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

Table of Contents

TS 4.12.01 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 4.12.02 Information to be Reviewed Prior to Bid Submission

For Tender Calls that identify that there are City CCTV inspection records of the sewers available, the Bidder shall review these inspection records prior to submission of Bid. Arrangements for viewing these records shall be made accoarding to the instructions in the Tender Call. Upon viewing, the Bidder shall fill out and sign the *CCTV Review Sign Up Sheet*.

If, for bidding purposes, the contractor is of the opinion further inspection is required in order 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 shall be obtained from the Contract Administrator.

TS 4.12.03 Information to be Submitted with Bid

The Tender Call requires the following information to be submitted with the Bid for the review and approval of the Contract Administrator. Further information could be required to be submitted elsewhere in the Tender Call other than in TS 4.12 herein.

Submit with Bid:

1) The name of a professional engineer licensed in the province of Ontario who will provide the stamped CIPPSR engineering designs required in accordance with the spot repair liner design requirements in TS 4.12. 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 4.12 herein. The designs shall bear the seal and signature of an Engineer.

3) A CIPPSR liner design example if no spot repair sections are identified in the Tender Call: The liner design example shall be submitted according to TS 4.12 herein. 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 4.12, herein. Include the proposed resin manufacturer, resin type and manufacturer's resin identification number. Include the CIPPSR tube manufacturer and type of tube.

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) 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.

TS 4.12.04 Notification to Public

Prior to commencement of any work on the Contract, the Contractor must 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. Such written notices 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 will 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 such notice for approval.

TS 4.12.05 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 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 4.12.06 Existing Video Inspection Records and Drawings

The Contract Administrator shall provide the Contractor with a list of sewer locations for CIPPSRs along with the City's available CCTV inspections, inspection reports and sewer map drawings for the 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.

TS 4.12.07 Excavations for Retrieval of Equipment or Other Purposes

Where the retrieval of lodged equipment is required by open-cut excavation, 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.

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

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 4.12.08 Use of Fire Hydrants

Prior to the use of any fire hydrant, a hydrant use permit shall be obtained from a Toronto Water service counter. When water from a fire hydrant is used, care shall be taken to ensure water is conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the fire hydrant. At all times, backflow preventers shall be employed when drawing water from any hydrant and proper ramps must be employed for all vehicular and pedestrian traffic.

TS 4.12.09 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.

TS 4.12.10 Flow Control and Bypass

When interruption of sewer line flows is necessary to properly conduct the Work including such as CCTV inspection and CIPPSR installation operations, acceptable methods of flow control shall be provided. Where bypass pumping is used, flow control shall be according to TS 4.01 – *Construction Specification for Temporary Sewer Bypass System.*

The Contractor is to make all necessary arrangements with the owners of each building. The Contractor shall contact all property owners or tenants or both to co-ordinate the repair work to the sewer and minimize any impact on residents or 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.

On all CIPPSR installation dates, the Contractor must maintain on site both a primary and stand-by bypass pump and pump power supply. Sufficient power supply and hoses must be on site in order to allow the pump to discharge into the next downstream sewer section. The stand-by bypass pump and power supply shall be of an equal or better capability than the primary bypass pump and power supply. No bypass pumps or related equipment shall be disconnected or removed from the sewer or job site until after all service connections have been reinstated and the Contractor has recorded the post-installation CCTV inspection.

All bypass pumping shall be in place and operation prior to the final pre-installation inspection. All bypass pumping capacities and configurations shall be approved by the Contract Administrator prior to the actual CIPPSR installation date.

All bypass pumps and related equipment shall be silenced equipment or contained within an acceptable sound reduction structure.

Flow Control Included Limit Provision

The Contractor shall provide for all bypass capacity up to and including 150 mm pump configurations where a 150 mm pump shall have a minimum capacity of 4540 L/min (1200 USGPM). The Contractor shall be responsible for determining the bypass capacity. Where the Contractor has determined that the bypass requires capacities exceeding 4540 L/min, the Contractor shall advise the Contract Administrator of the requirement and any additional cost for the higher bypass capacity. The Contract Administrator shall provide further instruction to the Contractor as needed including, as required, negotiation of additional payment for the bypass capacities exceeding 4540 L/min.

Sufficient Capacity for Flow Control

Flow control shall have sufficient 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 base flow control.

TS 4.12.11 CCTV Inspection Methodology

The following applies to CCTV inspections for submission to the Contract Administrator. Some CCTV inspections submitted to the Contract Administrator may not require all of the requirements described in this section. Refer to specific requirements for V1, V2 and V3 CCTV inspections for whether defect coding and reports are required.

CCTV Equipment

The cameras and transmission cables utilized under this contract shall produce colour recordings and the recording equipment utilized shall produce MPEG-1 or MPEG-2.

The CCTV camera used in the inspections shall be colour, pan, tilt and zoom view type capable of radial rotation of 360°, lateral rotation of 270°, and of producing a continuous picture resolution of not less than 400 lines at the periphery of the picture. Picture resolutions shall, at the discretion of the Contract Administrator, be confirmed using a RS Resolution Chart—Retina Type.

The cameras shall be equipped with a self-contained, adjustable, directed light source compatible with the lens angle and dispersed to create even distribution of the light around the pipe perimeter without the loss of contrast, flare out of picture or shadowing.

The camera shall be self-propelled. The mounting of the camera shall be adjustable such that the central axis of the camera lies at the centre of the pipe during inspection of the sewer. In the case of egg shaped sewers, the camera lens must be positioned vertically above the invert at a height two thirds of the vertical dimension of the sewer. In all instances, when transporting the camera through the sewer, the camera lens must be positioned on, and looking along the central axis of the sewer.

The equipment and cables utilized shall be capable of inspecting a minimum sewer length of 150 m, without reversal.

Sewer Conditions for CCTV Inspections

The sewer section under inspection shall be sufficiently dry so that any remaining water does not obscure any part of the interior of the sewer during the CCTV inspection. Where required, flow control shall be used to accomplish this clear viewing of the sewer.

The camera shall provide sufficient light and proper focus to enable clear viewing of the pipe surface at all locations.

The sewer section under inspection shall be free of any fog or vapour that obscures the view. Where required ventilation or other provision shall be used to eliminate such fog or vapour.

The inspection speed shall allow proper analysis of the sewer condition. The maximum camera travel speed shall be 5 m/minute.

When required for a specific inspection, the CCTV camera shall stop and view each service connection clearly and completely for at least five seconds.

Each individual CCTV inspection shall be continuous over the sewer section.

Notice to City of Inspections

The Contractor shall provide 48 hours notice prior to a required CCTV inspection in order that, if required, the Contract Administrator can arrange to be present for the CCTV inspection.

CCTV Screen Information

The sewer section video inspection shall include the Title Screen in the format indicated below, clearly displayed for a minimum of 30 seconds at the start of all video inspection recordings. Inspection of the sewer section shall not proceed while the information screen is being displayed:

Line Number	**TITLE SCREEN**
1	**CITY OF TORONTO** **CONTRACT No.** 12345
2	**SL** – 9 **STREET:** NIAGARA ST.
3	PRELIMINARY / POST-PREPARATION VIDEO
4	**DATE:** 21 MAR/99 **TIME:** 11:55 AM
5	**SURFACE DISTANCE:** 112.0 M
6	**START MH No:** 23 2ND S/O WELLINGTON
7	**END MH No:** 22 1ST S/O WELLINGTON
8	**WEATHER:** DRY / RAIN / MELTING SNOW / etc.
9	**FLOW DIRECTION:** N TO S
10	**CAMERA DIRECTION:** S TO N
11	**START & S/C REFERENCE POINT:** CAMERA PANNED 90°
12	**SIZE:** 305 mm **TYPE:** CLAY **DUTY:** COMBINED
13	**CONTRACTOR:** ACME LINERS INC.

Upon commencement of, and throughout the inspection, the following information shall be continuously displayed on-screen and captured on the recording: start and ending maintenance hole numbers, street name, continuous chainage, and feature/defect coding.

Sewer Condition and Defect Coding

The CCTV inspection shall include condition, feature and defect classification coding according to the Water Research Council (WRc) *Manual of Sewer Condition and Classification* Third Edition.

CCTV inspection and defect coding shall be carried out by former North American Association of Pipeline Inspectors (NAAPI) certified operators. New operators and operators with an expired NAAPI certification over three years must provide sufficient evidence of training by an approved entity such as an individual or association that has been approved by the Contract Administrator.

The Contract Administrator may at any time during this contract specify a form of training or certification to be undertaken by inspection operators based on the current standard or any other industry standard the City adopts in the future.

Inspection Information Recorded as Sewer.dat File

The CCTV inspection equipment and software shall make and record a WRc sewer.dat file of the inspection. The sewer.dat file shall capture all the information required to describe the sewer and its defect coding according to the required WRc sewer condition classifications. The sewer.dat file shall be according to the City's requirements for such files. Prior to the regular contract required submissions of CCTV inspections/reports, the Contractor shall submit a trial sewer.dat file of an inspection for approval by the Contract Administrator.

CCTV Video Recording Files to be Provided on Portable Hard Drive(s)

The required video recordings of CCTV inspections shall be provided on a portable hard drive or other approved media. Each portable hard drive shall be externally identified such as by a label with the following:

- contract number;
- contractor name;
- hard drive number; and
- date hard drive provided.

Each hard drive shall contain a clearly identified document that lists the CIPPSR locations for which CCTV inspections are included on the hard drive, that is to say a contents document. The contents document shall be in a PDF format.

CCTV Video Recording File Format and Conventions

The video file format shall be MPEG-1 or MPEG-2. The MPEG files shall be of a minimum video size resolution of 320 x 240 and encoded at a rate of no less than 750 kb/s

The MPEG file naming convention shall be:
startmaintenancehole_finishmaintenancehole_direction_MMDDYY.mpg
where direction is either "U" for upstream or "D" for downstream

CCTV Inspection Video Player Requirements

CCTV inspection video files shall play properly and completely on commonly used video file playing software applications. The video files must play properly and completely on correctly configured, up to date versions of Microsoft Windows Media Player, VideoLAN VLC Player and Apple QuickTime Player. Video files that do not play properly and completely on all these three players will be rejected.

Inspection Reports

Each CCTV inspection submitted shall be accompanied by an electronic sewer inspection report in PDF file format that is generated from the sewer.dat file. The structure of the reports shall be in the format required by the City. The PDF reports shall be included on the portable hard drive along with the video file and sewer.dat 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 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 section of sewer shall include the video file, the sewer.dat file and the PDF report file. These three files, along with any other information relevant to the specific CCTV inspection such as images from the inspection, shall be grouped together in a clearly identified folder on the portable hard drive.

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.

CCTV Inspections Submission Schedule

The Contractor shall submit the CCTV inspection portable hard drives to the Contract Administrator every 14 Days or as agreed with the Contract Administrator.

Provide CCTV Inspection Video Recordings

For each sewer maintenance hole to maintenance hole section with CIPPSR locations, the Contractor shall submit, on portable hard drive, the three video inspection records of the work every 14 Days or as agreed by the Contract Administrator for the review and approval.

TS 4.12.12 CCTV Truck Units

Proper seating accommodation shall be provided by the Contractor to enable two persons, in addition to the operator, to clearly view the screen of the on-site monitor, which displays the inspection work in the sewers as such work proceeds. No equipment utilized within the sewer shall be allowed to be stored in the viewing area.

The Contractor will equip the inspection units and crew supervisor with a cellular telephone utilizing province of Ontario telephone numbers and will provide the Contract Administrator with the cellular telephone numbers.

Each inspection unit shall be equipped with all fans or blowers or both necessary to remove any fog that may be present in the sewers during inspection.

TS 4.12.13 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.

WRc 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.

TS 4.12.14 Field Measurement of Sewers and Spot Repair Sizing

The Contractor shall measure the internal diameters of the sewer sections to be CIPPSR. The measurements taken shall be suitable for proper sizing of the CIPPSRs to be installed. For requirements for CIPPSR's, see TS 4.12 herein. The Contractor shall not rely on dimensions provided by the City. Measurements shall be provided to the Contract Administrator on request.

TS 4.12.15 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 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 A.

TS 4.12.16 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 4.12.17 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.

Payment for trimming of protruding laterals shall be according to the Contract Price.

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 4.12.18 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 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 13 mm. However regardless of the 13 mm 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.

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 4.12.19 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 cleaned, flushed, scraped, or cut out of the sewer line. Flushing and abandoning of debris in sewer lines is not permitted.

The Contractor shall submit its MOE license with the Bid.

Prior to commencement of the Contract, the Contractor shall notify the Contract Administrator of the disposal site(s). The Contractor shall also provide the Contract Administrator with documentation, such as weigh scale tickets and attached to all relevant invoices, indicating discharge quantities, pertinent dates and discharge location(s).

TS 4.12.20 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 Contactor 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 4.12.21 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 4.12 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.

WRc defect coding is not required for the V2.

TS 4.12.22 CIPP Spot Repair Requirements

The CIPPSR shall be a one piece CIPP construction. The 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 surface on the interior of the sewer shall have an impermeable plastic coating suitable for corrosion prevention, 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 receiving Ontario Ministry of Environment approval and 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 4.12.23 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 install a CIPPSR that has no overlap, that is to say all cured as one piece over the length required or 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 4.12.24 Sizing

The Contractor is responsible to verify the actual the internal diameter of each sewer where a CIPPSR is required. Sizes provided in tender 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 4.12.25 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.
Live Load	AASHTO HS-20 or the actual live load that exists at the CIPPSR location, whichever is greater.
Soil Weight	18.85 KN/m3 (1922 Kg/m3)
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 short-term value shall be 2413 MPa.

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 34.5 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 4.12.26 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 if 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 4.12.27 Installation of CIPPSR

Installation Procedure

The actual CIPPSR installation procedure shall be according to the Bid submission. Any proposed deviation from the submitted procedure shall be submitted, with explanation, to the City for approval and the submission shall include the approval of the CIPPSR supplier, manufacturer or senior licensor.

The sewer line and connection shall be disrupted no more than 4 hours during the entire rehabilitation process including inspection, cleaning and preparation and CIPPSR installation.

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

In the case where CIPPSR installation is expected to or does result in significant odour, the Contractor shall include the following as part of the Work.

The Contractor shall provide notice to the affected residents indicating possible odour resulting from CIPPSR installation. The notice shall indicate to the residents what to expect and typical procedures to alleviate odour.

The Contractor is responsible to respond, investigate and act immediately on any odour complaint that may occur. Actions to be taken by the Contractor to alleviate an odour problem within a property shall include:

- seeking permission to enter the property,
- filling of any dry traps,
- preventing air flow from any traps which to do not function properly—will not water seal,
- ventilating the property via open windows and doors,
- ventilating the property with fans/blowers; and
- other actions that are useful in alleviating the odour problem.

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

Exhaust Fans for Sewer: Two maintenance holes exhaust fans with a minimum capacity of 2100 cfm 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 the ambient temperature of the sewer into which it will drain.

TS 4.12.28 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.

Immediately 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 covered 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 contemplate providing 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.

TS 4.12.29 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.

WRc 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 4.12.30 Samples of Resin and Cured CIPPSR Installations

Field Resin Samples

When required, the Contract Administrator will take an on-site sample of resin from a wet-out CIPPSR that has not been installed yet. The Contractor shall provide necessary assistance in the taking of this sample. The Contract Administrator may have this resin sample tested by IR analysis and compare the resulting spectrograph to the reference spectrograph provided in the Bid for the resin identified for use by the Contractor for the CIPP lining work.

All field resin samples taken for this Contract shall produce IR spectrographs that correspond to the reference IR 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 4.12.31 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. The Contractor shall authorize the testing agency to forward the test reports to the Contract Administrator 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 provision of testing service shall allow for the obtaining of test reports within 10 Days of delivery of the sample to the testing agency.

The Contractor shall provide for the testing agency to forward test reports by e-mail to the Contract Administrator.

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

- flexural strength short-term
- 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 4.12.32 Deficiencies

When the Contractor is aware of any deficiencies in the Work or in the results of the Work, the Contractor shall advise the Contract Administrator of these deficiencies within 48-hours including situations where the deficiency has already been rectified.

Where deficiencies have been identified, either by the Contract Administrator or the Contractor, the Contractor shall resolve, correct or rectify the deficiencies to the satisfaction of the Contract Administrator. Depending on the nature of the deficiency, the Contract Administrator may request that the Contractor provide the Contract Administrator with a method statement, subject to the Contract Administrator's approval, for the repair of the deficiency.

Where in the Contract Administrator's opinion, there is no repair or correction that is satisfactory, the Contract Administrator may require removal and replacement of the CIPPSR or require an alternate resolution at the discretion of the Contract Administrator.

A deficiency will exist when the work or the results of the work is/are not in according to the Contract Documents.

TS 4.12.33 Payment

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the Work.

Appendix

Appendix A: 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)