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INTRODUCTION

The wing leading edges and the engine intake cowls are heated using engine bleed air. The windshields, windows and the air data probes are heated using electrical power. Anti-icing of the aircraft tail surface is not required.

Two ice detectors provide indication to the flight crew of icing conditions.

The anti-ice protection system (AIPS) is controlled by the integrated air system controllers (IASC) with indications displayed on the EICAS. The ANTI ICE synoptic display provides an overview of status of the pneumatically operated anti-icing systems.

ICE DETECTION SYSTEM

DESCRIPTION

The Challenger 300 has two ice detectors, one on each side of the fuselage just above the nose landing gear doors. Each detector is supplied with 28 VDC and continuously monitors internal circuits and components for failure conditions.

COMPONENTS AND OPERATION

The ice detector uses a vibrating probe to detect the presence of icing conditions. Two detectors provide system redundancy; only one signal is needed to generate an EICAS message.

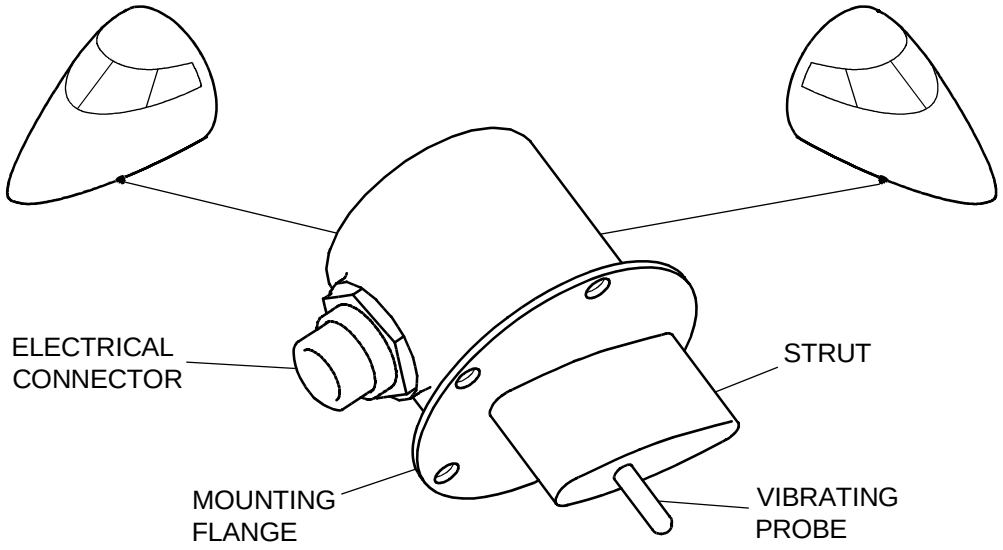
The ice detector probes vibrates at high frequency. As the ice detector enters an icing environment, ice collects on the sensing probe causing the frequency of the sensing probe to decrease. At the same time the ice detector de-ices the unit strut and probe through internal thermal heaters. Shedding the ice on the probe returns the vibration frequency of the probe to a non-icing value that allows the detection system to reassess if ice is accumulating. When the ice is removed, the heaters are de-energized. As ice builds again on the probe, the heater are reenergized and the process is repeated.

When ice is detected the following will occur:

- An amber ice icon is displayed on the PFD if the anti-ice systems are off
- An ICE DETECTED (C) CAS message is displayed if the anti-ice systems are off
- An ICE DETECTED (A) CAS is displayed if the anti-ice systems are on

A caution ICE DETECTOR FAIL is displayed on the EICAS when both ice detectors have failed. An advisory ICE DETECTOR FAULT is displayed on the EICAS when one of the ice detectors is failed.

Each ice detector is provided with a power on test capability as well as a continuous built in and pilot initiated test capability. To initiate a test of the system, select ICE DET on the SYSTEMS TEST panel and push the test switch. During the test sequence, an internal check of the electronics, probe heater, and CAS messages will be performed.



WING ANTI-ICE SYSTEM

DESCRIPTION

The wing anti-icing system heats the leading edge of the wing by heating the surfaces with high-pressure bleed-air from the engines. The left and right wings are normally heated with bleed-air from the respective engine, however the capability exists to provide bleed-air from either engine to both wings.

A WING push button switch, located on the ANTI-ICE control panel, is used to operate the wing anti-ice system. The WING SOURCE rotary switch on the ANTI-ICE control panel allows the pilot to select FROM L, NORM, or FROM R as the source of anti-icing bleed-air.

The anti-ice ducting is continuously monitored for bleed-air leakage.

COMPONENTS AND OPERATION

INTEGRATED AIR SYSTEM CONTROLLER (IASC)

Two dual-channel integrated air system controller (IASC) controls the operation of the wing anti-ice and leak detection systems.

Each IASC receives data from dual temperature sensors located in the inboard and outboard section of each leading edge. The IASC uses the sensor data to independently control the amount of bleed-air supplied to each wing to ensure that the leading edges are maintained in the correct temperature range.

BLEED LEAK DETECTION SYSTEM

To detect hot air leaks from the bleed system, the anti-ice ducts are monitored by the leak detection loops. The bleed leak detection system protects components and structure against over heating and fire hazards. Ducting is divided into four distinctive zones of dual loops. The four zones are divided as follows:

- Right pylon dual loops: includes the powerplant interface to the right intermediate pressure valve (IPV) and right high pressure valve (HPV)
- Left pylon dual loops: includes the powerplant interface to the left (IPV) and left (HPV)
- Right anti-ice ducting dual loops: includes all the ducting downstream of the right HPV to the end of the right wing bleed-air tubing
- Left anti-ice ducting dual loops: includes all the ducting downstream of the left HPV to the end of the left wing bleed-air tubing

When a leak is detected in the pylon zone (upstream of the HPV), a L (R) PYLON BLEED LEAK (W) message is displayed on the EICAS. The pilot must reduce the corresponding engine throttle and if the leak persists, shut down the corresponding engine.

When a leak is detected downstream of the HPV, a WING ANTI-ICE LEAK (W) CAS message is illuminated and the IASC will automatically close both wing anti-ice valves to isolate the failure and stop the leakage. If the leak stops after the automatic shutdown, the warning message will be replaced by a L (R) WING ANTI-ICE FAIL (C) CAS message. The pilot should then complete the shutdown of the wing anti-ice system

WING TEMPERATURE SENSORS

Dual temperature sensors provide feedback temperature data to the integrated air system controller (IASC). Two dual-temperature sensors are installed in the outboard section of each wing and two in the inboard section. Channel B of each IASC receives data from one sensor at each of the four wing positions.

Each outboard sensor monitors the leading edge of its associated wing for insufficient temperature. A L (R) WING ANTI-ICE FAIL (C) message will illuminate if there is insufficient heat.

The inboard sensor supplies the temperature data used to modulate the wing anti-icing valves. The sensor also monitors the wing for overheat and will display L (R) WING OVHT (W) CAS message if the condition exists.

WING ANTI-ICE SYSTEM (Cont)

WING ANTI-ICING VALVES

The left and right wing anti-icing valves are installed on the bleed-air manifold in the aft equipment bay.

When the WING switch is selected to ON, the wing anti-icing valves modulate as a function of the wing temperature.

The valves are spring-loaded to the closed position. The valve will close when:

- Bleed-air supply pressure is removed
- Loss of electrical power at the valve
- Anti-ice duct failure is detected by the IASC
- Anti-ice system is operated in either FROM L or FROM R mode

The high pressure valves limit the high stage engine bleed pressure to 36 ±3 psi. If a valve fails and pressure exceeds 46 psi, a caution (L) R WING A/I PRESS HI CAS message is displayed.

WING ANTI-ICE DUCTS

The aft equipment bay and center fuselage anti-icing ducts provide bleed-air to the wing anti-icing ducts. The hot air enters the wing via the piccolo tube in the leading edges.

In the wing leading edges, dual sensing loops and dual temperature sensors are used to detect the failure of a wing anti-ice duct (piccolo tube) or duct connector. The detectors can discriminate between overheat condition caused by a leaking duct and the normal temperatures associated with wing anti-icing. The wing anti-icing piccolo ducts uniformly spray hot bleed-air onto the inner surfaces of the leading edges.

The bleed-air used to anti-ice the leading edges is dissipated to the atmosphere through vent holes located on the bottom side of the wing surface.

WING OVERHEAT

When the anti-icing system overheats, a L (R) WING OVERHEAT (W) CAS illuminates, and the pilot shuts off the wing anti-ice system, selects FROM L or FROM R and selects the system ON. Bleed flow is modulated by the sensor on the same side as the bleed source when FROM L or FROM R is selected.

On the ANTI-ICE synoptic page, the overheated leading edge will be identified in red.

WING ISOLATION VALVE

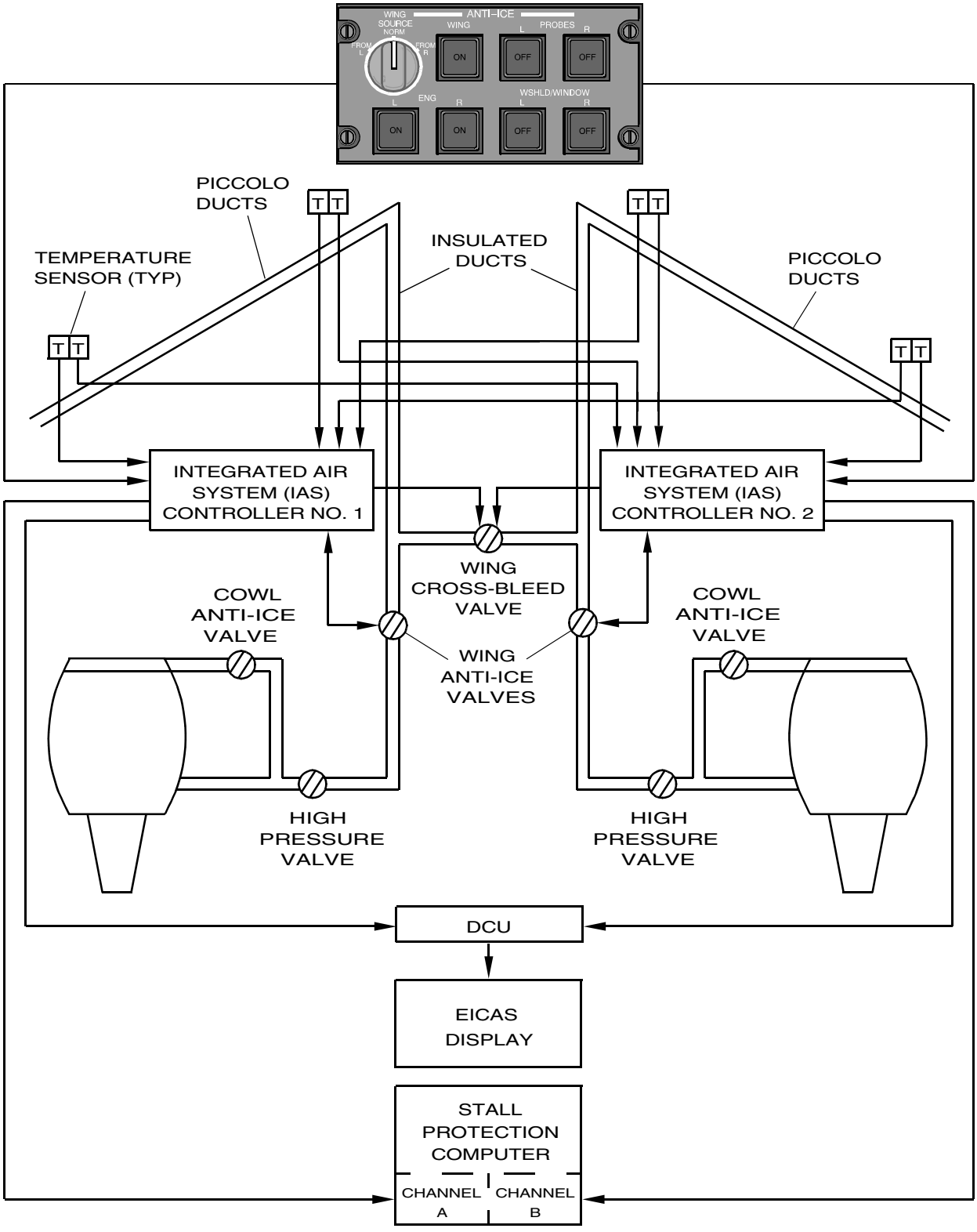
A crossbleed duct bridges the two anti-ice lines and contains the wing isolation valve.When opened, bleed air can be supplied to the wings by one engine. This function is automatic in case of engine failure. In normal operation, the isolation valve is closed.

The wing isolation valve is pneumatically actuated and electrically controlled. The valve is controlled from the ANTI-ICE control panel. When FROM L is selected at the WING SOURCE rotary switch, the right wing anti-ice and high pressure valves are closed and the crossbleed valve opens to permit bleed-air from the left engine to anti-ice both wings.

When the FROM R is selected, the left wing anti-ice and high pressure valves are closed and the crossbleed valve opens allowing bleed-air from the right engine to anti-ice both wings.

WING ANTI-ICE SYSTEM (Cont)

WING ANTI-ICE SYSTEM SCHEMATIC



ENGINE ANTI-ICE

DESCRIPTION

Each of the engine nacelle inlets are anti-iced with engine bleed-air. The left and right engine anti-icing systems are controlled by L (R) ENG switches on the ANTI-ICE control panel located on the center pedestal.

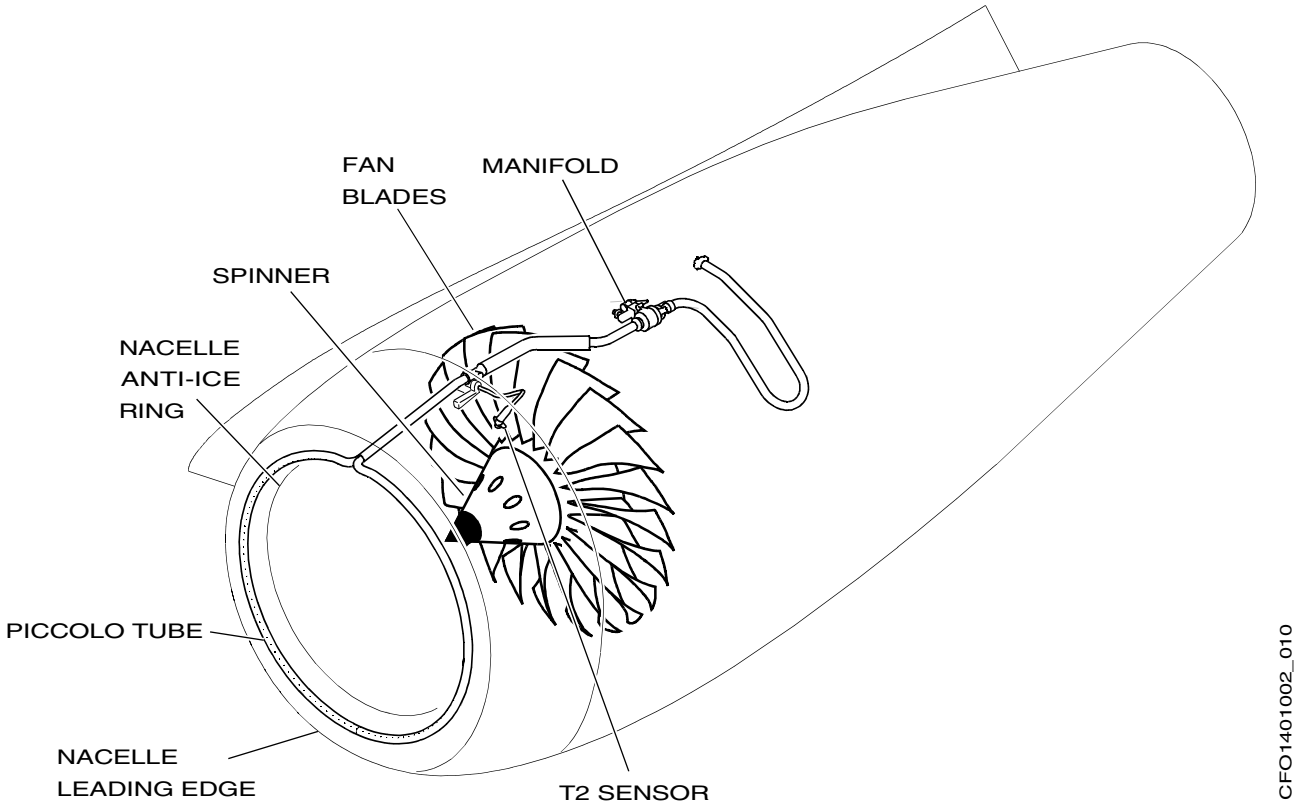
COMPONENTS AND OPERATION

NACELLE ANTI-ICING VALVES

Nacelle anti-icing valves are located on top of each engine downstream of the high pressure duct. The valves are electrically operated and pneumatically controlled and incorporates a fail safe open feature.

ENGINE NACELLE DUCTING

Hot bleed-air is directed to and then sprayed by a piccolo tube onto the inner surface of the nacelle leading edge. The air is then discharged overboard through an exhaust duct located at the bottom of the nacelle inlet.



T2 SENSOR

A T2 sensor is installed in the inlet housing of each engine and senses the engine inlet total-air temperature. The T2 sensor supplies the inlet total-air temperature to each of the electronic control units (ECU).

The in-control ECU uses the engine inlet total-air temperature for power control. The sensor contains two resistance temperature devices and a heat device for anti-ice. The anti-ice function is controlled from the L or R ENG switches on the ANTI-ICE panel.

ENGINE SPINNER

The engine spinner is a two-piece, aluminum forging with a conical shape to provide a surface that sheds ice in icing conditions and operates without the need for anti-icing heat.

AIR DATA AND SENSORS ANTI-ICE

DESCRIPTION

The air data probes and sensors are located on either side of the aircraft nose and are electrically heated to prevent ice formation. Separate air data sensor heat controllers provide control and monitoring of the probe heaters.

L (R) PROBES switches are provided on the ANTI-ICE control panel. When selected On, the following probes and sensors are heated:

- Left and right standby static port
- Left and right AOA sensor
- Left and right pitot-static probe
- TAT probe
- Standby pitot probe

Failure of a probe heater will signal the DCU to display the appropriate EICAS message.

COMPONENTS AND OPERATION

PITOT STATIC PROBES

There are two pitot static masts, one on either side of the nose. The pitot static mast consists of a head and mounting base. The mast has two heaters, one in the head and the other in the base.

STANDBY PITOT PROBE

There is one standby pitot probe on the left side of the nose.

STANDBY STATIC PORTS

One flush standby static port located in each side of the aircraft.

ANGLE-OF-ATTACK VANES (AOA)

Angle-of-attack vanes are located on each side of the aircraft under the side windows and behind the pitot tubes. The AOA vanes are heated when activated by the PROBES switch.

TOTAL AIR TEMPERATURE PROBE (TAT)

One total air temperature sensor is located in the right side of the aircraft. The TAT heater operates in flight only.

WINDSHIELD ICE AND RAIN PROTECTION

DESCRIPTION

The windshield and side window heating system includes two windshields and two side windows that contain embedded heater elements and sensor elements. The windshield and windows are treated with a rain resistant coating

COMPONENTS AND OPERATION

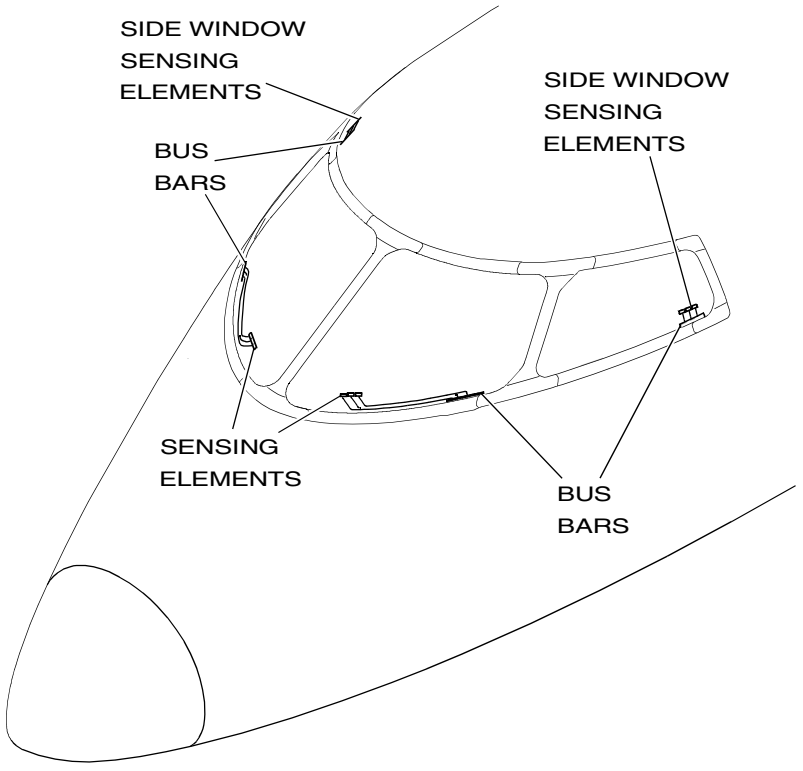
WINDSHIELD AND SIDE WINDOW HEATING

The windshield heater elements are segmented into three sections, and allow for concentration of heating in a smaller area of the windshield in order to allow visibility in severe icing conditions. The side window heater elements have no segmentation. Flight in super-cooled large droplet icing (SLD) conditions may, but not necessarily be indicated by ice accretion on side windows. Temperature controllers, one for each windshield and window, monitor the electrical resistance of the temperature sensors that are embedded in the glass. The temperature controllers cycle power on and off to maintain a predetermined glass surface temperature.

CONTROL SWITCHES AND FUNCTION

Switches located on the ANTI-ICE panel control windshield and window heat. The L WSHLD/WINDOW switch controls the left windshield and left window. The R WSHLD/WINDOW switch controls the right windshield and right window.

Overheat protection circuits for each windshield or window remove power from the affected surface during an overheat condition. Selecting the L (R) WSHLD/WINDOW off de-energizes the applicable windshield and window and resets the temperature controller.



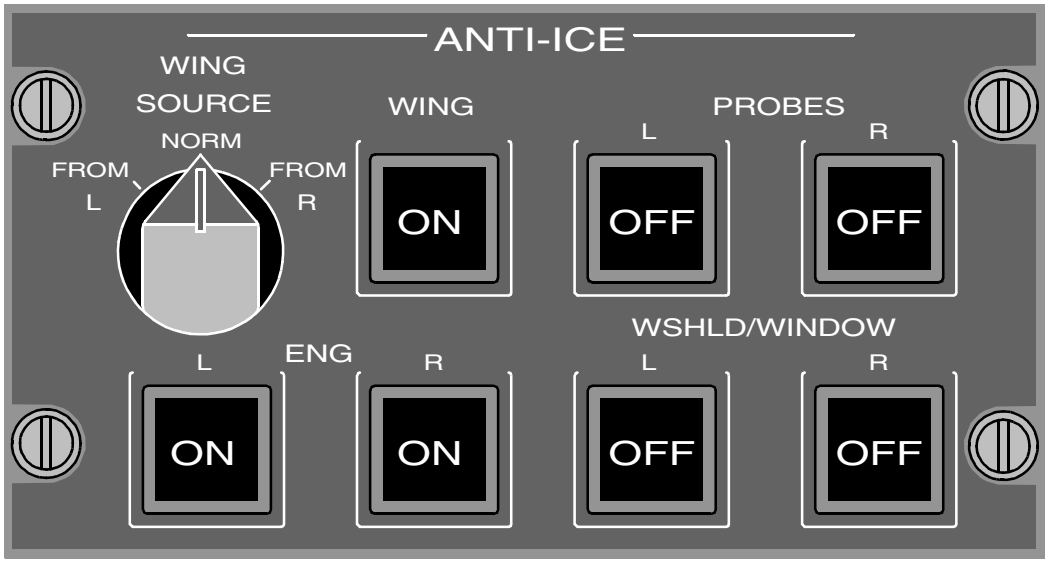
CONTROLS AND INDICATIONS

DESCRIPTION

The ANTI-ICE control panel located on the center pedestal is used to operate the anti-ice systems.

Anti-ice system operation and fault presentation is provided on the ANTI-ICE synoptic display. The ANTI-ICE synoptic display monitors the pneumatically-operated anti-icing and ice detection systems.

ANTI-ICE CONTROL PANEL



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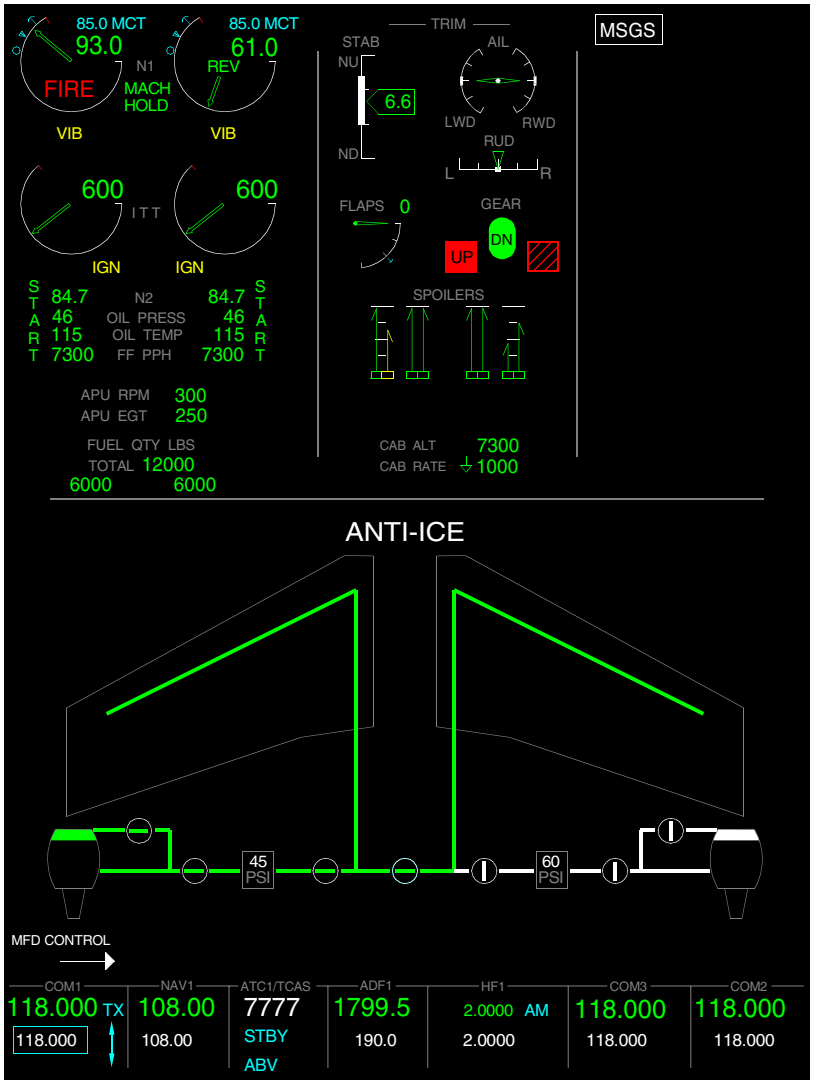
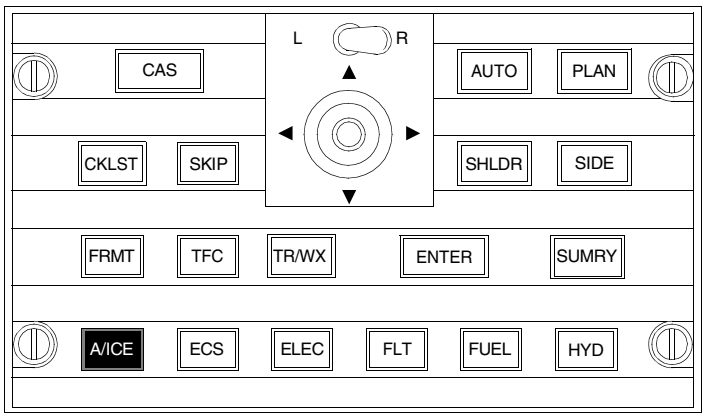
CONTROLS AND INDICATIONS (Cont)

ANTI-ICE SYNOPTIC PAGE

The ANTI-ICE synoptic page is used to monitor the pneumatically operated anti-icing and ice detection systems.





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EICAS MESSAGES

The ice and rain protection system messages are shown on the EICAS. In the table below, the ice and rain protection system messages are listed. A brief explanation of each message is provided.

MESSAGE	INHIBITS	MEANING	AURAL WARNING
WING ANTI-ICE LEAK		A leak has been detected along the wing anti-ice ducting	
L (R) WING OVERHEAT		A wing anti-ice overheat condition exists in the indicated wing	
L (R) ENG ANTI-ICE FAIL	TO	Bleed air pressure to the respective nacelle is too low for effective anti-icing, or the electrically heated T_2 heater has failed when the respective L or R ENG switch is ON	
ICE DETECTED	TO/LAND	Ice has been detected, and both the engine and wing anti-ice systems are not selected on	
ICE DETECTOR FAIL	TO/LAND	Both ice detectors have failed	
L (R) PITOT HEAT FAIL	TO/LAND	The respective pitot mast or base heater has failed	
L (R) PROBE HEAT OFF	TO/LAND	Probe heat is off	
STBY PITOT HEAT FAIL	TO/LAND	The standby pitot heater has failed	
STBY STAT HEAT FAIL	TO/LAND	The respective standby static heater has failed	
L (R) WING A/I LOW TEMP	TO/LAND	Indicates that the respective wing has an anti-ice low temperature condition	
L (R) WING ANTI-ICE FAIL	TO/LAND	The respective anti-ice system has failed	
WINDOW HEAT FAIL	TO/LAND	The respective window heat has failed and the temperature is too low or too high. A failure may also be indicated by the formation of condensation (fog) on the window	
WING ANTI-ICE FAULT	TO/LAND	Both outboard wing leading-edge sensors have failed	
WING A/ICE LOOP FAIL	TO	Both detection loops failed. This is only checked during power up self-test	
L (R) WING A/I PRESS HI	TO/LAND	High pressure has been sensed in the wing anti-ice system	

EICAS MESSAGES (Cont)

MESSAGE	INHIBITS	MEANING	AURAL WARNING
L (R) WSHLD HEAT FAIL	TO/LAND	The respective window heat has failed, and the temperature is too low or too high. a failure may also be indicated by the formation of ice or condensation (fog) on the windshield	
L (R) AOA CASE HEAT FAIL	TO/LAND	The respective angle-of-attack case heater has failed	
L (R) ENG A/ICE FAIL ON	TO/LAND	The respective engine nacelle anti-ice has failed ON. If the T_2 probe heater has failed on, an amber "T_2" icon will be displayed on the anti-ice synoptic. If engine anti-ice bleed air has failed on, a green flow line will be displayed downstream of the failed anti-ice valve on the synoptic	
ICE DETECTED	TO/LAND	Ice has been detected and the engine and wing anti-ice systems are selected on	
ICE DETECTOR FAULT	TO/LAND	One ice detector has failed; the other should continue to operate normally	
L (R) PROBE HT CTRL FAIL	TO/LAND	The respective probe heat controller has failed. The probe heat will fail ON	
TAT HEAT FAIL	TO/LAND	The total air temperature probe heater has failed	
WING SOURCE XBLEED	TO/LAND	Wing crossbleed valve is open	
WING ANTI-ICE FAULT	TO/LAND	One channel has failed on the outboard wing leading-edge sensor. The wing anti-ice should work normally	
L (R) ENGINE ANTI-ICE ON		The respective (or both) ENG ANTI-ICE switch(es) is/are ON	
ENGINE ANTI-ICE ON		The respective (or both) ENG ANTI-ICE switch(es) is/are ON	
PROBE HEAT TEST OK		The pilot initiated probe heat test has passed.	
WING ANTI-ICE ON		The WING ANTI-ICE switch is selected ON	
WING/ENG ANTI-ICE ON		The wing and both engine anti-ice systems are ON	
WING SOURCE XBLEED		Either FROM L or FROM R has been selected on the ANTI-ICE WING SOURCE switch	

EICAS MESSAGES (Cont)

MESSAGE	INHIBITS	MEANING	AURAL WARNING
L (R) AOA CASE HEAT FAIL	TO/LAND	The respective angle-of-attack case heater has failed	
L (R) ENG A/ICE FAIL ON	TO/LAND	The respective engine nacelle anti-ice has failed ON. If the T_2 probe heater has failed on, an amber "T_2" icon will be displayed on the anti-ice synoptic. If engine anti-ice bleed air has failed on, a green flow line will be displayed down-stream of the failed anti-ice valve on the synop-tic	
ICE DETECTED	TO/LAND	Ice has been detected and the engine and wing anti-ice systems are selected on	
ICE DETECTOR FAULT	TO/LAND	One ice detector has failed; the other should continue to operate normally	
L (R) PROBE HT CTRL FAIL	TO/LAND	The respective probe heat controller has failed. The probe heat will fail ON	
TAT HEAT FAIL	TO/LAND	The total air temperature probe heater has failed	
WING SOURCE XBLEED		Wing xbleed valve open	
WING ANTI-ICE FAULT	TO/LAND	One channel has failed on the outboard wing leading-edge sensor. The wing anti-ice should work normally	
L (R) ENGINE ANTI-ICE ON		The respective (or both) ENG ANTI-ICE switch(es) is/are ON	
ENGINE ANTI-ICE ON		The respective (or both) ENG ANTI-ICE switch(es) is/are ON	
PROBE HEAT TEST OK		The pilot initiated probe heat test has passed.	
WING ANTI-ICE ON		The WING ANTI-ICE switch is selected ON	
WING/ENG ANTI-ICE ON		The wing and both engine anti-ice systems are ON	
WING SOURCE XBLEED		Either FROM L or FROM R has been selected on the ANTI-ICE WING SOURCE switch	