Application Procedures for Uncured Rubber Linings on Pipe

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1.0 GENERAL

1.1 This specification covers the procedures necessary to assure that all materials, equipment and operations are in conformance with RubberSource and industry standards.

1.2 Hold points may include (but are not limited to):

a. Pre-surface preparation
b. Ambient conditions/compressed air cleanness
c. Immediately following surface preparation
d. Adhesion test panels
e. Prior to each cement layer application
f. Following each material layer
g. Spark testing
h. Cure testing
i. Repairs

1.3 SSPC refers to specifications and published information of the “Steel Structures Painting Council”, 4400 Fifth Avenue, Pittsburgh, PA 15113, USA.

1.4 NACE refers to publications of the “National Association of Corrosion Engineers”, P.O. Box 218340, Houston, TX 77218, USA.

1.5 ASTM refers to standards of the “American Society for Testing of Materials”, 1916 Race Street, Philadelphia, PA 19103, USA.

1.6 RMA refers to technical bulletins of the “Rubber Manufacturers Association”, 1400 K Street N.W., Washington, D.C. 20005 USA.

SURFACE PREPARATION

2.1 Surfaces shall be inspected prior to the start of surface preparation to assure that they are dry and that visible deposits of oil and grease have been removed by "Solvent Cleaning" (SSPC-SP1). In addition, the inspector shall identify surface imperfections (such as weld spatter, porosity, pits, laminations, slivers or crevices) for repair as appropriate. (Ref. RMA Bulletins 1, 2, 3.)

2.2 Ambient conditions shall be checked before and during operations which will expose bare steel (e.g. abrasive blasting, power tools) to determine the air and surface temperatures, relative humidity and dew point temperature. These operations shall not be permitted when the surface temperature is less than 5 degrees F. above the dew point, the relative humidity is over 80% and the temperature is not in the range of 50°F (10°C) to 90°F (32°C).

ABRASIVE BLAST CLEANING

2.2.1 The compressed air supply for abrasive blasting shall be inspected before and during operations for the presence of oil and/or water by means of the white blotter test. The test shall be performed downstream of separators. The blotter shall be free of visible contaminants of oil or water after being held in the air stream at a distance of 18" (457mm) to 24" (610mm) inches from the source for at least two minutes. (Ref. SSPC Painting Manual Vol.1 Good Painting Practice, Chapter Six, Section VI.A. "Air Compressor and Air Cleanness".) Air pressure at the nozzle shall be determined using a hypodermic needle pressure gauge according to the procedure outlined in SSPC-Vol. I Good Painting Practice.

2.2.2 Chapter VI.E "Blast Cleaning Nozzles and Nozzle Pressure." A hypodermic needle gauge indicates the pressure at the nozzle, the end of the system.

2.2.3 Abrasive shall be inspected to assure that it is clean, dry and the type size capable of producing the desired surface profile. Reference data for determination of the adequacy of abrasive type and size can be found in NACE Publication 6G164 and SSPC-SP COM "Surface Preparation Commentary" Sections 5 and 6 which state the type, grade, and surface condition of the steel to be cleaned, type of blast cleaning system employed the finished surface to be produced. (See coloured chart at the end of this specification).

2.2.4 On stainless steel components, special care must be taken to assure that a profile of 2.0 mils (0.05mm) minimum is achieved.

2.2.5 Strict adherence to air temperature, 50°F (10°C) to 90°F (32°C), relative humidity and shell temperature 5°F (2.8°C) above the dew point will be required. At the beginning and middle of every shift, the inspector will record in the area of the tank they will be working, the steel temperature, the air temperature, and calculate the dew point and relative humidity.

RELATIVE HUMIDITY	MINIMUM TIME SPAN
Over 90%	No Application
86 – 90%	1 Hour
80 – 90%	4 Hours
50 – 79%	8 Hours
50% or Below	24 Hours

2.2.6 The entire surface of the tank to be lined is to be white metal blasted clean (SSPC-SP-5) to a profile of 2.0 mils (0.051 mm) minimum. This will be tested and recorded by the contractor using a Testex Press 0 film blast profile gauge (Testex, Inc.) or other suitable method. Applicator shall supply testing materials as specified and make them available for additional inspection.

2.2.7 All areas blasted are to be primed with one coat C-193 Green primer as soon as possible after blasting. Allow to dry one-hour minimum and preferably 24 hours.

2.2.8 All sandblasted areas are to be vacuumed and wiped to “white glove” clean to remove all contaminating materials prior to applying primers.

2.2.9 A test panel must be made prior to the start of production blasting to establish the proper grade of blast media to be used to achieve the required blast profile. The test and panel must be reviewed and approved. Test panel shall be supplied by the lining applicator.

2.2.10 Upon commencement of sandblasting and continuing for the remainder of the project; no gasoline, kerosene or diesel operated engines will be permitted in or near the tank without venting such equipment to the exterior atmosphere.

3.0 CEMENTING INSTRUCTIONS

3.1 Strict adherence to environmental conditions is required for all stages of adhesive application.

3.2 Vacuum C-194 if dust has accumulated on its’ surface. Apply one coat of C-193 Red intermediate over the C-194 Green primer that was applied to hold the blast. Allow to dry one hour.

3.3 Apply one coat C-195 Black tack cement over the C-194 at least on the same day as the C-194 has been applied. Allow to dry at least one half-hour. Once the C-195 has been applied over the C-194, the cement system is now stable.

3.4 Just prior to the application of the rubber, apply a second coat of C-195 tack adhesive. Allow to dry until tacky – about one hour.

4.0 APPLICATION OF RUBBER LINING

4.1 Strict adherence to environmental conditions as in 2.4.1 is required for all stages of lining application.

4.2 All layout marks on rubber must be made using chalk or chalk lines. Use of a metal scribe or other device that cuts or scratches the rubber is not permitted.

4.3 Rubber is to be cut using a skiving machine with blade set for a 30 degree skive cut or sharp hand knife. Reservoir of water must be kept full during cutting. Rough, wavy, irregular surface of skive cuts will be rejected. All mill edges and mills ends shall be cut off by liner.

4.4 Prior to application, rubber is to be protected from dust, grease and oil while laying on the cutting tables by covering with polyethylene sheets. All cutting tables must be smooth and flat and not leave joint impressions on the rubber.

4.5 Form a tube with stock using longitude skived butt seams. To facilitate stitching of the skived seam, a metal strip of aluminum 1" wide and 5 ft

4.6 To permit venting of air between pipe and lining, two lengths of cotton string are strung in the pipe after cementing and before lining. Strings may be tied at each end of the flange bolt holes. On sizes of 4" or over 4 "bleeder strings" are used. For large pipe, string every 2" in circumference.

4.7 The tube is to be drawn into the pipe on a liner, which is then removed, leaving the tuber in the pipe.

4.8 Inflate tube slowly with air pressure to about 10 psi, and hold pressure for 5 minutes. Various mechanical aids may be used to perform this operation depending on the volume to be lined.

4.9 Once the lining is inflated against the pipe wall, the excess stock is flared out over the flange face and trimmed flush.

4.10 Apply circular flange covering of 1/8" thickness (regardless of lining thickness), the OD of the flange stock to come within 1/8" of bolt holes. On sizes larger than 6", the flange stock may be lapped into the pipe lining instead of the skive used on smaller sizes. This will make a stronger joint but restricts flow

4.11 The ambient temperature during lining application shall be maintained between 50°F (10°C) and 120°F (51°C) and the relative humidity shall not exceed 80%. The temperature of the surface being cemented shall be at least 5°F (2.8°C) above the dew point or wet bulb temperature.

4.12 All deficiencies and defects found must be removed and relined prior to cure.

5.0 CURING

5.1 The rubber lining shall be cured by autoclave, or internal pressure as per the time and temperatures listed on the Material Specification Sheet.

5.2 It is recommended that a multi-point temperature recording device be used at the autoclave to monitor the cure.

5.7 A pressure cure is used it is extremely important to cool down under air pressure. If this is not done, the lining can blister and crack.

5.8 Internal temperature and outside surface metal temperature shall be monitored throughout the entire cure cycle on an hourly basis.

5.9 Line blind flanges or metal plate and cure for ASTM Adhesion Testing.

6.0 INSPECTION AFTER CURE

6.1 After cure, all surfaces are to be thoroughly inspected to the same criteria as the pre-cure inspection. Blisters (trapped air), loose laps, etc., are to be marked in chalk and numbered for future repairs.

6.2 All surfaces are to be spark tested (RMA Bulletin 13).

6.2.1 This spark test and all others shall be the same using Electro-Technic model BD-10AV or BD-50EV model testers operated at 15,000 volts (15kv).

6.2.2 All personnel spark testing shall carry a second spark tester because spark testers are subject to failure from overheating.

6.2.3 All testers are to be operated 15 minutes, and then turned off for 15 minutes. Testers must be allowed to cool down to avoid burnout.

6.2.4 A durometer (Shore “A” or “D”) hardness survey shall be made of the cured lining. A sufficient number of readings shall be taken at all elevations to assure all areas of the lining are properly cured. The lining shall be allowed to cool to ambient temperature before durometer readings are taken.

6.2.5 Monitor adhesion testing (per ASTM D429) on blind flange assembly that contractor has previously lined, installed and cured. The rubber shall be adhered to the steel so that tests will show strength of adhesion not less than 25 pounds (11.3 kilos) as determined by the standard test in accordance with ASTM D429.

6.2.6 All pinholes indicated by breakthroughs when spark testing shall be repaired. The repair materials, application methods, and curing procedures shall be based upon the type, size and frequency of the defect. Patching with materials other than those recommended by RubberSource is not permitted.

7.0 REPAIRS TO LINING

7.1 Bubbles or Blisters:

All lining material containing bubbles or blisters (air trapped between rubber & steel substrate) shall be removed to an area of good adhesion. Bevel edges of remaining rubber to approximately 45 degree angle to the metal and buff existing rubber back at least 4” (100mm) from the edge of area to be repaired. Repairs are to be made with the same rubber as the parent lining material.

7.2 All exposed steel surfaces shall be prepared by blasting or grinding to a clean bright metal finish.

7.3 Upon completion of surface preparation, adhesives shall be prepared and applied as follows:

` One coat C-193 on metal only
One coat C-194 on metal only
Two coats C-195 on metal & surrounding 4” (100mm) of parent lining

7.4 Upon completion of adhesives system application, rubber will be applied as follows:

7.4.1 To repair cracks and small areas, fill in the area flush with existing lining using uncured filler stock. Cover this with larger patch extending out 4” (100mm) on the existing lining, using the specified material. Activate the backside with toluol as well as the top of the inlay piece.

7.4.2 For large areas (above 12” (300mm) diameter or equivalent) to be covered, it will be satisfactory to use a single thickness of the repair stock over the metal area. Bringing stock up over an extended bevel in the existing lining and back 4” (100mm) on the original rubber. Activate the backside side with toluol before applying.

7.4.3 Should air be inadvertently trapped during these procedures, puncture blisters with a hypodermic needle and stitch down the stock. The air will bleed out through the needle. Remove needle, dry the area and stitch the needle hole closed. Apply a 2” (50mm) square patch of uncured rubber centered over point of needle insertion.

7.4.4 Completed repair shall be re-spark tested at 15,000 volts (15kv) in accordance with established procedures.

7.4.5 Area of repair shall then be re-cured in accordance with manufacturers’ material specification sheet.

7.4.6 Repaired areas will be re-checked in accordance with the spark tests.

7.5 Loose seam edges and skives must be corrected.

7.5.1 Loose seam edges and skives shall be repaired be grinding feather edging loose area, if it is possible to maintain a minimum seam overlap of 2” (50mm) upon completion of the repair.

7.5.2 If 2” (50mm) minimum overlap cannot be maintained, an area of 4” (100mm) back from defect on all sides shall be buffed to a rough grainy surface.

7.5.3 Adhesives system shall be applied in accordance with application of adhesives in this procedure.

7.5.4 Upon completing application of adhesive, an overlay will be applied to the cemented area, skives down and stitched in place.

7.5.5 Testing prior to curing will be in accordance with spark test procedures outlined in this procedure.

7.5.6 Curing will be in accordance with curing procedures outlined in this procedure.

7.5.7 Testing after curing will be in accordance with testing procedures as outlined in this procedure.
***Note:** The above procedures is based as a guideline**,** please refer to the NACE Standard Practice / Sheet Rubber Linings for Abrasion and Corrosion Services (SP0298-2007) for in-depth procedures and methods.

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