ROYAL CANADIAN AIR FORCE

DESCRIPTION AND MAINTENANCE INSTRUCTIONS

INSTALLATION, INSPECTION, MAINTENANCE, REPAIR AND STORAGE OF DE-ICER BOOTS

(This EO replaces EO 15-80-2C dated 11 Jan 55, EO 15-80-9 dated 13 Jan 55 and EO 05-1-2AA dated 16 Nov 51)

ISSUED ON AUTHORITY OF THE CHIEF OF THE AIR STAFF

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PART 1

DESCRIPTION

1 A de-icer is a sheet of rubber covering the leading edge of airfoils for protection against the build-up of ice on the leading edges. It is actually built of several pieces of rubber, synthetic rubber, and fabric material.

2 De-icer boots are attached along their span-wise edges. The hollow threaded rivets are arranged to correspond with the boot and spaced approximately 2" apart. The extruded aluminum alloy fairing strip distributes the pressure of the attachment screwheads and also form the boot to the contour of the airfoil. The tension of the boot is resisted chord-wise by the attachment screws against which the flat steel bead wires abut. The bead wire is wrapped in reinforcing fabric.

3 The majority of de-icer boots contain two or more inflatable fabric tubes. These extend span-wise through the central portion of the shoe. During operation of the de-icer system, the tubes are periodically inflated with compressed air. The resulting distortion of the leading edge contour causes the accumulating ice to crack and the airstream removes the broken ice. When the system is not in operation the tubes or cells lie flat and conform to the contour of the airfoil as closely as is possible.

4 Stretch areas are the elastic areas which border the tube area, see Figure 1-1. A wing boot has an upper and a lower stretch area. A boot installed on a vertical stabilizer has a right and left stretch area. During operation, the inflating of the tubes causes the stretch areas to be elongated chord-wise, thus breaking the adhesion of the ice to the rubber.

5 Portions of a de-icer boot which must be trimmed or cut out during installation have a built-in inner ply of reinforcing fabric. This rubberized fabric can be stretched only chord-wise.

6 The majority of de-icer boots have built-in fabric reinforcing strips which run chord-wise across the boot. These strips are spaced about 10" apart and are intended to prevent tears and breaks from enlarging in a span-wise direction during flying. Each strip is made of reinforced stretchable fabric and is free to elongate as an integral part of the stretch area. On some types of boots the underside of each reinforcing strip has a chord-wise depression called a venting channel. Most reinforcing strips have one or more venting holes, which serve to bleed air from the underside of the boot and thus prevent lifting of the stretch areas during flying. These venting holes should not be mistaken for punctures in the boot. On some later types of boots the reinforcing strips have been replaced by a continuous fabric inner ply throughout the upper and lower stretch areas.

7 The ends of the de-icer boots are held down by aluminum alloy strips called end clamps, and are approximately 1" wide. These are fastened down with 6 - 32 x 5/8" or 6 - 32 x 1/2" steel attachment screws and hollow threaded rivets. The screws passing through holes punched in the reinforced end of the de-icer boot.

8 Where such items as wing lights, air scoop openings, and pitot head are encountered the de-icer boot is cut out to accommodate. The fabric reinforcing edges of these cut-outs are held down by means of circular or rectangular frames cut from aluminum-alloy flat stock. As in the case of the end clamps, the clamp rings are fastened to the leading edge by means of attachment screws and hollow threaded rivets.

9 Large wing boots are sometimes provided with snubbers to prevent creeping of the boot material toward the upper attachment. Snubbers are a nonstretchable fabric flap built

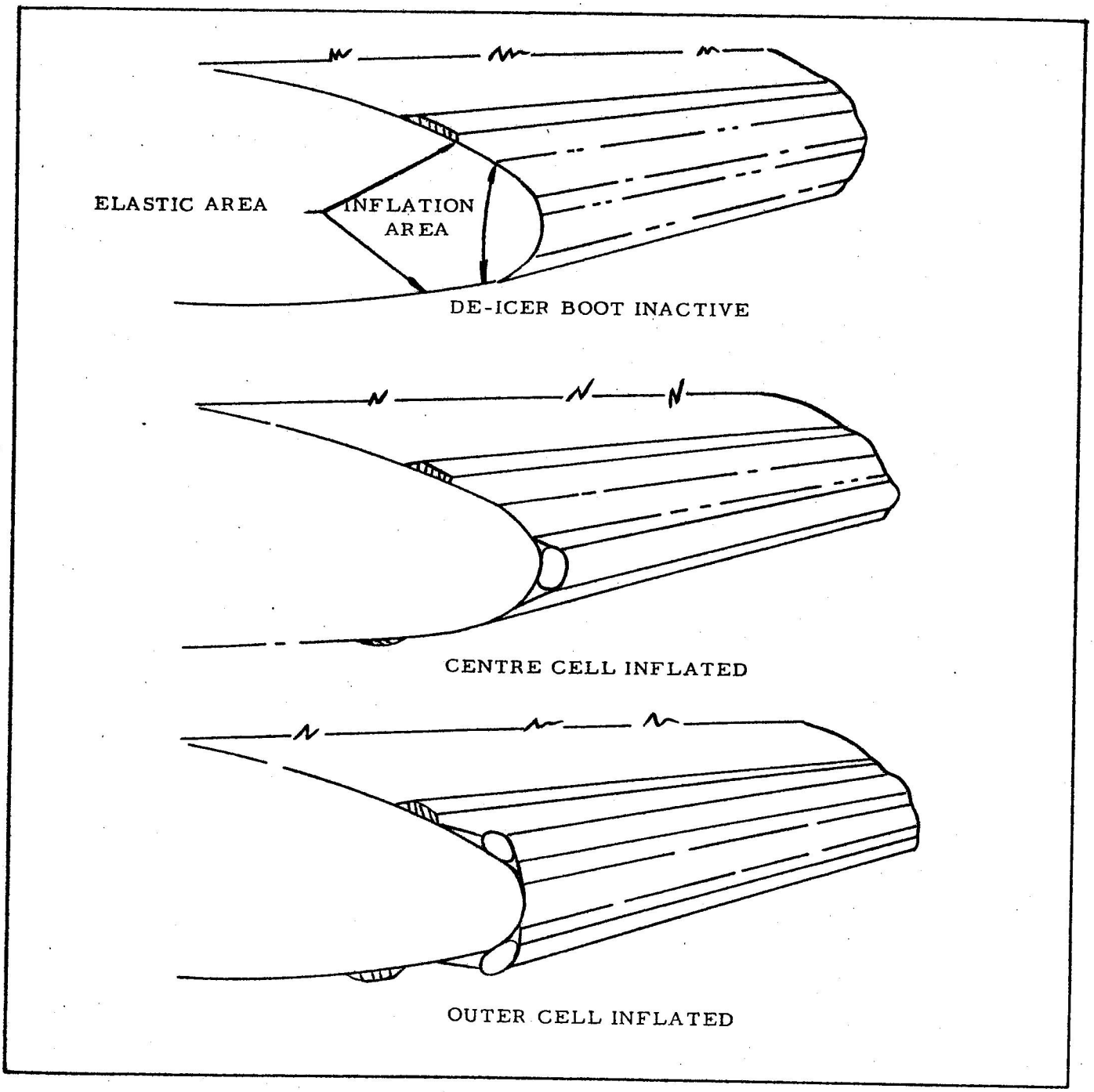


Figure 1-1 Elastic Areas and Cell Inflation

into the underside of the boot. Its lower edge is fastened to the wing skin along an intermediate row of hollow threaded rivets or rivnuts. The attachment screws pass through a flat metal bead strip built into the lower edge of the snubber flap. No fairing strip is required over the snubber flap.

10 The undersurface of some types of de-icer boots are ribbed to permit span-wise movement of air beneath the boot. Any air, which might otherwise become trapped beneath the boot, is bled span-wise until it reaches a venting channel, which in turn is situated chord-wise, and escapes to the atmosphere.

11 A thin layer of synthetic neoprene rubber is used as the outer ply on de-icer boots because of its resistance to deterioration by oil and gasoline.

12 A thin coating of conductive coating compound is provided over the neoprene ply to dissipate static-electrical charges. The conductive cement consists of a solution of acetylene black in rubber cement, RCAF Sec/Ref. 33A/531, Coating Compound, Conductive, De-Icer Boot.

13 Some boots are provided with a sponge rubber filler ply in the stretch areas. This thickens the boot where it would otherwise be rather thin. Boots of this type have a relatively uniform thickness and are distinguishable by their softness in the stretch areas.

14 Air hose connections are provided through the leading edge to admit compressed air to the fabric tubes. Usually each fabric tube is provided with a 5/8" outside diameter short steel tube as an air connection stem. Each stem projects from the underside of the boot into the leading edge through a round orifice provided in the metal skin. The end of the non-kink hose which carries air to the inflatable tubes, is clipped over the stem. The hose connection is supported in the orifice by a special grommet or cemented rubber sheet which prevents chafing of the hose and also acts as a seal. Without this seal air from the interior of the wing would bleed to the underside of the boot during flying.

15 To eliminate the use of locking wire when attaching de-icer boot connections to hose lines, clips non-kink hose Tinnerman Part 3122-14 are held as RCAF Sec/Ref. 28/NAS397-14. These clamps are to be utilized when making connections to hose lines.

PART 2

INSTALLATION

1 Installation shall be assumed to cover the replacement of de-icer boots on aircraft which have had the boots removed for maintenance reasons.

2 Where applicable, remove the summer plugs from the air connection grommets. Remove all coverings from the air connection holes. Draw out the ends of the non-kink hose sections so they protrude through the applicable leading edge orifice, to ensure proper sequence of cell inflation. Ensure hose is in a serviceable condition.

(a) Remove plug screws from the rivnuts in the skin.

(b) Clean the unpainted surface ensuring all oil and grease film is removed.

(c) Replace damaged rivnuts. Installation instructions contained in EO 70-1D-2

(d) Apply strips of adhesive tape over laps in the leading edge skin, rivet heads and any sharp edges, to prevent damage to the underside of the de-icer boots. Ensure all crevices, holes or joints are covered to prevent bleeding of air from the interior of the wing to the underside of the de-icer boot.

NOTE

It is imperative that the bleeding of air to the underside of the de-icer boots be prevented. If air bleeds to the underside of the boots more rapidly than being expelled through the vent holes, the air pressure beneath the boot will increase until the upper stretch areas lift from the metal skin. Lifting of the upper stretch areas increases the drag and may result in damage to the boots.

(e) Where applicable, ensure grommet in leading edge are in serviceable condition

(f) Where no grommets are provided seals must be provided to prevent air fror bleeding past the air connections. Moisten th underside of the seal until tacky then slip th seal over the end of the non-kink hose an press it firmly down against the leading edg so that it is concentric with the connectio orifice. Locally made seals from rubber stoc should be 3" diameter circular seals with th central orifice slightly smaller than the out side diameter of the non-kink hose. Slip th seal over the non-kink hose and cement to th leading edge.

(g) Brush a mixture of talc RCAF Ref 33C/11 and non-leaded fuel on the leadin edge skin and allow to dry. The talc will re main on the metal in a uniform coating. En sure fuel does not contact the non-kink hos ends, grommets or seals.

NOTE

Do not use graphite as a lubricant for de-icer boots. Electrolytic action of graphite between boots and metal skin will cause corrosion.

(h) Ensure fairing strips are not dente or damaged. The ends of fairing strips shoul butt but not overlap succeeding strips whe being installed.

(j) Unroll each boot on a clean surface inspect for serviceable condition.

(k) Holding the underside close to th leading edge, fasten each non-kink hose to it air connection end using clip Tinnerman Par 3122-14, RCAF Ref. 28/NAS397-14. Tighte

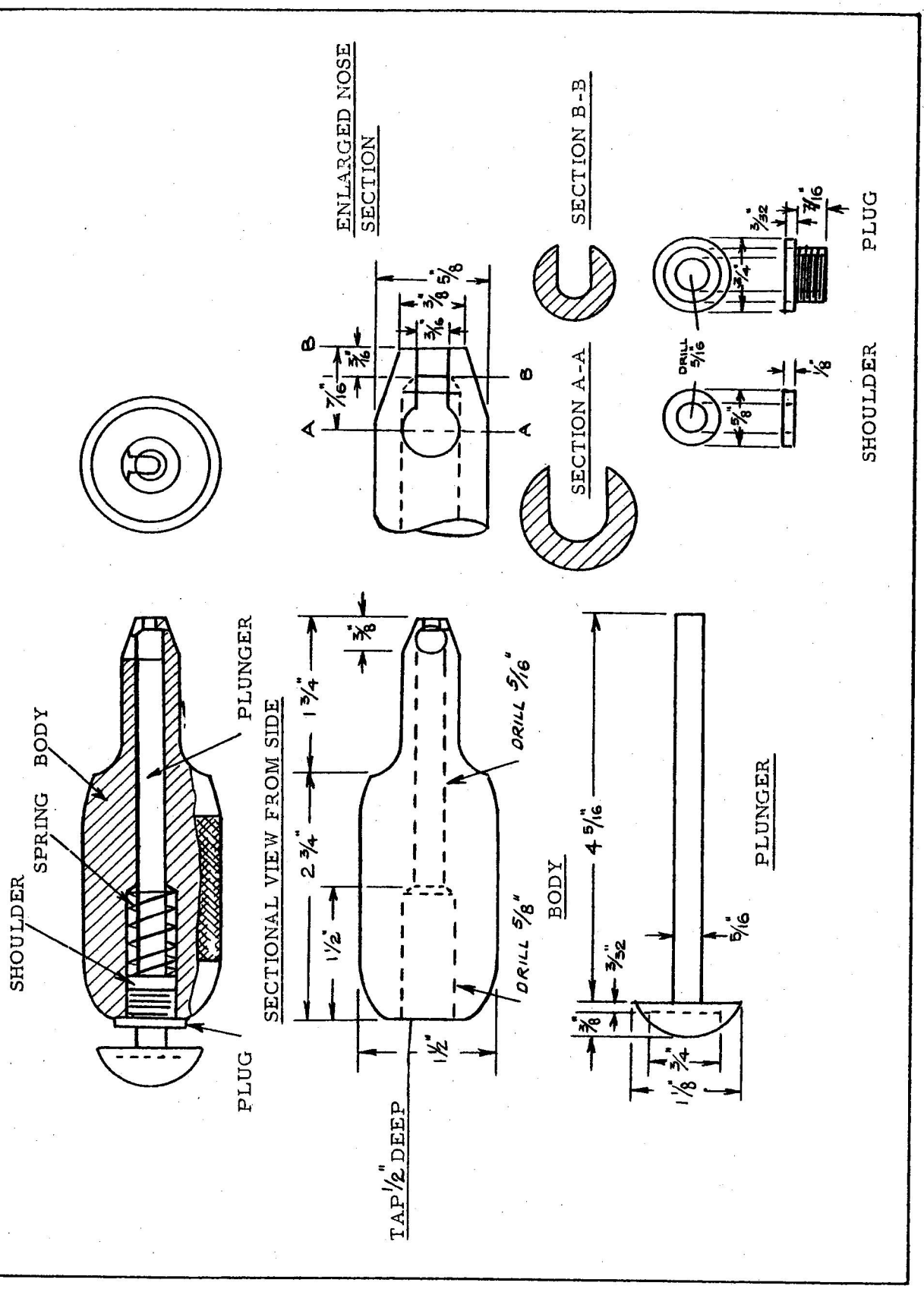


Figure 2-1 Diagram of Peg Holder (Local Mfg.)

each clip securely. Ensure that the clip is tightened in such a manner as to prevent damaging the hose.

(m) Lay the upper fairing strip on the wing in the position it will be when installed and push the hose connections into the leading edge grommets or seals, as applicable.

(n) With a tensioning tool RCAF Ref. 1T/2811, see Figure 2-4, pull the edge back to the upper row of hollow threaded rivets and with a peg holder tool RCAF Ref. 1T/2827, insert a positioning peg RCAF Ref. 28NS/B226 or 28/code 5, through the adjacent inboard orifice. Push the peg down into hollow threaded rivet corresponding to this orifice. When the peg is firmly inserted, disengage the tensioning tool and withdraw the peg tool holder RCAF Ref. 1T/2827. The tension in the rubber will hold the peg in position.

(p) Working alternately from inboard to outboard, continue insertion of pegs until three or four pegs are in the upper row. Continue same procedure and insert six pegs through lower edge of the boot below the main group of air connectors and ensure air connections are properly seated.

(q) To ensure even tension in the upper and lower stretch areas insertion of pegs should be alternated between the upper and lower edges every few feet.

(r) Where snubber flaps are fitted, insert pegs only along the upper attachment above the main air connections for a short distance in the outboard direction. Pull the lower edge of the snubber down close to the intermediate row of rivnuts. Fasten lower edge to intermediate row of rivnuts by means of 6 - 32 x 1/2" steel screws RCAF Ref. 28/AN507-632R8 (Phillips). Apply tape over the heads of these screws to prevent damage to the boot. When the snubber has been attached peg the lower edges of the boot as stipulated in paragraphs (p) and (q) above.

(s) If the outboard end of the boot is to be installed around a curved tip peg the boot as stipulated in paragraphs (p) and (q) above.

(t) Using the screw holder RCAF Ref. 1T/2828, install the screws, 6 - 32 x 5/8" steel Ref. 28/AN507-632R10 (Phillips) through the fairing strip, after removing positioning pegs as required. The head of the attachment screw is dropped into the hollow chuck of the screw holder through a slot at the end. The screw chuck is then tightened to hold screw rigid. When the screw is started release tool and complete fastening by use of an ordinary wide blade screwdriver. For a similar tool which may be manufactured locally by units see Figures 2-1, 2-2 and 2-3.

NOTE

When using a screwdriver to complete the fastening of hold down screws precautions are necessary to avoid slipping off and damaging the boot.

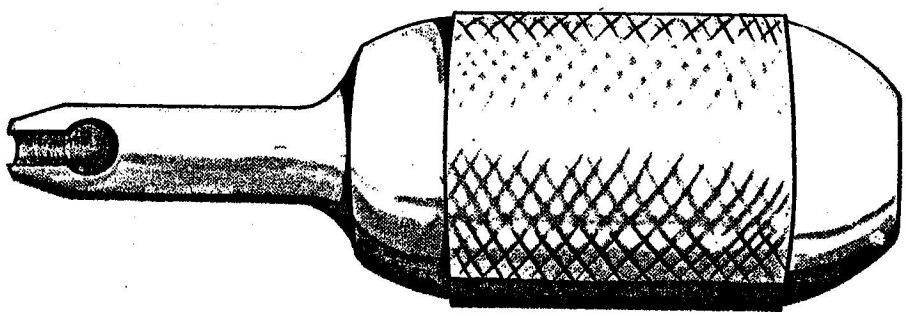
(u) When upper attachment screws have been fastened, place the lower fairing strip into position and removing pegs as required replace with attachment screws. Ensure all attachment screws are fastened securely.

(v) Install end clamps and rings in a similar manner as stipulated in paragraphs (p) and (q).

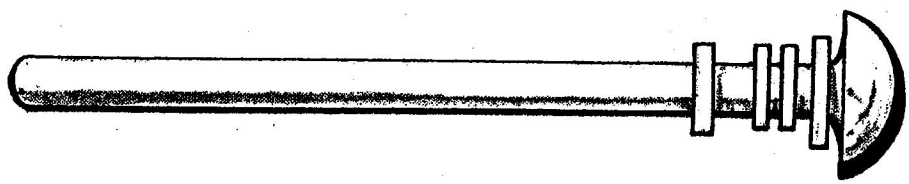
(w) After final instal'ation carry out a functional test to ensure complete serviceability.

PEG SCREW

3 The peg screw is about 1" in length having a 100° countersunk or Phillips head. It is threaded 6/32 for one half of the length and the remainder cut smooth to the inside clearance of 6/32 rivnut, and sharpened to a point.



Peg Holder Shank



Internal Handle

Spring

Figure 2-2 Accessories of Peg Holder

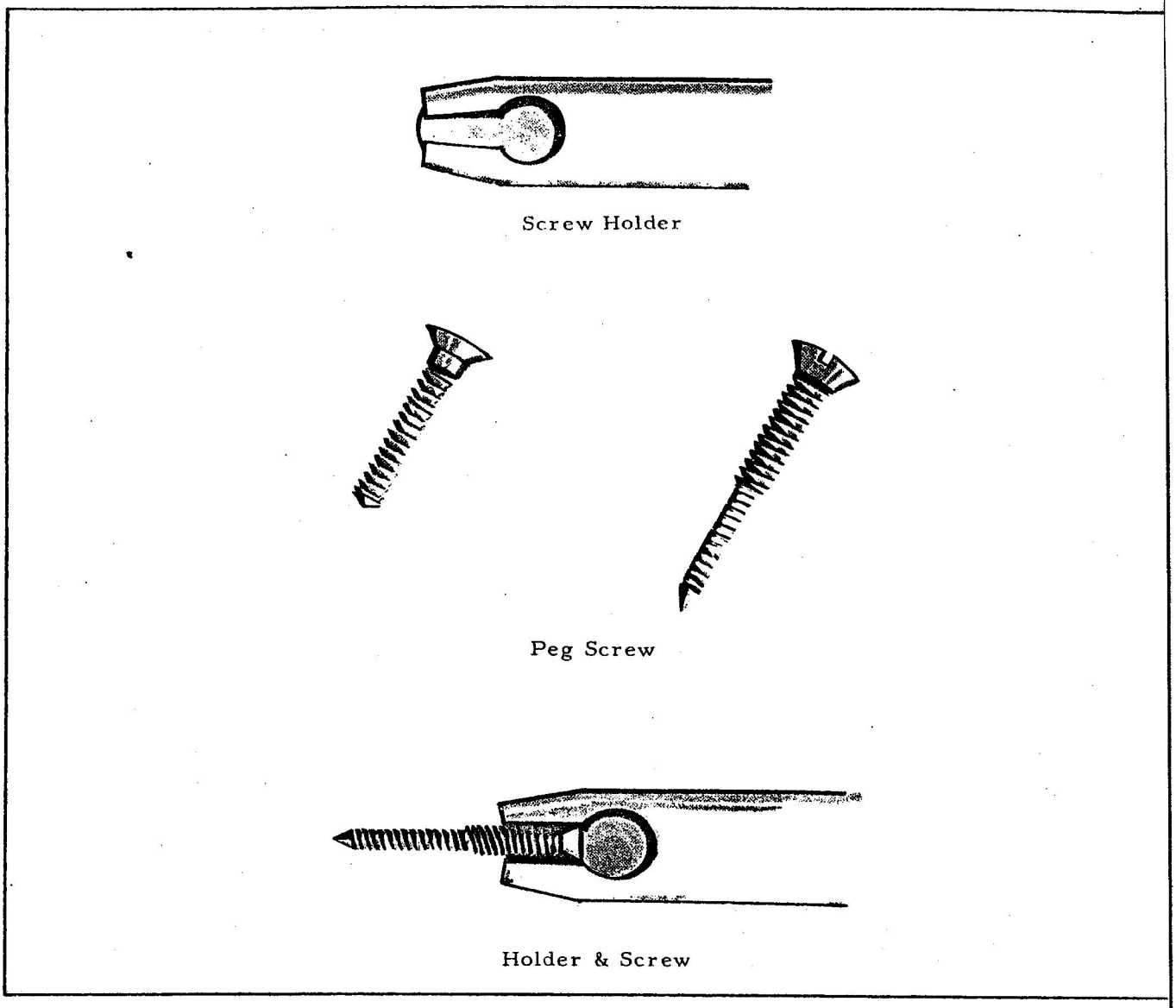


Figure 2-3 Peg Screw

METHOD OF USE

4 When all line connections are made secure, the de-icer boot is pulled into position over the first rivnut. The peg screw is then placed through the hole in the fairing strip, through the de-icer boot and into the rivnut. This temporarily pegs the de-icer boot and the fairing strip in place. This operation is then repeated top and bottom, until the complete boot is held in position. A screwdriver is then used to screw the remaining portion of the peg screw down and the de-icer boot is installed.

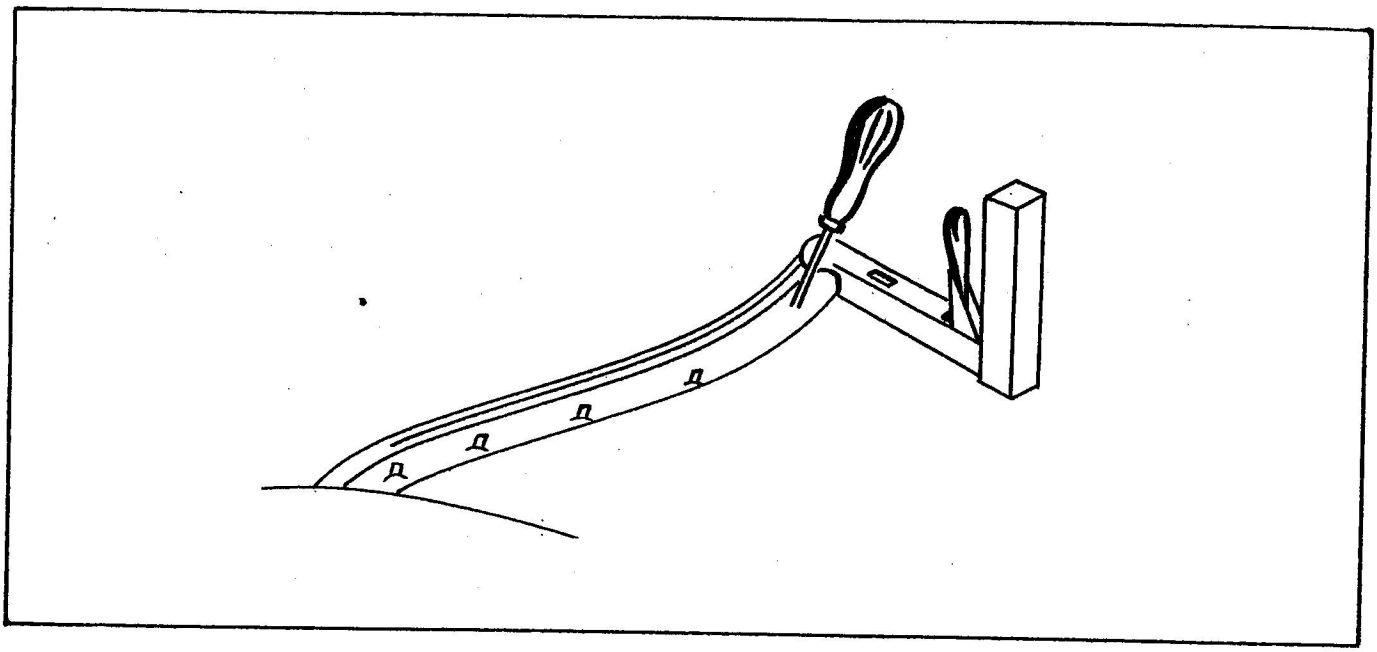


Figure 2-4 De-Icer Tensioning Tool

5 The complete operation of installing a de-icer boot is less complicated and removal of the various phases of work such as pegging, insertion of screws, and tightening, reduces the time factor to a minimum.

PEG SCREW HOLDER

6 This item is designed to hold the peg screw until it is inserted. It is not intended as a screwdriver.

7 Figures 2-1, 2-2 and 2-3 show details of construction. The body is of light alloy and all other parts of mild steel. Assembly of the tool is by the plug being slipped onto plunger shaft. Next slip on the shoulder and braze in place, 3 1/2" from the shaft end. A steel wire coil spring is then slipped onto the shaft and the whole unit inserted into the body and the plug screwed in tight.

8 To use, insert a peg screw and squeeze plunger down to retain peg screw firmly. When hand pressure is released, the tool is disengaged from the inserted peg screw.

PART 3

INSPECTION

GENERAL

1 Normally de-icer boots should have a service life of two successive icing seasons. This can be extended by removal during severe summer conditions. Severe heat and strong sunlight conditions will contribute to a shorter life period.

2 Removed de-icer boots should be tagged for ready identification and stored as per Part 6.

3 The following are general precautions that should be exercised to ensure the maximum serviceability and life period of de-icer boots:-

(a) Keep boots free of oil, fuel, paint and solvents.

(b) Repair all damage immediately.

(c) Do not lean objects such as stands or ladders against the boots. Where stands or ladders must come in contact with de-icer boots, protection should be afforded by insertion of suitable padding.

(d) When refuelling, ensure suitable padding is placed over the de-icer boot to prevent scuffing the de-icer boot.

(e) De-icer boot stretch areas are under tension when installed, therefore its resistance to abrasion is reduced. Avoid walking on this area or placing of heavy objects.

(f) When cleaning down engines, suitably protect the necessary sections of the de-icer boots from spray which may contribute to deterioration of the rubber.

(g) As applicable when storing in hangars during cold weather, avoid placing aircraft under heater units.

4 Inspection of de-icer boots should be as follows:-

(a) Visually examine the surface of each boot for tears, holes, abrasions, loose patches, loose fairings, clamps and screws.

(b) Operate the engines and turn on the de-icer system checking the pressure gauge. The gauge will fluctuate as the cells are inflated and deflated. It should rise to at least 8 psi several times during the forty second operating cycle.

(c) Check the pressure and instrument suction with the vacuum selector valve in both alternate positions. A faulty vacuum pump is indicated if any appreciable change in readings is apparent.

(d) If pressure is satisfactory observe operation of the boots for any malfunctioning. Sticking of the stretch areas will indicate a lack of talc for lubrication.

(e) Check the operating cycling period which should not be less than 35 seconds nor more than 45 seconds. Where the period falls outside these limits:-

(1) Check the voltage applied to the distributor valve.

(2) Where manifold type piping system applies, the voltage supplied to the electric timer motor should be checked.

(3) Worn brushes may cause slow rotation.

(f) In cold weather, allow de-icer system

to operate for about five minutes prior to checking the operating cycle.

(g) Ensure all drainage is clear.

CAUTION

Oil will cause rapid deterioration of the rubber. In cold weather extreme care is to be taken to ensure oil does not collect in critical parts of the system and congeal. Congealed oil causes sticking of the control valve and distributor valve.

(h) Check on-off control handle or switch for freedom of action. Check the associated control linkages and the electric wiring, as applicable.

(j) Remove and clean copper mesh filter element secondary oil separator (de-icer air filter). Where temperature is below -12°C (10°F) air filter should be cleaned frequently if difficulties are encountered with the valves sticking due to congealed oil.

WASHING

5 De-icer boots are to be washed with a solution of warm water and mild soap at every periodic inspection.

6 The use of fuels or solvents as cleaners is not approved as they are injurious to the rubber.

7 After removal of grease, oil and other contaminants by washing, allow the de-icer boot to dry thoroughly before application of coating compound conductive, de-icer boot. RCAF Ref. 33A/531.

PART 4

MAINTENANCE

1 Maintenance of de-icer boots is to be carried out as follows:-

(a) Remove all oil and grease from the surface of the boots by washing with a neutral solution of soap and water. Rinse with fresh water and dry thoroughly.

CAUTION

Care is to be exercised to avoid scrubbing as this will tend to remove the Prenite Graphite surfacing provided to afford electrical conductivity for the elimination of static electricity.

(b) Inspect boots periodically for tears, holes, bruises and loose patches.

(c) The polished dark brown or black surface which develops on rubber parts is not to be removed. When necessary to apply patches, only sufficient space should be cleaned off for this purpose.

CAUTION

Extreme care is to be exercised when refuelling, to avoid dragging fuel lines etc., over the boots.

GROUND CHECK

GENERAL

2 A ground check of the de-icer system is to be carried out at periods as detailed in relevant aircraft EOs. The following procedure is to be carried out when ground checking.

(a) The piping arrangement of the de-icer installation should be provided with a test plug for connecting an outside source of air supply so that running the aircraft engines or pumps will be unnecessary for this ground check. The test plug is to be located beyond the check valves in the lines coming from the pumps and ahead of the control valve. A means of supplying flow of air required, which is not to exceed 10 psi is to be devised and plugged into the system at the test plug. This test device is to consist of a pressure regulator and an accumulator tank of sufficient capacity to fill the respective de-icer groups in the brief interval of time allowed for inflation by the distributor valve.

(b) When the air supply has been connected into the test plug, the check valves are to be checked to ensure that they are not allowing air to blow back through the pumps to the gyroscopic instruments.

(c) An airman is to be stationed in the cockpit to operate the de-icer system.

(d) If, for any reason, the relief valve in the de-icer system is blocked and the pressure should go above the 8 psi operating pressure, the air is to be shut off immediately and an inspection made to discover the fault.

(e) With pressure gauge at from 7 1/2 to 8 psi operate de-icer system. If a complete operating cycle takes less than thirty-five seconds or more than forty-five seconds, the distributor valve is to be checked to determine the cause. In cold weather when checking the de-icer system outside with the aircraft engines running, allow the system to operate for about five minutes before checking the cycle.

NOTE

A slow operating cycle during a ground check may be caused by an inadequate source of electrical supply to the distributor motor.

(f) If any parts inflate or deflate slowly or if any gurgling is noted in the lines, such parts are to be disconnected and the lines blown out under pressure. All sumps and drains are to be opened and blown out.

(g) The surface of the de-icer boots is to be checked for tears, holes, bruises and loose patches, during the timing check.

PART 5

REPAIRS

GENERAL

1 Repairs to the de-icer boots are to be made in accordance with the following instructions:-

(a) Small cuts or breaks in the rubber (3/4" or less) are to be repaired with cold patches.

(b) Damage that affects the fabric reinforcement or cuts and breaks which run at right angles to the direction of stretch are to be repaired with rubberized fabric patches.

(c) Parts damaged beyond repair by the methods described in (a) or (b) above, are to be removed and returned to stores for vulcanized repair.

CAUTION

Aircraft are not to be allowed to fly with unrepaired damage to de-icer parts.

PROCEDURE FOR COLD PATCH AND RUBBERIZED FABRIC REPAIR

2 The following procedure is to be carried out when making cold patch or rubberized fabric repairs:-

NOTE

Before repairing installed de-icer boots the tension is to be relieved by removing ten to twelve attachment screws in the vicinity of the repair. This will ensure a tension on the patch and prevent bulging during flight.

(a) Clean the surface in the vicinity o the damage with soap and water and dr thoroughly.

(b) Determine the size of patch require and select a template or buffing shield o corresponding size.

(c) Place the shield over the hole so tha the cut-out portion exposes area to be patched and retain the shield in place throughout th following operations:-

(1) Rub area to be patched with a clot soaked in trichloroethylene Ref. 33C/163 o 1-1-1-trichloroethane Ref. 33C/774, to softe and remove the Prenite Graphite surface. En sure that cut or tear is not allowed to spread

(2) Roughen surface with a wire buffer

(3) Smooth out with an emery buffer s that the surface has been removed to approxi mately .003".

(4) Wash with trichloroethylene or 1-1- 1-trichloroethane and allow to dry.

(5) Brush on one coat of #1 cement an allow to dry.

(d) Remove the starched fabric backing from the patch and apply a light coat of #1 cement to the surface thus exposed and allow it to dry.

NOTE

Keep tacky surface of the patch clean after removing fabric and cementing.

(e) Apply patch to the prepared surface by sticking the center or one edge lightly and

working the remainder down so as not to trap air between surfaces.

(f) Roll the patch down securely with a metal roller or other suitable tool, ensuring that the edges of the patch are down firmly. Re-cement them if necessary.

(g) Allow the job to stand ten or fifteen minutes then wipe the patch and surrounding area lightly with trichloroethylene or 1-1-1-trichloroethane.

(h) Apply a coat of Prenite Graphite cement to restore the conductive surface (Stores Ref. 33A/531).

NOTE

In the event that the damage cannot be repaired with the standard patches, repair material is to be cut to suit from sheet rubber or rubberized fabric Ref. 32C/449, whichever is required; refer to paragraphs 1(a) and (b). In such repairs the procedure is the same as for prepared patches except that the sheet patches are to be thoroughly cleaned and given TWO coats of cement.

RESURFACING

GENERAL

3 Re-surfacing is necessary when any one or a combination of the conditions listed below is encountered.

(a) Flaking off surfacing material.

(b) Cracks developing in surfacing.

(c) Low conductivity.

RE-SURFACING PROCEDURE

4 The following procedure is to be carried out:-

(a) Scrub the surface to be re-coated with a clean cloth soaked in trichloroethylene or 1-1-1-trichloroethane. Use a vigorous scrubbing action to remove all loose particles and to smooth out any wrinkles in the old coating.

(b) Mask off the fairing strips so as to shield the wing during spraying operations.

(c) Spray on two light coats of Prenite Graphite, allowing ample drying time between coats.

(d) Avoid contacting surface after spraying until the coat is completely dry.

(e) If possible the aircraft should remain in a warm place for as long as is practical after spraying to allow the Prenite Graphite coating to cure. This coating will cure in about twenty-four hours at room temperature.

5 All cold patch repairs shall be made using the following materials:-

Ref. 33G/174 Adhesive rubber natural cement
Ref. 33C/388 Patches oval 7/8 x 1-3/4"
Ref. 32C/389 Patches oval 2-1/2 x 1-1/4"
Ref. 32C/390 Patches round 1-1/4" dia.

PART 6

STORAGE OF AIRCRAFT DE-ICER BOOTS - GENERAL

1 Deterioration of rubber is caused by several elements and conditions and may be appreciably reduced by application of proper storage procedures. Care should be taken to store packaged de-icer boots in a space free from sunlight, extreme temperatures, harmful fumes, excessive dust and draft. A temperature range of 16° C to 27° C (60° F to 80° F) is considered satisfactory.

2 Cartons are to be stacked but assurance against placing the de-icer boots under stress conditions is necessary.

3 Cartons containing de-icer boots are not to be stored adjacent to any cartons or articles which contain chemicals.

4 When storing de-icer boots removed from aircraft for a temporary period or for vulcanizing repairs the following procedure is to apply:-

(a) After removal from the aircraft the de-icer boots shall be washed thoroughly using detergent general purpose, powder, RCAF Ref. 33C/CM16.

(b) Inspect thoroughly for damaged areas, tears or leaks.

(c) Where cold patches exist return the de-icer boots for vulcanizing.

(d) Apply a coating of chalk, French, RCA Ref. 33C/11.

(e) Wrap the bead wire ends and the ai connection stems with masking tape or suit able covers, as applicable.

(f) Starting at the end having the metal ai connection stems, roll each boot in a coil The internal diameter of the coiled de-ice boot should be approximately 5". Ensure tha the boots are not wrinkled when coiled.

(g) Some de-icer boots have a rubbe tube type air connection which extends fror the exterior of the boot. When rolling or coil ing boots of this type commence coiling fror the opposite end.

(h) Wrap each coiled de-icer boot in bar rier material, waterproof, flexible, to Spec 43-GP-7. Tie the coils and label each de-ice boot for future identification indicating aircra number and its position for re-installation

(j) Place complete set of de-icer boots i a suitable carton and mark carton for futur identification purposes.

(k) Temporary storage of de-icer boot may be carried out at units when authorize by the C Tech O.