SECTION 691 – MANHOLE REHABILITATION AND CORROSION PROTECTIVE COATING

**DESCRIPTION**

**691.01.01 GENERAL**

1. This section specifies the coating systems used for rehabilitation of existing access manholes and new concrete sanitary sewer manholes.
2. Where required by the approved plans, existing manholes shall be rehabilitated and an approved corrosion protective coating applied to their interior surfaces, as specified herein.
3. The approved coating system shall be applied to all exposed concrete, grout, mortar, and cementitious surfaces within the manhole, including bench, channel from above the spring line, risers, cones, adjusting rings, etc. Coating of the metallic manhole frame and cover shall not be required. Corroded manhole frame and cover shall be replaced as noted in the Drawings.
4. Manhole coating work shall take place after CIPP lining work.

**691.01.02 DEFINITIONS**

A. Specific coating terminology used in this section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions:

1. Coating Systems.

a. In this specification, the words “coating” (or “coatings”) and “lining” (or “linings”) are used interchangeably. Similarly, “to coat” is used interchangeably with “to line” (or other variations of these words).

b. All components together as a unit used to repair the manhole and protect against further corrosion.

c. These components include, as applicable: defect filler and resurfacing materials, material used to repair invert and bench, infiltration control, primer and finish coats

d. The word “manhole” shall mean “sewer structure” and shall encompass sewer manholes, sewage lift station wet wells, sewer diversion structures, sewer junction structures, and other sewer structures. It also encompasses sewer pipes (or portions thereof) that are located within the sewer structure, but does not include sewer pipes (or portions thereof) that are located outside of the limits of the structure.

e. “Existing manholes” shall mean those manholes not constructed as part of this project.

f. “Rehabilitating” existing manholes by applying corrosion protective coating shall include the following activities:

1. Cleaning the manhole and removing corroded/deteriorated materials from the manhole and preparing the manhole per the approved coating systems manufacturer’s specifications.
2. Applying one of the approved coating systems, as specified herein.
3. Testing the finished surface coating, as required herein.
4. Other related activities, as noted herein.

2. Dry Film Thickness (DFT).

a. The thickness of one fully cured continuous application of coating.

3. Certified Applicator.

a. The person, who is certified by the approved coating system manufacturer assigned by the Contractor to apply the specified coating system.

4. Coating Systems Manufacturer.

a. The manufacturer of the various components that comprise the Coating Systems.

5. Manufacturer’s Representative

a. A representative authorized to act on behalf of the manufacturer regarding technical and commercial issues, which includes Third Party Inspector approved by the Engineer

**691.01.03 REFERENCES**

1. This section contains references to the following standards, latest editions. They are a part of this section as specified and modified. Where a referenced document contains references to other standards the requirements affording the greatest protection to the Owner shall apply, as determined by the Engineer.

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| --- | --- |
| Reference | Title |
|  |  |
| ASTM D16 | Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products |
|  |  |
| ASTM D3960 | Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paint and Related Coatings |
|  |  |
| ASTM D7234 | Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers |
|  |  |
| ATSM D4787 | Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates |
|  |  |
| OSHA 29CFR | Occupational Safety and Health Administration (OSHA), 1926/1910 Safety and Health Standards |
|  |  |
| SSPC | Steel Structures Painting Council Specifications |
|  |  |
| ICRI | International Concrete Repair Institute |

**691.01.04 MANUFACTURER'S REPRESENTATIVE**

A. The Manufacturer’s Representative shall provide field inspections per Section 691.03.01 C.

B. The Manufacturer’s Representative shall be present, and shall verify in writing that the proper procedures and equipment are used by the applicator and that the coating is being applied per the Coating System Application plan.

**691.01.05 CERTIFIED APPLICATOR**

A. The coating system shall be applied by an Applicator certified by the Coatings System Manufacturer.

1. The certification program shall include an annual renewal.

2. The Contractor shall provide evidence that the personnel performing the coating application for each project received the manufacturer’s training for certification.

B. The Applicator shall appoint a Quality Assurance Manager to take full responsibility for the quality of the work. The Quality Assurance Manager shall be fully certified by the Coatings System Manufacturer.

**691.01.06 SUBMITTALS**

A. The submittals designated below shall be provided:

B. Submit certificate of responsibility attesting that the Contractor accepts responsibility for products and the installation of the products specified herein.

C. Submit Manufacturer’s Certification attesting that the Applicator is qualified and approved to install the products specified herein.

1. The coating applicator shall also submit a certification letter from the manufacturer of the product (i.e., one of the approved products listed in this specification) that the applicator intends to install in the manholes. The certification letter shall state that the coating applicator has been trained and is certified and approved by the manufacturer to apply the manufacturer's coating in sewer manholes.

2. Certification and qualifications for testing for holidays and other discontinuities.

D. Submit manufacturer’s written warranty per 691.02.03.

1. Before materials are delivered to the job site submit manufacturer specifications containing instructions and quality control procedures meeting the following requirements:

1. Instructions must be written and published by the manufacturer for the purpose of giving complete instruction for the use and application of the proposed coating for the conditions for which the coating is specified.

2. The Contractor shall furnish Material Safety Data Sheets (MSDS) for all products used in the coating system.

3. Limitations, exceptions, precautions, and requirements that may adversely affect the performance of the coating system shall be clearly and completely stated in the instructions. If the manufacturer’s requirements differ from these specifications, the instructions shall clearly state where deviations are required. Temperature and humidity limitations for minimum and maximum conditions are to be included. Approval by the Engineer is required prior to the acceptance of any manufacturer deviations from these specifications.

4. For all coating system components, the Contractor shall provide the manufacturer's application instructions, which shall include the following:

a. Surface preparation (including repairs and resurfacing) recommendations.

b. Primer type, where required.

c. Application of primer and final coating.

d. Maximum dry and wet film thickness.

e. Minimum and maximum curing time between coats, including atmospheric conditions for each.

f. Curing Methods.

g. Curing time before submergence in liquid.

h. Ventilation requirements.

i. Minimum atmospheric conditions during which the coating shall be applied.

j. Allowable application methods.

k. Maximum allowable moisture content.

l. Maximum storage life.

m. Special equipment.

n. Testing procedures for dry film thickness, holiday testing, adhesion testing, and acceptance test.

1. Coating System Application Plan shall be prepared that includes a description of the following:

1. Quality Assurance Procedures

a. Detailed duties of the Applicator’s Quality Assurance Manager.

b. Detailed duties of the Manufacturer’s Representative.

c. List of application and testing equipment to be used, including inspections confirming satisfactory condition of equipment.

d. Correct storage and handling of coating materials, and the necessary safety requirements.

2. Criteria for acceptance of the preparation of concrete and manhole surfaces.

3. Plan for sewage diversion (when required) as specified in Section 695 “Diversion of Sewage Flows”.

4. Method and material for sealing active leaks.

5. Detailed environmental provisions such as shading from the sun and other conditions that adversely affect coating application.

6. Detailed scheduling provisions for environmental considerations such as working at night.

**MATERIALS**

**691.02.01 COATING SYSTEM**

A. Coating Systems shall be compatible with the surface preparation methods as specified herein. Any limitations or deviations requested by the manufacturer shall be approved in writing by the Engineer prior to surface preparation.

B. Coatings shall be applied within two (2) months of their date of manufacture unless the manufacturer’s requirements are more stringent.

C. Thicknesses specified herein are the minimum dry film thickness required and does not include the primer thickness, unless otherwise noted. A minimum thickness of 125 mils is required. Ground water depth of ten feet from the top of the manhole bench shall be used to determine the coating thickness. Provide greater thickness where recommended by the manufacturer.

D. Primer shall be as recommended by the manufacturer for each installation.

E. Defect filler and repair materials shall be as recommended by the manufacturer for each installation.

F. Manhole infiltration control material such as chimney seal shall be as recommended by the manufacturer for each installation, and shall be covered under the same warranty as the rest of the coating system.

**691.02.02 APPROVED MANUFACTURERS**

A. The approved corrosion protective coating systems for application to existing manholes shall be as listed below in paragraph B.

B. The approved coating systems has an underlayment material and a surface coating material:

1. Epoxy Tec Epoxy Coating
2. Raven Lining Systems – Raven 405 – Spray on Epoxy Liner
3. Sauereisen – SewerGard No. 210S and 210X – Spray on Epoxy Liner
4. Permacast – COR+GARD – Spray on Epoxy Liner
5. Warren Environmental 301-14 Spray on Epoxy Liner and 301-18 Epoxy Mastic
6. Sherwin-Williams – Dura-Plate 6100
7. Vortex Companies – Structure Gaurd
8. The underlayment material and the surface coating material installed in any one manhole shall be from the same manufacturer.
9. Sprayable or trowelable formulations of the products listed above are acceptable. If "sprayable", the product shall be applied by an airless sprayer or spincaster. In addition, if applied by airless sprayer or spincaster, the final underlayment layer and the final surface coating layer shall both be trowel finished before setting. The Contractor shall not re-use or apply rebounded, spilled or over-sprayed material.
10. No substitutions outside of the foregoing list of products and manufacturers are permitted. All coating systems shall be applied in accordance with these specifications.

**691.02.03 WARRANTY**

A. The Coating Manufacturer shall provide a written warranty to cover workmanship and materials for each manhole coated with an approved corrosion protective coating for a period of not less than five (5) years from the date of final acceptance of the project. The warranty shall be delivered to the Engineer prior to and as a condition of final acceptance for this project.

1. Coating failure is defined as blistering, cracking, embrittlement, or softening, or failure to adhere to the substrate.

2. The warranty shall also apply to any repair materials, primers, or other products used in the application and shall conform with Section 11 of the General Conditions.

3. By executing this contract, the Contractor certifies and agrees that any testing performed by the City during construction (e.g., spark testing, adhesion testing and/or other testing) shall not in any way modify the warranty, nor relieve the Contractor’s responsibility for responding and correcting defects during the warranty period.

**691.02.04 ENVIRONMENTAL CONDITIONS**

A. The products furnished under this section will be installed in sanitary sewer access manholes, junction structures, and wastewater conveyance channels.

B. The products will be exposed to the extremes in temperatures and humidity.

C. In addition, the products will be exposed to corrosive, abrasive and reactive liquids and gasses associated with wastewater conveyance.

D. The products will be immersed or intermittently immersed in wastewater and the product surfaces are subject to splashing of wastewater.

**691.02.05 PRODUCT DATA**

A. Before materials are delivered to the job site, the Contractor shall provide the following information.

B. The Contractor shall furnish Material Safety Data Sheets (MSDS) for all products used in the coating system.

C. For all coating system components, the Contractor shall provide the manufacturer’s application instructions, which shall include the following:

1. Surface preparation recommendations.

2. Primer type, where required.

3. Maximum dry and wet film thickness.

4. Minimum and maximum curing time between coats, including atmospheric conditions for each.

5. Curing time before submergence in liquid.

6. Thinner to be used with coating material.

7. Ventilation requirements.

8. Minimum atmospheric conditions during which the coating shall be applied.

9. Allowable application methods.

10. Maximum allowable moisture content.

11. Maximum storage life.

D. List of materials proposed to be used under this section and manufacturer’s data for each material.

**CONSTRUCTION**

**691.03.01 GENERAL**

A. Coating products shall not be used until the Engineer has inspected the materials and equipment.

B. Coatings shall only be applied by a Manufacturer’s Certified Applicator.

C. A Manufacturer’s Representative must be present during the first 25 percent of installations for the project or as deemed necessary by the Engineer and Owner. For the remaining construction period, the Manufacturer’s Representative must be available either by phone or person for the project, if deemed necessary by the Engineer and/or Owner to resolve any issues.

**691.03.02 SAFETY AND VENTILATION REQUIREMENTS**

A. Requirements for safety and ventilation shall be in accordance with SSPC Paint Application Guide No. 3, and all applicable federal, state and local regulations.

**691.03.03 SEWAGE FLOW AND DIVERSION**

A. If the approved plans and project specifications do not require sewer bypass pumping for this project, sewer flows will be allowed to continue in the existing sewer lines during the manhole coating work identified in this section. The Contractor shall not impede or restrict said flows. In some cases, the City may (at the City’s sole discretion) be able to reduce flows in existing sewer lines by effecting upstream sewer diversions. Prior to working in manholes on existing sewer lines, the Contractor shall coordinate with the Engineer to determine if the City desires to put said diversions into effect for one or more of the existing manholes included in this project. If so, the Contractor shall coordinate with the Engineer a minimum of 48 hours prior to working on said manholes so that the City’s staff can put said diversions into effect. The Contractor shall also coordinate with the Engineer to notify the City when said diversions are no longer needed.

B. If the approved plans or project specifications require sewer bypass pumping for this project (whether specifically identified as being for the manhole rehabilitation and corrosion protective coating work or not) and if said sewer bypass pump-around removes flow from any manholes to be rehabilitated and/or coated as part of this project, said sewer bypass pump-around operations shall remain in effect until the requirements of this specification are fully satisfied for those manholes.

C. The Contractor shall use whatever means necessary to prevent foreign material from entering the sewer lines and/or sewer flows. The Contractor shall remove from the sewer lines any material that enters the sewer lines due to his operations at no cost to the City.

**691.03.04 CLEANING AND PREPARATION**

A. Manufacturer’s inspection prior to coating application shall include surface cleaning and preparation that meets the Manufacturer’s written instructions. Refer to Section 692 “Sewer Pipe and Structure Cleaning”.

B. Prior to coating application, Contractor shall notify Engineer of any noticeable disparity in the surfaces that may interfere with the proper preparation, or application of the coating system.

C. Existing Liner Removal

1. The entire manhole interior including frame, walls, and bench shall be cleaned prior to rehabilitation using either abrasive blasting and high-pressure water blast as recommended by the coating and/or repair product manufacturer.

2. Unless otherwise noted on the plans, for existing manholes lined with an existing PVC liner (e.g., T-lock liner), the Contractor shall remove the existing PVC liner prior to other cleaning activities. If the "tees" (i.e., the portion of the PVC liner that is embedded in the concrete) are not "strongly embedded" in the concrete, the Contractor shall entirely remove the tees from the concrete and shall remove both the PVC liner sheet and the tees from the manhole. For the purposes of making this determination, "strongly embedded" shall be defined as embedded within the concrete well enough that when the PVC liner is cut into strips (i.e., by cutting the PVC liner parallel to the tees at a point midway between each line of tees) and a pulling force of 100 pounds is applied to each strip incrementally along the length of each strip to pull said tees from the concrete. Tees that remain firmly embedded in the concrete after doing so are judged to be "strongly embedded". The Contractor shall cut PVC Liner Sheet loose from tees and the remaining tees embedded in the concrete shall be cut flush with surface of the existing manhole wall. No portion of the remaining tees shall protrude above the surface after surface preparation for coating is complete. The Contractor may at his own discretion remove even strongly embedded tees from the concrete.

3. Unless otherwise noted, existing or new PVC liners on pipelines connecting to or passing through the manhole shall be left intact and in-place.

4. Unless otherwise noted on the plans, for existing manholes lined or coated with a previously applied cured-in-place corrosion protective coating, the Contractor shall entirely remove the existing liner/coating (including any underlayment layers) prior to performing other cleaning activities.

D. Surface Preparation

1. Prior to application of the approved coating, all portions of the manhole to be coated shall be cleaned of all dust, loose particles, corroded or damaged materials, oils, grease, curing compounds, chemical contaminants, and previously applied paints, and insecticide coatings. The Contractor shall clean the manhole by abrasive blasting, and/or water blasting. Abrasive blasting may be either wet or dry. Abrasive blasting equipment shall be rated for a minimum of 90 psi. Water blasting shall be performed with water blasting equipment capable of a minimum of 5,000- to 10,000-psi at 4 gpm. The Contractor shall remove all sand or other abrasive material and debris from the manhole with an industrial vacuum cleaner or other means approved by the Engineer.

2. Other manhole cleaning methods may be used **in addition to** abrasive blasting and/or water blasting, subject to Engineer approval, as necessary to properly clean and prepare the manhole, but **shall not be used as a substitute for** abrasive blasting and/or water blasting. Other methods are high pressure water jetting, shot blasting, grinding, mechanical removal methods, chemical cleaning, detergent cleaning, hot water blasting and acid etching. If chemical cleaning or acid-etching are used, the substrate shall be neutralized and washed of residue. The Contractor shall use whatever methods are required to properly clean and prepare the manhole for the coating system.

3. The Contractor shall be aware that manhole cleaning and preparation activities (e.g., water blasting and abrasive blasting) may cause damage to certain materials and finishes. The Contractor shall be solely responsible to protect portions of the manhole (including appurtenances and attachments) that are not slated for such cleaning and preparation activities from damage and shall be responsible to repair any damage caused by the cleaning and preparation activities.

4. The Engineer shall approve all chemicals used for this project prior to their use. Chemical use shall conform to local, state and federal laws and regulations.

5. A manhole suitably prepared for coating shall have all loose, soft, discolored or otherwise deteriorated material removed from the manhole and the surface profile of the manhole shall be in accordance with ICRI Guidelines No. 03732. Expose aggregate and obtain a uniform surface texture resembling an ICRI – CPS (Concrete Surface Profile) #4-6. The Engineer may use one or more of the following observations/tests to determine whether the manhole substrate has been properly cleaned and prepared:

a. Visual appearance of the manhole – The prepared substrate shall have the appearance of sound concrete, free from discolored, white, chalky and cracked areas.

b. Aural observations – When struck with a metal hammer or similar metal tool, the prepared substrate shall exhibit the characteristic sound of solid, competent concrete (or brick). Care should be taken not to fracture sound concrete.

c. Mechanical abrasion tests – The substrate should be competent enough such that it cannot be scraped off with the claw of a hammer or similar metal tool.

d. pH testing – The Engineer may use wetted litmus paper applied to the surface of the substrate to ensure that the pH of the substrate is 7 or higher.

e. Phenolthalein testing – The Engineer may apply a few drops of phenolthalein to the surface of the concrete, which if the concrete is competent should yield a purple color.

6. The Engineer is not obligated to use all of the above tests, but may do so at the City's sole discretion. Often visual, mechanical and/or aural observations and tests alone will be adequate, but the pH and/or phenolthalein tests may be used if there is still some uncertainty.

7. If after cleaning, a new or existing manhole does not meet these requirements, the Engineer shall have authority to require additional cleaning effort and/or increased blasting pressure as required to adequately prepare the manhole. If necessary, the Engineer may also require acid etching of the concrete surface to create the desired texture. For existing manholes, the Engineer may also require mechanical removal of deteriorated concrete or other substrate materials.

8. A mild chlorine solution may be used to neutralize the surface to diminish microbiological bacteria growth prior to final rinse and coating system if approved by the Manufacturer’s Representative.

9. The time between manhole cleaning and preparation activities and application of the first coating layer shall be within the coating manufacturer’s recommendation.

E. Manhole Step Removal

1. Unless otherwise directed by the Engineer, manhole steps shall be cut flush with wall surface.

2. Voids or holes remaining from removal of the steps shall be filled and troweled flush with the wall using a manhole patching material approved by the Manufacturer’s Representative.

F. Debris Removal

1. Contractor shall also remove all dirt, rocks, rust, spalled masonry (including mortar, concrete), roots, sludge, grease grit, and other deleterious materials and debris from the interior of the junction structure and access manholes.

2. Debris from cleaning operations shall be collected within the manhole and disposed of at the APEX landfill.

3. Hauling containers shall be watertight.

4. Refer to Section 692 “Sewer and Structure Cleaning”.

1. Defects

1. Any visible water infiltration or seepage through seams in the existing manhole walls shall be eliminated using a material approved by the Manufacturer’s Representative and compatible with the underlayment material (in the case of existing manholes) or the primer coat and finish surface coating material (in the case of new manholes). A letter from the underlayment material manufacturer and finish surface coating material manufacturer stating that the material used to stop the infiltration is compatible with and will adhere to their product is required before any such material can be used.

2. The area between the manhole frame and the manhole grade ring and any other area that might exhibit movement or cracking due to expansion and contraction, shall be grouted with a watertight, expansive grout, approved for use by the Manufacturer’s Representative. No coating shall be applied over the grout and the manhole frame. Chimney seal shall be applied over the grout and the grade ring coating as recommended by the Manufacturer.

3. If directed by the Engineer, the Contractor shall restore the profile surface to the original thickness, and replace corroded or missing reinforcement in a manner to be proposed by the Contractor and reviewed and approved by the Engineer.

**691.03.05 DELIVERY AND STORAGE**

A. Materials shall be delivered to the job site in their original, unopened containers. Each container shall bear the manufacturer's name, coating type, batch number, date of manufacture, storage life, and special handling directions.

B. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding the storage life recommended by the manufacturer shall be rejected and they shall be removed from the site, and replaced at no additional cost to the Owner.

* + 1. **COATING APPLICATION**

A. Underlayment Material Application

1. Prior to any surface coating work in existing manholes, the Contractor shall fill all voids (including any "ruts" left by the removal of PVC liner tees) and restore the manhole surface to an even and uniform surface profile using one of the underlayment materials listed in “APPROVED MANUFACTURERS” herein in accordance with the manufacturers recommendation.

2. The underlayment, if required, shall be installed over a clean surface prepared in accordance with the requirements of this specification and Section 692, “Sewer Pipe and Structure Cleaning”. The Contractor shall employ whatever means necessary (e.g., humidity control, temperature control, additional blasting, mechanical surface preparation, etc.) to ensure proper curing of the underlayment layer, strong adherence of the underlayment layer to the prepared manhole surface, and strong adherence to any layer installed over the underlayment layer.

3. After installation, the underlayment shall be free of trowel marks and irregularities.

4. The underlayment shall be applied throughout the entire manhole at a minimum 250 mil total cured thickness.

5. This paragraph shall apply only to those manholes where an adhesion test (or tests) has been requested by the City. (Refer to the section herein titled "ADHESION TESTING"): For such manholes the Contractor shall test the underlayment layer for proper adhesion to the underlying substrate in accordance with the section herein titled, "ADHESION TESTING ". Only if the underlayment layer in a manhole passes the adhesion test(s) in that manhole shall the Contractor progress to the next step of surface coating application. If the underlayment layer does not pass the adhesion test (or tests), the Contractor shall perform the remedial and re-testing steps discussed in the "ADHESION TESTING" section before progressing to the next step of surface coating application.

B. Surface Coating Application

1. Unless otherwise specified, the finish coat shall not be applied until other work in the area is complete and until the previous primer or underlayment coat has been accepted. The Contractor shall request approval authorization at all Inspection Hold Points.

2. All coatings shall be applied in strict accordance with the manufacturer’s requirements and recommendations.

3. Test prepared surfaces after cleaning but prior to application of the epoxy coating system to determine pH and moisture content of the concrete, as required according to manufacturer’s recommendations.

4. Ensure that the moisture content of the surface is in accordance with the coating manufacturer’s recommendations and/or requirements. If moisture content of the surface is not in accordance with the coating manufacturer’s recommendations and/or requirements, Contractor shall bring surface up to the coating manufacture’s recommendations and/or requirements at no additional cost to the Owner.

5. The approved surface coating shall be mixed in a clean, dry mixing container.

6. Ensure that pump, hoses, gun, tip, and pressure are properly matched for the coating to be applied. Ensure that the application equipment has been properly cleaned prior to application of coating. Test spray pattern for uniformity of distribution.

7. The prime and finish coat (as applicable) shall be a contrasting color. The color of the final coat shall be chosen by the Engineer, if different colors are available.

8. The Contractor shall ensure strong adherence of the surface coating layer(s) to any underlying and overlying layers and proper curing of the surface coating layer(s). If the surface coating is applied in two or more layers, the time between applications of the various layers shall be controlled to ensure proper bond between layers.

9. For all coatings, trowel marks and other surface irregularities shall be removed by using a short nap mohair paint roller. The short nap mohair shall be dampened with water. Excess water shall be shaken off prior to use.

10. The Contractor shall follow coating manufacturer’s requirements for bonding the coating systems to the installed sewer liner, if applicable.

11. The coating shall be applied to a minimum thickness of 125 mil. The authorized Engineer shall verify and measure film thickness.

12. The Contractor shall install coating key-ins as recommended by the coating manufacturer.

13. Compound that has begun to set shall not be recovered by adding additional liquid but shall be discarded.

14. Protect surfaces from rapid drying due to heavy wind or hot sun.

15. Drying time between multiple coats shall be as recommended by coating manufacturer. The recoat time cannot exceed manufacturers recommended hours or the surface must be power washed with Trisodiumphosphate (TSP) at 4,000 psi in order to remove amine blush prior to recoat.

16. Cure coatings in strict accordance with the manufacturer’s recommendations, prior to putting into service.

17. Imperfections, including but not limited to pinholes and bubbles, observed in the liner are not acceptable and shall be repaired per manufacturer’s recommendations. This requirement is independent of Spark (Holiday) Test results.

**691.03.07 INSPECTION HOLD POINTS**

A. At certain stages in the coating application process, the Contractor shall request approval from the Engineer, to proceed with the next stage of the installation.

1. The Contractor shall provide 24 hour notice that approval of an Inspection Hold Point is needed.

2. The Engineer shall respond to the approval request within 24 hours.

3. Failure to receive authorization from the Engineer at one of the designated Inspection Hold Points, may prevent the acceptance of the work by the Engineer.

B. The following are the designated Inspection Hold Points for each installation:

At each manhole, the Engineer shall inspect and accept the work completed to-date at the completion of each Hold Point listed below before the Contractor shall commerce work on the next Hold Point:

1. Completion of the cleaning and surface preparation activities.

2. Completion of all void-filling activities and underlayment application, prior to surface coating application, with the associated adhesion testing of the underlayment layer.

3. Completion of the surface coating installation prior to testing.

4. Adhesion/bond testing of the finished coating system.

5. Spark (Holiday) testing of the final surface coating.

6. Final clean-up and inspection.

**691.03.08 DEFECT REPAIR**

A. All surface defects identified by the Manufacturer’s Representative or Engineer including tie holds, any honeycombing or otherwise defective concrete shall be repaired. All voids, holes, and rough or irregular surfaces shall be filled.

B. The Contractor shall use only approved repair and fill material (i.e., epoxy mastic or concrete bonding agent) recommended by the coating manufacturer to repair or fill all defects.

1. Areas to be patched shall be cleaned per manufacturer recommendations.

2. Minor honeycombed or otherwise defective areas shall be removed to solid concrete. The edges of the cut shall be perpendicular to the surface of the concrete.

3. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set.

4. Finishes shall be equal in workmanship, texture and general appearance to that of the adjacent undamaged concrete.

5. Concrete with honeycombing which exposes the reinforcing steel or with defects that affect the structural strength shall be repaired. The proposed repair method shall be approved by the Engineer.

**691.03.09 TESTING**

A. Adhesion Testing

Adhesion testing will be performed at two different stages: 1) Adhesion of the underlayment layer to the underlying substrate shall be tested before the surface coating layer(s) are applied. 2) After the surface coating layer(s) have been applied, all adhesions in the coating system shall be tested.

1. A minimum of three (3) adhesion tests performed at different elevations, randomly selected by the Inspector, is required for every five (5) access sewer manholes rehabilitated.

2. The manholes to be subjected to adhesion testing and the specific test locations within each manhole shall be selected by the Engineer. The Engineer shall be present to observe all adhesion testing.

3. The need to repeat an adhesion test due to an error in the performance of the adhesion testing (e.g., a dolly coming off prematurely) or due to a failure in the coating system before the required full test pressure is applied (i.e., a "not pass" test result) shall not count as a completed test for the purposes of determining compliance with the minimum number of tests required per Item No. 1.

4. Adhesion testing of the underlayment layer shall conform to the following: After the underlayment layer has cured for a minimum of 4 hours but before the surface coating has been applied over the underlayment layer, the Contractor shall test the underlayment layer for proper adhesion to the underlying substrate. The Contractor will perform the adhesion testing in-place and in accordance with ASTM Standard D­7234 and the requirements as dictated in the remainder of this section.

5. Adhesion testing of the finished coating system shall conform to the following: After the approved coating has been applied to all specified surfaces and has adequately cured (as determined by the manufacturer, but no more than 4 days), the Contractor shall test the finished coating system for adequate adhesion between the underlying substrate and the coating system and between the various layers of the coating system. Said test shall be performed in-place and in accordance with ASTM Standard D7234 and the requirements as dictated in the remainder of this section.

The remaining paragraphs of this section apply to both the adhesion testing of the underlayment layer and the adhesion testing of the finished coating system:

6. The Contractor shall perform the adhesion testing discussed in this section using a DeFelsko Positest Pull-off Adhesion Tester Model AT-M or AT-A. The adhesion tester shall be obtained by the Contractor. The Contractor shall be responsible to purchase and provide enough appropriately sized dollies (as sold by DeFelsko, one 20 millimeter dolly for each adhesion test, not re-usable) and adhesive for the dollies to perform all of the required tests. The Contractor shall also provide the equipment and tools to core drill around the test location, as discussed later in this section.

7. The Contractor shall first core drill the manhole surface (using a circle-cutting "hole saw" type drill bit that leaves the center of the drill area intact) around the perimeter of the dolly and shall then glue the test dolly to the surface of the manhole at the test location selected by the Engineer. The Contractor may lightly sand the coating surface with sandpaper at the test location to improve dolly adhesion. After the adhesive has set, the Contractor shall test the dolly for adhesion to the surface of the manhole by pulling on it by hand. If the dolly comes off, the Contractor shall re-adhere the dolly, using different glue if necessary. After the dolly is properly set, the drill bit shall penetrate through the layers to be tested, but shall not penetrate more than 1/8-inch into the underlying substrate. The diameter of the drilled circle shall match (1/8-inch +/-) the diameter of the test dolly.

8. The adhesion testing machine shall then be attached to the dolly and each test location shall be tested. Align the device according to the manufacturer’s instructions and set the force indicator to zero. Each test location shall be tested to a minimum pulling stress of 250 psi.

9. Increase the load to the fixture in a smooth and continuous manner, at a uniform rate of less than 30 psi per second so that failure occurs or the maximum stress is reached before 30 seconds. If delamination or any other failure occurs before reaching 250 psi, the Adhesion Test is Failed. Record the force attained at failure. The following user rates are built into the tester:

|  |  |  |
| --- | --- | --- |
| Dolly Size | PSI Rates | Maximum Pull-Off Pressure |
| 20 mm | 30, 50, 100, 150, 180 | 3,000 psi |

Designate cohesive substrate failure by the quantity and type of substrate removed and coating failures by the layers which they occur. The Engineer may require additional testing and/or remedial action on any failed test. Remedial action may include removing the entire coating system (or whatever components of it have been installed in the manhole to that point) from the entire manhole, re-cleaning of the manhole, re-application of the coating system to all required surfaces and re-testing. Said retesting and remedial action shall be at no additional cost to the City.

10. After the adhesion tests have been performed, the Contractor shall mechanically grind down the test locations to the underlying substrate and re-apply the underlayment and/or coating system (whatever has been installed up to that point in the manhole) in accordance with these specifications to patch the area. The Contractor shall not use acetone, MEK or other chemicals to dissolve the underlayment or coating system as a substitute for mechanical grinding down of the test area.

B. Spark (Holiday) Testing

Whereas adhesion testing is required at two stages of the project work in each manhole, spark testing is required only on the fully installed coating system.

1. After the manhole is properly cleaned and prepared, the Contractor shall drill a hole no larger than 1/2-inch in diameter that penetrates a minimum of 2-inches into the concrete (or other manhole wall surface type). The Contractor shall then install a 3/8-inch diameter stainless steel expansion bolt into the hole. The bolt shall penetrate a minimum of 2-inches into the manhole wall, but shall be long enough that a minimum of 1-inch length (but no more than 2-inches length) of the bolt will be exposed after the finished manhole coating system is installed. The hex-head end of the bolt shall be the exposed end. Unless otherwise directed by the Engineer, the bolt shall be installed on the manhole riser section at a location approximately 12-inches below the point where the manhole cone and manhole riser meet. The Engineer will direct the Contractor where to install the bolt around the circumferential perimeter of the manhole. The various layers of the coating system shall be installed securely up to and around the base of the bolt to seal the bolt penetration off as a pathway for corrosion. This bolt will be used during the spark testing of the manhole discussed later in this specification to provide grounding for said spark testing.

2. After the approved coating has been applied to all specified surfaces, the Contractor shall spark test the coated surfaces in accordance with ASTM D-4787. The Contractor shall provide all equipment and materials necessary to perform said testing, which equipment and materials shall remain the property of the Contractor.

3. Testing shall be performed with a wire brush-type test wand (the squeegee-type is not acceptable) with a minimum test voltage of 100 volts per mil (where 1 mil = 1/1000-inch) of finished surface coat thickness. For example, a minimum of 12,500 volts shall be used for a surface coat thickness of 1/8-inch (125 mils). The Contractor will use the stainless steel bolt installed during the cleaning and surface preparation activities as a grounding rod for the spark testing equipment.

4. As a test of the proper functioning of the spark testing equipment, the Engineer may require the Contractor to drill a hole through the coating system into the underlying concrete substrate and to demonstrate to the Engineer that the spark testing equipment can "find" the hole. The Contractor shall then patch and repair the hole. At the Engineer's discretion, one such quality control test may be required for each manhole. Unless otherwise determined by the Engineer, any adjustments to the spark testing methodology (e.g., adjusting the grounding method, increasing the test voltage, etc.) required to "find" the known holiday (hole) shall remain in effect for the remainder of the spark testing of that manhole.

5. The entire surface of the manhole shall then be spark tested. Any imperfections found in the coating system shall be ground down and refilled. Use of a chemical solvent such as acetone or MEK in lieu of mechanical grinding down the area shall not be permitted. Repaired areas shall be re-tested. Said testing, repairs and re­testing shall continue until all portions of the manhole pass the spark test as specified herein.

6. The Contractor shall perform repairs and re-testing. The Engineer shall observe and approve of all testing and retesting. In addition, the Contractor shall provide certification for each manhole stating that the coating is free of holes or other imperfections.

**691.03.10 CLEANUP**

A. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray, splashes, splatters or other coating-related damage.

B. Surfaces damaged resulting from this clean up shall also be cleaned, repaired and refinished to the original or required condition.

**691.03.11 VIDEO INSPECTION**

***Note to Spec Writer – Section 693 is to be used on all projects with new sewer and storm drain pipelines and structures, rehabilitated manholes, and rehabilitated sewer lines.***

1. Internal video inspection shall be performed by the Contractor per Section 693 – INTERNAL INSPECTION OF SEWER AND STORM DRAIN FACILITIES.

**METHOD OF MEASUREMENT**

**691.04.01 MEASUREMENT**

[NOTE TO SPEC WRITER. DELETE UNUSED ITEMS BUT DO NOT RENUMBER. THIS SECTION HAS THE BID ITEMS STANDARDISED]

The quantity of the following will be measured per each:

* Coat Existing 48-INCH manhole (≥5 DEPTH AND <10 Depth)
* Coat Existing 48-INCH manhole (≥10 DEPTH AND <15 Depth)
* Coat Existing 48-INCH manhole (≥15 DEPTH AND <20 Depth)
* Coat Existing 60‑INCH manhole (≥5 DEPTH AND <10 Depth)
* Coat Existing 60-INCH manhole (≥10 DEPTH AND <15 Depth)
* Coat Existing 60-INCH manhole (≥15 DEPTH AND <20 Depth)
* Coat Existing 60-INCH manhole (≥30 DEPTH AND <35 Depth)
* Coat Existing 72-INCH manhole (≥20 DEPTH AND <25 Depth)
* Coat Existing 60-INCH manhole (≥20 DEPTH AND <25 Depth)
* Coat Existing 60-INCH manhole (≥25 DEPTH AND <30 Depth)

will be measured per EACH.

The quantity of REPLACE CONCRETE GRADE RING, shall be measured each, and shall only be measured for rehabilitation replacement and will only be measured when shown on the pans. Measurement will not be provided for removal or restoration of grade rings to facilitate CIPP installation.

**BASIS OF PAYMENT**

**691.05.01 PAYMENT**

The accepted quantity of the following shall be paid for at the contract unit price per each coating system applied:

* Coat Existing 48-INCH manhole (≥5 DEPTH AND <10 Depth)
* Coat Existing 48-INCH manhole (≥10 DEPTH AND <15 Depth)
* Coat Existing 48-INCH manhole (≥15 DEPTH AND <20 Depth)
* Coat Existing 60‑INCH manhole (≥5 DEPTH AND <10 Depth)
* Coat Existing 60-INCH manhole (≥10 DEPTH AND <15 Depth)
* Coat Existing 60-INCH manhole (≥15 DEPTH AND <20 Depth)
* Coat Existing 60-INCH manhole (≥20 DEPTH AND <25 Depth)
* Coat Existing 72-INCH manhole (≥20 DEPTH AND <25 Depth)
* Coat Existing 60-INCH manhole (≥25 DEPTH AND <30 Depth)
* Coat Existing 60-INCH manhole (≥30 DEPTH AND <35 Depth)

shall be paid for at the contract unit price per each coating system applied and shall be full compensation for all labor, equipment and materials to complete the work including surface preparation, existing coating removal, chimney seal, grout, structure cleaning, testing equipment, sampling and testing and any other repair necessary to ensure proper bonding of coating to the inside of the existing structure, on-site visits of the Manufacturer’s Representative, video inspection, and all other items necessary to complete the work as shown on the Plans, as specified herein and as directed by the Engineer. Payments will be based on the existing access manholes and/or junction structures coated tested and approved. Partial payments for coating material delivered but not installed will not be made.

Payment will be made under:[NOTE TO SPEC WRITER. DELETE UNUSED ITEMS BUT DO NOT RENUMBER. THIS SECTION HAS THE BID ITEMS STANDARDISED].

|  |  |  |
| --- | --- | --- |
| **ITEM NO.** | **ITEM DESCRIPTION** | **UOM** |
| 691.0005 | Coat Existing 48-INCH manhole (≥5 DEPTH AND <10 Depth) | Ea |
| 691.0010 | Coat Existing 48-INCH manhole (≥10 DEPTH AND <15 Depth) | Ea |
| 691.0020 | Coat Existing 48-INCH manhole (≥15 DEPTH AND <20 Depth) | Ea |
| 691.0050 | Coat Existing 60-INCH manhole (≥5 DEPTH AND <10 Depth) | Ea |
| 691.0060 | Coat Existing 60-INCH manhole (≥10 DEPTH AND <15 Depth) | Ea |
| 691.0070 | Coat Existing 60-INCH manhole (≥15 DEPTH AND <20 Depth) | Ea |
| 691.0080 | Coat Existing 60-INCH manhole (≥20 DEPTH AND <25 Depth) | Ea |
| 691.0130 | Coat Existing 72-INCH manhole (≥20 DEPTH AND <25 Depth) | Ea |
| 691.0220 | Coat Existing 60-INCH manhole (≥25 DEPTH AND <30 Depth) | Ea |
| 691.0230 | Coat Existing 60-INCH manhole (≥30 DEPTH AND <35 Depth) | Ea |

**END OF SECTION 691**