Chapter 30
Ice and Rain Protection

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30-00-00 GENERAL

Description

The following icing protection systems are standard equipment on the EA-400:

1 Pneumatic de-ice boots for wing and empennage

2 Heated Pitot tubes and heated static ports

3 Heated stall warning sensor

4 Heated windshield

5 Alternate air intake for engine combustion air

6 Heated propeller blades

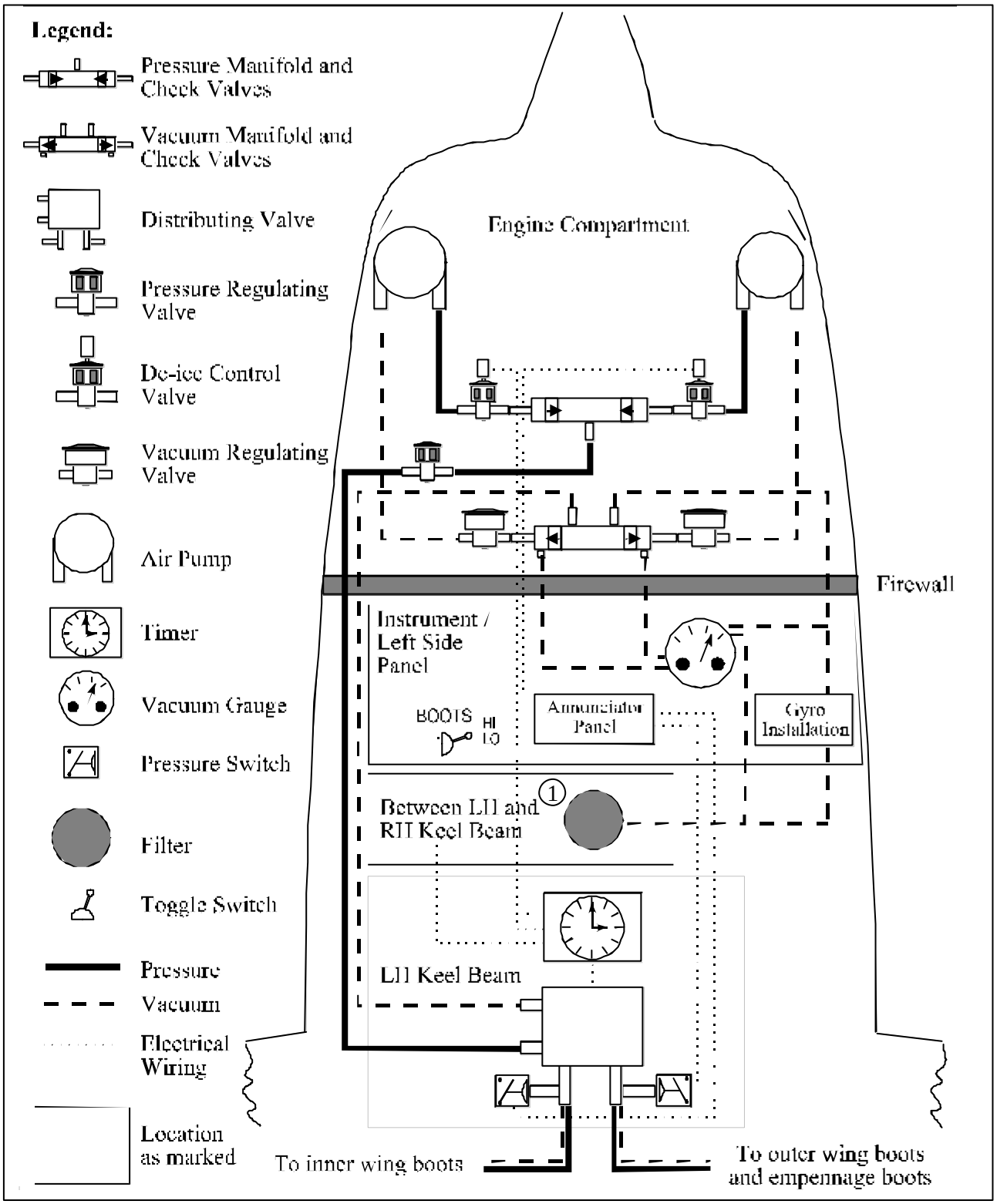

Figure 30-01
Vacuum and Pressure System Surview

NOTE With SN 03 through 14 filter ① is installed in wing leading edge. Airplanes will be modified on demand.

30-10-00 AIRFOIL

Description

The leading edges of the airfoils (wing, horizontal and vertical stabilizer) are protected against icing by inflatable rubber boots. The pressurized air for boot inflation is supplied by two engine driven pumps also operating the instrument vacuum system. Nominal inflation pressure of the system is 18psig (1.25bar). A system surview is given in *Figure 30-01*.

The function of the system is as follows: A part of the air is entering the system through an air filter located between the LH and RH keelbeams [1]. From there it is routed through the gyro instrumentation to the vacuum manifold installed on the upper part of the firewall in the engine compartment. Downstream the vacuum manifold (incorporating check valves to isolate a defective pump) two vacuum regulating valves, located on the same mounting bracket, are installed. These regulating valves (one for each vacuum pump) allow additional air from the engine compartment to enter the system and are regulating the differential pressure for the gyro instrumentation. After passing the vacuum pumps (mounted to accessory drives at the upper rear end of the engine) the air is routed through de-ice control valves (one for each pump) to the pressure manifold (also incorporating check valves to isolate a defective pump). These components are also bracketed to the firewall. As long as the boots are not inflated the air is bled into the engine compartment by means of the two control valves. Downstream the pressure manifold the pressure regulating valve is ensuring a differential pressure of 18 psig between ambient and boot inflation pressure. This is achieved by dumping superfluous air flow. The remaining pressurized airflow is then distributed by the distributing valve to the two boot groups (first group: inner wing boots, second group: outer wing boots and empennage boot). The de-ice cycle is controlled by a timer (located on the outer side of the left keel beam together with the distributing valve). The timer is actuating the de-ice control valves and the distribution valve electrically.

Two boot operation modes are selectable by the two stage switch (HI/LOW/OFF) in the switch panel left of the pilot's seat. In the low mode the first boot group is inflated for 6 seconds immediately followed by the second boot group for another 6 seconds. The next inflation cycle starts then after a pause of 3 minutes. In high mode the pause is reduced to one minute.

Aircraft approved for known-icing operation

With de-ice system installation approved for known-icing operation, only the high operation mode is activated. Accordingly, the two stage switch will be replaced by a switch with positions ON and OFF only.

During normal operation or in the pause between the inflation cycles the boots are evacuated (distributing valve is connecting the boots to the vacuum manifold) to ensure a smooth airfoil contour.

[1] With SN 03 through 14 filter is installed in wing leading edge. Airplanes will be modified on demand.

System Components

Pos.	Item	Manufacturer	Part-Nr.	Qty.
1	De-icer Inboard Wing LH	BF-Goodrich	S29S4D5271-01	1
2	De-icer Inboard Wing RH	BF-Goodrich	S29S4D5271-02	1
3	De-icer Outboard Wing LH	BF-Goodrich	S29S4D5271-03	1
4	De-icer Outboard Wing RH	BF-Goodrich	S29S4D5271-04	1
5	De-icer Hor. Stabilizer LH	BF-Goodrich	S29S4D5271-05	1
6	De-icer Hor. Stabilizer RH	BF-Goodrich	S29S4D5271-06	1
7	De-icer Vertical Fin	BF-Goodrich	S29S4D5271-07	1
8	Stall Strip	BF-Goodrich	3D3379-1	2
9	Timer	BF-Goodrich	3D2991-14	1
10	Distributor Valve	BF-Goodrich	1532-8c	1
11	Pressure Switch	BF-Goodrich	3D3535-15	2
12	**SET (Pos. 1-11)**	**BF-Goodrich**	**KIT 38-953**	**1**
13	Vacuum Pump *alternatively:*	Airborne Aero Accessories	A/M 442CW-6 CH 442CW-6	2 2
14	De-ice Control Valve	Airborne	2H48-22	2
15	Pressure Regulator Valve	Airborne	2-H30-32	1
16	Pressure Check Valve Manifold	Airborne	1H24-21	1
17	Vacuum Regulator Valve	Airborne	2H3-6	2
18	Vacuum Check Valve Manifold	Airborne	1H5-29	1
19	Dual Source Diff. Vac. Gauge	Airborne	1G5-4	1
20	Vacuum System Inlet Filter Ass.	Extra	75551.00	1

Troubleshooting

Complaint	Possible Cause	Remedy
Deice boots fail to inflate completely	Leakage in pressure system upstream distributing valve	Identify leak, seal or replace defective part
	Kinked pressure tube upstream distributing valve	Replace defective tube
	Electric failure	Check wiring
	Failure of: timer, pressure regulating valve, distributing valve, (both vacuum pumps, both de-ice control valves, pressure manifold)	Identify defective component(s) and replace
De-ice boots inflate only partially (low inflation pressure, no indication light)	Leakage in pressure lines	Identify leak, seal or replace defective part
	Kinked pressure tube	Replace defective tube
	Failure of pressure regulating valve	Replace valve
	Electric failure	Check pressure sensors, wiring and indication light
One of the two inflation sections (inner wing, outer wing and tail surfaces) fails to inflate	Failure of: Timer, distributing valve, electric wiring	Identify defective component and replace
	Leakage of pressure lines downstream distributing valve	Check for leaks in pressure lines and boots, repair or replace defective parts
	Blockage downstream distributing valve	Check for kinks in tubing, replace
Time intervals out of tolerances	Failure of timer (or false timer)	Replace timer
Boot evacuation fails	Vacuum system failure	Refer to chapter 37
	Timer or distributing valve failure	Identify and replace or repair
	Electric failure	Check and repair wiring
	Vacuum line blocked or collapsed downstream distributor valve	Identify and clean or replace damaged line
	Boot or vacuum line leakage	Identify and replace or repair

Removal / Installation / Repair

For respective information see manufacturers (BF Goodrich) publications concerning “Estane De-Icers” as listed in the LOAP (Doc.-No. 05710.0).

30-10-01 De-Ice Control Valve

Removal (LH / RH Side)

CAUTION **Turn battery switch OFF and pull OFF circuit breaker BOOTS (left side panel) before beginning work.**

CAUTION **When working on vacuum/pressure system, take care not to contaminate vacuum hoses. Install blind plugs on hose ends. Even small residues of dirt may damage air pumps.**

	Detail Steps/Work Items	Key Items
1	Remove upper cowling	
2	Disconnect pressure hose from vacuum pump	VW spring clamp at de-ice control valve
3	Remove VW spring clamp at pressure hose to pressure check valve manifold	
4	Cut electrical wiring to control valve on both sides of 2 splices	
5	Loosen tightening nut of control valve from bracket at firewall	Use $1\ ^{1}/_{8}$ inches wrench
6	Remove control valve	

Installation (LH / RH Side)

	Detail Steps/Work Items	Key Items
1	Install control valve with tightening nut to bracket at firewall	
2	Install pressure hose to pressure check valve manifold	Use VW spring clamp
3	Install pressure hose from vacuum pump	Use VW spring clamp
4	Re-establish splices at electrical wiring to control valves	
5	Install upper cowling	

30-10-02 Pressure Check Valve Manifold

Refer to Airborne Service Letter No. 39, latest edition.

Removal

CAUTION **Turn battery switch OFF and pull OFF circuit breaker BOOTS (left side panel) before beginning work.**

CAUTION **When working on vacuum/pressure system, take care not to contaminate vacuum hoses. Install blind plugs on hose ends. Even small residues of dirt may damage air pumps.**

	Detail Steps/Work Items	Key Items
1	Remove upper cowling	
2	Disconnect pressure hose from pressure check valve manifold to de-ice system	VW spring clamp
3	Remove LH de-ice control valve	Refer to Sec. 30-10-01
4	Remove pressure hose from LH de-ice control valve	VW spring clamp
5	Remove VW spring clamp at pressure hose from RH de-ice control valve	
6	Pull off pressure check valve manifold from pressure hose from RH de-ice control valve	

Installation

	Detail Steps/Work Items	Key Items
1	Slip pressure check valve manifold on pressure hose from RH de-ice control valve	Use VW spring clamp
2	Install pressure hose from LH de-ice control valve	Use VW spring clamp
3	Install LH de-ice control valve	Refer to Sec. 30-10-01
4	Install pressure hose to de-ice system	Use VW spring clamp
5	Install upper cowling	

30-10-03 Pressure Regulator Valve

On older system installations, the pressure regulator valve is accessible by removing the fuselage floor cover between nose wheel and main wheel well.

From SN 20 on and with older aircraft modified for known icing operation, the pressure regulator valve is located under the cowling, downstream the pressure check valve manifold.

Removal

CAUTION **Turn battery switch OFF and pull OFF circuit breaker BOOTS (left side panel) before beginning work.**

CAUTION **When working on vacuum/pressure system, take care not to contaminate vacuum hoses. Install blind plugs on hose ends. Even small residues of dirt may damage air pumps.**

	Detail Steps/Work Items	Key Items
1	Remove upper cowling resp. fuselage floor cover	
2	Disconnect pressure hose from pressure check valve manifold	VW spring clamp at regulator valve
3	Disconnect pressure hose to de-ice system	VW spring clamp at regulator valve
4	Remove regulator valve	

Installation

	Detail Steps/Work Items	Key Items
	Install in reverse sequence of removal	

30-20-00 AIR INTAKES

Description

The engine combustion air intake features an alternate air inlet for icing protection. The combustion air is normally taken from a Pitot type inlet and then filtered by a polyurethane filter element. When switching to alternate air by pulling the alternate air control in the cockpits middle console, a flap in the coolant radiator outlet is opened allowing warm air to enter the engine induction system downstream the filter element. The system is maintenance free, after reinstallation of radiator outlet ducting a readjustment of the control is necessary (refer to chapter 71). Make sure that alternate air flap closes and opens completely when operating the cockpit control.

30-30-00 PITOT, STATIC AND STALL SENSOR HEAT

Description

Pitot Heat

The EA 400 is equipped with two heated Pitot tubes, one underneath each wing. Standard AN-type (AN 5812-1) pitot tubes are used. The electric pitot heat is activated by switching the "PITOT L " and "PITOT R" switch to the ON position. As long as the aircraft is on ground the heating of the pitot tubes is avoided by means of a squat switch installed at the nose gear strut. To provide a means for checking the system on ground the switches can be set to a momentary "TEST" position to override the squat switch. Avoid operating the system in this mode longer than 10 sec. on ground to avoid an overheat condition. The current consumption of the heating elements is monitored by current sensors during operation. If an open circuit causes the Pitot tube heaters to fail, a warning light illuminates in the warning panel.

Static Heat

The two dual static ports installed in the aft fuselage sides are equipped with electric heater elements to prevent icing. They are also activated by the Pitot heat switches, heating is disabled on ground by means of a squat switch and current sensors generate a warning information in case of malfunction. Temperature rise after activation of the test mode on ground is much slower than for the Pitot heat. Be aware of this behavior when checking the system on ground.

Stall Detector Heat

The Stall detector installed in the left wing leading edge within the access panel for the recognition lights features three electric circuits for icing protection. The movable sensing vane, the mounting plate and the case itself are heated by electric heating elements. The heatings are activated by the "PITOT R" switch and protected by the squat switch against inadvertent operation on ground. The TEST position of the switch overrides this protection to allow system checks on the ground (time limited up to max. 10 sec). The main heating circuits (vane and mounting plate) are monitored by a current sensor, giving a warning indication in the warning panel in case of an open circuit.

NOTE **In case of defective Pitot tube, static port or stall detector heat elements, the respective components have to be replaced as a whole (refer to Sec. 34-10).**

Troubleshooting

Complaint	Possible Cause	Remedy
Pitot tube does not heat	Wiring defective	Check and repair wiring
	Pitot tube heat defective	Replace Pitot tube
Static port does not heat	Wiring defective	Check and repair wiring
	Static port heat defective	Replace static port
Lift detector (3 heating circuits) does not heat	Wiring defective	Check and repair wiring
	Lift detector heat defective	Replace lift detector

30-40-00 WINDSHIELD HEAT

An electric windshield heat for the pilot's side of the windshield is part of the standard icing protection system.

The system consists of three wire circuits bonded between the inner and outer windshield layer, one for the heating itself and two for the redundant temperature sensing. The heating current is switched by a special heat controller regulating the windshield temperature between 20°C and 40°C in case the system is active. The system may be activated by means of the windshield heat switch located in the icing protection group within the switch panel left of the pilot's seat. In case of malfunction of the system, this condition is indicated by a red warning light in the warning panel. The following failure conditions cause a warning indication:

- One or both temperature sensing circuits open or shorted
- Overheat signal from at least one of the sensing circuits (more than 50°C)

An additional means for monitoring the function of the windshield is provided by a green annunciator light (controlled by a current sensor in the heating circuit) illuminating when the heating current flows. This light is cycling during normal windshield heat operation.

The system remains operative (green light cycling) as long as one of the two sensing circuits is functioning although the red warning annunciates one defective temperature sensing circuit. If both sensing circuits are defective the windshield controller inhibits any further windshield heating.

Troubleshooting

Complaint	Possible Cause	Remedy
Windshield heat inactive, no green light cycling	High ambient temperature (windshield above 40°C)	Normal system function
Red windshield heat warning light active, windshield heat (cycling green light) still active	Wiring to one temperature sensor in windshield defective	Check and repair
	One windshield temperature sensor defective	Replace windshield
	Respective circuit in controller defective	Replace controller
Red windshield heat warning light active, windshield heat inactive	Wiring to or both temperature sensors in windshield defective	Check and repair
	Windshield controller defective	Replace controller
Windshield heat inactive	Wiring to heatfield defective	Check and repair

Complaint	Possible Cause	Remedy
	Heatfield in windshield defective	Replace windshield
	Windshield controller defective	Replace controller

30-60-00 PROPELLER HEAT

Description

The propeller of the EA 400 is equipped with electrically heated blades for icing protection. The system does not include a timer for intermittent operation, it is operated continuously. All necessary information for repair and maintenance of the system is contained in manufacturers publications as listed in the LOAP (Doc.-No. 05710.0).

Troubleshooting

Complaint	Possible Cause	Remedy
Prop Ammeter shows zero	No power from aircraft to brushes	Check wiring, circuit breaker and switch, repair or replace defective part
	Open circuit brushes to heater boots	Repair wiring (check when stretching and flexing the leads) or replace propeller in case of heater element failure
	Ammeter defective	Replace ammeter
Prop Ammeter shows low current	Open circuit (or high resistance) to at least one of the blade heating elements	Identify whether wiring or heater element itself is defective. Repair wiring or replace propeller
	Ammeter defective	Replace ammeter
Ammeter shows excess current	Power lead shorted to ground	Check insulation and replace defective lead
	Ammeter defective	Replace ammeter
Radio noise	Brushes arcing	Check for brush alignment, dirty or rough slip rings and slip ring alignment
	Loose connection	Check wiring connections
Rapid brush wear and frequent breakage	Brush assembly out of alignment	Check and adjust brush alignment
	Slip ring wobbles	Check slip ring alignment, replace slip ring
	Rough slip rings	Replace (or refinish) slip ring