

**CURRENTLY AVAILABLE  
PRODUCTS AND TECHNIQUES  
FOR  
MANHOLE REHABILITATION**

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## 1 PREFORMED MANHOLE UNITS

### 1.1 **Containment Solutions, Inc (Conroe, TX): Flowtite® Fiberglass Rehabilitation Manhole**

<http://www.containmentsolutions.com/index.html>

**Flowtite® Fiberglass Rehabilitation Manhole** is a one-piece monolithic manhole unit that is made to be installed WITHIN an existing concrete, brick, or precast manhole. The unit is constructed of glass-fiber reinforcements, supplier-certified unsaturated isophthalic polyester resin, and chemically enhanced silica to improve corrosion resistance, strength and overall performance. The installation can often be accomplished without sewage bypassing or diversion. Flowtite® Fiberglass Rehabilitation Manhole is available in one-foot increments in heights from 3 feet to 25 feet, and inside diameters in six-inch increments from 42" to 72". Other diameters can be made upon request.

## 2 CONCRETE LINERS: POURED-IN-PLACE

### 2.1 **AP/M Permaform (Johnston, IA): Permaform®**

[www.professormanhole.com](http://www.professormanhole.com)

**Permaform®** is a poured-in-place thick-wall, seamless concrete manhole liner that extends from the bench to the frame. After segmented, stackable steel forms are positioned into the manhole, concrete is carefully poured into the forms. When the concrete has sufficiently cured, the forms are disassembled and removed. If the plastic liner is employed, it is fitted securely to the exterior of the steel forms during their erection within the manhole and when the forms are removed, any joints in the liner are welded and tested.

### 2.2 **Improved Construction Methods, Inc (Jacksonville, AR): Mono-Cast™, Nu-Wall™**

<http://www.improvedconstructionmethods.com>

**Mono-Cast™** manholes are cast-in-place concrete manholes. Construction involves ABS plastic forms that are easy-to-setup and disassemble, and is monolithic (no joints). Mono-Cast™ manholes are available in 4', 5', 6', 8', 10', 12', 14' and 15' diameters.

**Nu-Wall™** is a poured in place concrete manhole liner. The liner mix is Type I or II Portland cement with pea-gravel or ½ inch minus coarse aggregate with fiber reinforcement, producing an average compressive strength of 4500 psi when fully cured.

### 2.3 **Monoform, Inc (Cedar Creek, TX): Monoform**

Phone: (512) 303-9820

**Monoform** Manhole Liner System is a cast-in-place concrete liner for rehabilitation of existing manholes. The system uses modularized lightweight ABS plastic forms that come in three nominal diameters (40", 32" and 26") and height increment of 12", and reducers available for 40"x32" and 32"x26" reducing sections. The concrete is poured in 3-foot lifts and selectively vibrated as the forms are filled. The entire process takes less than twenty minutes and requires about one yard of concrete for an average 8-ft manhole.

## 3 LINERS: CURED-IN-PLACE (CIP)

### 3.1 **LMK, Inc. (Ottawa, IL): CIPMH™ Chimney**

<http://www.performanceliner.com/manhole.htm>

**CIPMH™ Chimney** is a CIP liner for manhole chimneys. The liner is made of stretchable "one size fits most" coated polyester and is vacuum impregnated with a "100% solids" silicate resin. The resin cures under ambient temperature and pressure in about one hour. CIPMH™ bonds extremely

well, provides a high level of chemical resistance, eliminates inflow and infiltration, and structurally enhances the manhole chimney.

CIPMH™ is capable of lining the entire chimney with 12” overlap onto cone section. It is installed easily with two men and no confined space entry is required. Liner is backed by a 10-year non-prorated materials and labor warranty from the manufacturer and the installer.

The first installation was in 2005.

### 3.2 Poly-Triplex Technologies, Inc. (Denver, CO): Poly-Triplex®

[www.poly-triplex.com](http://www.poly-triplex.com)

**Poly-Triplex® Liner** is a CIP manhole liner. The liner is saturated at the jobsite with an epoxy, lowered into place in the structure, and removable inflation bladder is put in place. The epoxy is then steam cured at 325 degrees.

### 3.3 Protective Liner Systems (Lithonia, GA): PerpetuWall™

<http://www.protectivelinersystems.com>

**PerpetuWall™** is a CIP Fiberglass Reinforced Plastic Liner (a composite liner composed of epoxy and fiberglass layers that produces a liner that is monolithic and a liner that is able to adhere 100% to the walls of the host structure regardless of the shape and size).

**PerpetuSeal™** is a cured-in-place fiberglass liner that extends from the frame down to the bottom of the manhole chimney.

**PerpetuCoat™** is a 100% solids epoxy mastic with a tenacious bonding capability and the ability to cure in the presence of water.

### 3.4 Terre Hill Concrete Products (Terre Hill, PA): MultiPlexx Liner™, MultiPlexx Layup™

<http://www.terrehill.com/>

**MultiPlexx Liner™** is a CIP manhole liner. Following manhole preparation (pressure-cleaning and grouting where necessary), an epoxy-coated liner is inserted into manhole interior and flexible diaphragm is inflated. The epoxy is then heat cured, forming a protective barrier within the manhole.

**MultiPlexx Layup™** is a segmented MultiPlexx Liner™ used in hard to reach places. It is pressed to the concrete surface by hand (without the inflation bladder). This allows rehabilitation of the structure while simply leaving the hardware and pipes in place.

## 4 CEMENTITIOUS COATINGS/GROUTS - SPRAYED/PUMPED/TROWELED

### 4.1 AP/M Permaform (Johnston, IA): Permacast®, Con(mic)Shield™

[www.professormanhole.com](http://www.professormanhole.com)

**Permacast®** is a centrifugally applied cementitious liner. The synthetic mortar is cast from a patented robotic applicator positioned in the center of the manhole. A dense, uniform layer is compacted in-place at any thickness from ¼” to 2” depending upon the degree of deterioration and the depth of the manhole. Multiple passes can be made until the specified thickness is attained. When severe corrosion is the problem, a topcoat of COR+GARD® (100% solids, high build, white epoxy) may be applied over the freshly applied PERMACAST® mortar.

**Permacast® Dry** is a dry powder (combination of cementitious and silicate based materials) that hardens in seconds when exposed to water. Permacast® Dry is used to seal and stop leakage caused by hydrostatic pressure.

**Permacast® Patch** is a fast setting, ready-to-use, cement based concrete and masonry patching compound formulated specifically for underwater use. When properly mixed and applied, Permacast® Patch develops a very high strength and a tenacious bond.

**Permacast® Plug** is a quick setting hydraulic cement compound used to instantly stop running water or seepage leaks in masonry or concrete. Permacast® Plug requires only potable water for mixing, and achieves initial set in 1 to 3 minutes, even when applied under water.

**Con(mic)Shield™** is a concrete admixture for the prevention of hydrogen sulfide generated corrosion common to concrete pipe, manholes and similar structures in municipal sewer environments. As an additive, it permeates the concrete or repair mortar during the mixing phase and molecularly bonds to the cement particles to become an integral component of the hardened product and to create an environment incompatible to harmful bacterial growth.

#### 4.2 **Fox Industries, Inc (Baltimore, MD): FX-262 Repair Mortar**

<http://www.fox-ind.com>

**FX-262 Repair Mortar** is a shrinkage-compensated, fiber-reinforced cement mortar that contains a migratory corrosion inhibitor. It contains FX-32 Silica Fume that improves the properties and offers high strength and superior performance for structural concrete repair. FX-262 is applied by low-pressure spraying and hand troweling.

#### 4.3 **IPA Systems Inc (Philadelphia, PA): Octocrete, Drycon, Octoplug Plus, Ipanex Rapid**

<http://www.ipasystems.com/>

**Octocrete** is a polymer modified cementitious mortar used for horizontal, vertical and overhead patching of concrete and masonry. It is a single component dry mortar ready to use with water. The mortar is available in 15 minute and 30 minute set times. Octocrete U is a variant of Octocrete mortar for underwater use.

**Drycon** contains Portland cement, finely graded mineral fillers, and chemical additives. The contents are mixed with water to produce slurry that is brushed or sprayed onto the surface of the masonry or concrete.

**Octoplug Plus** is a fast setting hydraulic cementitious plug to stop flowing water in masonry and concrete. It is a single component, expanding, hydraulic cement based formulation, ready to use with water and sets rapidly in 60 to 90 seconds at 70°F.

**Ipanex Rapid** is a complex alkaline earth silicate admixture that chemically reacts with Portland cement to become an extremely rapid setting plastic material used to stop pressure leaks in concrete and masonry structures. Ipanex Rapid is sprayed onto the surface and should be top-coated with Drycon to attain a permanent watertight seal.

#### 4.4 **Kaufman Products, Inc (Baltimore, MD): HiCap, SurePlug, SureBond**

[www.kaufmanproducts.net](http://www.kaufmanproducts.net)

**HiCap** is a line of quick setting, cementitious patching and finishing compounds that protect against temperatures extremes and corrosion. After initial set (5, 15, or 30 min), the applied product can be featheredged or shaved to desired shape. Special versions are offered for patches over 2" deep and for underwater repairs.

**SurePlug** is a fast setting, non-shrinking, hydraulic cement compound formulated to stop leaks in all types of concrete or masonry surfaces; and is particularly designed to instantly stop the flow of running water. It is available in three set times (30 sec, 1 min, and 3 min).

**SureBond** is a high performance, low viscosity emulsion of high molecular weight, internally plasticized acrylic polymers, designed to modify cementitious materials used for repairing concrete surfaces and help bond fresh concrete to existing substrates. This is an alternative to very expensive epoxy and polyester modifiers for concrete. SureBond modified mortars have strength considerably higher than unmodified mortars (although somewhat lower than epoxies). Overall they offer freeze/thaw resistance, increased bond strength and greater resistance to impact, vibration and thermal movement.

#### 4.5 **Lafarge Calcium Aluminates (Chesapeake, VA): SewperCoat**

<http://www.lcainc.com>

**SewperCoat** is a ready-to-use mortar that provides a structural, abrasion and corrosion resistant protective lining. SewperCoat is a 100% calcium aluminate mortar premix. It is typically spray applied either with a high or low-pressure, wet process, or with the traditional high-velocity, drygunite or shotcrete process.

**SewperCoat PG** is the “pumpable grade” version of SuperCoat, applied with low pressure, wet spray equipment. The material is mixed with water and conveyed through a hose with a progressive cavity (rotor-stator) or piston type (swing tube) pump system. There is an air nozzle on the hose that atomizes the wet material, spraying it onto the surface at a low velocity.

**SewperCoat 2000 HS Regular** is the “dry-gunite” version. It is applied with high-velocity, drygunite/ shotcrete equipment. The material is blown dry through a hose with very high air pressure. There is a nozzle on the hose that contains a special water ring, which injects a precise amount of water into the dry material as it passes through. The SewperCoat is mixed as it hits the sub-surface. The nozzleman uses a circular application pattern that shears the material and mixes it through displacement.

#### 4.6 **Madewell Products Corporation (Alpharetta, GA): Mainstay® Composite Liner**

<http://www.madewell.com>

**Mainstay® Composite Liner** is comprised of a restoration mortar over which a corrosion barrier mortar is immediately applied. Once applied, the two mortars simultaneously cure together to form the composite liner.

**Mainstay ML-72 Sprayable Microsilica Cement Mortar** is a restoration mortar that forms a high strength moisture barrier with extremely low permeability and a strong chemical/mechanical bond to brick and cementitious substrates. It can be applied by low to medium velocity wet mix shotcrete equipment (pneumatic spray) or by hand using a trowel. Application thickness up to 5" in a single lift are possible depending on the amount of water added, the condition of the surfaces being treated and jobsite conditions. A variety of piston, systolic and rotor/stator pumps may be used depending on job requirements and desired production rates.

Where corrosion control is not a consideration, the Mainstay ML-72 can be left without application of a corrosion barrier. Otherwise, while the ML-72 is still soft, one of the Mainstay corrosion barrier mortars (DS-4, DS-5 or DS-6) is quickly spray applied to provide corrosion protection.

**Mainstay DS-5** is a corrosion barrier mortar particularly well suited for sanitary sewers exposed to microbiologically influenced hydrogen sulfide corrosion. It is a chemically modified epoxy coating that can be spray applied at thickness up to 100 mils or more in a single application.

#### 4.7 **Parson Environmental Products, Inc. (Reading, PA): Parson cementitious coatings**

[www.parsonenvironmental.com](http://www.parsonenvironmental.com)

**Parson Quick Plug** is a rapid setting hydraulic cement material that is mixed with clean, potable water to produce an extremely rapid setting plug. It is inserted into properly prepared areas to stop leaks under pressure. It may also be used for repairing cracks in concrete and mortar. It is non-corrosive and produces extremely high early strengths. Will stop leaks in approximately 1 minute.

**Parson RPM** is a fast setting, fiber reinforced, H<sub>2</sub>S resistant mortar that is mixed with clean, potable water and used to repair inverts and other deteriorated areas in manholes.

**Parson MH Liner** is a spray or hand trowel applied, high strength, fiber reinforced Microsilica Mortar for use in restoring manholes with low to moderate levels of corrosion, or as an underlayment for PARSONPOXY SEL-80 or SEL-80HB corrosion resistant epoxy coatings. Can be spray applied up to 3" thick per coat using rotor/stator type pumping equipment, or hand troweled up to 1 ½" thick.

**Parson CA Liner 100** is a spray or hand trowel applied high strength, fiber reinforced 100% Calcium Aluminate Cement with select aggregates, for use in rehabilitating manholes, lift station wet wells and wastewater treatment plant structures with moderate to high levels of corrosion. May also be used as an underlayment for PARSONPOXY SEL-80 or SEL-80HB corrosion resistant

epoxy coatings. Can be spray applied up to 2" thick per coat using rotor/stator type pumping equipment, or hand troweled up to 1 1/2" thick.

**Parson CA Liner 100+** is a spray or hand trowel applied, high early strength, fiber reinforced, pure-fused Calcium Aluminate Cement and Aggregate lining designed to protect both new and existing manholes, wet wells and wastewater treatment Plant structures against H<sub>2</sub>S attack. Can be spray applied up to 2" thick using rotor/stator type pumping equipment or hand troweled up to 1" thick.

#### 4.8 **Perma-Liner Industries, Inc (Largo, FL): Uni-Mortars, Quick Set Hydraulic Cement**

<http://www.perma-liner.com/mh01.html>

Perma-Liner Uni-Mortars are cementitious, one component repair mortars for sewer manhole rehabilitation. They can be prepared as a thick batter for glove pointing or troweled application, or to a pumpable consistency for spray (gunite) applications.

**Uni-Mortar CA**, with calcium aluminate formulation, provides corrosion resistance.

**Uni-Mortar 1ZSR** has hydrophobic (water repellent) properties and high sulfate resistance, and prevents water infiltration or ex-filtration in sewer manholes.

**Uni-Mortar V/O**, with microsilica (silica fume) enhanced formulation, restores structure integrity of the manhole.

**Quick Set Hydraulic Cement Fix 10-S** is a fast setting, chloride-free hydraulic cement which sets immediately when exposed to water. It plugs/stops active water leaks, dries out wet areas and seals leaky joints, cracks or forms tie holes. It is applied by pressing the mixed material firmly into the crack or hole using gloved hand or a brick jointer

#### 4.9 **Quadex, Inc (Little Rock, AR): Quadex Mortars**

<http://www.quadexonline.com/>

**Quadex QM-1s Restore** is a cement-based, polypropylene fiber reinforced mortar, enhanced with NSG aggregate (nepheline synite granite). Quadex QM-1s Restore is the mortar with high compressive, flexural and bond strengths, resistance to sulfide attack, and extremely low permeability.

**Quadex Aluminaliner** is a fiber reinforced, 100% calcium aluminate mortar, enhanced with NSG aggregate (nepheline synite granite). This mortar is specifically designed to provide ultimate protection against hydrogen sulfide gas induced corrosion, add structural integrity and stop the infiltration of groundwater in sewer structures. Quadex QM-1s Restore and Quadex Aluminaliner come as factory blended, one-component mixes and are applied by low pressure spraying.

**Quadex Quad-Plug** is a blend of special cements and admixtures that are designed to instantly stop running water or seepage in all types of concrete and masonry structures. Running water or leaks are sealed by placing a generous amount of dry Quadex Quad-Plug on cracks with a rubber-gloved hand.

**Quadex Hyperform** is a one component, rapid setting, high early strength patching material designed for repairing vertical and horizontal concrete and masonry structures. Recommended for filling large voids in manhole walls and reconstructing inverts.

#### 4.10 **Standard Cement Materials, Inc. (Houston, TX): Reliner MSP**

<http://www.standardcement.com/>

Reliner MSP is a pre-blended, high strength, durable and chemical resistant Portland cement concentrate. It comes prepared and ready to use in 75-pound bags.

#### 4.11 **Strong Company, Inc (Pine Bluff, AR): Strong-Seal®**

<http://www.strongseal.com>

**Strong-Seal® MS-2A** and **MS-2C** are fiber-reinforced, spray-applied cementitious mortars. Both products fill all voids and achieve a mechanical and chemical bond to the existing substrate. The

result, when spray-applied to a minimum 1/2-inch thickness, is an impervious monolithic liner with compressive and flexural strengths exceeding that of the original structure. The MS-2A product is the most cost-effective solution for stopping infiltration and restoring structural integrity, while the MS-2C product provides high early strengths and added corrosion protection in mild sulfide environments.

**Strong-Plug** is a rapid-set (60 seconds), hand-applied cementitious product for stopping infiltrating water and making repairs that require high early strength. Strong-Plug may be applied in a dry form directly to minor infiltration or mixed with water to a thicker consistency for application to more active leaks.

**Strong-Seal® QSR** is a rapid-set (10-15 minutes), high early strength, acid-resistant, hand-mixed and hand-applied, calcium aluminate based cement product for filling voids and repairing inverts in concrete, brick or other masonry-constructed structures.

#### 4.12 **ThoRoc - Division of ChemRex® (Shakopee, MN): ThoRoc Mortars**

<http://www.chemrex.com/thoroc>

**SP15 Spray Mortar** is a single-component fiber-reinforced wet spray mortar for manhole rehabilitation. It is ideal for large structural concrete repairs where a wet-process spray application method is required. It is microsilica-enhanced for improved chemical resistance.

**Brushbond** is a two-component acrylic polymer-modified cement-based coating. Brushbond fills holes, cracks, and imperfections in concrete structures, permanently seals the manholes and protects walls from both positive and negative hydrostatic pressure.

**ThoRoc™ Patch** is a rapid-setting joint filler and waterproofing cement used to prevent seepage through cracks. It requires no additives (water only) and sets in 3 to 20 minutes.

**ThoRoc™ Plug** is a rapid-setting cement-based water-stop mortar that sets in 45 – 60 seconds, producing the rapid strength needed to stop hydrostatic water flow. It can be used to stop water or seepage through cracks in concrete sewer pipes, manholes, tanks, elevator pits and other concrete structures. It also provides watertight seals at joints in sewer lines, tanks, and manholes.

#### 4.13 **Unitex (Kansas City, MO): Unitex Hydraulic Cement**

[http://www.unitex-chemicals.com/catalog/hydraulic\\_cement.shtml](http://www.unitex-chemicals.com/catalog/hydraulic_cement.shtml)

**Unitex Hydraulic Cement** is a cementitious grout (a blend of hydraulic cement and admixtures) for stopping leaks in concrete structures and masonry walls. When mixed to a thick consistency and hand formed, Hydraulic Cement will set in 3-5 minutes to seal out water for the life of the structure. Hydraulic Cement is a non-corrosive, non-rusting, and non-shrink material. Applied by gloved hand or with a trowel.

### 5 **POLYMER COATINGS/GROUTS - SPRAYED/PUMPED/TROWELED**

#### 5.1 **Avanti International (Webster, TX): 3M Avanti Grouts, Scotch-Seal Chemical Grout**

<http://www.avantigrout.com>

**3M Avanti Grouts** are gel type chemical grouts that are injected from the inside of the manhole to the outside to form a gel curtain around the outside of the manhole. Typically applied with hand-held injection equipment. **AV-100 Chemical Grout (Gel)** comes as water-soluble white granular powder (Acrylamide) that produces stiff gels when mixed with water. Gel times vary from 5 seconds to several hours, with variety of additives. Chemical data and job histories from over 40 years lead to the conclusion that for all practical purposes, AV-100 gels may be considered permanent. **AV-118 Duriflex (Gel)** is a water solution of acrylic resins. With the addition of catalysts, a cohesive gel is formed. Duriflex has approximately the same viscosity as water (1 or 2 centipoise). Pumped into cracks or soil voids, it produces, after a controlled setting time, an elastic and cohesive gel which stops flowing water. **AV-254 Gelseal (Gel)** is a low viscosity urethane prepolymer grout that forms a gel mass when it comes in contact with water and is applied in much

the same manner as acrylamide grout, but has the advantages of being a one-component system. AV-254 Gelseal has superior strength and safety features compared to other grouts. **AV-350 Multi Gel** (Gel) is a hydrophilic urethane resin that reacts with water to form an impermeable gel material. Typically, AV-350 is injected at a ratio of 8 parts water to 1 part resin. The low viscosity at this ratio provides a free-flowing liquid for enhanced penetration into small cracks, void spaces, soil and backfill materials.

**Scotch-Seal Chemical Grout 5600** (foam) is a light brown liquid prepolymer that reacts with water to form stiff rubber-like solid. This is a low viscosity injection resin for sealing water leaks in small to moderately wide concrete cracks. **Scotch-Seal Chemical Grout 5610** (gel) is a blue liquid resin 600 to 1200 CPS prepolymer. Reacts with 6 to 10 parts water to form stiff gel. Reaction time is controllable from 5 seconds to 1 minute. Gel time and strength influenced by 5611 Gel Control Agent and 5612 Gel Reinforcing Agent added to reaction water. Scotch-Seal Chemical Grout 5600 (foam) and Scotch-Seal Chemical Grout 5610 (gel) can be used in combination. When used together, foam is typically used with oakum to seal large cracks and gel is used to seal fine cracks, consolidate the surrounding soil, fill voids and encase the entire manhole in a protective Grout layer.

## 5.2 **Carylon Corporation (Chicago, IL): Spray-Seal**

<http://www.caryloncorp.com> (800) 621-4342 Herb Cosova

**Spray-Seal** is a polyurea method of manhole rehabilitation.

## 5.3 **CITADEL Technologies, Inc (Tulsa, OK): Citadel Coatings**

<http://www.cittech.com>

**SLS-20** and **SLS-30** are two component, 100% solids epoxy coating systems, applied to brick, concrete or steel surfaces at thickness of from 40 to over 275 mils.

SLS-20 is the lower cost liner and a product of choice when very thick liner buildups are required or when a less expensive choice for infiltration control is desired. SLS-30 is the product of choice when chemical and corrosion resistance and structural enhancement resistance are critical. SLS products are typically spray applied.

## 5.4 **CCI Spectrum (Jacksonville, FL): SpectraShield™**

<http://www.ccispectrum.com>

**SpectraShield™** is a multi-layered poly resin liner system applied in minimal thickness of 500 mils, consisting of a moisture barrier (modified polymer), a surfacer (polyurethane/polymeric blend foam), and final corrosion barrier (modified polymer). Before system application, the manhole surface is prepared by hydro blasting to remove all corrosion from structure, and any cracks and holes that leak are sealed with a chemical or hydraulic sealant. Severe cracks are repaired using a urethane based chemical sealant. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. are done utilizing non-shrink grout or approved alternative method. The entire structure may be again re-blasted prior to the application of final liner. Liner is spray applied.

**SpectraShield™** comes with a 10-year manufacturer's warranty against failure.

## 5.5 **Deneef Construction Chemicals (Waller, TX): Denepox Epoxies**

<http://www.deneef.com/>

**Denepox 40 Epoxy** is an ultra-low-viscosity, two-component epoxy system for grouting and sealing of cracks. It is designed specifically for pressure injection.

## 5.6 **Environmental Coatings (Mesa, AZ): Sewer Shield® Liner 100, 101S, 101A, 150**

<http://www.sewershield.com/ec/index.html>

Sewer Shield Liners are epoxy coating liners that protect concrete and steel surfaces in the wastewater industry and, in particular, offer high acid resistance (chemical resistance of 10% to 98% sulfuric acid).

**Sewer Shield 100** is trowelable and applied at 1/8" to 1/4", resistant to 98% sulfuric acid.

**Sewer Shield 101S** is sprayable and applied at 1/8" to 1", resistant to 98% sulfuric acid.

**Sewer Shield 101A** is sprayable and applied at 1/8" to 1/4", resistant to 75% sulfuric acid.

**Sewer Shield 150** is sprayable and applied at 1/8", resistant to 50% sulfuric acid.

The product has been applied for 20 years and comes with a 5-year warranty. Composite Sewer Shield manholes capable of 58,000-lbs direct load are presently being manufactured.

#### 5.7 Fosroc Ltd (Tamworth, UK): Supercast

[http://www.fosrocuk.com/comp\\_page1.htm](http://www.fosrocuk.com/comp_page1.htm)

**Supercast SW Adhesive** is a gun-applied adhesive for sealing around joints in difficult areas such as precast manhole covers.

#### 5.8 Fox Industries, Inc (Baltimore, MD): Manhole Cover Gasket, Jet Set Gel, Epoxy Coatings

<http://www.fox-ind.com>

**FX-574 Manhole Cover Field Formed Gasket** is a two component elastomeric compressible rubberlike material. It is used as a seal for manhole covers to prevent the penetration of runoff water in manholes and to reduce the noise during the passage of vehicles by preventing the friction between the two metals such as the lid and frame. The product is applied to the manhole frame with the use of a spatula or putty knife. It can also be loaded into a hand-caulking gun and gunned onto the frame. The material is applied 3/8" to 1/2" thick, and immediately afterwards.

**FX-XXX Jet Set Gel** is a low viscosity, rapid gelling hydrophilic grout. It is used to seal leaks in cracked concrete, for soil stabilization and repairing leaking joints. This all-purpose grout is easily mixed with water or stabilizer at a convenient 1 to 1 by volume mix ratio. FX-XXX Jet Set Gel can be pumped using hand or air operated piston pumps from the outside of the manhole or by drilling holes and pumping from inside the manhole.

**FX-494 Corrosion Resistant Epoxy Protective Primer and Coating** is two-component, 100% solids epoxy coating a corrosion barrier and chemical resistance. The product is used as a two-coat system and is applied by brush, roller, or spray.

**FX-544 Flexibilized Novolac Epoxy Coating** is a two-component, 100% solids epoxy coating that provides a corrosion barrier and chemical resistance. It is applied by brush, roller, or spray.

#### 5.9 Kaufman Products, Inc (Baltimore, MD): K Pro, SurePoxy

[www.kaufmanproducts.net](http://www.kaufmanproducts.net)

**K Pro CRS** is a special blend of chemical and abrasion resistant epoxy resins and hardeners (100% solids). It is particularly recommended for cold and or damp conditions (can cure at 45°F and under wet conditions). The product is recommended as a binder for both chemical and abrasion resistant mortars and grouts, whenever a durable coating, grout or mortar is desired on floors and walls.

**SurePoxy HiBild** is a two component flexibilized epoxy coating (100% solids) that forms a protective coating resistant to mild abrasion and chemicals. Special hardeners provide excellent adhesion to either dry or damp surfaces and make the coating completely insensitive to moisture after cure. The product does not blush or form other surface imperfections during cure.

**SurePoxy HM-SLV** is a two component, high modulus epoxy adhesive, and healer/penetrating sealer (100% solids). It has extremely low viscosity (60-85% lower than other low viscosity epoxy products), which enables the product to penetrate deeper into smaller cracks than normal low viscosity epoxies.

**K Pro Underwater Curing UC** is a line of 100% solids, special epoxy resins and a blend of many types of hardeners. The product is designed for underwater application, but can also be used for patching and grouting of surfaces that are not submerged but could be buried in soil. The product

protects surfaces against corrosion, erosion and deterioration of concrete or wood in either salt or fresh water.

#### 5.10 Miller Pipeline Corp. (Indianapolis, IN): Safe-T-Seal® Surface Kit

<http://www.mpc-tech.com/prod8.html>

**Safe-T-Seal® Surface Kit** is a two-component polyurethane based surface repair system used for of the rehabilitation of manhole's top part. It provides waterproofing and an absolute bond between the frame and the casting (grade rings or cone section), absorbs vibrations and ground movements due to traffic, earth consolidation, freezing and thawing, and accommodates thermal expansion/contraction of manhole components. Installation is fast and easy, and requires minimal structure preparation. After the surface is coated with a primer, two components are mixed and poured into a foam mold, which is left in the manhole after the curing.

#### 5.11 Neopoxy International (Hayward, CA): Neopoxy NPR-5300 Series, NPR-3501

<http://www.neopoxy.us>

**Neopoxy NPR-5300 Series** includes 5 products for manhole rehabilitation. These are structural liners with excellent corrosion resistance that can cure under water and can be applied at 20-500 mills in a single pass.

**NPR-3501** is a flexible epoxy system to seal manhole chimneys. A 100% solids, zero VOC, resin is specially formulated for traffic impact loading and freeze-thaw conditions where life-long performance is critical. Applied with trowel

#### 5.12 Parson Environmental Products, Inc (Reading, PA): Parson epoxy coatings and polyurethane grouts

[www.parsonenvironmental.com](http://www.parsonenvironmental.com)

**Parsonpoxy SEL-80** is a 100% solids, two component modified epoxy coating that provides excellent corrosion protection and abrasion resistance to concrete and steel sewage structures. It protects against mild acids, alkalis, oils, grease, sodium and calcium chlorides and many other contaminants. The product may be applied by brush, roller or single-component airless spray equipment up to 80 mils thick per coat.

**Parsonpoxy SEL-80HB** is a 100% solids, two component Ultra High Build epoxy coating designed to be applied over brick, concrete or metal structures or as a topcoat over PARSON MH LINER OR CA LINER 100. It provides excellent corrosion protection and abrasion resistance for concrete and steel sewage structures. The product is spray applied using specialized plural component equipment up to 125 mils thick per coat.

**Parson Hydro Grout** is a tough, low viscosity hydrophobic polyurethane grout when mixed with predetermined amounts of Accelerator, will exhibit controlled reaction times from 30 seconds to 3 minutes. It can be used to stop medium to high volume active leaks in manholes, pump stations, wastewater tanks, concrete pipes and other concrete and masonry structures.

**Parson Multi Grout** is a versatile, high viscosity hydrophobic polyurethane expanding grout that has similar physical properties to that of a hydrophilic system and can be used with Accelerator to adjust the reaction time to as fast as 20 seconds. Using no Accelerator will yield a reaction time of approximately 1½ minutes. The product can be used to stop high volume active leaks through cracks, voids or fractures in manholes, pump stations, wastewater tanks, concrete pipes and other concrete and masonry structures.

**Parson Perma Seal** is a single component, hydrophilic polyurethane grout that can become a foam, gel or elastomeric mass depending upon the amount of water encountered. It contains no TDI or solvents and has excellent elongation and flexibility properties. Reaction time at a 1:1 ratio is approximately 30 seconds. The product may be used to stop medium volume leaks through cracks, voids or fractures in manholes, pump stations, wastewater tanks, concrete pipes or other concrete and masonry structures.

**Parson Seal-Tite** is a moisture insensitive, two component, fast reacting hydrophobic polyurethane grout designed to stop high volume active leaks in manholes, pump stations and other wastewater structures. It is packaged in a dual cartridge with a static mixer and injected at or near the source of the leak, using a dual component caulk gun. It contains no CFC's or HFC's. Reaction time is approximately 8 seconds and full cure occurs in approximately 30 seconds.

#### 5.13 Perma-Liner Industries, Inc (Largo, FL): Perma-Flex, Hydro-Pox; Hydrostop-Flex

<http://www.perma-liner.com/mh01.html>

**Perma-Flex Manhole Chimney Seal** is a product manufactured to eliminate deterioration of the chimney section of the manhole and prevent infiltration. Perma-flex is applied quickly and easily. Elastomers are known for their durability and elongation, and although very flexible, perma-flex will resist the attack of acids, detergents, and solvents while maintaining the ability to flex with ground movement.

**Hydro-Pox Epoxy** (Hydro-Pox Epoxy 212 GL) is a two- component, self-priming, silica filled 100% solids epoxy grouting and lining system that provides a corrosion protection of concrete in sewer manholes with severe sulfide conditions. It is designed for application with peristaltic (carrousel) pump, but can be also trowel applied. Typically thickness of a single monolithic coat is 80 - 160 mils (2 - 4 mm).

**Hydrostop-Flex 40/500** is a hydrophobic polyurethane injection grout used to stop water infiltration through voids, cracks and honeycombs in concrete. It is typically injected by use of a high-pressure (1500+ psi) airless sprayer pump.

#### 5.14 Press-Seal Gasket Corporation (Fort Wayne, IN): EZ-Stik, EZ-Wrap

<http://www.press-seal.com>

**Trowelable EZ-Stik #3** is a butyl sealant suitable for pumping or trowel dispensing for concrete structures as a primary or secondary joint seal.

**EZ-Wrap** is an extruded butyl adhesive tape, designed to provide high strength, water tight seals on properly primed concrete surfaces and joints of any kind. The butyl compound is soft, tacky and bonded to either a plastic backing or an E.P.D.M. rubber backing. Both kinds of tape are wound in rolls on a release liner for easy application. EZ-Wrap can be used for new construction, repair or rehabilitation

#### 5.15 Prime Resins (Conyers, GA): Prime-Flex Grouts

<http://www.primeresins.com>

Prime-Flex Grouts are polyurethane grouts designed for manhole, sewer pipe and lateral grouting.

**Prime-Flex 910** is a low viscosity, polyurethane injection resin designed to stabilize soil. When mixed with a catalyst and injected, it migrates through loose soil and into below grade voids. As it comes into contact with ground water, the Prime-Flex 910 begins to react and expands to form rigid foam. The foam encapsulates loose soil, fills voids and forms a solid, watertight barrier.

**Prime-Flex 920** is a liquid polyurethane injection resin designed to seal leaks and fill voids behind concrete and masonry structures. When mixed with a catalyst and injected, it migrates through cracks, loose soil and below grade voids. As it comes in contact with ground water, Prime-Flex 920 begins to react and expands to form a tough, rigid foam seal that cannot be penetrated by water. Prime-Flex 920 is typically used to seal gushing leaks, fill voids and stabilize soil.

Prime-Flex 920 can be used in **probe grouting**, in which a small diameter pipe is driven down from the surface to the vicinity of the leak, and a resin injected through the pipe. A camera can be placed in the line upstream from the repair to monitor the grouting process. When the crack or joint is sealed, the probe pipe is withdrawn. Any excess grout material in the sewer line can be easily removed by cutting or water jetting.

#### 5.16 PrimeLine Products, Inc (Edgewater, FL): PrimeLiner™ Flexible Seal

<http://www.prime-line.net/main.html>

**PrimeLiner™ Flexible Seal** is an elastomeric material used to coat the inside of the adjustment area of the manhole, including the manhole ring, adjustment rings and top of the cone. It is manufactured from a unique, patented resin that adheres firmly to virtually any surface and cures tack-free in about an hour and completely within several hours. When applied, PrimeLiner™ Flexible Seal provides a watertight, flexible coating designed to withstand movement from traffic, freeze/thaw cycles, etc.

#### 5.17 Raven Lining Systems (Tulsa, OK): Raven 400 Epoxy Lining Systems

<http://www.ravenlining.com>

**Raven 400 Series Liners** are ultra-high build sprayable epoxy coatings that provide chemical resistance and structural strength ideal for rehabilitation projects. These formulas can be applied at 30 - 500 mils per coat covering more than 500 sf per hour. These liners improve the integrity of the existing system and protect it from future corrosion.

#### 5.18 Remote Orbital Installations (Middleton, WI): SPOD®

<http://www.roi360.com>

**SPOD®** is a robotic device designed specifically for a continuous, 360-degree application of two-component polymer resin to manhole structures (also sewer pipe interiors). The system provides a manhole lining from a rapid curing polyurea elastomer.

First, the manhole surface is prepared for coating: the manhole wall is hydroblasted or dry media blasted, any leaks/inflow sites repaired by injecting hydrophilic grout (ESI Hydroloc), and any large voids filled with a synthetic mortar (ESI PolyBon with masonry sand) or a polymer modified hydraulic cement. Also, the area between the cover frame and structure is cleaned of loose material and, using a trowel, filled with 100% solids, high elongation polyurea (ESI Elastogel) to create a "formed in place" seal and impact barrier.

Approximately 10 mil of waterborne epoxy primer (ESI Poxypriime H20) is sprayed, brushed, or rolled. When the primer is dried, a high density (10-12 pcf) closed-cell structural foam (ROI-nuwall/12) is sprayed. The final step is a spraying of approximately 125 mil (ROI specification) of 100% solids polyurea elastomer (ESI ARC or DLX). Robotic application ensures uniform mil thickness throughout the structure.

#### 5.19 Sauereisen (Pittsburgh, PA): SewerGard, “The 60-Minute Solution”

<http://www.sauereisen.com>

**SewerGard** is a polymer lining that protects manhole’s concrete surface from chemical attack and physical abuse. It can be trowel applied (**SewerGard No. 210**), spray applied (**SewerGard No. 210S**), and spincasted (rotary spray applied) (**SewerGard No. 210RS**).

Sauereisen’s “**The 60-Minute Solution**” is a three-step system for rapid cleaning and restoration of manholes. First step involves surface preparation using specialized Hydrojetting system: a hydrojet nozzle fixed on a special manhole cover rotates along all three planes and utilizes pressures from 4,000 to 7,000 psi. Severely corroded manhole can be cleaned in approximately 15min. Next, the surface is coated with specialized materials applied with a “spinning nozzle” (about 20 min) and finally, the same equipment is used to apply a corrosion-resistant polymer barrier SewerGard.

#### 5.20 SealGuard, Inc (Mars, PA): Seal-Guard II

[www.sealguardinc.com](http://www.sealguardinc.com)

**SealGuard II** is a dual component polyurethane grout for sealing leaking manholes and pipes. It can be applied (injected) directly into flowing water and stop the leaking within seconds (for example, a 50 GPM leak within 1-3 seconds). The application kit contains caulk tubes (6 or 12 pack), gun, mixers and safety items. Each set of caulk tubes contains a cubic foot of cured materials. After drilling a 5/8” hole and inserting a static mixer, the sealant is pumped with the gun.

Depending on the number of fractures, 1-2 tubes of material are typically required. SealGuard II® is now patent pending.

**5.21 Sealing Systems, Inc (Loretto, MN): Flex-Seal Utility Sealant®**

[www.ssisealingsystems.com](http://www.ssisealingsystems.com)

**Flex-Seal Utility Sealant®** is an aromatic urethane rubber coating that protects the manhole from infiltration and corrosion due to hydrogen sulfide or road salt. The sealant is typically applied to the grade adjustment ring area in the manhole (from 3 inches above the bottom of the frame to 3 inches below the bottom of the adjustment ring) and to the manhole joints (from 3 inches above the joint to 3 inches below the joint). It is applied with a brush to a dry and clean surface in two different coats. Final thickness of the sealant is typically 170-250 mils.

**5.22 Sprayroq (Birmingham, AL): SprayWall® CIP; SprayShield®**

[www.marpo.com/sprayroq](http://www.marpo.com/sprayroq)

**SprayWall® CIP** is an engineered, spray-applied stand-alone solution (urethane) for long-term rehabilitation of manholes and similar structures.

**SprayShield®** is a spray-applied elastomeric urethane membrane that provides a barrier to corrosion, abrasion, and exfiltration.

**5.23 Strike Products (Cannon Falls, MN): I/I Barrier**

<http://www.striketool.com/index.htm>

The **I/I Barrier** is a UV stabilized low density polyethylene liner, which lines the top of the manhole starting from between the cone and grade rings. It eliminates water and dirt infiltration into the manhole. The installation of this product requires limited open cut - the top of the manhole has to be excavated so that the grade rings can be temporarily removed. The liner is then sealed to the cone or flat top of the manhole with EZ-Stik and the grade rings put back in place. The I/I Barrier is equipped with a drip edge to seal around the outside of the manhole. The liner has a 1/4" thick polyethylene wall and comes in 27" and 24" diameters.

**5.24 Terre Hill Concrete Products (Terre Hill, PA): HydroPoxxy™, Terre Light™**

<http://www.terrehill.com>

**HydroPoxxy™** is a two-component epoxy with outstanding underwater curing ability that is used as protective coating of concrete benches in both new and existing manholes. It has a consistency of thick oil and is brush or trowel applied.

**Terre Light™** is a lightweight, two-component epoxy used to finish the edges of the liner and "blend" the liner into the concrete. It has a consistency of a paste and is trowel applied.

**5.25 ThoRoc, Division of ChemRex® (Shakopee, MN): Sewer Guard® Epoxy Liners**

<http://www.chemrex.com/thoroc>

**Sewer Guard® HBS100 Epoxy Liner** is a sprayable, high-build chemical-resistant epoxy coating and **Sewer Guard® TG Epoxy Liner** is a three-component trowelable epoxy mortar. Both products are designed for vertical and overhead applications, and they both resist chemicals commonly found in sanitary sewer environments

**5.26 Trenchless Rehabilitation Services (Westchester, PA): Perma-Guard**

<http://www.trenchlessservices.com/index.html>

**Perma-Guard Manhole Lining System** is a 100% solids, solventless two-component epoxy resin system thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance. It is available in spray-rite and trowel-on applications.

## 5.27 Warren Environmental, Inc (Carver, MA): Warren Environmental Systems

<http://www.warrenenviro.com>

The Warren Lining Systems are spray applied epoxy resin systems that provide chemical resistance in extreme environments, and are used for protection of new and restoration of existing sewer and water systems. The patented spin and spray application system applies 100% solids epoxies without the use of harmful solvents and chemicals in thickness up to 3/8".

## 5.28 Webac Corp. (Santa Ana, CA): W151-Water Stop Foam, W1403-PU Resin, W160-Structural Foam, Flexgel-Foam/Gel

<http://www.webac.com>

**W151-Water Stop Foam** is a hydrophobic water cut-off grout and soil stabilization grout based on a MDI (methylenediphenyl- isocyanate) polyurethane. The resin is 100% solvent free and 100% solids. This product is suited for the filling of large cavernous spaces and cracks in stone or concrete structures as well as for cutting off gushing water of high pressure and speed. The resin is applied with single component injection equipment.

**W1403-PU Resin** is a low viscosity two components hydrophobic resin based on a MDI (methylene-diphenylisocyanate) polyurethane. The product is 100% solvent free and 100% solids. Due to its low viscosity and good penetration properties, WEBAC 1403 is recommended for the injection of hairline cracks. When pressure injected, the material cures to a dense and flexible sealant.

**W160-Structural Foam** is a dry-reactive, closed cell, two-component, non-shrink polyurethane foam. This MDI (methylene-diphenyl-isocyanate) based product is 100% solvent free and 100% solids. The cured foam offers structural strength combined with increase in volume (unlike epoxies), and excellent bonding properties on dry and wet surfaces. The product is applied by injection. Due to the short gel time dual-component injection equipment is recommended but not mandatory.

**Flexgel-Foam/Gel** is a single component hydrophilic polyurethane grout. The product cures to a closed cell foam or a gel when it comes in contact with water. It is applied with single component injection equipment.

## 6 MECHANICAL SEALS/INSERTS

### 6.1 A•LOK Products, Inc. (Tullytown, PA): Water•Lok Connector

<http://www.a-lok.com>

**Water•Lok Connector** is a PVC insert installed between entry casting and precast concrete cones and flat top sections for a corrosion resistant and watertight connection. The connector is flexible so that freeze/thaw and heat expansion cycles do not compromise the watertight integrity. Easy installation does not require special tools, plus its design allows for future grade adjustment (up to 14-in.) without added parts. The connector is available for manhole openings of 24-in, 27-in, and 30-in diameters.

### 6.2 Cretex Specialty Products (Waukesha, WI): CretexWrap

<http://www.cretexseals.com>

**CretexWrap Internal Manhole Joint Seal** is an internal sealing system for stopping leakage in precast manhole joints. The system involves a flexible rubber sleeve extruded or molded from a high grade rubber compound, that can be double, triple or quadruple pleated with a minimum unexpanded vertical height of 8 inches, 10 inches or 13 inches respectively and a minimum thickness of 3/16 inches. The top and bottom section of the sleeve compresses against the manhole and secures a watertight seal.

### 6.3 No Flow In Flow (San Antonio, TX): No Flow In Flow

<http://www.noflowinflow.com>

**No Flow In Flow** is a manhole dish insert that eliminates flow of rainwater into the sanitary sewer system, and in addition eliminates debris and dirt, and reduces odors and manhole cover rattle noise. The dish is made of ultra high density polyethylene copolymer material in uniform thickness of 1/8" or greater.

### 6.4 NPC, Inc (Milford, NH): FlexRib Seal

<http://www.npc.com>

**FlexRib Seal** is a watertight seal that is mounted in the manhole grade adjustment area. It is made from a premium quality rubber compound that is designed to withstand the corrosive environment present in a sanitary sewer manhole. The sealing is achieved when the stainless steel expansion bands compress the rubber seal against the inside of the frame and cone.

### 6.5 Parson Environmental Products, Inc (Reading, PA): Parson Manhole Inserts, Parsonpoxy FP

**Parson Manhole Inserts** are dish inserts manufactured from HDPE or stainless steel that fit directly under the manhole cover. They reduce or prevent surface water inflow, dirt, grit and road oils from entering the collection system through the manhole cover. There are several venting options and gaskets. All units come equipped with a lifting strap that is pop-riveted to the bottom of the insert. A modified version that contains activated carbon is very effective in preventing odors from being emitted from sanitary sewer manholes.

**Parsonpoxy FP** is a two component, flexible, high strength, corrosion resistant, 100% solids polyamine epoxy/urethane hybrid that will bond to manhole frames and brick or precast corbels to create a waterproof seal, without the use of a primer. It is packaged in a pre-measured kit that includes an applicator brush.

### 6.6 Reliner/Duran Inc (Lyme, CT): Reliner® Replacement Invert

<http://reliner.com/index.html>

Reliner® Replacement Invert is a modular plastic composite invert system for new or existing manholes that stops leakage, infiltration and corrosion. Standard components consist of a fiberglass flume section and a pipe end consisting of a PVC pipe length bonded to an end flange/adaptor that bolts onto the flume section. The basic shapes for single flumes are straight, 45-degree sweep right and left, 22.5-degree sweep right and left, standard and short versions of these options.

### 6.7 Sewer Shield Composite LLC (Mesa, AZ): Sewer Shield® Manholes and Manhole Inserts

<http://www.sewershieldinserts.com/http://www.sewershield.com/ssc/manholes.html>

**Sewer Shield® Manhole** is a composite manhole made of epoxy resins throughout, designed and tested for H2O loading per ASTM D3753-99. The installed manhole requires zero maintenance, has acid resistance from 1% to 98%, zero cracking and zero water infiltration. The product weight is 600 lbs per 5-ft section and can be installed by backhoe. Rectangular and other shapes are available upon request.

The manhole consists of a cover section (concentric, eccentric or flat) and a riser section (can be made in stackable bell & spigot sections or in continuous sections up to 22 ft long). Sewer Shield® 150 is applied as a putty between the bell and spigot sections, as well as for bonding the inserts to existing piping systems.

**Sewer Shield® Manhole Insert** is installed inside a corroding manhole after which it acts as a freestanding manhole. To install the new insert, the old manhole's top is cut off and the interior hydroblasted to remove any loose materials.

### 6.8 Inflow Systems, Inc. (Largo, FL): InflowShield

<http://www.inflowshield.com>

**InflowShield** is a manhole cover insert for replacement of leaky manhole covers. The insert is custom sized and is manufactured of 304 Stainless Steel with a minimum thickness of 18 gage. It has a deep-dish bowl design that fits sufficiently loosely into the manhole frame to allow easy removal. Between the insert and the manhole frame is a ring-type gasket of Black EPDM Neoprene with a minimum thickness of 1/8 inch.

## 6.9 Southwestern Packing & Seals (Shreveport, LA): Rainstopper

[www.no-dig.com/sw/](http://www.no-dig.com/sw/)

**Rainstopper** is a manhole cover inserts that stops flow of rainwater into sewage systems, control manhole odors, keep dirt out of the system, and helps prevent manhole rattling and flipping due to street traffic. Rainstopper can be made from plastic (HDPE) or corrosion resistant, high strength stainless steel.

## 6.10 ThoRoc, Division of ChemRex® (Shakopee, MN): Sewer Guard® Manhole Insert

<http://www.chemrex.com/thoroc>

**Sewer Guard® Manhole Insert** is a watertight polyethylene manhole insert made of specially formulated high-density polyethylene. The insert prevents a rainwater and runoff from entering the collection system and collects debris that can filter into the manhole. Once installed, it can be easily removed to allow normal access for manhole maintenance or inspection.

## 7 OTHER

### 7.1 Sanipor (Feldkirchen, Germany): Sanipor®

<http://www.sanipor.de/sanipor.htm>

**Sanipor®** is a process for sealing in one continuous operation of one sewer section that consists of a main, its laterals and manholes. The system is intended for systems of sewer mains and laterals that have exfiltration and infiltration problems but are structurally sound. The sewer section is first cleaned and plugged, then filled with solution S1 until specific hydrostatic head is attained in the manhole thus forcing the solution S1 through the defects into the soil surrounding the sewer pipe and manhole. The S1 is then rapidly pumped out, and the section is immediately refilled with solution S2. The S2 reacts with the S1 in the ground and forms a concrete-like matrix, binding the soil particles and consolidating the ground around the defects. When the reaction is complete and watertightness established, solution S2 is pumped out.

## 8 PROTECTIVE SYSTEMS FOR NEW MANHOLES

### 8.1 Ameron International Corporation (Pasadena, CA): T-Lock®Lining

[http://www.ameron.com/linings/product\\_info/t-lock.htm](http://www.ameron.com/linings/product_info/t-lock.htm)

**T-Lock®** is a PVC sheet lining material that protects new concrete manholes against corrosion. Manhole installation with T-Lock is performed in five steps: (1) T-Lock sheets are secured to the inner forms of the manhole, (2) reinforcing and outer forms are placed, (3) concrete is poured or pumped, (4) forms are removed and the exposed liner sections connected by hot-air welding, (5) the lining is inspected and any imperfections are repaired. T-Lock has molded-in T-ribs that allow concrete to flow around them during casting. This helps locking the liner permanently into place as an integral part of the substrate.

### 8.2 Canusa (Toronto, Canada): WrapidSeal™

<http://www.wrapidseal.com/media/wrapidseal.pdf>

**WrapidSeal™** is an external manhole sealing system. It is a wrap-around heat-shrinkable sheet that has been specifically designed for protection of buried and exposed manhole structures.

WrapidSeal is supplied in bulk rolls of varying widths and consists of a cross-linked polyolefin backing, coated with a protective heat-activated adhesive. The heat required to shrink the sheet to fit the manhole is torch applied. Once installed, the system prevents water infiltration and protects the manhole support structure and frame from ground moisture.

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