

***CORROSION ENGINEERING SPECIFICATION FOR
INSTALLATION***

***TUFCHEM[®] II / TUFCHEM[®] II SPRAY GRADE AND
PENNCHEM[®] 97 MEMBRANE INSTALLATION ON STEEL***

1. SCOPE

- 1.1 This procedure governs the installation of urethane and urethane asphalt membranes manufactured by Corrosion Engineering on carbon steel, including Cor-Ten steel. Throughout this document the product description “TUFCHEM II Membrane Spray Grade” may be referenced as the base material. It should be assumed the same procedures shall apply for PENNCHEM 97 and TUFCHEM II Membrane unless specifically noted as being applicable to Spray Grade material. Contact Corrosion Engineering if in doubt.

2. MATERIALS

2.1 Primer:

- 2.1.1 PENNGUARD Block Primer manufactured by Corrosion Engineering, applicable product data sheet is CE-227.

2.2 Membrane:

- 2.1.2 Urethane or urethane asphalt membranes manufactured by Corrosion Engineering include TUFCHEM II Membrane - Spray Grade, data sheet CE-228, TUFCHEM II Membrane - Regular Grade, CE-196, and PENNCHEM 97 Membrane, CE-293.

3. SURFACE PREPARATION - NEW CONSTRUCTION STEEL

- 3.1 Unless specified by Corrosion Engineering in writing to the contrary, the steel shall be blasted to a near white blast cleaning conforming to SSPC-SP10, NACE #2, or SA 2.5.

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 2 OF 10

- 3.2 All welds shall be continuous. Intermittent or spot welding is not acceptable.
- 3.3 Weld spatter, slag, and old anchor welds shall be removed and the area ground smooth and flush with the substrate. Chipping is acceptable if followed by grinding for finish.
- 3.4 Pinholes, pits, blind holes, porosity, undercutting or similar depressions shall not exist in the finished surface of the weld before or after blast cleaning.
- 3.5 Welds shall be finished in conformance with American Welding Specification D.1.1-8Q Section 3.6 Weld Profiles and Section 3.7 - Repairs.
- 3.6 Plates welded together shall be properly aligned. Butt-welded joints are preferred over lap-welded joints. If lap-welded joints are present they shall be fully welded on the inside.
- 3.7 All connections to the equipment shall be flanged.
- 3.8 The structural reinforcing members shall be installed on the equipment exterior wherever possible. Should internal structural reinforcing members be present, they shall be fabricated of simple shapes, such as smooth round bars or pipe for ease of applying the lining material. The use of angles, I-beams and other complex shapes is not preferred. Should these complex shapes be lined, these members shall be fully seal-welded and edges ground smooth.
- 3.9 All surfaces shall be dust, dirt, grease, and oil-free. Any foreign material which will interfere with adhesion must be removed.
- 3.10 Surfaces shall be dry and at a minimum temperature of 50° F (10° C), and a maximum temperature of 90° F (32° C) for brush and trowel application. The surface shall be dry and at a minimum temperature of 60° F (16° C), and a maximum temperature of 90° F (32° C) for spray application of urethane asphalt membranes. Surfaces shall be 5° F (2° C) above the moisture dewpoint.
- 3.11 Steel shall not be sandblasted if the surface temperature is less than 5° F (2° C) above the moisture dewpoint or if condensation is imminent, there is moisture on the surface, the sandblasting abrasive is wet, there is insufficient light, or the sandblasting operation interferes with priming or urethane asphalt membrane application.

4. MEMBRANE STORAGE AND MIXING

- 4.1 Individual product data sheets shall also be consulted on the mixing, storing, and application procedures for each product.
- 4.2 Remove the lid from the TUFCEM II Membrane-Spray Grade can. Inspect for damage incurred during transit. Insure that there are no leaks in the Component B container and that there is no water present on or in Component A.
- 4.3 Utilizing a drill, delivering shaft rotation of 400 to 600 rpm, and the proper mixer blade, mix Component A by itself for a minimum of one minute.
- 4.4 Open Component B. Continue to mix Component A at the recommended speed. Begin pouring the Component B into the Component A (there will be a vortex created by the mixer). Total elapsed time for the addition of the component B should be 15 to 20 seconds while mixing.
- 4.5 When the material temperature is 70°F (21°C) or higher, mix for at least three (3) minutes using a good mixing technique to yield a uniform mix. When the temperature of the components is 50°F (10°C), mix for at least five (5) minutes using a good mixing technique to yield a uniform mix.
- 4.6 A good mixing technique involves movement of the rotating blade within the pail. Move the blade around the base of the pail in a circular motion and also lift the blade from the base of the pail without bringing the blade above the surface of the liquid and continue the circular motion around the side of the pail.
- 4.7 The TUFCEM II Membrane-Spray Grade is a thixotrope i.e. - it will thicken if allowed to sit after the components have been mixed together. Material is generally ready for use immediately after mixing.
- 4.8 Never allow moisture or other contaminants to come in contact with either membrane component or the wet mix.

5. APPLICATION

- 5.1 PENNGUARD® Block Primer may be spray roller or brush-applied to a full wet film, avoiding runs and sags. Application by spray is preferred for uniform and consistent results. Make even, parallel passes applying Primer at a rate of 225/250 sf/gal (22 sm per gallon) insuring substrate is uniformly covered. WFT (Wet Film Thickness) testing is not practical with Pennguard Block

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 4 OF 10

Primer. A visual check along with consumption monitoring is the best method to determine correct coverage.

Read and understand Material Safety Data Sheets and labels for any solvent to be used.

5.1.1 Complete details outlining the spray installation PENNGUARD® Block Primer can be found in Corrosion Engineering specification CES-350, Section 13.3 through 13.6. Consult this specification for detailed primer installation instructions.

5.2 Corrosion Engineering's urethane and urethane asphalt membranes may be brushed, or troweled. PENNCHEM 97 and TUFCEM II Membrane are recommended to be applied by trowel only. TUFCEM II Membrane Spray Grade is recommended to be applied by spray.

Spray application of TUFCEM II Membrane-Spray Grade is preferred in lining continuous areas, as well as structural reinforcing members, and around metal anchors.

5.3 Recommended equipment for spray application of TUFCEM II Spray Grade is as follows:

Mastic Pump Graco Xtreme Airless Pump - X45DH4 (45:1 Fluid to Air Ratio) or X70DH4 (70:1 Fluid to Air Ratio). Pump has built in filter assy. w/60 mesh screen. All Pumps should have inlet siphon hose/tube removed. A piece of 1 ½" (38 mm) pipe should be cut and threaded the depth of 5 gallon pail. Inlet of pump pipe should be submerged in product.

Hydra-mastic Gun Graco Mastic Gun XTR705.

Gun Tip XHD001 Housing
XHD543 Tip

Material Hose 50' (15 m) - ½" (13 mm) hose H75050 (2 sections)
50' (15 m) - 3/8" (9-10 mm) hose H73850 (up to 2 sections w/70:1 pump.
Above hose sizes depend on length of run anticipated and pump size. 3/8" hose to gun is preferred due to more flexibility but gun must be close enough to pump. Temperature may impact hose selection as viscosity is increased in cooler weather. Contact Corrosion Engineering if in doubt.

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 5 OF 10

Inline Filter	Spray Quip inline Filter with 0.020" mesh screen
Air Compressor	Air Compressor: 150 SCFM (270 cu/m per hr) @ 100 psi (6.9 bar).
Air Hose	3/4" or 1" (19-25 mm) to pump inlet Air Regulator(3/4" minimum size regulator).

NOTE: The above equipment list is a suggested starting point based on field experience. Site conditions can vary this selection. Contractor shall be experienced in spray equipment intricacies and compatibility to optimize the spray characteristics (spray ability) of material. Consult Corrosion Engineering if there are any questions on equipment specifics.

- 5.4 The membrane lining shall be applied in a minimum number of coats to achieve a dry film thickness of 3/32" (93 mils) to 1/8" (125 mils) minimum, or as otherwise specified. Thickness shall be dependant upon mechanical service requirements and whether the membrane will be subsequently protected by brick or shall serve as a stand alone lining. For non-immersion conditions, TUFCEM II Membrane-Spray Grade may be applied to a thickness of 125 mils (3 mm) WFT which will result in a DFT lining thickness of +-93 mils (2.25 mm). Immersion service a total DFT of 125 mils (3 mm) is suggested. Overhead surfaces may require three coats.
- 5.5 Apply subsequent coats before the preceding coat is "dry to the touch". The membrane is "tacky wet" if, when touched, it comes off on one's fingers.
- 5.6 Wet TUFCEM II Membrane Spray Grade does not bond well to cured TUFCEM II Membrane Spray Grade and hence should TUFCEM II Membrane Spray Grade cure for greater than 8 hours @ 50°F (10°C), 4 hours @ 70°F (21°C), and 1 hour at 90°F (32°C), it shall be necessary to first clean the cured TUFCEM II Membrane Spray Grade. The surface should be cleaned by solvent-wiping with isopropyl alcohol. Allow 5 minutes of solvent evaporation before reapplying fresh TUFCEM II Membrane Spray Grade. For best adhesion, cured Membrane should be abraded to roughen the surface and remove surface gloss. When work stoppage is anticipated, remove as much of the TUFCEM II Membrane Spray Grade as practical from the substrate and edges of the completed lining that will have additional lining when the stoppage ends.

Read and understand Material Safety Data Sheets and labels for any solvent to be used.

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 6 OF 10

- 5.7 Membrane over spray, runs or sags shall not remain on primed steel. Membrane which has begun to set on primed steel to be coated later shall be removed with MEK or isopropyl alcohol. Mask primed areas to be lined later to avoid overspray contamination. Read and understand Material Safety Data Sheets and labels for any solvent to be used.
- 5.8 Unused membrane which has begun to set before application cannot be recovered and shall be discarded.
- 5.9 The membrane lining is sufficiently cured to accept the inorganic monolithic lining after 48 hours at 60°F (16°C), 24 hours at 75°F (24°C), or 16 hours at 90°F (32°C).
- 5.10 For cleaning the surface of cured Membrane, use isopropyl alcohol (IPA) As noted in section 4.6 Read and follow manufacturers MSDS's and handling precautions when using this chemical.

Use mineral spirits for cleaning and soaking trowels, etc., for loosening cured TUFCEM II Membrane.

6. INSPECTION AND TESTS

- 6.1 The abrasively blasted surface shall be visually inspected to ensure it conforms to SSPC-SP10, NACE #2, or SA 2.5. The surface shall then correspond to the color prints in accordance with the pictorial surface preparation standards for painting steel structures published by the Steel Structures Painting Council. Photographs representative of the sandblasted steel shall be taken during each blasting shift and logged.
- 6.2 Air, surface and material temperature shall be measured and recorded every two hours during sandblasting, priming and membrane application. The moisture dewpoint shall also be measured and recorded during sandblasting, priming and membrane application every two hours.
- 6.3 Random dry film thickness measurements (4 per 100 sf (10 sm)) shall be taken of the urethane asphalt membrane and recorded. Dry film thickness shall be as outlined in paragraph 5.4 or as otherwise specified.
- 6.4 After installation and cure of the membrane lining, it shall be spark-tested for pinholes, using a voltage of 14,000+/-20% for a 1/8" (3 mm) minimum thickness in accordance with the procedure on Spark Testing Corrosion Engineering Urethane Asphalt Membranes in section 7 below.

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 7 OF 10

6.5 Recorded measurements shall be documented on a suitable form. Forms shall include a sandblasting, primer and membrane lining record. The priming and membrane lining record shall include air, surface, material and moisture dewpoint temperatures, visual inspection results, dry film thickness of urethane asphalt membranes, and spark test results for each time and location.

7. SPARK TESTING

7.1 Detection and correction of defects in protection linings are important factors in an effective corrosion control program. High voltage electrical inspection is one method in general use.

7.2 Electrical inspection is a test of the continuity of a protective lining. This type of inspection does not provide information concerning lining resistance, bond, physical characteristics, or the overall quality of the lining, nor is it intended to do so. It will detect bubble or blister-type voids, cracks, thin spots, and foreign inclusions or contaminants in the lining that are of such size, number, or conductivity as to significantly lower the electrical resistance of the lining.

7.3 Spark testing is an excellent method of detecting leaks not visible to the human eye. There are two principal types of spark testers in common use. These are the electrostatic tester and the DC type of detector. The electrostatic testers are known as high frequency Tesla coil type electrostatic tester. This type of spark tester does not require grounding to the test piece. It constantly emits a spark which is blue in color, provided it does not come into direct contact with the metal. When a break in the lining is passed over, however, the spark turns a bright white and points toward the break. The results of this test are determined visually as there is no audible monitor unit on the instrument itself. Care must be taken when using this instrument because damp spots or surface contaminants may also have a tendency to change the color of the spark. One must be sure that the surface is clean to conclusively establish the presence of a break in the lining. This type of tester is used when inspecting conductive linings.

7.4 The DC type high voltage detector is used for non-conductive linings applied to conductive substrates. The instrument consists of a ground cable, an exploring electrode of conductive neoprene, brass, steel, etc, and a detector unit with multiple voltage outputs. The electrode is the means by which the electrical potential is applied to the surface of the lining. The electrode should always be in motion when the testing voltage is applied, to avoid possibly burning a hole in the lining. The ground cable is securely attached

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 8 OF 10

to the bare substrate, or alternatively, the part being tested is grounded to the earth and the instrument ground wire is permitted to drag across the earth. The exploring electrode is passed across the entire surface emitting a spark to the substrate through the air gap at discontinuities, simultaneously detonating an audible signaling device in the unit.

- 7.5 Common sense should dictate proper care of any spark testing unit. Several important points to remember would be to keep all parts of the unit clean and free of moisture at all times. The electrode should be kept free of lining materials and in such mechanical condition to maintain contact with the lined surface at all times. All electrical contacts should be kept free of corrosion. After choosing the correct instrument for the lining to be tested, it is a relatively simple matter to conduct an accurate spark test inspection.
- 7.6 The DC type procedure for spark testing urethane asphalt membranes is as follows: A suitable instrument is the "Spy High Voltage Model 900 Holiday Detector" with a range of 10 kv-22 kv. The Spy Model 900 is a DC type high voltage detector used for testing non-conductive linings applied to conductive substrates. Components of this unit include a ground cable an exploring electrode of conductive neoprene, brass, steel, etc. and a detector unit with multiple voltage output. The electrode, which must remain in contact with the surface at all times, is the means by which the electrical potential is applied to the lining. The electrode should always be in motion when the testing voltage is applied to avoid possibly burning a hole in the lining. The ground cable is securely attached to the bare substrate or if conditions make it necessary, the unit being tested is grounded to the earth and the instrument ground wire is dragged across the earth during testing.
- 7.7 Testing the Lining
- 7.7.1 To test a lining:
- 1) Select proper voltage (refer to lining manufacturer specifications).
 - 2) Attach ground wire to substrate securely
 - 3) Activate the unit
 - 4) Sweep electrode over lining, making full contact with surface
- When a void or hole is passed over, the instrument will emit a spark through the electrode at the defective area, simultaneously detonating an audible signaling device in the unit
- 7.8 Test Voltage
- 7.8.1 The minimum testing voltage for a particular coating thickness shall

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 9 OF 10

be within 20% of the value determined from the following table:

Lining Thickness

Mils	Inches	Metric	Testing Voltage*
16	1/64	0.39 mm	5,000
31	1/32	0.79 mm	7,000
62	1/16	1.58 mm	9,800
94	3/32	2.36 mm	12,100
125	1/8	3.17 mm	14,000
156	5/32	3.96 mm	15,000
188	3/16	4.75 mm	17,100
250	1/4	6.35 mm	19,700

* Test voltages set forth are taken from NACE Standard R.-02-74

8 REPAIR AND RELINE OF EXISTING STEEL STRUCTURES

8.1 All pinholes found by spark testing, damaged areas, thin spots or other imperfections shall be marked with a grease-free chalk, and the areas repaired as follows:

8.1.1 Damaged membrane consisting of cuts or tears must be removed back to sound lining. It may not be necessary to remove lining down to the primed steel. Abrade existing membrane to promote adhesion. Exposed steel should be prepared to an SSPC SP6 finish.

8.1.2 Solvent-wipe affected area with methyl ethyl ketone (MEK), or isopropyl alcohol (IPA). Allow for a 2" (50 mm) minimum overlap onto unaffected membrane. Read and understand Material Safety Data Sheets and labels for any solvent to be used.

8.1.3 Allow 5 to 10 minutes, at 70°F (21°C), for solvent evaporation. Apply urethane asphalt membrane lining in accordance with the Product Data Sheet. Small areas may be easier to trowel or brush repair. Apply urethane or urethane asphalt membrane lining in accordance with Product Data Sheet.

8.1.4 Spark testing and dry film thickness inspection shall be performed in all repaired areas and recorded.

9. SAFETY PRECAUTIONS / DISCLAIMER

9.1 Read and follow the hazard information, precautions and first aid directions on the individual product labels and material safety data sheets before using. While all statements, technical information, and recommendations contained

INSTALLATION SPECIFICATION - TUFCEM® II / PENNCHEM® 97 ON STEEL
CES-326
10/12 SUPERSEDES 11/09 PAGE 10 OF 10

herein are based on information our company believes to be reliable, nothing contained herein shall constitute any warranty, express or implied, with respect to the products and/or services described herein and any such warranties are expressly disclaimed. We recommend that the prospective purchaser or user independently determine the suitability of our product(s) for their intended use. No statement, information or recommendation with respect to our products, whether contained herein or otherwise communicated, shall be legally binding upon us unless expressly set forth in a written agreement between us and the purchaser/user.

- 9.2 Please contact Corrosion Engineering for specific recommendations at +1-610-833-4000 or fax +1-610-833-3040.

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