ERJ 145

BLEED AIR THERMAL ANTI-ICING SYSTEM

NOT FOR REAL WORLD USE!

GENERAL

For safe operation in heavy rain or icing conditions the plane is equipped with Ice and Rain Protection Systems. To protect the plane from Icing, critical Areas are heated using electrical power or hot air (taken from the pneumatic system).

Electrical power is used to heat windshields, all Pitot tubes, pressurisation static ports and the AOA sensors.

Areas heated with hot bleed air consist of the leading edges of all stabilisers and the Engine air inlet lips.

The system used for ice detection works automatically and properly activates and configures electrical heated systems and hot air protection systems once it detects icing conditions. Values set for AOA by the SPS (Stall Protection System) are reduced in addition.

Thermal Bleed Air Anti-Icing System Overview

Both engines provide hot air to the bleed air thermal anti-Icing system. In automatic mode the system is automatically turned on by any ice detector activation. In addition the system can be turned on manual using the OVERRIDE Knob.

If visible moisture is present and any of the following conditions are met

- OAT on ground or for takeoff is 10°C or below
- TAT in flight is 10°C or below

icing may occur. Ice accumulation usually starts on the wiper arm and the visible corners of the windshields. Inspection lights installed on wing-to-fuselage fairing allow the crew to check for ice accumulation during night flights.

For the engine air inlet lips, leading edges of the horizontal and wing stabilisers sufficient ice protection is ensured by heating these surfaces with hot air provided by the respective side of the pneumatic system. The hot air is ducted through perforated tubes routed along the surfaces. These tubes are called Piccolo tubes. The air is exhausted through dedicated slots after heating the surfaces.

The hot air for the anti-ice system of the horizontal stabilisers is provided by the left side of the pneumatic system.

The rate of airflow provided by the pneumatic system of the aircraft is limited by an airflow restrictor. Pressure switches are monitoring the system for indication of abnormal conditions like high or low air pressure. The subsystems are protected against excessive (my causing structural damage) or insufficient (ice accumulation may occur) rate of airflow. Each subsystem is equipped with an anti-icing valve.

Thermostats installed close to any connection of ducts are detecting air leakage. Additional protection against a high level of leakage is provided by low-pressure switches.

Sufficient ice protection for the engine is ensured by heating the engine air inlet lip with hot air (without any control of temperature) supplied directly through an upstream of each high stage valve.

Engine anti ice system can be run on ground without limitations as long as the engines are running.

To prevent any structural damage caused by overheating surfaces the anti-icing systems for the wings and the horizontal stabilisers are automatically inhibited when the airplane is operated on ground.

Inhibition is active under following conditions: Wheels on ground and ground speed below 25 knots.

Using the buttons located on the overhead panel the thermal air anti-icing systems can be deactivated at any time.

Bleed Air provided by the APU is not hot enough to be used for anti-icing purposes. For this reason the use of the APU for anti-icing is prohibited.

To automatically compensate a sudden loss of thrust during the takeoff phase when using thermal anti-ice protection an ice-compensation logic is incorporated in the FADEC. This logic can be activated by selecting (Ref A-Ice: ON) on the takeoff page on the MFD. In addition an automatic logic to guarantee a minimum of thrust during icing conditions is provided by the FADEC.

To improve the airplane rate of glide and descent this logic automatically inhibits when landing gear is down.

Windshield Heating System Overview

To prevent anti-icing and anti-fogging the windshields are electrically heated. For proper electrical heating of the windshields an electric conductive film, functioning as an electric resistor, is embedded in its interlayer. Using the respective buttons, located on the OVERHEAD panel, heating can be individual controlled for each side of the windshields. Using temperature sensors, heating is interrupted as soon as the upper temperature limit is reached and automatically restored when temperature drops under the lower limit.

Sensor Heating System Overview

Automatic operation for heating of all Pitot/Static pressure tubes, all TAT sensors and AOA a vane is provided by the Sensor Heating System. Heating of all sensors is accomplished by electrical elements

and can be controlled using the buttons located on the OVERHEAD panel.

In automatic mode the Sensor Heating System operates using the following rules:

- TAT sensors are heated if the airplane is in flight or either Engine 1 or 2 anti-icing subsystems are used
- ADS Static Ports 1, 2, 3 & 4, Pitot 1 & 2, Static 3 pressure tubes and AOA 1 & 2 vanes are heated whenever an engine is running (N2 >56.4%)
- Heating of Pitot/Static 3 and Pressurisation System Static Port 3 in any flight condition is ensured by a additional logic

The Heaters are deactivated when the associated button on the OVERHEAD panel is manual releases or when the above conditions are not met.

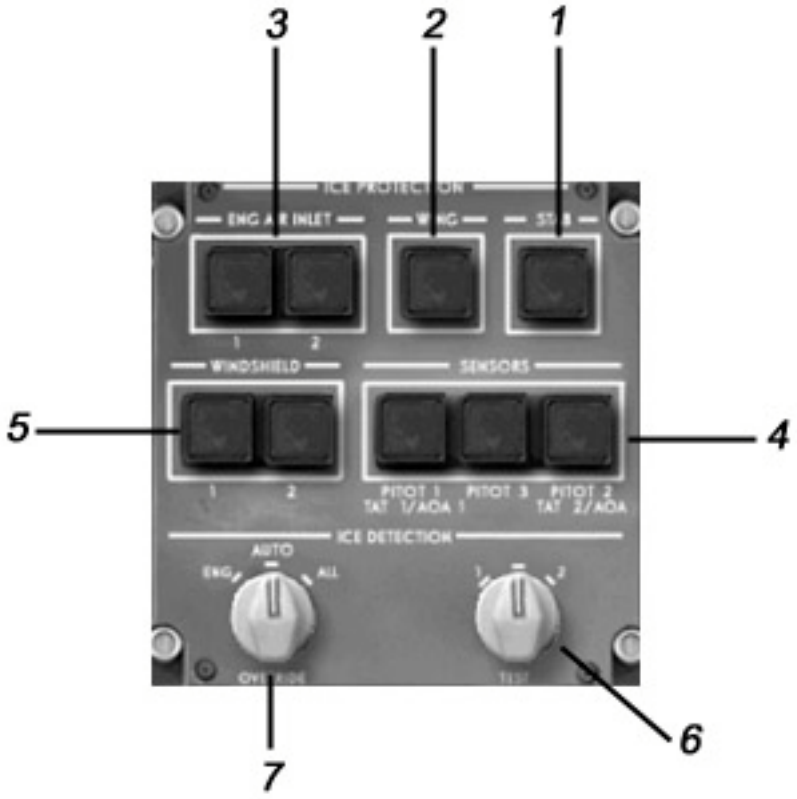
Ice Detection System Overview

For reliable detection of icing conditions two ice detectors are installed on the left and right side of the plane’s nose. They are designed to pick up ice quickly (by a special shape) to ensure icing is detected by the Ice Detection System before the crew does. An ice layer of 0.5 mm thickness on any probe will engage the thermal bleed air anti-icing systems automatic mode and a caution message will appear on the EICAS.

This message will remain active for 60 seconds. Within this time the ice detector heater will de-ice the ice detector probe. After the detector has been properly de-iced the heating of the probe is automatically turned off and a new detection cycle starts.

Ice Protection Controls and Indicators

Ice Protection Control Panel



1. **Horizontal Stabiliser Anti-Icing Button**
   - If released turns off (or if pressed permits) automatic activation for the anti-icing subsystem respective for the horizontal stabiliser
   - An illuminated “OPEN” inscription within the button indicates an open anti-icing valve for the horizontal stabiliser
   - An illuminated striped bar within the button indicates released position of the button
2. **Wing Anti-Icing Button**
   - If released turns off (or if pressed permits) automatic activation for the anti-icing subsystem respective for the Wing
   - An illuminated “OPEN” inscription within the button indicates

    - one of both valves is open, system not commanded to open
    - both valves are open, system commanded to open
  - An illuminated striped bar within the button indicates released position of the button
3. **Engine Air Inlet Anti-Icing Button**
  - If released turns off (or if pressed permits) automatic activation for the anti-icing subsystem respective for the horizontal stabiliser
  - An illuminated “OPEN” inscription within the button indicates an open anti-icing valve for the Engine Air Inlet
  - An illuminated striped bar within the button indicates released position of the button
4. **Sensor Heating Buttons**
  - Pitot/Static tube 3 and pressurisation static port 2 are controlled with the central button
  - Pitot tube 1, TAT probe 1, ADC Static Ports 1 & 3 and AOA vane 1 are controlled with the left button
  - Pitot tube 2, TAT probe 2, ADC Static Ports 2 & 4 and AOA vane 2 are controlled with the right button
  - When released the respective sensor heating system is turned off, when pressed the respective sensor heating system operates in automatic mode
  - An illuminated striped bar within the button indicates released position of the button
5. **Windshield Heating Button**
  - If released turns off (or if pressed permits) the windshield heating system
  - An illuminated striped bar within the button indicates released position of the button
6. **Ice Detection Test Knob**
  - Allows for testing purposes (by simulating an icing condition) all anti-icing subsystems to operate. Illumination of the “OPEN” inscription within the respective buttons confirms operation of the subsystem (and indicates current position of the valve)

NOTE: The following messages will appear on the EICAS during test: “ICE DET 1(2) FAIL”, “BLEED 1(2) TEMP”, “CROSS BLD OPEN” and “ICE CONDITION”

7. Ice Detection Override Knob

- “ENG” turns on the engine air inlet anti-icing subsystems only

NOTE: If an ice condition is detected and groundspeed is >= 25 knots horizontal stabilisers and wing anti-icing subsystems are turned on automatically.

- “AUTO” thermal bleed air anti-icing system will operate in automatic mode

NOTE: If an ice condition is detected and groundspeed is >= 25 knots horizontal stabilisers and wing anti-icing subsystems are turned on automatically.

- “ALL” the complete thermal bleed air anti-icing system will be turned on, only the engine anti-icing subsystem will be turned on when the airplane is operated on ground

NOTE: If an ice condition is detected and groundspeed is >= 25 knots horizontal stabilisers and wing anti-icing subsystems are turned on automatically.