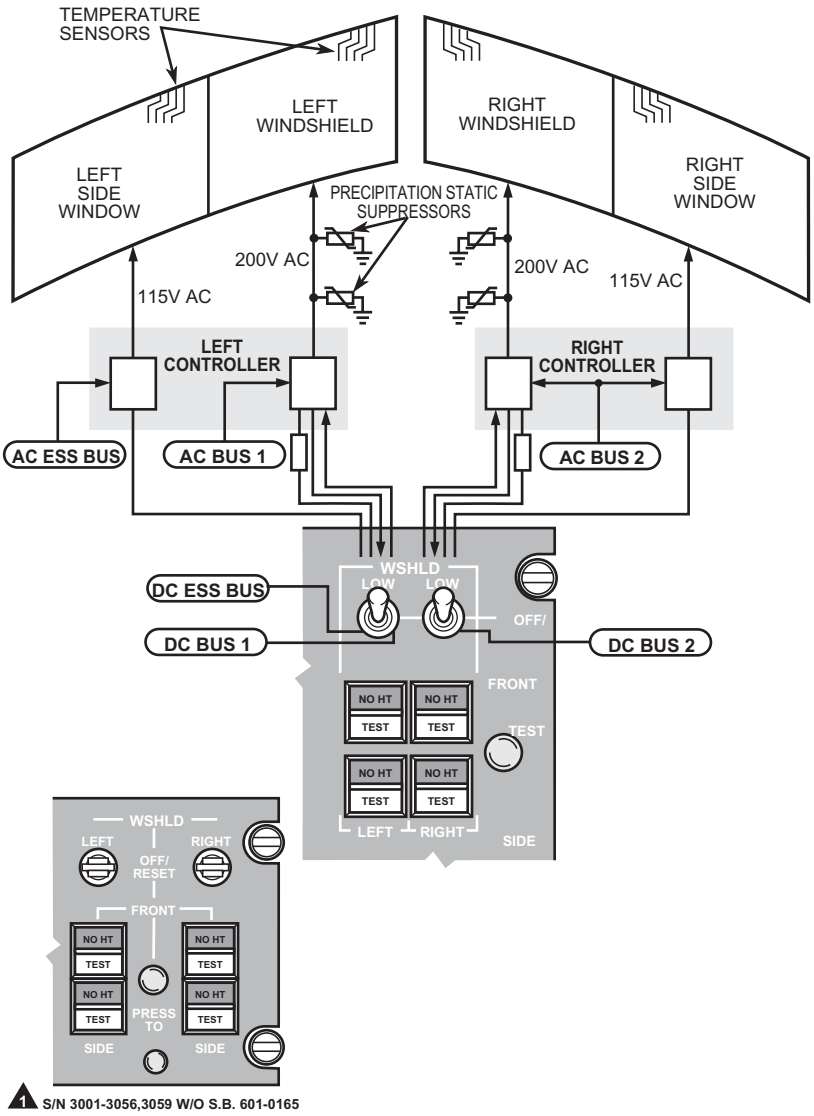
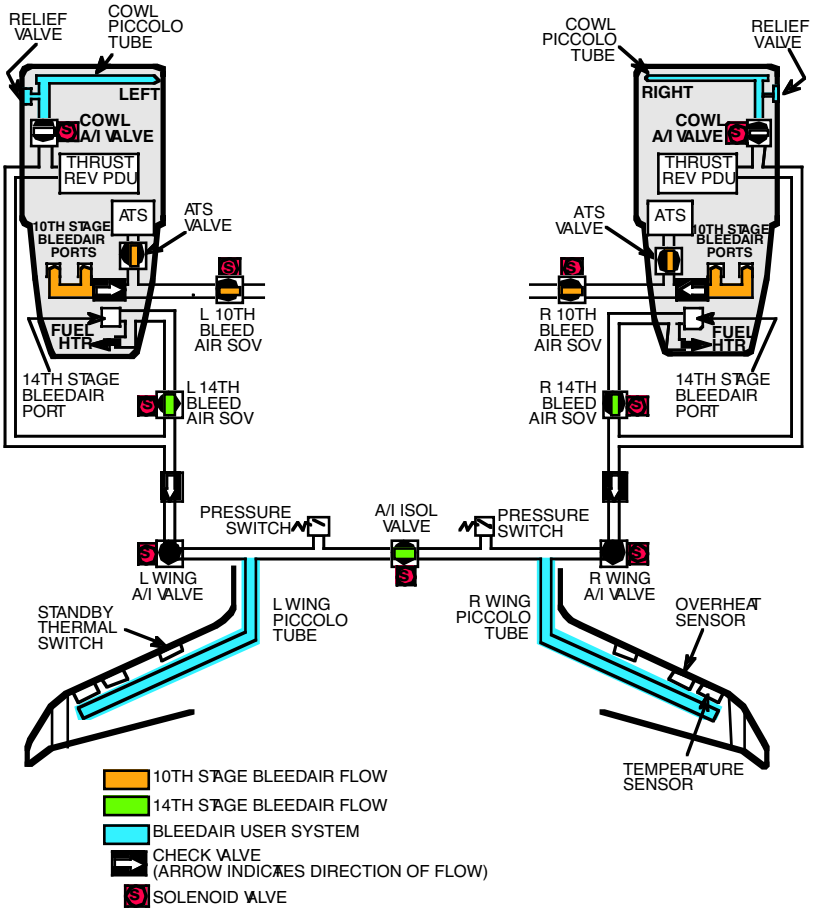
Windshield Heating



1 S/N 3001-3056,3059 W/O S.B. 601-0165

Engine and Wing Anti-Icing System



Ice and Rain Protection

Ice and rain protection systems use engine bleed air or electrical heating elements to prevent the formation of ice on the airfoil leading edges, engine inlet, pitot/static probes, and windshields.

Ice Detection

Ice detector probes, on either side of the fuselage, vibrate at approximately 40,000 Hertz (Hz). As ice accumulates on an ice detector probe, the increase in mass decreases the vibration frequency of the probe. When sufficient ice accumulates on the probe, the probe's microcomputer flashes the appropriate red (amber on Canadian) ICE light. The crew must then select wing and cowl anti-icing. After turning the wing and cowl anti-icing systems on, the red ICE light extinguishes and the white ICE light illuminates. When the heated ice detector probe remains clear of ice for 60 seconds, the white ICE light extinguishes to indicate the aircraft is clear of icing conditions.

If a probe heater or microcomputer fails, the respective FAIL light illuminates.

Wing

With the engine's 14th stage shutoff valve open and the wing anti-icing modulating/shutoff valves open, bleed air enters the wing anti-icing system.

Placing the WING switch in the NORMAL position allows the anti-icing controller to open the wing anti-icing modulating/shutoff valve. Bleed air then flows through the open valve and into the wing leading edge piccolo tubes. As bleed air pressure in the line reaches approximately 10 PSI, the pressure switch extinguishes the corresponding wing FAIL light. The air exhausts overboard after warming the leading edge.

During normal operation, the anti-icing controller senses leading edge temperature through its sensor. The controller regulates temperature to 87.7 ±7°C by increasing or decreasing bleed air flow through the wing anti-icing modulating/shutoff valve. As the temperature reaches 29.4°C, the corresponding HEAT light illuminates.

Placing the WING switch in the STANDBY position bypasses the anti-icing controller and directly opens the wing anti-icing modulating/shutoff valve. As leading edge temperature reaches 82.2 ±4.5°C, the standby thermal switch opens, the modulating/shutoff valve closes, and bleed air flow to the leading edge stops. When temperature drops to 48.8 ±4.5°C, the thermal switch closes and the modulating/shutoff valve opens. This sequence of valve opening and closing continues as the leading edge warms, then cools.

Pressing the OVHT/ISOL OPEN switchlight opens an isolation valve to allow one engine to supply 14th stage bleed air to both wing's anti-icing systems. With the isolation valve open, the ISOL OPEN caption illuminates.

If leading edge temperature reaches 129.4 ±4.5°C, the overheat sensor closes to illuminate the OVHT light and flash the WING ANTI ICE OVHT light.

During thrust reverser operation, the wing anti-icing nacelle pressure regulator shutoff valves close to provide dedicated bleed air flow to the thrust reverser system.

Cowl

With the engine's 14th stage shutoff valve open, hot bleed air flows to the cowl anti-icing pressure regulating shutoff valve. Pressing the associated COWL anti-ice switchlight illuminates the ON light and energizes the pressure regulating shutoff valve solenoid. The valve opens and, as bleed air pressure exceeds 9 ±1 PSI, a pressure switch extinguishes the cowl FAIL light.

Operation of the pressure regulating shutoff valve governs bleed air pressure to 50 ±5 PSI. If the pressure regulating shutoff valve malfunctions and bleed air pressure exceeds 134 PSI, a pressure relief valve opens to vent bleed air pressure overboard.

After flowing through the valve and ejector, bleed air enters the inlet piccolo tube. After warming the inlet, bleed air exhausts overboard.

Bleed Air Leak Detect

If a leak develops in the bleed air ducting and temperature exceeds trigger values, the thermal switches close to energize the detection control unit relay. The appropriate DUCT FAIL light illuminates and the associated bleed air leak indicator, located on the bulkhead behind the copilot, changes to white.

Pitot/Static

With the ADS HEATER CONT. selector in any position other than OFF, 115V AC supplies the various pitot/static heating elements (**see Table 4-K**). If a pitot/static probe heating element fails, the respective PITOT HEAT light illuminates and the light illuminates. The PITOT HEAT light is not resettable.

Heating Element	Power Source	Fault Indication
Left AOA Transducer	AC Essential	HTR FAIL
Right AOA Transducer	AC Bus 2	HTR FAIL
Left pitot probe	AC Essential	PITOT HEAT
Right Pitot Probe	AC Bus 2	PITOT HEAT
TAT Probe	AC Bus 2	HTR FAIL
Left Static Port	AC Bus 1	HTR FAIL
Right Static Ports	AC Bus 2	HTR FAIL

Table 4-K; Pitot/Static Anti-Icing

If a failure occurs in an AOA transducer, static port, or TAT probe heating element, the HTR FAIL switchlight illuminates. After identifying the failed system by rotating the ADS HEATER CONT. knob through the various positions and noting the failed heating element through the % HTR CURRENT meter, pressing the HTR FAIL switchlight resets the warning system. With the ADS HEATER CONT. selector in OFF or with any of the above described failures, the 10-channel ANTI-ICE annunciator and the MASTER CAUTION lights illuminate.

Placing the ADS HEATER CONT. selector in the OFF position cuts power to the heating elements and illuminates the PITOT HEAT and HTR FAIL lights. The % HTR CURRENT indicates in the red zone to show no current drain by the heating elements.

Windshield

On S/Ns 3001 to 3056 and 3059 without SB 601-0165, placing both WINDSHIELD switches in the ON position activates the windshield heat systems (see **Table 4-L**). The temperature controllers then regulate windshield and window temperature to approximately 58°C (137°F) and 41°C (105°F) respectively.

Pressing the TEST button with the WINDSHIELD switches ON, tests all four windshield heating system circuits (two per controller). During the system test, the TEST lights illuminate to indicate power to the windshield and window heating circuits.

On S/Ns 3001 to 3056 and 3059 with SB 601-0165, 3057, 3060 to 3066, and 5001 and subsequent, placing both WSHLD switches in the HIGH position regulates windshield and window temperature to approximately 55.6°C (132°F) and 36.7°C (98°F) respectively. With the switches in LOW, the system regulates both the windshield and window temperature to approximately 36.7 °C (98°F).

On all aircraft: If a failure occurs in the windshield heat system, the associated NO HT light, the ANTI-ICE light on the 10 chanel annunciator panel, and the MASTER CAUTION lights illuminate. The temperature control units illuminate the associated NO HT light if any of the following occurs:

- open circuit sensor
- overtemperature condition
- shorted temperature sensor
- halfwave output or no current flow
- loss of AC or DC power
- halfwave input or full output
- AC overvoltage.

Window	Power Source	Control Power
Left Windshield	AC Bus 1 – 200V	DC Bus 1
Left Window	AC Essential – 115V	DC Essential
Right Windshield	AC Bus 2 – 200V	DC Bus 2
Right Window	AC Bus 2 – 115V	DC Bus 2

Table 4-L; Windshield Anti-Icing Power Sources

Window Demisting

On S/Ns 3001 to 3066 and 5001 to 5134, hot air flows from the bleed air manifold through a pressure regulator and shutoff valve to a heat exchanger where the air cools to approximately 66 to 77°C (150 to 170°F). To select windshield demisting or footwarmer, the cockpit heat switch must be selected to NORM, which extracts air through the right footwarmer SOV from the bleed air manifold. Selection of STBY extracts bleed air from the left footwarmer SOV which extracts bleed outside of the left bleed air SOV. Pulling the DEMIST knob out directs this air from the diverter valve assembly to the windshields for demisting.

On S/N 5135 and subsequent, conditioned air from the air conditioning system flows to a diverter valve assembly. Pulling the DEMIST knob out directs this air against the inside of the windshields.

On S/Ns 5135 to 5141 and 5143 to 5159 with SB 601-419; 5160 and subsequent, a fan and heater provide warm air through a three-way diverter valve for windshield demisting. Adjusting the DEMIST and FOOTWARMER varies the amount of warm air provided for windshield demisting and cockpit heating.

Wing Anti-Ice

Power Source	14th stage engine bleed air Essential DC bus DC Bus 1 and DC Bus 2
Distribution	Wing leading edges
Control	WING switchlights OVHT/ISOL OPEN switchlight Anti-icing controllers Wing anti-icing modulating/shutoff valves
Monitor	L/R HEAT lights (29°C) L/R FAIL lights DUCT FAIL light (bleed air leak detect) SENSOR FAIL light WING ANTI ICE OVHT light (129°C)
Protection	Wing overheat sensors Circuit breakers

Engine Anti-Ice

Power Source	14th stage engine bleed air Battery bus
Distribution	Engine inlet
Control	COWL switchlights Pressure regulating shutoff valves
Monitor	COWL ON/FAIL lights
Protection	Pressure relief valves (134 PSI) Circuit breakers

Pitot/Static

Power Source	AC Essential bus AC Bus 1 and AC Bus 2
Distribution	Pitot probes Static ports AOA transducers TAT probe
Control	ADS HEATER CONT. selector
Monitor	PITOT HEAT HTR FAIL % HTR CURRENT meter
Protection	Circuit breakers

Windshield

Power Source	AC Essential bus AC Bus 1 and AC Bus 2 Bleed air manifold (demisting)
Distribution	Windshields and windows
Control	WINDSHIELD or WSHLD switches Temperature control units
Monitor	TEST lights NO HT lights
Protection	Temperature control units Circuit breakers