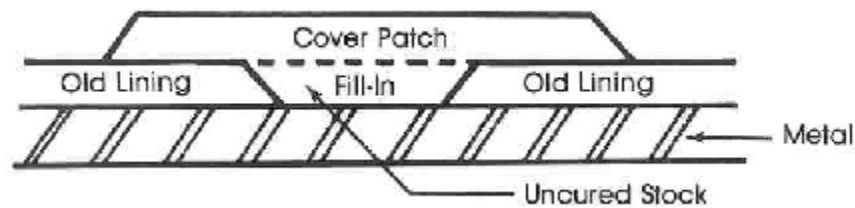


REPAIR OF RUBBER LINED EQUIPMENT

1. GENERAL REPAIR INFORMATION

Regardless of all the precautions taken in the original cure and maintenance of rubber lined equipment some rubber linings will eventually need repairs. When repairs are necessary, they can vary from small blisters or cracks to major areas in numerous panels of rubber. The methods of repair are generally dictated by the type of the original lining, extent of repair, intended service and the facilities available. For these reasons there are no standard methods of repair especially when considering field repairs. The only repairs that can be presumed to be equal to the original lining are those that are made with the same stock used in the original lining and given a full recure in the factory. Repairs that are made in the field should, when possible, be made by using the original lining and given a full recure. On occasions it is not possible to recure the vessel in the same original manner and when this happens, other alternate methods have to be used. Such alternate methods are often satisfactory for the intended service and may be justified by cost and time considerations. The success of rubber repairs, to a great extent, depends upon the thoroughness of the workman. It is possible that the original lining may be in such bad condition that a successful repair cannot be made. In this repair section there are step-by-step procedures for different repairs, but there may be occasions where slight deviations have to be made. In general the following standards have to be met regardless of the type of repairs that are made.

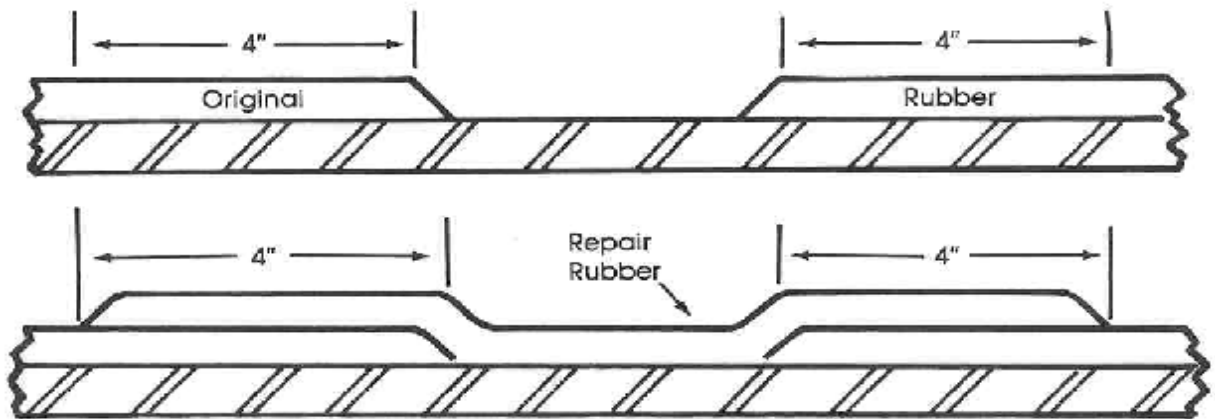
- a) The damaged metal and rubber must be properly prepared by buffing or grinding. The surface of the rubber adjacent to the repair area should be buffed to clean rubber back for a minimum of 4 inches.
- b) Before cementing, the entire work area must be clean. All buffing dust, grindings, moisture and acid fumes, etc. should be removed not only from the direct area, but also from any adjacent area where it might be carried or blown in.
- c) The cements must be applied in the proper sequence on the metal and/or buffed rubber and allowed to dry between each coat.
- d) The mating surfaces of the repair stocks must be swabbed with toluene and allowed to dry.
- e) The repair compounds must be carefully rolled and stitched down and all trapped air removed.

2. SOFT NATURAL RUBBER REPAIR USING ORIGINAL LINING WITH RECURE,**SKETCH 1****Sketch 1**

- a) Remove the defective rubber to good adhesion. In the case of a pinhole leak, this operation is omitted.
- b) Buff or grind exposed metal until clean and bright. If metal damage has occurred the rubber must be removed back to good adhesion or 6" beyond damaged metal. Metal repairs are made by cutting out damaged metal and flush welding a metal patch in place. During metal cutting and welding, the metal between the weld and original rubber must be kept cool so as not to overheat rubber or the bond. After the welding is complete the weld spatter must be removed and the weld ground smooth.
- c) Buff edges of exposed rubber to a minimum 45° bevel.
- d) Buff surface of original lining back 4" from cut edge. The rubber surface must be free from dust, humidity and acid fumes. Moisture will reduce and often destroy adhesion of the cement, making a successful repair impossible. Any traces of contamination on the rubber being repaired should be neutralized.
- e) Cement the metal with the following:

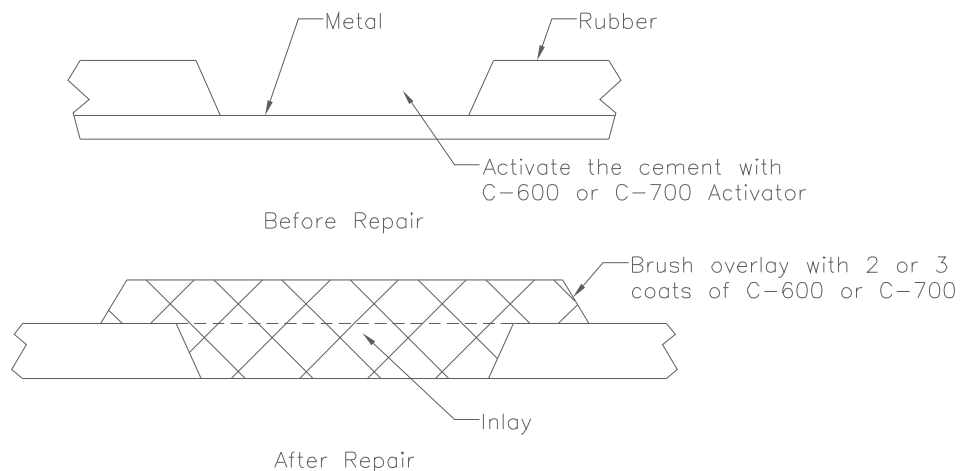
1 coat	C-90
1 coat	C-91
1 coat	C-202S
1 coat	C202S
- f) Cement the buffed rubber with two coats of C-202S.
- g) Use pattern and cut a piece of the original uncured lining to conform with the edges that have been skived to a 45° bevel. Cement the surface of the rubber patch with C-202S and allow to dry.
- h) Inlay the uncured lining stock over the metal and skive onto the beveled edges of the buffed rubber. This is usually done by using a slightly larger piece of stock than necessary and trimming flush with original lining after thoroughly rolling into place.
- i) Apply a cover patch of uncured lining over the inlay. This cover patch should be cut with skived edges and be large enough to fit the buffed and cemented surface of the original lining.
- j) Roll the stock in a straight line working from center to edges allowing the air to escape ahead of the roller.

- k) Recure entire unit in the same manner as originally cured. In the case of large vessels that were cured originally with atmospheric steam, a single repair may be cured by building a box around the patch, or otherwise confining the steam to the area of the patch. The patch should then be exposed to steam at 212°F for the same length of time as the original cure.
- l) For large repair areas it is permissible to use a single thickness of uncured stock over the area to be repaired. The patch should extend out 4" onto the old rubber. See Sketch 2.



Sketch 2

3. CHEMICAL CURE REPAIR



- a) Remove the defective rubber to good adhesion.
- b) Buff or grind exposed metal until clean and bright.
- c) Buff surface of original lining back 4" from cut edge. The rubber must be free from dust, humidity and acid fumes. Moisture will materially reduce and often destroy adhesion of the cement, making a successful repair impossible.
- d) Cement the metal as follows:
 - 1 coat C-90
 - 1 coat C-91
 - 2 coats C-202SThe C-202S cement should be further activated by the addition of 1 teaspoon of C-700 or C-600 per 1/2 pint of C-202S or 1/4 pint per gallon. The C-700 or C-600 should be thoroughly stirred into the C-202S cement before applying. Mix only amounts of C-202S/C-700 or C-600 that will be used in 12 hours.
- e) Cement the buffed rubber with 2 coats of the C-202S that has been activated with the C-700/C-600. Allow each coat of cement to dry thoroughly. In small repairs where the

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rubber is cut or gouged, but not loose from the metal, the buffed out areas should have 2 coats of the C-202S cement that has been activated with the C-700 or C-600.

- f) Cut a piece of chemical cure repair rubber to conform to the edges skived to a 45° bevel. Cement the surface of the rubber with C-202S and allow to dry.
- g) Inlay the chemical cure repair material over the metal and skive onto the beveled edges of the buffed rubber. This is usually done by using a slightly larger piece of stock than necessary and trimming flush with original lining after thoroughly rolling into place.
- h) After the inlay is in place the top surface should receive an additional coat of the activated C-202S/C-700 or C-600 cement.
- i) Apply a cover patch of chemical cure rubber over the inlay. The cover patch should be cut large enough to fit the buffed and cemented surface on the original lining.
- j) If any air is trapped under the repair rubber, wet the point of a hypodermic needle with solvent and puncture the blister. Force the air out through the needle by using the fingers. Close the needle hole by stitching or rolling thoroughly. Patch the puncture hole by applying a patch approximately 2" in diameter.
- k) Brush the entire exposed surface of the cover patch with 3 separate coats of C-700 or C-600 activator. Dry 30 minutes between coats. Take care that activator C-700 or C-600 does not run off the surface. If repair is on a vertical surface or overhead, apply at least one coat of C-700 or C-600 to surface of repair stock before it is positioned. After completion of the final coat of C-700 or C-600, there should be a time lapse of at least 8 hours before repair is put into service. The chemical cure repair will vulcanize in several days at room temperature or sooner with application of some heat.
- l) For large repair areas it is permissible to use single thickness of chemical cure stock over area to be repaired. This patch should extend out 4" on old rubber. See Sketch 2. Use the same cement and activator scheme as outlined above.

4. CURED AND UNCURED SOFT NATURAL RUBBER REPAIR

This procedure is a variation of Item 2 above and is used primarily in brick sheathed tanks where the brick work will aid in holding the repair in place. This repair is to be used on flat or large radiused surface only. Do not try to bend around corners or around plain ends.

- a) Rubber preparation, cementing and inlaying the uncured code 2000 is the same as outlined in 2.
- b) Apply a cover patch of uncured code 2000 (1/8" thickness). This cover patch should be cut with skived edges and be large enough to fit the buffed and cemented surface of the original lining.
- c) Roll down cover patch and remove any trapped air.
- d) Cut a piece of cured code 2000 (1/8" thick) with an up skive on edges. Roughen adhesion side of cured sheet, swab with toluene and let dry.
- e) Cement adhesion side of cured sheet with 2 coats of C-202S.

- f) Apply the cured sheet of code 2000 over the uncured cover patch. Roll down carefully.
- g) This repair is ready for use without any cure, but again it must be emphasized that this repair is designed to be used behind brick work.

5. TRIFLEX RUBBER REPAIRS

Repairs can be made by one of several ways. The method used will depend on available time, available materials, nature of repair, condition of lining and intended service.

- a) Repair as outlined in 2. The cover patch should be the same as outside ply of the Triflex.
- b) Repair as outlined in 2, except use the original Triflex as the inlay material. The cover patch should be the same as outside ply of the Triflex. On large repair areas it is permissible to use a single thickness of the repair stock over the metal area, but this stock should be brought up over the beveled and extended 4" back on the existing rubber.
- c) Repair as outlined in 3 – Repair using Chemical Cure.

6. HARD AND SEMI HARD RUBBER REPAIRS

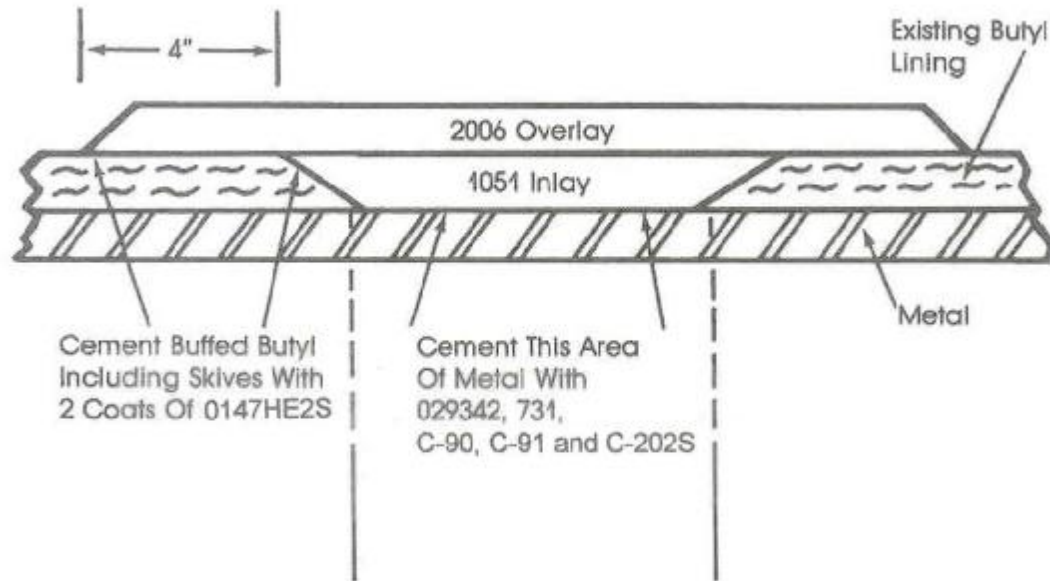
- a) Repair down to metal using semi hard rubber code 1035 Superflexite B.
- b) Remove the defective rubber to good adhesion.
- c) Buff or grind exposed metal until clean and bright.
- d) Buff surface or original lining back 4" from cut edge. The rubber must be free from dust, humidity and acid fumes.
- e) Cement metal and buffed rubber as follows:
 - 1 coat C-90 on metal.
 - 1 coat C-91 on metal.
 - 2 coats C-202S on metal and buffed rubber.
- f) Inlay code 1035 Superflexite B over the metal and skive onto the beveled edges of the buffed rubber. This is usually done by using a slightly larger piece of stock than necessary and trimming flush with original lining after it is rolled and stitched into place.
- g) Cement the top surface of the inlay patch with C-202S.
- h) Apply a cover patch (1/8" thick) of plain Superflexite B Code 2017. If there is no plain Superflexite B 2017 available, use Code 1035. Cement the mating surfaces of the patch material with C-202S. The cover patch should be cut large enough to extend out 4" on the buffed and cemented area of original lining.

- i) For large repair areas it is permissible to use a single thickness of Superflexite B code 1035 over the metal. The single thickness should be brought up over the bevel of existing lining and extended 4" back on the buffed and cemented area.
- j) Thoroughly roll and stitch repair stocks to original lining.
- k) Cure repair with atmospheric steam for 24 hours @ 212°F.

7. CHLOROBUTYL REPAIRS

a) Repair Using Chlorobutyl 1051

- i. Remove the defective rubber to good adhesion.
- ii. Buff or grind exposed metal until clean and bright.
- iii. Buff surface of original lining back 4" from cut edge. The rubber must be free from dust, humidity and acid fumes.
- iv. Cement metal as follows:
 - 1 coat C-90
 - 1 coat C-91
 - 2 coats C-202S
- v. Cement buffed surface and beveled portion of the lining as follows:
 - 2 coats – CB Tack cement. When repairing plain chlorobutyl 2006 either chlorobutyl 1051 or chlorobutyl 2006 can be used as inlay material. If 1051 is used the C-90 Primer cement should be used on the metal.
 - If plain chlorobutyl 2006 is used as the inlay material use the following - 1 coat C-100, 1 coat C-101, 2 coats CB Tack. The cover patch should be plain chlorobutyl 2006.
- vi. Inlay chlorobutyl 1051 over the metal and skive butt to the 45° beveled slope of the buffed rubber. This is usually done by using a slightly larger piece of stock than necessary and trimming flush with original lining after it is rolled and stitched into place.
- vii. Swab the top surface of the inlay patch with solvent toluene.
- viii. Apply a cover patch (1/8" thick) of plain chlorobutyl 2006 (See Sketch 5). To conserve stock it is permissible to strip the skive-butt seams with 6" to 8" wide strip of chlorobutyl 2007-A (1/8" thick) in lieu of covering the entire inlay patch. In small repairs where the rubber is cut or gouged, but not loose from the metal the buffed out area should only have 2 coats of the CB Tack cement before applying the chlorobutyl 2006. For large repair areas it is permissible to use a single thickness (3/16" or 1/4") of uncured stock code 2006 over areas to be repaired.



Sketch 5

ix. Cure 40 hours with atmospheric steam 212°F or 9 hours @ 260°F (20 psi).

b) **Repair Using Chlorobutyl 1055**

- i. Use same repair procedure as outlined in a) with the following exceptions.
 - Use 1055 for inlays and cover patches.
 - Use Polymer cement system – C-90, C-91, C-202S on all 1055 overlays to steel.
- ii. Use C-202S on the adherent side of 1055 cover patch.

8. **NEOPRENE REPAIRS**

- a. Repair down to metal using Neoprene 2010, 2011 or 2012
- b. Remove the defective rubber to good adhesion.
- c. Buff or grind exposed metal until clean and bright.
- d. Buff surface of original lining back 4" from cut edge. The rubber must be free from dust, humidity and acid fumes.
- e. Cement exposed metal as follows:
 - 1 coat C-200
 - 2 coats 021052

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- f. Cement buffed rubber as follows:
2 coats 021052
- g. Inlay Neoprene over the exposed metal and skive butt to the 45° beveled slope of the buffed rubber.
- h. Swab the top surface of the inlay patch with solvent toluene.
- i. Apply a 1/8" cover patch of Neoprene to the cemented and buffed rubber. The type of cover patch will depend on what type of Neoprene was used as inlay material. To conserve stock it is permissible to strip the skive butt seams with 6" to 8" wide strips of the same Neoprene that was used on the inlay patch. When using this method the entire inlay patch does not have to be covered. All mating surfaces of Neoprene repair stocks must be thoroughly swabbed with toluene solvent and stitched down carefully. For large repairs it is permissible to use a single thickness over the metal. The single thickness should be brought up over the bevel of existing lining and extended 4" back on the buffed and cemented surface.
- j. Cure Neoprene repair by one of the following methods:

Autoclave cure	1 hour @ 260°F
Internal steam cure	2 hours @ 260°F (20 psi)
	or 5 hours @ 240°F (10 psi)
	or 8 hours @ 227°F (5 psi)
- k. Cure 2011 Neoprene repair by atmospheric steam 16 hours @ 212°F.