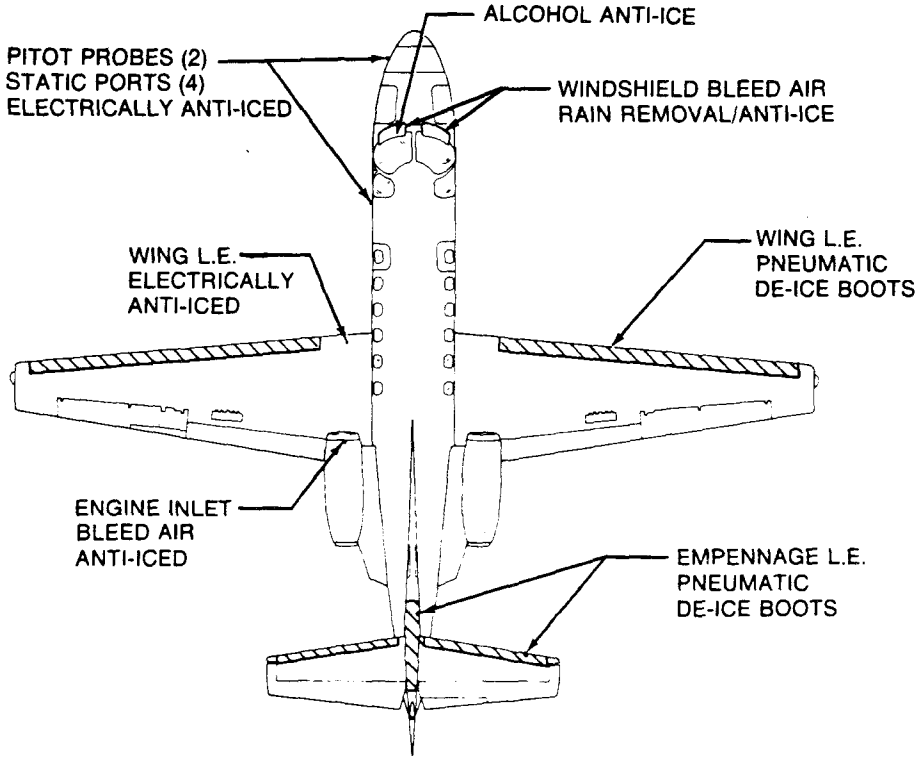
ICE AND RAIN PROTECTION

The anti-ice systems are designed to prevent ice formation on the pitot tubes, static ports, windshields, angle-of-attack probe (if installed) and protect against engine ice damage. The various anti-icing functions use electrical power or engine bleed air and are actuated by switches on the left switch panel and control knobs on the copilot's panel. Anti-ice systems should be turned on when operating in visible moisture with an indicated OAT between +4°C and -30°C.



The airframe deice system provides for removal of ice formed on the leading edge of the wing (outboard of the heated area) and tail aerodynamic surfaces by pneumatically expanded boots.

Pitot-Static Anti-Ice

Electric elements heat the pilot's and copilot's pitot tubes, the static ports and angle-of-attack probe (if installed). The PITOT & STATIC anti-ice switch on the lower left panel controls these elements. An annunciator light will come on when power is removed from the heaters or when a heater fails.

Engine Anti-Ice

Electrical elements and bleed air provide engine ice protection. Any time an engine is operating, hot air flows continually to the nose cone and temperature probe forward of the fan in the engine inlet. Turning on an ENGINE ANTI-ICE switch (LH or RH) with sufficient engine RPM will open valves that route bleed air to the engine cowl leading edge and stator vanes just aft of the fan. Approximately 60% N_2 is required to open and keep these valves open.

ICE AND RAIN PROTECTION

Selecting ENGINE ANTI-ICE also electrically heats a 61-inch section of the inboard wing in front of the engine, and initiates continuous ignition. Operation of the inboard leading edge and auto-ignition is dependent only on a source of electrical power and not engine RPM.

Each inboard wing section incorporates five heating elements and a thermal control switch. With engine anti-ice selected, each side will draw approximately 150 amps of electrical power. The control switch then causes the elements to cycle off and on to maintain a temperature between 54°C and 78°C.

Cockpit indications of system function are obtained from the RPM, ITT and AMPS gauges and the amber L and R ENG ICE FAIL annunciator panel lights. Opening of the stator and inlet cowl valves will be shown by an ITT rise and RPM decrease indicating bleed air extraction is taking place. Electrical power to the inboard wing leading edges will cause an increase in generator load on the ammeters.

With the respective switch on, an ENG ICE FAIL light will illuminate for any one of the following conditions:

1. Either the cowl or stator valve fails to open. (A five-second delay is normal from the time the switch is turned on until the valves move.)
2. Cowl leading edge temperature below 104°C.
3. Inboard wing section below 16°C.
4. Failure of one or more wing heating elements (if the system is cycling with a failed heater, the L or R ENG ICE FAIL light will illuminate each time the system cycles on).
5. Failure of the temperature controller. (If the system is cycling with a failed controller, the L or R ENG ICE FAIL light will illuminate each time the system cycles off.)

The time for the lights to extinguish after initiating operation will vary with outside air temperature and engine power setting. Normally, no more than two minutes are required at cruise or climb thrust settings. During descent into anticipated icing conditions, due to the normally associated low power settings, it is advisable to turn on the system well before entering the visible moisture environment. Once the conditions necessary to extinguish the lights are satisfied, minimum power will sustain operation.

Engine anti-ice is, as the name implies, designed as a preventative system. Its use should be anticipated and the system actuated any time flight in visible moisture with indicated OAT from +4°C to -30°C is imminent. Failure to turn on the system before ice accumulation has begun may result in engine damage due to ice ingestion. For sustained ground operation in visible moisture at +4°C to -30°C, the system should be turned on one minute out of four with N_2 set above 65%.

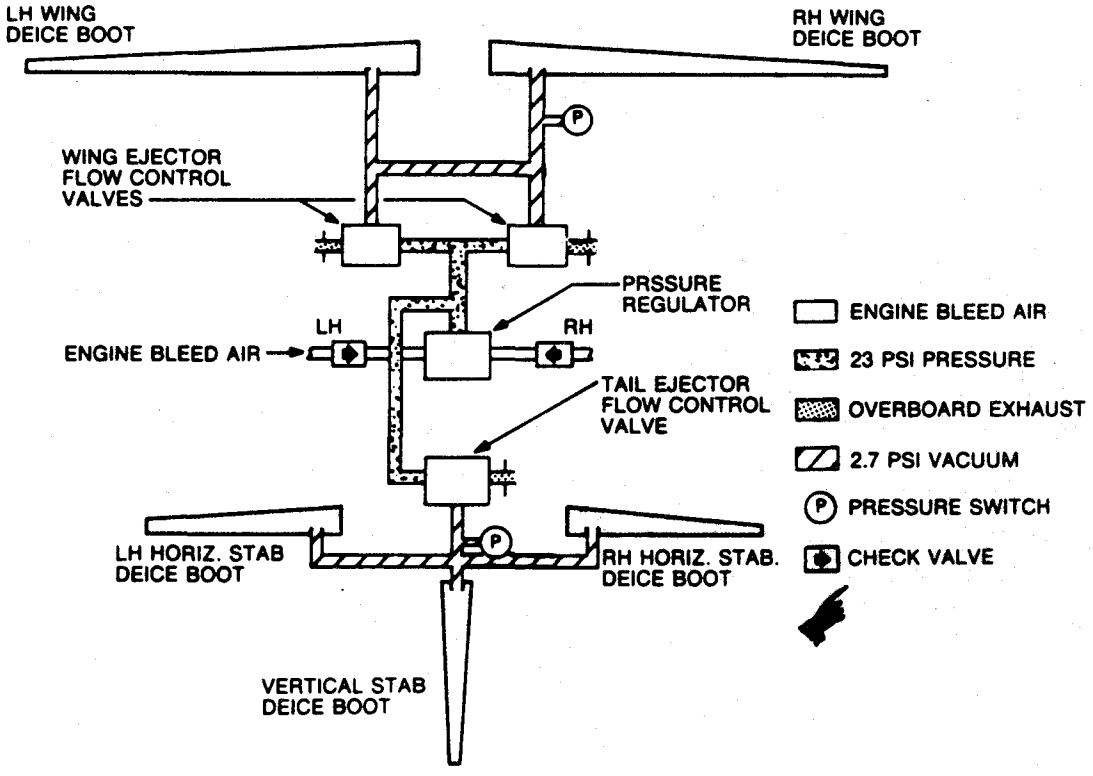
Because of engine bleed air extraction with system operation, maximum allowable power settings are reduced as shown in Section IV of the Airplane Flight Manual.

Airframe Deice

The airframe deice boots are controlled by a three-position SURFACE DEICE switch which is spring-loaded to OFF and provides two six-second cycles following momentary actuation. Boot cycling is controlled by three control valves. On the first six-second cycle, one valve opens to inflate the boots on the empennage. Two control valves actuate on the second cycle to direct air to both wings. The time circuit will elapse twelve seconds after initiation and deenergize the control valves. The boots deflate by bleeding the air back through the control valve and dumping it overboard. The boots are held deflated by vacuum.

In the event the boots remain inflated or it is desirable to stop boot inflation and terminate the cycle, place the surface deice switch to the RESET position. This overrides the timer circuit and immediately deactivates the control valves. It is not necessary to go to the reset position after every boot cycle. Returning the switch to the OFF position prepares the system for the next actuation. Satisfactory operation of the deice boot cycle is verified by illumination of the surface deice annunciator light and visual inspection of the wing leading edges. Illumination of the surface deice light indicates there is bleed air pressure to the boots for inflation. The light will blink off momentarily between each cycle. Operation of the boots should be functionally checked prior to icing encounters while on the ground or in flight with the OAT above -40°C (-40°F).

Surface deice should be used when ice buildup is estimated between 1/4 and 1/2 inch thickness. Early activation of the boots may result in ice bridging on the wing. If accumulation is in excess of 1/2 inch, boot cycling may not clear it. A wing inspection light is provided to illuminate the left wing to observe ice buildup during night flight.



ICE AND RAIN PROTECTION

Windshield Anti-Ice

The windshield bleed air system provides windshield anti-ice under all normal operating conditions. This system also provides external windshield defog and rain removal. The system supplies engine bleed air through an electrically actuated pressure regulating shutoff valve in the tailcone of the airplane and manually positioned valves which regulate air to each windshield. The manual valves are located at each bleed air nozzle and are left in the OFF position for all normal operation. A check should be made to insure that the rain removal knob is pushed IN, prior to turning the windshield bleed switch on. When windshield anti-icing is required, the W/S bleed valves are turned ON and the W/S bleed switch is turned to LOW if the Indicated OAT is above -18°C or to HI if the Indicated OAT is -18°C or below. Normal system operation is indicated by an increase in air noise as the bleed air discharges from the nozzles. A temperature sensor is located near the discharge nozzles and automatically controls the windshield bleed air temperature by modulating crossflow air through a heat exchanger in the tailcone. An additional temperature sensor is located in the bleed air line, which automatically actuates the electrical shutoff valve and illuminates the windshield air overheat annunciator light should the bleed air temperature exceed the normal control value. This condition should not occur unless a sustained high power, low airspeed condition is maintained or a system malfunction occurs. If the windshield air overheat light illuminates, the manual bleed air valves should be modulated to reduce the flow. If the light remains on for over 60 seconds, position the manual valves to OFF. The windshield air overheat light will also illuminate if the electrical shutoff valve in the tailcone opens with the windshield bleed air switch in the OFF position.

In the event of a complete electrical system failure, the bleed air control valve would open and the overheat annunciator would be inoperative. If the manual bleed air valves are open, they should be closed as soon as practical, subject to icing conditions. Damage to the windshield could result from continued operation without electrical control.

Self-test of the temperature monitor system is normally accomplished during the preflight warning systems check by turning the windshield bleed air switch to either the HI or LOW position and selecting the W/S TEMP position on the rotary test switch. Proper system function is verified by illumination of the windshield air overheat annunciator light. Self-tests may also be accomplished in flight, if desired.

If the windshield bleed air anti-ice system fails, a backup alcohol anti-ice system is provided for the left windshield only. The system is controlled by a two-position W/S ALCOHOL switch which, when moved to the ON position, activates an electric pump which sprays alcohol on the pilot's windshield. Sufficient alcohol is provided for approximately ten minutes continuous operation with a fully serviced reservoir.

ICE AND RAIN PROTECTION

Rain Removal

This system utilizes the normal windshield bleed air anti-ice system for rain removal with augmenter doors to provide increased airflow over each windshield in heavy rain. These doors are manually operated by pulling the PULL RAIN handle located under the WINDSHIELD BLEED AIR knobs on the copilot's panel. For rain removal, the manual bleed air controls on the copilot's panel should be turned to the MAX position, the PULL RAIN handle pulled out and the W/S BLEED switch positioned to LOW. Augmenter door opening will be difficult should the W/S BLEED switch be turned on first.