EO 05-1-3/15

ROYAL CANADIAN AIR FORCE

FUEL AND OIL TANKS AND CELLS

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15 JUL 65
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LIST OF RCAF REVISIONS

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INTRODUCTION

1 This Engineering Order establishes the policy and procedure for the effective maintenance and repair of Aircraft Fuel, Oil, and Water-Alcohol cells and tanks, and details preparations, safety precautions and activities necessary for the cleaning and inhibition, removal and installation, handling, inspection repair and transportation of cells and tanks currently in use with the RCAF.

DEFINITIONS

CELLS

2 A cell is a flexible container of rubber, rubber and nylon, or all nylon construction, which can be removed from an aircraft. Cells are sub-divided into two categories:-

Self-Sealing, and those (namely Bladder and Nylon cells) which are not self-sealing.

TANKS

3 A tank is a rigid container being either that part of the aircraft structure sealed to contain and confine a liquid (Integral Tank) or is a separate removable container constructed of metal or fibreglass, or a combination of both (Removable Tank).

HAZARDS

4 Fuel, oil, repair materials and solvents are highly volatile, toxic and inflammable commodities, but the attendant fire and health hazards can be effectively minimized by strict adherence to the safety precautions and other instructions contained in this manual. Personnel are to acquaint themselves with all aspects of the dangers to life health and property, and are to comply with all directives concerning safety precautions. Refer to EO 00-80-4/7.

SAFETY PRECAUTIONS

PURPOSE

5 Safety precautions are issued to prevent injury to personnel, and damage to equipment or property as a result of explosion or fire, oxygen deficiency and the harmful effects of toxic liquids, gasses, or dust.

GENERAL

6 The safety precautions given in this publication and in conjunction with EO 00-80-4/7 are the minimum requirements applicable to average conditions. Personnel engaged in the cleaning, maintenance or repair of aircraft fuel, oil or water-alcohol tanks and cells must be alert to the attendant hazards at all times.

7 Accidents do not happen. They are caused by negligence, or failure to detect the presence of a hazard. Accidents are prevented by the use of common sense together with the strict observance of prescribed safety precautions.

CLOTHING

8 All clothing worn by personnel in fuel tank and cell repair areas is to be of non-static producing cotton, this includes coveralls, under-clothing and socks. Street shoes shall be removed and changed for Gym shoes before working in any fuel tank/cell repair area.

Hats

9 When working inside a fuel tank or cell, the hair is to be covered by a cotton cloth head covering.

Goggles

10 Safety goggles will be worn when buffing the exterior of a cell, or when carrying out a blow-back test on integral tanks.

Gloves

11 Rubber gloves will be worn when de-puddling, or applying solvents by hand.

12 Cotton gloves will be worn when applying sealant.

Metal Buckles

13 Clothing having metal buckles, fasteners or buttons is not to be worn when inside a fuel cell or tank.

Protective Suit

14 A solvent-, fuel- and acid-resistant suit equipped with a hood for protection of the head, and drawstrings or rubber cuffs at the wrists and ankles, is to be worn by personnel entering a tank for desealing operations. In addition a life line, rubber boots, rubber gloves and a full-face, positive-pressure type air-line respirator will be worn.

15 On completion of desealing, the suit is to be well rinsed with clear water before being removed.

Respirators

16 A full-face, air-supplied respirator, equipped with non-kink hose is to be worn by personnel:-

(a) when working inside a fuel wetted cell or tank, or

(b) when solvents are being used inside cells or tanks.

17 Half-face respirators having two charcoal filters are to be worn by personnel when buffing the exterior of fuel cells, or during the applicaiton of lacquer.

18 If hot air is used to render the tank free from explosive vapour the temperature of the air is not to exceed 100°C (212°F).

19 Fresh filtered air is to be continously supplied while personnel are working in the tank.

STATIC ELECTRICITY

20 Static electricity is a constant source of danger when generated near fuels or flammable vapours, and has been responsible for many fires, causing extensive property damage, personnel injuries and fatalities.

21 Static electricity is created primarily by almost any sort of motion of persons or material. High static electrical charges are created by persons walking or moving, rubber-tired vehicles, liquid dropping through space, and petroleum products being pumped through lines and hoses, when not properly grounded.

22 Static electricity can be generated through the use of pneumatic tools. Tools of this type shall be effectively grounded to reduce the possibility of fire or explosion resulting from generation of static electricity.

23 Static charges of only 1500 volts can ignite fuel vapours. A person walking across a dry area creates many times the voltage needed to ignite fuel, and a parked aircraft can easily build up high static charges from wind or dust blown over its surface. These are only a few examples of the hazards of static electricity. It is almost everywhere.

24 Supervisory and operating personnel, will readily recognize the need for implementing immediate and effective control measures.

Grounding

25 Grounding is the most practical way to control the accumulation of static electricity, and provides a path of least resistance, through which static charges will easily flow to the ground.

Bonding

26 Bonding is essential and is invariably used together with static grounds. Effective bonding will eliminate the difference in electrical charges which may exist or be generated between two objects.

27 A static electrical discharge cannot occur between two objects adequately connected by bonding wire attached to clean unpainted surfaces.

28 Although bonding will equalize the charge between two electrically connected objects, the objects themselves may still be highly charged. By connecting a ground wire to the bonded object, this charge will be drained off without danger.

WORK STANDS

29 Personnel are subjected to the hazards of falling when working above floor or ground levels. To minimize this danger, suitable work stands shall be provided and used during maintenance of fuel systems.

Care Of Work Stands

30 Periodic inspection of work stands shall

be made to determine their safe use and need of repair. Defective stands shall be replaced or repaired. The work stand steps and working platform shall be kept free of grease and oil at all times. Stands with worn non-slip step surface shall be replaced. Removable railings shall be in place before personnel begin work.

WARNING

Under no circumstances will makeshift scaffolding or stands be used. In cases of extreme necessity, temporary improvised stands or scaffolds may be used if approved by the Ground Safety Officer as being safe for one time use.

31 Work stands are to be grounded to an approved static ground. All stands shall be equipped with a personnel static discharge plate made of copper, zinc or zinc-coated material marked "PERSONNEL STATIC DISCHARGE PLATE" affixed in such a position that personnel will make contact with it before coming in contact with aircraft.

	Material	RCAF Ref	Specification	Manufacturer
1	Cement DR 3200		MIL-A-9117	Dominion Rubber Co. Kitchener Ontario
2	Cement DR 3230		MIL-A-5092	
3	Syn Rubber Coated Fabric DR 5200			
4	Syn Rubber Coated Fabric DR 5241			
5	Syn Rubber Coated Fabric DR 5247			
6	Syn Rubber Coated Fabric DR 5200/5187			
7	Sheet Sealant Fuel Cell Self-sealing 0.110"	32/C		
8	Sandpaper 120 Grit			
9	Methyl Ethyl Ketone	33C/520	TT-M-261	
10	Methyl Isobutyl Ketone		Technical Grade	
11	Cloth, Emery 40-80 grit	29/1833 to 1840		
12	Oil Engine Grade 100	34A/17	3-GP-100A	
13	Oil Engine SAE 10W	33C/35	3-GP-4S	
14	Talc	33C/11	MAT-2-1	
15	Clay Bentonite			
16	Soap Paste	33CM/25	2-GP-4A	
17	Lacquer, Buna Viny-lite	33A/	Spec 1727	Dominion Rubber Co Montreal P.Q.
18	Primer, Ty-Ply, BN	33A/462	MIL-P-6889A	
19	Cloth, Aloxite			
20	Naphtha	33C/653	TT-N-95	

Table 1-1 (Sheet 1 of 3) Material Specifications

	Material	RCAF Ref	Specification	Manufacturer
21	Acetone	33C/417	15-GP-50	
22	Fabric, Pliocel Repair Mat'l FT 45			Goodyear Tire & Rubber Co.,
23	Cellophane, Water-Permeable 6" wide		Commercial Grade	
24	Nylon, Liquid Blue 5073C			
25	Nylon, Liquid Yellow 5074C			
26	Cement, Chemigum Coating 5071C (5070C & 1408C)			
27	Glycerine	14B/43	MIL-0-491	
28	Detergent	33C/667		
29	Silver Pencil, or Suitable non-greasy marker			
30	Sealant E.C. 1675A		MIL-S-8802C Class A	
31	Sealant E.C. 1675B		MIL-S-8802C Class B	
32	Accelerator E.C. 807			
33	Butyl Acetate		Technical Grade	
34	Soap, Bubble (dilute 1 to 10)	33C/NIC		
35	Alcohol- denatured	34A/216	3-GP-530	
36	Stripper-Turco Paint L-800	34A/456	1-GP-38	
37	Methylene Chloride	33C/583	MIL-M-6998	
38	Alcohol,Isopropyl	34A/214	3-GP-525	
39	Lacquer,Aluminized	34A/424	1-GP-12B	

Table 1-1 (Sheet 2 of 3) Material Specifications

	Material	RCAF Ref	Specification	Manufacturer
40	Cleaner	33C/182	3-GP-8	
41	Ethyl Acetate	33C/294	C 31-302	
42	Cement 6136			U.S. Rubber Co 48th Street & 6th Avenue New York
43	Thread Nylon 0.015" dia	32B/384		
44	Stripper	33C/584	LAR 388	
45	Toluol	33A/467	TT-T-548	
46	Sealer N.T blend G			
47	Ethyl-Alcohol	34A/214	3-GP-525	
48 49	Protective Coating, Buna-N Phenolic EC 776	33G/38	MIL-S-4833B	
49	Protective Coating, Polyurethane		MIL-C-27725	
50	Cement Sealing Synthetic Rubber No. 4006	33G/116	MIL-G-9117A	
51	Ammonium Hydroxide		FSN-6810-222-9643	
52	Phenolphthalein Crystals		FSN-6810-223-7612	
53	Varsol		Industrial Grade	
54	Polyurethane Cleaner Solvent PR 146			
55	Cellosolve Acetate		Industrial Grade	

Table 1-1 (Sheet 3 of 3) Material Specifications

PART 2

SELF-SEALING AND BLADDER-TYPE FUEL CELLS

DESCRIPTION

SELF-SEALING CELLS

1 A self-sealing fuel cell has four primary layers of material; the inner liner, a barrier of nylon film, the sealant, and the retainer. Many cells in service contain more than the four basic layers; but each ply may be classified as being related to one of the four.

2 The purpose of the inner-liner is to contain the fuel and to keep it apart from the sealant layers to prevent premature swelling or deterioration of the sealant.

3 The sealant material remains inactive in the fuel cell until the liner is penetrated. When this occurs the sealant will swell, sealing the ruptured area so that no fuel is allowed to escape.

4 The purpose of the retainer material is to strengthen the fuel cell to protect the sealant and inner liner; it also increases the efficiency of sealing action after the cell is penetrated.

5 In this construction the Buna-N synthetic rubber acts as the inner liner. Nylon is used as a barrier to prevent the diffusion of aromatic fuels into sealant material. The sealant is placed on the cell in two layers, a layer of cord fabric being placed on the exterior of the fuel cell. (See Figure 2-1).

6 The sealing action is brought about by the mechanical action and chemical reaction which takes place upon penetration of the fuel cell. The mechanical action results from the fact that rubber, both natural and synthetic, will give under the shock of impact, limiting damage to a small hole in the fuel cell. The fuel cell materials will allow the projectile to enter or leave the cell and then will closely approximate their original position. The mechanical action is almost instantaneous. The chemical reaction of the sealant takes place when fuel or fuel vapours reach the sealant which will swell to several times its normal size, closing the rupture.

7 A fuel cell is self-sealing but not self-healing. Any fuel cell which has been ruptured so that gasoline is in contact with the sealant material must be repaired as soon as possible, with 72 hours as a maximum time limit.

BLADDER TYPE CELLS (NON SELF-SEALING)

8 Non self-sealing, bladder type fuel cells are of lightweight construction comprising one or two layers of square-woven rubberized fabric outside, a nylon film barrier, and an inside layer of Buna-N synthetic rubber.

'PLIOCEL' (NYLON) FUEL CELLS

9 Pliocel fuel cells differ in construction and material from Buna-N rubber cells, and are identified by the Goodyear trade name 'Pliocel' stenciled on the cell. Pliocel construction is of two nylon woven fabric layers laminated with three layers of transparent nylon film, and is not self-sealing.

HANDLING

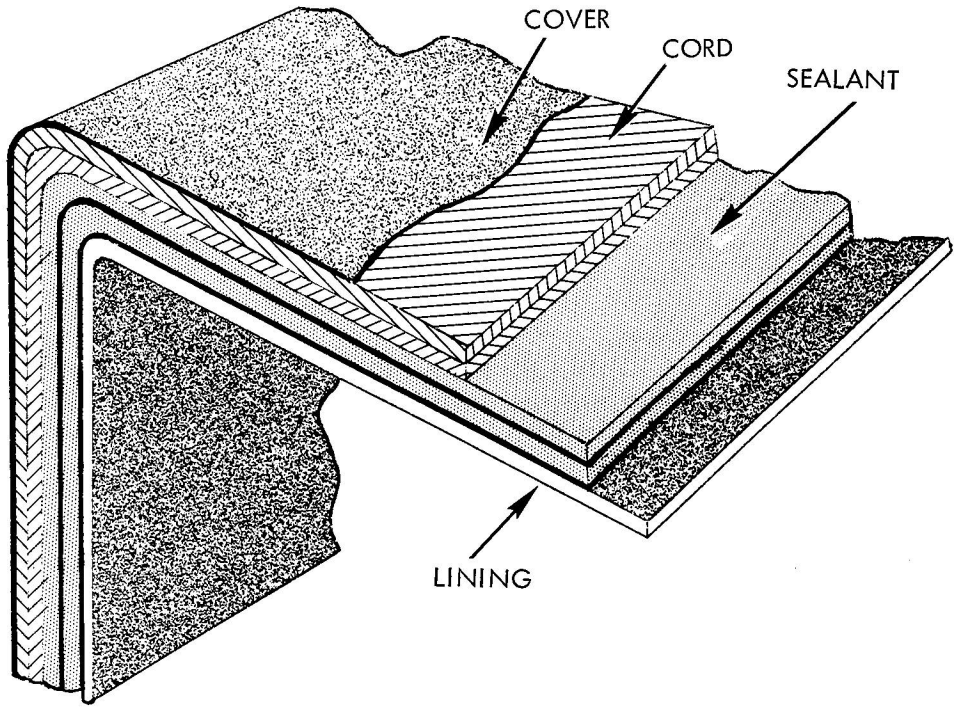
CAUTION

Extreme care is to be taken when handling fuel cells; they are prone to various types of damage during uncrating, preparation, transportation, installation or removal from their cavities. The use of proper working surfaces is mandatory to prevent costly damage, which may not be detected until after the cell has been installed and fuelled. All working surfaces used in cell repair are to be smooth clean, and padded. Rips, scratches, abrasions, distorted fittings, careless handling of cells or tools, dirt or grit in cell cavities and broken or sharp edges on backing boards or cavity structure, can result in eventual leaks.

10 Handle cells as little as possible, observing the following precautions:-

(a) Never lift or carry a cell by its fittings.

(b) Do not allow cells to rest on protruding fittings or to be stacked unsupported one upon another.



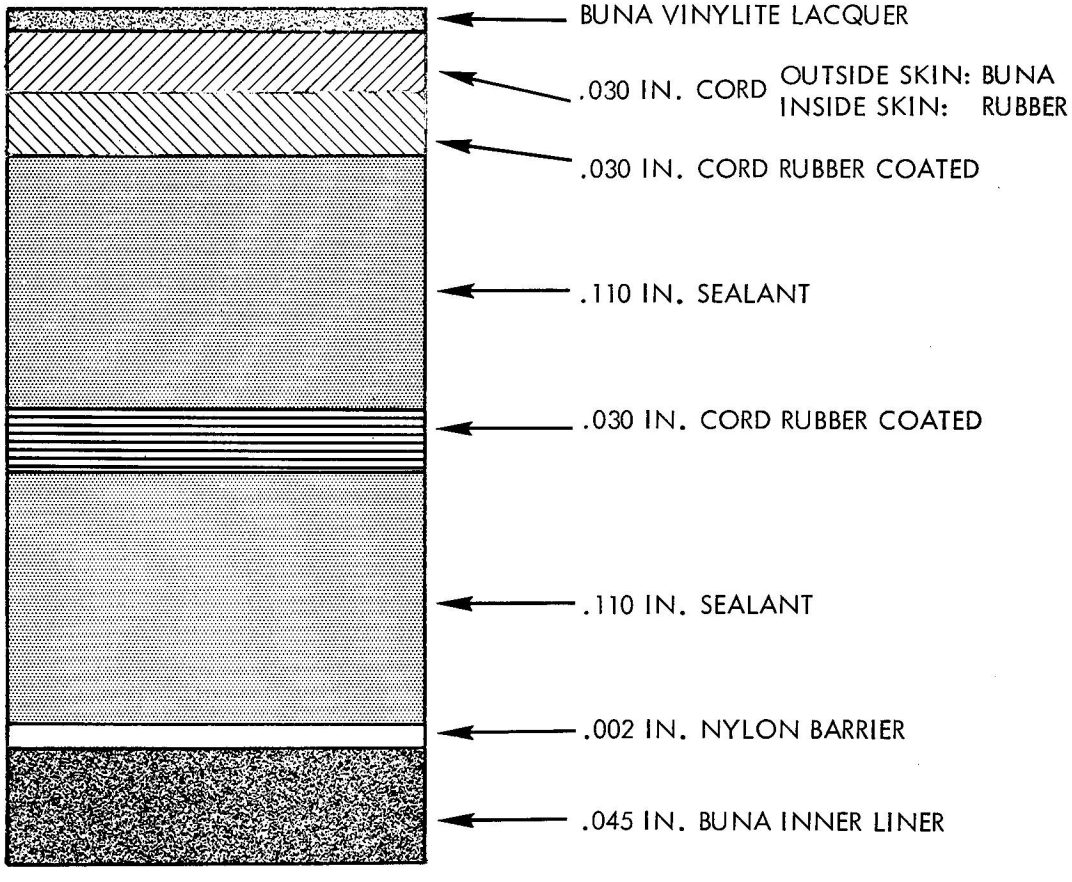


Figure 2-1 Section Through Wall of Self-Sealing Cell

(c) Seal all cell openings.

(d) Carry rubber parts; do not drag or scuff along the floor; avoid knocks, distortion and damage to fittings.

(e) Do not paint rubber parts except where required as camouflage. Small parts need not be masked to prevent overspray from spray painting of adjacent components. Do not paint fittings having rubber portions or inserts.

(f) Self-sealing cells shall not be left collapsed for more than one hour.

(g) Rubber protector caps are required for hangar receptacles at all times while the self-sealing cells are out of their cavities.

11 Fold self-sealing cells only when necessary for removal and installation, observing the following precautions:-

(a) Fold and/or strap just before the cell is to be installed; do not keep cells folded any longer than is absolutely necessary.

(b) Ensure that fittings are not damaged or torn loose from the cell during folding.

(c) Ensure work areas are free of foreign objects, never drop tools or other objects on to cells.

(d) When uncrating a cell follow all instructions attached to container to prevent damage to the cell and reusable container.

12 Bladder cells, including beaded fitting-type cells, are to be collapsed and folded into small packages before they are placed in their shipping and storage containers. Additional protection is provided for beaded-fitting cells by the installation of a split hose over the bead and by collapsing the cell over a cardboard tube with a minimum diameter of six inches. The following precautions shall be observed at all times while unfolding and refolding bladder-type cells:-

(a) Never fold or unfold a cell in temperatures below 40 degrees Fahrenheit. In extremly cold weather, folded cells may be placed in their cavities and the cell and cavity warmed to room temperature. Never let heated air blow directly on a cell.

(b) Always fold or unfold a cell on a smooth, clean, padded surface that has been covered with canvas and wax paper or rubberized fabric.

(c) Do not fold a cell abusively or unnecessarily as this may damage the nylon barrier. Never collapse a cell by air evacuation. Avoid unnecessary creasing, sharp folds and bends.

(d) Protector rings are required on some cell access door fittings. (Consult the applicable aircraft Engineering Order for cells which require this protection). Always install the protector ring before collapsing and folding the cell.

CLEANING

WARNING

Fuel cells and containers, improperly cleaned, are a fire hazard when they contain a certain ratio of oxygen and fuel fumes. Before removal from the aircraft, completely drain and de-puddle cells which have been in use or have contained fuel. Thoroughly vent cells before attempting any work on them.

13 Clean fuel and oil cells inside and outside to remove any oil or foreign substances, by using a solution of soap paste (33C/684) and hot water at a temperature not exceeding 120°F. After cleaning, remove all soap residue with clean hot water (not to exceed 120°F). Alternatively clean by hand using detergent 33C/667 mixed with warm water. Rinse with warm water.

14 Clean nylon fuel cells by moistening a lint-free cloth with Methyl Ethyl Ketone (Item 9) or Acetone (Item 21), to remove any residual matter left by the fuel.

PACKING AND STORAGE

15 Pack in accordance with CAP 16, Vol.3. Provide adequately protected storage for non-metallic fuel cells, observing the following precautions:-

(a) Avoid exposure to direct sunlight.

(b) Cells should be packed in special containers. Do not remove cells from containers except when necessary.

(c) Containers may be stacked, but do not allow partial or complete collapse of the lower containers or cells.

(d) Cells to be stored without containers should have adequate internal bracing and are to be stored on trestles. In no instance should cells without containers be stacked.

(e) Store in a well ventilated area. Do not place cells whether in or out of container near fire hazards such as electric motors, con ol panels, heaters or hot pipes.

(f) Prior to storage, cells which have been in service or have contained fuel shall be drained and de-puddled. Within ten days of removal of fuel, cells should be cleaned and, after completion of necessary repairs, the interior surfaces sprayed, painted or slushed with engine oil SAE 10W (34A/35). Do not permit excessive amounts of oil to remain in the cell. Re-oil interior surfaces of cells at intervals. of twelve months. After the first and each subsequent oiling, mark cells with a tag containing the following information: "Interior sprayed (painted or slushed) with oil" and "date". When the cells are returned to service, flush the oil with cleaner (33C/142).

(g) Do not collapse self-sealing cells for shipment or storage. Shipping and storage containers support cells in their normal configuration.

(h) When removing cells from storage for installation, use the oldest cells first.

16 If a nylon fuel cell is to be packed or is otherwise expected to remain without fuel for a period exceeding seven days, fog the interior of the cell with a solution of equal parts of water and glycerine (14B/43). If spray equipment is not available, apply with a lint-free cloth moistened in the solution.

INSPECTION BEFORE REPAIR

17 Inspect visually to determine the extent of unserviceability. Some injuries are simple to repair. Injuries in corners or other awkward places may prove very difficult if not impossible to repair. It is better to abandon a repair and condemn the cell rather than make a doubtful repair in an area where the cell contour is likely to prevent good patch adhesion.

18 Repairs can be effected if the area to be repaired is less than two inches in diameter or length. If the repair area is more than two inches but less than ten inches in diameter or length, repair may be effected only on authority of AMCHQ.

19 Repairability of a cell can be determined only by the number and location of injuries. Do not repair large injuries located where a cell is folded sharply during installation. The limit to the number of repairs is left to the discretion of engineering officer.

20 The time and effort required to make temporary repairs is as great as that necessary for permanent repairs and the results are not satisfactory. Therefore all repairs are to be of a permanent nature.

TESTING OF CELLS

21 To enable all leaks to be repaired at the same time and to check for efficient repair of leaks, test fuel cells before and after repair by one or more of the following methods:-

SOAP-SUDS TEST

(a) Proceed as follows:-

(1) Locally fabricate an air inlet fitting to fit any of the fittings in the cell.

(2) Attach the cover plates and install the air inlet fitting. Torque the cover plates and the air fitting, using the torque values marked on the cell as a guide.

(3) Inflate the cell to the appropriate air pressure as detailed for 'Footprint Check.'

(4) Mix one cup of soap (Item 34) to one gallon of water. Apply the solution to test-repaired areas or areas suspected of leakage. Check the soaped areas for bubbles which indicate leaks, and mark any leaks found.

(5) After the test wash off soap residue from exterior of the cell and dry completely. Remove the test equipment and cover plates from the cell.

INTERNAL DETERGENT TEST

(b) Proceed as follows:-

(1) Attach plate and cap assemblies (locally fabricate if not furnished with the test kit) to all openings except the access door.

(2) Torque the plates and cap assemblies, using the torque values specified on the cell.

(3) Mix a solution of one cup of soap (Item 34) in three gallons of water for each 1000 gallons of tank capacity.

(4) Pour the solution into the cell.

(5) Install an access plate (locally fabricate if not furnished) and torque, using the value marked on the cell.

(6) Slosh the solution around in the cell to cover all interior surfaces.

(7) Inflate the cell to the appropriate air pressure as shown in paragraph 21 (d) 5.

NOTE

A discoloured (dark) appearance of the outer ply will indicate that it has been soaked with fuel, and could be misinterpreted as indicating a leak in this test. Ensure that outer ply is completely dry before starting the test.

(8) Carefully check the exterior of the cell for bubbles, wet spots, or seepage, and mark any defects found.

(9) After the test, remove the test equipment and cover plates from the cell. Flush the cell with warm water; dry with lint-free cloth.

FOOTPRINT CHECKS

(c) Proceed as follows:-

(1) Locally manufacture a plate of plexiglass large enough to cover the cell fitting. The plexiglass shall be approximately one-inch thick and flat on at least one surface. The plates shall be drilled with bolt holes to match the fitting.

(2) Install plate on fitting with flat surface against the fitting flange. Torque to 30±5 inch-pounds.

(3) Looking through the plexiglass, check for any irregularities in the surface of the fitting. These will look like air spaces or be light gray in colour. If irregularities appear, sand the fitting with fine sandpaper.

CHEMICAL TEST

(d) Before making the chemical test, remove all red-coloured markings from the outside of the cell, as such markings will indicate a leak during the test.

(1) Locally fabricate a plate with two inlet fittings to fit any one of the fittings in the cell; one for the air inlet and the other for the water manometer.

(2) Attach cover plates to all openings except the access door. Install the air inlet fitting and torque the cover plates to 35±5 inch-pounds or recommended torque value marked on cell.

(3) Pour ammonium hydroxide (Item 51) on an absorbent cloth placed in the cell, at the ratio of three cc per cubic foot of cell capacity, using a minimum of 10 cc of fluid.

(4) Mix a solution of equal parts of ethyl alcohol (Item 47) and water to which 15 grams of phenolphthalein crystals (Item 52) per gallon of solution have been added.

NOTE

Add phenolphthalein crystals to alcohol, mix and add water.

(5) Inflate the cell with air to a positive test pressure as shown in the table below.

NOTE

Cage or jig need not be used to confine cell if following air pressures are not exceeded:-

CAPACITY	AIR PRESSURE	WATER MANOMETER
0-1000 gals.	1/2 psi	14 inches
1000 gals. and up	1/4 psi	7 inches

(6) Soak a large white cloth in the solution, wring thoroughly and spread smoothly on the outer surfaces of the cell. Press the cloth down to insure the detection of minute leaks.

(7) Check the cloth for red spots which will indicate a leak. Mark any leaks found. Move the cloth and repeat until the entire exterior

surface of the cell has been checked. Red spots on the cloth may be removed by resoaking the cloth in the solution.

(8) The solution and test cloth are satisfactory as long as they are clean. Indicator solution that is not in immediate use shall be stored in a closed container to prevent evaporation and deterioration.

(9) After the test, remove the test equipment and cover plates from the cell. Clean all metal fittings as soon as possible, because the alcohol and ammonium will cause corrosion. Allow cell to vent thoroughly before entering.

VARSOL LEAK TEST FOR BLADDER FUEL CELLS

(e) The following materials and equipment are required for this test:-

(1) Varsol.

(2) Controlled air pressure line.

(3) Closure plates for cells - one with air line connector.

(4) Flexible coupling for air line.

(f) Carry out test as follows:-

(1) Plug fitting holes in cells.

(2) To access door apply plate with air line connector.

(3) Add Varsol to cell, 2 gallons for a small cell, 4 gallons for a large cell.

(4) Connect cell to air line.

(5) Inflate to 1/8 lb. air pressure.

(6) Gently roll cell so that the whole of the inner surface becomes covered with liquid.

(7) Inspect cell for leaks (leaks appear as a smear of oil).

(8) Cell should remain under pressure for 5 minutes.

(9) Inspect cell again for leaks and mark any found with wax crayon.

(10) Deflate cell, empty out Varsol and wipe the excess.

(11) Send cell for shipment or repair as appropriate.

TESTING CELL WALLS

22 The only satisfactory method for testing the walls of a self-sealing cell is to stand-test with fuel for 24 hours. Leaks in the barrier can be detected by draining the fuel, opening the cell and looking for evidence of sealant activation.

TOOLS

23 A useful locally-manufactured tool for fuel cell work can be made from an ordinary soldering iron: Braze a semi-circular piece of copper (approximately 3/8-inch thick and cut on a 1-inch radius) onto a 3-1/2 inch length of 3/8-inch diameter round copper stock. Taper the head down so that the tool resembles a rod cutter (Figure 2-2). Insert the finished part into the soldering iron in place of the regular copper tip. This "hot knife" is adaptable for removing fittings, trimming sealant, etc. It cuts very easily when hot and care shall be taken not to cut too deeply. Practice is recommended on repair material before using the knife for actual repair.

REPAIR PROCEDURES

24 Repair fuel cells in a dry place, controlled at 60 to 80 degrees Fahrenheit.

WARNING

In addition to the fire risk, vapours from fuel, rubber and solvents constitute a health hazard which cannot be too strongly stressed. Adherence to safety precautions contained in EO 00-80-4/7 is imperative.

BUFFING

25 Self-sealing cells shall be buffed by hand or with an air-driven power buffer. Buff the repair area with clean medium-grit emery cloth or a buffing stone. When hand buffing Buna Materials, use 40-80 grit emery cloth (Item 11). Buffing shall be heavy enough to remove all gloss, leaving the surface covered

with fine scratches. Hand buff using coarse emery cloth if it is found that power buffing produces a surface too smooth for good adhesion. Ensure that the nylon barrier is not damaged during buffing. When using a power buffer, do not allow buffing hand or stone to dwell in one place, as the fabric will burn and cause inadequate adhesion of the patch.

CAUTION

Extreme care shall be taken when buffing interior or exterior fabric of cell walls. Buffing through fabric causes additional damage.

26 To simplify patch buffing, buffing shall be done before patch is cut. This provides a greater area of material to hold and eliminates the possibility of a small patch being thrown into the air and possibly causing injury. It will also assure more even buffing around edges of patch.

WARNING

Power buffing and grinding produces large quantities of dust and smoke which are irritating if inhaled. All power buffing should take place in a well ventilated area. Personnel shall wear a half-mask, chemical cartridge respirator equipped with filter pads and goggles when outside of cell is being buffed. An air supply full-face respirator shall be worn whilst buffing a cell interior.

27 After the cell and all patches have been buffed, remove all buffing dust with a vacuum cleaner.

CLEANING AFTER BUFFING

28 The area to which patches are to be applied shall be cleaned with a lint-free cheesecloth pad moistened in solvent. Hand and finger tips shall be thereafter kept off the surface to be cemented, as fingers and hands deposit an oil that will prevent the adhesion of the cement and patch.

WARNING

Most cleaning compounds and cement used in repair of fuel cells have low flash points and are health hazards. All cleaning compounds are harmful to the skin. Extreme care shall be taken in handling these materials. Always use an air-supply respirator when working inside a cell. All fuel cell repair areas shall be equipped with exhaust ventilation to be used when operator is inside cell.

CEMENTING

29 Use only fresh cements and keep containers capped when not in use. Stir the cement thoroughly before use and stir frequently while in use to maintain proper consistency. Cements which are jellied, lumpy, too thin, or which possess any abnormal characteristics shall not be used. Ensure that

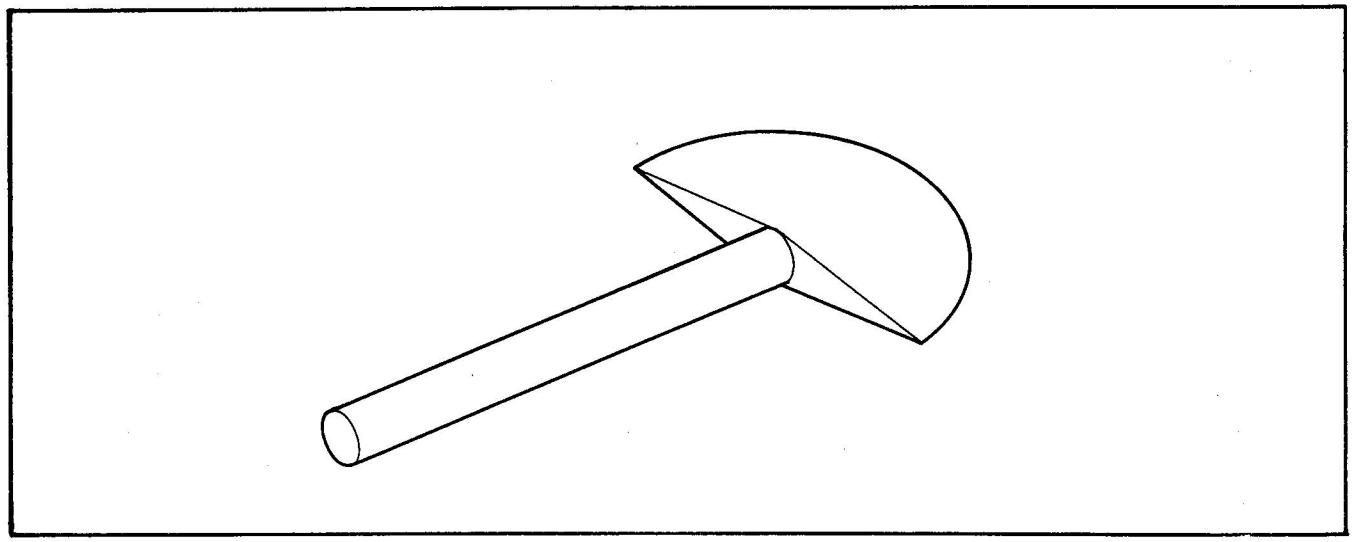


Figure 2-2 Typical 'Hot-knife'

cement containers are correctly identified. Use of unmarked cans leads to mistakes which may cause adhesion failure. Cement is to be applied evenly and thinly in three coats to each surface allowing a lapse of 45 minutes between each coat for drying time. After the third coat has been applied, allow 24 hours for the cement to dry.

PATCHING

30 Cut a bevelled patch (Figure 2-3) of the correct repair material to extend two inches from the edge of the injury in all directions.

31 The outside repair material is a fabric, coated on both sides with Buna-N synthetic rubber (Item 3), available in gauges .038 to .062 inch. The .020 inch gauge material (Item 4) is used for internal and external corner repairs, chafing strips, fitting wraps, and in other instances where a lighter gauge material is suitable.

32 The inside repair material is sheet Buna-N synthetic rubber, cured on both sides, of .045 inch gauge (Item 5).

33 The bottom or contact side of the patch shall be buffed and all corners of the patch rounded to avoid loose edges. Only one patch is required on the interior flat surface and one on the exterior flat surface of the cell for injuries not exceeding two square inches in area. Repair of larger injuries, subject to Engineering Authority, requires two patches on both the inside and the outside of the cell.

34 The edges of the first patch are to be well "feathered" to provide adhesion and to prevent the formation of a channel between the two patches.

35 When applying a patch, the surface to be repaired shall be backed by a firm, padded surface such as a table, an adjustable support or a padded hardwood board. (Figure 2-4).

36 Before the patch is applied, the cement on both the patch and the cell shall be wiped with a clean, lint-free cheesecloth pad, moistened with solvent (Item 9) to make the cemented areas tacky to the touch.

37 When the cemented areas are sufficiently tacky, centre the patch over the injury (Figure 2-5) roll down firmly with a 1/4-inch hand roller, starting from the centre of the patch and working to the outer edges to prevent trapped air or a blistered condition.

ACCEPTABLE LIMITS OF DEFECTS

38 The limitations shown against defects in Table 2-1 are Standards of Serviceability. Defects in excess of these limits do not mean that a cell is condemned, but that it is not acceptable for use in an aircraft until repairs have been effected, tested and approved.

NOTE

Fittings are not to be disturbed for inspection unless leakage is suspected.

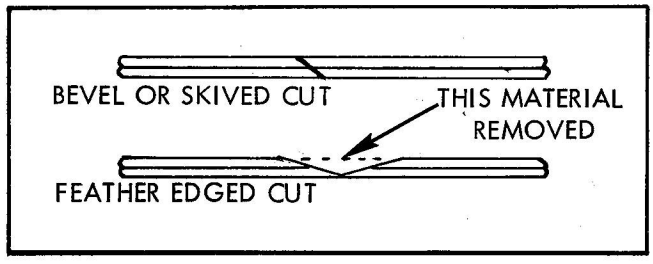


Figure 2-3 Bevel and Feather-edged Cuts

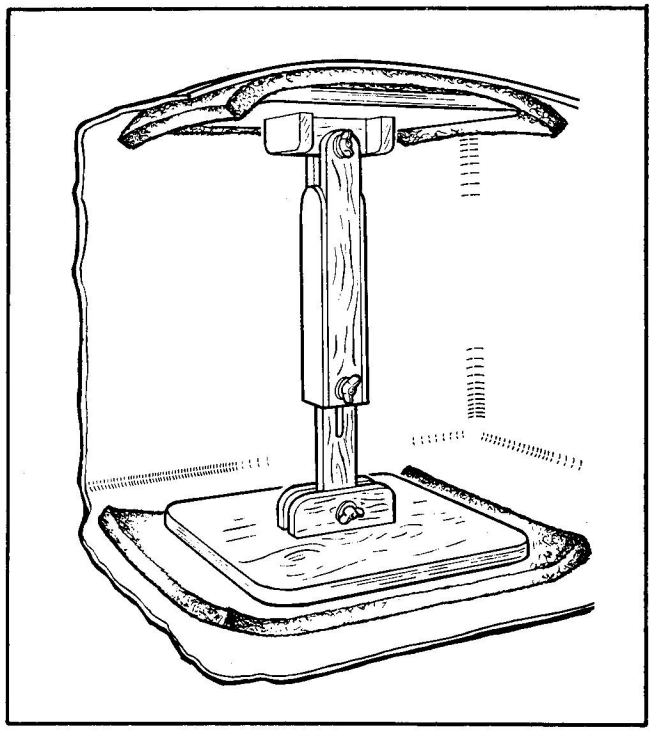


Figure 2-4 Support Pedestal

INTERIOR INSPECTION	
CONDITION	LIMIT
Loose liner at throat of fitting.	1/2-inch looseness in width around circumference at throat of fitting. Looseness to be trimmed at time of other repair up to 1/4-inch width provided 1-inch bond is maintained between laps.
Edge looseness at liner lap.	1/2-inch width provided 1-inch bond is maintained between laps.
Edge looseness on liner reinforcements, corner patches and chafing patches.	1/2-inch maximum looseness area provided it does not exceed 20 percent of width of patch. Blisters or separations other than in edge area allowable up to 20 percent of total area.
Looseness under cemented components such as attaching straps, baffle shoes, etc.	20 percent of individual areas provided 1/4-inch bond is maintained around edge.
Blisters between liner and fitting flange.	1/2-inch maximum dimension; maximum two per lineal foot and three per fitting if 1-inch bond is maintained.
Damaged grommets in accessories.	Acceptable if serviceability is not affected and rust corrosion or other deterioration not present. Repair at time of other repair.
Damaged coating on accessories (metal or rubber)	Acceptable if rust, corrosion or other deterioration is not present.
Checking due to weather, ozone, dry cracking, or surface imperfections in liner.	Not acceptable.
Blisters in liner laps.	1/2-inch maximum dimensions; no more than five in any 5 lineal feet with minimum 6-inch bond between blisters.
Blisters, delaminations of ply separations.	1-square-inch maximum dimension provided there is a 6-inch bond between blisters, and no more than one per square foot of area.
Channels in inner-liner laps.	1/4 x 3-inch maximum dimensions with maximum of one in any 5 lineal feet of splice.

Table 2-1 (Sheet 1 of 3) Acceptable Limits of Defects - Self-Sealing Cells

INTERIOR INSPECTION (Cont'd)	
CONDITION	LIMIT
Channels around entire outer edge of fitting flange.	1/4-inch maximum width.
Channels at tapered construction step off area or edge of lap splices of any ply.	1/4-inch maximum width, entire length of lap.
Open end channels in three-ply liner over-laps or tailored corners.	1/4 x 3-inch maximum dimensions provided 1-inch minimum bond is maintained between end of channel and sealant.
Cuts or holes in inner-liner.	Not acceptable.
Buffing through inner-liner.	Not acceptable.
Activated area.	Not acceptable.
Broken stiffeners or supports.	Not acceptable.

EXTERIOR INSPECTION	
CONDITION	LIMIT
Blisters or ply separation between any plies except liner sealant.	1-inch maximum dimension.
Skim coat blister.	Acceptable.
Loose hangar straps or hangar attaching points.	Acceptable up to 20 percent looseness in total area if 1/4-inch bond is maintained around edge.
Loose or damaged tapes, corner patches and other outside accessories.	1/2-inch maximum allowable looseness if it does not exceed 15 percent of total area.
Checking due to weather, ozone, dry cracking, or surface imperfections other than fittings.	Acceptable.
Damaged grommets in accessories.	Acceptable if serviceability is not affected, but repair shall be made at time of other repair.
Damage through outer cord or fabric ply.	Not to exceed 1/2-inch without repair.

Table 2-1 (Sheet 2 of 3) Acceptable Limits of Defects - Self-Sealing Cells

EXTERIOR INSPECTION (Cont'd)	
CONDITION	LIMIT
Channels or bridging of outer plies at cord or fabric splice.	1/2-inch maximum width full length of splice.
Outer ply cuts or splits parallel to cords where cords are not damaged.	Not acceptable. (May cause outside activation.)
FULLY RUBBER-MOULDED FITTINGS INSPECTION	
CONDITION	LIMIT
Gouges, splits or deep indentations on sealing surface.	1/16-inch maximum depth by 1/8-inch maximum length.
Weather checking on sealing surface of fitting.	Acceptable unless cell not installed, when repair is to be made.
Weather checking outer flange.	Acceptable up to 1/16-inch depth.
SEALING FACE WITHOUT O-RING GROOVE	
CONDITION	LIMIT
Scratches within sealing surface area.	Not acceptable.
Burrs or scratches on mating surface.	Not acceptable.
Corrosion or rust.	Not acceptable.
Weather checking on outer flange.	Acceptable.
SEALING FACE WITH O-RING GROOVE	
CONDITION	LIMIT
Minor surface damage outside O-ring groove other than rust, corrosion or burrs.	Acceptable.
Physical damage to O-ring groove.	Not acceptable.
Corrosion or rust.	Not acceptable.
Cement or other foreign material in O-ring groove.	Not acceptable.
Bent or broken fittings.	Not acceptable.
Thread-damaged fittings.	Not acceptable.

Table 2-1 (Sheet 3 of 3) Acceptable Limits of Defects - Self-Sealing Cells

INTERIOR INSPECTION	
CONDITION	LIMIT
Loose liner at throat of fitting except sump type and three plane fittings.	1/2-inch looseness in width around circumference at throat of fitting. (Except Firestone construction 1052-6, on which 1/16-inch edge looseness is allowable.)
Loose collar at throat of sump type and three-plane fitting.	1/4-inch maximum looseness.
Loose liner lap.	1/4-inch looseness minimum width in edge of liner lap and full length of lap provided 1-inch bond is maintained. (Except Firestone construction 1052-6, on which 1/16 inch edge looseness is acceptable.)
Edge looseness on liner reinforcements and chafing patches.	1/2-inch maximum allowable provided it does not exceed 20% of total area. Blisters or separations other than in edge area allowable up to 15% total area.
Looseness of cemented internal support components such as attaching straps, baffle supports, etc.	Acceptable up to 20% of component area provided 1/4-inch solid bond is maintained around edge.
Blisters between fitting and adjacent ply.	1/2-inch maximum dimension; maximum two per lineal foot and two per fitting, provided 1-inch bond is maintained.
Damaged grommets in accessories.	Acceptable if serviceability is not affected.
Damaged coating on accessories (rubber, metal or wood).	Acceptable if no rust, corrosion or deterioration is apparent.
Weather ozone checking Buna rubber.	Not acceptable.
Channels between liner.	1/4-inch width by 2-inch length maximum dimension; one per lineal foot of splice with maximum of five in any 5-foot length of splice.
Blisters between plies (in cell panels).	1/4-inch maximum dimension; minimum 6-inch bond between blisters, maximum one per square foot of cell area.
Blisters between liner laps.	1/2-inch maximum dimension; maximum of five in any 5 lineal feet of splice with minimum of 6-inch bond between blisters.

Table 2-2 (Sheet 1 of 4) Acceptable Limits of Defects - Bladder-Type Cells

INTERIOR INSPECTION (Cont'd)	
CONDITION	LIMIT
Channels in liner laps.	1/4-inch by 3-inch maximum dimensions with maximum of one in any 5 lineal feet of lap.
Weather ozone checking on fabric inner-liners.	Not acceptable.
Channels around entire outer edge of fitting flange.	1/4-inch maximum width around fitting flange.
Buffing through inner-liner.	Not acceptable.
Exposed fabric.	Acceptable unless cell undergoing other repair.
Delamination between plies.	1-inch maximum dimensions one per 5 square feet of area, minimum 6-inch solid bond between delaminations.
Broken stiffeners or supports.	Not acceptable.
Cuts or holes in inner liners.	Not acceptable.
Skin coat blisters.	Acceptable.
Lap splice edge looseness.	1/4-inch by 4-inch maximum dimension; one per 5 square feet of area, minimum 6-inch solid bond between delaminations.
Loose or damaged hangar straps or hangar attaching points.	Acceptable up to 20% of component area provided 1/4-inch solid bond is maintained around edge.
Loose tapes, corner patches or other outside non-load-carrying accessories.	1/2-inch maximum allowable looseness provided it does not exceed 20% of total area.
Skim coat off outer ply.	Acceptable if cords or fabrics are not cut or broken.
Mislocated, blistered split, or weather checked tape.	Acceptable; mission tape to be replaced.
Blisters or looseness between labels or decals and body of cell.	Acceptable.
Weather checked or surface imperfections in outer ply or reinforcements.	Acceptable if fabric not damaged or broken.

Table 2-2 (Sheet 2 of 4) Acceptable Limits of Defects - Bladder-Type Cells

INTERIOR INSPECTION (Cont'd)	
CONDITION	LIMIT
Blistered, loose or missing lacquer coating.	Acceptable.
Blisters between fitting flange and adjacent ply.	1/2-inch maximum dimension; maximum of two per lineal foot and two per fitting provided 1-inch bond is maintained.
Delamination between plies.	1-inch maximum dimension; one per 5 square feet of area with maximum of five in any 5-foot area; minimum 6-inch solid bond between delaminations.
Damaged grommets in accessories.	Acceptable if serviceability is not affected.
Blisters between outer ply laps.	1/2-inch width by 1-inch length maximum dimension; one per 5 lineal feet of splice with maximum of five in any 5-foot length of splice.
Blisters between plies (in cell panels).	1-inch maximum dimension; minimum of 6-inch bond between blisters and no more than one per square foot of cell area.
Channels in outer ply laps.	Half length of channel provided one-inch bond at outer edge.
Channels around entire edge of fitting flange.	1/4-inch maximum width around fitting flange.
Looseness around outer fitting flange.	1/4-inch maximum around fitting flange if 1-inch bond is maintained.
Damage through any cord or fabric ply.	Not acceptable.

RUBBER FACE FITTINGS	
CONDITIONS	LIMIT
Gouges, splits or indentations on sealing surface.	Maximum of 1/16-inch depth by 1/8-inch length.
Weather ozone checking of surfaces other than sealing surface.	Acceptable.
Weather ozone checking of sealing surface.	Not acceptable.

Table 2-2 (Sheet 3 of 4) Acceptable Limits of Defects - Bladder-Type Cells

SEALING SURFACE WITHOUT O-RING GROOVE	
CONDITION	LIMIT
Scratches within sealing area.	Not acceptable.
Burrs on mating surface.	Not acceptable.
Corrosion or rust.	Not acceptable.
SEALING SURFACE WITH O-RING GROOVE	
CONDITION	LIMIT
Minor surface damage outside O-ring groove other than rust, corrosion or burrs.	Acceptable.
Physical damage to O-ring groove.	Not acceptable.
Corrosion or rust.	Not acceptable.
Cement or other foreign matter in O-ring groove.	Not acceptable.
Bent or broken fittings or damaged dome nuts.	Not acceptable.
Elongated or torn holes in fitting of cells using U.S. Rubber removable two-piece metal compression fittings.	Acceptable if elongation or tear does not extend beyond outer or inner sealing groove of inner ring or over half distance to next hole; minimum of 3 holes in row with these conditions.
Thread-damaged fittings.	Acceptable if serviceability not affected.

Table 2-2 (Sheet 4 of 4) Acceptable Limits of Defects - Bladder-Type Cells

TYPICAL REPAIRS

SELF-SEALING CELLS

Interior Surface Injury

39 Repair an inside closed hole or slit-type injury less than two inches long (which does not extend through the barrier and with no material displacement) as follows:-

(a) Outline an area two inches in all directions from the injury with marker (Item 29).

(b) Prepare a patch to extend 1-1/2 inches in all directions from the edge of the injury using nylon sandwich material, for rubber (Buna) inner-liner; or from nylon fabric sandwich material for cells with fabric liners.

Exterior Surface Injury

40 Repair an outside closed hole or slit-type injury less then two inches long (extending through outer ply only) as follows:-

(a) The cell shall be supported around the injury so that the edges of the injury can be aligned in their natural positions.

(b) Build a trestle or other support inside the cell. (See Figure 2-4). Wooden blocks or boards shall be padded or covered with felt or sponge rubber to protect the liner from damage. The patch material used will be outside fabric.

(c) Prepare one patch to extend 1/2-inch in all directions from the injury, using the

same type of material as that being repaired. This patch shall be buffed and feather-edged on both sides. A second patch shall extend 2-1/2 inches in all directions from the injury. (Refer to 'Patching').

(d) Apply two coats of Buna Vinylite lacquer (Item 17) to the patch and buffed area allowing sufficient drying time between coats. Alternatively, cement may be used but care must be taken not to apply cement to an unbuffed area, as this will eventually flake, and could clog fuel filter screens.

41 When repairing a self-sealing cell with a closed hole or split-type injury of over two inches, mark and buff an area three inches in all directions from the injury.

Blister Repair

42 An inner-liner blister is caused by trapped air between the liner and the barrier and is often mistaken for ply separation, which is the loss of adhesion between successive layers. Blisters under 1/2-square inch are not injurious and need not be repaired; however, if two or more are found within a six-square inch area, repair as follows:-

(a) Buff the surface of the blister and an area extending two inches in all directions from its edge.

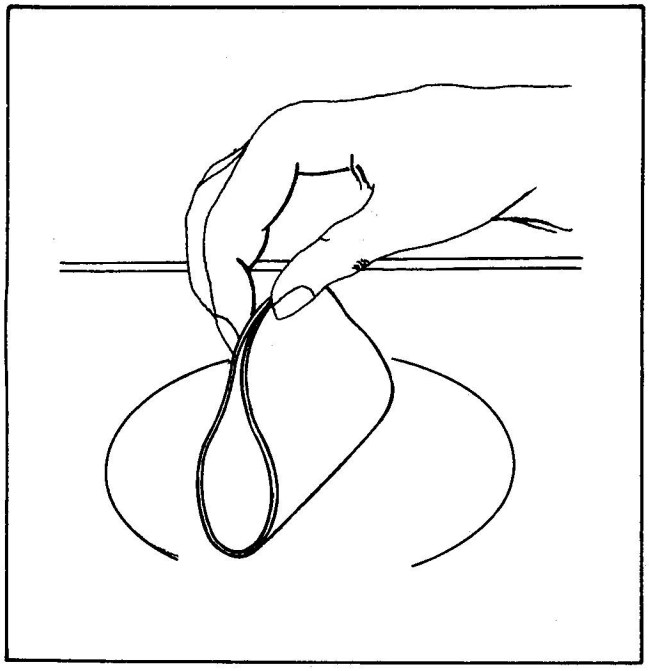


Figure 2-5 Centreing a Patch

(b) Slit the blister with a knife from end to end and buff the underside of the loose edges by hand. The slit shall be cut to resemble two "Y's" placed end to end. (see Figure 2-6)

(c) Apply three coats of general purpose cement to the inside surfaces, letting each coat dry thoroughly.

(d) Reactivate the cement with MIK Solvent (Item 10) and roll down the blister to remove all trapped air; allow to dry thoroughly.

(e) Apply a patch of Buna nylon sandwich material (for a bladder cell with a fabric liner) extending 1-1/2 inches in all directions from the edges of the blister.

(f) Complete the repair as for an inside injury.

Loose Seams and Patches (Outer Edge)

43 Loose lap seams on the inside of a cell shall be repaired as follows as soon as they are noticed, to prevent the looseness from spreading to the sealant:-

(a) Buff an area on top of the seam two inches in all directions from the edges of the loose seams, continuing the measurement to the cell wall if necessary.

(b) Clean the area inside the separation with a lint-free cheesecloth pad moistened with the solvent (Item 9); let the area dry.

(c) Apply three coats of cement, (Item 30) allowing it to dry thoroughly between coats.

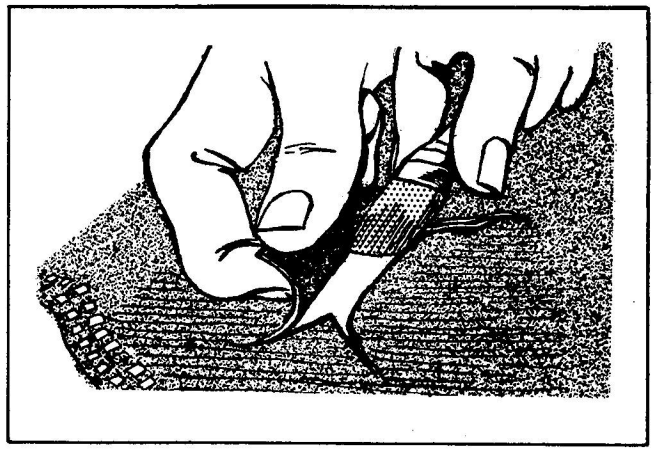


Figure 2-6 Cementing a Blister

(d) Wipe the cemented area with lint-free cheesecloth moistened with solvent to obtain a tacky condition.

(e) Firmly roll down the loose seams to remove trapped air and let the seal dry before proceeding.

(f) Using Buna-N sandwich material or nylon fabric sandwich material extending 1-1/2 inches in all directions from the edge of the loose seams, round the corners slightly and bevel the edge of the patch by tilting the shears instead of cutting straight.

(g) Buff the patch on the side to be cemented to the cell with the beveled side out.

(h) Clean the buffed surface of the patch and cell with the solvent.

(j) Apply the patch and complete the repair in the same manner as for an inside injury.

(k) Apply two coats of cement, to the edges of the patch.

NOTE

Repair loose lap seams on the outside of the cell in the same manner, except that material comparable to the outside material of the cell shall be used. Loose patches shall be removed and replaced.

Hanger Supports and Straps

44 Many cells require external or internal support hangers to hold the cell in installed position. Some larger cells have straps on the outside for handling and packing convenience. Most fittings are single flange construction and are not difficult to install. When a damaged hanger, strap or fitting is found it shall be replaced as follows:-

(a) To remove hangers having metal insert, cut the fabric away around the insert using the insert as a guide. Hangers without metal insert shall be buffed off or pulled off using solvent. (Item 10). When solvent is used, the repair shall be delayed for 24 hours to allow the area to dry completely.

CAUTION

When buffing off the old fitting flange, do not break the fabric on the cell.

(b) Buff the contact side of the new fitting.

(c) Clean the fitting and an area on the cell which has been buffed 1/2-inch larger than the flange of the new fitting.

(d) Apply three coats of cement, allowing each coat to dry completely. (Item 2)

(e) Activate both cemented surfaces with lint-free cheesecloth pads moistened in the solvent.

(f) When the surface is properly tacky, place a hanger directly over the old hanger location and roll down firmly with roller.

(g) Prepare a cover patch that extends one inch beyond the fitting flange.

(h) Cut out the centre of the patch and allow one inch to overlap the fitting flange.

(j) Buff the inside of the patch and the area to which it is to be joined.

(k) Clean the area and apply three coats of cement (Item 2) to both surfaces, allowing each coat to dry completely.

(m) Activate both surfaces; place in position, and roll down.

(n) After the cement has dried, apply two coats of cement to the entire buffed surface.

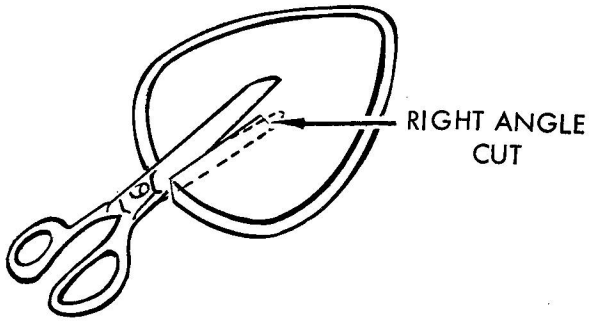
CAUTION

Care shall be taken not to cement area that has not been buffed. Cement applied to areas not buffed will crack and peel off, clogging fuel screens of the fuel system.

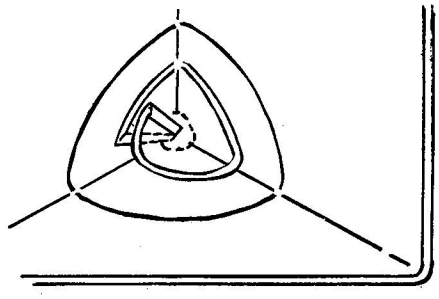
Inside Corner Repairs

45 All inside corner repairs require a two-layer patch. To prevent wrinkling or stretching the repair material, these patches shall be cone-shaped and shall fit accurately into the corner. (Figure 2-7.) Proceed as follows:-

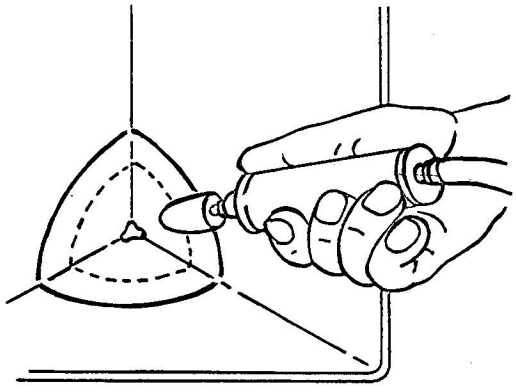
(a) Buff the area around the injury for two inches in all directions from the edge of the



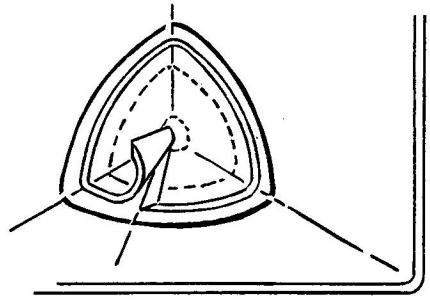
BEVEL CUTTING (SKIVING) CORNER PATCH



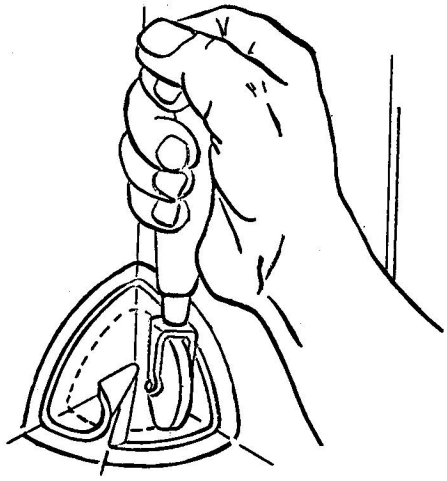
APPLYING FIRST PATCH



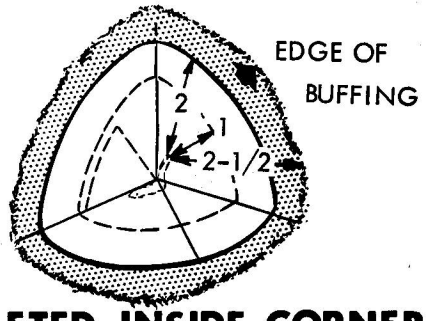
BUFFING



APPLYING SECOND PATCH



ROLLING PATCH



COMPLETED INSIDE CORNER REPAIR

Figure 2-7 Inside Corner Repair Procedure

injury in the same way as when repairing a flat surface.

(b) Cut a patch of Buna nylon sandwich material (Item 4) large enough to extend 1/2 inch in all directions from the edge of the injury.

(c) Cut a single bevel in the patch running from the outside edge to the apex of the corner. At the end of the slit in the centre of the patch make a second slit 1/8-inch long at a right angel to the first slit.

(d) Before any cement is applied, fit the patch carefully into the corner. Trim it to size and place the slit so that the lap will form itself to the flat surface of the cell.

(e) Mark the outline of the patch on the cell with the patch in place, indicating the location of the slit so that the patch can be returned to the same position after cementing.

(f) Buff patch on both sides and feather-edge before cementing. Buff top side of overlapped patch at the slit; clean and cement.

(g) Apply three coats of cement, (Item 2), to the buffed area of the cell and the inside of the patch.

(h) When the third coat is completely dry, wipe with a lint-free cheesecloth pad moistened in solvent (Item 10). When tacky, the patch shall be aligned with the outline previously drawn on the cell. Press down a narrow strip of the patch running from the outer edge to the corner of the slit. Place the patch so that it accurately matches its outline and so that the inner end of the slit actually falls in the apex of the corner.

(j) Work the patch down with a hand roller. Start rolling from the edge of the slit which has already been stuck down and work around the patch to the outer edge of the slit. Be extremely careful to avoid any wrinkles or trapped air. If rolling is too awkward the patch may be applied with a rolling motion of the finger.

(k) After patch has been rolled down, apply three coats of cement to the flat surfaces forming the lap; allow each coat to dry thoroughly before applying the next coat.

(m) When the third coat is dry, moisten the area with a lint-free cheesecloth pad moistened with solvent and roll down the lap.

NOTE

Be sure that all edges are rolled down securely. If some do not stick, wipe the loose places with a clean, lint-free cheesecloth pad moistened with the solvent. If loose edges are found after two hours dry time, apply another thin coat of cement. Allow to dry and roll again after it has been remoistened with the solvent. If the patch is still loose at any place, it shall be removed and scrapped, the cell cleaned of cement and the repair restarted.

(n) After the first patch has been carefully examined and found to be smooth and tight, apply a second patch of Buna nylon sandwich material (Item 4) large enough to overlap the first patch by one inch. Apply the second patch in the same manner as the first after it has been fitted to the corner by making a slit and overlapping. Locate the overlap on the second patch opposite that of the first patch.

Outside Corner Repairs

46 Outside corner repairs are made in approximately the same manner as inside corner repairs. Patches are cut from outside repair material (Item 3) similar to the outer ply construction and are applied by the same method as outside patches for slit-type injuries on a flat surface. The lap on the outside corner patch shall be covered by an extra strip of repair fabric extending 1/2-inch on each side of the lap from the apex of the corner to the outer edge of the patch.

Repairing Separations of Over Three Square Inches

47 Sealant separation or swelling is caused by fuel coming into contact with the sealant, and will sometimes split or rupture the inner liner. Repair as follows:-

(a) After the damaged area has dried for 72 hours, trim the plies allowing a 2-inch step or lap of each ply. If all plies were damaged and removed, start the repair by applying to

the outside, a patch of fabric material (of the same weight as that of which the cell was manufactured) large enough to extend four inches in all directions from the edge of the cutaway section.

(b) Centre the patch over the section; outline an area 1/2-inch larger in all directions than the outside patch; buff the patch and the outlined area on the cell.

(c) Clean the area and the patch with lint-free cheesecloth and solvent. (Item 10)

(d) Apply three coats of cement, (Item 2), to the area and the patch, and allow each coat to dry thoroughly.

(e) Before the patch is applied, wipe with a clean, lint-free cheesecloth pad moistened in solvent.

CAUTION

Do not apply a patch before cement has reached proper stage of tackiness, as air bubbles or blisters will form under patch while drying. When cement reaches proper drying stage, there will be no skidding or sliding of the patch.

(f) When the cement areas are tacky, centre the patch within the marking lines and roll down firmly with a 1/4-inch hand roller. This will require assistance on a large cell, as one operator must enter the cell and back the area being rolled with a sheet of plywood (or other solid backing) with all sharp corners or edges removed.

(g) After the outside patch has dried for 24 hours, complete the repair from inside the cell. Make a patch of repair fabric to fit the first inside step area of the repair and buff both sides.

(h) Apply three coats of cement to one side to the patch and to the inside of the cell.

(j) When cement reaches a tacky condition, install the patch by holding two edges together, centreing the patch, and rolling it into place, starting in the centre and rolling outwards.

(k) After the fabric ply has been installed and checked to make sure that there is no trapped air, cut the next ply of gum sealant to fit as close as possible to the area in which it is to be applied.

(m) Remove gloss from both sides of the uncured sealant by using 120-grit sandpaper (Item 8) by hand. Care shall be taken in cleaning the sealant and only a minimum amount of solvent shall be used, as solvent will cause the sealant to swell.

(n) Apply three coats of cement, (Item 2), to both the sealant and the area in which it is to be applied. Care shall also be taken in rolling this ply into place, because the sealant will cut easily under the pressure of the rollers.

(p) Cut the next ply from outside fabric repair material; buff both sides and clean; apply three coats of cement, (Item 2), and roll down in position after the cement has reached its proper tackiness.

(q) Cut next ply of sealant gum; prepare and apply in the same way as the first ply of sealant gum.

(r) The application of the second ply of sealant gum should bring the repair up to the level of the outer ply. If additional thickness is needed to obtain this required level, use .055-inch gauge or 0.110-inch gauge, sealant gum.

(s) After reaching the required level, prepare a patch of Buna nylon sandwich material cured on both sides. The patch shall be cut large enough to extend two inches in all directions beyond the cutaway area. This patch shall be buffed and feather-edged on both sides to prevent air becoming trapped at step-off area when the cover patch is applied.

(t) After the patch is buffed and cleaned, apply three coats of cement to the cell and patch. Allow to dry until tacky.

(u) Centre the patch on the repair and roll down.

(v) When the nylon sandwich patch has been completely installed, all air bubbles removed, and edges rolled down, make a cover patch from Buna nylon sandwich material, to extend three inches beyond the first inside patch.

(w) Buff the inside of patch and bevel the patch on the outside edge.

(x) Apply three coats of cement to both the patch and the area. Allow both areas to dry until tacky.

(y) Roll the patch down and apply two coats of cement around the edges of the patch.

(z) Keep the cell in the position in which it was repaired for 48 hours before any flexing is allowed. Repair may then be flexed normally to permit inspection for air bubbles.

Repairing Separation that Extends into Fitting Area

48 A separation that extends into and under a fitting flange shall be repaired in the same way as an inside repair with the following exceptions:-

(a) Outline the fitting by marking lines long enough to extend beyond the repair area; cut out the fittings.

(b) When installing an outside cover patch, the patch shall be cut to a shape and size large enough to extend completely around and three inches in all directions from the throat of the fitting.

(c) After the repair has been completed, install the fitting as instructed in Paragraph 51.

Reinforcing Wrap for Tubular Fittings

CAUTION

Do not wrap a fitting if the weather-cracks penetrate beyond 50 percent of the depth of the stock. Fittings that are weather-cracked to this extent must be replaced. When wrapping a fitting that is weather-cracked less than 50 percent of depth of the stock, work the cement into the cracks and allow to dry thoroughly.

49 The procedure for wrapping fittings is as follows:-

(a) Remove any existing fabric wrapping from the fittings.

(b) Determine the extent to which fitting surface is to be wrapped. Include as much of the tubular portion as possible and, in one-piece fitting, extend the fingers two inches along the flat surface of the cell itself, Figure 2-8.

(c) Make a paper template of the stock required, allowing a 1/4-inch overlap.

(d) Cut a wrap of outside repair stock (Item 3) to the above template.

(e) Buff the surface of the fitting to be wrapped. This should be done carefully with 40 or 80-grit emery cloth (Item 11). Do not use a power buffer, as fittings are easily damaged and difficult to procure and replace.

(f) Apply two coats of cement (Item 2) to the surface, allowing adequate drying time between coats.

(g) Buff and cement fabric wrap in the same manner as in preparing an outside patch.

(h) Apply fabric wrap carefully to the fitting, sticking securely and overlapping 1/4-inch at adjoining surfaces. A mandrel the same size as the inside diameter of the tubular fitting may be inserted to facilitate sticking.

(j) After one-piece fittings have been wrapped, cover the fingers with a reinforcing

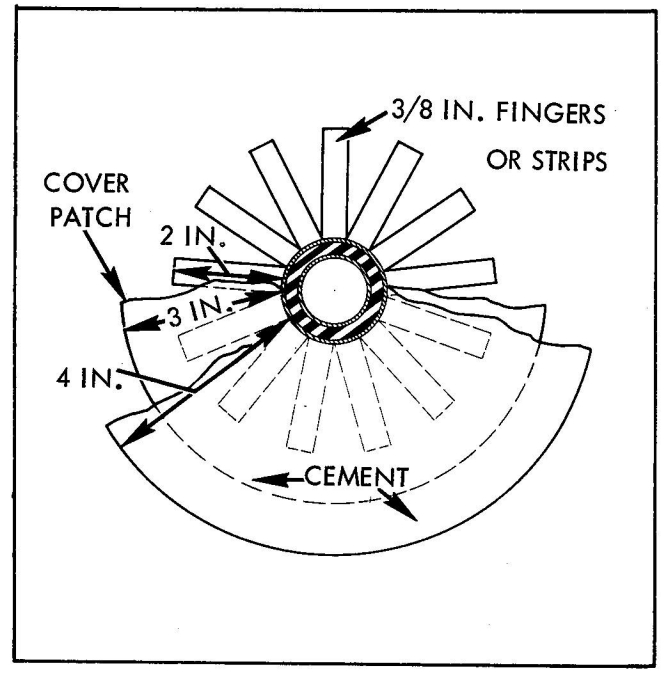


Figure 2-8 Application of Wrap

patch (Item 4). Cut this cover patch so that the inside diameter is the same as the outside diameter of the base of the fitting, and the outside diameter extends one inch beyond the fingers of the wrap.

Removing Fittings

50 Proceed as follows:-

(a) Locate and mark the old fitting accurately by measuring from selected points of the cell, so that the new fitting can be centred in exactly the same position. Marks from crayon or chalk, are generally too wide to be accurate.

(b) When replacing one-piece fittings with those of the two-piece type, it may be necessary to relocate the fitting opening in the cell, due to variations between the two types. Whenever possible, use replacement fittings of the same type as the fitting removed from the cell. Relocation of fitting openings should only be attempted where an alternative repair is not possible.

(c) If there is a finishing collar covering the fitting flange on the outside of the cell, loosen the cement under the collar with solvent (Item 10) and strip off the collar with a pair of pliers.

(d) Strip the outside flange from its edge back to the centre of the fitting, taking care to avoid injury to the outside ply of the cell material.

(e) After the outside flange has been stripped back, cut off the fitting and flange flush with the outside surface of the cell. Cut out the core of the fitting to the edge of the cell wall, but avoid cutting the cell or enlarging the original opening (Figure 2-9).

Installing Fittings

51 To install new fittings proceed as follows:-

(a) Using a sand wheel or emery buffer, remove enough of the inside flange of the old fitting and the covering ply to reduce the thickness of the cell wall so that it will fit between the flanges of the new fitting.

(b) Buff the inside and outside surfaces of the cell where flanges of the new fitting are to be placed. This buffing must cover an area extending 2-1/2 inches beyond the edge of the flanges when the new fitting is set in place.

(c) If the new fitting has not been buffed, buff the surfaces inside and outside both flanges, avoiding deep cuts in the material.

(d) If the cell wall does not have sufficient thickness to fit the space between the flanges of the new fitting, apply a patch of inside repair material to the inside of the cell in the same manner as in applying an inside patch. This patch must be large enough to extend 1/2-inch beyond the area to be covered by the fitting flange, and the centre must be cut out to match the throat of the fitting.

(e) Before the patch is applied, buff the outside surface and feather the edge.

(f) Before inserting the fitting through the opening, check the size and shape carefully, using a pair of calipers. Make cutout opening to conform exactly with the size and shape of the throat of the fitting. When making replacement of the same fitting, a plug or template can be used to advantage.

(g) Moisten the surfaces of the fitting with solvent and force the fitting through the opening of the cell, pulling the top flange through from the inside of the cell.

(h) Check the fit of the new fitting in the cell opening. If the opening is too small, buff until the new fitting fits satisfactorily. If the opening is too large, fill the excess area with sufficient sealant (Item 7) to assure a perfect fit. After making sure the fit is satisfactory, remove the fitting from the cell.

(j) Apply two coats of cement (Item 2) to the inside of the fitting flanges and the buffed area of the cell wall, allowing each coat to dry thoroughly.

(k) Insert the fitting in the opening of the fuel cell, pulling the top flange through hole from inside the cell. Line up the fitting carefully so that its location is exactly the same as that of the old fitting.

(m) Re-activate the cement on the inside

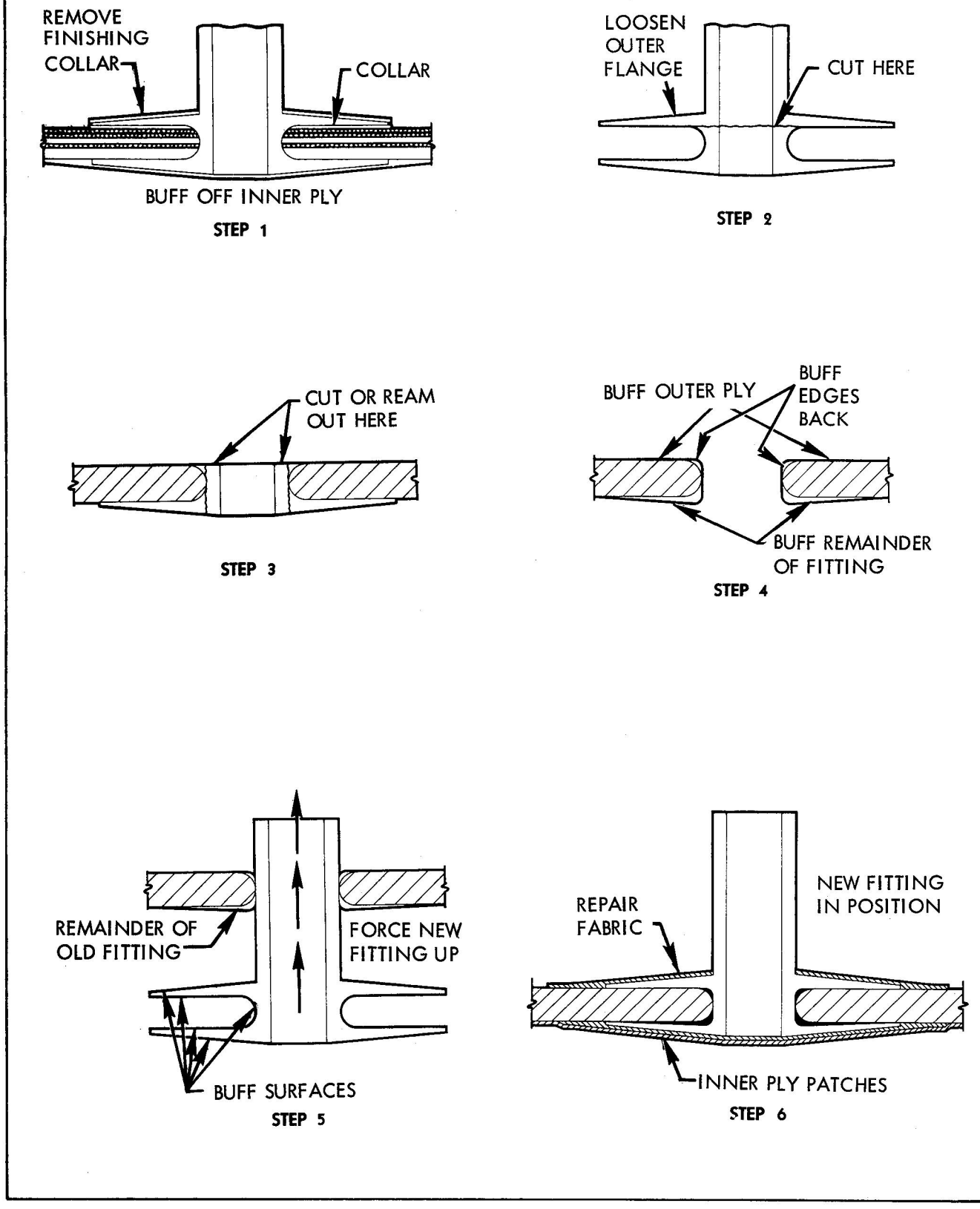


Figure 2-9 Replacement of Fitting

fitting flange with solvent (Item 10), using lintless material, preferably sponge. Stick the flange to the cell wall. Let inside flange dry approximately thirty minutes before working the outside flange.

(n) Use the same procedure on the outside flange as outlined above for the inside flange, ensuring that the cement on the throat of the fitting is re-activated.

Application Of Cover Patches

52 Apply cover patches over fitting flanges as follows:-

(a) Apply two patches (Item 6) over each inside flange after the cement holding the fitting has dried thoroughly, (approximately 45 minutes). Cut the first patch one inch larger in all directions than the fitting flange, buff the cured surface, and feather the edge. Cut an opening in the centre of the same shape as the opening in the fitting but 1/8-inch larger in all directions.

(b) Cut the second patch one inch larger in all directions than the first patch. The opening in this patch is cut 1/4-inch larger than the opening in the fitting. Cut and buff all patches at one time.

(c) Cement and apply patches. Centre the opening carefully so that two steps of equal width are formed. After the patches have cured approximately two hours, use a power buffer to blend the edge of the patches so that there will be no irregular surface which would be attacked by fuel.

(d) Use only one patch (Item 6) on the outside of the fitting. Cut this patch two inches larger in all directions than the fitting flange. Cut the centre to the correct size and shape to accommodate the fitting. A patch applied to a protruding or barrel-type fitting must fit snugly around the base of the fitting barrel. A patch applied to a metal insert fitting may have an opening 1/2-inch larger in all directions than the gasket or compression surface of the fitting.

53 The fitting replacement procedure described above may not be practicable with all replacements. In some cases it may be more convenient to insert the fitting from the outside of the cell, and the following points must be observed:-

(a) Outside patch on metal insert fittings must not interfere with gasket or compression surface.

(b) Feather the edge of first patch on inside.

(c) Fill in any void between cutout opening of cell and fitting throat with strips of sealant.

(d) Make sure fitting is in proper position before sticking and applying patches. Fittings are to be wrapped after installation. Wrapping to two-piece fittings will terminate 3/8-inch from the tube base.

Repair Of Fully Moulded Fittings

54 Vulcanizing of moulded fittings is not to be attempted in the field. If circumstances warrant, a damaged vulcanized fitting can be replaced by a new fitting (or an identical fitting removed from an otherwise condemned cell) as follows:-

(a) Mark and cut out an area including the damaged fitting to match the insertion. Prepare a patch of internal repair material to fit an overlap the insertion by two inches and feather the edges.

(b) Clean the internal and insertion patches, apply three coats of cement and allow to dry.

(c) Activate the cemented surfaces with solvent and stick together, allowing normal drying time before proceding further.

(d) Buff and clean the interior of the cell for an area 3-1/2 inches around the hole and coat with three applications of cement allowing each to dry thoroughly.

(e) Activate the cement on the extending patch of the insertion with solvent (Item 10) and roll down on to the interior surface: Proceed with the repair in the same manner as for a built up repair.

Repairing Hole-Type Injury Less Than Three Inches In Diameter (Build-Up Repair)

55 Support inside the cell under the area to

be repaired. Wooden blocks and boards used inside cells shall be padded or covered with felt or sponge rubber to protect the liner from damage. Proceed as follows:-

(a) Mark two circles around the injury on the outside of the cell wall with a silver pencil. Draw the inside circle large enough to include all damaged sealant and ragged edges, but not smaller than three inches in diameter; draw the outer circle on a one inch larger radius (see Figure 2-10.)

(b) Buff an area on the cell extending from the outside circle outward for a 2-1/2-inch larger radius and re-mark the outside circle.

(c) Using the inside circle as a guide, cut away the cell material with a knife blade held at a right angle to the cell wall. Then bevel-cut the edge of the hole, using the larger circle as one guide and the edge of the liner in the hole as another. This will result in a shallow bevel of about 30 degrees, providing an efficient adhesion surface.

(d) Buff the inner liner for 4-1/2 inches away from the edge of the hole.

(e) Make a patch of Buna nylon sandwich material (Item 6) three inches larger than the diameter of the hole. Make a second patch of repair Buna material to overlap the first patch 1-1/2 inches.

(f) Feather-edge the first patch and buff both sides.

(g) Apply cement (Item 1) to the inner liner of the cell and the first patch.

(h) When proper tackiness is obtained, centre the patch over the injury and roll down.

(j) Prepare the second patch and, when the first patch is dry, apply three coats of cement to the areas and the patch. When the cement is properly tacky, centre the patch and roll down. When the cement is dry, check for air bubbles and apply two coats of cement to the edges of the patch.

NOTE

If injury is in an awkward location, making patches impossible to roll down, repair shall be abandoned and cell condemned.

Laying And Rolling Sealant

56 Proceed as follows:-

(a) Cut as many patches of sealant (Item 7) as there are layers of sealant in the injured area one inch larger in diameter than the diameter of the cut-out in the cell. Use sealant material comparable in thickness to the material in the area of the injury.

(b) Coat each surface with three coats of cement, (Item 2) on both sides of the sealant for adhesion, and let them dry to tacky consistency.

(c) Apply each layer separately rolling down thoroughly. Care shall be taken not to cut the sealant with the roller.

(d) After the repair has dried, carefully trim the excess sealant to a line flush with the outside of the cell. (see Figure 2-10.)

(e) Apply an outside retainer or cover patch in the same manner as detailed for a 'Build-up' repair, except that outside material fabric shall be used.

Repairing Weather-Ozone Checked Inner Liners

57 Self-sealing fuel cells having inner liners with weather-ozone checking which does not exceed five percent of the total surface of the cell, shall be repaired as follows:-

(a) Mark an area one-inch larger in all directions from the checking with a silver pencil.

NOTE

Make sure cell liner is completely dry. Any fuel trapped in checked liner will cause patch to have poor adhesion.

(b) Make a patch of Buna-N sandwich material (Item 6) to extend 1/2-inch in all directions from the checked area.

(c) Buff the patch and the area. When using a power buffer, buff very lightly to keep the liner from burning and never buff the liner to the barrier.

(d) Clean the patch and the area with clean, lint-free cheesecloth moistened in solvent (Item 9).

(e) Apply three coats of cement (Item 2) to the patch and the area. The first coat shall be applied with a stiff bristle brush, working with a circular motion so that the cement may be worked into the checks. Each coat of cement shall dry completely before the next is applied. Activate both surfaces; place the patch in position and roll down.

(f) After the cement has dried and been checked for looseness (see Inspection of Repair) apply two coats to the outer edge of the patch.

BLADDER TYPE CELLS (NON SELF-SEALING)

58 Non self-sealing, bladder type fuel cells are of lightweight construction comprising one or two layers of square-woven rubberized fabric outside, a nylon film barrier, and an inside layer of Buna-N synthetic rubber.

59 Repair patches should be of the same material as the injured surface, however, Buna nylon sandwich and a fabric cover patch may be used as an alternative internal repair material for fabric lined cells.

60 Repairs to bladder-type cells are made by air-cure methods similar to that used for self-sealing cells (disregarding references to sealant layers).

(a) Injuries through the cell over two inches in length require a double patch. The double patch may be prepared on a work bench and installed in the fuel cell in one operation rather than by a separate ply build-up. This method simplifies application technique and is preferred for flat surface repairs.

(b) Buff inner liner of the fuel cell 2-3/4 inches in all directions from the edge of the injury.

Repair of Moulded Fittings

61 Moulded rubber fittings shall be repaired in the same way and with the same material as detailed for Self-Sealing Cells. Repair lightweight fabric flange fittings as follows:-

(a) Buff the injured area by hand, being careful not to buff through the fabric cords.

(b) Clean the buffed area with solvent (Item 9).

(c) Apply three coats of cement (Item 2).

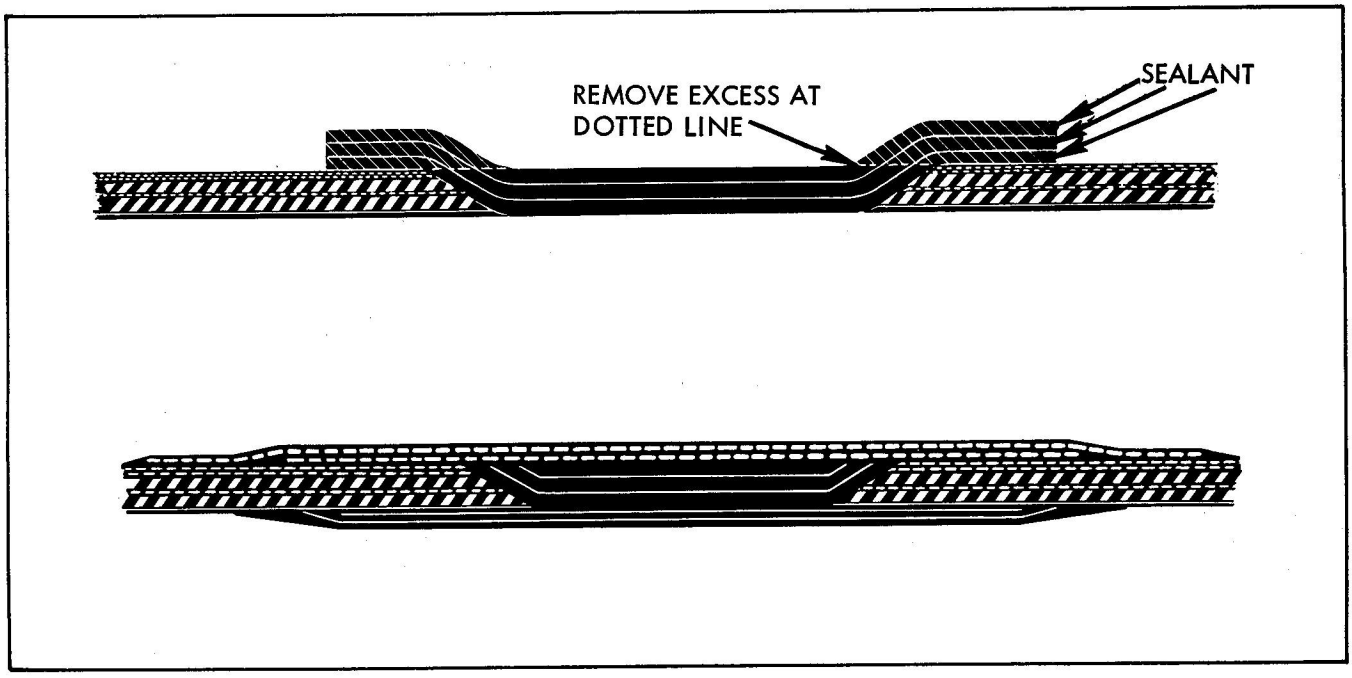


Figure 2-10 Build-up Repair

(d) When dry, roll-in uncured Buna-N stock, to which three coats of adhesive have been applied. Add enough Buna-N sheets to the injured area to bring the thickness of the repaired area up to that of the rest of the fitting after curing has been completed.

Replacement of Fittings

62 Replacement of fittings on bladder type cells is not satisfactory and will not normally be attempted.

OIL CELLS

63 These cells are of lightweight construction, composed of one layer of rubberized fabric outside and one layer of Buna-N synthetic rubber inside, with no nylon barriers. Repair in the same manner as bladder cells.

WATER-ALCOHOL CELLS

64 Water-alcohol cells are constructed and repaired in the same manner as bladder cells.

'PLIOCEL' (NYLON) FUEL CELLS

65 Pliocel fuel cells differ in construction and material from Buna-N rubber cells, and are identified by the Goodyear trade name 'Pliocel' stenciled on the cell. Pliocel construction is of two nylon woven fabric layers laminated with three layers of transparent nylon film, and is not self-sealing.

66 Repairs to injuries not exceeding 2 inches in length may be undertaken at local level. Repairs in excess of this limit are permissable with approval of Engineering Authority only.

Repair of Injuries Less Than Two Inches Long

67 Repair, tears, holes and cuts less than two inches long with like material (Item 22) applied to the inside of the cell in the following manner:-

(a) Clean the repair area with a cloth moistened with Methyl Ethyl Ketone (Item 9) or Acetone (Item 21) to remove any residual matter left by the fuel.

(b) Trim the damaged area with scissors or knife to remove rough edges or irregularities. Round the corners.

(c) Cut a patch of repair material (Item 22) to sufficient size and shape extending 3/4-inch beyond the damaged area in all directions.

(d) Wipe the mating surfaces of the patch and the cell with a cloth moistened with ethyl alcohol (Item 47). Excess alcohol is to be squeezed from the cloth beforehand.

(e) Back the damaged area on a suitably shaped smooth block.

(f) Position the patch on the damaged area and cover temporarily with cellophane (Item 23). The cellophane protects the nylon construction from sticking to the iron and, at the same time, permits visibility. (See Figure 2-11.)

(g) Apply heat to approximately two square inches of the repair patch until the cellophane is slightly browned.

CAUTION

Heavy browning is unnecessary and may cause excessive porosity of the repair area. Refer to 'Checking Temperature of Sealing Iron ', following.

(h) Do not press down on the sealing iron. Hold gently and apply a gliding movement rather than pressure. Do not permit the sealing iron to roll beyond the edge of the patch.

(j) Heat applied to the single layer of material will induce porosity. Small blisters will probably appear as the material heats, but these blisters are not harmful.

(k) When the area is properly heated, roll down immediately with cold roller and repeat operation until entire patch is completed.

(m) Do not attempt to heat more than two square inches at a time, as a greater area would cool before it could be rolled down properly with the cold roller. Finished patch must be bonded securely around its entire edge. (See Figure 2-12.)

(n) The cellophane will be easily peeled off if covered for several minutes with a lintless cloth, moistened with water. Wipe repaired area with a dry, clean cloth.

(p) Prepare nylon paint by heating liquid nylon (Items 24 & 25) in a small double boiler or glue pot to a temperature of 65° to 72°C (150° to 160°F). Maintain this temperature throughout the working period. Heat only the amount of nylon required for use each day.

(q) Wipe repair with cloth moistened in ethyl alcohol (Item 47). Apply these coats of nylon to the entire repaired area; the first and third coats of blue nylon, the second coat of yellow nylon. Allow 20 minutes drying time between coats.

(r) Between applications keep the brush either in the liquid nylon or in a container of ethyl alcohol (Item 47). Do not allow nylon to dry on the brush. Clean brushes thoroughly with ethyl alcohol when changing from one material to the other, and at the end of each working period.

Repair of Injuries Two Inches Long or More

68 At the discretion of Engineering Authority, repair injuries of two inches or over in the same manner as detailed for smaller injuries. In addition, apply a patch on the outside of the cell. The outside patch follows the same pattern as the inside patch but is 1/2-inch larger in all directions and is applied after the inside patch. Before beginning outside repair remove the black outer lacquer with solvent (Item 9 or 21). Paint the finished patch with one coat of synthetic rubber cement (Item 26) over the normal three coats of nylon. Mix the cement (Item 26) at a ratio of one fluid ounce of 1408C to 5071C. Mix only the amount which can be used in one day. Do not use any cement which has been left over from the day before.

Repair of Fittings

69 Make fitting repairs basically the same as any other repair. Replacement fitting assemblies as found on self-sealing cells are not required. It may be simpler to replace a small section of cell rather than attempt a repair in such places as a turned end or corner. The replacement section could be cut from a condemned cell if a new part is not available.

70 Repair fabric fitting opening by removing the fabric collars by working a small amount of ethyl alcohol (Item 47) under the edge, lifting the collar until it is removed. Repair tear in cell ply by overlapping and heat sealing a narrow strip of nylon fabric (Item 22). Apply collars to cell and cut holes, using holes in cell fabric.

71 If a pliocel cell is to remain without fuel for a period exceeding seven days, fog the inside of the cell with a solution of equal parts of water and glycerine (Item 27). If spray equipment is not convenient, make the application with a lintless cloth moistened in the solution. Prior to installation of the pliocel cell in the aircraft or before any repair, remove the residual solution with a cloth well moistened with water. Wipe area with a dry clean cloth.

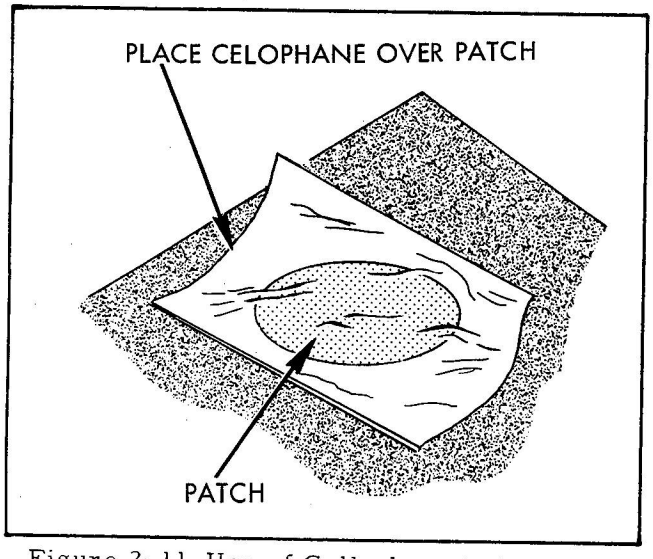


Figure 2-11 Use of Cellophane in Repair of Nylon Cells

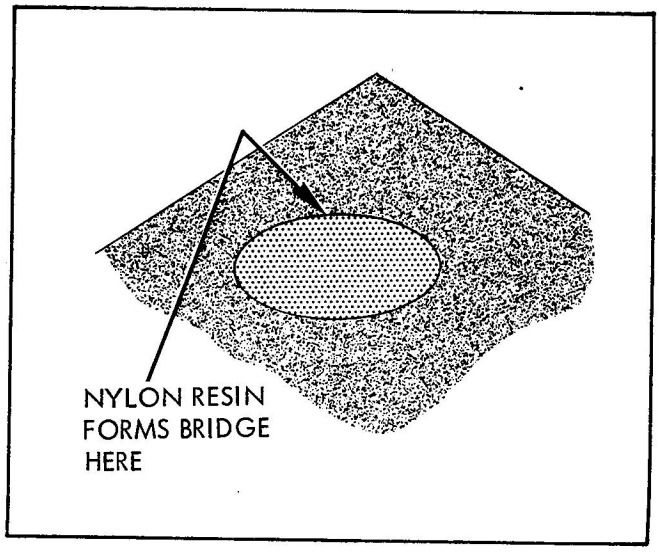


Figure 2-12 Finished Repair of Nylon Cell

Checking Temperature of Sealing Iron

72 Check Sealing Iron Temperature as follows:-

(a) Simulate a repair with pieces of scrap repair fabric (Item 22) and cellophane (Item 23).

(b) Apply heat to approximately two square inches until cellophane is slightly browned.

(c) Roll down with cold roller.

(d) Dampen and remove cellophane.

(e) Pull the sealed pieces apart and note their appearance. If all the nylon film has adhered to one piece of the material and the remaining piece has bared fabric, the temperature of the iron is correct and the seal is satisfactory. If, when applying the iron to fabric, blisters immediately turn dark brown, the iron is too hot and should be allowed to cool before being applied again.

INSPECTION AFTER REPAIR

73 No inspection shall be made on repair patches for 24 hours. After the patch has set without the cell having been moved, check for looseness. After the patch has been accepted as serviceable, seal the edges with two coats of cement, and allow to dry completely.

CAUTION

Air-cure repaired fuel cells for at least 72 hours before refuelling. Use extreme care not to flex repair area for first 24 hours. Do not, under any circumstances, place cell in any type of heating chamber; this will cause cell to deteriorate and shrink beyond safe dimensions.

PART 3
FUEL AND OIL TANKS

REPAIRS OF REMOVABLE TANKS

GENERAL

1 Refer to applicable Engineering Order for specific repairs. Repairs to tanks that are pressurized or subject to structural loads, as in the case of integral tanks, must be governed by all the restrictions affecting a structural part of the aircraft, in addition to being fluid-tight. If the tank has been damaged in a flat or moderately curved section, it may be repaired using a soldered, silver brazed, welded, riveted, or machine screw patch, as applicable.

NOTE

In any tank repairs, the provisions of EO 00-80-4/7 must be adhered to. All patches and doublers must be of the same materials as the tank, and of the same or one gauge heavier material.

2 Clean the damaged area and inspect thoroughly. If the skin is broken, or if it has sustained a dent or scratch sufficiently sharp or deep to require a patch, clean out the damaged area to the smallest round or oval hole. If a doubler is to be used in a tank without access, an oval hole is required.

DENTS

3 Dents can frequently be removed by tapping from inside the tank, by pulling on a piece of soldered-on wire by air pressure or a combination of these. Do not use air pressure unless the proof pressure of the tank is known. Do not exceed. Acceptability limits of sharp corners in dents, scratches and score marks must be assessed individually. As a general rule, scratches and similar defects not deeper than 10% of the skin thickness need only be blended out (not burnished), and given appropriate anti-corrosion treatment. Scratches deeper than this should be filled with silver solder if the tank material is suitable. If the local area appears to have been weakened, it should be brought up to strength with an overlap patch or an inserted doubler.

SKIN BREAKS

4 Soldering is permitted on terneplate, brass, copper and stainless steel. In cases of cracked skin, drill a stop hole (3/32 inch) at each end of the crack and seal the crack with solder. For soldering methods, refer to EO 05-1-3/20. If a break in the skin can be cleaned up to a hole less than two inches in diameter, cut a patch to shape and solder flush. If the tank is pressurized or the cleaned up hole larger than two inches, proceed as follows:-

(a) Stainless steel: Weld in a patch.

(b) Brass or copper: Install a doubler with silver solder.

(c) Terneplate: Install a doubler with rivets or machine screws, then install a plug filler as a soft soldered patch. Use rivets of mild steel, or screws of steel and solder around the heads.

(d) Aluminum alloy tanks: Weld tanks made of 2S or 52S. Repair holes in tanks of the heat-treatable aluminum alloys with doublers and patches of the same alloy and heat treatment as the tank. If this data is unknown, use higher strength material. (Refer to EO 05-1-3/25.) If there is access for rivet bucking, install a riveted patch, (refer to Paragraph 5, following). For rivet selections and spacing, refer to EO 05-1-3/5. If access is not available, use a machine screw patch.

Riveted or Machine Screw Patch

5 The riveted or machine screw patch must be large enough to overlap on all sides at least 5/8 inch. To install the patch, proceed as follows:-

(a) Mark off and drill the tank for rivets or screws. Insert patch through oval-shaped opening or other access, centre patch over repair and mark location of drilled holes on patch. Drill two diametrically opposite holes, relocate and check marking. Drill hole in patch. Use patch as template for nylon thread (Item 43). gasket. Apply between faying surfaces. (see Figure 3-1):-

(b) Re-insert patch over repair and complete repair by riveting, inserting and bucking rivets from inside tank. Seal patch.

INTEGRAL TANKS

GENERAL

6 The most common cause of unserviceability in Integral Tanks is failure of the sealant. Repair procedures outlined in this Engineering Order, are concerned primarily with the detection and repair of the resulting leaks and testing of the repaired tanks. Refer to appropriate aircraft Engineering Orders for instructions for effecting structural repairs to integral tanks.

7 Sealant failure in integral tanks may occur as a result of one or more of the following:-

Blisters

8 Blisters are air bubbles or cleaning solvents trapped in the sealant. Expansion at altitude, flexing of the structure or an extreme increase in temperature can cause rupture of the sealant.

Flexing of Tank Structure

9 Excessive flexing of the tank structure in flight, rough landings, or taxiing too rapidly over rough terrain with a heavy fuel load, can cause ruptures in sealant.

Voids or Omissions in Sealant

10 Leaks will result if sealant is not thoroughly worked into all seam voids especially if particular attention is not paid to areas having difficult access.

Poor Adhesion

11 Sealant applied over dirt, grease, soap film, oil film or moisture will not result in a leak proof joint.

Pinholes in Sealant

12 Brush sealant, not worked thoroughly around each rivet or fastener, may crack as it cures. If accelerator and base compound are not thoroughly blended, fuel will extract any unmixed accelerator from the sealant causing deterioration of the seal. This will occur sooner if the sealant is not cover-coated adequately. Mixing accelerator and base compounds too rapidly can allow air bubbles to form in the sealant, which may break and cause pinhole leaks.

REPAIR OF SEALANT LEAKS

13 Repairs to leaks in the sealant of integral tanks is effected by removing existing sealants in the vicinity of the leak, cleaning the area, applying protective coating to the bared metal surfaces, and re-applying sealant. Particular attention is paid to fasteners (bolts, rivets etc.) faying surfaces and mating faces. A final internal protective coating is provided, either by spray or by rotating the tank. Pressure and vacuum tests determine both the effectiveness of the seal and its bonding to the tank structure. A final coating is applied by brush to the exterior surfaces.

NOTE

In an emergency, integral fuel tanks may be put into service after pressure testing without the application of the coating (Item 49). However, this topcoat must be applied as soon as the schedule permits.

Locating Source of Leak

14 Sources of leaks may be determined by Bubble Method as follows:-

(a) Cover a small area around the suspected leak on the outside of the tank with bubble solution (Item 34).

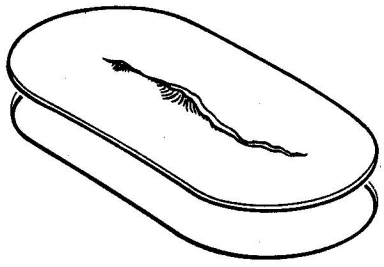
(b) Apply the plain open end of the filtered compressed air line to the inside of the tank, pressing it against the sealant in the area of the suspected leak. Increase the air pressure to a maximum of 100 psi and move the open end of the air line until a positive indication is given on the bubble solution outside the tank.

(c) Mark the position determined on the inside of the tank as accurately as possible.

(d) Remove bubble solution thoroughly by wiping with a clean dry cloth.

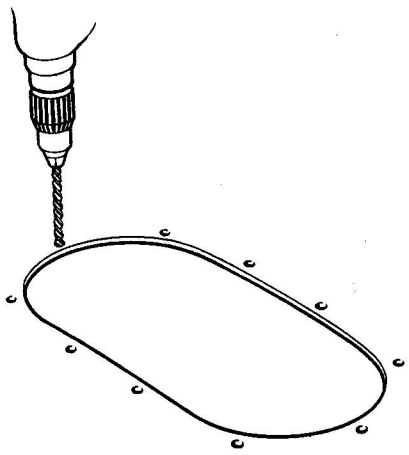
Fluid Blowback Method

15 This procedure is comparable to the



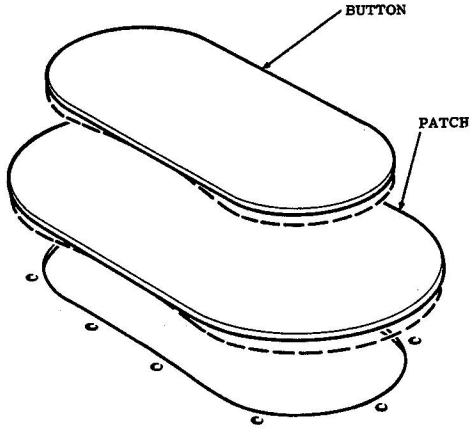
STEP 1

CLEAN OUT DAMAGED AREA TO OVAL SHAPED HOLE. DEBURR AND REMOVE CUTTINGS FROM TANK.



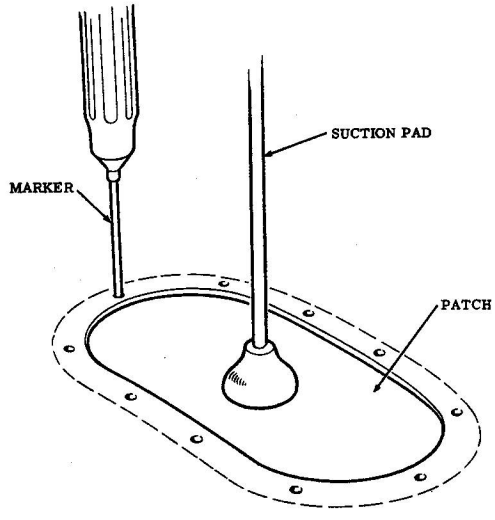
STEP 2

MARK OFF AND DRILL HOLES IN TANK



STEP 3

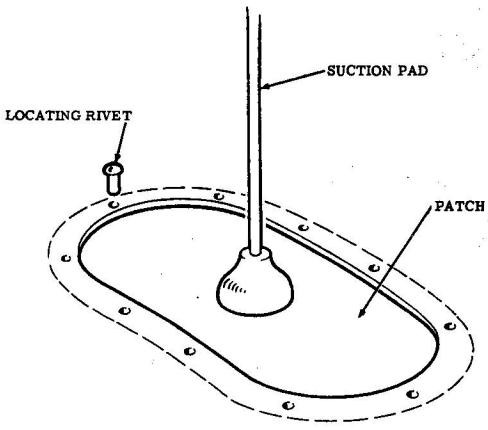
LOCATE PATCH AND BUTTON OVER REPAIR AND FORM TO CONTOUR IF NECESSARY.



STEP 4

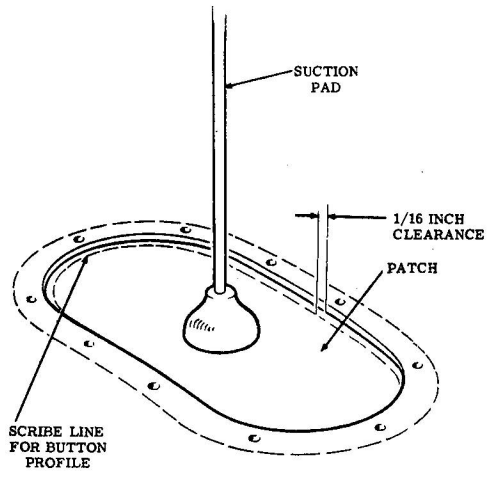
ATTACH HANDLE AND INSERT IN TANK. MARK OFF HOLES ON PATCH.

Figure 3-1 (Sheet 1 of 2) Flush Repair Patch - Reverse Side Inaccessible



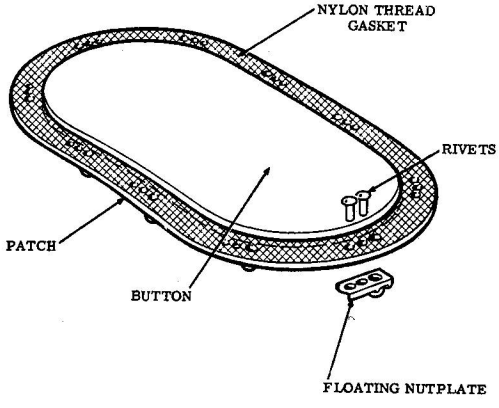
STEP 5

DRILL TWO DIAMETRALLY OPPOSITE HOLES IN PATCH, LOCATE AT REPAIR AND CHECK MARKING OFF. CORRECT AS REQUIRED.



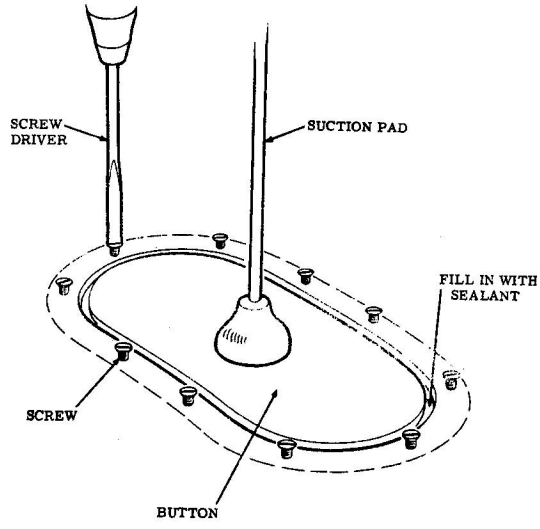
STEP 6

DRILL HOLES IN PATCH. LOCATE TEMPORARILY AND MARK OFF FOR BUTTON. LEAVE 1/16 INCH CLEARANCE ALL AROUND.



STEP 7

ATTACH BUTTON TO PATCH ON OUTSIDE SURFACE. ATTACH NUT-PLATE, FLOATING TYPE ON INNER SURFACE. APPLY NYLON THREAD GASKET ON OUTER SURFACE AND SEALANT ON NUTS ON INNER SURFACE.



STEP 8

INSERT PATCH. DO NOT DISTURB NYLON THREAD GASKET. TIGHTEN SCREWS. APPLY SEALANT TO BUTTON CLEARANCE. REMOVE SURPLUS SEALANT. ALLOW SEALANT TO CURE AND SLUSH TANK WITH EC776.

Figure 3-1 (Sheet 2 of 2) Flush Repair Patch - Reverse Side Inaccessible

Bubble Method. Isopropyl alcohol (Item 38) is applied (10 psi maximum) at the rivet or other leak exit point. A pressure pot, regulating valve and gauge arrangements may be used to apply the alcohol. In using this method, it is unnecessary to use leak detector fluid or soap suds inside the tank, as the leak source is identified when the alcohol emerges inside the tank. (See Figure 3-2.)

Other Leak Detection Methods

16 For particularly difficult leaks the drilled screw method, and the air blowback method, are very effective. (See Figures 3-2 and 3-3.)

17 When it is not possible to detect the source of leak, the following method may be used to seal the leak:-

(a) Drill a No. 40 (.098) hole through the outside thickness of metal at the point of leak. A round-nosed drill should be used so as not to damage the underlying material. The hole

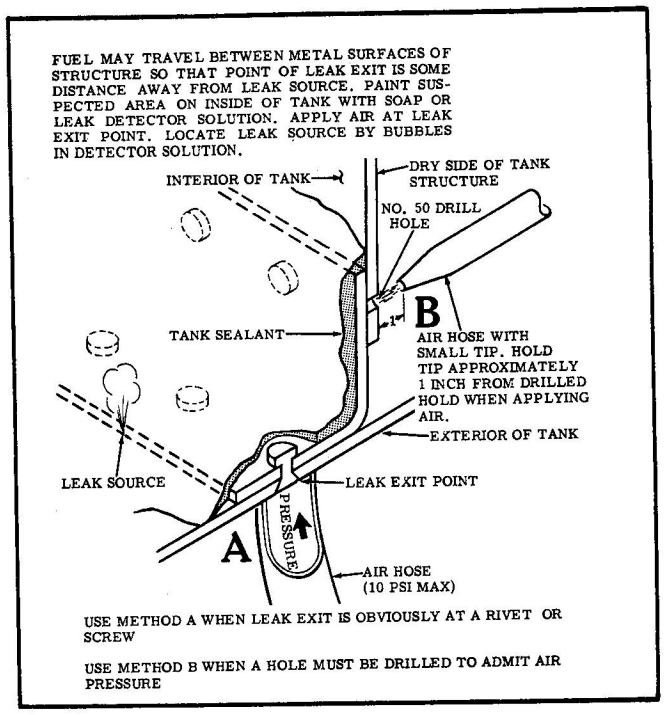


Figure 3-2 Air Blowback Method of Locating Leaks

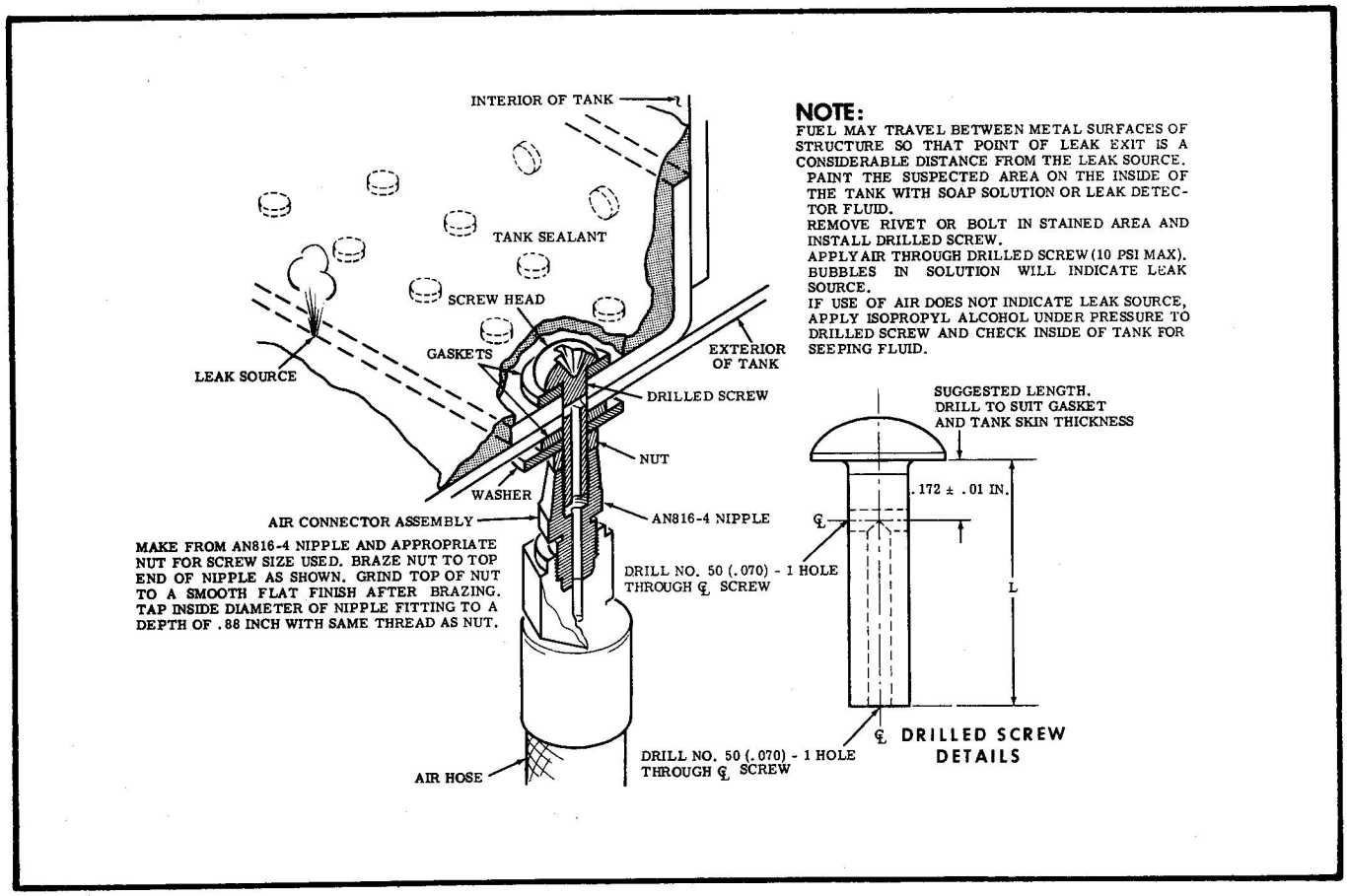


Figure 3-3 Drilled - Screw Method of Locating Leaks

should be drilled equidistant to adjacent rivets and at a minimum of 3/16 inch from the skin edge.

(b) Inject, by means of a pressure gun, sealant (Item 30) into the hole so that the faying surfaces are locally covered. Care should be taken not to inject too much sealant as bulging of the skin may occur. The injection should not be done too rapidly, otherwise the sealant may not spread.

(c) Where it is possible, the injection hole should be plugged by means of a 3/32 inch diameter rivet. Where this cannot be done, the hole may be filled with excess sealant (Item 30).

(d) More than four such repairs in one sub-bay should not be made without specific approval from engineering authority.

Classification of Leaks

18 Careful inspection in a well-lighted area is of prime importance. It is particularly important to inspect carefully for seeps and leaks in confined areas. Care and judgement will ensure that old stains from leaks that have been repaired are not recorded. If there is doubt as to whether a stain actually indicates the presence of a leak, the stain should be wiped off and the area observed for a period of time to see if fuel re-appears.

19 Fuel leaks are classified into four groups:-

(a) Slow seep.

(b) Seep.

(c) Heavy seep.

(d) Running leak.

20 A slow seep is defined as a leak in which fuel wets an area around the leak source not over three-quarters of an inch in diameter. A seep wets an area not over one and one-half inches in diameter. In both cases the fuel will not run, flow, or drip. A heavy seep is a leak in which fuel appears to spread very slowly to cover an area not larger than three inches in diameter, but does not flow, run or drip. A running leak is a leak in which fuel is dripping or running from the structure. This type of leak renders the aircraft unserviceable and requires immediate repair.

21 Strictly observe fuel leak classification when determining the degree of leak and the corrective action necessary. This will help to eliminate the unnecessary repair of leaks during service.

Stripping Sealants

22 Sealants may be stripped as follows:-

(a) If the sealant (Item 30) has a cover coating (Item 49), remove the latter around the repair area by scrubbing with a clean cloth dampened with butyl acetate (Item 33). Apply the cloth to only a small area at a time and wipe off with a clean dry cloth before the butyl acetate dries. Change cloths frequently.

NOTE

In reworking to correct leakage, existing sealant should not be removed nor fresh sealant applied until the source of the leak has been definitely determined. Reworking of sealant to repair leakage should be performed only by authorized personnel.

CAUTION

Rubber gloves must be worn at all times, and a heavy pair is mandatory when using stripper (Item 44). Keep stripper in an air-tight container and store in a cool dry place when not in use.

(b) Cut away as much of the sealant as possible locally around the repair area, using a sharp micarta scraper, (see Figure 3-4). Sealant remover tools may be used in a slow-hitting rivet gun or corner hammer to facilitate initial removal of the sealant. Do not use a tool made of metal. Take care not to scratch the surrounding metal surfaces.

(c) Mask off the area surrounding the scraped sealant with fabric-backed masking tape. Similarly mask any other areas where the ensuing application of stripper may splash or drip.

(d) Apply stripper to the scraped sealant as heavily as possible without running or

dripping. A micarta scraper pushed under the sealant will accelerate the action of the stripper. Wipe off immediately any stripper which falls accidentally on unmasked surrounding areas using a clean, dry cloth, and mark its position for cleaning later.

(e) At 10 minute intervals, remove the stripper and any loosened sealant with a micarta scraper, and apply a fresh quantity of stripper. Do not allow the stripper to dry on the solvent at any time. Repeat this cycle of operations until all the sealant has been removed. If there is any finish such as primer or lacquer under the sealant, continue stripping to bare metal.

NOTE

When the time available for stripping operations permits, the amount of hand labour involved may be reduced by applying stripper to the scraped sealant and covering the area with cellophane, attaching it around the edges with masking tape or equivalent. Allow to stand for approximately 12 hours. The sealant will be stripped during this period, while the cellophane helps to prevent the drying out of the stripper.

(f) Remove all masking tape.

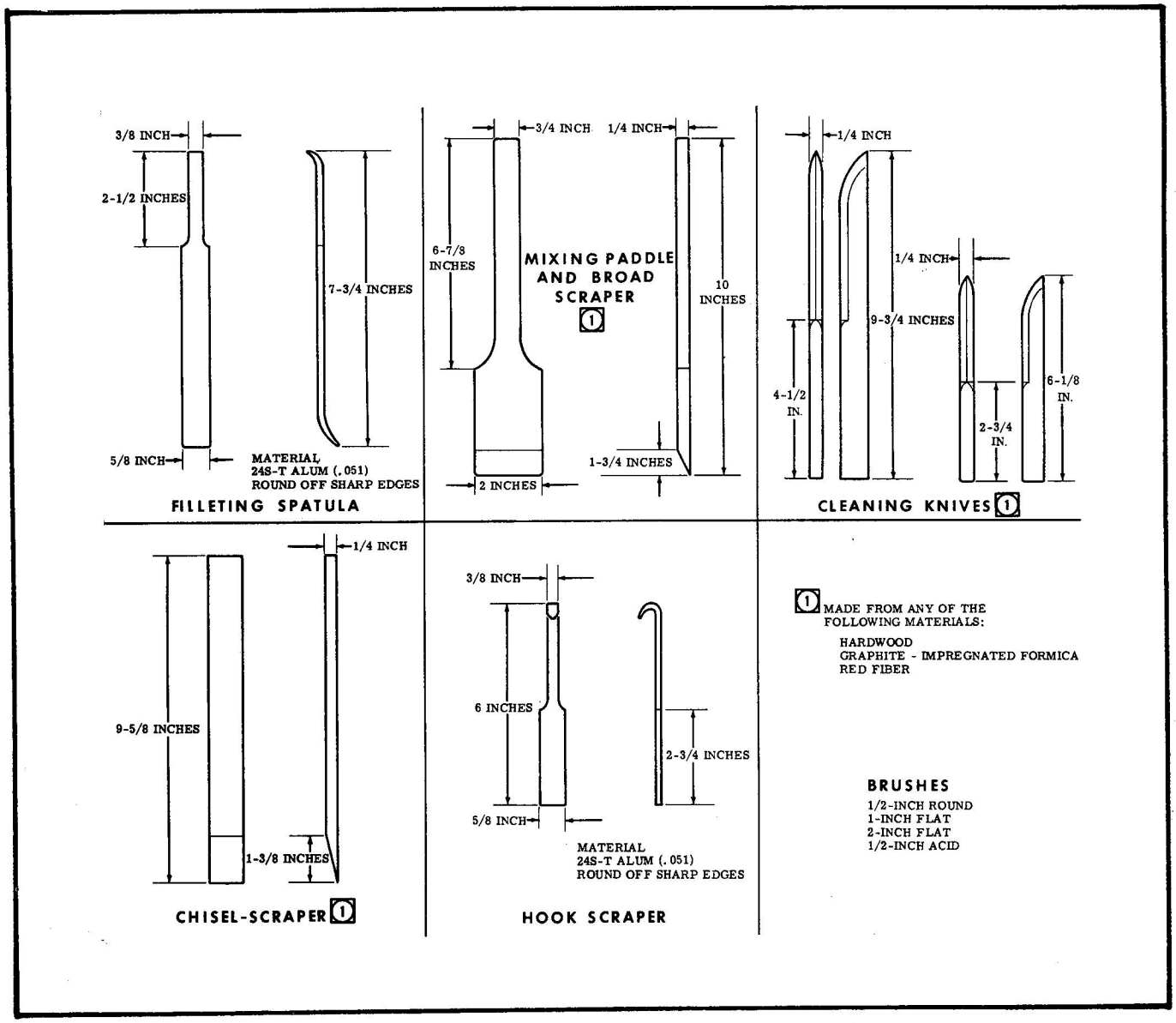


Figure 3-4 Typical Hand Tools

(g) Roughen all surfaces of the original sealant adjacent to the stripped area over at least 1 inch of their length, using a micarta scraper or clean hardwood stick. Take care not to scratch the surrounding metal surfaces.

Structural Repairs

23 Carry out any structural repairs required before proceeding with any repairs to sealants. No repair of any kind is to be performed on a tank after it has been sealed, unless specifically approved by Engineering Authority. Refer to appropriate aircraft Engineering Orders for structural repairs procedures.

Cleaning (General)

24 Remove all chips and foreign materials from the tank structure. Thoroughly clean the area to be sealed and adjacent areas with solvent (Item 9). Beginning at the top and working downwards use a clean lint free cheese cloth pad saturated with cleaning solvent. Remove solvent together with freed oil, grease and dirt by wiping dry with a dry lint free cheese cloth, changing cloths frequently.

25 Do not allow the solvent to evaporate from the surface before wiping dry, as oil and grease will remain on the tank surface where it cannot be removed by a dry cloth. Always pour the solvent on to the cloth to avoid contamination of the solvent supply by grease or dirt from the cloth. A stiff bristle brush may be used to clean around bolts, rivets and angles.

26 A dry, filtered air supply may be used to assist drying areas which cannot be reached by the drying cloth.

Cleaning Prior to Sealant Application

27 The final cleaning, to obtain a good bond between the structure and the sealant, shall be completed immediately prior to sealant application. Gently scrub the area to be sealed using a cleaning mixture (comprised of 5 parts Item 20, 2 parts each of Items 9 and 41, and one part Item 38, by volume). Rinse the area at least twice with the mixture wiping dry each time with a dry lint-free cheese cloth pad.

NOTE

Do not allow cleaning solvent to air dry. If a previously cleaned area should become contaminated, it is to be cleaned again before sealant is applied.

Bolting

28 Use calibrated torque wrenches when installing either permanent or temporary bolts. Whenever possible, insert all bolts passing through tank boundaries from the in-tank side of the boundary. Coat final bolts and drive pins on the shanks with sealant compound (Item 30) before insertion. Clean heads of bolts before coating and installation.

29 When bolts are specified in an assembly and no sealing material is to be used between the faying surfaces, insert final installation bolts and torque them to the values given in EO 05-1-3/25.

30 When bolts are specified in an assembly and a sealant is to be used between the faying surfaces, install as follows:-

(a) Install permanent or temporary bolts in all holes in light attachments and in every other hole in castings and heavy fittings. Starting from the centre bolt and working outward, tighten every bolt to the torque values given in EO 05-1-3/25.

NOTE

Torque inspection of bolts must be made within 2-1/2 hours after application of sealant.

(b) After any temporary bolts have been torqued as above, remove the centre bolt and replace with a final bolt. Tighten this bolt to the installation torque value. Repeat this procedure on all surrounding bolts until all final bolts are in place.

31 When gaskets are used between faying surfaces, proceed as follows:-

(a) Do not use temporary bolts. Insert final installation bolts to the installation torque values.

(b) Fifteen minutes after the installation of the last bolt in the installation involved, check and retighten.

(c) Complete all final torque inspections

for a given area before fillets of sealant are applied to the area.

NOTE

Install all hard-type gaskets (Johns-Manville No. 76 and similar) with sealer (Item 30) on the faying surfaces.

Riveting

32 Where sealing material is used between riveted faying surfaces and drawing and rivet before upsetting is not sufficient to give metal-to-metal contact, draw up with temporary bolts.

33 When bolts and rivets are specified for the seam part and sealing material is used between faying surfaces, completely install final installation bolts whenever possible before any riveting is done. After the riveting has been completed, recheck and, if necessary, retighten all bolts to the installation torque. If no sealing material is used between faying surfaces bolts may be installed after rivets are upset.

34 Keep rivet sets, bucking bars and draw sets clean. A roughened bar set may be used to buck rivets if sealing compound is causing clinched rivets. Use a pressure pad set wherever possible.

35 Install parts on assemblies with Cherry Tack Rivets or permanent rivets at no greater than six inch intervals to prevent any shifting during riveting, since shifting of parts causes misalignment and undesirable displacement of sealing material (if used) from between faying surfaces during riveting. Use only rivets, either temporary or permanent, as fasteners in holes that have been drilled to final size. Spot rivet the assemblies securely in place of approximately six inch intervals. On spars, alternate rivets from inside to outside rows. Draw and buck each rivet before proceeding to the next. All hand driven rivets must be drawn with standard draw sets before bucking.

36 When rivets are installed by squeezing use pressure feet, employing the maximum pressure that can be used without distortion, quilting or marring of members being riveted.

37 Perform final trimming of flush rivet heads. (Refer to EO 05-1-3/5).

38 For sealing tooling holes and similar holes in the tank, install rivets oriented according to Figure 3-5.

Orientation of Rivets

39 Orient rivets in tanks as follows: (See Figure 3-5.)

(a) For attachments involving one or more members inside the tank as well as the skin or web, but involving no seams leading to the outside of the tank or no members attached outside the tank, upset the rivet outside the tank. (See Detail A, Figure 3-5.)

(b) For attachments involving one or more members inside and one or more members outside the tank, as well as the skin or web, but involving no seam leading to the outside of the tank, upset the rivet inside the tank. (See Detail B.)

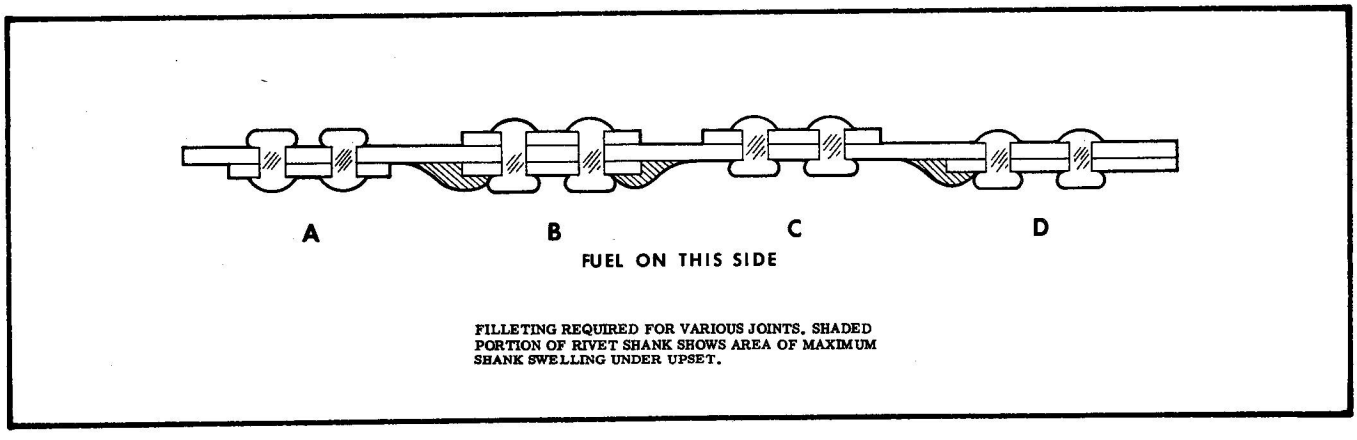


Figure 3-5 Filleting of Riveted Joint

(c) For attachments involving one or more members outside the tank as well as the skin or web, but involving no seam leading to the outside of the tank, upset the rivet inside the tank. (See Detail C.)

(d) For seams leading to the outside of the tank, upset the rivet inside the tank. (See Detail D.)

NOTE

Whenever there is an out-tank attachment involved at any point coinciding with an in-tank attachment such as in Sub-Paragraph (b), all the rivets passing through the tank boundary and through the in-tank attachment must have the upsets on the in-tank side.

(e) In dimpling, use only tooling that is in perfect condition. Check punch and die for damage at least every 15 minutes while machine is in operation by visual inspection with the aid of an inspection mirror.

(f) Use a brazier head rivet set or flat rivet set on round head rivets whenever possible.

Sealing Between Faying Surfaces With Nylon Thread

40 To seal between faying surfaces with nylon thread, proceed as follows:-

(a) Carefully check members and see that all drilling, removing of burrs, fitting, reaming and cleaning has been completed before application of thread. Be certain that all burrs are removed from areas where thread is to be applied.

(b) Apply a uniformly thin layer of rubber cement (Item 50), that has been thinned with an equal amount of methyl ethyl ketone (Item 9), to one of the faying surfaces. This layer of rubber cement must not be over .001 inch thick. Allow to dry for one to two minutes.

(c) Using special applicator, lay nylon thread (Item 43) along inside and outside of rivet pattern and between each row of rivets. Plan thread pattern so as to lay the thread continuously and avoid splicing of the thread as much as possible. Keep thread at least 1/64 inch away from rivet holes, but do not allow it to lie over 3/16 inch away from the holes.

(d) After thread has been applied, handle and assemble parts carefully to avoid dislocating the thread.

Sealing Compound (Sealant)

41 This material is essentially a long-chain polymer thiokol-type synthetic liquid rubber that cures chemically to solid rubber when mixed with an accelerator in the correct proportion. Refer to Table 1-1 for the list of materials and the protective coatings and cleaners used. When correctly mixed and applied to a properly cleaned area, these sealants may be depended upon for a good seal. They may be used to repair any sealant previously installed, providing that the deteriorated portion of the old sealant is completely removed. Sealant (Item 31) has a heavy viscosity and is used for injection and fillet sealing in voids, holes, and along structure seams and joints. Sealant (Item 30) is a brushable material used for sealing fasteners, such as rivets and bolts.

42 The different brands of base-sealing compounds range from black to white. The accelerator is dark brown. The white basic compound shows definite streaks of colour until it is thoroughly blended with the brown accelerator. Where large quantities of sealant are used, the base and accelerator are mixed on a flat glass plate so that the two can be thoroughly blended.

43 For service repairs, suppliers provide the correct proportions of base compound to accelerator in a kit consisting of an accelerator container attached to the lid of the base compound container. It is suggested that the 1/2 pint kit be used, as this amount suffices for average repairs. The proper and complete mixing of these materials is vital for efficient sealing. Storage limitations for kits are as specified by the manufacturer.

Instructions for Mixing Sealants

44 Follow the manufacturers instructions carefully and proceed as follows:-

(a) Mix the entire content of the kit regardless of how much sealant will be required.

(b) Scrape all accelerator and base compound from the cans and lids to ensure that the correct proportion of accelerator and base compound is maintained.

(c) Maintain the accelerator (Item 32) at the consistency of a heavy syrup. If it dries out excessively, restore consistency by the addition of Toluol (Item 45) and stirring.

NOTE

Unbalanced proportions of base compound and accelerator can affect the quality of the sealant. Too much accelerator for the amount of base compound results in loss of flexibility at low temperatures. If too little accelerator is used, the sealant will lack required fuel resistance. Do not intermix different brands of sealing materials. Do not intermix different types of the same brand of sealing materials.

(d) Stir the mixture slowly by hand using a flat mixing paddle from three to six minutes. Rapid stirring will introduce air bubbles which might burst and result in pinhole leaks.

(e) Stir thoroughly until the accelerator and base compound are completely blended and the mixture is of a uniform colour.

Test of Mixed Sealants

45 After completion of mixing, test each batch of sealant by spreading a small amount of sealant from each batch on a sheet of aluminum or a sheet of white bond paper making a very thin film of sealant. Visually examine the sealant film to make certain that small particles of accelerator are not visible. If particles are visible, continue mixing; if because of subnormal accelerator, particles persist after mixing up to five minutes the entire batch shall be discarded.

Application Life

46 The period during which the sealant retains a consistency suitable to its particular use (for example, brushing, filleting or injection sealing) is termed its 'Application Life'. The brush material is usable until brush marks no longer flow out when it is applied. The fillet and injection material is usable until the sealant becomes rubbery and adheres to the application gun instead of to the tank surface.

47 Application life is related to temperature and relative humidity; the sealant cures by chemical action and does not harden through evaporation. Sealant must be discarded when it becomes too stiff to work readily.

48 The mixed sealant may be stored on dry ice for three days, or at -12°C (+10°F) for 24 hours, before it is used. Mix sealant materials as required in the manner specified by the manufacturer.

Cure Time

49 The time the sealant takes to cure depends on the initial application life, the ambient temperature, the temperature of the material and the relative humidity. The time of cure is about 10 times the application life if the air temperature and relative humidity do not vary. If, during the cure time, the air temperature is increased above room temperature to 36°C (99°F) the sealant will cure in approximately half the time. Below 20°C (65°F) the sealant will not cure, but will remain tacky until exposed to higher temperatures.

Determining Degree of Cure

50 To assist in the observation of the "curing" use a 5" square of plate glass with a red cloth tape approximately 2" x 20" affixed by means of a spring type paper clamp. The glass is to be placed in the tank as soon as it is opened. While the tank is having fresh air circulated through it the glass will attain the same temperature as the tank.

51 After applying the sealant, a sample of sealant is to be applied to the glass to the same minimum depth that has been applied to the tank, and in a bead 3" to 4" long.

52 The bead then may be inspected from top or bottom or cut cross section. This will assist in observing when the curing process is completed. A Shore durometer should be used, when available, to ascertain the minimum hardness of the sealant (see Paragraph 54).

53 To reduce the cure time, air may be circulated through the tank at 50° to 60°C

(120° to 140°F) until sealant is cured.

Shore Durometer

54 The Shore Durometer is used to measure the hardness of rubber and similar materials. The impressor point is pressed into the material under test, and the degree of hardness is read on the scale. The hardness numbers are arbitrary, with no relation to any other scale of hardness numbers (see Figure 3-6.)

Application of Sealant

55 Sealant is applied in four stages; a coat of brush sealant, followed by the bead, the fillet, and a final application of brush sealant. The complete process is achieved in the following manner (see Figure 3-7):-

(a) Apply a heavy brush coat of sealant (Item 31) to the stripped and roughened repair area to overlap one inch on to the original sealant. Cure for thirty minutes by infra-red heat lamps at a temperature not exceeding 70°C (160°F). The temperature may be regulated by varying the distance between the coating and the heat lamps.

NOTE

Where integral fuel tanks have never been filled with fuel (such as prior to going into service) the application of brush sealant may be omitted when resealing.

(b) Apply a 1/4 inch bead of sealant with applicator gun to not more than two feet of repair area at a time. Work the bead into the angle with a spatula to form a solid packing. (See Figure 3-7).

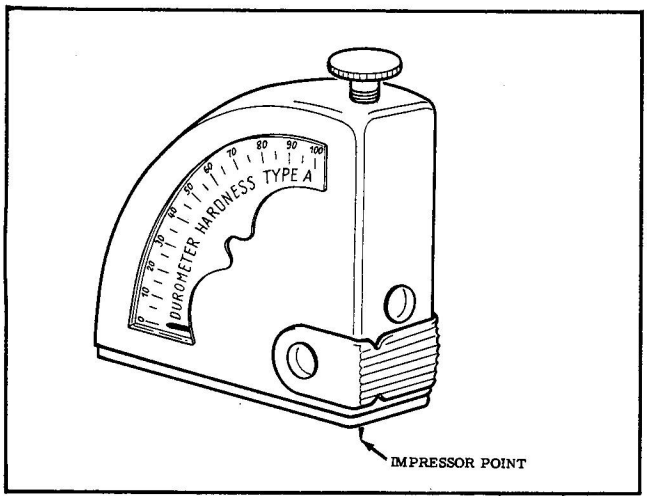


Figure 3-6 Shore Durometer

(c) Thoroughly inspect the bead for blisters, bubbles and cracks. Remove sufficient sealer from areas of imperfection to enable subsequent sealant fillet to flow in and fill any pockets. This application must be approved by Engineering Authority before being covered.

(d) The fillet sealant is applied directly on to the bead and surroundings, with a 3/16 to 1/4 inch base until the repair area is completely covered as shown. The fillet should cover a width of 1/2 inch on either side of the repair and there should be an overlap of at least 3/4 inch at the join between the repair and original sealant. Blend smoothly over all changes in section within the repair area. Cure the bead and fillet at this stage for 1-1/3 to 2 hours with infra red heat lamps in the same manner as the brush sealant in sub-para (a). When cured the sealant will be tack free and show a Shore Durometer hardness of 40-45 (refer to Paragraph 54).

NOTE

In an emergency, the sealant bead and fillet may be applied in one operation. Work the sealant in with a spatula as before. The dimensions of the completed fillet should be maintained as set out in sub-para (d).

(e) Filleting and cleaning of tanks must be completed and the sealant completely cured, before tanks are filled and drained.

(f) If repair is inaccessible from inside tank, a screwed patch will be necessary. After drilling holes through patch, rivet Nut-plate, floating, all metal types only, (refer to EO-05-1-3/6), in position over these holes. Apply appropriate sealant over Nut-plates, apply nylon gasket on other side of patch and re-insert oval-shaped patch. Attach patch to tank and replace original finish. If a flush repair is required, radius dimple or countersink and use countersunk rivets or screws as applicable.

NOTE

For smoothness, attach a plug filler by soldering, spotwelding or riveting. If repair area is curved, form curve on

patch and plug prior to marking for drilling.

TESTING

56 After application of sealant, plug tank vent and other openings, with the exceptions of one adapted for an air or vacuum line connection.

57 During testing open any electrical tubing, hydraulic or fuel lines which pass completely through the tank at a union outside the tank, so that any leakage into the tubing from the tank will be indicated.

Pressure Testing

58 Proceed as follows:-

(a) Attach air supply pressure relief valve and pressure gauge to adapter; slowly pressurize tank. Refer to appropriate Engineering Authority for specific pressures.

CAUTION

The use of a calibrated pressure gauge is preferred to a mercury manometer, since mercury is very harmful to aluminum.

WARNING

Ensure that relief valve operates correctly. Exclusive pressure may cause serious damage to structure and injury to personnel.

(b) Allow fifteen minutes for pressure to stabilize and close off the air supply; there should be no drop in pressure over the next fifteen minutes.

(c) If leakage is indicated use bubble solution (Item 34) to check all joints, seams, screws, rivets plugs and plates to determine location, while maintaining air pressure.

(d) Mark leaks, and repair in accordance with previous instructions.

NOTE

Do not peen or centre punch rivets to stop air test leaks.

Vacuum Test

59 Proceed as follows:-

(a) Manufacture a suitable adapter and attach a water vacuum Manometer.

(b) Attach a vacuum line to adapter formerly used for pressure air supply during pressure test.

(c) Blank off pressure gauge connection.

(d) Open vacuum source and reduce tank

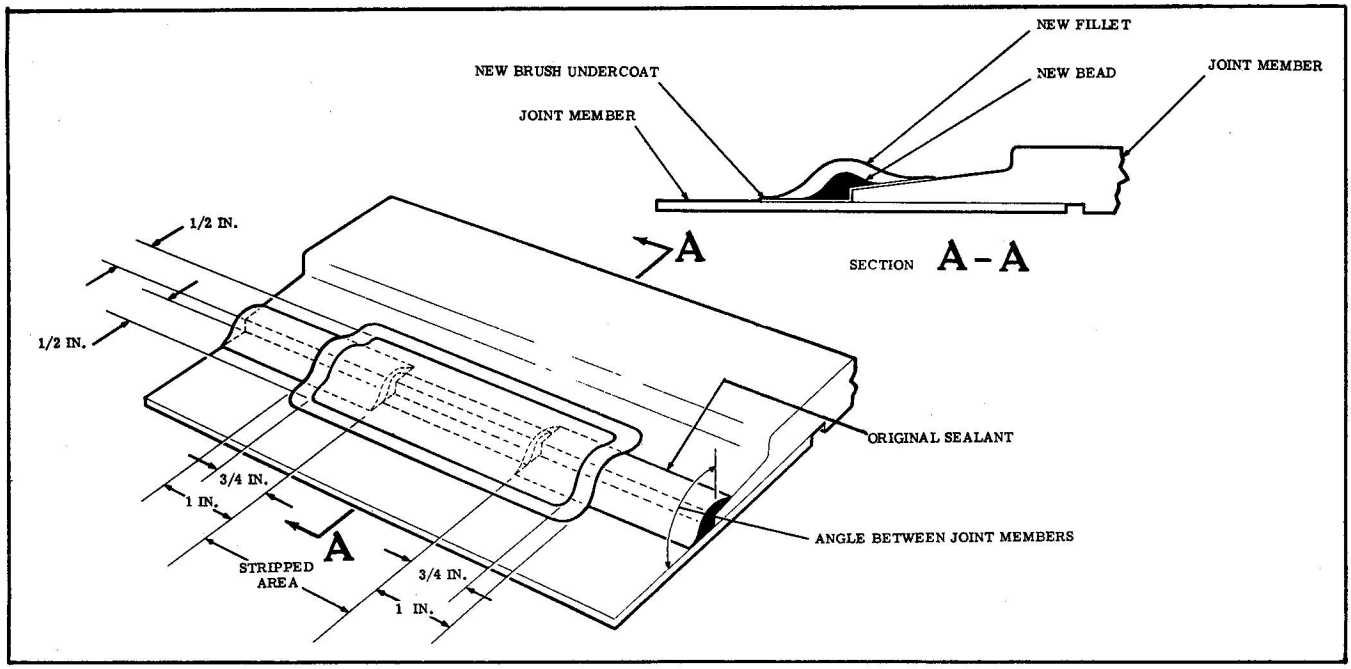


Figure 3-7 Typical Re-sealing Procedure

pressure to 55 inches water below atmospheric, and close vacuum source.

(e) Allow fifteen minutes to stabilize, then note Manometer reading. There shall be no loss of vacuum during the next fifteen minutes.

(f) If leakage is indicated reduce vacuum to zero and carry out further pressure test being particularly diligent whilst checking with leak solution.

(g) If no leakage, reduce vacuum to zero and remove all plugs, plates and adapters.

'BUNA-N' PROTECTIVE COATING

60 After pressure testing, apply protective coating to the repaired area as follows, (refer also to 'Polyurethane Coating').

Brush Coating

61 Where the repair area is reasonably small apply a heavy brush coat of coating (Item 48) to completely cover the new sealant and overlapping the adjacent original sealant. Coating (Item 48) may be thinned adding MEK (Item 9). Cure the coating for 30 minutes with infra-red lamps at a temperature not exceeding 70°C (160°F). When cured, the overcoat should be tack free.

Coating by Filling and Draining

62 For large repair areas, or tanks which have been completely re-sealed, re-apply coating as follows:-

(a) Dry tanks by circulating air at 50°C (120°F) through tanks for 30 minutes and allow to return to room temperature.

(b) Fill tank approximately 75% full of Sealant (Item 49).

(c) Rotate tanks through 360° at a rate of 30° per minute.

(d) Apply and maintain two psi of air pressure on the sealant while rotating the tank 360° in the opposite direction to the first rotation.

(e) Remove pressure and again rotate the tank 360° in the same direction as the first rotation.

(f) Drain sealant from the tank.

(g) Allow tank to complete draining in normal flight position, at room temperature, for two hours. Carefully check for any tendency toward collection of puddles of sealant at the end of first hour and again at the end of the second hour. Check drain holes every 10 minutes to see that they are kept open. If any puddles are found at this inspection, remove them by mopping with a cloth or by brushing excess material to the drain.

(h) Allow tank to stand for one additional hour and then check for any puddling.

(j) Introduce 42°C (110°F) air through inboard door and attach air mover to filer neck to circulate the air through the tank for three hours or until the material has lost all tackiness.

POLYURETHANE COATING

63 For large areas (or re-sealed tanks) and where facilities and equipment are available, a protective coating of polyurethane (Item 49) may be applied as follows, either as an alternative internal coating to 'Buna-N' coating, or as a protective coating on internal metal surfaces before sealing, or exterior surfaces after sealing and testing:-

Safety Precautions

64 Precautions in the use of polyurethane coatings are the same as those observed in handling organic coatings.

65 Parts are to be sprayed in an adequately ventilated booth, or if such a facility is not available, an air-supplied full-face respirator is to be worn by the operator.

66 Mixed, uncured polyurethane components act as an irritant to the eyes and skin, especially to cuts and scratches. Extreme care is to be taken not to inhale the vapour, or swallow any of the liquid. The hands are to be thoroughly washed before eating food or smoking.

Mixing Instructions

67 Polyurethane is supplied in Kits consisting of two parts (A and B) in the following quantities:-

Kit Size	Part A Container	Part B Container
24 fl. oz.	1-1/2 pint can	1-1 pint can
96 fl. oz.	1-1 qt. can	2-1 qt. cans
3 gallons	1-1 gal. can	2-1 gal. cans

68 Mix complete Kits only. Do not open containers until the contents are required for use.

69 Thoroughly stir the base material (Part B), loosening any sedimented material from the bottom of the container; mix one volume of part A to two volumes of part B.

70 Slowly agitate Polyurethane during use to keep the pigment in suspension. Do not add thinners or solvents to this material.

71 The mixed coating has a maximum pot life dependant on temperature, as follows:-

Material Temperature		Pot Life
°C	°F	Hours
18-24	65-74	8
24-29	75-84	4
29-35	85-95	2

NOTE

Mixed polyurethane coating is not to be used beyond the specified pot life.

Application

72 Apply Polyurethane Coating by spray. Examine the coating to see that it is fully wet, and is free from voids, pinholes, bubbles, excessive runs or sags, and foreign matter. One wet spray coating will produce a dry film thickness of approximately one mil, having a smooth, translucent yellow appearance. Minor sags or runs (which may be visible, but not felt when passing a finger over them) are permissible.

73 Prepare a test plate twelve inches square, in the same manner as the parts to be sprayed. The test plate is to be coated, dried and cured by the same method, under the same conditions and at the same time as these parts. Retain the plate for subsequent cure check if required.

74 If more than one coating is required, allow a minimum of one, and a maximum of twenty four hours air dry to elapse between applications.

75 Do not apply polyurethane coating when the temperature of the material is above 35°C (95°F) or is below 15°C (60°F), or when the relative humidity is outside the 30% - 85% range.

NOTE

All equipment and lines are to be washed out with methyl-ethyl ketone, IMMEDIATELY after use.

Equipment

76 Spray equipment suitable for epoxy coating application will be suitable for application of polyurethane; however a De-Vilbiss P-MBC-510 spray gun with a 45G nozzle combination, a feed pressure of five to six psig, and an atomizing air pressure of approximately thirty-five psig may be used. Provision must be made for the removal of all water from the compressed air supply. Water in the system will form bubbles in the coating. Pressure feed tanks must be equipped with mechanical agitators to keep the pigment suspension.

Drying

77 At room temperature 24°C (75°F) 50% RH the coating will normally dry to a tack-free state within two hours and will be sufficiently dry to be handled carefully within four hours.

Curing

78 Allow the applied coating to air dry for a minimum of four hours at a temperature of 21-32°C (70° - 90°F) and relative humidity of 30-90% and cure for a minimum of 10 hours at a temperature of 54±5°C (130±10°F) and relative humidity 50±10%. The coating cannot be over dried or cured, therefore there is no maximum to the drying or curing times.

79 Sprayed parts air dried at room temperature for eight hours or more may be assembled or installed, provided that these parts are not exposed to fuel, solvents or sealants until completely cured.

Testing

80 The coating is deemed to be fully cured when the undersurface is not exposed following fifty strokes of moderate pressure with a gauze pad wet with methyl-ethyl ketone.

Repair of Defective Coating

81 To remove any irregularity, foreign matter, excessive sag or run etc, from a part, carefully wipe the affected area clean with a clean cloth moistened with Cellosolve Acetate and recoat the area.

NOTE

This must be accomplished before the coating has been force cured. (Paragraph 78) or before the coating has air dried for more than twenty-four hours.

82 Parts which have been cured, or which have been air dried for more than 24 hours, which are found to have voids or coating defects, may be repaired, (in lieu of complete stripping and reprocessing)by the following procedure:-

(a) Lightly abrade the defective area, or area immediately adjacent to the coating void. Use 320 or 400 grit abrasive paper. Care must be exercised since abrasion through the coating could damage the chemical finish on metal.

(b) Clean the abraded and/or void area by wiping with clean, lint-free rags moistened with methyl-ethyl ketone, and wipe the surfaces thoroughly dry.

(c) Spray one full application of coating over the surface requiring refinishing.

(d) Air dry and cure the coating.

NOTE

Only one rework is permitted in any one area.

EXTERIOR SEALING

Preparation

83 Sealer (Item 46) must be in a free-flowing fluid condition when applied. Since it becomes jellied in temperatures below 90°F, place the container in a water bath preheated to a temperature of 50°C to 70°C (120°F to 160°F). Maintain heat within the range of 50°C to 70°C (120°F to 160°F). When the temperature is constant and the blend is clear, it is ready for application. Evaporation of the volatile and inflammable solvent will produce a concentration of the materials. Loosen caps, lids or corks before heating to prevent excessive container pressures.

84 For exterior sealing, proceed as follows:-

(a) Remove all compound, camouflage paint and zinc chromate primer from surfaces to be sealed, with stripper (Item 36). Remove excessive sealing compound from crevices and slots in the screw heads. Do not use metal scrapers.

(b) Make a final clean up of the metal surfaces with clean cloths dampened with stripper. Wipe dry with absolutely clean, dry cloths. Areas cleaned must be at least 12 inches greater than the surface to be coated.

(c) Fill any crevices with sealing compound (Item 30) applied with a putty knife. Apply carefully to completely fill the depressions, and level the sealant flush with the adjacent surfaces. Remove all surplus material from the adjacent surfaces using a clean cloth wetted with stripper. Allow the sealant to cure before applying subsequent coatings. Cure can be expedited by applying heat.

(d) With a clean stiff bristle brush, apply one even medium coat of cement (Item 48) and allow to dry until the film is dry to touch. The cement must be applied over a greater area than the subsequent coats of sealer.

NOTE

The surface of the cement must be free from foreign matter, such as oily fingerprints, grease, etc. Immediately prior to the application of sealer remove all contamination with a clean cloth dampened with denatured alcohol (Item 8).

(e) With a clean, stiff bristle brush apply three normal coats of sealer allowing a minimum of 30 minutes drying time between coats. Best results are obtained by applying

the sealer as rapidly as possible. Each application of sealer should cover a slightly smaller area than the preceding coat. Do not apply the sealer over bare metal, as inferior adhesion will result, with subsequent loosening of the coat along the edges.

(f) Allow the final coat of sealer to dry thoroughly. Apply two spray coats of aluminized lacquer (Item 39), allowing 30 minutes drying time between coats. Overlap the primed and sealed surfaces at least six inches with the lacquer, where practicable.