

APPLICATION SPECIFICATION GUIDE

1. Scope of Work

- 1.1 This specification covers materials and procedures to be used for lining vessels.
- 1.2 Whenever the word “Contractor” occurs in this specification, reference is made to the Rubber Lining Contractor.
- 1.3 Whenever the phrase “Company Site Representative” occurs in this specification, reference is made to the individual accountable to the company.

2. Material and Workmanship

- 2.1 The protective lining selected is to provide the maximum chemical and mechanical resistance for the service indicated. The adhesives used shall be compatible to the lining stock, as recommended by the rubber stock manufacturer, and shall meet the service and physical conditions indicated. See Section 6 for the “Service Conditions Information Required” Form.
- 2.2 Workmanship shall be high quality in all respects and the finished appearance shall conform to the highest standards.

3. Rejection

- 3.1 Failure by the contractor to comply with these specifications in any manner shall constitute sufficient cause for rejection of lining by the Company’s representative.

4. Storage and Handling

- 4.1 Rubber linings shall be stored in areas where they are not exposed to direct sunlight and where the temperature does not exceed 50°F.
- 4.2 The materials shall be stored and handled in a manner such that at no time is there any possibility of the material being exposed to freezing conditions, heat, flame, or spark which could damage or ignite the material.
- 4.3 Materials issued from storage shall be limited to the quality required for the use of each shift with sufficient lead time to allow it to reach ambient temperature.

- 4.4 Materials once removed from cold storage shall be stored in a shady area, or protected from direct sunlight.
- 4.5 The Contractor shall monitor container labeling, condition and shelf life expiration prior to use of materials.
- 4.6 The oldest materials in storage shall be issued for use first (up to the limit of shelf life).
- 4.7 Materials shall be transported to and stored at the work area in a manner to prevent their damage, contamination or access by unauthorized personnel.
- 4.8 Unused materials not required for seven days shall be returned to controlled storage.

5. Receiving

- 5.1 The Contractor is responsible for receiving and inspecting all materials delivered to the job site.
- 5.2 Abrasive Blast Media Receipt Method
 - 5.2.1 Abrasive blast media shall be surveyed for evidence of shipping damage, excessive leakage or loss of materials or evidence of contamination by water or other substances. Contaminated abrasive blast media shall be rejected.
 - 5.2.2 Abrasive blast media shall be promptly stored in a dry and protected area, in a manner which precludes damage to packaging and allows for reasonable access. As a minimum, abrasive shall be raised off the ground and securely covered with reinforced polyethylene.
- 5.3 Adhesives & Lining Receipt Method
 - 5.3.1 Each container shall be examined to verify the presence of a proper label identifying component type and size, batch *or lot* number, and date of **delivery** (or shelf life expiration date). **Rubber lining material must be stored in accordance with shelf life conditions in the specification.**
 - 5.3.2 Torn, broken or punctured lining material containers shall be marked and segregated for use as patch or seam material, if contents are damaged but still usable.
 - 5.3.3 Adhesive material containers which are punctured, leaking or otherwise exposed shall be marked and removed to the approved material disposal area.

6. Surface Preparation

- 6.1 Rubber shall be mechanically stripped in accordance with contractors standard practice.
- 6.2 Care must be used at weld seams and welded joints to prevent metal damage.
- 6.3 All rubber not removed in the initial stripping operation must be removed by buffing. No rubber shall remain after completion of this operation.
- 6.4 All metal damage incurred by air hammers from the stripping operation will be ground to a suitable finish for relining at the completion of this operation.
- 6.5 All buffing dust and debris shall be removed from the vessel and disposed of by the Contractor.
- 6.6 The Company Site Representative will inspect the equipment after elastomer removal.

7. Solvent Cleaning

- 7.1 Solvent clean per SSPC-SP1-63, as required to remove detrimental oil, grease, or dirt on the surfaces to be blasted.
- 7.2 The Company Site Representative will inspect the equipment after solvent cleaning.

8. Abrasive Blast Cleaning

- 8.1 All carbon steel surfaces shall be dry abrasive blasted in accordance with NACE 1/SSPC-SP5-63 "White Metal Blast Cleaning".
 - 8.1.1 Abrasive media shall be 20/30 Mesh, or Company approved blast material.
 - 8.1.2 Surface profile shall be 1.5 mils to 3.0 mils as determined by using a Keane Tator Comparator (Section 10).
 - 8.1.3 Blasting material shall be thoroughly dry and air shall be free of moisture and contaminants.
 - 8.1.4 The steel surface temperature must be a minimum of 5°F above the dew point.

- 8.2 Blow down, brush and/or vacuum to remove all visible abrasive and dust from the surfaces to be primed.
- 8.3 The Company Site Representative will inspect the equipment after abrasive blast cleaning.

9. Adhesives, Mixing and Application

- 9.1 Mixing and application to be in accordance with the “manufacturers recommended procedures” and the supplementary requirements of this Section.
- 9.2 All areas that are prepared and satisfactory shall have the cement system applied:
 - 9.2.1 Using only undamaged containers, mix and thoroughly agitate with a power driven mixer for 5 minutes.
 - 9.2.2 Apply each coat by brush or roller to all areas, frequently hand stirring the container to maintain contents in suspension.
 - 9.2.3 All adhesives shall be kept out of direct sunlight at all times before and after application.
 - 9.2.4 Tightly re-seal all containers when not in use.
 - 9.2.5 The primer shall be applied to the sandblast surface in accordance with the following schedule. The time span between surface preparation and adhesive application is dependent on the relative humidity.

Relative Humidity	Maximum Time Span
Over 90%	No application
86-90%	1 hour
80-85%	4 hours
50-79%	8 hours
50 or below	24 hours

In any case, there shall be no visible rust bloom on the prepared surface when the adhesive is applied.

- 9.2.6 The steel substrate temperature during the adhesive application shall be maintained between 60°F and 90°F. The temperature of the substrate shall be maintained at least 5°F above the dew point.
- 9.2.7 Separate containers and application tools shall be used for each type of cement.

9.2.8 During periods of high humidity, condensation of moisture can occur on the surface to be lined. If this happens, adhesive application shall stop until the condition is eliminated. All necessary precautions must be taken during adhesive application to prevent condensation of moisture inside the tank.

9.3 The Company Site Representative will inspect the vessel after all adhesives have been applied.

10. Installation of Lining

10.1 Lining thickness shall be shown on drawings or as called for in the purchase order and bid package.

10.2 Allow sheet stock to come to the temperature of the minimum substrate allowable temperature.

10.3 Install sheet and completely roll out making sure not to entrap air. If strings are used for venting, ends will be trimmed so as not to extend onto flange faces.

10.4 Panel lay-up must be staggered so that no area of the lining has more than two layers of sheet stock. Where three sheet corners must come together, the overlay shall be cut down before application of the third sheet. Every effort shall be made to avoid four layer overlaps including staggering alternate panels.

10.5 All edges and seams shall be laid straight, and all lapped seams shall be made by overlapping adjacent sheets by not less than two (2) inches. Overlapping edges shall be skived and turned down so as to give a smooth, neat appearance with no exposed tie gum. The number of seams shall be kept to a minimum, consistent with good workmanship. The bond between adjacent sheets of overlap shall be such that separation cannot occur.

10.6 Butt seams may be used only where lapped seams are impractical. Butt seams shall be covered with a cap strip 4 inches wide.

10.7 The rubber lining shall extend out on all flanges, manholes, and nozzles. Circumferential joints in nozzles shall be located so as not to restrict the opening.

10.8 The ambient temperature during lining application shall be maintained between 50°F and 100°F and the relative humidity shall not exceed 90%. The temperature of the surface being cemented shall be at least 5°F above the dew point.

10.9 Equipment requiring double linings shall be lined such that item 10.6 (above) is

accomplished for the outer lining only. Seams of the underlying lining shall be butt joints and shall not be within six (6) inches of the lapped seams of the overlay lining unless approved by the Company Site Representative.

- 10.10 Internal flanges shall be completely lined, including the bolt holes.
- 10.11 After cure, all flange faces shall be ground smooth and even.
- 10.12 Lining shall be spark tested with a spark tester adjusted to 10,000 to 15,000 volts.
- 10.13 Lining shall be checked for blisters, physical damage, looseness of splices, etc. Defective areas shall be repaired and the lining shall be retested and inspected after cure.
- 10.14 All air blisters shall be removed from between the lining and the metal surface. Any air not removed by rolling shall be removed with a hypodermic needle. Each needle puncture is to be capped with a patch. All patches must have 45 degree beveled edges and be a minimum of 2 square inches. This repair procedure shall be the absolute last resort. Every effort shall be made to prevent an entrapment when stitching the lining in place.
- 10.15 A test panel will be prepared, lined and cured concurrently with the equipment. Sample panel design to be supplied by the Company Site Representative.
- 10.16 The Company Site Representative will inspect the equipment after application of all elastomeric sheet lining.

11. Cure of Lining

- 11.1 Vulcanizing or curing methods, including temperature, time required, etc., shall comply with the stock manufacturer's written procedures for the rubber stock to be used.
- 11.2 Uniform temperatures shall be maintained during the curing process, and the lining or covering shall be protected against excessive heat losses to insure uniform vulcanizing conditions. Vessels should be tarped or otherwise insulated from the detrimental effects of in-climate weather and temperatures below 60°F.
- 11.3 The following instrumentation shall be installed to monitor temperatures:
 - ④ Internal temperature and pressure measuring devices
 - ④ Internal temperature recorder
 - ④ Outside steel temperature measuring devices
- 11.4 Contractor may use a multi point recorder to measure temperatures required on

the "Record of Temperature During Cure" log sheet. These readings are to be recorded hourly, every shift during temperature warm-up and throughout the entire cure cycle.

- 11.5 Cure times may have to be adjusted in accordance with data or curves on outside metal surface temperature vs. time provided by the lining manufacturer.
- 11.6 The cure times shall be in accordance with the manufacturer's recommendation.
- 11.7 Temperature and pressure shall be monitored throughout the entire cure cycle.
- 11.8 Cured linings shall attain hardness values recommended by the manufacturer.

12. Inspection and Repairs After Cure

- 12.1 A durometer (Shore "A") 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.
- 12.2 Spark testing shall be conducted over the entire surface lining with a high potential spark tester adjusted to 10,000 - 15,000 volts.
- 12.3 All joint and seam areas shall be visually inspected.
- 12.4 Defective areas shall be repaired and the lining shall be retested and inspected after curing. The repair materials, application methods and curing procedures shall be based upon the type, size and frequency of the defects.
- 10.6 The adhesion test sample that the contract has previously lined and cured shall be tested in accordance with ASTM D-429. The rubber shall be adhered to the steel so that tests will show a strength of adhesion that is specified for each lining.
- 12.6 All lining material containing bubbles and blisters shall be removed to an area of good adhesion. Bevel edges of remaining rubber to approximately 30° angle to the metal and buff existing rubber back at least 4" from the edge of area to be repaired.
- 12.7 All exposed steel surfaces shall be prepared by grinding to a clean bright metal finish.
- 12.8 Upon completion of surface preparation, adhesives shall be prepared and applied in accordance with the procedures for Adhesives, Mixing and Application; prime coat only on the steel and the remaining adhesive system on the entire patch area.
- 12.9 Upon completion of adhesives system application, rubber shall be applied as follows:

- 12.9.1 To repair cracks and small areas, fill in the area flush with existing lining using full thickness original lining stock. Cover this with larger patch extending out 4" over the existing lining.
- 12.9.2 For larger areas (above 12" diameter or equivalent) it will be satisfactory to use a single layer of the full thickness original lining stock over the metal area bringing stock up over the bevel and back 4" over the existing lining.
- 12.10 Area of repair shall then be re-cured in accordance with the System Steam Curing Procedure.
- 12.11 Areas will be re-checked in accordance with spark test procedures and hardness.

13. Inspection and Documentation

- 13.1 This Section outlines all inspections and documentation required by the Contractor for the satisfaction of the contract. It shall be the Contractors' responsibility to maintain all documentation and turn over a complete package to the Company Site Representative at the completion of the contract. Routine type "log" entries such as temperature, pressure, relative humidity, time, date, etc. will be entered by the Contractor. Other entries for documentation concerning the quality of work such as surface profile, seams, overlaps, spark testing, etc. will be made by the Contractor after proper testing and inspection by the Company Site Representative. The Company Site Representative will review all entries on a daily basis.
- 13.2 The following inspections are required for surface preparation:
 - 13.2.1 Inspection after elastomer removal and buffing to assure no metal damage has taken place.
 - 13.2.2 Inspection after solvent cleaning for SSPC-SP1.
 - 13.2.3 Inspection after abrasive blast cleaning per SSPC-SP5 to assure a minimum surface profile of 2.0-3.0 or equal mils. Use a KTA-Tator Comparator or something similar for this inspection and document. Make one check at minimum of 90° increments for each staging level.
 - 13.2.4 Inspection after blowdown, brush and/or vacuum cleaning prior to application of primers and adhesives.
- 13.3 Documentation: All inspections listed above shall be documented on the

INNOVATION TO MAKE IT FIRST, QUALITY TO MAKE IT LAST inspection sheets for this contract.

13.4 The following inspections of rubber lining application are required:

13.4.1 Visual inspection of surfaces to receive adhesive to assure there are no visible rust blooms on the surface.

13.4.2 Visual inspection of mixing and adhesives to assure compliance with manufacturers recommendations, proper adhesive number and proper sequence of application.

13.4.3 Visual inspection of adhesive application for complete coverage, film thickness and drying time. Use a KTA-Tator, Inc. Positector or equal for measuring dry film thickness.

13.4.4 Visual inspection of the lining raw sheet stock, temperature of the sheet stock, rolling of the sheet and stitching of seams, seam width and overlap and lining of internal and external flanges, nozzles and openings.

13.4.5 Visual inspection of all steam cure equipment such as pressure gauges, condensate removal system, pressure vacuum relief system, internal & external temperature measuring devices and closure of all openings to assure steam cure is in strict compliance with manufacturers recommendations.

13.4.6 After repairs, visual inspection and re-spark test.

13.4.7 Visual inspection at job completion.

13.5 Documentation: All inspection entries for rubber lining application shall be documented on the inspection sheets for this contract.

14. Inspection Documents

14.1 Responsibility

14.1.1 The Contractor shall be responsible for proper documentation of all inspection sheets covered by this specification. This will become a permanent record for each project/contract.

14.2 Inspection sheets (attached)

14.2.1 Record of Atmospheric Conditions

This sheet will be used to record atmospheric conditions during surface preparation including sandblasting, application of primers and adhesives and installation of rubber. Readings to be recorded every hour of every

14.2.2 Inspection Log: Surface Preparation, Primary and Spark Test

This inspection log will be used for the four inspection activities listed during these inspections. The “Comments” column will be used to describe the area being tested such as “Pipe Spool Mark No.,” “N-E Floor Quadrant,” etc. and to list inspection deficiencies or failures.

14.2.3 Record of Temperature During Cure

During the steam cure, this record or log will be maintained. Entries will be made every hour of every shift during warm-up and steam cure.

