2.23. ICE DETECTION SYSTEM

The ice detection system consists of an ice detector located on the right side of the airplane nose and two ICE amber caution lighted pushbuttons on both the pilot's and copilot's side of the instrument panel.

The detector generates a 5-second electrical output pulse when a 0.5-millimeter thickness of ice is reached on the detector probe, and simultaneously heating is applied to the probe to be cleared from ice and becoming ready to repeat the cycle.
The detector output signal drives the ICE caution lights and is utilized by the electronic control unit that controls the operation of the deicing boots on the left and right engine nacelle air intakes when the automatic mode is selected.

A visual ice accretion probe, located on the windshield, is provided as a back-up of the ice detector.

During an ice encounter, a periodic illumination of the ICE lights (for 5 seconds) shall then be observed: the duration of the interval between two signals depends on the severity of the ice condition.
Should the amber lights remain always ON (even in clear air), that would indicate a failure of the sensing probe: in this case the ice accretion may be checked observing the visual accretion probe.

A wing inspection light is installed in the outboard side of the left engine nacelle to allow the pilot, if necessary, to check icing conditions during night flight. This light is controlled by the WING switch located in the LIGHTS control panel: electrical power is supplied by the right single feed bus through the WING INSP LT 3-ampere circuit breaker located on the right circuit breaker panel.

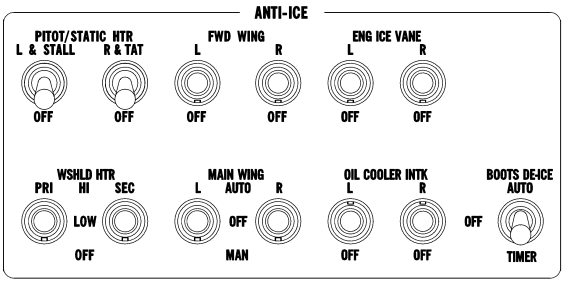

Figure 2.23-1. Anti-ice System Controls

The ICE lights flashing (at a rate of one second approximately) indicates that one or more of the anti-ice systems has not been switched on, or a malfunction exists, or the normal operating conditions have not yet been reached.
The systems monitored are: the left and right forward and main wings, the left and right engine ice vane and the oil cooler intake.
The ICE lights will continue to flash until reset by pushing the lighted pushbutton. To locate the affected system, check the corresponding indications on the Anti-ice System status section of the MFD System Page.

The preflight test of the ice detection system is accomplished by selecting the ICE DET position on the SYS TEST panel and pressing the central button: the ICE amber lights will illuminate then, after few seconds, will blink until the system is reset.

The ice detection system is fed from the essential bus through the ICE DET 10-ampere circuit breaker on the pilot circuit breaker panel.

2.24. WINDSHIELD DEFOG/ANTI ICE SYSTEM

Electric heating of the windshield is used to guard against and/or alleviate icing and fogging.
The windshield heating is based on six heating elements divided in two independent systems: one primary and one secondary.

The two systems are controlled by individual switches, labeled WSHLD HTR PRI and SEC, located in the ANTI-ICE control panel on the central lower portion of the instruments panel: each switch can be set in HI, LO and OFF position.
Setting the switches to the LO or HI position, the heating elements operate as illustrated in the following table:

Switch position	LO	HI
PRI	ZONE 2, 5, 4: DE FOG	ZONE 2: ANTI ICE
SEC	ZONE 1, 5, 3, 6: DE FOG	ZONE 1: ANTI ICE ZONE 6: DEFOG

The windshield is thermostatically controlled against overheating. Three controllers drive the on/off cycling time of the heating elements as a function of the selected operating mode and of the temperatures measured by the thermal sensors located on each heating element.
The L and R WSHD ZONE red warning lights on the annunciator panel will illuminate either if an overheating condition is detected or a malfunction of a controller occurs.

The proper operation of each heating system (primary and secondary) can be checked by selecting the PRI WSHLD HTR switch to LO position while monitoring the electrical load on the MFD System Page: with both engines running an increase of power absorption between 20 and 30 Amp should be read; similarly, when selecting the SEC system to LO position, the increment should be between 25 and 35 Amp. The higher values correspond to peak condition or to low ambient temperature, while the lower ones to stabilized condition or high ambient temperature.

Separate circuit breakers for the heating and for the control system are provided. The electrical power is delivered as follows:

– from the left generator bus to the heating elements of ZONE 2 and 4 through the PLT L WSHLD Z HTR and of ZONE 5 through the PLT S WSHLD HTR, both rated at 0.5 Amp. and located on the left circuit breaker panel.

– from the right generator bus to the heating elements of ZONE 1 and 3 through the CPLT WSHLD HTR and of ZONE 6 through the PLT R WSHLD Z HTR, both rated at 0.5 Amp. and located on the right circuit breaker panel.

Primary system control circuits are fed by left single feed bus through the PRI WSHLD CONT 3 Amp circuit breaker located in the left panel and the secondary system control circuits by the right single feed bus through the SEC WSHLD CONT 3 Amp circuit breaker located in the right panel.

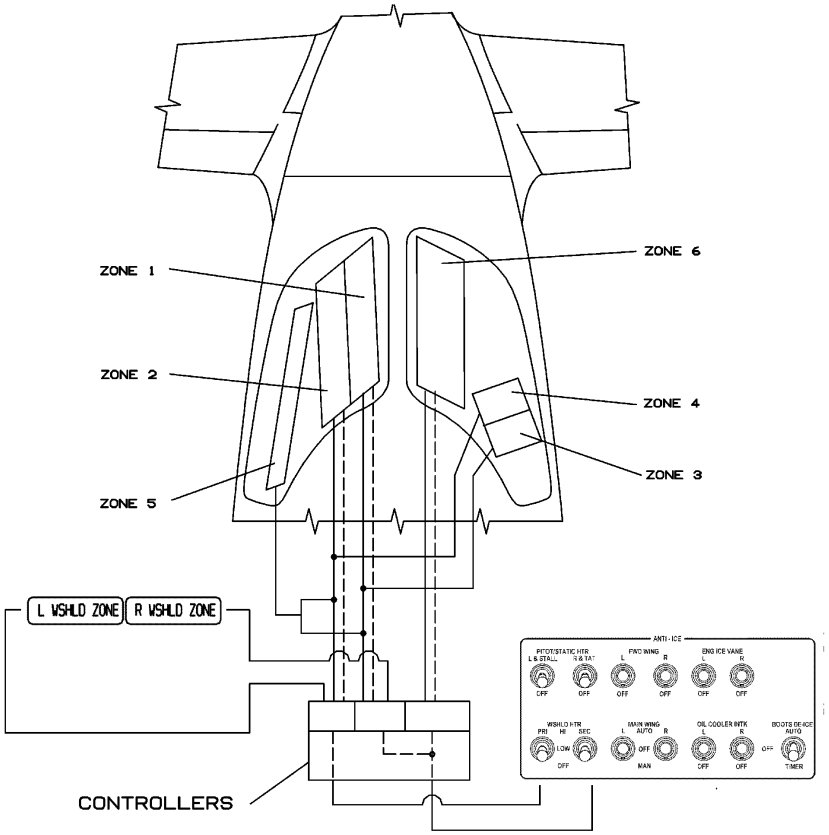

Figure 2.24-1. Windshield Defog/Anti-ice System

2.25. SURFACES ICE PROTECTION

MAIN WING ICE PROTECTION

The main wing leading edge is protected against ice accretion by a hot air system utilizing the engine compressor delivery bleed air while the forward wing leading edge is protected by an electrical heating system. No anti ice system is provided on the horizontal and the vertical tail.

Wing anti-icing is accomplished by hot air flowing through three diffusers, one installed in the inboard and two in the outboard leading edge.

The system is controlled by two three-position switches (one for each wing) located in the ANTI-ICE control panel on the central lower section of the instrument panel and placarded MAIN WING L/R AUTO-OFF-MAN.

The airflow coming from the engine high pressure port is routed, through the emergency pressurization/anti-ice lines, a control valve and an ejector to the wing leading edge.
Left and right emergency pressurization lines are interconnected in order to feed both wings anti-ice system in the event of engine failure.
The control valve can be controlled directly by the pilot (MANUAL mode) or by the automatic temperature control unit (AUTO mode).
The hot air, mixed by the ejector with cold ambient air, reaches the diffusers in the inboard and ouboard leading edge: discharges of the air are provided inside the engine nacelle and at the wing tip.

The indications of the Anti-ice System status, on the MFD System Page, are controlled by a temperature switch for each wing, downstream the control valve, and the green ON indications will appeare when a preset value is reached, giving a positive indication that the air is going to the leading edge and that the sensors and the controller are efficient.
In the AUTO mode the green ON indications, on the left and right side of the "MW" legend, will be displayed if the system is working properly and extinguish if the air temperature is too low or the system has failed.

Three temperature sensors have been installed (close to the warmest zone of the leading edge) which provide both the feedback to the control unit (AUTO mode only) and a warning signal in case of wing skin overtemperature (L or R MN WG OVHT red light will illuminate on the annunciator panel).

Control circuits are fed by the left and right dual feed bus through the 3 Amp. L and R WING HTR circuit breakers located respectively on the left and right circuit breakers panel.
Overtemperature sensing circuits are fed by the essential bus through the 3 Amp. WING OVHT circuit breaker on the left panel.

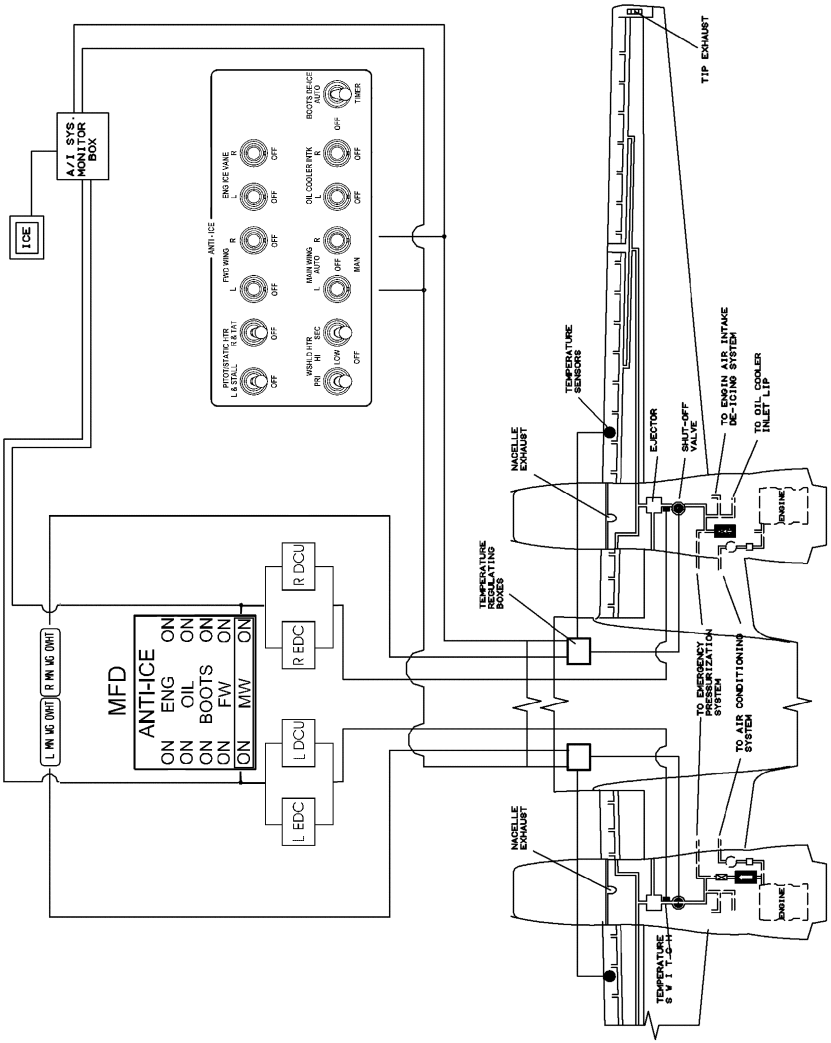

Figure 2.25-1. Main Wing Surface Ice Protection System

When the system operates in AUTO mode, two of the temperature sensors send signal to the control unit which calculate the main value and, as function of this value, operates the shut off/control valve step by step or continuously.

The MANUAL mode of operation should be used only in case of a failure in the automatic mode (green ON indications not displayed in AUTO mode) and the ON indications appear to indicate that the hot air is flowing to the diffusers at the right temperature value.

The third temperature sensor allows the pilot to control the maximum wing skin temperature (red L or R MN WG OVHT lights illuminated).

The OFF position of the switch causes the shut off/control valve to return in the closed position.

When the MANUAL mode of operation is necessary, pilot must periodically switch the system to MANUAL then OFF (if the ice conditions are such to maintain the overtemperature light off, the switch may be maintained constantly on "MANUAL" till the overtemperature is detected).

FORWARD WING ICE PROTECTION

The forward wing anti-ice system consists of eight heating elements installed in the leading edge.

The two-position switches on the ANTI-ICE control panel placarded FWD WING L / R -OFF allow the operation of the system.

The leading edge temperature is automatically maintained below a preset value by two thermostats for each wing.
Should a malfunction occur to the thermostats, two thermal switches per each wing provide protection against overtemperature: in this case the L/R FWD WG OVHT red light will illuminate on the annunciator panel.

The indications of the Anti-ice System status, on the MFD System Page, are controlled by a temperature switch for each wing, and the green ON indications, on the left and right side of the "FW" legend, will appeare when the skin temperature reaches a preset value.

Electrical power to control both systems (left & right) is supplied by the left and right single feed bus through the L and R FWD WING HTR 3 Amp. circuit breakers located on the left and right circuit breaker panels. Electrical power for the heating elements is supplied from the L and R GEN bus remote control circuit breakers (RCCB) located in the main junction box.
Two additional 0.5 Amp. circuit breakers, labeled L and R FWD WG HTR CONT and located in the left and right circuit breaker panel, are connected with the above mentioned RCCB.

In case of failure of a surface de-ice system, the corresponding green ON indication will extinguish and simultaneously the amber ICE lights will blink until reset.

Consult the Normal Procedure section of the AFM for the preflight check of the surfaces de-ice systems.

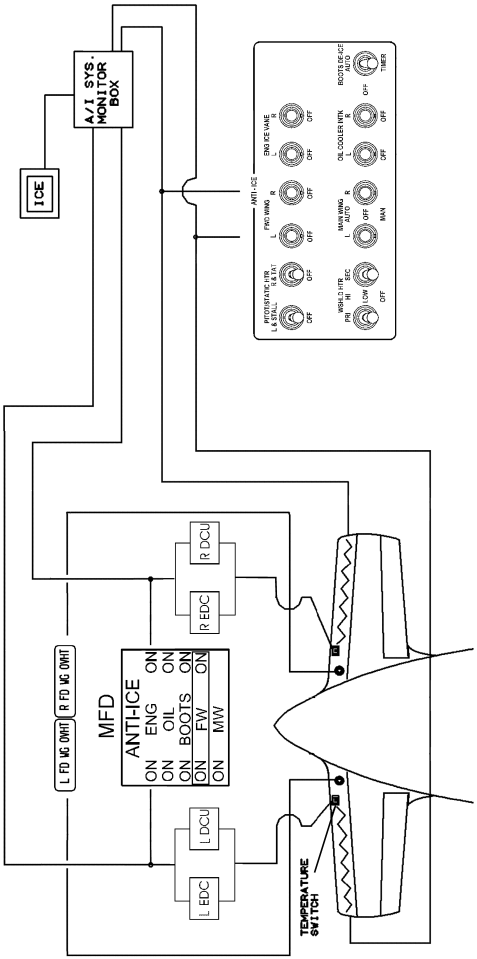

Figure 2.25-2. Forward Wing Surface Ice Protection System

2.11. ENGINE ICE PROTECTION

The ice protection system of each engine consists of an engine nacelle air intake lip deicing system, an inertial separator system built into the engine air intake duct, and an anti-icing system on the air intake of the engine oil cooler.

BOOTS DE-ICE SYSTEM

Each nacelle air intake lip is protected by a pneumatic boot deicer operated by compressor bleed air through a pressure regulating/relief valve and a distributor valve which provides inflation and deflation of the boot. Suction for deflating and holding down the boot is supplied by an integral ejector incorporated in the distributor valve.

The deicing boots of the left and right engine nacelle air intake are actuated through a single control. The BOOTS DE ICE three position switch allows controlling the deicing boots in two modes of operation.

Setting the switch from the OFF to the TIMER position, the two distributor valves to the left and to the right engine nacelle air intake boot are operated by a single sequential timer. The operating sequence is of 5 seconds simultaneous inflation of all boots followed by 175 seconds deflation for a total time of 180 seconds per cycle. Setting the switch to the AUTO position the distributor valves are operated by an electronic control unit connected with the ice detector. The ice detector generates a 5-second electrical output pulse each time a preset thickness of ice is reached on the probe, then deices and becomes ready to icing again in about 7 seconds. The electronic control unit operates the distributor valves for a 6-seconds pressure delivery to the boots after 10 pulses from the ice detector then resets the counter.

A pressure switch, connected downstream each distributor valve, allows monitoring the inflation of the corresponding boot by switching on an advisory indication on the MFD System Page (Anti-ice System Status section): two green ON annunciations are displayed on the left and right side of the "BOOTS" legend, respectively for the left and for the right nacelle air intake boots,

The boot deice system is energized from the right dual feed bus through the 5-ampere BOOTS DEICE circuit breaker located on the copilot circuit breaker panel.

INERTIAL SEPARATOR SYSTEM

The inertial separator system prevents not acceptable ice accretion at the engine inlet and/or ice ingestion. A deflector vane and the coupled by-pass door are operated by an electrical linear actuator. Electrical power is delivered to the left engine nacelle actuator from the left dual feed bus through the 3-ampere L ENG ICE VANE circuit breaker on the pilot circuit breaker panel and to the right engine nacelle actuator from the right dual feed bus through the 3-ampere R ENG ICE VANE circuit breaker on the copilot circuit breaker panel.

The two-position switches L and R ENG ICE VANE control the inertial separator system actuator of the corresponding left or right engine. Setting the switches to L and R positions the deflector vanes and the by-pass doors are extended in about 20 seconds. On the MFD System Page (Anti-ice System status section), two green ON annunciations are displayed on the left and right side of the "ENG" legend when the corresponding inertial separator vanes are extended. When a system malfunction occurs the "ENG" legend becomes yellow and the amber ICE lights start flashing.

OIL COOLER ANTI-ICE SYSTEM

Compressor bleed air is derived from each engine to the corresponding oil cooler air inlet for ice prevention. Bleed air delivery to the air inlets is controlled through electrically actuated shutoff valves.

Electrical power is supplied to these shutoff valves from the right single feed bus through the 3-ampere L and R OIL COOLER circuit breakers on the copilot circuit breaker panel.

The two-position switches L and R OIL COOLER INTK control the oil cooler anti-icing valve of the corresponding left or right engine. Setting the switches to L and R positions the oil cooler anti-icing valves open. On the MFD System Page (Anti-ice System status section), two green ON annunciations are displayed on the left and right side of the "OIL" legend when the corresponding oil cooler intake lip reaches a preset value. When a system malfunction occurs the "OIL" legend becomes yellow and the amber ICE lights start flashing.

NOTE

A torque drop will be noted when the deflector vane and the by-pass door are extended.

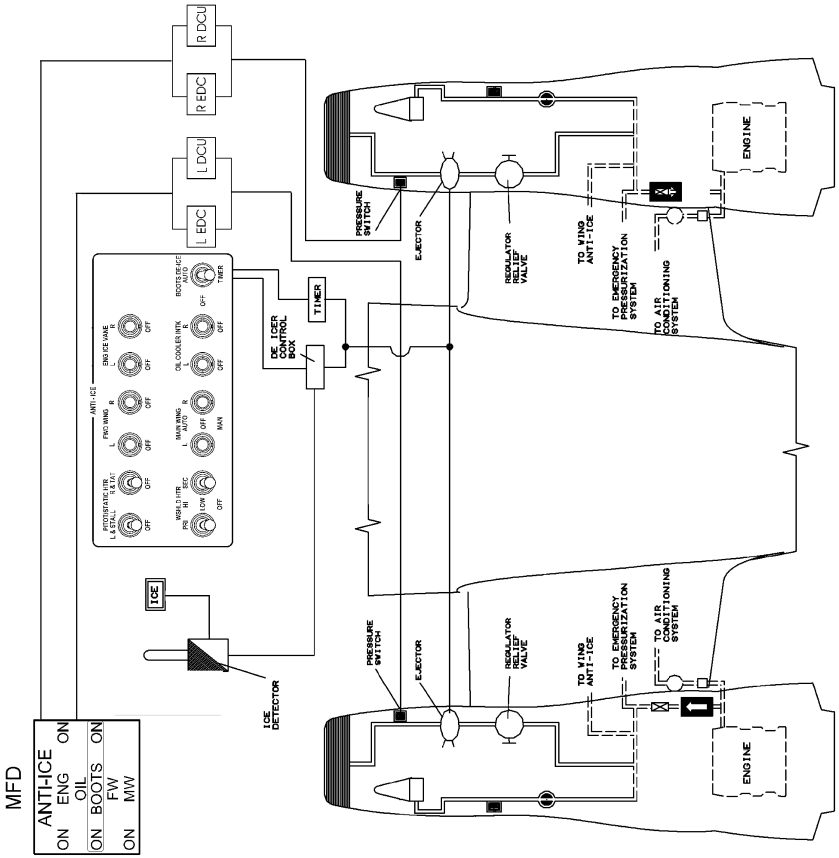

Figure 2.11-1. Engine ice protection - Boots Deice System

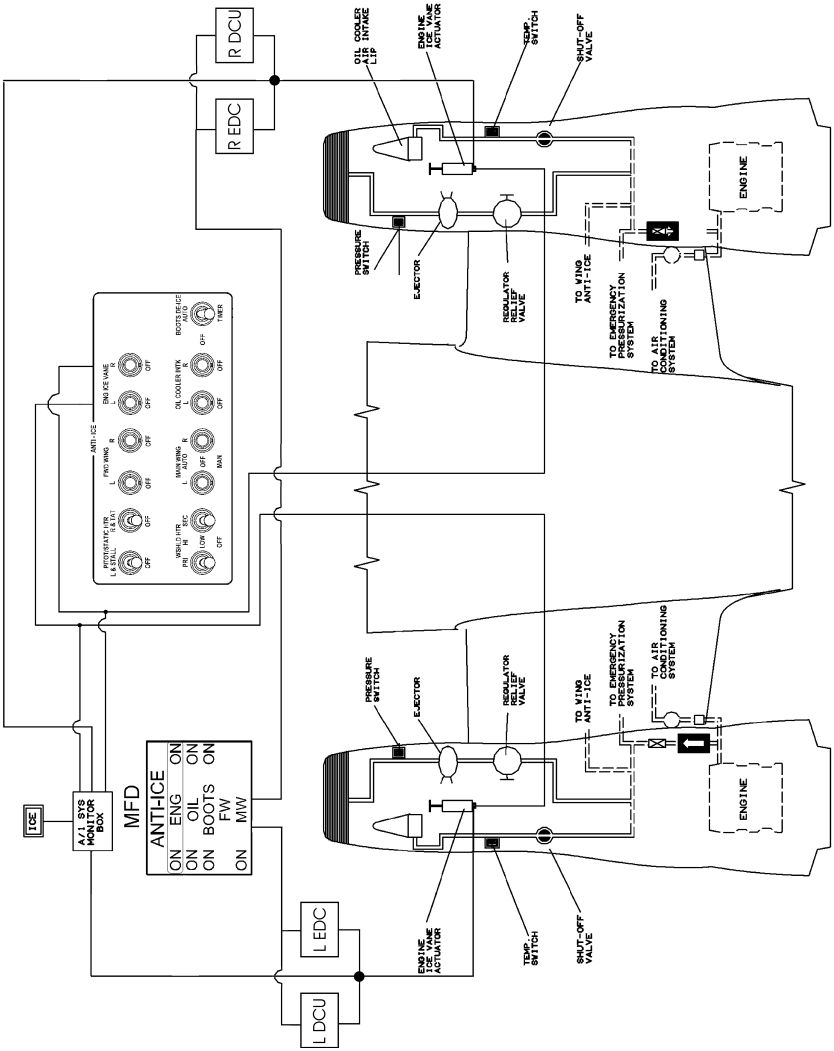

Figure 2.11-2. Engine ice protection - Inertial Separator System

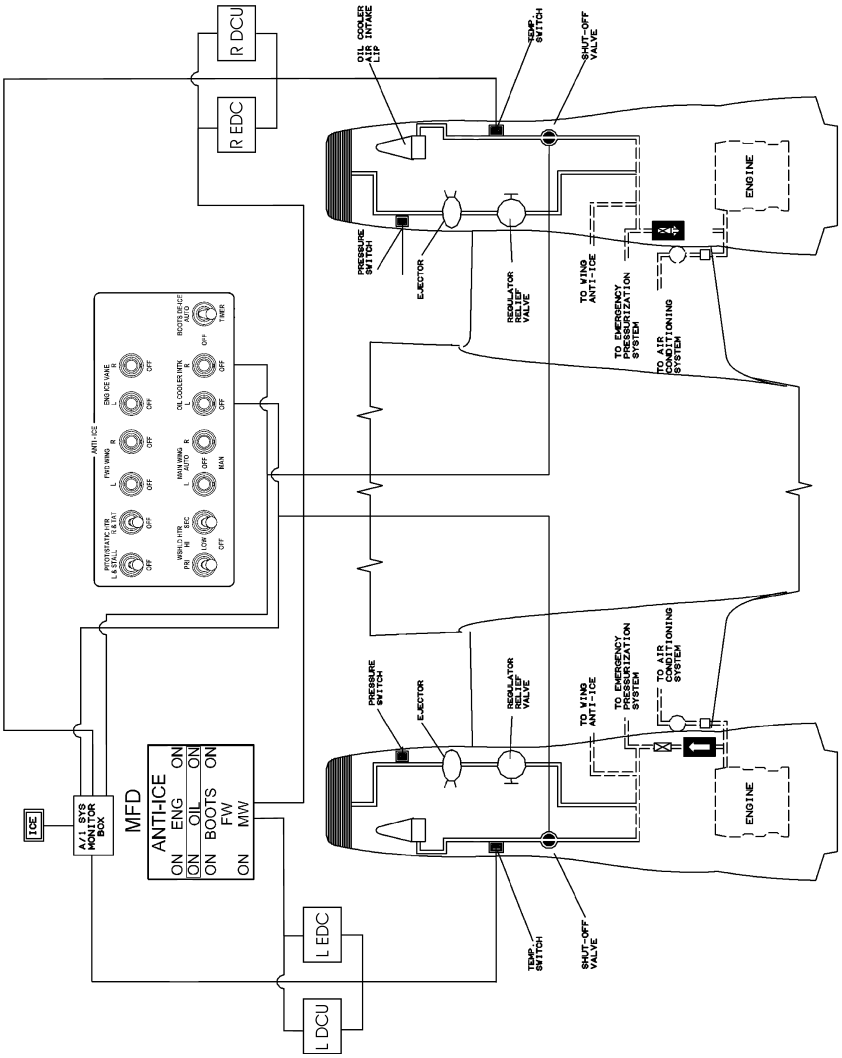

Figure 2.11-3. Engine ice protection - Oil Cooler Anti-ice System