


# GRAVITY SEWER PIPE REHABILITAION

## SPIRAL WOUND LINING – PERFORMANCE SPECIFICATION GUIDELINE

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Watercare

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**More information**

If you have further queries, please contact the Asset Lifecycle team at standards@water.co.nz

# DOCUMENT CONTROL

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|---|---|
| Document owner | Principal Asset Lifecycle Engineer (Standards) |
| Review | Head of Sustainability and Innovation |

## Version history

| Version | Description of revision | Prepared by | Approved by | Date |
|---|---|---|---|---|
| 1.0 | First release | W Strydom | B Harkness | 17-03-2025 |

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# Definitions

| | |
|---|---|
| ASTM | American Society for Testing Materials |
| ASTT | Australasian Society for Trenchless Technology |
| CCTV | Closed Circuit Television – which includes cameras and displays to record and inspect pipelines. |
| Contractor | Main contractor engaged by Watercare, responsible for delivering the works |
| Defect | Any discontinuity, imperfection or inclusion arising from substandard materials, improper pipe preparation, or faulty manufacture, installation or workmanship which affects the hydraulic or structural performance of the lining |
| Flow management plan (FMP) | Contractor plan(s) and methods to divert flows whilst preventing overflows or any adverse consequences whilst preparing the host pipe and installing the new liner. |
| IANZ | International Accreditation New Zealand |
| ISO | International Organisation for Standardisation |
| Lateral Junction repair (LJR) | Repair made with CIPP technology to a damaged lateral connection, either stand alone or in conjunction with a full or part liner |
| MSWL | Machine spiral wound liners |
| NDSRs | No-dig spot repairs |
| Project Specification | Project specific requirements specific by the design engineer which form part of the minimum requirements to be met during construction |
| PVC-U | Unplasticized polyvinyl chloride |
| Quality Control Plan | The Contractor's documentation that defines the procedures for delivering the level of construction quality required by the project. |
| SGSWL | Structural grout spiral wound liners |
| Specialist Contractor | Contractor carrying out the physical installation of the liner in accordance with the project specifications and manufacturer's recommendations. |

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|---|---|
| Spiral wound lining | Linings installed by the spiral winding of a profiled strip to form a continuous pipe |
| Watercare | Watercare's representative responsible for managing the project. |

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# 1. Scope

This Performance Specification includes the minimum requirements for the rehabilitation of pipelines using spiral wound liners. These liners are installed using continuous strips of profiled PVC-U sections into a spirally wound pipe (or liner) that fits into an existing pipe.

Spiral wound liners can be categorised as either Machine Spiral Wound Liners (MSWL) or Structural Grout Spiral Wound Liners (SGSWL). MSWL are generally used for smaller diameter (non-person entry) pipelines, where SGSWL are considered for larger diameter sewers where liners are installed tight against the pipe wall or constructed to a predetermined size prior to installation.

This document shall be read in conjunction *ESF-600-STD-206: Gravity sewer pipe rehabilitation – General requirements for the installation of lining systems*.

## 1.1 Overview

The lining shall be a PVC-U profile, field-fabricated into a spiral wound liner pipe. After insertion, the spiral wound liner pipe shall expand to meet the interior surface of the existing pipeline or installed in a manner that the profile is wound tight against the pipe wall in the case of SGSWL methods. Alternatively, the spiral wound liner pipe can be inserted into the existing pipe after it has been manufactured to a fixed diameter, and the annular space between the spiral wound liner pipe and the existing pipe is grouted.

***Table 1**: Application of spiral wound liners*

| Reference | Description |
|---|---|
| **Liner material** | PVC-U |
| **Roughness coefficient** | 0.009 mm |
| **Liner Classification** | Class A – Fully structural<br>Class B – Semi-structural<br>Class C – Semi-structural |
| **Applications** | Wastewater: Non-pressure |
| **Pipe sizes** | 150mm to 1800mm diameter |
| **Installation** | Manhole to manhole |
| **Design life** | 50 years |

# 2. Relevant Standards

***Table 2**: Standards applicable to spiral wound PVC-U liners*

| Standard | Relevance | Applicable SWL method |
|---|---|---|
| **AS/NZS ISO 11295**: Plastics piping systems used for the rehabilitation of pipelines - Classification and overview of strategic, tactical and operational activities | Planning and general | All – General |
| **AS/NZS ISO 11296.1**: Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks, Part 1: General | General | All |
| **AS/NZS ISO 11296.7**: Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks - Part 7: Lining with spirally-wound pipes | Design, materials and testing | |
| **ASTT – DS-D001:** Design for Structural Renovation of Pipelines by Internal Lining, Part 1 – Circular Non-pressure Pipelines | Design | |

| Standard | Relevance | Applicable SWL method |
|---|---|---|
| **ASTM F1741**: Standard Practice for Installation of Machine Spiral-Wound Poly (Vinyl Chloride) (PVC) Liner Pipe Rehabilitation of Existing Sewers and Conduit | Design and Installation | Machine spiral wound liners (MSWL) |
| **ASTM F1697**: Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduits | Installation, materials and testing | |
| **ASTM F1735:** Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for PVC Liners for Rehabilitation of Existing Man-Entry Sewers and Conduits | Material | Structural grout spiral wound liners (SGSWL) |
| **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 | Installation, materials and testing | |
| **ASTM D638:** Standard Test Method for Tensile Properties of Plastics | Material and testing | All |
| **ASTM D790:** Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials | Material and testing | |
| **ISO 23818-3**: Assessment of conformity of plastics piping systems for the rehabilitation of existing pipelines - Part 3: Unplasticised poly(vinyl chloride) (PVC-U) material | Material and testing | |
| **ASTM D543**: Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents. | Material | |

**Note**: The latest revisions of the standards listed above shall be referred to when carrying out any of the associated works.

# 3. Design

Design of the lining system shall meet all the relevant requirements of *ESF-600-STD-206: Gravity sewer pipe rehabilitation – General requirements for the installation of lining systems*.

The spiral wound liner shall be designed using one of the following standards:

- Machine spiral wound liners (MSWL)
  - **ASTT – DS-D001 Specification:** Design for Structural Renovation of Pipelines by Internal Lining, Part 1 – Circular Non-pressure Pipelines
  - **ASTM F1741:** Standard Practice for Installation of Machine Spiral-Wound Poly (Vinyl Chloride) (PVC) Liner Pipe Rehabilitation of Existing Sewers and Conduit – Appendix X1

- Structural grout spiral wound liners (SSGSWL)
  - **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 – Appendix X1

The long term (50 year extrapolated) Creep Reduction Factor shall be set 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.

The lining shall be designed and fabricated in a manner that, when installed, will fit the internal wall and length of the pipe being lined, within the tolerances specified by the designer.

All work on the preparation of the design calculations, including proof checking and review, shall be included in the Contractor's quality assurance documentation.

# 4. Material requirements

## 4.1 Material properties

The Contractor shall submit test data to substantiate that the values for material properties nominated in the design calculations can be achieved by the materials supplied for the pipeline installation.

Where material properties under load vary with time, material properties of the lining at the end of the 50-year design life shall be used in design calculations. The exception to this is design of the lining for loads applied only during installation, which may be based on short-term material properties.

The material properties of the lining material used in the rehabilitation of the pipeline shall be consistent with the design properties. These properties shall have the same values as those nominated by the Designer.

## 4.2 Profile

The spiral wound liner profile shall meet the requirements set out in the following standards:

- Machine spiral wound liners (MSWL)
  - **ASTM F1697**: Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduits

- Structural grout spiral wound liners (SGSWL)
  - **ASTM F1735**: Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for PVC Liners for Rehabilitation of Existing Man-Entry Sewers and Conduits

## 4.3 Chemical, temperature and abrasion resistance

The contactor shall provide evidence that the materials proposed, meet the applicable standards listed in this document. Refer to *ESF-600-STD-206: Gravity sewer pipe rehabilitation – General requirements for the installation of lining systems*, Section 4.3.

# 5. Construction

For all general construction requirements refer to *ESF-600-STD-206: Gravity sewer pipe rehabilitation – General requirements for the installation of lining systems*.

## 5.1 Installation

### 5.1.1 Liner installation

The liner installation shall be in accordance with the following standards and shall be installed as per the liner manufacturer's specification:

- Machine spiral wound liners (MSWL)
  - **ASTM F1697:** Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduits
  - **ASTM F1741**: Standard Practice for Installation of Machine Spiral-Wound Poly (Vinyl Chloride) (PVC) Liner Pipe Rehabilitation of Existing Sewers and Conduit

- Structural grout spiral wound liners (SGSWL)
  - **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

There shall be no defects or discontinuities that could adversely affect the hydraulic performance or long-term life of the lining.

#### 5.1.2 Defects

Liners shall be assessed for defects as per the relevant requirements of Section 5.2.10 of *ESF-600-STD-206: Gravity sewer pipe rehabilitation – General requirements for the installation of lining systems*.

The following are common examples of defects that are considered unacceptable and must be remediated:

- Liner installed over debris.
- Liner installed over unacceptable protrusions or deformations in the host pipe.
- Under-strength finished liner materials – short term flexural strength or modulus is less than the respective design value declared in the design.
- Defective joints e.g. popped lock in spiral wound lining.
- Leakage observed through the liner.
- Poor quality cut outs or misalignment of cut out with lateral connections / LJR's.
- Inadequate seals at manholes or lateral connections
- Liner thickness installed is less than specified design value (incorrect procurement of liner).
- Liner not fully expanded

**Note**: The defects listed above are not intended to be an exhaustive list. Installed liners will be assessed to confirm they meet the functional requirements over the design life of the lining system.

# 6. Acceptance Control

Refer to *ESF-600-STD-206: Gravity sewer pipe rehabilitation – General requirements for the installation of lining systems*.

## 6.1 Testing

#### 6.1.1 Leak testing

Refer to *ESF-600-STD-206: Gravity sewer pipe rehabilitation – General requirements for the installation of lining systems*.

## 6.2 Sampling

The Contractor shall retain a sample of the profile from each liner section between upstream and downstream manhole and record the batch number of the profile. If grouting is undertaken (on pipes larger than DN375), it shall be sampled and tested in accordance with ASTM F1741.

Material shall also be assessed and tested to demonstrate conformity with:

- **ASTM F1697:** Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduits
- **ISO 23818-3**: Assessment of conformity of plastics piping systems for the rehabilitation of existing pipelines — Part 3: Unplasticised poly (vinyl chloride) (PVC-U) material.

# Appendix A: Example Inspection and Test Plan

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|---|---|---|---|---|---|
| **Contractor Name** | ABC Limited | **To be completed, submitted, and approved before works can commence** | **Complete Watercare's Health and Safety induction** | *Yes* | *Date* |
| **Project Reference** | (Project Name) | | **Control of Work documentation submitted (AA, JSA, Work Permits etc.)** | *Yes* | *Date* |
| **Contractor Representative** | | | **Work Method Statement** | *Yes* | *Date* |
| | | | **Flow management plan** | *Yes* | *Date* |
| | | | **Quality Control Plan** | *Yes* | *Date* |

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| Upstream Structure (e.g. MH 01) | Downstream Structure (e.g. MH 02) | Pipe Cleaned (Yes / No) | Flow Management in place (Yes/No) | CCTV Inspection (Reference Report No.) | Confirm Pipe Size (mm) | Confirm Liner Size (mm) | Liner Material and Certificates | Confirm location of laterals | Pipeline preparation after cleaning (e.g. repairs) | Installed liner - no defects | Grouting around liner anulus (if required) | Liner termination and epoxy around manholes | Post-installation CCTV | Testing and sampling of pipeline | Remediate all defects | Contractor's Representative |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *MH01* | *MH-02* | *Yes* | *Yes - in place (17/04/2024)* | *Yes: Report No. 1234 (18/04/2024)* | *300 mm* | *285 mm* | *PVC-U / Yes* | *Yes* | *Repairs completed (21/04/2024)* | *Yes* | *Not required, only at terminations* | *Yes (25/04/2024)* | *Yes: Report No. 9876 (26/04/2024)* | *Pass (30/04/2024)* | *Completed (02/05/2024)* | *Signed and Date* |
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