TKS ANTI-ICE SYSTEM - DESCRIPTION AND OPERATION (Fairing Installation)

1. General

A. The TKS system is a fluid anti-ice system that helps prevent the formation of ice on the airplane surfaces. A monoethylene glycol/isopropyl alcohol/deionized water solution is the anti-ice fluid that is used for the TKS system. The fluid solution changes the freezing point and moves rearward on the surfaces. The surfaces the TKS system gives protection to are the wings, the horizontal stabilizers, the struts, the vertical stabilizer, the propeller, and windshield. Overspray from the propeller also protects portions of the fuselage. For a list of approved TKS anti-icing fluids, refer to Chapter 12, Replenishing - Description and Operation.

B. Airplanes that have the optional TKS system also have the Low Airspeed Awareness (LAA) system installed. This system gives pilots a warning if the airspeed goes below 97.5 KIAS, +2 or -2 knots when operation is in icing conditions. For more data on the LAA system, refer to Low Airspeed Awareness System - Description and Operation (With TKS).

2. Description

A. The porous panels are laser-drilled titanium installed to the leading edges of the airplane flight surfaces. The panels give TKS ice protection for the wings, wing struts, horizontal and vertical stabilizers. A slinger ring gives ice protection to the propeller and a spray bar gives ice protection to the windshield. The TKS system is divided into two subsystems, the airframe system and the windshield system. The TKS system tank, metering pumps, and related components are installed in the fairing assembly on the bottom of the airplane fuselage. Refer to Figure 1, and Figure 2, and Figure 4.

(1) The anti-ice fluid solution comes out of the airframe anti-ice system through flush-fitting titanium porous panels. A laser is used to drill the holes in the porous panels. The porous panels are installed on the leading edge of the wings, stabilizers, and struts. There are three panels on each wing, one panel on each strut, and one panel on each horizontal and vertical stabilizer leading edge. The system gives full protection of the wings leading edge, wing struts, horizontal and vertical stabilizer, but does not include the dorsal fin. The airframe system also includes the propeller slinger ring.

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

(b) The panel holes are 0.0025 inches in diameter, 800 per square inch. The porous area of the titanium panels covers the stagnation point travel on the applicable leading edge in the flight environment the airplane usually operates.

(c) The back plates of the porous panels are manufactured with 0.7-mm thick titanium. The inboard wing only is 0.9-mm thick titanium. They are reservoirs for the ice protection fluid to supply all of the porous area. A porous membrane between the outer skin and the reservoir gives smooth flow and distribution through all the porous area of the panel.

(d) The porous panels are bonded or attached as a cuff on 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 different flow rates to the panels and propeller. One pump operation, a combined pump mode, and timed operation give a range of flow rates for different icing conditions.

(f) The fluid flows through microfilters before it gets to the porous panels and propeller. The filter removes contamination from the fluid and prevents panel blockage. A system of nylon tubing carries the fluid from the 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 and tail of the aircraft and feed each panel and device through nylon tubing.

(g) The system has a tank that gives the shortest required quantity of time for ice protection when the fluid is at the sight glass mark. The operation time quantity is more than the operation time given in AC 23.1419-2C. The tank gives a mount for the metering pumps. An isolated accessory bracket holds the windshield pump, timer box, a high pressure switch, solenoid valve, check valves, and hardware for easier removal and installation. The tank assembly is installed in a fairing below the forward fuselage. Refer to Figure 1 and Figure 4

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

(i) The external filler for the tank is on the left airplane fuselage at FS 176, WL 94.73. Refer to Chapter 12, Replenishing - Description and Operation.

(j) The system operates 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 serviceable condition of the TKS is monitored with CAS messages and indications that show on the G1000 displays.

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

(a) Fluid for the windshield spray bar system comes from an on-demand gear pump that is attached to the accessory bracket. The spray bar is operated if necessary to clear forward vision through the windshield.

B. The system configuration has two main metering pumps. The pumps gives the supply mechanism for all modes of operation of the system, and a pump auxiliary system. The modes of operation are (1) NORMAL, (2) HIGH, (3) MAXIMUM, and (4) BACKUP.

(1) NORMAL mode is 66% of the HIGH or design flow rate, and occurs when the two pumps operate for a time cycle of 17% on and 83% off.

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

(3) 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.

(4) If there is a pump failure, The BACKUP mode gives power to the second pump. The BACKUP mode power is independent of the circuit used for the other modes.

C. The operation of the TKS system is controlled by three switches on the left panel. The switches are PRIMARY, MAX FLOW, and BACKUP. Figure 3.

D. The airframe and windshield spray bar anti-ice systems use the anti-icing tank which is in the fairing. The tank assembly is attached to the bottom of the aircraft. Remove the aft fairing to access the fluid tank equipment. To remove and/or install the tank, remove the forward and aft fairings. Refer to Figure 4.

(1) Indications on the MFD display 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 tank. Refer to, Figure 4.

(2) In addition to the fluid level monitors, the tank has a low level switch. Refer to Figure 4.

(a) The low level switch is monitored with a CAS message on the G1000 system. Refer to Table 2.

(3) There is a fluid window on the left side of the fairing. At the fluid window you can see the tank sight glass that gives the fluid level indication. This can help you when you fill the tank. Refer to Figure 1 and Figure 4.

E. The airframe and windshield spray bar anti-ice system have pumps installed on the tank and on the TKS accessory bracket in the fairing. Refer to Figure 4.

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

(2) An assembly of five filters 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.

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 outboard of the strut attach fittings.

(2) A single-place proportioning unit is found in the feed line to the propeller under the floor near the copilot's seat.

(3) A three-place proportioning unit is found on the floor of the tail cone (RBL 3.35, FS 374.75). 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 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 system plumbing. There are two low pressure switches and one pressure switch in the system. The pressure switches transmit signals to show CAS messages on the G1000 displays.

(1) One pressure switch is installed downstream of the two airframe metering pumps in the fairing. Refer to Figure 4.

(a) The pressure switch is monitored with a CAS message on the G1000 displays. Refer to Table 2.

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

(a) The low pressure switches are monitored with a CAS message that shows on the G1000 displays. Refer to Table 2.

I. There are a total of two check valves installed in the fluid tube system downstream of the metering pumps in the fairing. The check valves prevent opposite fluid flow through the tube system.

J. There is a solenoid valve installed between the tank and the windshield pump to make sure that the fluid in the tubes does not flow back in the tank when the pump is not operating.

K. There is a strainer for the windshield pump mounted between the tank and the solenoid valve.

3. Operation

A. Operation of the TKS system is controlled by three FLUID CONTROL switches on the left switch panel. The switches are PRIMARY (SI022) MAX FLOW (SI023), and BACKUP (SI024). Refer to Figure 3 and Figure 4.

B. There are a total of 18 different switch configurations possible with the three FLUID CONTROL switches. Only six of the switch configurations are usually correct. These switch configurations are shown in Table 1.

NOTE: The MAX FLOW switches only operate momentarily when pushed.

NOTE: Timer:

- **Number one comes on for 20 seconds and goes off, and again each 100 seconds.**
- **Number two comes on for 120 seconds and then goes off.**
- **Number three comes on for four seconds and then goes off.**

NOTE: Table 1 gives the operation matrix for the FLUID CONTROL switches, pumps, and timers. Refer to Table 1.

NOTE: Table 2 gives the CAS Message Triggers and corresponding CAS Messages. Refer to Table 2.

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

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-ICE LOW FLUID (AMBER)**
	ON		ON	OFF	OFF
		ON	OFF	ON	OFF
ON			OFF	OFF	ON

Figure 1 : Sheet 1 : TKS System Components

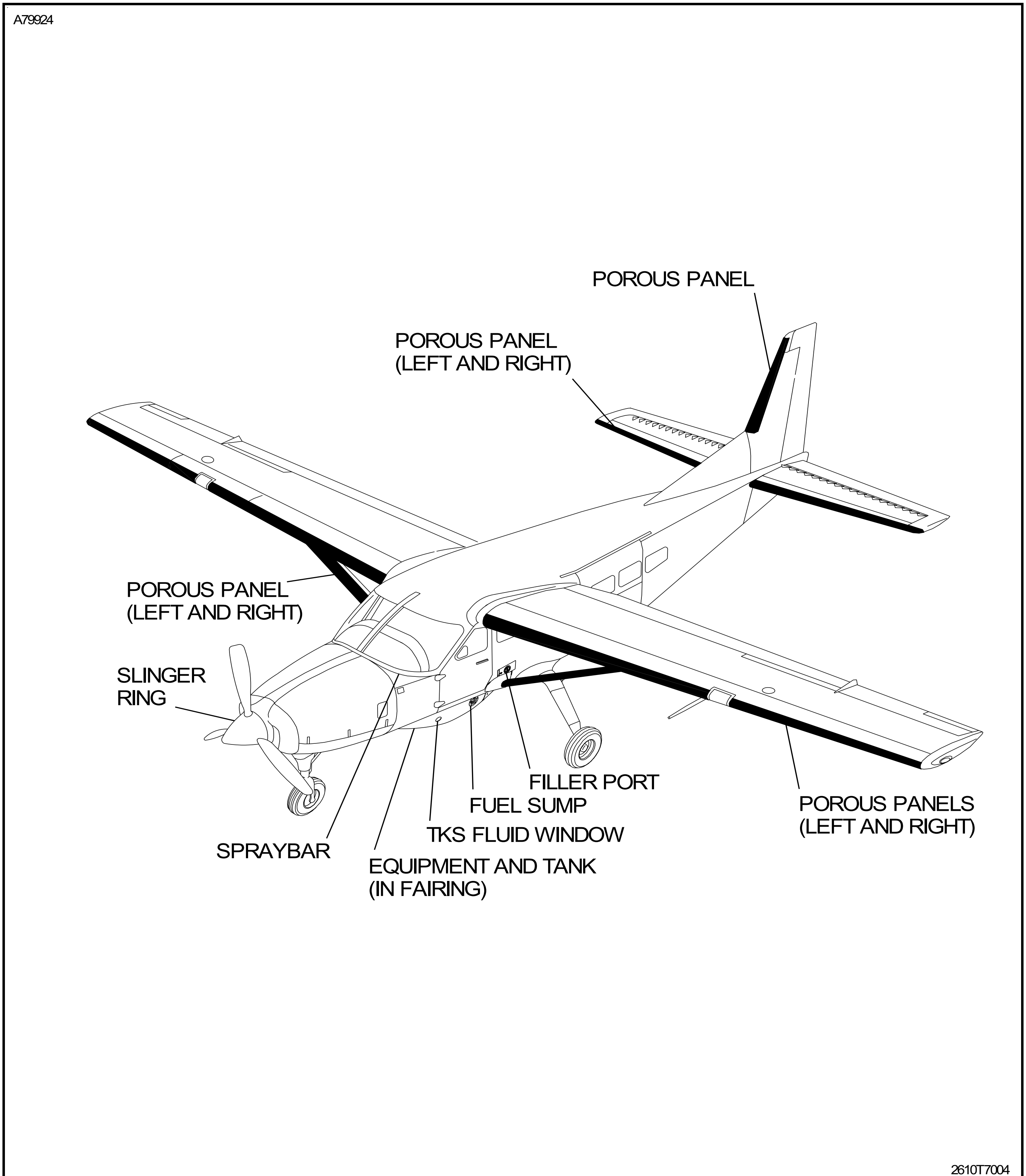
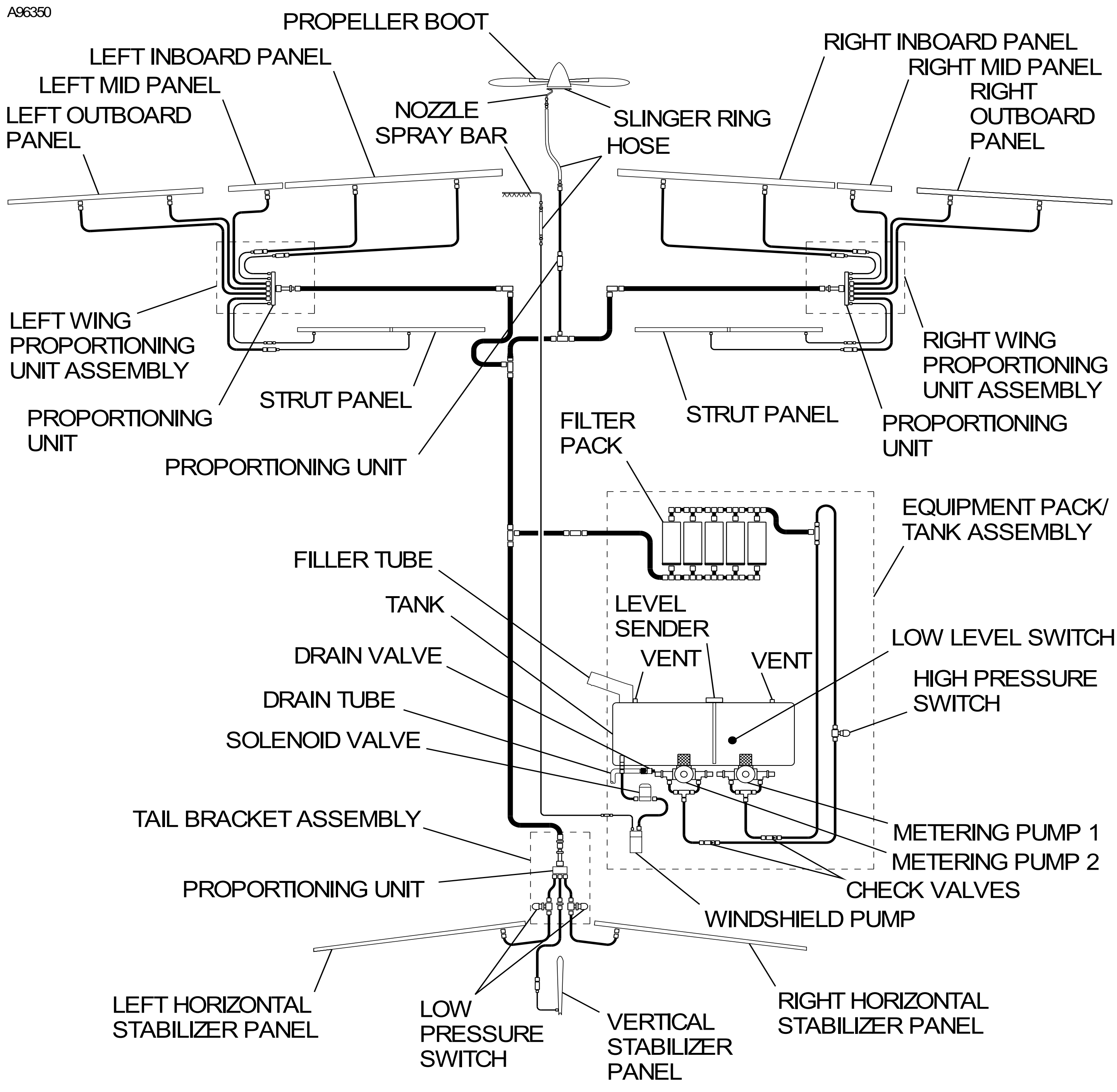


Figure 2 : Sheet 1 : TKS Anti-Ice System Flow Diagram



LEGEND	
(thin line)	3/16 INCH O.D. NYLON
(medium line)	5/16 INCH O.D. NYLON
(thick line)	1/2 INCH O.D. NYLON

AIRPLANES WITH A FIVE FILTER TKS SYSTEM

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

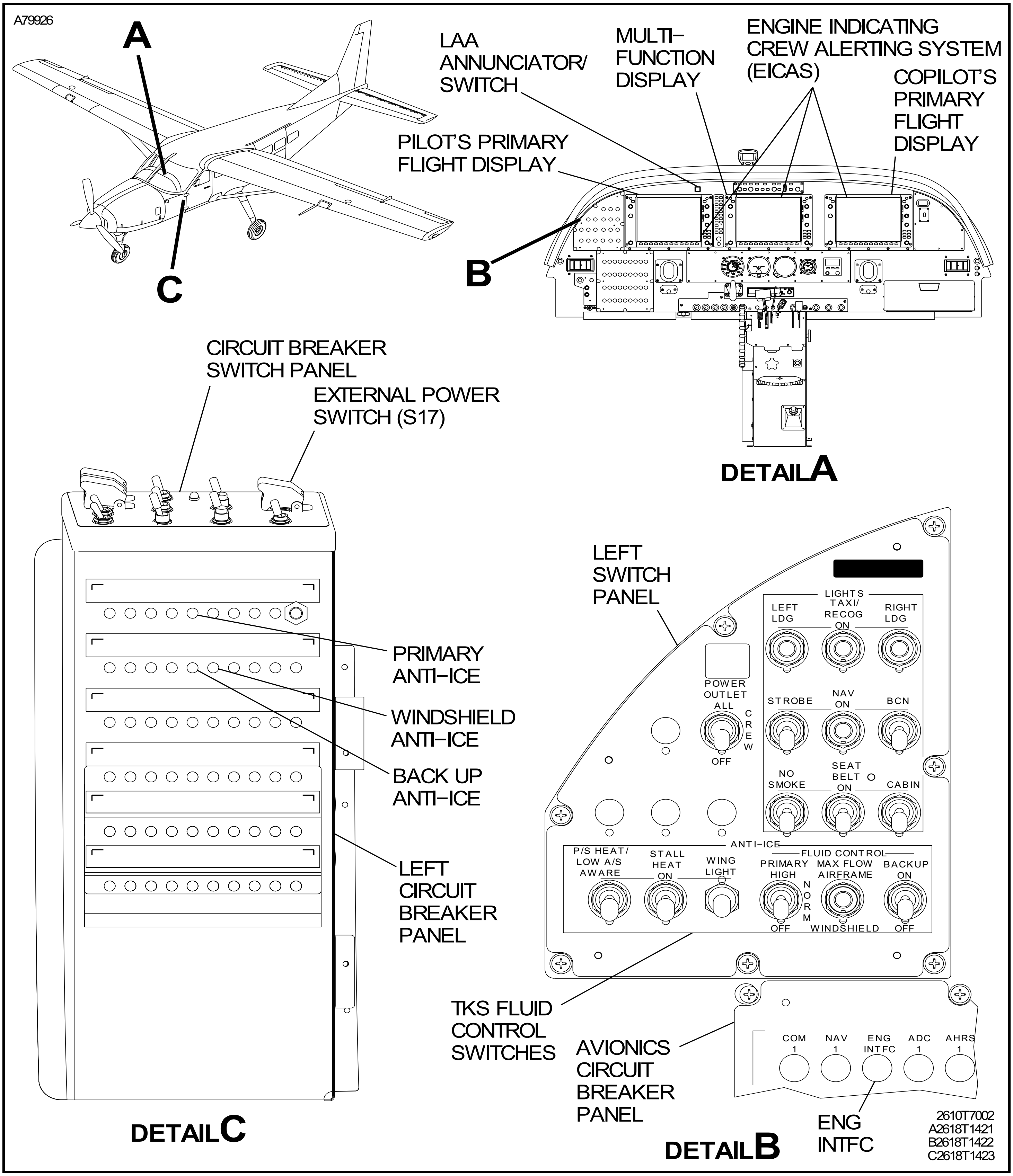

Figure 4 : Sheet 1 : TKS Fairing Components