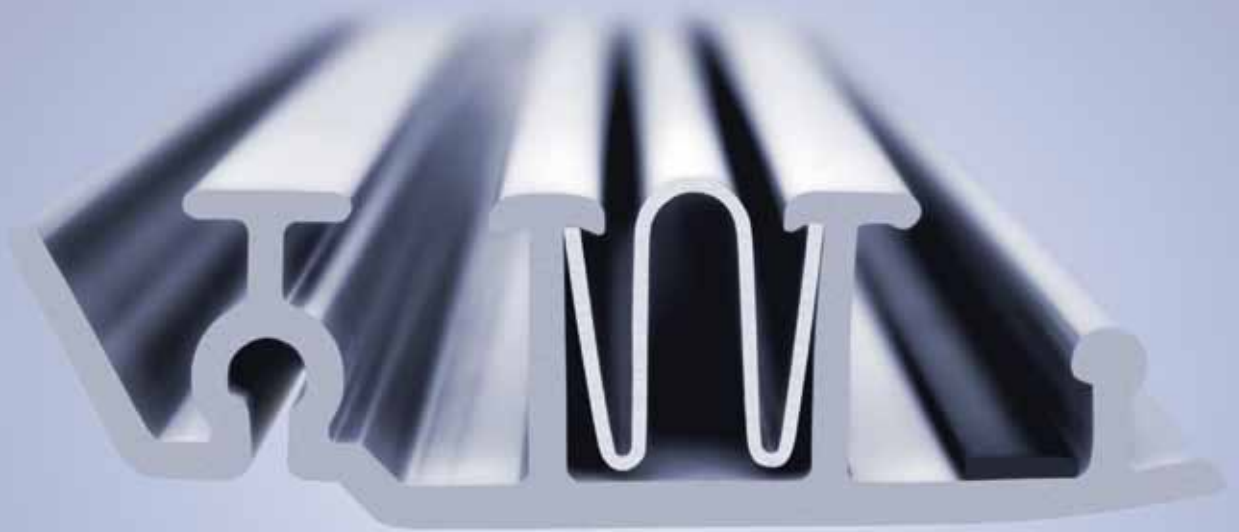


SEWER REHABILITATION SPR TECHNOLOGIES



FORMING GLOBAL CONNECTIONS





SEKISUI SPR'S REHABILITATION TECHNOLOGIES FOR SEWER REHABILITATION

SEKISUI SPR is synonymous with the development and implementation of trenchless pipe rehabilitation world-wide. In its activities, SEKISUI SPR uses the two leading key technologies, the spiral wound technology (SPR) and the cured in place pipe technology (CIPP).

SEKISUI SPR's innovative, patented and world renowned spiral wound technologies are used the world over for the time and cost efficient means they offer for rehabilitating damaged pipes with minimum impact on the environment. SEKISUI SPR sewer rehabilitation products are based on the principle of spiral winding a factory manufactured continuous plastic strip into a liner of high stiffness and low weight directly into the deteriorated pipe.

The system consists of a single, manageable strip of PVC or HDPE, which is spirally wound into the existing pipeline via a patented winding machine positioned in the base of an existing manhole or access chamber.

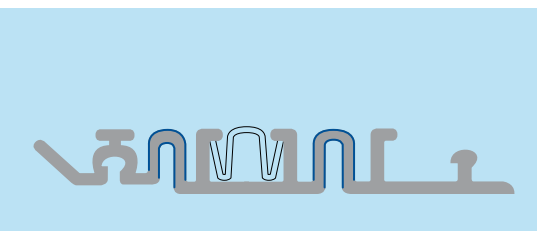
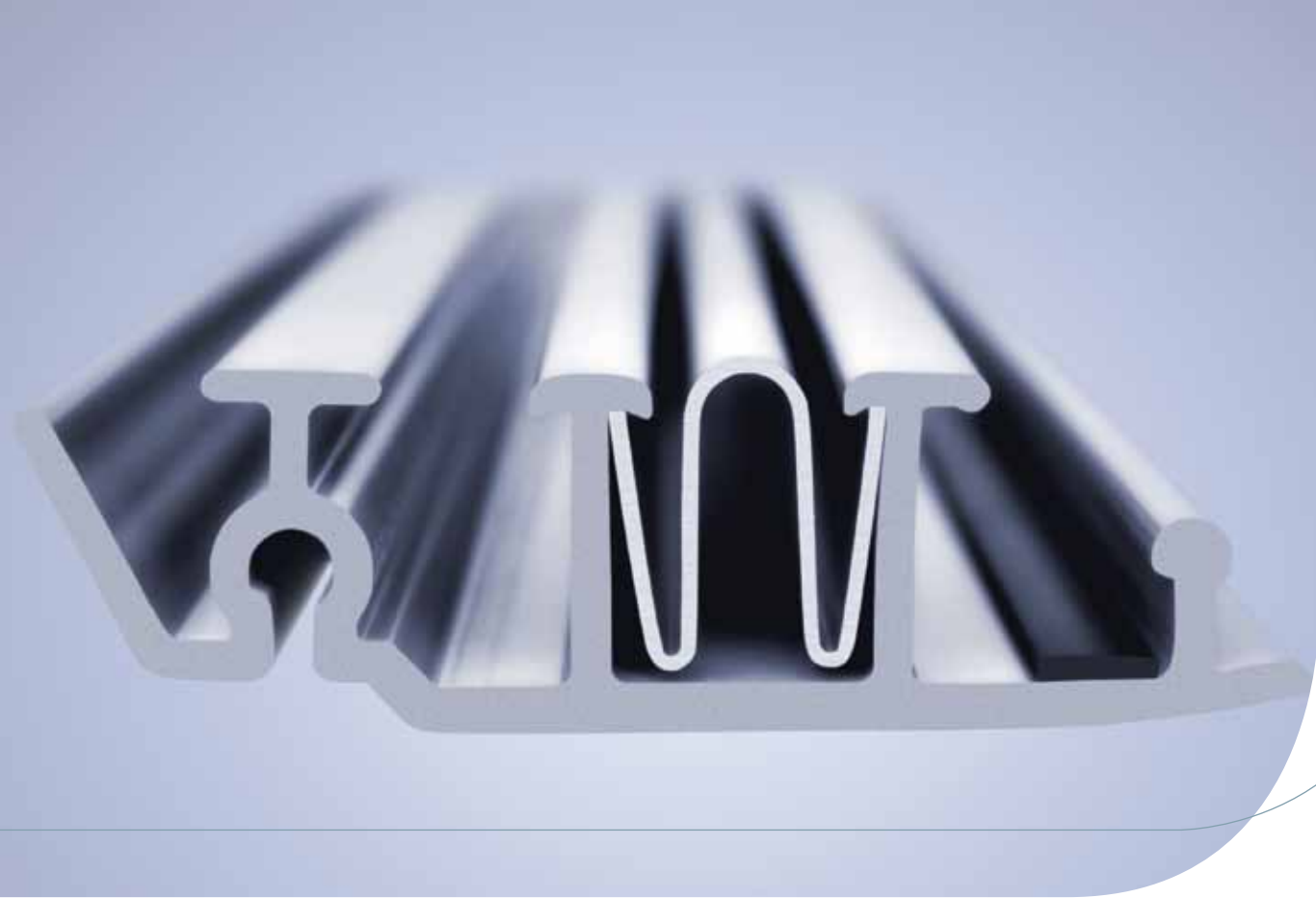
The edges of the strip interlock as it is spirally wound to form a continuous watertight liner inside the host pipe.

For the spiral wound rehabilitation of sewer pipes SEKISUI SPR offers four technologies:

- SPR™
- SPR™ PE
- SPR™ EX
- SPR™ ST



	SPR™	SPR™ PE	SPR™ EX	SPR™ ST
Diameter	800 mm to 5000 mm	900 mm to 3000 mm	150 mm to 750 mm	450 mm to 2500 mm
Material	PVC	HDPE	PVC	PVC
Shape	circular, non-circular, custom shape	circular	circular	circular
	fixed diameter	fixed diameter	close fit	fixed diameter



Typical SPR™ profile for bends (>5d)



Rehabilitation of bends



Rehabilitation of custom shape

SPR™

LARGE DIAMETER TRENCHLESS PIPE RENEWAL

SPR™ is a spiral wound trenchless pipeline renewal process designed for the rehabilitation of large diameter pipelines up to 5000 mm. SPR™ utilizes steel reinforced interlocking PVC profile strips grouted in place with a high compressive strength grout. The installation equipment can be utilized via standard access points without site excavation. The Japanese SPR™ technology can also be installed in vertical applications such as wet wells, access shafts and other large diameter structures.

The SPR™ process is unique as it can provide a customized structural solution to aging pipelines. It can be engineered to correct hydraulic anomalies as well as restore the slope of the original pipe.

The interlocking edges of the profile create an impermeable mechanical lock that can withstand strong deformational forces. SPR™ liners have been tested in accordance with industry standards and meet or exceed the standards for machine spiral-wound liners, ASTM F 1697 and ASTM F 1741. It is also DIBt approved.

Benefits of SPR™ at a glance

- Rehabilitation of large diameter pipes (800-5000 mm)
- Rehabilitation of circular, non-circular and custom shapes
- Truly trenchless – requires only standard manhole entry
- Designed for installation in live flow conditions
- Negotiate curves and bends
- Improved flow with smooth PVC material
- Environmental-friendly installation and application
- Over 400 km successfully installed worldwide

INSTALLATION PROCESS – MINIMAL IMPACT ON THE ENVIRONMENT

The SPR™ installation process can be divided in the following steps:

1. Inspection and cleaning of host pipe
2. Winding process
3. Installation of bracing system
4. Grouting

Inspection

Prior to the SPR™ winding process the host pipe is inspected via camera and all incrustations and debris are removed by hydraulic jet cleaning.

Winding process

SPR™ profile is fed through the manhole into the winding machine placed in the host pipe. The winding machine winds the PVC profile to the requested form and interlocks the PVC strips to form a new watertight pipe. Due to the forward motion the winding machine moves to the next access chamber. For longer rehabilitation sections, when the winding machine passes an intermediate shaft the profile is cut and the above ground equipment relocated before continuing winding.

Bracing system

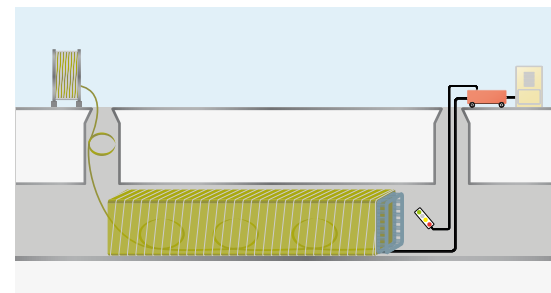
After the winding process is completed the bracing system is installed. The bracing material is lowered through standard manhole openings. In the next step the bracing system is set up to provide structural support during the grouting process and positions the SPR™ profile in the host pipe according to engineering specifications.

Grouting

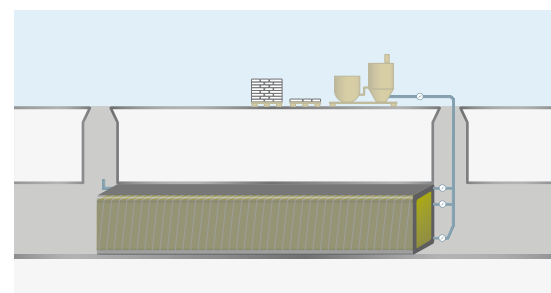
The grouting process is split into the injection of grouting material into annular space between host pipe and wound PVC profile and the curing of special high-strength grout. After completion the bracing system is dismantled and the rehabilitated pipe is ready for service.



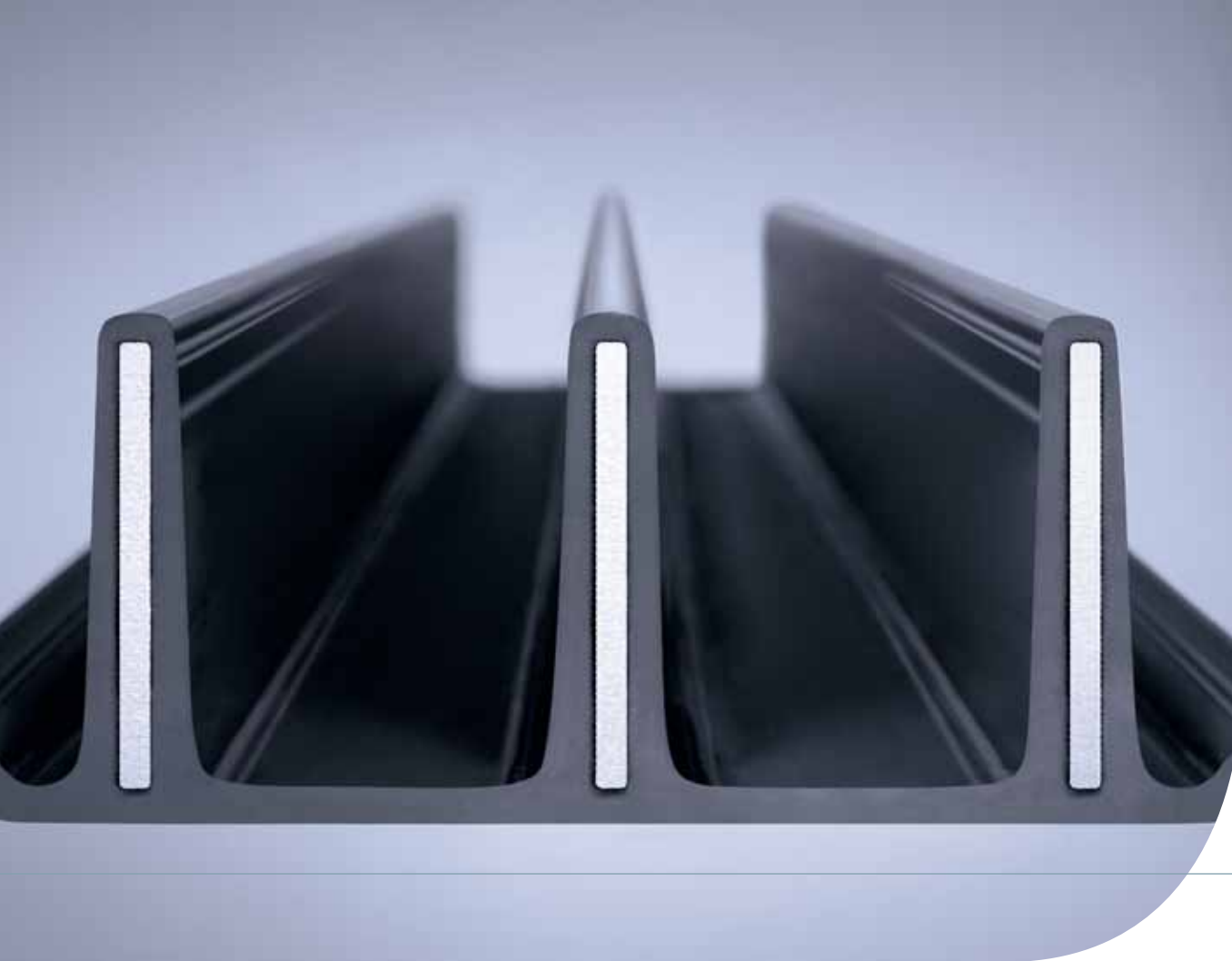
Feeding PVC profile



The SPR™ profile is fed into the winding machine, which forms the liner by joining the profile's double locking mechanism



SPR™ is installed through standard manholes. After winding the annular space is filled with high strength grout



SPR™ PE

STRUCTURAL, REINFORCED HDPE LINER FOR GRAVITY PIPELINES

The SPR™ PE pipe rehabilitation process is a solution for restoring the hydraulic efficiency, reliability and integrity of aging sewers, storm drains and culverts.

The fully encapsulated steel reinforcement is designed to provide a liner of optimum stiffness for the application.

SPR™ PE liners can structurally rehabilitate brick, concrete, glass reinforced plastic or corrugated metal sanitary sewer and stormwater pipelines with diameters from 900 mm to 3000 mm.

The plastic profile that forms the liner is provided in a range of sizes. The profile is reinforced with steel that is completely encapsulated within the HDPE material. The steel reinforcement is selected to provide a liner with sufficient stiffness to meet the design requirements of the project.

Project experience

SPR™ PE has been used to rehabilitate sewers, stormwater lines and culverts around the world. It has been proven capable of providing a structural liner for severely deteriorated pipelines, and has been installed under difficult site conditions with minimal community disruption.

Easy mechanical installation

The deteriorated pipeline is first cleared of debris and obstructions, cleaned and inspected, the diameter measured and then proved. The winding machine is lowered to the base of the access chamber through standard manhole openings. The reinforced HDPE profile is fed into the machine from an above ground spool.

The winding machine then winds the reinforced HDPE profile to form a new pipe. The process continues until the

liner wound by the SPR™ PE winding machine reaches the end of the pipeline length to be rehabilitated. The ends of the liner at both access chambers are sealed and rendered to make them smooth with the host pipe.

The annulus between the fixed diameter liner and the host pipe can be filled with cementitious grout immediately after the winding is completed.

The benefits of SPR™ PE at a glance

- Structural liner, strong and lightweight
- Manufactured from pipe grade high density polyethylene (HDPE) with embedded steel reinforcing
- Steel thickness can be varied to vary pipeline stiffness
- Diameters from 900 mm to 3000 mm using three profiles
- Suitable for gravity flow sanitary sewer and stormwater pipelines
- WRc Approved™ (PT/295/0110)

FULLY ENCAPSULATED STEEL

Flow advantages

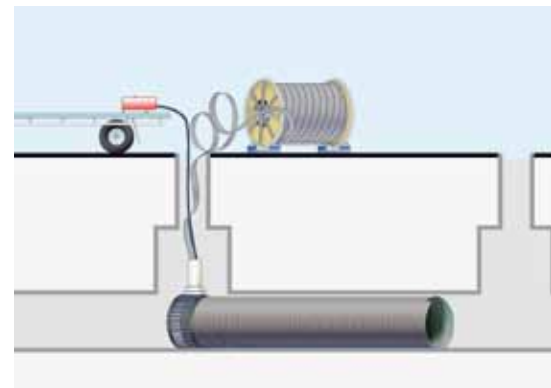
- Hydraulically efficient, smooth bore with circular cross section
- Usually greater hydraulic capacity than the host pipe
- No ripples or wrinkles even when host pipe joints are offset

A strong flexible liner

- Can be designed as a structural liner, a range of HDPE and steel combinations are available to meet design requirements
- Structurally efficient circular cross section – even when the host pipe is misaligned
- Constant wall thickness even when negotiating voids in the host pipe
- Factory manufactured and machine installed, liner installation does not depend on the standard of workmanship in difficult conditions

Fast installation with minimum community disruption

- Rapid set up, safe work sites and low noise during construction
- No need to excavate launch pits or store pipes on-site
- Small support vehicles – less disruption of traffic
- Can operate with some flow in the existing pipe, up to 25 % subject to velocity and safety considerations
- Installation possible from difficult to reach access chambers – support vehicles and equipment can be placed remotely

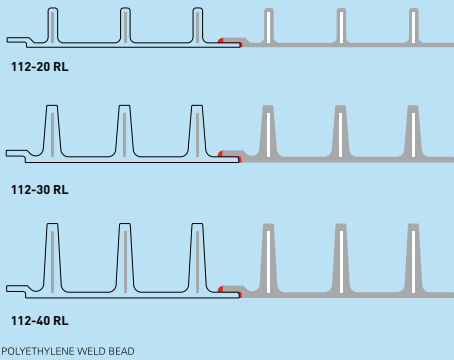


On-site setup for SPR™ PE installation



SPR™ PE liner being produced by the winding machine

HDPE Profiles and Sealant Materials



Cross-section of a typical profile, showing the weld that joins together successive wraps of steel reinforced HDPE profile.

Proven pipe material

- Made from similar grade of HDPE as new sewer and drainage pipe
- Cell Classification of 335420C (or E) in accordance with ASTM D 3350
- Profile sealing is achieved by extrusion welding to produce a continuous jointless HDPE liner
- Consistent material properties. The pipe strength does not rely upon the grout for its strength, only to transfer the load to the liner

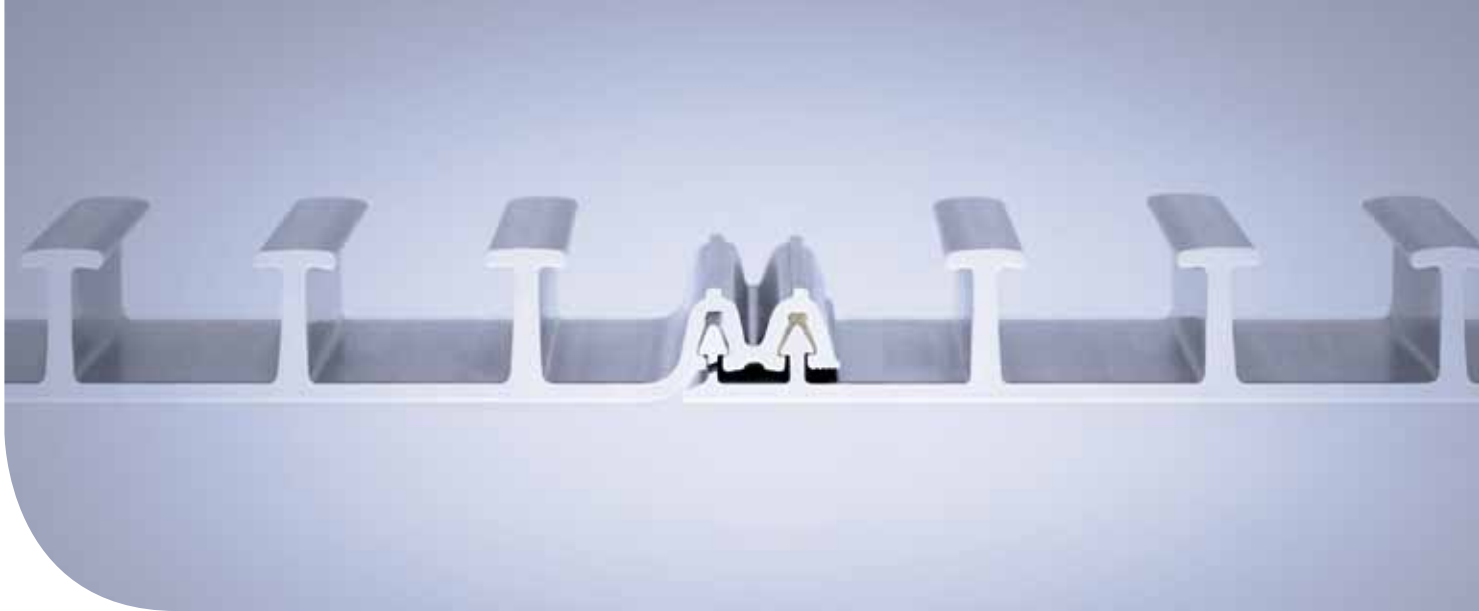
Design

Numerous industry specifications provide design methods applicable to SPR™ PE, including:

- ASTM F 1741: “Standard Practice for Installation of Machine Spiral Wound PVC Liner Pipe for Rehabilitation of Existing Sewers and Conduit” modified for SPR™ PE (HDPE) liner pipe
- Australian Water Authority Specifications, usually based on Australian Standard AS 2566.1: “Buried Flexible Pipelines, Part 1: Structural Design”

Section Properties of Typical SPR™ PE Profiles

PROFILE	NOMINAL HEIGHT	TYPICAL PIPE DIAMETER	
112 - 20RL	20	900 - 1100	mm
112 - 30RL	30	1100 - 1650	mm
112 - 40RL	40	1650 - 3000	mm



SPR™ EX

STRUCTURAL, LIGHT WEIGHT, CLOSE FIT LINER FOR GRAVITY PIPELINES

The SPR™ EX lining system is a unique process for restoring the efficiency, reliability and structural integrity of aging sewers, stormdrains and culverts.

SPR™ EX liners can structurally rehabilitate brick, concrete, glass reinforced plastic or corrugated metal sewer and stormwater pipelines with diameters from 150 mm to 750 mm.

The plastic profile that forms the liner is provided in a range of sizes and thicknesses. The appropriate profile is selected to provide a liner with sufficient stiffness to meet the design requirements for the project.

Project experience

SPR™ EX has been used to rehabilitate sewers, stormwater lines around the world. It has proven capable of providing a structural liner for severely deteriorated pipelines, and has been installed under difficult site conditions with minimal community disruption.

A smooth winding and expanding process

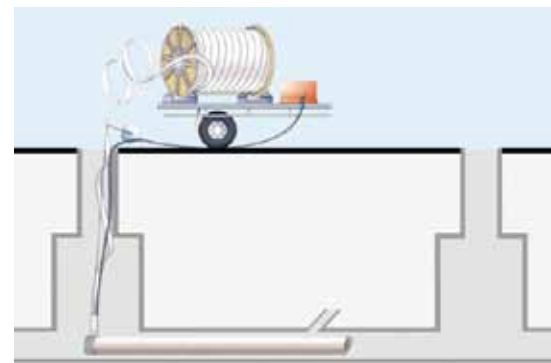
The pipeline is first cleared of debris and obstructions, cleaned and inspected. Locations of lateral connections or branch lines are logged. The SPR™ EX winding machine is lowered to the base of the access chamber through a standard opening. The PVC profile is fed

through into the machine from an above ground spool. The SPR™ EX profile is wound in at a diameter smaller than the host pipe. The liner is held together at the smaller diameter by the secondary lock.

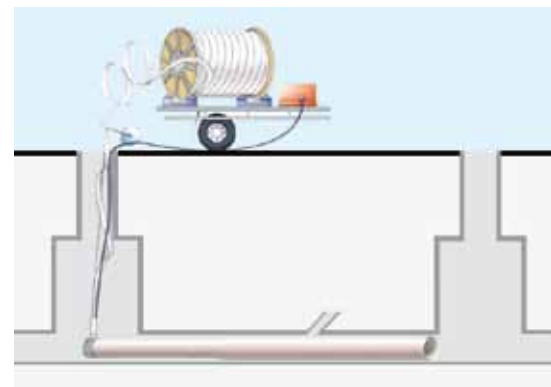
Winding is stopped when the wound pipe reaches the upstream access chamber. The end of SPR™ EX liner is then torsionally restrained. Expansion of the liner commences by pulling the cutting wire, severing the secondary lock.

As the wire is progressively removed, more profile is wound into the line. The lubricating sealant in the primary lock allows adjacent profile wraps to slide relative to each other. In response to the additional profile, the liner expands in diameter to fit tightly against the inside wall of the deteriorated pipe. The process continues until the liner has been expanded for the full length of the deteriorated pipeline between access chambers. Then the lining is complete.

The ends of the liner at both access chambers are sealed and rendered to make them smooth with the host pipe. Lateral connections can be immediately reinstated by robotic cutting. The connection between the main pipe and the lateral can then be sealed.



The wind in process



The expansion process



MINIMAL LOSS OF DIAMETER, IMPROVED FLOW

Flow advantages

- Installed to fit tightly against the existing pipe wall – minimum loss of cross sectional area
- Flow efficient, smooth bore with circular cross section
- Usually greater hydraulic capacity than the host pipe
- No ripples or wrinkles even when host pipe joints are offset
- Winds smoothly around large radius pipeline bends

A strong flexible liner

- Can be designed as a structural liner, a range of PVC profiles are available to meet design requirements
- Lines even the worst pipes – including those with missing inverts, obverts or other structural defects
- Structurally efficient circular cross section – even when the host pipe is misaligned

- Constant wall thickness even when negotiating voids in the host pipe
- No heating, stress cracking, shrinkage or stretching
- Machine installed, liner installation does not depend on the standard of workmanship in difficult conditions

Fast installation with minimum community disruption

- Rapid set up
- Uses existing access chambers, no need to excavate launch pits
- No on-site pipe storage required
- Small support vehicles – less disruption of traffic
- Safe work sites
- Can operate with some flow in the existing pipe
- Installation possible from difficult to reach access chambers – support vehicles and equipment



Quality control during the profile extrusion process

The benefits of SPR™ EX at a glance

- Structural liner, strong and lightweight
- Close fit with the host pipe
- Diameters from 150 mm to 750 mm using only five profile types
- Manufactured from pipe grade PVC
- Suitable for gravity flow sanitary sewer and stormwater pipelines
- WRc Approved™ (PT/305/0710)

Proven pipe material

- Made from similar grade of PVC as new sewer and drainage pipe
- Cell Classification of 13354 in accordance with ASTM D 1784
- Profile sealing materials are tested to confirm suitability in high ambient temperature sewer environments
- Consistent material properties – the pipe strength does not rely in curing in uncertain conditions

Design

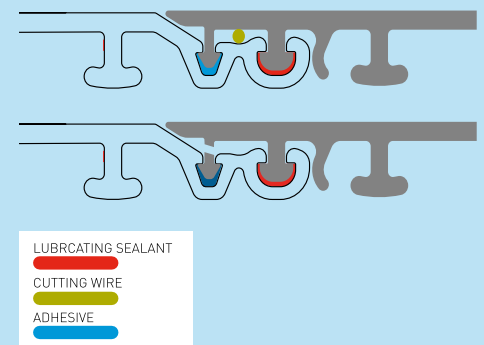
Numerous industry specifications provide design methods applicable to SPR™ EX, including:

- ASTM F 1741: “Standard Practice for Installation of Machine Spiral Wound PVC Liner Pipe for Rehabilitation of Existing Sewers and Conduit”
- Australian Water Authority Specifications, usually based on Australian Standard AS 2566.1: “Buried Flexible Pipelines, Part 1: Structural Design”

Section Properties of Typical SPR™ EX Profiles

PROFILE	NOMINAL HEIGHT	TYPICAL PIPE DIAMETER	
56-7EX	7	150 - 200	mm
85-7EX	7	200 - 300	mm
85-8EX	8	200 - 375	mm
126-13EX	13	375 - 600	mm
126-20EX	20	450 - 750	mm

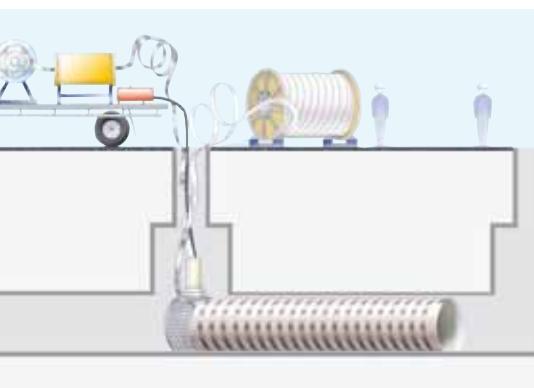
PVC Profiles and Sealant Materials



Cross-section of a typical profile, showing the mechanism that locks together successive wraps of profile



Quality assured profile extrusion



On-site setup for SPR™ ST installation

SPR™ ST

A STEEL REINFORCED AND FLEXIBLE LINER

The SPR™ ST pipe rehabilitation process is a solution for restoring the hydraulic efficiency, reliability and integrity of aging sewers, storm drains and culverts.

Where required for greater stiffness, the liner can be reinforced by simultaneously winding a profiled strip of steel under the tees of the PVC profile.

SPR™ ST liners can structurally rehabilitate brick, concrete, glass reinforced plastic or corrugated metal sanitary and storm water pipelines with diameters from 450 mm to over 2500 mm.

The plastic profile that forms the liner is provided in a range of sizes and thicknesses. The appropriate profile is selected to provide a liner with sufficient stiffness to meet the design requirements for the project. Profiles may be reinforced with steel for high loading applications, maximizing liner stiffness whilst minimizing loss of cross section.

Project experience

SPR™ ST has been used to rehabilitate sewers, stormwater lines and culverts around the world. It has proven capable of providing a structural liner for severely deteriorated pipelines, and has been installed under difficult site conditions with minimal community disruption.

SAFE WORK SITES AND LOW NOISE

The deteriorated pipeline is first cleared of debris and obstructions, cleaned and inspected, the diameter measured and then proved.

The SPR™ ST winding machine is lowered to the base of the access chamber through standard manhole openings. The PVC profile and steel is fed into the machine from an above ground spool. The winding machine then winds the PVC profile to form a liner. If required, a continuous strip of steel can be locked under the PVC profile tees by the winding machine.

The process continues until the liner wound by the SPR™ ST winding machine reaches the end of the pipeline length to be rehabilitated.

The ends of the liner at both access chambers are sealed and rendered to make them smooth with the host pipe.

The annulus between the fixed diameter liner and the host pipe can be filled with cementitious grout immediately after winding is completed.

The benefits of SPR™ ST at a glance

- High stiffness structural liner
- Fixed diameter
- Diameters from 450 mm to 2500 mm using two profile types
- Manufactured from pipe grade PVC with steel stiffening ribs
- Suitable for gravity flow sanitary sewer and stormwater applications
- Cell Classification of 13354 in accordance with ASTM D 1784
- WRc Approved™ (PT/304/0710)

HIGH STIFFNESS TO MEET THE STRICTEST REQUIREMENTS

Flow advantages

- Diameter can be varied with adjustable winding cages to maximise liner diameter
- Hydraulically efficient, smooth bore with circular cross section
- Usually greater hydraulic capacity than the host pipe
- No ripples or wrinkles even when host pipe joints are offset
- Winds smoothly around large radius pipeline bends

A strong flexible liner

- Can be designed as a structural liner. A range of PVC and steel combinations are available to meet design requirements
- Structurally efficient circular cross section - even when the host pipe is misaligned
- Constant wall thickness even when negotiating voids in the host pipe
- Machine installed. Liner installation does not depend on the standard of workmanship in difficult conditions

Fast installation with minimum community disruption

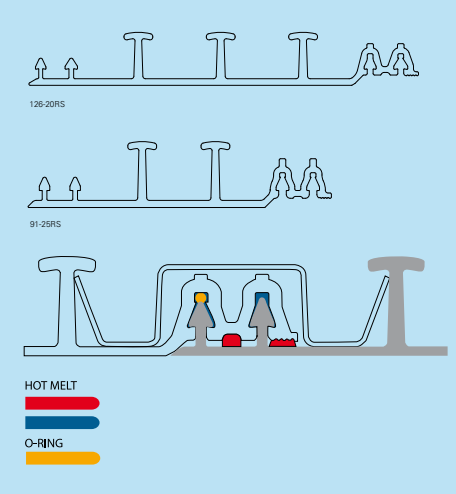
- Rapid set up, safe work sites and low noise during construction
- No need to excavate launch pits or store pipes on-site
- Oval cages in many cases conform to invert and minimise benching removal
- Small support vehicles - less disruption of traffic
- Can operate with some flow in the existing pipe, up to 25 % subject to velocity and safety considerations
- Installation possible from difficult to reach access chambers - support vehicles and equipment can be placed remotely

Design

Numerous industry specifications provide design methods applicable to SPR™ ST, including:

- ASTM F 1741
- Australian Water Authority Specifications

PVC Profiles and Sealant Materials



Cross-section of a typical profile, showing the mechanism that locks together successive wraps of profile, overlaid with steel reinforcement

Section Properties of Typical SPR™ ST Profiles

PROFILE	HEIGHT	TYPICAL PIPE DIAMETER	TYPICAL STEEL GAUGES	
126 - 20RS	20	450 - 1500	0.7, 0.9, 1.2	mm
91 - 25RS	25	900 - 2500	0.7, 0.9, 1.2, 1.5	mm

Everything from a single source.

SEKISUI SPR Group is synonymous with superior solutions for underground infrastructure worldwide. SEKISUI SPR offers outstanding and environmentally sustainable technologies and services for supply and drainage through its global sales network. Customers profit from the broad portfolio including trenchless rehabilitation, vacuum sewer systems and pipe inspection. With experts in the rehabilitation, construction and maintenance of underground infrastructure systems worldwide, SEKISUI SPR offers all services from a single source.



THE BEST ALL IN ONE THE BEST FOR YOU – WORLDWIDE

Modern urban life would be utterly impossible without underground infrastructure. However, it is becoming apparent that underground infrastructure systems worldwide are deteriorating substantially as a result of age and a steady increase in traffic loads. The also rising demands on sustainable and environmentally-friendly urban development pose a major challenge to local authorities. SEKISUI SPR offers the right solutions to meet those challenges. Trenchless technologies permit renewal by rehabilitating and improving the existing infrastructure without protracted construction works and without modification of the cityscape. It is also possible to expand and maintain existing infrastructure systems without excavation. Trenchless technologies guarantee a faster, more cost-effective and environmentally-friendly solution compared to replacement.

SEKISUI SPR employs some of the world's leading technical and operational infrastructure specialists, and is thus in a position to offer a solution for all requirements, from planning through to construction. In delivering those solutions, SEKISUI SPR operates in three divisions: Sales & Support, Trenchless Infrastructure Solutions and Construction. In concrete terms, this provides for a global interchange of experience between individual experts to devise the optimum infrastructure solution for the specific location.

SEKISUI SPR brings together the international underground infrastructure competencies of the SEKISUI Chemical Corporation (Osaka). It is already represented in over 40 countries on all continents.



 GLOBAL CONNECTION

 PROMINENT TECHNOLOGY

 ENVIRONMENTAL CONTRIBUTION

SALES & SUPPORT

Sales Asia

Sales Europe

Sales America

Sales Australia

TRENCHLESS INFRA-STRUCTURE SOLUTIONS

Trenchless rehabilitation

CIPP

- > NORDIPIPE™
- > TUBETEX™
- > UNILINER™
- > NORDIWALL™
- > PULL-INLINER

SPR

- > SPR™
- > SPR™ PE
- > SPR™ EX
- > SPR™ ST

Vacuum sewer system

- > SIVAC®

Pipe inspection

CONSTRUCTION

Rehabilitation of pipe networks

Pipe construction

Maintenance of drainage systems on waste disposals

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