TKS ANTI-ICE SYSTEM - DESCRIPTION AND OPERATION
(Cargo Pod Installation)

1. General

A. The TKS anti-ice system is a fluid anti-ice system to prevent ice formation on the leading edges of the wings, horizontal stabilizers, struts, vertical stabilizer, propeller, and the windshield. A monoethylene glycol/isopropyl alcohol/deionized water solution is used to anti-ice the airframe surfaces and windshield in flight. The fluid solution is a freezing point depressant that is swept rearward over the surfaces and prevents ice buildup. For a list of approved TKS anti-icing fluids, refer to Chapter 12, Replenishing - Description and Operation.

2. Description

A. Laser-drilled titanium panels are mounted to the leading edges of the wings, wing struts, horizontal and vertical stabilizers that give TKS ice protection for the Caravan. The propeller is protected with a fluid slinger ring and the windshield is protected with a fluid spray bar. The TKS anti-ice system is divided into two subsystems; the airframe anti-ice system and the windshield anti-ice system. Refer to Figure 1 and Figure 2.

(1) Anti-ice fluid solution comes out of the airframe anti-ice system through flush-fitting laser drilled titanium leading edge panels on the wings, stabilizers, and struts. The airframe anti-ice system applies anti-icing fluid to the wing leading edge, that has three panels on each wing, two panels on each strut, and one panel on each horizontal and vertical stabilizer leading edge. The system provides full coverage of the leading edge of the wings, lift struts, horizontal and vertical stabilizer, excluding the dorsal fin. The airframe system also includes the propeller slinger application anti-icing system.

(a) The outer skin of the ice protection panels are manufactured with titanium, 0.9 mm thick. Titanium provides excellent strength, durability, light weight, and corrosion resistance.

(b) The panel skin is perforated by laser drilled holes, 0.0025 inches in diameter, 800 per square inch. The porous area of the titanium panels is designed to cover the stagnation point travel on the appropriate leading edge over a normal operating environment.

(c) The back plates of the porous panels are manufactured from titanium. They are formed to create reservoirs for the ice protection fluid to supply the entire porous area. A porous membrane between the outer skin and the reservoir gives even flow and distribution through the entire porous area of the panel.

(d) The porous panels are bonded or attached as a cuff over a leading edge. Panels are bonded to the airframe with a two-part flexible adhesive.

(e) Fluid is supplied to the panels and propeller by two positive displacement, constant volume metering pumps. The pumps give various flow rates to the panels and propeller. Single pump operation, a combined pump mode, and timed pumping provide a range of flow rates for different icing conditions.

(f) The fluid passes through microfilter(s) before it gets to the porous panels and propeller. The filter(s) removes contaminants from the fluid and prevents panel blockage. A system of nylon tubing carries the fluid from the fluid tank to the proportioning units that divide the flow into the volumetric requirements of each panel or device supplied through the unit. The proportioning units are located in the wings, fuselage, and tail of the aircraft and feed each panel and device through nylon tubing.

(g) The system has a fluid tank that gives a minimum ice protection endurance when filled. The endurance capacity is more than the endurance guidelines of AC 23.1419-2C. The tank also serves as an attachment structure for the main metering pumps, windshield pump, filter(s), and additional hardware. The combination of equipment creates an equipment pack assembly to ease installation. The tank assembly is mounted to the belly of the aircraft in the mid cargo pod area. Refer to Figure 5.

(h) The fluid tank is equipped with a low level switch, that gives a warning annunciation at a predetermined fluid level. The annunciation level is when only 20 minutes of fluid remains in the tank with the system in the normal operation mode.

(i) An external filler for the fluid tank is on the left side of the cargo pod. Refer to Chapter 12, Replenishing - Description and Operation.

(j) The system is operated through a series of three control switches. All modes of operation and selection for the metering pumps and the windshield pump are controlled through these devices. Refer to Figure 3 and Figure 4.

(k) The operational state can be monitored with:

1 Annunciators on the instrument panel of the non G1000 TKS system. This system annunciation is done

through a 3-element annunciator light array. Indications of normal operation state, cautionary state, and warning conditions will be displayed when necessary. These annunciators are independent of the other aircraft annunciators. The fluid level for this system is monitored with a 270° sweep reservoir contents gage that is coupled to a capacitive level sender. Refer to Tables 1-5 and Figure 4.

2 CAS messages and indications on the MFD with the G1000 TKS System.

(2) The windshield anti-ice system applies anti-icing fluid through a spray bar to the pilot's windshield. Refer to Chapter 30, TKS Anti-Ice Windshield Spray Bar.

(a) Fluid for the windshield spray bar system comes from an on-demand gear pump that is attached to the fluid tank. The spray bar can be operated as needed to clear forward vision through the windshield.

B. The system is configured with two main metering pumps. The pumps give both the delivery mechanism for all modes of operation of the system, and a pump backup system. The modes of operation are (1) NORMAL, (2) HIGH, (3) MAXIMUM, and (4) BACKUP.

(1) HIGH mode is the design flow rate for the system and occurs when one pump is run continuously.

(2) MAXIMUM mode is a flow rate that is used for a intermittent maximum icing condition, and occurs when both pumps run continuously. MAXIMUM mode is twice the flow rate of HIGH mode.

(3) NORMAL mode is 66% of the HIGH or design flow rate, and happens when both pumps run for a time cycle of 17% on and 83% off.

(4) The final mode is BACKUP. In the event that a pump fails, one of the pumps will be available and capable to pump the design flow rate to the system. The BACKUP system provides power to the second pump, independent of the circuit used for the other modes.

C. The operation of the TKS anti-ice systems is controlled by three switches on the left panel. The switches are PRIMARY, MAX FLOW, and BACKUP. Refer to Figure 3 and Figure 4.

D. The airframe and windshield spray bar anti-ice systems share the anti-icing fluid tank which is in the cargo pod. The fluid tank assembly is attached to the belly of the aircraft in the second bay area of the cargo pod. The assembly is accessible through the cargo pod doors on the left side of the pod. Refer to Figure 1, Figure 2, and Figure 5.

(1) The tank anti-ice fluid level is monitored with a gage that is on the left meter panel in the cockpit on the non G1000 TKS system, and is monitored with an indication on the MFD on the G1000 system. The fluid level monitor devices show the total fluid available for operation of both the airframe and windshield spray bar anti-ice systems. The tank fluid level monitor devices are electrically operated and receive inputs from a capacitance sensing level sender probe in the fluid tank. Refer to Figure 2, Figure 3, Figure 4, and Figure 5.

(2) In addition to the fluid level monitors, the tank has a low level switch. Refer to Figure 2 and Figure 5.

(a) The low level switch controls operation of the ANTI-ICE annunciator CAUT (amber light) on the annunciator panel for the non G1000 TKS system. The low level switch illuminates the annunciator CAUT when there is only enough anti-ice fluid in the tank to last for approximately 20 minutes of full system continuous operation.

(b) The low level switch is monitored by the G1000 system and shows the CAS messages A-ICE LOW FLUID (amber) when the anti-ice fluid is low.

(3) The anti-ice fluid tank also has a sight glass that gives a visual indication of the fluid level in the tank to assist when you fill the tank. Refer to Figure 4 and Figure 5.

E. The airframe and windshield spray bar anti-ice system have pumps, filter(s), and a high pressure switch that are installed on the fluid tank in the cargo pod. Refer to Figure 4.

(1) The anti-ice windshield spray bar pump and the two airframe pumps are electric motor driven.

(2) Filter(s) are installed downstream of the two airframe pumps. Each filter contains a replaceable element. The filter ports are marked IN and OUT for correct plumbing connection.

(3) A high pressure switch is installed in line with the metering pumps. Refer to Figure 1, Figure 2, and Figure 5.

F. Proportioning units are installed in four different locations on the airplane. Refer to Figure 2.

(1) A seven-place proportioning unit is found in each wing leading edge near the strut attach fitting.

(2) A seven-place proportioning unit is found

(3) A single-place proportioning unit is found in the feed line to the propeller, under the floor near the copilots seat.

(4) A three-place proportioning unit is found on the floor of the tail cone (RBL 3.35, FS 422.75). This proportioning unit

supplies the vertical stabilizer and each horizontal stabilizer.

G. The proportioning units are metering units which supply anti-icing fluid at a predetermined flow rate for each individual porous leading edge panel. The proportioning units incorporate a manifold with calibrated capillary tubes which meter the fluid through the outlet ports. The outlets are marked 1, 2, 3, 4, 5, 6, and 7 on each wing's seven-place proportioning unit. Plumbing to the outlet ports must be connected as specified for proper operation. Refer to Figure 2.

H. A total of three pressure switches are installed in the TKS anti-ice system plumbing. There are two low pressure switches and one high pressure switch in the system. The pressure switches transmit signals to annunciator lights on the non G1000 models and to CAS display messages on the G1000 models.

(1) One high pressure switch is installed downstream of the two surface metering pumps in the cargo pod. Refer to Figure 5.

(a) On the non G1000 TKS system, the high pressure switch is electrically connected to the CAUT (amber) light on the ICE FLUID annunciator. Closure of the high pressure switch will cause the ICE FLUID CAUT annunciator to come on.

(b) On the G1000 system, the high pressure switch is monitored by the G1000 system and shows the CAS messages A-ICE HIGH PRESS (amber) when the anti-ice fluid pressure is high.

(2) There are two low pressure switches to monitor the horizontal stabilizers leading edge panels; one pressure switch for each panel.

(a) On the non G1000 TKS system, the low pressure switches are electrically connected to the WARN (red) light on the ICE FLUID annunciator. Closure of the low pressure switch will cause the ICE FLUID WARN annunciator to come on.

(b) On the G1000 system, the low pressure switches are monitored by the G1000 system and shows the CAS messages A-ICE LOW PRESS (red) when the anti-ice fluid pressure is low.

I. There are a total of two check valves installed in the fluid anti-ice system plumbing network downstream of the metering pumps in the cargo pod. The check valves prevent reverse of fluid flow through the plumbing.

J. There is a solenoid valve installed between the fluid tank and the windshield pump. The valve makes sure that fluid does not run back in the tank when the pump stops operation.

(1) There is a strainer installed at the fluid tank for the windshield pump.

3. Operation

A. Operation of the TKS anti-ice system is controlled by three switches on the left meter panel. The switches are PRIMARY, MAX FLOW, and BACKUP. Refer to Figure 3 and Figure 4.

B. There are a total of 18 different switch position configurations possible with the three TKS ANTI-ICE system control switches. Of the 18 possible switch configurations, only six are considered normal. These switch configurations are shown in the TKS Anti-Ice System Operation Matrix in Table 1 and Table 3.

NOTE: All of the switch configurations recorded in the tables below are true when the electrical power is applied to the airplane, the ICE circuit breakers are on, and the anti-ice system starts operation.

NOTE: The MAX FLOW switches only operate momentary when depressed.

NOTE: Timer:

- **Number one comes on for 20 seconds and turns off, and repeats every 100 seconds**
- **Number two comes on for 120 seconds and then turns off**
- **Number three comes on for four seconds and then turns off.**

NOTE: Table 2, and Table 4 give the G1000 CAS Message Triggers and Annunciator Triggers for the G1000 and non G1000 TKS anti-ice systems, respectively. Refer to Table 2 and Table 4

NOTE: The MAX FLOW only operates with the NORM or HIGH switch ON.

Table 1. Pumps Operation Matrix for the TKS Anti-Ice System With the G1000

Pumps Operation Matrix For the TKS Anti-Ice System With the G1000					
CONTROL SWITCHES			PUMPS	TIMERS	ANNUNCIATORS
PRIMARY	MAX FLOW	BACK UP			G1000 CAS MESSAGE

Off	Norm	High	Air-Frame	Wind-Shield		#1	#2	Wind-Shield	#1	#2 Max Flow	#3 Wind-Shield	A-ICE NORM (white)	A-ICE HIGH (white)
	ON				OFF	INT	INT	OFF	ON	OFF	OFF	ON	OFF
		ON			OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON
	ON		TRIP		OFF	INT	INT	OFF	ON	ON	OFF	ON	OFF
		ON	TRIP		OFF	ON	INT	OFF	OFF	ON	OFF	OFF	ON
	ON			TRIP	OFF	INT	INT	ON	ON	OFF	ON	ON	OFF
		ON		TRIP	OFF	ON	OFF	ON	OFF	OFF	ON	OFF	ON
***			TRIP		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
***				TRIP	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
***					OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	ON				ON	INT	ON	OFF	ON	OFF	OFF	ON	OFF
		ON			ON	ON	ON	OFF	OFF	OFF	OFF	OFF	ON
	ON		TRIP		ON	INT	ON	OFF	ON	ON	OFF	ON	OFF
		ON	TRIP		ON	ON	ON	OFF	OFF	ON	OFF	OFF	ON
	ON			TRIP	ON	INT	ON	ON	ON	OFF	ON	ON	OFF
		ON		TRIP	ON	ON	ON	ON	OFF	OFF	ON	OFF	ON
***			TRIP		ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
***				TRIP	ON	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
***					ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF

NOTE: INT = Intermittent

Table 2. Operation Matrix for the TKS Anti-Ice System With the G1000

TKS with G1000 CAS Message Triggers					
SWITCH			G1000 CAS Message		
LOW LEVEL SWITCH	LOW PRESSURE SWITCH	HIGH PRESSURE SWITCH	A-ICE LOW PRESS (red)	A-ICE HI PRESS (AMBER)	A-LOW FLUID (AMBER)
	ON		ON	OFF	OFF
		ON	OFF	ON	OFF
ON			OFF	OFF	ON

Table 3. Operation Matrix for Field Installed TKS Anti-Ice System Without the G1000

Operation Matrix For the TKS Anti-Ice System Without the G1000														
CONTROL SWITCHES						PUMPS			TIMERS			ANNUNCIATORS		
PRIMARY			MAX FLOW		BACK UP									
Off	Norm	High	Air-Frame	Wind-Shield		#1	#2	Wind-Shield	#1	#2 Max Flow	#3 Wind-Shield	ANTI-ICE ON	CAUT	WARN
	ON				OFF	INT	INT	OFF	ON	OFF	OFF	ON	OFF	OFF
		ON			OFF	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
	ON		TRIP		OFF	INT	INT	OFF	ON	ON	OFF	ON	OFF	OFF

		ON	TRIP		OFF	ON	INT	OFF	OFF	ON	OFF	ON	OFF	OFF
	ON			TRIP	OFF	ON	ON	ON	ON	OFF	ON	ON	OFF	OFF
		ON		TRIP	OFF	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF
***			TRIP		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
***				TRIP	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
***					OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	ON				ON	INT	ON	OFF	ON	OFF	OFF	ON	OFF	OFF
		ON			ON	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF
	ON		TRIP		ON	INT	ON	OFF	ON	ON	OFF	ON	OFF	OFF
		ON	TRIP		ON	ON	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
	ON			TRIP	ON	INT	ON	ON	ON	OFF	ON	ON	OFF	OFF
		ON		TRIP	ON	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF
***			TRIP		ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
***				TRIP	ON	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	OFF
***					ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF

NOTE: The field installed TKS without the G1000: ANTI-ICE ON annunciator is white, the CAUT annunciator is amber, and the WARN annunciator is red.

NOTE: INT = Intermittent

Table 4. Operation Matrix for Field Installed TKS Anti-Ice System Without the G1000

TKS without G1000 Annunciator Triggers					
SWITCH			**ANNUNCIATORS**		
LOW PRESSURE SWITCH	**LOW LEVEL SWITCH**	**HIGH PRESSURE SWITCH**	**ANTI-ICE ON**	**CAUT**	**WARN**
	ON		ON	ON	OFF
		ON	ON	ON	OFF
ON			ON	OFF	ON

Figure 1 : Sheet 1 : TKS Anti-Ice System Components

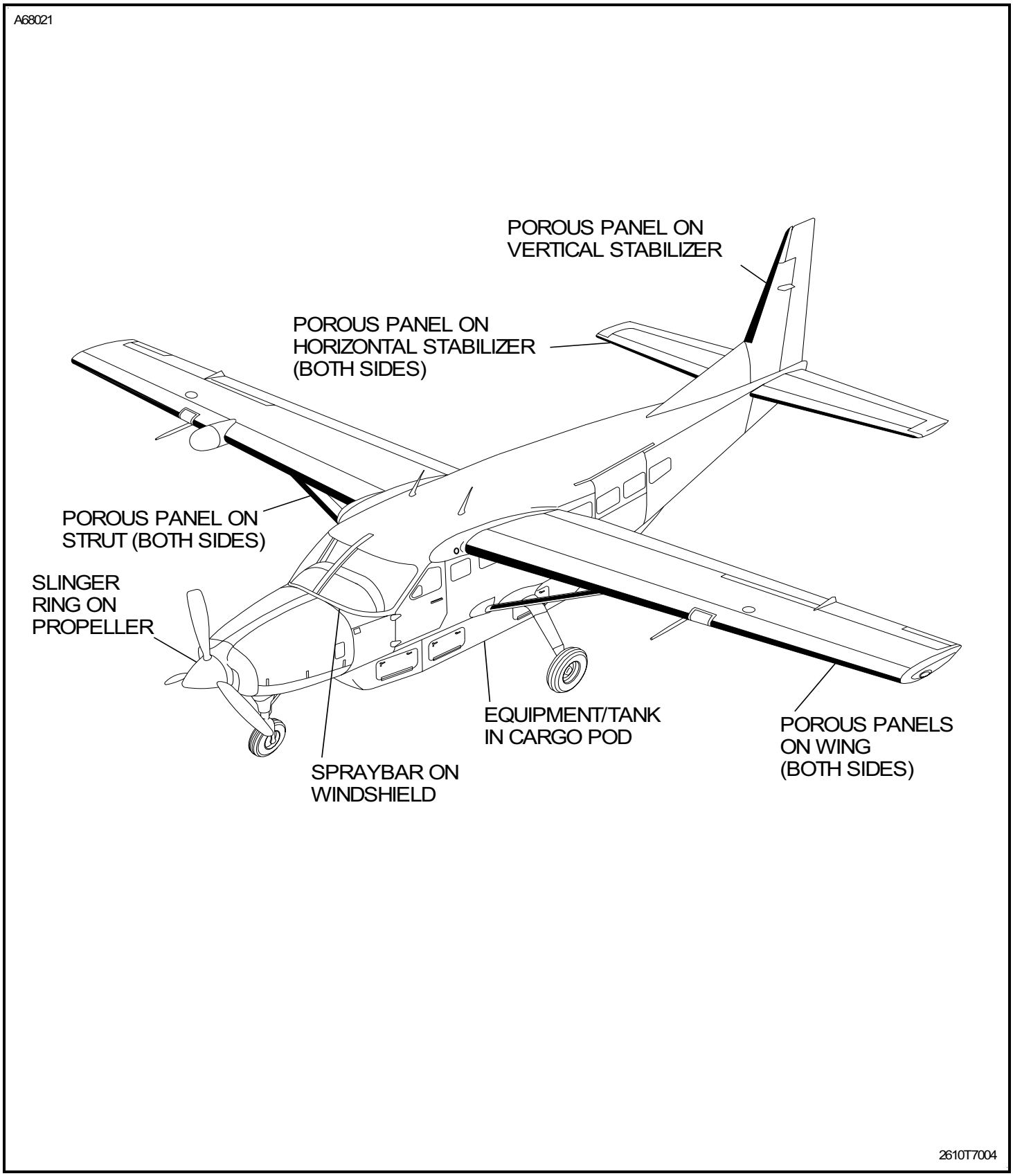

Figure 2 : Sheet 1 : TKS Anti-Ice System Flow Diagram

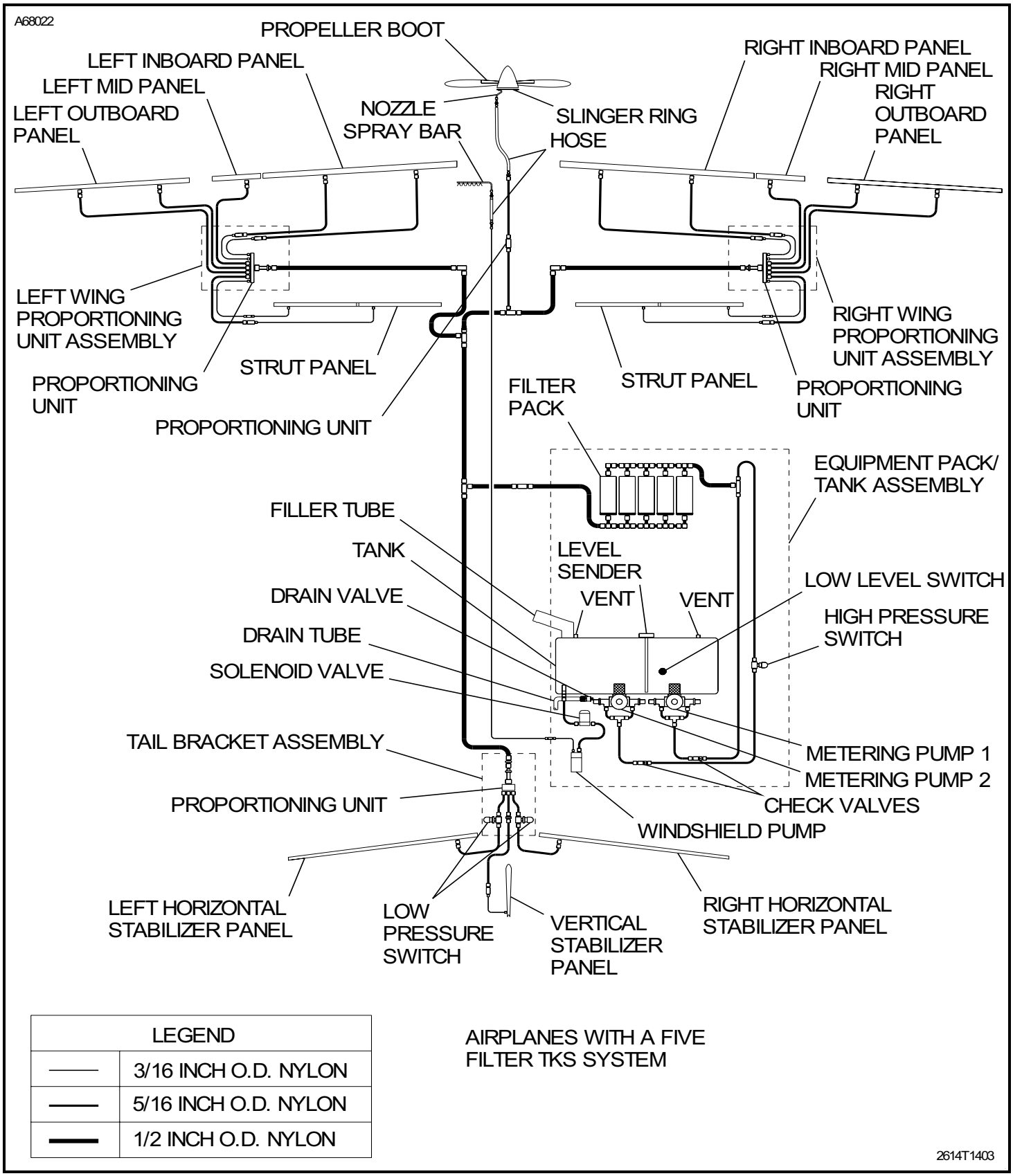

Figure 2 : Sheet 2 : TKS Anti-Ice System Flow Diagram

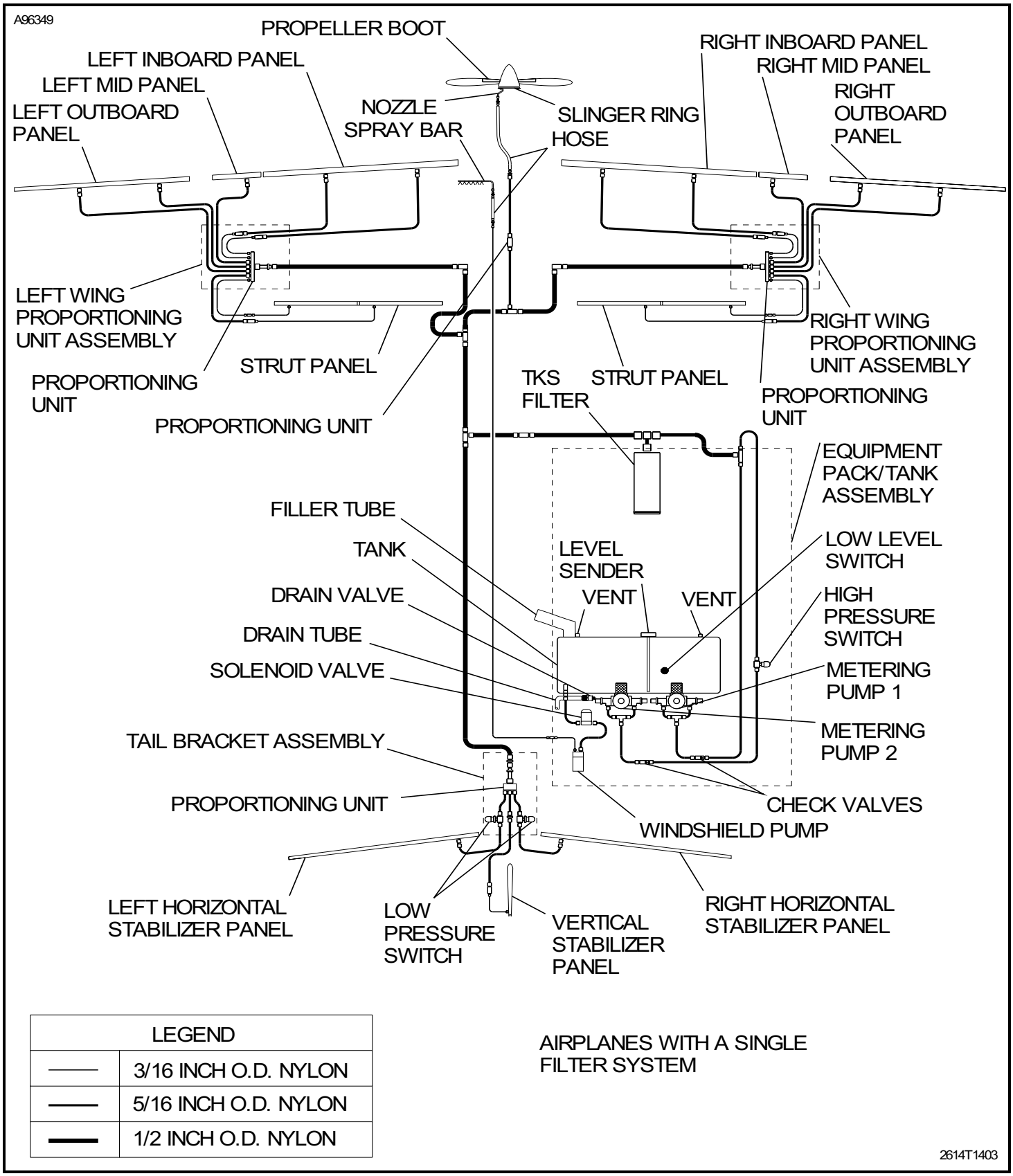

Figure 3 : Sheet 1 : TKS Anti-Ice System Instrument Panel Operation Devices With G1000 Systems

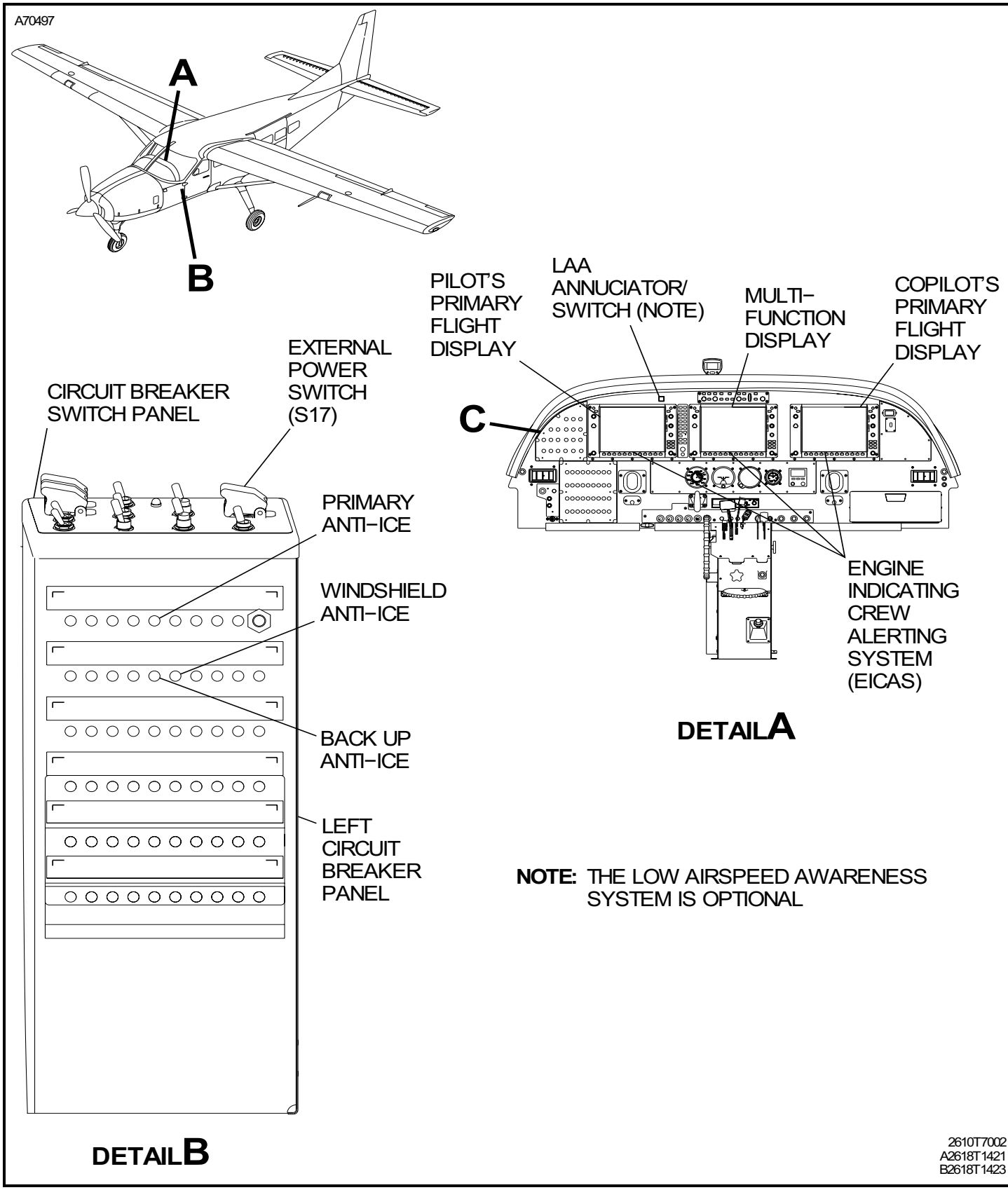

Figure 3 : Sheet 2 : TKS Anti-Ice System Instrument Panel Operation Devices With G1000 Systems

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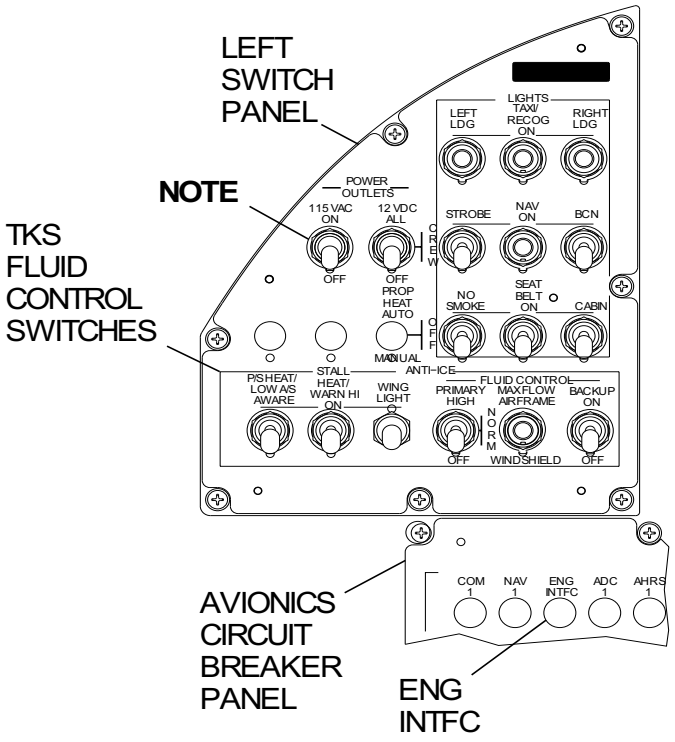
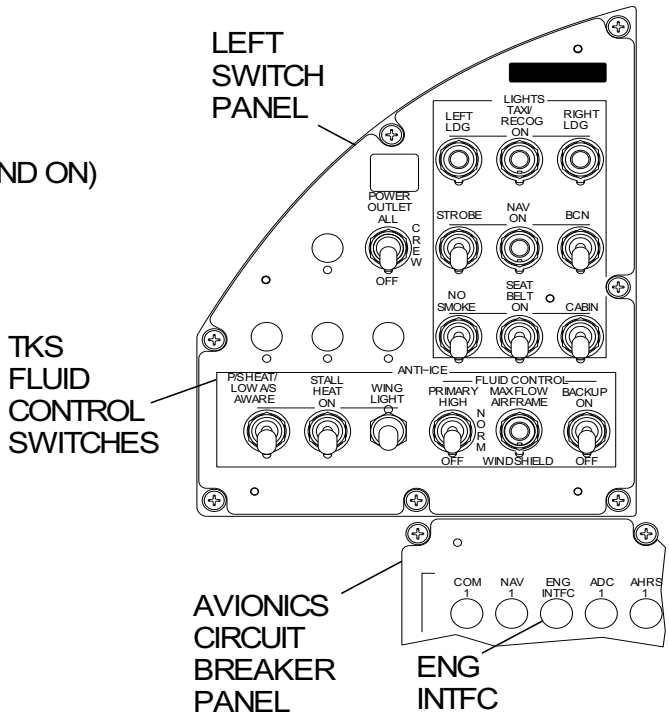


DETAIL C

(AIRPLANE 208B2197,
AIRPLANES 208B5000 AND ON)

NOTE: 115 VAC SWITCH IS OPTIONAL.



DETAIL C

(AIRPLANES 20800518 AND ON,
AIRPLANES 208B0001 thru 208B2196,
AND 208B2198 thru 208B4999)

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C2618T1423

Figure 4 : Sheet 1 : TKS Anti-Ice System Instrument Panel Operation Devices Without G1000 System

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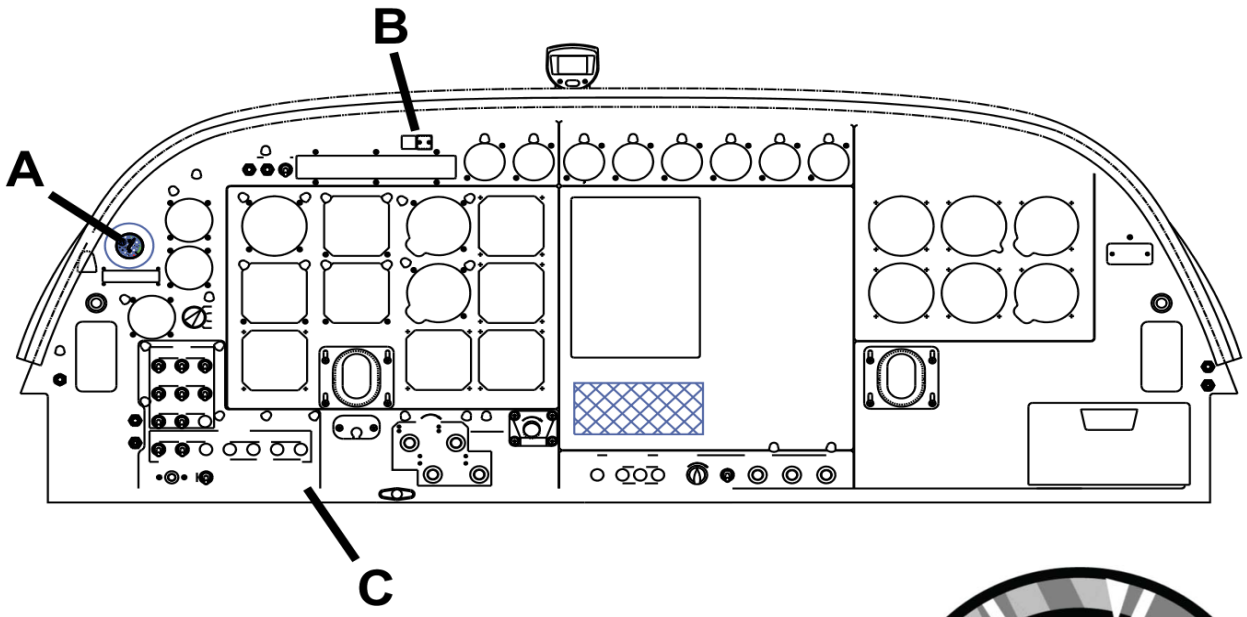
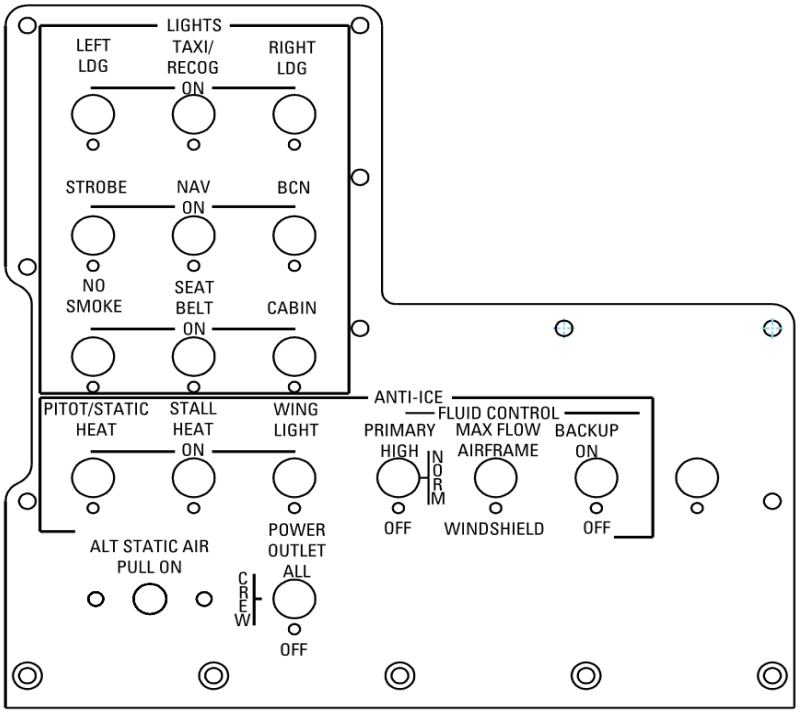
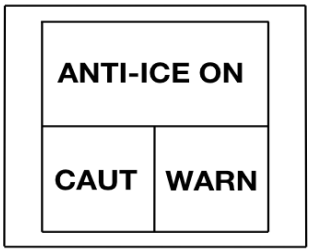


DETAIL A
ANTI-ICE FLUID TANK
QUANTITY LEVEL GAGE



DETAIL C
SWITCH PANEL



DETAIL B
TKS ANTI-ICE SYSTEM
ANNUNCIATOR

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A2614T1404
B2614T1404
C2614T1404

Figure 5 : Sheet 1 : TKS Anti-Ice System Fluid Tank