2A-30-10: General Description

The Ice and Rain Protection system provides the flight crew with a means of preventing, detecting, and disposing of ice formation and rain on various components of the aircraft. Its primary purpose is to detect icing conditions. Its secondary purpose is controlling aircraft cowl and wing anti-ice systems to minimize fuel use and maximize aircraft range.

Ice buildup is prevented on the following components:

- Wing Leading Edges
- Engine Cowl Inlet Leading Edges
- Windshields
- Probe Sensors

The Ice and Rain Protection System is divided into the following subsystems:

- 2A-30-20: Wing Anti-Ice System
- 2A-30-30: Cowl Anti-Ice System
- 2A-30-40: Windshield Ice and Rain Protection System
- 2A-30-50: Probe Anti-Ice System
- 2A-30-60: Ice Detection System

2A-30-20: Wing Anti-Ice System

1. **General Description:**

   The Wing Anti-Ice system provides ice protection for each wing leading edge using commands from Ice Detectors to Bleed Air Controllers (BACs).

   The Wing Anti-Ice system consists of identical left and right sides. The left and right anti-ice system ducts are joined by a crossover duct downstream of the wing check valves. This design allows either anti-ice valve to service both wings in the event one anti-ice valve becomes inoperative.

   The wing anti-ice system is controlled by the L/R WING switches located on the ANTI ICE control panel. Each switch has three positions labeled OFF, AUTO, and ON. The AUTO (automatic) position is used in flight and considered the normal mode of operation. In the AUTO position, aircraft altitude and ice detector input data determines the operation of the wing anti-ice system. To preserve aircraft performance, system logic inhibits AUTO functioning of wing anti-ice during climb when below 1500 feet AGL and again above FL350. During descent, however, wing anti-ice remains functional below 1500 feet AGL, automatically shutting off when Weight-On-Wheels (WOW) shifts to the GROUND mode upon landing. Because of this feature, the flight crew is required to position the L/R WING ANTI ICE switches to ON if deicing is necessary for takeoff or immediately after takeoff.The ON position bypasses the ice detectors and auto anti-ice relays, and is used primarily for wing deicing when the aircraft is on the ground. However, the

ON position may be used anytime deicing is required. The OFF position disables the wing anti-ice system.

NOTE:

If wing anti-ice is selected ON for takeoff, ensure TAKEOFF INIT reflects this selection or performance data will not be displayed and autothrottles will not engage.

Whenever the wing anti-ice system is in the AUTO mode and the left and/or right ice detector detects ice, the respective ICE DETECTED messages are displayed on CAS and wing anti-ice valves are commanded open through the left or right ice detector. Ice detection system outputs will shut off in the following order after ice is no longer detected:

- ICE DETECTED Signal — 60 seconds
- Wing Anti-Ice Signal — 5 minutes

The following subsystems, units, and components together compose this system:

- Bleed Air Controller
- Temperature Sensors
- Wing Anti-Ice Valves
- Check Valves

2. Description of Subsystems, Units and Components:

A. Bleed Air Controllers (BACs):

The BACs control the wing anti-ice valves to maintain bleed air temperature within the wing anti-ice duct at 130° F during all icing conditions. Temperature within the wing anti-ice duct is sensed by temperature sensors and monitored by the BACs. The output data from the BACs is routed to the wing anti-ice valves which open or close, as required, maintain 130 ±10° F.

When the L/R WING ANTI ICE switches are in the ON position, bleed air to the wing anti-ice ducts is provided continuously. BACs monitor the duct bleed air temperature to maintain 130 ±10° F, whether ice is detected or not.

When the L/R WING ANTI ICE switches are in the AUTO position, bleed air to wing anti-ice ducts is provided only when ice is detected. The BACs continue to process information but do not position wing anti-ice valves to provide bleed air unless ice is detected.

B. Temperature Sensors:

Temperature sensors are located in the left and right wing anti-ice return ducts. The sensors monitor bleed air temperature within the ducts. Dual thermal switches rated at 180° F and 100° F are located mid-wing to provide logic for display of L WING HOT, R WING HOT, L WING TEMP LOW, and R WING TEMP LOW Crew Alerting System (CAS) messages. A one minute delay is provided to allow the system to warm before a WING TEMP LOW message is displayed.

Additional thermal switches rated at 180° F are mounted at the end of each wing to measure ambient air temperature flowing through the wing anti-ice

return duct and provide logic for display of L WING HOT and R WING HOT CAS messages.

C. Wing Anti-Ice Valves:

Wing anti-ice valves are located in the left and right wing anti-ice return ducts. Controlled by the BACs, they open and close to maintain 130 ±10° F temperature in the wing anti-ice ducts during all icing conditions.

3. Controls and Indications:

(See Figure 1.)

NOTE:

A full description of the ECS / PRESS synoptic page can be found in Section 2B-03-30: Crew Alerting System Description.

A. Circuit Breakers (CBs):

The Wing Anti-Ice system is protected by the following Circuit Breakers (CBs):

Circuit Breaker	Circuit Breaker Panel	Location	Power Souce
L WING ANTI-ICE	LEER	D-4	L ESS DC Bus
R WING ANTI-ICE	REER	D-13	R ESS DC Bus

A. Crew Alerting System (CAS) Messages:

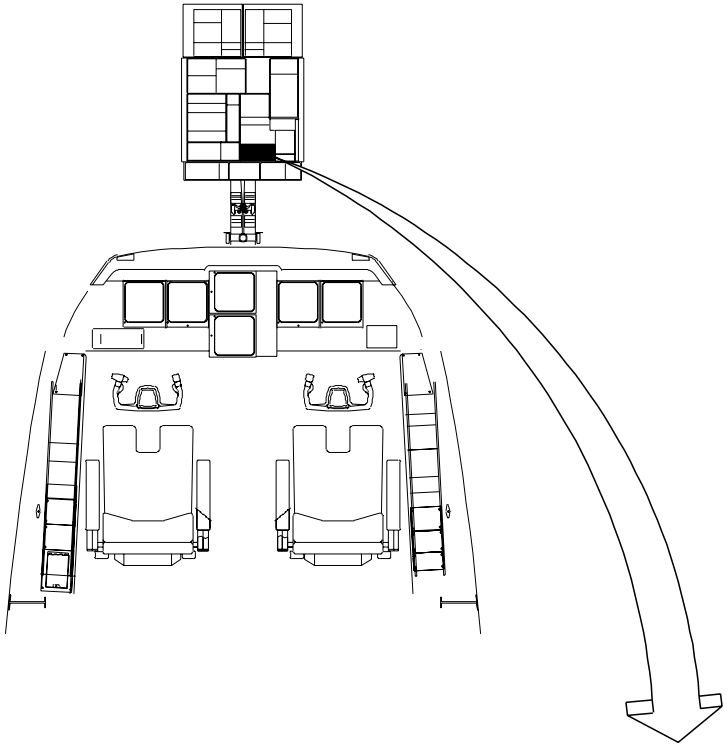
CAS messages associated with the Wing Anti-Ice system are:

Area Monitored:	CAS Message:	Message Color:
Left / Right Wing Thermal Switch	L-R WING HOT	Amber
	L-R WING TEMP LOW	Amber
Left / Right Bleed Air / Wing Anti-Ice Controller	L-R WG A/I SYS FAIL	Amber
Left / Right Wing Anti-Ice Switch Relay	L-R WING A/I ON	Blue

4. Limitations:

A. Flight Manual Limitations:

Operation of wing anti-icing is required if icing conditions are imminent, or immediately upon detection of ice formation on wings, winglets, or windshield edges.



L WING / R WING ANTI ICE

OFF:

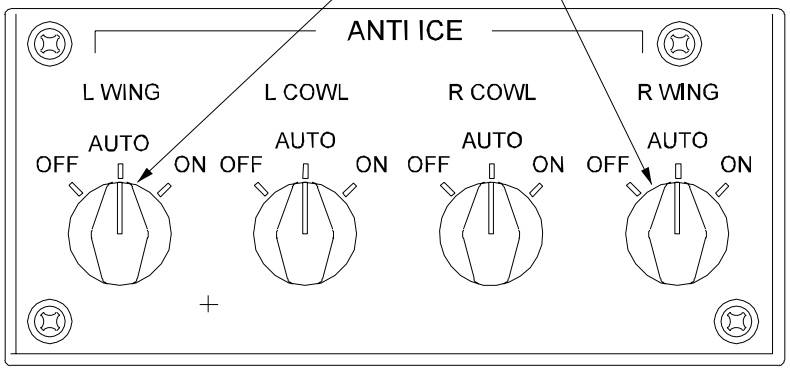
- Wing anti-ice valves are closed; airflow is inhibited.

AUTO:

- Normal mode of operation.
- Left Essential DC Bus powers L WING, Right Essential DC Bus powers R WING.
- Airflow inhibited from ground to 1500 feet AGL (during climbout only) and above FL350. During descent, system remains functional until WOW shift to GROUND mode.
- Bleed Air Controllers (BACs) continually process information, but take no action unless ice is detected.
- Aircraft altitude and ice detector input data used to schedule airflow. If ice is detected and altitude allows, anti-ice valves are opened.
- Blue L/R WING A/I ON message displayed on Crew Alerting System (CAS) when airflow is operating.
- Wing temperature is controlled to 130 ± 10°F when airflow is present.

ON:

- Used primarily when aircraft is on ground, but may be used anytime anti-ice is required.
- Bypasses ice detectors and automatic relays.
- Airflow is provided continuously and controlled to 130 ± 10°F whether ice is detected or not.



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Wing Anti-Ice Controls
Figure 1

2A-30-30: Cowl Anti-Ice System

1. **General Description:**

   The Cowl Anti-Ice system provides control and routing of fifth-stage engine bleed air to the leading edge of the engine cowl inlets, to maintain engine efficiency and reduce risk of mechanical damage due to ice ingestion. Control of the system is accomplished by providing 28V DC control current to the cowl anti-ice valves. When the cowl anti-ice valves are open, bleed air is routed to the cowl anti-ice ducts. The valves also provide discrete signals to the Data Acquisition Units (DAUs) for fault annunciation on the Crew Alerting System (CAS).

   The cowl anti-ice system is controlled by the L/R COWL switches located on the ANTI ICE control panel. Each switch has three positions labeled OFF, AUTO, and ON. The AUTO (automatic) position is used in flight and considered the normal mode of operation. In the AUTO position, aircraft altitude and ice detector input data determines the operation of the cowl anti-ice system. To preserve aircraft performance, system logic inhibits AUTO functioning of cowl anti-ice during climb when below 1500 feet AGL and again above FL350. During descent, however, cowl anti-ice remains functional below 1500 feet AGL, automatically shutting off when Weight-On-Wheels (WOW) shifts to the GROUND mode upon landing. Because of this feature, the flight crew is required to position the L/R COWL ANTI ICE switches to ON if deicing is necessary for takeoff or immediately after takeoff. The ON position bypasses the ice detectors and auto anti-ice relays, and is used primarily for cowl deicing when the aircraft is on the ground. However, the ON position may be used anytime deicing is required. The OFF position disables the cowl anti-ice system.

   NOTE:

   If cowl anti-ice is selected ON for takeoff, ensure TAKEOFF INIT reflects this selection or performance data will not be displayed and autothrottles will not engage.

   Whenever the cowl anti-ice system is in the AUTO mode and the left and/or right ice detector detects ice, the respective ICE DETECTED messages are displayed on CAS and cowl anti-ice valves are commanded open through the left or right ice detector. Ice detection system outputs will shut off in the following order after ice is no longer detected:

   - ICE DETECTED Signal — 60 seconds
   - Cowl Anti-Ice Signal — 3 minutes

   The following subsystems, units, and components together compose this system:

   - Cowl Anti-Ice Valves
   - Cowl Anti-Ice Indicating System

2. **Description of Subsystems, Units and Components:**

   A. **Cowl Anti-Ice Valves:**

      The cowl anti-ice valves are electrically controlled and pneumatically operated. The valves receive 28V DC power from the respective (Left and Right) Essential DC bus, and are designed to be energized closed and de-energized open allowing full cowl anti-icing during normal aircraft operation.

B. Cowl Anti-Ice Indicating System:

The cowl anti-ice indicating system monitors fifth-stage bleed air pressure in the engine nose cowlings and transmits the data for display. The system consists of left and right cowl anti-ice pressure transducers installed in each engine inner feed duct and outer exhaust duct to sense high pressure conditions or pressure miscomparison. Sensed data is sent to the respective DAUs for presentation on CAS.

3. Controls and Indications:

(See Figure 2.)

NOTE:

A full description of the ECS / PRESS synoptic page can be found in Section 2B-03-30: Crew Alerting System Description.

A. Circuit Breakers (CBs):

The Cowl Anti-Ice system is protected by the following Circuit Breakers (CBs):

Circuit Breaker	Circuit Breaker Panel	Location	Power Source
L COWL ANTI-ICE	LEER	D-3	L ESS DC Bus
R COWL ANTI-ICE	REER	D-14	R ESS DC Bus
L COWL A/I PRESS	LEER	E-4	L MAIN DC Bus
R COWL A/I PRESS	REER	E-13	R MAIN DC Bus

A. Crew Alerting System (CAS) Messages:

CAS messages associated with the Cowl Anti-Ice system are:

Area Monitored:	CAS Message:	Message Color:
Left / Right Cowl Anti-Ice Valve Position Switch	L-R COWL VLV FL CL	Amber
	L-R COWL VLV FL OP	Amber
Left / Right Cowl Pressure Transducer	L-R COWL A/I HI	Amber
Left / Right Anti-Ice Switch Relay	L-R COWL A/I ON	Blue
Left / Right Cowl Pressure Transducer (Pressure Differential Greater Than 7 ±1 psig)	COWL A/I MISCOMP	Blue

NOTE:

A 15 second delay is incorporated into fault logic to minimize false messages.

4. Limitations:

(See Figure 3.)

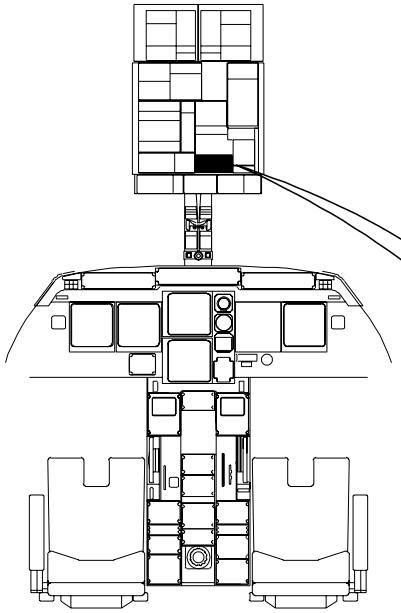
A. Flight Manual Limitations:

(1) Cowl Anti-Ice Requirements:

- Use of cowl anti-icing is required for taxi and takeoff when Static Air Temperature (SAT) is +8° C or below and visible moisture, precipitation, or wet runway are present. When taxiing or holding on the ground at low power in temperatures less than 1° C, engine operation at 40% LP for ten (10) seconds is recommended just prior to takeoff and at intervals of not more than sixty (60) minutes under these temperature and moisture conditions.
- Use of Cowl Anti-Icing system is required in flight as indicated in Figure 3: Temperature Range For Cowl Anti-Icing, when visible moisture or precipitation is present, or when signs of icing are observed. Ice accretion may be observed on wings or windshield edges.
- Increase in engine vibration levels may develop in icing. The fan should normally shed the ice and vibration will return to normal. To assist in shedding ice, if high vibration occurs and operational circumstances permit, one engine at a time may be quickly retarded to idle, held there for five (5) seconds and then accelerated to 90% LP, the power lever may then be returned to its original position.
- Automatic anti-ice is inhibited above 35,000 ft. If anti-ice protection is required, it must be manually selected.

(2) Takeoff With Cowl Anti-Ice Valve Locked Open:

Dispatch is prohibited with the cowl anti-ice valve (Grimes Aerospace Thermal Anti-Ice (TAI) Valve, Part No. 510-0020-02) locked (wrenched) OPEN.

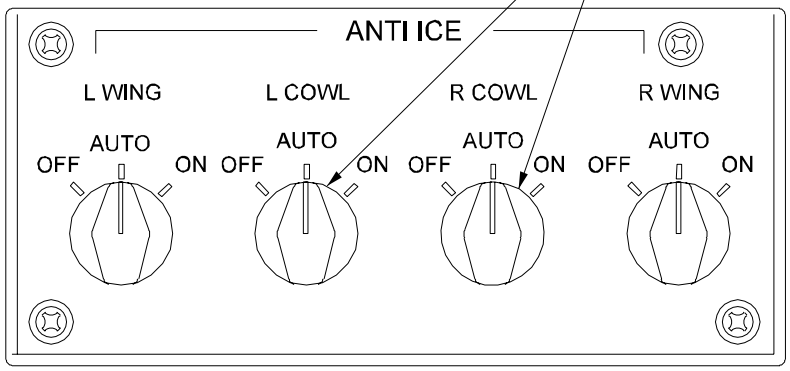


L COWL / R COWL ANTI ICE

OFF:
- Cowl anti-ice valves are closed; airflow is inhibited.

AUTO:
- Normal mode of operation.
- Left Essential DC Bus powers L COWL, Right Essential DC Bus powers R COWL.
- Airflow inhibited from ground to 1500 feet AGL (during climbout only) and above FL350. During descent, system remains functional until WOW shift to GROUND mode.
- BAC's continually process information, but take no action unless ice is detected.
- Aircraft altitude and ice detector input data used to schedule airflow. If ice is detected and altitude allows, anti-ice valves are opened.
- Blue L/R COWL A/I ON message displayed on Crew Alerting System (CAS) when airflow is operating.

ON:
- Used primarily when aircraft is on ground, but may be used anytime anti-ice is required.
- Bypasses ice detectors and automatic relays.



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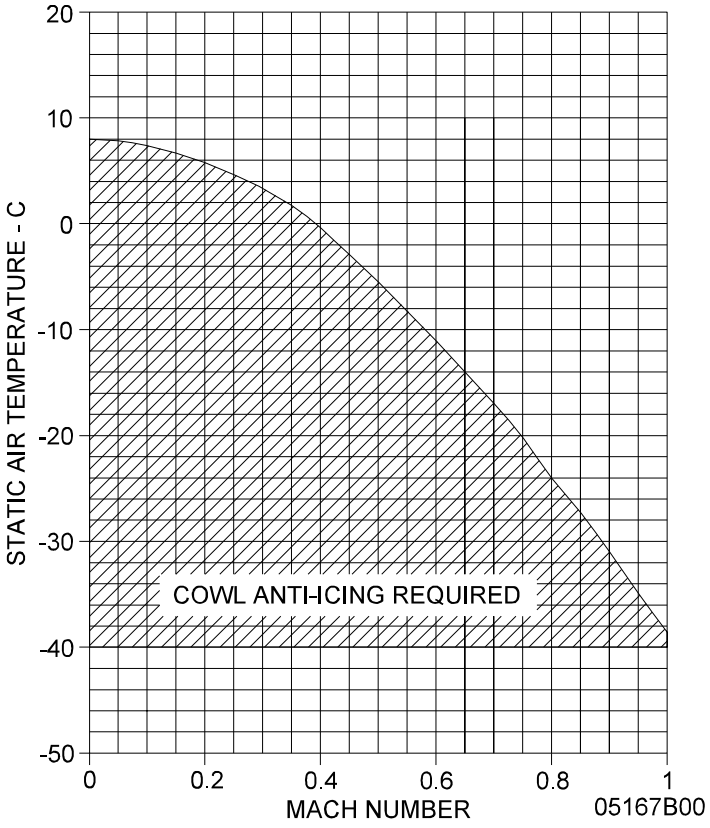
Cowl Anti-Ice Controls
Figure 2



Temperature Range For Cowl Anti-Icing
Figure 3

2A-30-40: Windshield Ice and Rain Protection System

1. General Description:

The windshield ice and rain protection system provides heat to remove ice accumulation and defog the front and side windshields, and to defog the cabin windows. A rain removal system is incorporated to remove rain from the front windshields.

It is divided into the following subsystems:

- Windshield Heat System
- Cabin Window Heat System
- Rain Removal System

A. Windshield Heat System:

The windshield heat system consists of two independent subsystems:

- Left Front and Right Side Windshield Heat System

- Right Front and Left Side Windshield Heat System

Each subsystem is composed of the following units and components:

- Windshield Heat Control Switches (LF/RS and RF/LS)
- Windshield Heat Control Units (WHCUs)

In addition, each front and side windshield is fitted with a heater film, two thermal sensors, and Metal Oxide Varistors (MOVs). The MOVs protect the system from an overvoltage condition resulting from an accumulation of static electricity.

B. Cabin Window Heat System:

The cabin window heat system consists of two independent subsystems:

- Left Cabin Window Heat
- Right Cabin Window Heat

Each subsystem is composed of the following units and components:

- Cabin Window Heat Control Switch (CABIN WDO HT)
- Power Fuses (SN 501 through 689)
- Emergency Exit Window Handle Switches

C. Rain Removal System:

There are two types of rain removal systems currently used on GV aircraft. They are:

(1) Windshield Blower System:

Effectivity: SN 501, 503, 505, 507 through 512, and SN 523 and subsequent. SN 504, 506 and SN 513 through 522 having Aircraft Service Change (ASC) 4.

The windshield blower system is composed of the following units and components:

- Windshield Blower Control Switch (WSHLD BLWR)
- Windshield Blower Actuator
- Windshield Blower Motor

(2) Windshield Wiper System:

Effectivity: SN 504, 506 and SN 513 through 522, not having ASC 4.

The windshield wiper system is composed of the following units and components:

- Windshield Wiper Control Switches (L / R WIPER)
- Windshield Wiper Speed Switches (L / R WIPER HI)
- Windshield Wiper Controllers
- Windshield Wiper Motors

2. Description of Subsystems, Units and Components:

A. Windshield Heat System:

(1) Windshield Heat Control Switches (LF/RS and RF/LS):

The Left Front/Right Side (LF/RS) switch and/or Right Front/Left Side (RF/LS) heat control switches are two-position (ON/OFF) switches. They are located on the Cockpit Overhead Panel (COP) in

the WINDSHIELD HEAT section. When in the OFF position, an amber OFF legend is illuminated in the switch.

When placed in the ON position, 115V AC power from the Left and Right Main AC buses is routed to the Windshield Heat Control Units (WHCUs), and the OFF legend in the switch is extinguished.

(2) Windshield Heat Control Units (WHCUs):

There are two Windshield Heat Control Units (WHCUs) located under the floor in the area of the Main Entrance Door. At initial power-on, each controller performs a self-test. If the self-test is passed, heating power is gradually applied to the front windshields, reaching full power in approximately four minutes. After the front windshields are fully powered, full power is applied to the side windshields. If power is removed for any reason, the controller repeats the procedure from the start.

The WHCUs automatically choose and monitor the sensors located on the front and side windshields. When the sensors reaches a temperature of approximately 114° F, the controller shuts off power to the front or side windshield until the temperature drops to approximately 104° F, and power is again applied. If one sensor fails, the controller automatically switches to the other sensor. If both sensors fail, or if a WHCU fails, a failure message is prompted for display on the Crew Alerting System (CAS) and stored in the Maintenance Data Acquisition Unit (MDAU).

(3) Windshield Heat Annunciator Lights:

There are two windshield heat annunciator lights located on the COP in the WINDSHIELD HEAT section. They are labeled LEFT and RIGHT. Each annunciator light contains two legends: FRONT and SIDE. The legends will either illuminate steady, blink at different rates or extinguish corresponding to the following logic:

(a) Steady Illumination:

Windshield has heating power applied – no faults exist.

(b) Blinking At One Cycle Per Second For Ninety Seconds:

Power to the windshield will be removed, the annunciator legend will extinguish, and a L/R F (or S) WSHLD FAIL message will be displayed on CAS, indicating one of the following conditions:

1 Overtemperature.

2 Both sensors have failed.

3 Overcurrent or no current detected with control switch selected on.

4 Current detected with control switch selected to OFF.

(c) Blinking At Three Cycles Per Second For Ninety Seconds:

Power will remain applied to the windshield and a L/R F (or S) WSHLD FAULT message will be displayed on CAS, indicating one of the following conditions:

- Single windshield sensor failure.

- Windshield heating film exceeds acceptable range of operation.

NOTE:

The CAS message will be extinguished five minutes after takeoff or five minutes after the fault has been detected, if already airborne.

(d) Extinguished:

Windshield does not have heating power applied for one of the following reasons:

1 A fault exists.

2 Control switch is selected OFF.

B. Cabin Window Heat System:

(1) Cabin Window Heat Control Switch (CABIN WDO HT):

The cabin window heat (CABIN WDO HT) control switch is a two-position (ON/OFF) switch. When in the OFF position, a blue OFF legend is illuminated in the switch. The location of the CABIN WDO HT switch varies according to the airplane's serial number. On SN 501 through 633, the switch is located in the MASTERS section of the COP, below the CABIN and GALLEY MASTER switches. On SN 634 through 644, the switch is located in the ANTI ICE HTR section of the COP, above the LEFT AOA switch. On SN 645 and subsequent, the switch is located above the LOWER PROBE switch.

When the CABIN WDO HT switch is placed in the ON position, 28V DC control power is routed to the Combined Weight-On-Wheels (CWOW) relay. If the aircraft is airborne (or the CABIN WDO HTRS GROUND BYPASS switch, located on the system monitor/test panel, is in the BYPASS position), 28V DC power is allowed through the CWOW relay to the cabin window heat control relays. These relays then route 115V AC power from the Left and Right Main AC buses to the acoustic window panes through power fuses (SN 501 through 689) and the emergency exit window handle switches. The OFF legend in the switch is then extinguished.

NOTE:

The cabin window heat system uses cooling airflow from flight to prevent cabin window temperatures from rising above design limits. While on the ground, use of the CABIN WDO HTRS GROUND BYPASS feature should be limited to a ten (10) minute period, followed by a ten (10) minute cool-down period. The use/cool-down period may be repeated as necessary. In addition, cabin window temperatures should be carefully monitored.

(2) Power Fuses (SN 501 through 689):

On SN 501 through 689, three 115V AC power fuses provide additional protection for each side of the cabin window heat system.

Each side's three fuses are wired in series and divided among the three phases of the 115V AC L/R WDO AC PWR circuit. Phase A is routed through a power fuse to the first and fourth window heaters, Phase B is routed to the second and fifth window heaters, and Phase C is routed to the third and sixth window heaters.

On SN 690 and subsequent airplanes, all power fuses and two 3-phase circuit breakers (L/R WDO HT) have been removed and replaced with six, single-phase circuit breakers (see circuit breakers list).

(3) Emergency Exit Window Handle Switches:

These switches remove 115V AC power from the breakaway electrical contacts to the heater film on the acoustic panes of the left and right side number 5 and 6 windows. The switches also provide a discrete to CAS to alert the flight crew that an emergency exit handle has been unlocked.

C. Rain Removal System:

(1) Windshield Blower System:

Effectivity: SN 501, 503, 505, 507 through 512, and SN 523 and subsequent. SN 504, 506 and SN 513 through 522 having ASC 4.

(a) Windshield Blower Control Switch (WSHLD BLWR):

The Windshield Blower (WSHLD BLWR) control switch is a two-position (ON/OFF) switch, located on the COP adjacent to the WINDSHIELD HEAT section. When in the OFF position, the blue ON legend is extinguished.

When placed in the ON position, 28V DC control power is routed to the windshield blower actuator relay and Weight-On-Wheels (WOW) relay. If aircraft WOW is in the GROUND mode, 28V DC power is allowed through the WOW relay to the windshield blower motor relay and windshield blower actuator. The ON legend in the WSHLD BLWR switch illuminates blue. The blower actuator opens the two blower doors, one for each front windshield. 115V AC power is then supplied to the windshield blower motor, forcing blower fan air across the front windshields.

When placed in the OFF position, power is removed from the blower motor and power is routed to the blower actuator to close the blower doors. The ON legend in the switch is extinguished.

NOTE:

WOW shift to the AIR mode will inhibit operation of the system, regardless of control switch position.

(b) Windshield Blower Actuator:

The windshield blower actuator opens and closes the blower doors. It receives open and close power from the WSHLD BLWR switch through the windshield blower actuator relay, from power supplied by the Left Main DC Bus. Its operation is governed as a function of WOW.

(c) Windshield Blower Motor:

The windshield blower motor powers a fan used to direct high speed fan air across the pilot and copilot front windshields. The motor receives power from the Left Main AC Bus. Operation of the motor is governed as a function of WOW and is dependent upon the blower doors being open.

(2) Windshield Wiper System:

Effectivity: SN 504, 506 and SN 513 through 522, not having ASC 4.

(a) Windshield Wiper Control Switches (L / R WIPER):

The Windshield Wiper (L / R WIPER) control switches are two-position (ON/OFF) switches, located on the COP adjacent to the WINDSHIELD HEAT section. When in the OFF position, the blue ON legend is extinguished.

When placed in the ON position, the ON legend in the switch illuminates blue. 28V DC power is routed through the windshield wiper speed switch to the windshield wiper controller. The controller will then command the wiper motor brake to release and allows power to the windshield wiper motor proportional to the speed selected by the speed switch.

When placed in the OFF position, the controller commands the wiper motor to park the wiper blades. When the controller determines the blade is parked, the brake is applied to the wiper motor to prevent movement of the wiper blades due to slipstream air. The ON legend in the switch is extinguished.

(b) Windshield Wiper Speed Switches (L / R WIPER HI):

The Windshield Wiper Speed (HI) control switches are two-position (high/low) switches, located beside their respective wiper control switches. When in the low (normal) speed position, the blue HI legend is extinguished.

When placed in the HI position, the HI legend in the switch illuminates blue and the wiper controller commands the wiper motor to high speed. When selected to the low speed position, the wiper controller commands the wiper motor to low speed and the HI legend is extinguished.

Operation of the speed control switches is dependent upon their respective wiper control switch being selected ON.

(c) Windshield Wiper Controllers:

A windshield wiper controller is incorporated into each windshield wiper system. They are located in the radome and are filtered for radio frequency interference.

The left (pilot's) controller receives power from the Left Essential DC Bus. The right (copilot's) controller receives power from the Right Main DC Bus. Each controller serves to determine inputs to the wiper motors (power and speed choice). It provides power to the wiper motor according to the inputs, controls parking of the wiper blades, and operates the motor brakes.

(d) Windshield Wiper Motors:

A windshield wiper motor is also incorporated into each windshield wiper system. They are located in the radome and are dedicated to their respective windshield wiper controller.

Like the windshield wiper controllers, the left (pilot's) wiper motor receives power from the Left Essential DC Bus and the right (copilot's) wiper motor receives power from the Right Main DC Bus. Each motor serves its controller by operating, braking and parking its associated wiper blade according to commands issued by the associated controller.

3. Controls and Indications:

(See Figure 4 and Figure 5.)

A. Circuit Breakers (CBs):

(1) The windshield ice and rain protection system is protected by the following CBs:

Circuit Breaker Name:	CB Panel:	Location:	Power Source:
L FRONT WSHLD	POP	B-2	L MAIN AC Bus
R FRONT WSHLD	CPOP	B-2	R MAIN AC Bus
L SIDE WSHLD	CPOP	A-3	R MAIN AC Bus
R SIDE WSHLD	POP	A-3	L MAIN AC Bus
L WDO HEAT CONT	LEER	K-15	L MAIN DC Bus
L WDO HEAT **(1)**	LEER	K-13	L MAIN AC Bus, ϕ A, B, C
L WDO HEAT 1&4 **(2)**	LEER	K-12	L MAIN AC Bus, ϕ A
L WDO HEAT 2&5 **(2)**	LEER	K-13	L MAIN AC Bus, ϕ B
L WDO HEAT 3&6 **(2)**	LEER	K-14	L MAIN AC Bus, ϕ C
R WDO HEAT CONT	REER	F-28	R MAIN DC Bus
R WDO HEAT **(1)**	REER	F-29	R MAIN AC Bus, ϕ A, B, C
R WDO HEAT 1&4 **(2)**	REER	F-29	R MAIN AC Bus, ϕ A
R WDO HEAT 2&5 **(2)**	REER	F-30	R MAIN AC Bus, ϕ B
R WDO HEAT 3&6 **(2)**	REER	F-31	R MAIN AC Bus, ϕ C

NOTE(S):

(1) SN 501 through 689.

(2) SN 690 and subsequent.

(2) The windshield blower system is protected by the following CBs:

Circuit Breaker Name:	CB Panel:	Location:	Power Source:
WSHLD BLWR	LEER	F-5	L MAIN AC Bus
WSHLD BLWR CONT	LEER	E-6	L MAIN DC Bus

NOTE(S):

(1) **Effectivity:** SN 501, 503, 505, 507 through 512, and SN 523 and subsequent. SN 504, 506 and SN 513 through 522 having ASC 4.

(3) The windshield wiper system is protected by the following CBs:

Circuit Breaker Name:	CB Panel:	Location:	Power Source:
L WSHLD WIPER	LEER	F-5	L ESS DC Bus
R WSHLD WIPER	REER	F-12	R MAIN DC Bus

NOTE(S):

(1) **Effectivity:** SN 504, 506 and SN 513 through 522, not having ASC 4.

A. Crew Alerting System (CAS) Messages:

CAS messages associated with the windshield ice and rain protection system are:

Area Monitored:	CAS Message:	Message Color:
LF/RS and RF/LS Windshield Heat Controllers & Temperature Sensors	L-R F WSHLD FAIL	Amber
LF/RS and RF/LS Windshield Heat Controllers & Temperature Sensors	L-R S WSHLD FAIL	Amber
Emergency Exit Window Handle Switches	CABIN WDO UNLOCKED	Amber
LF/RS and RF/LS Windshield Heat Controllers & Temperature Sensors	L-R F WSHLD FAULT	Blue
LF/RS and RF/LS Windshield Heat Controllers & Temperature Sensors	L-R S WSHLD FAULT	Blue

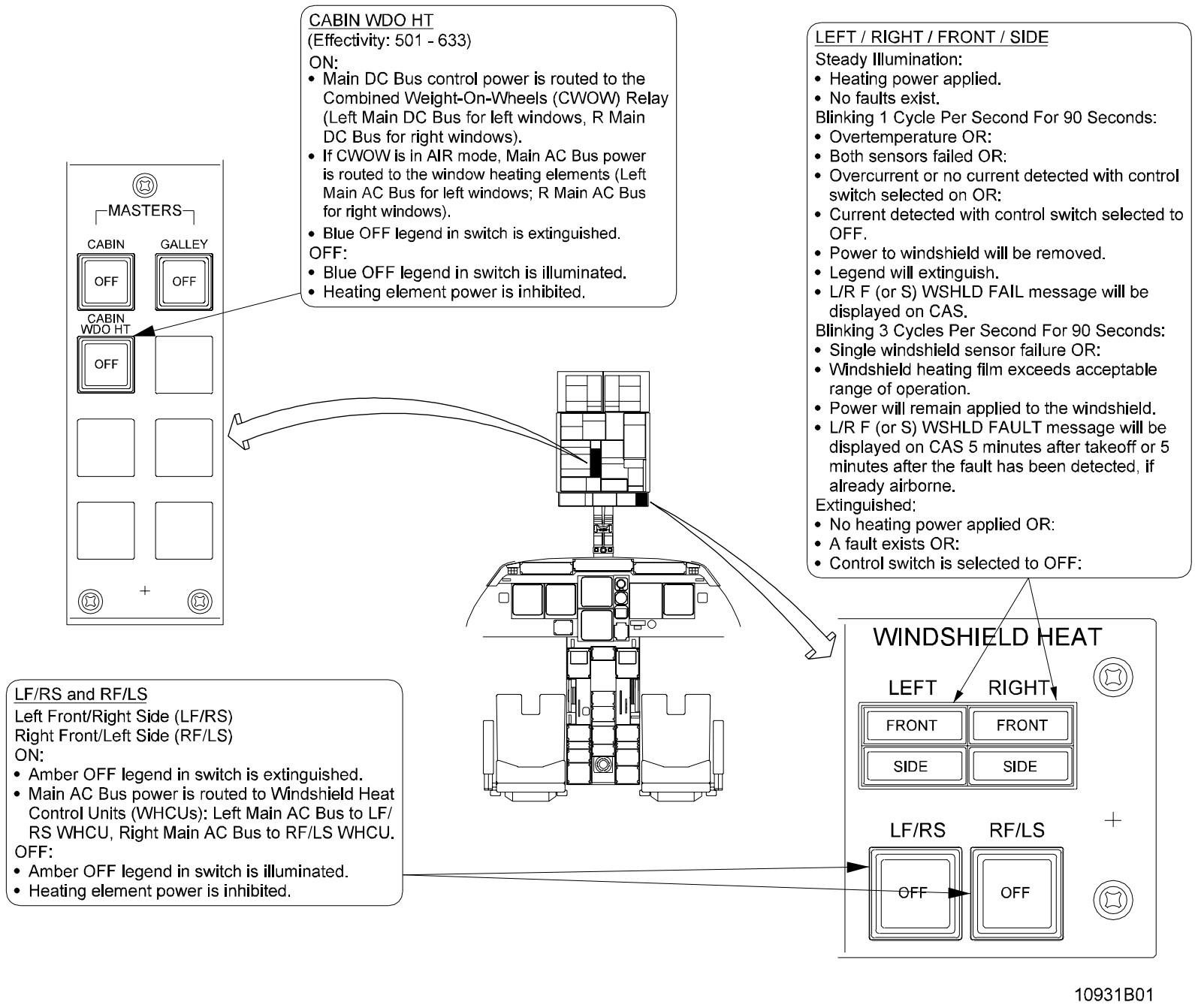
4. Limitations:

A. Flight Manual Limitations:

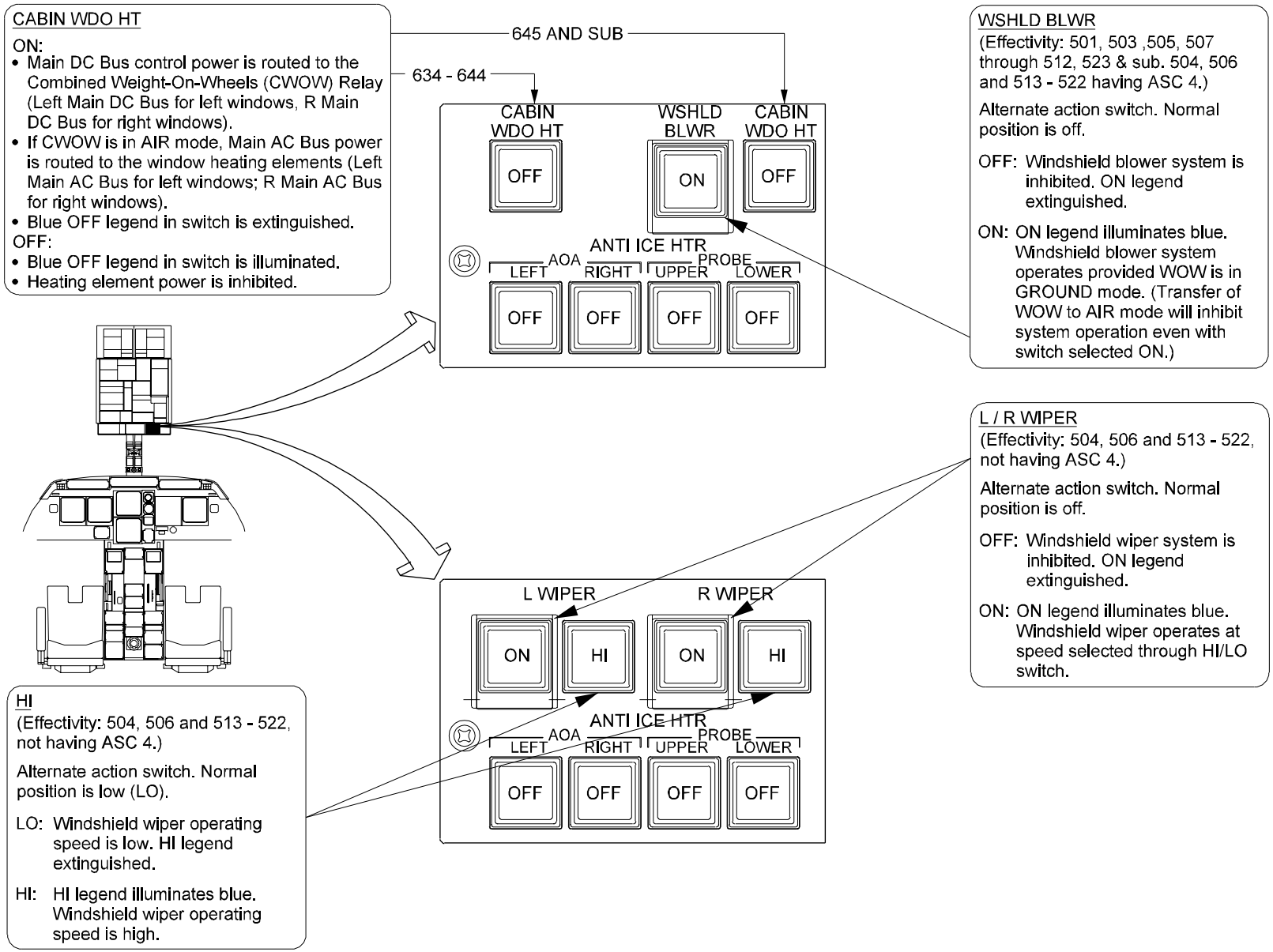
There are no Flight Manual limitations for the windshield ice protection system at the time of this revision.

B. Other Limitations:

Ground operation of the cabin window heat system using the CABIN WDO HTRS GROUND BYPASS feature should be limited to a ten (10) minute period, followed by a ten (10) minute cool-down period. The use/cool-down period may be repeated as necessary. In addition, cabin window temperatures should be carefully monitored.



Windshield Ice Protection System Controls and Indications
Figure 4



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Windshield Blower/Wiper System Controls and Indications
Figure 5

2A-30-50: Probe Anti-Ice System

1. **General Description:**

   The Probe Anti-Ice system prevents icing of the Angle of Attack (AOA) probes, pitot-static probes, and Total Air Temperature (TAT) probes.

   It is divided into the following subsystems:

   - AOA Probe Heat System
   - Pitot-Static Probe Heat System
   - TAT Probe Heat System

2. **Description of Subsystems, Units, and Components:**

   A. AOA Probe Heat System:

   The AOA probe heat system is activated by the LEFT and RIGHT AOA switches in the ANTI ICE HTR section of the Cockpit Overhead Panel (COP). If the AOA probes detect a probe heat failure or loss of heater power, an internal current sensing device sends a signal to the Crew Alerting System (CAS) via the data Acquisition Units (DAUs).

   B. Pitot-Static Probe Heat System:

   The pitot-static probe heat system is activated by the UPPER and LOWER PROBE switches, also located in the ANTI ICE HTR section of the COP. The lower left and upper right probes are dedicated as standby pitot-static probes for the standby airspeed/altimeter indicator unit. The two upper pitot-static probes are activated simultaneously by the UPPER probe anti-ice heater switch while the two lower probes are activated simultaneously by the LOWER probe anti-ice switch.

   C. TAT Probe Heat System:

   The TAT probe heat system is also activated by the UPPER and LOWER PROBE switches. Each TAT probe heater is wired in series with the Weight-On-Wheels (WOW) circuitry in the AIR mode. This feature allows TAT probe heat to be normally enabled when the aircraft is in flight.

   Each TAT probe has a ground bypass switch to check the heaters on the ground and to manually allow TAT probe deicing if required. It is located on the System Monitor / Test Panel on the Left Electronic Equipment Rack (LEER) and labeled TAT GROUND BYPASS. This switch bypasses the WOW relay circuit breaker to power the TAT probe heaters and activate the heater current sensors when the aircraft is on the ground. A guard is incorporated that automatically turns the switch off when the guard is closed.

   A TAT Probe Valve provides bleed air for aspirating the TAT Probes when the aircraft is on the ground. The valve is activated via the WOW relay.

3. **Controls and Indications:**

   (See Figure 6.)

   A. Circuit Breakers (CBs):

   The Probe Anti-Ice system is protected by the following CBs:

Circuit Breaker Name:	CB Panel:	Location:	Power Source:
#1 AOA HTRS	POP	A-4	L ESS DC Bus

Circuit Breaker Name:	CB Panel:	Location:	Power Source:
#2 AOA HTRS	CPOP	A-4	R ESS DC Bus
L UPR PITOT HTR	POP	A-6	L STBY AC Bus
R UPR PITOT HTR	CPOP	A-6	ESS AC Bus ΦA
L LWR PITOT HTR	POP	A-5	ESS AC Bus ΦA
R LWR PITOT HTR	CPOP	A-5	R STBY AC Bus
L UPR PITOT HT CONT	LEER	E-5	L ESS DC Bus
R UPR PITOT HT CONT	REER	E-12	R ESS DC Bus
L LWR PITOT HT CONT	LEER	D-5	L ESS DC Bus
R LWR PITOT HT CONT	REER	D-12	R ESS DC Bus
TAT #1 HEAT CONT	LEER	D-2	L ESS DC Bus
TAT #2 HEAT CONT	REER	D-15	R ESS DC Bus
#1 TAT PROBE HTR	LEER	E-2	L STBY AC Bus
#2 TAT PROBE HTR	REER	E-15	R STBY AC Bus
TOTAL TEMP VALVE	REER	F-15	R MAIN DC Bus

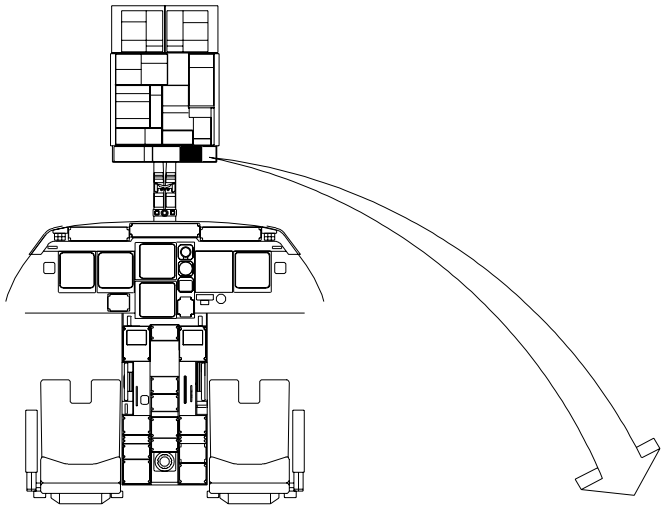
A. Crew Alerting System (CAS) Messages:

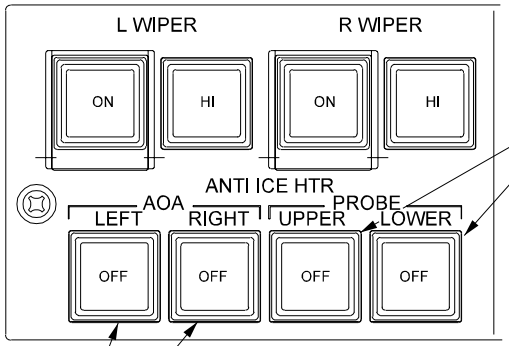
CAS messages associated with the Probe Anti-Ice system are:

Area Monitored:	CAS Message:	Message Color:
Left/Right Lower Pitot Heater	MADC 1-3 PITOT FL	Amber
Left/Right Upper Pitot Heater	MADC 2-SBY PITOT FL	Amber
TAT #1/2 Probe Heater	TAT PROB 1-2 HT FL	Amber
AOA #1/2 Probe Heater	AOA PROB 1-2 FL	Amber

4. Limitations:

There are no limitations for the Probe Anti-Ice system at the time of this revision.





UPPER / LOWER PROBE

ON:

- Amber OFF legend is extinguished.
- Pitot Probes:
  Essential DC Bus control power is routed to the UPPER and LOWER pitot heat power relays (Left Essential DC Bus for Left UPPER and LOWER probe relays; Right Essential DC Bus for Right UPPER and LOWER probe relays). The power relays then allow AC Bus power to the probes (Left Main AC Bus for Left UPPER and Right LOWER probes; Essential AC Bus for Right UPPER and Left LOWER probes).
- Total Air Temperature (TAT) Probes:
  Essential DC Bus control power is routed to the (Combined Weight-On-Wheels (CWOW) Relay (Left Essential DC Bus for #1 TAT Probe, R Essential DC Bus for #2 TAT Probe). If CWOW is in AIR mode, Main AC Bus power is allowed to heat probes (Left Main AC Bus for #1 TAT Probe; R Main AC Bus for #2 TAT Probe).
- Total Temperature Probe Heat Valve:
  Right Main DC Bus power is routed to the CWOW relay. If CWOW is in GND mode, power opens valve to allow heating air.

OFF:

- Amber OFF legend in switch is illuminated.
- Heating power to pitot probes and TAT probes is inhibited.
- Power is inhibited from total temperature probe heat valve. Valve then closes.

LEFT / RIGHT AOA

ON:

- Amber OFF legend is extinguished.
- Essential DC Bus power is routed to the left and right AOA case/vane heaters (Left Essential DC Bus to left; Right Essential DC Bus to right).

OFF:

- Amber OFF legend is illuminated.
- Heating power to case/vane heaters is inhibited.

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ANTI ICE HTR Control Panel
Figure 6

2A-30-60: Ice Detection System

1. General Description:

The primary purpose of the Ice Detection system is to detect icing conditions. The secondary purpose is to control aircraft cowl and wing anti-ice systems to minimize fuel use and maximize aircraft range.

It is composed of the following units and components:

- Ice Detector Probes
- Ice Detector Test Switch

2. Description of Subsystems, Units and Components:

A. Ice Detector Probes:

One ice detector probe is mounted on each side of fuselage (located below pilot and copilot windows) to provide a receptive surface for ice droplets. Ice accumulation is measured on the tip of both detector probes. Ice formation on the probe tips change the resonant properties of the probes in proportion to the accumulated ice thickness.

Messages are displayed on the Crew Alerting System (CAS) whenever a failure occurs or ice is detected. The messages are inhibited on the ground by Weight-On-Wheels (WOW) logic.

System logic inhibits automatic functioning of cowl and wing anti-ice during climb when below 1500 feet AGL and again above FL350. During descent, however, cowl and wing anti-ice remain functional below 1500 feet AGL.

Whenever the anti-ice system is in the Automatic (AUTO) mode, and the left and/or right ice detector detects ice, the respective ICE DETECTED messages are displayed on CAS. Cowl and wing anti-ice valves are commanded open through the left or right ice detector.

In the AUTO mode, ice detection system outputs will shut off in the following order after ice is no longer detected:

(1) ICE DETECTED signal — 60 seconds.

(2) Cowl anti-ice signal — 3 minutes.

(3) Wing anti-ice signal — 5 minutes.

B. Ice Detector Test Switch:

The ice detector test switch, labeled ICE DET, is located on the Cockpit Overhead Panel (COP) in the SYSTEM TEST section. Depressing the switch tests both ice detector probes simultaneously by simulating detection of wing and/or cowl inlet ice. For the test to be accomplished, the following conditions must be present:

(1) L/R WING ANTI ICE switches must be in AUTO to test wing anti-ice valves.

(2) L/R COWL ANTI ICE switches must be in AUTO to test cowl anti-ice valves.

(3) Actual detected icing conditions must not be present.

(4) No detected failures can be present.

With the system correctly configured, the following events occur:

- Associated anti-ice valves are opened.
- Bleed air is provided.

- L/R ICE DETECT FL and L/R ICE DETECTED messages are displayed on CAS.
- If on the ground with APU BLEED AIR ON, the APU load control valve will close until the test is complete.

The test lasts for three seconds and verifies correct output state.

3. Controls and Indications:

(See Figure 7.)

A. Circuit Breakers (CBs):

The Ice Detection system is protected by the following CBs:

Circuit Breaker Name:	Circuit Breaker Panel:	Location:	Power Source:
L ICE DET	LEER	F-3	ESS AC Bus
L ICE DET CONT	LEER	E-3	L ESS DC Bus
R ICE DET	REER	F-14	ESS AC Bus
R ICE DET CONT	REER	E-14	R ESS DC Bus

A. Crew Alerting System (CAS) Messages:

CAS messages associated with the Ice Detection system are:

Area Monitored:	CAS Message:	Message Color:
Left/Right Ice Detector Probe	L/R ICE DETECT FL	Amber
Left/Right Ice Detector Probe	L/R ICE DETECTED	Amber

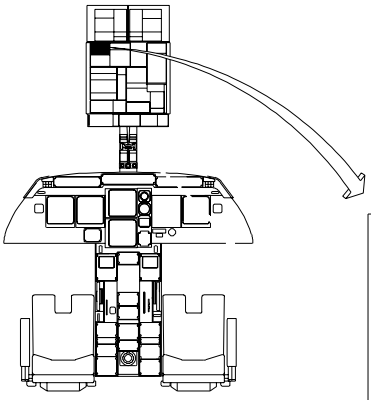
4. Limitations:

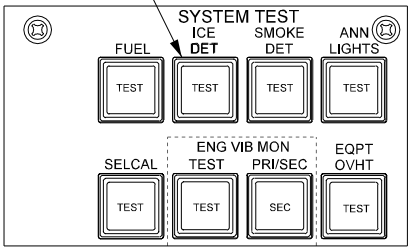
There are no limitations for the Ice Detection system at the time of this revision.

ICE DET

When selected:

- Blue TEST legend is illuminated for 3 seconds.
- Detection of wing and/or cowl inlet ice is simulated.
- L/R WING ANTI ICE switches must be in AUTO to test wing anti-ice valves.
- L/R COWL ANTI ICE switches must be in AUTO to test cowl anti-ice valves.
- Actual detected icing conditions must not be present.
- No detected failures can be present.
- The associated anti-ice valves are opened and bleed air is provided.





SYSTEM TEST Panel
Figure 7