SPIRAL WOUND PIPE LINER

PERFORMANCE SPECIFICATION GUIDELINE (PSG)

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Disclaimer

These Specifications were prepared by a Committee comprised of representatives of NASSCO members and peer-reviewed by industry professionals. These Specifications are not specific to any one product, project, or job site, and should be considered a guideline only. Conditions for use may require additions, deletions or amendments to these guidelines so as to conform to project-specific site conditions and to comply with applicable laws, regulations, and ordinances. NASSCO does not guarantee, certify or assure any result and assumes no liability as to content, use and application of these guidelines

EFFECTIVE SPECIFICATIONS

Effective specifications should encourage the most innovative, efficient and experienced Contractor to provide the level of quality required by the Owner at the best and lowest competitive price.

The specification should not strive to encourage the Contractor to seek the cheapest approach and product delivery available to provide the lowest price.

Effective specifications include the following, which are critical for project success:

1. Product selection for the best solution.
2. Definition of project goals and requirements, both short and long term.
3. Construction means and methods as defined, in writing, by the Contractor.
4. Product provided and installed as specified by the product manufacturer.
5. Product quality and quantity confirmed through inspection and testing.
6. Product design and service life verified through warranty inspection.

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PART 1: GENERAL

These Performance Specification Guidelines (PSGs) include the minimum requirements for the rehabilitation of gravity pipelines including sanitary sewer, storm drains and culverts by the installation of either,

Machine Spiral Wound Liners (MSWL)
Structural Grout Spiral Wound Liners (SGSWL)

within the existing deteriorated pipe as shown on the plans included as part of these contract documents.

Please note that while both MSWL and SGSWL are considered to be spiral wound rehabilitation methods, each has unique characteristics that require periodic differentiation. Therefore, the following specification guideline applies to both MSWL and SGSWL systems unless noted otherwise.

A. The rehabilitation of pipelines shall be done by the installation of a PVC profile strip or modular panel system which, when installed, may be continuous throughout the entire length of the host pipe. The Contractor is responsible for proper, accurate and complete installation of the Spiral Wound Liner (SWL) in accordance with the contract documents and approved design using the installation equipment as recommended by the liner manufacturer.

   MSWL shall extend the full length of the host pipe and provide a structurally sound, watertight new pipe within a pipe.

   SGSWL shall extend along specified lengths of the host pipe and provide a structurally sound, watertight composite pipe.

B. Installation of the SWL, regardless of method/type, shall not cause adverse effects to any of the Owner's processes or facilities. The use of the product shall not result in the formation or production of any detrimental compounds or by-products downstream at the wastewater treatment plant. The Contractor shall notify the Owner and identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements. The Contractor shall cleanup, restore existing surface conditions and structures, and repair any SWL determined to be defective. The Contractor shall conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property owners and tenants.

C. The prices submitted by the Contractor shall include all costs of permits, labor, equipment, and materials for the various bid items necessary for furnishing and installing, complete in place, SWL in accordance with these specifications. All items of work not specifically mentioned herein which are required by the contractor, to make the product perform as intended and deliver the final product as specified herein, shall be included in the respective lump sum and unit prices bid.

1.1 DESCRIPTION OF WORK AND PRODUCT DELIVERY

These PSGs cover all the work necessary to furnish and install the Spiral Wound Liner (SWL). The Contractor shall provide all materials, labor, equipment, and services necessary for traffic

control, bypass pumping and/or diversion of gravity flows, cleaning and television inspection of gravity pipelines to be lined, liner installation, reconnection of service connections, all quality controls, provide samples for performance of required material tests, final television inspection, testing of lined pipe system and warranty work, all as specified herein.

A. The product furnished shall be a complete SWL system, including all materials, equipment, and installation procedures. The SWL system manufacturer may submit, a minimum of 14 calendar days in advance of the bid date, required information to the Owner to obtain pre-approval status. Those SWL systems that have been pre-approved will not be required to furnish information as required in the submittal section of these specifications unless specifically requested to do so by the Owner or if any of the SWL system components have changed from those pre-approved by the Owner. All other SWL systems or multi-component products will be required to meet the submittal requirements contained herein.

B. Installation Methodology - Both MSWL and SGSWL shall be free of all defects that will affect the long-term life and operation of the host pipe.

1) MSWL shall be continuous from manhole to manhole or access point to access point. MSWL can be installed as a 1) tight fit or 2) as a fixed diameter grouted solution for 6" to 200"+ diameters based on the pipe diameter and the project design requirements.

   a) Tight fit MSWL shall fit sufficiently tight within the existing pipe as to not leak at the manholes, at the service connections or through the continuous interlocking strips of profile. Manholes & service connections will be sealed in accordance with the specification.

   b) Fixed diameter MSWL shall be installed as a fixed diameter liner and grouted in the annular space. If leakage occurs at the manholes or the service connections the Contractor shall seal these areas to stop all leakage using a material compatible with the SWL as directed by the Owner at the price bid specified in the Proposal. If leakage occurs, the liner shall be repaired or removed as recommended by the SWL manufacturer. Final approval of the liner installation will be based on a leak tight pipe. Manholes & service connections will be sealed in accordance with the specification.

2) SGSWL shall utilize existing access points. SGSWL installations can be continuous from pre-determined starting and end of work zone, independent of manhole locations or access points. The SGSWL is a rigid composite liner system (PVC/grout/existing pipe) installed in worker-entry sizes (diameters of 36"and greater) with coils or modular flat panels or both.

   a) SGSWL is installed to a fixed diameter or shape leaving an annular space between the installed liner and existing pipe wall. Based on design calculations, additional reinforcing (if required) is to be installed in the annular space prior to liner installation, and the annular space is then filled with cementitious structural grout as specified. No infiltration of ground water through the PVC liner should be observed. Final approval of the liner installation will be based on visual inspection and/or closed-circuit television.

C. All SWL's shall be designed for a service life of 50 years or greater.

D. Design Methodology:

1) The MSWL shall be designed as a partially or fully deteriorated liner in accordance with

ASTM F-1741 Appendix X.1. If designing for partially deteriorated pipe conditions, the liner shall be designed to resist external groundwater pressures. The groundwater level is required to finalize designs. If the design requires ~~or as~~ a fully structural standalone pipe-within-a-pipe meeting or exceeding all contract specified physical properties and installed within the existing pipe within the tolerances specified. The fully structural installed MSWL shall withstand all applicable surcharge loads (soil overburden, live loads, etc.) and external hydrostatic (groundwater) pressure, if present, for each specific installation location (with safety factor).

2) The SGSWL shall be designed in accordance with ASTM F1698 Appendix X1. The condition of the host pipe will be evaluated to determine if partial or fully deteriorated pipe design conditions apply. Both partial and fully deteriorated pipes are designed as a rigid composite structure.

E. All existing and confirmed active service locations and any other service laterals to be reinstated as directed by the Owner shall be re-opened robotically or by hand in the case of worker-entry size piping, to their original shape and to 95% to 105% of their original capacity. All over-cut serviced connections will be properly repaired to meet the requirements of these specifications.

F. All materials furnished, as part of this contract shall be marked with detailed product information, stored in a manner specified by the manufacturer and tested to the requirement of this contract.

G. Testing and warranty inspections shall be executed by the Owner. Any defects found shall be repaired or replaced by the Contractor.

H. The Contractor shall furnish all samples for product testing at the request of the Owner. The Owner shall take possession of the samples for testing and shall maintain the chain of custody, deliver the samples to an approved laboratory and pay for all material and product testing performed under this contract.

1.2 REFRENCES

The following documents for a part of this specification to the extent stated herein and shall be the latest editions thereof. Where differences exist between codes and standards, the requirements of these specifications shall apply. All references to codes and standards shall be to the latest revised version.

ASTM C942 – Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory

ASTM D256 – Standard Test Methods for Determining the Izod Pendulum Impact of Resistance of Plastic

ASTM D618 – Practice for Conditioning Plastics for Testing

ASTM D638 – Standard Test Method for Tensile Properties of Plastics

ASTM D790 – Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D883 – Terminology Relating to Plastics

ASTM D1600 – Terminology for Abbreviated Terms Relating to Plastics

ASTM D1784 – Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

ASTM D2122 – Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

ASTM D2152 – Test Method for Adequacy of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion

ASTM D2412 – Standard Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

ASTM D2444 – Test for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe Fittings Materials

ASTM D4226-19 – Standard Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products

ASTM F412 – Terminology Relating to Plastic Piping Systems of Existing Sewers and Conduits

ASTM F1057 – Standard practice for Estimating the Quality of Extruded Poly(Vinyl Chloride) (PVC) Pipe by Heat Reversion Technique

ASTM F1697 – Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduit1

ASTM F1698 – Standard Practice for Installation of Poly (Vinyl Chloride) (PVC) Profile Strip and Cementitious Grout for Rehabilitation of Existing Man-Entry Sewers and Conduits

ASTM F1735 – Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for PVC Liners for Rehabilitation of Existing Man-Entry Sewers and Conduits

ASTM F1741 – Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits

ASTM F2136 – Standard Test Method for Notched Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe

1.3 PERFORMANCE WORK STATEMENT (PWS) SUBMITTAL

The Contractor shall submit, to the Owner, a Performance Work Statement (PWS) at the pre-construction meeting, which clearly defines the Spiral Wound Liner (SWL) product delivery is in conformance with the requirements of the contract documents. Unless otherwise directed by the Owner, the PWS shall at a minimum contain the following.

A. Clearly indicate that the SWL will conform to the project requirements as outlined in the Description of Work and as delineated in these specifications.

B. The scope of work including a detailed installation plan describing all preparation work, cleaning operations, pre-CCTV inspections, bypass pumping, traffic control, installation procedure, method of installation, warrantees furnished and all else necessary and appropriate for a complete SWL installation. A detailed installation schedule shall be prepared, submitted and conform to the requirements of this contract.

C. Contractor's description of the proposed SWL technology, including a detailed plan for identifying all active service connections, maintaining services during mainline installation to each home connected to the section of pipe being lined, including temporary service if required by this contract.

D. A description of the SWL materials to be furnished for this project. Materials should be fully detailed in the submittals and conform to these specifications and/or shall conform to the pre-approved product submission.

E. A statement of the Contractor's experience: The Contractor's personnel and/or Subcontractors shall be able to demonstrate that they have successfully completed a minimum of 5,000 linear feet (LF) of trenchless sewer lining work. Only manufacturer certified Contractors or Subcontractors may install SGSWL or MSWL lining systems.

F. Engineering design calculations - Contractor will submit drawings defining the liner dimensions and design calculations prepared by a licensed professional engineer and, if required, minimum grout thickness and reinforcing steel.

    1. MSWL shall be in accordance with the Appendix X1. Structural Design Considerations of ASTM F-1741.

    2. SGSWL shall be in accordance with the Appendix X1. Structural Design Considerations of ASTM F-1698.

G. Proposed manufacturers technology data shall be submitted for all SWL products and all associated technologies to be furnished.

H. Submittals shall include information on the SWL profile intended for installation and all tools and equipment required for a complete installation. The PWS shall identify which tools and equipment will be redundant on the job site in the event of equipment breakdown. All equipment, to be furnished for the project, including proposed back-up equipment, shall be clearly described. The Contractor shall outline the mitigation procedure to be implemented in the event of key equipment failure during the installation process.

I. A description of the Contractor's proposed procedures for removal of anticipated obstructions/debris in the pipeline that may be encountered during the cleaning process.

J. A detailed public notification plan shall be prepared and submitted including detailed staged notification to residences affected by the SWL installation, if applicable.

K. An odor control plan shall be submitted by the contractor indicating how project specific odors will be minimized at the project site and surrounding area, if applicable.

L. Compensation for all work required for the submittal of the PWS shall be included in the various pipelining items contained in the Proposal.

M. Work plan including tentative schedule, work sequence, points of ingress/egress, means

of ventilation, bulkheads and staging area.

N. The Contractor shall outline specific repair or replacement procedures for potential defects that may occur in the installed SWL. Repair/replacement procedures, if any, shall be as recommended by the Spiral Wound Liner system manufacturer for the three conditions listed in 1.7 SPIRAL WOUND REPAIR/REPLACEMENT.

1.4 PRODUCT SUBMITTALS

A. PVC profile – including the manufacturer and description of product components.

B. Raw material data – including the manufacturer and description of product components.

C. Repair methodology if applicable. Show any modifications, if required, to line host pipe with profiled PVC liner including restoring host pipe wall thickness.

D. Manufacturer's shipping, storage and handling recommendations for all components of the SWL system.

E. MSDS sheets for all materials to be furnished for the project.

F. The Manufacturer's recommended installation procedure for each diameter and profile to be installed. The PWS shall contain a detailed installation procedure detailing the installation process and method of application.

G. Compensation for all work required for the submittal of product data shall be included in the Lump Sum price contained in the Proposal for Mobilization.

H. Grout design mix and grouting plan for fixed diameter MSWL liners and for SGSWL. Please refer to section 3.B.2 below for SGSWL application.

1.5 SAFETY

A. The Contractor shall conform to all work safety requirements of pertinent regulatory agencies and shall secure the site for the working conditions in compliance with the same.

B. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.

C. The Contractor shall perform all the work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and within the equipment being utilized for pipe renewal.

D. The Contractor shall submit a proposed Safety Plan to the Owner, prior to beginning any work, identifying all competent persons. The plan shall include a description of a daily safety program for the job site and all emergency procedures to be implemented in the event of a safety incident. All work shall be conducted in accordance with the Contractor's submitted Safety Plan.

E. Compensation for all work required for the submittal of the Safety Plan shall be included in the various pipelining items contained in the proposal.

1.6 QUALITY CONTROL PLAN (QCP)

A detailed quality control plan (QCP) shall be submitted to the Owner that fully represents and conforms to the requirements of these specifications. At a minimum the QPC shall include the following:

A. Defined responsibilities, of the Contractor's personnel, for assuring that all quality requirements for this contract are met. These shall be assigned by the Contractor to specific personnel.

B. Proposed procedures for quality control, product sampling and testing shall be defined and submitted as part of the plan.

C. Proposed methods for product performance, controls, including method of frequency of product sampling and testing both in raw material form and installed product form.

D. Scheduled performance and product test result reviews between the Contractor and the Owner at a regularly scheduled job meetings.

E. Inspection forms and guidelines for quality control inspections shall be prepared in accordance with the standards specified in this contract and submitted with the QCP.

1.7 SPIRAL WOUND REPAIR/REPLACEMENT

Occasionally installations will result in the need to repair or replace a defective Spiral Wound Liner. The Contractor shall outline specific repair or replacement procedures for potential defects that may occur in the installed Spiral Wound Liner (SWL). Repair/replacement procedures shall be as recommended by the Spiral Wound Liner system manufacturer and shall be submitted as part of the PWS.

A. Defects in the installed SWL that will not affect the operation or long-term life of the product shall be identified and defined.

B. Repairable defects that may occur in the installed SWL shall be specifically defined by the Contractor based on manufacturer's recommendations, including a detailed step-by-step repair procedure, resulting in a finished product meeting the requirements of these contract specifications.

C. Unrepairable defects that may occur to the SWL shall be clearly defined by the Contractor based on the manufacturer's recommendations, including a recommended procedure for the removal and replacement of the Spiral Wound Liner.

1.8 RECORD DRAWINGS

A. Record drawings and pre & post CCTV inspection shall be submitted to the Owner by the Contractor within 2 weeks of final acceptance of said work or as specified by the Owner. Record drawings will include the identification of the work completed by the Contractor and shall be prepared on one set of Contract Drawings provided to the Contractor at the onset of the project.

B. Record drawings shall be kept on the project site at all times, shall include all necessary information as outlined in the PWS or as agreed to by the Owner and the Contractor at the start of the Contract and shall be updated as the work is being completed, and shall

be clearly legible.

C. Compensation for all work required for the submittal and approval of As-Built Drawings shall be included in the various pipelining items contained in the proposal.

1.9 WARRANTY

A. The materials used for the project shall be certified by the manufacturer for the specified purpose. The Contractor shall warrant the liner material and installation for a period of one (1) year. During the Contractor warranty period, any defect which may materially affect the integrity, strength, function and/or operation of the pipe shall be repaired at the Contractor's expense in accordance with procedures included in the PWS and as recommended by the manufacturer.

B. On any work completed by the contractor that is defective and/or has been repaired, the contractor shall warrant this work for (1) year in addition to the warrantee required by the contract.

C. After a pipe section has been lined and for a period up to one (1) year following completion of the project, the Owner may inspect all or portions of the lined system. The specific locations will be selected at random by the Owner and will include all sizes of Spiral Wound Liner (SWL) from this project. If it is found than any of the SWL has developed abnormalities since the time of "Post Construction Television Inspection", the abnormalities shall be repaired and/or replaced as defined in the PWS and as recommended by the manufacturer. If, after inspection of a portion of the lined system under the contract, problems are found, the Owner may televise all the SWL installed by the contractor. All verified defects shall be repaired and/or replaced by the Contractor and shall be performed in accordance with the PWS and per the original specifications, all at no additional cost to the Owner.

PART 2: PRODUCTS

1. MATERIALS

A. The SWL System must meet the chemical resistance requirements of these contract documents.

B. The Spiral Wound Liner must be H_2S corrosion resistant in accordance with ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.

C. All materials for the project will require a letter of compliance from the manufacturer. Test reports certifying that the material conforms to the ASTM standards listed herein will be made available upon request.

D. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the SWL system manufacturer to avoid damage. Damage includes, but not limited to: gouging, abrasion, flattening, cutting, puncturing or ultra-violet (UV) degradation. All damaged materials shall be promptly removed from the project site at the Contractor's expense and disposed of in accordance with all current applicable agency regulations.

2. PVC PROFILE

A. MSWL

1. The MSWL profile is made from pipe grade unplasticized Poly Vinyl Chloride(uPVC), manufactured in accordance with ASTM F1697 – Standard Specification for Poly Vinyl Chloride (PVC) Profile Strip for Machine Spiral-Wound Liner (SWL) Pipe Rehabilitation of Existing Sewers and Conduit.

2. Installed to approved drawings and per ASTM F-1741 Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride)(PVC) Pipe for Rehabilitation of Existing Sewers and Conduits.

3. The minimum length of SWL profile deemed necessary by the installer to effectively span the distance from the installation manhole to the terminating manhole or access point, plus the amount required to trim and end seal, shall be determined by design calculations prepared by an engineer for each installation and diameter per ASTM F-1741.

B. SGSWL

1. The SGSWL profile is made from pipe grade unplasticized Rigid Poly Vinyl Chloride (uPVC), manufactured in accordance with ASTM F1735 – Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for PVC Liners for Rehabilitation of Existing Man-Entry Sewers and Conduits.

2. Installed according to approved drawings and per ASTM F-1698 Standard Practice for Installation of Poly (Vinyl Chloride) (PVC) Profile Strip Liner and Cementitious Grout for Rehabilitation of Existing Man- Entry Sewers and Conduits.

3. If lining entails only a portion of the circumference of circular pipes/conduits or the conduit is highly non-circular (e.g., low rise arch or semi-elliptical), the PVC liner may be supplied as flat panels. These flat panels shall be cut and trimmed to fit near as practical to the internal circumference of the structure to be lined, or as specified. The panels shall be kept square with the pipe wall, and the adjacent panel edges shall be locked together using the manufacturer supplied joiner strip as recommended in ASTM F1698.

3. STRUCTURAL REQUIREMENTS AND PHYSICAL PROPERTIES

A. MSWL

1. The physical properties and characteristics of the finished liner shall be constant and not vary from pre to post installation.

2. The SWL shall be designed as per ASTM F-1741 Appendixes. The SWL shall assume no bonding to the original host pipe wall.

3. The design engineer shall set the long term (50 year extrapolated) Creep Reduction Factor at 50% of the initial flexural modulus as determined by ASTM D790 test method. This value shall be used unless the Contractor submits long term test data (ASTM D2990) to substantiate a higher retention factor.

4. The SWL material shall, at a minimum meet or exceed the structural properties per ASTM F1741.

5. The required structural properties of the MSWL profile shall be based, as a minimum, on the physical properties of the profile and per the design of a professional engineer (see section 1.3 F) and in accordance with the Design Equations in the appendix of the ASTM F1741.

6. The Contractor shall submit, prior to installation of the lining materials, certification of the compliance with these specifications and/or the requirements of the pre-approved SWL system. Certified material test results shall be included that confirm that all materials conform to these specifications and/or the pre-approved system. Materials not complying with these requirements will be rejected.

7. The design soil modulus may be adjusted based on data determined from detailed project soil testing results as provided by the Owner in the contract documents.

B. SGSWL

1. The physical properties and characteristics of the finished liner shall be constant and not vary from pre to post installation, unless approved and specified by the Engineer and owner.

2. The SWL shall be designed as per ASTM F-1698 Appendix X1. The SWL shall assume bonding to the original host pipe wall and utilize high strength cementitious grout with a minimum of 5,000 psi compressive strength in 28 days.

3. The required structural properties of the SGSWL profile shall be based, as a minimum, on the physical properties of the profile in accordance with ASTM F1735 and per the design of a professional engineer (see section 1.3 F) in accordance with the Design Equations in the appendix of the ASTM F1698.

4. The Contractor shall submit, prior to installation of the lining materials, certification of the compliance with these specifications and/or the requirements of the pre-approved SWL system. Certified material test results shall be included that confirm that all materials conform to these specifications and/or the pre-approved system. Materials not complying with these requirements will be rejected.

PART 3: INSTALLATION

3.1 CONSTRUCTION REQUIREMENTS

A. Preparation, cleaning, inspection, storm or sanitary flow bypassing and public notification. The Contractor shall clean the interior of the host pipe prior to installation of the SWL. All debris and obstructions, that will affect the installation and the final Spiral Wound product deliver to the Owner, shall be removed and disposed of.

B. The SWL shall be constructed of materials and methods, that when installed, shall provide a structurally sound liner capable to withstand all imposed static and dynamic loads on a long-term basis.

C. The Contractor may, under the direction of the Owner, utilize any of the existing manholes

in the project area as installation access points. If a street must be closed to traffic because of the location of the gravity pipeline, the Contractor shall furnish a detailed traffic control plan and all labor and equipment necessary. The plan shall be in conformance with the requirements of the local agency having jurisdiction over traffic control.

D. Cleaning of Pipelines – The Contractor shall remove all internal debris from the pipeline that will interfere with the installation and the final product delivery of the Spiral Wound liner, as required in these specifications. Solid debris and deposits shall be removed from the system and disposed of properly by the Contractor. Moving material from manhole to manhole section shall not be allowed. As applicable the contractor shall either plug or install bypass pumping system to properly clean the pipelines. Precaution should be taken, by the Contractor in the use of cleaning equipment, to avoid damage to the existing pipe. The repair of any damage, caused by the cleaning equipment, shall be the responsibility of the Contractor. The Owner will designate a site for the disposal of all debris removed, from the Owner's system, as a direct result of the cleaning operation. Unless otherwise specified by the Owner, the Contractor shall be compensated at the respective unit price bid in the Proposal for cleaning. For high pressure requirements regarding SGSWL refer to ASTM F1698.

E. Bypassing Existing storm or sanitary Flows – If required, the Contractor shall provide for the flow of the existing mainline and service connection effluent around the section or sections of pipe designated for rehabilitation by the SWL process. SWL can be installed in live flow conditions, typically up to 25% full pipe. Mainline plugging or temporary flow restriction using flow through plugs, etc., can be utilized to temporarily restrict flow to install the liners. Any temporary restriction of flows should be continuously monitored to prevent back up of flow into adjacent homes or businesses. Service connections do not have to be plugged prior to the installation of the SWL. The Contractor shall coordinate any necessary flow bypassing and service interruptions with the Owner at least 14 days in advance and with the property owners and businesses at least 1 day in advance. The pump and bypass lines shall be of adequate capacity and size to handle peak flows. The Contractor shall submit a detail of the bypass plan and design to the Owner before proceeding with any SWL installation. Compensation for by-pass pumping and all associated plans and approvals shall be at the price bid therefore in the Proposal.

F. The Contractor shall perform post-cleaning video inspections of the pipelines locating leaks, obstacles and service connections by closed circuit television inspection. The Contractor shall provide the Owner a copy of the pre-cleaning video and suitable log, and/or in digital format for review prior to installation of the SWL and for later reference by the Owner.

G. Line Obstructions – It shall be the responsibility of the Contractor to clear the line of obstructions that will interfere with the installation and long-term performance of the SWL. If pre-installation inspection reveals an obstruction, misalignment, broken or collapsed section or sag that was not identified as part of the original scope of work and will prohibit proper installation of the SWL, the Contractor may be directed by the Owner to correct the problems or remove the obstruction prior to lining. The Contractor shall be compensated for this work under a contingency pay item.

H. Removal of any previously unknown obstructions that appeared on pre-bid video documentation and made available to the Contractor, prior to the bid opening, shall be compensated for on a unit basis in accordance with the contract documents.

I. The Contractor shall be allowed to use water from an owner-approved fire hydrant in the project vicinity. Use of an approved double check backflow assembly shall be required. Contractor shall provide his own approved assembly. Contractor shall pay market price for all water usage.

3.2 INSTALLATION OF LINER

The Spiral Wound Liner (SWL) shall be installed per the liner manufacturer's specifications as described and submitted in the PWS.

A. MSWL - Installations shall be in accordance with the applicable ASTM F1697 standards.

1. The MSWL process includes drive tray assemblies, winding cages, profile and other peripheral equipment necessary for the installation process.

2. The MSWL installation equipment can be stationary or traversing depending upon the lining method and process based on design criteria and host pipe conditions.

3. MSWL are mechanically installed and do not require heat monitoring or control. The installation process is continuously monitored via CCTV which allows the operator to have visual inspection and control over the installation process. The process can be temporarily stopped and resumed if required to address field related issues or sudden wet weather-related events.

4. The MSWL system can be designed and installed as tight fitting or fixed diameter grouted solutions capable of withstanding all applied loads. If installed as a fixed diameter liner, the Contractor shall provide the Owner with a grouting submittal which outlines the annular space grouting requirements, type of grout, staging plan including number of lifts and cubic yards of grout required.

B. SGSWL installations shall be in accordance with the applicable ASTM F1698 standards.

1. SGSWL are manually installed using liner panels and/or coils or both. If the project entails the lining of only a portion of the circumference of circular pipes/conduits or the conduit is highly non-circular (e.g., low rise arch or semi-elliptical), the PVC liner will be supplied as flat panels. These panels shall be cut and trimmed to fit as near as practical to the internal circumference of the structure to be lined, or as specified. If the profiled PVC liner is provided in the form of coils, the liner shall be spirally wound with the ribbed profile of the strip as near as practical (but not less than 0.5") to the wall of the existing structure or as specified by approved installation plan.

2. SGSWL installation process includes cleaning of the host pipe to remove oils, latencies and loose concrete to sound concrete.

3. Installation bolsters to maintain annular spacing will be installed. If required by engineered design, additional rebar/mesh will be installed according to approved plans, at this time.

4. The SGSWL panel segments are joined together with a gasketed joiner strip using pneumatic tools. QC inspection is performed during installation to ensure liner maintains proper internal diameter.

5. A bulkhead is built at the beginning and the end of the lined section to secure the grout during the grouting process.

6. Grouting will be done either by controlled lifts or with the use of a bracing system. If a bracing system is used, it will be installed and secured prior to grouting. Refer to Part 2: 3.B.2 for grout compressive strength properties and Part 3: 3.5.B.2 for quality assurance testing

7. Installation tasks can be stopped/resumed in the event of wet weather or culvert evacuations are necessary.

8. Structural Grout will be introduced into the annular space either internally through drilled grout holes in the liner or through grout ports in crown of pipe or ends of section bulkheads. The grouting of SWSWL systems shall be in accordance with ASTM F1698.

3.3 FINISH

A. The installed SWL shall be continuous over the entire length of the lined section and be free from visual defects. The SWL shall be impervious and free from any leakage from the pipe to the surrounding ground or from the ground to inside the lined pipe.

B. Any defect which will or could affect the structural integrity or strength of the linings shall be repaired at the Contractor's expense, in accordance with the procedures submitted in the PWS.

C. The beginning and end of the SWL shall be sealed to the existing host pipe. The sealing material shall be compatible with the pipe end and shall provide a watertight seal.

D. If required by the agency, the service connections can be sealed post installation using a wide range of sealing solutions including injectable grouts and CIPP sealing lateral connections.

E. Compensation shall be at the actual length of the SWL installed. The length shall be measured from center of manhole to center of manhole. The unit price per linear foot installed shall include all materials, labor, equipment and supplies necessary for the complete Spiral Wound Liner (SWL) installation. Compensation for service connection sealing at the manhole/wall interface, shall be at the unit price bid therefore in the Proposal.

3.4 MANHOLE CONNECTION & RECONNECTIONS OF EXISTING SERVICES

A. MSWL

1. A seal, consisting of a resin mixture or hydrophilic seal compatible with the installed SWL, shall be applied at the manhole/wall interface in accordance with the System manufacturer's recommendations.

2. Existing services shall be internally or externally reconnected unless indicated otherwise in the contract documents.

3. Reconnections of existing services shall be made after the SWL has been installed. It is the Contractor's responsibility to make sure that all active service connections are

reconnected.

4. External reconnections are to be made with a tee fitting in accordance with the SWL system manufacturer's recommendations. Saddle connections shall be seated and sealed to the new SWL using grout or resin compatible with the PVC liner material.

5. A CCTV camera and remote cutting tool shall be used for internal reconnections. The opening shall be 95% to105% of the service connection opening. The edges of the opening shall not have pipe fragments or liner fragments, which may obstruct flow or snag debris. In all cases the invert of the host pipe connection shall be cut flush with the invert entering the mainline.

6. If service reinstatements result in openings that are greater than 105 percent of the service connection opening, the Contractor shall install a CIPP type repair, sufficiently in the size to completely cover the over-cut service connection.

7. Coupons of pipe material resulting from service tap cutting shall be collected at the next manhole downstream of the pipe rehabilitation operation prior to leaving the site. Coupons may not be allowed to pass through the system.

8. Compensation shall be of the actual number of services re-connected using either internal or external means as contained in the Proposal. The unit price bid per service line re-connected shall include all materials, all labor, equipment, and supplies necessary to complete the work as required in these specifications.

B. SGSWL

1. Service connections for SGSWL should be cut in as the PVC lining is being installed, leaving the lateral flow unobstructed by the lining.

2. A sleeve slightly smaller than the ID of the existing lateral will be installed into existing lateral/service connection and protrude into the new lined section.

3. All laterals/service connections will be sealed inside the new lined section with a liner manufacturer approved sealant.

4. Internal lateral end will be sealed with a cementitious material to prevent the flow of grout into the lateral during the grouting operation.

3.5 TESTING OF INSTALLED SPIRAL WOUND LINER (SWL) AND GROUT – IF APPLICABLE

A. MSWL

1. The physical properties of the installed SWL shall be verified through field sampling and laboratory testing. All materials for testing shall be furnished by the Contractor to the Owner for testing. All materials testing shall be performed at the Owners expense, by an independent third-party laboratory selected by the Owner as recommended by the SWL manufacturer. All tests shall be in accordance with applicable ASTM test methods to confirm compliance with the requirements specified in these contract documents if applicable.

2. The Contractor shall provide samples for testing to the Owner from the reel of profile installed on the project. Controlled flat samples shall be provided from spools for SWL installations or as required by the Owner. The samples shall be provided from every

spool or production batch from the SWL profile required for the project if applicable.

3. The laboratory results shall identify the test samples from each spool and profile type being utilized on the project. Final payment for the project shall be withheld pending receipt and approval of the test results. If properties tested do not meet the minimum physical and profile dimensions, the SWL shall be repaired or replaced by the Contractor unless the samples tested meet the design requirements as required in the contract if applicable.

4. Chemical resistance – A certification may be submitted by the Contractor, from the manufacturer, verifying that the chemical resistance of the SWL meets the contract requirements if applicable.

5. Hydraulic Capacity – Overall, the hydraulic capacity shall be maintained as large as possible. The installed SWL shall at a minimum be equal to the full flow capacity of the original pipe before rehabilitation. In those cases where full capacity cannot be achieved after liner installation, the Contractor shall submit a request to waive this requirement, together with the reasons for the waiver request. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition if applicable.

6. The installed SWL dimensions shall be measured per spool of profile provided for the project. If the liner dimensions do not meet those that are specified in the contract and submitted as the approved design by the Contractor, then the liner shall be repaired or removed unless the installed liner meets the design requirements in the contract. In addition to third party laboratory testing, the Contractor can use industry proven, non-destructive methods for verifying installed liner dimensions as an alternative.

7. All costs to the Contractor associated with providing SWL samples for testing shall be included in the Lump Sum price bid for Mobilization. Payment for all testing by a laboratory will be paid for by the Owner, directly to the laboratory under the lump sum reserve for testing item force bid in the Bid Proposal.

B. SGSWL

1. The installation should be inspected by closed-circuit television or visually. The PVC liner should be continuous over the entire length of the installation. Variations from true line and grade may be inherent because of the conditions of the existing pipeline. The SWL shall be free of visual defects, damage or excessive deflection. There shall be no visible infiltration through the liner at the joints or lateral connections.

2. Grout Compressive Strength Testing—If required by the Owner or designated in the contract documents, samples from the mixed grout being injected into the annulus should be collected and tested for compressive strength, in accordance with ASTM Test Method C942. Three samples should be taken for each day of grouting. Measured values of compressive strength should meet the job specifications.

3. Where personnel entry is feasible, perform an internal “Hammer Test” of the installed lining system may be performed to verify that the annular space has been filled with grout. Hammer Test may be performed by the Contractor in the presence of an Owners representative when confined space entry is feasible.

4. The hammer test shall consist of lightly tapping on the inner surface of the completed liner with a solid plastic headed hammer, changes in the tone of the audible response

could indicate the presence of grout voids.

5. Hammer testing shall be performed longitudinally for a minimum of 5 passes along the lined pipe. The passes shall include the crown (0 degrees) and the 45, 135, 225 and 315-degree points.

6. Voids detected during this process shall be localized to determine the extent. Voids greater than 6 inches in any direction are considered “unacceptable”. All unacceptable voids should be reported to the Owner/Engineer for approval. Unacceptable voids shall be filled by drilling a hole into the void, pumping grout into the void and plugging the grout hole with a liner manufacturer approved PVC plug.

3.6 FINAL ACCEPTANCE

A. All Spiral Wound sample testing and repairs to the SWL, as applicable, shall be completed before final acceptance, meeting the requirements of these specifications and documented in written form.

B. The Contractor shall perform a detailed, closed-circuit television inspection in accordance with ASTM standards after the installation of the Spiral Wound Liner (SWL) and reconnection of the service/lateral’s connections. A radial view (pan and tilt) TV camera shall be used. The finished liner shall be continuous over the entire length ofthe installation and shall be free of significant visual defects, damage, deflection, holes, leaks or other defects. Unedited digital documentation of the inspection shall be provided the Owner within ten (10) working days of the liner installation. The data shall note the inspection date, location of all reconnected side sewers, debris as well as any other defects in the liner, including but not limited to gouges, cracks, bumps or bulges

C. Bypass pumping or plugging from the upstream manhole or worker-entry structure shall be utilized, if necessary, to minimizes sewage from entering the line during inspection. In the case of bellies in the line, the pipe shall be cleaned to provide continuous visibility during the inspection.

D. If additional testing is required, the Contractor may perform air testing, localized testing and any other testing that will verify the installed SWL does not exceed the acceptable tolerances for leakage as specified in the contract.

3.7 TYPICAL BID ITEMS

A. Mobilization – Lump Sum – Includes all PWS information, submittals, safety plan, as-built drawings, testing samples, mobilization/demobilization of labor, equipment and materials to the project site. Generally limited to 5% of the total amount bid for the project.

B. Pre-Lining CCTV Inspection – Per linear foot

C. Point Repairs – Per each or by Lump Sum Contingency. Includes excavation and restoration of a section or sections of pipe that are beyond rehabilitation using a SWL. Note: point repair items shall be categorized by pipe size, a minimum length of excavation and depth category of excavation to be paid for in the Proposal. If point repairs are not identified in the contact documents, payment shall be on a contingency basis.

D. Standard Pipe Cleaning – Per linear foot for each pipe size category – including all labor, equipment, materials and cost of material disposal, per liner manufacturers cleaning requirement.

E. Debris removal – Per cubic yard or ton for each pipe category – including all labor, equipment, materials and cost of material disposal.

F. Liner Installation – Per linear foot for each pipe size category – Includes all labor, equipment and materials required for the complete installation of a SWL.

G. Traffic Control – Lump Sum – Includes all labor, equipment and materials required to implement a traffic control plan for the entire project and shall include all costs associated subcontracted traffic control specialists.

H. Service Reconnections – Per Each – Includes reconnecting existing live sewer service connections to the installed SWL. Owner shall review and verify those connections that are not live and will be left unopened or abandoned.

I. Service Connection Sealing – Per Each – Includes sealing the interface between the installed SWL and the host pipe at the location of the service connection, if applicable.

J. Post Construction CCTV Inspection – Per Linear Foot – Includes post lining CCTV for submission to the Owner.

K. Grouting – Lump Sum or Cubic Yard – Includes all labor, equipment and materials to grout annulus between host pipe and PVC liner system.

**END OF SECTION*