

AIRFRAME ICE PROTECTION SYSTEM - DESCRIPTION AND OPERATION

1. Description

An airframe ice protection system is provided as shown (Ref. [Figure 1](#)) with the detailed fuselage component location (Ref. [Figure 2](#)) and the associated schematic wiring diagram (Ref. [Figure 3](#)).

De-icing fluid is stored in a tank which is vented to cabin pressure through a main rising pipe and a secondary vent pipe connected to the forward face of the tank and coupled to the rising pipe.

The de-icing fluid pump is a two-speed compound wound 28 volt d.c. motor-driven unit, controlled by a WING/TAIL ANTICE time switch located on the flight compartment roof panel CG. The time switch is clockwork-driven such that the action of setting the pointer winds the clockwork mechanism for any period up to a maximum of 10 minutes.

When the switch is reset from zero, the pump will run at high speed for 1 minute and then revert to normal speed for the remainder of the time selected. This facility provides an approximate 50% increase in initial flow rate which aids system priming. The increased 'priming' flow can be selected at any time by resetting the switch from zero. If the switch is reset prior to reaching zero, then priming flow will not be supplied.

When the time switch has run down to zero, audio warning is given by an antice chime unit or tone generator and directed through the Audio Integrating System (Ref. [23-50-10](#)) to headset/speakers to indicate that pump operation has ceased.

Indication of low fluid supply pressure is given, after a 15 second delay (to allow initial pressure build-up), by the amber ANTICE LO PRESS annunciator on the roof panel and the amber ICE PROT↑ repeater annunciator on the MWS panel.

Indication of de-icing fluid tank contents is provided by a gauge mounted on the front main panel of the pilots' right-hand console. The gauge is a moving coil d.c. voltmeter, calibrated to indicate de-ice fluid levels, and is electrically connected to a vertically mounted transmitter in the tank. The transmitter (Ref. [Figure 2](#) and [Figure 3](#)) consists of a chain of resistors arranged as a potential divider, reed switches connected between the resistors and the output to the gauge, and a sliding float assembly with integral magnet. The magnet will operate a reed switch to connect a voltage from the potential divider, proportional to fluid level, to the contents gauge. When the tank contents fall below the level approximately equal to 30 minutes fluid supply remaining, a switch within the transmitter operates an amber ANTICE LO QTY annunciator on the roof panel and the amber ICE PROT↑ repeater annunciator on the MWS panel. A 25 second time delay is incorporated in the circuit to prevent false indications due to fluid movement in the tank when the level is near that at which the switch operates.

2. Operation

A. General

With the d.c. busbars energized, capacitor EL is fully charged. Selecting the WING/TAIL ANTICE time switch for a period of operation up to 10 minutes allows capacitor EL to discharge and also connect a PS2 busbar supply to operate the motor-driven pump (Ref. [Figure 1](#) and [Figure 2](#)).

De-icing fluid is drawn from the tank through a suction filter to the pump where its output is fed through the pressure filter and the check valve, which opens when delivery pressure reaches 10 psi. The head compensating valve, which is set at approximately 4.5 psi, makes sure equal fluid pressure at the wings and horizontal stabilizers. The fluid next passes to the wing and horizontal stabilizers proportioning units and finally to the distribution panels at the aerofoil leading edges.

The proportioning units have accurately calibrated metering plugs through which the fluid is apportioned to each individual distributor. This makes sure that if a pipe disconnect takes place in service the fluid supply to the other outlets is maintained. A non-return valve in each proportioner outlet prevents back-flow of fluid.

The outboard distributor panel on each wing is constructed of laser drilled titanium. At each distributor panel the de-icing fluid enters a cavity before passing through a micro-porous plastic sheet to a sintered mesh stainless steel or laser drilled titanium outer skin. As fluid escapes to atmosphere, it is directed, by the airflow, rearward over the aerofoil.

To facilitate purging of air during system priming, each distributor panel incorporates a capillary tube which enters the rear of the panel at a high point in the cavity, and exits at a low point on the front face of the panel. As fluid is pumped into the cavity, trapped air will escape through the capillary tube. During normal system operation a small quantity of fluid will bleed from this tube. A non-return valve and protective filter screen installed in the capillary tube prevent air entering the cavity when the system is inoperative.

The motor driven pump supplies fluid to the distributor panels at two flow rates, initially for 1 minute at high rate and the remaining time at normal rate. The initial rate makes sure of rapid priming of the system.

When the time switch runs down to zero, PS2 busbar supply is automatically disconnected by the switch from the pump motor and connected to the chime circuit or tone generator, as applicable, and fed into the Audio Integrating System central control unit. The resultant sound is audible over the flight compartment headsets or speakers and indicates that the de-icing fluid pump has ceased to operate as the cycle is complete.

Due to the charge build-up on capacitor EL the current through relay GD coil falls, and subsequently the relay becomes de-energized. The relay contacts revert to the relaxed position and breaks the chime or tone unit earth return circuit, to cancel the

audible warning.

B. Tank Contents Indication

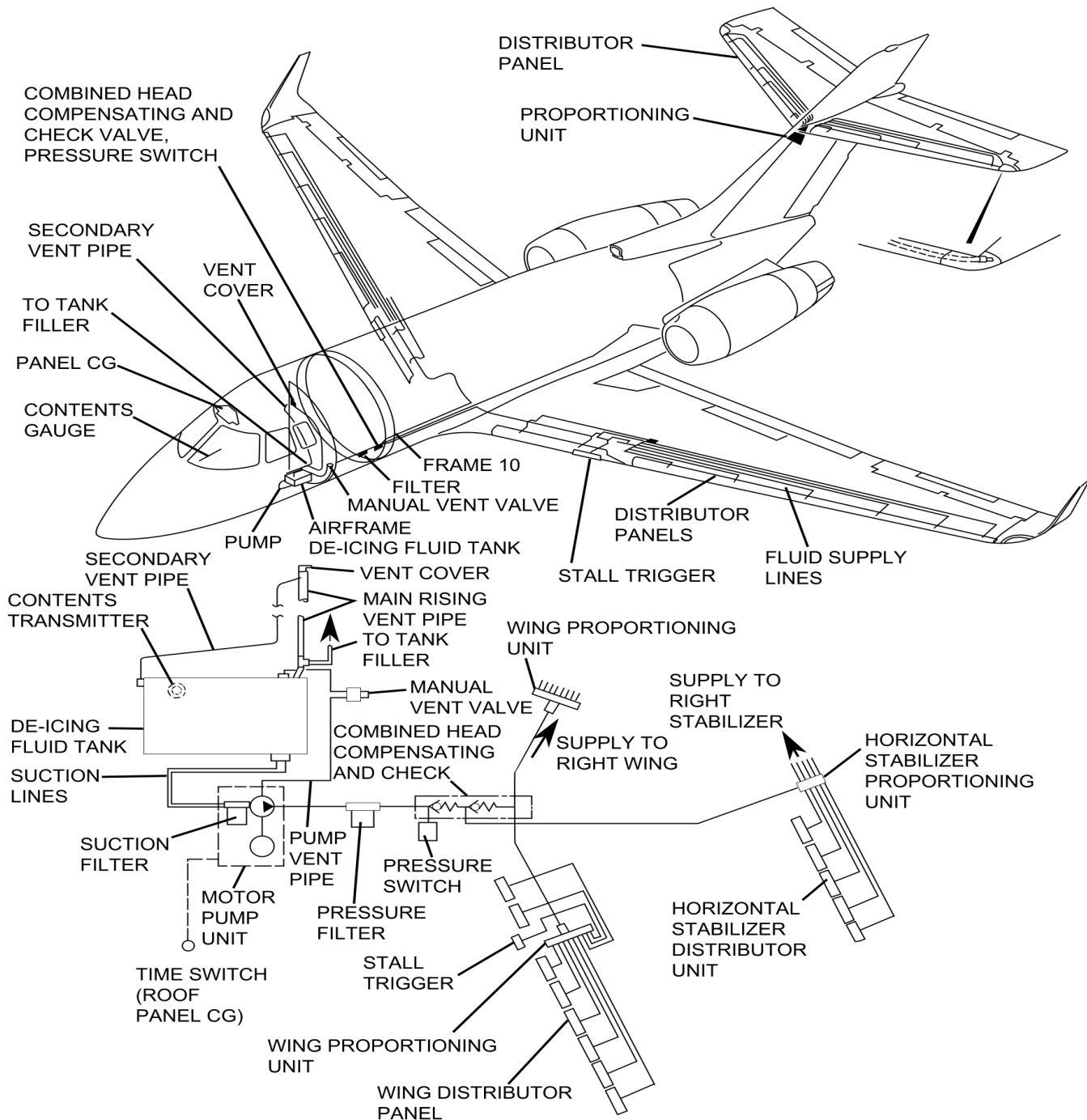
When the de-icing fluid tank is full, the transmitter float assembly is fully raised and the integral magnet closes the contacts of the reed switch RS1 (Ref. [Figure 3](#)), connecting the meter across the part of the potential divider made up of resistors R3 to R14. The potential at this point is set by resistor R2 to give full scale deflection of the meter.

As the fluid level falls the float assembly moves towards RS2; due to the magnetic linkage RS1 will open after RS2 closes, to make sure of continuity of gauge indication. With RS2 closed and RS1 open the contents gauge is connected across resistors R4 to R14 and a reduced potential proportional to the fall in fluid level is applied to the gauge. A falling level of fluid from full to empty will result in a total of 12 switching steps, each step progressively switching a further step down the potential divider.

When the fluid level falls below the level at which there is approximately 30 minutes fluid remaining, the LO QTY switch contacts close and direct a supply from PE busbar to energize the LO QTY relay. The 25 second time delay is then energized from PE busbar through the operated contacts of the LO QTY relay and the relaxed contacts of relay LM. If, after 25 seconds, the LO QTY switch contacts are still made, the output from the time delay unit will energize relay LP through the relaxed contacts of relay LM. Relay LP contacts change over to connect a supply from PE busbar to the ANTICE LO QTY annunciator on the roof panel CG and the ICE PROT↑ repeater annunciator in the MWS, and to energize relay LM to disconnect the input to the time delay unit. When the fluid is replenished, the LO QTY switch contacts will open to de-energize the LO QTY relay. A PE busbar supply is then connected through its relaxed contacts and the operated contacts of relay LM to energize the time delay unit. After 25 seconds the output from the time delay unit is routed through the operated contacts of relay LM to energize relay LP whose contacts open to disconnect the supplies to the annunciator and the coil of relay LM.

Figure 1 : Sheet 1 : Airframe Ice Protection System

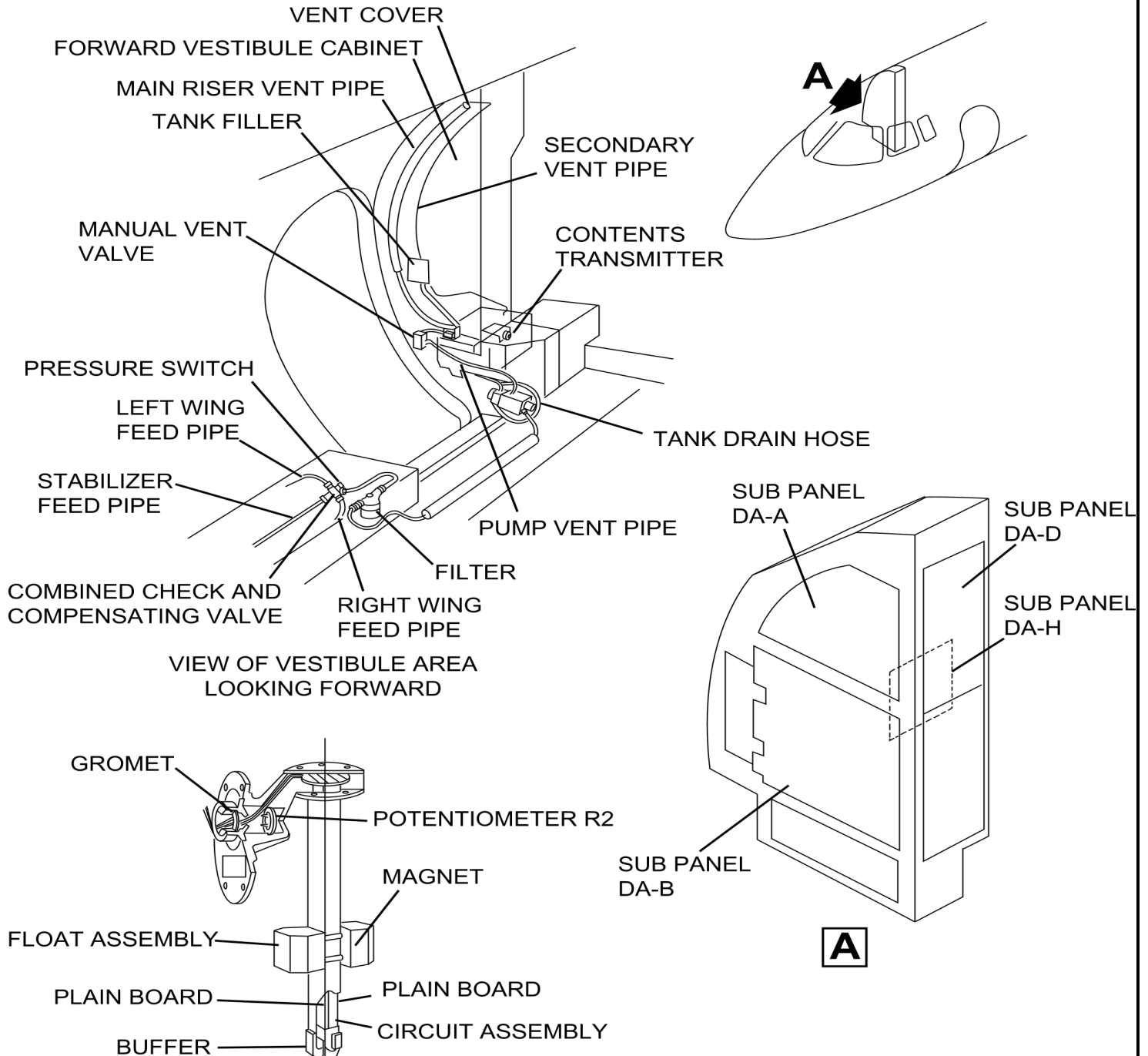
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Figure 2 : Sheet 1 : Ice Protection System Equipment Installation in Fuselage

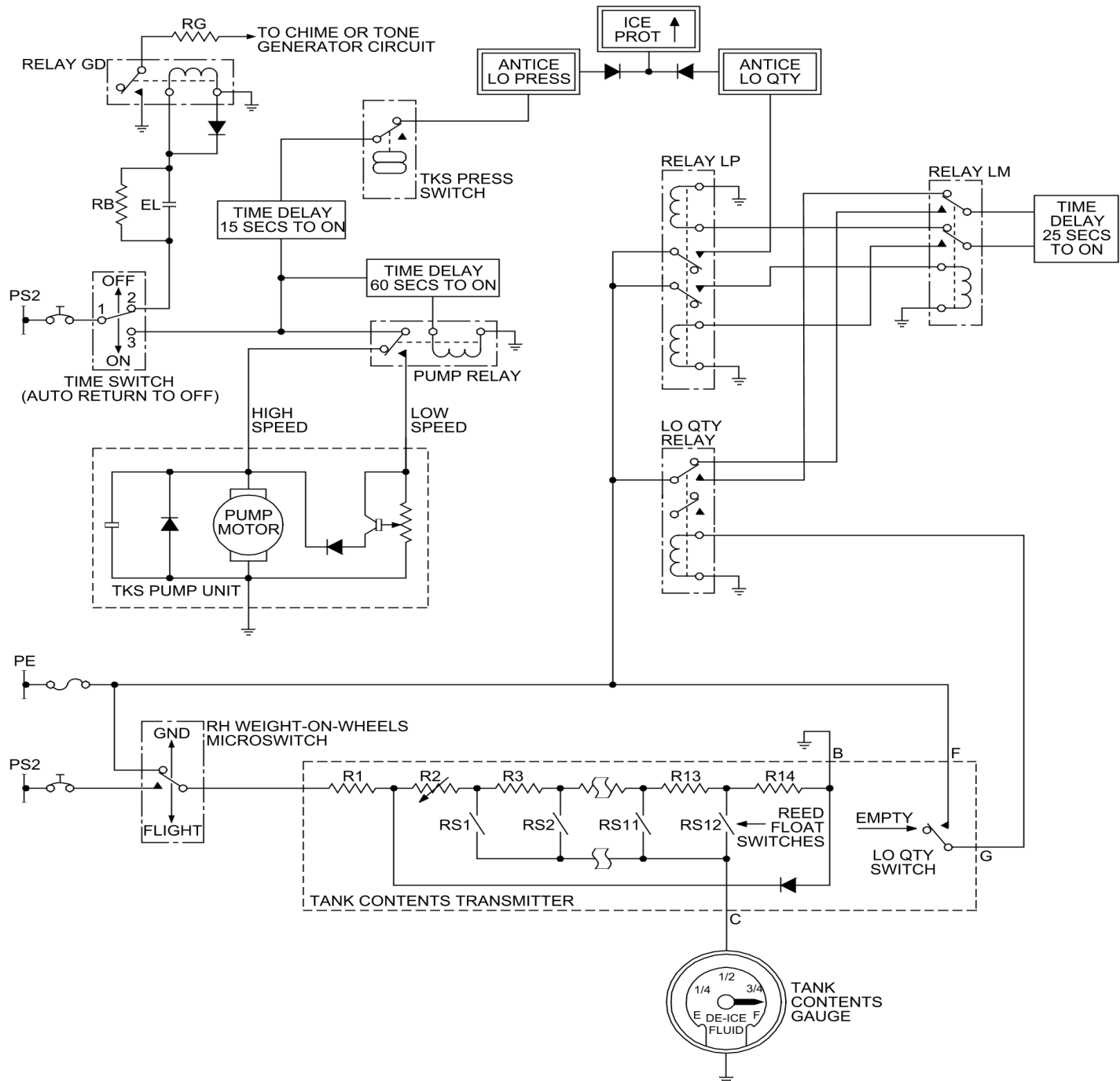
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Figure 3 : Sheet 1 : TKS Airframe De-icing Schematic Wiring Diagram

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