

**Construction Specification for the
Cured-In-Place Pipe Spot Repairs in Sewers**

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TS 466.01 SCOPE

This specification is for the Cured-in-Place Pipe Spot Repair (CIPPSR) for sewers. A CIPPSR is a short length of CIPP installed at a location within a maintenance hole to maintenance hole section of sewer in the city of Toronto. The sewers may include sanitary sewers, storm sewers and combined sewers. The purpose of the CIPPSR is to address a localized problem within the maintenance hole to maintenance hole section.

The Work shall include performing the following operations: notification of public, CCTV inspections, determining sewer and CIPPSR dimensions, determining/confirming design parameters for CIPPSRs, flow control and bypass pumping, cleaning and preparation of the sewers for CIPPSR installation, installation and curing of the CIPPSR, reinstatement of sewer service connections, return of the sewer with CIPPSRs to regular service plus any other work required for and incidental to the foregoing.

The work involved for CIPPSR installation requires special equipment to be handled by persons experienced in all phases of the Work.

TS 466.02 REFERENCES

This specification refers to the following standards, specifications or publications:

City of Toronto Standard Specifications

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|---------|--|
| TS 4.01 | Construction Specification for Sewer Bypass Flow Pumping for Local Sewers |
| TS 4.02 | Construction Specification for Sewer Bypass Flow Pumping for Trunk Sewers |
| TS 409 | Construction Specification for Closed-Circuit Television Inspection of Pipelines |

American Society for Testing and Materials

- | | |
|----------------|--|
| D790 | Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| D5813-04(2008) | Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems |
| F1216-07a | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube |
| F1216-09 | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube |
| F1743-08 | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP) |
| F2019-03(2009) | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP) |

TS 466.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Engineer means the licensed individual or firm responsible for the design of the works or their designate and registered with the Professional Engineers of Ontario.

NASSCO means the standards developed by the National Association of Sewer Service Companies for sewer inspections.

PACP means Pipeline Assessment and Certification Program

Void means a volume of space starting at the outside wall surface of the existing sewer where there is an absence of soil or ground material. Depending on the size and geometry the void may represent a structural weakness in the pipe or soil system that may continue after lining of the sewer. A void will often be evidenced by missing sewer pipe wall that has allowed the ground material to escape in the sewer, exacerbated by ground water infiltration. Where a void is deemed to create a significant structural weakness in the lined pipe, the void requires filling to re-establish the soil and ground support around the sewer.

TS 466.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 466.04.01 Site Investigation

Before commencing any construction work at a site, the Contractor shall investigate each site to determine the existing site conditions and identify any obstructions (ladders, platforms, etc.) or any other problem that may affect the completion of the proposed works. No additional payment shall be made on account of difficulties to complete the works because the Contractor failed to investigate the site prior to commencement of the work.

TS 466.04.02 Existing Video Inspection Records and Drawings

The Contract Administrator shall provide the Contractor with a list of sewer locations for CIPPSRs the City's available CCTV inspections, inspection reports and GIS data (for trunk sewers only) that identifies the location of sewer sections. This information will be provided either in full at the start of the Contract or alternately on an incremental monthly basis during the Contract. The method of provision either in full or incrementally will depend on the structure of the contract as specified in the Contract Documents.

The Contractor shall review the inspection information and drawings prior to undertaking any work in the sewer sections.

The Contractor shall review the available CCTV inspection data and shall be responsible for determining the actual amount of sediment and debris in the sewer to be removed and the site specific repairs included in this work.

TS 466.04.03 CIPP Spot Repair Requirements

The CIPPSR shall be a one-piece CIPP construction. The installed CIPPSR shall be a complete cylindrical construction that when cured-in-place within the sewer, fits tightly to and conforms to the complete inside surface of the sewer over the length of the CIPPSR. The finished CIPPSR inside the sewer shall be constrained in place so that it shall not move within the pipe during normal sewer operations including cleaning, maintenance and inspection operations. The CIPPSR liner shall be leak tight to infiltration. There shall be no leakage of ground water through the CIPPSR wall or at end terminations.

The CIPPSR surface on the interior of the sewer shall be corrosion resistant with smooth flow characteristics and abrasion resistance. All materials of the CIPPSR shall be fully resistant to degradation in the municipal sewage environment including complete or partial submergence in municipal sewage. The CIPPSR shall be according to the following standards:

- ASTM F1216-09;
- ASTM F1216-07a Appendix X1 for liner design;
- ASTM F1743; and
- ASTM F2019.

The quantity of resin used in the CIPPSRs and its impregnation shall meet with the requirements of the applicable ASTM standard.

All CIPPSR materials shall have a substantial history of successful use as CIPP materials in municipal sewer application in the province of Ontario. Material properties shall meet the requirements of referenced standards or the properties used in the CIPPSR designs, whichever are greater.

The CIPPSR may be of non-reinforced or reinforced construction. All materials such as carrier fabric, coatings, reinforcement and resin in their final cured-in-place form shall not degrade or deteriorate in the presence of municipal sewage.

The CIPPSR shall have testing from an accredited testing agency to support the short-term and long-term properties that are used in the design of the CIPPSR.

The CIPPSR system shall be capable of carrying effluent within the limits of the Toronto Municipal Code, Chapter 681 Sewers without adverse effect on the CIPPSR or the effluent.

Where, in the course of work, the Contractor has reason to use materials that differ from the original proposed materials, either in general or for a specific installation, proposed alternate materials shall meet the above standards and require the approval of the Contract Administrator prior to use.

Minimum Physical Properties

The CIPPSR shall have the following minimum properties that are achieved in the cured-in-place construction within the sewer.

Physical property	Minimum value	Test method
Modulus of Elasticity in Flexure (Flexural Modulus)	2413 MPa	ASTM D790
Strength in Flexure (Flexural Strength)	34.5 MPa	ASTM D790

TS 466.04.04 Size and Length Requirements

The size and length requirements are shown in the table below.

Nominal sewer diameter mm	Minimum length m	Maximum length m
200	1.0	6.0
225	1.0	6.0
250	1.0	6.0
300	1.0	6.0
375	1.0	6.0
450	1.0	4.5
525	1.0	3.0
600	1.0	3.0
675	1.0	3.0
750	1.5	3.0
825	1.5	3.0
900	1.5	3.0

Longitudinal Seams and Joints

Any longitudinal—lengthwise—seams or joints in the finished in-place CIPPSR shall be made integral with the curing process. There shall be no lengthwise seams or joints in a CIPPSR that are the result of CIPPSR material being cured beside, over or abutting other already cured-in-place CIPPSR material.

Circumferential Seams and Joints

For CIPPSRs up to 2.0 m in length, there shall be no circumferential seams or joints that are not made as an integral part of the one piece curing process. For lengths over 2.0 m, separately cured-in-place CIPPSRs may be overlapped to provide the required length, providing that:

- 1) The overlapped circumferential joint is water tight to twice external water pressure design head.
- 2) The in-place thickness of the CIPPSR within the overlap zone does not exceed the following maximum thickness.

Nominal sewer diameter mm	Maximum CIPPSR thickness in overlap zone mm
200	6.9
225	6.9
250	6.9
300	9.2
375	11.5
450	11.5
525	13.8
600	16.1
675	18.4
750	20.7
825	23.0
900	23.0

Should a proposed CIPPSR overlapped installation result in an in-place thickness greater than listed in the above table, the overlapped installation shall not be permitted. In this case, the Contractor must either

- a) install a CIPPSR that has no overlap, that is to say, all cured as one piece over the length required; or
- b) shall use a CIPPSR with higher unit properties of flexural modulus and flexural strength such that the thickness required is reduced so that the maximum CIPPSR thickness in the overlap zone is not exceeded.

TS 466.04.05 Sizing

The Contractor is responsible to verify the actual the internal diameter of each sewer where a CIPPSR is required. Sizes provided in Contract Documents and construction drawings are nominal sizes and size errors may exist. It is the Contractor's responsibility to correctly size the CIPPSR and its materials for the installation location. A record of the internal diameter measurements shall be available to the Contract Administrator for review.

TS 466.04.06 Design Requirements

The Contractor shall design the CIPPSR for its installation location according to ASTM F1216-07a Appendix X1 and design parameters in Table 1. The CIPPSR design shall determine the minimum cured-in-place wall thickness required in the installation.

The Contract Administrator reserves the right to reject any design, if in the Contract Administrator's opinion, it is not according to the requirements. In this case, the Contractor shall submit a new design to the Contract Administrator.

Engineered designs for each CIPPSR shall bear the seal and signature of an Engineer. Alternately, and on the approval of the Contract Administrator, instead of an approved design for each CIPPSR installation, a single design bearing the seal and signature of an Engineer may be provided that covers a range of CIPPSR installations.

Designs shall be submitted to the Contract Administrator for approval. No CIPPSR shall be installed without an approved design.

Table 1: Design parameters for CIPPSR liners

Parameter	Requirement
Design Method	ASTM F1216-07a, Appendix X1, Design Considerations X1.2 Gravity Pipe. X1.2.2 Fully Deteriorated Gravity Pipe Condition Later versions of F1216 shall not be used for design
Design Life	50 years
Sewer Condition	Fully deteriorated
Safety Factor	2.0 for all equations
Ovality	3% or the actual ovality of the sewer section, whichever is greater.
External Hydrostatic Pressure	Corresponding to ground water table at 1.5 m below ground surface.
External Earth Load	Based on 2.5 m over top of pipe or the actual height of cover that exists at the CIPPSR location, whichever is greater. If the ground cover height varies by more than 0.5 m from one end to other, use the highest ground cover for that maintenance hole to maintenance hole section (more conservative depth).
Live Load	AASHTO HS-20 or the actual live load that exists at the CIPPSR location, whichever is greater. (Use E-80 live load for railway crossing)
Soil Weight	18.85 KN/m ³ (1922 Kg/m ³)
Soil Modulus	6.89 MPa
CIPPSR Liner Flexural Modulus used for design	The flexural modulus used for design shall be the long-term flexural modulus for the design life. The long-term flexural modulus shall be the amount of short-term flexural modulus (according to ASTM D790) retained for the design life. The short-term flexural modulus used shall be the value that will be reliably and repeatedly achieved in CIPPSR installations. The retention factor shall be derived from long-term testing and be appropriate for stress and stress duration in the installed liner. Independent third party test data is required to substantiate the short-term and long-term values used in design. The design must identify the short-term and long-term values. Minimum Value should be as per below. For pipes with diameter less than and equal to 900 mm Flexural modulus (ASTM D790) – 250,000 psi (1,723 MPa) For pipes with diameter greater than 900 mm Flexural modulus (ASTM D790) – 400,000 psi (2,757 MPa)

Table 1: Design parameters for CIPPSR liners (continued)

Parameter	Requirement
CIPPSR Liner Flexural Strength used for design	The flexural strength used for design shall be the long-term flexural strength for the design life. The long-term flexural strength shall be the amount of short-term flexural strength (according to ASTM D790) adjusted downwards by a retention factor for the design life. The short-term flexural strength used shall be the value that will be reliably and repeatedly achieved in CIPPSR installations. The retention factor shall be derived from long-term testing and be appropriate for stress and stress duration in the installed CIPPSR. Independent third party test data is required (submit with Bid) to substantiate the short-term and long-term values used in design. The design must identify the short-term and long-term values. The minimum short-term value shall be 4,500 psi (31 MPa)

Designs to be Correct for Field Conditions

The Contractor shall check and determine that actual field conditions for each CIPPSR installation correspond with the design for that installation. The field conditions to be checked shall include deepest depth to invert, ovality of the existing sewer and live load situation. Where the existing CIPPSR design is not appropriate for the field conditions, the Contractor shall adjust the design accordingly and the CIPPSR installed shall meet the requirements of the adjusted design. The adjusted CIPPSR design shall be submitted to the Contract Administrator for approval.

Where a CIPPSR design is found to require adjustment due to determined actual field conditions, the Contractor shall advise the Contract Administrator within 48 hours and wait for the Contract Administrator's instructions. Where the adjusted design results in a thicker CIPPSR to be installed, any additional cost involved shall be according to the Contract Price where applicable and if Contract Prices are not applicable, then they shall be negotiated with the Contract Administrator.

No CIPPSR shall be installed that does not meet the requirements for actual field conditions, including required CIPPSR thickness for actual field conditions.

TS 466.04.07 Thickness, Fit, Finish and Physical Properties

Thickness

The CIPPSR's finished in-place wall thickness shall be no less than the required thickness from the design for the CIPPSR. The determination of whether wall thickness is in keeping with the requirements shall be based on measurement method and analysis provided in ASTM D5813. Where and when samples are taken, thickness measured on the samples shall be an indication of installed thickness of CIPPSRs of the same size and thickness as the sample.

CIPPSR Fit to Existing Sewer

The outside surface of the finished CIPPSR shall be in contact with the inside surface of the existing sewer CIPPSR subject to the contact tolerance. The inside surface of the existing sewer is defined as the surface after the sewer has been prepared for lining according to the cleaning and preparation requirements. The contact tolerance is 1.0 mm. Where any space of gap between the outside surface of the CIPPSR and the inside surface of the existing sewer line exceeds 1.0 mm, the CIPPSR fit will be deficient, subject to exceptions noted below.

Exception to CIPPSR Fit at Existing Sewer Irregularities

Existing sewer irregularities include off set joints, protrusions, bumps or other similar situations in the existing sewer that remain after the sewer has been prepared according to the preparation requirements. Neither ovalisation of the existing sewer nor curves made by joint deflection are irregularities in this context. Where an irregularity exists, exception to the CIPPSR contact tolerance requirements will be allowed in the irregularity zone. The irregularity zone is defined as a zone extending a distance of up to one-quarter of the CIPPSR inside diameter in any direction from the irregularity as measured along the inside surface of the CIPPSR.

A CIPPSR fit exception at an existing sewer irregularity shall not present an obstruction to sewage flow whether or not it complies with the allowed exception.

CIPPSR Shape

The CIPPSR shape will be as defined by CIPPSR fit to existing sewer. The in-place CIPPSR shape shall conform to the shape of the existing sewer inside surface after its cleaning and preparation. However, where the existing sewer shape is not defined—missing pieces of sewer line—the CIPPSR may either bridge the missing wall section or indent into the missing wall section. Where the CIPPSR bridges, the shape of the CIPPSR shall match the shape of adjacent sewer and the inside diameter of the CIPPSR shall be as required for contact tolerance for the adjacent sewer. Where the CIPPSR indents, the depth of the indent shall not reduce the CIPPSR wall thickness below the required wall thickness.

There shall be no sags or lifts in the CIPPSR.

Finished CIPPSR Installation

The CIPPSR shall be free of any interior bulges, ribs, ripples, folds or other irregularities except where these irregularities comply with the CIPPSR fit exceptions listed above.

The finished CIPPSR installation shall be firmly fixed in place against the inside surface of the sewer such that the CIPPSR will not be moved by sewer flow or sewer inspection, cleaning or maintenance operations.

CIPPSR End Terminations

The start and end of the CIPPSR shall be tapered towards and into the sewer surface so that the CIPPSR ends do not result in an impediment to flow. The ends of the CIPPSR shall not present any shoulder or lip at which debris or sedimentation can build up. The ends of the CIPPSR shall not have any irregularity that will interfere with sewer maintenance operations such as cleaning and inspection.

CIPPSR ends shall be free of any loose or jagged material and shall be firmly fixed in position tightly against the surface of the sewer. The CIPPSR ends shall taper smoothly to the surface of the existing sewer so that there is no pronounced step or shoulder.

CIPPSR Wall

The wall of the CIPPSR shall be homogeneous and be free of any voids, cavities, bubbles or de-laminations.

The completed installed CIPPSRs shall conform to the following requirements.

Physical Properties

The completed installation of the CIPPSR shall have the following required physical properties:

- Flexural modulus: Shall meet or exceed the short-term value used in the CIPPSR design.
- Flexural strength: Shall meet or exceed the short-term value used in the CIPPSR design.

When required, the determination of physical properties may be from above ground made samples of the CIPPSR, from an excavated sample of the CIPPSR or from CIPPSR material from any other sampling method deemed suitable by the Contract Administrator.

For long-term values of flexural modulus and flexural strength used in design, the CIPPSR shall possess the required long-term retention characteristics such that the long-term values used in design will be met by the CIPPSR over its design life.

TS 466.05 MATERIALS

TS 466.05.01 Tube

The tube should consist of one or more layers of flexible needled felt, fiberglass or an equivalent nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube should be compatible with the resin system used. The material shall be able to stretch to fit irregular pipe sections and negotiate bends. The outside layer of the tube should not absorb residual water from the sewer. The tube shall be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit. Allowance should be made for circumferential stretching during inversion.

TS 466.05.02 Resin

A resin designed for and compatible with the CIPPSR material, process and sewer system shall be used. The resin must be able to cure in the presence of water. The CIPPSR system can be expected to have as a minimum the initial structural properties given in Table 1.

TS 466.05.03 Samples of Resin and Cured CIPPSR Installations

Field Resin Samples

The field resin samples should be stored in a clean bag and the bag should be marked with the following:

- Contract Number
- Date
- MH# to MH# reference of CIPPSR liner where resin was used
- Location in the tube, where the sample was collected from

The Contract Administrator may ask the Contractor to provide arrange for a cured sample for each maintenance hole to maintenance hole section the resin sample which will be to be tested by Spectral Analysis infrared (FTIR) analysis and compare the resulting spectrograph to the "fingerprint" reference spectrograph of the resin used for the original creep testing to confirm that the correct, long term creep qualified resin is actually being installed. The IR analysis must match with the one provided in the tender submission for the resin identified for use by the Contractor for the CIPPSR liner work.

All field resin samples supplied for this Contract shall produce FTIRIR spectrographs that correspond to the reference FTIRIR spectrograph.

Field Samples from in Place Cured CIPPSR

The Contractor may be required to furnish to the Contract Administrator a cylindrical sample of a CIPPSR at least 1000 mm in length. The sampling shall be done through a separate excavation performed after the CIPPSR is installed and cured. The sewer where the sample was removed shall be repaired with PVC pipe and fittings suitable for the depth of the installation. The restoration of excavated areas shall be carried out according to the Special Specifications.

The Contractor shall identify on the sample by permanent marker the contract number, street name, closest street number address, CIPPSR size, date of installation and date of removal.

Samples shall be taken into custody by the Contract Administrator immediately and delivered to the testing agency by the Contract Administrator.

Failed Samples

Should the sample fail to meet the specifications as specified in the Contract Documents, the Contractor shall cover the cost of sampling. The City will also reserve the right to ask for further sampling at no extra cost to the City for any other CIPPSRs that were installed on or near the day the failed CIPPSR was installed.

TS 466.06 EQUIPMENT

TS 466.06.01 Excavations for Retrieval of Equipment

Where the retrieval of lodged equipment is required by open-cut excavation, the Contractor shall immediately notify the Contract Administrator. The Contractor shall provide for retrieval including any excavation, maintenance of flow, repair, backfill and restoration. However, if the equipment became lodged in a portion of a sewer section for which no previous CCTV inspection or other advice was provided to the Contractor by the City, then the City will pay the Contractor for 75 per cent of the total above noted cost only if such cost occurs during the preliminary V1 CCTV inspection or during preliminary cleaning operations for the V1. However, the City will not entertain any other associated cost related to this work.

TS 466.06.02 Excavation for Other Purposes

If it is necessary to excavate for any reason such as repair of defective CIPPSR, reinstatement of service connections, by-pass of flow or repair of pipe broken during work, the Contractor shall provide such excavation, repair, backfill and restoration. However, dependent on the reason why an excavation is required and at the discretion of the Contract Administrator, additional payment for such work may be negotiated with the Contractor. In such case where the work is determined by the Contract Administrator to be an extra to the Contract, the work shall not proceed without the approval of the Contract Administrator prior to the work.

All such work shall be performed by an approved sub-contractor and shall be according to City standards and specifications.

TS 466.06.03 Flow Control and Bypass

No flow control or bypass pumping shall be employed that has insufficient capacity to maintain flow in the sewer system. It is the Contractor's responsibility to employ flow control of sufficient capacity. No work requiring flow control shall proceed until flow control arrangements are in place that provide sufficient flow control capacity including for situations that exceed the Flow Control Included Limit Provision.

When interruption of sewer line flows is necessary to properly conduct the work including such as CCTV inspection and CIPP liner operations, acceptable methods of flow control shall be provided. Where bypass pumping is used, flow control shall be in accordance with TS 4.01 or TS 4.02. These specifications outline the requirements and submittals required for the design of a fully operational temporary bypass system and associated requirements.

The Contractor shall make all necessary arrangements with the owners of each building in the work area. The Contractor shall contact all property owners or tenants or both to coordinate the repair work to the sewer and minimize any impact on residents, businesses or both.

During the inspection and rehabilitation, sewer flows shall be shut off in order to enable proper inspection of the pipe, including the invert. After the work is completed, flows shall be restored to normal. Excess sewage flows shall be transported through a closed, leak tight pipeline or by tank trucks to the nearest or most economical disposal area.

When Flow Control Is Required

Flow control of the sewer flow will be required periodically during the work as set out below. Achieving flow control may require temporary bypass pumping, diversion or other method that will achieve the required flow control.

Measurement of Sewers to Determine Sizing for Liners

Flow control shall be sufficient so that dimensions needed for sizing the CIPPSR liners can be accurately and reliably determined including accounting for liner sizing for H₂S corroded sewers.

Cleaning and Preparation

Flow control during cleaning and preparation operations shall be sufficient for the work and the need for flow control shall be at the Contractor's discretion.

CCTV Inspections

Flow control is required for the preliminary CCTV inspection (V1), the post-cleaning and preparation CCTV inspection (V2) and for the final CCTV inspection after CIPPSR liner and lateral reinstatement are complete (V3). The flow control shall be sufficient such that any flow or standing fluid in the sewer shall not obscure the inspection of all surfaces that will result in difficulty or inability to view all surfaces of the sewer to sufficiently judge, in the opinion of the Contract Administrator, the results of the work. The results of the work include cleaning, preparation, liner and service connection reinstatement. For CCTV requirements, see CCTV specification TS 409.

CIPPSR Liner Installation

Flow control is required for the complete duration of the actual liner installation operation including insertion, curing, cool-down, liner end cutting and up until the lined sewer run is fully open for upstream flow. Flow control shall be for 100% of the upstream flow that would otherwise enter the section(s) being lined for the period when the liner is blocking the sewer.

Service Connection Reinstatement

Flow control during service connection reinstatement shall be sufficient for fully reliable CCTV monitoring of remote robotic reinstatement and the reinstatement itself. For man entry reinstatements, flow control shall be sufficient to enable proper reinstatement of the service connections and shall comply will all safety requirements for man entry.

Responsibility for Leaks, Spills and Backups

The Contractor shall be responsible for all leaks, spills and backups, should they occur and shall take immediate action to restore flow control/bypass integrity and cleanup of any leak, spill or backup. Any leaks or spills shall be immediately reported to the Contract Administrator.

Handling and Cleanup of Sewage

The Contractor is responsible for removing or otherwise handling any sewage that must be removed or controlled during setup and removal of flow control. This includes any sewage remaining in the forcemains that requires removal for setup or take down of the flow control, any sewage remaining in temporary MHs to be removed, any sewage to be removed during setup/removal of flow control and any sewage remaining in bypass conduits when removed.

Existing Utilities and Excavation for Flow Control

Where the Contractor requires to bury flow control conduits (such as for road crossings or other purposes) or install MHs for flow control, the Contractor shall be responsible for locating and avoiding other utilities that may be in the path of the buried flow control conduit(s) or maintenance holes. Wherever any excavations are required for flow control installations, the Contractor shall locate any existing utilities such as gas, water, hydro and so on prior to making any excavation and shall not damage or otherwise interfere with any utilities.

Cold Weather Operation

The Contractor shall prevent freezing of the flow control system including any bypass pumps and discharge conduits. Discharge conduits shall be equipped with provisions for blowing out or otherwise draining all conduits in the event that a shutdown of the bypass is required during freezing weather conditions.

Contractor's Flow Control Plan

A flow control plan shall be provided with sufficient detail for the Contract Administrator to assess the Contractor's approach to flow control.

The Contractor shall provide the Contract Administrator with an enhanced Flow Control Plan that has been further detailed as needed to provide a comprehensive plan for the flow control covering all phases of the work. The Flow Control Plan shall be submitted to the Contract Administrator a minimum of 10 business days prior to any liner installation of other work requiring bypass. The Flow Control Plan requires acceptance from the Contract Administrator before any work involving flow control commences.

The enhanced Flow Control Plan shall contain engineering calculations that verify diversion pumps, conduit ratings and sizing are fully sufficient. The calculations shall be certified and stamped by an Ontario Professional Engineer.

Flow Control Included Limit Provision

Standard flow control shall be included as part of the liner items up to and including a capacity of 4,540 litres/minute (1200 usgpm). Standard flow control and pumping/by-passing should include all necessary piping/fitting, fuel, traffic protection, road crossing devices and monitoring. The Contractor shall be responsible for determining the bypass capacity. For sewers that require additional flow control when flows exceed 4,540 litres/minute (1200 usgpm), the bypass must be carried out—supply, install and maintain bypass system—in accordance with TS 4.01 and TS 4.02.

Where the Contractor has determined that the bypass requires capacities exceeding 4540 Litres/minute (1200 uspgm), the Contractor shall advise the Contract Administrator of the requirement and any additional cost for the higher bypass capacity. When it is necessary for liner and directed by the Contract Administrator, the Contractor must submit a detailed by-pass plan stamped by a professional engineer at least two weeks prior to the scheduled work. The proposed by-pass must clearly demonstrate the ability to handle the identified flows for the period of time required to fully install the liner and re-commission the sewer to normal operations.

TS 466.07 CONSTRUCTION

TS 466.07.01 Notification to Public

Prior to the commencement of any work on the Contract, the Contractor shall deliver written notices to all affected parties a minimum of 7 Days to a maximum of 14 Days prior to any work commencing at each location. The Contractor must schedule the works accordingly and provide the Contract Administrator with a one month planned look ahead of all scheduled work for each location. Such written notices to the public shall consist of letters supplied by both the Contract Administrator and the Contractor and both must be delivered at the same time. From time to time during the Contract other notices, such as the Service Interruption Notice, shall be distributed by the Contractor.

Contractor's notices shall be typed on the Contractor's letterhead and clearly indicate both daytime and after hours local contact telephone numbers. Telephone numbers shall be either local area code or toll-free numbers. No work will be allowed to commence without such notices. Any Contractor's written notice shall be submitted to the Contract Administrator for approval prior to notice delivery.

The Contractor shall be responsible for notifying the homeowners to limit their sewer use, including the use of any mechanical devices, for example sump or ejector pumps from discharging to the sewer service, in a manner that may adversely affect the lining process. The Contractor shall provide the Contract Administrator with a copy of any such notices for approval prior to delivery of the notices.

TS 466.07.02 Weather Conditions

The Contractor shall review the Environment Canada weather forecast prior to commencement of CIPPSR installation operation. Where the anticipated weather conditions are such that anticipated sewer/drain flows may exceed the Contractor's bypass pumping capacity or may cause potential basement flooding such as blocked laterals due to the CIPPSR, commencement of construction shall be delayed until favourable weather is forecast.

This applies to all storm, sanitary and combined sewers to be spot repaired.

Sewer flows are significantly and readily boosted by wet weather and snow melt events.

A liner installation shall not be started when rain or snow melt is forecast within the predicted time period of the liner installation. Liner installation is defined as the beginning of the insertion of an impregnated liner tube until the time that all service connections and sewer inlets are reinstated. Liner installation does not include sewer cleaning and preparation.

Regardless of the scheduling of liner installations or the Contractor's decision on carrying out a liner installation, the Contract Administrator, at its sole discretion, has the right to direct the Contractor to delay a liner installation at no extra cost to the City, when, in the Contract Administrator's opinion, there exists a reasonable potential that a detrimental rain or snow melt event will occur which could cause unacceptable surcharge in the sewer.

TS 466.07.03 CCTV Inspection and Reports

CCTV inspections for V1, V2 and V3 assessments shall be according to TS 409.

Inspection Reports

Each CCTV inspection submitted shall be accompanied by an electronic format sewer inspection report in PDF file format. The reports shall be in the format required by the City. The PDF reports shall be included on the USB media along with the video file.

Prior to the regular contract required submissions of CCTV inspections/reports, the Contractor shall submit a trial inspection report in PDF format for approval by the Contract Administrator.

CCTV Inspection Submission

When a required CCTV inspection has been completed, it shall be submitted to the Contract Administrator on a properly identified portable hard drive or other media approved by the Contract Administrator. The submission for a sewer service shall include the video file and the PDF report file and NASSCO PACP access database.

The hard drive shall be properly organized with each CCTV inspection submission in its own folder. Such folders shall be clearly and properly identified in regard to the sewer section to which it pertains.

The reports shall be in a format that will enable direct down loading of the data into data management system.

TS 466.07.04 Preliminary CCTV Inspection – V1

Prior to any cleaning or preparation for CIPPSR installation, a recorded CCTV inspection—called the V1—shall be made of the full length of maintenance hole to maintenance hole sewer section where CIPPSR(s) are to be installed.

NASSCO PACP defect coding is not required for the V1.

The Contractor shall make the V1 before undertaking any work required for the CIPPSRs. The purpose of the V1 is to determine and record the initial condition of the sewer section and to determine if a significant changed condition exists versus any CCTV inspection provided to the Contractor by the Contract Administrator. Significant changed condition means a condition that will prevent CIPPSR installation(s) in the section, require an unexpected excavated repair before CIPPSR installation, require a change in the CIPPSR design resulting in an increased CIPPSR thickness to deal with the changed condition or any other situation, which in the Contract Administrator's opinion, is a significant changed condition. Where a significant changed condition is encountered, the Contractor shall immediately inform the Contract Administrator.

In making the V1, the Contractor shall employ only such preliminary cleaning that is necessary to obtain a CCTV inspection sufficient to record the initial condition including a count and condition of service connections.

Flow control for and de-watering of the sewer shall be sufficient for V1 inspection purposes and bypassing of the sewer flow shall be done where the sewer is not sufficiently clear for V1 inspection purposes.

The V1 CCTV inspections shall be submitted to the Contract Administrator according to the requirements of TS 466 herein.

The Contractor shall be responsible for confirming the following design parameters as part of the V1 inspection:

- a) sewer diameter
- b) depth to invert of pipe to be lined
- c) pipe ovality —confirmed during V2 if required
- d) live load condition, e.g. pipe under train tracks

The Contractor shall provide the Contract Administrator with a record log of all verified field conditions prior to the ordering and installation of any spot repair liners. This log will be used to determine the need for increased liner thickness. Should the Contractor order or install a spot repair liner without confirmed field conditions and such conditions are found to have required liner thickness increase, no payment shall be made for the installed liner.

TS 466.07.05 Field Measurement of Sewers and Spot Repair Sizing

The Contractor shall measure the internal diameters of the sewer sections to be lined and the length of the sections to be lined. The measurements taken shall be suitable for proper sizing of the liners to be installed. Refer to requirements for CIPPSR Liners in TS 466 herein. The Contractor shall not rely on dimensions provided by the City. The Contractor shall log all field measurement verification and provide this record log to the Contract Administrator prior to installation of the associated liners.

TS 466.07.06 Service Connection Statement

The Contractor shall prepare a *Service Connection Statement* for all service connections in the vicinity of CIPPSRs. The statement shall include and specifically identify any service connections that will be covered by a CIPPSR and therefore will require reinstatement through the CIPPSR. The statement shall be used to confirm and verify that no existing service connections have been left covered or otherwise negatively affected by CIPPSR installations. The Contractor with assistance from the City shall determine the presence of abandoned service connections within the sewer section to be lined. The statement shall be completed as part of the V1 and V2 CCTV inspection work.

The statement shall be updated during service connections reinstatement to show which service connections have been reinstated with date and time of reinstatement.

The statement shall be provided to the Contract Administrator on request.

For an example of the *Service Connection Statement* form go to Appendix B.

TS 466.07.07 Service Connection Investigation

The Contractor shall perform a service investigation when and where, in the Contractor's opinion, any service investigation is required to assure successful performance of any work. The service inspection can include the following:

- determining the routing of any service connection laterals
- determining flow control to be required for any service connection laterals
- determining multiple buildings or units connected to any service connection and
- any purpose needed for the Contractor's work.

The method of service investigation shall be the Contractor's responsibility and according to the Contractor's needs for the investigation. It shall be the Contractor's responsibility to assess the need for any service investigation, to perform the service investigation and to perform any work on the Contract according to the Contractor's findings from the service investigation. The Contractor shall be responsible for any problems or costs that occur due to not performing a service investigation or that would not have occurred should the service connection investigation have been performed.

Any service connection investigation performed shall be considered as included work required for the execution of contract requirements and shall not be considered as additional work.

TS 466.07.08 Sewer Cleaning and Preparation

At the location of the CIPPSR, over the length of the final position of the CIPPSR and at least 1.5 m past each end of the CIPPSR, the sewer shall be cleaned to remove foreign materials prior to CIPPSR installation by means of a controlled hydro pressure sewer cleaner. Precautions shall be taken to ensure that no flooding of public or private property occurs during any phase of the cleaning or reaming operations or both. Satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the use of cleaning equipment.

All sludge, dirt, sand, rocks, grease and other solid or semi-solid material shall be removed. Resulting debris and waste material from the cleaning operations shall be removed at the immediate downstream maintenance hole. Passing material to further downstream maintenance holes shall not be permitted. The Contractor shall also install a screen in the downstream maintenance holes in order to catch any material that might migrate downstream. Such material from the maintenance hole shall be removed and proper disposal shall be done at an approved disposal location.

Where CCTV inspection or sewer cleaning operations indicate the presence of deposits, roots, protrusions or other foreign materials in the sewer that are resistant to sewer cleaning operations, these shall be removed by sewer reaming cutting or grinding.

Protruding Laterals

Where a protruding lateral exists that will interfere with the installation of the CIPPSR or negatively impact the performance of the CIPPSR, the protruding lateral shall be trimmed back sufficiently to remove the interference or negative impact. After trimming, the protruding lateral shall be uniform and free of any sharp or ragged edges. The method used to trim back the protruding lateral shall not damage the lateral or any of the adjacent sewer pipe. Robotic cutter trimming is an approved method. Protruding laterals shall not be removed or trimmed back by flailing or chain knockers. The Contractor shall be responsible for repairing any lateral damage caused by inappropriate trimming or removal up to an including replacing the lateral connection by open cut excavation.

Sewer Condition Problems Away From CIPPSR Location

The City believes that the sewer sections where CIPPSRs are to be installed are in an interior condition that will allow passage by the Contractor's equipment from a maintenance hole to the location(s) of the CIPPSR(s). However, there may be sewer sections with interior conditions that prevent reasonable passage of the Contractor's equipment to the CIPPSR location(s). Where this is the case, the Contractor shall proceed as follows.

- 1) Where initial V1 CCTV inspection reveals that the sewer section condition will not allow reasonable passage of the Contractor's equipment to the CIPPSR location(s), the Contractor shall advise the Contract Administrator of this situation and record the V1 CCTV inspection of the sewer section as support for this conclusion.
- 2) The Contract Administrator could request the Contractor to provide an estimated time and cost to adequately clean the sewer section to allow passage of the Contractor's CIPPSR equipment. The Contractor shall provide a cost estimate based on applicable Contract Price. With the approval of the Contract Administrator, the Contractor shall clean the sewer section and shall be paid for this Work under applicable Contract Price. After cleaning of the sewer section, the Contractor shall proceed with the CIPPSR installation(s).
- 3) Alternately, the City may cancel the CIPPSR installations in the sewer section, in which case, the Contractor will be paid for the V1 CCTV inspection according to the tender item for V1 inspection.

TS 466.07.09 Sewer Reaming, Cutting and Grinding

At the location of the CIPPSR plus 1.5 m past each end of the CIPPSR the sewer section shall be reamed to remove fixed debris such as deposits and protrusions. An approved reaming method shall be used. Deposits and protrusions could include calcite build up and tree roots. An acceptable CCTV camera must monitor reaming operations.

Fixed debris does not include protruding laterals.

Reaming Tolerance

All protrusions, deposits, previous liner wrinkles and build-ups in the sewer section shall be removed such that the internal diameter of the sewer pipe is not reduced by more than 5 mm for sewers 450 mm diameter or less, and no more than 10 mm for sewers greater than 450 mm. Any. However regardless of this allowance, no debris shall be left in place that will have a detrimental effect on the performance of the CIPPSR such as pointed or jagged protrusions or deposits or that will result in void space behind the CIPPSR due to the geometry of the remaining deposit or protrusion. Any material remaining after reaming providing that such material must be hard and firmly attached to the sewer wall. All sharp encrustations and debris shall be removed, as they can damage the liner during installation (inversion or by pull-in method).

Precaution to Prevent Damage to the Sewer Section

The Contractor shall plan and execute the reaming operation to prevent damage to the sewer section and any service connections in the sewer section. Proper precautions shall be taken by the Contractor to ensure that the reaming operation does not cut into the sewer itself, to ensure that the reaming tools do not become jammed in the sewer and that any areas of the sewer that are structurally unsound are not further damaged. Any extraction of reaming tools or other equipment, including extraction by excavation, is the responsibility of the Contractor.

TS 466.07.10 Disposal of Materials

In accordance with the requirements of the Environmental Protection Act, R.S.O. 1990, Section 27 and subject to all terms and conditions related to Waste Management, the Contractor shall be responsible for the complete removal and disposal off-site, of all foreign materials flushed, scraped, or cut out of the sewer line. Flushing and abandoning of debris in sewer lines is not permitted.

Before disposing of solids, the Contractor shall decant all liquids into the City designated sanitary sewer main. There shall not be any dumping or decanting into any storm sewers. Decanting of solids into any sewer main is not permitted. The Contractor shall decant liquid only into sanitary or combined sewers greater than 250 mm in diameter clear of debris and with low flow. Filtering devices shall be used during the decanting process to prevent any debris from entering the sewer system. Prior to decanting, the Contractor shall verify the type of flow in the sewer. Should a blockage occur in the sanitary or combined sewer due to decanting, the cost of all sewer backups and cleaning shall be at no extra cost the City.

Prior to commencement of the Contract, the Contractor shall notify the Contract Administrator of the disposal site(s). The Contractor shall provide the Contract Administrator with the following documentation attached to all relevant invoices:

- a) Contract name and No.
- b) Vehicle ID – License Plate Number
- c) Date of disposal
- d) Time of disposal
- e) Net weight of load
- f) Provide log books and scale printouts to the Contract Administrator.

All debris must be decanted prior to disposal. Off-site debris dewatering facilities must meet provincial environmental regulations and requirements. Provide copies of required licenses, permits and relevant documentation required for dewatering facility to the Contract Administrator before starting the Work.

TS 466.07.11 Filling of Voids

Voids Identified for Filling in the Contract

The Contractor shall fill voids as specified for filling in the Contract Documents. Void filling shall ensure structural integrity of the lined sewer and prevent bridging by the CIPPSR. The Contractor shall submit for the approval of the Contract Administrator a detailed method statement outlining the procedures and materials to be used in filling the voids. The method statement shall correspond with requirements that may be specified for void filling such as in the Tender Call.

Voids Requiring Filling Not Identified in the Contract

If, during the course of the work such as during the V1 or cleaning and preparation, the Contractor identifies voids that require filling to ensure the structural integrity of the CIPPSR and to prevent bridging by the CIPPSR, the Contractor shall advise the Contract Administrator of these voids. Where the filling of such voids is required by the Contract Administrator, the Contractor shall submit a detailed method statement outlining the procedures and materials to be used in filling the voids. Where the Contract Administrator requires filling of the voids, the cost shall be negotiated. However, this provision shall not apply to any voids created as a result of the Contractor's work unless, and at the discretion of the Contract Administrator, the creation of such voids was an unavoidable repercussion of the work.

TS 466.07.12 Post Cleaning and Preparation CCTV Inspection – V2

After completion of the cleaning, preparation and any fixed debris removal of the sewer section, a CCTV inspection—called the V2—of the full length of the sewer section shall be done. The V2 shall be according to the requirements of TS 466 herein.

The V2 complete with all reports shall be provided to the Contract Administrator at least 2 Days prior to CIPPSR installation for the Contract Administrator's approval of the cleaning and preparation.

On its discretion, the Contract Administrator may waive the requirement for the V2 to be submitted for approval 2 Days prior to CIPPSR installation, such as when approval is provided at a live viewing of the V2 by a City representative. However, in such cases the V2 submission shall always be submitted at a later time.

CIPPSR installation shall not commence until approval of the preparation has been provided by the Contract Administrator to the Contractor.

In the event that, after the V2, a deficiency in the cleaning and preparation is identified that requires correction, the V2 shall be redone after the correction has been done and the redone V2 submitted to the Contract Administrator.

NASSCO PACP defect coding is required for the V2.

TS 466.07.13 Installation of CIPPSR

The installation method shall conform to the manufacturer's instructions and the requirements as specified in TS 466.04.03 herein. The tube should be pulled-in an existing maintenance hole or access pit and fully extended to the next designated termination point as per shop drawing submittal. If pulled into place, a power winch or equivalent should be utilized, and care should be exercised not to damage the tube as a result of pull-in friction. Where Bid submissions included a method statement with additional procedures, such additional procedures shall be followed. The specific details and execution of the installation are the responsibility of the Contractor.

Flow and odour control shall be in operation during the complete liner installation process including liner insertion, curing and opening of the liner ends.

The Contractor shall provide a minimum of 48 hours advanced notice to the Contract Administrator of any CIPPSR liner installation including time to review the V2 and to confirm the final design parameters after reviewing the V2.

All affected property occupants shall receive written notice 48 hours in advance of any work that will interfere with sewer use for that property.

The Contractor shall ensure that all required equipment including as required by the Contract is on site and in satisfactory working order prior to commencing the installation of a CIPPSR liner section.

The Contractor shall ensure that all maintenance hole's used for insertion of liners are adequate in size as not to impact the required finished liner quality. Where the Contractor identifies a maintenance hole opening size to be inadequate, the maintenance hole shall be modified appropriately. The Contract Administrator, at its discretion, may also require the Contractor to make adjustments to the maintenance hole opening prior to the insertion of the liner. Any additional costs associated with modifying the maintenance hole opening and repairing the maintenance hole after installation of the liner shall be paid under the appropriate pay item.

When curing with steam or hot water, temperature gauges shall be placed between the tube and the host pipe's invert position at both ends to monitor the temperature during the cure cycle. A cool down process shall be conducted that complies with the resin manufacturer's specifications. The Contractor must submit the following upon completion of liner installation:

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- the temperature curves for the steam leaving the boiler, and two locations in the sewer at both ends for the entire curing cycling including heating – maintaining temperature and cooling for each section and demonstrate that the recommended cycle was met.
 - the pressure curve for the inversion medium–hot water or steam–to demonstrate the desired pressure was maintained during the entire cycle. If there is drop in the pressure, the Contractor must demonstrate, that there are no lifts, bulge, excessive wrinkles, delamination and should be evaluated for its ability to meet applicable requirements.

When curing with steam or hot water, a sufficient liner cool down period, under continuous cure head or pressure, shall be allowed to minimize shrinkage and thermal stresses in the liner. The new pipe should be cooled down to minimum 35°C or as recommended by the resin supplier before relieving the static head in the installation process.

Equipment Ready for CIPPSR Installation

The Contractor shall ensure that all required equipment, including as required by the Contract, is on site and in satisfactory working order prior to commencing the installation of a CIPPSR.

CIPPSR Exact Installation Locations

The locations for CIPPSRs provided by the City are approximate. The Contractor shall determine the proper specific location for the placement of the CIPPSR including the start and end points so that the sewer defect is enclosed within the length of the spot repair and meet the requirement for the CIPPSR to extend beyond the defect at each end. The Contractor is responsible for ensuring that the CIPPSR is installed at the correct location so that the CIPPSR completely covers the sewer defect that is to be repaired including sufficient overlap on either side of the sewer defect.

CIPPSR Installation Odour Control

When the sewer has service connections, the Contractor shall provide notice to the affected residents indicating possible odour resulting from sewer CIPPSR liner and curing process. A template of the notice is attached to the specification as Appendix B, and the Contractor will have to revise the notice as per the impact. The notice shall indicate to the residents the reason for odour, what to expect, procedures to alleviate odour including ensuring all plumbing drain traps are full of water. The contractor's supervisor must have with them at all times a “calibrated styrene monitor” to be used when residents complain about styrene or a chemical smell is detected.

The Contractor shall provide 24 hours a day 7 days a week contact on the notice and is responsible to respond, investigate and act immediately on any odour complaint that may occur including after work hours and week end. Actions to be taken by the Contractor to alleviate an odour problem within a property shall include:

- Seeking permission to enter the property
- Diagnosing the cause of odour and remedial actions
- Requesting the resident to ventilate the property via open window and doors
- Providing fans and blowers to maintain negative pressure in the sewer and ventilating the property with fans/blowers; and

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- Other actions that are useful in alleviating the odour problem.

The Contractor shall provide adequate sewer ventilation and odour mitigation during the sewer lining process. The following steps shall be taken:

Exhaust Fans for Sewer: During lining of sewer having service connections, including trunk sewers having service connections. Two maintenance holes exhaust fans with a minimum capacity of 991 l/s each shall be used to exhaust air from the sewer via maintenance holes. One fan shall be located at an adjacent maintenance hole immediately downstream of the sewer section being lined. The second fan shall be employed at the tail end maintenance hole as soon as access for the fan is available following removal of the CIPPSR tail. If the second fan cannot be readily employed at the tail end maintenance hole, it shall be employed at the closest possible adjacent maintenance hole that will permit air to be exhausted from the sewer being lined. In the event that odour control becomes a problem, the Contractor shall provide additional exhaust ventilation of the sewer to alleviate odour.

Cool Down: In the case of hot water curing, prior to release into the sewer, the cure water shall be cooled to minimum 45°C the ambient temperature of the before discharging it to the sanitary sewer into which it will drain. Higher temperature. Heated water shall not be discharged into the sewer. The cure water shall not be discharged to a storm sewer.

TS 466.07.14 Reinstatement of Sewer Service Connections

Reinstatement of the service connections that have been covered by a CIPPSR shall be carried out according to the approved method statement.

All live service connections shall be reopened to their full diameter. If required, the interface between the sewer and the CIPPSR shall be made leak tight by remote means.

Service connections must be reinstated to the entire opening of the service connection or service connection pipe, whichever is the greater. No CIPPSR protrusions, sealer, grout or other foreign material is permitted into such area.

Following any installation that covers a live service connection the Contractor must open each service connection to a minimum of 75 per cent within 8 hours. All service connections must be entirely opened by no later than the next day.

At all times when live service connections are to be blocked the Contractor must provide a 48-hour *Service Disruption Notice* to all affected parties. Such notice will be typed on the Contractor's letterhead and clearly indicate both daytime and after-hours local contact telephone numbers. The Contractor shall schedule the CIPPSR installation accordingly. No service disruption will be allowed without such 48-hour notification.

In the event that the Contractor is unable to install the CIPPSR on the date stated in the Service Disruption Notice, the Contractor must immediately provide written notification of the change of date including the new date for the CIPPSR installation. After the service connection has been reinstated the Contractor shall provide written notification to all affected parties that the service connection is back in service. The notification format shall be submitted to the Contract Administrator for approval prior to the commencement of Work.

The 48-hour *Service Disruption Notice* shall be provided to residents, upon request of the resident, the supply of a clean, properly functioning portable chemical toilet for the entire time that such resident's service connection is blocked at the sewer. When required, such toilets shall be delivered prior to any service connections being blocked in the sewer and shall be promptly retrieved by the Contractor upon service connection return to service after reinstatement.

The Contractor shall maintain a detailed record of the time at which the reinstatement of each service connection is completed, and this record shall be entered on the *Service Connection Statement* and submitted to CCTV operators and Contract Administrator for verification during V3.

TS 466.07.15 CCTV Inspection of Completed Installations – V3

After completion of the CIPPSR(s) installation, including any required service connection reinstatements, a CCTV inspection—called the V3—shall be made of the maintenance hole to maintenance hole sewer section where CIPPSR(s) have been installed.

NASSCO PACP defect coding is not required for the V3.

The V3 inspection recordings must clearly show the CIPPSRs, termination point at each end and any service connection reinstatements.

If there are multiple CIPPSRs in a given sewer section, one final V3 CCTV inspection should be carried out to capture all CIPPSRs. Multiple V3s are not required for a sewer section with multiple CIPPSRs.

In the event that, after the V3, a deficiency in the lined sewer section is identified that requires repair or remediation, the V3 shall be redone after the repairs or remedial action have taken place and the redone V3 submitted to the Contract Administrator.

TS 466.08 QUALITY ASSURANCE

TS 466.08.01 Testing of Samples of CIPPSR

When required, the Contractor shall provide for testing of CIPPSR samples at an independent testing agency. The testing agency shall be subject to the approval of the Contract Administrator. At random, the Contract Administrator may also complete testing at another testing facility. The Contractor shall authorize the testing agency to forward the test reports to the Contract Administrator via email and communicate with the Contract Administrator concerning the testing and results. The Contract Administrator will arrange for delivery of the CIPPSR samples to the testing agency. Samples shall be tested for flexural modulus and flexural strength according to ASTM D790 and thickness according to ASTM D5813-04(2008). The testing agency will prepare the required test samples from the circular liner. The provision of testing service shall allow for the obtaining of test reports within 10 working days of delivery of the sample to the testing agency.

The Contractor shall provide the test agency with the design parameters for the CIPPSR corresponding with the sample as follows:

- flexural strength short-term

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- flexural modulus short-term
 - required CIPPSR in place thickness according to ASTM F1216-07a Appendix X1 design

These values shall have been identified in the Contactor's CIPPSR design. The testing agency's report shall reference these values as the specified values.

TS 466.08.02 Deficiencies

Where a CIPPSR liner is deficient, the Contractor shall rectify the deficiency(s) with a remedial method that is acceptable to the Contract Administrator. Where there is no remedial method acceptable to the Contract Administrator, the liner shall be removed and replaced at no cost to the Contract Administrator. In cases where the CIPPSR liner thickness is deficient after completing reconciliation exercise, following action will be taken by the Contract Administrator:

Up to 95% but below desired design strength / thickness after reconciliation exercise: Will be accepted for up to 10% of CIPPSR length.

Up to 90% and below 95% design strength / thickness after reconciliation exercise: If the Contractor is not able to address the deficiency at no additional cost, 15% payment for the CIPPSR section to be retained from the final payment. If this issue is more than 20% of CIPPSR length, additional 10% amount will be deducted from the payment.

Up to 75% and below 90% design strength / thickness after reconciliation exercise: If the Contractor is not able to address the deficiency at no additional cost, 50% payment for the CIPPSR section to be retained from the final payment. If this issue is more than 20% of length of the entire project, additional 10% amount will be deducted from the payment.

Below 75% design strength / thickness – Not Acceptable. Contractor will have to complete CIPPSR relining and additional CIPPSR to meet requirements as no further cost. Contractor will be responsible for temporary bypass installation, operation and removal cost and all other ancillary restoration and construction cost to address the deficiency. If the Contractor fails to do so, the Contract Administrator will deduct the amount to complete this work through a separate contract and use bid price to arrive at the amount required to complete all work required to achieve 100% strength.

In each case, Contract Performance Evaluation will be completed based on the severity of the issue and remedial actions taken by the Contractor.

The specific deficiencies addressed below are examples and do not represent all the deficiencies that may occur.

TS 466.08.02.01 *Excessive Fining or Wrinkling*

Excessive liner material shall be removed to the acceptance of the Contract Administrator at no extra cost to the City. Wrinkles generally form due to larger liner than the host pipe and due to insufficient pressure or pressure fluctuations during curing. Where excessive material cannot be removed without compromising the structural integrity of the liner, the Contractor shall take other remedial action as acceptable to the Contract Administrator.

Remedial Action: Radial wrinkles and all wrinkles or fins at the invert which can obstruct flow shall be removed. For thin liners using a wire brush technique and on thicker liners using a cutting blade or grinding technique. If the wrinkles or fins have cured in a tight configuration causing the resin to be contiguous in the fin cross-section then removal of the fin shall require no additional repair. If they have not cured in a tight configuration and the resin is not contiguous across the wrinkle, a short liner repair shall be installed where the wrinkles or fins have been removed. If the repair is extensive the Contractor may choose to install a thin liner into the entire section instead of multiple short liner repairs. It is up to the Contract Administrator to determine if the wrinkles are acceptable or not.

TS 466.08.02.02 *Bulges, Lifts and Sags*

There shall be no bulges in the liner that are not consistent with the surface profile of the existing sewer before lining. Such bulges will be considered an indication of a major structural deficiency in the liner and will require major remedial action. Where bulges are suspected or proven to contain internal separations within the wall of the liner, remedial action up to and including removal and replacement of the liner will be required. This applies to bulges that are may could be called lifts or sags.

TS 466.08.02.03 *Remedial Action*

Where deficiencies are identified, the Contractor shall perform the accepted remedial action without unreasonable delay.

Where a deficiency will seriously impact sewer or service connection flow capacity and are considered likely to cause sewer back-ups onto properties or other overflows, the Contractor shall take immediate action to prevent such problems without waiting for acceptance of remedial method from the Contract Administrator. In such case, the final resolution of a deficiency, if required, shall be by a method acceptable to the Contract Administrator.

The cost of any work to rectify a deficiency is the responsibility of the Contractor.

TS 466.09 MEASUREMENT FOR PAYMENT

TS 466.09.01 *Spot Repair Liner*

Measurement of spot repair liner shall be by length in metres (m).

TS 466.10 BASIS OF PAYMENT

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the Work and shall be as per below:

- 5% of payment for CIPPSR section upon submission of detailed design shop drawing
- 5% of payment for CIPPSR section upon approval of detailed design by the Contract Administrator
- 5% after V1
- 10% after cleaning, preparing the CIPPSR section and V2 inclusive of submission and acceptance of Contractor's measurement for liner sizing according to clause TS 466.04.06, Design Requirements.

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- 50% after installing and curing of liner inclusive of submission and acceptance of Contractor installation documentation according to clause TS 466.07.12.
 - 5% after V3
 - 20% after testing, reconciliation and final acceptance
 - Deductions for deficiencies as specified in this specification

APPENDIXES

Appendix A: Notes to Designer

Appendix B: Service Connection Statement

Appendix C: Notice Template for Service Connection and Odour

Appendix 466-A, September 2019 For Use While Designing and Administrating City Contracts

Note: This is a non-mandatory commentary appendix intended to provide information to a designer and contract administrator during the design and construction stage of a contract on the use of this TS specification in a City contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an owner's design decisions and methodology.

Notes to Designer:

- 1) *The designer should insert the following text into the tender template in Section 4, Scope of Work*

Information to be Reviewed Prior to Bid Submission

For Tender Calls that identify that there are available City CCTV inspection records of the sewer sections, the Bidder shall review these inspection records, geotechnical and hydrogeological reports and elevations provided on the drawings for these sections prior to submission of Bid. Arrangements for viewing these records shall be made according to the instructions in the Tender Call. The CCTV inspection records can be a few years old and the Contractor shall acknowledge that the sewer condition may be further deteriorated including more encrustation, more debris, and more corrosion and, prepare the bid with such consideration.

If, for bidding purposes, the Contractor is of the opinion further inspection is required to properly assess the work to be undertaken, the Contractor will be responsible to perform such additional inspection. Permission to enter the City's sewer system for inspection purposes during the Bidding period shall be obtained through City's Purchasing and Materials Management division.

- 2) *The designer should insert the following text into the tender template in Section 2, Clause 8.1 Mandatory Bid Submission Requirements*

Information to be Submitted with Bid

The following information shall be submitted with the Bid.

Submit with Bid:

- 1) The name of a professional engineer licensed in the province of Ontario who will prepare and stamp the CIPPSR engineering designs required according to the spot repair liner design requirements in TS 466. The professional engineer shall be authorized to perform such work by Professional Engineers Ontario (PEO).
- 2) CIPPSR liner design for all spot repair sections identified in the Tender Call: The liner design shall be according to TS 466. The designs shall bear the seal and signature of an Engineer.

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- 3) A CIPPSR liner design example if no spot repair sections identified in the Tender Call: The liner design shall be according to TS 466. The example designs shall be illustrative of future designs that shall be submitted during the Contract. As spot repair sections are identified during the contract, the designs submitted shall bear the seal and signature of an Engineer.
 - 4) Material specifications and structural details of the proposed CIPPSR or CIPPSR's in sufficient detail to enable confirmation by the Contract Administrator that the CIPPSRs proposed will meet the design requirements according to TS 466. Include information for the proposed resin manufacturer, resin type and manufacturer's resin identification number, design parameters suggested by the resin manufacturer. Include the CIPPSR tube manufacturer and type of tube for each spot repair location.
 - 5) A complete list of equipment including CCTV cameras, robotic service connection cutters, reamers and other necessary major items to be dedicated to the work. The list of equipment shall specify type, manufacture and quantity of equipment.
 - 6) A summary of the Contractor's proposed CIPPSR procedure. Include one example of the CIPPSR wet-out process sheet and one example of the CIPPSR curing process summary sheet to be used.
 - 7) Resin to felt ratio and excess percentage according to ASTM F1216-07a.
 - 8) A certified original copy complete with supporting literature from the resin manufacturer of the Infrared Spectrograph of the catalyzed resin mixture proposed for this Contract.
 - 9) A certified original copy from the resin manufacture of the cure temperature requirements and example resin volume calculation along with example cure time calculation
 - 10) The location where the CIPPSR tube will be impregnated.
 - 11) The temperature curves for the steam leaving the boiler for the resin intended to be used by the Contractor for each sewer section to be lined.
 - 12) The pressure curve for the inversion medium (hot water or steam) to facilitate expansion of the CIPP liner.
 - 13) Submit the Ministry of the Environment, Conservation and Parks (MECP) license to haul and dispose of materials from sewer lines.

Appendix 460-B

Service Connection Statement

SERVICE CONNECTION STATEMENT (SCS) – TORONTO CONTRACT NO. _____

Sewer Section (MH-MH) _____ **Date:** _____ **Page #** _____ **of** _____

Street Name	Contractor's Name	Distance Between M.H. (camera)	Sewer Dia. (mm)	From M.H. #	To M.H. #	Camera Direction	Total # of S/C	Total # of Live S/C

S/C Address	Live (yes/no)	Visible Plug (yes/no)	Camera Distance from M.H. #	Clock Position	S/C Size	S/C Material	S/C (P/F/R)*	S/C Open (yes/no)	S/C Open (Date)	S/C Open (Time)	Comments

* P (protruding), F (flushed with the main sewer line), R (recessed)

Appendix 460-C

Notice for Service Connection and Odour

Go to www.toronto.ca/services-payments/building-construction/infrastructure-city-construction/construction-standards-permits/standards-for-designing-and-constructing-city-infrastructure/construction-specifications-for-sewers-and-watermains/?accordion=rehabilitation-specifications for MS Word version of notice.