30 Ice & Rain Protection

CHAPTER 30

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CHAPTER 30 - ICE AND RAIN PROTECTION

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CHAPTER 30 - ICE AND RAIN PROTECTION

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GENERAL - DESCRIPTION AND OPERATION

The Duke 60 series aircraft utilizes heated pitot, heated stall warning, and heated fuel vents for standard ice protection equipment. Optional icing equipment includes: pneumatically operated surface deice boots and electrically heated propellers, heated windshield and heated ventilation ram air inlet scoop. In addition, an alternate static air source backs up the fuselage mounted static air source buttons.

"END"

AIRFOIL - DESCRIPTION AND OPERATION (Figure 1)

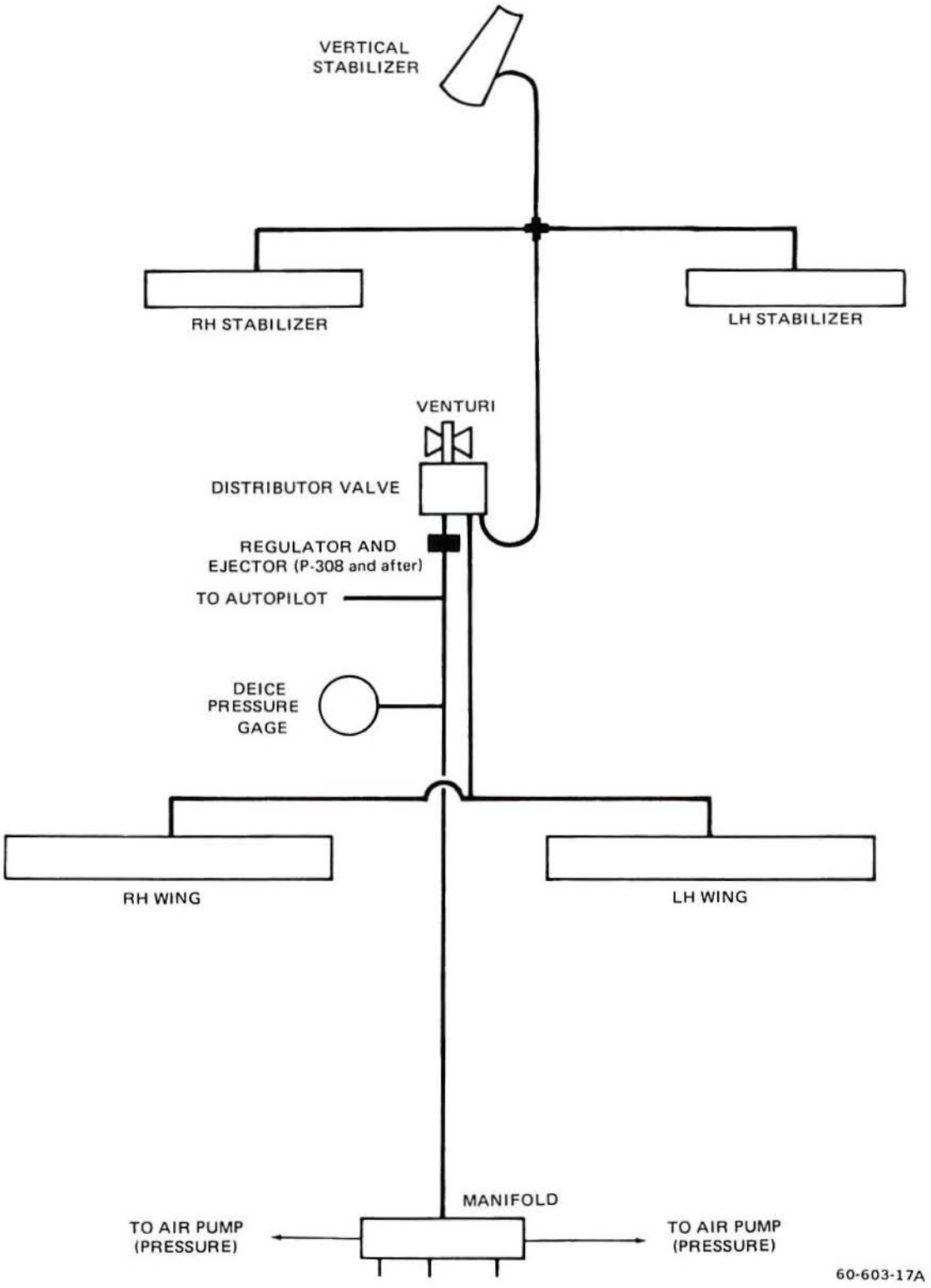
Deice boots on the wing and empennage leading edges are inflated by the two engine-driven pressure pumps. A venturi, operated from the pressure pumps, supplies vacuum for boot hold down at all times except during the inflation mode. Through an electric timer, solenoid-operated control valves cause all the boots to be inflated simultaneously. The timer is controlled by a three-position switch: SURFACE ONE CYCLE, and MANUAL with OFF position centered. This switch is located on the left subpanel. ONE CYCLE and MANUAL switch positions are momentary. A gage is provided to indicate system pressure. Momentary engagement of the ONE CYCLE position will cause the boots to inflate for five to eight seconds, then deflate to the vacuum hold-down condition. The MANUAL position will inflate the boots only as long as the switch is held in engagement; when the switch is released, the boots deflate. Leave the deicing system off until 1/2 to 1 inch of ice is accumulated. During inflation, the deice system pressure gage should register approximately 15 to 18 psi. Sufficient pressure for proper operation of the system is available with one engine inoperative.

On airplane serials P-3 through P-307, when the surface deice system is operated with the cabin pressure switch in the DUMP position, cabin pressure oscillations will occur. This is caused by a momentary loss of vacuum to the outflow valve while the boots are pressurizing. This vacuum loss allows the outflow valve to close and create a small residual cabin pressure. After a small increase, this pressure is then dumped by the safety valve.

The cabin pressurization shut off controls should be pulled during this mode to divert cabin pressurizing air overboard and prevent excessive cabin pressure oscillations. Cabin ventilation may be obtained by pulling out the cabin air control. In this mode pressure oscillations will be small.

On airplane serials P-308 and after, the vacuum used by the cabin pressurization system is developed in an ejector installed in the supply line for the deice distribution valve. Thus, operation of the deice system does not cause fluctuations of cabin pressurization.

For night operation, a wing ice light is provided on the outboard side of the left nacelle. The switch, placarded WING ICE, is on the left subpanel.



Airfoil Deice System Schematic
Figure 1

"END"

TROUBLESHOOTING
AIRFOIL DEICER SYSTEM

The following troubleshooting procedures are based on the assumption that the engine-driven dry air pumps are operational.

TROUBLE	*PROBABLE CAUSE*	*REMARKS*
1. Deicer boots do not inflate (either or both engines operating at a minimum cruise RPM for a period of eight seconds).	a. Open circuit breaker.	a. Push deicer circuit breaker to reset.
	b. Loose electrical connection or broken wire.	b. Tighten or repair as required.
	c. Time delay relay not functioning.	c. Replace time delay relay.
	d. Control relay not functioning	d. Replace control relay.
	e. Deicer boot punctured.	e. Repair as described in this chapter or replace.
	f. Distributor valve not functioning.	f. See steps 4 and 5.
	g. Piping lines kinked, blocked, or not connected.	g. Inspect and repair or replace as required.
	h. Leak in system.	h. Locate and repair.
2. Deicer boots inflate too slowly (either or both engine operating at minimum cruise RPM for a period of eight seconds)	a. Piping lines kinked, partially blocked, or not securely connected.	a. Inspect and repair or replace as required.
	b. Leak in system.	b. Locate and repair.
	c. Deicer boot punctured.	c. Repair as described in this chapter or replace.
	d. Distributor valve not functioning.	d. See steps 4 and 5.
3. Deicer boots deflate too slowly.	a. Piping lines kinked, partially blocked, or not securely connected.	a. Inspect and repair or replace as required.
	b. Overboard line from distributor valve partially blocked.	b. Inspect and repair or replace as required.
	c. Distributor valve not operating properly.	c. Overhaul or replace.
	d. Electrical circuit malfunctioning.	d. See Wiring Diagram Manual, P/N 60-590001-29.
	e. Vacuum ejector on distributor valve plugged.	e. Remove obstruction or replace.

TROUBLESHOOTING
AIRFOIL DEICER SYSTEM (Cont'd)

TROUBLE		*PROBABLE CAUSE*		*REMARKS*
		NOTE		
	The following items might aid in ascertaining whether or not the distributor valve is functioning properly.			
4. One or more boots do not inflate -- with pressure gage at normal reading with switch held in MANUAL or momentarily placed in SINGLE position.	a.	Defective wiring in external circuit or other units.	a.	See Wiring Diagram Manual P/N 60-590001-29 and disconnect plug at distributor valve. Voltage should be approximately 28 VDC between A-C and B-C. Make sure C is well grounded. On airplane P-390 and after, voltage should cycle at approximately 28 VDC between the blue-white wires. Make sure the white wire is well grounded
	b.	Faulty solenoids in distributor valve.	b.	Measure resistance of solenoids. Reading should be 17.5 ohms + 5% through the receptacle pins A-C and B-C. On airplanes P-390 and after reading should be 127 ohms ± 5% between the blue-white wires. Replace the distributor valve if readings do not check.
	c.	Mechanical failure in distributor valve.	c.	Disconnect lines at the outlet ports of the distributor valve and check valve operation with a gage. If trouble is not found in the distributor valve, inspect boots and lines for leaks or blockage.
	d.	Piping lines kinked, blocked, or not connected.	d.	Inspect and repair or replace as required.
5. One or more boots inflate but do not deflate readily -- with pressure gage at normal reading.	a.	Defective boots.	a.	Repair as described in this chapter or replace.
	b.	Obstruction of lines.	b.	Disconnect line from exhaust port of distributor valve and see if line is clear to low pressure area.
	c.	Mechanical failure in distributor valve.	c.	With line disconnected, see if exhaust port is discharging; if not replace distributor valve.

"END"

AIRFOIL DEICER - MAINTENANCE PRACTICES

SERVICING

Since the deicer boots and related components operate on clean air supplied from the pressure manifold, little is required in the form of servicing the system. The boots should be checked for engine oil after servicing and at the end of each flight, and any oil found should be removed. This can be accomplished by the use of a neutral soap and water solution. Care should be exercised to avoid scrubbing the surface of the boot as this will tend to remove the special conductive surfacing.

NOTE

Because the deicer boots are made of soft flexible stock, care must be exercised against dragging gasoline hoses over them or resting ladders or platforms against the surface of the boots.

SURFACE DEICER BOOT REMOVAL

To loosen or remove an installed deicer boot, use toluol (22, Chart 207, 91-00-00) to soften the "adhesion" line where the boot is joined to the metal surface. The solvent should be applied sparingly with a brush or trigger type oil can with a spout. Slowly peel the boot back, allowing the solvent time to undercut the boot. Exercise care not to injure the boot during removal.

SURFACE DEICER BOOT INSTALLATION

PREPARATION OF METAL SURFACES

Solvent Cleaning: The metal surface should be completely clean to prevent adhesion failure. Using a grease-free cloth dampened in MIL-M-13999 methyl ethyl ketone, (21, Chart 207, 91-00-00) go over the area to be covered by the boot. Change the cloths frequently, to avoid contaminating a previously cleaned area. Do not contaminate the clean supply of methyl ethyl ketone, by dipping a used cloth into it. Repeat the process. Using a clean, damp cloth and a clean dry cloth, go over the area again; use the dry cloth (following the damp cloth) to wipe the surface dry, rather than letting it air dry.

Chemical Cleaning: Follow the solvent cleaning, with a grease-free cloth wetted with an acid cleaner (41, Chart 207, 91-00-00). Vigorously scrub surface.

CAUTION

Although the acid cleaner is a mild acid solution, protective rubber gloves should be worn and contact with the skin should be avoided.

After the acid cleaner has had one minute's contact, wipe dry with a clean cloth. Allow a minimum of one hour dry-time before applying cement. At the end of the dry-time, wipe the surface with a clean cloth and inspect the cloth for dirt. If dirt is present, reclean with methyl ethyl ketone; if not, cover the clean surface with paper until the cementing operations are begun.

PREPARATION OF RUBBER SURFACES

If the deicer boot has a smooth back finish, roughen it slightly with sandpaper before beginning the cleaning operation. Wet a clean cloth with toluol (22, Chart 207, 91-00-00) and carefully clean the rough back surface of the boot. Change cloths frequently to avoid contamination of the cleaned areas. Clean the boot a minimum of two times; if the area still seems dirty, reclean the surface in the same manner.

Application of Adhesive: The drying of the cement is a function of time and temperature, and the table below should be used as a shop guide when applying the cement:

Temperature - °F	Minutes of Dry Time
Above 80	30
60-80	45
Below 60	60

Do not apply cement under dusty conditions or in high humidity (80% relative humidity or above). Prior to cementing, mask off the boot area on the metal surfaces, allowing 1/2 to 3/4 inch margin.

SPRAY COAT METHOD:

If the EC-1300L adhesive (12, Chart 205, 91-00-00) is applied by spray, the first coat on the back surface of the boot and on the metal surface should dry a minimum of 30 minutes. The second cross coat on each surface should be allowed to dry a minimum of 30 minutes, preferably one hour.

BRUSH COAT METHOD:

Apply an even brush coat of EC-1300L adhesive (12, Chart 205, 91-00-00) to the back surface of the boot and the metal surface of the airplane. Allow a minimum of 30 minutes to dry. Apply a second coat to each surface in a smooth, even layer. Brushing in one area too long tends to soften the first coat and "rolling" and "balling up" will result. Allow the coating to thoroughly dry a minimum of 30 minutes, preferably one hour before installation. Excess drying time (not to exceed 7 days) is not critical as long as the surfaces are not contaminated.

INSTALLATION OF THE BOOT

Using a chalk line, snap a line centrally located on the leading edge of the surface. Snap a line, centrally located cordwise, on the cemented side of the boot.

Securely attach hoses to the deicer connection, being careful to handle the boot section without getting finger marks on the adhesive. Using a lint-free cloth, heavily moistened (not dripping) with toluol, (22, Chart 207, 91-00-00) reactivate the surface of the leading edge and boot about 3 inches on either side of the chalk line. Position the boot chalk line directly on the leading edge chalk line and hand roll the boot surface onto the leading edge. Moving along the center line of the leading edge, continue reactivating the adhesive in strips 6 inches wide by 24 inches long. Avoid excessive rubbing of the adhesive surface as some of the adhesive may be removed. Hand roll the joined surfaces to ensure complete contact of the adhesive and elimination of air pockets. If the boot does not follow the chalk line on the leading edge, pull it up immediately with a quick motion and reposition properly. Now complete the installation by activating the adhesive surfaces and rolling on the top and lower half of the boot in sequence. Finally roll the entire boot (applying pressure) moving in a direction parallel with the inflatable tubes. Use a narrow stitch roller between tubes to eliminate air entrapment. If an air pocket or blister is noted immediately after boot installation, the air may be removed by inserting a hypodermic needle into the blister and allowing the air to escape. The surfaces may then be pressed down, permitting the surfaces to adhere.

NOTE

When removing entrapped air from the boot by use of a needle, be extremely careful not to puncture one of the inflatable tubes.

SEALING EDGES

Fair in all around cut edges and trailing edges of the boot with EC-801 sealer (11, Chart 205, 91-00-00) and cover all exposed adhesive. Never try to remove excess adhesive closer than 1/4 inch from the boot edge. After all adhesives and sealing compounds have dried and cured, remove masking tape and clean adjacent areas with solvent.

STALL STRIP INSTALLATION (RUBBER)
(Figure 201)

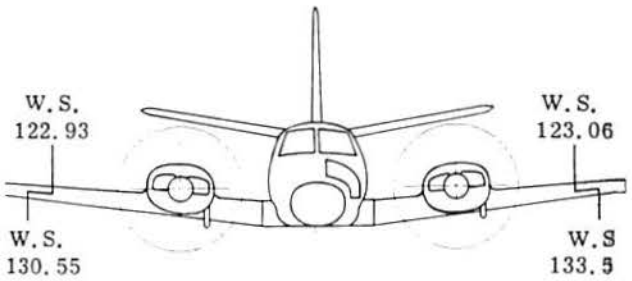
a. The stall strips are 7.62 inches long for the right wing and 10.50 inches long for the left. The right stall strip is installed with its inboard end at Wing Station 122.93 and the left stall strip is installed with its inboard end at Wing Station 123.06.

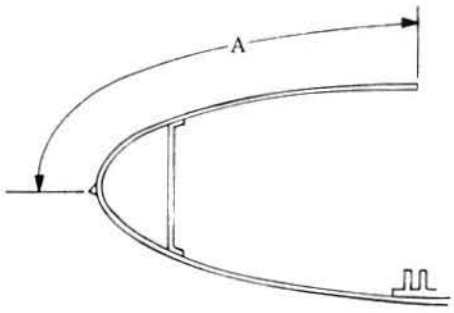
b. Clean boot surface thoroughly, removing all old cement. Mask off the area where the new strip is to be installed and wipe with MIL-M-13999 methyl ethyl ketone (21, Chart 207, 91-00-00).

c. Bostic 1008, a two part cement, (18, Chart 205, 91-00-00) is used to join the stall strip to the deicer boot. Mix the Bostic 1008 in the following manner: 30 parts (by weight) of the base material (in the "A" package) with 1 part (by weight) of the accelerator (in the "B" package).

d. Apply a coat to both the stall strip and the area to which it will be bonded. Allow to dry 10 to 15 minutes, then install the strip as shown in the illustration. The cement will set in about 6 hours.

e. When dry, coat the area with A56B cement (1, Chart 205, 91-00-00) to replace the conductivity of the boot.





Right Wing	Left Wing
Dimension "A" is 15.69 at Wing Station 122.93 and 15.06 at Wing Station 130.55.	Dimension "A" is 15.69 at Wing Station 123.06 and 15.00 at Wing Station 133.56.

Stall Strip Installation
Figure 201

RESURFACING DEICER BOOTS

Static electric charges, if allowed to accumulate, would eventually discharge through the boot to the metal skin beneath,

causing static interference with radio equipment and possibly puncturing the rubber. Also, such static changes are a temporary fire hazard after each flight. To dissipate static electric charges, a thin coating of conductive cement is applied over the neoprene of the boot. From time to time it may be necessary to restore the conductivity to efficiently dissipate such charges. When resurfacing seems advisable, the principal factors involved are:

a. If the surfacing material has abraded.
b. If the surfacing has developed cracks.
c. If the conductivity is low.

The following procedures should be accomplished when resurfacing deicer boots.

a. Clean the deicer boots thoroughly with toluol (22, Chart 207, 91-00-00).
b. Roughen the entire surface of the boot with fine sandpaper.
c. Clean the surface again with a clean lint-free cloth moistened with toluol.
d. Apply masking tape beyond the upper and lower trailing edges, leaving a 1/4 inch gap of bare metal.
e. Brush one coat of Goodrich A56B cement (1, Chart 205, 91-00-00) on the boot and allow it to dry at least one hour. Then apply a second coat and allow it to dry at least four hours before operating the deicers. The airplane may be flown as soon as the cement is dry.

NOTE

If A56B cement has aged three months or more, it may be necessary to dilute it with toluol to obtain the proper brushing consistency. Mix thoroughly, approximately five parts cement to one part toluol.

ADJUSTMENT

Adjustment of the pneumatic pressure system is performed by adjusting the various regulators in a specified sequence. A PRESSURIZATION SYSTEM ADJUSTMENT CHART corresponding to applicable illustrations and a general adjustment procedure for each individual regulator are provided in Chapter 36-00-00.

COMPONENT LOCATION

TIME DELAY RELAY

The time delay relay is located forward of the instrument panel in the upper LH corner of the forward pressure bulkhead.

CONTROL RELAY

The control relay is located forward of the instrument panel in the upper LH corner of the forward pressure bulkhead.

DISTRIBUTOR VALVE

The distributor valve is located just forward of the access opening on the RH side of the aft fuselage. The distributor valve is accessible, for removal and installation, through the access openings on the lower aft fuselage and the RH side of the aft fuselage. The valve may be removed by disconnecting the hoses and removing the attaching screws.

COMPONENT REPLACEMENT

No maintenance on these components is recommended. Repair or replacement of parts should be made through the Beech Aircraft Corporation overhaul, and exchange program.

"END"

AIR INTAKES - DESCRIPTION AND OPERATION

The possibility of induction system icing is reduced by the non-icing characteristics of fuel injection engines and is backed up by an automatic alternate air source. Should the ram air scoop or filter become clogged with ice, a spring-loaded door on the firewall will open automatically, and the induction system will operate on alternate air. When operating on alternate air above the critical altitude, approximately 8 to 10 inches of manifold pressure will be lost.

On airplanes P-3 thru P-266, an optional equipment ram air inlet electrothermal lip boot is utilized. The boot is activated by a separate switch placarded RAM AIR INLET-OFF.

"END"

PITOT AND STATIC - DESCRIPTION AND OPERATION

A heating element in the pitot mast prevents the pitot opening from becoming clogged with ice. The heating element is connected into the aircraft electrical system through a 5-ampere circuit breaker.

"END"

WINDOWS AND WINDSHIELD - DESCRIPTION AND OPERATION

The pilot's and copilot's windshields are electrically heated to protect against icing. An inverter, also used as a standby for the avionics inverter, is installed for the operation of the pilot's windshield heat and is activated by a switch on the pilot's subpanel marked L WSHLD - OFF. The copilot's windshield is activated by a switch on the pilot's subpanel marked R WSHLD - OFF - L WSHLD. Each switch is protected by a 3/4-ampere circuit breaker located on the right subpanel. The 45-ampere circuit breaker that protects the other components of the system is located between the two LH bus isolation circuit breakers in the LH nacelle electrical equipment compartment. For equipment requiring AC current, a three position switch marked MN INV - OFF - STBY INV must be placed in the MN INV position. Should a failure occur in the main inverter, the switch can be placed in the STBY INV position. This opens a relay to direct the current from the windshield heat inverter to the avionics provided the L WSHLD switch is on. Power for the operation of both systems cannot be supplied by this inverter at the same time.

On airplane serials P-459 and after and prior airplane serials with Kit No. 60-3008-1S installed, a windshield voltage indicator is provided on the instrument panel which enables the operator and/or maintenance to monitor the voltage from the inverter to the windshield heater.

In operation a sensing element installed in the windshield sends a signal to the temperature control box located on the aft side of the forward pressure bulkhead at the base of the pilot's windshield, closing a relay permitting current to flow through the heating elements. The control box is factory adjusted between 90°F and 110°F to maintain the desired mean temperature. The control box operates in an ambient temperature range of −65°F to 160°F.

"END"

TROUBLESHOOTING
WINDOWS AND WINDSHIELD DEICER SYSTEM

TROUBLE	*PROBABLE CAUSE*	*REMARKS*
1. Windshield fails to heat.	a. Circuit breaker on RH subpanel tripped.	a. If circuit breaker persists in tripping, check for short and correct.
	b. Switch faulty.	b. If no voltage at switch output with correct voltage at switch input, replace switch.
	c. No input or output voltage to inverter circuit breaker.	c. Check for short and correct.
	d. Sensing element faulty.	d. Check for circuit continuity and replace windshield.
	e. No AC output voltage from control relay.	e. Check control relay, sensing element and control box and replace as required.
	f. Damaged heater circuit.	f. Replace windshield.

"END"

WINDOWS AND WINDSHIELD - MAINTENANCE PRACTICES

ELECTRICALLY HEATED WINDSHIELD RESISTANCE CHECK

To check for incorrect resistance or the presence of a short or open circuit in the heating elements of the windshield, the following procedure may be used:

a. With the windshield deicing system turned OFF, disconnect the leads to the heating element at the lower end of each bus.

b. Using an ohmmeter, determine the resistance of the heating element by placing the leads of the ohmmeter across the heating element leads. The resistance should measure 97.0 ± 9.7 ohms.

c. Reconnect the leads of the heating element.

SENSING ELEMENT RESISTANCE CHECK (Figure 201)

The resistance of the sensing element of the windshield varies with temperature changes. Figure 201 provides the acceptable range of resistance values at various ambient temperatures. The resistance of the sensing element may be checked as follows:

a. With the windshield deicing system turned OFF, disconnect the wire connected to one of the terminals of the sensing element.

b. Use an ohmmeter to determine the resistance of the sensing element.

c. Determine the temperature of the windshield.

d. Determine if the resistance measured falls within the tolerance shown in Figure 201.

e. Reconnect the windshield sensing element wire.

ELECTRICALLY HEATED WINDSHIELD VOLTAGE CHECK

CAUTION

Ground use of windshield heat is limited to 10 minutes.

a. Connect a precision voltmeter between the windshield heater control switch and the windshield heater.

b. Start the engines in accordance with the applicable Pilot's Operating Manual.

c. Set propeller speed at 1200 to 1500 rpm.

d. Turn the LH windshield switch ON. Note the increase on the voltmeter (minimum reading of 220 vac). A voltmeter reading of less than 220 vac indicates a malfunction of windshield heat.

e. Repeat steps "a" through "d" with the RH windshield heat switch ON.

f. Shut-down airplane engines in accordance with the applicable Pilot's Operating Manual.

g. Remove voltmeter from the airplane and restore wiring to the windshield heater circuit.

ELECTRICALLY HEATED WINDSHIELD FUNCTIONAL TEST

After completing the preceeding resistance checks, determine that the ambient temperature is 90° or less and perform the following functional check:

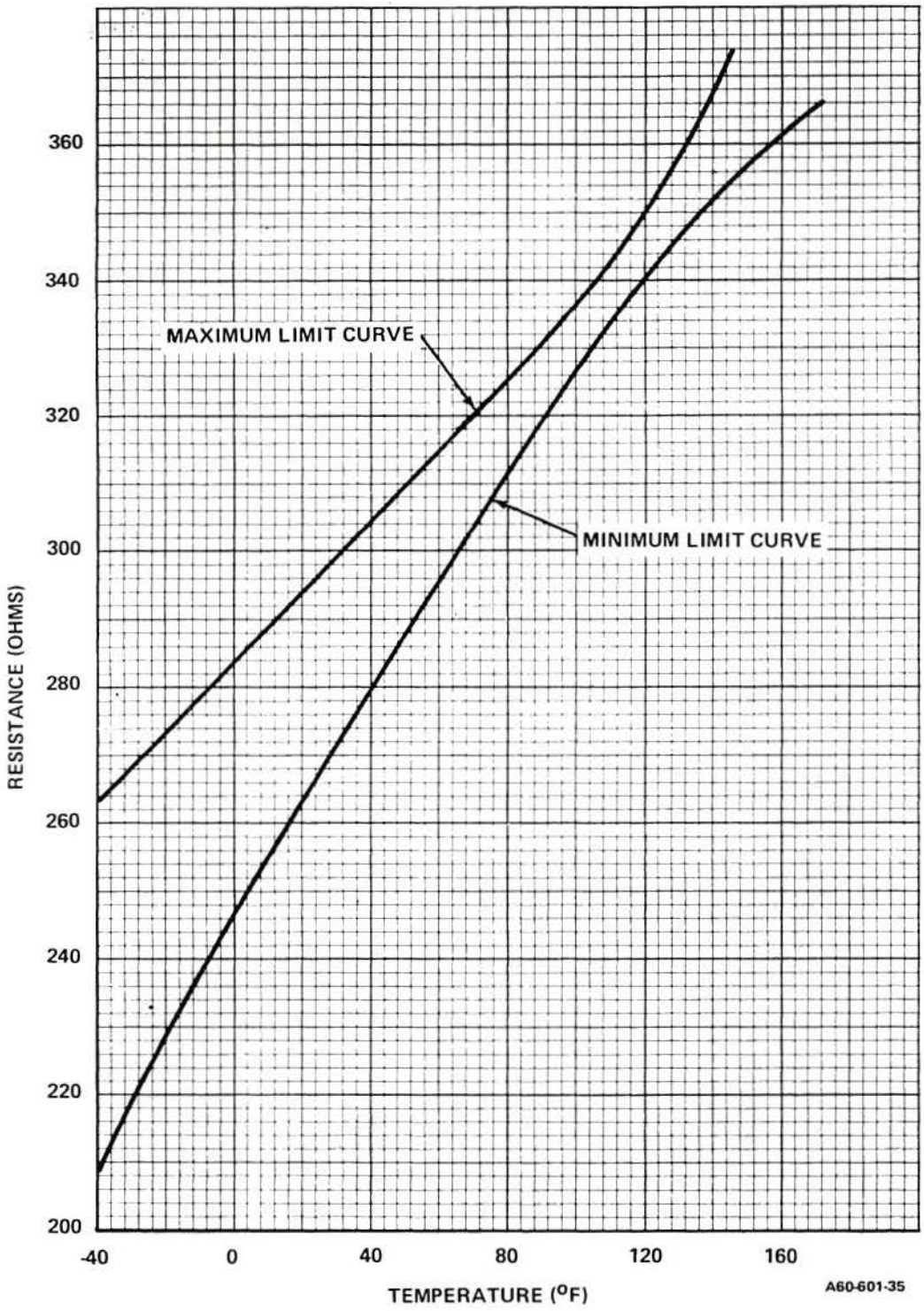
CAUTION

Ground use of windshield heat is limited to 10 minutes to prevent damage to the inverter.

a. Place the windshield DEICE control switch in the L WSHLD position.

b. Determine that the windshield should immediately begin to heat. Presence of heat may be determined by holding the hand against the heated portion of the windshield.

c. Place the windshield DEICE control switch in the OFF position.



Sensing Element Resistance Graph
Figure 201

"END"

PROPELLERS - DESCRIPTION AND OPERATION

ELECTRIC PROPELLER DEICING (Prior to P-579, FIGURE 1)

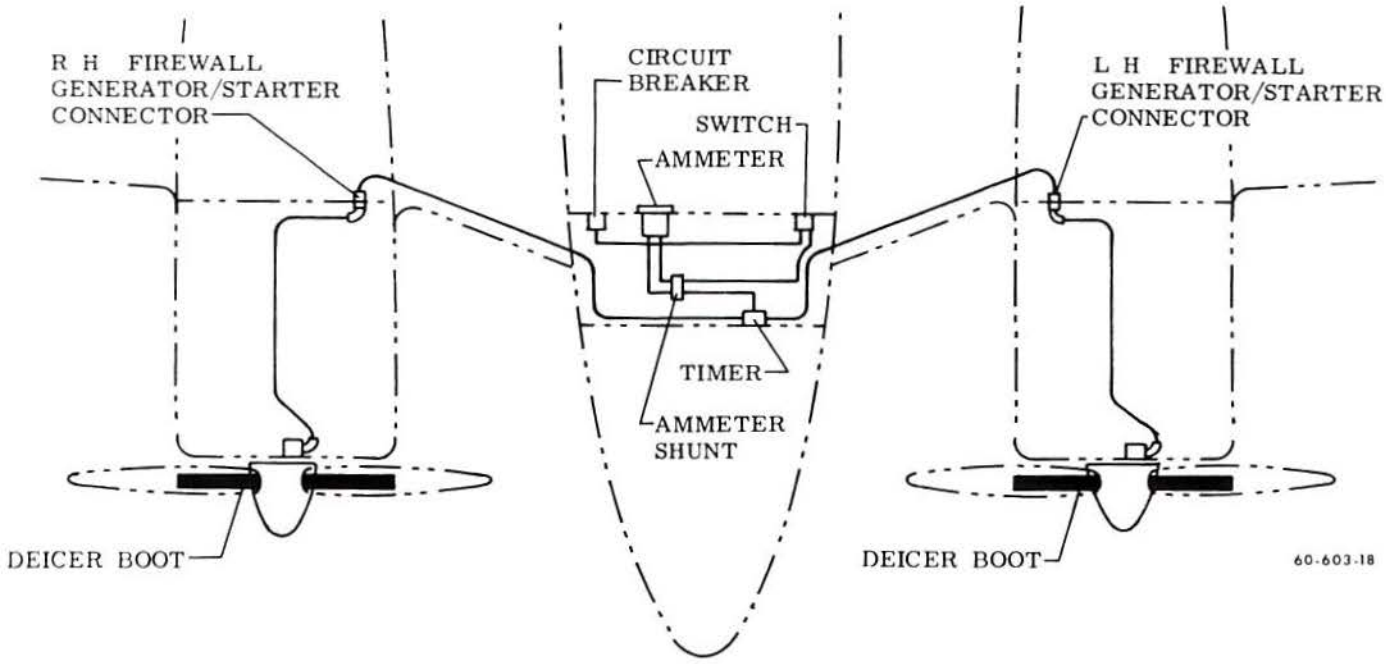
The electric propeller deicer system includes an electrically heated boot for each propeller blade, brush assemblies, slip rings, an ammeter, a control switch and a circuit breaker. When the switch is turned on, the ammeter registers the amount of current (14 to 18 amps) passing through the system. If a short develops in the system the circuit breaker will cut off the power to the timer. The current flows from the timer to the brush assembly mounted on the front of the engine case and is conducted by the brush assembly to the slip rings installed on the starter ring gear. The slip rings distribute current to the deicer boots on the propeller blades. Heat from the boots reduces the grip of the ice, which is then removed by the centrifugal effect of propeller rotation and the blast of the airstream. Power to the two heating elements on each blade is cycled by the timer to the outboard and inboard heating elements in the following sequence: RH outboard, RH inboard, LH outboard, LH inboard. Since each of these phases is 30 seconds in duration, the timer makes a complete cycle every two minutes. Whenever the timer switches to the next phase of operation, the ammeter will register a momentary deflection.

ELECTRIC PROPELLER DEICING (P-579 and after)

On airplanes P-579 and after, the electrothermal deice boots mounted on the propeller blades are electrically heated. Direct current for deice boot heating is supplied through a system of controls by two brushes which ride on dual slip rings mounted on the propeller assembly.

The brushes used on this installation are of the modular block type. The dual slip rings are supplied as an assembly. Maintenance of the modular brush blocks and slip ring assemblies are covered elsewhere in this chapter under respective headings.

Current for operation of the deice timing control and the deice boots is supplied through a switch, located on the pilot's LH subpanel, and a 20-ampere circuit breaker. When the switch is placed in the ON position, the deice timer begins to run, initiating automatic cycling of electrical power to the deice boots. At intervals of approximately 90 seconds in duration, the timer alternately cycles power to the LH then RH propeller deice boots. Current for operation of the deice system is indicated by an ammeter located on the RH instrument panel.



Propeller Deicer System
Figure 1

"END"

PROPELLERS - TROUBLESHOOTING

The ammeter of the deicer system can be used to indicate the general nature of most electrical problems. Consequently, it is recommended that troubleshooting be preceded by the ammeter test as outlined under ELECTRIC PROPELLER DEICER in Chapter 5-20-00 of this manual, and the HEAT TEST described in this chapter to determine which circuits are involved. A reading of two-thirds the normal amount of current is an indication that one of the circuits is open between the slip ring and deicer heater. If the ammeter registers excess current, the power lead is shorted to ground. It may be possible that the excess current has welded the timer contacts in one phase. Under these circumstances, the timer will either feed current to the welded contacts continuously or will not cycle. If the former is true, the heat test will show two phases heating simultaneously throughout three of the four phases. Unless the grounded power lead is located and corrected, any new timer that is installed may suffer the same internal damage during the first use of the system.

TROUBLESHOOTING
PROPELLER DEICING SYSTEM (PRIOR TO P-579)

	TROUBLE		*PROBABLE CAUSE*		*REMARKS*
1.	Ammeter shows zero current. (All 4 phases of the 2-minute 16-second cycle.)	a.	Circuit breaker tripped.	a.	Locate and correct short before resetting circuit breaker.
		b.	Switch faulty.	b.	If no voltage at switch output with voltage at switch input, replace the switch. If voltage is OK at switch output, go to step "d".
		c.	No power from aircraft.	c.	If no voltage into switch, locate and correct open circuit.
		d.	Ammeter faulty. (If some or all deicers heat with ammeter at zero, replace the ammeter.)	d.	Test for voltage up to and out of ammeter. If low or zero output but proper input, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter.
		e.	Open circuit between ammeter and timer.	e.	Disconnect harness at timer and check voltage pin B (of harness) to ground. If none, locate and correct open circuit.
2.	Ammeter shows normal current part of cycle, zero current rest of cycle.	a.	Open in wiring between timer and firewall connector.	a.	Refer to HEAT TEST in this chapter to find deicers not heating and test for voltage on that pin of firewall connector. If zero over 2 minutes, locate and fix open in wiring from timer to firewall.
		b.	Open between firewall and deicer lead straps.	b.	If voltage to firewall plug, try voltage at junction of deicer lead and slip ring lead. If no voltage, find and correct open in wiring to brush block, open within brush block, or no contact brush to slip ring.
		c.	No ground circuit, one engine.	c.	If voltage at deicer leads, locate and fix open from deicer to ground.
3.	Ammeter shows normal current part of cycle, low current rest of cycle.	a.	Inner and outer deicers heating same phase.	a.	Locate and repair incorrect connections.

TROUBLESHOOTING
PROPELLER DEICING SYSTEM (Cont'd)
(PRIOR TO P-579)

TROUBLE		PROBABLE CAUSE		REMARKS
	b.	Open in deicer or slip ring assembly.	b.	Disconnect deicer straps to check heater resistance. If resistance is within specified limits, locate and fix open in slip ring leads. If not, replace deicer with open circuit.
	c.	High resistance in circuit with low current.	c.	If not in contact of brush to slip ring (including ground brush), trace wiring to deicer and to timer to fix partially broken wire, loose or corroded connection.
4. Ammeter shows low current over entire cycle.	a.	Aircraft voltage low.	a.	Check voltage into switch.
	b.	Ammeter faulty.	b.	Refer to step "1d".
	c.	High resistance up to timer.	c.	Check for partially broken wire, loose or corroded connection in wiring from aircraft supply to timer input.
5. Ammeter shows excess current over entire cycle.	a.	Ammeter faulty.	a.	Refer to step "1d".
	b.	Ground between ammeter and timer.	b.	Disconnect harness at timer and, with ohmmeter, check from pin B (of harness) to ground. If ground is indicated, locate and correct.
6. Ammeter shows normal current part of cycle, excess current rest of cycle.	a.	Ground between timer and brush block.	a.	Disconnect leads at brush block and check from power leads to ground with ohmmeter. If ground is indicated, locate and correct.
	b.	Ground between brush block and deicers. (Excluding ground brush circuit.)	b.	If no short exists at brush-slip ring contact, check for ground from slip ring lead to bare prop while flexing slip ring and deicer leads. If a ground is indicated, locate and correct.
	c.	Short between two adjacent circuits.	c.	Check for shorts or low resistance between circuits, if any, locate and correct.
	d.	Timer faulty.	d.	Test timer as indicated in DEICER TIMER CHECK in this chapter.
7. Ammeter does not "flick" each 34 seconds.	a.	Timer ground open.	a.	Disconnect harness at timer check with ohmmeter from pin G (of harness) to ground. If no circuit, refer to Wiring Diagram Manual (P/N 60-590001-29) to fix open circuit.

TROUBLESHOOTING
PROPELLER DEICING SYSTEM (Cont'd)
(PRIOR TO P-579)

	TROUBLE		*PROBABLE CAUSE*		*REMARKS*
		b.	Timer contacts are welded (caused by short circuit in system).	b.	Test timer as in DEICER TIMER CHECK in this chapter. If timer does not cycle with voltage at pin B, replace timer but be sure short causing original problem has been located and corrected.
8.	Ammeter flicks between 34 second phase periods.	a.	Loose connection between aircraft power supply and timer input.	a.	If trouble occurs over entire cycle, trace wiring from power source to timer input to locate and tighten loose connection.
		b.	Loose or poor connection timer to deicers.	b.	If trouble occurs in part of cycle, find which deicers are affected and check for rough to dirty slip rings causing brush to "skip". If not this, trace circuits to locate and fix loose or poor connection. (If all deicers on one prop are affected, check the ground circuit.)
		c.	Timer cycles erratically.	c.	Test timer as indicated in DEICER TIMER CHECK in this chapter.
9.	Radio noise or interference with deicers on.	a.	Brushes "arcing".	a.	Check brush alignment as outlined under ELECTRICAL PROPELLER DEICER in Chapter 5-20-00 of this manual. Look for rough or dirty slip rings. If this is the cause, clean, machine or replace slip ring assembly. Check for slip ring alignment.
		b.	Loose connection.	b.	Refer to step 8 above.
		c.	Switch faulty.	c.	Try jumper wire across switch. If radio noise disappears, replace the switch.
		d.	Wiring located less than 8 inches from radio equipment wiring.	d.	Replace at least 8 inches from input wiring to radio equipment.
10.	Cycling sequence not correct.	a.	Crossed connections.	a.	Check Wiring Diagram Manual (P/N 60-590001-29) for improper connections.
11.	Rapid brush wear or frequent breakage.	a.	Brush block out of alignment.	a.	Check brush alignment as outlined under ELECTRIC PROPELLER DEICER in Chapter 5-20-00 of this manual.
		b.	Slip ring wobbles.	b.	Check slip ring alignment with dial indicator.

"END"

TROUBLESHOOTING ELECTROTHERMAL PROPELLER DEICE SYSTEM (P-579 and After)

Propeller deice ammeter reading outside the shaded area of the meter (14-18 amperes) is an indication that a fault may exist in the deice system. It should be noted, however, that current readings above or below the shaded areas of the deice ammeter may indicate an output voltage outside the normal operating range (28.25 ± .25 vdc) rather than a defect in the deice system itself. Excessively high operating voltage could conceivably damage the deice system and create a multiple fault condition; therefore, operation should not be instituted until the fault or faults have been corrected. Use of battery power alone, during operation of the deice system, should be avoided because the battery output voltage will be lower than normal operating voltage and may produce ammeter readings below the shaded area of the meter.

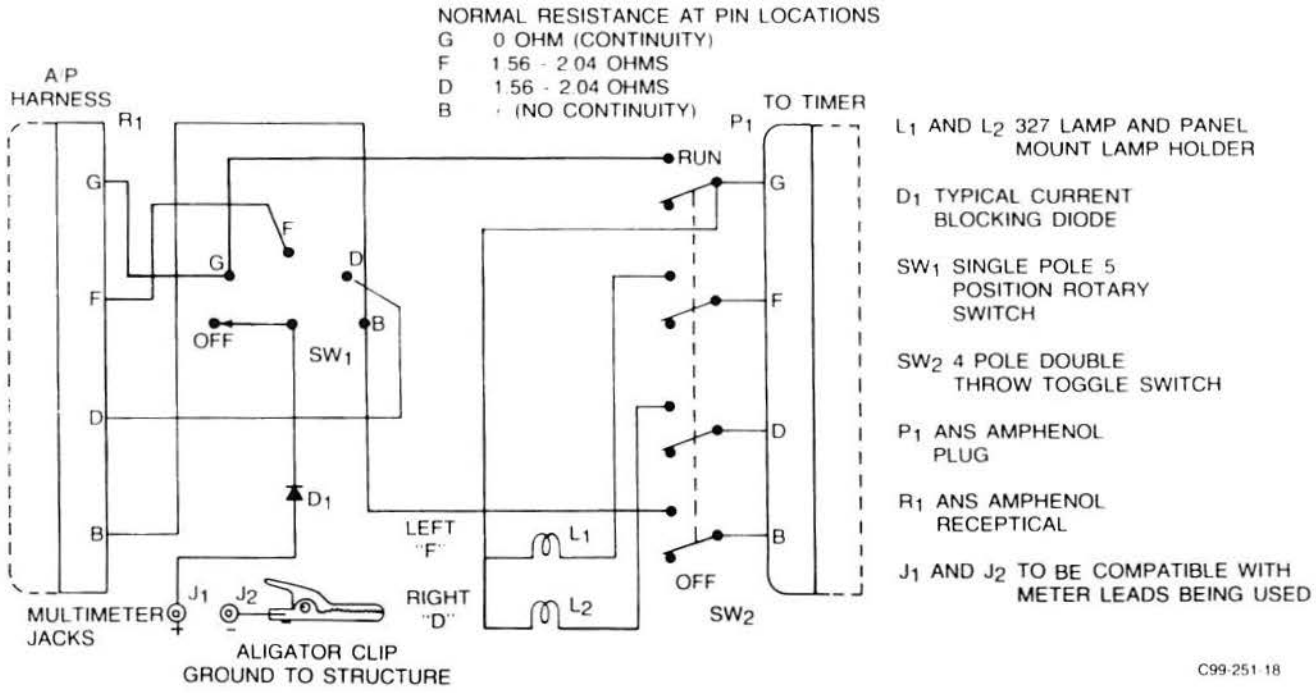
All resistance and continuity checks are made with the engines off, battery off and the timer disconnected. Resistance values specified in the troubleshooting chart may not be exact, as small variances may occur from one installation to another and will be subject to the accuracy of the particular resistance measuring instrument being used. For this reason it is recommended that a sensitive multimeter be used known to be accurate with ±1% (digital being preferred).

The test unit (Figure 101) was designed to be used in conjunction with these troubleshooting procedures and can be built with standard parts normally found in the shop. Operation and use of the test unit as outlined in the troubleshooting procedure makes it possible to positively check the timer in the airplane during system operation.

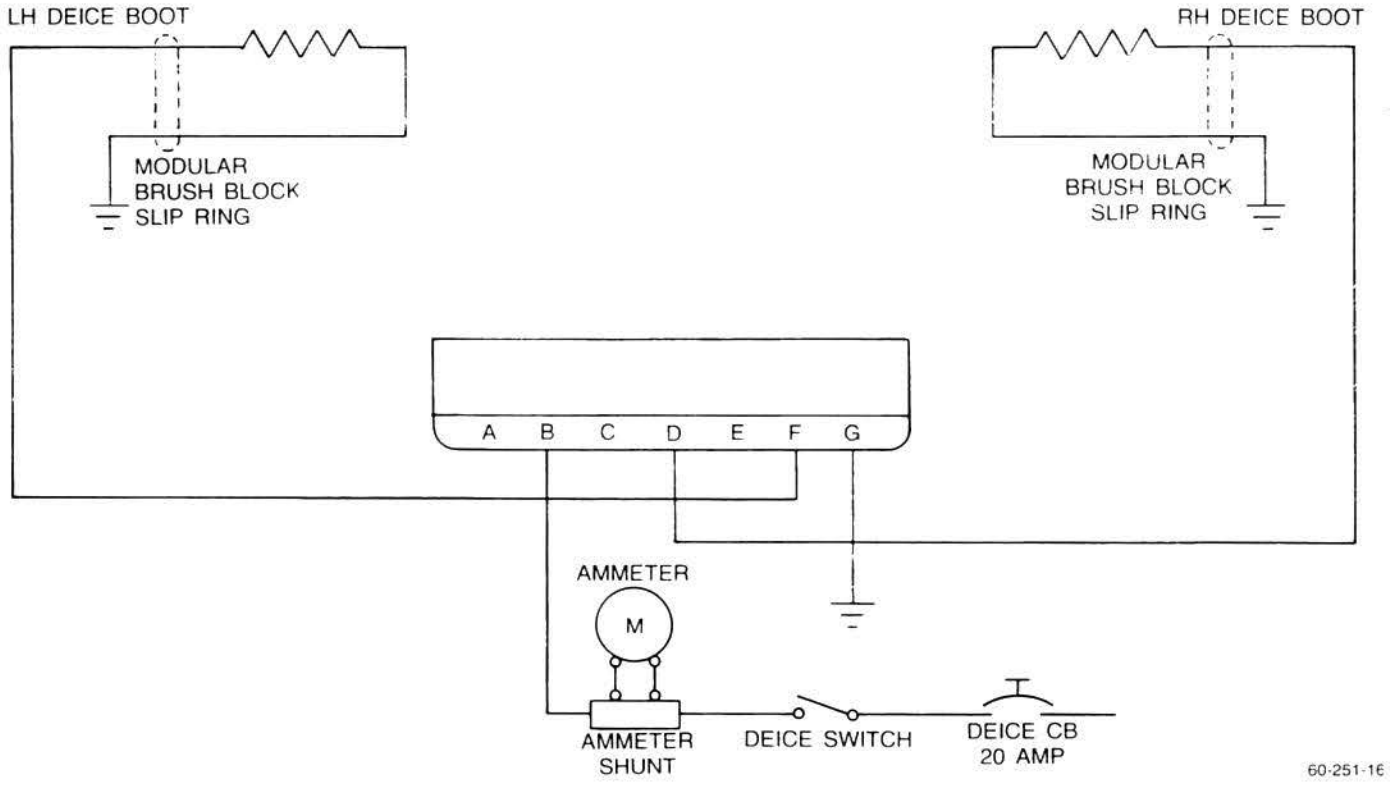
The troubleshooting chart which follows allows for an orderly flow of checks in a sequence consistent with the most convenient order of activity for the technician. The numbers in parenthesis, preceding some steps of the troubleshooting sequence, refer to notes found at the bottom of the chart. An electrothermal propeller deice control schematic (Figure 102) should be used for reference during system troubleshooting.

CAUTION

Propeller deice system must not be ground operated for extended periods of time as damage to the deice boots and pitting of the slip rings may occur.

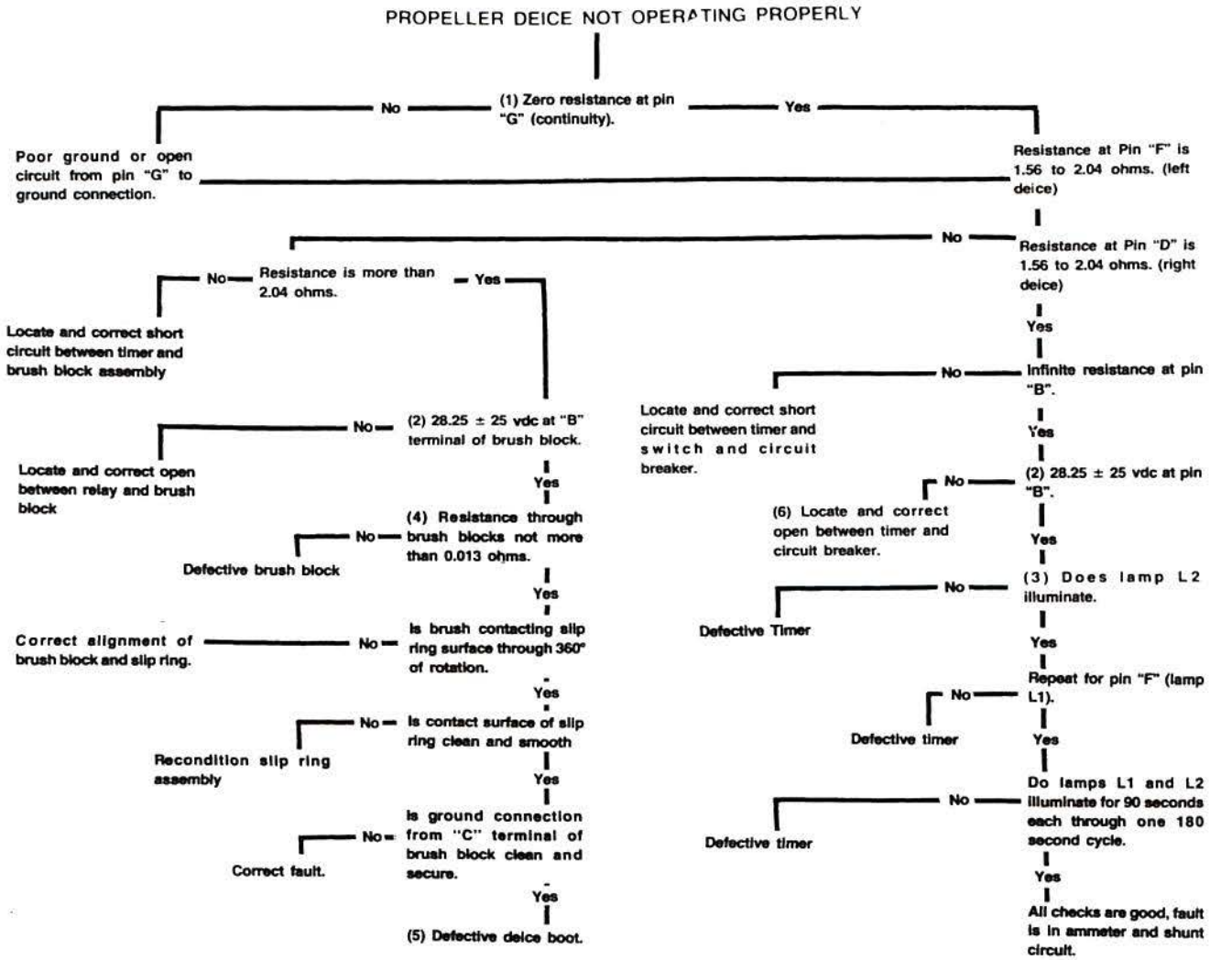


Electrothermal Propeller Deice Test Unit
Figure 101



Propeller Deice Control Schematic
Figure 102

TROUBLESHOOTING
ELECTROTHERMAL PROPELLER
DEICE (P-579 and after)



(1) All resistance and continuity checks are made with the battery switch OFF and the timer disconnected (If using test unit in Figure 101, placing SW 2 in the OFF position will disconnect timer)

(2) Voltage measurements are made with the propeller deice switch ON, circuit breaker in, and an auxiliary power unit connected or at least one generator on the line. Deice ammeter readings will vary directly with voltage.

(3) Reconnect timer (if using test unit Figure 101, place SW 2 in run position) advance timer by turning automatic propeller deice switch off then on again till lamp L2 illuminates. At no time during this check should both lamps (L1 and L2) be illuminated.

(4) Resistance is measured from face of brush block to terminal and must not exceed 0.013 ohms.

(5) Resistance measured through individual deiced boots should not exceed 5.9 ohm.

(6) Check switch and circuit breaker for continuity through switch in on position.

"END"

PROPELLER - MAINTENANCE PRACTICES

PROPELLER DEICER BOOT REMOVAL

a. Remove the propeller spinner.

b. On airplanes P-3 thru P-309, disconnect the deicer boot leads from the spinner bulkhead. Remove the clip securing the strap to the spinner bulkhead and the clamp securing it to the propeller hub.

c. On airplanes P-310 and after, disconnect the deicer boot leads from the clamp on the propeller hub.

d. Use MIL-M-13999 methyl ethyl ketone (21, Chart 207, 91-00-00) or toluol (22, Chart 207, 91-00-00) to soften the adhesion line between the boot and the blade, loosen one corner of the boot sufficiently to grasp it with vise grip pliers or a similar tool.

CAUTION

Unless the boot being removed is to be scrapped, cushion the jaws of any pulling tool to prevent damaging the boot surface.

e. Apply a slow, steady pull on the boot to pull it off the propeller surface while continuing to use the solvent to soften the adhesive.

f. Remove the remaining adhesive from the boot and propeller blade with toluol or methyl ethyl ketone.

PROPELLER DEICER BOOT INSTALLATION (Figure 201)

a. Position the deicer boot on the propeller blade so that its center line at the inboard end is adjacent to the split in the propeller blade clamp and 2 ± 1/16 inch outboard of the clamp, and the center line at the outboard end falls on the blade leading edge. Be sure the lead strap is in the proper position to be clamped to the blade retaining clamp.

b. Mask off an area approximately 1/2 inch from the end and each side of the boot.

c. Remove the deice boot and strip any paint in the masked area from the retaining clamp outboard. On propeller blades coated with urethane, sand lightly, using 320 grit sandpaper, to remove all glaze from the urethane coating. Clean the area thoroughly with MIL-M-13999 methyl ethyl ketone (21, Chart 207, 91-00-00). For final cleaning, wipe the solvent off quickly with a clean, dry, lint-free cloth to avoid leaving a film.

CAUTION

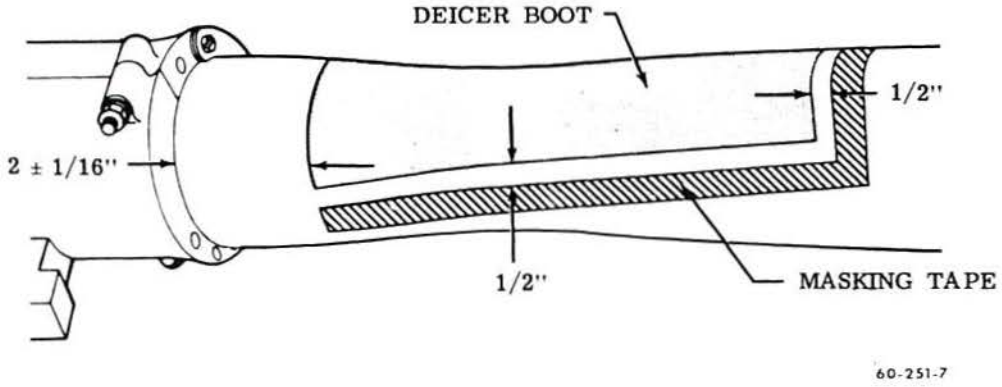
The metal and rubber parts must be thoroughly clean to assure maximum adhesion.

d. Moisten a clean cloth with methyl ethyl ketone or toluol and clean the unglazed surface of the deicer boot, changing the cloth frequently to avoid contamination of the clean area.

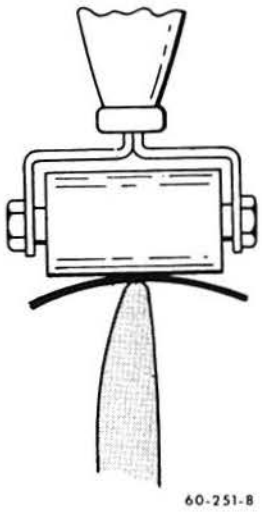
NOTE

To prevent the edges of the deicer boots from curling while applying the cement, place masking tape around the edges of the glazed side of the boot. Remove the masking tape before installing the boot.

e. Apply one even brush coat of EC-1300L cement (12, Chart 205, 91-00-00) to the propeller blade. Allow the cement to dry for at least one hour at 40°F or above when the relative humidity is less than 75%, or two hours if the



Deicer Boot Installation
Figure 201

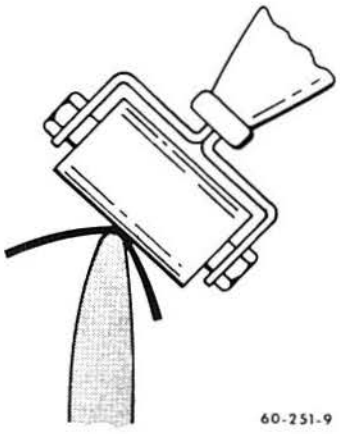


Center Rolling
Figure 202

humidity is between 75% and 90%. Do not apply the cement if the relative humidity is higher than 90%.

f. After allowing sufficient drying time, apply a second brush coat of cement to the propeller and one coat of cement to the unglazed surface of the deicer boot. Do not apply cement to more than 1/2 inch of the deicer lead strap. Allow the cement to dry.

g. Position the deicer boot on the propeller, starting 2 ± 1/16 inch from the blade retaining clamp, making sure the lead strap is in position to clamp to the blade retaining clamp. Moisten the cement lightly with methyl ethyl ketone or toluol and tack the boot center line to the blade leading edge. If the center line of the boot deviates from the blade leading edge, pull up with a quick motion and replace properly. Roll firmly along the center line with a rubber roller. (See Figure 202.)



Side Rolling
Figure 203

CAUTION

Never use a metal or wooden roller for this purpose, for they would damage the heating elements in the deicer boot.

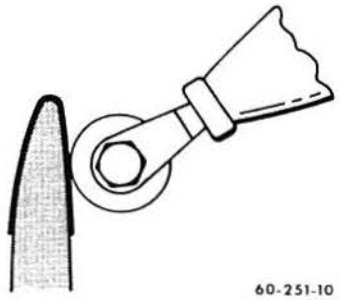
h. Gradually tilting the roller, work the boot carefully over each side of the blade contour. Avoid trapping air pockets under the boot. (See Figure 203.)

i. Roll outwardly from the center line to the edges of the boot. (See Figure 204.) If excess material at the edges tends to form puckers, work them out smoothly and carefully with the fingers.

j. Roll the tapered edges of the boot with a narrow steel stitcher roller.

k. Clean the blade with a clean cloth moistened with toluol or methyl ethyl ketone. Be careful not to let solvent run into the edge of the boot.

l. Apply one even brush coat or EC-801 sealer (11, Chart 205, 91-00-00) behind the lead strap where the boot and the blade meet.



Edge Rolling
Figure 204

NOTE

The EC-801 sealer is a two part sealer and must be thoroughly mixed. Mix the EC-801A and EC-801B combination as directed on the containers.

m. Apply one even brush coat of EC-801 sealer around the edges of the boot, allowing 1/16 to 1/8 inch overlap on the boot but extended to the masking tape. Remove the masking tape immediately after applying the sealer to obtain a neat border.

n. Allow sufficient time for the EC-801 to dry (from 24 to 72 hours, depending on conditions).

o. Apply satin finish black urethane paint to an area around the boot so that it covers all of the sealer and overlaps the edge of the boot and the blade by a minimum of 1/8 inch.

NOTE

To prevent propeller blade bearing grease from causing the boot to peel back or deteriorate, the urethane paint should be applied in a uniform coat so that grease cannot get to the boot cement or sealer.

p. Allow the urethane paint to dry as specified by the manufacturer.

q. On airplanes P-3 thru P-309, install the clamp securing the lead strap to the propeller blade retaining clamps. Connect the lead terminals and install the clip on the spinner bulkhead. There must be no slack between the terminal and the clip to assure enough slack between the clip and the clamp on the blade to allow propeller feathering.

r. On airplanes P-310 and after, connect the lead terminals to the clamp at the propeller hub.

DEICER TIMER CHECK (PRIOR TO P-579)

Experience in the field has indicated that often the timer is considered defective when the source of the trouble lies elsewhere. For this reason, the following test should be performed before the timer is removed as defective.

a. With the wiring harness disconnected at the timer and the deicer switch in the ON position, check the voltage from pin B of the harness plug to ground. If no voltage is present, the timer is NOT at fault; however, if system voltage is present at pin B, check the circuit from harness plug pin G to ground with an ohmmeter. If no circuit is indicated, the fault is in the ground lead rather than the timer. If ground connection is open, the timer step switch will not change position.

b. After the ground and power circuits have been checked, connect a jumper wire between pin B of the timer receptacle and terminal B of the connector plug and from pin G of the timer receptacle to ground. With the deicing system switch ON, check the voltage to ground from pin B of the timer. The voltmeter should indicate approximately 24 volts when the airplane battery supply is being used. Next, check the DC voltage to ground from pins C, D, E, and F, the points at which the system voltage is impressed in sequence to cycle power to the propeller deicers. Each of the plugs should read 24 volts in the following sequence.

Timing Sequence	Time ON	Areas of Prop Deicers Heated
Pin C	30 sec.	Right engine prop, Outb'd. halves
Pin D	30 sec.	Right engine prop, Inb'd. halves
Pin E	30 sec.	Left engine prop, Outb'd. halves
Pin F	30 sec.	Left engine prop, Inb'd. halves

NOTE

The timer does not reposition itself to start at pin C when the system is turned off, but will begin its cycling at the same position in which it was when last turned off. Cycling will then proceed in the order of C, D, E, and F as before.

After a voltage reading of 24 volts DC is obtained, hold the voltmeter probe on the pin until the voltage drops to zero before moving the probe on to the next pin in the sequence noted above. After the correctness of the cycling sequence has been established, turn the deicing system switch OFF at the beginning of one of the "on-time" periods and record the letter of the pin at which the voltage supply is present to facilitate performance of the following test.

DEICER TIMER CHECK (P-579 AND AFTER)

Experience in the field has indicated that often the timer is considered inoperable when the source of the trouble is elsewhere. For this reason, the following test should be performed before the timer is judged to be inoperable.

a. With the timer harness plug disconnected and the deicer switch in the ON position, check for voltage from pin B of the plug to ground. If no voltage is present, the timer is not defective; check the circuit breaker switch or the power supply. However, if system voltage is present at pin B, check the circuit from the harness to ground with an ohmmeter. If there is no continuity, the fault is in the ground circuit rather than the timer. If the ground circuit is open, the timer will not cycle.

b. After the ground and power circuits have been checked, connect a jumper wire between pin B of the timer receptacle and terminal B of the connector plug, and from pin G on the timer receptacle to ground. With the deicing system switch ON, check the voltage to ground from pin B of the timer. The voltmeter should indicate approximately 24 volts dc when the airplane battery supply is being used. Next, check the voltage to ground from pins D and F, the points at which the system voltage is impressed in sequence to cycle power to the LH and RH propeller deicers. The presence of 24 vdc system voltage should alternate at pins D and F for 90 seconds in duration as the timer cycles.

HEAT TEST (PRIOR TO P-579)

Before this test can be performed, the jumper wire installed for the timer test must be removed so that the connector plug can be replaced in the timer receptacle. Two men are required to perform this test, one in the pilot's compartment

to monitor the ammeter while the other checks the deicer boots. The man in the pilot's compartment turns the deicer system switch ON while the man outside feels the deicer boots to see if they are heating properly. The man in the pilot's compartment observes the ammeter for the proper readings (14 to 18 amperes) throughout the timing sequence. The ammeter needle should deflect every 30 seconds in response to the switching action of the timer. Each time this occurs, the man in the pilot's compartment must notify the man inspecting the propeller deicer boots so that the latter can change the position of his hands to check the proper heating sequence of the propeller deicer areas. If any irregularities are detected, a continuity check should be performed on the wiring from the timer to the brush block holders and the propeller deicer terminal connections.

HEAT TEST (P-579 AND AFTER)

Remove the jumper wires that were installed for the timer test and reconnect the timer receptacle. To perform this test, two people are required - one person in the flight compartment to operate the propeller deice switch and observe the propeller deice ammeter, the other on the ground checking the deice boots for proper heating. While the person in the flight compartment observes the ammeter for a reading of 14 to 18 amps, the person on the ground checks for a rise in heat on each propeller deice boot for approximately 90 seconds on each side. If either boot fails to heat, check the circuit between the timer and the propeller deice boot for continuity.

CAUTION

While following the instructions of the above "Heat Test" section, rotate the propeller back and forth to prevent arcing between the brushes and slip ring.

WARNING

Before moving the propeller, ensure that the ignition switch if OFF and that the engine has completely cooled, as there is always the danger of a cylinder firing when the propeller is moved.

CONTINUITY TEST (PRIOR TO P-579)

After removing the plug from the timer, use an ohmmeter to check continuity from:

a. Pin C of the plug to the outboard terminal of one prop boot on the right engine.
b. Pin D of the plug to the inboard terminal of one prop boot on the right engine.
c. Pin E of the plug to the outboard terminal of one prop boot on the left engine.
d. Pin F of the plug to the inboard terminal of one prop boot on the left engine.
e. Pin G of the plug to ground.
f. Ground terminal of one prop boot on the right engine to ground.
g. Ground terminal of one prop boot on the left engine to ground.

CONTINUITY TEST (P-579 AND AFTER)

After removing the plug from the timer, use an ohmmeter to check continuity from:

a. Pin D of the plug to the terminal of the propeller deice boot on the right engine.
b. Pin F of the plug to the terminal of the propeller deice boot on the left engine.
c. Pin G of the plug to ground.
d. Ground terminal of the propeller boot on the right engine to ground.
e. Ground terminal of the propeller boot on the left engine to ground.

BRUSH TO SLIP RING RESISTANCE TEST

To check for incorrect resistance or the presence of a short or open circuit at the brush-to-slip ring contact, disconnect the harness at the timer and check the resistance from each deicer circuit lead (pins C, D, E, and F of the harness plug) to ground with a low range ohmmeter. If the resultant readings are not 1.55 to 1.78 ohms, disconnect the deicer lead straps to measure heater resistance individually. Individual boot resistance should measure between 4.58 and 5.26 ohms. If the readings in the first check are not within the accepted limits but those in the second check are, the trouble is probably in the brush-to-slip ring area. If the readings in the second check are also off, the deicer concerned is damaged and must be replaced.

BRUSH BLOCK RESISTANCE CHECK (PRIOR TO P-579)

To check for an open circuit, a short, or high resistance in the brush block, measure the resistance from the face of the brush to its terminal studs with a low range ohmmeter. If this resistance measures over 0.013 ohms, locate and repair the cause of excessive resistance. If the resistance is infinite, locate and correct the open circuit or ground, or else replace the brush. Check the resistance between the three terminal studs. This resistance should not be less than 5 megohms.

indicated, the fault is in the ground lead rather than the timer. If ground connection is open, the timer step switch will not change position.

b. After the ground and power circuits have been checked, connect a jumper wire between pin B of the timer receptacle and terminal B of the connector plug and from pin G of the timer receptacle to ground. With the deicing system switch ON, check the voltage to ground from pin B of the timer. The voltmeter should indicate approximately 24 volts when the airplane battery supply is being used. Next, check the DC voltage to ground from pins C, D, E, and F, the points at which the system voltage is impressed in sequence to cycle power to the propeller deicers. Each of the plugs should read 24 volts in the following sequence.

Timing Sequence	Time ON	Areas of Prop Deicers Heated
Pin C	30 sec.	Right engine prop, Outb'd. halves
Pin D	30 sec.	Right engine prop, Inb'd. halves
Pin E	30 sec.	Left engine prop, Outb'd. halves
Pin F	30 sec.	Left engine prop, Inb'd. halves

NOTE

The timer does not reposition itself to start at pin C when the system is turned off, but will begin its cycling at the same position in which it was when last turned off. Cycling will then proceed in the order of C, D, E, and F as before.

After a voltage reading of 24 volts DC is obtained, hold the voltmeter probe on the pin until the voltage drops to zero before moving the probe on to the next pin in the sequence noted above. After the correctness of the cycling sequence has been established, turn the deicing system switch OFF at the beginning of one of the "on-time" periods and record the letter of the pin at which the voltage supply is present to facilitate performance of the following test.

HEAT TEST

Before this test can be performed, the jumper wire installed for the timer test must be removed so that the connector plug can be replaced in the timer receptacle. Two men are required to perform this test, one in the pilot's compartment to monitor the ammeter while the other checks the deicer boots. The man in the pilot's compartment turns the deicer system circuit breaker switch ON while the man outside feels the deicer boots to see if they are heating properly. The man in the pilot's compartment observes the ammeter for the proper readings (14 to 18 amperes) throughout the timing sequence. The ammeter needle should deflect every 30 seconds in response to the switching action of the timer. Each time this occurs, the man in the pilot's compartment must notify the man inspecting the propeller deicer boots so that the latter can change the position of his hands to check the proper heating sequence of the propeller deicer areas. If any irregularities are detected, a continuity check should be performed on the wiring from the timer to the brush block holders and the propeller deicer terminal connections.

CONTINUITY TEST

After removing the plug from the timer, use an ohmmeter to check continuity from:

a. Pin C of the plug to the outboard terminal of one prop boot on the right engine.
b. Pin D of the plug to the inboard terminal of one prop boot on the right engine.
c. Pin E of the plug to the outboard terminal of one prop boot on the left engine.
d. Pin F of the plug to the inboard terminal of one prop boot on the left engine.
e. Pin G of the plug to ground.
f. Ground terminal of one prop boot on the right engine to ground.
g. Ground terminal of one prop boot on the left engine to ground.

BRUSH TO SLIP RING RESISTANCE TEST

To check for incorrect resistance or the presence of a short or open circuit at the brush-to-slip ring contact, disconnect the harness at the timer and check the resistance from each deicer circuit lead (pins C, D, E, and F of the harness plug) to ground with a low range ohmmeter. If the resultant readings are not 1.55 to 1.78 ohms, disconnect the deicer lead straps to measure heater resistance individually. Individual boot resistance should measure between 4.58 and 5.26 ohms. If the readings in the first check are not within the accepted limits but those in the second check are, the trouble is probably in the brush-to-slip ring area. If the readings in the second check are also off, the deicer concerned is damaged and must be replaced.

BRUSH BLOCK RESISTANCE CHECK

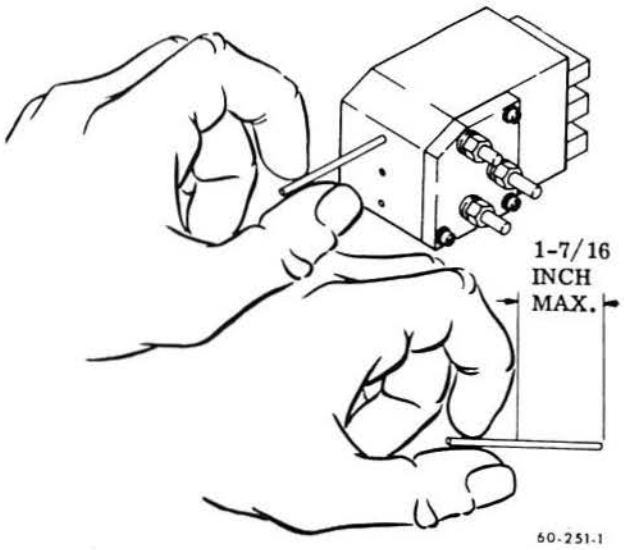
To check for an open circuit, a short, or high resistance in the brush block, measure the resistance from the face of the brush to its terminal studs with a low range ohmmeter. If this resistance measures over 0.013 ohms, locate and repair the cause of excessive resistance. If the resistance is infinite, locate and correct the open circuit or ground, or else replace the brush. Check the resistance between the three terminal studs. This resistance should not be less than 5 megohms.

BRUSH REPLACEMENT

The propeller deicer brushes should be replaced when a minimum of 1/4 inch of brush material remains. It is good practice, however, to replace the brushes when 3/8 inch of the brush material still remains. Brush length may be determined by inserting a piece of safety wire into the holes

BRUSH BLOCK RESISTANCE CHECK (P-579 AND AFTER)

To determine if an open or short circuit or high resistance is present in the brush block, measure the resistance from the face of the brush to its terminal stud or receptacle pin with a low-range ohmmeter. The resistance reading should not exceed 0.013 ohms. If this ohm value is exceeded, locate and repair the problem area. If the resistance reading is infinite, locate and repair the open circuit or replace the brush. Check the resistance between the receptacle pins and the terminal studs. (The resistance reading should be less than 0.5 megohms).



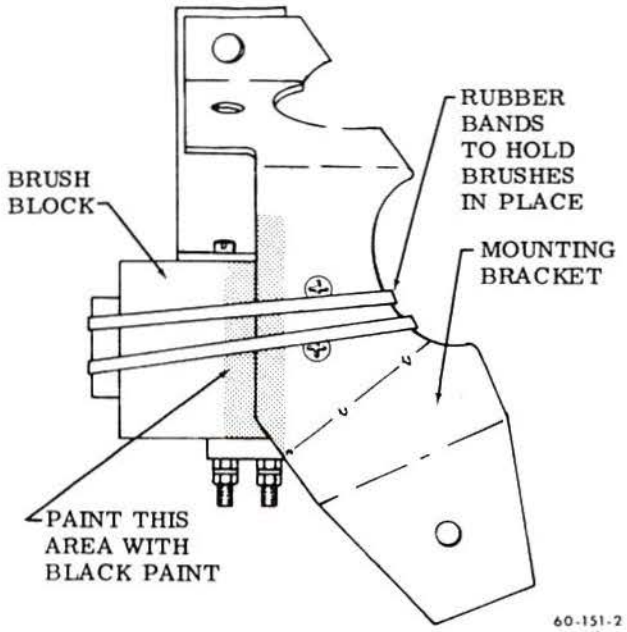
Determining Deicer Brush Wear
Figure 205

BRUSH REPLACEMENT (PRIOR TO P-579)

The propeller deicer brushes should be replaced when a minimum of 1/4 inch of brush material remains. It is good practice, however, to replace the brushes when 3/8 inch of the brush material still remains. Brush length may be determined by inserting a piece of safety wire into the holes at the back of the brush block assembly (Figure 205). When 1-7/16 inch dimension is measured, there is approximately 1/4 inch of brush material left. Replace the brushes as follows:

NOTE

The brush block and mounting bracket should be removed intact so the brush block's exact location with respect to the mounting bracket can be marked. This will facilitate alignment of the brush block during reinstallation.



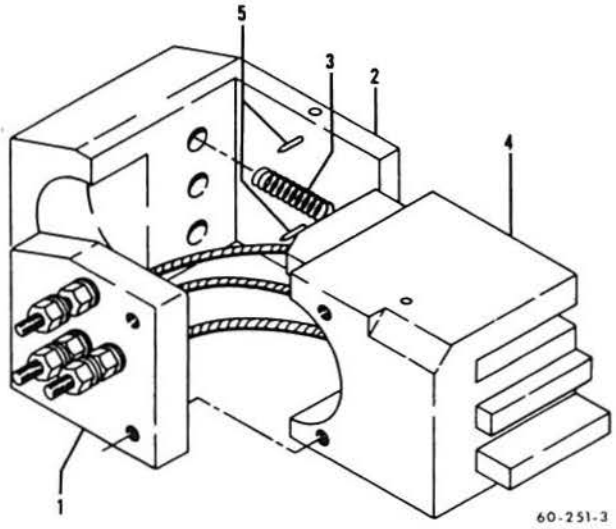
Marking Location of Brush Block
Figure 206

a. Loosen both ends of the brush block mounting bracket and remove the complete assembly.

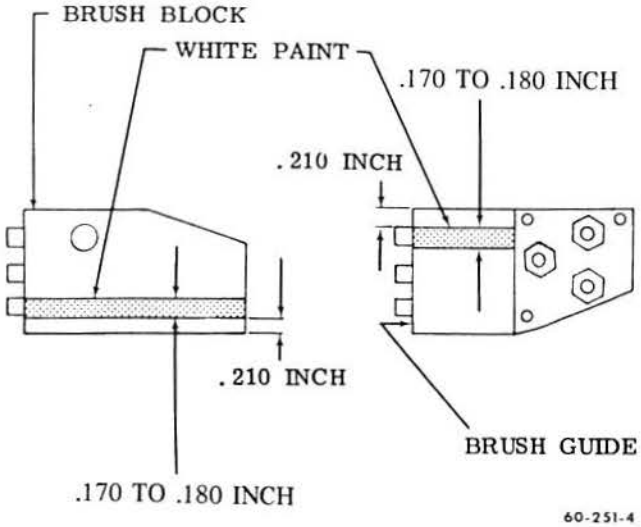
b. Tag the lead wires attached to the terminals on the brush block and disconnect them.

c. Clean the brush block and mounting bracket. Paint the side of the brush block and the edge of the mounting bracket as shown in Figure 206 with black paint.

d. Remove the brush block from the mounting bracket.



Deicer Brush Block Assembly
Figure 207



Deicer Brush Alignment Strip
Figure 208

e. Disassemble the brush block (Figure 207) by removing the screws attaching the terminal plate to the brush block, then separate the brush block by pulling the guide block approximately 1/4 inch toward the terminals to disengage the guide pins.

f. Mask off and paint a white stripe .170 to .180 inch wide on the brush block and brush guide. Locate as shown in Figure 208. The white stripes should be in line with the outer brush and will be used to align the brushes with the slip ring during reinstallation.

g. Remove the terminal plate, brushes and springs from the brush block.

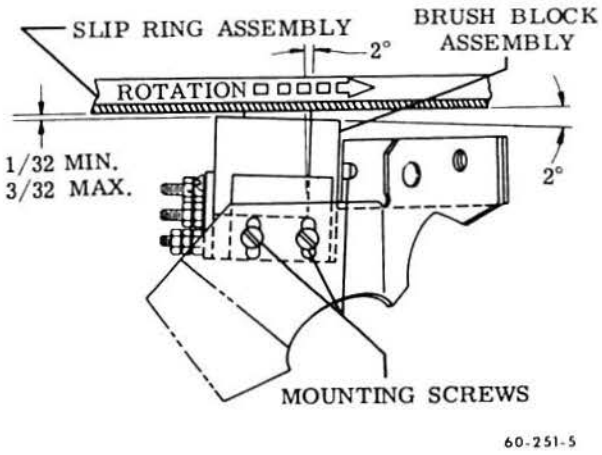
h. Disconnect the wires from the brushes being replaced, noting which terminal they correspond to.

i. Solder the wires from the new brushes to the appropriate terminals, holding the "wicking" to 1/8 inch maximum.

j. Install each brush in its correct groove in the guide block. Insert new springs into the guide block behind the brushes. Taking care not to apply a side load on the brushes or damage or pinch the brush leads, bring the support block into position. Install the opposite end of the springs into their corresponding holes in the support block. Press the two blocks together until the guide pins in the support block slip into the holes in the guide block. Install the screws which hold the terminal plate to both blocks.

NOTE

When replacing brushes or brush retainer assemblies, always install new brush springs.



Deicer Brush Block Installation
Figure 209

k. Check the amount of brush protrusion from the block. If the brushes protrude less than 9/16 inch, the brush leads should be untwisted to give more length. If this distance is more than 5/8 inch, the lead should be twisted to shorten the effective length until the brushes protrude from 9/16 to 5/8 inch. The brushes should then be checked for free sliding action.

l. Reinstall the brush block assembly on the mounting bracket, using the black paint (see step "c") as a guide for correct alignment.

m. Carefully push the brushes back into the brush block and secure them in place with a rubber band. (See Figure 206).

n. Using care not to bend or distort the mounting brackets, reinstall the brush block and bracket assembly as originally removed from the engine in step "a". Cut the rubber band and rotate the propeller to remove the broken pieces of rubber band.

NOTE

The white stripes on the top and bottom of the brush block should align with the outer slip ring. If the white stripes do not align with the outer slip ring it may be necessary to add or remove, all or part of the laminated shim. Removing shim material will move the brush block out. Each laminate in the shim is approximately .003 inch.

o. Check for proper clearance between the slip rings and the brush block (see Figure 209). The clearance should be 1/16 ± 1/32 inch with an angle of approximately two degrees from perpendicular, as measured toward the direction of slip ring rotation. If not correct, loosen the brush

block mounting screws and move in the elongated holes to correct the brush block position.

p. To preclude arcing caused by the rough surfaces of the new brushes, the engine should be operated for at least five hours before the deicer system is turned on. This does not apply to ground checks of the system performed while the engine is not running.

BRUSH REPLACEMENT (P-579 AND AFTER)

The modular brush assembly (P/N 3E2071) is made up of two modules (P/N 3E2011-1 and P/N 3E2011-2), each consisting of a plastic housing with an integral brush and spring. These modular units are stacked with a spacer and held together by screws to produce the modular brush assembly. When a brush wears out, the module containing it must be replaced since individual brush replacements are not available. Replace the entire brush module when only 3/8 inch of the brush material remains.

NOTE

During measurement, only 1/16 inch of brush should protrude from the brush module, with this being the normal protrusion when the brush is installed on the airplane.

Brush wear is determined by inserting a pin into a hole in the back of the brush module as shown in Figure 205. On all modules having brushes with rods, the brush module should be replaced when the dimension shown in Figure 205 is 17/34 ± 1/32 inch. On all rodless brushes, the module should be replaced when this dimension is 1 7/64 ± 1/32 inch. Use the following procedures when replacing the brushes:

a. Disconnect the wire harness terminals at the modular unit terminals.

b. Remove the screws, nuts, and washers that secure the modular unit to the mounting bracket.

c. Remove the assembly retaining screws and separate the modules and spacers.

d. Replace each module with another of the same part number. (The part number is etched into the plastic housing.)

e. Restack the modules and spacers as they were unstacked in step "c". (Stacking arrangement may be changed if there is interference with any other engine or propeller component.)

f. Install the assembly screws so that the screw head fits in the recess in the spacer. Place the flat washer between the star washer and the modular housing and install the retaining nut. Ensure that the assembly is square before tightening the assembly screws.

g. Place the modular brush assembly on the mounting bracket and insert the mounting screw through both the bracket and the brush block assembly. Place one washer under the head of the screw and one under the nut.

h. Before installing the retaining nuts, ensure that the brushes are aligned with the slip rings so that the entire face of the brush is in contact with the copper rings. If the brushes do not align with the slip rings throughout the entire 360 degree rotation of the slip ring, add or remove spacers (P/N 4E2218-3) between the modules until the brushes are properly aligned with the approximate center of the copper ring.

i. Install the retaining nut and washers, ensuring that 1/16 ± 1/32 inch is maintained between the brush module and the slip ring surface. To prevent damage to the brushes, the modular brush assembly should be angled so that the brushes contact the slip ring at an angle of approximately 2 degrees from perpendicular as measured toward the direction of slip ring rotation.

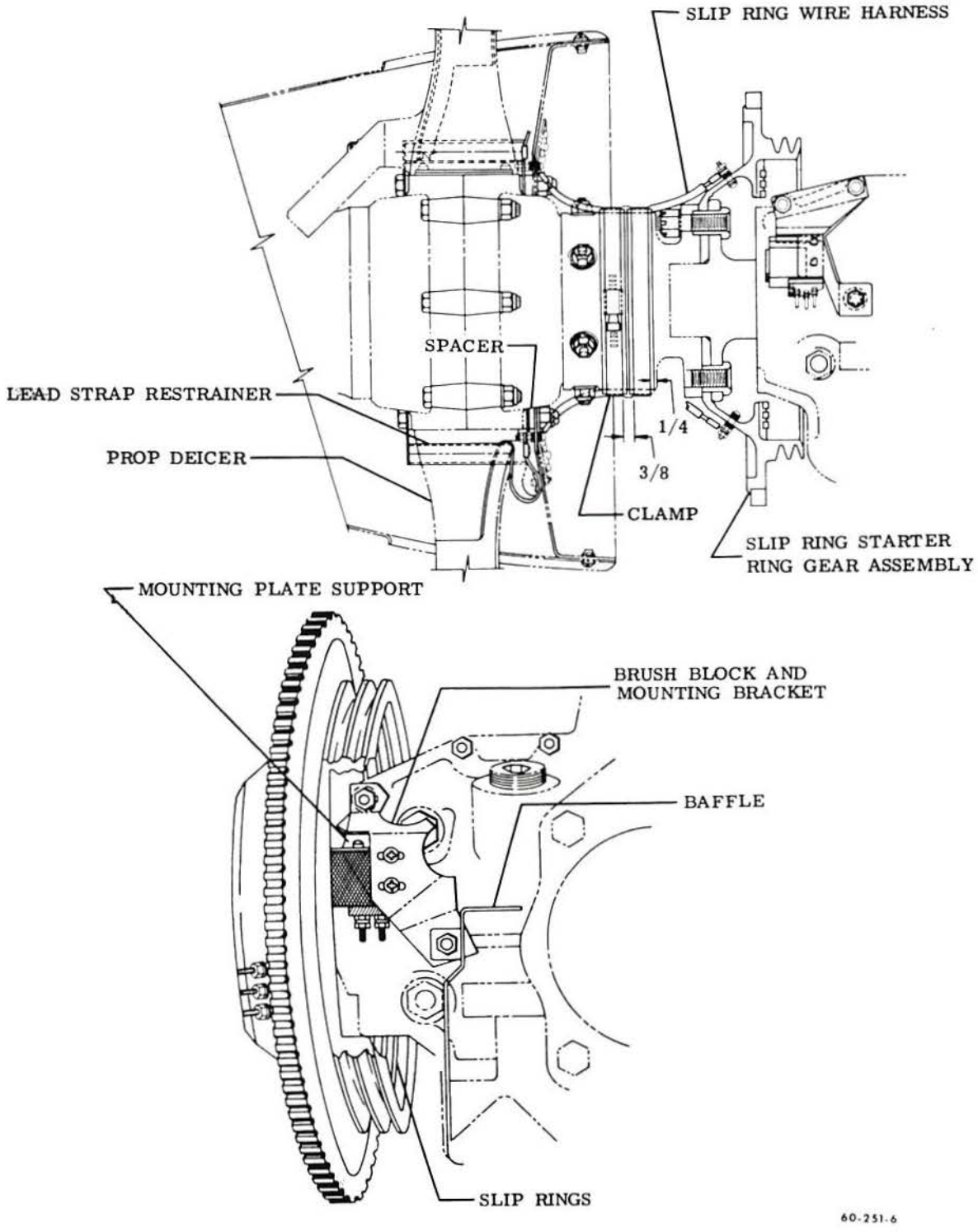
j. Reconnect the wire harness terminals to the modular unit terminals.

SLIP RING MACHINING

Slip rings which have roughened or damaged surfaces, but which are structurally sound, can be machined and restored to serviceability. Remove the slip ring assembly from the aircraft and mount it in a lathe. Position is concentrically in the lathe, with not over 0.002 inch wobble or run-out over 360 degree rotation. Take light cuts for a smooth finish and cut no deeper than required to remove surface damage. The contact surfaces of the three slip rings must be parallel within 0.005 inch, and flat within 0.005 inch overall. Deviation from flat is not to exceed 0.002 inch over a 4 inch arc. If necessary, undercut the insulation between the slip rings to a depth of 0.020 to 0.030 inches below the contact surface of the slip rings. In this operation, width of the slip ring MUST NOT be reduced more than 0.005 inch. Contact surfaces of the slip rings must have a finish of 29-35 micro inches. Deburr the slip ring edges and reinstall in the aircraft and align.

NOTE

If, in machining, the solder or braze connection on the underside of the slip ring is exposed, replacement of the slip ring assembly will be necessary.



Propeller Deicer Installation
Figure 210

"END"