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SECTION 1: GENERAL

1.1 INTENT

The intent of the Specification is to define the requirements for the reinstatement of live service connections in sewer pipelines that have been renewed by trenchless lining methods. Reinstatement of the connection between the lined pipe and the lateral (house service) line is required to ensure the renovated sewer is completely sealed. Sealing the lateral connection prevents infiltration of groundwater into the pipe, exfiltration of sewage, and root intrusion at the service connections.

1.2 SCOPE

This Specification details the requirements for the design, manufacture, installation, quality, and testing of systems that are used to reinstate and seal a service connection in the following range of sizes and configurations.

- Mainline diameters: 6", 8", 10", 12"
- Lateral diameters: 4" to 6"
- Lateral angles: 0° to 180°
- Lateral length options: 4", 12", 20"

1.3 REFERENCE DOCUMENTS AND STANDARDS

- AS/NZS 2566.1 Buried Flexible Pipe Design Standard
- InterfitUSA Lateral Sealing System Installation Guideline Specification
- EN 13566-4 Plastics piping systems for renovation of underground non-pressure drainage and sewer networks.
- ASTM F1216-09 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
- ASTM F1606 Standard Practice for Rehabilitation of Existing Sewers and Conduits with Deformed Polyethylene (PE) Liner
- ASTM F1741 Standard Practice for Installation of Machine Spiral Wound PVC Liner Pipe for Rehabilitation of Existing Sewer and Conduit

1.4 TERMINOLOGY

Annulus: The void between the external surface of the liner and the inside surface of the existing pipe
Contractor: InterfitUSA “Certified Applicator” commissioned to carry out the rehabilitation on behalf of the Principal.

Lateral Connection Seal: Refers to the short-form cured-in-place liner that reinstates the service connection and provides the seal between the lined pipe and the lateral opening.

Liner: The product that has been installed in the main pipe for the purposes of renewing the pipe.

Principal: The authority or asset owner.

Standard Junction: Refers to a standard junction type that of standard configuration and is in satisfactory condition. Standard configuration junctions are those constructed by using standard pipe fittings to connect pipes to one another.

Defective Junction: Refers to a standard junction that is either defective (one that is collapsed or has missing sections) or a junction that has been constructed using non-standard pipe fittings or pipe joining methods.

Superintendent: Authorized representative of the Principal

SECTION 2: PRODUCT
This section specifies the material, design, and performance criteria of the installed Lateral Connection Seal.

2.1 MATERIALS
The minimum expected service life of the installed Lateral Connection Seal shall be equivalent to the expected service life of the installed sewer main liner (>50 years).

The Lateral Connection Seal shall be comprised of materials which are compatible with the installed liner and for the duration of the service life are:

- Resistant to sewage, sewage related gases and industrial effluent and chemicals which may be commonly found inside the pipe. Chemical resistance shall include satisfactory performance in the presence of small quantities of carbon monoxide, carbon dioxide, methane, vegetable oil, gasoline, kerosene, detergent, soap, tap water (pH 5.5-9.0), ferrous chloride and dilute concentrations of nitric, hydrochloric and phosphoric acid. The system shall be chemically resistant to high concentrations of sulphuric acid resulting from bacterial conversion of hydrogen sulfide.

- Resistant to gases that may naturally occur inside the pipe including any possible condensate solutions from these gases.

- Resistant to soil bacteria and any chemical attack which may be due to materials in the surrounding ground
- Resistant to sewer corrosion
- Not subject to shrinkage, thermal contraction, or recovery after installation
- Abrasion resistant; maximum abrasion wear index shall be \( \leq 0.18\text{gr (11.5mg)/1,000 cycles when tested to ASTM D4060 using a 2.2 lb. load under a Taber Abraser 503 and CS-10 abrasive wheels.} \)

2.1.1 CONSTRUCTION

Reinstated lateral connections shall be sealed with short-form cured-in-place sewer liner or equivalent composed from a combination of felt and resin. Seals achieved by injection of grout or similar techniques are not acceptable as they do not provide an effective long term seal.

The felt shall be capable of being fully impregnated with resin, which shall be retained within the felt layers under installation pressures and temperatures.

Since a seal is required to be maintained to the host pipe, it is necessary that the resin does not shrink during the curing process. Permitted resins shall be silicate or epoxy based or other non-shrink resins. Polyester and vinyl ester resins shall not be permitted.

The Lateral Connection Seal shall be of a continuous and homogenous construction and shall not rely of a sacrificial coating or protective layer to achieve the material performance criteria listed above.

2.1.2 MANUFACTURE OF LATERAL SEAL COMPONENTS

The components comprising the Lateral Connection Seal shall be made from materials that are suitable for use in sewer systems and are compatible with the installed liner material. The manufacturer’s representative of the Lateral Connection Seal components shall provide relevant Material Safety Data Sheets and Technical Data Sheets pertaining to the components to be used by the Contractor.

The installation of the product shall be performed by a “Certified Applicator,” and in accordance with the manufacturer’s recommendations.

2.2 DESIGN

The Lateral Connection Seal shall provide, for the duration of its expected service life, >50 years, the following:

1. A fitting with sufficient strength, and
2. An infiltration/exfiltration and root intrusion proof seal
to ensure the Lateral Connection Seal is structurally adequate, the seal shall be designed in accordance with the following:

- The flexural modulus of the cured Lateral Connection seal shall be a minimum of 400,000 psi
- In 4" and 6" diameter pipes, the ring stiffness of the Lateral Connection Seal shall be ≥ 21lb/ft² (1000 N/m²) when tested

2.2.1 DIMENSIONS

The Lateral Connection Seal shall provide a water tight seal by covering the gap between the main pipe liner and the lateral line and shall extend into the house service line lateral. A typical configuration of the seal is shown in Fig. 1 below.

![Diagram of Lateral Connection Seal Configuration]

**“T” CONFIGURATION**

Fig. 1. Lateral Connection Seal Configurations

In the “T” configuration, the seal is applied around the full circumference of both the main line and lateral line.

The dimensions of the seal shall comply with Fig. 2.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>“Tee” Seal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension “A”</td>
<td>2” (50mm) (refer Clause 3.3.3)- 12”</td>
</tr>
<tr>
<td>Dimension “B” Minimum</td>
<td>16” (400mm) for all main line diameters from 6” (150mm) to 12” (300mm)</td>
</tr>
</tbody>
</table>

Fig 2. Dimensional Specifications
In addition to the dimensions above, the seal shall extend for a minimum of 2” past the lateral opening on either side of the connection/coupon cut-out for the full circumference of the main line and lateral line.

### 2.2.2 RESISTANCE TO PIPE CLEANING TOOLS

The Lateral Connection Seal shall maintain long term resistance when subjected to the following jetting and pipe cleaning tools: Pressures and flow rates are as measured at the nozzle.

1. “DCS 102200 Penetrator Bomb” when operated at 2500 psi and flow rate of 60 gal minute

![DCS 102200 Penetrator Bomb](image)

2. “DCS 102500 Bomb” when operated at 2500 psi and flow rate of 80 gal/minute

![DCS 102500 Bomb](image)

3. “ENZ02.050b Rotojet HRH ¾” Bomb” when operated at 2500 psi and flow rate of 60 gal/minute

![ENZ02.050b Rotojet HRH ¾” Bomb](image)
4. “WG-1 Warthog” when operated at 2500 psi and flow rate of 60 gal./minute

The Contractor shall provide a recommended maintenance procedure for cleaning liners with Lateral Connection Seals installed. The maintenance procedure shall specify allowable jetting and pipeline cleaning procedures that may be used including any limitations on the type of jetter and nozzle heads that can be used, and maximum allowable pressures and flow rates so that the seal does not become damaged or dislodged during cleaning.

2.3 SEALING

The Lateral Connection Seal shall maintain a seal when subjected to a minimum of 5 psi of external water pressure. A suitable test for validating the sealing performance of the product is to apply a hydrostatic pressure head of 5.1 psi to an above ground cured Lateral Connection Seal for a period of 2 minutes. At the end of the test, the pressure reading shall be taken. A pressure loss of more than 1 psi, within the allotted time, shall indicate failure of the seal.

Satisfactory results of the above seal test shall be considered as evidence that the sealing performance of the installed product is acceptable.

2.4 HYDRAULICS

The installed Lateral Connection Seal shall not impede the hydraulic performance of the lined pipe as well as the lateral pipe. The Lateral Connection Seal shall not reduce the internal diameter of the existing pipe by more than 5 percent of the installed sewer liner diameter and the lateral pipe unless otherwise approved by the Superintendent.

The short form liner must have a smooth transition in both the house connection branch and sewer main.

SECTION 3: EXECUTION

This section details the processes for execution of the work including site establishment, pre-installation cleaning and inspection, installation, testing, post-installation inspection and product acceptance.
3.1 SITE ESTABLISHMENT

Delivery to and storage of the Lateral Connection Seal material on site shall be performed in a manner that minimizes the disruption to the surrounding environment, residents, local community, and nearby traffic.

The site shall be secured to prevent entry by unauthorized personnel or members of the general public. The site shall comply with municipal regulations.

3.2 CLEANING AND INSPECTION

The Contractor must remove all internal debris and if required clean the existing pipe until it is in a suitable state of cleanliness to install the Lateral Connection Seal. All surfaces that will be in contract with the Lateral Connection Seal shall be thoroughly cleaned, and all traces of grease, oil, and fat must be removed, to ensure that good adhesion is achieved. The use of high velocity jet cleaners or mechanically powered equipment shall be used if necessary, provided they do not damage the liner and the existing pipe.

The existing pipe shall be inspected by robotic CCTV prior to installation of any Lateral Connection Seals. The location and orientation of the lateral connection joints shall be noted.

3.3 INSTALLATION OF SEAL

In general, the Lateral Connection Seal shall be capable of being installed in the widest possible range of junction configurations and diameters. For this reason, all junctions in renewed/lined pipes of a standard configuration, as detailed in Clause 3.3.1, shall be reinstated in-situ and in accordance with methods outlined in this specification.

The Lateral Connection Seal shall be installed using a retrievable packer from a nearby manhole. To minimize disruption, excavation for the purposes of installing the Lateral Connection Seal, or accessing the lateral connection to install the short form liner from any other location, such as the lateral line itself, the Inspection Opening (IO) or cleanout shall not be permitted.

The Lateral Connection Seal shall be capable of being installed in live flow. Bypass pumping or diverting the sewer flow shall not be permitted during installation unless authorized by the Supervisor or Principal. To aid in sealing, the packer shall be capable of forcing excess resin into the gap between the sewer line and the host pipe at the connection.

To minimize disruption to the community, the Lateral Connection Seal shall be capable of being installed and cured without disrupting the service to the residents. Further, the resin shall be capable of curing under water.

At the completion of installation, the line is to be inspected and recorded using CCTV in accordance with Clause 4.1
3.3.1 STANDARD JUNCTIONS

Since the purpose of reinstating connections is to seal the renewed pipe, all Standard Junctions, as defined in Clause 1.4, and those detailed in the table below, shall be reinstated and sealed. Omissions or excavations of standard connections to a relined pipe shall not be permitted.

The following table specifies junctions which shall be considered as standard:

<table>
<thead>
<tr>
<th>Junction Type</th>
<th>Dimensions &amp; Configurations</th>
<th>Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square Junctions</td>
<td>- Diameter of main: 6” to 12”</td>
<td>![Square Junction Diagram]</td>
</tr>
<tr>
<td>- Joined using standard pipe fittings</td>
<td>- Diameter of lateral: 4” &amp; 6”</td>
<td></td>
</tr>
<tr>
<td>Square Junctions: Cut in</td>
<td>- Diameter of main: 6” to 12”</td>
<td>![Square Cut in Diagram]</td>
</tr>
<tr>
<td></td>
<td>- Diameter of lateral: 4” &amp; 6”</td>
<td></td>
</tr>
<tr>
<td>Oblique Junctions</td>
<td>- Diameter of main: 6” to 12”</td>
<td>![Oblique Junction Diagram]</td>
</tr>
<tr>
<td>- Joined using standard pipe fittings</td>
<td>- Diameter of lateral: 4” &amp; 6”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Angle of Lateral: 25°, 45°, 60°</td>
<td></td>
</tr>
<tr>
<td>Oblique Junctions: Cut in</td>
<td>- Diameter of main: 6” to 12”</td>
<td>![Oblique Cut in Diagram]</td>
</tr>
<tr>
<td></td>
<td>- Diameter of lateral: 4” &amp; 6”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Angle of Lateral: 25°, 45°, 60°</td>
<td></td>
</tr>
<tr>
<td>Junctions with Off-takes</td>
<td>- Diameter of main: 6” to 12”</td>
<td>![Junction with Off-takes Diagram]</td>
</tr>
<tr>
<td></td>
<td>- Diameter of lateral: 4” &amp; 6”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Offtake pipe offset distance to main line ≥ 4” (100mm).</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Standard Junction Configurations

In addition to the Standard Junction configurations above, the Principal may nominate, other configurations to be standard as part of a contract of works. If this is the case the proposed configurations shall be agreed to by the Contractor for the junction configuration to be classed as Standard.
3.3.2 LATERAL EXTENSION CONFIGURATIONS

In addition to the junction configurations above, the Lateral Connection Seal shall be capable of being installed in junctions with the following lateral extensions after the connection:

<table>
<thead>
<tr>
<th>Lateral Extension Type</th>
<th>Dimensions &amp; Configurations</th>
<th>Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bends</td>
<td>- 45° and 90° bends in 6” lateral pipes made of Clay or PVC</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>- 45° bends in 4” lateral pipes made of Clay or PVC</td>
<td></td>
</tr>
<tr>
<td>Eccentric Taper</td>
<td>Reduction of diameter from 6” to 4” Straight or curved</td>
<td></td>
</tr>
<tr>
<td>Concentric Taper</td>
<td>Reduction of diameter from 6” to 4” Straight or curved</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Lateral Extension Configurations

3.3.3 SEALING OF THE FIRST JOINT OF THE LATERAL

The primary purpose of the Lateral Connection Seal is to seal the connection to the main line. For this reason, and unless specified by the Principal, the seal dimensions detailed in Clause 2.2.1 shall be appropriate for sealing the connection.

3.3.4 DEFECTIVE JUNCTIONS

Sealing of defective junctions, as defined in Clause 1.4, such as junctions with missing or collapsed sections, or with offset joints shall not be attempted. If the Contractor believes there is a risk that the installation attempt will be unsuccessful or if installation is not possible, then digging up and replacing the defective junction shall be considered acceptable. If this is required, it is necessary to replace the defective junctions before the sewer main is lined.
3.4 RETENTION OF EXISTING PIPE CONDITION

The activity carried out by the Contractor during installation of the Lateral Connection Seal shall not adversely affect the structural integrity of the existing pipe fitting, sewer main, sewer main liner, lateral pipe, or any other structures that are associated with the contract of works.

SECTION 4: INSPECTION, TESTING, AND ACCEPTANCE

This section specifies the requirements for inspection, testing, and acceptance of the Lateral Connection Seal.

4.1 POST INSTALLATION CCTV INSPECTION

A closed circuit television (CCTV) inspection must be carried out after installation to establish that the Lateral Connection Seal has been installed according to specification. The CCTV survey shall be in color and shall start and finish in the channel of the upstream and downstream access chambers. At each Lateral Connection Seal, the CCTV inspection must include a 360° video recording.

- To ensure that the seal has completely inflated inside the host main liner and lateral with no visible annular space or active infiltration emanating from the seal and a...

- Video recording of the lateral opening to ensure the pipe is clear of any obstructions

4.2 TESTING

The Contractor shall provide test data in accordance with relevant Standards which verify the physical, material, and chemical properties of the Lateral Connection Seal material in accordance with Clause 2.1.

Verification and acceptance of the installed seal shall be based on CCTV inspection in accordance with Clause 4.3.

4.3 LATERAL CONNECTION SEAL ACCEPTANCE CRITERIA

After curing, the installed Lateral Connection Seal shall be free of all defects, which may affect the sealing properties and/or impede or restrict the flow though the main line and flow from the lateral line into the main. Typically unacceptable defects may include, but are not limited to:

- Excessive wrinkling, ridges, pimples, or bulges that may cause blockages or impede sewer flows

- Foreign inclusions
Irregularity in lining caused by inadequate pipe preparation
- Leakage through the seal material or between the bond
- Dry spots, bubbles, cracks, or delaminations
- Pinholes
- Shrinkage and gap between the host surface and the seal

Where the defect cannot be repaired, the defective Lateral Connection Seal shall be removed and replaced. This shall be the responsibility of the Contractor.

All standard junctions and configurations in the sewer renewal contract shall be reinstated and sealed in accordance with this specification.

5.0 PAYMENT

Pricing includes traffic control, permits, and video documentation. Unit prices shall be submitted for the following items:

- Mobilization Lump Sum
- Lateral cleaning/video inspection from cleanout to main per lineal foot
- Setup for each manhole-to-manhole segment
- Interfit Lateral Connection Seal extending up to 12” into the lateral

6.0 QUALIFIED BIDDER

A qualified bidder for installing a main line/lateral connection system shall use a Manufactured system that has a minimum of a five-year history of satisfactory performance and a minimum of 10,000 successful installations during this time period.