G550
ICE RAIN
PROTECTION SYSTEM

L-R Wing Anti-ice ON
L-R Cowl Anti-ice ON

130 °F
The ICE & RAIN PROTECTION system is about detection, prevention, or removal of ice formation on:

**Bleed Air Heat**
- Engine cowls inlets
- Wing leading edges

**Electrical Heat**
- Air data probes
- Total air temperature probes
- Windshields / cabin windows
- EVS windshield
Icing Conditions

- Icing conditions exist when the static air temperature (SAT) on the ground or inflight is between +10°C and -40°C and visible moisture in any form is present, such as:

  - Rain
  - Snow
  - Clouds
  - fog w/ visibility < 1SM
  - Sleet
  - Ice crystals

- Icing conditions also exist when the SAT on the ground and for takeoff is +10°C or below when operating on ramps, taxiways or runways where:

  - Surface snow
  - Ice
  - Standing water
  - Slush

May be ingested by the engines, or freeze on the engines, nacelles or engine probes
ICE DETECTION SYSTEM

- The ICE DETECTION SYSTEM consists of two (2) exterior probes located on both sides of the fuselage just below the pilot's and copilot's windows.

- Ice detector probes vibrate at a frequency of 40,000 Hz. Ice thickness affects the resonate properties of the probes. Activation of the system occurs when probes accumulate >0.020 inches of ice formation. This decreases the probe's frequency by approximately 133 Hz.

- When this happens the crew is notified of the presence of ice via a CAS message: ICE DETECTED.
If the wing and cowl anti-ice system are in AUTO, the wing and cowl anti-ice valves open automatically and allow hot engine bleed air to heat the wing leading edges and engine cowl inlets.

![Diagram of wing and cowl anti-ice valves](image)

Auto: 1,500 AGL - 35,000 MSL
- The crew is then notified via CAS messages:

  L-R Wing Anti-ice ON
  L-R Cowl Anti-ice ON

- The probes are then heated to melt the ice formation and allow its vibration frequency to return to normal speed - ready to continue detecting more icing. The process continues until there is no more icing.

- When ice is no longer detected by

  ① ICE DETECTED extinguishes > one (1) minute
  ② Cowl Anti-ice valves close > three (3) minutes and L-R Cowl Anti-ice ON extinguishes
  ③ Wing Anti-ice valves close > five (5) minutes and L-R Wing Anti-ice ON extinguishes

- Left = L MAIN AC
  Right = R MAIN AC
Prior to entering icing conditions, or when icing is detected by the ice detection system, the crew should select wing and cowl anti-ice systems ON.

L wing  L cowl  R cowl  R wing

Holding in icing conditions:

flaps 0° (up)

Use of flaps in icing conditions restricted to:

Takeoff  Approach  Landing
Wing Anti-ice System (WAIS)

- Protects wing leading edges from ice accumulation
- Uses **hot** engine bleed air to heat up its onside wing leading edge

- The two (2) Bleed Air Controllers (BAC) control and regulate the use of **hot** engine bleed air.

![Diagram of wing anti-ice system]
In case of engine failure, a crossover duct allows bleed air from the operating engine to heat the inoperative side's wing leading edges.

Bleed air supply for WAIS is extracted from:

- Mid stage bleed port
- High stage bleed valve

During climb and cruise, the 5th stage provides adequate bleed air pressure and temperature for wing anti-ice.
AT low power settings, such as on descent, bleed air is also extracted from the 8th stage.

- The wing anti-ice valves are spring-loaded close, pneumatically actuated variable pressure regulator and shut-off valves.

- Wing anti-ice valves fail **CLOSED**

- The WAIS heats the leading edges **120° - 150° F** by modulating the anti-ice valves. **Target: 130°F**
- When the WAIS is selected on the command:

1st Fan Air Valves to Modulate OPEN

Outlet Temperature

Inlet Temperature 630°F

1 = 400°F
2 = 500°F

High-stage Valves (8th) to OPEN if Mid-stage (5th) is insufficient
ECS/PRESSURIZATION SYNOPTIC PAGE

Wing Anti-ice

Crossover Duct

Flow Tube

Precipitator

Temperature

W AIS SELECTED OFF

W AIS SELECTED ON AND TEMPERATURE INCREASING

W AIS SELECTED ON AND TEMPERATURE ≥ 100°F < 180°F

OFF AUTO ON

OFF AUTO ON

OFF AUTO ON

OR

OFF AUTO ON
WAIS SELECTED ON

> 2 minutes; Temperature < 100°F

WAIS SELECTED ON AND
Temperature ≥ 180°F

Wing Temp Low

OR

Wing Hot

L-R Wing Anti-ice ON
L-R Cowl Anti-ice ON
- Protects engine cowl inlets from ice accumulation
- Uses hot engine bleed air to heat up its onside engine cowl inlet

Engine cowl inlets
CAIS selected ON

- Bleed air supply for CAIS is extracted from:

Mid stage bleed port
5th stage HP

HP Compressor Section
- Cowl anti-ice valves are electropneumatic. They require 28 V DC power and pneumatic pressure to close. They fail in the **OPEN** position.

- Cowl anti-ice status is indicated in pressure (PSI) instead of temperature because engine bleed air is not modulated by the cowl anti-ice valves. Pressure varies based on engine power.
ECS/PRESSURIZATION synoptic page

CAIS selected OFF

--- Psi

CAIS selected ON

Pressure

25 Psi

- Normal pressure is between 1.6 - 33 Psi

L-R Cowl Anti-ice ON

OR

OR

25 Psi

OFF AUTO ON

OFF AUTO ON
- Abnormal pressure is: 1.6 → 33 psi

- Miscompare between L and R pressures

- Engine spinner = passive de-icing
  Tip is made of rubber which distorts and sheds ice
The WAIS and CAIS can be activated:

1. **Manually** by the crew (no altitude restriction)
   - L Wing
   - L Cowl
   - R Cowl
   - R Wing

2. **Automatically** when ice is detected by the ice detection system from 1,500’ AGL up to 35,000’ MSL
   - L Wing
   - L Cowl
   - R Cowl
   - R Wing

   **ICE DETECTED**
   - L-R Wing Anti-ice ON
   - L-R Cowl Anti-ice ON
- **Automatic Activation of the WAIS** is inhibited above 35,000', but if WAIS and CAIS are already activated, they remain on.

- **ICE DETECTED** CAS is inhibited on the ground because all **AMBER** CAS messages are considered "No Go" messages.
**Pitot/Static and Total Air Temperature (TAT) Probes**

- Probes are electrically-heated to prevent ice formation

- Probe heaters are turned on after engine start

- Below 60 kts Pitot/Static probes are heated to 150°C
- Above 60 kts Pitot/Static probes are heated to 300°C

- TAT probes are only heated above 60 kts or when both throttles are advanced above 30°
Windshield and Windows

- Windshield Heat cycles **ON** and **OFF** to ensure a window temperature between **104° to 114° F**

Windshield Heat

- Cabin windows are heated with WOW-Air mode

- EVS windshield Heat
  - Manual: Two (2) minutes
  - Automatic:
    - WOW Air and CAIS ON
      - One (1) minute on
      - Seven (7) minutes off
    - Gear down - continuously
Questions, comments or errors?

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Thank you!