and Temperature Probe Anti-Icing System Circuit - Troubleshooting
Figure 101

PITOT STATIC AND TEMPERATURE PROBE ANTI-ICING SYSTEM - MAINTENANCE PRACTICES

1. General
   A. The maintenance practices in this section are limited to the components listed below with cross-
      references to the section that covers the detail maintenance practices for these components.
2. Pitot Static Control Module (P5-9)
   A. Refer to 30-09-111 for removal/installation and adjustment/test instructions.
3. Pitot Static Probes
   A. Refer to Chapter 34 for removal/installation and adjustment/test instructions.
4. Elevator Feel System Pitot Probes
   A. Refer to Chapter 27 for removal/installation instructions.
5. Total Air Temperature Probes
   A. Refer to Chapter 34 for removal/installation, adjustment/test, and cleaning/painting instructions.

PITOT STATIC AND TEMPERATURE PROBE ANTI-ICING SYSTEM - ADJUSTMENT/TEST

1. Pitot Static and Temperature Probe Anti-Icing System Test
   A. General
      (1) The following procedure is provided to check the operation of the pitot static probe heater and temperature probe heater, and the continuity of each heater circuit individually and each corresponding indicator light circuit to the window and pitot heat module.

WARNING: DO NOT TOUCH PROBES WHILE HEATERS ARE ON. TEST HEATERS FOR OPERATION BY FEELING FOR HEAT RADIATION IN THE NEAR VICINITY OF HEATER BEING SUBJECTED TO TEST TO AVOID POSSIBILITY OF PERSONNEL BEING BURNED.

CAUTION: DO NOT OPERATE THE SYSTEM ANTI-ICING HEATERS FOR MORE THAN 5 MINUTES WHILE THE AIRPLANE IS ON THE GROUND. EXTENDED OPERATION MAY SHORTEN HEATER LIFE.

NOTE: A black oxide heat discoloration develops on the forward end of the pitot tubes when the heater is operated in still air. This is a natural phenomenon and does not indicate that the pitot tube is burned out.

   B. Prepare Pitot Static and Temperature Probe Anti-Icing System for Tests
      (1) Remove any installed protective caps or covers from pitot tubes and outside air temperature probe.
      (2) Provide electrical power (Ref 24-22-0, M/P).
      (3) Check that the following circuit breakers are closed:
         (a) On P6 panel, MSTR CAUTION BUS
            1) No. 1 BATT
            2) BATT
         (b) On P6 panel, INDICATOR LTS MASTER DIMMING BUS
            1) No. 1 DC
            2) No. 2 DC
         (c) On P6 panel, DIM & TEST
         (d) On P6 panel, INDICATOR
            1) F/O's PITOT STATIC (If installed)
            2) CAPT'S PITOT STATIC (If installed)
         (e) On P18 panel
            1) LEFT SIDE WINDOW
            2) RIGHT SIDE WINDOW
         (f) On P6 panel
            1) MASTER CAUTION - ANTI-ICE (If installed)

(g) On P18 panel
1) LEFT SIDE WINDOW
2) RIGHT SIDE WINDOW
(h) On P6 panel
1) MASTER CAUTION - ANTI-ICE (If installed)
(4) Open the following circuit breakers:
(a) On P18 panel, HEATERS - PITOT STATIC
1) CAPT - UPPER L
2) CAPT - LWR R
3) F/O UPPER R
4) F/O LWR L
5) ELEVATOR PITOT - L
6) ELEVATOR PITOT - R
7) TEMP PROBE
(5) On P5 panel check that PITOT-STATIC A & B switches are in OFF position.
(6) On P5 panel, check that all pitot static and temperature probe anti-icing system indicator lights are out.

C. Test Pitot Static and Temperature Probe Anti-Icing System
(1) Test upper left pitot static probe heater and indicator light.
(a) Close CAPT-UPPER L circuit breaker and position PITOT-STATIC A switch to ON position.
1) Check for following results:
a) CAPT PITOT indicator light illuminates, all other indicator lights remain off.
b) Upper left pitot static probe radiates heat (Do not touch and do not operate for more than 5 minutes); all other heaters remain OFF.
(b) Open the CAPT-UPPER L circuit breaker and check that CAPT PITOT light goes out. Move PITOT-STATIC A switch to OFF position.
(2) Repeat step (1) for upper right pitot-static, right elevator pitot, left elevator pitot, and temperature probe heaters, using respective circuit breakers, switch and indicator lights.

<u>NOTE</u>: Allow time for heaters to cool before starting next test.

(3) Test lower right pitot-static probe heater and indicator light.
(a) Close CAPT-LWR R circuit breaker and position PITOT-STATIC A switch to ON.
1) Check for following results:
a) All indicator lights remain off.
b) Lower right pitot-static probe radiates heat (Do not touch and do not operate more than 5 minutes); all other probe heaters off.

(b) Close CAPT-UPPER L circuit breaker.
  1) Check for following results:
    a) CAPT PITOT and CAPT STATIC 1 AUX P/S indicator lights illuminate. All other indicator lights remain off.
    b) Upper left and lower right pitot-static probes radiate heat (Do not touch and do not operate more than 5 minutes); all other heaters off.

(c) Open captain's UPPER-L and LWR-R circuit breakers and check that CAPT PITOT and CAPT STATIC 1 AUX P/S lights go out.

(d) Place PITOT-STATIC A switch in OFF position.

(4) Repeat step (3) for lower left pitot-static probe heater and indicator light, using F/O's LWR L and UPPER R circuit breakers and indicator lights and PITOT-STATIC B switch.

D. Restore Airplane to Normal Configuration:

(1) Close circuit breakers.

(2) Remove electrical power, if no longer required.

(3) Install protective caps or covers as required.

CONTROL CABIN WINDOW ANTI-ICING SYSTEM - DESCRIPTION AND OPERATION

1. General

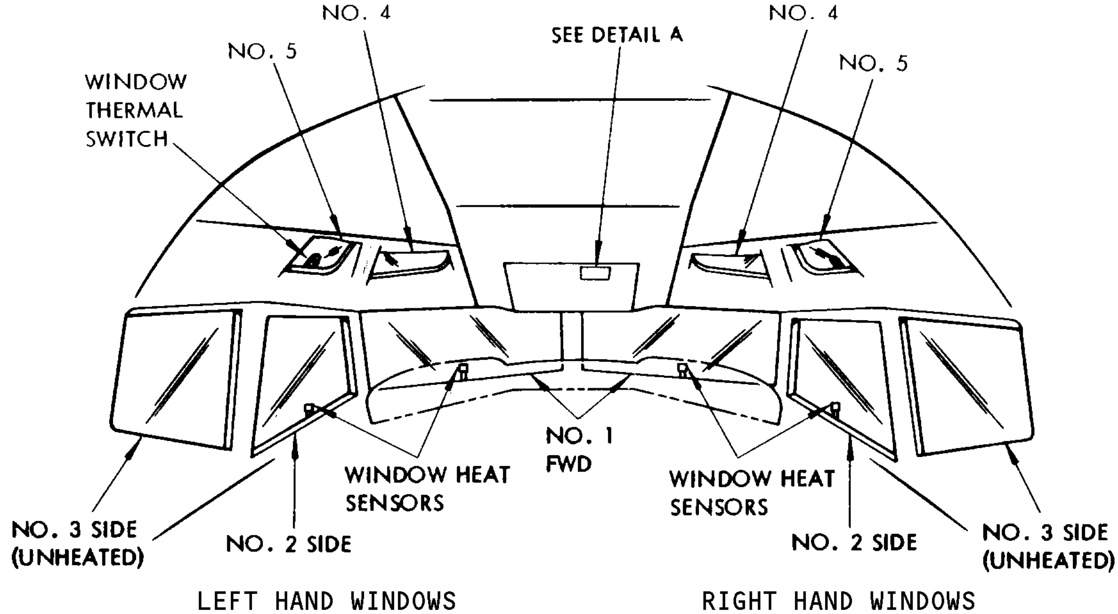
A. Windows No. 1, 2, 4 and 5 on each side of the control cabin are provided with electrical heating for window anti-icing and defogging (Fig. 1). Heating of the control cabin windows also improves the impact strength of the windows and is used for birdproofing the windows when flying at altitudes where bird strikes are possible. Power to the left No. 1, 4 and 5 windows and the right No. 2 window is supplied from the left generator and the right No. 1, 4 and 5 and left No. 2 window is supplied from the right generator. In the event of a power failure from one generator, the No. 2 window on that side and the No. 1, 4, and 5 windows on the other side will still be supplied power from the other generator, thus ensuring that reasonable forward vision from each side will be maintained.

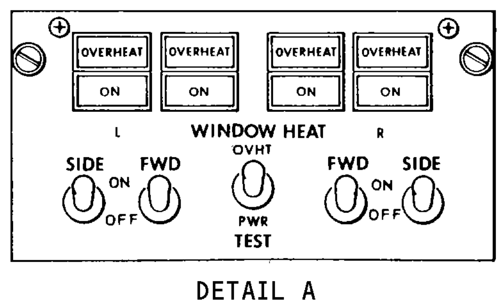
B. The forward No. 1 windshield and the No. 2 sliding window on each side of the cabin have a separate control system for each window (Fig. 2). The control system maintains its respective window at the required temperature by the use of automatic controls. Each system consists of the heated window, a window heat sensor, a control switch, a heat control unit, a power indicating light, and an overheat indicating light. A power and overheat test switch is used in common with all four systems. The No. 4 and 5 windows receive power through the side window heat switch. Power to windows No. 4 and 5 is regulated by a thermal switch located in the circuit between the two windows. While the system is in operation, the temperature of the windows is regulated at 107 + 7/-7°F for the No. 1 and 2 windows and from 80-120°F for the No. 4 and 5 windows. The control system turns off the power to the No. 1 and 2 windows when an overheat condition of approximately 145°F is detected.

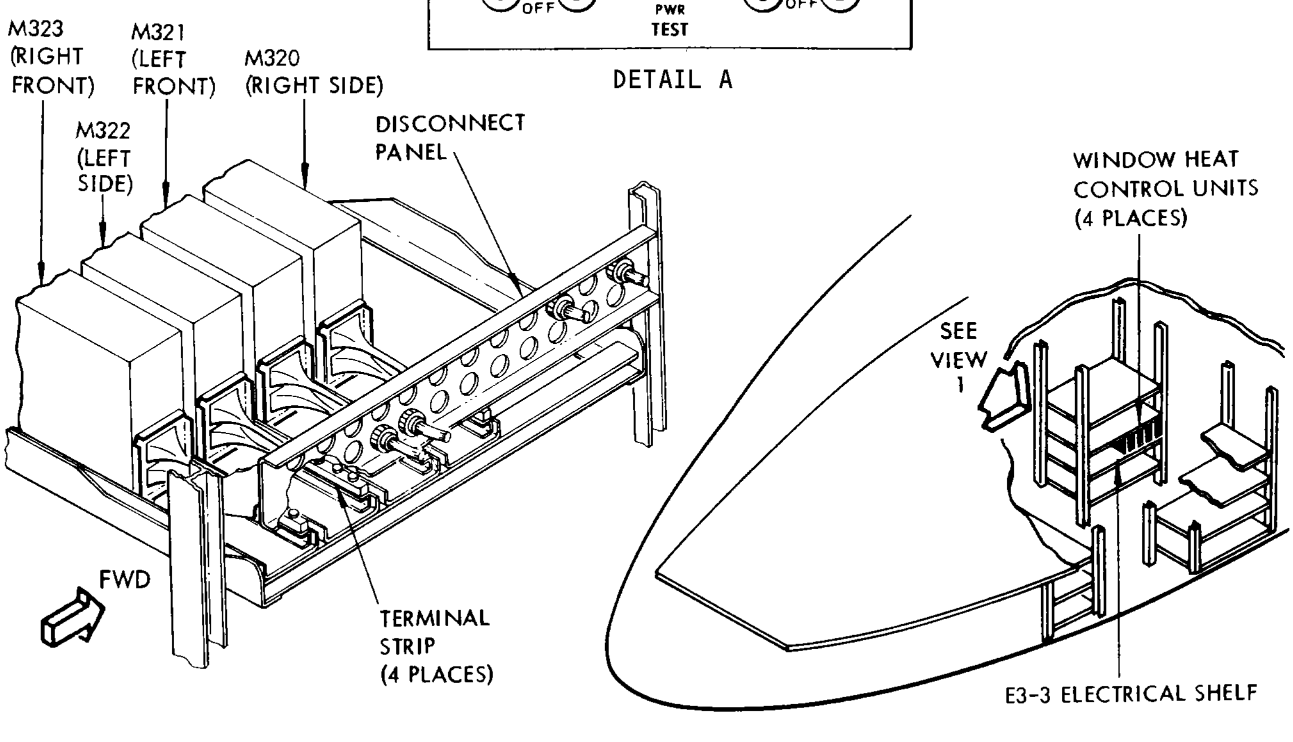
C. When the system is first energized, a ramp function in the heat control unit causes the power delivered to the No. 1 and No. 2 windows to increase gradually from zero to full power in approximately 3 minutes, unless it is controlled at a lesser level by the window reaching control temperature before the ramp time runs out. This reduces the thermal shock to the pane when the power is applied to a cold window. A power interruption of 5 seconds or more will cause the ramp function to start over from zero, while for lesser interruptions, the ramp will start over at a fraction that is proportional to the time off. The window heat sensor provides a temperature control signal to the heat control unit, which in turn modulates the amount of power to the window to maintain the window at the required operating temperature. The power indicating light will be illuminated when power is being supplied to the window. If an overheat condition is detected, the heat control unit will cutoff power to the windows, turn off the power indicating light, illuminate the overheat indicating light and the master caution and anti-ice lights of the master caution system (Refer to Chapter 33, Master Warning and Caution Lights). While the system is in operation, the heat control unit may be functionally tested by the use of the system test switch. Holding the test switch in the POWER position will force the control unit to supply power to the window and illuminate the power indicating light. If the operational confidence check is performed under conditions where the window temperature is within the overheat cutoff range, whether by outside environment or by excessively long testing, an overheat cutoff will occur. An overheat condition can be simulated by holding the test switch in the OVERHEAT position. The system is returned to normal by momentarily placing the control switch in the OFF position. The temperature of the No. 4 and 5 windows is controlled by the thermal switch on the No. 5 window.

2. <u>Window Conductive Coating</u>

A. The control cabin windows are of laminated glass-vinyl construction. Refer to Chapter 56, Control Cabin Windows, for details of window construction. The No. 1 and 2 windows have a conductive coating between the outer glass pane and vinyl core where it is most effective for window anti-icing, whereas the No. 4 and 5 windows have their conductive coating between the inner glass pane and the vinyl core where it will be most effective for window defogging. All four windows have electrical terminals connected to bus bars, which are molded into the upper and lower edges of the window in contact with the conductive coating. The windows are heated by allowing current to flow thru the conductive coating between the upper and lower bus bars. The resistance of the conductive coating increases with age and higher voltages are required across the bus bars to maintain equivalent heat output. The No. 1 window heaters have two series of fine wires imbedded in the vinyl. Each series of wires is electrically connected with the other in parallel. If one series fails, the remaining one provides approximately 50 percent of the heat provided when both are heating.







Control Cabin Window Anti-Icing System Equipment Location
Figure 1

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3. Window Heat Sensor

A. The No. 1 and 2 windows each have a heat sensor consisting of a filament of non-insulated resistance wire. The wire is arranged in a single plane coil and imbedded in a thin plastic wafer installed near the lower edge of the window (Fig. 1 and 2), between the outer pane and plastic core. The resistance of the wire is sensitive to temperature and increases as the temperature increases. A change in window temperature causes a change in sensor resistance, providing a signal for the heat control unit. Some No. 1 and 2 windows have a spare heat sensor mounted adjacent to the heat sensor, which may be used if the original sensor has failed.

4. Control Switches

A. There are four window heat control switches, one for each of the No. 1 and 2 windows on each side of the cabin. The switches are four poled two position ON-OFF toggle switches and are on the overhead panel. The No. 4 and 5 windows are controlled by the respective left or right side window heat switch (Fig. 1 and 2).

5. Control Unit

A. There are four window heat control units, one for each of the window No. 1 and 2 heating systems. The units are located in the E3-3 electrical rack (Fig. 1 and 2).

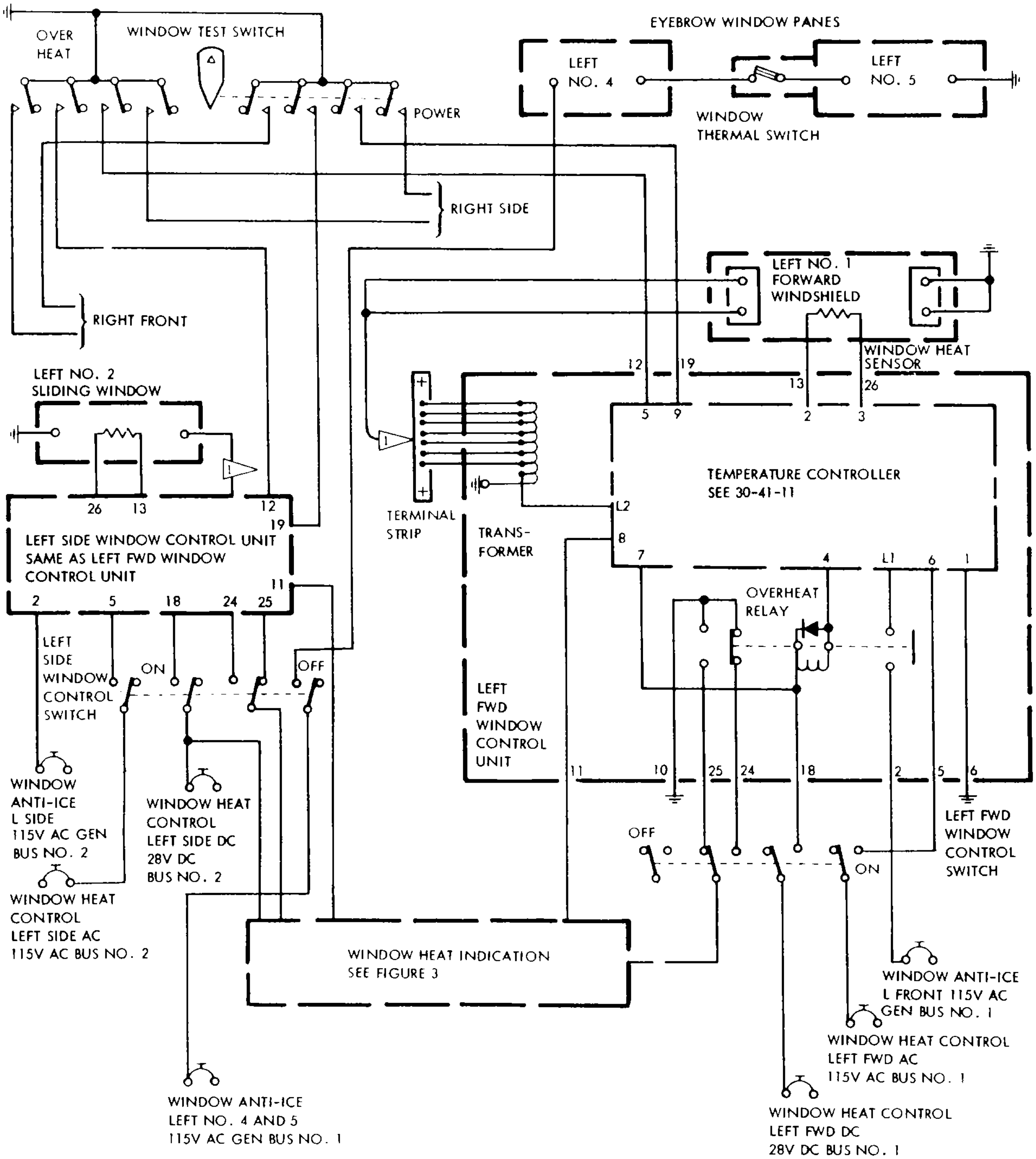
B. The temperature control unit is a solid state device which performs three functions; overheat control, temperature control including ramp control and shorted sensor protection, and power indication.

C. The control unit overheat circuit when energized directs 115-volt ac power from the window anti-ice circuit breaker to the control unit temperature control circuit.

D. The terminal strip on the E3-3 electrical shelf is supplied a selection of voltages from an autotransformer within the control unit to suit the resistance of the conductive coating on the windows. Selection of voltage is accomplished by moving the window power lead to the appropriate tap on the terminal strip located on the outboard end of the control unit tray.

6. Indicating Lights

A. There are two indicating lights for each of the No. 1 and 2 window heating systems; one is for power indication and the other is for overheat indication. The circuit for the overheat indication also controls a master caution indicating circuit for the anti-ice (A/I) and master caution annunciators on the pilots' lightshield. (See figure 1.) Both indicating lights are located adjacent to their respective control switch on the overhead panel; and the master caution control circuit is on three printed circuit cards mounted behind the panel. The lights receive 28-volt dc power from the IND LIGHTS circuit breaker on the No. 1 and 2 DC bus, and the master caution control circuit receives 28-volt dc power from the window heat control circuit breaker on Bus No. 2 (See figure 3.) The lights are of the press-to-test type and may be tested individually or through the use of the master light test switch. The lights may also be dimmed through the use of the master dim switch. Refer to Chapter 33, Master Warning and Caution Lights, for master caution lights, and the master dim and test switches.



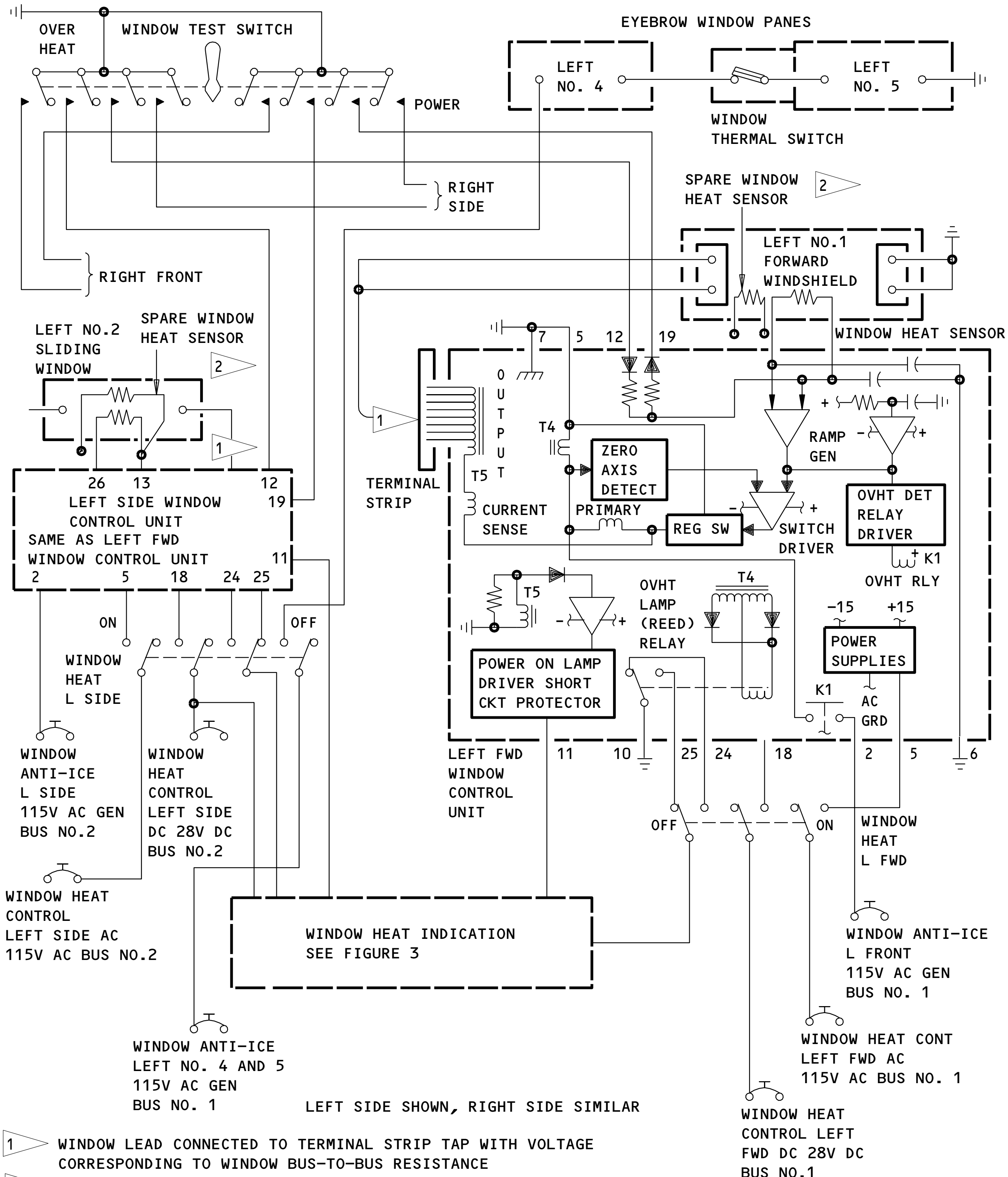
LEFT SIDE SHOWN, RIGHT SIDE SIMILAR

1 WINDOW LEAD CONNECTED TO TERMINAL STRIP TAP WITH VOLTAGE CORRESPONDING TO WINDOW BUS-TO-BUS RESISTANCE

EFFECTIVITY

AIRPLANES WITH
P/N 65-52803 CONTROLLER

Control Cabin Window Anti-Icing System Circuit
Figure 2 (Sheet 1)



1 WINDOW LEAD CONNECTED TO TERMINAL STRIP TAP WITH VOLTAGE CORRESPONDING TO WINDOW BUS-TO-BUS RESISTANCE

2 NOT INSTALLED ON ALL WINDOWS

Control Cabin Window Anti-Icing System Circuit
Figure 2 (Sheet 2)

B. The power indicating light is controlled by its respective window heat control unit. When 28-volt dc power is available, the light is illuminated whenever the power-on circuitry in the control unit exceeds approximately 5 watts of power.

C. The overheat indicating light is controlled by its respective window heat control switch and the auxiliary contacts of the overheat relay in the window heat control unit. When 28 volt dc power is available the light is illuminated whenever the overheat relay does not agree with the control switch position (switch on - relay energized, switch off - relay de-energized.)

D. The master caution warning system consists of four time delay circuits, one for each of the overheat indication circuits, and a warning latch circuit. The reaction time of the overheat relay may cause a momentary overheat signal when the control switch is turned on. To avoid nuisance trips of the master caution system the signal is directed first to the delay circuit. If the signal persists for approximately one second the delay circuit provides an impulse to the latch circuit which then provides a ground for the master caution lights through the overheat relay. The latch circuit will remain conductive until the power is interrupted either through the use of the master caution light reset or by resetting the window heat control system. The warning latch circuit may also be tripped by the master caution light recall switch or master light test switch and completes a circuit to ground through these switches for the master caution indicating lights.

7. <u>Test Switch</u>

A. The window heat test switch is an eight pole, double throw, with center OFF position and momentarily on at both extremes, toggle actuated switch. The switch has momentary POWER and OVERHEAT positions and is located between the window heat control switches on the overhead panel (Figs. 1 and 2). The switch provides a ground for the power test input on each of the four window heat control units (pin 19) when placed in a POWER position, and similarly provides a ground for each of the overheat test inputs (pin 12) when placed in the OVERHEAT position.

8. <u>Window No. 5 Thermal Switch</u>

A. The window No. 5 thermal switch is a temperature sensitive, bimetallic, single pole, snap action switch with normally closed contact points which open at 110° (+ 10°)F and close at 90° (+ 10°) F. The switches are spring mounted near the lower edge of each of the No. 5 windows and regulates the application of power to the No. 4 and 5 windows of its respective side (Figs. 1 and 2).

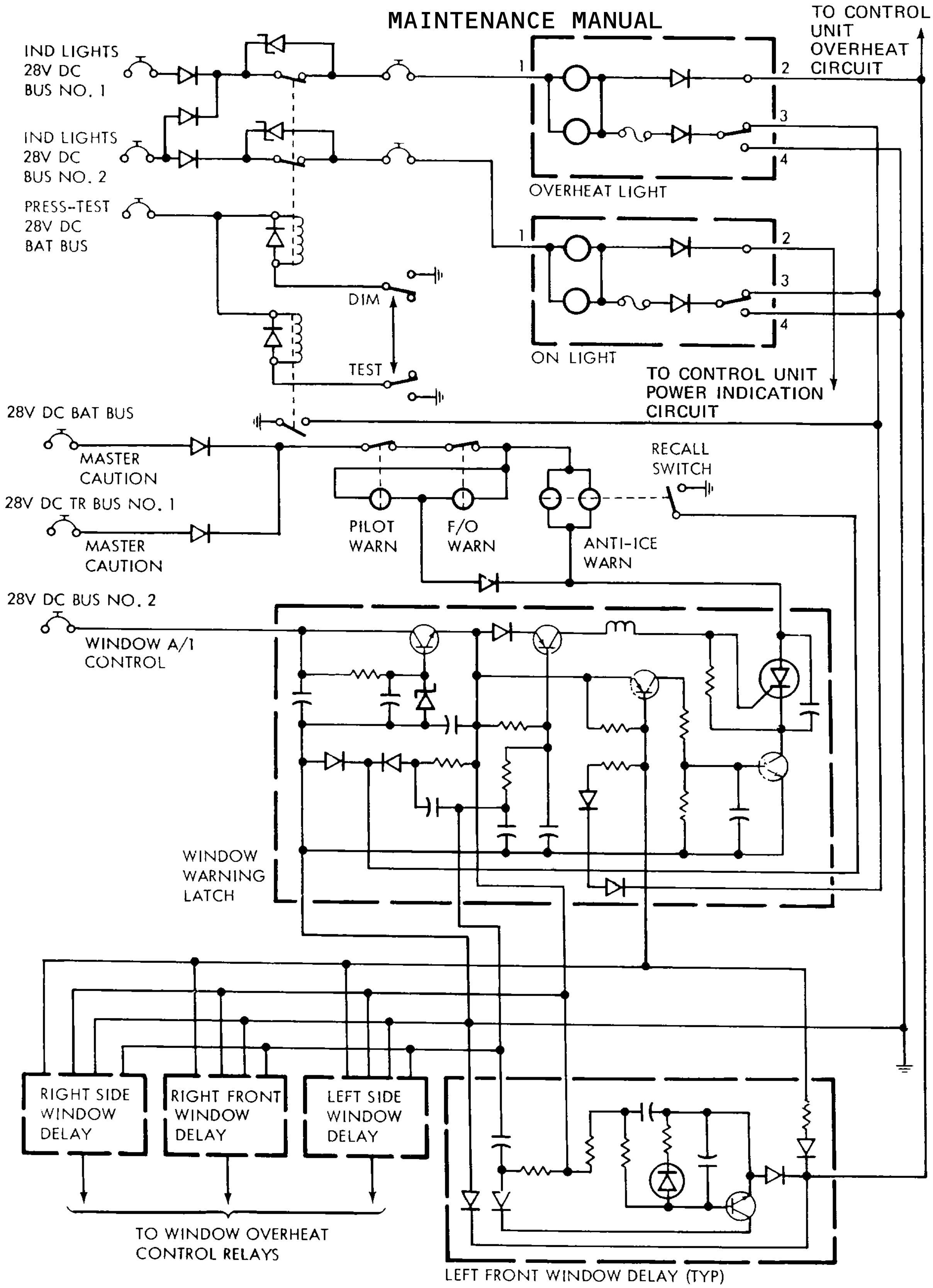
9. Control Module P5-9

A. The P5-9 module in the pilots' P 5 overhead panel contains all the switches and indicating lights for the control cabin window anti-icing system. The P5-9 module also contains the switches and indicating lights for the pitot-static and temperature probe anti-icing system. For description and operation of module switches and indicating lights, see paragraphs 4 (control switch), 6 (indicator lights), and 7 (test switch). See Section 30-09-111 for removal, installation, and adjustment/test instructions.

10. Operation

A. Each of the No. 1 and 2 window heat systems are operated by the actuation of the respective control switch to the ON position (Fig. 2). With either switch for either side in the ON position, 28 volt dc and 115 volt-ac control power will be directed from the load control center to the window heat control unit for its respective window, and 115-volt ac heating power will be directed to windows No. 4 and 5 by the side switch of the respective side. The No. 1 and 2 windows are maintained at 107 + 7/-7°F by the window heat control unit and the No. 4 and 5 windows are regulated between 80 to 120°F by the window thermal switch on the No. 5 window.

B. With control power supplied to the heat control unit in the absence of an overheat condition the control unit overheat circuit will direct 115-volt ac heating power from the load control center to the control unit temperature control circuit for modulation to the control unit heat transformer . If the window is below 100°F the window heat sensor will signal the temperature control circuit for heating power and the temperature control circuit will gradually increase power to the control unit transformer circuit. The transformer circuit in turn will apply the preselected voltage to the terminal strip on the E3-3 electrical shelf then directly to the window. The window heating power will continue to increase until the temperature control circuit output reaches full operating power within 3 minutes or until the window sensor detects the window temperature approaching operating temperature. As operating temperature is approached the temperature control circuit will begin to decrease power until power output and heat dissipation from the window are held in equilibrium at the required operating temperature. When the temperature control circuit supplies power to the control unit transformer it also supplies a ground for the power on lamp driver circuit, illuminating the ON light and providing visual indication that power is actually being supplied to the window. The light will remain illuminated as long as the control unit power output exceeds approximately 5 watts. The window heat control unit may be confidence tested for power output through the use of the system test switch. Placing the switch in the POWER position completes a circuit to ground from the temperature control circuit which forces the temperature control circuit to full power output, regardless of window temperature.



Window Heat Indicating Circuit
Figure 3

C. If the window heat sensor detects a window temperature above 145°F while power is being applied to the window, the temperature control circuit will de-energize the control unit overheat circuit. Having the overheat detection section of the temperature control circuit operate only while power is actually being applied to the window allows a lower overheat trip setting, without nuisance system trips and lockouts under hot summer day conditions. With the control unit overheat circuit de-energized the 115-volt ac heating power will be cut off from the temperature control circuit, removing window heat and turning off the power ON indicating light. Also, whenever the control unit overheat circuit is de-energized with the control switch in the ON position or energized with the control switch in the OFF position, the overheat indication circuit through the control switch will be completed to ground through the control unit overheat circuit. This will illuminate the overheat indication light and after a 1-second delay, activate the master caution indicating circuit, illuminating the master caution and anti-ice indicating lights. The master caution and anti-ice lights will remain illuminated until the master caution indicating circuit is reset by pressing the master caution light cover. The overheat indication light will remain illuminated until the system is reset by momentarily turning the control switch to the OFF position. While the system is in operation the control unit overheat detection system may be confidence tested through the use of the system test switch. Placing the switch in the OVERHEAT position completes a circuit to ground from the temperature control circuit which forces the temperature control circuit to apply power to the window and then simulates the overheat condition, de-energizing the control unit overheat circuit and illuminating the master caution, anti-ice and system overheat indicating lights.

CONTROL CABIN WINDOW ANTI-ICING SYSTEM - TROUBLESHOOTING

1. General
   A. The most practical method for isolating any trouble in the control cabin window anti-icing system is to utilize the control cabin window anti-icing - adjustment/test procedure.
   B. Before using the following troubleshooting chart, prepare to test the window anti-icing system in accordance with adjustment/test procedure. Proceed with test to extent practical to determine extend of trouble. The following trouble symptoms are presented in the order in which they would occur during system test.
2. Troubleshooting Chart

   NOTE: In this troubleshooting chart, the abbreviation "WHCU" is used for the window heat control unit.

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Circuit breaker continues to trip (power on condition)	Defective airplane wiring, P5-9 module, heat sensor, or control unit	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for a direct short between the pins of the plug on the WHCU (except there should be a short between pins 6 and 10 on the plug for the A connector and between pins 5 and 7 on the plug for the B connector). IF -	
		Short exists -	Replace control unit
		Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Check for a direct short between the pins of the WHCU connectors on the E3-3 rack. Also check for a short to ground from any of the pins (except pins 6 and 10 of the A connector and pins 5 and 7 of the B connector should all be grounded). IF -	
		Short exists -	Repair wiring between control unit plug and P5-9 module plug
		No short exists - Check window heat sensor for short, faulty window lead-in wire, and faulty window conductor bus. IF -	Replace or repair defective part
		Condition exists -	Replace faulty part

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Circuit breaker continues to trip (power on condition) (Cont)		Check for a direct short between the pins of the applicable plug on the P5-9 module. IF -	
		Short exists -	Replace or repair P5-9 module
		No short exists -	Repair airplane wiring between P5-9 panel and electrical bus
Power at window terminals with control switch in ON position - ON power light illuminates intermittently	Defective (or loose) lamp, lamp base, lamp fuse, lamp wiring, airplane wiring or indicating circuit in control unit	Check lamp, lamp base, lamp wiring, and lamp fuse for loose or defective condition. IF -	
		Condition exists -	Replace or repair defective part
		No condition exists - Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for an intermittent short to ground from pin 11 of the WHCU "A" connector on the E3-3 rack. IF -	
		Short exists -	Repair defective wiring between control unit plug and P5-9 panel

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 1)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Power at window terminals with control switch in ON position power OFF light illuminates intermittently (Cont)		No short exists - Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Check for an intermittent short to ground from pins 3, 6, and 18 on connector D638 or from pins 4, 5, and 46 on D644 connector. IF -	
		Short exists -	Repair airplane wiring between control unit plug and P5-9 module plug
		No short exists -	Repair or replace P5-9 module
Overheat light trips with control switch in ON position (overheat condition)	Defective lamp, lamp base, airplane wiring, P5-9 module, control unit, or master caution circuitry	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for an intermittent short between the pins 10, 24, 25 on the plug on the WHCU for the "A" connector. IF -	
		Short exists -	Replace control unit
		No short exists - Check for an intermittent short between the pins 24 and 25 of the WHCU "A" connector on the E3-3 rack. Also check for a short to ground from each of these pins. IF -	
		Short exists -	Repair wiring from control unit to P5-9 module

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 2)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Overheat light trips with control switch in ON position (overheat condition) (Cont)		No short exists - Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Check for an intermittent short between pins 11 and 18 on connector D638 or between pins 18 and 46 on connector D644. IF -	
		Short exists -	Repair airplane wiring
		No short exists - Check lamp, lamp fuse, and wiring for defective condition. IF -	
		Condition exists -	Replace or repair part
		No condition exists - Set master dim and test switch to TEST and dimmer switch from DIM to BRIGHT and check overheat light for defective condition. IF -	
		Condition exists -	Repair master caution circuit (Refer to Chapter 33)
		No condition exists -	Replace or repair P5-9 module
With switch off all indicating lights on P5-9 panel and master caution anti-ice indicating light illuminate	Defective airplane or module wiring	Remove connector D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-12. Check for a short to ground from pin 25 of D644 connector. IF -	
		No short exists -	Replace P5-9 panel
		Short exists -	Repair wiring between D638 or D644 and light switch test relay

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 3)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
With switch off, one window over-heat indicating light and master caution anti-ice indicating light illuminate	Defective air-plane or module wiring or control unit	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for a short between the pins 10 and 25 of the plug on the WHCU for the "A" connector. IF -	
		Short exists -	Replace respec-tive control unit
		No short exists -	Repair wiring be-tween D638 (left module) or D644 (right module) and control unit
		Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-11 or 30-41-12. Check for a short to ground from pin 22 of D638 connector or from pin 19 of D644 connector. IF -	
		No short exists -	Replace P5-9 panel
		Short exists - Check master caution circuitry for short to ground on overheat indi-cating light	Repair master caution circuitry (Refer to Chapter 33)
With switch off, master caution anti-ice indi-cating light illuminates	Defective air-plane or module wiring	Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-11 or 30-41-12. Check for a short to ground from pin 22 of D638 connector or from pin 19 of D644 connector. IF -	
		No short exists -	Replace P5-9 panel
		Short exists -	Repair wiring between D638 or D644 and master caution lights

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 4)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
No indicating lights on P5-9 panel illuminate when light test switch actuated to TEST position	Defective airplane or module wiring	Remove connector D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-12. Check for continuity to ground from pin 25 of D644 connector with test switch actuated. IF -	
		Continuity OK -	Replace P5-9 panel
		No continuity -	Repair circuit between D638 or D644 and test relay
Only front window indicating lights illuminate when light test switch actuated to test position	Defective airplane or module wiring	Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-11 or 30-41-12. Check for a dc voltage at pin 3 of D638 connector or at pin 5 of D644 connector. IF -	
		Voltage OK -	Replace P5-9 panel
		No voltage -	Repair circuitry between D638 or D644 and indicating lights circuit breaker
All except front, window lights illuminate when light test switch actuated to TEST position	Defective airplane or module wiring	Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-11 or 30-41-12. Check for a dc voltage at pin 18 of D638 connector or at pin 46 of D644 connector. IF -	
		Voltage OK -	Replace P5-9 panel
			Repair circuit between D644 or D638 and indicating lights circuit breaker

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 5)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Master caution anti-ice light does not illuminate when light test switch actuated to TEST position	Defective airplane or module wiring	Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-11 or 30-41-12. Check for a dc voltage at pin 12 of D638 connector or at pin 38 of D644 connector. IF -	
		Voltage OK -	Replace P5-9 panel
		No voltage -	Repair circuit between D638 or D644 and master caution indicating lights
One indicating light only does not illuminate when light test switch actuated to TEST position	Defective lamp, lamp fuse, or lamp base	Check lamp, lamp base, and lamp fuse for continuity	Replace defective part

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 6)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Power OFF light does not illuminate when control switch placed in ON position (no overheat indication)	Defective airplane wiring, indicating circuit control unit or window heat sensor	Interchange control unit with adjacent unit. IF -	
		Trouble shifts -	Replace control
		Trouble remains - Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for dc power at pin 11 and ac power at pin 5 of the WHCU "A" connector on the E3-3 rack. Check for ac power at pin 2 of the WHCU "B" connector on the E3-3 rack. IF -	
		No power -	Repair defective circuit between plug and P5-9 panel or circuit breaker as required
		Power OK - Check the window sensor resistance between pins 13 and 26 of the WHCU "A" connector on the E3-3 rack. Refer to the window heat sensor adjustment/test procedure for the acceptable value of sensor resistance.	Repair defective wiring between plug and respective window, or replace window as required *[1]
Window overheat indicating light comes on when control switch placed in ON position (no window power on indication)	Defective airplane wiring or control unit	Interchange control unit with adjacent unit. IF -	
		Trouble shifts -	Replace control unit
		Trouble remains - remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for dc power at pin 18, continuity to ground at pin 6, and that there is no short to ground at pin 12 of the WHCU "A" connector on the E3-3 rack.	Repair defective circuit or replace P5-9 panel

*[1]

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 7)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Window power and overheat indicating lights illuminate when control switch placed in ON position	Defective airplane wiring or control unit	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for a short to ground at pin 24 of the WHCU "A" connector on the E3-3 rack. IF -	
		Short exists -	Repair defective circuit or replace P5-9 panel
		No short exists -	Replace control unit
No power at window terminals (power on light illuminated)	Defective airplane wiring or control unit	Check for power output at respective window power receptacle on E3-3 electrical shelf. IF -	
		Power OK -	Repair circuit between receptacle and window ground connection
		No Power - Check for continuity between power receptacle and respective pins on WHCU connector. IF -	
		No Continuity -	Repair circuit between receptacle and plug to control unit
		Continuity OK -	Replace control unit
Overheat and master caution light does not come on when test switch actuated to OVERHEAT (power on light remains illuminated)	Defective airplane wiring or control unit	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-14-12. Check for continuity to ground at pin 12 of the WHCU "A" connector on the E3-3 rack with the switch in the overheat position. IF -	
		No Continuity -	Repair circuit between control unit and P5-9 panel or replace P5-9 panel
			Replace control unit

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 8)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Overheat and master caution light does not illuminate when test switch actuated to OVERHEAT (power on light not illuminated)	Defective airplane wiring, P5-9 panel or control unit	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-14-12. Check for dc power at pin 24 and continuity to ground at pin 10 of the WHCU "A" connector on the E3-3 rack. IF -	
		Circuit OK -	Replace control unit
		Circuit Not OK -	Repair circuit between plug and ground or P5-9 panel as required or replace P5-9 panel
Master caution light does not illuminate when test switch actuated to OVERHEAT (overheat light illuminated)	Defective P5-9 panel	NONE	Replace P5-9 panel
Master caution lights will not remain off when reset	Defective P5-9 panel	NONE	Replace P5-9 panel
Master caution light will not recall when anti-ice light cap is pressed	Defective airplane wiring or P5-9 panel	Remove the applicable connector D638 or D644 from the P5-9 window and pitot heat module. Look at WDM 30-41-11 or 30-41-12. Check for continuity to ground from pin 22 of D638 connector or from pin 19 of D644 connector while the light cap is pressed. IF -	
		Continuity OK -	Replace P5-9 panel
		No Continuity -	Repair circuit between plug D638 and master caution lights

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 9)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Voltage across window terminals not within limits during power test	Defective airplane wiring, control unit or window	Check if voltage increases when switch actuated to POWER position. IF -	
		(1) Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check for continuity to ground at pin 19 of the WHCU "A" connector on the E3-3 rack. IF -	
		No Continuity -	Repair circuit between control unit and test switch
		Continuity OK -	Replace control unit
		(2) Voltage increases - check resistance of window in accordance with window heat conductive coating adjustment/test. IF -	
		Window resistance not within limits -	Replace window *[1]
		Window resistance within limits - check for connection to proper output terminal. IF -	
		Window connected to correct terminal -	Replace control unit

*[1] Spare window sensors, if installed, should be used before replacing No. 1 or 2 windows

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 10)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Window power remains on until system overheat is tripped when control switch placed in ON position	Defective airplane wiring or control unit	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-14-12. Check for short to ground at pin 19 of the WHCU "A" connector on the E3-3 rack. IF -	
		Short exists -	Repair defective circuit or replace P5-9 panel
		No short exists -	Replace control unit
Window No. 1 or 2 temperature not maintained within limits	Defective window heat sensor or control unit	Remove the applicable WHCU. Look at WDM 30-41-11 or 30-41-12. Check the window sensor resistance between pins 13 and 26 of the WHCU "A" connector on the E3-3 rack. Refer to the window heat sensor adjustment/test procedure for the acceptable value of sensor resistance. IF -	
		Sensor not within limits -	Replace window *[1]
		Sensor within limits -	Replace control unit

*[1] Spare window sensors, if installed, should be used before replacing No. 1 or 2 windows

Control Cabin Window Anti-Icing System - Troubleshooting
Figure 101 (Sheet 11)

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
No power to windows No. 4 and 5 when side window control switch is positioned to ON	Defective switch, defective wiring, thermal switch, or window	Check switch for continuity. IF -	
		No continuity -	Replace P5-9 panel
		Continuity OK - Check for ac voltage at window No. 4 input bus terminal. IF -	
		No Voltage -	Repair wiring between window circuit breaker
		Voltage OK - Check for continuity between windows No. 4 and 5 and between window No. 5 and ground. IF -	
		No Continuity -	Repair wiring or replace defective thermal switch or window
Power to windows No. 4 and 5 does not cut off within proper time or temper- ature limits	Defective thermal switch or window	Check No. 4 and 5 window resistance in accordance with window heat conductive coating adjustment test procedure. IF -	
		Window Resistance OK -	Replace window thermal switch
		Window Resistance NOT OK -	Replace defective window

CONTROL CABIN WINDOW ANTI-ICING SYSTEM - ADJUSTMENT/TEST

1. Control Cabin Window Anti-Icing System Test
   A. General
      (1) The following system tests are intended to provide reasonable assurance prior to airplane flight that the system will operate as designed during service. The window heat control systems are tested in two parts consisting of windows No. 1 and 2 and windows No. 4 and 5. To test window temperature regulation, the test should be conducted when ambient temperatures are below 70°F to make sure that cycling of the controls. To conduct test at ambient temperatures above 70°F, cool the windows with running water until window temperature stabilizes below 70°F.
   B. Window No. 1 and 2 Heat Control Test
      (1) Equipment and Materials
         (a) Voltmeter - 0-500 volts AC-DC, ± 1% full scale minimum accuracy
         (b) Instrument for measuring windowpane temperature. Infrared Measurement Instrument, IRE-50E, Wahl Instruments Inc., Culver City, CA 90231 (Preferred), or Alnor Portable Pyrometer, Type 4000A, Alnor Instrument Co., Skokie, IL 60077 (Alternate)
             Or
             FLUKE Model 189 multimeter (including 80PK3A probe and 80AK adapter)
      (2) Prepare Window No. 1 and 2 Heat Control for Test
         (a) Connect external power supply to airplane.
         (b) Make sure that the following circuit breakers are closed.
            1) On P6-3 panel, MSTR CAUTION BUS
               a) NO. 1
               b) BATT
            2) On P6-3 panel INDICATOR LTS MASTER DIMMING BUS
               a) NO. 1 DC
               b) NO. 2 DC
               c) SECT 4
               d) SECT 5
            3) On P6-panel, DIM & TEST
            4) On P6-11 panel, WINDOW ANTI-ICE
               a) L FRONT
               b) R SIDE
            5) On P6-12 panel, WINDOW ANTI-ICE
               a) R FRONT
               b) L SIDE
            6) On P18-3 panel, WINDOW HEAT CONTROL
               a) LEFT FRONT AC
               b) LEFT FRONT DC
               c) LEFT SIDE AC
               d) LEFT SIDE DC
               e) RIGHT FRONT AC
               f) RIGHT FRONT DC

g) RIGHT SIDE AC
h) RIGHT SIDE DC

(c) Open the following circuit breakers:
1) On P6-11 panel, WINDOW ANTI-ICE, L4 & L5
2) On P6-12 panel, WINDOW ANTI-ICE, R4 & R5

(d) Make sure that all window indicating lights are off, the window heat control switches are in the OFF position, and that the No. 2 sliding windows are closed and the handles latched.

(3) Test Window No. 1 and 2 Heat Control

(a) Momentarily actuate light test switch located on P2 center instrument panel to TEST position and check that window POWER ON, window OVERHEAT, and master caution ANTI-ICE indicating lights illuminate while switch is held in TEST position.

<u>NOTE</u>: This test verifies the integrity of the indicating lights (bulbs, sockets, wiring, etc.).

(4) Test Window No. 1 and 2 Heat Control

(a) Momentarily actuate light test switch located on P2 center instrument panel to TEST position and make sure that window PWR ON, window OVERHEAT, and master caution ANTI-ICE indicating lights come on while switch is held in TEST position.

<u>NOTE</u>: This test verifies integrity of indicating lights (bulbs, sockets, wiring, etc.).

(b) Connect voltmeter across left window No. 1 bus terminals to determine when voltage is applied to window.

(c) Position left window No. 1 control switch to ON and make sure that left No. 1 window PWR ON light comes on and that voltage is applied to window.

<u>NOTE</u>: Window PWR ON light will not come on immediately because power to windows is applied gradually by controller. Allow up to 15 seconds for light to come on after closing control switch. On warm days under solar heating or from previous use of window heat, window temperature may be above temperature control point, preventing controller from applying heat. Under these conditions, controller may be forced to momentarily apply heat and turn on PWR ON light by actuating window heat control test switch to PWR position. If operational confidence check is performed under conditions where window temperature is within overheat cutoff range, whether by outside environment or by excessively long testing, an overheat cutoff will occur.

(d) Momentarily actuate window heat control test switch to OVERHEAT position and make sure that window OVERHEAT, MASTER CAUTION and ANTI-ICE warning lights come on, window PWR ON light goes off in less than 70 seconds, and no voltage is applied to window.
(e) Momentarily press either captain's or first officer's master caution warning light to reset master caution circuit and make sure that master caution and anti-ice warning lights go off.
(f) Momentarily press anti-ice master caution warning light and make sure that master caution and anti-ice warning lights come on.
(g) Position left window No. 1 control switch momentarily to OFF and then back to ON, and make sure that window OVERHEAT, MASTER CAUTION and ANTI-ICE warning lights go off, left No. 1 window PWR ON light comes on and that voltage is applied to window.

<u>CAUTION</u>: THE WINDOW HEAT CONTROL SWITCH MUST BE ON FOR AT LEAST 5 MINUTES BEFORE YOU SET THE TEST SWITCH TO THE PWR POSITION. IF YOU SET THE TEST SWITCH TO PWR BEFORE THE WINDOW IS AT FULL OPERATING TEMPERATURE, YOU CAN CAUSE DAMAGE TO THE WINDOW.

<u>NOTE</u>: Master caution and anti-ice annunciator warning lights will not go off if pitot heat OFF amber light is on.

Allow at least 4 minutes before proceeding to next step.

(h) Hold window heat control test switch in the PWR position and make sure that voltage applied to window corresponds to voltage shown in Fig. 501.

<u>CAUTION</u>: RELEASE TEST SWITCH AS SOON AS THE OVERHEAT LIGHT ILLUMINATES.

<u>NOTE</u>: If control switch has been left in OFF position for more than 5 seconds, power will be applied gradually from approximately zero volts to full voltage in a maximum of 3 minutes. If control switch has been left off for less than 5 seconds, ramp time will be adjusted proportionally to time off. If overheat cutoff occurs before required voltage is obtained, release test switch, allow window to cool, and repeat steps (g) and (h).

(i) Release heat control test switch, allow window voltage to stabilize, and make sure that window temperature is maintained at 107 ±7°F. Take temperature reading on outside of panel directly over heat sensing element.

(j) Return left window No. 1 control switch to OFF and remove voltmeter installed in step (3)(b).

(k) Repeat steps (3)(b) thru (3)(j) for remaining three heat-modulated windows using corresponding control switch and indicating lights.

(5) Restore Airplane to Normal Configuration

(a) Close circuit breakers opened in step (2)(c).

(b) Remove electrical power, if no longer required.

C. Windows No. 4 and 5 Heat Control Test

(1) Equipment and Materials

(a) Same as step 1.B.(1)

(2) Prepare Windows No. 4 and 5 Heat Control for Test

(a) Connect external power supply to airplane.

(b) Check that the following circuit breakers are closed:

1) On P6-11 panel, WINDOW ANTI-ICE L4 & L5

2) On P6-12 panel, WINDOW ANTI-ICE R4 & R5

(c) Open the following circuit breakers:

1) On P6-11 panel, WINDOW ANTI-ICE

a) R SIDE

2) On P6-12 panel, WINDOW ANTI-ICE

a) L SIDE

(3) Test Windows No. 4 and 5 Heat Control

(a) Connect voltmeter to power input terminal of thermal switch on left side No. 5 window to determine when power is applied to window.

(b) Position left side window control switch to ON, and make sure that voltmeter indicates 46 ±12 volts ac.

(c) Allow windows to continue heating and make sure that thermal switch on No. 5 left window opens to cut off power within proper time. Cutoff should occur within 15 minutes at 70°F ambient temperature, within 25 minutes at 50°F, and within 40 minutes at 30°F.

WINDOW CODE WHEN NEW		BUS TO BUS WINDOW RESISTANCE (OHMS) MIN	MAX	LOAD VOLTAGE (± 20V) AT FULL POWER [2]	TERMINAL STRIP TAP
WINDOW NO. 1	H13	31.4	35.1	271	1
	H12	35.1	38.8	285	2
	H11	38.8	42.6	300	3
		42.6	47.3	315	4
		47.3	52.0	331	5
		52.0	57.7	348	6 [1]
WINDOW NO. 2	H16	55.7	62.3	272	1
	H15	62.3	69.0	285	2
	H14	69.0	75.5	299	3
		75.5	81.6	315	4
		81.6	90.3	331	5
		90.3	100	347	6

[1] TERMINAL NOT AVAILABLE ON CONTROL UNITS PART NO. 10–61833–( ) OR 231–( ). INSTALL CONTROL UNIT PART NO. 65–52803–( ) OR REPLACE WINDOW

[2] EACH SUCCEEDING VOLTAGE SHALL BE GREATER THAN THE PRECEDING ONE

Control Unit Output and Window Resistance Table
Figure 501

(d) After initial heating, make sure that thermal switch continues to cycle to maintain window temperatures. Thermal switch P/N 10-1468 opens at 110 ±10°F, and closes at 90 ±10°F. Thermal switch P/N 10-1468-5 opens at 95 ±10°F and closes at 75 ±10°F. Take temperature reading on inside pane of window No. 5 immediately adjacent to thermal switch.

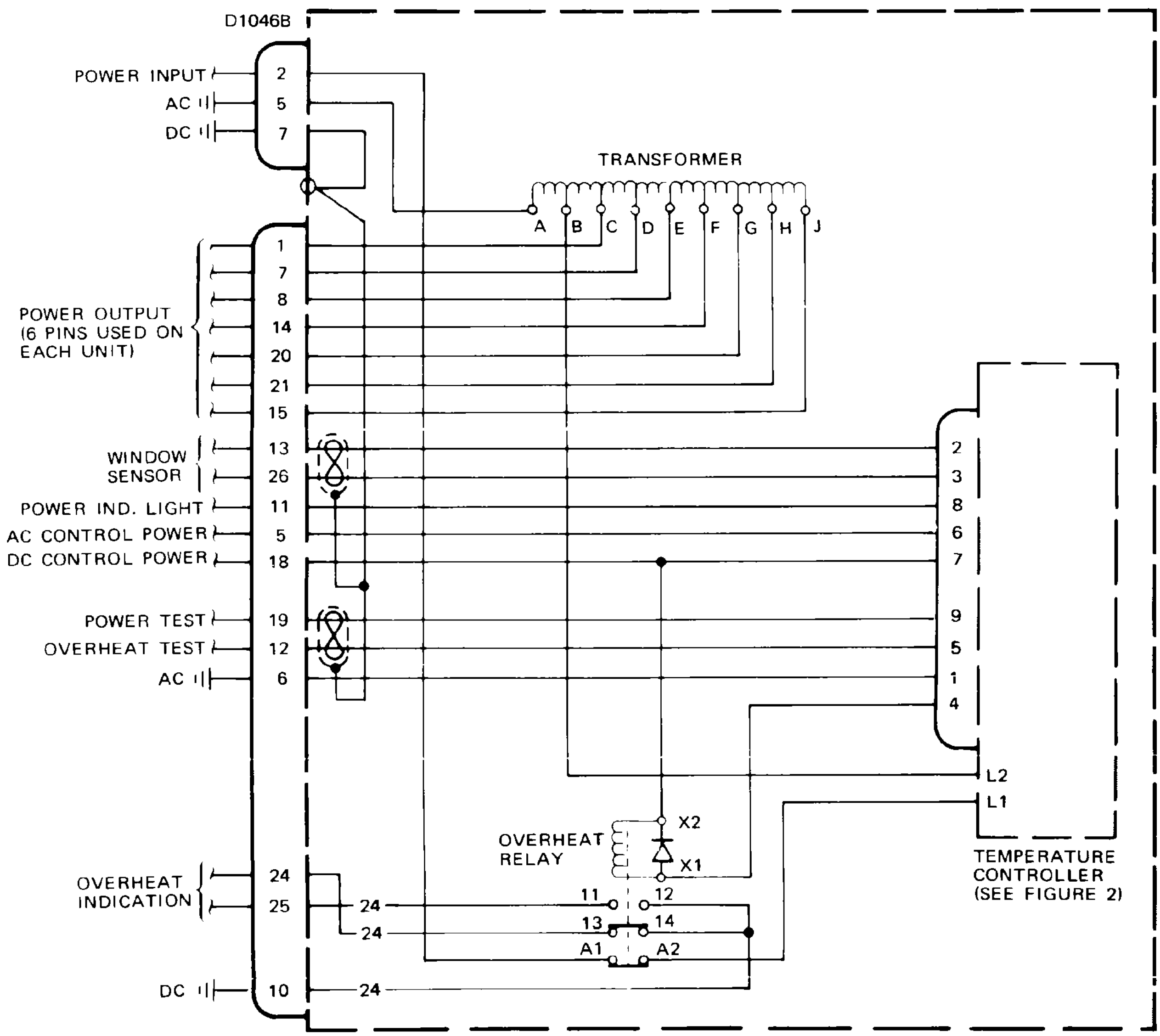
NOTE: Cool ambient conditions may limit temperature of glass and cause some thermal switches to appear to malfunction. An apparently malfunctioning thermal switch shall not be rejected unless a temperature of 125 ±1°F has been attained while conducting above test. Conversely, warm conditions may delay switch closing to 65°F or lower. Temperature of glass need not be measured on closing as long as switch action is produced.

(e) Return left side window control switch to OFF position and remove voltmeter.
(f) Repeat steps (a) thru (e) for right side system, using right side window control switch.

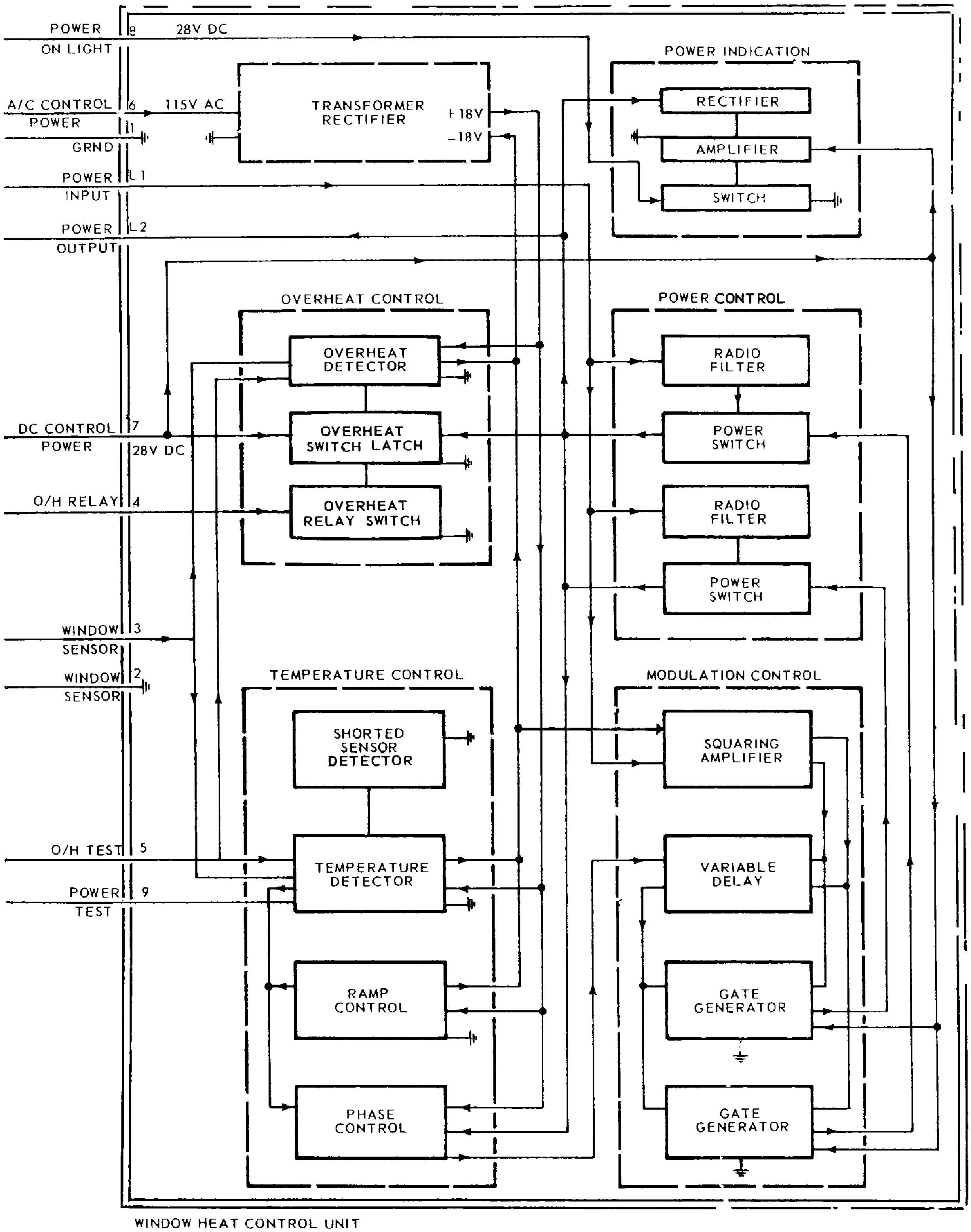
(4) Restore Airplane to Normal
(a) Close circuit breakers opened in step (2)(c).
(b) Determine if there is further need for external power, if not, remove external power.

WINDOW HEAT CONTROL UNIT - DESCRIPTION AND OPERATION

1. General
   A. There are four window heat control units, one for each of the window No. 1 and 2 heating systems. Each unit consists of a temperature controller, an overheat relay, and a transformer (Fig. 1). The units are located in the E3-3 electrical rack.
2. Temperature Controller
   A. The temperature control unit is a solid state device which performs three functions; overheat control, temperature control including ramp control and shorted sensor protection, and power indication.
   B. The temperature control function uses phase angle control to modulate the amount of power delivered to the power transformer. Phase angle control means the load current is conducted over a varying portion of each half cycle to vary the power. At half power for instance, the unit conducts only during the last half of each half wave. The modulation scheme employed makes it possible to secure conduction angles from zero to 170 degrees of each half cycle, depending on the sensor input signal. At 170-degree conduction angle the power delivered is approximately 5 watts less than would be delivered by a 180-degree conduction angle. The overheat function controls the operation of the overheat relay, and allows the relay to deliver window heat power to the temperature control function as long as a system malfunction does not occur. The circuit will drop out the relay when the signal from the window sensor indicates a window overheat, only when the control function is actually putting out power to the window. Having the overheat detection circuit operate only while power is actually being applied to the windows allows a lower overheat trip setting without nuisance system trips and lockouts under hot summer day conditions . The circuit will also provide an overheat cutout if power is applied to the window in the absence of 115-volt ac control power, whether an overheat actually exists or not. The system can only be reset by temporarily interrupting the 28-volt dc control power. Of course, if the overheat condition still exists, the overheat cutout will be immediately re-established. The power indication function will provide a ground for the power indicating light circuit when the power output of the control function exceeds approximately 5 watts. With power on the airplane, the window anti-ice circuit breakers closed and the respective window heat control switch in the ON position,115-volt ac control power will be applied to pin 6 and 28-volt dc control power will be applied directly to pin 7 and indirectly through the overheat relay to pin 4. (See figure 2.) Also 28 volts dc from the window power indicating light will be applied to pin 8. When the overheat relay is energized, power will be directed from the 115-volt ac window heat-circuit breaker to pin L1. The unit consists of six circuits; a transformer rectifier, an overheat control, a temperature control a modulation control, a power control and power indication. The transformer rectifier converts the 115-volt ac power received at pin 6 to plus and minus 18 volt dc for the overheat and temperature control circuits. The modulation control and power control circuits are part of the temperature control function.



Window Heat Control Unit
Figure 1



Temperature Controller Block Diagram
Figure 2

C. The temperature control circuit monitors the resistance of the window heat sensor and produces a signal to the modulation control circuit to maintain the window at the required temperature. The circuit operates on the plus and minus 18-volt supply and consists of a temperature detector, a shorted sensor detector, a ramp control and a phase control. When the unit is first energized the input from the window sensor causes the temperature detector to put out a signal to the phase control that is proportional to the difference between the window temperature and the required operating temperature. At the same time the ramp control will provide an equal and opposite signal to the phase control producing a zero input signal to the phase control. However, the ramp signal decays with time and the power delivered to the windows increases to 100% in three minutes, or until the sensor reaches its equilibrium resistance, whichever occurs first. After the sensor reaches the required temperature, the temperature detector assumes control of the window heating and the ramp has no further effect unless it should become partially discharged by a power interruption. If the sensor is shorted or shunted to approximately 135 ohms equivalent resistance, the shorted sensor detector will prevent the temperature detector from producing a signal, causing a complete shutdown of power to the window. Grounding of either the power test input (pin 9) or overheat test input (pin 5) will force the detector to put out a signal for maximum power. The phase control circuit accepts the output of the temperature detector, compares this with a rectified and filtered sample of the power control circuit output, and puts out a signal to the modulation control circuit that is proportional to the difference between the two. A conversion of this sort is necessary because equal changes in the conduction angle do not produce equal changes in power output.

D. The modulation control circuit accepts the phase control signal and produces signals to control the conduction angle of the power control circuit. The circuit operates on the 18 volts dc supply and consists of a squaring amplifier, a variable delay and two gate generators. The squaring amplifier receives an input signal from the 115 volt ac power input and produces a signal to synchronize each of the gate generators to one half of the ac cycle and to reset the variable delay circuit at the beginning of each half cycle. The variable delay provides a signal to both gate generators, but because of the overriding signal from the squaring amplifier only one of the gate generators will be triggered on each half cycle, each then firing alternately under the control of the variable delay signal. The one delay signal is used for both generators so that the conduction angle for both halves of the cycle will be as nearly equal as possible, causing the least net dc flow in the system power transformer and filters.

E. The power control circuit accepts the signal from the gate generators and modulates the ac power supply current delivered to the system power transformer. The circuit operates on the 115-volt ac supply and has two power switches with filter circuits to control radio frequency interference. Each power switch conducts on one half of the ac cycle when triggered by a signal from its respective gate generator. The delay of the signal to each gate generator after each zero crossing of the ac supply is inversely proportional to the magnitude of the phase control current, therefore the power switch conduction angle is directly proportional to the phase control current. If there is no phase control current the gate generator will not be triggered and the control switch conduction angle will be zero. The output from the power control circuit supplies the system transformer and provides a sample to the power indication circuit, the overheat latch and phase control.

F. The power indication circuit senses the power output and provides a ground for the power indicating light circuit whenever the conduction angle exceeds 10 degrees. The circuit operates on the 28-volt dc supply and consists of a rectifier, amplifier and switch. The sample is rectified, filtered, and amplified to control the switch.

NOTE: There can be a difference in the amount of time for the Power On light to go out if different part number window heat controllers are used on the same airplane. For the P/N 65-52803 controller, the light goes out as soon as the overheat light comes on. On windows using the P/N 10-61833 controller, there is a 40 to 70 second delay between the overheat light illuminating and the power on light going out.

G. The overheat control circuit monitors the resistance of the window heat sensor and provides a ground for the overheat relay circuit as long as the sensor resistance is less than 363 ohms. The circuit operates on the 28 volt dc control power and the minus 18 volt dc supply and consists of an overheat detector, overheat switch latch, and an overheat relay switch. The 28 volt dc control power applied to the switch latch provides a signal causing the relay switch to conduct, providing a ground for the overheat relay. A rectified sample of the power output tends to trip the latch, removing the signal to the switch. An opposing signal from the overheat detector prevents the power sample from tripping the latch. When the detector senses a resistance of more than 363 ohms the signal to the switch latch is removed allowing the power sample to trip the latch, removing the signal to the relay switch and removing the ground for the overheat relay. The latch will remain tripped until the 28-volt dc control power is interrupted. The latch can only be tripped while the system is actually putting out power and will automatically trip in the absence of the 115-volt ac control power, via the 18-volt dc supply. Grounding of the overheat test input (pin 5) will prevent the detector from producing a signal, thus tripping the switch latch.

3. Overheat Relay
   A. The overheat relay is a single-pole, single-throw, normally open sealed relay with a pair of normally open and normally closed auxiliary contacts. The relay directs 115 volts ac power from the window heat circuit breaker to the temperature controller when energized (Fig. 1). The auxiliary contacts complete a circuit to ground for the overheat indicating lights when the control switch is in the ON position and the relay is de-energized or when the control switch is in the OFF position and the relay is energized. The relay is energized whenever the system is in operation in the absence of an overheat detection.
4. Transformer
   A. The transformer is an autotransformer providing high voltage for heating the window. It has an input, ground, and 7 output taps, which provide a selection of voltages to suit the resistance of the conductive coating on the windows (Fig. 1). The load voltage of the output taps range from 270 volts to 350 volts. The transformer supplies the selected voltage directly to the window. Selection of voltage is accomplished by moving the window power lead to the appropriate tap on the terminal strip located on the outboard end of the control unit tray.
5. Induction Coil
   A. The induction coil is an iron cored coil in the transformer input circuit to reduce the initial current surge through the transformer, minimizing waveform distortion produced by the phase angle control of the window power (Fig. 1). To further reduce waveform distortion on the power supply the window load on each generator is divided over the three phases.

WINDOW HEAT CONTROL UNIT - REMOVAL/INSTALLATION

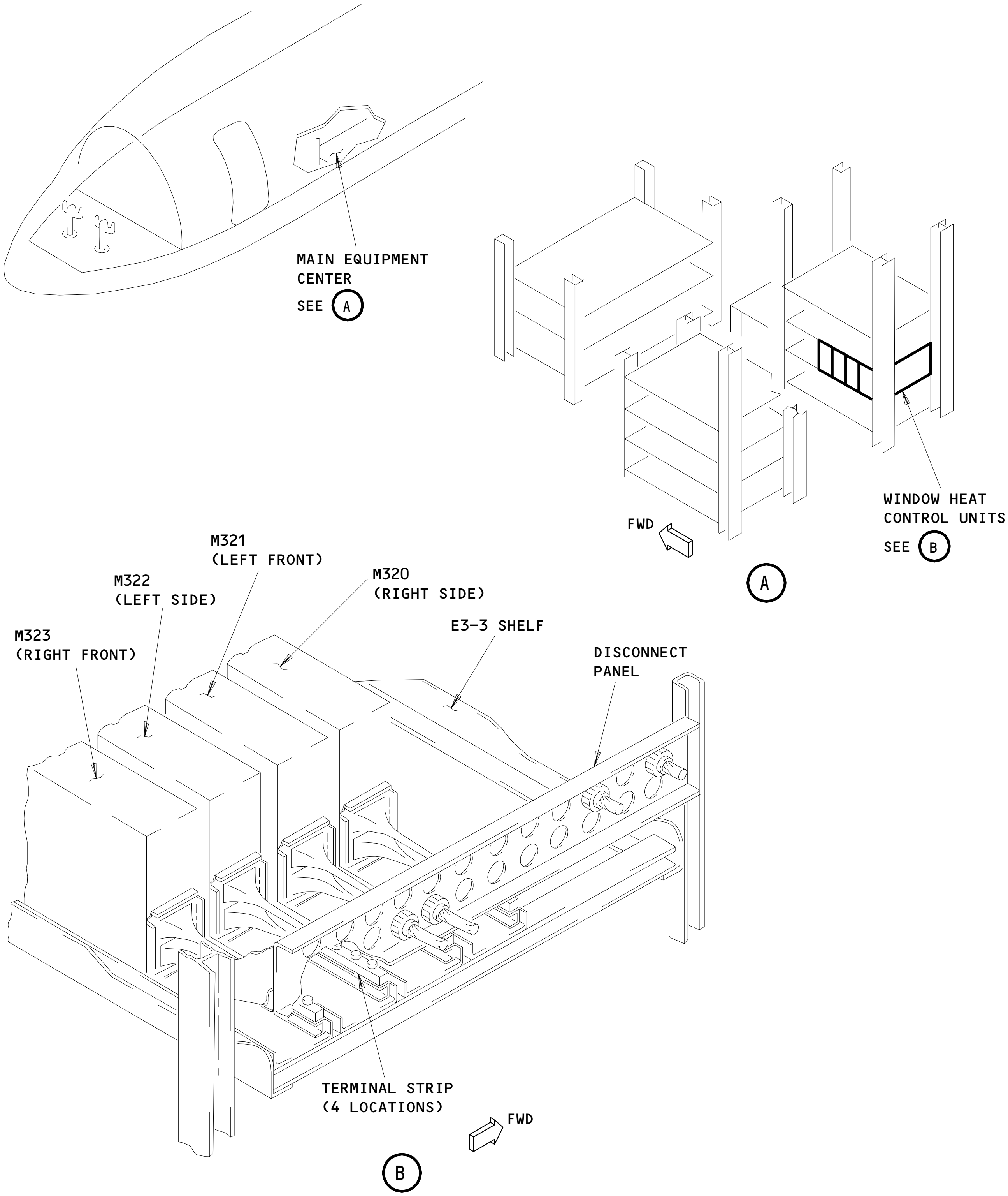
1. General
   A. This subject contains two tasks, one for the removal and one for the installation of the window heat control unit. The procedure is the same for all window heat control units.
2. Window Heat Control Unit Removal (Fig. 401)
   A. References
      (1) 20-40-12/201, Electrostatic Discharge Sensitive Devices
   B. Procedure
      (1) Open these circuit breakers and attach DO-NOT-CLOSE tags:
         (a) P6 Panel
            1) WINDOW ANTI-ICE L FRONT
            2) WINDOW ANTI-ICE R FRONT
            3) WINDOW ANTI-ICE L SIDE
            4) WINDOW ANTI-ICE R SIDE
         (b) P18 Panel
            1) WINDOW HEAT CONTROL LEFT FRONT AC
            2) WINDOW HEAT CONTROL LEFT SIDE AC
            3) WINDOW HEAT CONTROL RIGHT FRONT AC
            4) WINDOW HEAT CONTROL RIGHT SIDE AC
            5) WINDOW HEAT CONTROL LEFT FRONT DC
            6) WINDOW HEAT CONTROL LEFT SIDE DC
            7) WINDOW HEAT CONTROL RIGHT FRONT DC
            8) WINDOW HEAT CONTROL RIGHT SIDE DC
      (2) Obey the procedure for electrostatic discharge sensitive devices (Ref 20-40-12/201).

CAUTION: YOU MUST DO THE STEPS IN THE SPECIFIED PROCEDURE WHEN YOU MOVE THE WINDOW HEAT CONTROL UNIT. STATIC DISCHARGE CAN CAUSE DAMAGE TO THE WINDOW HEAT CONTROL UNIT.

      (3) Remove the window heat control unit from the shelf.
3. Window Heat Control Unit Installation (Fig. 401)
   A. References
      (1) 20-40-12/201, Electrostatic Discharge Sensitive Devices
      (2) 30-41-11/501, Window Heat Control Unit
   B. Procedure
      (1) Obey the procedure for electrostatic discharge sensitive devices (Ref 20-40-12/201).

CAUTION: YOU MUST DO THE STEPS IN THE SPECIFIED PROCEDURE WHEN YOU MOVE THE WINDOW HEAT CONTROL UNIT. STATIC DISCHARGE CAN CAUSE DAMAGE TO THE WINDOW HEAT CONTROL UNIT.

      (2) Install the window heat control unit on the shelf.



Window Heat Control Unit Installation
Figure 401

(3) Remove the DO-NOT-CLOSE tags and close these circuit breakers:
   (a) P6 Panel
      1) WINDOW ANTI-ICE FRONT
      2) WINDOW ANTI-ICE R FRONT
      3) WINDOW ANTI-ICE L SIDE
      4) WINDOW ANTI-ICE R SIDE
   (b) P18 Panel
      1) WINDOW HEAT CONTROL LEFT FRONT AC
      2) WINDOW HEAT CONTROL LEFT SIDE AC
      3) WINDOW HEAT CONTROL RIGHT FRONT AC
      4) WINDOW HEAT CONTROL RIGHT SIDE AC
      5) WINDOW HEAT CONTROL LEFT FRONT DC
      6) WINDOW HEAT CONTROL LEFT SIDE DC
      7) WINDOW HEAT CONTROL RIGHT FRONT DC
      8) WINDOW HEAT CONTROL RIGHT SIDE DC
(4) Do the window heat control unit test (Ref 30-41-11/501).

WINDOW HEAT CONTROL UNIT - ADJUSTMENT/TEST

1. General
   A. After replacement of a window heat control unit, test the window heat and indicator light circuits for that control unit.
2. Window Heat Control Unit Test
   A. Connect electrical power and energize appropriate buses furnishing power to the window and indicating lights controlled by replaced window heat control unit.
   B. Check that appropriate circuit breakers for replaced window heat control unit on 28-volt dc bus, 115-volt ac bus, and 115-volt ac generator bus are closed. Also check that appropriate circuit breakers for indicator lights are closed.
   C. Check indicator lights for window controlled by replaced window heat control unit (push-to-test).
   D. Position appropriate window heat control switch to ON. Check that corresponding window temperature is increasing and the POWER ON indicator light illuminates.
   E. Depress either master caution lights and observe that both master caution lights and anti-ice annunciator lights are off.
   F. Momentarily turn the window heat control test switch to the OVHT position. Check that the overheat light, the two master caution lights and the anti-ice annunciator light illuminate and power on light extinguishes in less than 70 seconds.
   G. Momentarily set the window heat control switch to OFF and back to ON. The window OVERHEAT light and the ANTI-ICE annunciator light shall extinguish, the POWER ON light shall illuminate. If all other master caution annunciator lights are extinguished, the two master caution lights shall also extinguish.
   H. Position window test switch to PWR. Check that respective window temperature increases and if temperature is allowed to rise to upper safe temperature limits, that OVERHEAT light, the two MASTER CAUTION lights and the ANTI-ICE annunciator light illuminates and the POWER ON light extinguishes in less than 70 seconds, or extinguishes immediately, depending on which window heat control unit is installed.

      CAUTION: RELEASE TEST SWITCH AS SOON AS THE OVERHEAT LIGHT ILLUMINATES.

   I. Return window control switch to OFF. All lights shall extinguish.
   J. Determine if there is any further need for electrical power on airplane. If not, remove electrical power.

WINDOW HEAT CONDUCTIVE COATING AND SENSOR - ADJUSTMENT/TEST

1. Window Heat Conductive Coating and Sensor Test
   A. General
      (1) The control cabin window test consists of three separate tests, a window No. 1 and 2 conductive coating resistance test, a window No. 1 and 2 sensor resistance test and a window No. 4 and 5 conductive coating resistance test. The conductive coating resistance tests are effective in establishing that the power dissipation of the windows is within acceptable limits. The sensor resistance test is effective in checking the window sensor for shorts, open circuits, and that the sensor resistance is within acceptable control limits.
      (2) Refer to Chapter 56, for access to window bus terminals and window replacement.
   B. Windows No. 1 and 2 Conductive Coating Resistance Test
      (1) General
         (a) Windows No. 1 and 2 have a code number etched on the inner pane adjacent to one of the bus terminals, which designates the window resistance when new. The resistance of the conductive coating increases slightly with age. If the resistance differs widely enough from that indicated by the window marking, the window power lead should be connected to a different control unit output terminal, as required to maintain the correct heating current. See figure 501 for correct terminal number for windows No. 1 and 2 resistances.
      (2) Equipment and Materials
         (a) Ohmmeter, zero to 500 ohm range, accurate to + 5 percent
      (3) Test Window Resistance
         (a) Open respective WINDOW ANTI-ICE circuit breaker on circuit breaker panels P6-11 or P6-12.
         (b) Disconnect electrical leads from window No. 1 and 2 bus bar terminals and measure bus to bus resistance of window by connecting ohmmeter across window terminals.
         (c) Check that window resistance is within limits and electrical leads are connected to correct control unit output terminals as shown on Fig. 501.
         (d) Disconnect ohmmeter, reconnect all window leads and close window anti-ice circuit breakers opened in step (2)(a).
   C. Windows No. 1 and 2 Heat Sensor Resistance Test
      (1) Equipment and Materials
         (a) Ohmmeter, zero to 500 ohm range, accurate to + 5%
      (2) Test Window Heat Sensor
         (a) Open respective WINDOW HEAT CONTROL circuit breakers on circuit breaker panel P18-3.

WINDOW CODE WHEN NEW		BUS TO BUS WINDOW RESISTANCE (OHMS) (WINDOW UNDER 88°F ± 20°) MIN	MAX	TERMINAL STRIP TAP
WINDOW NO. 1	H13	31.4	35.1	1
	H12	35.1	38.8	2
	H11	38.8	42.6	3
		42.6	47.3	4
		47.3	52.0	5
		52.0	57.7	6 [1]
WINDOW NO. 2	H16	55.7	62.3	1
	H15	62.3	69.0	2
	H14	69.0	75.5	3
		75.5	81.6	4
		81.6	90.3	5
		90.3	100	6

[1] TERMINAL NOT AVAILABLE ON CONTROL UNITS PART NO. 10-61833-( ) OR 231-( ). INSTALL CONTROL UNIT PART NO. 65-52803-( ) OR REPLACE WINDOW

Window Resistance and Control Unit Output Terminal Table
Figure 501

(b) Disconnect electrical leads from window heat sensor terminals and measure resistance of sensor by connecting ohmmeter across sensor terminals.

(c) Check that resistance is within limits shown on figure 502.

NOTE: Sensing elements which have become open circuited during flight while airplane is pressurized will commonly exhibit continuity when tested with airplane depressurized. If a sensor is suspected of intermittent operation, apply the following test for intermittent sensor operation.

1) Test for intermittent sensor operation.

CAUTION: DO NOT APPLY CHECK FOR INTERMITTENT SENSOR OPERATION IF WINDOW IS IN A COLD SOAKED CONDITION AS CONTACT WITH HOT PLATE COULD CAUSE DAMAGE TO WINDOW.

a) Heat a piece of aluminum plate, approximately 1/4 to 3/8 inch thick by 3 inches square, to 200 + 10°F by placing in boiling water and place against outer pane of window directly over window heat sensing element.

b) Select as high a scale multiplier on ohmmeter as practical to observe increase in sensor resistance. If resistance increases to infinity, sensor is defective.

NOTE: If too high a scale multiplier is selected, a resistance between 1000 ohms to infinity may be noted; however, this would still indicate a defective sensor.

(d) Disconnect ohmmeter, reconnect window heat sensor terminals and close window anti-ice circuit breakers opened in step (2)(a).

D. Windows No. 4 and 5 Conductive Coating Resistance Test

(1) Equipment and Materials

(a) Ohmmeter - 0- to 500-ohm range, accurate to + 5 %

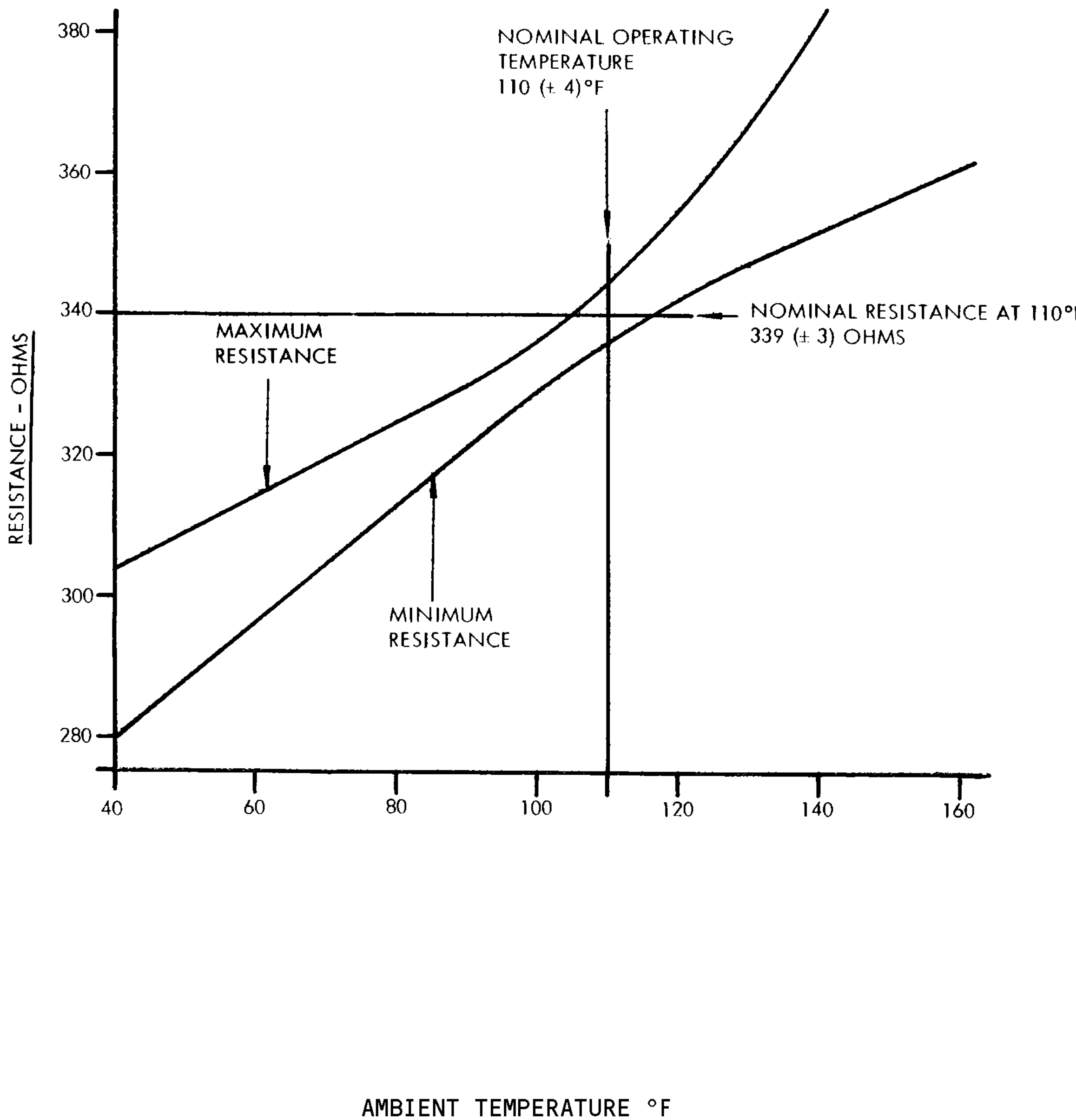
(2) Test Window Resistance

(a) Open respective WINDOW ANTI-ICE No. 4 and 5 circuit breakers on panel P6-11 or P6-12.

(b) Disconnect electrical leads from window No. 4 and 5 bus bar terminals and measure bus to bus resistance by connecting ohmmeter across window terminals.

(c) Check that resistance is within the following limits.

1) Window No. 4, PPG: between 61.6 and 83.4 ohms Triplex: between 41.3 and 55.8 ohms



Window Heat Control Sensor Resistance
Figure 502

2) Window No. 5, PPG: between 40.6 and 55.0 ohms Triplex: between 34.1 and 46.0 ohms

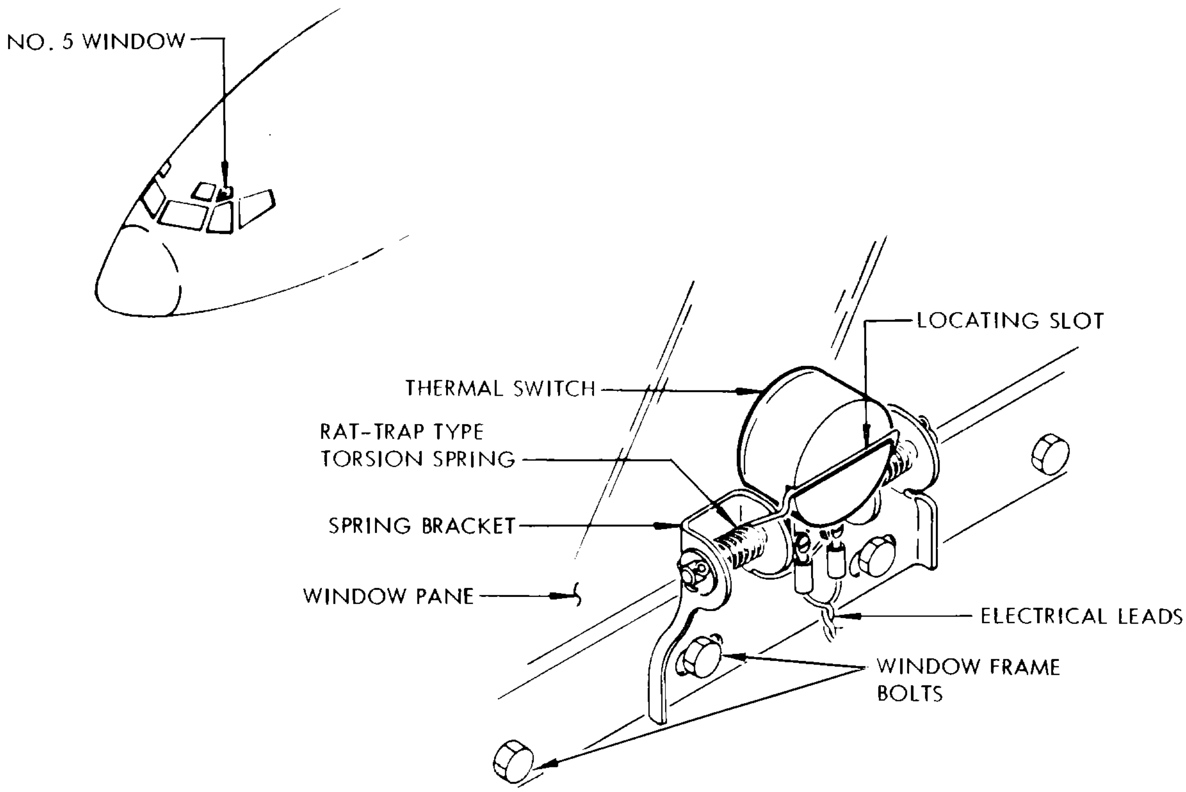
(d) Disconnect ohmmeter, reconnect all window leads and close window anti-ice circuit breakers opened in step (2)(a).

WINDOW NO. 3 AND 5 THERMAL SWITCH - REMOVAL/INSTALLATION

1. General
   A. A window heat thermal switch is installed near the bottom of the No. 5 window on each side of the control cabin. The window has an arrow and the words LOCATE SWITCH etched on the inner pane parallel to the lower bus bar to indicate the preferred area for thermal switch location. Each thermal switch is held against its window by a rat-trap type spring (Fig. 401).
   B. A conductive cement compound is applied between the contacting surfaces of the switch and the pane, the curvature of which would otherwise impair transfer of heat to the switch.
2. Equipment and Materials
   A. CD Mold Release B-2, Chemical Development Corp., Danvers, Mass. Optional: Permacel 422 Teflon Tape, Permacel Tape Corp, New Brunswick, New Jersey
   B. BMS 3-2, Type I Solvent
   C. Conductive Compound (Use only one of the compounds listed below):
      (1) A00062 Compound, Thermal Heat Sink - DC340
      (2) A00214 Compound, Potting - BMS 5-28, Type 3
      (3) A00323 Adhesive - BAC 501, Type 54
3. Remove Window Heat Thermal Switch
   A. Open respective WINDOW ANTI-ICE No. 4 and 5 circuit breaker on circuit breaker panel P6-11 or P6-12.
   B. Disconnect electrical leads from switch.
   C. Remove switch by pulling back rat-trap spring, which holds switch against window.
4. Install Window Heat Thermal Switch

   NOTE: If new window pane has been fitted, thermal switch must be installed as closely as possible to arrow on window's lower edge, because this mark indicates best switch location for that individual window. To achieve this it may be necessary to install rattrap spring bracket on different pair of window frame bolts from those originally used. Elongated holes in bracket provide further adjustment. Trim royalite cover as required to accommodate new switch location.

   A. Thoroughly clean face of switch and surface of window with solvent, BMS 3-2, Type I. Wipe off surplus solvent and allow both surfaces to dry.



Window No. 5 Thermal Switch Installation
Figure 401

B. Thermal switch must be installed with conductive compound as follows:
   (1) If you use the two part or four part compounds, do these steps:
      (a) Mix the compounds as instructed:
         1) If you use Marco conductive compound (four part), prepare compound by thoroughly mixing ingredients in following order and proportions (by weight): Resin (100 parts), Aluminum powder (70 parts), Accelerator (2 parts), Catalyst (2 parts).

            NOTE: At temperatures between 70°F and 90°F, compound must be used within approximately 30 minutes of mixing. Approximately 43.5 grams of the mixture should be sufficient to install switch on both No. 5 windows.

         2) If you use two part compounds, mix and use in accordance with manufacturer's instructions.
      (b) Apply CD-2 Mold Release B-2, or Permacel 422 Teflon Tape, to the switch surface facing the window.
      (c) Apply compound over mold release or tape on face of switch to be in contact with window. Compound should be slightly thicker at center of face than around its rim.
   (2) If you use DC-340 apply coating of heat sink compound to face of thermal switch.

      CAUTION: EXCESS THICKNESS OF COMPOUND WILL AFFECT ITS THERMAL LAG, THEREFORE, AMOUNT USED SHOULD BE HELD TO THE MINIMUM REQUIRED FOR FILLING THE GAP.

   (3) Pull rattrap spring back and engage with locating slot across back of switch, whose terminal lugs should point toward spring hinge.
   (4) Allow spring to press switch against window and wipe off surplus compound, which exudes from joint.
   (5) Observe bond from outside window and check that no air bubbles larger than 3/32 inch in diameter are visible in compound and that total area of smaller bubbles does not exceed 10 percent of bonded area. If these requirements are not fulfilled, heat conductivity will be impaired and bond must be dissolved and made again.
   (6) If you used the two part or four part compounds, wait at least one hour for compound to cure. At temperatures below 50°F a longer time will be required. Curing can be regarded as complete when compound has become hard and brittle.

(7) When compound is completely cured, use solvent to wipe off excess compound still remaining on window. Remove teflon tape from microswitch if used in step (2).

CAUTION: TEFLON TAPE MUST BE REMOVED FROM FACE OF THERMAL SWITCH BEFORE TURNING ON WINDOW HEAT. THE TAPE ACTS AS AN INSULATOR AND WILL PREVENT SWITCH FROM PROTECTING WINDOW AGAINST OVERHEAT.

C. Connect electrical leads to switch terminal lugs.
D. Close circuit breaker opened in step 3.A.

WINDSHIELD WIPER SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. A windshield wiper is provided to maintain a clear area on the pilots' No. 1 windows during takeoff, approach and landing, in rain or snow. Each wiper is operated by a separate system to ensure that clear vision through one of the windows will be maintained in the event of a system failure. The wiper blades clear a path approximately 13-1/2 inches wide through an arc of 84 +4 degrees.
   B. Both wiper systems are electrically operated and controlled by a common gang switch located on the overhead panel. The switch provides a selection of two wiper action speeds ranging from a minimum of 250 strokes per minute with the windshield wiper switch in HIGH position to a minimum attainable speed commensurate with stable motor operation with switch in LOW position and controls the stowing of the wiper blades in a PARK position when the system is not in use.
   C. Each windshield wiper system consists of a drive motor and torque converter assembly, a control switch, a resistor box, and a windshield wiper assembly (Fig. 1).
   D. Speed control is accomplished by changing the voltage applied to the windshield wiper motor by means of resistances arranged in the resistor box. The required resistance is connected into the motor circuit by turning the windshield wiper switch to a selected speed (Fig. 2). The rotary motion of the drive motor is transmitted to the converter, which reduces the shaft speed and changes rotary motion to an oscillating motion of the windshield wiper arm.

      CAUTION: DO NOT OPERATE WINDSHIELD WIPERS ON DRY WINDSHIELDS.

   E. A second method for maintaining clear windows in heavy rain is by the use of rain repellant (Ref 30-43-0, Rain Repellant System).
2. Motor-Converter Assembly
   A. The wiper assembly for each system is driven by a motor-converter assembly. The motor-converter assembly consists of a 28 volt dc variable speed electric motor and torque converter coupled together by a connector sleeve and assembled on a support fitting. Each assembly is mounted on a bracket on its respective windowsill close to the inner surface of the skin.

B. Each motor is equipped with two radio noise filters, an automatically resetting thermal overload switch, and a cam actuated switch. The thermal switch temporarily opens the motor field circuit when the motor temperature exceeds 300°F, or when the field current exceeds 8 to 10 amps. The cam-actuated switch is a two pole two position microswitch. The operating cam is driven by reduction gearing in the motor to coincide with the wiper cycle. One pole of the switch is closed when the motor is in any part of the wiper cycle other than PARK. The other pole of the switch is closed only when the motor is in the PARK position of the cycle. The switch is used in conjunction with the system control switch to stop the motor with the wipers in the PARK position when the system is not in use.

C. The converter has a serrated drive shaft, which protrudes through the skin just forward of the windshield for attachment of the wiper assembly. The converters change the high-speed low torque rotary motion of the motor to a low speed high torque circular oscillating motion for the wiper arm, by the use of a worm gear and eccentric drive mechanism. The motor and converter are synchronized with respect to the wiper cycle before the units are coupled together.

3. Control Switch

A. The windshield wiper control switch is a six position-double wafer-rotary gang switch. The switch is located on the overhead panel and is used to control the action of both windshield wiper motors by changing the motor circuitry. On PW CF-PWC thru CF-PWE and C-GPWA, NZ ZK-NAC thru ZK-NAM, the switch has a momentary PARK position and five detent positions, OFF-LOW-1/2-3/4 and HIGH. On all other airplanes the switch has a momentary PARK position and three detent positions, OFF-LOW and HIGH.

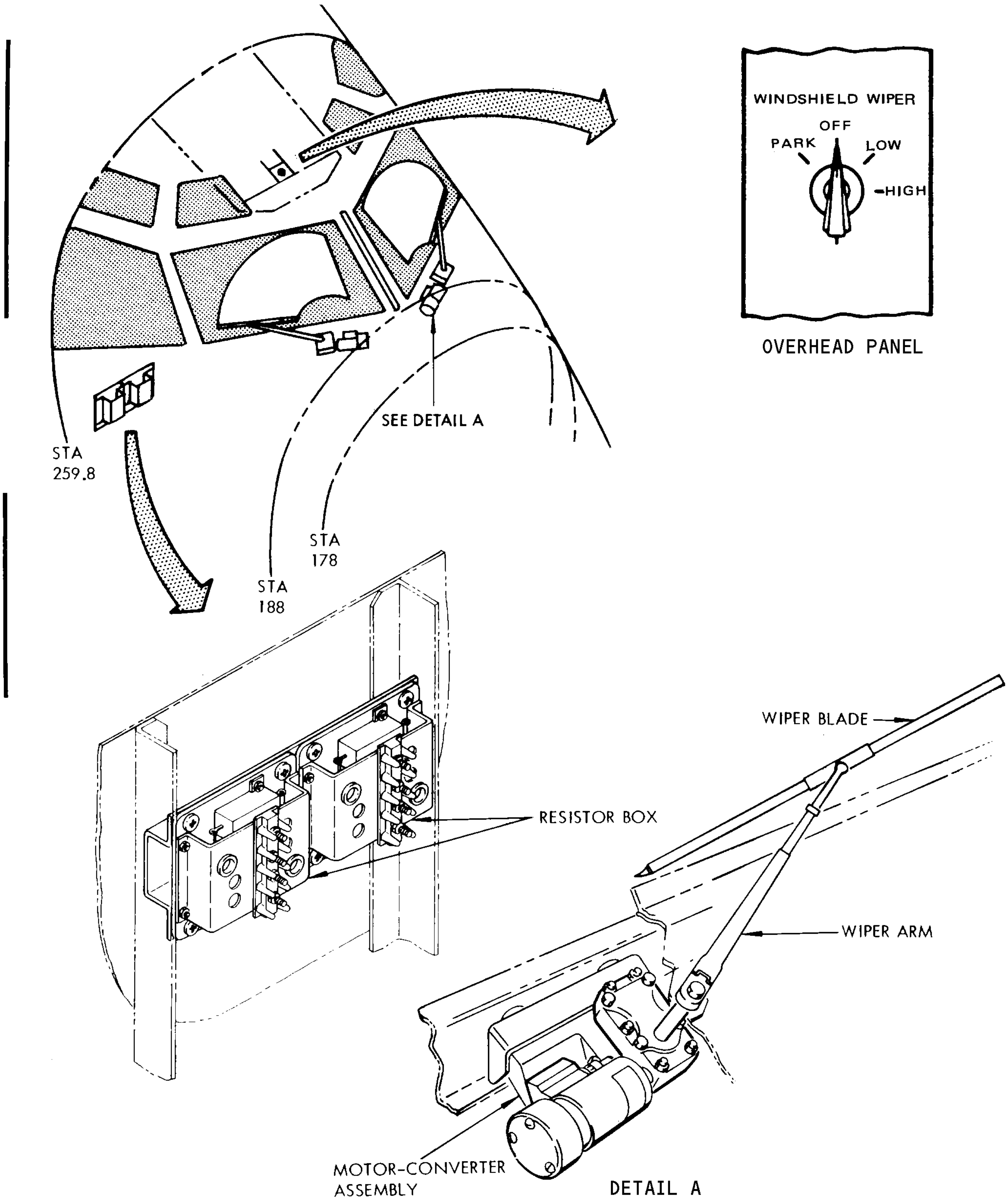
B. The windshield wiper control switch is a four position-double wafer-rotary gang switch. The switch is located on the overhead panel and is used to control the action of both windshield wiper motors by changing the motor circuitry. The switch has a momentary PARK position and three detent positions, OFF-LOW- and HIGH.

4. Resistor Box

A. Each windshield wiper system has a resistor box for its motor (Fig. 1). The box contains three resistors, which may be selected by the control switch to be added in series with the motor circuit to control the motor speed.

5. Wiper Assembly

A. The windshield wiper assembly consists of a wiper blade and wiper arm. The wiper arm has a serrated sleeve at its hub to provide angular adjustment between the arm and the converter drive shaft, and is attached to the shaft by a bolt through the hub. The wiper tension of the arm can be adjusted by a tension-adjusting nut near the hub of the arm. The wiper blade is bolted to the end of the wiper arm and the angle between the blade and the arm can be adjusted by means of a serrated disc attached to each part.



Windshield Wiper System Component Location
Figure 1

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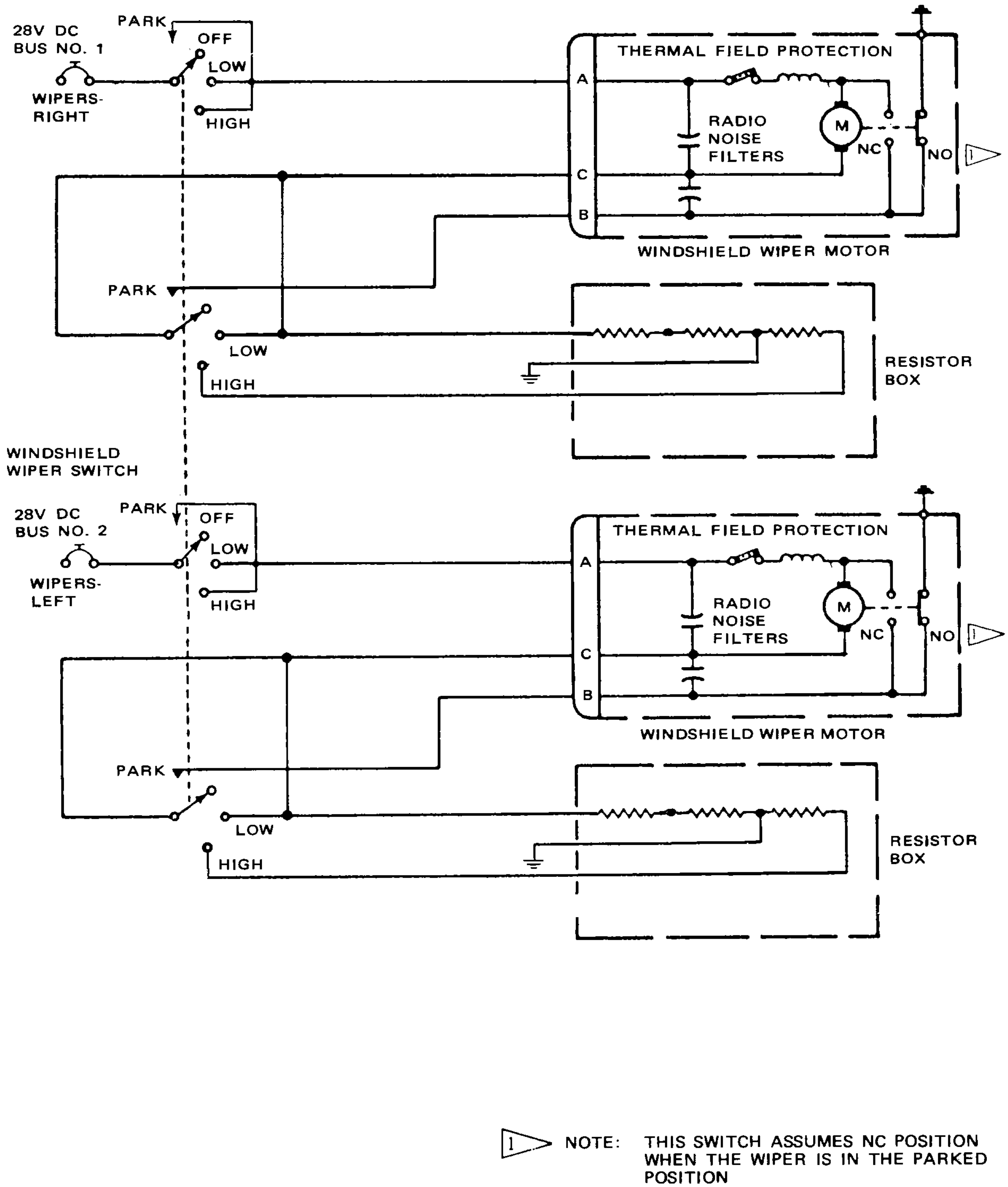
6. Operation

A. The operation of both windshield wiper systems is controlled by turning the windshield wiper control switch located on the overhead panel to the rate of wiper action desired. When switch position LOW or HIGH is selected, power will be directed from the respective system bus through the control switch to the motor, back through the control switch for resistance or speed selection, then to selected resistance to ground (Fig. 2). The amount of resistance selected determines the motor speed and therefore the rate of wiper action.

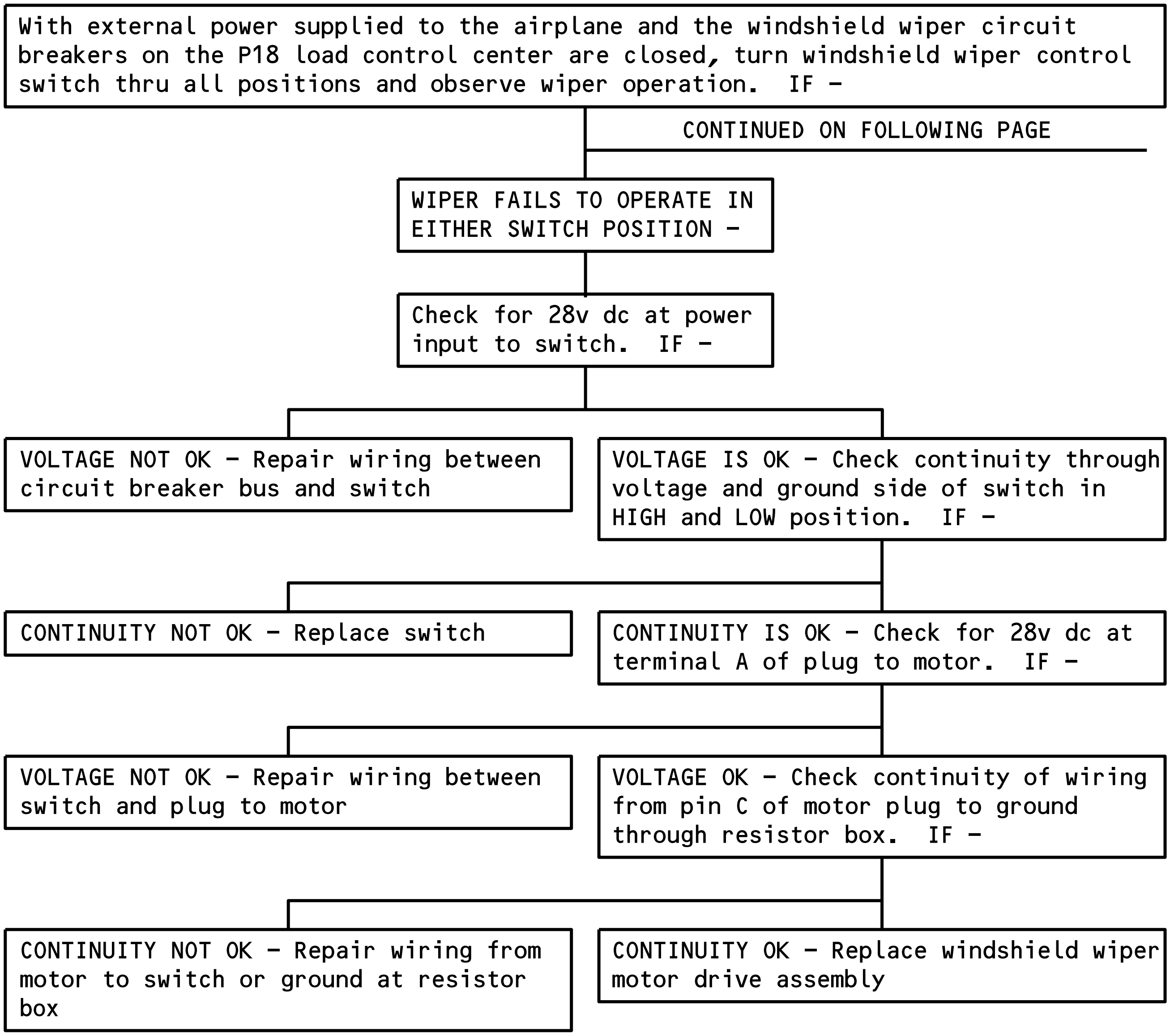
B. When the control switch is turned to the PARK position and the wiper is in any position other than PARK, the switch completes a circuit through the PARK contacts of the control switch and through the N O contacts of the cam operated switch in the motor to ground. This will shunt the resistor box out of the control circuit and drive the motor at high speed until the motor reaches the PARK position of the wiper cycle and the switch cam moves the switch to close the N C contacts of the cam operated switch. With the cam operated switch in the N C position the motor armature is shunted out by the cam operated switch and the circuit is completed to ground through the PARK contact of the control switch and the full resistor load. With the motor field coil still energized and the motor armature shorted by the cam operated switch, dynamic braking is provided to stop the motor from coasting. This stops the motor with the wiper blades in the PARK position.



Windshield Wipers Circuit
Figure 2

WINDSHIELD WIPER SYSTEM -TROUBLE SHOOTING

1. Windshield Wiper System Trouble Shooting Chart



Windshield Wiper System - Troubleshooting
Figure 101 (Sheet 1)

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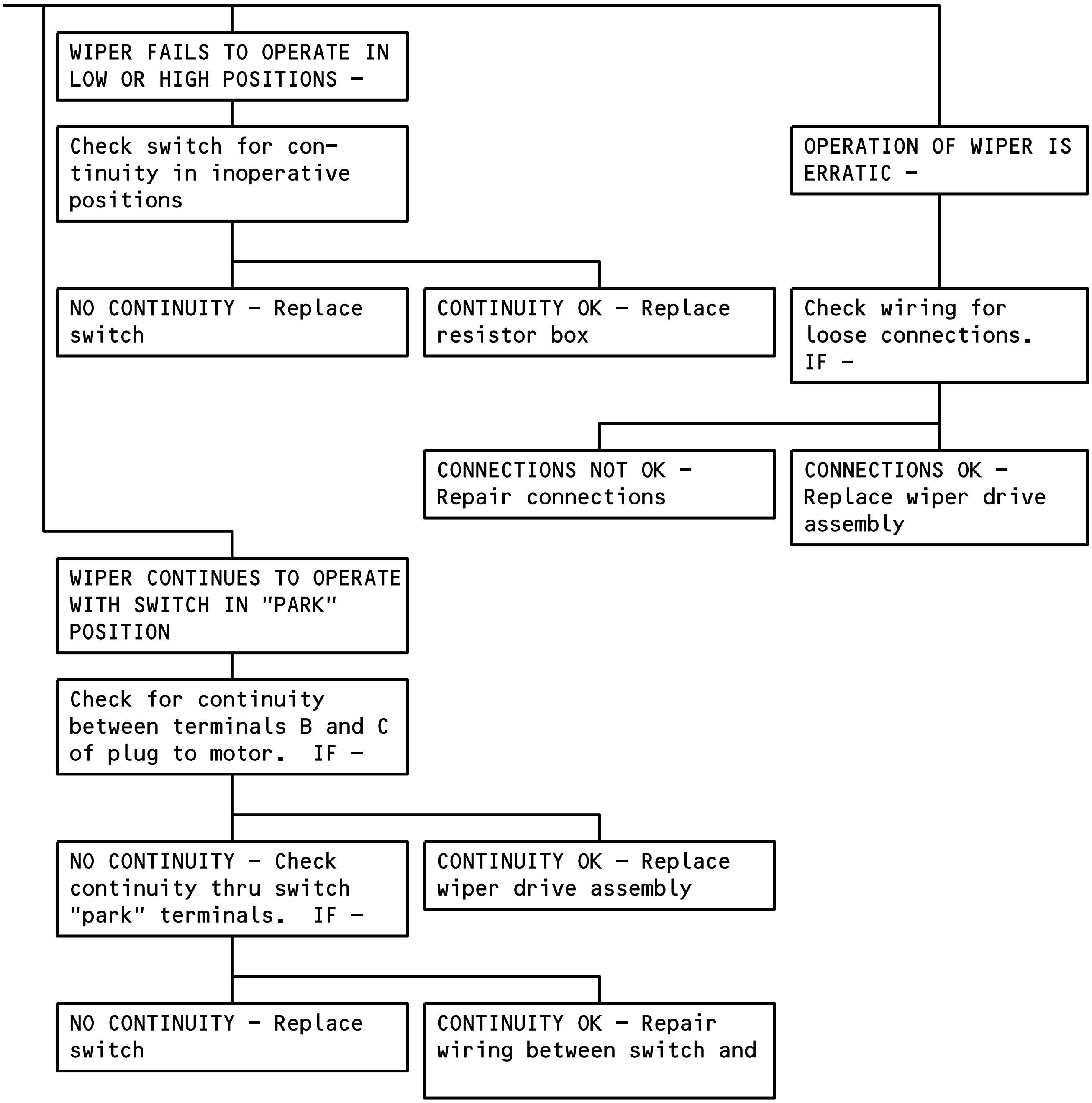


Windshield Wiper System - Troubleshooting
Figure 101 (Sheet 2)

WINDSHIELD WIPER SYSTEM - ADJUSTMENT/TEST

1. Windshield Wiper System Test
   A. Connect external electrical power and check that the WINDSHIELD WIPER R and L circuit breakers on P18 panel are closed.
   B. Simulating rain with a water spray, turn windshield wiper switch successively to each speed, and check wiper operation for satisfactory rain removal through each wiping speed. Check that wipers operate smoothly without excessive noise, and that wiped area does not overlap onto structure.

      CAUTION: DO NOT OPERATE WINDSHIELD WIPERS ON DRY WINDSHIELDS.

      NOTE: Wipers should make a minimum of 250 strokes per minute with windshield wiper switch in HIGH position, and a minimum attainable speed commensurate with stable motor operation with switch in LOW position.

   C. Turn switch to PARK position and check that wipers park in proper position.
   D. Determine whether there is any further need for electrical power on the airplane, if not, remove external power.

WINDSHIELD WIPER ASSEMBLY - REMOVAL/INSTALLATION

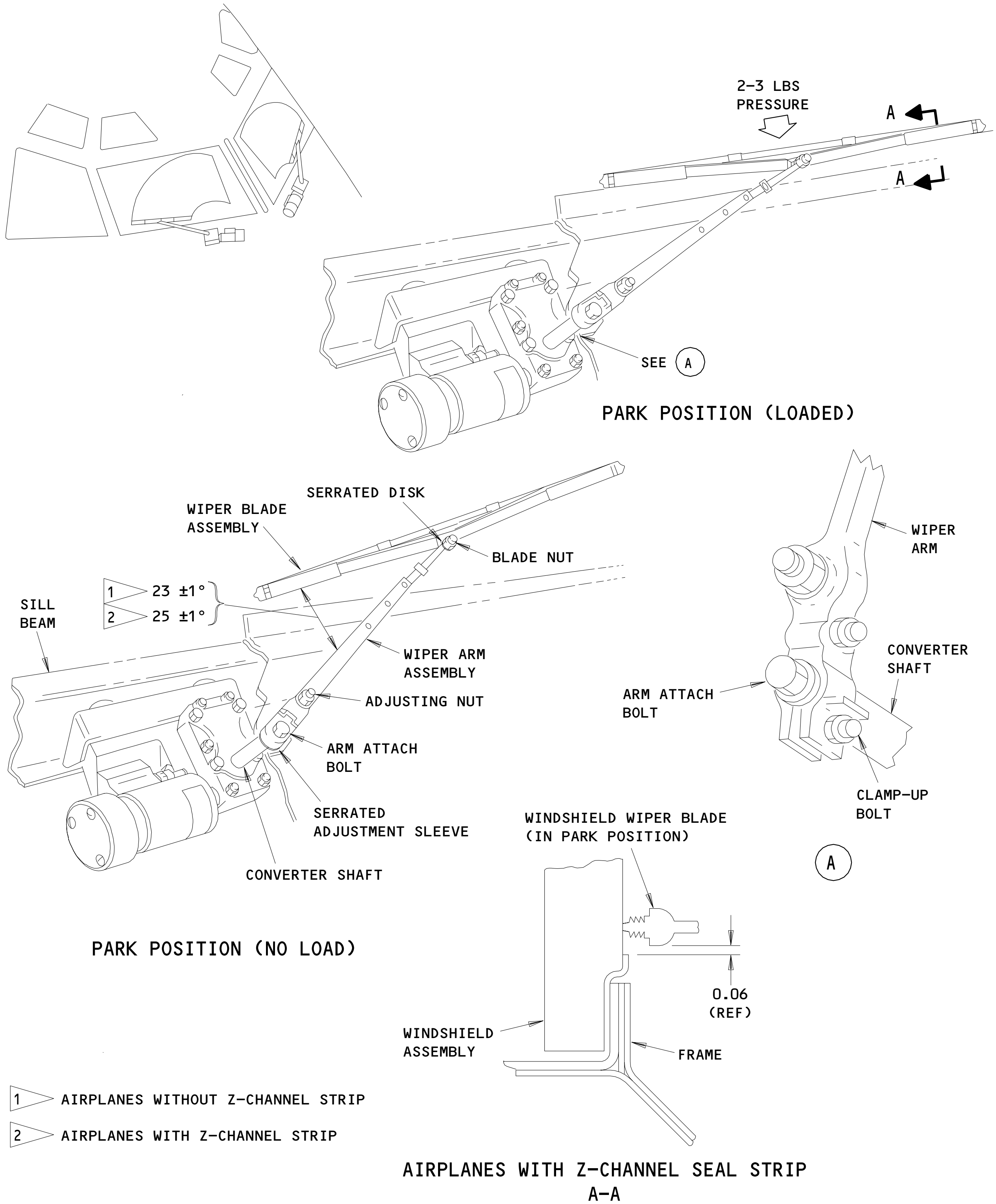
1. Equipment and Materials
   A. Grease - BMS 3-33 (Preferred)
   B. Grease - MIL-PRF-23827 (Supercedes MIL-G-23827) (Alternate)
   C. Tension Spring Scale - 0-20 pounds
2. Remove Windshield Wiper Assembly
   A. Open WIPERS-LEFT or WIPERS-RIGHT circuit breaker on P18 panel.
   B. Loosen adjusting nut on wiper arm.
   C. Remove nut securing wiper blade to wiper arm and remove wiper blade.

      CAUTION: DO NOT ALLOW ARM TO SLAP WINDSHIELD.

   D. Loosen wiper arm pinch screw securing serrated adjustment sleeve.
   E. Remove bolt securing arm to converter shaft and remove wiper arm.
3. Install Windshield Wiper Assembly
   A. Attach wiper blade to wiper arm and secure blade with nut. Set wiper blade at proper angle with wiper arm (Fig. 401).
   B. Close appropriate WIPERS circuit breaker on P18 panel.
   C. Check that motor and converter are synchronized by noting that motor stops in PARK position with converter output shaft at limit of rotation in direction of park stroke.
   D. Apply grease to serrations on wiper arm adjustment sleeve and converter shaft. Ensure that sleeve is installed with slot in sleeve in line with slot in arm hub.
   E. Install wiper arm in PARK position by locating arm on converter shaft so that when a 2 to 3 pound force is applied to blade attach point, blade will lie adjacent to window sealant along sill beam (Fig. 401). On windows with Z-channel strip, position wiper blade per Fig. 401. If correct blade position cannot be obtained, relocate arm as follows:
      (1) Mark relative position of converter shaft and arm before removing sleeve.

          NOTE: Slot in serrated sleeve must align within 30 degrees of slot in wiper arm hub.

      (2) Remove wiper arm from converter shaft.
      (3) Rotate arm in direction of required adjustment. A rotation of one serration is equivalent to 0.034-inch movement of end of wiper arm. Install arm on converter shaft. Lockwire clamp-up bolt.
   F. Secure wiper arm to converter shaft with attaching bolt and lockwire.
   G. Tighten pinch screw and lockwire.



Windshield Wiper Assembly Installation
Figure 401

H. Spray water on windshield and drive wiper blade to check that blade does not contact metal structure. If blade contacts structure, adjust wiper arm until blade is clear of structure.

CAUTION: DO NOT OPERATE WINDSHIELD WIPERS ON DRY WINDSHIELDS.

I. Adjust and test per Windshield Wiper Assembly - A/T.

4. Remove Windshield Wiper Blade

A. Loosen adjusting nut on wiper arm (Fig. 401).

CAUTION: DO NOT PULL WIPER ARM AWAY FROM WINDSHIELD WITHOUT RELEASING ARM TENSION.

B. Remove nut securing wiper blade and remove blade.

5. Install Windshield Wiper Blade

A. Attach wiper blade to wiper arm and secure blade with nut so that blade is at proper angle with arm.

B. Tighten adjusting nut.

C. Adjust and test per Windshield Wiper Assembly - A/T.

WINDSHIELD WIPER ASSEMBLY - ADJUSTMENT/TEST

1. Equipment and Materials
   A. Tension spring scale - 0- to 20-pound capacity
2. Windshield Wiper Assembly Adjustment
   A. Spray water on windshield and adjust wiper arm approximately in center of stroke if system can be operated; otherwise in park position.

      CAUTION: DO NOT OPERATE WINDSHIELD WIPERS ON DRY WINDSHIELDS.

   B. Adjust pressure with adjusting nut. Blade pressure adjustment is made at hub of arm. Then turn it backward slightly to make sure head of tee bolt is seated parallel to groove.

      CAUTION: DISCARD THE ADJUSTING NUT AND TEE BOLT IF THEY ARE LOOSE. THE WIPER BLADE MAY BECOME LOOSE IF THE ADJUSTING NUT AND TEE BOLT ARE USED AGAIN.

   C. Hook a spring scale under arm where blade and arm connect and check that scale reads 5.5 to 6.5 pounds perpendicular to windshield just as any part of wiper blade starts to lift from glass. If required tension cannot be obtained, replace wiper arm.
   D. Turn wipers on HIGH and allow to operate for several seconds. Stop wipers in mid-travel position and recheck tension per step C. If tension has changed repeat steps B, C, and D until tension has stabilized.
3. Windshield Wiper Assembly Test
   A. Refer to Windshield Wiper System - A/T.

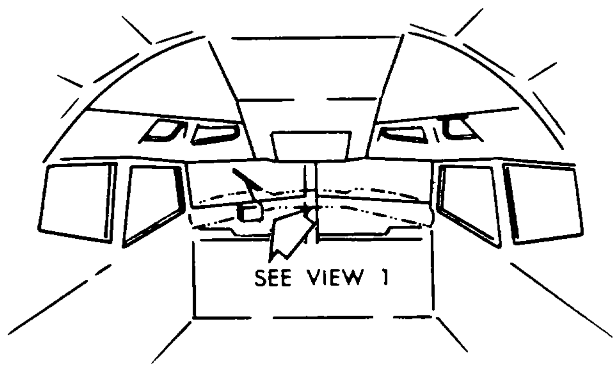
WINDSHIELD WIPER DRIVE ASSEMBLY - REMOVAL/INSTALLATION

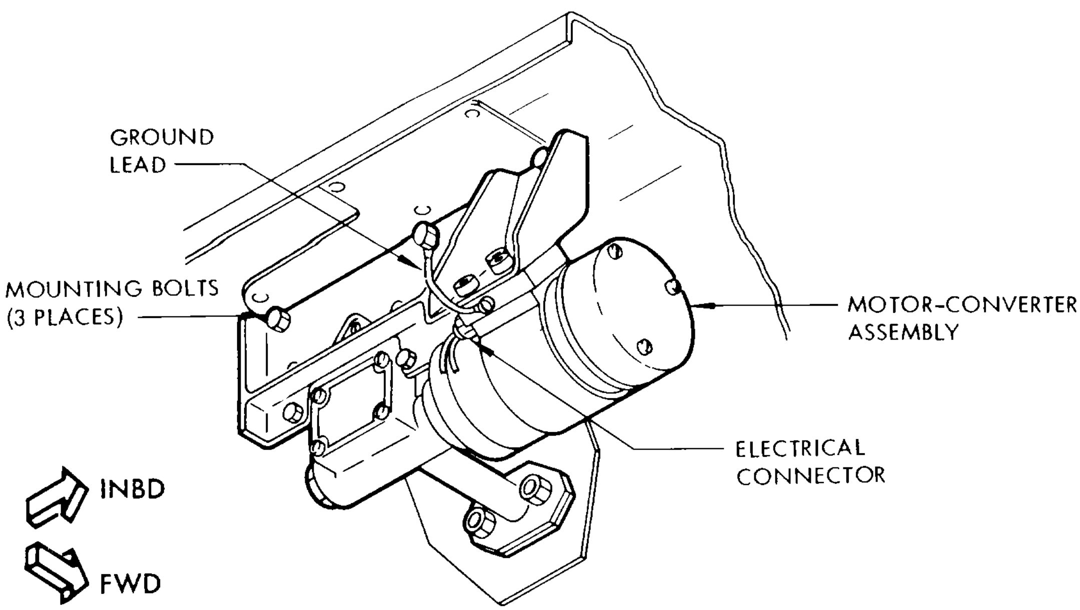
1. General

2. Remove Windshield Wiper Drive Assembly (See figure 401.)
   A. Open WIPER L or WIPER R circuit breakers on P18 load control center.
   B. Open pilot's (or copilot's) instrument panel.
   C. Disconnect connector plug from motor.
   D. Remove wiper assembly. See 30-42-11, Windshield Wiper Assembly - R/I.
   E. Remove bolts attaching drive assembly support fitting to structure and remove drive assembly.
   F. Remove ground lead from drive motor.
3. Install Windshield Wiper Drive Assembly
   A. Check that converter worm gear end cap is safety wired. If not, instal1 safety wire.
   B. Connect ground lead to drive motor mounting bracket.
   C. Place drive assembly in position and install bolts attaching drive assembly support fitting and ground lead to structure.
   D. Turn the rain repellent solenoid toward the center of the airplane if it will touch the wiper motor.

      NOTE: The rain repellent solenoid must not touch the wiper motor.

   E. Connect plug to motor.
   F. Close pilot's (or copilot's) instrument panel.
   G. Close appropriate circuit breaker on P18 load control center.
   H. Install wiper assembly. See 30-42-11, Windshield Wiper Assembly - R/I.





VIEW 1

Windshield Wiper Drive Assembly Installation
Figure 401

RAIN REPELLENT SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. A rain repellent system is provided to be used in conjunction with the windshield wiper system to improve windshield visibility through the pilots' No. 1 windshields during heavy rain. The system is controlled independently for each window by separate control switches located on the overhead panel and when actuated the system sprays a rain repellent solution on the respective window as selected. The maximum quantity of solution sprayed per system actuation (approx. 6cc) is predetermined by the setting on a time delay relay and cannot be exceeded by extended duration of switch actuation. The solution is spread over almost all of the window by the rain and airstream, however spreading is enhanced within the wiped area of the windows by the action of the wiper blades. The length of time that an application remains effective varies inversely with the rain intensity and will last longer in the wiped area than in the unwiped area. Reapplication is repeated as required to maintain repellent effectiveness.
   B. The rain repellent system should not be operated on dry windows, as heavy undiluted solution will restrict window visibility. In the event of inadvertent dry window application do not operate the windshield wipers, as this tends to increase smearing. Also the rain repellent residues caused by application in dry weather or very light rain may cause staining or minor corrosion of the airplane skin. To prevent this any concentrated repellant or residue should be removed by a thorough fresh water rinse at the earliest opportunity, preferably within a few hours after exposure. Repellent residues allowed to dry or "cure" on the surface will require polishing with an approved aluminum polish to remove the stain. To remove residue from glass windows, use a repellent remover pad.
   C. The rain repellent system consists of a pressurized container of rain repellent fluid, a container receptacle, a visual reservoir, a pressure gage, two solenoid valves, two nozzles, associated plumbing, and two electrical control circuits (Fig. 1 and 2).
2. Container and Receptacle
   A. The rain repellent fluid is packaged in a pressurized disposable-type container (Fig. 1) which is replaced when empty. Each container has a self-sealing valve with a threaded boss for attaching the container to the system receptacle.

B. There are two types of fluid presently in use, type I and type III, which are packaged in different size containers. Type III is preferred due to its longer shelf life and repellent effectiveness. The two types of fluid are miscible, however when mixed the resultant solution tends to reflect the properties of the type I fluid. Therefore when converting from type I fluid to type III fluid it is recommended that the system be emptied of all type I fluid before introducing the type III fluid.

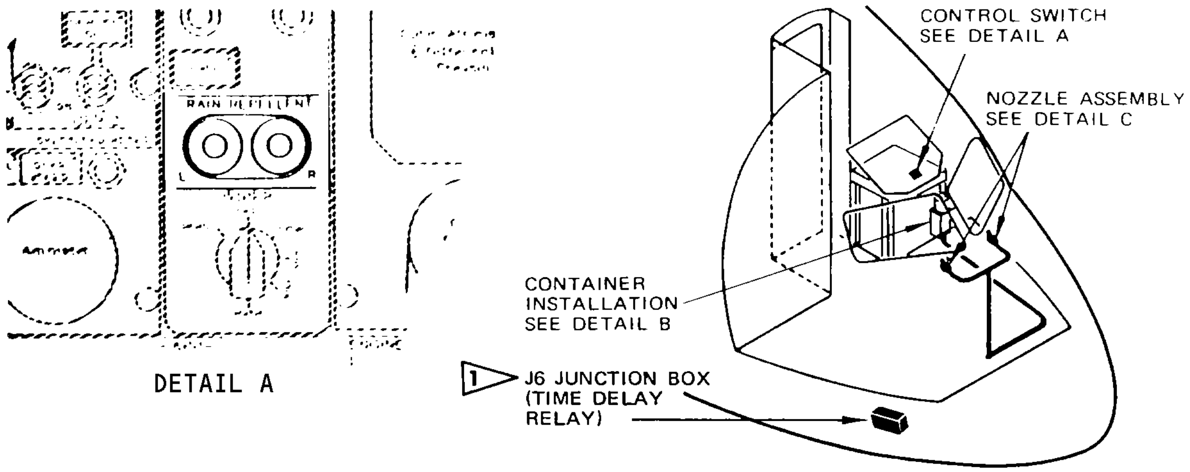
NOTE: The useful service life of type I rain repellent fluid is dependent upon the temperature to which it is exposed. Stored at room temperature, 65 to 75°F, a service life of about one year may be expected. Exposure to higher temperatures shortens the service life. The time rain repellent cans are installed on airplanes must be accredited to the one year useful service life storage period. Type III rain repellent fluid is not service life limited.

FLUID TYPE	CONTAINER VOLUME	FLUID CONTENT		CONTAINER WEIGHT		CHARGING PRES. AT 70°F
		CHARGED	DISCHARGED	CHARGED	DISCHARGED	
I	793CC (26.8 fl oz)	425CC (14.4 fl oz)	30CC (1.0 fl oz)	795 gms (1 lb 12 oz)	237 gms (8.4 oz)	85 psia
III	936CC (32.0 fl oz)	505CC (17.0 fl oz)	30CC (1.0 fl oz)	955 gms (2 lbs 2 oz)	240 gms (8.5 oz)	85 psia

C. Contact with the rain repellent fluid can cause irritation of the skin or eyes. Precautions should be taken to prevent contact with the skin or eyes and to avoid breathing the fluid vapors.

D. The fluid in rain repellent container P/N 65-38196-5 has a citrus scent.

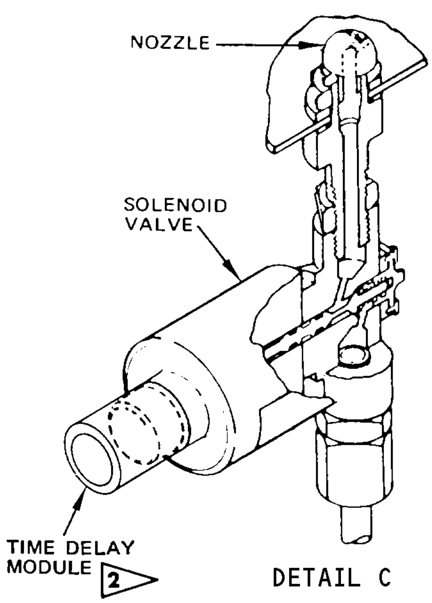
E. The system receptacle has a valve actuating pin which opens the container valve as the container is attached to the receptacle. As the pin enters the valve assembly it is sealed by an O-ring in the valve prior to unseating of the valve to prevent fluid leakage. The pin is hollow and has inlet ports near the tip of the pin to allow fluid to enter the system from the container. The container and receptacle are mounted to the left of the second observer's station.



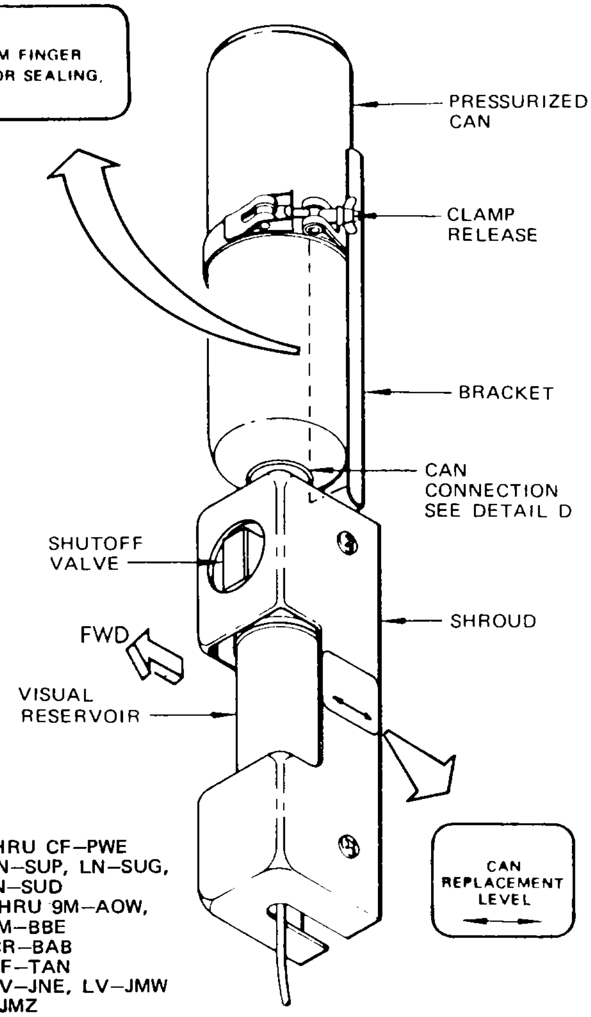
DETAIL A

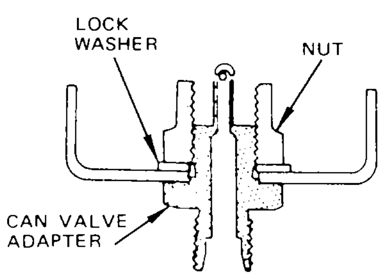
CAUTION

TIGHTEN RAIN REPELLENT CAN INTO SYSTEM FINGER TIGHT ONLY. TORQUE IS NOT REQUIRED FOR SEALING. EXCESSIVE TORQUE MAY CAUSE LEAKAGE.



DETAIL C





DETAIL D

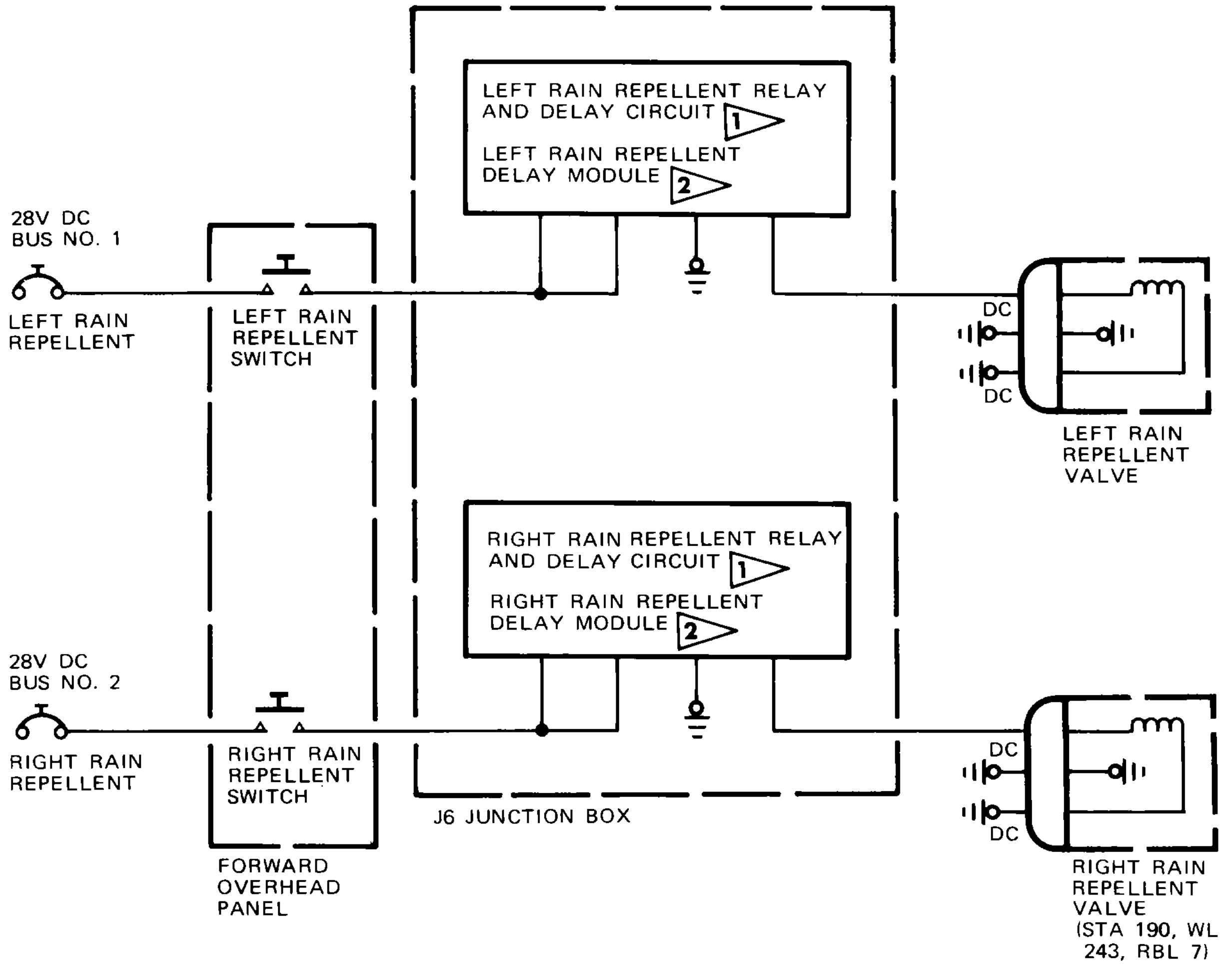
1 PW CF-PWC THRU CF-PWE
BU LN-SUS, LN-SUP, LN-SUG, LN-SUI, LN-SUD
ML 9M-AOU THRU 9M-AOW, 9M-BBC, 9M-BBE
TM CR-BAA, CR-BAB
TZ CF-TAO, CF-TAN
AR LV-JND, LV-JNE, LV-JMW THRU LV-JMZ

2 ALL EXCEPT 1

DETAIL B

Rain Repellent System Equipment Location
Figure 1

3. Visual Reservoir and Plumbing
   A. The container receptacle is connected by an adapter and fittings, through a shutoff valve to a translucent fiberglass fluid reservoir mounted below the receptacle (Fig. 1). The container, receptacle and reservoir are all supported by a common bracket. The can valve adapter, shutoff valve, and plumbing are enclosed in a plastic cover with cutouts for access to the shutoff valve and for viewing the reservoir. The reservoir contains a red float level indicator, which is visible through the side of the reservoir. A decal on the cover indicates the fluid level at which the container should be replaced. When the level of the fluid is at the container replacement level approximately ten individual repellent applications of fluid are left in the reservoir and plumbing leading to the spray nozzles.
   B. From the reservoir connection, a teflon supply line is routed below the control cabin floor to a stainless steel T-connection mounted forward of the windshield. The T is connected by stainless steel tubing to a solenoid control valve for each window.
4. Solenoid and Spray Nozzles
   A. The solenoid valves are normally closed electrically operated 28-volt dc valves (Fig. 2). The valves control the flow of repellent fluid released to the spray nozzles and are coupled directly to the nozzles.
   B. The solenoid valves are normally closed electrically operated 28-volt dc valves (Fig. 2). The valves control the flow of repellent fluid released to the spray nozzles and are coupled directly to the nozzles.
   C. The spray nozzles are mounted externally at the base of each No. 1 window inboard of the windshield wiper drive shaft (Fig. 1). Each nozzle has four spray holes which direct the repellent fluid onto the windshield.
5. Time Delay Circuit
   A. Each solenoid valve is controlled by an independent electrical control circuit (Fig. 2). The electrical control components of each circuit consist of a system control switch and a time delay circuit. The control switches are pushbutton type momentary switches and are located on the overhead panel.
      (1) On airplanes with the time delay relay (Fig. 1 for effectivity), the time delay circuit consists of a relay and an adjustable time delay circuit. A resistor in the circuit is variable and may be adjusted to change the time required to charge a condenser and thus control the time delay action. The delay is adjusted to open the relay contacts after the required amount of repellent has been sprayed on the window. The relay and delay circuit are located in the J6 junction box located in lower right side of the forward electronics compartment.



1 PW CF-PWC THRU CF-PWE
BU LN-SUS, LN-SUP, LN-SUG, LN-SUI, LN-SUD
ML 9M-AOU THRU 9M-AOW, 9M-BBC, 9M-BBE
TM CR-BAA, CR-BAB
TZ CF-TAB, CF-TAN
AR LV-JND, LV-JNE, LV-JMW THRU LV-JMZ

2 ALL EXCEPT 1

Rain Repellent System Circuit
Figure 2

(2) On airplanes with the time delay module (Fig. 1 for effectivity), the time delay circuit is mounted within the delay module which is connected to the solenoid valve electrical connector. A resistor in the time delay circuit is variable and may be adjusted to change the time required to charge a capacitor and thus control the time delay action. The delay is adjusted to open the circuit to the solenoid valve after the required amount of repellent has been sprayed on the window, allowing the valve to close.

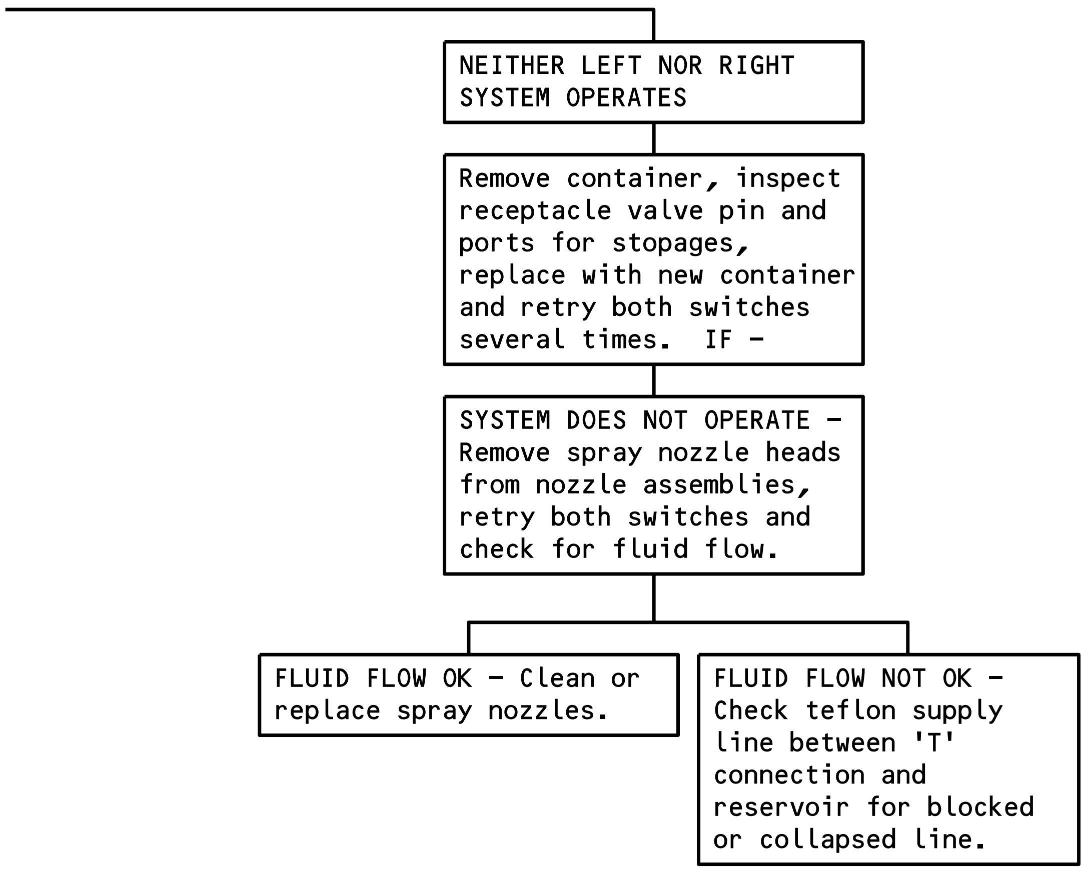
6. Operation

A. With the pressurized fluid container installed in the system receptacle, the shutoff valve in the open position, and 28-volt dc power available on the No. 1 and No. 2 dc bus, the system is ready for use. The operation of the rain repellent system for each window is individually controlled by pushing the respective control switch (Fig. 2). Pushing the control switch completes a circuit from its respective RAIN REPELLENT circuit breaker through the switch and time delay circuit, to energize the respective control valve solenoid. Actuation of the solenoid valve allows the pressurized reservoir to supply rain repellent through the tubing to the spray nozzles and onto the window. When the required amount of repellent has been sprayed on the window the time delay circuit will operate to break the circuit, de-energizing the solenoid valve and preventing further flow of repellent solution. Releasing the control switch breaks the circuit to the relay coil, de-energizing the relay and closing the relay points for the next operation. The pressurized fluid container will replenish the fluid in the reservoir as the fluid level drops and the pressure is decreased.

B. When actuating the control switch, hold switch depressed until fluid stops flowing from the nozzle. Rapid actuations of the control switch (less than 0.2 seconds) may de-energize the solenoid valve before the time delay circuit operates, releasing less than the normal amount of fluid.

RAIN REPELLENT SYSTEM - TROUBLESHOOTING

CONTINUED FROM PRECEDING PAGE



Rain Repellent System - Troubleshooting
Figure 101

RAIN REPELLENT SYSTEM - MAINTENANCE PRACTICES

1. General
   A. The rain repellent system maintenance practices are instructions on replacing an empty rain repellent container, depressurizing the system prior to maintenance on the system plumbing, and cleaning rain repellent from the windshield that has been allowed to dry to a hard film.
   B. With repellent container installed and the shutoff valve open, the rain repellent system will be pressurized between 40 and 80 psi, depending on the amount of fluid in the container. Before attempting maintenance on the pressurized plumbing, the system should be depressurized to avoid spraying repellent solution on the airplane structure or personnel. Rain repellent allowed to stand on the windshield will dry to a hard film. Special cleaner must be used to remove the hard film.
2. Rain Repellent Container - Replacement
   A. Remove Rain Repellent Container
      (1) Turn selector valve to the closed position.
      (2) Unfasten container retaining clamp (Fig. 201).

         WARNING: DO NOT LET THE RAIN REPELLENT FLUID TOUCH YOUR SKIN OR EYES. THE FLUID CAN CAUSE IRRITATION. DO NOT BREATHE THE FUMES. IF THE FLUID TOUCHES YOU, WASH YOUR SKIN OR EYES WITH WATER.

      (3) Unscrew container from receptacle and remove.

         WARNING: DO NOT REMOVE CONTAINER UNLESS SELECTOR VALVE IS IN CLOSED POSITION AS PRESSURIZED REPELLENT FROM SYSTEM MAY BE SPRAYED FROM RECEPTACLE ONTO PERSONNEL.

   B. Install Rain Repellent Container
      (1) Ensure that selector valve is turned to closed position.
      (2) Position container in receptacle and screw in position.

         NOTE: Tighten container finger tight only. If connection shows evidence of leaking remove container and inspect container valve and receptacle for damage.

      (3) Fasten container retaining clamp.

(4) Turn shutoff valve to open position.

NOTE: If a new rain repellent container is installed and the fluid remains at the low level, then the removal and reinstallation of the rain repellent container is required to relieve the gas pressure. This allows the fluid level indicator to read the correct level of the fluid.

3. Rain Repellent System Depressurization

A. Depressurize Selector Valve to Solenoid Valve.

(1) Provide electrical power and check that the REPELLENT circuit breakers on the P6-1 panel are closed.

(2) Turn shutoff valve to the closed position.

(3) Wet windshield area down with water and actuate the repellent control switches several times to relieve system of any residual pressure.

(4) Wash any remaining repellent from airplane structure.

CAUTION: DO NOT ALLOW REPELLENT SOLUTION TO REMAIN IN CONTACT WITH THE AIRPLANE STRUCTURE. ALL REPELLENT SOLUTION SHOULD BE WASHED OFF WITHIN TWO HOURS AFTER IT IS APPLIED.

(5) If no longer required, remove electrical power from the airplane.

B. Depressurize container to shutoff valve.

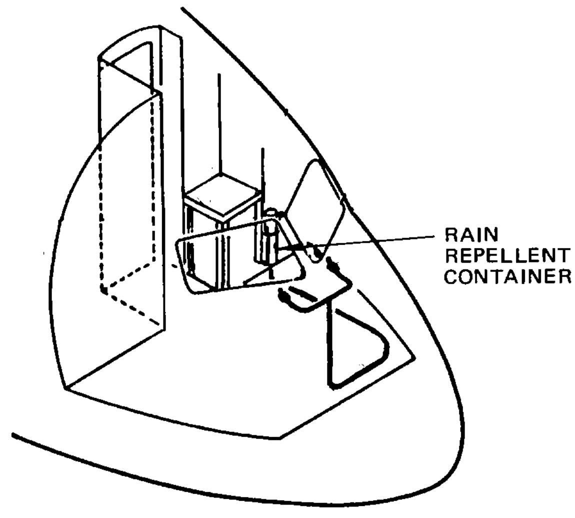
(1) Remove container per paragraph 2.

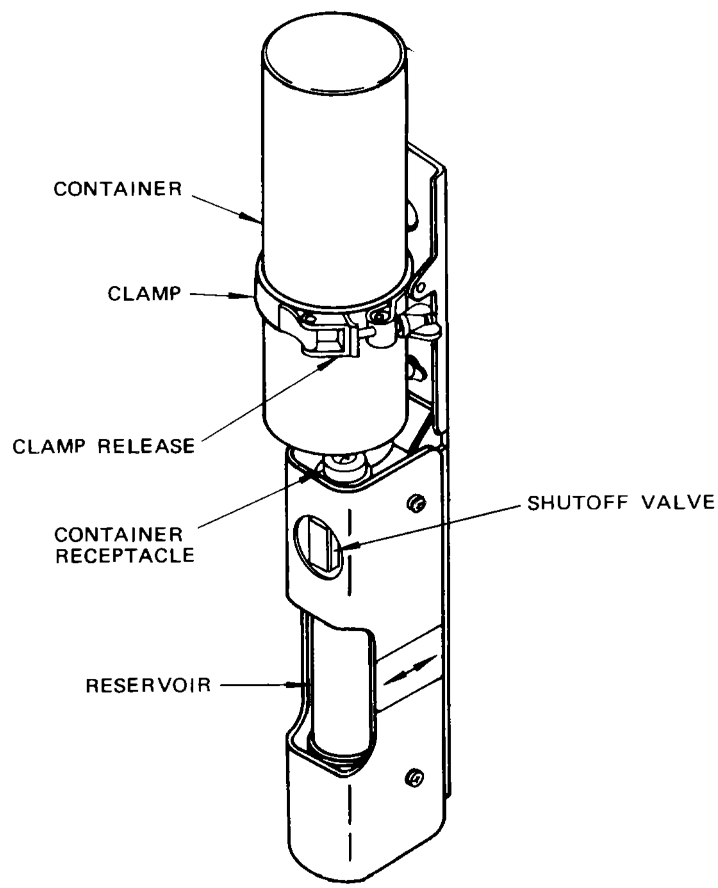
4. Cleaning Dried Rain Repellent from Windshield

A. If rain repellent is inadvertently applied to a dry windshield and not washed off, it will dry to a hard film. To remove the hard film, use a mild detergent and a foam-filled nylon scrubber or its equivalent with a damp cloth and water, or an Ardrox 275-G cleaning pad (Ref 20-30-51).

B. In cases of heavy concentration of dried rain repellent on windshield, use rain repellent as a solvent with a damp cloth and water. Then rinse with clear water. Rain repellent may be applied from rain repellent system.

C. Wash any remaining repellent from the airplane structure.





Rain Repellent Container Installation
Figure 201

RAIN REPELLENT SYSTEM - ADJUSTMENT/TEST

1. Rain Repellent System Test

A. General

(1) The following system tests are intended to functionally check the valve control circuit for continuity, the pressurized plumbing system for leakage and the time delay setting for proper flow control.

(2) Do not allow the rain repellent solution to remain in contact with the airplane structure. The area around the outside of the windshields should be wetted down with water prior to test. All repellent solution should be washed off within 2 hours after it is applied.

B. Equipment and Materials

(1) Supply of new repellent containers

(2) Source of clean water for washing repellent solution from airplane structure

C. Test Rain Repellent System

(1) Connect external electrical power and check that the left and right RAIN REPELLENT circuit breakers on the P18 circuit breaker panel are closed.

(2) Install a new container of repellent solution in the receptacle.

WARNING: DO NOT LET THE RAIN REPELLENT FLUID TOUCH YOUR SKIN OR EYES. THE FLUID CAN CAUSE IRRITATION. DO NOT BREATHE THE FUMES. IF THE FLUID TOUCHES YOU, WASH YOUR SKIN OR EYES WITH WATER.

NOTE: Tighten container finger-tight only. If connection shows evidence of leaking remove container and inspect container valve and receptacle for damage.

(3) Lower the left and right pilot instrument panels.

(4) Wet down the left windshield area with water and actuate the LEFT rain repellent control switch until solution is observed squirting from the nozzle.

(5) Check that by the third actuation the rain repellent solution is sprayed on the windshield from all holes in the nozzle head in approximately equal streams, no evidence of entrapped air is present and the time delay circuit is shutting the system off while the switch is depressed. If fluid discharge time appears inadequate or excessive, adjust the time delay circuit as follows:

NOTE: If amount of fluid released is insufficient, before attempting circuit adjustment, check that cause is not due to release of entrapped air or blocked spray holes.

(a) On airplanes with a time delay module mounted on the rain repellent solenoid valve, disconnect the time delay module from solenoid valve by backing off attachment nut.
1) Adjust time delay circuit through access hole in module.

NOTE: Adjusting for increased delay time provides increased repellent discharge volume.

2) Reconnect time delay module to solenoid valve.
(b) On airplanes without the time delay module, adjust the time delay relay mounted in the J6 Junction Box in the lower right side of the electronics compartment.
1) Adjust time delay relay to alter the amount of fluid released. Make adjustments in small increments and do not loosen locknut around adjustments screw.

NOTE: Adjusting for increased delay time provides increased repellent discharge volume. The setting scale on the time delay relay is nonlinear and should be used only as a reference point when making adjustments.

(c) Repeat steps (4) and (5).
(6) Repeat steps (4) and (5) using the RIGHT rain repellent control switch.
(7) Check all pressurized joints, connections and couplings between container receptacles and nozzles for evidence of leakage. No detectable leakage is permissible.

NOTE: The fluid in rain repellent container P/N 65-38196-5 has a citrus scent.

(8) Raise and secure pilot's instruments panels back in place.
(9) Upon completion of test and adjustments check that fluid level in reservoir is above REPLACE CAN Mark, if not, replace container.

(10) Determine whether or not there is any further need for electrical power on the airplane, if not, remove external power.
(11) Wash all remaining repellent solution from airplane structure.

RAIN REPELLENT SYSTEM - MAINTENANCE PRACTICES

1. General
   A. This procedure lists the equipment required to test and reapply the hydrophobic coating.
   B. A vendor kit is necessary to do this procedure.
2. Hydrophobic Coating Maintenance Practices
   A. General
      (1) The maintenance procedures for the hydrophobic coating are contained in the Master Kit listed below.
   B. References

      NOTE: These references are in the Master Kit.

      (1) Maintenance Assessment, Application Procedures for Boeing Aircraft Models (P/N DSS 1022)
      (2) Coating-Efficiency Assessment - video tape (P/N DSS 1023)
      (3) Reapplication and First Time Application - video tape (P/N DSS 1024)
   C. Equipment
      (1) Master Kit Complete (P/N DSS 1020)
          PPG Industries, Inc.
          Aircraft Products Sales
          P.O. Box 04004
          Huntsville, AL 35804 USA
          FAX 205-851-8822
      (2) Stand - 17 feet minimum
   D. Prepare for the Test/Reapplication

      WARNING: BEFORE YOU DO MAINTENANCE ON THE WINDSHIELD, OPEN THE WINDOW HEAT CIRCUIT BREAKERS. IF YOU DO NOT OPEN THESE CIRCUIT BREAKERS DURING MAINTENANCE, YOU CAN GET AN ELECTRICAL SHOCK WHEN YOU TOUCH THE WINDOW.

      (1) Open these circuit breakers and install DO-NOT-CLOSE tags:
          (a) P6 Panel
              1) Window Anti-Ice
   E. Procedures

      NOTE: Use the procedure in the Master Kit to do these maintenance tasks.

      (1) Cleaning Procedure
      (2) Coating Efficiency Assessment
      (3) Application

F. Return the Airplane to Its Usual Condition

(1) Remove the DO-NOT-CLOSE tags and close these circuit breakers:

(a) P6 Panel

1) Window Anti-Ice

RAIN REPELLENT SPRAY NOZZLE - REMOVAL/INSTALLATION

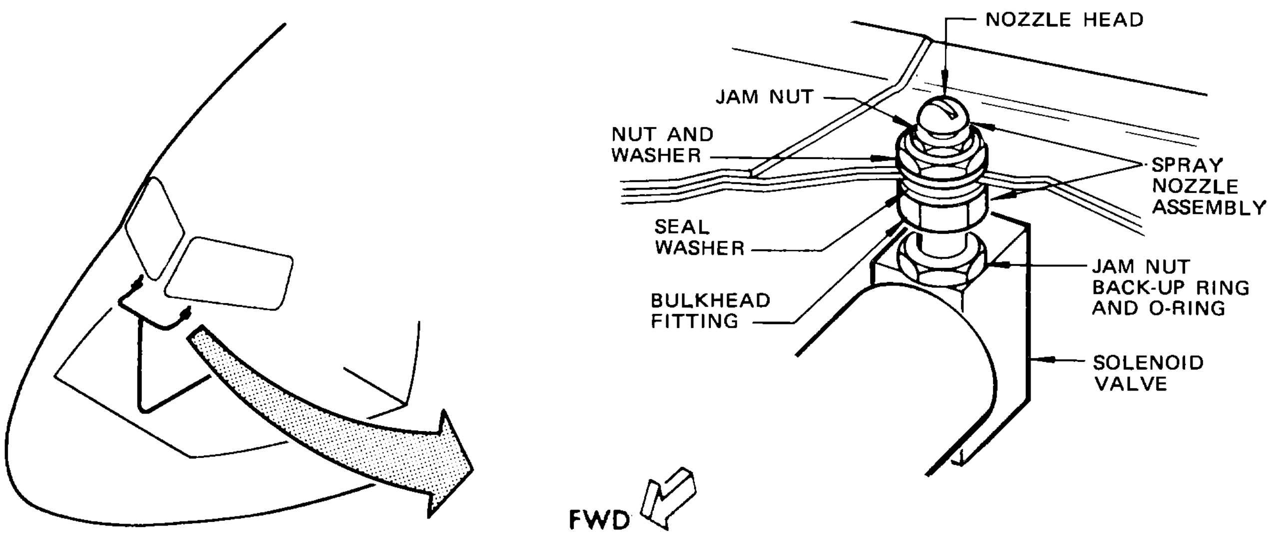
1. Equipment and Materials
   A. Primer, BMS 10-11 type 1
2. Remove Spray Nozzle
   A. Open the left and right RAIN REPELLENT circuit breakers on the P18 circuit breaker panel.
   B. Operate shutoff valve above repellent reservoir to closed position.
   C. Loosen jamnut locking nozzle head to nozzle assembly and remove nozzle head and jamnut (Fig. 401).

   WARNING: DO NOT LET THE RAIN REPELLENT FLUID TOUCH YOUR SKIN OR EYES. THE FLUID CAN CAUSE IRRITATION. DO NOT BREATHE THE FUMES. IF THE FLUID TOUCHES YOU, WASH YOUR SKIN OR EYES WITH WATER.

   D. Lower pilot instrument panel to gain access to respective nozzle plumbing.
   E. Remove nut and washer attaching bulkhead fitting to airplane structure.
   F. Loosen jamnut locking bulkhead fitting to solenoid valve and remove bulkhead fitting.
   G. Remove O-ring, backup ring, jamnut and seal washer from bulkhead fitting.
3. Install Spray Nozzle
   A. Install seal washer on upper end of bulkhead fitting and jamnut, backup ring and O-ring on lower end of bulkhead fitting.
   B. Screw bulkhead fitting into solenoid valve and tighten jamnut.
   C. Install fitting.
      (1) Insert fitting through hole in airplane structure.
      (2) Apply brush coat of primer to protruding portion of bulkhead fitting, washer, nut and exterior surface of skin to 1.00 diameter around hole before assembly, and assemble while wet. Do not allow primer to enter inside fitting.
      (3) Install washer and nut and tighten.
   D. Install jamnut on nozzle head and screw nozzle head into bulkhead fitting, align slot in head with station line with spray holes facing window, and tighten jamnut to lock nozzle head to nozzle assembly.
   E. Open shutoff valve on repellent reservoir.
   F. Close right and left RAIN REPELLENT circuit breakers on P18 circuit breaker panel.
   G. Wet down windshield and operate right or left rain repellent system and check for adequate flow from nozzles.
   H. Check for any evidence of leaking around nozzle assembly.

   NOTE: The fluid in rain repellent container P/N 65-38196-5 has a citrus scent.

   I. Close pilot's instrument panel.



Rain Repellent Spray Nozzle Installation
Figure 401

NOZZLE - CLEANING/PAINTING

1. General
   A. The following cleaning procedure applies to the spray nozzles for the windshield washer system and the rain repellent system mounted at the base of the windshields.
2. Cleaning
   A. Remove nozzle (Ref 30-43-11, R/I).
   B. Clean nozzle spray openings with 0.032-inch diameter wire.
   C. Blow out all debris with compressed air.
   D. Install nozzle (Ref 30-43-11, R/I).
   E. Test rain repellent system (Ref 30-43-0, A/T).

RAIN REPELLENT SOLENOID VALVE - REMOVAL/INSTALLATION

1. Remove Solenoid Valve
   A. Remove respective spray nozzle (Ref 30-43-11, Removal/Installation).
   B. Open REPELLENT circuit breakers on the P18 circuit breaker panel.
   C. Disconnect electrical connector of time delay module, if installed, from solenoid receptacle (Fig. 401).
   D. Disconnect repellent supply line from valve coupling.

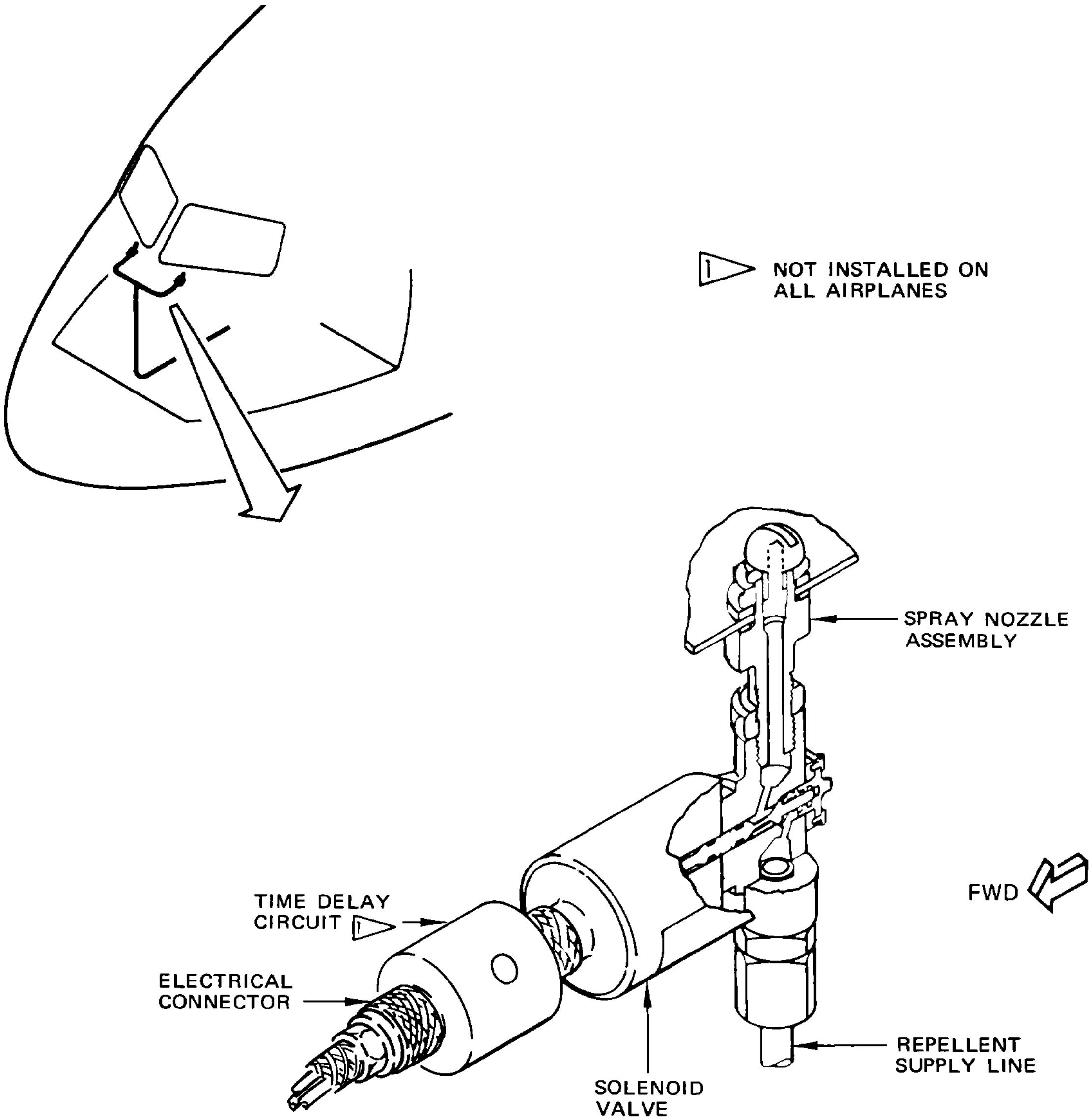
   WARNING: DO NOT LET THE RAIN REPELLENT FLUID TOUCH YOUR SKIN OR EYES. THE FLUID CAN CAUSE IRRITATION. DO NOT BREATHE THE FUMES. IF THE FLUID TOUCHES YOU, WASH YOUR SKIN OR EYES WITH WATER.

   CAUTION: DO NOT DISTURB OR ATTEMPT TO REMOVE SOLENOID VALVE IF SYSTEM IS PRESSURIZED AS FLUID MAY BE SPRAYED OVER ADJACENT STRUCTURE OR PERSONNEL.

   E. Remove valve and remove coupling and O-ring from valve.
2. Install Solenoid Valve (Fig. 401)
   A. Install O-ring and coupling on lower end of valve (inlet port).
   B. Position valve above repellent supply line with solenoid on forward side and flow direction arrow pointing up.

   NOTE: The rain repellent solenoid must not touch the wiper motor.

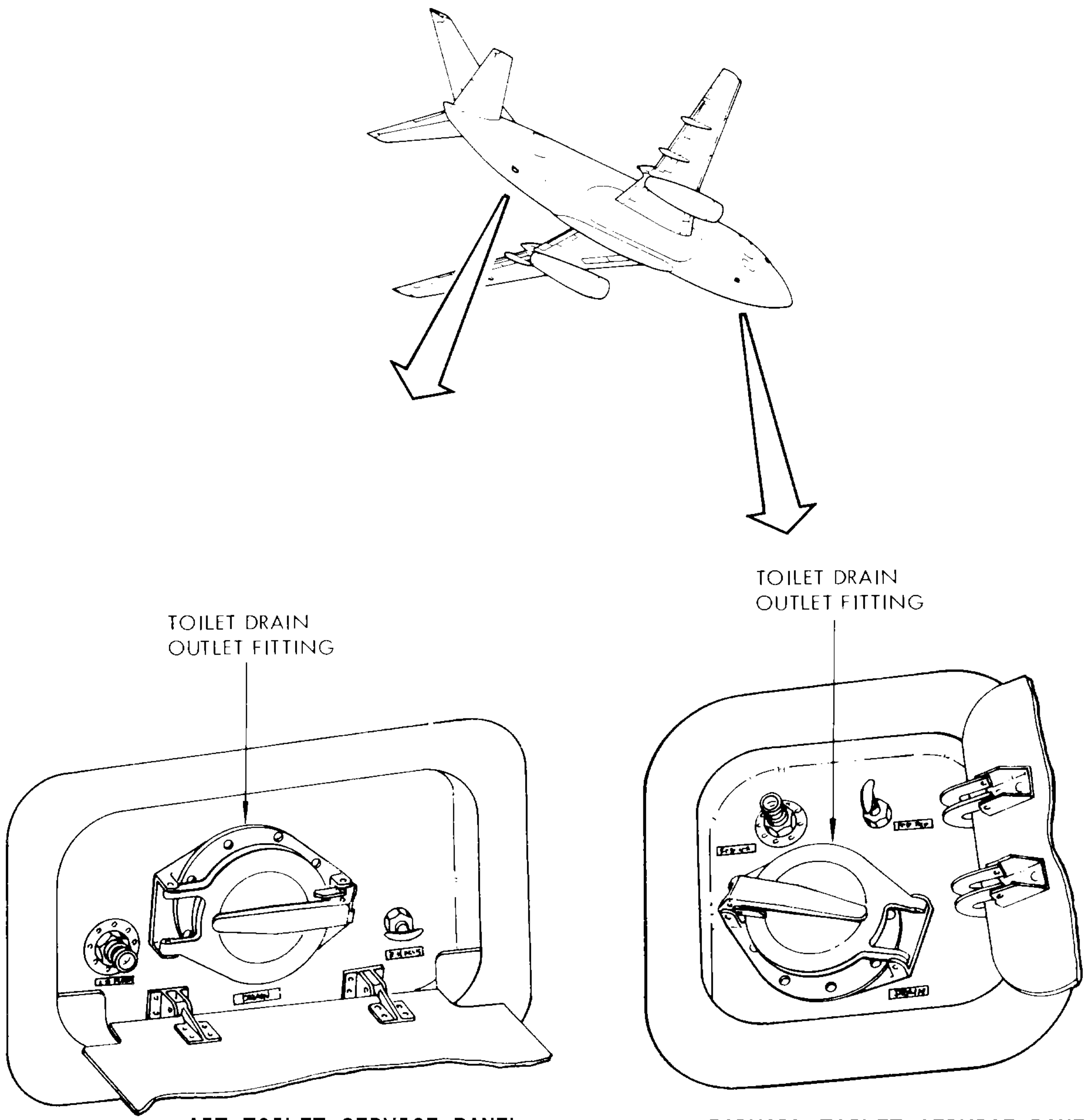
   C. Connect repellent supply line to solenoid valve, and electrical connector or time delay module, if installed, solenoid receptacle.
   D. Connect electrical connector to solenoid valve or time delay module, if installed.
   E. Close circuit breakers opened in step 1.B.
   F. Install respective spray nozzle and test system (Ref 30-43-11 R/I).



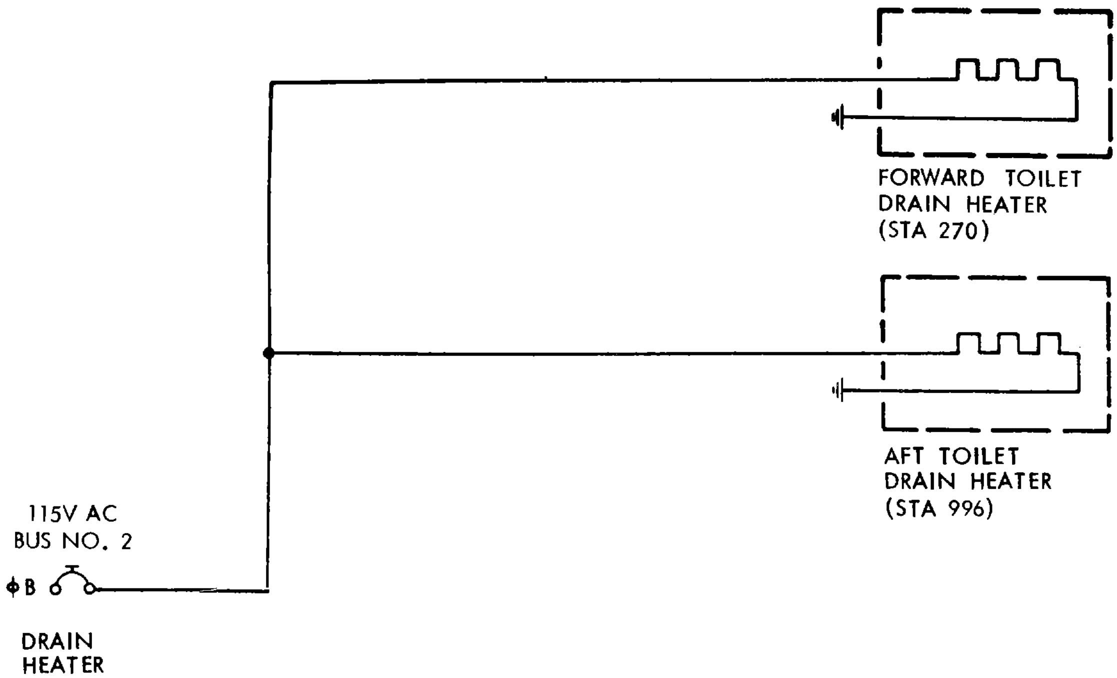
Rain Repellent System Solenoid Valve Installation
Figure 401

WATER AND TOILET DRAIN ANTI-ICING SYSTEM - DESCRIPTION AND OPERATION

1. General
   A. The fore and aft toilet drains are electrically heated to stop ice from forming in the drain connection and preventing removal of the drain cap or obstructing the toilet drain. (See figure 1.) The heating element is an integral part of the drain connector fitting gasket, and operates on 115 volt ac current. The heaters are controlled directly by the DRAIN HEATER circuit breaker on the P18 load control center. (See figure 2.)



Water and Toilet Drain Anti-Icing System Equipment Location
Figure 1



Toilet Drain Anti-Icing System Circuit
Figure 2

WATER AND TOILET DRAIN ANTI-ICING SYSTEM - ADJUMENT/TEST

1. Toilet Drain Anti-Icing System Test
   A. General
      (1) The following test gives the procedure for testing the toilet drain heaters.
   B. Test Toilet Drain Heaters
      (1) Check that DRAIN HEATER circuit breaker on P18 panel is open.
      (2) Provide electrical power.
      (3) Close DRAIN HEATER circuit breaker on P18 panel and check by hand that toilet drain fitting and cap are being heated.
      (4) Open DRAIN HEATER circuit breaker.
      (5) If no longer required, remove electrical power from airplane.

RIBBON HEATERS - REMOVAL/INSTALLATION

1. General
   A. Ribbon heater tapes are used to prevent ice formation on some potable water supply lines and drain lines. The heaters are wrapped around and secured to the lines with flame-resistant adhesive tape.
2. Equipment and Materials
   A. Flame-resistant adhesive tape (Ref 20-30-51)
   B. Tape, Hook/Loop Fastener (use one of these tapes):
      (1) G02360 BMS8-285, Type IV
      (2) G50333 BMS8-372, Type I
3. Remove Ribbon Heater
   A. Open DRAIN HEATERS circuit breakers on applicable circuit breaker panel.
   B. Gain access to defective heater.
   C. Cut heater electrical leads.

      NOTE: Leave cut electrical leads in place as guide in locating splice. Remove when splicing new leads.

   D. Remove adhesive tape from heater and remove heater from line.

      NOTE: Observe adhesive tape locations and record. Apply adhesive tape to new heater at some locations as old heater.

4. Install Ribbon Heater
   A. Position heater on water line and secure with flame-resistant adhesive tape in same locations as old heater.

      WARNING: DO NOT OVERLAP RIBBON HEATERS. DO NOT INSTALL CLAMPS OVER RIBBON HEATERS. DO NOT INSTALL INSULATION BLANKETS OVER RIBBON HEATERS. PROVIDE 1.0-INCH MINIMUM CLEARANCE BETWEEN RIBBON HEATERS AND INSULATION. RESTAIN RIBBON HEATERS WITH FLAME-RESISTANT TAPE. RESTRAIN ELECTRICAL LEADS WITH STRAP. INCORRECT INSTALLATION OF RIBBON HEATERS CAN RESULT IN EXCESSIVE HEAT BUILDUP AND DAMAGE TO HEATER.

      NOTE: Excess heater length may be absorbed by increasing turns or wraps as long as heaters do not overlap.

   B. Locate splice area and splice electrical leads.

WARNING: DO NOT INSTALL INSULATION BLANKETS OVER RIBBON HEATERS. PROVIDE 1.0-INCH MINIMUM CLEARANCE BETWEEN RIBBON HEATERS AND INSULATION.

C. AIRPLANES WITHOUT ADVANCED INSULATION;
If applicable, install the insulation on the water lines with the hook/loop fastening tape, G02360, or tape, G50333.

D. AIRPLANES WITH ADVANCED INSULATION;
If applicable, install the insulation on the water lines with the hook/loop fastening tape, G50333.

E. Test heater.
   (1) Close DRAIN HEATERS circuit breakers on applicable circuit breaker panel.
   (2) Provide electrical power.
   (3) Confirm that heater warms up.

   NOTE: Heaters will not warm up if ambient or water line temperature at thermostat is above approximately 45°F (7.2°C).

   (4) Remove electrical power if no longer required.

F. Reinstall panels or close access doors as applicable.