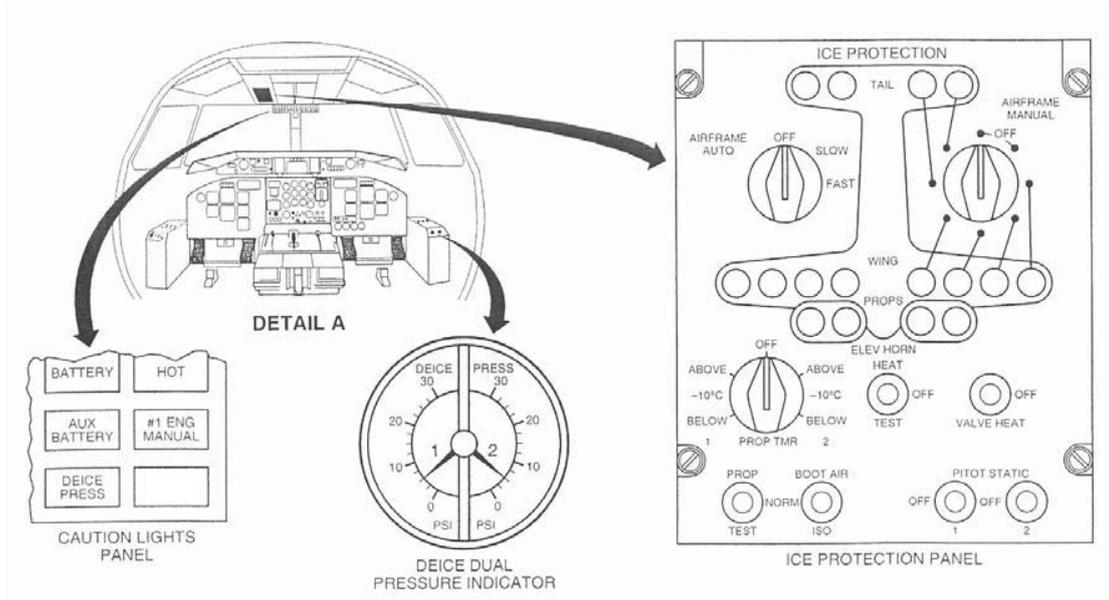
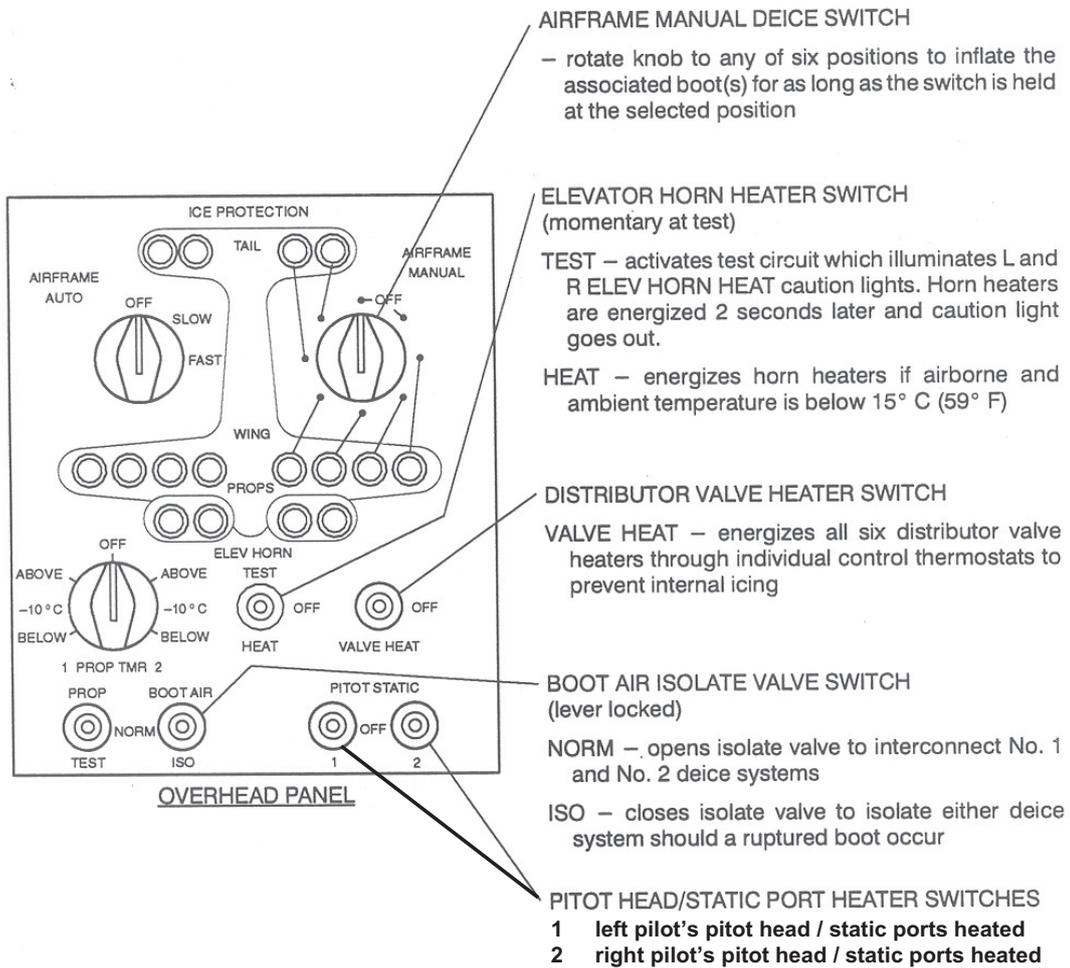


ICE AND RAIN PROTECTION

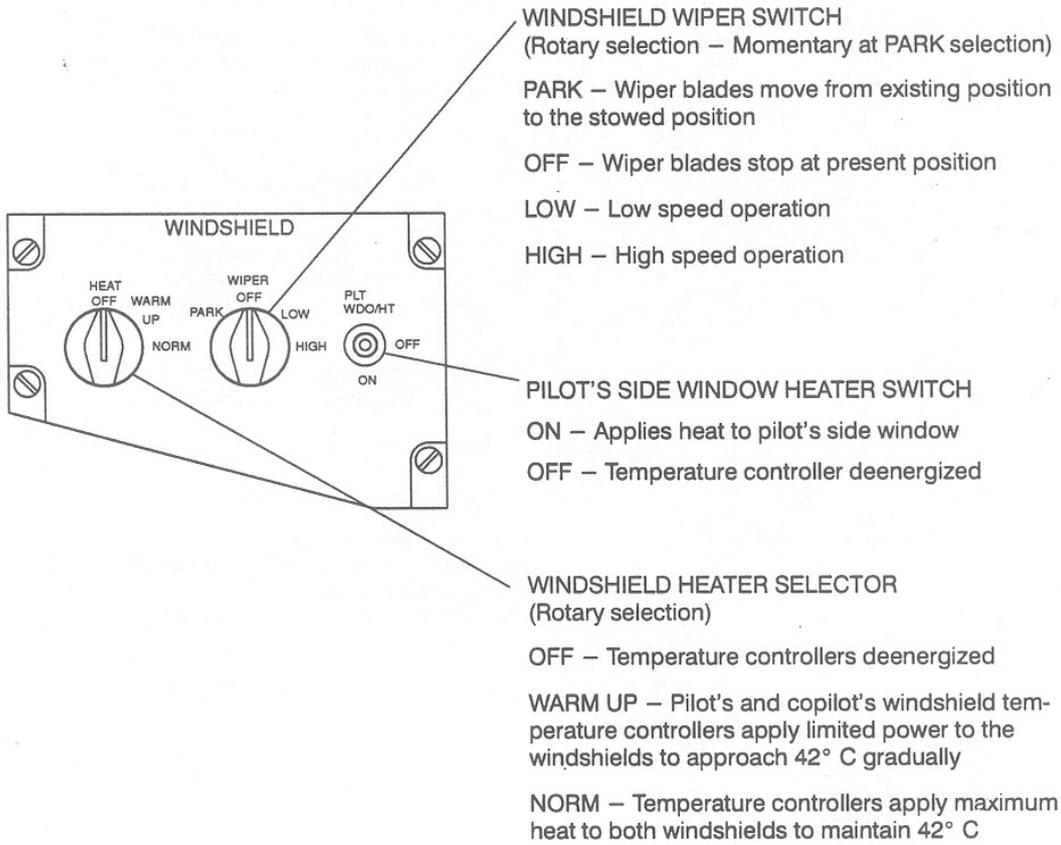
CONTROLS AND INDICATORS



Locations



Ice protection panel



Windshield heat / wiper control

SYSTEM DESCRIPTION

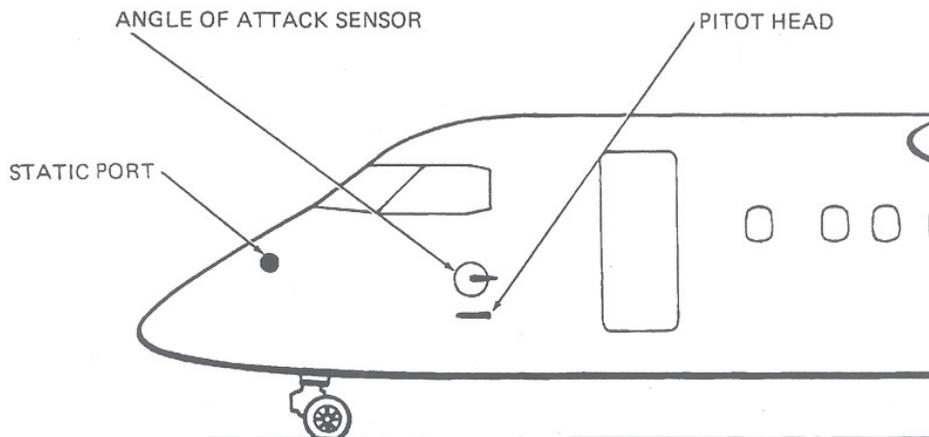
Pitot head/static port heaters

The pilots and co-pilot's pitot head and left and right static pressure ports incorporate heaters for anti-ice protection. The PITOT STATIC heater switches labelled 1 and 2 activate the heaters. If either the number 1 or number 2 pitot switches are selected OFF or a pitot heater is not receiving electrical power, the associated PITOT HEAT caution light illuminates.

Angle of attack (AOA) vane heaters

The angle of attack vanes (number 1 and number 2) are each equipped with a case and a vane heater. The heaters are powered from the 115 VAC variable frequency bus and are active as long as the bus is powered.

If power to either vane is lost, or, either vane or case heater is defective the associated STALL SYST FAIL caution light illuminates.



Pitot head, static ports and AOA vanes

Windshield heat

The left and right windshield and pilot's side window is heated to provide anti-icing and demisting.

Panel temperature is regulated by individual controllers, which maintain the temperature at approximately 42°C.

The WINDSHIELD HEAT rotary selector when selected to WARM UP or NORM heats both windshields. The PLT WDO/HT switch when selected to ON heats the left pilot's side window.

Windshield wipers

Each windshield is equipped with a wiper and controlled simultaneously from a single WIPER rotary selector on the WINDSHIELD panel, with positions PARK, OFF, LOW and HIGH. Selection from LOW or HIGH to OFF stops the blades at their existing position. When the switch is selected to, and held at the spring-loaded PARK position, the blades resume operation at low speed until they reach the bottom of their travel, where they automatically stop at the parked position.

Ice detection post

A small, round, post is vertically mounted at the top end of each windshield wiper arm. In flight the ice accumulation on the post provides an early indication of airframe icing. Illumination of each post is controlled by an individual W/S WIPER ICE DETECT LIGHT momentary switch on each pilots' side console.

Elevator horn heaters

The number 1 and number 2 elevator horn heaters prevent ice build up between the horns and tips of the horizontal stabilizer. Each elevator horn has a dual heater element built into the leading edge of the horn.

The heater system is armed when the ELEV HORN heater switch is selected to HEAT and the airplane becomes airborne. However, the heaters become active only when ambient temperature drops below 15°C.

Selecting the switch to TEST momentarily illuminates both L and R ELEV HORN HEAT caution lights. Two seconds later, the horn heaters energize and the caution lights go out to indicate the heaters are functioning.

If either horn heater fails, the associated ELEV HORN HEAT caution light illuminates. On the ground, the alternate heating element may be activated by maintenance personnel.

Propeller heaters

General

The propeller blade leading edges are protected from ice accumulation by electric heater elements moulded into each blade. Electric power to heat each blade is 115 VAC variable frequency.

Four propeller de-ice lights on the ice protection panel, monitor the sequencing and confirm blade heating. Each illuminates when the timer powers the associated blade pair. Fuselage ice protection panels, installed on both side of the fuselage adjacent to the propeller arc, prevent damage to the fuselage from ice thrown by the propeller.

To protect the propeller heaters from possible overheat, the proximity switch electronics unit (PSEU) deactivates the heaters when the airplane is on the ground through weight on wheels (WOW) switches on the main landing gear.

Operation of the propeller heaters provides a signal to the INCR REF SPEED system. Further information about this system can be found in chapter 12-18.

Propeller anti-ice test

Each blade heater may be tested on the ground by selecting the PROP anti-ice test switch to TEST while the PROP TMR switch is selected to either number 1 or number 2 timer. The propeller indicator lights illuminate in sequence as the propeller test is carried out to confirm heater/timer operation.

- CAUTION:**
- Test operation of the propeller heaters on the ground must be kept to a minimum as severe damage can result if blade heaters overheat.
 - This test is normally performed by maintenance.

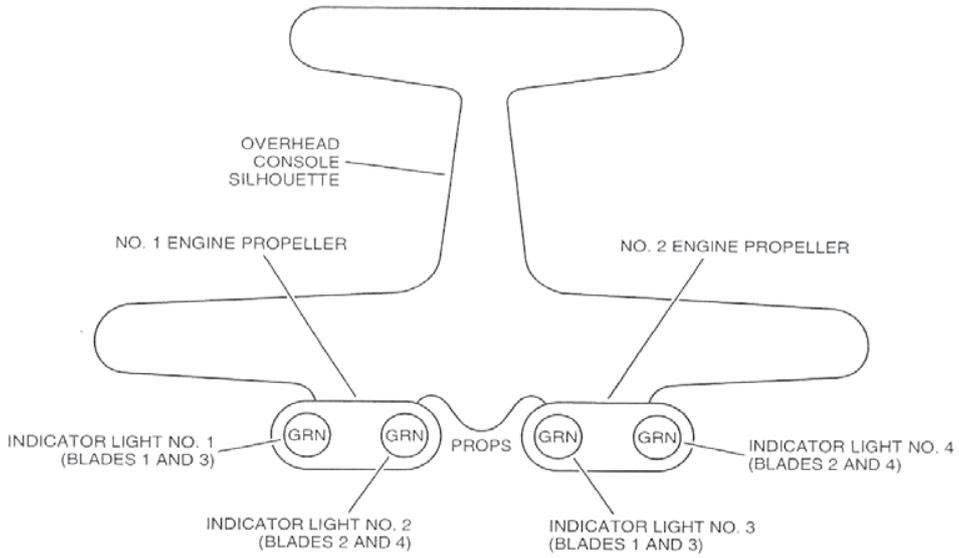
Propeller anti-ice operation

When the PROP TMR switch is appropriately selected, the timer simultaneously energizes the heaters of two blades on each propeller in a consecutive sequence.

PROP TMR 1 position should normally be selected with PROP TMR 2 as a backup.

Propeller heater operation sequence

TIMER SETTING	TIME	BLADE HEATERS	
		1 & 3 (Both propellers)	2 & 4 (Both propellers)
Below -10°C	20 seconds	ON	OFF
	20 seconds	OFF	ON
	40 seconds	OFF	OFF
Above -10°C	10 seconds	ON	OFF
	10 seconds	OFF	ON
	50 seconds	OFF	OFF



PROPELLER DEICING INDICATOR LIGHT SEQUENCE 1 3 2 4

SELECT VARIABLE FREQUENCY SWITCHES L BUS A R BUS A L BUS B R BUS B

TIMER SETTING	BLADE HEATERS ENERGIZED	BLADE SEQUENCE
BELOW - 10° C	ON 20 SECONDS, OFF 60 SECONDS	LEFT PROP 1 AND 3
ABOVE - 10° C	ON 10 SECONDS, OFF 60 SECONDS	RIGHT PROP 1 AND 3
		LEFT PROP 2 AND 4
		RIGHT PROP 2 AND 4

Engine intake heaters

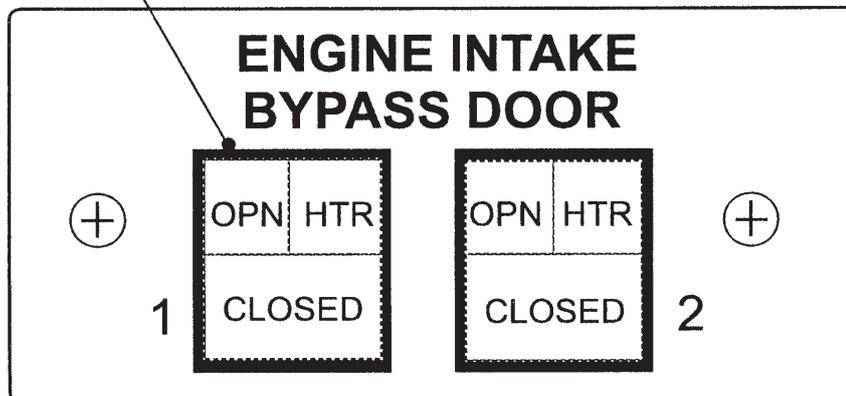
An electric heater is installed around the engine compressor intake flange (bolted to the compressor housing) in the upper surface of the intake duct of each nacelle. The heaters, powered by 115-volt variable frequency AC, are energized automatically when the engine intake bypass doors are opened. An oil pressure switch and temperature sensor in the heater control circuit, however, prevent heater activation when the engine is shutdown and/or air temperature is above 15°C. Activation of the heaters is confirmed by the illumination of HTR legends on the ENGINE INTAKE BYPASS DOOR switchlights when the doors are opened.

ENGINE INTAKE BYPASS DOOR SWITCHLIGHT (alternate action)

PUSH - CLOSED segment (green)
 - indicates door is closed and heater deactivated

PUSH - OPEN segment (amber)
 - indicates door opened and heater activation

HTR segment (amber)
 - activates with door open, and associated engine running, and SAT less than +15° C, and AC variable frequency power available



Wing and tail de-icing - General

The airplane is protected from airframe icing by a pneumatic airframe de-icing system. The airframe de-icing system uses regulated engine bleed air to inflate and deflate pneumatic rubber boots bonded to the leading edges of the wing, horizontal and vertical stabilizer, nacelle intake and wing inner root. The boots are alternately inflated and deflated by six distributor valves, which is controlled by a two-speed timer

When the boots are not inflated the boot ports are connected to a suction line by their distribution valves to keep them flush with the leading edge. Suction is generated by blowing an amount of the regulated engine bleed air through an ejector, located in the vicinity of each distributor valve. Suction ejectors and distributor valves are electrically heated to prevent internal icing.

Inflation of the individual boots is controlled automatically in a timed sequence at either of two intervals. A manual control of boot sequencing is provided as a backup.

Bleed air comes directly from the low-pressure bleed port of the engine, therefore the supply of de-icing air is unaffected if the bleed air switches are selected OFF. Normal system pressure is 18 Psi. Each engine supplies its associated de-ice system with bleed air, however the system is interconnected by an isolation valve (ISO valve). A lever locked BOOT AIR ISO valve switch on the ice protection panel controls it. The valve is normally open to ensure uninterrupted operation of either system should one engine be shut down. The BOOT AIR ISO valve switch may be selected momentarily to ISO when on the ground to check regulated pressure in each individual system.

Normal operations

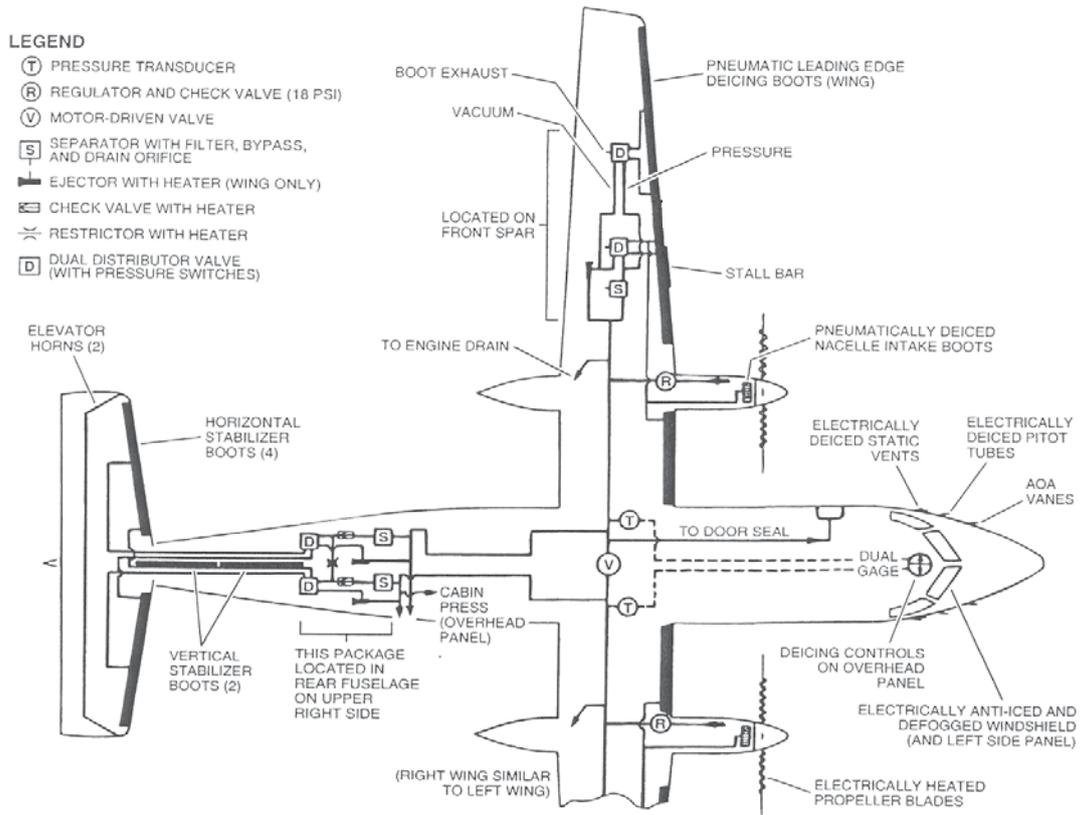
Automatic de-icer operation is controlled by the airframe auto de-icer rotary switch on the ice protection panel. When selected to SLOW or FAST, this initiates the boot inflation sequence and provides a dwell period appropriate to the selected rate. If the airframe auto de-icer switch is selected OFF in mid-cycle, the timer completes the cycle then resets before deactivating.

Boot inflation lights

Boot inflation lights on the ice protection panel monitor the sequencing and confirm de-icer boot inflation. Each light represents one or more de-icer boots relative to their position on the airplane and illuminates when the boot inflates.

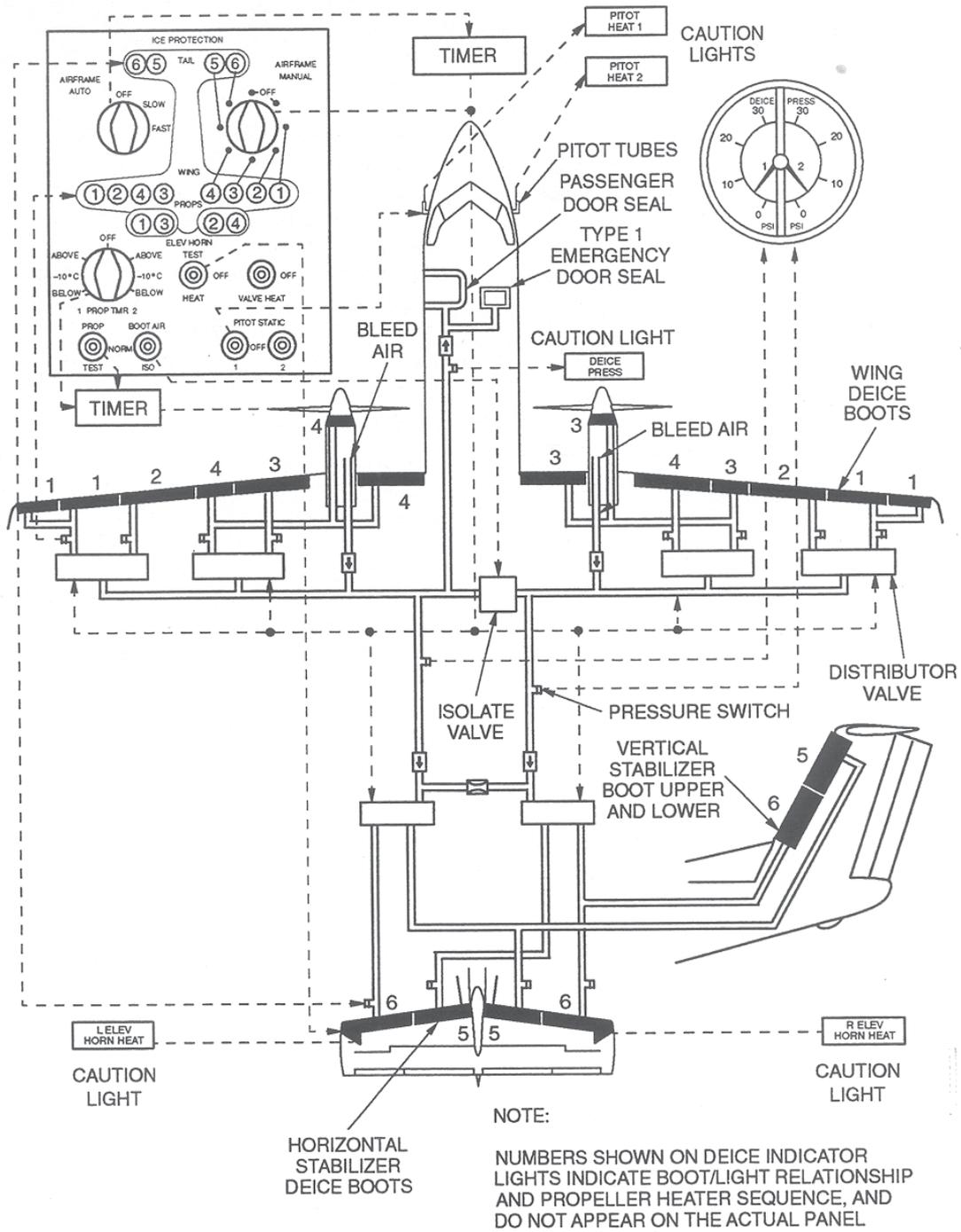
Distributor valve heaters

Certain de-icing system ejectors, water drains, check valves and a rear fuselage restrictor incorporate wrap-around heaters to prevent the formation of internal ice in these components. The heaters operated on secondary 28-volts DC and activate automatically by thermostats when ambient temperature falls below 10°C. Integral heaters are also built into the distributor assemblies, all of which are activated manually by a single distributor valve heat switch on the ice protection panel.



De-icer boot operation sequence

BOOT SEQUENCE		INFLATION TIME	DWELL TIME	
DISTRIBUTOR VALVES	BOOT LOCATION		FAST	SLOW
Wing outboard.	1. Left and right wing.	6 seconds for each combination of boots	24 seconds between end of (6) and restart of (1)	204 seconds between end of (6) and restart of (1)
Wing outboard.	2. Left and right wing.			
Wing inner.	3. Left and right wing, right wing root and right engine air intake.			
Wing inner.	4. Left and right wing, left wing root and left engine air intake.			
Horizontal and vertical stabilizer.	5. Inboard horizontal and upper vertical stabilizer.			
Horizontal and vertical stabilizer.	6. Outboard horizontal and lower vertical stabilizer.			



Airframe de-icing schematic

NON-NORMAL INDICATIONS AND OPERATION

Windshield

Loss of electrical power or excessive heat to either windshield panel, or pilot's side window will illuminate the associated L WSHLD HOT, R WSHLD HOT or SIDE WDO HOT caution light. The affected system caution light remains illuminated until the temperature drops below the caution threshold. The windshield system must be reset by briefly selecting the WINDSHIELD HEAT switch to WARM UP then to NORM. The pilot's side window will reset automatically with the switch selected to ON.

De-ice pressure

If a loss of bleed air within the de-ice system causes the de-ice pressure to fall below 5.5 Psi, the DEICE PRESS caution light illuminates.

Wing and tail de-icing

If a malfunction occurs to the automatic timer, the boots can be cycled manually with the airframe manual de-ice switch on the ice protection panel. Rotate the switch clockwise through each of the six-detent positions to duplicate the automatic inflation sequence. Each set of boots (wing and tail) will inflate as long as the switch is left at a given position. The associated indicator lights illuminating indicate full inflation.

NOTE: Each selection should be held until the corresponding pair of lights illuminate before moving to the next position.

If a rupture occurs to the pneumatic lines of the number 1 or number 2 de-ice system, the affected side will have to be isolated from the functioning side to prevent further loss of de-ice pressure.

To isolate the systems, select the BOOT AIR ISO valve switch to ISO. This closes the isolation valve thereby isolating the affected system and maintaining de-ice pressure in the functioning system.

WARNING: With no de-ice pressure to one wing following a rupture and subsequent ISO selection with the boot air switch, the system must not be operated in AUTO or the wings will be de-iced asymmetrically. To minimize lateral control problems while keeping the unaffected engine intake and the tail clear of ice, the system must be operated in MANUAL, with selections limited to the engine intakes and the tail boots.

Caution lights

PITOT HEAT 1	PITOT HEAT 2	Associated pitot head heater failed or is not selected ON, with DC electrical system energized.
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Applicable ECL PITOT HEAT 1 or PITOT HEAT 2 FAILURE.

Remarks

DEICE PRESS	Pneumatic pressure within the de-ice system is below 5.5 Psi.
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Applicable ECL DE-ICE PRESSURE LOW.

Remarks Pressure is sensed at passenger door seal supply line.

L WSHLD HOT	R WSHLD HOT	Associated windshield overheated. Normal temperature sensor or normal temperature control circuits in L or R window controller inoperative.
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Applicable ECL L WSHLD HOT or R WSHLD HOT.

Remarks Electrical power to the affected panel is automatically de-energized.
If necessary, windshield may be selected to NORMAL for short intervals to maintain clear vision or applicable windshield circuit breaker could be pulled to de-energize the affected windshield and allow normal operation of non-affected windshield.
Caution light goes out as windshield cools.

SIDE WDO HOT	Side window overheated. Normal temperature sensor or normal temperature control circuits in side window controller inoperative.
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Applicable ECL SIDE WINDOW HOT.

Remarks Caution light goes out as windshield cools.
If necessary, windshield may be selected to ON if caution light goes out.

L ELEV HORN HEAT	R ELEV HORN HEAT	Elevator horn heat element(s) failed, are not powered or the test circuit is activated.
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Applicable ECL L ELEV HORN HEAT or R ELEV HORN HEAT FAILURE.

Remarks Light goes out when system is restored or test is completed.