1.00 GENERAL

1.01 Scope

A. This specification covers the work necessary to furnish and install a 100% solids polyurethane elastomer such as Sher-flex, Silkaflex, etc or equivalent concrete potable water tank rehabilitation and lining system, as shown on the drawings and as specified herein. Work includes, but is not limited to, the following.

1. Stopping Leaks by repair and sealing of the concrete to include removal of unsound and unbonded materials, chemical grouting, patching compounds, resurfacing compounds, and plugging compounds.

2. Surface preparation, and installation of the Polyurethane Elastomer Lining System such as Sher-flex, Silkaflex or equivalent, to include protection of surfaces not to be treated, touch-up, clean-up, and appurtenant work all in accordance with the requirements of the Contract Documents and this Specification.

3. Surface preparation and protective coating of miscellaneous exposed structural and mechanical metals at the interior of the concrete tank.

1.02 Referenced Specifications Codes and Standards

A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section. All references and standards listed shall be the latest revisions. Joint and individual documents are referenced.

1. SSPC – The Society for Protective Coatings
   40 24th Street, 6th Floor
   Pittsburgh, PA 15222-4643
   (412) 281-2331

2. NACE – National Association of Corrosion Engineers
   P.O. Box 218340
   Houston, TX 77218-8340
   (281) 492-0535

   a. SSPC-SP 13/NACE No. 6 Surface Preparation of Concrete
   b. SSPC-SP10/NACE No. 2, Near White Metal Blast Cleaning
   c. SSPC-PA9, Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
   d. NACE RP0892 “Linings over Concrete for Immersion Service”
   e. NACE SP0188 “Discontinuity Holiday Testing of Protective Coatings”
   f. NACE RP 6F-164 “Curing of Interior Tank Linings”
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3. ICRI – International Concrete Repair Institute
1323 Shepard Dr., Suite D
Sterling, VA 20164-4428
(703) 450-0116

4. ASTM – American Society for Testing and Materials
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
(610) 832-9585
a. ASTM D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
b. ASTM E-337: Test Method for Measuring Humidity with a Psychrometer
c. ASTM D 4258 “Practice for Surface Cleaning Concrete for Coating”
e. ASTM D 4262 “Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces”
f. ASTM D 4414 “Standard Practice for Measurement of Wet Film Thickness by Notch Gages”
g. ASTM Committee D01.23: Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gauge
i. ASTM D 4787 “Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates”
j. ASTM D 5162 “Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates”

5. ACI – American Concrete Institute
Box 19150, Redford Station
Detroit, Michigan 48219
(248) 848-3700
a. ACI 350R-01 Requirements for Environmental Engineering Concrete Structures
b. ACI 350.1 “Testing of Reinforced Concrete Structures for Water Tightness”
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c. ACI 350.2 “Concrete Structures for Containment of Hazardous Material”  
d. ACI 503 “Use of Epoxy Compounds with Concrete”  
e. ACI 504 “Guide to Sealing Joints in Concrete Structures”  

6. AWWA – American Water Works Association  
6666 West Quincy Avenue  
Denver, Colorado 80235  
(303) 794-7711  
a. ANSI/AWWA C652 “Disinfection of Water Storage Facilities”

7. ANSI – American National Standards Institute  
1899 L Street, NW, 11th Floor  
Washington, DC 20036  
(202) 293-8020  
a. ANSI/NSF Standard 61 “Drinking Water System Components”

1.04 Submittals

A. Submit product data for each component specified including data substantiating that the proposed materials comply with specified requirements and recommendations by the manufacturer covering all materials.

1.05 Quality Assurance

A. Acceptable Manufacturers: The manufacturer of the specified products shall have in existence, for a minimum of five (5) years, a program of training, certifying and technically supporting a nationally organized Approved Contractor Program with annual recertification of its participants. Manufacturer must provide five (5) project histories with names, dates, addresses, and phone numbers of contact persons for projects of similar scope, two of which have been completed at least three (3) or more years ago.

B. Single Source Responsibility: Provide primers and undercoat materials produced by the same manufacturer, or recommended by manufacturer, for each type of Special Coating / Lining specified to ensure compatibility, and proper chemical and mechanical bond.

C. Installer Qualifications: Engage only factory trained and qualified applicator that have successfully completed applications using specified materials on projects of similar size and scope. Provide references with name, address, and telephone number.

1. Contractor shall have completed an approval program in the use of heated plural component equipment and the specified polyurethane elastomer material such as Sher-flex, Silkaflex or equivalent. Provide
written certification from the material manufacturer that the contractor is an approved contractor of the system specified.

D. Equipment Requirements:

1. Correct material processing equipment is critical in achieving correct mix for the plural component system specified.

2. Equipment must be heated plural component unit capable of consistently producing 4000 psi, at 140°F to 160°F.

3. Acceptable pumps and spray gun: Graco Hydra-Cat, Graco XP50/XP70, WIWA Duo-Mix. Equivalent application equipment may be substituted and must be approved in writing by the manufacturers Technical Service Group.

E. Substitutions:

1. Manufacturers seeking approval of products other than the materials used as the basis of design must supply cured samples, full product information, project histories and references, technical data with specifications, SDS, and certifications regarding conformity of performance properties from an independent testing laboratory. The product being submitted for approval must meet all requirements of the performance properties specified within this specification. Compliance with the above quality assurances must be provided in written form at least fourteen (14) days before bids are received. Omission or non-conformance of any item will result in rejection of the request.

F. Pre-Installation Conference

1. The contractor, the installation sub-contractor, and the concrete tank lining system manufacturer’s representative shall meet on site with the owner’s representative. Particular emphasis shall be placed on these specifications, safety, weather conditions, surface preparation, material application, and inspection.

2. The contractor shall submit to the owner’s representative any revisions or changes agreed upon, reasons thereof, and parties agreeing or disagreeing with them.

E. Substrate Conditions: Do not proceed with work until substrate preparation and tolerances have been approved by the owner’s representative, concrete tank lining system manufacturer’s representative, the approved installation sub-contractor, and the contractor.

1.06 Delivery, Storage, and Handling

A. Deliver products to the job site in manufacturer’s original, unopened containers bearing manufacturer’s name and label and the following information
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1. Product name
2. Product description (generic product classification)
3. Manufacturer’s lot number
4. Color

B. Store materials in sealed original manufacturer’s containers. Store materials in a protected area out of direct sunlight. Keep containers clean and undamaged. Adhere to manufacturer’s published storage temperature and shelf life recommendations. Protect all materials from freezing.

2.00 PRODUCTS

2.01 Acceptable Manufacturers and Materials

A. The Polyurethane Elastomer Lining System such as Sher-flex, Silkaflex or equivalent shall consist of one or more systems for concrete repair and corrosion protection. Products are specified as a standard of quality, and are manufactured or distributed by The Sherwin-Williams Company, Cleveland, Ohio.

1. Stopping Leaks - Infiltration leakage of all concrete shall be stopped by trenchless technology method of chemical grouting with polyurethane grouts. Products shall be manufactured by Avanti Grouts or equivalent and shall be classified as “Hydrophobic Foam”, “Hydrophilic Gel” or “Hydrophilic Foam” grouting compounds or a combination of these materials and methods as recommended by the manufacturer.

Hydrophobic Polyurethane Grouts are hydrophobic polyurethanes that when mixed and makes contact with the water, is designed to fill large voids in rock fissures, gravel layers, and cracks in concrete structures and for the cut-off of gushing water.

Avanti Grouts AV-280 Hydrofoam with AV-281 Hydrocel
Properties - Uncured
Appearance: Amber liquid
Viscosity: 1700-2000 cP @ 72°F
Flash Point: >200°F
Specific Gravity: 1.14
Weight: 9.49 lbs/gal +/- 3%
Properties – Cured
Appearance: Pale yellow rigid foam
Toxicity: Non-Toxic

Hydrophilic Polyurethane Gels are hydrophilic polyurethanes designed to react with water and form a water impermeable gel mass. When they come into contact with water, the grout begins to
foam and gel, and depending on the temperature and amount of water present, quickly cure to a flexible, impermeable foam or gel mass unaffected by mildly corrosive environments.

**Avanti Grouts AV-202 Multi-Grout**
Properties - Uncured
Appearance: Brown resin
Viscosity: 3200-6000 cP @ 72°F
Flash Point: >200°F
Specific Gravity: 1.147
Weight: 71.7 lbs/ft³ +/- 3%
Properties – Cured
Appearance: Milky colored flexible foam

Hydrophilic Polyurethane Foams are designed to form a flexible gaskets or plug in joints and cracks in concrete. When it comes into contact with water, the grout expands quickly and cures to tough, flexible, adhesive, closed-cell, foam that is essentially unaffected by mildly corrosive environments.

**Avanti Grouts AV-202 Multi-Grout**
Properties - Uncured
Appearance: Brown resin
Viscosity: 3200-6000 cP @ 72°F
Flash Point: >200°F
Specific Gravity: 1.147
Weight: 71.7 lbs/ft³ +/- 3%
Properties – Cured
Appearance: Milky colored flexible foam

Hydrophobic Polyurethane Grouts that are designed to form flexible gasket or plugs in very tight joints and hairline cracks. When they come into contact with water the grout expands and depending on temperature and the amount of accelerator used quickly cures to a tough, flexible closed cell polyurethane foam that is essentially unaffected by corrosive environments.

**Avanti Grouts AV-248 Flexseal LV with AV-249 Catalyst LV**
Properties - Uncured
Appearance: Milky white to clear
Viscosity: 550-830 cP @ 72°F
Flash Point: >200°F
Specific Gravity: 1.056
Weight: 8.8 lbs/gal +/- 3%
Properties – Cured
Appearance: Milky white flexible foam
Toxicity: Non-Toxic
2. Resurfacing Materials – Designated structures shall receive an application of resurfacing compounds/repair mortar. The resurfacing compounds/repair mortars are classified as Hydraulic Cements or Microsilica Repair Mortars. Microsilica Repair Mortars shall be designated for areas of substrate depth loss of ¼”-2” in a single lift and to be top coated with the polyurethane elastomer such as Sherflex, Silkaflex or equivalent lining system as shown on the drawings. Thickness shall be sufficient to replace lost cross section and fill voids

Hydraulic Cements shall be cement based, quick setting, hydraulic cement compound which instantly stops weeping water through concrete or masonry walls and floors. They will become harder and more resistant when subjected to constant water pressure. (Used primarily for filling large voids and stopping minor weeping water leaks)

A.W. Cook Cement, CEMTEC Hydraulic Cement
Physical Properties (28 day cure)
Compressive Strength ASTM C-109 5,500 psi
Tensile Strength ASTM C-496 650 psi
Bond Strength ASTM C-882 (Modified) 880 psi
Setting Times (Gilmore) “Hot Mix” 65 seconds

Rapid Cure Vertical Grade repair mortars shall be a one part, polymer modified, fast setting, silica fume, fiber reinforced mortar designed for vertical and overhead repairs from ¼” to 2” in one lift. The product may be applied by hand trowel or sprayed with a low-pressure pump. (Used to hand place large voids, bench repair, or hand troweled structural wall linings)

A.W. Cook Cement, CEMTEC Silatec Rapid Cure Vertical Grade
Physical Properties (28 day cure)
Compressive Strength ASTM C-109 6,800 psi
Flexural Strength ASTM C-293 990 psi
Bond Strength ASTM C-882 (Modified) 1,600 psi
Shrinkage ASTM C-596 0.07%
Abrasion Resistance – ¼” APCI 1
Setting Times @ 77°F
Initial Set – 35 min
Final Set – 50 min

Microsilica repair mortars shall be a blend of Portland cement, graded silica sand, fibers and silica fume. The mortar may be hand troweled or spray applied, usually from ½” to 1” in depth. Uses include repairing concrete walls, ceilings, lining brick or concrete manholes and lift stations, etc. Microsilica repair mortar provides an extremely dense matrix and will accept coatings at earlier ages than
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typical Portland cement repair products. (Used primarily for structural wall linings)

A.W. Cook Cement, CEMTEC Silatec MSM
Physical Properties (28 days cure)
Compressive Strength ASTM C-109 10,400 psi
Flexural Strength ASTM C-293 1,695 psi
Shrinkage ASTM C-596 0.00%
Freeze/Thaw ASTM C-666 100 cycles No Effect
Bond Strength ASTM C-882 (Modified) 1,695 psi
Modulus of Elasticity ASTM C-469 4,533,333 psi
Tensile Strength ASTM C-496 750 psi

3. Concrete Crack and Joint Details – Exposed cracks, construction joints, contraction joints, and isolation joints shall be prepared, filled and detailed in accordance with the attached detail drawings. All Sealants shall be ANSI/NSF Standard 61 approved. Should any conditions or joint design be discovered that is not detailed in the attached drawings, the contractor shall notify the owner and consult with the material manufacturer for recommendations.

4. Miscellaneous Metals Lining System: All interior concrete tank exposed metal surfaces shall receive application of Sher-flex, Silkaflex or equivalent polyurethane elastomer lining system.

5. Concrete Tank Lining System: All interior concrete tank surfaces shall receive application of Sher-flex, Silkaflex or equivalent polyurethane elastomer lining system.

2.02 Performance Criteria

A. The concrete potable water tank lining system shall be ANSI/NSF Standard 61 approved material for Drinking Water Components.

B. The concrete tank lining system shall be resistant to cracking from concrete shrinkage and atmospheric thermal movement at construction joints and contraction joints up to 1/8” at temperatures down to 0°F.

C. Physical Properties

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion</td>
<td>ASTM D4541</td>
<td>350 psi</td>
</tr>
<tr>
<td></td>
<td>Concrete failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Steel</td>
<td>1,800 psi</td>
</tr>
<tr>
<td>Tensile Elongation</td>
<td>ASTM D-638</td>
<td>37%</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D-638</td>
<td>1800 psi</td>
</tr>
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</table>
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<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shore D Hardness</td>
<td>ASTM D-2240</td>
<td>68</td>
</tr>
<tr>
<td>Flash Point</td>
<td></td>
<td>&gt; 200 F</td>
</tr>
<tr>
<td>Solids by Volume</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Water Vapor Permeance</td>
<td>ASTM E-96</td>
<td>0.574 grains/hr ft² Hg</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>ASTM D-4060, CS-17</td>
<td>106.0 mg.loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Applied to 1/32&quot; steel panels)</td>
</tr>
<tr>
<td>Mandrel Bend</td>
<td>ASTM D-1737</td>
<td>8 mm Conical bend Pass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(20 mils applied to .5mm steel panels)</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>ASTM C-177</td>
<td>0.000550 cal (0.133 BTU)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gardener Impact Direct</td>
<td>ASTM D-2794</td>
<td>&gt;160 in-lbs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Applied to 1/32&quot; steel panels)</td>
</tr>
</tbody>
</table>

3.00 EXECUTION

3.01 Surface Preparation

A. Concrete

1. The NACE/SSPC Joint Surface Preparation Standards for concrete surface preparation are incorporated in and made part of this specification. All references to SSPC-SP-13/NACE No.6, designate the definitions and other requirements in these documents. The International Concrete Repair Institute (ICRI) Technical Guideline No. 0310.2R, Guide to Surface Preparation of Concrete to Receive Sealers, Coatings and Polymer Overlays shall be used to visually evaluate the concrete surface profile.

2. Inspect concrete surface for soundness, flatness, levelness and overall condition. Report any discrepancies to the owner’s representative.

3. Create a minimum surface profile in the host substrate for the concrete repair and resurfacing in accordance with the methods described in ICRI No. 0310.2R to achieve substrate surface profile numbers CSP-5 to CSP7. After installation of the concrete repair and resurfacing materials create a minimum surface profile for the lining system specified in accordance with the methods described in ICRI No. 0310.2R to achieve profile numbers CSP-3 to CSP-5.
4. Following host substrate surface preparation, concrete surfaces shall be tested for the presence of moisture in accordance with ASTM D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method only if deemed necessary. Report results to owner or owner’s representative. If this step is not deemed applicable/necessary, the proposed cost for this task will be credited to owner or owners representative.

5. Stop concrete leaks and infiltration at cracks and joints by use of polyurethane injection grouting through trenchless technology application methods.

6. Concrete Surface Repair: Bug holes, honeycombs and voids
   a. Areas less than 1/4" deep shall be repaired with Steel-Seam FT910 epoxy patching and surfacing compound or A.W. Cook Cement repair mortars or approved equal.
   b. Areas that are greater than 1/4" deep shall be repaired with A.W. Cook Cement repair mortars or approved equal.

7. Provide a clean, saturated surface dry (SSD) concrete surface with no free standing or glistening water, with a minimum surface profile as previously defined. SSD is defined as the capillary pores of the cement matrix and pores of the aggregate in the concrete matrix being saturated with water but the surface of the substrate shall be visibly dry with no standing or glistening water. All substrates are to be vacuumed, swept and blown down with clean, dry air to remove spent abrasive, dust and other foreign material that might interfere with the adhesion of the primer and lining.

B. Iron and steel

1. The NACE / SSPC Joint Surface Preparation Standards for abrasive blasting approved in October 1994 are incorporated in and made a part of this specification. All references to SSPC-SP10 / NACE No. 2 designate the definitions and other requirements in these documents. SSPC VIS 1-89 Visual Standard for Abrasive Blast Cleaned steel shall be used to visually evaluate the blast cleanliness.

2. Remove all oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from surface by solvent cleaning per SSPC-SP1. Minimum surface preparation is SSPC-SP10 / NACE No. 2, Near White Metal Blast Cleaning. Abrasive blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (3-4 mils). Prime any bare steel the same day as it is cleaned and before flash rusting occurs.
a. Inspect the surfaces to be lined. All holes in the steel surfaces or pits greater than 1/8 inch shall be repaired in accordance with the tank owner’s repair procedures.

b. Remove or grind down all sharp burrs, edges, and weld spatter from all steel that is to be coated. Corners and edges shall be chamfered 1/16” at a 45° angle minimum or rounded to a 1/16” radius (1/8” diameter) minimum. The anchor profile shall be restored by abrasive blasting prior to the application of lining materials.

c. All substrates are to be vacuumed, swept and blown down with clean, dry air to remove spent abrasive, dust and other foreign material that might interfere with the adhesion of the primer and lining.

d. The maximum allowable residual salt contamination, as measured with a KTA Scat Kit or equivalent field test method, immediately prior to the application of the first coat is as follows:

- 5 micrograms per square centimeter (50mg/m²) most commodities up to 120°F

e. Corrosion pits in the blasted steel shall be filled flush with the substrate with Steel-Seam FT910 epoxy patching and surfacing compound putty/patching and surfacing compound.

f. Projections and lap joints on welded plates and on riveted plates to be coated shall be filled with Steel-Seam FT910 epoxy patching and surfacing compound putty/patching and surfacing compound in order to smooth out the surface and provide for a smooth transition of the lining over the substrate.

3.02 Application

A. Comply with manufacturers written installation procedures, individual product data sheet, application bulletins and detail drawings.

B. Apply materials in accordance with the following material coverage.

**Approved Polyurethane Elastomer Tank Lining System (e.g. Sher-flex, Silkaflex or equivalent)**

<table>
<thead>
<tr>
<th>Products</th>
<th>Thickness (mils dft)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primer</strong></td>
<td></td>
</tr>
<tr>
<td>Dura-Plate 235 Multi-Purpose Epoxy</td>
<td>5.0-7.0</td>
</tr>
<tr>
<td><strong>Repair/Patching and surfacing Compound</strong></td>
<td></td>
</tr>
<tr>
<td>Steel Seam FT910</td>
<td>As needed</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Repair Mortars</th>
<th>As needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stopping Leaks</td>
<td>As needed</td>
</tr>
</tbody>
</table>

**Flexible Coating/Lining**
Sher-flex, Silkaflex or equivalent Polyurethane Elastomer

- Concrete Water Storage Tank: 80.0 – 100.0
- Miscellaneous Steel: 30.0 – 50.0

**Total Dry Film Thickness**
85.0 – 107.0

### 3.03 Inspection and Testing

**A.** The owner or owner's authorized representative may require the services of an independent testing laboratory to test the installed system.

**B.** If test results indicate noncompliance with the specification, the following corrective action may be required of the contractor:

1. Remove non-compliant systems or components.
2. Replace system or components in (1)
3. Assume the testing expenses.

**C.** Minimum requirements of the Sher-flex, Silkaflex or equivalent polyurethane elastomer lining system are that it be free of the following:

1. Uncured material per visual and physical inspection
2. Inadequate thickness per SSPC PA-9
3. Pinholes per NACE SP0188
4. Blisters per ASTM D714
5. Foreign matter per visual inspection
6. Unspecified materials per QA/QC Documentation

**D.** The lined surface of the potable water storage tank shall be disinfected per the requirements of AWWA C652 prior to the storage of water. After disinfection there shall be no one permitted to make entry in to the tank. Entry in to the tank after disinfection shall require this process to be repeated.

### 3.04 Protection

**A.** The Sher-flex, Silkaflex or equivalent Polyurethane Elastomer Lining System shall be protected from damage or detrimental elements during cure and until the time of final acceptance.

**End of Section**