SPECIFICATIONS FOR CURED-IN-PLACE PIPE (CIPP)

1. GENERAL

1.1 It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin-impregnated flexible tube which is inverted into the original conduit by use of a hydrostatic head. The resin is cured by circulating hot water within the tube. When cured, the finished pipe (CIPP) will be continuous and tight fitting.

1.2 This Particular Specification is to be read in conjunction with the General Specification for Building, 2017 Edition, ("the General Specification" or the "G.S.") together with all current amendments thereto issued by the Drainage Services Department (DSD).

1.3 In the event of any doubt or discrepancy in the PS, the Architect's attention shall be drawn to such discrepancy or lack of information as soon as possible in order that he may advise the Contractor of the required Specification.

1.4 All clauses and descriptions in the General Specification are relevant to the Works and are to apply wherever applicable. The Particular Specification is an amplification of the General Specification and refers only to those clauses and items, which are at variance with or are not specified in the General Specification. In the event of any doubt or discrepancy, the Particular Specification shall prevail, and the Architect's attention shall be drawn to such discrepancy or lack of information as soon as possible in order that he may advise the Contractor of the required specification.

1.5 The Contractor shall include all demolition, alteration, subsequent make good and any other incidental and enabling work, whether stated or not, required for the completion of the work shown in the drawing/specification.

1.6 Should instances arise for which the technical/design standards or specification do not exist in this Particular Specification or the General Specification, the British Standard Codes of Practice and Specification shall be followed.

1.7 The Contractor shall check for any discrepancy between drawings and the site condition, and report to the Architect before the commencement of work. Such the discrepancy shall be included in the Tender Sum and so forth in the Contract Sum.

1.8 Possession of Site/ Time for Completion
The Contractor shall take possession of the site from the date of commencement as notified in the letter of acceptance.
Contractor is to incorporate the above time frames for site possession and completion into the programme of work to be submitted.

1.9 In the performance of the contract, the Contractor shall comply with all laws, ordinances, rules and regulations with respect to the authorities concerned, bearing on the conduct of the work as shown and specified. It is the Contractor's obligation to notify the Architect at the early stage of the work of any work, materials or equipment specified which do not conform to the requirements of the said laws, ordinances, rules and regulations and the Contractor to conform thereto.

2. REFERENCED DOCUMENTS

2.1 This specification referenced ASTM F1216 which is made a part hereof by such reference and shall be the latest edition and revision thereof. In case of conflicting requirements between this specification and F1216, this specification will govern.

3. PRODUCT, MANUFACTURER, CONTRACTOR QUALIFICATION REQUIREMENTS

3.1 Since sewer products are intended to have a 50-year design life, and in order to minimize the Owner's risk, only proven products with substantial successful long term track records will be approved. All trench-less rehabilitation products and installers must be pre-approved prior to receiving bid documents.

Products and Contractors seeking approval must meet all of the following criteria to be deemed Commercially Acceptable:

3.1.1 Supervisory personnel associated with project must also have a minimum of five (5) years experience with specified products.

3.1.2 For a product and installer to be Commercially Proven, the installer must own and operate a permanent facility to impregnate the CIPP tubes. To ensure the Owner all installed products will meet the minimum product quality control standards set forth by the manufacturer, all CIPP liners shall be impregnated by the approved product's licensed installer that is performing the work. No pre- impregnated CIPP products will be accepted from a third-party vendor.

3.1.3 Sewer rehabilitation products submitted for approval must provide third party test results supporting the long term performance and structural strength of the product and such data shall be satisfactory to the Owner. Test samples shall be prepared so as to simulate installation methods and trauma of the product. No product will be approved without independent third party testing verification.

3.1.4 Both the rehabilitation manufacturing and installation processes shall operate under a quality management system which is third-party certified to ISO 9001 and ISO 14001. Proof of certification shall be required for approval.

3.1.5 The rehabilitation manufacturing and installation must be performed by a Specialist Contractors in the "Supply and Installation of Glass (or Fibre) Reinforced Plastic Units" category of the list of approved Suppliers of Materials and Specialist Contractors for Public Works of HKSAR Government and in the approved list of registered sub-contractor under the construction industry co-ordination board. The specialist contractor should have included in the list for over 20 years.

3.1.6 Proposals must be labeled clearly on the outside of the proposal envelope, listing the product name and Contractor being proposed.

4. MATERIALS

4.1 TUBE – The tube material shall meet the requirements of ASTM F1216. Section 5.1.

4.1.1 The tubes shall have a uniform thickness that when compressed at installation pressures will equal the specified nominal tube thickness.

4.1.2 The tube shall be fabricated to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion.

4.1.3 The outside layer of the tube (before inversion) shall be plastic coated with a translucent flexible material that clearly allows inspection of resin impregnation (wetout) procedure. The plastic coating shall not be subject to delamination after curing the CIPP.

4.1.4 The tube shall be homogenous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No materials shall be included in the tubes that are subject todelamination in the cured CIPP.

4.1.5 The wall color of the interior pipe surface of the CIPP after installation shall be a light reflective color so that a clear detail examination with closed circuit television inspection equipment may be made.

4.2 Resin – The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured within the tube composite meets the requirements or ASTM F1216 and ASTM F1743, the physical properties herein, and those which are to be utilized in the Design of the CIPP for this project. The resin shall produce CIPP which will comply with the structural and chemical resistance requirements of this specification.

5. STRUCTURAL REQUIREMENTS

5.1 The CIPP shall be designed as per ASTM F1216, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall.

5.2 The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed by his company. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D-790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Values in excess of 50% will not be applied unless substantiated by qualified third party test data. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in design.

5.3 The enhancement factor “K” to be used in “partially deteriorated” design conditions shall be assigned a value of 7. Application of enhancement (K) factors in excess of 7 shall be substantiated through independent test data.

5.4 The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occurs during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

5.5 The cured pipe material (CIPP) shall conform to the minimum structural standards; as listed below.

Property	Test Method	Cured Composite min. per ASTM F1216	Cured Composite (400,000 psi Resin)
Flexural Stress	ASTM D-790	4,500 psi	4,500 psi
Modulus of Elasticity	ASTM D-790 (short term)	250,000 psi	400,000 psi

5.6 The required structural CIPP wall thickness shall be based as a minimum, on the physical properties in Section 5.5 and in accordance with the design Equations in the appendix of ASTM F1216, and the following design parameters:

Design Safety Factor	= 2.0
Retention Factor for Long-Term Flexural Modulus to be used in Design *(as determined by Long-Term tests described in paragraph 5.2)*	= 1%-60%
Ovality*	= 2%
Enhancement Factor, K	= See Section 5.3
Groundwater Depth (above invert)*	= ft.
Soil Depth (above crown)*	= ft.
Soil Modulus**	= Psi
Soil Density**	= 120 pcf
Live Load**	= H20 Highway
Design Condition (fully deteriorated)***	= ***

* Denotes information which can be provided here or in inspection video tapes or project construction plans. Multiple line segments may require a table of values.

** Denotes information required only for fully deteriorated design conditions.

*** Based on review of video logs, conditions of pipeline can be fully or partially deteriorated. (See ASTM F1216 Appendix) The Owner will be sole judge as to pipe conditions and parameters utilized in Design.

5.7 Refer to the attached Dimensional Ratio table for specific pipe section requirements, based on the pipe condition, depth, ovality, etc. as computed for the conditions shown, using ASTM F1216 Design Equations.

5.8 Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

6. TESTING REQUIREMENTS

6.1 Chemical Resistance – The Contractor shall certify that CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

6.2 Hydraulic Capacity – The Contractor shall certify that the CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition. The roughness coefficient of the CIPP shall be verified by third party test

data.

6.3 CIPP Field Samples – When requested by the Owner, the Contractor shall submit test results from previous field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Section 5.3 have been achieved in previous field applications. In addition, the Contractor must also submit third party test results from an unrelated company when requested by the Engineer and at the Contractor's cost. Testing samples for this project shall be made and tested as described in Section 10.1.

7. INSTALLATION RESPONSIBILITIES FOR INCIDENTAL ITEMS

7.1 It shall be the responsibility of the Contractor to locate and designate all manhole access points open and accessible for the work, and provide rights of access to these points. If a street must be closed to traffic because of the orientation of the sewer, the Owner shall institute the actions necessary to do this for the mutually agreed time period. The Owner shall also provide free access to water hydrants (locations determined by owner, setup fees may be applicable) for cleaning, inversion and other work items requiring water.

7.2 Cleaning of Sewer Lines – The Contractor shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP (refer to sewer cleaning specifications contained elsewhere in this document). The Owner shall also provide a dump site for all debris removed from the sewers during the cleaning operation. Unless stated otherwise, it is assumed this site will be at the sewage treatment facility (sludge dumping pad or as determined by owner) to which the debris would have arrived in absence of the cleaning operation. Any hazardous waste material encountered during this project will be considered as a changed condition.

7.3 Bypassing Sewage – The Contractor, when required, shall provide for the flow of sewage around the section or sections or pipe designated for repair. The bypass shall be made by plugging the line at an existing upstream manhole(s) and pumping the flow into a downstream manhole or adjacent system / zone. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Owner may require a detail of the bypass plan to be submitted. Note, dam #6 bypass flow can be routed to the 30" suction system on the downstream side of the dam. Dam #1 bypass flow can be routed to the 15" sewer and or the 30" suction sewer on the north bank of the river. Alternative means can be provided by the contractor for ease of completing the work.

7.4 Inspection of Pipelines – Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by close circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent property installation of CIPP into the pipelines, and it shall be noted so that these conditions can be corrected. A video DVD and suitable log shall be kept for later reference by the Owner (pre & post DVDs required).

7.5 Line Obstructions – It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of the CIPP. If

pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the inversion process, and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work and shall be considered as a separate pay item.

8. INSTALLATION

8.1 CIPP installation shall be in accordance with ASTM F1216, section 7, with the following additional requirements:

8.1.1 Resin Impregnation – The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of the resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used. To insure thorough resin saturation throughout the length of the felt tube, the point of vacuum shall be no further than 25 feet from the point of initial resin introduction.

After vacuum in the tube is established, a vacuum point shall be no further than 75 feet from the leading edge of the resign. The leading edge of the resin slug shall be as near to perpendicular as possible. A roller system shall be used to uniformly distribute the resign throughout the tube. If the Installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.

8.1.2 Temperature gauges shall be placed to determine the temperature of the incoming and outgoing water from the heat source. Another such gauge shall be placed inside the tube and at the end to determine the temperature at the location during the cure cycle.

8.1.3 Installation and curing shall be accomplished by inversion utilizing water under hydrostatic pressure of a vertical standpipe.

9. REINSTATEMENT OF BRANCH CONNECTIONS

9.1 It is the intent of these specifications that branch connections to buildings be reopened without excavation, utilizing a remotely controlled cutting device, monitored by a video TV camera or alternative means. The Contractor shall certify he has a minimum of 2 complete working units plus spare key components on the site before each inversion. No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work. Contractor shall locate and field verify along with owners assistance on which sewer leads are active and are to bereinstated.

10. INSPECTION

10.1 CIPP samples shall be prepared and tested in accordance with ASTM F1216 or ASTM F1743, Section 8 using either method proposed. The flexural properties must meet or exceed the values listed in Table 1 of the applicable ASTM.

10.2 Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F1743. The minimum wall thickness at any point shall not be less than 87.5% of the design thickness as calculated in paragraph 5.6 of thisdocument.

10.3 Leakage testing of the CIPP shall be accomplished during cure while under a positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g., a removable bladder) must be tested by an alternative method approved by the Owner.

10.4 Visual inspection of the CIPP shall be in accordance with ASTM F1216, Section 8.6.

11. CLEAN-UP

11.1 Upon acceptance of the installation work and testing, the Contractor shall reinstate the project area affected by the operations to a condition at least equal to that existing prior to the work.