



**DUBBO
REGIONAL
COUNCIL**

TECHNICAL SCHEDULE

DRC-W304

**REHABILITATION OF SEWER MAINS -
LINING**

TECHNICAL SCHEDULE DRC-W304 – REHABILITATION OF SEWER MAINS - LINING

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DRC-W304: REHABILITATION OF SEWER MAINS - LINING

DRC-W304.1 SCOPE

This Specification applies to the rehabilitation of gravity sewer mains by the insertion of a suitable internal lining system to re-establish the structural integrity of the sewer with minimal excavation.

Details of the individual gravity sewers to be rehabilitated by lining are listed separately in the Contract Specific Scope of Work document.

The work required to be performed under this Contract shall comply with the referenced documents in Clause DRC-W304.2, unless specified otherwise herein.

DRC-W304.2 REFERENCED DOCUMENTS

The following documents are referred to in this Specification. The latest version of the document including any published amendments, shall apply unless noted otherwise. Where the drawings or a project specific specification are in conflict or inconsistent with these referenced documents or this Specification, then the details on the drawings or project specific specification shall apply.

Australian Standards

AS 2566	Buried Flexible Pipelines
AS 2865	Confined Spaces
AS 3572	Plastics – Glass filament reinforced plastics (GRP) – Methods of test

Works shall also comply with the current versions of all other relevant Australian Standards where not specifically listed above.

Water Services Association of Australia Standards

WSA02	Sewerage Code of Australia
WSA05	Conduit Inspection and Reporting Code of Australia
N/A	WSAA Product Specifications

International Standards

ASTM D638	Standard Test Method for Tensile Properties of Plastics.
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced Plastics and Electrical Isolating Materials.
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
ASTM D2583	Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
BS2782	Methods of Testing Plastics.

DRC-W304.3 GENERAL REQUIREMENTS

The Contractor shall comply with the general requirements for sewer maintenance activities and accessing sewer maintenance holes as detailed in Technical Schedule DRC-W301.

DRC-W304.4 SAFETY

Refer to Technical Schedule DRC-W301 for details of safety requirements.

DRC-W304.5 CUSTOMER NOTIFICATION AND COMPLAINTS

The Contractor is responsible for notifying customers where entry to private property is required and also for handling and addressing any customer complaints. Refer to Technical Schedule DRC-W301 for details of customer notification and complaints requirements.

DRC-W304.6 PROVISION OF INFORMATION TO THE CONTRACTOR

The Principal will, where available, provide the Contractor with information regarding the sewers selected for rehabilitation, including:

- a) Location of the sewer (plan or map).
- b) Approximate length of the sewer.
- c) Sewer material type.
- d) Diameter of sewer.
- e) Depth to invert of upstream and downstream maintenance holes.
- f) Approximate number of property branches to be reinstated to new lined sewer.
- g) Summary of condition of the sewer as assessed from previous CCTV inspections carried out by the Principal.

Where the Principal has carried out previous CCTV inspections of the sewer to be rehabilitated and previous documentation is available, CCTV footage and reports may be made available to the Contractor as background information.

It should be noted that information regarding flow rates within the sewerage system are normally not available. The Contractor will need to make its own assessment of likely flows through the sewer.

DRC-W304.7 DESIGN AND SUPPLY OF LINER

The liner to be installed to rehabilitate the sewer shall be designed with the expectation that no bond shall exist between the liner and the existing sewer. All liners shall be fully structural and shall be designed on the assumption that the existing pipe has no structural capacity.

The liner shall be designed to:

- a) Withstand all loadings applied to the existing sewer.
- b) Minimise cross-sectional area loss for sewage flow.
- c) Have a certified minimum service life of 50 years.

All mains requiring lining under this Contract have been classified as deteriorated. As such, design of the lining shall ignore any contribution from the original pipe. The lining shall be designed as a flexible pipe and be capable of supporting all imposed loading. Each liner shall be designed to satisfy the critical performance criteria of:

- Vertical deflection
- Strength
- Buckling

The liner shall be comprised of materials which are resistant to chemical, biological and mechanical degradation by domestic and industrial sewage and corrosive soils and substances generally. The liner shall also prevent the intrusion of tree roots through the lining.

The lining material shall also be resistant to abrasion caused by the migration of silt, sand and debris along the pipe. It shall be sufficiently robust not to be damaged by pipe cleaning equipment which may be required to remove any future blockages in the pipe.

The liner thickness shall be calculated by the Contractor to suit the specific job and shall take account of ground water pressures, soil pressure and structural requirements. The lining system shall not reduce the internal diameter of the existing pipe by more than 10% in lines 500 mm and smaller, nor more than 5% in lines greater than 500 mm diameter. The lining material shall be such that the reduction in capacity owing to reduction in diameter shall be made up by improvements in the coefficient of friction.

The Contractor shall submit the following information:

- a) Full details of the liner material, including its physical and chemical properties and standards governing the manufacture of the liner material.
- b) Details on liner material durability, abrasion resistance and chemical resistance, including its suitability for resisting damage during future pipe cleaning operations.
- c) Full details of methods of liner manufacture, including governing standards.
- d) Full details on methods of liner installation including methods of flow control as required.
- e) Full details on methods of grouting of liner should grouting be required.
- f) List of any defects inherent in the proposed lining system. (Inherent defects are those that commonly occur with the lining system where it is not possible or commercially practical to eliminate because of the inherent nature of the system).
- g) Full details on methods of reinstatement of junctions and property connection branch sewers. The Contractor should also provide a procedure for cutting a new connection into the rehabilitated pipeline, and for sealing the gap between the host pipe and the liner at the point of connection, if required.
- h) The range of thicknesses available for the liner.
- i) Full details of liner finishing and effective sealing at maintenance holes.

DRC-W304.8 DESIGN LOADS

The loads used in the design of a liner shall be the most severe of any combination of earth pressure, ground water hydrostatic pressure, traffic loading and internal hydrostatic pressure.

Vertical earth pressure shall be calculated as follows:

- Where cover to a deteriorated pipeline is less than 3 m or less than 10 times its nominal diameter – weight of the full height of the prism of soil above the host pipe, without reduction for trench effects;
- Where cover to the deteriorated pipeline is greater than 3 m and greater than 10 times its nominal diameter – calculated in accordance with Clause C4.3 AS 2566.1:1998). Trench material shall be assumed to be soft clay;
- Where the host pipe is known (by as-constructed information) to have been constructed in a tunnel, the design vertical earth pressure shall be equivalent to no less than 2 m of soil above the host pipe (larger values may be required depending on the size of the host pipe and the geotechnical properties of the ground);
- The maximum depth of cover for each maintenance hole length shall be used to calculate the earth pressure for that length. The soil unit weight shall be taken as at least 20kN/m³. As this is usually the weight assumed for saturated clay, it shall be assumed to include groundwater for the purposes of calculating buckling loads.

Traffic surcharge loads shall be calculated in accordance with Clause 4.7 of AS 2566.1 for the following types of traffic loadings:

- Type A Main Road: Multiple adjacent lanes of Standard T44 or Standard W7 wheel loads;
- Type B Light Road: Single lane of Standard T44 or Standard W7 wheel loads; and
- Type C Field Load: 60% of light road loading.

For each liner, the type of traffic load used for liner design shall be explained in terms of assumptions and communication with the relevant authority. Full consideration of future traffic flows shall also be taken into account.

Hydrostatic loading shall be calculated assuming an internal pressure from sewage and external hydrostatic loading shall be calculated assuming a water table located at the ground surface, acting in isolation from, or in combination with, any other loads. Hydrostatic loading internally with sewer surcharged to maintenance hole cover level shall be calculated, acting in isolation from or in combination with any other loads.

Vertical Deflection

The liner shall be designed with a long term deflection limit of 6% calculated in accordance with Clause 5.2 of AS 2566.1:1998.

The total design load shall be the maximum produced by the combination of vertical earth pressure and traffic surcharge load. The effect of groundwater hydrostatic pressure and internal surcharge shall be ignored.

Liner long term Modulus of Elasticity used in calculating long term ring-bending stiffness of the pipe in equation 5.2(2) of AS 2566.1:1998 shall be as submitted by the Contractor in the Schedule of Technical Data.

The value of soil modulus (E') used in equation 5.2(2) of AS 2566.1 shall be taken as:

- 2.0 MPa for a sewer where voids outside the pipe are not grouted.
- 5.0 MPa for a sewer where voids outside the pipe are filled with grout.

A soil modulus of 2.0 MPa assumes that voids may be present outside the host pipe. This value shall be used for the vertical deflection calculations unless the Contractor proposes to fill all the possible voids. Where filling of the voids is to be incorporated as part of the liner installation, a maximum value of 5.0 MPa may be used for deflection calculations.

Design for Strength

The liner shall be designed with a long term flexural strain developed in the wall of the liner under the load or load combination not exceeding the permissible value appropriate for the liner material. This shall be detailed in the Schedule of Technical Data.

The long term flexural strain shall be calculated in accordance with Clause 5.3.1 of AS 2566.1:1998.

Design for Buckling Resistance

The total imposed buckling pressure shall be the maximum produced by the combination of vertical earth pressure, groundwater hydrostatic pressure and traffic surcharge load in accordance with Section 5.4. AS 2566.1:1998. A soil load of not less than 20kN/m³ shall be assumed. This load should be considered to include groundwater. The effect of internal surcharge shall be ignored.

The total imposed buckling pressure shall be less than the allowable buckling pressure calculated in accordance with equation 5.4(5) of AS 2566.1:1998. The factor of safety shall be 2.5.

Local Buckling

In addition to the requirements of Section 5 of AS 2566.1, the liner shall have a minimum ring bending stiffness in accordance with the local buckling requirements for an intact pipe. It shall be designed to support the external hydrostatic load imposed from a groundwater table located at the ground surface.

The design shall be based on the buckling strength of the liner taking into account the enhancement provided by the existing pipe.

DRC-W304.9 MANUFACTURE OF LINER

The Contractor shall manufacture the liner in accordance with the material, methods and equipment proposed by the Contractor in its Tender and accepted by the Principal.

The liner shall be designed and fabricated in a manner that, when installed, will neatly fit the internal circumference and length of the pipe being lined. Where lining technology requires, suitable allowance shall be provided for longitudinal and circumferential stretching of the lining during installation.

The Contractor shall be responsible for measuring the internal diameter of the existing pipeline at the manholes at both ends of the line prior to fabrication, to ensure that a proper fit is achieved.

The Contractor shall nominate the minimum standards of the liner's internal surface finishes observed or measured after the liner's installation, which the Contractor would consider as the minimum requirement in meeting the Colebrook-White coefficient of friction, that being not more than 1.0 mm. These nominated minimum standards may take the form of the maximum allowable number of visible wrinkles or ridges per linear metre of liner, etc.

In the event that the liner's internal surface finishes does not meet the minimum standards nominated by the Contractor, the liner shall be repaired and defects/irregularities removed by using methods approved by the Superintendent and to the satisfaction of the Superintendent. The cost of such liner repair work shall be borne by the Contractor.

DRC-W304.10 PREPARATION OF SEWERS FOR LINING

The Contractor shall clean the sewer line prior to insertion of the liner to ensure precise CCTV inspections and installation of the lining system. The cleaning method employed must not cause further damage to the line. Foreign matter, roots, silt, encrustation and similar must be removed from the line to the satisfaction of the Superintendent and the requirements of the lining method to be used.

Four cleaning passes are to be allowed for in the tendered rate and a CCTV camera is to be used to verify the effectiveness of the cleaning procedure. One cleaning pass constitutes cleaning a section upstream and downstream. The Contractor shall ensure that a high pressure water jet cleaning system is used as a minimum, to clean existing sewer lines.

Debris and other matter cleaned from the sewers and maintenance holes shall be removed appropriately and legally. The Contractor shall not leave debris and other matter onsite. All materials resulting from the cleaning operation shall be trapped in the downstream maintenance holes. The Contractor shall remove all trapped materials and dispose of them in a manner acceptable to the Environmental Protection Authority and other relevant local authorities. All costs associated with removal and disposal of the debris and other matter shall be borne totally by the Contractor.

CCTV inspection shall be carried out by the Contractor prior to installation of liners to establish that the pipe is clean and ready to receive the liner.

The Contractor shall confirm which property connection junctions are live prior to lining. Where necessary, the Contractor shall liaise with the Principal's system operators and/or undertake dye testing through the house service line.

DRC-W304.11 INSTALLATION OF LINER

Liner Installation

All work shall be carried out under the technical direction of a qualified and experienced person who has had suitable training and experience in the installation of the liner, nominated by the Contractor in its Tender and accepted by the Principal.

The Contractor shall have submitted with its Tender full details of the installation procedure and the Installation Quality Plan for the lining to the Superintendent for approval based on the proposal made in its Tender. These details shall be compatible with the liner design. The Contractor shall provide all the equipment for the safety of its workforce and for installing the lining and shall install the lining in accordance with the procedures approved by the Superintendent.

Where applicable the Contractor shall:

- Install the liner in a continuous operation.
- Ensure that the liners are not over stressed and that the inner and outer surface layer is not damaged.
- Transport the liners and position them inside the sewer conduit to ensure that damage to the inner and outer surface layer is prevented.
- Support the liners against the sewer wall to prevent flotation and movement during grouting (required) and to achieve accurate alignment.
- Joint liners utilising a suitable jointing system.
- Support the liners to ensure that installed liners are not distorted or displaced during periods of sewage flow through the sewer.
- Construct liner transitions at manholes using epoxy grout or other material approved by the Superintendent.

For soft linings and reverted slip linings, the liners shall be transported to the site under controlled environment conditions. The Contractor shall decide when to transport the liners to the site and when to commence liner insertion with regard to the weather conditions.

Where polyethylene liners are used, all welds shall be de-beaded on the internal surface of the pipe. An approved hydrophilic rubber ring shall be used where polyethylene enters the wall of a maintenance hole to ensure no infiltration occurs at this location. Following installation of the hydrophilic rubber ring, the annulus between the PE pipe and maintenance hole shall be grouted.

Launch and Reception Points

Where possible, existing maintenance holes shall be utilised as launch and reception points. New maintenance holes required to complete the lining shall be approved by the Superintendent and may be constructed by the Principal or its agent at its discretion. Any new maintenance holes shall be constructed cast in-situ and in accordance with the WSAA Sewerage Code of Australia (WSA02).

Where necessary, the maintenance hole channel benching and walls shall be altered to receive the lining. Details of proposed alterations shall be submitted to the Superintendent for approval. No alterations shall be carried out until the proposals have been approved by the Superintendent. All maintenance hole alterations shall be made good following the completion of the lining. Photographic evidence of reinstatement work within maintenance holes may be requested by the Superintendent before payment is made.

The Contractor shall reinstate all maintenance holes, to WSAA standards, such that installed liners do not form irregularities around the edges of the liners at the maintenance holes. After installation of liners, the Contractor shall provide a channel in the maintenance hole, free from any irregularities or differences in level, which may cause accumulation of solids (ie debris, silt, rags, etc) in the sewer or maintenance hole channel.

Where liners have been installed to one side of the maintenance hole, the maintenance hole channel shall be rendered to form a smooth slope to the liner to prevent accumulation near the liner edge.

The Contractor shall seal the ends of the lining once they have been trimmed to match the face of the maintenance hole. The materials used and the method of sealing shall be determined by the Contractor. The minimum requirements of the seal are as follows:

- Compatibility with the composition of lining and maintenance hole;
- Provide a permanent watertight seal against infiltration and exfiltration.

If requested by the Superintendent, the Contractor shall provide information such as chemical resistance data, accelerated aging tests, bond tests, full-scale trials or hydrostatic testing to demonstrate the suitability of the sealing system.

The Contractor shall replace any internal drops within maintenance holes that are damaged due to the rehabilitation works. The cost of these replacements shall be deemed to be included in the Contractor's tendered rate.

In the event that the Contractor identifies broken or damaged internal drops within maintenance holes prior to lining works, the Contractor shall notify the Superintendent and provide an opportunity for the damaged drop to be inspected. The Superintendent shall then determine the required remedial works and advise the Contractor accordingly.

Lining Through Maintenance Holes

Where upstream and/or downstream sewers from a maintenance hole are to be lined, the maintenance hole chase (or channel) may also be lined.

The Contractor shall adjust maintenance hole benching and bases to accommodate linings to ensure a continuous invert without steps between the lining and the upstream or downstream sewers.

Where the liner has been extended into the maintenance hole chase, the liner in the chase shall be neatly cut over the pipe entry and exit and 10 mm above springing level.

Standard of Finish

The liner shall have a surface finish free of all defects such as foreign inclusions, dry spots, air bubbles, pinholes, pimples and delamination which may cause obstruction to flow or adversely affect the hydraulic capacity of the sewer. The liner shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe. The liner is to be sealed so as to prevent infiltration into the annular space between the host pipe and the liner. This may involve grouting at each end of the liner and at locations where junctions have been reinstated.

Facilities including CCTV cameras and access shall be made available at all time by the Contractor to the Superintendent to enable inspections of the liner to be made. Where the Superintendent determines that any defects shall adversely affect the integrity, structural strength of the liner, or hydraulic capacity of the lined sewer, then such defects shall be repaired or the liner replaced at the Contractor's expense.

Grouting

The Contractor shall submit full details of any proposed grouting to the Superintendent for approval. This shall include technical data on characteristics and performance of the grouting materials to be used, the construction methodology, and the spacing of injection points.

Where voids are detected in, or around, the host pipe and grouting has been either recommended during assessment or directed by the Superintendent, the Contractor shall grout the voids to the satisfaction of the Superintendent.

Where grouting of the liner is necessary to meet liner design requirements or as directed by the Superintendent, the Contractor shall grout the annulus between the liner and the host pipe to the satisfaction of the Superintendent.

DRC-W304.12 PROPERTY CONNECTION BRANCHES

Only live property connection branch sewers are to be reconnected to the lined sewer. It is the Contractor's responsibility to test and confirm before connection which branches are live in addition to any specified on the drawings. The Principal will provide any available information to assist in this investigation.

If remote controlled internal cutting equipment is to be used the cutting equipment shall be suitable for the work. The cutting tool shall be so designed as to be compatible with the liner material and shall leave a clear smooth and bevel edge free of protrusions which may inhibit sewage flow or catch solid material. The cut edge shall conform exactly to the inner surface of the existing sewer pipe and there shall be no discontinuity between the liner material and the cut hole and the lateral sewer line.

Connection shall not be made at, or within 100 mm of a circumferential liner joint.

The Contractor shall guarantee each and every hole cut by its equipment will not inhibit flow into the Principal's sewer from the property connection branch, or cause any obstructions or blockage at the junction. This guarantee shall extend for a period of five years after the cut out at the connection. Any costs incurred by the Principal for clearing a blockage caused by a defective cut-out may be passed on to the Contractor.

DRC-W304.13 PROPERTY CONNECTION BRANCH SEALING (WHERE SPECIFIED)

When specified by the Principal the connection between the cut line and the property branch shall be restored to seal off any infiltration sources that may cause entry into the sewer at the junction and to form a continuous and smooth connection between the liner and the main or branch line.

The sealing of lateral connections must be achieved by installing a short-form cured-in-place property branch connection seal. For reticulation sewers up to and including DN300 mm, the property branch connection seal shall be a "T" configuration. "Top Hat" property branch connection seals will only be accepted for main sewers DN375 mm and greater. The property branch connection seal shall extend a minimum of 150 mm beyond the first joint on the property connection sewer from the main. It must have sufficient overlap (50 mm minimum) with the sewer main to ensure a sealed bond between the short form liner and the sewer liner is achieved.

Short form liners shall be constructed of a suitable felt impregnated with silicate or epoxy resin only. Polyester and vinylester resins shall not be permitted. The Contractor is required to provide full details, including Material Safety Data Sheet, for the proposed resin.

The felt, when installed, must have the inside face sealed with an impermeable membrane. The felt must be capable of being fully impregnated with resin, which must be retained within the felt layers under installation pressures and temperatures.

The short form liner must be installed using a packer capable of forcing excess resin into the gap between the sewer liner and the host pipe at the connection.

An approved root inhibitor shall also be mixed with the grout used for property branch reconnections.

DRC-W304.14 CONTROL OF SEWAGE FLOWS

It is the full responsibility of the Contractor to control sewage flows as necessary to enable the Work Under Contract to be successfully carried out. No spilling of sewage in any situation is acceptable and the Contractor will be held fully responsible and accountable. The Contractor shall be responsible for the full cost of clean-up and associated activities that may be required to rectify the effects of any spillage as well as any fines by EPA or other authorities.

No work is to be undertaken during conditions where the reticulation sewer is flowing under surcharge conditions.

If required, sewers may be plugged by the Contractor to prevent flow of sewage into the subject length of sewer. The Contractor must monitor the lines that have been plugged to ensure surcharging does not occur. The Contractor shall remove the plugs at the earliest possible time after the lines have been cleaned and ensure that all material has been removed from the downstream manhole.

The Contractor shall install a diversionary system if required after prior approval of the Superintendent. It must be designed with sufficient capacity and security to ensure surcharge does not occur. Bypass pumping and diversion of sewer flows shall be undertaken in accordance with Technical Schedule SW-308.

All costs associated with plugging and diversion systems are to be fully borne by the Contractor.

If the Contractor requires the Principal to shut down upstream pumping stations then a written request must be received by the Superintendent at least 24 hours prior to the intended commencement of the work.

DRC-W304.15 POST-LINING CCTV INSPECTION

A post-renewal CCTV inspection shall be completed on all renewed sewers. CCTV inspection shall be carried out in accordance with Technical Schedule SW-303 and the WSAA Conduit Inspection Reporting Code of Australia WSA05-2008.

The post renewal CCTV inspection shall show that no obvious defects are present and that all live property connection sewers have been opened fully.

In the event that the lining is unacceptable, the Contractor shall remove the defective parts of the lining by approved method and shall reline the sewer with a lining of the same thickness as the failed lining.

The Contractor shall submit to the Superintendent for approval a complete method statement of these or any other processes proposed to be used. All such remedial works of renovation, repair or replacement, control of by-pass pumping and all other related costs shall be borne fully by the Contractor.

DRC-W304.16 TESTING

At the Superintendent's discretion, the Contractor may be required to carry out inspections and testing of any rehabilitated sewer. The Contractor shall provide all labour, materials and equipment required for the testing, inspection and monitoring, including pressure gauges and thermostats certified by an approved authority, and shall prepare and supply all necessary test pieces.

Sample test pieces shall either be cut from the excess sections of the fully installed liner as part of the works for this Contract, or from a liner installed and cured in similar conditions to those installed for the Contract. The samples shall be referenced and either tested as set out below, or stored until the end of the Defect Liability Period.

The Contractor shall give the Superintendent at least three working days' notice of the date, time and place of the performance tests and provide all facilities required to satisfactorily complete the tests.

A NATA registered laboratory shall carry out all tests other than the exfiltration and infiltration tests, unless otherwise approved by the Superintendent.

Alternative overseas or Australian Standards to those listed may be considered acceptable by the Superintendent for testing purposes provided that the test method specified will provide an accurate measure of the required physical property or aspect of the installation quality.

Tests on "Cured-In-Place-Pipe" Type Liners (CIPP)

The following tests shall be carried out by the Contractor on samples extracted from the fully installed and cured CIPP liners:

- Hardness Test in accordance with ASTM D2583;
- Short Term Tensile Strength Test in accordance with ASTM D638 or BS2782: Method 1003;
- Short Term Flexural Strength and Flexural Modulus Tests in accordance with ASTM D790 or BS2782: Method 335A; or
- Short Term Ring Stiffness Test in accordance with AS 3572.10.

Samples for these tests may be taken from excess sections extracted from near the maintenance holes of the fully installed liners.

Tests on Fold and Form Type Linings

The Contractor on samples extracted from the fully installed and cured fold and form liners shall carry out the following tests:

- Short Term Tensile Strength Test in accordance with ASTM D638;
- Short Term Flexural Stiffness Test in accordance with ASTM D2412; or
- Short Term Ring Stiffness Test in accordance with AS 3572.10.

Samples for these tests may be taken from excess sections extracted from near the maintenance holes of the fully installed and cured fold and form liners.

Tests on Wound or Strip Linings

The following tests shall be carried out by the Contractor on the samples extracted from the fully installed wound or strip liners:

- Impact test in accordance with test method specified by the Superintendent with the impact weight contacting with the joint between strips; and
- If applicable and as directed by the Superintendent, grout cube and slump tests as for slip linings.

Samples for these tests may be produced by extending the liner into the maintenance hole at the opposite end to the winding machine.

Air Pressure and Vacuum Testing

Where directed by the Superintendent, the Contractor shall carry out air pressure or vacuum testing of sewer liners prior to cutting out of property branch sewer connections. Testing shall be carried out in accordance with Clause 22.4 of WSA 02-2002 and shall be witnessed by the Superintendent or Clerk of Works. The cost of air pressure or vacuum testing shall be deemed to be included in the Schedules Rates based on up to 5% of relined sewers to be tested in this manner.

DRC-W304.17 MONITORING OF LONGITUDINAL SHORTENING

Unless otherwise directed by the Superintendent, monitoring of the liners longitudinal shortening shall be carried out and the results reported to the Superintendent for each lining length installed.

Monitoring shall comprise the measurement of the longitudinal movement at both ends of the installed liner. Linings shall initially be cut off at their ends with 100 mm of the additional length protruding into the access chamber. Longitudinal movement shall be measured against fixed marks and shall be placed on the access chamber wall at:

- The completion of cut outs or 24 hours for linings without cut outs; 14 days ; and the end of the Defects Liability Period or other date as nominated by the Superintendent.
- Interim results of monitoring shall be forwarded to the Superintendent within 14 days after the date of readings. Following the acknowledgment by the Superintendent of the acceptance of the longitudinal monitoring results, the Contractor shall cut the liner to its final length and if necessary, resealed the liner at the access chamber walls.

DRC-W304.18 REPORTING

Upon completion, the Contractor is to submit a written report to the Superintendent for each sewer and sewer property branch treated. The reports are to include the following details:

- Location.
- Date of lining.
- Length of lined sewer (from centre of MH).
- Number of property branch connections cut out.
- Number of property branch connection seals.
- Date of property branch connection seals installed.
- Details (including photographs) of any damaged drop pipes repaired.

The Contractor shall submit a CCTV inspection video and report in Wincan 8 format as detailed in Technical Schedule DRC-W303.

DRC-W304.19 MEASUREMENT AND PAYMENT

The rates tendered in the Schedule of Rates shall be deemed to be inclusive of all responsibilities and obligations of the Contractor under the Contract including accommodation, travel, site establishment, waste disposal, and reporting.

Measurement for payment shall be based on the sewer length in metres measured from the centre of maintenance hole to centre of maintenance hole.

DRC-W304.20 PRACTICAL COMPLETION

Practical Completion for the Contract will not be granted until all of the following requirements are achieved:

- The Superintendent is satisfied that the work complies with the requirements of the Contract in all respects (subject to such minor omissions as may be accepted by the Superintendent) and that the Contractor has carried out all of its obligations under the Contract except as regards to their obligations during the Defects Liability Period.
- Reporting in accordance with clause DRC-W304.18 including CCTV inspection.