EXHIBIT A

WASTEWATER COLLECTION SYSTEM REHABILITATION – 2024

Project No.: 3221024

TECHNICAL SPECIFICATIONS

Submitted To:

CITY OF TEMPE

October 7, 2024

Mayor
Corey D. Woods

Vice Mayor
Doreen Garlid

City Council
Arlene Chin
Jennifer Adams
Berdetta Hodge
Randy Keating
Nikki Amberg

Submitted by:

DIBBLE

www.dibblecorp.com

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WASTEWATER COLLECTION SYSTEM REHABILITATION – 2024

TECHNICAL SPECIFICATIONS

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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 SCOPE

A. All construction shall be provided in accordance with the requirements of the 2023 Revision to the 2020 Maricopa Association of Government (MAG) and the 2014 City of Tempe Supplement to MAG Uniform Standard Specifications and Details for Public Works Construction.

B. The Contractor shall provide all materials, equipment, and labor necessary to rehabilitate / replace sanitary sewer pipes and access manholes utilizing epoxy coating technologies, composite inserts, Cured-In-Place-Pipe (CIPP) liner, and/or open cut replacement/installation methods according to project design drawings and/or technical specifications.

C. Major work to be performed under this contract includes, but is not limited to the following:

1. Provide all traffic control on streets, alleys and driveways during construction as necessary for sanitary sewer pipe rehabilitation, access manhole rehabilitation and bypass operations. Traffic control plans shall be submitted to the City for approval prior to construction activities.

2. Restore area disturbed by construction activities back to pre-construction conditions.

3. Provide coordination with the City for public notification of construction activities to the general public.

4. Provide all bypass pumping, piping, power, noise control, and odor control including materials, labor and equipment necessary to divert sanitary sewage flows around the rehabilitation construction area as necessary to complete the work.

5. Coordinate work activities with adjacent businesses, public events and special needs i.e. medical and emergency response.

6. Maintain access to private properties including sidewalks and driveways as necessary during the course of the work. Maintain sanitary sewer service to properties as necessary to prevent sewage backups into homes and businesses.

7. Perform initial cleaning of sanitary sewer pipe to remove all grease, scale, roots, debris, and foreign protrusions prior to pipe rehabilitation.

8. Provide all equipment, labor, and materials to remove and install sanitary sewer pipe.

9. Perform “pre” pipe rehabilitation analog CCTV and “post” pipe rehabilitation 360 degree view digital CCTV condition documentation.

10. Provide all equipment, labor, and materials required to install CIPP liner into sanitary sewer pipes as indicated in the design drawings and technical specifications.

11. Provide all necessary equipment to prevent construction debris from entering sanitary sewer system.

12. Provide all necessary equipment, labor, and materials required to relocate City fiber optic line to above the sanitary sewer pipe.

13. Coordinate work activities with City I.T. Department to relocate fiber optic line to above the sanitary sewer pipe.

14. Provide all equipment, labor, and materials required to install structural manhole inserts as indicated in the design drawings and technical specifications.

15. Provide all equipment, labor, and materials required to install polymer concrete manhole as indicated in the design drawings and technical specifications.

16. Provide all equipment, labor, and materials required to clean and coat access manholes as indicated in the design drawings and technical specifications.

17. Provide “post” rehabilitation 360 degree view digital scan of manholes to document as-built conditions.

1.02 UTILITIES

A. The Contractor shall field locate and verify the horizontal and vertical location of all pipe along with wet and dry utilities prior to conducting any excavation work.

B. The Contractor is required to contact Arizona 811, formerly Blue Stake, at (602) 263-1100 at least two (2) working days prior to start of any excavation.

C. Quarter Section maps of the City’s sanitary sewer collection system are available upon request from the City. It shall be the responsibility of the Contractor to coordinate, obtain and pay all fees associated with obtaining copies of these maps. The Contractor shall not solely rely upon the information contained in the mapping and shall field verify for accuracy.

1.03 FLOW CHARACTERISTICS

A. The project sanitary sewer collection system receives wastewater from residential, commercial, and industrial facilities within the City. The Contractor shall bypass flows

around the work area described in the project as necessary to complete the work specified.

B. The collection system may receive nuisance runoff water during storm events. Volumes of nuisance water are unpredictable. Contractor shall be responsible to take appropriate precaution when rain events are pending.

PART 2 - PRODUCTS
(NOT USED)

PART 3 - EXECUTION
(NOT USED)

**** END OF SECTION ****

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SECTION 01014
WORK SEQUENCE

PART 1 - GENERAL

1.01 CONTINUITY OF FACILITY OPERATIONS

Work under this Contract shall be planned, scheduled and performed so as to minimize disruption to the operation of existing business, facilities, surrounding residents and the traveling public. The Contractor shall provide all equipment and facilities (including piping, pumps, odor mitigation, and noise control along with standby power, pumps, equipment and appurtenances) necessary to maintain flow through and/or around existing facilities. Contractor shall be responsible for traffic control to redirect the flow of traffic through and/or around the work area.

1.02 PROJECT COMPLETION

The project shall be completed within the contract time as outlined in the Agreement.

1.03 PUBLIC INFORMATION

A. Refer to Technical Specification Section 01310 - Progress Schedule

1.04 PROJECT CONSTRUCTION COORDINATION

A. At the Preconstruction Meeting, the Contractor shall designate a Representative who will be on the job and available for communication at all times for the duration of the construction contract. The Contractor's Representative shall be available 24 hours a day by mobile telephone, home telephone, or other means acceptable to the City or City's Representative. The representative shall be the contact person representing the Contractor, and shall be capable of giving direct field orders as the need arises. Official job communication shall be conducted between Contractor's Representative and the City or City's Representative.

B. The Contractor shall obtain written approval from the City or City's Representative 72 hours in advance of any change in the Contractor's daily work schedule. Work performed at times other than the approved schedule must first be approved by the City or City's Representative.

C. The Contractor's Representative shall attend a weekly construction progress meeting. Location of the meeting shall be determined by the City or City's Representative. The Contractor shall present and distribute copies of the two week look-ahead schedule, report on status of resident concerns reported, any Traffic Control Plan updates, and upcoming construction activity coordination.

D. Contractor shall designate a Field Superintendent who shall be responsible for coordination of the work schedule. It shall be the responsibility of the Contractor to sequence work to resolve conflicts with adjacent construction and schedule work accordingly to minimize disruption. The City will not entertain Contractor claims for additional compensation arising out of construction delays caused by adjacent construction work. City may at its sole discretion grant an extension of contract time due to unforeseen delays caused by adjacent construction activity conflicts.

1.05 SCHEDULING AND SEQUENCING CONSTRAINTS

A. The Contractor shall rehabilitate sanitary sewer pipes and access manholes identified in the Design Drawings. Once construction activities commence, the Contractor shall continue uninterrupted until all sanitary sewer pipes and access manholes identified are completed unless variance is obtained in writing from the City.

B. No construction activities shall begin on-site until all required submittals are transmitted to the City or City's Representative and returned with a signed and dated approved stamp attached.

C. Traffic control shall remain in effect as dictated by the approved Traffic Control Plan and Permit until all work is completed and inspected. Contractor shall maintain access to all properties within the project area on a 24-hour basis unless written approval is otherwise obtained from property(s) owners for reduced access. Copies of all written approvals shall be provided to the City or City's Representative prior to work commencing. Refer to Technical Specification Section 02100 – Traffic Control.

D. Bypassing sewage flow as required for rehabilitation of sanitary sewer pipe and access manholes is part of this contract. Refer to Technical Specification Section 02145 – Diversion of Sewage Flow and Dewatering for the bypass pumping requirements and restrictions.

E. The Contractor shall perform a detailed inspection of the work to confirm completion of all work items and conformance to the project Technical Specifications. Final inspection of the work will be carried out by the City or City's Representative after receipt of the Contractor's written request for final inspection.

F. After receipt of the Contractor's written notice of work completion, the City or City's Representative will perform a detailed inspection and will create a punch list of omissions and defects observed. Punch list items shall be promptly corrected by the Contractor. The Contractor shall then schedule a time for re-inspection by the City or City's Representative upon satisfactory completion of the punch list items. All costs associated with re-inspection, including the City's Representative's time and re-inspection costs, shall be the responsibility of the Contractor.

1.06 CONTRACTOR WORK HOURS

A. The Contractor shall ensure adequate resources are available to complete all work within regular business hours per City of Tempe-Code of the City Chapter 20 Section 20-8 – Construction of Buildings and Projects.

B. Contractor may be required to operate bypass pumping systems 24-hous per day or work at night to minimize disruption to area residents or businesses. It shall be the responsibility of the Contractor to ensure City of Tempe work permit allows for extended work hours.

PART 2 - PRODUCTS
(NOT USED)

PART 3 - EXECUTION
(NOT USED)

**** END OF SECTION ****

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SECTION 01015
CONTRACTOR'S USE OF PREMISES

PART 1- GENERAL

1.01 OWNER'S RESPONSIBILITIES

A. The City of Tempe staff is responsible for operating the existing sewers and facilities throughout the execution of this Project.

1.02 CONTRACTOR'S RESPONSIBILITIES

A. Except where the Contractor is bypassing flows, sewer and force main (if present) pipes shall remain in operation throughout the performance of this Project. All coordination between the City of Tempe's operations personnel and the Contractor on all matters shall be through the City's appointed Project Manager unless otherwise approved in writing by the City.

1.03 USE AND OPERATION OF EXISTING FACILITIES

A. The Contractor shall not interfere with the operation of existing sewers and sanitary sewer pipes, except to bypass flows as necessary to perform the work. The Contractor shall exercise every precaution to ensure that debris and material from its operation does not enter the sewer. Any debris or blockage entering into the sewer as a result of the Contractor's work shall be immediately removed at the Contractor's expense. Any damages caused by or as a result of the debris entering the sewer shall be the responsibility of the Contractor.

B. All costs, coordination, permits, and fees associated with the location of staging areas, material, equipment storage, and site trailer location (if applicable) shall be the responsibility of the Contractor. The Contractor shall submit copies of individual landowner agreements (if present) to the City. All disturbed areas shall comply with the dust control plan required by Maricopa County Environmental Services Department as specified in Technical Specification Section 01062 – Permits and Easements.

1.04 TRAFFIC:

A. The Contractor shall comply with Technical Specification Section 02100 – Traffic Control.

1.05 DAMAGE TO EXISTING PROPERTY

A. Contractor shall be responsible for any damage to existing structures, piping, work, materials, or equipment because of its operations, and shall repair or replace any damaged structures, piping, work, materials or equipment to the satisfaction of, and at no additional cost to the City.

B. Contractor shall protect all existing structures and property from damage.

C. Contractor shall be responsible for all damage to streets, roads, curbs, sidewalks, walking trails, driveways, ditches, embankments, drainages, floodways, landscaping, or other public or private property, which may be caused by the work including transporting equipment, materials, or workers to or from the work. Contractor shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement and/or as specified in these Technical Specifications.

D. Contractor shall be responsible for any and all damage to private property as caused by the Contractor's operations including but not limited to sewage spills/backups.

PART 2 - PRODUCTS
(NOT USED)

PART 3 - EXECUTION
(NOT USED)

**** END OF SECTION ****

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

Measurement and payment for Work performed shall be in accordance with the unit price, unless work is defined as an allowance item.

1.02 AUTHORITY

A. The City's Representative will take all measurements and compute quantities accordingly.

B. The Contractor shall provide assistance by providing necessary equipment, workers, and survey personnel as required.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantities and measurements indicated are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the City's Representative shall determine payment.

B. If the actual Work requires more or fewer quantities than those quantities indicated, the Contractor shall provide the required quantities at the unit sum/prices contracted.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

B. Measurement by Area: Measured by square dimension using mean length and width or radius.

C. Thickness Measurement: Measured perpendicular to surface of liner or coating.

D. Linear Measurement: Measured by linear dimension at the item centerline or mean chord.

E. Each: Measured by item separately.

E. Lump Sum: Measured on a percent of complete basis.

1.05 PAYMENT

A. Payment Includes: Full compensation for all required labor, products, tools, equipment,

transportation, application or installation of an item of the Work; overhead and profit, insurance, bonding, taxes, and all incidentals necessary to complete the construction.

B. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the City's Representative multiplied by the unit sum/price for Work which is incorporated in or made necessary by the Work.

C. Payment for allowance items will be made on approved invoices with no additional markup by the Contractor.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

General Construction

Bid Item 1: Remove & Replace AC Pavement

This item includes full compensation to the Contractor for all costs associated with the removal and replacement of Asphalt Concrete pavement for pipe and manhole rehabilitation areas as indicated in the Design Drawings. This bid item shall be full compensation for all labor, materials, and equipment, including sawcut and removal of existing asphalt concrete pavement, subgrade preparation, aggregate base course, asphalt concrete pavement placement and any required testing. This item also includes all costs associated with labor, materials, equipment, for removal and temporary and permanent replacement of all obliterated pavement markings according to City of Tempe paving requirements. Measurement for payment will be per SQUARE YARD of asphalt concrete pavement installed complete and accepted in-place.

Bid Item 2: Remove & Replace Concrete Sidewalk & Alley Entrance

This item includes full compensation to the Contractor for all costs associated with the removal and replacement of concrete sidewalk and concrete alley entrance for pipe and manhole rehabilitation areas as indicated in the Design Drawings. This item includes all costs associated with saw cutting, excavation, removal, proper disposal of removed materials, backfill, compaction, concrete sidewalk placement, alley entrance placement, and any required testing. Payment shall be considered full compensation for materials, labor, equipment and all other work required to complete construction in accordance with the Contract Documents. Measurement for payment shall be made per SQUARE FOOT of sidewalk and alley entrance installed and accepted in place.

Bid Item 3: Remove & Replace Directional Sidewalk Ramp

This item includes full compensation to the Contractor for all costs associated with the removal and replacement of concrete directional sidewalk ramp for pipe rehabilitation as indicated in the Design Drawings per City of Tempe Standard Detail T-328. This item includes all costs associated with saw cutting, excavation, removal, proper disposal of removed materials, backfill, compaction, labor and materials for concrete curb ramp placement, and any required testing. Payment shall be considered full compensation to complete required work in accordance with the Contract

Documents. Measurement for payment shall be made per SQUARE FOOT of concrete directional curb ramp installed and accepted in place.

Bid Item 4: Remove & Replace 48-inch Diameter Brick Manhole

This item includes full compensation to the Contractor for all costs associated with the removal and replacement of 48-inch diameter brick manhole wall as indicated in the Design Drawings. This item includes all costs associated with saw cutting, excavation and removal, proper disposal of removed materials, and labor to complete brick manhole removal. This item also includes all labor, materials, and placement costs to construct 48-inch diameter concrete manhole as indicated in the Design Drawings per MAG Standard Detail 420. Payment shall be considered full compensation to complete required work in accordance with the Contract Documents. Measurement for payment shall be made per EACH installed and accepted in place.

Bid Item 5: Install 48-inch Diameter Sanitary Sewer Access Manhole

This item includes full compensation to the Contractor for all costs associated to construct 48-inch diameter sanitary sewer manhole as indicated in the Design Drawings. This item includes all labor, material, and equipment required to complete the work in accordance with MAG Standard Specifications and Standard Details 420-1, 420-2, and 420-3. This item also includes locate and remove cleanout, and 24-inch Frame and Cover and composite adjustment rings installed and adjusted in accordance with City of Tempe Standard Detail T-446. Measurement for payment shall be made on a per EACH basis. Payment shall be paid based on manhole installed and accepted in place.

Pipe Rehabilitation

Bid Item 6: Mobilization/ Demobilization

This item includes full compensation to the Contractor for all mobilization and demobilization to the project area(s) of Contractor's personnel, equipment, supplies and incidentals, including establishment of offices and other facilities required for the performance of the work on the project, preparatory work, field verification of all dimensions, and operations prior to the commencement of the work on the project site. Mobilization shall be on an authorized basis by the City.

Mobilization and demobilization will be measured for payment by LUMP SUM. Payment will be paid to the Contractor in two equal payments. First payment to be paid with the initial pay application and the second to be paid with final pay application.

Bid Item 7: Remove Sanitary Sewer Pipe

This item includes full compensation to the Contractor for all costs associated with the removal of sanitary sewer pipe as indicated in the Design Drawings. This item includes all costs associated with excavation, shoring, removal, handling, loading, hauling, and proper disposal of removed materials and any dump fees associated with legal disposal of materials removed. This item also

includes all costs associated with backfill in areas where sanitary sewer pipe will not be replaced. Payment shall be considered full compensation to complete required work in accordance with the Contract Documents. Measurement for payment shall be made per LINEAR FOOT.

Bid Item 8: Relocate Cross Bore Utility

This item includes full compensation to the Contractor to relocate cross bore utility above the sewer pipe as indicated in the Design Drawings. This item includes all costs associated with excavation, shoring, removal, handling, loading, hauling, and proper disposal of removed materials and any dump fees associated with legal disposal of materials removed. This item also includes all costs associated with moving utility to above the pipe and backfill. Payment shall be considered full compensation to complete required work in accordance with the Contract Documents. Measurement for payment shall be made per LINEAR FOOT.

Bid Item 9: Install 8-inch Sanitary Sewer Pipe

This item includes full compensation to the Contractor to install 8-inch sanitary sewer pipe as indicated in the Design Drawings. This item includes all labor, material, and equipment required to complete the work in accordance with MAG Standard Specification. This item also includes all costs associated with pipe bedding, furnishing and installing pipe material as indicated in the Design Drawings, connecting to existing pipe and service laterals, backfilling, compaction, surface restoration, replacing landscaping in kind, and testing. Payment shall be considered full compensation to complete required work in accordance with the Contract Documents. Measurement for payment shall be made per LINEAR FOOT of pipe installed and accepted in place.

Bid Item 10: Provide, Operate, & Remove Bypass Pumping & Piping System

This item includes full compensation to the Contractor for all labor, materials, and required equipment to divert sanitary sewer flow around the project work site and discharge back into the existing sanitary sewer system as specified in Technical Specification Section 02145 – Diversion of Sewage Flow and Dewatering. Also included in this bid item are standby pumps and system repair materials available and ready on-site in case of excess flow conditions or mechanical failures. This item shall also include installation, operation, maintenance, sewage spill containment around pumps, fuel spill containment system, by-pass pipes and valving, pneumatic plugs, pressure testing, odor control covers, noise suppression, air release/vacuum valves, and burp tanks. This item also includes flushing and removal of pumps and pipes after bypass completion, and any landscape restoration. Measurement for payment shall be made on a LUMP SUM basis and paid as a percentage of bypass operations completed.

Bid Item 11: Clean Existing 6-inch, 8-inch, 10-inch & 12-inch Diameter Sanitary Sewer Pipe

This item includes full compensation to the Contractor for hydro-blast cleaning as indicated in the Design Drawings and specified in the technical specifications Section 02760 – Sewer Pipe and Sewer Structure Cleaning of existing 6-inch, 8-inch, 10-inch, and 12-inch diameter sanitary sewer pipes. This item includes all costs associated with cleaning of pipes to be rehabilitated with off-site disposal of sediments and debris according to all applicable state and federal regulations. This item also includes removal of obstructions as indicated in the Design Drawings, removal of

obstructions that may hinder installation of CIPP liner, and all necessary safety and support systems, labor, equipment, and materials required to perform the work. Payment shall be considered full compensation to complete required work in accordance with the Contract Documents and accepted in place. Measurement for payment shall be made on a LINEAR FOOT basis of sewer pipe cleaned, measured from center of upstream manhole to center of downstream manhole, of pipe cleaned and accepted.

Bid Item 12: Clean Existing 21-inch, 27-inch & 36-inch Diameter Sanitary Sewer Pipe

This item includes full compensation to the Contractor for hydro-blast cleaning with up to three (3) passes of the nozzle as indicated in the Design Drawings and specified in the technical specifications Section 02760 – Sewer Pipe and Sewer Structure Cleaning of existing 21-inch, 27-inch, and 36-inch diameter sanitary sewer pipes. This item includes all costs associated with cleaning of pipes to be rehabilitated with off-site disposal of sediments and debris according to all applicable state and federal regulations. This item also includes removal of obstructions as indicated in the Design Drawings, removal of obstructions that may hinder installation of CIPP liner, and all necessary safety and support systems, labor, equipment, and materials required to perform the work. Payment shall be considered full compensation to complete required work in accordance with the Contract Documents. Measurement for payment shall be made on a LINEAR FOOT basis of sewer pipe cleaned as measured from center of upstream manhole to center of downstream manhole.

Bid Item 13: Mechanically Clean Ductile Iron Pipe

This item includes full compensation to the Contractor for mechanical cleaning of Ductile Iron Pipe (DIP) to remove tuberculation and debris that cannot be removed through typical hydro-blast cleaning as indicated in the Design Drawings and specified in the technical specifications Section 02760 – Sewer Pipe and Sewer Structure Cleaning. This item includes all costs associated with mechanical cleaning of tuberculated Ductile Iron Pipe, off-site disposal of sediments and debris according to all applicable state and federal regulations. This item also includes removal of any obstructions that may hinder installation of CIPP liner, all necessary safety and support systems, labor, equipment and materials required to perform the work. Measurement for payment shall be made on a LINEAR FOOT basis of Ductile Iron Pipe cleaned as indicated on the Design Drawings.

Bid Item 14: Pre & Post Pipe Rehabilitation CCTV Inspection

This item includes full compensation to the Contractor for CCTV video inspection as specified in the Technical Specifications Section 02761 - Remote Imaging Inspections of Existing and Rehabilitated Sewers of existing 8-inch, 10-inch, 12-inch, 15-inch, 21-inch, and 24-inch diameter sanitary sewer pipes utilizing analog or digital CCTV (pre-rehabilitation) and digital 360 view CCTV (post-rehabilitation) video equipment. This item includes all costs associated with CCTV inspection at two project milestones, pre-pipe rehabilitation (after cleaning) CCTV inspection and a second CCTV inspection at post-pipe rehabilitation (after liner installation and lateral reinstatement, and/or open cut excavation replacement is complete), all necessary safety and support systems, miscellaneous labor, materials and equipment required to perform the work. Payment shall be made on a LINEAR FOOT basis of sewer pipe CCTV inspected, measured from center of upstream manhole to center of downstream manhole.

Bid Item 15: Install 6-inch CIPP Liner

This item includes full compensation to the Contractor to install 6-inch diameter Cured-In-Place-Pipe (CIPP) liner including all labor, materials, and required equipment as indicated in the Design Drawings. This item includes terminating and sealing CIPP liner within the access manhole as indicated in the Design Drawings, reinstating factory tap service laterals, reinstating drop connection, and all required sampling and testing as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. This item also includes re-cleaning of pipes to be rehabilitated as required by the CIPP liner manufacturer requirements prior to pre-pipe rehabilitation CCTV inspection. Pre-CCTV (prior to liner installation), and post-CCTV (after liner installation) are included under a separate bid item.

This work will be measured for payment after installation of the liner is accepted in-place and complete. Measurement for length will be along the centerline of the pipe from center of upstream manhole cover to center of downstream manhole cover. No proportional payment shall be made for liner on-site, but not yet installed. Measurement for payment shall be per LINEAR FOOT of liner installed as measured from center of the upstream manhole to the center of the downstream manhole.

Bid Item 16: Install 8-inch CIPP Liner

This item includes full compensation to the Contractor to install 8-inch diameter Cured-In-Place-Pipe (CIPP) liner including all labor, materials, and required equipment as indicated in the Design Drawings. This item includes terminating and sealing CIPP liner within the access manhole as indicated in the Design Drawings, reinstating factory tap service laterals, reinstating drop connection, and all required sampling and testing as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. This item also includes re-cleaning of pipes to be rehabilitated as required by the CIPP liner manufacturer requirements prior to pre-pipe rehabilitation CCTV inspection. Pre-CCTV (prior to liner installation), and post-CCTV (after liner installation) are included under a separate bid item.

This work will be measured for payment after installation of the liner is accepted in-place and complete. Measurement for length will be along the centerline of the pipe from center of upstream manhole cover to center of downstream manhole cover. No proportional payment shall be made for liner on-site, but not yet installed. Measurement for payment shall be per LINEAR FOOT of liner installed as measured from center of the upstream manhole to the center of the downstream manhole.

Bid Item 17: Install 10-inch CIPP Liner

This item includes full compensation to the Contractor to install 10-inch diameter Cured-In-Place-Pipe (CIPP) liner including all labor, materials, and required equipment as indicated in the Design Drawings. This item includes terminating and sealing CIPP liner within the access manhole as indicated in the Design Drawings, reinstating factory tap service laterals, reinstating drop connection, and all required sampling and testing as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. This item also includes re-cleaning of pipes to be rehabilitated as required by the CIPP liner manufacturer requirements prior to pre-pipe rehabilitation CCTV inspection. Pre-CCTV (prior to liner installation), and post-CCTV (after liner

installation) are included under a separate bid item.

This work will be measured for payment after installation of the liner is accepted in-place and complete. Measurement for length will be along the centerline of the pipe from center of upstream manhole cover to center of downstream manhole cover. No proportional payment shall be made for liner on-site, but not yet installed. Measurement for payment shall be per LINEAR FOOT of liner installed as measured from center of the upstream manhole to the center of the downstream manhole.

Bid Item 18: Install 12-inch CIPP Liner

This item includes full compensation to the Contractor to install 12-inch diameter Cured-In-Place-Pipe (CIPP) liner including all labor, materials, and required equipment as indicated in the Design Drawings. This item includes terminating and sealing CIPP liner within the access manhole as indicated in the Design Drawings, reinstating factory tap service laterals, reinstating drop connection, and all required sampling and testing as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. This item also includes re-cleaning of pipes to be rehabilitated as required by the CIPP liner manufacturer requirements prior to pre-pipe rehabilitation CCTV inspection. Pre-CCTV (prior to liner installation), and post-CCTV (after liner installation) are included under a separate bid item.

This work will be measured for payment after installation of the liner is accepted in-place and complete. Measurement for length will be along the centerline of the pipe from center of upstream manhole cover to center of downstream manhole cover. No proportional payment shall be made for liner on-site, but not yet installed. Measurement for payment shall be per LINEAR FOOT of liner installed as measured from center of the upstream manhole to the center of the downstream manhole.

Bid Item 19: Install 21-inch CIPP Liner

This item includes full compensation to the Contractor to install 21-inch diameter Cured-In-Place-Pipe (CIPP) liner including all labor, materials, and required equipment as indicated in the Design Drawings. This item includes terminating and sealing CIPP liner within the access manhole as indicated in the Design Drawings, reinstating factory tap service laterals, reinstating drop connection, and all required sampling and testing as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. This item also includes re-cleaning of pipes to be rehabilitated as required by the CIPP liner manufacturer requirements prior to pre-pipe rehabilitation CCTV inspection. Pre-CCTV (prior to liner installation), and post-CCTV (after liner installation) are included under a separate bid item.

This work will be measured for payment after installation of the liner is accepted in-place and complete. Measurement for length will be along the centerline of the pipe from center of upstream manhole cover to center of downstream manhole cover. No proportional payment shall be made for liner on-site, but not yet installed. Measurement for payment shall be per LINEAR FOOT of liner installed as measured from center of the upstream manhole to the center of the downstream manhole.

Bid Item 20: Install 27-inch CIPP Liner

This item includes full compensation to the Contractor to install 27-inch diameter Cured-In-Place-Pipe (CIPP) liner including all labor, materials, and required equipment as indicated in the Design Drawings. This item includes terminating and sealing CIPP liner within the access manhole as indicated in the Design Drawings, reinstating factory tap service laterals, reinstating drop connection, and all required sampling and testing as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. This item also includes re-cleaning of pipes to be rehabilitated as required by the CIPP liner manufacturer requirements prior to pre-pipe rehabilitation CCTV inspection. Pre-CCTV (prior to liner installation), and post-CCTV (after liner installation) are included under a separate bid item.

This work will be measured for payment after installation of the liner is accepted in-place and complete. Measurement for length will be along the centerline of the pipe from center of upstream manhole cover to center of downstream manhole cover. No proportional payment shall be made for liner on-site, but not yet installed. Measurement for payment shall be per LINEAR FOOT of liner installed as measured from center of the upstream manhole to the center of the downstream manhole.

Bid Item 21: Install 36-inch CIPP Liner

This item includes full compensation to the Contractor to install 24-inch diameter Cured-In-Place-Pipe (CIPP) liner including all labor, materials, and required equipment as indicated in the Design Drawings. This item includes terminating and sealing CIPP liner within the access manhole as indicated in the Design Drawings, reinstating factory tap service laterals, reinstating drop connection, and all required sampling and testing as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. This item also includes re-cleaning of pipes to be rehabilitated as required by the CIPP liner manufacturer requirements prior to pre-pipe rehabilitation CCTV inspection. Pre-CCTV (prior to liner installation), and post-CCTV (after liner installation) are included under a separate bid item.

This work will be measured for payment after installation of the liner is accepted in-place and complete. Measurement for length will be along the centerline of the pipe from center of upstream manhole cover to center of downstream manhole cover. No proportional payment shall be made for liner on-site, but not yet installed. Measurement for payment shall be per LINEAR FOOT of liner installed as measured from center of the upstream manhole to the center of the downstream manhole.

Bid Item 22: Install Lateral Seal Connection

This item includes full compensation to the Contractor for all costs associated with the installation of Ultraviolet Light (UV) cured lateral seal connections as indicated in the Design Drawings. This item includes all labor, material, and equipment required to complete the work in accordance to Technical Specification Section 02148 – CIPP Lining of Existing Sewers. This item also includes all labor, material, and equipment required to trim intruding break-in service taps flush with the mainline as required. Measurement for payment shall be made on an EACH basis. Payment shall be paid based on the number of lateral seal connections installed and accepted in place.

Bid Item 23: Install Cured-In-Place-Pipe Patch

This item includes full compensation to the Contractor to install a 3-foot-long UV Cured-In-Place-Pipe (CIPP) patch of the diameter indicated in the Design Drawings. This item includes all labor, material, and equipment required to complete the work as specified in Technical Specification Section 02148 - CIPP Lining of Existing Sewers. Measurement for payment shall be made on an EACH basis. Payment shall be paid based on the number of CIPP patches installed and accepted in place.

Bid Item 24: Fill Void Above Sanitary Sewer Pipe

This item includes full compensation for all costs associated with filling voids above the sanitary sewer pipe after CIPP liner installation as indicated in the Design Drawings. This item includes all labor, material, equipment required to pothole above the pipe and fill void with half-sack Controlled Low Strength Material (CLSM). This item also includes all costs associated with pavement or surface replacement in accordance with COT Std Det T-450. Measurement for payment shall be made on an EACH location repaired basis. Payment shall be paid based on the number of voids filled and accepted in place.

Manhole Rehabilitation

Bid Item 25: Mobilization/ Demobilization

This item includes full compensation to the Contractor for all mobilization and demobilization to the project area(s) of Contractor's personnel, equipment, supplies and incidentals, including establishment of offices and other facilities required for the performance of the work on the project, preparatory work, field verification of all dimensions, and operations prior to the commencement of the work on the project site. Mobilization shall be on an authorized basis by the City.

Mobilization and demobilization will be measured for payment by LUMP SUM. Payment will be paid to the Contractor in two equal payments. First payment to be paid with the initial pay application and the second to be paid with final payment.

Bid Item 26: Remove & Replace Manhole Frame, Cover & Chimney

This item includes full compensation to the Contractor for all costs associated with the removal and replacement of sewer access manhole concrete collar, frame, cover and chimney as indicated in the Design Drawings per COT Standard Detail T-446 modified. This bid item shall be full compensation for all labor, materials, composite adjustment rings, frame and cover, concrete collar and equipment required to complete the work. Measurement for payment shall be made on an EACH basis. Payment shall be paid based on the number of frame and cover installed and accepted in place.

Bid Item 27: Install 60-inch Diameter Composite Manhole Insert

This item includes full compensation to the Contractor for all costs associated with the installation of a 60-inch diameter composite manhole insert per the manufacturer's recommendations, and the Contract Documents. This item includes all labor, material, and equipment required to install the composite manhole insert. This item also includes labor, materials, and equipment required to excavate, remove the existing manhole frame, cover, and cone, remove protruding pipe connections and steps (if present), proper disposal of removed materials and any dump fees associated with legal disposal of materials removed, reinstate service connections, composite grade adjustment rings, and install frame and cover and concrete collar per City of Tempe Standard Detail T-446, Type B. This item also includes all labor, material, and equipment required to install interior drop connection as indicated in the Design Drawings. Measurement for payment shall be per VERTICAL FOOT measured from Rim to Invert as indicated in the Design Drawings. Payment shall be based on the vertical foot of manhole inserts installed and accepted in place.

Bid Item 28: Install 60-inch Diameter Polymer Concrete Manhole

This item includes full compensation to the Contractor for all costs associated with the installation of a 60-inch diameter polymer concrete manhole per MAG Standard Detail 419-1 as indicated I the Design Drawings. This item includes all labor, material, and equipment required to install the polymer concrete manhole. This item also includes labor, materials, and equipment required to saw cut, excavate, remove waste material, proper disposal of removed materials and any dump fees associated with legal disposal of materials removed, build concrete base, cut existing pipe, apply Fiber Reinforced Polymer as indicated in the Design Drawings, and stack polymer concrete manhole per manufacturer's recommendation, composite grade adjustment rings, and install frame and cover and concrete collar per City of Tempe Standard Detail T-446, Type B. Measurement for payment shall be per VERTICAL FOOT measured from Rim to Invert as indicated in the Design Drawings. Payment shall be based on the vertical foot of manhole inserts installed and accepted in place.

Bid Item 29: Clean & Epoxy Coat Sanitary Sewer Access Manhole

This item includes full compensation to the Contractor for manhole surface preparation and application of an epoxy coating on the interior of existing sanitary sewer access manholes with depths indicated in the Design Drawings and specified in the Technical Specification Section - 09710 - Concrete and Masonry Coatings. This item includes all labor, materials, and required equipment to prepare the surface including grit and hydro blast clean manholes to remove all loose or deteriorated materials down to sound concrete, prevent material from entering sewer system, remove steps and fill voids, proper disposal of removed materials and any dump fees associated with legal disposal of materials removed, scarify and restore benches and channel to original dimensions, wash interior surfaces to neutralize pH, install product compatible underlayment to restore interior dimensions back to original dimensions, furnish and install a protective epoxy coating system to chimney, cone, wall, bench, channel, and perform and report spark testing, and perform and report pull adhesion testing. This item also includes all air quality testing and ventilation and confined space safety and support systems required to complete work along with safety equipment for the City's inspection staff, as described in the Design Drawings and Technical Specifications, along with any incidentals necessary to complete the work. Measurement for

payment shall be per SQUARE FOOT. Payment shall be paid based on coating installed and accepted in place.

Bid Item 30: Repair PVC T-Lock Liner

This item includes full compensation for all costs associated with repairing PVC T-Lock Liner as indicated in the Design Drawings. This item includes all labor, material, and equipment required to hydro-blast clean the manhole interior, remove deteriorated liner, fill voids, repair PVC T-Lock liner, and spark testing. Measurement for payment shall be made per SQUARE FOOT. Payment shall be paid based on PVC T-Lock liner repaired and accepted in place.

Bid Item 31: Post Access Manhole Rehabilitation CCTV

This item includes full compensation for all costs associated with conducting and providing post manhole rehabilitation digital 360-degree view CCTV of the manhole interior per Technical Specification Section 02761-Remote CCTV Inspection of Existing and Rehabilitated Sewers. Work shall include all labor and equipment required to digitally 360-degree view scan each manhole rehabilitated in as-built conditions. Measurement for payment shall be made on an EACH basis. Payment shall be paid based on the number of digital 360-degree view scans completed and accepted.

Allowances

Bid Item 32: Traffic Control

This item includes full compensation for all costs associated with providing and maintaining all traffic control necessary for sanitary sewer pipe and manhole rehabilitation and bypass pumping operations (if required) to complete the work according to City of Tempe requirements. Work shall include all labor, materials, and equipment required to plan, permit, mobilization, provide and maintain traffic control measures meeting applicable regulatory requirements associated with the project. This item also includes labor, materials, and equipment necessary to provide and remove temporary pedestrian pathways affected by construction activities. A written traffic control plan shall be submitted by the Contractor to City for approval and shall be modified to meet regulatory requirements and Technical Specification Section 02100 – Traffic Control. Also included in this item is the demobilization of equipment, cleaning, and restoring the site to original conditions. Payment shall be made from this ALLOWANCE and paid per actual traffic control invoices received and approved. The amount allocated for this ALLOWANCE is **$200,000.00 (Two Hundred Thousand dollars and no cents).**

Bid Item 33: Uniformed Off-duty Police Officer

This item includes full compensation for all costs associated with providing an off-duty law enforcement officer at signalized intersections or as directed by the City. Payment for this item includes all costs associated with providing an officer at signalized intersections when traffic is restricted as described in the 2016 City of Tempe Traffic Barricade Manual. When construction activities do not restrict traffic through the intersections, law enforcement officer's hours may be reduced or suspended at the direction of the City. Payment for work completed under this bid item shall be made from this ALLOWANCE based on approved invoiced hourly rates and hours expended. The amount allocated for this ALLOWANCE is **$45,000.00 (Forty-Five Thousand dollars and no cents).**

**** END OF SECTION ****

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SECTION 01060
HEALTH AND SAFETY

PART 1 - GENERAL

1.01 HEALTH AND SAFETY REGULATIONS

A. The Contractor shall exercise precaution at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal, State and Local occupational safety and health acts, codes, standards and regulations promulgated thereunder. Contractor shall have copies of, but not limited to, confined space entry permit on-site and available for review any time work activities are commencing.

B. Contractor shall comply with the provisions of the Federal Occupational Safety and Health Act, as amended.

C. Contractor shall comply with the provisions of the Maricopa County Air Quality Department.

D. The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of the employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health and/or as specified by the Maricopa County Health Department, Sanitary Code.

E. The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility reasonably necessary to protect the life and the health of employees on the job, the safety of the public, and to protect property in connection with the performance of the work covered by this contract.

1.02 SPECIAL CONSIDERATIONS

A. GENERAL

This Technical Specification Section describes certain minimum precautions the Contractor shall consider in developing its health and safety program. It supplements the regulatory requirements of Paragraph 1.01 and the requirements of the General Conditions. Sewers and appurtenant structures are considered confined spaces and are subject to federal, state and local regulations governing confined space entry and safety procedures.

B. INFECTIOUS DISEASES:

Contractor should anticipate that a wide spectrum of disease-producing organisms will be present in the sewer. In addition to the requirements set forth in the regulations described in Paragraph 1.01 above, the Contractor shall provide the following as a minimum:

1. Instruction in appropriate disease-prevention mechanisms and personal sanitation practices for all workers and supervisors.

2. A preventative inoculation program (tetanus/diphtheria, hepatitis, etc.) to all workers and supervisors.

3. Clothing to protect against infection, including rubber boots with full sole and heel steel insert-liners, safety glasses or goggles, and gloves to all workers and supervisors.

C. DANGEROUS GASES AND OXYGEN DEFICIENCY:

The sewer pipe, sewer access manholes and junction structures are confined spaces, which mean they have a limited means of egress and are subject to the accumulation of dangerous gases or oxygen deficiency. Volatile petroleum products and common household hazardous materials may be present within the sewer. Explosive gases, such as methane generated from decomposing organic material, may be accumulated. Toxic gases, such as hydrogen sulfide, may be present in life-threatening concentrations. Significant oxygen depletion may occur. In addition, construction procedures may require combustion engine machinery to be located in or near the work site. Therefore, gaseous combustion by-products, such as carbon monoxide, may be present.

In addition to the requirements set forth in the regulations described in Paragraph 1.01 above, the Contractor shall provide the following:

1. Portable atmospheric monitors that measure levels of oxygen, explosive gas (methane), carbon monoxide, and toxic gas (hydrogen sulfide). Monitors shall be properly calibrated and carefully maintained throughout the construction period. Monitors shall be used continuously while personnel are in the sewer.

D. TOXIC CHEMICALS:

Toxic chemicals may be part of the construction process. The Contractor shall abide by all handling procedures recommended by the manufacturer when dealing with toxic chemicals.

E. ASBESTOS-CEMENT PIPE:

The Contractor shall abide by all asbestos-cement handling procedures as required by all local, state and federal regulatory agencies.

1.03 SUBMITTALS

Contractor shall submit Health and Safety Plan according to Technical Specification Section 01300 – Submittals.

PART 2 - PRODUCTS

2.01 HEALTH AND SAFETY PLAN

A. GENERAL

The Contractor shall develop and maintain for the duration of the Contract three copies of a Health and Safety Plan that will effectively incorporate and implement all required health and safety precautions. At least one copy shall be located on the Contractor's work site.

B. COMPLIANCE

The Contractor shall appoint an on-site employee who is qualified, trained and authorized to supervise and enforce compliance with the Health and Safety Plan. The Contractor is responsible for ensuring that necessary gas monitoring, protective clothing, and other supplies and equipment as specified are available to implement this plan.

C. REVISIONS

In the event that regulatory agencies or jurisdictions determine the Health and Safety Plan to be inadequate to protect employees and the public:

1. The Contractor shall stop the work in progress until adequate safety measures are implemented.

2. The Contractor shall modify the plan to meet the requirements of said regulatory agencies, jurisdictions, and the City.

3. The Contractor shall provide the City and City’s Representative with the revisions to the plan within two (2) days of the notice of deficiency.

D. MINIMUM CONSIDERATIONS

The Health and Safety Plan shall, as a minimum, include the following considerations:

1. Objective.

2. Key personnel and responsibilities.

3. Hazard analysis of the work activities and environment.

4. Training requirements, including authorized personnel and qualifications for work in confined spaces.

5. Personal protective equipment.

6. Confined Space Entry Plan.

7. Site control measures.

8. Work practices, decontamination procedures, and work limitations.

9. Emergency procedures, including sewer evacuation plan, location of first aid, fire extinguishers, eyewash, drinking water, map showing route to nearest medical facility, list of key personnel who are currently certified in first aid/CPR.

10. Job site cleanup, and spill containment and cleanup procedures.

11. Telephone numbers:
    a. 24-hour number to contact Contractor's Representative.
    b. Emergency services.
    c. City
    d. City’s Representative.

12. Documentation (training, injury or illness, respirator-fit tests, hazards notification log, etc.).

PART 3 - EXECUTION

(NOT USED)

**** END OF SECTION ****

SECTION 01062
PERMITS AND EASEMENTS

PART 1 - GENERAL

1.01 EASEMENTS

All sewers and access manholes are assumed to be located in the City of Tempe right-of-way or utility easements. Contractor shall be responsible to limit construction activities to within these areas.

1.02 PERMITS TO BE OBTAINED BY THE CONTRACTOR

Contractor shall obtain any additional permits and access agreements required by the work and shall pay all costs thereof, including agency inspections. The Contractor shall comply with all applicable terms and conditions therein and provide copies to the City's Representative before working in areas covered by those permits. The following permits, but not necessarily limited to the following, shall be obtained by the Contractor if applicable to the work:

1) Occupational Safety and Health Association (OSHA) – Confined Space Entry Permit
2) Arizona Department of Environmental Quality (ADEQ) – Air Quality Division
3) Arizona Department of Transportation (ADOT) – Encroachment Permit
4) City of Tempe - Construction Permit
5) City of Tempe Traffic Control Permit
6) City of Tempe Night Work Permit (if required)
7) Others as applicable

1.03 POSTING

Permits shall be posted (or available for review) at the site of the work at all times work is commencing. All permits shall be submitted to the City in accordance with Technical Specification Section 01300 – Submittals.

PART 2 – PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

**** END OF SECTION ****

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SECTION 01064
INSPECTION AND TESTING

PART 1 - GENERAL

1.01 INSPECTION AND TESTING OF MATERIALS

All workmanship and materials shall be subject to inspection by the City or City's Representative, who may select samples of materials in such a quantity as the City or City's Representative may deem necessary to determine their qualities, as herein specified. Any samples taken shall be at the discretion of the City and shall be in addition to those required to be taken by the Contractor as specified in these Technical Specifications, manufacturer's recommendations, and permits requiring test results. The City or City's Representative will accept or reject the materials in accordance with the results of such trials or from test results submitted from an independent testing laboratory. All rejected materials shall be promptly replaced to the satisfaction of the City or City's Representative. The Contractor shall assist the City or City's Representative by providing access to the location where the work is in progress. The Contractor shall replace rejected work and materials and bear all costs for doing so.

Non-rejection or non-inspection of materials does not constitute acceptance by the City or the City's Representative.

The City's or City's Representative's inspection will be provided on an 8-hour per day, 5-day per week basis, excluding weekends and holidays. The Contractor shall not schedule any overtime work which requires inspection, survey or material testing without written permission from the City's Representative two (2) working days before the proposed overtime work. The City reserves the right to deny the requested overtime. If an overtime request is denied, the City may extend the contract time at no additional cost to the City.

1.02 REFERENCES

Refer to Technical Specification Section 02148 – CIPP Lining of Existing Sewers

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

**** END OF SECTION ****

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SECTION 01071
STANDARD REFERENCES

PART 1 - GENERAL

1.01 ABBREVIATIONS

Wherever used in the Contract Documents, the following abbreviations will have the meanings listed:

AAC	Arizona Administrative Code 1700 West Washington, 7th Floor Phoenix, AZ 85007-2808
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W., Suite 249 Washington, D.C. 20001
ACI	American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331-3439
ADEQ	Arizona Department of Environmental Quality 1110 West Washington Street Phoenix, AZ 85007
ADOT	Arizona Department of Transportation 206 South 17th Avenue Phoenix, AZ 85004
ADWR	Arizona Department of Water Resources 3550 North Central Avenue, Suite 200 Phoenix, AZ 85012
AEIC	Association of Edison Illuminating Companies 600 North 18th Street Birmingham, AL 35203
AISC	American Institute of Steel Construction, Inc. 130 East Randolph, Suite 2000 Chicago, IL 60601
AISI	American Iron and Steel Institute 25 Massachusetts Avenue, N.W., Suite 800 Washington, D.C. 20001

ANSI	American National Standards Institute, Inc. 1899 L Street, N.W., 11th Floor Washington, D.C. 20036
API	American Petroleum Institute 1220 L Street, N.W. Washington, D.C. 20005
ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia 20191
ASCII	American Standard Code for Information Interchange United States of America Standards Institute 10 East 40th Street New York, NY 10016
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive P.O. Box C700 West Conshohocken, PA 19428-2959
AT & SFRR	Atchison, Topeka and Santa Fe Railroad
AWS	American Welding Society 8669 N.W. 36th Street, Suite 130 Miami, FL 33166-6672
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
BOCA	Building Officials and Code Administrators 7926 Halstead Homewood, IL 60430
CFR	Code of Federal Regulations Superintendent of Documents Government Printing Office Washington, D.C. 20402
CMAA	Crane Manufacturers Association of America, Inc. (Formerly called: Overhead Electrical Crane Institute) (OECI) 8720 Red Oak Boulevard, Suite 201 Charlotte, NC 28217-3992

CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173-4758
COT	City of Tempe Engineering Division 31 East 5th Street Tempe, AZ 85281
EEI	Edison Electric Institute 701 Pennsylvania Avenue, N.W. Washington, D.C. 10016
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch Washington Navy Yard, Building 197 Washington, DC 20407
FEDSTDS	Federal Standards (see FEDSPECS)
FCDMC	Flood Control District Maricopa County 2801 West Durango Street Phoenix, AZ 85009
IES	Illuminating Engineering Society 120 Wall Street, Floor 17 New York, NY 10005-4001
MAG	Maricopa Association of Governments 302 North 1st Avenue, Suite 300 Phoenix, AZ 85003
MCESD	Maricopa County of Environmental Services Department 1001 North Central Avenue, Suite 200 Phoenix, AZ 85004
NACE	National Association of Corrosion Engineers 15835 Park Ten Place Houston, TX 77084

NASSCO	National Association of Sewer Service Companies 2470 Longstone Lane, Suite M Marriottsville, MD 21104
NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, MA 02169-7471
NPDES	National Pollutant Discharge Elimination System U.S. Environmental Protection Agency National Pollutant Discharge Elimination System Program Office of Water, Office of Wastewater Management 1200 Pennsylvania Avenue, N.W. (Mail code 4203M) Washington, D.C. 20460
OSHA	Occupational Safety and Health Act U.S. Department of Labor Occupational Safety and Health Administration 200 Constitution Avenue, N.W. Washington, D.C. 20210
SWPPP	Storm water Pollution Prevention Plan Environmental Protection Agency, Region 9 75 Hawthorne Street, San Francisco, CA
UBC	Uniform Building Code Published by ICBO
UL	Underwriters Laboratories Inc. 207 East Ohio Street Chicago, IL 60611
WABO	Washington Association of Building Officers Post Office Box 7310 Olympia, WA 98507

PART 2 - PRODUCTS
(NOT USED)

PART 3 - EXECUTION
(NOT USED)

**** END OF SECTION ****

SECTION 01102
CONTRACTOR'S HAZARDOUS MATERIALS MANAGEMENT PROGRAM

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall comply with all Federal, State, and local rules and regulations related to environmental protection and environmental safety including, but not limited to, the following:

1. Title 29 Code of Federal Regulations Part 1910, Occupational Safety and Health
2. Title 40 Code of Federal Regulations, Protection of Environment
3. Title 49 Code of Federal Regulations, Transportation
4. State Occupational Safety and Health Administration (OSHA)
5. Arizona Department of Environmental Quality (ADEQ)
6. Arizona Department of Water Resources (ADWR)
7. Maricopa County Air Pollution Control Regulations
8. Maricopa County Air Quality Department Regulations

B. In order to ensure the City that the Contractor is complying with the intent of the regulations stated in Paragraph 1.01.A above, as they relate to the on-site use of hazardous materials, hazardous wastes and other substances similarly defined in those regulations, develop and maintain a Contractor's Hazardous Materials Management Program that includes as a minimum, but is not limited to the requirements specified herein. The interests of the City are that accidental spills, site contamination, and injury of personnel on the site are avoided. The City will not enforce suspected violations of the rules and regulations referenced in Paragraph 1.01.A above, however the City will notify the Contractor of suspected violations. If in the opinion of the City, the Contractor fails to address the suspected violations in a timely and appropriate manner, the City will notify Federal, State, or local regulatory agencies, report the suspected violations to them, and request that they inspect the Contractor's operations. Any fines that may be levied against the City for violations committed on the site by the Contractor, as well as any costs to the City associated with cleanup of materials, shall be reimbursed immediately by the Contractor. All documents required by the program shall be made available to the City's Environmental Representative immediately, upon request.

C. Responsibility for any hazardous waste, as defined in any of the above listed regulations, and those generated by the Contractor, belongs to the Contractor. If the Contractor is going to generate, or has generated, a substance that qualifies as a hazardous waste, the Contractor must obtain an EPA identification number, listing the Contractor's name and construction site address as the generator of the hazardous waste. Responsibility for the identification, analysis, profiling, transport and disposal of hazardous wastes generated, belongs to the Contractor. The identification number can be obtained from the Arizona Department of Environmental Quality (ADEQ). This

number shall be provided to the City's Representative within five (5) days after the Notice to Proceed, or before any hazardous materials are brought onto the site.

1.02 HAZARDOUS MATERIALS PROGRAM REQUIREMENTS

A. Within the regulations listed in Paragraph 1.01.A, above, terms such as hazardous material, hazardous wastes, and similar terms have varying definitions. To dispel confusion regarding what materials fall under the Program Requirements and for the purposes of this Technical Specification Section, Hazardous Material is defined as "any material, whether solid, semi-solid, liquid, or gas, which, if not stored or used properly, may cause harm or injury to persons through inhalation, ingestion, absorption or injection, or which may negatively impact the environment through the use or discharge of the material on the ground, in the water (including groundwater), or to the air."

B. All chemicals brought onto the site must be approved by the City. Prior to bringing any chemical on site, request approval from the City's Environmental Representative for each chemical the Contractor proposes to bring on site. At the time of request, the City's Environmental Representative may request and receive from the Contractor, specific information associated with each chemical. The specific information may include, but is not limited to, MSDS, manufacture, vendor, container size(s), number of containers, minimum and maximum volume of material intended to be stored on site, as well a description to the process or procedures in which any requested chemical is to be used. The City, within five (5) working day from receipt of the specific chemical information, will inform the Contractor as to whether the chemical has been approved for use on site.

C. Maintain on site two notebooks containing (1) a chemical inventory, and (2*)* current (dated within the past two years) Safety Data Sheets for all materials being used on site, whether or not they are defined as a Hazardous Material in Paragraph 1.2.A, above. One notebook shall be kept in the Contractor's on-site office and the other shall be kept in a location specified by the City's Environmental Representative. These notebooks must be kept up-to-date as materials are brought onto and removed from the site. Copies of MSDS sheets for chemicals removed from the site shall be provided to the City's Environmental Representative.

D. Develop an emergency/spill response plan, for each hazardous material or class/group of materials. As a minimum, the response plan must address the following:

1. Provide a description of equipment on site available to contain or respond to an emergency/spill of the material.
2. Notification procedures.
3. Response coordination procedures between the Contractor, the City, and the City's Representative.
4. Provide a Site Plan showing the location of stored hazardous materials and location of spill containment/response equipment.
5. Provide a description of the hazardous material handling and spill response training provided to the Contractor's employees.

E. In accordance with applicable Laws and Regulations, properly and safely store all hazardous materials, which shall include as a minimum, the following:

1. Have a designated storage site for hazardous materials that includes secondary containment. The site must include barriers to prevent vehicles from colliding with the storage containers and offer protection from environmental factors such as weather.
2. Provide signage in accordance with applicable Laws and Regulations, clearly identifying the hazardous materials storage site.
3. All hazardous materials containers must bear the applicable Hazard Diamonds.

F. Properly label all containers of consumable materials, whether or not they are classified as Hazardous Materials under this Section. The name of the Contractor or subcontractor shall be stenciled on any container containing a hazardous material and on any container over five-gallon capacity containing a non-hazardous material. Any container must have a label clearly identifying the contents. If any such unlabeled containers are discovered on the site, the City's Environmental Representative will notify the Contractor. Responsibility to remove such containers belongs to the Contractor. Containers will be properly labeled or removed from the site within one (1) hour. Any containers that are filled from larger containers must also be properly labeled.

G. The City encourages storage of hazardous materials off site until the materials are needed on site.

H. Provide all documentation required herein available immediately upon request of the City's Environmental Representative. The Contractor's Safety Representative shall meet at least monthly with the City's Environmental Representative to review the Contractor's Hazardous Materials Management Program documents, procedures, and inspect the storage site and job site to ensure the requirements specified herein are being complied with. Also, provide the City's Environmental Representative and the City's Representative with copies of all permits obtained from environmental regulatory agencies.

I. Provide documentation to the City's Representative and the City's Environmental Representative that the Contractor, subcontractors, or others hired by the Contractor making deliveries of hazardous Materials (as defined in Title 49 CFR) to the site are in compliance with Title 49 CFR 172.800 – 172.804, which requires each person who offers for transportation in commerce or transports in commerce one or more of the following hazardous materials, as defined by Title 49 CFR, must develop and adhere to a security plan for hazardous materials that conforms to the requirements of this subpart.

PART 2 – PRODUCTS
(NOT USED)

PART 3 – EXECUTION
(NOT USED)

**** END OF SECTION ****

SECTION 01300
SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. The Contractor shall furnish all specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials to be furnished and the methods of work comply with the provisions and intent of the contract documents.

1.02 CONTRACTOR'S RESPONSIBILITIES

The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the City or City's Representative in each case where his submittal may affect the work of another Contractor or the City. The Contractor shall coordinate submittals among his subcontractors and suppliers.

The Contractor shall coordinate submittals so that work will not be delayed. The Contractor shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with work relating to a submittal until the submittal process is complete. This requires that submittals for review and comment shall be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."

The Contractor shall certify on each submittal document by signing Transmittal Form 01999-A specified in Technical Specification Section 01999 – Reference Forms they have reviewed the submittal, verified field conditions, and complied with the contract documents.

The Contractor may authorize in writing a material or equipment supplier to deal directly with the City's Representative or with the City with regard to a submittal. These dealings shall be limited to contract interpretations to clarify and expedite the work.

1.03 CATEGORIES OF SUBMITTALS

A. GENERAL

Submittals fall into two general categories; submittals for review and comment, and submittals, which are primarily for information only. Submittals, which are for information only, are typically specified in the Part 2 - PRODUCTS of the individual Technical Specification section.

a. SUBMITTALS FOR REVIEW AND COMMENT:

All submittals except where specified to be submitted as product data for information only shall be submitted by the Contractor to the City or City's Representative for review and comment.

b. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY

Where specified, the Contractor shall furnish submittals (product data) to the City or City's Representative for Information only.

1.04 TRANSMITTAL PROCEDURE

A. GENERAL

The City or City's Representative will furnish the Contractor a list of numbers for anticipated submittals as specified in the Construction Documents. The list of submittals will be marked for review and comment and product data (submittals) for information only. The list is not intended to be an all-inclusive list of submittals required. Contractor shall coordinate additional submittals and corresponding submittal numbers with the City or City's Representative.

Unless otherwise specified, all submittals shall be accompanied by Transmittal Form 01999-A specified in Technical Specification Section 01999 – Reference Forms. A separate Transmittal Form shall be used for each specific item, class of material, and items specified in separate, discrete sections, for which the submittal is required. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.

A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the City or City's Representative. Re-submittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for re-submittals, i.e., A, B, or C being the 1st, 2nd, and 3rd re-submittals,

respectively. Submittal 25B, for example, is the second re-submittal of submittal 25. Re-submittals shall include original information with all revisions.

B. DEVIATION FROM CONTRACT

1. The Contractor shall submit a copy of the specification section, with addendum updates included, and all referenced and applicable sections with addendum updates included, with each paragraph check-marked as follows:

   a. Marked to indicate specification compliance. Check marks (√) shall denote full compliance with a paragraph as a whole.

   b. Marked to indicate requested deviations from specification requirements. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The City shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. If the Contractor proposes to provide material, equipment, or method of work, which deviates from the Construction Documents, he shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.

C. SUBMITTAL COMPLETENESS

Submittals which do not have all the information required to be submitted, including deviations, and Contractor signature are not acceptable and will be returned without review. The Contractor will be charged an additional cost if a submittal requires three or more reviews. (See Sub-section: 1.07 THIRD AND SUBSEQUENT SUBMITTALS)

1.05 REVIEW PROCEDURE

A. GENERAL

Submittals are specified for those features and characteristics of materials, and methods of operation, which can be selected, based on the Contractor's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner, which enables the Contractor to determine acceptable options

without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the contract documents) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.

When the contract documents require a submittal, the Contractor shall submit the specified information as follows:

1. Unless otherwise specified, one (1) electronic Copy (.pdf format) of all submitted information shall be transmitted with submittals for review and comment.

2. Unless otherwise specified, one (1) electronic Copy (.pdf format) of all submitted information shall be transmitted with submittals (Product Data) for information only.

B. SUBMITTALS FOR REVIEW AND COMMENT

Unless otherwise specified, within ten (10) calendar days after receipt of a submittal for review and comment, the City or City’s Representative shall review the submittal and return one copy of the electronically marked-up original in PDF format. Shop drawing submittals that require markups shall be marked up in red by the City or City’s Representative. The City or City’s Representative will retain the original.

The returned submittal shall indicate one of the following actions:

1. If the review indicates that the material, equipment or work method complies with the contract documents, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

2. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. A corrected copy shall be resubmitted.

3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

4. If the review indicates that the material or work method does not comply with the contract documents, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations, which have not been clearly identified, may be rejected. Except at his own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

C. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY:

Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

1.06 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

Review methods of work or information regarding materials the Contractor proposes to provide, shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the City's Representative or the City, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the City has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials proposed.

1.07 THIRD AND SUBSEQUENT SUBMITTALS

The cost for third and subsequent submittals shall be borne by the Contractor. The cost of reviews for third and subsequent reviews shall be at a rate of $300 per review and shall be charged to the Contractor as a reduction in Contractor's pay request.

PART 2 - PRODUCTS
(NOT USED)

PART 3 - EXECUTION
(NOT USED)

**** END OF SECTION ****

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SECTION 01310
PROGRESS SCHEDULE

PART 1 - GENERAL

1.01 DESCRIPTION

This Technical Specification section specifies requirements and procedures for the Contractor in preparing schedules. The purpose of the schedule shall be to ensure adequate planning and execution of the work by the Contractor, notification and coordination of construction activities with the general public, to establish the standard against which satisfactory completion of the project shall be judged, to assist the City or City's Representative in monitoring progress and for the assessment of the impact of change orders on the Schedule.

1.02 SUBMITTAL

The Contractor shall submit a schedule to the City or City's Representative within five (5) working days of receiving Notice to Proceed and prior to pre-construction conference (if scheduled) with work identifying the duration of mobilization, anticipated time when work is to be performed, cleaning, pre-video, rehabilitation duration and date of project completion. Schedule shall be transmitted to the City or City's Representative per Technical Specification Section 01300 – Submittals.

PART 2 - PRODUCTS

2.01 PROGRESS SCHEDULES

A. Contractor shall provide a Schedule to the City and/or City's Representative. Schedule shall be updated weekly with anticipated sanitary sewer pipe and access manholes to be rehabilitated. Schedule shall also list pipe and access manholes rehabilitated to date.

B. Schedule shall be prepared on computer software (MS Project) that facilitates schedule updates and e-mailing.

C. Special considerations, coordination requirements, etc., as encountered for certain sanitary sewer pipe and access manholes shall be noted on schedule.

D. Time for completion for each separate sanitary sewer pipe and access manhole shall be shown on the schedule.

E. The schedule duration of each activity shall be based on the work being performed during the normal work week with allowances made for legal holidays. The schedule shall include a critical path for each separate sanitary sewer pipe and access manhole.

F. Dates imposed on the schedule by the Contractor shall not be binding on the City or City's Representative.

G. Failure to include elements of work required for the performance of this Project shall not excuse the Contractor from completing the work as described in the Construction Documents.

H. Provide a list of the holidays and non-work days applicable to the schedule.

I. Provide a schedule and narrative summary stating project status so the City or City's Representative may use them as a basis for determining the Contractor's compliance with the Technical Specification requirements regarding progress payments, contract time extensions, change order prices and impacts, and the overall progress of the work. Failure of the Contractor to comply with the requirements of this Technical Specification Section may delay the review and acceptance of the progress payment requests.

PART 3 - EXECUTION

3.01 GENERAL

The Contractor and the Contractor's Field Superintendent shall attend regularly scheduled project meetings with the City or City's Representative and others invited by the City or City's Representative.

3.02 UPDATES

A. Requests for extensions in time resulting from changes issued by the City shall be accompanied by a Time Extension Request - Narrative Report explaining the impacts and costs associated with the extension if it were to be granted.

B. If actual progress on the critical path items is observed to deviate from the schedule by one (1) week behind, the Contractor shall update and submit a revised (updated) schedule. In the case of the work being behind schedule, the Contractor shall submit, along with the revised schedule, a written plan for completing the work within the milestone and contract times.

**** END OF SECTION ****

SECTION 01380
PHOTOGRAPHS AND VIDEO RECORDINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies digital color photographs and digital video recordings to be taken at the ground surface level by the Contractor before and after construction commences for the rehabilitation of sanitary sewer pipes and access manholes located in City Right-of-Way or Utility Easements. These recordings shall clearly document site conditions prior to construction activities commencing and again following the completion of construction activities.

1.02 PAYMENT

A. Contractor shall pay costs for photography, video recording and prints. Parties requiring additional photography, video recordings or prints shall invoice and pay photographer directly.

1.03 SUBMITTAL

A. Contractor shall submit the following for information only per Technical Specification Section 01300 – Submittals at the Preconstruction Conference:

1. Site condition color photographs and video with audio commentary taken prior to construction.

PART 2 - PRODUCTS

2.01 GENERAL

A. The color photographs and audio-video recordings are intended for use as indisputable evidence in ascertaining the extent of any damage which may have occurred as a result of the Contractor's operations and are for the protection of the Contractor and the City, and may, at the City's discretion, be a means of determining whether and to what extent damage, resulting from the Contractor's operations, occurred during the Contract work.

B. PHOTOGRAPHS:

Photographs shall be color digital (high resolution) .jpeg format stored on DVD or USB media. Submitted DVD media shall indicate on the front of each jewel protection case the date, name of Project, and City where the photographs were taken. Submitted USB media shall contain a Readme Notepad file that contains the date, name of Project, and City where the photographs were taken. One copy of each DVD or USB shall be delivered to the City.

C. VIDEO RECORDINGS

Video recordings shall be .mpeg format stored on DVD or USB media. Submitted DVD media shall indicate on the front of each jewel protection case the date, name of Project, and City where the videos were taken. Submitted USB media shall contain an identification tag along with a Readme Notepad file that contains the date, name of Project, and City where the videos were taken. The video recordings should contain an audio track, which narrates the progression of the video recording through the site. One copy of each DVD or USB shall be delivered to the City.

PART 3 - EXECUTION

3.01 VIDEO / DVD

A. Contractor shall perform video recordings of all areas where the Contractor anticipates construction activities to occur, including all staging, storing, working, parking and excavation areas. Easements and areas outside of paved roadways are of particular interest.

B. After completion of construction and restoration, video recordings shall be taken from the same points, in the same direction as the preconstruction examination recording.

3.02 CONSTRUCTION PHOTOGRAPHY

A. Photographs shall be provided of items of special interest and/or special conditions during construction.

****END OF SECTION****

SECTION 01550
CONTRACTOR'S UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the facilities, utilities, and security the Contractor is required to furnish and maintain during construction.

B. Copies of any Design Drawing and Technical Specifications shall be kept at the work site and available for use at all times.

PART 2 - PRODUCTS

2.01 POWER

A. Contractor shall use battery, pneumatic, or hydraulic power for all interior sanitary sewer pipe and access manhole work. This limitation is not necessary for work on the surface.

2.02 LIGHTING AND ILLUMINATION

A. As necessary, the Contractor shall provide low voltage lighting and illumination in the sewer pipe and access manhole interior, in accordance with the guidelines published in Practice for Industrial Lighting, ANSI/IES RP7-1983. Lighting used by the Contractor on the surface shall be placed and directed to avoid nuisance to traffic or local residences. Light shields may be required to limit light pollution into adjacent residences or businesses.

2.03 TELEPHONE

A. Contractor shall provide and maintain telephone service at the construction site and the telephone shall be manned by the Contractor or Contractor's Representative 24 hours per day. Contractor or Contractor's Representative manning the telephone service shall be fluent in written and verbal English as well as Spanish languages. Cellular telephone service is acceptable as a substitute for telephone service. These telephone and labor costs shall be paid by the Contractor.

2.04 WATER

A. All water for testing, flushing, cleaning and construction activities shall be furnished and paid for by the Contractor. Water may be available upon request to the City for connecting to the City's water distribution system. Connection may be approved by the City with appropriate backflow prevention and metering devices installed by the Contractor according to City requirements. Authorization to receive water may be

rescinded by the City upon written notice to the Contractor at any time and for any reason.

The City shall charge the Contractor for water used in performing the above functions in accordance with the City's established rate schedule. An approved backflow prevention device, meeting the requirements of ANSI A40.6, latest revision, shall be installed in each and every connection to the City's water supply. The Contractor shall be required to meter all water used.

2.05 DEBRIS DISPOSAL

A. Contractor shall make provisions for legal, off-site debris disposal. Contractor shall be responsible to obtain and submit to the City a written letter of acceptance, signed by an authorized representative of the agency and/or authorized party accepting debris. Disposal of debris shall not occur until City has reviewed and accepted the disposal site. Contractor shall pay all fees and charges for debris disposal. Contractor shall be responsible for all permits and fees according to Technical Specification Section 01062 – Permits and Easements, subsection 1.02 Permits to be obtained by the Contractor for transport to the disposal site.

2.06 BYPASS PUMPS

A. Contractor shall provide and maintain a sanitary sewer by-pass pumping system to divert flow around the work area according to Technical Specification Section 02145 – Diversion of Sewage Sewer Flow and Dewatering. Contractor shall be responsible for all operation, maintenance and monitoring of bypass pumping and discharge piping system.

PART 3 - EXECUTION

(NOT USED)

****END OF SECTION****

SECTION 01560
ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and adjacent areas. Remove physical evidence of temporary facilities at completion of work.

1.02 TRANSPORTATION ROUTES

A. The Contractor shall select its transportation routes for hauling materials, equipment, or imported products based on the existing condition of the sanitary sewer pipe and access manholes and impacts on local traffic. Transportation routes shall be documented in a traffic control plan on a case by case basis.

1.03 TRAFFIC CONTROL

A. All streets, traffic ways, and sidewalks shall be kept open in a safe manner for the passage of traffic and pedestrians during the construction period unless otherwise approved by the City.

B. When required to cross, obstruct or close a street, traffic way, or sidewalk for a short duration that is approved by the City, the Contractor shall provide and maintain suitable bridges, detours or other approved temporary means for the accommodation of vehicular and pedestrian traffic. Closings shall be for the shortest time practical, and passage shall be restored immediately after completion of construction.

C. Contractor shall give the City 24 hours advance notice of their proposed operations within any public rights-of-way and temporary roadway closings. All proposed roadway closings shall be submitted in Traffic Control Plan and approved prior to commencement of operations.

D. Contractor shall provide signs, signals, barricades, flares, lights and all other equipment, service and personnel required to regulate and protect all traffic and warn of hazards in accordance with MAG specifications. All such work shall conform to requirements of the City or authority having jurisdiction. Remove temporary equipment and facilities when no longer required and restore grounds to original condition.

E. As specified in Technical Specification Section 02100 – Traffic Control, the Contractor shall provide a Traffic Control Plan and implement traffic control around all work as part of the contract.

F. Qualified and suitably equipped flaggers shall be used to assist all construction equipment and vehicles access to and from the construction site.

1.04 RELEASE OF HOT WATER

A. Contractor shall not release heated water into the sanitary sewer system directly upstream of any wastewater reclamation facility. Contractor shall be responsible to obtain written authorization from the facility operator receiving the sanitary sewer flow when discharging within one (1) mile of the facility. Authorization, if given, shall state the maximum discharge temperature of the water. Contractor shall submit Authorization to Release letter to the City according to Technical Specification Section 01300 – Submittals.

B. Contractor shall be responsible to cool process water to a temperature below levels required by the facility operator or find alternative hot water disposal methods and/or location at no additional cost to the City.

C. Contractor shall be responsible for and pay all damages caused by an unauthorized release of heated water into the headworks of the treatment facility.

1.05 SEWAGE SPILL CONTROL

A. A spill is defined as any uncontrolled release of raw sewage outside of the intended sanitary sewer collection system. Raw sewage releases shall not be allowed to occur and are not permitted. The Contractor shall be responsible for all consequences and damages caused by the overflow, backup, or spill due to the Contractor's work activities.

B. Contractor shall give both verbal and written notification to the City immediately in the event of any sewage release, overflow, backup, or spill.

C. Contractor shall complete and submit to the City Form 01999-C Confidential Spill Reporting form found in Technical Specification Section 01999 – Reference Forms within 2 hours of any spill.

1.06 EMERGENCY SPILL RESPONSE PLAN

A. The Contractor shall be responsible to develop and follow an emergency spill response plan. Plan shall be well communicated to all personnel in the event an emergency should occur, it can be handled in the safest and most efficient manner possible.

B. The primary responsibility for all Contractor personnel is to respond to sewer spills as quickly as possible.

C. Emergency telephone list is part of this procedure and will be kept up-to-date at all times.

D. Follow Standard Procedure List.

E. Complete Form 01999-C Confidential Spill Reporting Form, see Technical Specification Section 01999 – Reference Forms.

F. Contractor shall develop an Emergency Spill Response Phone List containing, but not limited to the following:

Submit list to City according to Technical Specification Section 01300 – Submittal.

(Name) ____ (Contractors Field Superintendent) (___) __ - ____
(Name) ____ (Engineer's Field Representative) (___) __ - ____
(Name) ____ (City's Construction Project Manager) (___) __ - ____
(Name) ____ (Engineer's Project Manager) (___) __ - ____

1.07 STANDARD REPORTING PROCEDURES

A. HANDLING EMERGENCIES

1. Medical emergency, fire or explosion, call **911** immediately. **Do not call 911 to report a wastewater spill.**

B. OBSERVATION

1. Contractor shall without endangering himself, obtain enough information to make an initial assessment of the situation.

C. PROTOCOL FOR NOTIFICATION OF SPILL

1. Contractor's Field Superintendent:
   Contractor's field personnel shall verbally notify the Contractor's Field Superintendent. Field Superintendent shall promptly notify Engineer's Field Representative and City's Construction Manager immediately, always less than one (1) hour from the time of being made aware of the spill. Document all calls and conversations.

2. Engineer's Field Representative:
   Engineer's Field Representative shall verbally notify City's Construction Project Manager, Contractor and Engineer's Project Manager in less than one (1) hour from the time of being made aware of the spill. Document all calls and conversations.

3. City's Construction Project Manager:
   City's Construction Project Manager shall verbally notify Engineer's Project Manager, and City's Project Manager within one (1) hour from the time of being made aware of the spill. Document all calls and conversations.

4. Engineer's Project Manager:

   Engineer's Project Manager shall confirm notification has occurred with City's Construction Project Manager, confirm Contractor's awareness of incident, and verifies that Engineer's Field Representative is monitoring events. Document all calls and conversations.

D. REPORT

As soon as possible, but no later than 24 hours following discovery of the spill, the Contractor shall complete Form 01999-C Confidential Spill Reporting Form, reference Technical Specification Section 01999 – Reference Forms. The Contractor shall take photographs at all stages of the incident to include in the report. Submit copies of all documentation to City per Technical Specification Section 01300 – Submittals except as herein modified. Spill reports shall be hand carried to City's Construction Project Manager as soon as complete.

E. SUBMITTAL

The Contractor shall verify that City has received a copy of the spill report and supporting documentation and submitted copy of said report to the City's Construction Project Manager in a timely manner. Compare all reports and report discrepancies to the City's Construction Project Manager and retain one (1) copy in the Project File located at Contractor's office.

1.08 SANITARY SEWAGE SPILL/BACKUP

A. If a sanitary sewage spill/backup occurs into a lateral and a citizen or business sustains property damage, the following procedure is to be adhered to:

1. The initial responsibility of the Contractor is to locate and eliminate the cause of the backup as soon as possible. As part of cleaning the backup, Contractor crews are to determine the cause and source (if possible) of the backup. Contractor will obtain an emergency clean-up service and relocate the residents, if necessary, to minimize health risks. Contractor shall be responsible for all costs and coordination efforts associated with the sewer backup and cleanup including but not limited to:

   a. Relocation of residents
   b. Temporary housing of displaced residents
   c. Clean-up and sanitizing costs
   d. Replacement of damaged personal items
   e. Relocation of residents back into the residence

2. Determine the extent of the property damage (photographs are recommended). A report (Incident Report), with the photos must be provided to the Contractor's or Contractor's designated Safety Officer. The Safety Officer will forward the information to the Contractor's corporate liability insurance carrier. Information compiled should include:

    a. Time call was received
    b. Time the crew arrived at the site
    c. Time work was completed
    d. Cause of stoppage/source of backup sewage (if possible) and location of stoppage causing the backup
    e. Name of property owner/tenant and address of affected property
    f. Extent of damage
    g. Action taken

3. Contractor-authorized personnel will also assist and pay all costs for obtaining and coordinating a sub-contractor to perform restoration work and will work with the selected sub-contractor to equitably restore the premises to its pre-loss condition.

4. The Contractor's Superintendent shall notify the City of the stoppage in the sanitary sewer pipe.

5. Notify City in the event of any spills.

6. The City of Tempe shall notify Arizona Department of Environmental Quality (ADEQ) only as it pertains to Arizona State Law Requirements.

1.09 SURCHARGING

A. Upon notification or discovery that a surcharge condition exists, crews shall respond immediately to the area with proper equipment and manpower to reduce the surcharge. If, due to limited capacity of the sewers, the surcharge cannot be reduced, any spill which occurs shall be properly cleaned. Waste products are to be disposed of in accordance with state and federal laws.

   Contractor shall be responsible for obtaining City's known areas or sections of sanitary sewer pipes that are subject to surcharging capacity situations. These instructions will remain in effect until the problem is resolved. These areas or sections of concern will be monitored throughout the bypass operations, and in the event of an emergency, City shall be notified by the Contractor immediately for response. Response of City crews shall not relieve the Contractor for project responsibilities or liabilities.

   A Confidential Spill Reporting Form must be completed by the Contractor and distributed to the required parties according to Section 1.05. Distribution of said Confidential Spill Reporting Form must take place, preferably by fax or electronic mail, within one (1) day of the occurrence.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 SITE MAINTENANCE

A. Contractor shall keep the work site, staging areas, storage and parking area, Contractor's facilities clean and free from rubbish and debris. Materials and equipment shall be promptly removed from the site when they are no longer necessary. Upon completion of the work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance in conformance with the preconstruction condition of the site.

B. Contractor shall not store equipment or materials anywhere other than locations approved by the City. Property surrounding the work site shall be completely free of all debris and rubbish at all times.

3.02 CLEAN-UP:

A. Waste material of any kind will not be permitted to remain on the site of the work or on adjacent streets. Immediately, upon such materials becoming unfit for use in the work, they shall be collected, carried off the site and legally disposed of by the Contractor. The Contractor shall be responsible for obtaining necessary permits or approval for the Contractor's disposal site.

B. The Contractor shall keep all buildings and areas occupied by the Contractor clear of all refuse, rubbish and debris that may accumulate from any source and shall keep them in a neat condition to the satisfaction of the City.

C. In the event that waste material, refuse, debris and/or rubbish are not so removed from the work area by the Contractor, the City reserves the right to have the waste material, refuse, debris and/or rubbish removed and the expense of the removal and disposal charged to the Contractor.

D. Paints, solvents, and other construction materials shall be handled with care to prevent entry of contaminants into storm drains, surface waters, or soils.

3.03. BARRIERS:

A. A barrier shall be provided around all unattended excavations and open structures. The barrier shall enclose the area and prevent unauthorized access.

3.04 STREET CLEANING:

A. Contractor shall be responsible for preventing dirt, dust, and sediments from escaping from trucks departing the project site, by covering dusty loads, washing truck tires before leaving the site, or other reasonable methods.

B. When working trucks and/or other equipment on paved streets and roadways, the Contractor will be required to clean said streets as soon as possible, but no later than at the conclusion of each day's operations or 24-hour period and at such interim periods as required by the City.

C. All streets in the construction area used by Contractor's trucks or any other equipment hauling material to and from the area, whether within the Contract limits or adjacent thereto, shall be kept clean by the Contractor and shall be continuously serviced by the Contractor's use of water trucks to control dust.

D. Cleaning and dust control shall be as specified in MAG Section 104.1.4 “Cleanup and Dust Control” and shall be at the Contractor's expense.

E. Any violation of the requirements shall be sufficient grounds for the City to order the streets in question cleaned by others and the cost to be paid by the Contractor.

F. No solid materials or soils may be flushed into storm drains or in the sanitary sewers or wastewater facilities.

G. Contractor shall use a power pick-up broom as part of the dust control effort.

3.05 AIR POLLUTION CONTROL

A. GENERAL:

The Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the regulations of any legally constituted authority. The Contractor shall maintain construction vehicles and equipment in good repair. Equipment exhaust emissions that are determined to be excessive by the City shall cause the equipment to be repaired or replaced.

B. Contractor shall also minimize dust nuisance by cleaning, sweeping, and sprinkling with water, or other means. The use of water, in amounts, which result in mud on public streets, is not acceptable as a substitute for sweeping or other methods. Equipment for this operation shall be on the job site or available at all times.

3.06 ODOR:

A. The Contractor shall employ methods and procedures that mitigate the generation and discharge of objectionable odors to the surface environment at all times.

3.07 ODOR CONTROL:

A. Contractor shall be prepared to add approved chemicals to the wastewater flow upstream of bypass pumping operations to reduce odor. Costs for chemical odor control dosing shall be as negotiated and approved by the City prior to use. The Contractor shall make his own determination of flow characteristic for required dosing.

The Contractor shall add the chemicals from a location upstream that will allow 10 to 15 minutes reaction time before the flow enters the work area. The chemical dosing shall reduce odors generated from the wastewater stream to a level acceptable to the City. If this is not accomplished by adding chemicals only, an additional control may be required.

3.08 NOISE CONTROL

A. Contractor shall perform all work in compliance with OSHA standards and in no case will noise levels be permitted which would interfere with the work of the City or others. Noise levels shall be in accordance with City noise ordinance.

B. If pumping operations and/or power generation occur after normal work hours as stated in the Technical Specification Section 02145 – Diversion of Sewage Flow and Dewatering, subsection 2.01A. Contractor shall utilize sound attenuated bypass pumps with a maximum decibel rating of 70 db @ 50 feet.

C. Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer for residential use. No internal combustion engine shall be operated on the project without said muffler.

D. Noisy portable equipment, such as generators, pumps or compressors, shall be located as far away from sensitive noise receptor areas as practical. Sensitive noise receptors are defined as occupied buildings with windows or doors facing the site. Noise barriers shall be constructed around noisy stationary construction equipment such as compressors, pumps or generators that have to be utilized at locations near (within 100 feet of) sensitive noise receptors as defined above.

E. Idling equipment not actively utilized for extended periods of time shall be shut off.

3.09 TREE AND PLANT PROTECTION

A. If a tree or any landscaped vegetation is damaged or destroyed by construction, or any action of the Contractor, the Contractor shall replace the damaged tree or plant with a healthy one of the same species. The replacement tree or plant shall be of the same size as the damaged tree or plant and will be placed at the existing grade. The Contractor shall bear all expenses required to establish the replacement tree or plant. The replacement tree or plant shall be guaranteed healthy for 1 year after the end of construction date. The Contractor shall be responsible for any tree or plant that the Contractor had replaced that is deemed unhealthy during that year.

B. All landscaped areas and other surface improvements which are damaged by actions of the Contractor shall be restored to their original condition at the Contractor's expense.

3.10 SURFACE WATER CONTROL

A. Contractor shall conform to the regulations and requirements of legally authorized surface water management agencies. The Contractor is responsible to provide and maintain any temporary pumping, drainage structures, or other means to manage or control nuisance surface water.

B. The Contractor shall be responsible for keeping any open excavations and other areas free from water as required to permit continuous progress of, or to prevent damage to, its own work or work of others. The Contractor shall cover exposed excavated areas and spoil piles when runoff from rain is or would be likely to cause turbid waters to enter local waterways. The Contractor shall suspend work in the rain if such work cannot be performed without causing turbid runoff.

3.11 STORM DRAIN

A. Contractor shall not discharge any wastewater, potable water used for testing, or cleaning, or any chemical or waste materials from the construction operation into the storm drain system.

3.12 SANITARY SEWER

A. Contractor shall not dispose of chemical or any waste materials from the construction operations into the sanitary sewer system.

**** END OF SECTION ****

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SECTION 01700
RESTORATION OF IMPROVEMENTS

PART 1 - GENERAL

1.01 GENERAL

This section specifies restoration of improvements of the Contractor's work area, staging area, storage area, and parking area.

1.02 STRUCTURES

Contractor shall remove such existing structures as may be necessary for the performance of the work and shall rebuild the structures thus removed, with the specified requirements, in as good a condition as found. The Contractor shall also repair existing structures that workers damage as a result of the work under this Project at no additional cost to the City.

1.03 ROADS AND STREETS

Unless otherwise specified, roads and streets in which the surface is removed, broken, or damaged, or in which the ground has caved or settled during or as a result of the work under this Project, shall be resurfaced and brought back to the original grade and section at the Contractor's expense. The Contractor shall document in video the entire road or street area to be used for the work and parking area as specified in Technical Specification Section 01380 – Photography and Video Recordings. Copies of the Digital Video Disk (DVD) or Universal Serial Bus (USB) shall be submitted to the City prior to starting the work. Once construction starts, Contractor assumes responsibility for road condition and repair.

Roadways used by the Contractor shall be cleaned and repaired if damaged. Before resurfacing material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of loose material. Streets, sidewalks, and other City, County or State-owned facilities impacted by construction activities shall be replaced or repaired in accordance with current City and MAG requirements.

1.04 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS

A. Cultivated or planted areas, other unpaved areas, and other surface improvements which are damaged by actions of the Contractor shall be restored to their original condition. The Contractor shall document in video the entire area to be used as the work area, staging area, storage area, and parking area as specified in Technical Specification Section 01380 – Photographs and Video Recordings. Copies of the DVD or USB shall be submitted to the City prior to starting the work. Once construction starts, Contractor assumes responsibility for road condition and repair.

B. Existing guard posts, barricades, and fences shall be protected and replaced if damaged.

1.05 PROTECTION OF EXISTING INSTALLATIONS

A. Contractor shall protect all existing operating facilities and structures from damage. However, if damage occurs, the Contractor shall immediately correct or replace existing equipment, materials, or systems that are damaged as a result of its operations to the satisfaction of the City.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 RESTORATION ACCEPTANCE

A. The Contractor shall restore the area to existing condition of the Contractor's work area, staging area, storage area, and parking area as documented in the photographs and video recordings.

B. The City shall determine if and when restoration of the site is acceptable following review of the pre-construction and post-construction recordings as specified in Technical Specification Section 01380 – Photographs and Video Recordings.

**** END OF SECTION ****

SECTION 01999
REFERENCE FORMS

PART 1 - GENERAL

1.01 REQUIRED FORMS

The forms listed below and included in this section are referenced from other Technical Specification sections of the contract documents:

Form No.	Title
01999- A	Submittal Transmittal
01999- B	Request for Information
01999- C	Confidential Spill Reporting
01999- D	Chain of Custody

1.02 SCOPE

The Contractor shall be responsible for the documentation forms for tests and evaluations required of the contract that do not have specific forms identified. Contractor generated forms shall follow the format established on Form 01999-A Submittal Transmittal contained herein.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

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FORM 01999-A SUBMITTAL TRANSMITTAL

Submittal Description: _____ Submittal No: _____

Spec Section: _____

	Routing	Sent	Received
OWNER:	Contractor		
PROJECT:	Engineer		
	Contractor		
CONTRACTOR:			

We are sending you ☐ Attached ☐ Under separate cover via _____

☐ Submittals for review and comment
☐ Product data for information only

Remarks: _____

Item	Copies	Date	Section No.	Description	Review action[a]	Reviewer initials	Review comments attached

Note: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
Attach additional sheets if necessary.

Contractor: Certify either A or B:

☐ A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work specified (no exceptions).

☐ B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation
_____	_____
_____	_____
_____	_____
_____	_____

Certified by: _____
Contractor's Signature

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FORM 01999-B REQUEST FOR INFORMATION

OWNER: _____

PROJECT: _____

CONTRACTOR _____

RFI TITLE: _____

	RFI NO.	
ROUTING	**SENT**	**RECEIVED**
Contractor	_____	_____
City Representative	_____	_____

REFERENCES: **DRAWING NO:** _____ **LOCATION:** _____

SPEC. SECTION: _____ **PAGE:** _____

OTHERS: _____

The following information is requested as described below or in the attachments:

_____

_____

_____

_____

_____

_____

_____

By: _____ Date: _____

The following information is provided as described below or in the attachments:

_____

_____

_____

_____

_____

_____

_____

_____

By: _____ Date: _____

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FORM 01999-C CONFIDENTIAL SPILL REPORTING

INSTRUCTIONS: The Contractor shall ensure that appropriate on-site personnel complete this form. The form shall be completed immediately upon discovery of a sanitary sewer spill or release by the individual who first made the discovery.

First at the Scene (name):

1. Facility name and address/location/intersection (or major cross streets):

2. Is/was there a fire or explosion or other release (except for sewage release) outside the facility?

   Yes ☐ No ☐
   If yes, immediately contact the Fire Department (911) for assistance, initiate appropriate facility response procedures, and then continue with this form.

3. Personal injuries and extent, if any:

4. Date and time of initial call or complaint:_____

5. Date and time of spill found or confirmed:_____

6. Date spill reporting completed:_____

7. Date and time spill occurred or started, if known:_____

8. What was spilled? Describe completely. List chemical names/wastewater if known.

9. How much was spilled? Use units such as gallons or pounds, etc._____

10. Where and how did the spill occur? Include a description of the container or vessel from which the spill occurred. Attach diagram or map, if available.

11. Where did the spilled material go? Check all that apply.

☐ drywell	☐ dry wash	☐ canal	☐ riverbed
☐ private property	☐ retention basin	☐ sanitary sewer	☐ secondary containment
☐ storm drain	☐ city street	☐ Air (vapors or odors)	☐ other (specify below)

_____
_____
_____
_____
_____

12. How far did the spill travel? Describe the path the spill took to its final destination.

13. Was the spill stopped or contained? Describe how and by whom.

14. How long did the spill last? _____

15. Who found the spill? Use the back of this form if necessary.

Name_____ Title_____ Phone_____

a.

b.

16. Who was notified of the spill? List names and identify how notification was made (phone call, fax, etc. Use the back of this form if necessary).

    Name Department/Division/Agency Date/Time Notified Method of Notification

    a.

    b.

Printed name and signature of person who completed this form:

Printed Name_____Title_____Phone_____

Signature_____ Date_____

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FORM 01999-D CHAIN OF CUSTODY

PROJECT:	CITY:
CITY CONTRACT NUMBER:	
PROJECT NUMBER:	

OWNERS REPRESENTATIVE:	
COMPANY NAME:	
ADDRESS	
CONTACT PHONE NUMBER:	
CONTACT NAME:	

CONTRACTOR:	
COMPANY NAME:	
ADDRESS	
CONTACT PHONE NUMBER:	
CONTACT NAME:	

TESTING LABORATORY:	
LAB NAME:	
ADDRESS	
CONTACT PHONE NUMBER:	
FAX NUMBER	
CONTACT NAME:	

Date Sample Taken:	
Sample Number:	
Quarter Section No.	
Upstream Manhole No.	

Pipe Segment No.	
Pipe Diameter	
Liner Design Thickness:	
Resign Type:	
Downstream Manhole No.	

SAMPLE TAKEN BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

ENGINEER, RECEIVED BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

LABORATORY RECIEVED BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

TEST RESULTS, RECEIVED BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

**** END OF SECTION ****

SECTION 02100
TRAFFIC CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

Traffic control during construction shall be provided in accordance with the requirements of the 2016 City of Tempe Traffic Barricade Manual.

1.02 TRAFFIC REGULATIONS

A. Traffic Control Plan must be submitted for review and approval by the City of Tempe (City) for arterial, collector, and local streets impacted by construction operations.

B. All traffic and/or traffic control devices on this project shall be provided, maintained and/or controlled as specified in the City of Tempe Traffic Barricade Manual, MUTCD, ADOT Supplement to MUTCD, and City of Phoenix Traffic Barricade Manual, except as modified per the City of Tempe Traffic Barricade Manual.

C. Pedestrian control shall comply with the City of Tempe Barricade Manual Section 4.6, City of Phoenix Traffic Barricade Manual, or any special condition required by the City.

D. The submitter/designer of the Traffic Control Plan (TCP) shall be IMSA or ATSSA certified.

E. The Barricade Company used by the Contractor shall have a current barricade certification permit as required by the City of Tempe Traffic Barricade Manual Section 2.

F. Law enforcement officers may be required within 300 feet of a signalized intersection. Officers may be required for non-signalized construction areas at the discretion of the City.

G. Traffic restrictions on arterial and collector streets are not permitted during peak traffic hours (7:00 am to 8:30 am and 3:30 p.m. to 6:30 p.m.) as per City of Tempe Traffic Barricade Manual Section 4.2.

H. 24-hour TCP setup on arterial streets is not permitted without prior written approval from City of Tempe Transportation Department.

I. A minimum of five (5) working days, is required for TCP review prior to construction starting. Re-submitted redline corrected TCP requires additional five (5) working days for review.

1.03 TRAFFIC CONTROL / ACCESS

A. Contractor shall be responsible to present traffic control plans at the regularly scheduled project progress meeting for review as outlined in Technical Specification Section 01014 – Work Sequence, subsection 1.04C. Uninterrupted access to commercial businesses and residences shall be maintained at all times. Contractor shall be responsible to adjust work schedule to minimize disruption to normal operation of businesses.

B. Contractor shall be responsible to coordinate traffic control plans and inform the project's public relations sub-consultant of any potential impacts to commercial businesses or residents. Contractor shall adjust work activities and schedules to minimize disruptions to the City, residents and traveling public. The City reserves the right to request the Contractor move his operations or modify work plans and schedules to minimize disruptions to commercial business or residents at no cost to the City.

1.04 TRAFFIC CONTROL PLAN DISTRIBUTION

A. Copy of approved Traffic Control Plan (TCP) shall be submitted to the City's representative prior to start of work.

B. Copy of approved traffic control plan shall be on-site and available for review at all times work activities are commencing. Failure to have approved TPC on-site while work is commencing will be grounds for rejection and non-payment of work being performed.

PART 2 - PRODUCTS
(NOT USED)

PART 3 - EXECUTION
(NOT USED)

**** END OF SECTION ****

SECTION 02145
DIVERSION OF SEWAGE FLOW AND DEWATERING

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This Technical Specification Section describes requirements for temporary bypassing and dewatering of sewers during sanitary sewer pipe and access manhole rehabilitation, if required.

B. REQUIREMENTS:

1. Contractor shall provide all coordination, labor, materials, equipment and supervision to temporarily bypass flow around the Contractor's work in accordance with the Contractor's specific needs of the rehabilitation method being utilized and dewater the pipelines and/or manholes in preparation for cleaning and rehabilitation.

2. Contractor shall provide all coordination, labor, materials, and equipment to bypass flow utilizing flow through plugs.

3. The actual design of the bypass arrangement shall be the responsibility of the Contractor and shall be submitted to the City and City's Representative to review for general conformance to project objectives. Means and methods of accomplishing the bypassing shall be the responsibility of the Contractor.

4. The Contractor shall have the entire bypassing system in place and successfully pressure tested with potable water at a minimum of 1.5 times the maximum operating pressure of the system before bypassing any sewage.

5. The Contractor shall notify the City 48 hours prior to shutting down or bypassing any pipeline. The bypass system equipment and existing flows shall be continuously monitored.

6. It is the Contractor's responsibility to arrange all necessary access and temporary construction agreements with all affected parties for the Contractor's proposed location of the bypass pumping system.

7. Contractor is responsible for immediate and proper cleanup as per Technical Specification Section 01560 – Environmental Controls should any sewage spill occur. Regardless of amount, the Contractor shall pay for all damages and fines incurred as a result of a spill.

C. EXPERIENCE:

Contractor shall utilize staff and/or a subcontractor that has been directly responsible for completion of a rehabilitation project that required the bypass pumping of sewage flows in excess of 1.0 mgd.

1.02 SUBMITTALS

A. At the preconstruction conference the Contractor shall submit, in accordance with Technical Specification Section 01300 - Submittals, drawings and complete design data showing methods and equipment the Contractor proposes to utilize in sewer bypassing for review by the City. The submittal shall include the following information:

1. Drawings indicating the scheme and location of temporary sewer plugs and bypass discharge pipes. The drawings shall also show the method and location for discharging the bypass pipes.

2. Capacities of pumps, prime movers, and standby equipment.

3. Design calculations verifying adequacy of the capacity of the pumping system and selected equipment, The Contractor shall have a professional civil engineer, registered in the State of Arizona, design and professionally seal bypassing pumping plan and calculations.

4. Flow through plugs material and size.

5. Standby power source.

6. Staffing plan.

1.03 EMERGENCY PLAN

A. Diversion of sewage into adjacent sewers (if applicable or proposed)

1. Drawings and/or design calculations verifying available flow capacity of sewer receiving the bypassed sewage.

2. CCTV showing the structural and internal condition of the sewer receiving the bypassed sewage.

1.04 JOB CONDITIONS

A. AVAILABLE FLOW DATA:

Sanitary sewer flow rates are unavailable for this project, the Contractor shall be responsible for measuring flow prior to construction to properly size the bypass pumping system to accommodate existing flow present at the time construction occurs.

B. PROTECTION:

No bypassing to the ground surface, receiving waters, storm drains, or bypassing which results in soil or groundwater contamination or any potential health hazards shall be permitted.

C. SCHEDULING:

The bypassing system shall operate continuously and shall not be shut down between shifts, on holidays or weekends, or during work stoppages without written permission from the City. The bypass system shall have attendants monitoring 24 hours a day whose only duty is to maintain the bypass pumping system until the bypassing of that specific pipeline is no longer required.

D. SERVICE LATERALS:

Sanitary sewers to be bypassed may have service laterals connected to adjacent users. The Contractor shall verify the locations of these laterals and any other service laterals not shown on the Design Drawings.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Contractor shall provide temporary pumps, conduits, and other equipment to bypass sewer flow around the Contractor's work area as required during CCTV inspection, cleaning and rehabilitation activities. Contractor shall furnish all necessary labor and supervision to set up, operate and remove the pumping and bypass piping system. Sound attenuated pumps shall be provided for the bypass pumping. The sound attenuated pumps and/or power generators shall be capable of achieving an operating noise level of 70 decibels or less, measured at a distance of 50 feet. Contractor shall be responsible to provide and install sound attenuation devices, methods, and/or systems to maintain noise levels below stated decibels. Sound measurements shall be made and recorded by the Contractor in accordance with American National Standard S1.13-2020. Pumps and bypass pipes shall be of adequate capacity and size to handle the required capacity.

1. Pumping: Contractor shall provide adequate size pump(s) to accommodate 150 percent of the maximum instantaneous flow. The Contractor shall determine the required flow capacity. The City may provide flow information (if available) to the Contractor but shall provide no guarantees regarding the accuracy of such data.

2. Contractor shall provide 100 percent redundant bypass pumping capability when only one pump is required to accommodate the flow. When multiple pumps are required to accommodate the bypass flows, the Contractor shall provide a minimum of 50 percent additional number of equal capacity pumps.

3. Contractor shall provide a full time operator/inspector with full responsibility for the bypass pumping operation.

4. In no case shall the Contractor allow any sewage to surcharge and backup into homes or businesses, or in any way overflow into the environment. If the bypass pumping capacity is insufficient to prevent surcharge and/or overflow at any time, the Contractor shall clear any blockages and pull the line plugs irrespective of the status of the application or rehabilitation process.

B. Contractor shall maintain on site, sufficient equipment and materials to ensure continuous and successful operation of the bypass and dewatering systems. The standby equipment shall be installed, fueled/powered and fully operational at all times including all pumps, support equipment being in-place. The Contractor shall maintain on site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping, and other parts or system hardware to ensure immediate repair or modification of any part of the system as necessary.

C. All pumps, generators and other fueled equipment shall be placed in a containment barrier to protect against gasoline, oil, and hydraulic fluid spills.

PART 3 - EXECUTION

3.01 ESTIMATED FLOWS AND SEWER CAPACITY

A. Reference Technical Specification Section 01010 – Summary of Work, paragraph 1.03.

3.02 PROTECTION

In areas where flows are bypassed, all bypass flow shall be discharged as described above or approved by the City's Representative. No bypassing to the ground surface, receiving waters, storm drains, or bypassing which results in groundwater contamination or potential health hazards shall be permitted.

3.03 DAMAGES

The Contractor shall repair, without cost to the City, any damage that result from the Contractof's negligence, inadequate or improper installation, maintenance and operation of bypassing system, including debris clogging, mechanical, or electrical failures.

**** END OF SECTION ****

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SECTION 02148
CIPP LINING OF EXISTING SEWERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE

This Technical Specification Section specifies the Cured-In-Place-Pipe (CIPP) rehabilitation lining, sets acceptable material and experience parameters, defines minimum performance requirements for the finished, installed product and details testing requirements for the completed product.

B. REQUIREMENTS

The Contractor shall provide and install a resin impregnated flexible tube (liner) with an interior plastic coating wearing surface into pipes identified for CIPP lining in accordance with American Society for Testing and Materials ASTM F1216 for the inversion installation method or ASTM F1743 for the pulled-in-place installation method, or ASTM F2019 for pulled-in-place (Glass Reinforced Plastic – liner) with resin cured by exposure to heated water, steam or UV light. When cured, the CIPP lining shall be continuous and tight fitting.

1.02 CLIMATIC CONDITIONS

The Contractor is made aware that the Work may occur during the summer months with temperatures exceeding 115 degrees F. The Contractor shall be prepared for these conditions and alter installation procedures or provide protection from detrimental exposure to adverse temperature or sunlight consistent with the materials proposed for use.

Severe thunderstorms could occur that may increase volume of flow present within the sewer system. The Contractor shall be prepared for these conditions and alter his installation procedures and/or provide bypass pumping capabilities accordingly. Contractor shall be responsible for review of the weather forecast prior to commencement of liner installation that restricts or impedes the flow capacity of sewer pipe being rehabilitated. When the anticipated weather conditions are such that the resulting sewer flow may exceed upstream sanitary system storage volume or the capacity of the bypass pumping system or otherwise adversely affect the liner installation then the City's Representative shall be informed and the installation shall be delayed until favorable weather is forecast.

1.03 EXPERIENCE RECORD OF THE CONTRACTOR

The Contractor shall provide to the satisfaction of the City, written documentation from the CIPP lining manufacturer that the Contractor's personnel have been adequately informed and trained in the installation procedures of CIPP liner process proposed. Such

written documentation shall describe manufacturer's procedures for installers, training program and, if applicable, licensing policies.

The Contractor shall have an experienced representative on-site that has been responsible for the successful installation of a minimum of 5,000 linear feet of CIPP liner installation of similar diameter in the United States utilizing the installation materials and techniques proposed.

1.04 REFERENCES

This Technical Specification Section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

AASHTO Loading	American Association of State Highway and Transportation Officials - Anticipated external load to be placed on the pipe.
ASTM F412	Definitions of Terms Relating to Plastic Piping Systems.
ASTM F1216 (including Appendix XI)	Standard practice for rehabilitation of existing pipelines and conduits by the inversion and curing of a resin-impregnated tube.
ASTM F1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).
ASTM F2019	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)
ASTM C581	Standard Practice for Determining Chemical Resistance of thermosetting resins used in glass fiber reinforced structures, intended for liquid service.
ASTM D543	Test Method for resistance of plastics to chemical reagents.

ASTM D638	Standard Test Method for Tensile Properties of Plastics.
ASTM D790	Test Method(s) for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.
ASTM D883	Definitions and Terms Relating to Plastics.
ASTM D1600	Abbreviations, Acronyms, and Codes for Terms Relating to Plastics.
ASTM D2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
ASTM D 1682	Test Method for Breaking Load and Elongation of Textile Fabrics.
ASTM D 5813	Specification for Cured-in-Place Thermosetting Resin Sewer Pipe APS Standard – Water tightness standard for cured-in-place thermo-setting resin pipe Porosity Test protocol.
ASTM D3039 / D3039M	Test Method for Tensile Properties of Polymer Matrix Composite Material
ASTM D 3567	Practice for Determining Dimensions of Reinforced Thermosetting Resin Pipe (RTRP) and Fittings
ASTM E797	Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method.
NASSCO Standard	Recommended Specifications for Sewer Collection System Rehabilitation.

1.05 SUBMITTALS

The following submittals shall be provided in accordance with Technical Specification Section 01300 – Submittals:

1. Shop drawings which detail short and long term properties (providing all supporting test data) of all component materials, construction and recommendations for material storage, sunlight control (if applicable), temperature control (if applicable), and CIPP liner handling constraints.

2. Representative cured liner sample (1-foot in length) for each diameter size of the same resin and felt/fiberglass liner proposed for the project depicting all material components, depicting the final quality of workmanship that can be expected on this project.

3. Structural calculations of each CIPP diameter size that is proposed for use in sanitary sewer pipes as identified in the design drawings using parameters stated in paragraph 2.04. CIPP liner calculations shall be stamped by a Professional Engineer in the State of Arizona.

4. 10,000-hour third party, 50-year Flexural Creep Modulus test data. Test shall be in accordance with ASTM D-2990 at 10,000 hours. If approved 10,000 hour tests are not available, Contractor shall use a minimum 50% reduction (50% retention) of Flexural Modulus of Elasticity (per ASTM F-1216) for all formula calculations.

5. Independent laboratory test reports of CIPP sample(s) and tests as specified in Technical Specification Section 02148 , paragraph 1.06 (A).

6. Remote visual inspection video and reports as specified in Technical Specification Section 02148 , paragraph 3.01 (C),

7. Liner manufacturer's recommended installation procedures per ASTM F1216 or ASTM F1743, Recommendations for material storage, temperature and sunlight control, CIPP liner handling, insertion, curing, trimming and finishing.

8. Liner manufacturer's recommended maximum pulling force that can be applied to the liner (if winched-in method employed).

9. Resin manufacturer's proposed rate of cure temperature change (heating and cooling) and the target temperature and duration for cure of resin along with the maximum rate and target temperature for cool down prior to the termination of the cure process.

10. Certification showing the Contractor is currently licensed by the appropriate licensor to perform CIPP installation. Certification shall be given to the City's Representative before any materials are delivered to the job site.

11. A certified affidavit, signed by an officer of the installation Company, shall be provided stating that the on-site superintendent has received proper training in the manufacturer's recommendations for CIPP liner installation methods and procedures.

12. Certification stating CIPP tube has been manufactured in accordance with ASTM F1216 and resin ASTM D5813 is suitable for its intended use.

13. Test results for chemical resistance performed on a previously prepared sample of the finished product proposed for this project. Contractor shall submit a certified affidavit, signed by an officer of the company, stating that the resin the tests apply to and the resin submitted for this project are the same.

14. Contractor shall submit method of measuring defects and an outline of specific repair or replacement procedures as recommended by the tube manufacturer for potential defects removal that may occur in the installed CIPP. Potential defects within the CIPP that cannot be repaired shall be clearly defined by the Contractor based on the manufacture's recommendations, accompanied by a proposal for compensation to the City.

15. Liner termination material proposed to seal the CIPP Liner end at the liner/manhole interface.

16. Warranty information and certificates.

17. Safety Data Sheets for all hazardous chemicals used or expected to be on-site. At a minimum, sheets for the resin, catalyst, cleaners and repair agents should be submitted.

18. Proposed equipment and fiber optic cable for monitoring the CIPP liner wall temperature during cure along the entire length being installed.

19. Contractor shall submit Lateral Seal connection material shop drawings and installation procedures.

20. Contractor shall submit UV cured CIPP patch shop drawings and installation procedures.

1.06 CIPP LINER QUALITY ASSURANCE

A. LABORATORY TEST SAMPLE:

1. Sample should be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted through a similar diameter pipe or other restraining system which will be held in place by a suitable heat sink, such as sandbags per ASTM F1216 or ASTM F1743 or ASTM F2019.

2. CIPP liner samples taken shall be sent to an independent laboratory within three (3) days of collection for quality control testing. Samples are to be signed by the City's Representative and accompanied by a completed Chain of Custody form, included in Technical Specification Section 01999 -Reference Forms – FORM 01999-D. Results of laboratory testing shall be submitted directly to the City's Representative within three (3) working days of receipt by the Contractor.

3. Samples taken for testing shall be individually labeled and logged to record the following:

    a. City name.
    b. City's project number and project title.
    c. Unique sample number.
    d. Pipe segment number as noted on Design Drawings or Pipe Rehabilitation List.
    e. Date and time sample was taken.
    f. Name of Contractor.
    g. Date, location and name of person by whom the sample was taken.

Updated copies of the test log shall be submitted to the City Representative at the regularly scheduled coordination meeting.

4. SAMPLE TESTING. The cured sample shall be tested by an independent testing laboratory approved by the City's Representative. Final payment will not be made until acceptable test results are received by the City's Representative. The Contractor shall be responsible for any deviation from the specified physical properties and those evaluated through testing. Failure to meet the specified physical properties will result in the CIPP liner being considered defective work which will be handled in accordance with MAG Section 106. The Contractor shall be responsible for all costs associated with the testing of the liner physical properties and repair of any defective work.

5. SAMPLING FREQUENCY: The above-stated sampling shall be performed for each manufacturing lot of CIPP liner materials (per diameter size). A sample shall be taken every 3,000 lineal feet or one semi-trailer load of liner whichever is less. City's Representative reserves the right to request the Contractor to perform one (1) additional test for every 3,000 lineal feet or one semi-trailer load of liner whichever is less.

6. Grounds for rejection of installed CIPP liner include, but not limited to the following:

    a. CIPP sample sent to laboratory that is missing City's Representative signature.

    b. CIPP samples missing the Chain of Custody form.

    c. Chain of Custody form missing information or signatures of all those who handled or processed the sample, including the signature of the City's Representative and the laboratory Manager responsible for performing the quality control testing.

    d. Laboratory test results not meeting minimum Technical Specification requirements.

B. LABELING

Each liner tube shall be labeled by the liner manufacturer with a permanent unique identification number that is referenced in accompanying documentation. Documentation shall include the following:

1. Liner manufacturer's name,
2. Location of the liner manufacturer,
3. Felt supplier,
4. Resin supplier,
5. Date of resin impregnation into felt liner,
6. Unique identification number of liner,
7. Resin identification number,
8. Resin weight – lbs/ft,
9. Manufactured liner length both resin impregnated felt "wet" and dry felt "dry"
10. Liner thickness,
11. Liner diameter.

1.07 WARRANTY

The work performed under this Project shall be warranted to be free from defects in material and workmanship for a period of **two (2) years** from the date of Final Acceptance. The City's Representative, while not acting as quality control agent for the Contractor, shall be allowed to view and document any portion of this contract, including but not limited to verifying type and quantities of resin used at any point during this work. If the City's Representative determines that the process/material/installation has failed during the warranty period, the Contractor shall perform any and all repairs, including ancillary costs associated with repair at no additional cost to the City.

The warranty period of any part of the Work repaired or replaced under the provisions of the warranty will be extended for one (1) additional year.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials and installation procedures provided by the Contractor for use in the CIPP installation process shall be equal to or exceed the requirements of ASTM F1216, ASTM F1743 and ASTM F2019 and ASTM D2990.

B. Contractor shall be responsible for control of all material and process variables to provide a finished CIPP possessing the minimum properties specified in ASTM F1216 and ASTM 5813 and/or supplemented herein.

2.02 COMPONENT PROPERTIES

A. MATERIAL

a. FELT LINER
The liner tube shall consist of one or more layers of flexible needled felt or an equivalent non-woven and/or woven material meeting ASTM 1216 Section 5 or ASTM F1743 Section 5.2.1 and capable of carrying resin, withstanding installation pressures and curing temperatures, and is compatible with the resin system used.

a. FIBERGLASS LINER
The liner tube shall consist of one or more layers of flexible fiberglass or an equivalent woven material meeting ASTM D2990 and ASTM D5813 and capable of carrying resin, withstanding installation pressures and curing temperatures and is compatible with the resin system used.

The fiberglass liner shall include an exterior and interior film that protects and contains the resin used in the liner. The exterior film shall be provided with an ultraviolet (UV) light blocker foil.

B. RESIN

The resin system to be used shall be manufactured by an approved company selected by the CIPP process manufacturer. Only corrosion resistant polyester or vinyl ester resins shall be used.

The resin used shall produce a properly cured-in-place pipe system, which will be resistant to abrasion caused by solids, grit, and/or sand. The cured-in-place pipe system shall also be resistant to corrosion due to acids and gases such as sulfuric acid, carbonic acid, hydrogen sulfide, methane, and carbon monoxide. The cured-in-place pipe system utilized shall withstand the corrosive effect of the existing residential, commercial, and industrial effluents, liquids and/or gases.

The chemical corrosion resistance of the actual resin system used by the Contractor shall be tested by the resin manufacturer in accordance with ASTM F1216, D543, or C581 as applicable. Exposure to the chemical solutions listed below shall result in a loss of not more than twenty percent (20%) of the initial physical properties when tested in accordance with ASTM C581:

C. CHEMICAL RESISTANCE

The chemical resistance tests should be completed in accordance with Test Method ASTM D 543. Exposure should be for a minimum of one month at 73.4 degrees F. During this period, the CIPP test specimens should lose no more than 20 percent of their initial flexural strength and flexural modulus when tested in accordance with Section 8 of ASTM F1216 when subjected to the following solutions:

Chemical Solution	Concentration (%)
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Gasoline	100
Vegetable Oil	100
Detergent	0.1
Soap	0.1

The Contractor shall be responsible for all costs associated with the chemical resistance tests. Proof of meeting these requirements shall be provided to the City's Representative for approval at least seven (7) days prior to commencement of work.

D. LINER TUBE

1. The liner tube shall be fabricated to a size that, when installed, will fit the internal circumference of the existing sanitary sewer main without any annular space between liner and walls of host pipe. Allowances shall be made for circumferential stretching due to insertion of liner and deterioration of host pipe walls.

2. The minimum liner tube length shall be that deemed necessary by the Contractor to effectively and continuously span the distance from the inlet to the outlet of the respective manholes, unless otherwise specified. The Contractor shall verify the lengths in the field before impregnation and installation of the tube. Individual insertion runs may be made over one or more manhole sections as determined in the field by the Contractor.

3. Measure the overall elongation of the fabric tube after pull-in completion and report to the City's Representative.

4. Contractor shall utilize a dynamometer or load cell per ASTM F1743 Section 6.4.1 or other approved method to monitor winch or cable pulling force.

5. Prior to insertion, the liner tube shall be free of all visible tears, holes, cuts, foreign materials, and other defects.

6. The physical properties quoted in Technical Specification 02148 – paragraph 2.03 applies to CIPP manufactured polyester, vinyl-ester, or epoxy resin. Resins shall be

tinted for visibility and provide positive indication of adequate liner wet-out. Resins should be appropriate for conditions encountered.

E. DIMENSIONS

1. The Contractor shall make allowances in determining the felt tube length and circumference for stretch during installation and shrinkage during curing. The Contractor shall verify the lengths in the field before the felt tube is cut and impregnated. Individual installation runs may include one or more manhole-to-manhole sections as approved by the City's Representative.

2. The diameter of the host pipe may be larger than the nominal inside diameter due to corrosion of the existing host pipe. It is the Contractor's responsibility to determine the required diameter of the liner.

3. "Minimum Design" thickness is defined as the CIPP calculated thickness according to ASTM F1216 or ASTM F1743 or ASTM D2990 as applicable, using design criteria then rounded up to next manufactured increment. Calculations of liner thickness shall be submitted to the City or City's Representative according to Technical Specification Technical Specification Section 01300 – Submittals prior to installation.

   Unless otherwise specified to provide for excess resin migration, the gap thickness of the wetting out equipment shall be sized to allow an excess of 5 to 10 percent resin to pass during impregnation. The measurement of installed dry cured liner thickness shall be determined at a minimum of three locations cut from a CIPP restrained liner sample, minus the thickness of any plastic coatings or CIPP layers not included in the structural design of the CIPP, using a method of measurement accurate to the nearest 0.005-mm.

2.03 FINISHED AND CURED CIPP LINER PROPERTIES

The physical properties of the cured CIPP shall have minimum initial test values as given in Table 1 of ASTM F1216 for resin impregnated felt tube and Table 1 of ASTM F2019 for resin impregnated Glass Reinforced Plastic tube and supplemented below in Table 1. Properties for these or any other enhanced resins shall be substantiated with test data.

Table 1: CIPP Liner Properties

Resin Impregnated Felt Tube

Test Property	Test Value	Test Method
Flexural strength	5,000 psi	ASTM D790
Flexural modulus	300,000 psi	ASTM D790
50-year flexural creep modulus	150,000 psi	ASTM D2990

Resin Impregnated GRP Tube		
Test Property	**Test Value**	**Test Method**
Flexural strength	7,000 psi	ASTM D790
Flexural modulus	750,000 psi	ASTM D790
50-year flexural creep modulus	375,000 psi	ASTM D2990

2.04 DESIGN CRITERIA

A. The liner thickness shall be designed in accordance with the procedures of ASTM F 1216, Appendix XI, ASTM D2990 and these Technical Specifications. All material properties used in design calculations shall be long-term (time-corrected) values. Contractor shall familiarize himself with site conditions when preparing liner design.

B. The following parameters shall be assumed for the liner design:

1. Modulus of soil reaction, E'_s = 1,000 psi (**fully deteriorated**)
2. Unit weight of soil = 140 pcf
3. The minimum ovality shall be 2.0 percent
4. Groundwater to ground surface elevation
5. AASHTO H20 Traffic loads
6. Safety Factor = 2.0

2.05 PAYMENT PENALTY / REDUCTION

A penalty will be assessed by the City to the Contractor for payment on all installed CIPP liners that do not meet or exceed the minimum CIPP wall thickness requirements as stated in Technical Specification Section 02148 - paragraph 2.02.E.3. Payment to the Contractor will be reduced on Contractor's unit price per foot payment for the total length of CIPP liner installed as measured between center of upstream manhole to center of downstream manhole. Payment/reduction shall be based on the following Table 2 – Payment Penalty / Reduction:

TABLE 2 - PAYMENT PENALTY / REDUCTION	
Payment Penalty (see note 1)	**Installed Dry Cured Liner Thickness Below Minimum Design (mm)**
0%	0% up to and including 5%
10%	Greater than 5% up to and including10%
20%	Greater than 10% up to and including 20%
Rejected	Greater than 20%
Note 1 – Reduction in payment assessed in Contractor's pay request to City	

2.06 CIPP TERMINATION POINTS

The Contractor shall provide CIPP liner terminations. The Contractor shall seal the liner/manhole interface with material consisting of a resin mixture compatible with the liner/resin system or approved equivalent. The sealing system shall be applied in accordance with material manufacturer specifications and extend a minimum 6-inches onto the manhole channel, bench, and wall. The material proposed shall be approved by the City's Representative.

2.07 CURE TEMPERATURE MONITORING

For CIPP 15-inches and larger, the Contractor shall provide equipment and fiber optic cable for monitoring the CIPP liner wall temperature during cure along the entire length being installed. Sensor technology shall be as manufactured by Zia Systems LLC., of Galloway, Ohio 43119-8137 or approved equal.

PART 3 - EXECUTION

3.01 PREPARATORY PROCEDURES

A. SET-UP

Prior to CIPP installation all necessary traffic control measures shall be put into place per Technical Specification Section 02100 – Traffic Control, and the bypass diversion pumping system, including back-up pumps, shall be tested and running per Technical Specification Section 02145 – Diversion of Sewage Flow and Dewatering.

Every effort should be made to protect the environment from any contamination from sanitary sewer.

B. SEWER CLEANING

Prior to CIPP tube installation, the Contractor shall clean the existing sewer in accordance with Technical Specification Section 02760 – Sewer Pipe and Sewer Structure Cleaning. The Contractor shall clear the existing sewer of obstructions such as solids that will prevent or hinder CIPP liner installation. The Contractor shall utilize a spinning nozzle as to ensure that the host pipe is free from any residual sediment prior to lining. A time lapse no greater than 30 calendar days shall be allowed between initial host pipe cleaning and liner installation.

C. CCTV INSPECTION

The interior of the sewer shall be inspected in accordance with Technical Specification Section 02761 – Remote CCTV Inspection of Existing and Rehabilitated Sewers to

determine the location of conditions, which may prevent proper installation of CIPP.

The Contractor shall furnish the cleaning CCTV and report to the City's Representative for host pipe segments that the Contractor determines existing conditions may impact the final operation of the lined pipe, either grade or condition. If existing host pipe defects or voids exist, the Contractor shall repair or replace that section of the host pipe.

The Contractor shall not line over any offset that is greater than 5% of the lined pipe internal diameter without first notifying the City's Representative.

D. CIPP LINER DIAMETER VERIFICATION

The internal diameter of the existing host pipe may be larger (or smaller) than their nominal size. It is the Contractor's responsibility to measure the actual inside diameter of the sewer to determine the appropriate size of CIPP liner to use.

3.02 INSTALLATION METHODS

A. GENERAL

The Contractor shall designate the location where the CIPP felt tube would be impregnated with resin ("wet-out"). Locations shall be subject to approval by the City's Representative and applicable local agencies. The Contractor shall allow the City and/or City's Representative to inspect the materials and "wet-out" procedure.

If the "wet-out" location is not at the project site, the impregnated CIPP tube shall be transported to the site under controlled environmental conditions. Transport vehicles shall include a tamper resistant, sealed temperature-recording device which records the temperature of the liner at all time after leaving the wet-out site. The Contractor shall decide when to transport the impregnated CIPP tube to the site and when to commence insertion with respect to weather conditions.

The Contractor is responsible for obtaining construction/ fire hydrant meters from City of Tempe and for paying all applicable deposit, fees and water usage fees according to revised City Code Section 49.

B. PRE-INSTALLATION

Prior to installation of the liner, the following activities are required to be completed:

1. Receipt and approval of pre-installation submittals by the City's Representative.

2. Verification of pipe condition and any obstructions by video inspection.

3. Verification of existing laterals and location of services by flowing water, dye test, or visually with a pan and tilt head camera or other means.
4. Cleaning of sewer main (recorded on video).

5. Perform required point repairs at pipe locations that would prevent or hinder proper CIPP liner. The Contractor shall obtain the approval of the point repairs from the City's Representative prior to proceeding with the liner installation. The Contractor assumes all responsibility of liner quality once installation begins if prior written notification is not received and acknowledged by the City's Representative.

6. The Contractor is to ensure liner tube is free of all visible tears, holes, cuts, foreign materials, and other defects.

C. HANDLING

The Contractor shall exercise adequate care during transportation, handling and installation to ensure the CIPP material is not torn, cut, or otherwise damaged. If any part or parts of the CIPP material becomes torn, cut or otherwise damaged before or during insertion, it shall be repaired or replaced in accordance with the manufacturer's recommendations and approval by the City's Representative before proceeding further; and at the Contractor's expense.

D. INSTALLATION PROCESS

No CIPP installations will be undertaken in weather conditions that could jeopardize the installation of the CIPP, or be detrimental to the long-term performance of the CIPP. The liner will be installed by the inversion tube method or winching method as follows.

1. INVERSION METHOD: The tube shall be impregnated with a liquid thermosetting resin and lowered into the insertion pit through an inversion tube. The inversion tube will then be inverted into the existing sewer by air pressure which will push the tube through the host pipe inside out, while pressing the resin impregnated side firmly against the inside walls of the host pipe. The smooth coated side of the liner shall become the new interior surface of the host pipe. After the tube is inverted through the host pipe section, the Contractor shall cure the liner by introducing steam or a combination of compressed air and steam to initiate the curing process.

2. WINCHING METHOD: The wet out liner shall be inserted through the upstream manhole and pulled through the section through the use of a power winch attached to the end of the liner with an appropriate pulling head.

   A monitoring device shall be provided to measure the pulling force. Should the pulling force exceed the manufacture recommendations, the tube shall be rejected, removed and replaced. Maximum manufacturer's pulling force shall be submitted according to Technical Specification Section 01300 – Submittals.

Rollers shall be installed in the upstream and downstream manholes to guide the liner into and out of the host pipe and to guard against chafing of the crowns at the entry and exit.

The sewer invert throughout the section to be lined shall be covered with a polyethylene foil or other suitable material to facilitate threading of the liner and reduce the risk of damage to the liner material. The CIPP shall be formed with a polyurethane, polyethylene, or polypropylene coating on its interior surface.

During insertion of the resin impregnated tube into the host pipe, the maximum allowable longitudinal elongation, or stretch, of the liner tube shall be 5% per ASTM F1743 Section 6.4.2. The longitudinal stretch of the tube shall be gauged by comparing the fully inserted tube to the actual length of host pipe being rehabilitated. Contractor shall field measure within the interior of the pipe the actual host pipe length and submit to the City's Representative.

The Contractor shall use a flexible and impermeable calibration hose to inflate the tube. The calibration hose may or may not remain in the complete installation. Any dry tube or inflation hose material that enters the existing pipe that has not been previously impregnated with resin under controlled conditions cannot be included in the structural wall of the CIPP. The nominal thickness of this material shall be deducted from the field sample thickness measured in order to verify that the minimum specified wall thickness is achieved. Hose material remaining in the installation shall be compatible with the resin system used, shall bond permanently with the tube, and shall be translucent to facilitate post installation inspection. Hose materials which are to be removed after curing shall be of non-bondable material.

The Contractor shall introduce air and/or steam into the liner and expand with pressure inflating and pressing the liner material in a tight fit against the inner walls of the host pipe producing dimples at lateral and side connections and flared ends at manholes. All hoses/pipes used for introducing water, air, and/or steam shall be ramped during the inversion and curing process to allow for the ease of vehicular and pedestrian traffic. All hoses/pipes shall be color-coded for identification to prevent the use of hoses/pipes used for water conveyance are not used for wastewater conveyance or vice versa.

E. CURING

The curing process shall be per ASTM F1216 or ASTM F1743 or similar approach recommended by the manufacturer and approved by the City's Representative, to ensure that the liner design physical properties are attained. Circulation water shall be cool down to at least 100 degrees F before releasing the hydrostatic head.

The rate of temperature rise and fall during heating and cooling shall not exceed 2

degrees F per minute or manufacturer's recommendation. Contractor shall submit per Technical Specification Section 01300 – Submittals the manufacturer recommendation for temperature control requirements during heat–up, cure, recommended cure temperature, and length of time at recommended cure temperature, and maximum rate of cool down of temperature.

F. CURE TEMPERATURE MONITORING

The Contractor shall monitor the temperature of the CIPP liner wall to verify and document manufacturer recommended curing temperature has been achieved. Temperature monitoring system shall be placed between the host pipe and the liner in the bottom of the host pipe (invert) to record the heating and cooling that takes place on the outside of the liner. The Contractor shall install and monitor temperature during the curing process with system/equipment as follows:

1. CIPP Liner in Pipe Less than 15-inch Diameter: Temperature sensors shall be placed between the host pipe and the liner at the invert of the host pipe. The sensors shall be placed at the upstream and downstream ends of the reach being lined to monitor the temperature during the curing process.

2. CIPP Liner in Pipe 15-inch Diameter and Larger: Fiber optic cable along the entire length of CIPP liner in addition to point temperature sensors installed at the upstream, downstream, and intermediate (if present) access manholes. The monitoring shall be by a computer which can record the temperatures at this interface throughout the processing of the CIPP utilizing a tamper-proof database.

   Prior to installing the CIPP liner in the host pipe, the temperature monitoring system's function shall be confirmed by hooking it up to the computer and seeing that the sensors are reporting ambient temperatures. No more than two sensors in sequence can be found faulty during this test. If three or more sensors in sequence are discovered faulty, a new sensor array shall be pulled into the host pipe replacing the previously installed array; and the new array shall be again tested for its proper function.

G. REINSTATEMENT OF LATERAL CONNECTIONS

It is the intent of this project that all service lateral connections be reopened.

Service laterals shall be reopened to 100% of original lateral pipe diameter without excavation, utilizing a remotely controlled cutting device, monitored by CCTV. The cut liner shall have no jagged edges and shall be brushed smooth with a wire brush. Contractor shall reinstate laterals back to a smooth finish with the lateral opening free of debris or obstruction to flow. Contractor shall remove any "coupons" that fall within laterals prior to performing a post-installation CIPP CCTV. The Contractor shall certify he has a minimum of two (2) complete working cutter units plus spare key components

on the site before the insertion of the liner. No additional payment shall be made for excavations for the purpose of reopening connections unless previously approved by the City's Representative prior to the start of work. The Contractor is responsible for all costs and liability associated with such excavations and restoration work.

Where identified in the design drawings, the Contractor shall install lateral seal connections within five (5) working days of CIPP liner installation. Surface preparation of installed liner and/or existing lateral shall be per lateral seal manufacturer recommendations. Surface preparation costs, including additional cleaning, shall be at no additional cost the City.

H. REINSTATEMENT OF DROP SEWER CONNECTIONS

The Contractor shall reinstate the opening of all vertical drop sewer connections to 100% of original drop pipe diameter without excavation, utilizing a remotely controlled cutting device, monitored by CCTV. The cut liner opening shall have no jagged edges and shall be brushed smooth with a wire brush. Contractor shall reinstate drop back to a smooth finish with the drop opening free of debris or obstruction to flow.

The existing host pipe drop connection may be constructed of PVC material that is easily damaged by robotic cutting equipment. The Contractor shall be responsible for all costs associated with repair of damaged host pipe, including installation of a UV cured seal and/or open cut excavation to repair damage to the existing host pipe and or vertical drop pipe due to overcut of drop sewer connection.

Contractor shall remove any liner "coupons" or shavings that fall within the drop pipe segment prior to performing a post-installation CIPP CCTV documentation.

3.03 FINISHED PRODUCT

A. FINISH

The finished CIPP shall be continuous over the entire length of an installation run.

B. MANHOLE CONNECTION

The contractor shall provide a watertight seal between the host pipe and liner pipe at the manhole connection.

C. INSPECTION

The Contractor shall inspect the CIPP after installation. The inspection will be performed and recorded using remote visual television inspection equipment in accordance with Technical Specification Section 02761 – Remote CCTV Inspection of Existing and Rehabilitated Sewers. If defects exist within the liner, the Contractor shall

repair or replace that section of liner at no additional cost to the City. Methods of repair shall be proposed by the Contractor and submitted to the City's Representative for review and approval prior to initiating repair work. City Representative shall be notified a minimum of 24 hours prior to performing repair work.

The Contractor shall resubmit a final video showing a post inspection after the liner issues have been addressed and approved.

D. REPAIR OF DEFECTS

Defects such as foreign inclusions, dry spots, pinholes, delamination, seam separation and wrinkling beyond the specification allowances or as determined by the City's Representative as affecting the integrity or structural stability of the CIPP pipe, or as adversely affecting the hydraulic capacity of the CIPP lined pipe are unacceptable and shall be repaired or replaced at the Contractor's expense.

1. Wrinkles in the finished lined pipe which cause a backwater of one (1) inch or more or reduce the hydraulic capacity of the lined pipe (wrinkle height that exceed 5 percent of the lined pipe internal diameter) are unacceptable and shall be removed and/or repaired by the Contractor at no additional cost to the City.

2. Voids or annular space that exists between a wrinkle and the host pipe shall be repaired or pipe section replaced and relined by the Contractor at no additional cost to the City. Methods of repair shall be proposed by the Contractor and submitted to the City's Representative for review and approval prior to initiating work.

3. Separations of CIPP liner seam in the finish lined pipe are unacceptable and shall be removed or repaired by the Contractor at no additional cost to the City. If a separation of a liner seam exists, the Contractor shall remove the CIPP liner or replace that section of pipe. Methods of repair shall be proposed by the Contractor and submitted to the City's Representative for approval.

3.04 CLEANUP

Following inspection, the Contractor shall clean up the entire project area. The Contractor shall dispose of all excess material and debris not incorporated into the permanent installation off site.

**** END OF SECTION ****

SECTION 02760
SEWER PIPE AND SEWER STRUCTURE CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE:

This Technical Specification section specifies the requirements for cleaning of the sewer pipe and sewer structures prior to remote visual inspection, City or City's Representative inspection, and pipe and manhole rehabilitation. The work to be done under this Contract consists of furnishing all labor, materials, and equipment to remove the accumulated sediments and clean the sanitary sewers and sewer structures.

B. REQUIREMENTS:

The work to be done consists of furnishing all labor, materials, and equipment to remove accumulated sediments and debris down to sound, solid structural material of the sanitary sewer pipe and/or access manhole. The Contractor shall hydro blast with a minimum 1000 PSI water pressure or grit blast for duration sufficient to clean the sanitary sewer pipe or access manhole per CIPP liner or coating manufacturer's recommendations.

Where composite manhole inserts are to be installed, the access manhole shall be cleaned using low pressure water to remove debris that may hinder the installation of the composite manhole insert. Removed debris shall not be allowed to enter the wastewater collection system.

The Contractor shall remove existing sediment, debris, roots, scale, encrustations, and grease accumulations from the sanitary sewer pipe and access manholes to be inspected and/or rehabilitated and adequately prepare the surfaces for CIPP liner installation, composite manhole insert installation, and/or bench repair.

All materials dislodged during cleaning shall not be allowed to enter the wastewater collection system, and shall be removed from the sanitary sewer pipe, and/or access manhole, and work area and delivered to an approved disposal site.

1.02 SUBMITTALS

A. The following submittal shall be provided in accordance with Technical Specification Section 01300 - Submittals:

1. A letter report identifying the methods the Contractor anticipates employing to remove sediment, debris, grease, scale, encrustations, and roots throughout the sanitary sewer pipe and access manhole to be CIPP lined or repaired. The letter report shall also include methods for removal of tuberculation in Ductile Iron Pipe (DIP), manhole PVC T-Lock liner (if required). The letter report shall include a detailed explanation of the surface preparation process and a description of how debris will be prevented from entering the sewer. The Contractor shall also provide a schedule of activities and references where the Contractor has used the identified cleaning method successfully in the past.

PART 2 - MATERIALS

2.01 CHEMICAL ADDITIVES

No chemicals shall be used without written approval of the City. In no case shall any chemical additive be used which might be considered hazardous, or might be considered detrimental to organisms or equipment of a wastewater treatment plant, or detrimental to old or new pipe materials.

A Safety Data Sheet (SDS) shall be posted onsite with a copy supplied to the City for all chemicals used in the project or brought on-site as approved by the City.

2.02 HYDRO BLAST CLEANING

A. The Contractor shall use a nozzle to ensure the interior 360 degree circumference of the pipe interior is clean and free from any residual sediment prior to lining.

B. It shall be the Contractor’s responsibility to determine whether structural condition of the existing pipe or access manhole will not be detrimentally damaged by use of spinning nozzle and water pressure utilized. The Contractor shall notify The City’s Representative of pipe condition that would be impacted through the proposed cleaning process and equipment. Once the Contractor initiates the cleaning operation, he accepts the responsibility of reinstating normal operation of the sewer.

2.03 MECHANCAL CLEANING

A. The Contractor shall use a mechanical cleaning method to ensure the interior 360 degree circumference of the pipe interior is clean of tuberculation, corrosion and/or encrustations prior to lining.

B. It shall be the Contractor’s responsibility to determine whether structural condition of the existing pipe and will not be detrimentally damaged by use of spinning mechanical device proposed. The Contractor shall notify The Owner’s Representative of pipe condition that would be impacted through the proposed cleaning process and equipment. Once the Contractor initiates the cleaning operation, he accepts the responsibility of reinstating normal operation of the sewer.

PART 3 - EXECUTION

3.01 GENERAL

The Contractor shall at all times conduct work so as to prevent any detrimental sewage blockage and minimize surcharging in the sewer manholes or connecting sanitary sewer system. Damage to existing facilities as a result of the Contractor's work shall be promptly repaired in kind at the Contractor's expense.

3.02 SEWER BYPASSING AND DEWATERING

Sewer flow shall be bypassed during the cleaning of the sewers as specified in Technical Specification Section 02145 – Diversion of Sewage Flow and Dewatering.

3.03 HYDRO BLAST CLEANING

The Contractor shall clean existing sediment, debris, roots, scale, encrustations, grout, and grease accumulations from the sanitary sewer pipes and access manholes to be inspected or scheduled to be rehabilitated and adequately prepare the surfaces for installation of liner and coating. Initial cleaning may not be performed more than thirty (30) days prior to start of lining installation.

Pipe discovered by the Contractor or his Subcontractor to be physically deteriorated to the extent where cleaning may detrimentally impact the structural integrity of the existing pipe shall be brought to the attention of the City's Representative prior to conducting cleaning operations.

Cleaning shall remove all sediment, rocks, debris, roots, grease accumulations and obstructions from the sewer to be lined and from the structures to be coated. Cleaning of the sewer and structure interior surfaces shall remove all grease, scale, encrustation, and any other foreign material from the surface. Multiple passes with cleaning equipment may be required at no additional cost to the City.

Sediment or debris from cleaning operations larger than U.S. #8 sieve shall not be deposited downstream in the sewer. Sedimentation deposited downstream shall be removed at no cost to the City. All materials dislodged during cleaning shall be removed from the pipe and delivered to an approved disposal site.

The Contractor shall be thoroughly familiar with all phases of sewer and structure cleaning to ensure the completion of this Contract without causing a health hazard or damage to the sewage system, public and private property.

The Contractor shall clean the sewer and structures so that there are no visible rocks, debris, roots, grease accumulation and obstructions. The Contractor shall clean the pipe to ensure proper installation of the sewer liner.

It shall be the responsibility of the Contractor to repeat the cleaning process if root re-growth or other detrimental obstructions are present between the time pre-video inspection for sanitary sewer lateral reinstatement determination and CIPP lining operation at no additional cost to the City.

3.05 MECHANICAL CLEANING

The Contractor shall clean existing interior pipe of tuberculation, scale, encrustations, and grout accumulations from the sanitary sewer pipes to be inspected or scheduled to be rehabilitated and adequately prepare the surfaces for installation of liner. Initial cleaning may not be performed more than thirty (30) days prior to start of lining installation.

Pipe discovered by the Contractor or his Subcontractor to be physically deteriorated to the extent where cleaning may detrimentally impact the structural integrity of the existing pipe shall be brought to the attention of the City's Representative prior to conducting cleaning operations.

Cleaning shall remove all mineral accumulations and/or attachments from corrosion of metallic surfaces from the sewer to be lined and from the structures to be coated. Cleaning of the sewer and structure interior surfaces shall remove all scale, encrustation, and any other foreign material from the surface.

The Contractor shall mechanically clean the pipe interior to within 95% of original interior pipe diameter. Multiple passes with mechanical cleaning equipment may be required at no additional cost to the City.

It shall be the responsibility of the Contractor to repeat the mechanical cleaning process if tuberculation or detrimental corrosion buildup occurs prior to CIPP lining operation at no additional cost to the City.

3.05 DISPOSAL OF SEDIMENTS

The Contractor shall be responsible for transporting and disposing, including all disposal fees, of any sediments and material removed from the sewer or structures per Technical Specification Section 01560 – Environmental Controls.

All sediment and debris removed from the sewer shall be disposed off-site in a lawful manner. Hauling containers shall be watertight. On-site stockpiling of removed material shall not be allowed.

The Contractor is responsible for obtaining all necessary permits, fees, and approval from all regulatory agencies required to perform the work, including transport of sediments. Off-site disposal of all material removed from the sewer shall be the Contractor's responsibility.

Copies of all disposal receipts shall be submitted to the City.

**** END OF SECTION ****

SECTION 02761
REMOTE CCTV INSPECTION OF EXISTING AND REHABILITATED SEWERS

PART 1 - GENERAL

1.01 DESCRIPTION

This specification defines the requirements for internal Closed Circuit Television (CCTV) inspection of the existing sewer pipes before and after rehabilitation according to the National Association of Sanitary Service Company (NASSCO) standards. Interior pipe condition (post video inspection) of rehabilitated sewer mains shall be documented using digital camera equipment.

1.02 SUBMITTALS

A. PRELIMINARY

At the preconstruction conference the Contractor shall submit the following information for review per Technical Specification Section 01300 – Submittals following notification of award of the Contract:

1. The Contractor shall submit operator name and NASSCO PACP certification number of CCTV operator for approval.

2. The Contractor shall submit an example of work of the analog and/or digital camera equipment to demonstrate proposed quality and clarity of video along with proposed methods of documentation. Example shall consist of one remote visual inspection record, in digital and/or analog format, of previous sewer inspection work complete with audio commentary and inspection log(s). The submitted record shall show operational and structural defects in sewers that are of the same diameter as the sewers in this project.

   The information will be reviewed to determine if the quality of the images, technique, and inspection procedures are acceptable and if defects were properly identified and documented. Samples shall be with the same camera, lighting equipment, and data handling procedures proposed for this work.

   The City's Representative will review the records, not for accuracy of content, but to make sure that the required information is provided and the recording is of acceptable quality. If the City's Representative determines that the records are defective or not of adequate quality, the Contractor shall repeat the inspection documentation at the Contractor's expense.

The Contractor shall be responsible for modifications to his equipment and/or inspection procedures to achieve report material of acceptable quality. No work shall commence prior to approval of the material by the City's Representative. Once accepted, the report material shall serve as a standard for the remaining work.

The Contractor shall resubmit a final video showing a post inspection after the liner issue(s) have been addressed and approved. Contractor shall correct all title information on the video and labels prior to final submittal.

Digital Video Disk (DVD) or Universal Serial Bus (USB) records shall include labels containing project titles, dates, including City and Contractor company names. The Contractor shall maintain a copy of all inspection documentation (disks, tapes, databases, and logs) for the duration of the work and warranty period.

B. OTHER SUBMITTALS

1. Pre-Construction Inspections: One copy of the pre-construction CCTV inspection stored on DVD or Universal Serial Bus (USB) media, showing the existing sewer pipe after preliminary cleaning, shall be submitted to the City's Representative, a minimum of fourteen (14) days prior to CIPP lining. The distance to each sanitary sewer lateral shall be recorded on the inspection tape and paper copy record. Each pipe segment to be rehabilitated shall be CCTV inspected and recorded. Multiple pipe segment inspections can be stored on one DVD or USB. If the City's Representative determines that the records are defective, not of adequate quality, not containing pipe identification information, or footage counter, the Contractor shall repeat the inspection documentation at the Contractor's expense.

   All laterals are to be reestablished and returned to normal operation.

2. One copy of the CCTV inspection stored on DVD, USB media, or external hard drive showing the existing sewer pipes after cleaning, just prior to CIPP installation along with a final inspection video after liner installation, lateral cutting, and lateral seal connection installation shall be submitted to the City's Representative within ten (10) days from the final inspection video date. The City's Representative will track and compile a final record of initial cleaning, pre-lining CCTV and post-lining CCTV and if necessary secondary post-lining CCTV after liner issues have been addressed and submitted to the City's Representative by the Contractor.

   Final CCTV inspection shall be completed utilizing digital Panoramo 360 or approved equal format.

   Final payment to the Contractor shall not be made until Final CCTV inspection for all rehabilitated sanitary sewer pipe and access manholes have been received by the City.

3. The Contractor shall submit written inspection logs and CCTV procedures according to National Association of Sanitary Service Companies (NASSCO) – Pipeline Assessment and Certification Program (PACP) for the sewer pipes inspected and/or lined.

PART 2 - PRODUCTS

2.01 MATERIALS

A. TELEVISION INSPECTION CAMERA(S)

Camera(s) shall be intrinsically safe and shall be operative in 100 percent humidity conditions. Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, focused picture of the entire inside periphery of the sewer. Analog type camera shall have tilt and zoom capabilities to view 90 degrees to the pipe centerline for the entire 360 degrees of the pipe circumference.

The Contractor shall utilize equipment that allows for CCTV to be performed within conditions noted in the specification. Contractor's equipment shall be sized to fit within lined segments. Any scrapes or damages to the liner resulting from equipment use shall be addressed and corrected based on City of Tempe inspection.

The Contractor shall utilize digital, IBAK PANORAMO 360 degree view or approved equal for Post CCTV inspection of rehabilitated pipes and access manholes.

B. DVD/USB

Video recordings of all sewer line inspections shall be made on DVD disks or USB drives. The audio portion of the video shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of the oral report. A copy of the video recordings shall be consolidated on DVD or USB media identified by City of Tempe quarter section number of lined sewer segments so to minimize the number of disks provided at end of project.

C. FOOTAGE COUNTER

A footage counter device, which measures the distance traveled by the camera in the sewer, shall be accurate to plus or minus 2 feet in 1,000 feet.

D. VIDEO TITLING

Video equipment shall include genlocking capabilities to the extent that computer generated data, (i.e., footage, date, size, address and location, etc.) as determined by the City can be overlaid onto video, and both indicated on the television monitor and permanently recorded on the inspection video.

E. SEWAGE FLOWS IN SEWERS:

During remote visual inspections, and continuously until completion of liner installation and final documentation inspection, the Contractor shall provide temporary dry conditions in the sewer pipes. The bypassing requirements are provided in Technical Specification Section 02145 – Diversion of Sewage Flow and Dewatering.

PART 3 - EXECUTION

3.01 CLEANING

The remote visual inspection shall be performed after cleaning the sewer as specified in Technical Specification Section 02760 – Sewer and Sewer Structure Cleaning, and prior to lining the pipe. The Contractor shall be responsible for properly inspecting and documenting the final condition of the rehabilitated pipe.

3.02 SCHEDULE

The Contractor shall submit post CCTV of segments within ten (10) working days from the date of installation. The Contractor shall also be responsible to produce and submit hard copy inspection logs of the inspection process.

3.03 SEQUENCE OF INSPECTION

The sewer pipe shall be remote visually inspected, in the same direction, prior to and following the lining of the sewer. Final CCTV inspection shall be performed after lateral reinstatement has been completed.

3.04 INSPECTION METHODS

The Contractor shall inspect the sewer interior using a camera or process capable of producing a color image for permanent record and documentation of inspection in digital format (mpeg or jpeg) with audio location and date information, data title information.

A. VERBAL COMMENTARY

The Contractor shall audio record narrative on the remote visual inspection the location, upstream and downstream control points, date, and time of the inspection.

B. ACCESS

The City’s Representative shall have full access to observe the monitor and all other operations at all times. The system of cabling employed to transport the camera and transmit its signal shall not obstruct the camera's view.

C. INSPECTION RATE

The camera shall be pulled through the sewer in either direction, but all inspections at each location shall be in the same direction. Maximum rate of travel shall be 30 feet per minute when recording with analog camera systems.

D. IMAGE PERSPECTIVE

The camera image shall be down the center axis of the pipe when the camera is in motion. The Contractor is required to provide a 360-degree view of the pipe interior. Points of interest shall also be documented and shall include, but not be limited to, defects, encrustations, mineral deposits, debris, sediment, any location determined not to be clean or part of a proper liner installation, or defects in the liner (including, but not limited to, bumps, folds, tears, dimples, etc.).

Each individual sanitary sewer lateral opening to the sewer main shall be remote visually inspected. Camera shall first pan and tilt to the lateral opening prior to zoom for analog camera systems. Full 360 degrees of the lateral opening shall be documented without zoom. Contractor shall not utilize pan, tilt and/or zoom simultaneously.

E. SEWER IDENTIFICATION

All inspection documentation shall include the sewer location identified by City of Tempe quarter section manhole numbers as indicated on the Design Drawings.

F. VIDEO NAMING CONVENTION

All CCTV inspection videos and reports shall be named based on the following convention: quarter section (XXXXXX), upstream manhole (MHXXX) or cleanout (COXXX) – quarter section (XXXXXX), downstream manhole (MHXXX) – Initial cleaning (Cleaning Pre-Video) or Pre-lining of CIPP (Pre-Video) or Post-lining of CIPP (Post-Video).

G. QUALITY CONTROL

The City's Representative will review DVDs or USBs to ensure compliance with the requirements listed in this specification and contract documents. If the sewer line is determined not to be adequately cleaned, as required in this Technical Specification Section, it shall be re-cleaned and remote visual inspection repeated by the Contractor at no additional cost to the City. If any portion of the liner is determined not acceptable, the liner shall be repaired or replaced, whichever the City's Representative deems appropriate, and re-inspected and documented.

**** END OF SECTION ****

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SECTION 09710
CONCRETE AND MASONRY COATING

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE

When specified in the Design Drawings or as directed by the City, this Technical Specification section specifies the coating system used for the rehabilitation of municipal sanitary sewer structures to provide protection against chemical or gas corrosion of the interior of sewer structures. The coating shall yield a hard, durable chemical resistant coating and provide a water and gas tight seal to concrete and other components within existing sanitary sewer collection system infrastructure.

B. DEFINITIONS

1) In this Technical Specification, the words “coating” (or “coatings”) and “lining” (or “linings” or “liner”) are used interchangeably. Similarly, “to coat” is used interchangeably with “to line” (or other variations of these words).

2) In this Technical Specification, unless otherwise specifically noted, the word “manhole” shall mean “sewer structure” and shall encompass sewer manholes, sewer junction structures, sewer vaults, and other structures contained within the sanitary sewer system. It also encompasses bench, channel, and sewer pipes (or portions thereof) that are located within the sewer structure but does not include sewer pipes (or portions thereof) that are located outside of the limits of the structure.

3) In this Technical Specification, “channel” shall encompass the entirety of the manhole channel, including the invert.

4) In this Technical Specification, “existing manholes” shall mean those manholes that are (or were) not constructed as part of this project work. “Rehabilitating” existing manholes and "applying corrosion protective coating" to those manholes shall include the following activities:

   a. Cleaning and preparation of the surface to coating manufacture’s recommended standards and removing corroded/deteriorated materials from the manhole, and otherwise preparing the manhole for one of the approved coating systems.

   b. Testing of the prepared surface to coating manufacturer’s standards prior to applying an approved coating system.

   c. Applying one of the approved coating systems, as specified herein.

   d. Testing the finished surface coating, as required herein.

   e. Other related activities, as noted herein.

Where required by the approved Design Drawings or as directed by the City, existing manholes shall be rehabilitated and an approved, or equal, corrosion protective coating applied to their interior surfaces, as specified herein.

The approved coating system (as specified herein) shall be applied to all exposed brick, concrete, grout, mortar, and cementitious surfaces or portions thereof that are not PVC lined within the manhole including pipe-to-throat transitions, throat, bench, risers, cones, chimney, adjusting rings, etc.

1.02 QUALITY ASSURANCE

A. REFERENCES

This Technical Specification section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
ASTM D4258	Standard Practice for Surface Cleaning Concrete for Coating
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness
ASTM D4541	Standard Test Method for Pull-off Strength of Coatings using Portable Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM D7234	Standard Test Method for Pull-off Adhesion Strength of coatings on Concrete Using Portable Pull-Off Adhesion Testers

OSHA – ADOSH	Occupational Safety and Health Association - Arizona Division of Occupational Safety and Health (ADOSH)
NACE	National Association of Corrosion Engineers Published Standards

B. STANDARDIZATION

Materials and supplies provided shall be the standard products of manufacturers. Materials in each coating system shall be the products of a single manufacturer or proven to be compatible.

C. INSPECTION

All work and testing shall be performed in presence of the City, unless City has granted prior approval to perform work in their absence. The Contractor shall provide testing as approved by the City. Cost of this inspection and testing shall be the responsibility of the Contractor. Inspection by the City or waiver of inspection in any particular portion of work shall not relieve the Contractor of responsibility to perform work in accordance with this Technical Specification.

a) Safety Equipment: Scaffolding and/or tri-pod safety equipment shall be erected and moved by the Contractor to locations to facilitate inspection by the City. The Contractor shall be responsible to provide equipment and conditions according to OSHA safety standards for the City or City's Representative to enter into confined space for inspection purposes. The Contractor shall provide additional illumination or fresh air upon request.

b) Surface pH Testing: The Contractor shall furnish services of a trained operator in surface pH testing, equipment and chemicals until acceptance of prepared surface. Surface pH testing shall be performed in the presence of the City or his on-site Representative. The Contractor shall perform pH testing on all surfaces prior to application of coating. The Contractor shall be responsible to perform additional surface cleaning as necessary to obtain pH readings acceptable to coating manufacturer's requirements.

c) Adhesion "Pull" Testing: The Contractor shall furnish (until final acceptance of coatings) inspection devices in good working condition for the verification of adhesion of any substrate repair material to the existing concrete. The Contractor shall furnish services of trained operator in pull test devices until final acceptance of coatings. Pull test devices shall be tested and operated in the presence of the City. The Contractor shall perform pull test in the presence of the City on all coated surfaces for each layer of material applied.

The Contractor shall perform pull test in the presence of the City on all coated surfaces for each layer of material applied. The Contractor shall be responsible to repair test areas and retest coating as necessary at no additional cost to the City. The Contractor shall furnish services of trained operator in pull test devices until final acceptance of coatings. Pull test devices shall be tested and operated in the presence of the City. Pull testing and repair of the coating test areas shall be performed prior to spark testing.

The Contractor shall conduct thickness measurements of coating retained on the destructive pull strength dolly. Measurements of thickness of applied protective coatings in the presence of the City.

d) Holiday "Spark" Testing: The Contractor shall furnish services of a trained operator in holiday detection devices until final acceptance of coatings. Devices shall be tested and operated in the presence of the City. The Contractor shall perform holiday test on all coated surfaces in the presence of the City or his on-site Representative. The Contractor shall be responsible to repair defective areas and retest coating as necessary at no additional cost to the City.

D. SUMMARY REPORT

Surface pH, pull strength, and coating thickness measurements shall be documented and reported in a Summary Report produced by the Contractor and submitted to the City. The report shall be presented after completion of underlayment, top coating operations, and shall state number of manufacturer's product units used and total square footage of surface area covered. City shall have option of requiring the Contractor to document number of units (coating materials) on hand before and after coating of each structure operations to verify actual minimum coating thickness applied. All coating thicknesses not meeting required minimums shall be removed and/or re-coated per manufacturer's recommendations.

E. INSPECTION MILESTONES

The Contractor shall keep City informed of his progress on rehabilitation of each structure. At each manhole, the City may inspect the work at the completion of each of the milestones listed below before the Contractor shall commerce work on the next milestone:

1. Completion of the cleaning and surface preparation activities required by these Technical Specifications.

2. Completion of all void-filling activities and underlayment application, prior to surface coating application, with the associated adhesion testing of the underlayment layer.

3. pH of surface following cleaning and void filling underlayment activities, prior to coating application.

4. Completion of the surface coating installation prior to testing.

5. Adhesion/bond testing of the finished coating system as required by these Technical Specifications.

6. Spark testing of the final surface coating as required by these Technical Specifications.

7. Following final clean-up and inspection, the Contractor shall prepare a table in Microsoft Excel format and summit digitally the results of testing that include at a minimum the manhole number, pull test locations with corresponding test results, and spark test pass/fail results.

F. QUALITY CONTROL TESTING

The Contractor shall submit the following test results to the City:

1. pH Testing: pH of surface shall be tested and reported.

2. Adhesion Testing: Adhesion of the coating to the substrate shall be tested per ASTM D4541, and the mode of failure shall be such that the substrate fails before the coating separates from the substrate.

3. Holiday Testing: Holiday “spark” testing shall be employed to identify holidays, defects, and substandard coating thickness.

4. Coating Thickness Test: Coating thickness testing shall be performed by pull test destructive testing methods and direct measurement of coating thickness to verify cured coating meets the minimum dry mil thickness.

1.03 CERTIFIED APPLICATOR

The Contractor applying coating shall be an Arizona Licensed Contractor. The coating system shall be applied by an Applicator certified within the prior two (2) years by the coating and underlayment material system manufacturer as properly trained for applying the manufacturer’s coating and underlayment products. Underlayment products include repair materials, grouts, fillers, primers, etc. A training outline for the certification program undergone by the applicators shall be submitted to the City, for review. The Contractor shall provide evidence that the personnel performing the product application received the manufacturer's training for certification.

The Contractor shall appoint a Quality Assurance Manager who shall take full responsibility for the oversight of the quality of the work. The Quality Assurance Manager shall be fully certified and have a minimum of five (5) years of application experience with the particular coating system.

Applicator(s) shall be fully certified by the product manufacturer and have a minimum of two (2) years of application experience with the particular coating system.

1.04 DELIVERY AND STORAGE

Materials shall be delivered to the job site in their original, unopened containers. Each container shall bear the manufacturer's name, coating type, batch number, date of manufacture, storage life, and special directions.

Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the manufacturer or visibly deviate from normal appearance or texture shall not be used, physically marked in Orange paint on the container as being REJECTED and physically removed from the project site so as not to be inadvertently incorporated into future work.

1.05 WARRANTY

A. A non-prorated written (but not bonded) warranty to cover workmanship and materials against coating failure shall be provided for the entire coating system, including all repair material, defect fillers, primers, intermediate (if applicable), and finish coats. The minimum duration of the warranty **shall be five (5) years** following final acceptance of project. The product and the installation shall both be covered by the Contractor’s warranty. The Contractor shall be responsible for administration, performance and all ancillary costs associated with implementation of the warranty. The warranty shall be delivered to the City prior to and as a condition of final acceptance and final payment for this project.

B. Inspection shall be conducted during the eleventh/fifty ninth months (FOR 12/60 MONTH WARRANTY ITEMS) following completion of all coating work. The Contractor and representative of coating manufacturer shall attend inspection. Defective work shall be repaired in accordance with specifications and satisfaction of the City within one (1) month of written notification. The City may, by written notice to the Contractor, reschedule warranty inspection to another date within one-year correction period, or may cancel warranty inspection altogether. If warranty inspection is not held, the Contractor is not relieved of the responsibilities stated under Contract Documents.

C. This warranty shall state that the coating(s) will not fail for a **minimum period of five (5) years**. Coating failure is defined as blistering, cracking, embrittlement, or softening, or failure to adhere to the substrate. The warranty shall also apply to any repair materials, primers, or other products used in the application. If any repair or replacement is necessary within the warranty period, a **new five (5) year** warranty period shall start at the date that the manhole is placed back into service following repairs.

D. By executing this contract, the Contractor certifies and agrees that any testing performed during construction (e.g., spark testing, adhesion testing and/or other testing) shall not in any way modify the warranty, nor relieve the Contractor for responding to defects during the warranty period.

E. The Contractors responsibility to provide the warranty is considered incidental to the work and is, therefore, a non-pay item.

F. The Contractor and coating system Manufacturer shall within one (1) month of written notice thereof, repair defects in materials or workmanship that may develop during said warranty period(s).

G. The costs for ancillary items associated with coating repair includes, but limited to, permitting costs, by-pass pumping, traffic control and third party quality control inspection shall be the Contractor’s responsibility and are to be included in and incidental to the cost(s) of warranty repairs.

1.06 SUBMITTALS

A. Before materials are delivered to the job site, the Contractor shall provide the following information in accordance with Technical Specification Section 01300 - Submittals:

1. Name(s) and qualifications of all proposed applicator(s) per paragraph 1.03, along with Certification of Applicator(s) and outline of training undertaken for the certification program.

2. Schedule identifying sequence and dates the Contractor will be working on each structure. When The Contractor is prepared to start work at a structure he shall inform the City of his schedule of milestone inspection points for that structure. Failure to provide notification of any milestone inspection point is grounds for rejection and non-payment of all work performed within the structure.

3. Current Arizona Contractor's license or equivalent (specifically for the rehabilitation of concrete manholes). If the manhole(s) to be rehabilitated is (are) brick, then the license or equivalent shall state for the rehabilitation of concrete and brick manholes.

4. Safety Data Sheet (SDS) for the grout, filler, primer and finish coating, the Contractor proposes to use.

5. For the filler and finish coating, the Contractor shall provide the manufacturer's technical literature and application instructions, which shall include the following:

    a. Surface preparation recommendations and limitation(s) of any existing subsurface materials for adherence bonding concerns.
    b. Primer type, where required.
    c. Maximum mil thickness per coat.
    d. Mixing and proportioning requirements (as applicable).
    e. Minimum and maximum curing time between coats (if applicable), including atmospheric temperature and humidity conditions for each.
    f. Curing time before submergence in liquid.
    g. Thinners (if allowed) that are acceptable with coating material.
    h. Environmental requirements for application and worker safety, including ventilation, humidity, and temperature ranges.
    i. Allowable application methods.
    j. Maximum allowable surface moisture content.
    k. Allowable surface pH range.
    l. Required storage conditions and maximum storage life.
    m. Sample of finished product showing final color.

6. List of materials proposed to be used under this section and manufacturer's technical literature and data for each material.

7. A letter or manufacturer’s technical literature and product data identifying the procedures recommended for repair of defect of each proposed material.

8. Written certification from the materials manufacturer that the surface material is compatible with proposed material, the surface has been prepared to acceptable standards, and the applied coating has been installed according to material manufacturer’s recommendations.

9. Minimum pull force reading that is anticipated for proposed pull test equipment and size of dolly for passing test.

10. Testing Summary Report per paragraph 1.02 D.

11. Written warranty per paragraph 1.05.

12. The Contractor shall provide procedures and products proposed for use to repair deteriorated steel reinforcement bars (if present).

13. The Contractor shall provide procedures and products proposed for use around utility penetrations (if present).

PART 2 – PRODUCTS

2.01 MANHOLE COATINGS

Materials shall be delivered to the site in factory sealed and labeled containers. Date of manufacture shall be labeled on each container. Materials shall be handled and stored according to the strictest requirements of the manufacturer and in accordance with all local, state, and federal laws and regulations.

1. Coating systems shall be compatible with the preparation methods as specified herein. Any limitations or deviations requested by the manufacturer shall be approved in writing by the City, prior to surface preparation. The Contractor shall provide all labor, materials and equipment as necessary at no additional cost to the City for any deviations of surface preparation required by the coating materials manufacturer.

2. Epoxy based coatings shall be applied within two months of their date of manufacture (unless the manufacturer's requirements are more stringent), or otherwise approved in writing by the City.

3. Thicknesses specified herein is the minimum dry thickness required and do not include the primer or underlayment thickness, unless otherwise noted. Provide greater thickness where recommended by the manufacturer.

4. Sealant or Primer, if required, shall be as recommended by the manufacturer for each installation.

5. Defect filler and repair materials shall be as recommended by the manufacturer for each installation. All materials shall be identified.

6. Manhole infiltration control material shall be as recommended by the manufacturer for each installation and shall be covered under the same warranty as the rest of the coating system.

2.02 CORROSION PROTECTIVE COATING SYSTEMS FOR EXISTING MANHOLES

Manhole coating materials shall be one of the products listed in this paragraph, or approved equal. Manhole coating system proposed shall be compatible with any existing manhole coating present or removed down to coating manufacturer acceptable substrate at no additional cost to the City. The approved corrosion protective coating systems shall be as listed below.

- Sauereisen Sewergard Lining No. 210 with Sauereisen Underlayment No. F-120, as manufactured by Sauereisen Cements, Pittsburgh, PA. The underlayment shall be used to repair and re-profile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and

coating system specification sheets (COATSPEC) in paragraph 3.19 prior to application.

- Carboline Plasite 5371 with Carboguard 510 as manufactured by Carboline Company, St. Louis, MO. The Carboguard 510 shall be used to repair and re-profile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and coating system specification sheets (COATSPEC) in Technical Specification Section 3.19 prior to application.

- Sewer Shield 150 Epoxy Lining as manufactured by Environmental Coatings, Mesa, Arizona. The underlayment shall be used to repair and re-profile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and coating system specification sheets (COATSPEC) in Technical Specification Section 3.19 prior to application.

- Raven 405 Epoxy Lining with calcium aluminate cement underlayment, as manufactured by PPG/Raven Lining Systems, Kansas City, Kansas. The underlayment shall be used to repair and re-profile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and coating system specification sheets (COATSPEC) in Technical Specification Section 3.19 prior to application.

The underlayment material and the surface coating material installed in any one manhole shall be from the same coating system.

2.03 CORROSION INHIBITOR FOR REINFORCING STEEL

Reinforcing steel, exposed by corrosion or during surface preparation operations, shall be treated with a water-based epoxy resin, anti-corrosion coating and bonding agent such as Armatec 110 EpoCem, manufactured by the Sika Corporation, or approved equal. The Contractor shall be responsible for verifying that the corrosion inhibitor product is compatible with proposed coating system materials.

2.04 BONDING COMPOUNDS

All surfaces where new concrete contacts existing concrete shall be coated with a bonding compound as recommended by the manufacturer of the concrete repair material.

2.05 BENCH REPAIR

Acid-resistant non-shrink grout mortar shall be used for bench restoration. The grout mortar shall be applied to a depth of at least ¾-inches on the bench. The finish surface shall be hand-troweled smooth to finish the bench and channel.

2.06 UNDERLAYMENT FOR STRUCTURE WALL REPAIR

Manhole wall repair (if necessary) shall be provided for manhole walls for re-profiling back to original manhole dimensions with a product as recommended by underlayment and coating manufacturer. Voids that extend beyond the exterior manhole wall shall be brought to the attention of the City for approved repair procedures. Costs for exterior manhole wall repair shall be considered a changed condition with costs for repairs negotiated and agreed upon prior to proceeding with the work. Failure to obtain prior approval of repair costs eliminates any claims by the Contractor for additional compensation for added work to repair the manhole.

PART 3 - EXECUTION

3.01 HAZARDOUS LOCATIONS

The City may wish to enter the manhole under the Contractor's safety program to perform observations and/or perform additional testing. The Contractor shall provide the necessary safety equipment, monitoring, and safe working atmosphere to allow the City or City's Representative to safely enter the manhole, at no additional cost to the City.

The Contractor is responsible for safety of the job site, including the responsibility to enforce and enact the provisions of the Contractor's Confined Space Entry program and the responsibilities to monitor the atmosphere within the structures and provide a safe working atmosphere and environment. These safety measures shall be at no additional cost to the City. The City shall not be responsible for safety or for safety monitoring of the job site.

3.02 SEWAGE FLOW AND DIVERSION

The Contractor shall be aware that the existing manholes included in this project are active, functioning manholes. The Contractor shall be required to coordinate the minimization of existing sewer flow and corresponding water level within the manhole through utilizing flow through plugs or upstream diversion as much as possible per Technical Specification Section 02145 – Diversion of Sewage Flow and Dewatering when rehabilitating the lower sections of the manhole. Manholes scheduled for rehabilitation that are contiguous to pipe rehabilitation activities shall be performed while flow is diverted, and manhole is dewatered.

3.03 MANHOLE PREPARATION AND CLEANING

Surface preparations for each type of surface shall be in accordance with manufacturer's recommendations or the specific requirements of the coating specification sheet (COATSPEC). Where epoxy coating is to be applied to Polyvinyl Chloride (PVC) and/or Cured-In-Place-Pipe (CIPP) liner, the surface shall be grind to uniform 80-grit surface scarification w/100% scratch density.

The Contractor shall inspect all surfaces specified to receive a coating system prior to surface preparation. The Contractor shall notify City, of any noticeable disparity in the surfaces, which may interfere with the proper preparation, or application of the coating system.

The entire manhole interior including frame, chimney, walls, bench and throat shall be cleaned prior to rehabilitation using abrasive blasting and/or high-pressure water blast. Cleaning shall remove deteriorated concrete down to sound solid substrate. The Contractor shall remove all manhole steps present within the interior or as directed and any voids repaired.

The Contractor shall use manhole debris shields or other approved method to prevent debris from entering the live sewers. Discharge of removed sediment and debris into the interceptor pipe is prohibited. The Contractor shall remove and legally dispose of dislodged debris offsite. All hauling equipment shall be water tight to prevent spillage during transport. The Contractor will be responsible for interceptor pipe cleaning and removal of all sediments, at no cost to the City, if construction debris is observed being discharged into the interceptor sewer.

3.04 DEFECT REPAIR

A. All surface defects including tie holes, any honeycombing or otherwise defective concrete or brick shall be repaired. All voids, holes, and rough or irregular surfaces shall be filled/repaired.

B. The Contractor shall use the fill/repair material recommended by the coating manufacturer, to repair or fill all defects. Areas to be patched shall be cleaned. Minor honeycombed or otherwise defective areas shall be removed to solid concrete. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Finishes shall be equal in workmanship, texture and general appearance to that of the adjacent material.

C. Deteriorated or honeycombed concrete which exposes the reinforcing steel or with defects that affect the structural strength shall be repaired. Any exposed reinforcing steel shall be mechanically cleaned and coated in accordance with paragraph 3.06. The proposed repair method shall be approved by the City.

D. Extend all existing control and expansion joints through any patch or repair area.

3.05 STRUCTURAL REINFORCING REPAIR

Structural repairs shall include splicing new reinforcing steel to existing reinforcing steel and providing additional reinforcing steel to reestablish the original structural integrity and existing loading capacity. Provide 3/8-inch diameter anchor bolts as needed to support reinforcing steel.

3.06 REINFORCING STEEL TREATMENT

Where corrosion or surface preparation activities have exposed reinforcing steel the following procedure shall be used:

1. If half the diameter of the reinforcing steel, or more, is exposed, chip out behind the reinforcing steel a minimum of 1-inch for placement of grout or polymer concrete.

2. Determine cross sectional area loss of reinforcing steel.

3. Where reinforcing steel cross sectional area loss exceeds 15% of the original reinforcing steel, perform structural repair as directed by the City.

4. Abrasive blast all exposed reinforcing steel surfaces to remove all contaminants and corrosion products.

5. Clean exposed reinforcing steel with stiff brush or grit blast equipment per Technical Specification Section 02760 – Sewer Pipe and Sewer Structure Cleaning.

6. Apply a 20 mil (wet) coat of corrosion inhibitor to all surfaces of the clean, exposed reinforcing steel with a stiff brush or spray equipment. Allow 2 to 3 hours for coating to cure or until surface is tack-free.

7. Apply a second 20 mil (wet) coat of corrosion inhibitor and allow for 2-hour to 3-hour cure prior to placement of polymer mortar, cementitious mortar, or grout.

3.07 REPAIR MANHOLE BENCH AND CHANNEL(S)

The Contractor shall repair manhole bench and channel(s) with acid-resistant mortar. Manhole bench shall be sloped a minimum ½-inch per foot to the edge of the channel or throat. Channel repair shall match existing slope from inlet(s) to outlet. Minimum mortar thickness shall be ¾-inch.

3.08 CHIMNEY REPAIR

Brick chimneys shall he repaired through re-pointing or replacement as necessary to ensure structural integrity.

3.09 MANHOLE FRAME AND COVER AND ADJUSTING RINGS REPLACEMENT

Manhole frames and covers shall be replaced as indicated in the Design Drawings or as directed by the City. Contractor shall notify the City or City's representative if access manhole frame and covers previously not identified are damaged. The Contractor shall perform work in accordance with City of Tempe Standard Detail T-446. The covers shall

contain the City of Tempe official logo and the words “City of Tempe Sanitary Sewer”. The frames and covers shall have a nominal opening diameter of 24-inches for 48-inch diameter access manholes and 30-inches for 60-inch and larger diameter access manholes. Adjusting rings on these manholes shall be replaced as necessary to raise the lid to surface grade and slope.

3.10 PREPARATION

A. GENERAL

Surfaces to be coated shall be clean and dry according to Technical Specification Section 02760 – Sewer Pipe and Sewer Structure Cleaning.

B. DETAILED SURFACE PREPARATION

Surface preparations for each type of surface shall be in accordance with the specific requirements of the coating specification sheet (COATSPEC). Where epoxy coating is to be applied to Polyvinyl Chloride (PVC) and/or Cured-In-Place-Pipe (CIPP) liner, the surface shall be grind to uniform 80-grit surface scarification w/100% scratch density.

3.11 COATINGS

A. GENERAL

Coating products shall not be used until the City has inspected the materials and the coating manufacturer's technical representative has instructed the Contractor and City in the recommended procedures for surface preparation, mixing and application of the coating.

B. COATING SYSTEMS

Field coats shall consist of one or more finish coats to build up the coating to the specified mil thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until all previous coats have been inspected.

The Contractor shall employ whatever means necessary (e.g., humidity control, temperature control, additional blasting, mechanical surface preparation, etc.) to ensure strong adhesion of the surface coating layer(s), to any underlying and overlying layers and proper curing of the surface coating layer(s). If the surface coating is applied in two or more layers, the time between applications of the various layers shall be controlled to ensure proper bond between layers.

C. COATING REQUIREMENTS

The approved surface coating shall be mixed in a clean, dry mixing container. Compound that has begun to set shall not be recovered by adding additional liquid but shall be discarded.

All items of equipment, or parts and surfaces of equipment, which are immersed when in service, with the exception of pumps shall have all surface preparation and coating work performed in the field.

3.12 APPLICATION

A. WORKMANSHIP

Coated surfaces shall be free from runs, drops, ridges, waves, laps, and trowel marks. Coats shall be applied so as to produce an even film of uniform thickness completely coating corners and crevices.

The Contractor's equipment shall be designed for application of the materials specified. The coating shall be applied using a trowel suitable for obtaining the proper thickness and surface characteristics as recommended by the coating manufacturer.

Each coat shall be applied evenly and sharply cut to line. Care shall be exercised to avoid over-coating or spattering on surfaces not to be coated. All over-coating or spattering shall be removed.

For all coatings, trowel marks and other surface irregularities shall be removed by using a short nap mohair paint roller. The short nap mohair shall be dampened with water. Excess water shall be shaken off prior to use.

B. ATMOSPHERIC CONDITIONS

Coatings shall be applied only to surfaces that are dry, and only under conditions of evaporation rather than condensation. Coatings shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10 degrees Fahrenheit (F) of the dew point, the surfaces shall be heated to prevent moisture condensation thereon. During coating, and for a period of at least 8 hours after the coating has been applied, the temperature of the surfaces to be coated, the coated surfaces, and the atmosphere in contact shall be maintained at or above 40 degrees F and 10 degrees F above the dew point. When applied, coating shall be approximately the same temperature as that of the surface on which it is applied. Fans or heaters shall be used inside enclosed areas where conditions causing condensation are present.

Structures shall be continuously ventilated to prevent condensation. The Contractor shall be responsible for providing, installing, maintaining and removal of all safety apparatus safeguarding open structure being ventilated.

Contractor shall confirm ambient temperature and humidity of the manhole interior and the surface temperature and moisture content of the surface, and the temperature of coating materials that is to be applied are within the manufacture's recommended ranges.

C. SURFACE CONDITIONS

The Contractor shall remove excess water from the surface using compressed air equipment with oil-trapping filters or other means to produce surface-dry conditions. Suitable heaters shall also be used as needed to produce the surface-dry condition. The surface shall be vacuumed to ensure that loose particle are not present.

D. PROTECTION OF COATED SURFACES

Items which have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. Do not allow flowing water, chemicals or other liquids on the approved, applied coating for a minimum of 4 hours after installation or longer as recommended by the coating manufacturer.

E. THICKNESS AND CONTINUITY

Coating system thickness is the total thickness of protective coats.

The surface area covered for various types of surfaces and thickness per coat shall not exceed those recommended by the manufacturer. Coatings shall be applied as a minimum to the mil thickness specified, in layers if necessary, as recommended by the coating manufacturer and in accordance with these Technical Specifications.
In testing for continuity of coating about welds, projections (such as bolts and nuts,) and crevices, the City will determine the minimum conductivity for smooth areas of like coating where the mil thickness has been accepted. This conductivity shall then be taken as the minimum required for these rough or irregular areas. Pinholes and holidays shall be repaired and recoated to the required coverage.

F. SAFETY AND VENTILATION REQUIREMENTS

Requirements for safety and ventilation shall be in accordance with manufacturer's recommendations.

3.13 ADHESION / BOND TESTING

A. GENERAL

1. The Contractor shall perform an adhesion test in accordance with ASTM D7234 after proper cure in accordance with manufacturer's recommended procedures to demonstrate that the specified field coatings adhere to the substrate. Costs associated with adhesion testing are considered to be incidental to the unit price cost of coating.

2. Where unacceptable test results are obtained, the Contractor shall be responsible for removing and reapplying the specified coatings at no additional expense to the City.

B. FREQUENCY OF TESTING

After the approved coating has been applied to all specified surfaces and has adequately cured (as determined by the manufacturer, but no more than 4 days), the Contractor shall test the finished coating system for adequate adhesion between the underlying substrate and the coating system and between the various layers of the coating system. Said test shall be performed in-place and in accordance with ASTM Standard D-7234 and the requirements as dictated in the remainder of this Technical Specification section.

1. Adhesion testing shall be performed at two different stages of the work:
   a. Underlayment Adhesion Testing: Underlying substrate shall be tested before the surface coating layer(s) are applied;
   b. Finish Coating System Adhesion Testing: After the surface coating layer(s) have been applied, the adhesion of all applied layers in the coating system to one another and to the underlying substrate shall be tested. The Contractor shall perform adhesion tests on 30% of the manholes coated, or at least one manhole if 30% of the manholes coated is equal to less than one.
2. Adhesion tests shall be required at a minimum of one (1) underlayment adhesion test and one (1) finished coating system adhesion test per manhole tested.
3. Specific test locations within each manhole shall be selected by the City. The City shall be present to observe all adhesion testing.
4. The need to repeat an adhesion test due to an error in the performance of the adhesion testing (e.g., a dolly coming off prematurely) or due to a failure in the coating system before the required full test pressure is applied (i.e., a "not pass" test result) shall not count as an additional test for the purposes of determining compliance with the minimum number of tests required per Item No. 1, but shall rather be denominated a "repeat test".

5. Adhesion testing of the underlayment layer shall conform to the following:

a. After the underlayment layer has cured for a minimum of 4 hours but before the surface coating has been applied over the underlayment layer, the Contractor shall test the underlayment layer for proper adhesion to the underlying substrate.

b. The Contractor shall perform the adhesion testing in-place and in accordance with ASTM Standard D-7234 and the requirements as dictated in the remainder of this section.

6. The adhesion/bond testing is in addition to the spark testing discussed in paragraph 3.14.

C. ADHESION TEST EQUIPMENT

The remaining paragraphs of this Technical Specification section apply to both the adhesion testing of the underlayment layer and the adhesion testing of the finished coating system:

The Contractor shall perform the adhesion testing discussed in this Technical Specification section using a DeFelsko Positest Pull-off Adhesion Tester Model AT-A or AT-M with 50mm dolly accessory kit or City Approved Equal, to be provided by the Contractor. The Contractor shall be responsible to purchase and provide enough 50 mm diameter dollies (as sold by DeFelsko, one dolly for each adhesion test, not re-usable) and adhesive for the dollies to perform all of the required tests. The Contractor shall also provide the equipment and tools to core drill around the test location, as discussed later in this Technical Specification section. The Contractor shall provide proof that the adhesion tester has been calibrated within the last six (6) months. Calibration test shall be submitted in accordance with Technical Specification Section 13000 – Submittal.

D. ADHESION TEST PROCEDURES

Adhesion testing shall be conducted after the coating system has cured per manufacturer instruction and in accordance with ASTM D-7234 (for concrete). Adhesion shall be completed per ASTM or as described as follows:

1. The Contractor shall first glue the test dolly to the surface of the manhole at the test location selected by the City. The Contractor may lightly sand the coating surface with sandpaper at the test location to improve dolly adhesion. After the adhesive has set, the Contractor shall test the dolly for adhesion to the surface of the manhole by pulling on it by hand. If the dolly comes off, the Contractor shall re-adhere the dolly, using different glue if necessary. The coated surface shall be scored prior to conducting the adhesion test.

2. The adhesion testing machine shall then be attached to the dolly and each test location shall be tested to a minimum pulling strength of 200 psi (defined herein as the pulling force divided by the test sample cross-sectional area perpendicular to the applied force).

3. If delamination or any other failure occurs between or within any of the coating system layers and/or the underlying concrete substrate prior to the application of the full, sustained (for 30 seconds minimum) test pulling pressure of 200 psi, the test shall be classified as “not pass”. However, if the dolly comes off the surface of the coating and no other delamination or failure occurs between or within any of the coating system layers and/or the underlying concrete substrate, the test will not be classified as a "failure" or "not pass", but the test shall be repeated at no additional cost to the City.

   The test can be discontinued if the testing pressure reaches a sustained (for 30 seconds minimum) at 200 psi and no delamination or other failure has occurred within or between any of the coating system layers and/or the underlying concrete substrate, which test would be judged a “pass”. If delamination or other failure occurs but only when the sustained, applied pulling pressure is in excess of 200 psi, the test shall also be judged to be a “pass”. To avoid damaging the test equipment, do not continue the test beyond 500 psi.

4. For tests that are classified as “not pass”, the City will require additional testing. In the event of a “not pass”, three (3) additional tests shall be performed. Location of tests shall be at the discretion of the City. If any one (1) of the three (3) additional tests is found to be “not pass”, the coating shall be determined as defective and remedial action required.

   Remedial action will include removal of the entire coating system (or whatever components of it that have been installed in the manhole to that point) from the entire manhole, re-cleaning of the manhole, re-application of the coating system to all required surfaces and re-testing. Said retesting and remedial action shall be at no additional cost to the City.

5. After the adhesion tests have been performed, the Contractor shall mechanically grind down the test locations to the underlying substrate and re-apply the underlayment and/or coating system (whatever has been installed up to that point in the manhole) in accordance with these provisions to patch the area. Said repair work shall be at no additional cost to the City. The Contractor shall not use acetone, MEK or other chemicals to dissolve the underlayment or coating system as a substitute for mechanical grinding down of the test area.

3.14 HIGH VOLTAGE SPARK TEST

A. DEFINITION – HOLIDAY: Holidays are defined as pinholes and voids in non-conductive coating that allow electrical current to pass through the protective coating to the base material.

B. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection wire brush wand style equipment. Surface shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99 or ASTM D5162).

In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the City will determine the minimum conductivity for smooth areas of like coating where the mil thickness has been accepted. This conductivity shall then be taken as the minimum required for these rough or irregular areas. Pinholes and holidays shall be repaired and recoated to the required coverage.

Whereas adhesion testing is required at two stages of the project work in each manhole, spark testing is required only on the fully installed coating system.

1. After the approved coating has been applied to all specified surfaces, the Contractor shall spark test the coated surfaces in accordance with ASTM D-4787. The Contractor shall provide all equipment and materials necessary to perform said testing, which equipment and materials shall remain the property of the Contractor.

2. Testing shall be performed with a wire brush-type test wand (the squeegee-type is not acceptable) with a minimum test voltage of 100 volts per mil (where 1 mil = 1/1000-inch) of finished surface coat thickness. For example, a minimum of 12,500 volts shall be used for a surface coat thickness of 1/8-inch (125 mils). The Contractor shall use a grounding rod, or other means to establish ground for the spark testing equipment.

3. As a test of the proper functioning of the spark testing equipment, the City may require the Contractor to drill a hole through the coating system into the underlying concrete substrate and to demonstrate to the City that the spark testing equipment can "find" the hole. The Contractor shall then patch and repair the hole at no additional cost to the City. At the City’s discretion, one such quality control test may be required for each manhole. Unless otherwise determined by the City, any adjustments to the spark testing methodology (e.g., adjusting the grounding method, increasing the test voltage, etc.) required to "find" the known holiday (hole) shall remain in effect for the remainder of the spark testing of that manhole.

4. The entire surface of the manhole shall then be spark tested. Any imperfections found in the coating system shall be ground down and refilled. Use of a chemical solvent such as acetone or MEK in lieu of mechanical grinding down the area shall not be permitted. Repaired areas shall be re-tested. Said testing, repairs and re-testing shall continue until all portions of the manhole pass the spark test as specified herein.
5. The Contractor shall perform repairs and re-testing at no additional cost to the City. All detected holidays shall be marked and repaired by abrading the coating surface. After abrading and cleaning, additional protective coating material shall be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.
6. The City shall be notified and present to observe testing and retesting. In addition, the Contractor shall provide certification for each manhole stating that the coating is free of holes or other imperfections.

3.15 UNDERLAYMENT DEFECT REPAIR

A. All surface defects in the underlayment including cracks, tie holds, minor honeycombing or otherwise defective concrete, shall be repaired. All voids, holes, rough or irregular concrete shall be cleaned with grit blasting and high pressure water cleaning to sound material and filled.

B. The Contractor shall use the repair and fill material recommended by the coating manufacturer to repair or fill all defects. Areas to be patched shall be cleaned. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1-inch. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Finishes shall be equal in workmanship, texture and general appearance to that of the adjacent concrete. Concrete with honeycombing which exposes the reinforcing steel or with defects, which affect the structural strength, shall be corrected.

3.16 REPAIRS OF COATING SYSTEMS

All pinholes, uncured coating, blisters, surface imperfections and damage to the coating resulting from the adhesion test shall be prepared to a point 1-inch minimum beyond the limits of the damaged area. Pinhole defects shall be primed and recoated with the same coating system to a minimum additional thickness of 30 mils unless otherwise specified by the coating manufacturer and/or City.

Blisters, uncured coating and surface imperfections shall be completely removed and the areas recoated with appropriate coating material to 1-inch minimum beyond the repair area at a minimum dry film thickness of 125 mils or design coating thickness whichever is greater. The damage resulting from the adhesion test shall be repaired by recoating with appropriate lining material to 1-inch beyond the repair area at 150 mils or design coating thickness whichever is greater. Additional spark testing shall be completed after repairs are completed.

3.17 INSPECTIONS

A. The Contractor shall notify City of impending completion of surface repairs, re-profiling, and prior to application of epoxy coating, or PVC lining repair.

B. The notifications shall be given a minimum 24-hours in advance of completion of the surface repairs and re-profiling, and 24-hours in advance of application of the epoxy coating and any testing; including spark testing, adhesion testing, and dry film thickness testing.

C. Failure to provide notification at these designated times/work stages may prevent the acceptance of the work by the City.

3.18 CLEANUP

Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray or other coating-related damage.

Any spilled or over sprayed material must be cleaned-up prior to curing. After curing has occurred, clean-up may be accomplished by chipping or blasting. All discarded materials shall be disposed of properly. Clean-up and disposal of discarded material shall be at no additional cost to the City. Surfaces damaged by clean-up procedures shall be cleaned, repaired and refurbished to required condition.

3.19 A. COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified.

Coating System Identification:	Sauereisen Sewergard Lining No. 210
Surface:	Concrete/Masonry
Minimum Surface Preparation:	Abrasive Blasting and Hydro Blasting
Concrete:	Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive and hydro blasting. Voids and cracks shall be repaired as specified in Technical Specification Section 09710 paragraphs 3.04 and as indicated by the underlayment defect repair paragraph. After grit abrasion blasting, the concrete should be high pressure washed to remove oil, grease, and other contaminants. All active hydrostatic leaks must be stopped by use of a water stop, waterproofing, or urethane grout.
Epoxy Coating Compatibility:	Except as otherwise specified, any existing coating that is incompatible with proposed epoxy coating as recommended by the proposed coating manufacturer's recommendation for proper bonding purposes, shall be removed from surfaces by abrasive and hydro blasting and chipping if required.
Underlayment:	Sauereisen Restokrete Substrate Resurfacer No. F-120 shall be used to fill holes and undulations in concrete surface found or created during the cleaning process. Sufficient material shall be used to build the concrete surface back to original dimensions prior to protective coating or lining installation. Holes and any defects up to 2-inches deep shall be filled with as manufactured by Sauereisen Cements, Pittsburgh, PA or approved equal to restore structural integrity. If the defects are larger than 2-inches deep a high early cement fill shall be used. Loose or splattered underlayment shall be removed by scraping and chipping. The Sauereisen No. F-120 and high early cement fill shall be applied as recommended by the manufacturer.

Application:	Underlayment shall dry a minimum of 5 hours at 70 degree F in an atmospheric environment with humidity below manufacturer's recommended levels prior to application of the protective coating Sewergard No. 210 or as recommended by the manufacturer. Underlayment must be cured by means of fog spray, wet burlap, or appropriate Sauereisen curing compound. The Contractor shall follow coating manufacturer's requirements for bonding the coating systems to the installed sewer liner. Coating shall be applied as recommended by the manufacturer, provided the coating as applied complies with prevailing air pollution control regulations. Only one coat should be applied to obtain the system thickness. The Contractor shall follow costing manufacturer's requirements for bonding the coating system to the installed liner. Drying time between coats shall be as recommended by coating manufacturer.
Design Coating Thickness:	125 mils dry thickness.
Coatings:	Coats at manufacturer's recommended dry thickness per coat to the specified total system thickness.
Color	Ivory white – or approved color

3.19 B. COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified.

Coating System Identification:	Carboline Plasite 5371
Surface:	Concrete/Masonry
Minimum Surface Preparation:	Abrasive Blasting and Hydro Blasting
Concrete:	Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive and hydro blasting. Voids and cracks shall be repaired as specified in Technical Specification Section 09710, paragraph 3.04 and as indicated by the underlayment defect repair paragraph. After grit abrasion blasting, the concrete should be high pressure washed to remove oil, grease, and other contaminants. All active hydrostatic leaks must be stopped by use of a water stop, waterproofing, or urethane grout.
Epoxy Coating Compatibility:	Except as otherwise specified, any existing coating that is incompatible with proposed epoxy coating as recommended by the proposed coating manufacturer's recommendation for proper bonding purposes, shall be removed from surfaces by abrasive and hydro blasting and chipping if required.
Underlayment:	Carbogaurd 510, a water-based epoxy repair mortar, shall be used to fill holes and undulations in concrete surface found or created during the cleaning process. Sufficient material shall be used to build the concrete surface back to original dimensions prior to protective coating or lining installation. Holes and any other defects up to 1/4-inches deep can be filled with Carbogaurd 510SG. Loose or splattered underlayment shall be removed by scraping and chipping. The Carboguard 510 and Carboguard 510SG shall be applied as recommended by the manufacturer.

Application:	Underlayment shall dry a minimum of 24 hours for every 2-inches of thickness at 75 degree F in an atmospheric environment with humidity below manufacturer's recommended levels prior to application of the protective coating Plasite 5371 or as recommended by the manufacturer. Coating shall be applied as recommended by the manufacturer, provided the coating as applied complies with prevailing air pollution control regulations. Drying time between coats shall be as recommended by coating manufacturer.
Design Coating Thickness:	125 mils dry thickness.
Coatings:	Coats at manufacturer's recommended dry thickness per coat to the specified total system thickness.
Color	Oxide Yellow

3.19 C. COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified.

Coating System Identification:	Raven 405 Epoxy Lining
Surface:	Concrete/Masonry
Minimum Surface Preparation:	Abrasive Blasting and Hydro Blasting
Concrete:	Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive and hydro blasting. Voids and cracks shall be repaired as specified in Technical Specification Section 09710 paragraph 3.04 and as indicated by the underlayment defect repair paragraph. After grit abrasion blasting, the concrete should be high pressure washed to remove oil, grease, and other contaminants. All active hydrostatic leaks must be stopped by use of a water stop, waterproofing, or urethane grout.
Epoxy Coating Compatibility:	Except as otherwise specified, any existing coating that is incompatible with proposed epoxy coating as recommended by the proposed coating manufacturer's recommendation for proper bonding purposes, shall be removed from surfaces by abrasive and hydro blasting and chipping if required.
Underlayment:	Underlayment with calcium aluminate cement as recommended by Raven 405 manufacturer shall be used to fill holes and undulations in concrete surface found or created during the cleaning process. Sufficient material shall be used to build the concrete surface back to original dimensions prior to protective coating or lining installation. Holes and any other defects up to 2-inches deep shall be filled with calcium aluminate cement (as manufactured by Raven Lining Systems, Tulsa, Oklahoma) or approved equal to restore structural integrity. If the defects are larger than 2-inches deep a high early cement fill shall be used. Loose or splattered underlayment shall be removed by scraping and chipping. The calcium aluminate cement and high early cement fill shall be applied as recommended by the manufacturer.

Application:	Underlayment shall dry a minimum of 5 hours at 70 degree Fahrenheit in an atmospheric environment with humidity below manufacturer's recommended levels prior to application of the protective coating Raven 405 or as recommended by the manufacturer. Coating shall be applied as recommended by the manufacturer, provided the coating as applied complies with prevailing air pollution control regulations. Only one coat should be applied to obtain the system thickness. The Contractor shall follow coating manufacturer's requirements for bonding the coating system to the installed liner.
Design Coating Thickness:	125 mils dry thickness.
Coatings:	Coats at manufacturer's recommended dry thickness per coat to the specified total system thickness.
Color	Ivory white – or approved color

3.19 D. COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified.

Coating System Identification:	Sewer Shield 150
Surface:	Concrete/Masonry
Minimum Surface Preparation:	Abrasive Blasting and Hydro Blasting
Concrete:	Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive and hydro blasting. Voids and cracks shall be repaired as specified in Technical Specification Section 09710, paragraph 3.04 and as indicated by the underlayment defect repair paragraph. After grit abrasion blasting, the concrete should be high pressure washed to remove oil, grease, and other contaminants. All active hydrostatic leaks must be stopped by use of a water stop, waterproofing, or urethane grout.
Epoxy Coating Compatibility:	Except as otherwise specified, any existing coating that is incompatible with proposed epoxy coating as recommended by the proposed coating manufacturer's recommendation for proper bonding purposes, shall be removed from surfaces by abrasive and hydro blasting and chipping if required.
Underlayment:	Use epoxy mortar or cemntitous materials that compatible with Sewer Shield 150 to fill holes and undulations in concrete surface found or created during the cleaning process. Sufficient material shall be used to build the concrete surface back to original dimensions prior to protective coating or lining installation. Loose or splattered underlayment shall be removed by scraping and chipping.
New Concrete:	Allow to cure for a minimum of 28 days. Remove any surface hardener or curing compounds by using the recommended mechanical methods for surface preparation.

Application:	Coating shall be applied as recommended by the manufacturer, provided the coating as applied complies with prevailing air pollution control regulations. Drying time between coats shall be as recommended by coating manufacturer.
Design Coating Thickness:	30 mils dry thickness.
Coatings:	Coats at manufacturer's recommended dry thickness per coat to the specified total system thickness.
Color	Ivory

**** END OF SECTION ****

SECTION 09720
FIBER REINFORCED POLYMER (FRP)

PART 1 – GENERAL

1.01 DESCRIPTION

This Technical Specification is intended to provide guidelines and performance requirements for the rehabilitation of structures and gravity sewers using internally bonded fiber reinforced polymer (FRP) composite systems. The rehabilitation system described herein shall include a carbon fiber reinforced polymer (CFRP) and/or glass fiber reinforced polymer (GFRP) as the main reinforcement system. The FRP can also include layers of other materials to increase stiffness of the FRP composite system in a cost-effective manner. The latter may be proprietary to the FRP Material Supplier. Any materials used for the FRP system shall be subject to the approval of the Engineer.

A. SCOPE:

The work includes furnishing of all materials, labor, equipment and services for the supply, installation and finish of structural strengthening using a FRP system.

The Contractor shall be licensed in the State of Arizona and shall include all engineering, labor, materials, tools, equipment, appliances and services required to design, deliver, furnish all items necessary for the proper execution and completion of the work as shown in the Contract Documents, as specified herein and/or as required by job conditions. A detailed design of the FRP system for the specific site conditions shall be included with the installation of the FRP system by the FRP installer selected by the City or General Contractor. All items not shown or specified, but which are necessary for the proper execution and completion of the Work, shall be provided by the Contractor.

The extent of the FRP composite system covered shall be as defined herein and as shown on the plans.

The Contractor shall cooperate and coordinate with all other trades in executing the work described in the contract documents.

The Contractor shall deliver finished product(s) including all materials, labor, equipment, and services necessary for product installation, all quality controls and material samples required for performance tests, final inspection, and warranty work, all as specified in these Contract Documents and at the quantities of each component to complete the work.

The prices submitted by the Contractor shall include all costs of permits, labor, equipment and materials for the various bid items necessary for rehabilitation materials and processes in accordance with these Technical Specifications complete and in place, including all items of work not specifically mentioned herein which are required to

make the product perform as intended. All Contractor costs to deliver the final product shall be included in the respective lump sum and/or unit price bid items depicted in the Bid Proposal.

1.02 SAFETY REQUIREMENTS:

The Contractor shall conform to all work safety and health requirements of pertinent regulatory agencies and/or shown in Technical Specification Section 01060 – Health and Safety and shall secure the site for working conditions in compliance with the same. The Contractor shall perform existing material testing as required by regulatory regulation requirements and provide/install/maintain and be responsible such signs and/or other devices as are necessary for safety at the work site.

1.03 NOTIFICATION:

It shall be the Contractor's responsibility to notify all utility companies involved whenever a utility is to be cut, tapped, moved, or in any way disturbed from its original placement. Sufficient notice shall be given to the utility company so that its users can be informed of any disruption of service. Such notice shall be given no less than 48 hours in advance.

It is the Contractor's responsibility to inform the City of construction activities which may lead to interruption in pedestrian or vehicular traffic or sewer service. The Contractor shall provide 72-hour notice prior to construction to verify all applicable residents have been alerted.

1.04 QUALITY CONTROL

A. REFERENCES:

Reference	**Title**
ACI—American Concrete Institute	
117-90	Specifications for Tolerances for Concrete Construction and Materials, and Commentary.
224.1R-07	Causes, Evaluation, and Repair of Cracks in Concrete Structures.
224R-01	Control of Cracking in Concrete Structures.
440R-07	State-of-the-Art Report on Fiber Reinforced Plastic Reinforcement for Concrete Structures.
503R-93	Use of Epoxy Compounds with Concrete.

503.4-R92	Standard Specifications for Repairing Concrete with Epoxy Mortars.
503.6R-97	Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes.
546R-04	Concrete Repair Guide.

ASTM- American Society for Testing and Materials

D3039	Test Method for Tensile Properties of Polymer Matrix Composite Materials
D3418	Test Method for Transition Temperatures of Polymers by Differential Scanning Calorimetry.
D5687	Guide for Preparation of Flat Composite Panels with Processing Guidelines for Specimen Preparation.
D7565	Standard Test Method for Determining Tensile Properties of Fiber Reinforced Polymer Matrix Composites Used for Strengthening of Civil Structures.
D7290	Standard Practice for Evaluating Material Property Characteristic Values for Polymeric Composites for Civil Engineering Structural Applications.
D638	Standard Test Method for Tensile Properties of Plastics.
D695	Standard Test Method for Compressive Properties of Rigid Plastics.
D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.

NACE International

SSPC-SP12 / NACE 5	Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultra High- Pressure Water Jetting Prior to Recoating.
SSPC-SP13 / NACE 6	Surface Preparation of Concrete.

ICRI- International Concrete Repair Institute

No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
No. 03733	Guide for Selecting and Specifying Materials for Repairs of Concrete Surfaces.

1.05 CERTIFIED INSTALLER

The Contractor must be trained and certified by the FRP Material Supplier and approved by the City and City's Representative for installation of the FRP system. A training outline for the certification program shall be submitted to the City or City's Representative for review. The Contractor shall provide evidence that the on-site Superintendent responsible for supervision of the FRP installation crew has received the FRP Material Supplier's training.

The Contractor shall appoint a Quality Assurance Manager who will be on-site full-time during-FRP installation to take full responsibility for the quality of the work. The Quality Assurance Manager shall be fully certified.

1.06 SUBMITTALS:

A performance work statement (PWS) shall be submitted by the Contractor for the approval of City and City's Representative. The PWS shall include submittals consisting of drawings, sketches, FRP Material Supplier's literature, catalog descriptions, or other descriptions in sufficient detail to allow a decision for submittal acceptance.

One (1) electronic copy of submittal(s) shall be provided to the City and City's Representative at least two (2) weeks before a determination is required.

Contractor shall submit the following information to the City or City's Representative in accordance with Technical Specification Section 01300 - SUBMITTALS.

A. Certifications of applicator with written consent from the FRP Material Supplier that the Contractor has been trained in proper application of FRP Material Supplier's systems.

B. Physical and mechanical properties shall be provided of each proposed FRP system and other components, including test results conducted per the ASTM standards as applicable to the project. Physical properties shall, at the minimum include: Laminate density, Laminate Shore D hardness (ASTM D2240), corrosion resistance (ASTM D543), fully cured resin water absorption (ASTM D570), glass transition temperature (ASTM E1640), fabric ply thickness, resin cure times, Volatile organic compound (VOC) of laminate materials (ASTM D2369), and FRP fabric roll

dimensions range. Mechanical properties shall, at the minimum include: Minimum Ultimate and characteristic design tensile strength, elongation percent, and tensile modulus of the laminate in fiber direction (per ASTM D3039and D7290, respectively), and minimum design laminate thickness per layer.

C. FRP Material Supplier's Safety Data Sheets (SDS) for all materials to be used.

D. Product data sheets (PDS) for the components of the FRP system.

E. Safety plan in compliance with local, state, and federal requirements.

F. Detailed installation plan describing all work items.

G. FRP Material Supplier's qualifications and pertinent test data.

H. FRP system designer's qualifications and the criteria used for the design.

I. Installer's qualifications including their experience in similar projects.

J. Product installation procedure.

K. QA/QC plan including field sampling and testing.

L. Design Drawings and Technical Specifications.

M. Documentation of Contractor's Experience: Contractor shall provide references for all jobs within the last two (2) years that were either completed or under construction using the proposed rehabilitation method.

N. Installer's Qualifications: The installer of the FRP system shall show experience in the installation of the proposed rehabilitation method for all jobs within the last five (5) years. References shall be provided for a minimum of five (5) jobs. Information provided shall include a description of the job, the location of the job, the value of the job, the City name, and the City contact person for the job including name, title, address, and phone number. The total jobs submitted shall show that at least 500 linear feet of the product installed by the installation Contractor.

O. Submit FRP Material Supplier's published product and installation literature and published quality control testing criteria data for the proposed FRP system.

P. Submit independent test report showing that the physical properties of the proposed materials meet the requirements of these Technical Specifications and will meet or exceed the physical properties given in the FRP Material Supplier's published literature submitted as required by Part 2 – PRODUCTS.

Q. Submit a report of the proposed installation process and procedures as directed by the FRP system to be used. The report shall include information specific to the installation instructions and any unique site condition(s) that must be taken into consideration including grout curing operations and procedures, annular space grout type requirements and lift limitations, access coordination, installation timing and identification and any coordination requirements/requests from the City or City's Representative.

R. Shop Drawings: Contractor shall provide shop drawings of proposed materials for approval prior to ordering. Shop drawings shall depict:

1. All measurements made by the Contractor to verify critical dimensions.

2. Material(s) proposed for construction.

3. Critical dimensions, jointing and connections, fasteners, and anchors with sizes, spacing, and location, connections, attachments, and openings.

4. Color(s).

S. Documentation of the control checks for materials used in the fabrications and each part of the fabrication including resin.

T. Warranty: Contractor shall submit warranty documents signed by an officer of the company and notarized stating the terms and conditions of the warranty identified in Paragraph 1.10 – WARRANTY.

U. Any item the Contractor proposes to utilize as an "or equal" to that proposed in the Contract Documents.

1.07 SUBSTITUTIONS

Any item the Contractor proposes to substitute for a specified item as an "or equal" must be made in writing, received, and approved by the City or City's Representative prior to the start of construction activities. Substitutions or deviations not approved by the City or City's Representative shall risk rejection and replacement at no additional cost to the City.

1. For any proposed design change or deviation from these Technical Specifications.

2. For anything in these Technical Specifications found to conflict with applicable codes and ordinances.

3. For anything not understood by the Contractor.

1.08 QUALITY ASSURANCE/QUALITY CONTROL

A. EXAMINATION: Each component part shall be examined by the Contractor for dimensional requirements, soundness, and workmanship in accordance with ASTM C478.

B. COMPOSITION CONTROL: FRP installer shall control and document the fiber to resin ratio content for each part of the installation. Documentation of the control checks shall be maintained by the Contractor and FRP installer. Proper content may be shown by fiber to resin ratio usage rate checks, in accordance with the FRP Material Supplier's recommended material composition.

C. TESTING RECORDS: Records of all testing shall be kept, and copies of test results shall be submitted in accordance with Paragraph 1.06 - SUBMITTALS.

1.09 INSPECTION POINTS

Contractor shall keep the City or City's Representative informed of milestone progress for the following items:

1. Completion of removal of unsound material and pressure wash cleaning.
2. Completion of leveling/seal material placement and surface preparation prior to FRP placement.
3. Completion of FRP placement.
4. Complete of FRP protective coating.

1.10 WARRANTY

The Contractor shall replace promptly and at no expense to the City, any materials which fails during the warranty period. Warranty work shall include all ancillary items including, but not limited to permits, traffic control, exposure, and flow control and all other work required to compete the repair/replacement work. Warranty and durations are described below:

A. Project Warranty: The Contractor shall warrant all materials and workmanship performed under this contract for a period of **one (1) year** from the date of formal acceptance or as stated in the project Contract Documents whichever is longer.

B. Materials Warranty: The FRP system installed shall be free of defects that will affect the long-term life and operation of the system. The Contractor shall warrant in writing all materials provided under this contract for a period of **five (5) years** from the date of formal acceptance.

C. Design Life: Material(s) shall provide a design life of a minimum of **fifty (50) years** against deterioration from H2S corrosion and typical chemicals found in municipal sanitary sewage.

PART 2 – PRODUCTS

2.01 ACCEPTABLE FRP MATERIAL SUPPLIERS & COMPOSITE STRENGTHENING SYSTEM

A. General

Materials for the FRP system must be suitably qualified, compliant with industry standards and properties provided herein, and supplied by a reputable FRP Material Supplier approved by the City or City's Represeantative. Before the materials are ordered or work is performed, Contractor must identify which materials are proposed to be utilized and from which FRP Material Supplier(s) Contractor proposes to obtain the materials.

Quality Control Testing and Certification: FRP Material Supplier shall certify that every material conforms to the project specification and shall submit test results for every material.

Labeling, packaging, and storage shall include any health hazard warnings, precautions for handling and recommended first aid procedures in case of contact.

All materials used shall conform to the project specification and other specifications referenced within and subject to the approval of the ENGINEER.

B. Design Loads

The FRP system shall be designed for the following loads as they apply for the specific site conditions:

1. Earth load (a long-term loading)
2. External pressure from ground water calculated at pipe invert (a long-term loading)
3. Live load (a short-term loading, usually will not occur simultaneously with other
4. short-term loads)
5. Internal working pressure (a long-term loading, where applicable)
6. Water weight (a long-term loading)
7. Host pipe weight (a long-term loading)
8. Wind loads (if applicable)
9. Seismic (if applicable)

2.02 GLASS FABRIC

A. Glass fabric layers may be used with or without carbon fiber, where loading conditions allow.

B. A glass fabric layer shall be used to create a dielectric barrier if the host pipe is conducive to electricity (steel, iron, etc.). The minimum dielectric constant (κ) shall be 4 (ASTM D150) for the dielectric barrier. Glass fabric shall have the minimum physical and mechanical properties as agreed upon by the Engineer and FRP Material Supplier. A sample material properties table is provided below.

C.

Longitudinal (0°) Direction:			
Weight (Fabric Only)	20 oz/yd^2 (670 g/m^2)	27 oz/yd^2 (904 g/m^2)	26 oz/yd^2 (871 g/m^2)
Fiber Orientation	Uniaxial	Uniaxial	Biaxial
Tensile Strength	63.7 ksi (439 MPa)	85.2 ksi (587 MPa)	54.2 ksi (374 MPa)
Tensile Modulus	2,940 ksi (20,270 MPa)	3,980 ksi (27,440 MPa)	3,217 ksi (22,180 MPa)
Ultimate Elongation	2.20%	2.30%	2.10%
Breaking Force	2,365 lb./in. (4,140 N/cm)	3,490 lb./in. (6,110 N/cm)	2,170 lb./in. (3,800 N/cm)
Transverse (90°) Direction:			
Tensile Strength	N/A	N/A	52.0 ksi (358 MPa)
Tensile Modulus	N/A	N/A	2,700 ksi (18,615 MPa)
Ultimate Elongation	N/A	N/A	1.90%
Breaking Force	N/A	N/A	1,560 lb./in. (138 N/cm)
Ply Thickness	.037 in	N/A	0.040 in. (1.0 mm)

2.03 CARBON FABRIC

A. The carbon fabric shall be composed of high strength, high modulus carbon fibers. The fabric shall be black in color and impregnated using two component high strength epoxy or other approved resin.

B. Fiber sizing and coupling agent shall be compatible with the resin system used to impregnate the fibers. To avoid galvanic corrosion of steel in proximity to carbon fibers, a dielectric barrier such as glass fiber fabric may be used to isolate the steel from the FRP laminate.

C. Carbon fabric shall conform to the minimum physical and mechanical properties as agreed upon by the ENGINEER and FRP Material Supplier. A sample material properties table is provided below.

Carbon Fabric and Laminate Properties	
Dry Fiber Properties	
Tensile Strength	400 ksi (2,760 MPa)
Tensile Modulus	25,000 ksi (172,400 MPa)
Ultimate Elongation	1.5%
Density	0.065 lb./in^3 (1.8 g/cm3)
Aerial Weight	27.8 oz/yd^2 (931 kg/m2)
Laminate Properties	
Tensile Strength	135 ksi (930 MPa)
Tensile Modulus	9,000 ksi (62,000 MPa)
Ultimate Elongation	0.98%
Breaking Force	2,500 lb./in (4,380 N/cm)
Ply Thickness	0.047 in (1.2 mm)

2.04 ALTERNATIVE FABRICS

Alternative fabrics can be used for improved ring stiffness at reduced costs. Such materials can be proprietary and are subject to the approval of the Engineer. Although revealing the chemical composition of alternative systems is at the discretion of the FRP Material Supplier, the physical and mechanical properties of such materials and the overall system are subject to the review of the Engineer.

2.05 SATURATING RESIN – POLYMER

A. Fabrics shall be impregnated with a two component, high strength, and low viscosity structural epoxy or other resin system as listed in Section 2.05 paragraph D. The resin shall have low viscosity and long pot life, with a fast cure time designed for high volume saturation of heavy reinforcement fabrics using an impregnator machine or hand tools as per project requirements to saturate the fabric thoroughly and uniformly.

1. The resin system shall be resistant to service environment conditions, including but not limited to moisture, elevated temperature, and chemicals in the fluid flowing inside host pipe.

2. The resin system shall not be diluted with any organic solvents such as a thinner.

3. The resin system shall not be used outside of the FRP Material Supplier's specified pot life.

4. The resin system shall not be applied on cold or frozen surfaces.

5. Only moisture tolerant resins shall be allowed to be applied on wet surfaces.

6. Temperature and moisture range for application shall be within the FRP Material Supplier's specified values.

B. Primer: For systems requiring a primer, the primer shall have sufficiently low viscosity to penetrate the concrete substrate and provide an adhesive bond for the thickened resin applied.

C. Thickened Resin: A thickened resin system, which consists of the saturating resin and fumed silica (or similar) supplied by the FRP Material Supplier as premixed or mixed at the site according to the FRP Material Supplier's recommended procedure, shall be used to provide a smooth surface for the application of the FRP laminate. The thickened resin system shall be used to fill in surface voids and even out the concrete substrate. It is permissible to use a thin coat of thickened epoxy between laminae to enhance adhesion.

D. Saturating Resins: Saturating Resins shall be 100% solids formulation with low odor conforming to the minimum physical and mechanical properties as approved by the Engineer. A sample epoxy resin properties table is provided below.

Epoxy Resin Properties	
Color – Part "A" is pigmented syrup, Part "B" is amber liquid	
Viscosity Mixed at 770 F (250 C)	1,500 – 1,600 cps
Pot Life at 770 F (250 C)	3 – 4 h (thin film set time)
Cure time (>55 °F)	24 h
Density at 392 ºF (200 ºC)	Part A: 70.5 lb./ft^3 (1.13 kg/L) Part B: 62.4 lb./ ft^3 (1.00 kg/L)
Tensile Strength (ASTM D638) Tensile Modulus (ASTM D638)	7,150 psi (49 MPa) 289,000 psi (1,992 MPa)
Flexural Strength (ASTM D790) Flexural Modulus (ASTM D790)	11,140 psi (77 MPa) 252,400 psi (1,740 MPa)
Compressive Strength (ASTM D695) Compressive Modulus (ASTM D695)	13,000 psi (90 MPa) 350,000 psi (240 MPa)
Water Absorption (% gain) in 24 hours	< 1%
Expansion Coefficient [-37.40 – 40.10 ºC] Expansion Coefficient [1,200 – 2,220 ºC]	78 ×10^{-6} m/m ºC 151.8 ×10^{-6} m/m ºC

2.06 OTHER MATERIALS

Contractor to provide compatible primer, filler and other materials recommended by the FRP Material Supplier as needed for the proper installation of the complete surface bonded FRP system. Vinyl ester resins can be used to saturate the FRP fabrics as an alternative to epoxy. The vinyl ester (or epoxy vinyl ester) resins shall have the minimum physical and mechanical properties as approved by the Engineer. A sample epoxy vinyl ester resin properties table is provided below. It should be noted that use of vinyl ester resins will require additional safety measures when applied in confined space due to styrene or other monomer emissions. Cure times of vinyl ester resins vary in a wide range, and if the project requires faster cure times than those provided by the FRP Material Supplier in ambient temperature, then heating of resin during application should be considered commensurate with the FRP Material Supplier's curing schedule.

Sample Epoxy Vinyl Ester Resin Properties Table	
Viscosity (ISO 2555)	200 – 250 cps
Gel Time	30 min
Density	62.4 lb./ ft3 (1.00 kg/L)
Tensile Strength (ASTM D638) Tensile Modulus (ASTM D638)	12,800 psi (88 MPa) 460,000 psi (3.2 GPa)
Flexural Strength (ASTM D790) Flexural Modulus (ASTM D790)	22,000 psi (153 MPa) 500,000 psi (3.5 GPa)
Compressive Strength (ASTM D695)	17,600 psi (121 MPa)
Water Absorption (% gain) in 24 hours	< 1%
Expansion Coefficient [-37.40 – 40.10 ºC] Expansion Coefficient [1,200 – 2,220 ºC]	78 $\times 10^{-6}$ m/m ºC 151.8 $\times 10^{-6}$ m/m ºC

PART 3 – EXECUTION

3.01 GENERAL PROCEDURES

The design of the FRP reinforcement shall conform to the design provisions given for the particular project and applicable standards.

3.02 INSTALLATION BY THE WET LAYUP METHOD

Contractor can propose alternative installation techniques and design improvements to meet the project goals and design requirements outlined in the drawings and technical specifications. Such proposed changes will be submitted as a part of the Performance Work Statement (PWS) 30 days before the start of construction and is subject to the approval of the City and City's Representative.

A. Surface Preparation

1. The Contractor shall expose and inspect the interior of the pipe to be rehabilitated with the FRP system. Inspection shall check the location and inspect cracks and existing conditions of the concrete.

   All necessary repair and restoration of a concrete section shall be approved by the ENGINEER prior to surface preparation.

   The Contractor shall examine the existing conditions to identify potential obstructions and constraints; shall verify dimensions, geometry, and access locations; and shall map all visible voids and cracks in the host pipe.

An adhesive bond with adequate strength shall always be provided between the first layer of the FRP system and substrate. Surface preparation shall also promote continuous intimate contact between the FRP system and substrate by providing a clean, and smooth surface.

2. Surface Grinding/Blasting: All irregularities, unevenness, and sharp protrusions in the surface profile shall be ground away to a smooth surface with CSP 3/CSP 2 surface profile for concrete substrate. Disk grinders or other similar devices shall be used to remove stain, paint, or any other surface substance that may affect the bond. Voids or depressions with diameters larger than 1 ½ in. or depths greater than 1/8 in., when measured from a 12-in. straight edge placed on the surface, shall be filled according to Section 3.02 paragraphs A.4.

3. Crack Injection: In case of host pipe having deep cracks and fractures to an extent that it imposes a risk of failure of the substrate during FRP application, these cracks and fractures will be filled, and the host pipe shall be pre-strengthened by crack injection. Where crack injection is necessary, internal, or external cracks at a width specified by the Engineer shall be filled using pressure injection of epoxy. The FRP system shall be installed no earlier than 12 hours after crack injection. Any surface roughness caused by injection shall be removed as per Section 3.02 paragraph A.2. The limit of crack injection shall be as indicated on the plans.

4. Surface Profiling: After surface grinding, any remaining unevenness in the surface greater than that specified in Section 3.02 paragraph A.2, fins, protrusions, bug holes, eroded surfaces shall be filled and smoothened over by using putty made of epoxy resin mortar or polymer cement mortar.

5. Surface Cleaning: Substrate concrete and finished surface of concrete shall be cleaned prior to application of the FRP system. Cleaning shall remove any dust, laitance, grease, oil, curing compounds, wax, stains, coatings (as necessary), surface lubricants, foreign particles, weathered layers, or any other bond-inhibiting material. If power wash is used, the surface shall be allowed to dry thoroughly before installing the FRP system. The cleaned surface shall be protected against redeposit of any bond-inhibiting materials.

6. Surface Preparation for Metal Pipes: Surface of steel and any other metallic pipes or pipe joint rings shall be prepared to achieve adequate bond strength between the FRP system and the metal substrate. The surface preparation procedure for the steel substrate shall be a minimum of SSPC SP-10/ NACE No. 2 near white metal surface. Sand blasting or another suitable method shall be used to ensure the required surface profile is achieved. The prepared steel surface shall be free of materials including epoxy mortar, concrete, dust, dirt, and oil at the time of the FRP system installation. The cleaned metal substrate shall be primed with epoxy prior to the installation of the initial layer of glass fiber lamina for the system's dielectric barrier.

B. Installation

This section specifies general installation procedures for the wet lay-up of the FRP system composed of FRP laminae. Contractor shall submit a site-specific installation procedure in the PWS, which shall, at the minimum include the following measures.

1. Environmental Conditions: Environmental conditions for installation shall be examined before and during installation of the FRP system to ensure conformity to the contract documents and FRP Material Supplier's recommendations. Primers, putty, saturating resins, or adhesives shall not be applied on cold, frozen, damp, or wet surfaces, unless the resin is moisture tolerant. Ambient and concrete surface temperatures shall be within 45-95 °F (7-35 °C). Moisture level on all contact surfaces shall be less than 10 percent at the time of installation of the FRP system, as evaluated according to ACI 503R-93. Moisture restrictions may be waived for resins that have been formulated for wet applications. Work areas identified as a confined space will require an entry permit in accordance with OSHA regulations. The Contractor is responsible for the training of all personnel, air testing, safety equipment and complying with the requirements of OSHA. A detailed safety plan shall be submitted by the Contractor as part of the Technical Specification Section 01300 – SUBMITTALS.

2. Moisture Vapor Transmission: Application of bonded FRP systems shall not proceed if any moisture vapor transmission is present. Concrete dryness is necessary when using elevated temperature cure. Any bubble that develops from moisture vapor transmission can effectively be injected with the same adhesive material used for the FRP system following the procedure specified in Section 3.02 paragraph A.3.

3. Applications in Inclement Weather: When inclement weather does not allow installation of the FRP system, as specified in Section 3.02 paragraph B.1, auxiliary measures may be employed to correct the conditions. An auxiliary heat source may be used in cold weather to raise the ambient and concrete surface temperatures to acceptable levels, as recommended by the FRP Material Supplier, but not higher than the glass transition temperature (Tg) of the primer or saturating resin. Pressurized air may be used to dry the surface dampness.

4. Equipment: The Contractor shall provide all necessary equipment in sufficient quantities and clean operating conditions for continuous uninterrupted FRP system installation.

5. Mixing of Resin Components: All resin components, including the main agent and hardener, shall be mixed at the proper temperature using the appropriate weight ratio and for a duration specified by the FRP Material Supplier until thorough mixing with uniform color and consistency is achieved. Resins shall not be diluted with any organic solvents such as a thinner. Electrically powered mixing blades shall be used for mixing. Resin shall be mixed in quantities sufficiently small to ensure that it can be used within its pot life. Any mixed resin that exceeds its pot

life or begins to generate heat or shows signs of increased viscosity shall not be used and shall be disposed of according to the SDS. Mixing of some resins may be accompanied by noxious fumes. Precautions must be taken regarding the resin's impact on the environment, including emission of volatile organic compounds. If flammable resins are used, explosion proof electrical motors or air driven motors should be used for mixing.

6. Primer and Putty: When necessary, apply one or two coats of primer on the substrate surface to penetrate its open pores. The putty shall be applied as soon as the primer becomes tack free or is not sticky to the fingers. The putty shall be applied within 7 days after primer application; otherwise, the primer- coated surface shall be roughened with sandpaper or a similar tool. The resulting surface shall be cleaned according to Section 3.02 paragraph A.5 before applying the putty. Apply 40-mil (1 mm) thick coat of putty in one layer, and smooth over the surface to fill in any small voids, cracks, or uneven areas. Any swelling on the surface after applying the putty shall be corrected to meet surface profile as specified in Section 3.02 paragraph A.4. The surfaces of primer and putty shall be protected from dust, moisture, and any other contaminants before applying the FRP system.

7. Saturant: Saturant is the term for the engineered resin used to impregnate FRP fabrics and turn them into laminae upon cure. The saturant used in a FRP system shall have sufficiently low viscosity to ensure full impregnation of the fiber sheets prior to curing. To maintain proper viscosity of the saturant, the ambient and substrate surface temperatures must be within the range specified in Section 3.02 paragraph B.1. Any mixed saturant that exceeds its pot life shall be disposed of according to Section 3.05.

8. Applying Fiber Sheet and Saturant: The fabric will be uniformly saturated with the saturant using the saturating machine or hand saturated, where site conditions are not favorable for using the machine. The fabric will be cut to the length specified in the contract documents and shall be installed in place and gently pressed onto the wet putty. Any entrapped air between the fiber sheet and the concrete surface shall be released or rolled across the sheet in the direction parallel to the fibers while allowing the resin to impregnate the fibers and achieve intimate contact with the substrate. Rolling perpendicular to the fiber direction is not allowed. In bi-directional fabrics, rolling shall be initially in the fill (transverse) direction end to end and then in the warp (longitudinal) direction. Subsequent layers of fabric (if called for in the design) shall be properly saturated with saturant and applied on top of the first sheet of fabric with no interruption.

9. Multiple-Fiber Plies: Subsequent layers of fabric (if called for in the design), shall be properly saturated with saturant and applied on top of the first sheet of fabric with no interruption. The amount of resin overcoat for intermediate plies shall factor in overcoat for the applied ply and undercoat for the next ply. Follow the PWS and approved shop and contract drawings for the fiber orientation and ply stacking sequence. Each ply and core fabric shall be applied before the onset of complete gelation of the previous layer. The number of plies that can be applied in

a single day shall be based on the FRP Material Supplier's recommendation and the approval of the Engineer. When previous layers are cured, interlayer surface preparation, such as light sanding and filling with putty, may be required, as specified in Section 3.02 paragraph B.6.

10. Overlapping: Lap joints shall be constructed over a minimum of one CFRP or GFRP laminate. The lap joint layer shall not be the top laminate. The length of the lap splice shall be as specified by the contract documents but must be at least 6 in. (152 mm) long. Staggering of lap splices on multiple plies and adjacent strips shall be required unless permitted by contract documents.

11. Alignment of FRP Materials: The fiber plies shall be aligned on the host pipe according to the contract documents. Any deviation in the alignment more than 5 degrees (approximately 1 in./ft) is not acceptable. Once installed, the fibers shall be free of kinks, folds, and waviness.

12. Termination Points: The termination points of the FRP system shall be designed such that water is not allowed to seep in between the host pipe and the FRP system. The FRP system shall be sealed properly at the termination points by applying epoxy sealant. Where flow velocities are high or in pressurized conduits, elastomeric internal joint seals with compressed steel bands shall be used at the termination points, at the discretion of the Engineer, with the appropriate approved details included in the drawing set.

13. Curing: The FRP system shall be allowed to cure for the minimum amount of time specified per the FRP Material Supplier's recommendations. Field modification of resin chemistry for rapid curing shall not be allowed. Elevated cure temperature may be used if rapid curing is necessary. Cure of installed plies shall be monitored before placing subsequent plies. In case of any curing irregularity, installation of subsequent plies shall be halted. Protect the FRP system while curing.

14. Protective Coating and Finishing: It is permissible to use a topcoat for abrasion resistance and improved flow conditions. The topcoat shall be either thickened epoxy, with or without a pigment added to facilitate inspection, or another resin as agreed between the City or City's Representative and Contractor. The topcoat shall be compatible with exposure conditions including moisture, abrasive chemicals in sewage, salt water, and physical abrasion due to debris and silt in sewers. Applicability of the topcoat to the FRP system in abrasive environments shall be verified by testing (ASTM D4060) as required by the Engineer.

15. Protective Coating Field Application: Surface preparation shall be as recommended by the FRP Material Supplier. Solvent wipes shall not be used to clean the FRP surface unless approved by the FRP Material Supplier. If abrasive cleaning is necessary, air pressure shall be limited to avoid any damage to fibers. Ambient and surface temperatures shall be within the range specified in Section 3.02 paragraph B.1, prior to applying the protective coating.

3.03 INSPECTION & QUALITY ASSURANCE

A specific quality assurance (QA) plan shall be developed from the tests identified in this section. All inspections and tests in this section will be performed by a trained inspector acting on behalf of the City for QA of the project in the presence of the Contractor and Engineer. The Contractor may have its own inspector for Quality Control (QC). The project specific QA/QC plan shall be included in the PWS submittal.

A. Inspection of Materials: The FRP Material Supplier's certifications for all delivered and stored FRP components will be inspected for conformity to the contract documents before starting the project. Materials testing will be conducted on samples as detailed in the PWS. Any material that does not meet the requirements of the contract documents or PWS will be rejected. Additional inspection measures may be taken during the installation process if specified in the contract documents or PWS.

B. Daily Inspection: Daily inspection will include date and time of repair; relative humidity; general weather conditions; surface dryness per ACI 503.4-92; surface preparation and surface profile using ICRI surface profile chips; qualitative description of surface cleanliness; type of auxiliary heat source, if any; widths of cracks not injected with epoxy; fiber or procured laminate batch numbers and their locations in the structure; batch numbers, mixture ratios, mixing times, and qualitative descriptions of the appearance of all mixed resins, primers, putties, saturants, adhesives, and coatings; observations of the progress of the cure of resins; conformance with installation procedures; adhesion test results of bond strength, failure mode, and location; FRP properties from tests of field sample panels or witness panels, if required; location and size of any delamination's or air voids; and the general progress of work.

C. Inspection for Fiber Orientation: Fiber or ply orientation, fiber kinks, and waviness will be examined by visual inspection for conformity to the contract documents. Tolerances will follow Sections 3.02 and 3.03. Any nonconforming FRP repair area will be removed and required as per Section 3.04 - Repair of Defective Work.

D. Inspection for Debonding: After at least 24 hours from initial installation of the resin, a visual inspection of the surface will be performed for any swelling, bubbles, voids, or delamination. If an air pocket is suspected, an acoustic tap test will be carried out with a hard object to identify delaminated areas by sound, with at least one strike per one ft^2 (0.1 m^2). Defects smaller than 0.5 in. (12 mm) in diameter will require no corrective action, unless as specified in Section 3.04 paragraph A. Defects larger than 0.5 in. (12 mm) but smaller than 2 in. (50 mm) in diameter will be repaired as per Section 3.04 paragraph B. Defects larger than 2 in. (50 mm) but smaller than 6 in. (150 mm) in diameter, and with a frequency of less than 5 per 10 ft^2 (1 m^2) of surface area, will be repaired as per Section 3.04 paragraph C. Larger defects will be repaired as per Section 3.04 paragraph D.

E. Inspection for Cure of Resin: If specified in the contract documents, the relative cure of resin in FRP systems will be examined by visual inspection or by third party laboratory testing of resin-cup samples using ASTM D3418. Follow recommendations

of the resin FRP Material Supplier for acceptance criteria. If the cure of resin is found unacceptable, the entire area will be marked and repaired as per Section 3.04.

F. Tests: Specimens from the installed FRP system or samples representative thereof, shall be tested for tensile, compressive, and adhesive strengths.

Adhesion test: Refer to ASTM D7234 for adhesion to concrete and ASTM D4541 for adhesion to metal (e.g., steel). To validate the adequacy of the surface preparation and the adhesion strength of the FRP system, the Contractor shall perform random adhesion tests on the prepared concrete and steel substrate of pipe segments adjacent to repair pipes as directed by the Engineer and witnessed by the City's Representative. The City's Representative should designate the areas for trial adhesion tests prior to the surface preparation activities. These areas shall be cleaned, prepared, and covered with two-ply FRP system test patches with minimum dimensions of 2 ft x 2 ft (60 cm x 60 cm) for adhesion test to concrete substrate and minimum dimensions of 4 in. x 4 in. (10 cm x 10 cm) for adhesion to steel substrate. The patch shall consist of two orthogonal plies of FRP laminae, with a layer of GFRP first applied on any steel substrate. Three adhesion tests shall be performed on each test patch. The remaining adhesion test patches shall be finish coated and remain in place for future testing purposes as needed. The Contractor shall log the location of the adhesion test and report the test results to the City or City’s Representative.

Tensile strength test (ASTMD3039): Depending on the composition of the FRP system used for a particular application, test panels shall be field fabricated using the (2) FRP system layers of carbon/glass fiber fabric, any core (3D) fabric, resins and saturation equipment used in the application. Tensile test panels shall be approximately 12 in. by 12 in. The test panel shall be prepared on a smooth flat surface overlaid with plastic (polyethylene or vinyl) sheeting. Saturating resin shall be used to prime the surface, followed by the saturated system, and finally topped with more saturating resin. A cover of plastic sheeting shall be placed over the panel and the panel squeegeed to remove any bubbles and other surface irregularities to ensure a smooth flat surface. The panel shall be labeled with time, date, and sample panel number, fabric lot numbers, and resin batch numbers, and stored in an environment representative of the pipeline inside condition to cure until collected for lab testing.

The test lab will perform a minimum of ten tensile tests with the fibers oriented in the strong direction for each tensile test panel in accordance with ASTM D3039, and report certified tests results for tensile strength, tensile modulus, related specimen dimensions, and percent elongation. For projects where multiple test panels with the same fabric batch are prepared, it is permissible to perform 5 tension tests per panel instead of 10 tests per panel, subject to review and approval by the Engineer.

The FRP system will be unacceptable if the average tensile strength is below that specified in the contract documents. Compressive strength test (ASTM D695). The resin used for the FRP system shall have the minimum compressive strength as required by the ENGINEER. This shall be verified by taking resin samples from the job site. A

minimum of five samples shall be prepared for compressive strength testing per ASTM D695.

The standard test specimen, except as indicated shall be in the form of a right cylinder or prism whose length is twice its principal width or diameter. Preferred specimen sizes are 12.7 by 12.7 by 25.4 mm (0.50 by 0.50 by 1 in.) (prism), or 12.7 mm in diameter by 25.4 mm (cylinder). Results of the compressive strength test shall be reviewed and approved by the Engineer. If the average compressive (yield) strength of the samples is less than the value as indicated in the design, then that resin batch shall be rejected. Two or more individual samples having a yield strength less than the value indicated in the design shall also result in rejection of the resin batch regardless of the average value.

3.04 REPAIR OF DEFECTS

This section specifies the conditions and types of defects that require repair and the acceptable methods of repair. Defects are of different types and may be generally classified as aesthetic, short-term critical, or long-term critical. Repair procedure depends on the type, size, and extent of defects. Repair procedures indicated below are exemplary, and the actual procedure specific to each project shall be submitted as a part of the PWS.

D. Repair of Protective Coating:
Defects in protective coating can be of three types: small hairline cracks, blistering, and peeling. In all cases, moisture content of the substrate should be below 0.05% before applying a new coating. Prior to any repair of protective coating, the FRP system shall be examined visually or otherwise to ensure that no defect exists within or on the surface.

Defects in FRP, if found, shall be repaired as described below. If protective coating appears to show small areas with cracks, the local surface shall be lightly sanded. Then a new coating with appropriate primer shall be applied according to the FRP Material Supplier's recommendations. At the minimum, the coating shall be applied over an area extending 1 in. (25 mm) on either side of the defect. If the protective coating shows signs of blistering, the entire area of blisters as well as the surrounding area to a distance of at least 12 in. (30 cm) shall be carefully scraped clean. In no case should a blistered surface be recoated without complete removal of the existing coating. The area shall be wiped clean and dried thoroughly. Once dry, the area can be recoated after application of the primer coat if required by the FRP Material Supplier. If the surface shows signs of excessive peeling, the entire coating shall be scraped off and the surface lightly sanded, wiped clean, and thoroughly dried before applying a new coat according to the FRP Material Supplier's recommendations.

E. Epoxy Injection of Small Defects: Small entrapped voids or surface discontinuities no larger than 0.5 in. (12 mm) in diameter shall not be considered defects and require no corrective action unless they occur next to edges or when there are more than five such defects in an area of 10 ft^2 (1 m2). Small defects of size between 0.5 and 2 in. (12 and

50 mm) in diameter shall be repaired using low-pressure epoxy injection as long as the defect is local and does not extend through the complete thickness of the FRP system.

F. Patching of Minor Damage: Minor defects are those with diameters between 2 and 6 in. (50 and 150 mm) and a frequency of less than five per any unit surface area of 10 ft^2 (1 m^2) length or width. The area surrounding the defects to an extent of at least 1 in. (25 mm) on all sides shall be carefully removed. The area shall be wiped clean and thoroughly dried. The area shall then be patched by adding an FRP patch extending at least 1 in. (25 mm) on all sides of the removed area.

G. Replacement of Large Defects: Defects larger than 6 in. (150 mm) in diameter shall be carefully marked and scarfed out extending to a minimum of 1 in. (25 mm) on all sides. Scarfing shall be progressing through the layers of the FRP system until past the defective area. The substrate shall be appropriately prepared and primer reapplied after ensuring that the surface is clean and dry. Application of an FRP patch system shall extend a minimum of 6 in. (150 mm) on all sides of the scarfed area. Once cured, the protective coating shall be applied over the entire area.

3.05 STORAGE, HANDLING, AND DISPOSAL

A. Storage Requirements: All components of the FRP system must be delivered and stored in the original factory-sealed, unopened packaging or in containers with proper labels identifying the FRP Material Supplier, brand name, system identification number, and date. Catalysts and initiators should be stored separately. All components must be protected from dust, moisture, chemicals, direct sunlight, physical damage, fire, and temperatures outside the range specified in the system data sheets. Any component that has been stored in a condition different from that stated above must be disposed of, as specified in Section 3.05 paragraph G.

B. Shelf Life: All components of the FRP system, especially resins and adhesives, that have been stored longer than the shelf life specified on the system data sheet shall not be used and must be disposed of, as specified in Section 3.05 paragraph G.

C. Handling: All components of the FRP system, especially fiber sheets, must be handled with care according to the FRP Material Supplier recommendations to protect them from damage and to avoid misalignment or breakage of the fibers by pulling, separating, or wrinkling them or by folding the sheets. After cutting, sheets shall be either stacked dry with separators or at a radius no tighter than 12 in. (30 cm) or as recommended by the FRP Material Supplier.

D. Safety Hazards: All components of the CFRP system, especially resins and adhesives, must be handled with care to avoid safety hazards, including but not limited to skin irritation and sensitization and breathing vapors and dusts. Mixing resins shall be monitored to avoid fuming and inflammable vapors, fire hazards, or violent boiling. The Contractor is responsible for ensuring that all components of the FRP system at all stages of work conform to the local, state, and federal environmental and worker's safety laws and regulations. The Contractor is advised that a forced ventilator system

may be required inside enclosed sections and that provision for ventilation, if any, shall be included in the cost of the work. Refer to the Safety Plan for details.

E. Safety Data Sheets: The SDS for all components of the FRP system shall be accessible to all at the project site. Specific handling hazards and disposal instructions shall be specified in the SDS section entitled Personnel and Workplace Protection. The Contractor is responsible for providing the proper means of protection for safety of the personnel and the workplace.

The Contractor shall inform the personnel of the dangers of inhaling fumes of primer, putty, or resin and shall take all necessary precautions against injury to personnel. The resin mixing area shall be well vented to the outside. Refer to the Safety Plan for details.

F. Clean-Up: The Contractor is responsible for the cleanup of the equipment and the project site from hazardous and aesthetically undesirable FRP components using appropriate solvents, as recommended in the system data sheet.

G. Disposal: Any component of the FRP system that has exceeded its shelf life or pot life or has not been properly stored, and any unused or excess material that is deemed waste shall be disposed of in a manner amiable to the protection of the environment and consistent with the SDS.

3.06 PROJECT CLOSE-OUT AND MAINTENANCE

Documentation of the work: The City requires documentation of the work be prepared and submitted to the City or City's Representative by the Contractor on completion of the work according to Technical Specification Section 01300 - SUBMITTALS. The documentation shall include the following:

1. Information on the products and installation method used.
2. Pre- and post-inspection results.
3. Test results.
4. Any changes or deviations from the contract documents and possible corrective work.

A. Verification/Basis for Rejection: Materials not complying with the requirements of this Technical Specification shall be rejected at the discretion of the City or City's Representative. Repairs, replacements, and retesting shall be accomplished in accordance with the contract documents at no additional cost to the City.

B. Affidavit of Compliance: The City requires an affidavit from the FRP Material Supplier or Contractor, as applicable, that the material provided, or the installation performed complies with the applicable requirements of the Technical Specifications provided herein and delivered to the City or City's Representative according to Technical Specification Section 01300 - SUBMITTALS.

3.07 PROTECTION OF SITE:

Except as otherwise provided herein, the Contractor shall protect from damage all fences, structures, sidewalks, utilities, trees, shrubbery, lawns, etc., during the progress of this work. All debris and unused materials shall be removed immediately upon completion of the work. The site shall be restored as nearly as possible to its original condition, including the replacement, at the Contractor's sole expense, of any facility or landscaping which has been destroyed or damaged beyond restoration.

3.01 UTILITIES:

Unless otherwise indicated in Technical Specification Section 01550 – CONTRACTOR'S UTILITIES, the Contractor shall arrange for and provide any required utilities at the Contractor's sole cost and expense. This includes but is not limited to water, power for operating any equipment along with personnel sanitation facilities.

3.02 CLEANING AND PREPARATION

A. The Contractor shall be responsible for all cleaning and surface preparation according to Technical Specification Section 02760 – SEWERS AND SEWER STRUCTURE CLEANING. The Contractor shall notify the City's Representative of any irregularity, which may interfere with the proper installation

3.03 ACCEPTANCE

As a condition precedent to Final Acceptance of the work, Contractor shall certify the proper installation and testing of material provided under this section. Certification shall warrant that materials and installation are free of defects and/or workmanship and suitable for trouble-free operation under the conditions set forth in these Technical Specifications.

3.04 RECORD DRAWINGS:

Prior to final payment, the Contractor shall provide a complete set of redlined Design Drawings showing the project as constructed including manhole insert depth, diameter, along with location and diameter of any insert penetrations and interior piping configurations. A spreadsheet and/or Design Drawings shall include all information required elsewhere in these Technical Specifications as well as any changes.

**** END OF SECTION ****

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SECTION 13000
SPECIAL PROTECTIVE MATERIALS INSTALLATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies the PVC lining system used for the rehabilitation of PVC lined municipal sanitary sewer manholes and structures to provide protection against chemical or gas corrosion. The lining shall yield a durable, chemical resistant lining and provide a water and gas tight seal to concrete components within existing sanitary sewer collection system infrastructure.

B. DEFINITIONS

1. In this Technical Specification, the word “lining” (or “linings” or “liner”) is used interchangeably. Similarly, “line” is used interchangeably with “to line” (or other variations of these words).

2. In this Technical Specification, unless otherwise specifically noted, the word “manhole” shall mean “sewer structure” and shall encompass sewer manholes, sewer structures, sewer vaults, and other structures contained within the sanitary sewer system. It also encompasses sewer pipes (or portions thereof) that are located within the sewer structure including sewer pipes (or portions thereof) that are located outside of the limits of the structure.

3. In this Technical Specification, “channel” shall encompass the entirety of the manhole channel, including the invert.

4. In this Technical Specification, “existing manholes” shall mean those manholes that are (or were) not constructed as part of this project work. “Rehabilitating” existing manholes and "applying corrosion protective coating" to those manholes shall include the following activities:

   a. Cleaning and preparation of the surface to PVC lining manufacturer’s recommended standards and removing loose, corroded, deteriorated, hanging materials from the manhole or pipe per Technical Specification Section 02146 - SEWER PIPE AND SEWER STRUCTURE CLEANING and otherwise preparing the manhole or pipe for liner installation/repair.

   b. Testing of the prepared surface to lining manufacturer’s standards prior to applying an approved lining system.

   c. Testing the finished surface coating, as required herein.

Where required by the Contract Documents, existing manholes and pipes shall be rehabilitated and an approved corrosion protective PVC lining installed to their interior surfaces, as specified herein.

The approved lining system (as specified herein) shall be installed to all exposed concrete, grout, mortar, and cementitious surfaces or portions thereof within the manhole including pipe-to-throat transitions (or pipe-to-bench transitions), throat, bench, and channel.

1.02 CITY OF TEMPE SUPPLEMENT TO MAG SPECIFICATIONS

A. All materials, work and methods relating to the special protective materials installation shall conform to the applicable provisions of the City of Tempe Supplement to MAG Uniform Standard Specifications and Details for Public Works Construction, latest edition.

B. Acceptance of the completed work is subject to inspection by the City or City's Representative. If the overall quality of the materials and installations is found to be unacceptable in the opinion of the City or City's Representative, repair and retesting will be required.

1.03 INSTALLER QUALIFICATIONS

Applicator of specialized linings shall be certified by the lining material manufacturer.

1.04 SUBMITTALS

The following submittals shall be provided in accordance with Technical Specification Section 01300 – SUBMITTALS.

1. Complete shop drawings including description of installation.
   a. PVC liner spot repair detail.
   b. PVC weld joint installation detail.
   c. Large PVC lining patch with mechanical anchors repair detail.
   d. Filling of voids behind pipe wall and pipe repair detail, (as necessary).
   e. Epoxy coated manhole/PVC lined pipe interface connection detail.
   f. PVC lined manhole/PVC lined pipe interface connection detail.
   g. Repair detail for bypass pump suction and discharge port(s) cut into an existing PVC lined pipe.
   h. Adhesive system material.
2. Complete material lists.
3. PVC welder/installer certifications from lining material manufacturer.
4. Contractor's quality control test procedures and test results.

PART 2 - PRODUCTS

2.01 PVC LINING REPAIR – PLAIN SHEET

A. "Small" and "medium" sized defects that are present within the existing PVC protective lining, as detailed in the Contract Documents, shall be repaired using Armorlok Incorporated, 1420 Richardson Street, San Bernadino, CA or approved equivalent, and Sikaflex 1A or approved equivalent. The lining material shall be PVC, white in color, compounded of inert synthetic resins, pigments and plasticizers to make it permanently flexible sheets. Liner sheets shall be a nominal 0.065-inch in thickness. Submittal required per Technical Specification Section 01300 – SUBMITTALS

B. Joint strips and welding strips shall have the same corrosion resistance as the sheet lining material but shall not have locking extensions. Liner sheets joint, corner, and welding strips shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material. All lining shall have good impact resistance and shall have an elongation sufficient to bridge up to 1/4-inch crack without damage to the lining sheets.

C. Mechanical anchors shall be 1/4–inch diameter Zamac nail with mushroom head or approved equivalent. Minimum anchor length shall be 1¼-inch. Submittal required per Technical Specification Section 01300 – SUBMITTALS.

D. Installation of "Large Patch" repairs shall be reviewed by the City or City's Representative for approval prior to installation.

2.02 PVC PROTECTIVE LINING – NEW SURFACES

A. Concrete surface/repair shall include a protective lining as detailed in the project Contract Documents. Surfaces shall be protected using Armorlok PVC Shieldlok Mini D-Key liner material as manufactured by Armorlok Incorporated, 1420 Richardson Street, San Bernadino, CA or approved equivalent. The lining material shall be PVC, white in color, compounded of inert synthetic resins, pigments and plasticizers to make it permanently flexible sheets. Liner sheets shall be a nominal 0.065-inch in thickness. Submittal required per Technical Specification Section 01300 – SUBMITTALS.

B. Shieldlok Mini D-Key PVC protective lining material that is to be placed over new concrete shall be embedded into Shieldlok two-part mastic (Part A / Part B), Mixed according to manufacturer recommendations. Concrete shall be coated with Shieldlok primer prior to application of two-part mastic. Mini D-Key extensions of the same material as to the liner shall be integrally extrude with the sheet. Locking extensions shall be approximately 2.5 inches apart and shall be at least 0.375 inch high.

C. Joint strips and welding strips shall have the same corrosion resistance as the sheet

lining material. Liner sheets, including locking extensions shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material. Liner joints, corner, and welding strips shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material.

PART 3 - EXECUTION

3.01 HAZARDOUS LOCATIONS

The City or City's Representative may wish to enter the manhole under the Contractor's safety program to perform observations and/or perform additional testing. The Contractor shall provide the necessary safety plan, safety equipment, monitoring, and safe working atmosphere that allow the City or City's Representative to safely enter the manhole, at no additional cost to the City.

The Contractor is responsible for safety of the job site, including the responsibility to enforce and enact the provisions of the Contractor's Confined Space Entry program and the responsibilities to monitor the atmosphere within the structures and provide a safe working atmosphere and environment. These safety measures shall be at no additional cost to the City. The City shall not be responsible for safety or for safety monitoring of the job site.

3.02 SEWAGE FLOW AND DIVERSION

The Contractor shall be aware that the existing manholes included in this project are active, functioning manholes. The Contractor shall be required to coordinate the minimization of existing sewer flow and corresponding water level within the manhole through upstream diversion as much as possible per Technical Specification Section 02145 – DIVERSION OF SEWAGE FLOW AND DEWATERING when rehabilitating the lower sections of the manhole.

Manholes designated for rehabilitation that are contiguous to pipe rehabilitation activities shall be performed while flow is diverted, and manhole is dewatered.

3.03 MANHOLE PREPARATION AND CLEANING

Deteriorated or soft substrate concrete shall be removed down to sound concrete with surface profile equivalent to ICRI SCP 3-4, using abrasive blasting or hydro-jet cleaned per Technical Specification Section 02146 - SEWER PIPE AND SEWER STRUCTURE CLEANING. Substrate shall be repaired back to original pipe dimensions per Technical Specification Section 09710 - CONCRETE AND MASONRY COATING.

Existing PVC surface preparation shall include a high-pressure wash with a minimum water pressure of 1,000 psi to remove all grease, oils, or foreign material in accordance with PVC liner material manufacturer's recommendations.

The Contractor shall inspect all surfaces specified to receive the PVC lining system prior to surface preparation. The Contractor shall notify City of any noticeable disparity in the surfaces which may interfere with the proper preparation or lining system. Remove all loose PVC material back to sound material. Any part of the existing field joint that cannot be caused to lie flat shall be trimmed away and discarded.

The entire manhole interior including frame, chimney, walls, bench, channel, and throat shall be cleaned prior to rehabilitation using high-pressure water blast per Technical Specification Section 02146 – SEWER PIPE AND SEWER STRUCTURE CLEANING.

The Contractor shall use manhole debris shields or other approved method to prevent debris from entering the live sewers. The Contractor shall remove and legally dispose of dislodged debris offsite. Discharge of removed sediment and debris into the interceptor pipe is prohibited. If sediments are inadvertently or intentionally released into the interceptor sewer, the Contractor will be responsible for interceptor pipe cleaning and removal of all sediments from the location of observed release for a distance one (1) mile downstream along the length of pipe, regardless of diameter(s) as directed by the City.

Contractor shall notify the City or City's Representative in the event significant structural degradation of existing concrete has occurred, and sound concrete is not encountered during the cleaning process.

3.04 UNDERLAYMENT DEFECT REPAIR

A. All defects in the underlayment including deteriorated concrete, cracks, honeycombing or otherwise defective concrete, shall be repaired. All deteriorated concrete, voids, holes, rough or irregular concrete shall be cleaned with abrasive blasting and high-pressure water cleaning to sound material and filled.

B. The Contractor shall use the repair and fill material to repair or fill all defects. Deteriorated concrete or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1-inch. The edges of the cut shall be perpendicular to the surface of the concrete. Patches shall be finished to match the adjoining surfaces profile. Concrete with honeycombing which exposes the reinforcing steel or with defects, which affect the structural strength, shall be corrected.

3.05 STRUCTURAL REINFORCING REPAIR

Structural repairs shall include splicing new reinforcing steel to existing reinforcing steel and providing additional reinforcing steel to reestablish the original structural integrity and existing loading capacity. Provide 3/8-inch diameter anchor bolts as needed to support reinforcing steel.

3.06 REINFORCING STEEL TREATMENT

Where corrosion or surface preparation activities have exposed reinforcing steel, the following procedure shall be used:

1. If half the diameter of the reinforcing steel, or more, is exposed, chip out behind the reinforcing steel a minimum of 1-inch for placement of grout or polymer concrete.

2. Determine cross sectional area loss of reinforcing steel.

3. Where reinforcing steel cross sectional area loss exceeds 15% of the original reinforcing steel, perform structural repair as directed by the City.

4. Abrasive blast all exposed reinforcing steel surfaces to remove all contaminants and corrosion products.

5. Clean exposed reinforcing steel with stiff brush or grit blast equipment.

6. Apply a second 20 mil (wet) coat of corrosion inhibitor and allow for 2-hour to 3-hour cure prior to placement of polymer mortar, cementitious mortar, or grout.

3.07 NEW PVC JOINTS OVER EXISTING FIELD JOINTS

A. Field joints at the pipe or manhole joints shall be Armorlok – Detail J-1 with 6-inch-wide joint strip and 1-inch-wide weld strips as depicted in the Contract Documents. Detail J-1 joint shall be centered over the existing pipe joint.

B. Edge of new 6-inch-wide joint strip shall be heat fuse welded to the existing PVC lining along the circumference of the pipe or manhole on both edges of the new joint along with 1-inch weld strips at the edges per Contract Documents and Armorlok – Detail J-1 or approved equivalent.

3.08 TERMINATION OF PVC-LINER TO CONCRETE OR EPOXY COATED SURFACE

Where PVC-liner is to be attached to an existing epoxy coated surface, Armor liner plain sheet PVC lining or approved equivalent shall be terminated with a PVC turn-back that is mechanically anchored to the existing concrete substrate. The installation of epoxy coating to the manhole shall be performed prior to installation of the PVC lining turn-back. The turn-back shall be sealed to the epoxy surface with Sikaflex 1A sealant, or approved equivalent, such that the connection of the turn-back to the manhole wall, bench, throat, pipe connection or chimney is gas tight.

3.09 REPAIR MANHOLE BENCH AND NON-MAIN CHANNEL(S)

The Contractor shall repair manhole bench and non-main channel(s) with acid-resistant mortar per Technical Specification Section 09710 – CONCRETE AND MASONRY COATING. Manhole bench shall be sloped a minimum ½-inch per foot to the edge of the throat. Minimum mortar thickness shall be ¾-inch.

3.10 ADHESION/BOND TESTING

A. GENERAL

1. The Contractor shall perform an adhesion test with a thin bladed chisel after proper heat fuse welding of the PVC material in accordance with manufacturer's recommended procedures. Costs associated with weld testing are incidental to the unit price cost of lining.

2. Where unacceptable test results are obtained, the Contractor shall be responsible for re-welding at no additional expense to the City.

B. FREQUENCY OF TESTING

The Contractor shall test all finished PVC heat fuse welded joints for adequate adhesion.

3.11 HIGH VOLTAGE SPARK TEST

A. DEFINITION – HOLIDAY: Holidays are defined as pinholes and voids in non-conductive lining that allow electrical current to pass through the protective lining to the base material.

B. After the protective lining is installed it shall be inspected with high-voltage holiday detection wire brush/squeegee wand style equipment, Tinker and Rasor Model AP-W, maximum 35,000 Volts or approved equivalent. Surface shall first be dried, an induced holiday shall then be made on to the PVC lined surface and shall serve to determine the minimum/maximum voltage to be used to test the lining for holidays at that particular area.

1. The entire surface of the manhole, whether PVC lined, or epoxy coated, shall then be spark tested. Any imperfections found in the lining/epoxy coating system shall be re-welded or ground down and refilled. The Contractor shall perform repairs and re-testing at no additional cost to the City.

2. The City shall be notified and present to observe testing and retesting. In addition, the Contractor shall provide certification for each manhole stating that the lining and epoxy coating is free of holidays, holes, or other imperfections.

3.12 REPAIRS OF PVC LINING SYSTEM

1. Pinhole defects shall be cleaned and sealed with a 1-inch-wide heat fused weld strip.

2. All blisters, splits and damage to the existing PVC lining shall be prepared to a point 1-inch beyond the limits of the damaged lining area.
3. Blisters splits and damage to the existing PVC lining shall be completely removed to a 1-inch minimum beyond the repair area.

4. Repairs large than 18-inches in any direction shall be brought to the attention of the City or City's Representative for review and approval of proposed repair procedure.

3.13 INSPECTIONS

A. The Contractor shall notify City of impending completion of surface cleaning, re-profiling, and prior to PVC lining repair or application of the epoxy coating per Technical Specification Section 09710 – CONCRETE AND MASONRY COATING.

B. The notifications shall be given a minimum 24-hours in advance of completion of the surface repairs and re-profiling, and 24-hours in advance of PVC lining repairs or application of the epoxy coating and any testing, including spark testing, and adhesion testing and dry film thickness testing of the epoxy lined areas.

C. Failure to provide notification at these designated times/work stages may prevent the acceptance of the work by the City.

3.14 CLEANUP

Upon completion of PVC lining, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish.

**** END OF SECTION ****

SECTION 13130
POLYMER CONCRETE MANHOLE INSERT

PART 1 – GENERAL

1.01 DESCRIPTION

The purpose for this Technical Specification is to provide guidance for the rehabilitation of sanitary sewer access manholes using a fully structural insert capable of supporting loads without the addition of internal or external stiffeners and manufactured out of materials that are chemically inert from chemicals and corrosive gasses typically found in a municipal sanitary sewer system. The insert shall be comprised of barrel and cone segments as a single or multi piece monolithic designed unit constructed and installed in a manner consistent with acceptable manufacturing and construction techniques and practices.

A. SCOPE:

This Technical Specification covers all work necessary to furnish and install a structural manhole insert. The Contractor shall be licensed in the State of Arizona. The Contractor shall deliver finished insert product(s) including all materials, labor, equipment, and services necessary for product installation, all quality controls and material samples required for performance tests, final inspection and warranty work, all as specified in these Contract Documents and at the quantities of each component contained in the Bid Proposal. Anticipated work to be provided also includes all traffic control, bypass pumping diversion and/or temporary restriction of sewage flows (as necessary) for durations to complete the work, removal and reinstallation of any grade rings along with ring and cover, excavation of existing manhole cone including removal, transport and offsite disposal of materials, manhole interior cleaning, any manhole bench modifications and placement of insert base support/seal grout along with grouting of insert exterior annular space. Work also included removal and replacement of any interior piping and equipment and reconnection of any lateral pipe connections as necessary to reinstate normal sewer service.

The work shall be for the renewal of sanitary sewer manholes that shall be accomplished by the installation of a number of components either individually or together with other components. These may include acid resistant non-shrink grout to structurally rebuild the manhole bench and throat section (if present) back to original dimensions and the application of a protective polymer coating at a minimum thickness to all exposed concrete/grout to establish chemical resistance.

Any steps present within the manhole shall be removed flush with the manhole interior wall. The Contractor is responsible for extension and proper reconnection of any sewer and/or utility piping present within the manhole including all seals and/or mechanical hangers and devices to properly restore original service and capabilities.

Contractor is responsible for accurate and complete manhole rehabilitation as specified. The prices submitted by the Contractor shall include all costs of permits, labor, equipment and materials for the various bid items necessary for furnishing and installing the manhole rehabilitation materials and processes in accordance with these Technical Specifications complete and in place, including all items of work not specifically mentioned herein which are required to make the product perform as intended. All Contractor costs to deliver the final product shall be included in the respective lump sum and/or unit price bid items depicted in the Bid Proposal.

1.02 SAFETY REQUIREMENTS:

The Contractor shall conform to all work safety and health requirements of pertinent regulatory agencies and/or shown in Technical Specification Section 01060 – Health and Safety and shall secure the site for working conditions in compliance with the same. The Contractor shall perform existing material testing as required by regulatory regulation requirements and provide/install/maintain and be responsible such signs and/or other devices as are necessary for safety at the work site.

1.03 NOTIFICATION:

It shall be the Contractor's responsibility to notify all utility companies involved whenever a utility is to be cut, tapped, moved, or in any way disturbed from its original placement. Sufficient notice shall be given to the utility company so that its users can be informed of any disruption of service. Such notice shall be given no less than 48 hours in advance.

It is the Contractor's responsibility to inform the City of construction activities which may lead to interruption in sewer service. The Contractor shall provide 72 hour notice prior to construction in order for the City to alert all applicable residents.

1.04 QUALITY CONTROL

A. REFERENCES:

Reference	**Title**
ASTM C478	Standard Specification for Precast Reinforced Concrete Manholes Sections (Structural intent only)
ASTM C478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C497	Test Methods for Concrete Pipe, Manhole Sections, or Tile
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

ASTM C587	Standard Practice for Minimum Structural Design Loading for Underground Utility Structure
ASTM C923	Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM D2584	Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D6783	Standard Specification for Polymer Concrete Pipe (material mix design)
ASTM G20	Standard Test Method for Chemical Resistance of Pipeline Coatings
AASHTO HS-20	Standard Specification for Highway Bridges Codes - Axle Loading
AASHTO HL 93	(LRFD) Bridge Design and Axial Load Specifications

1.05 CERTIFIED INSTALLER

The insert shall be installed by a Contractor certified by the insert manufacturer. A training outline for the certification program shall be submitted to the City for review. The Contractor shall provide evidence that the on-site Superintendent responsible for supervision of the insert installation crew has received the manufacturer's training.

The Contractor shall appoint a Quality Assurance Manager who will be on-site full time during manhole bench preparation, insert installation, annular space grouting, and backfill to take full responsibility for the quality of the work. The Quality Assurance Manager shall be fully certified.

1.06 SUBMITTALS:

Contractor shall submit information to the City or City's Representative in accordance with Technical Specification Section 01300 - Submittals.

A. Insert Manufacturer's Qualifications: The manufacturer of the manhole insert shall show experience in the manufacture of proposed insert for more than five (5) years.

B. Documentation of Contractor's Experience: Contractor shall provide references for all jobs within the last two (2) years that were either completed or under construction using the proposed rehabilitation method.

C. Installer's Qualifications: The installer of the manhole insert shall show experience in the installation of the proposed inserts for more than five (5) years. References shall be provided for a minimum of five (5) jobs. Information provided shall include a description of the job, the location of the job, the value of the job, the Owner name, and the Owner contact person for the job including name, title, address, and phone number. The total jobs submitted shall show that at least 1,000 vertical feet of the product installed by the installation Contractor.

D. Submit Manufacturer's published product and installation literature and published quality control testing criteria data for the proposed manhole insert system.

E. Submit Test Reports: The manufacturer shall design, fabricate and certify that the manhole insert conforms to ASTM C478 - Standard Specification for Precast Reinforced Concrete Manholes Sections and the requirements of this Technical Specification.

F. Submit independent test report showing that the physical properties of the proposed insert meet the requirements of these Technical Specifications and will meet or exceed the physical properties given in the manufacturer's published literature submitted as required by Part 2 – PRODUCTS.

G. Submit a report outlining the proposed installation process and procedures as directed by the insert manufacturer to be used. The report shall include information specific to the installation instructions and any unique site condition(s) that must be taken into consideration including grout curing operations and procedures, annular space grout type requirements and lift limitations, access coordination, installation timing and identification and any coordination requirements/requests from the City or others.

H. Shop Drawings: Contractor shall provide shop drawings of proposed materials for approval prior to ordering. Shop drawings shall depict:

1. All measurements made by the Contractor to verify manhole critical dimensions including but not limited to depth and diameter along with any pipe penetrations or equipment hanger requirements.
2. Material(s) proposed for construction.
3. Critical dimensions, jointing and connections, fasteners and anchors with sizes, spacing, and location, connections, attachments, and openings.
4. Anticipated grade adjustment ring(s) and height.
5. Color(s).

I. Contractor to provide design detail for manhole bench conditions with insufficient circumferential bearing area to support the manhole insert. Modifications shall be per manufacturer's recommendations.

J. Documentation of the control checks for materials used in the fabrications each part of insert fabrication including resin and aggregate content.

K. Approved maximum depth of annular space grout per lift as calculated by the insert manufacturer structural engineer.

L. Warranty: Contractor shall submit warranty documents signed by an officer of the company and notarized stating the terms and conditions of the warranty identified in Paragraph 1.10 – WARRANTY.

M. Any item the Contractor proposes to utilize as an "or equal" to that proposed in the Contract Documents.

N. Contractor's installation procedures, quality control, and water ratio (if applicable) for annular space grout.

1.07 SUBSTITUTIONS

Any item the Contractor proposes to substitute for a specified item as an "or equal" must be made in writing, received and approved by the City or City's Representative prior to the start of construction activities. Substitutions or deviations not approved by the City shall risk rejection and replacement at no additional cost to the City.

1. For any proposed design change or deviation from these Technical Specifications,
2. For anything in these Technical Specifications found to conflict with applicable codes and ordinances,
3. For anything not understood by the Contractor.
4. One (1) electronic copy of submittal(s) shall be provided to the City at least two (2) weeks before a determination is required.
5. Submittals may be drawings, sketches, manufacturer's literature, catalog descriptions, or other descriptions in sufficient detail to allow a decision. The submittal shall indicate the amount to be added to or deducted from the bid price should the submittal be accepted.

1.08 QUALITY ASSURANCE/QUALITY CONTROL

A. EXAMINATION: Each insert component part shall be examined by the Contractor for dimensional requirements, soundness, and workmanship in accordance with ASTM C478.

B. COMPOSITION CONTROL: Manufacturer shall control and document the resin and aggregate content for each part of manhole fabrication. Documentation of the control

checks shall be maintained by the manufacturer. Proper content may be shown by resin and aggregate usage rate checks, in accordance with the manufacturer's recommended material composition.

C. TESTING RECORDS: Records of all testing shall be kept and copies of test results shall be submitted in accordance with Paragraph 1.06 - SUBMITTALS.

1.09 INSPECTION POINTS

Contractor shall keep the City or City's Representative informed of milestone progress on each insert location for the following items:

1. Start of excavation to remove the cone, chimney, frame and cover.
2. Completion of removal of unsound material and manhole pressure wash cleaning.
3. Completion of bench cleaning and preparation (if any).
4. Completion of leveling/seal grout placement prior to insert placement.
5. Prior to annular space grouting.
6. During placement of grout in annular space.
7. Completion of bench protective coating.
8. Completion of backfill placement.

1.10 WARRANTY

The Contractor shall replace promptly and at no expense to the City, any materials which fails during the warranty period. Warranty work shall include all ancillary items including, but not limited to permits, traffic control, and flow control required to compete the repair/replacement work. Warranty and durations are described below:

A. Project Warranty: The Contractor shall warrant all materials and workmanship performed under this contract for a period of **one (1) year** from the date of formal acceptance or as stated in the project Contract Documents whichever is longer.

B. Materials Warranty: The manhole insert shall be free of defects that will affect the long term life and operation of the manhole. The Contractor shall warrant in writing all materials provided under this contract for a period of **five (5) years** from the date of formal acceptance.

C. Insert: Insert material(s) shall be tested for a design life of a minimum of **fifty (50) years** against deterioration from H2S corrosion and typical chemicals found in municipal sanitary sewage.

PART 2 – PRODUCTS

2.01 POLYMER CONCRETE INSERT

A structural insert shall be installed into the interior of existing deteriorated sanitary sewer manhole that meet or exceed the structural requirements as stated in ASTM C478 Standard Specification for Circular Precast Reinforced Concrete Manhole Sections. Approved insert manufacturers:

1) Armorock™: Manufactured by Armorock, 3555 21st Street, Boulder City, NV 89005 (702) 479-1772
2) Rock Hard™scp Manufactured by SolidCast Polymer Technology, LLC, 5422 Chapel Brook Drive, Houston, Texas 77069 (844) 476-2542
3) Approved Equal.

2.02 MATERIAL and DESIGN

This section is to provide minimum design calculations and testing requirements for a barrel section and cone together. There are some Technical Specifications that shall differ between the cone and the barrel that shall be described in separate sections.

A. The design of the insert shall be prepared and professionally sealed by an Engineer licensed in the State of Arizona. The insert shall meet or exceed the requirements of buried manholes up to 40 feet deep without the use or reliance upon external or internal structural stiffeners. The design shall not allow infiltration of ground water.

B. Insert shall be designed and tested to withstand AASHTO HS-20 loading with no structural strength derived from the existing manhole structure or installation of external or internal structural stiffeners.

C. Material of the insert shall be consistent throughout the structure consisting of resin and aggregate material, including reinforcement that is inert to corrosion from sewer gasses per ASTM D6783 - Standard Specification for Polymer Concrete Pipe (material mix design). Epoxy shall be 100% solids, solvent free, low odor emitting, environmentally friendly, and impervious to chemicals. Manufacture shall determine the need for and type of reinforcement including that for safety and lifting requirements. Reinforcement, if determined necessary, shall be made of non-ferrous material.

D. The resins used shall be unsaturated, supplier certified commercial grade resins. Mixing lots of resin from different manufacturers or “odd-lotting” of resins shall not be permitted. Quality-assurance records on the resin shall be maintained. Interior surface shall be light in color in order to facilitate ease of inspection from ground surface.

E. Load Rating: The complete manhole shall have a minimum dynamic load rating of 16,000 pounds. To establish this rating the complete manhole shall not leak, crack, or suffer other damage when load tested to 40,000 pounds.

F. The use of a multi-piece insert must be approved by the City prior to ordering. If allowed, joints shall be of bell and spigot configuration. Joints every 5 feet shall be sealed with a material consistent with the chemical resistance of the manhole sections per ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants and shall not affect the warranty. All joints shall be water proofed and shall not allow infiltration.

2.03 THIRD PARTY TESTING

The Manufacturer shall have testing of the manhole insert materials performed by an independent test laboratory. Where there are conflicts between the requirements of the ASTM and this Technical Specification, this Technical Specification shall supersede. The Manufacturer shall submit the results of third-party testing, as specified below, and in accordance with Technical Specification Section 01300 - Submittals.

1. LOAD RATING: The insert shall have an AASHTO HS-20 load rating.

2. CHEMICAL RESISTANCE TESTING: The following chemical resistance tests shall be performed in accordance with ASTM G20 - Standard Test Method for Chemical Resistance of Pipeline Coatings. After exposure to the solutions, specimens shall exhibit zero (0) weight loss, spalling, cracking or blistering. Any changes to appearance such as color and texture shall be noted.

2.04 BARREL DESIGN SPECIFICATIONS:

The barrel section of the polymer concrete insert shall meet general design specifications as noted in Paragraph 2.02 - Material and Design.

Dimensions: Barrel sections of the manhole insert shall be designed to maximize the diameter of the existing manhole interior.

2.05 CONE DESIGN SPECIFICATIONS:

The cone section of the insert shall meet general design specifications as noted in Paragraph 2.02 - Material and Design. Cones shall be concentric for all manhole diameters. The cone section must provide a bearing flat shoulder surface on which a chimney consisting of adjustment grade rings may be supported.

Dimensions: Cone sections of the manhole insert shall be a designed according to MAG Standard Detail 520.

2.06 CHIMNEY CONSTRUCTION:

The chimney shall be constructed on the flat shoulder bearing surface of the cone using grade adjustment rings. The chimney shall be built to support the cast iron frame and cover adjusted to final surrounding grade. Height of the chimney shall be according to MAG Standard Detail 420-1.

2.07 STANDARD CITY CAST IRON FRAME AND COVER:

The cast iron frame and cover shall be supported by the chimney and shall not be installed directly on the cone. Contractor shall inform City if existing frame and/or cover is worn or damaged and shall obtain approval prior to replacing frame and cover.

2.08 GROUTS:

All grout or concrete applied to the manhole interior shall be acid resistant quick-setting non-shrink epoxy grouts, approved by the insert manufacturer and compatible with the polymer protective coating material and tested in accordance with ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

2.09 MARKING AND IDENTIFICATION:

A. Manhole insert shall be marked on both the interior and exterior with the following information:

1. Manufacturer's Company Name identification.
2. Date of Manufacture.
3. Manhole wall thickness.
4. Installation assist marks.

2.10 DELIVERY, STORAGE AND HANDLING

Contractor shall be responsible for any damage resulting from improper storage and/or handing. Damaged materials shall be replaced at no additional cost to the City.

A. Materials shall be handled in accordance with MAG 106.

B. Store all products according to manufacturer's recommendations until installation. Protect from construction traffic and damage.

C. During the loading, unloading, and storage, care should be taken to ensure that the manhole insert is not dropped or otherwise damaged.

D. The manhole insert should be stored on a smooth surface free of sharp objects.

E. Nylon or fabric slings should be used in conjunction with a spreader bar to lift or move the manhole.

F. UNDER NO CIRCUMSTANCES SHOULD CABLES OR CHAINS BE USED.

G. If the manhole insert is stored horizontally, the manhole insert should be placed in such a way as to avoid damage and braced.

PART 3 – EXECUTION

3.01 PROTECTION OF SITE:

Except as otherwise provided herein, the Contractor shall protect from damage all fences, structures, sidewalks, utilities, trees, shrubbery, lawns, etc., during the progress of this work. All debris and unused materials shall be removed immediately upon completion of the work. The site shall be restored as nearly as possible to its original condition, including the replacement, at the Contractor's sole expense, of any facility or landscaping which has been destroyed or damaged beyond restoration.

3.02 UTILITIES:

Unless otherwise indicated in Technical Specification Section 01550 – Contractor's Utilities, the Contractor shall arrange for and provide any required utilities at his sole cost and expense. This includes but is not limited to water for compaction or testing, power for operating any equipment along with personnel sanitation facilities.

3.03 CLEANING AND PREPARATION

A. The Contractor shall be responsible for all existing manhole cleaning and surface preparation according to Technical Specification Section 02760 – Sewer and Sewer Structure Cleaning. The Contractor shall notify the City of any irregularity, which may interfere with the proper installation of the manhole insert.

3.04 COMPOSITE INSERT

A. The manhole insert installed shall bond to or fit sufficiently tight to the existing manhole so as to eliminate water leakage into the manhole or allow water or vapors to leak out of the manhole through pin-holes or other defects. If infiltration or exfiltration leakage occurs, the Contractor shall seal these areas to stop all leakage using a material compatible with the insert material installed and as specified by the manufacturer. If leakage continues to occur, the Contractor shall remove and replace the insert at no additional cost to the City. All repair materials shall have the same estimated life expectancy as the insert installed. Final approval of the installation will be based on meeting the acceptance test requirements for each insert installed.

B. All existing manhole interior piping shall be removed prior to insert installation and bench protective coating application. Interior piping shall be reinstalled per project Design Drawings or as required by these contract Technical Specifications.

C. Flow from existing active service connections entering the manhole shall be plugged or diverted through by-passed pumping operation, if the flow affects proper installation.

D. Testing and warranty inspections shall be witnessed by the City or the City's Representative. Any defects found shall be repaired by the Contractor.

E. Compensation for all work required for providing test samples and independent laboratory testing shall be included in the in the Bid Proposal cost of the item contained.

3.05 INSTALLATION:

A. The Contractor shall install the manhole insert in accordance to approved manufacturer's techniques.

B. The insert shall be centered inside the existing manhole or as otherwise approved.

C. Contractor shall use an acid resistant polymer grout around circumference of the bench prior to lowering insert into position. The insert base section shall be installed into fresh grout to evenly support the weight of the insert and establish a gas tight seal. The polymer grout shall be compatible with insert material and approved for use by the insert manufacturer and compatible with the bench protective coating material. The bottom seal shall also prevent loss of annular space grout material installed between the outside of the insert and the interior wall of the existing manhole.

D. After placement of insert, Contractor shall complete installation of the protective coating of the manhole bench. As a minimum, Contractor shall raise manhole bench to the same elevation as the crown of the pipe as directed or shown in project Design Drawings. Manhole bench shall be sloped a minimum ¼-inch per foot to the channel. Minimum repair grout thickness shall be ¾-inch.

E. Where insert is installed using multiple barrel sections in lieu of a single piece barrel, apply a non-shrink epoxy putty or butyl mastic sealant approved by the manufacturer, to the joint of each barrel or cone section. Wipe excess material from the inside seam to provide a smooth finish.

F. Replace all existing manhole connections with the same inside diameter pipe. Sewer main and lateral connections in the existing manholes shall be extended through the insert with sealed watertight connections. Seal all penetrations through the insert with an acid resistant non-shrink polymer grout. Installation shall be in accordance with

Manufacturer's written instructions utilizing installation equipment approved for use by the Manufacturer.

G. Fill the annular space between the insert and the existing manhole wall with a Portland cement and sand grout mixture or hydrophobic grout. The grout backfill shall be placed in a maximum 12-inch lifts or as approved by the insert manufacturer structural engineer. Manufacturer's approved maximum lift shall be submitted to the City per Technical Specification Section 01300 – Submittals. Grout shall cure to provide a minimum compressive strength of 100 psi. The grout shall be consolidated without damage to the insert or connecting pipes.

H. Install the cone section (if applicable). after grouting the top bell section

3.06 CONE BACKFILL MATERIAL

Contractor shall backfill around the manhole cone and chimney with sand, crushed stone, pea gravel or aggregate base course (ABC) per MAG Section 701, unless directed otherwise and approved by the Engineer. The material chosen shall be free of large lumps or clods, which shall not readily break down under compaction.

Backfill shall be placed in layers of not more than twelve (12) loose measure inches and mechanically tamped to 95 percent Standard Proctor Density, unless otherwise approved by the City or City's Representative. Flooding or water jet compaction shall not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the manhole structure.

Contractor shall install grade rings and adjust height to surrounding elevation and slope. Pour a concrete collar around the manhole ring and cover after setting the proper height.

All damaged pavement shall be removed and replaced in kind with new pavement. In landscaped areas the surface shall be restored in kind. Any damaged irrigation facilities shall be repaired.

3.07 GROUTING:

Annular space grouting shall be done in accordance with manufacturer's requirements and as described in "Installation" procedures, and should meet the following minimum requirements:

Test Type	Results	Test Method
Density	4 lbs.	ASTM D-1622
Water Absorption (volume confined)	<1%	ASTM D-2842

Shear Strength	17.10 PSI	ASTM C-273
Tensile Strength	29.30 PSI	ASTM D-1623
Elongation	44%	ASTM D-1623
Viscosity	@ 500 CPS	
Chemical Emersion Testing	Excellent results	ASTM G20-88

The system should also use an accelerator to quicken the reaction time (30 minutes) where needed. All physical properties shall be expected to be detailed in submittals showing that they meet these Technical Specifications.

3.08 MANHOLE BENCH and CHANNEL RESTORATION

Manhole bench and channel shall be cleaned and coated as follows:

A. The manhole bench shall be grit blasted down to solid/sound substrate, followed by high pressure water blasting to remove any lose debris and adjust pH acidity to Neutral. Debris shields shall be used to prevent any dislodged material from entering the sewer system as per Technical Specification Section 02760 – Sewer Pipe and Sewer Structure Cleaning.

B. Manhole bench shall be rebuilt with non-shrink acid resistant grout as necessary to restore original dimensions in preparation for structural foundation of insert.

C. A polymer grout should then be applied to the circumference of the bench as necessary to manhole insert manufacturer’s recommended dimensions for structural foundation of insert to create a level bearing area and seal of the first insert barrel section installation.

D. Manhole channel shall be rebuilt with acid resistant polymer coating, as necessary, to dimensions consistent with existing incoming and outgoing pipe grades

E. After the manhole insert has been installed and base rebuilt, the entire bench and channel shall be coated with a protective acid-resistant coating to ensure the exposed manhole base/throat/channel have the similar acid resistance as the remainder of the rehabilitated manhole. The acid-resistant coating applied to the bench and channel shall extend a minimum of 6-inches up the manhole insert wall.

3.09 LATERALS AND CONNECTIONS:

Sewer main and lateral connections present in the existing manholes shall be extended through the insert wall with sealed watertight connections. Existing pipe diameters shall be maintained. Penetration installation shall be in accordance with insert manufacturer's

written instructions utilizing installation equipment approved for use by the manufacturer. Penetrations cut through the insert wall shall be made with tools capable of cutting circular shapes. Use of a carbide blade chop saw or other tools that cut a straight edge shaped is strictly prohibited. Penetrations through the insert shall be sealed with an approved non shrink, acid resistant polymer grout material approved by the insert manufacture.

3.10 PROTECTIVE BENCH COATING TESTING

Contractor shall perform spark test and pull test on applied coatings per Technical Specification Section 09710 – Concrete and Masonry Coatings.

3.11 ACCEPTANCE

As a condition precedent to Final Acceptance of the work, Contractor shall certify the proper installation and testing of material provided under this section. Certification shall warrant that materials and installation are free of defects and/or workmanship and suitable for trouble-free operation under the conditions set forth in these Technical Specifications.

3.12 RECORD DRAWINGS:

Prior to final payment, the Contractor shall provide a complete set of redlined Design Drawings showing the project as constructed including manhole insert depth, diameter, along with location and diameter of any insert penetrations and interior piping configurations. A spreadsheet and/or Design Drawings shall include all information required elsewhere in these Technical Specifications as well as any changes.

**** END OF SECTION ****

SECTION 13133
POLYPROPYLENE
GRADE ADJUSTING RINGS

PART 1 - GENERAL

1.01 SCOPE

This Technical Specification defines the materials required for the adjustment of grade of manhole structures to surrounding area finish final grade elevation or as shown on the project Design Drawings.

1.02 WORK REQUIRED

In areas approved by the City, grade adjustment rings meeting the requirements of this section shall be used to adjust and support the frame and cover to the final elevation on all project manholes.

1.03 SYSTEM DESCRIPTION

A. Design Requirements – The grade adjustment rings shall be designed to allow final adjustment of the frame and cover to the surrounding grade. The rings shall also be designed to accommodate flat or sloping surfaces to within ¼-inch (one quarter inch) of the final elevation. The grade adjustment system shall have a minimum 50 (fifty) year design life.

B. Performance Requirements – The grade adjustment rings shall be capable of supporting the minimum requirements of AASHTO H-20 and HS-20, be UV stable and be resistant to chemicals and corrosion commonly associated with the sanitary sewer environments.

1.04 SUBMITTALS

The following submittal shall be provided in accordance with Technical Specification Section 01300 – SUBMITTALS:

1. Test Report: A test report from an approved third party testing agency showing the grade adjustment rings meets the minimum requirements of ASSHTO H-20 and HS-20.

2. Certification: The manufacturer of the grade adjustment rings shall provide certification to the City stating that the product meets the design life and material requirements of this specification.

1.05 REFERENCES

This Technical Specification Section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the

requirements of this section and those of the listed documents, the requirements of this section shall prevail.

AASHTO Loading	American Association of State Highway and Transportation Officials - Anticipated external load to be placed on the pipe.
ASTM D3575	Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.
ASTM C920	Standard Specification for Elastomeric Joint Sealants

PART 2 - PRODUCTS

2.01 MANHOLE GRADE ADJUSTMENT RING

Manhole grade adjustment rings shall consist of a variety of heights (thicknesses), diameters and shapes all conforming to the following requirements:

A. The grade adjustment rings shall be manufactured from expanded polypropylene (EPP), black, meeting ASTM D3575. The rings shall be manufactured using a high compression molding process to produce a finished density of 120 g/l ((7.5 pcf).

B. “Grade” adjustment rings may contain either an upper and lower keyway (tongue and groove) for vertical alignment and/or an adhesive trench on the underside with a flat top.

C. “Finish” or “Flat” rings may either have a keyway (groove) on the underside for vertical alignment and/or an adhesive trench with a flat upper surface. These rings shall be available in heights (thicknesses) which will allow final adjustment of the frame and cover or grate to within ¼” (one quarter inch) of the specified final elevation.

   “Finish” rings may also have a keyway on the upper surface of the inner diameter to facilitate installation of an “Angle” ring.

D. “Angle” rings may either have an upper and lower keyway (tongue and groove) for vertical alignment and/or an adhesive trench on the underside. When required, the “Angle” ring or rings shall allow final adjustment of the frame and cover or grate to within ¼” (one quarter inch) of the specified final elevation.

2.02 APPROVED MANUFACTURER

1) Cretex Specialty Products Inc., N16 W23390 Stone Ridge Dr A, Waukesha, WI 53186 PRO-RING™
2) Approved Equal

2.03 EQUIPMENT

The contractor shall have the required tools and equipment necessary to facilitate proper installation of the grade adjustment rings.

2.04 ADHESIVE/SEALANT

A. Any adhesive or sealant used for watertight installation of the manhole grade adjustment rings shall be M-1 Structural Adhesive/Sealant or equal meeting ASTM C-920, Type S, Grade NS, Class 25, Uses NT, T, M, G, A and O.

B. Other adhesives or sealants may only be used with City's written authorization.

2.05 REPAIR MORTAR

Repair mortar shall be a one component, quick set, high strength, non-shrink; polymer modified cementitious patching mortar, which has been formulated for vertical or overhead use meeting the requirements of ASTM C-109 for Compressive Strength, C-348 and C-78 for Flexural Strength and C-882 for Slant Shear Bond Strength. Repair mortar shall not contain any chlorides, gypsums, plasters, iron particles, aluminum powder or gas-forming agents nor shall it promote the corrosion of any steel that it may come in contact with. Octocrete or approved equal.

Any repair mortar exposed to the environmentally corrosive environment of the manhole interior shall be coated with a vinyl ester polymer coating.

2.06 CEMENTITIOUS GROUT

Cementitious grout shall be a premixed, non-metallic, high strength, non-shrink grout which meets the requirements of ASTM C-191 and C-827 as well as CRD-C-588 and C-621. When mixed to a mortar or "plastic" consistency, it shall have minimum one day and 28 day compressive strength of 6,000 and 9,000 psi, respectively. Commercial Grade Quikrete Non-Shrink General Purpose Grout, Penn Grout, or approved equal.

Any cementitious grout exposed to the environmentally corrosive environment of the manhole interior shall be coated with a vinyl ester polymer coating per Technical Specification Section 09710 – Concrete and Masonry Coating.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation and surface preparation shall be in accordance with the grade ring manufacturer's instructions.

B. The joint between the first grade ring and top of the manhole shall be sealed using an adhesive/sealant meeting the requirements of paragraph 2.03.

C. If the top of the manhole structure is not level or is irregular, then a non-shrink repair mortar meeting the requirements of Section 2.04 or non-shrink cementitious grout meeting the requirements of Section 2.05 shall be used. A bed of the specified mortar or grout shall be placed on the top surface of the utility structure and then the first grade ring shall be embedded and leveled into the bed of material.

D. The remaining joints between all manhole adjustment rings and the frame and cover or grate shall be sealed using an adhesive/sealant meeting the requirements of Section 2.03.

E. No other materials shall be used in the construction of the grade adjustment area beyond those specified above. Prohibited materials include, but are not limited to wood or wood shims of any kind, concrete, brick, block, stones, etc.

**** END OF SECTION ****