CITY OF FORT WAYNE MASTER UPDATED: 02/01/19

SECTION 33 01 30.78

1. GENERAL
	1. DEscription
		1. Section Includes: Requirements for repair and rehabilitation of sanitary sewer manholes.
		2. Cementious materials such as grouts or mortars shall not be utilized for coating and will not be considered by the Engineer as an equivalent technology unless such coating is considered ancillary to the manhole preparation itself as it provides a clean substrate to which the coating will bond.
		3. Geopolymer – micro-fiber reinforced ultra-dense mortar with high anti-corrosion characteristics. Specifications for geopolymers are included in this specification.
		4. Water plugs and patches may be used only as a means of stopping leaks in order to coat the manhole. Plugs and patches shall not be considered the final solution to leakage.
		5. Chimney - The cylindrical variable height portion of the manhole structure used to support and adjust the finished grade of the manhole frame. The chimney extends from the top of the cone to the base of the manhole frame.
		6. Cone – That portion of the manhole structure which slopes upward and inward from the barrel of the manhole to the required chimney or frame diameter.
	2. QUALITY ASSURANCE
		1. Follow manufacturers’ requirements for installation and specifications listed herein.
		2. Contractor’s personnel involved in installation of materials shall be certified by manufacturer that they have successfully completed training in handling, applying, and finishing materials used.
		3. Contractor shall inspect pre-rehabilitation work, rehabilitation operations, and post-rehabilitation work.
		4. For a product to be considered commercially proven, a minimum of 1,000 vertical feet of manhole rehabilitation must have been completed over a period of at least three years with the material proposed, by the Contractor or by other contractors. Submit description of previous projects including material used, vertical linear feet of manhole rehabilitated, and owner’s contact information.
		5. Both Contractor and Product Manufacturer must warrant the installation and coating product against infiltration between all manhole barrel and chimney joints, pipe connections, and chimney/casting joints for a minimum of three (3) years commencing on the date of Substantial Completion. Warranty shall be received with, or before, application for Substantial Completion.
	3. SUBMITTALS
		1. Submit the following:
			1. Patching Materials and Manhole Coatings

Material type and manufacturer to be used, including catalog data showing manufacturer’s clarifications and updates, ASTM references and test results, material composition, specifications, physical properties and chemical resistance, manufacturer’s recommended mix, additives and set time.

Manufacturer’s detailed description of recommended procedures for handling and storing material to include use of strip recorder to monitor temperature at storage location.

Manufacturer’s detailed description of processes to execute the use of the material including equipment required.

Detailed description of field testing processes and procedures.

Certification that backup equipment is available and can be delivered to project sites within 24 hours.

* + - 1. Certified statement from manufacturer that Contractor is approved installer of the material or system. Owner may request certificates of training for each crew member involved in each process from manufacturer.

a. Documentation for products and installers must be approved by Engineer before installation of material.

* + - 1. For each manhole rehabilitated, a complete and accurate record of work completed.

Submittal shall indicate the manhole identification number, the location and quantities of rehabilitation material used, and results of post-rehabilitation inspection.

* + - 1. 3- year Warranty.
	1. MEASUREMENT AND PAYMENT

NTS: Edit below the various rehabilitation methods to be used for project. Adjust Section “1.2” below for additional work item numbers as needed. Delete sections not applicable to the project.

* + 1. Manhole Cleaning and Coating
			1. Work Item Number and Title

 **33 01 30.78-A Manhole Cleaning and Coating**

* + - 1. The price shall include all costs associated with traffic control; removal/disposal of brush near manholes; removing/disposal of debris from bottom of manhole; application of hydraulic water plugs; cleaning and preparing manhole surfaces; bypassing/blocking sanitary sewer flow; application of coating system (including chimney seal if using Raven product); and all surface restoration.
			2. The Contractor shall provide all labor, materials, and equipment, both temporary and permanent, associated with the Work described.
			3. Measurement of vertical feet placed shall be made from the casting/adjustment ring interface to the manhole bench. If the coating system chosen actually coats the entire bench, one (1) additional foot for every manhole bench coated shall be added to the total vertical footage for payment. For example: a manhole 10’ deep with a coated bench will be measured and invoiced at 11 vertical feet.
			4. Measurement shall be rounded to the nearest quarter (0.25) foot.
			5. Payment for this item shall be made based on actual amount of vertical feet installed.
		1. Rebuilding Benches
			1. Work Item Number and Title

 **33 01 30.78-B Rebuilding Benches**

* + - 1. The price shall include all costs associated with traffic control; removal/disposal of brush near manholes; pressure washing manhole inside surfaces; all materials and labor necessary to rebuild bench channel to extend to the crown of the incoming pipe.
			2. Measure and payment on this item shall be per bench rebuilt.
		1. Manhole Chimney Realignment
			1. Work Item Number and Title

 **33 01 30.78-C Chimney Realignment**

* + - 1. The price shall include all costs associated with traffic control; excavation; backfill; removal/disposal of brush near manholes; pressure washing manhole chimney surfaces; adjusting existing casting to grade and aligning riser rings as described in “Casting Adjustment” Detail. If existing riser rings are damaged beyond what is reasonable for continued use, the Contractor shall replace with new as requested by Engineer.
			2. The Contractor shall provide all labor, materials, and equipment, both temporary and permanent, associated with the Work described.
			3. Measure and payment on this Item shall be per manhole chimney realigned.
		1. Manhole Chimney Seals
			1. Work Item Number and Title

 **33 01 30.78-D Chimney Seals**

* + - 1. The price shall include all costs associated with traffic control; removal/disposal of brush near manholes; cleaning and preparation of chimney surfaces; application of coating system or approved chimney seal; and all surface restoration.
			2. Measure and payment on this Item shall be per manhole chimney seal applied.
	1. REFERENCES
		1. Standards referenced in the Section are listed below. The testing for concrete and cement products are for reference strictly with the Geopolymer materials:
			1. American Society for Testing and Materials (ASTM)
				1. ASTM C 39 / C 109 – Compressive Strength Hydraulic Cement Mortars
				2. ASTM C 78 – Flexural Strength of Concrete
				3. ASTM C 138 / C 642 – Standard Test Method for Density
				4. ASTM C 157 – Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
				5. ASTM C 267 – Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes
				6. ASTM C 307 – Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
				7. ASTM C 469 – Static Modulus of Elasticity & Poisson’s Ratio of Concrete Compression
				8. ASTM C 478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
				9. ASTM C 496 – Splitting Tensile Strength of Cylindrical Concrete Specimens
				10. ASTM C 580 – Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
				11. ASTM C 666 – Freeze Thaw Durability
				12. ASTM C 882 – Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
				13. ASTM C 1090 – Shrinkage Test
				14. ASTM C 1138 - Standard Test Method for Abrasion Resistance of Concrete (Underwater Method)
				15. ASTM C 1140-03A – Preparing and Testing Specimens from Shotcrete Test Panels
				16. ASTM C 1202 – Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration
				17. ASTM D 4787 – Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
				18. ASTM F 2414 – Practice for Sealing Sewer Manhole Using Chemical Grouting
			2. American Concrete Institute (ACI)
				1. ACI 305R – Hot Weather Concreting
				2. ACI 306R – Cold Weather Concreting
				3. ACI Certified Field Testing Tehcnician, Level 1
1. PRODUCTS
	1. MATERIALS
		1. Hydraulic Water Plugs
			1. Rapid setting hydraulic water plug to plug active leaks prior to other rehabilitation Work.
			2. Initial Set Time at 70 degrees F shall be 60 to 90 seconds.
			3. Final Set Time at 70 degrees F shall be no more than one hour.
			4. Compressive Strength (ASTM C109) at 28 days.
				1. Per manufacturer’s recommendation.
				2. Minimum acceptable: 4,000 psi.
			5. Length Change (ASTM C157): 0 percent.
			6. Approved Manufacturers
				1. Sauereisen, Instaplug F-180.
				2. IPA Systems, Inc., Octoplug Plus.
				3. The Strong Company, Inc., Strong-Seal Strong-Plug.
				4. AP/M Permaform, Permacast-Plug.
				5. Parson Quick Plug, Parson Environmental.
				6. Or Engineer approved equal.
		2. Oil-free Oakum Water Plugs
			1. Rapid setting oil-free oakum and hydrophilic grout to plug active water leaks prior to other rehabilitation work.
			2. Oil-free oakum meeting Federal Specification HH-P-117.
			3. Two-part urethane resin.
			4. Initial set time shall be 5 to 10 minutes.
				1. Use accelerator to decrease initial set time.
			5. Approved Manufacturers.
				1. Avanti International, Oil-free Oakum (AV-219) and Multigrout (AV-202).
				2. DeNeef, Inc., Oil-free Oakum and Hydro Active Sealfoam or Hydro Active Flex LV grout.
				3. Parson Perma Seal, Parson Environmental.
				4. Spectra-Grout, SpectraTech.
				5. Or Engineer approved equal.
		3. Epoxy or Polymer/Polyurethane Manhole Coatings
			1. Spray-on and Trowelable Coatings.
				1. Two or three-part epoxy or polymer resin and polyurethanes to protect concrete and steel from chemical attack.
				2. Minimum thickness.

Sprayed or troweled: 80 mils.

Rotary cast: 125 mils.

* + - * 1. Tensile Strength (ASTM C307): Minimum 2,500 psi.
				2. Flexural Strength (ASTM C580): Minimum 4,600 psi.
				3. Working time at 70 degrees F: 30 minutes.
				4. Initial set time at 70 degrees F: 17 hours.
				5. Approved Manufacturers.

Sauereisen, Sewer Tuff No. 210, No. 210S or No. 210RS.

Raven, Raven 400S or 405 \*\*

AP/M Permaform, Cor+Gard

SprayRoq, Inc., SprayWall

Spectrashield (wastewater structures), SpectraTech

Madewell, Mainstay DS-5

Ceilcote, Ceilcote 663SG Lining

Strong-Seal, Epoxy, Profile Plus Mix

Parson, Parsonpoxy Sel-80

Quadex, Structure Guard

Duraline Duraseal

OBIC, OBIC Armor 1000F

Or Engineer Approved Equal.

\*\* If using the Raven product, all manholes in any paved areas shall utilize an Engineer approved chimney sealing system.

* + 1. Geopolymer Manhole Coatings
			1. Centrifugally cast, manually sprayed, or hand troweled micro-fiber reinforced ultra-dense Geopolymer
				1. Thickness

Minimum thickness: ½ inch

Contractor responsible to check manhole condition to ensure ½ inch thickness is adequate. Contractor to work with Supplier’s Licensed Professional Engineer to design required thickness.

* + - * 1. Compressive Strength (ASTM C39/C109): Minimum 4,000 psi.
				2. Tensile Strength (ASTM C496): Minimum 900 psi.
				3. Flexural Strength (ASTM C580): Minimum 1,300 psi.
				4. Density (ASTM C138/C642): Dry 110-120 lb/ft3 and Wet 120-130 lb/ft3
				5. Chemical Resistance, Surfuric Acid PH 1.0 (ASTM C267): Max 2% mass loss at 8 weeks
				6. Modulus of Elasticity (ASTM C469): Minimum 5,400,000 psi
				7. Freeze/Thaw Durability (ASTM C666): Max 0.1% Loss at 300 Cycles
				8. Bond Strength to Concrete (ASTM C882): Minimum 3,000 psi
				9. Shrinkage Test (ASTM C1090): Max 0.02%
				10. Abrasion Resistance (ASTM C1138): Max 1.5% Weight Loss at 6 cycles
				11. Composition

Acceptable Values (%wt)

Oxides

1) SiO2: 40-60% as determined by X-Ray Fluorescence (XRF)

2) Al2O3: 13-30% as determined by X-Ray Fluorescence (XRF)

3) Total amorphous SiO2 + Al2O3 (geopolymer precursor): >50%

4) Total CaO: <25%

5) Na2O: 0.35-20%

b) Oxide Ratios

 1) Amorphous SiO2/Al2O3 (Ratio): 1-3

 2) Total amorphous Na2O/Al2O3 (Ratio): 0.05-1.5

c) Cement Content: <1%

* + - * 1. Approved Manufacturers.

Quadex GeoKrete

Geospray

Parson Environmental Geoliner

Or Engineer Approved Equal

* + 1. Riser Rings
			1. Precast concrete riser rings shall be used where required.
			2. Rings shall be a minimum nominal thickness of three (3) inches and shall conform to ASTM C478, latest revision. Ashphaltic mastic type sealant with ½” minimum thickness and 4” minimum width or nominal ½” butyl rubber base extrudable preformed gasket material shall be placed in the center of the concrete rings along with any necessary grout. The gasket material shall also be placed at the cone/slab interface and below the casting.
			3. All new manhole joints including barrel, cone, grade rings and castings, must be externally sealed using a heat-shrinkable seal such as WrapidSeal or Engineer approved equal.
		2. Chimney Seals
			1. If Contractor elects to use a Raven coating system for manholes in a paved area, an internal or external chimney seal must also be provided.
			2. Chimney seals must overlap onto the casting and extend onto the cone.
			3. Approved chimney sealing methods are as follows:
				1. CIPMH Chimney Liner
				2. Cretex Internal Chimney Seal
				3. Mr. Manhole Manhole Leveling System
				4. WrapidSeal – External heat-shrink wrap at all chimney joints
				5. Products Approved in Manhole Coatings Section if approved by Engineer
				6. Or Engineer Approved Equal
1. EXECUTION
	1. PUBLIC NOTIFICATION
		1. Maintain service usage throughout duration of project.
			1. Maximum amount of time without service: 8 hours for any property served by sewer. Any service out longer than 8 hours will be bypassed to a sanitary sewer.
		2. Public Notification Program:
			1. Deliver written notices to each home or business which may be affected, no more than 48 hours before commencement of work. Notice shall include contractor’s telephone number for inquiries or complaints.
			2. Provide owner or occupant a summary of work to be completed, and time and duration of service interruption to building if applicable.
			3. Contact any home or business that cannot be reconnected within time stated in written notice if applicable.
			4. Provide a sample of notice to be used to the Engineer upon request.
	2. INSTALLATION
		1. Temperature inside the manhole shall be between 34 degrees Fahrenheit and 100 degrees Fahrenheit during all installation and curing procedures. Provide all necessary cooling, heating, and ventilation needed to the provide optimal environment for the entire rehabilitation process. Contractor shall strictly adhere to the Supplier’s cure schedule.
		2. Clean interior surfaces of manhole of debris, dirt, oil, grease, remains of old coating materials, and any other extraneous materials following approved submittals for rehabilitation products used.
		3. Pressure wash manhole walls to remove loose mortar, concrete, debris following approved submittals for rehabilitation products used.
		4. Repair irregularities in manhole following approved submittals for rehabilitation products used.
		5. Contractor may remove existing manhole steps for ease of preparation and application of coating material at no additional cost to the Owner.
		6. Repair leakage in manhole following approved submittals for rehabilitation products used. Hydraulic Water Plugs shall be used on all manholes receiving full depth coatings.
		7. Any flow metering devices found in a manhole scheduled for rehabilitation shall be reported to the Engineer for coordination of removal prior to preparation for coating.
		8. Trim and seal incoming laterals and pipes.
		9. Remove debris from manhole and sewer.
			1. Handle cleaning water in closed discharge hoses to prevent water and residue from causing damage.
			2. Do not discharge debris through sanitary sewer system.
			3. Contractor shall be responsible for proper and legal removal and disposal of all materials in manholes to be rehabilitated.
		10. Hydraulic Water Plugs
			1. Provide mechanical key by undercutting or square cutting the opening and removing loose materials per manufacturer’s recommendations.
			2. Mix, handle, place and cure per manufacturer’s recommendations.
			3. Finish surface per manufacturer’s recommendations and as required for other rehabilitation Work.
		11. Oil-free Oakum Water Plugs
			1. Saturate oakum with resin per manufacturer’s recommendations.
			2. Use additives as required.
			3. Place and cure per manufacturer’s recommendations.
		12. Epoxy or Polymer/Polyurethane Manhole Coatings
			1. Mix and apply per manufacturer’s recommendations.
			2. Sagging of epoxy coating is not permitted.
			3. Seal around pipe connections and steps.
			4. Seal at casting/chimney interface.
			5. Cure per manufacturer’s recommendations
			6. If Contractor uses a rotary cast system, the following areas are required to be hand applied:
				1. precast manhole cap-barrel interfaces;
				2. pipe-manhole interfaces;
				3. bench-barrel interfaces.
		13. Geopolymer Manhole Coatings
			1. Application Equipment
				1. Manufacturer approved equipment shall be used in the application of the specified
				2. Application equipment shall include a vertical shaft, horizontal blade mixer with at least a 45-gallon capacity and three stage progressive cavity material pump.
				3. Application equipment shall have a water metering system to monitor the rate of water addition. This will ensure water/material ratios are known and controlled. Water/material ratio must be maintained per manufacturers’ recommendations.
				4. Application equipment shall include a diesel engine/generator sufficiently sized to operate all components on the trailer as needed for completion of the lining.
				5. Application equipment shall include sufficiently sized water transfer pump so as to provide continuous delivery of water to all components. Similarly an adequately sized pressure washer for use in surface preparation and equipment clean-up.
				6. Application equipment shall include an air compressor and reservoir providing compressed air for spray atomization.
				7. Application equipment shall include either a manual spray nozzle, or a spinner head. Spinner head shall be attached to an electric winch mounted on a tripod allowing for control of vertical movement at a constant rate.
			2. Mixing of the Geopolymer Lining Material
				1. Contractor shall add the Geopolymer material to the batch water following precisely the manufacturer’s water/material ratio. Precision metering of water in mixer is required to maintain the strict water to material ratio. The ability to closely adjust and monitor the addition of water through the use of a water meter is required.
				2. Mixing water temperatures must be determined before blending operations begin. The mixing water temperature must be recorded in the data log at multiple times throughout the day during the installation process. Water temperatures should be maintained at all times to within the limits required by the system supplier or manufacturer. The ability to provide mixing water at a consistent temperature is a critical aspect of the mixing and installation process.
				3. The lining material shall be mixed in a high shear mixer, or similar, to ensure thorough and uniform mix of water with the material prior to pumping.
				4. The mixing operations must be performed so that the minimum of dust is released into the surrounding environment.
				5. The batch style mixing, precise metering of water and pump rate eliminates wet/dry and thick/thin variations resulting in a uniform structure regardless of the pumping distance.
				6. Multiple application nozzles should be onsite at all times to address any application issues or failure of the nozzle. Multiple nozzles may be required to produce the required depth or finish of the liner surface.
			3. Application of the Geopolymer Lining Material
				1. The work consists of spray applying and/or centrifugally spin-casting the specified geopolymer liner material to the inside of an existing structure. The necessary equipment and application methods to apply the liner materials shall be only as approved by the material manufacturer. Material shall be mixed in accordance with manufacturer’s specifications to proper consistency, then the materials shall be pumped through a high pressure material hose for delivery to the appropriate and / or selected application device.
				2. Application on all pre-cast/poured-in-place manholes shall occur after preparing surfaces. Material shall be applied to the bench area in such a manner as to provide for proper drainage without ponding and to compensate for abrasion. Material must be applied only when surfaces are damp but with no visible water dripping or running.
				3. Hand Troweled Application

In locations where equipment access is limited or work scope is such that mobilization of equipment is not justifiable, material may be hand troweled into place.

Proper mixing should be achieved with a portable mixing unit of sufficient strength to thoroughly mix product to manufacturers recommended consistency.

Application of material by troweling shall be performed by starting at the bottom of the structure and progressing up the wall.

Material shall be applied to a specified uniform minimum thickness no less than 1/2 inch, unless otherwise instructed by Engineer and/or the Manufacturer’s Guidelines. Material shall be applied to the bench area in such a manner as to provide for proper drainage without ponding and accounting for anticipated abrasion.

Troweling of materials shall begin immediately following the mixing of the product. Initial troweling shall be in a motion, to compress the material into any voids within the structure walls. Precautions should be taken not to over trowel.

Once troweling has been completed the applied liner shall be brushed to remove trowel marks and to break up the latent surface brought about by troweling. Brushing should be in the horizontal plane and as with troweling do not over work the coating material.

* + - * 1. Hand Spray Application

Material hose shall be coupled to a low-velocity spray application nozzle. Pumping of the material shall commence and the mortar shall be atomized by the introduction of air at the nozzle, creating a low-velocity spray pattern for material application.

Spraying shall be performed by starting at the bottom of the structure and progressing up the wall.

Material shall be applied to the bench area in such a manner as to provide for proper drainage without ponding and accounting for anticipated abrasion.

Troweling of materials shall begin immediately following the spray application. Initial troweling shall be in a motion, to compress the material into any voids within the structure walls. Precautions should be taken not to over trowel.

Once troweling has been completed the applied liner shall be brushed to remove trowel marks and to break up the latent surface brought about by troweling. Brushing should be in the horizontal plane and as with troweling do not over work the lining material.

* + - * 1. Centrifugal Application

Spin-cast unit shall be approved by the material manufacturer. Mechanical insertion/extraction equipment and speeds shall be calibrated to the structure diameter to ensure uniform application to specified thickness. Material hose shall be coupled to the spincast unit. The spin-cast unit shall then be positioned within the center of the horizontal or vertical structure.

Initially locate the spinner at either the top of the manhole chimney or the lowest point corresponding to the junction of the manhole bench and walls.

The spin-cast unit shall then be initialized, and pumping of the material shall commence.

As the mortar begins to be centrifugally cast evenly around the interior of the structure, the rotating applicator head may be cycled up and down, when installing in rough, non-uniform vertical structures, at a controlled retrieval speed conducive to providing a uniform material thickness on the structure walls.

* + 1. Contractor is responsible to measure and provide thickness readings to the Inspector and on their final submittal for each manhole coating installed.
	1. TESTING
		1. Visual inspections shall be performed to determine integrity of rehabilitation materials and water-tightness.
			1. Provide flow-through plugs for the duration of inspection.
			2. No infiltration or inflow shall be permitted.
			3. Contractor shall repair any leakage or Work found to be unsatisfactory by Engineer.
		2. Test manhole coating for continuity following ASTM D4787 and approved submittals. Repair holes and discontinuities following manufacturer’s recommendations.
	2. WARRANTY INSPECTIONS
		1. Visual inspections may be performed by Engineer to determine integrity of rehabilitation materials and water-tightness prior to expiration of the guarantee period, preferably in spring season.
		2. Contractor may accompany Engineer on inspections.
		3. Engineer will inspect a minimum of 25 percent of manholes rehabilitated at locations selected by Engineer.
			1. No infiltration or inflow shall be permitted.
			2. If any manhole fails warranty inspection, all manholes on contract will be inspected by the Engineer.
		4. Upon notification from Engineer of any defects found during the warranty period, Contractor shall correct all defects found in a timely manner, at no additional cost to the Owner.

++END OF SECTION++