




dallas **water** utilities  
city of dallas

# **STANDARD TECHNICAL SPECIFICATIONS FOR WATER & WASTEWATER CONSTRUCTION**



**October. 2017**

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## PREFACE

### PART 1: ACKNOWLEDGMENTS

This manual replaces second edition of Standard Technical Specifications for Water & Wastewater Construction Manual by Dallas Water Utilities (DWU) dated August, 2014. The chronological list of events in developing the DWU manual is summarized as follows:

- AUG, 2011:** Compilation of various standard specifications into first edition of the manual.
- AUG, 2014:** Revision of 2011 manual to include additional specifications on various water and wastewater trenchless technologies and rehabilitation methods.
- OCT, 2017:** Revision of 2014 manual to include additional sections and updates on various water/wastewater appurtenances, procedures and rehabilitation methods.

### PART 2: BACKGROUND

The intent of this manual is to provide standard technical specifications for various commonly used items which may not be covered in details under the latest editions of Public Works Construction Standards by North Central Texas Council of Governments (NCTCOG), City of Dallas Addendum to NCTCOG and Standard Drawings for Water & Wastewater Construction by Dallas Water Utilities (DWU).

This technical resource is not intended to substitute for any professional engineering judgment by the designer. Any appropriate modifications shall be incorporated into the contract document upon approval by Owner. Unless otherwise specified in the contract document, this manual shall be used by the Contractor in the construction of water and wastewater mains owned and operated by DWU. In case of conflict between contract documents, priority of interpretation shall be in the following order:

- Project Plans & Specifications
- DWU Standard Technical Specifications for Water and Wastewater Construction, Latest Edition
- DWU Standard Drawings for Water & Wastewater Construction, Latest Edition
- City of Dallas Addendum to NCTCOG, Latest Edition
- Public Works Construction Standards by NCTCOG, Latest Edition

Official approved materials for water distribution and wastewater collection systems are available on the internet, as well as this manual, at: [http://dallascityhall.com/departments/waterutilities/Pages/dwu\\_design\\_standards.aspx](http://dallascityhall.com/departments/waterutilities/Pages/dwu_design_standards.aspx). Unless otherwise specified in the project plans and/or specifications, these materials can be considered by the Contractor contingent upon approval by the Owner.

This manual is written by Engineering Services, Dallas Water Utilities. Any questions or suggestions regarding this manual should be forwarded to Engineering Services, Dallas Water Utilities.

**SECTION 1.1**  
**SAMPLE BID**

ITEM NO.	QUAN-TITY	UNIT	DESRPTION AND PRICE IN WORDS	UNIT PRICE	TOTAL AMOUNT
3550	2	EA	Removal of Internal Obstruction in Existing 6" Wastewater main, complete in place, the sum of  <u>One Thousand</u> DOLLARS  and <u>No</u> CENTS per each	1,000.00	2,000.00
3551	2	EA	Removal of Internal Obstruction in Existing 8" Wastewater main, complete in place, the sum of  <u>Fifteen Hundred</u> DOLLARS  and <u>No</u> CENTS per each	1,500.00	3,000.00
3560	4	EA	Furnish and place Connection to Existing Manhole, complete in place, the sum of  <u>One Thousand Five Hundred</u> DOLLARS  and <u>Ten</u> CENTS per each	1,500.10	6,000.40

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**THIS PAGE TO BE USED AS AN EXAMPLE FOR COMPLETING PROPOSAL PAGES**

**NOTE:** The Contractor's Unit Price In Words, Unit Price In Numbers And Total Amount Must Be Shown For Each Bid Item

## SECTION 1.2

### TECHNICAL SPECIFICATION FOR SUBMITTALS

#### PART 1: GENERAL

##### 1.1 Data Required

The Contractor shall furnish engineering data covering all materials and equipment in the contract. The data should be prepared and transmitted promptly following execution of the general contract. Delays due to failure to provide timely submittal will not result in a time extension.

##### 1.2 Type of Data

As applicable, the following types of data will be required:

- Fabrication, Erection/ Placement Details:
  - Laying plans for large diameter pipelines
  - Drawings, lists and schedules for special structures
- Outline, Dimension, Assembly and Installation Drawings
  - Terminal connection diagrams for all electrical power and lighting, and for all types of instrumentation and control circuits.
- Catalog Sheets with clearly indicating items to be used
- Specification Sheets
- Written Statements or Certifications
- Laboratory, Shop or Mill Test Reports
- Basis of Design and Design Calculations
- Experience and Facilities Brochures.
- Samples
- Parts Lists
- Instruction and Maintenance Manuals



**1.3 Information to be Included:**

All data needed to determine the following facts shall be submitted:

- 1.3.1 Conformance to specifications, including: kind, type, size, arrangement, finishes, and operation of component materials, and devices.
- 1.3.2 Conformance to plans, including: dimensions, orientation, appearance, external connections and anchorages, installation clearances.
- 1.3.3 Specific purpose or design conditions and adequacy to meet same: weights, dynamic, loads, supports required, operating characteristics.
- 1.3.4 Coordination with other work, including: items needed by this trade, but furnished by others, and information needed by others to perform their part.
- 1.3.5 Exceptions to or deviations from specified requirements if any, and reasons for same.
- 1.3.6 Delivery Date:
- This should be stated as a firm date of delivery, not measured from approval of drawings to date of shipping. For this purpose the time taken by the Owner to process data may be taken as not exceeding ten (10) working days. However, the Owner does not assume responsibility for correctness or completeness of the data.
  - The Contractor should determine that proposed delivery dates will not cause delay or result in failure to complete the project on time.
  - No extension of time or waiver of liquidated damages will be granted due to failure to deliver on time unless the Contractor presents written evidence approved by the Owner that favorable delivery is not obtainable for an acceptable item.
  - Such evidence will be considered as a basis for extension of time only when presented promptly after award of contract and approved by the Owner.

## **PART 2: SUBMITTAL APPROVAL PROCESS**

### **2.1 Routing of Submittal**

Approval data and routine correspondence should be routed as follows:

- Contractor to Owner (5 copies)
  - DWU Project Manager to Designer
  - DWU Project Manager to Operation Divisions (Distribution and Wastewater Collection Divisions)
- Owner to Contractor (2 copies)
  - DWU Project Manager to Contractor

### **2.2 Address for Communications**

DWU Project Manager  
Dallas Water Utilities  
2121 Main Street, Suite 300  
Dallas, Texas 75201

### **2.3 Checking and Review of Data Approval**

- The Contractor should check all data for correctness and completeness. He will note any exceptions or discrepancies to be approved or verified by the Owner.
- The Owner will review the data for general conformity to the plans and specifications. He will comment on items called to his attention for approval or verification. Approvals will be based on this review and do not constitute a blanket approval of substance, fit or function.
- The Owner Engineer may at his discretion check dimensions, samples and details as a service as needed. Any discrepancies found thus will be noted for verification by the Contractor.

## 2.4 Disposition of Data Approval

The typical disposition of data approval by the Owner is as follows:

- **No Exception Taken:**

Data that is approved without correction or with only insignificant corrections will be checked as “**No Exception Taken**” and distributed for fabrication and/or construction.

- **Make Correction as Noted:**

Data generally meeting contract requirements but requiring minor changes or corrections, will be checked as “**Make Corrections as Noted**” or as noted by letter and returned for revision. When revised, the data will be stamped and distributed for construction.

- **Revise and Resubmit:**

Data that contains substantial errors or omissions or which is not clearly legible will be checked as “**Revise and Resubmit**” and will be returned for corrected material. Such data may be also returned unchecked.

- **Rejected:**

Data that does not conform to the plans or meet the specifications or fully equal the DWU established standard will be “**Rejected**”.

## 2.5 Data for Construction

- Only data bearing the Owner’s mark of approval shall be kept or used at any work site.

**\*\*END OF SECTION\*\***

## SECTION 1.3

### TECHNICAL SPECIFICATION FOR “APPROVED EQUAL”

Contractor wishing to propose an alternative item in lieu of any item as specified in the contract document shall provide appropriate submittal to Owner for review and approval. An alternative material proposed by the Contractor may be considered as “an approved” under the following criteria:

1. The material has physical characteristics substantially similar to the existing approved material. These physical characteristics include but are not limited to:
  - Size and shape (where appropriate)
  - Thickness (where appropriate)
  - Compressive Strength (as good or better)
  - Tensile Strength (as good or better)
  - Shear/Strain (as good or better)
  - Cohesiveness
  - Other properties as defined by the use of the product

**And**

2. All applicable ASTM/AWWA/NSF Standards are met (and can be verified by certified independent laboratories located within the United States or Canada).

**And**

3. The material has the same or better long term maintenance requirements as the existing approved product.

**And**

4. DWU Operations groups can maintain the proposed product with existing equipment and processes. No new special equipment or additional purchases are needed.

All request for “Approved Equal” must be sent through Owner and include the necessary product information as outlined in Section 1.2 Technical Specification for Submittals. The Owner must provide a written confirmation that the requested material in “Approve Equal” before the Contractor has the authorization to use it in the project.

**\*\*END OF SECTION\*\***

## SECTION 1.4

### TECHNICAL SPECIFICATION FOR PROJECT PARTNERING

#### PART 1: GENERAL

##### 1.1 Scope

The Contractor is to participate in the ongoing "project partnering" along with the Owner prior to initiation of project construction. Partnering will be effective only if all parties willingly and enthusiastically enter into this cooperative arrangement which is supported by each entity at the highest level in their organizations. Partnering is considered important to the overall success of this project by both the Engineer and the Owner. It is desired that the Contractor will be equally concerned with quality, performance, budget and schedule and will endorse and adopt partnering as an effective tool for achieving these objectives. This is a requirement of the Contract Documents, and the Contractor shall include all costs associated with this item in his bid.

#### PART 2: EXECUTION

##### 2.1 Requirements

2.2.1 It must be recognized that the Owner, Contractor and Engineer all hold in common the goal of successful completion of this project. Success necessarily must include the following requirements:

- Construction that meets the project performance standards as defined in the Drawings and Technical Specifications.
- Completion of this project on schedule.
- Conformance to budgetary requirements and limitations.
- Recognize that safety, profit, liability limitation, avoidance of litigation, reputation, goodwill and other factors are of significant importance to all parties involved in the project. These goals can be achieved most readily, if the Contractor, Owner and Engineer join together in a mutually beneficial alliance which recognizes the issues that each considers of greatest importance and work to accomplish them.

2.2.2 Through partnering, the three parties will agree among themselves regarding the primary goals for the project and the methods that will be used to accomplish them. This will require development of a trust relationship, not an adversarial one, among these parties who will be working closely and cooperatively for the duration of the

- project. Commitment, communication and conflict resolution must be of highest importance for this relationship to succeed. The parties will mutually develop a communication framework and a conflict-resolution system to be used throughout the project.
- 2.2.3 The Contractor should include his major subcontractors and suppliers in partnering, so these participants may "buy-into" the concept and work cooperatively with other parties on the project.
- 2.2.4 Partnering will include an initial one-day workshop in which the basic requirements for the partnering relationship will be established. The following persons will be expected to attend the workshop, at a minimum:
- **Contractor**
    - Project Sponsor (Principal-In-Charge)
    - Superintendent
    - Foreman
    - Representatives of each subcontractor on the project (with their individual respective schedules and a copy of construction drawings for the project.)
  - **Owner**
    - DWU Project Manager
    - DWU Construction Field Manager(s)
    - DWU Construction Superintendent(s)
    - DWU Inspector(s)
    - City of Dallas Storm Water Management Inspector(s)
  - **Engineer**
    - Consulting Engineer(s)
    - In-House Design Engineer(s)
- 2.2.5 The one-day partnering workshop will be held within thirty (30) days of the Notice to Proceed, at a time and date agreed upon by all parties and at neutral location within the City of Dallas which is away from each entity's home office and/or field facilities.
- 2.2.6 Partnering will become a part of every meeting and will be advertised and endorsed by development of a partnering logo, including the names of the Contractor,

Engineer, and Owner. It is an important goal that everyone on the job, including tradesmen, laborers, suppliers and staff, will become enthusiastic supporters of, and participants in partnering.

- 2.2.7 Quarterly half-day partnering sessions, also may be held throughout the project in order to confirm the relationship and assure the partnering effort continues to be successful. In this manner, it can best be assured that the Contractor, Owner, and Engineer all will enjoy a win-win-win relationship throughout the project. The costs associated with a partnering facilitator will be included in the Contractor's lump sum bid for the project. The anticipated costs of the partnering facilitator include facilitator labor cost, travel and lodging expenses, meeting room rental, food and reproduction costs. The Contractor shall also pay all costs (including travel and lodging) associated with its own personnel, subcontractors and suppliers participating in partnering at no additional cost or time extension to the Owner.

### **PART 3: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 1.5

### TECHNICAL SPECIFICATION FOR PRE AND POST CONSTRUCTION VIDEO OF PROJECT SITE

#### PART 1 GENERAL

##### 1.1 Scope of Work:

Furnish all necessary labor, materials, and equipment to perform color audio-video recording of the pre- and post-construction project site surfaces as specified herein. Contractor shall furnish to the Owner an original copy of the continuous color audio-video DVD recordings of each project segment.

The owner reserves the right to reject the audio-video DVDs because of poor quality, unintelligible audio or uncontrolled pan or zoom. Any videos rejected by the Owner shall be re-videoed at no additional cost to the Owner. The Contractor shall submit one (1) DVD to the Owner for format and content approval prior to the start of any work.

##### 1.2 Purpose of Work:

The purpose of the color audio-video taping of the project is to provide the necessary information for restoration of surface features after completion of the project. The contractor shall be responsible for repairing any damage(s) or defect(s) not documented as existing prior to construction.

#### PART 2 QUALITY ASSURANCE

The video recordings shall be performed by a qualified audio-video taping firm or individual knowledgeable in construction practices and experienced in the implementation of established inspection procedures. The minimum qualification of a videographer shall be as follows:

- Videographer shall be a firm or an individual of established reputation who has been regularly engaged as professional photographer for not less than three (3) years.
- The videographer must have had previous experience video documenting a minimum of ten (10) miles of preconstruction work.
- Any apprentice videographer must be continuously supervised by an above described experienced videographer.



**PART 3 EXECUTION**

Ten (10) days prior to the commencement of any construction, equipment or material mobilization, the Contractor shall perform an audio-video survey of each project site area which will be excavated or which has the potential to be disturbed by the Contractor’s operations. The Contractor shall also perform an audio video survey of each project site after all construction work and site restoration is completed. Specific areas of this project include, but are not limited to:

- All areas to be entered by vehicles or equipment, including construction areas for both internal and excavated improvements.
- Areas requiring utility work.
- Paved and unpaved areas which will be entered by vehicles or equipment.
- Other areas that may be impacted by the work, including work staging areas and field offices, as directed by the Owner.

The Contractor shall be responsible for the timely execution of the pre and post construction audio-video survey, its vantage points, and quality. The contractor shall cooperate with the videographer’s work and provide reasonable auxiliary services as requested, including access and use of temporary facilities including temporary lighting.

Submitted DVDs shall be reviewed and approved by the Owner within five (5) days of submittal of a satisfactory survey. Should the DVD not provide adequate coverage to fully illustrate the physical condition of the work area or not be in compliance with the specifications, project areas shall be resurveyed prior to the initiation of construction at the project sites, with no additional cost to the Owner.

The Contractor shall provide one (1) copy for each pre and post construction phases; labeled on the DVD and jewel case cover as follows:

**Face of DVD & Case Cover**

**(PRE) OR (POST) CONSTRUCTION AUDIO-VIDEO SURVEY**

**Contract No.** \_\_\_\_\_ **Project Title:** \_\_\_\_\_

**Contractor:** \_\_\_\_\_ **DVD No.** \_\_\_\_\_

**Date Televised (MM/YY)** \_\_\_\_\_ **Date Submitted** \_\_\_\_\_

**Inside of Case Cover**

<b>Project Segment No.</b>	<b>Street, Address/Location</b>	<b>Starting Video Counter No.</b>

The video portion of the recordings shall produce bright, sharp clear pictures with accurate colors and shall be free from distortion, tearing, rolls, or any other form of picture imperfection. The audio portion of the recordings shall reproduce precise and concise explanatory notes by the camera operator with proper volume, clarity and freedom from distortion.

The recorder shall record the color signal with a minimum vertical resolution of 400 lines and a minimum horizontal resolution of 700 lines at the center.

To preclude the possibility of tampering or editing the DVD shall display continuous digital information including the following:

- Date and time of the recordings; date information will contain the month, day and year; time information will contain hours, minutes and seconds, separated by colons.
- The engineering stationing corresponding to the stationing on the contract documents, or as directed by the Owner.

Digital information shall appear at the bottom of the viewing screen and in no way interfere with the video portion of the recordings.

At the start of each video recording segment, an identification summary shall be read into the record simultaneously with a wide-angle view with digital information. The identification summary shall include the following:

- PID number
- Contract number
- Contractor’s name

- Date and time
- General location and name of street
- Weather
- Direction of travel and viewing direction

The recordings shall include the coverage of all surface and other site features located in areas to be affected by the Work, extending to a minimum of 15 feet outside the actual right of way (street, construction, etc.). The surface features recorded shall include, but not be limited to, roadways, driveways, sidewalks, curbs, culverts, headwalls, retaining walls, buildings, above-ground utilities, parks, lawns, landscaping, trees, tree canopies, shrubbery and fences. The area of coverage shall extend to 50 feet from the proposed work site but shall also include all unpaved areas and access routes where vehicles or equipment will pass.

Video recordings may be ordered outside of the area of coverage in order to establish those features deemed necessary by the Owner.

The rate of travel for the video recordings shall be determined by the number, size, and value of the surface and other site features within the construction area of coverage so as to produce a clear, detailed view of each feature accompanied by audio comments. At no time shall the rate of travel exceed 264 feet per minute. Forward motion of the camera shall be halted when viewing objects or structures outside the limits of the street or easement being documented.

The videographer shall pan and zoom in and out at a reasonable rate so as to control sufficiently the clarity of object being viewed.

When recording in right-of-ways, the camera shall be mounted on a steady base. Horizontal and vertical shots shall be made from the base, in order to insure proper perspective. The distance from the camera lens to the ground shall be no more than 12 feet. If not accessible by motorized vehicle, height shall be determined by the distance from ground to shoulder height of the camera operator. Contractor shall furnish all auxiliary lighting as required to produce a quality recording. At no time will the Contractor be allowed to use any electrical circuits within a building on private properties.

All video recording shall be performed during regular business hours, unless otherwise approved by the Owner. No video recording shall be performed if the weather is not acceptable, such as rain, fog, or elongated shadows that distort perception and tend to prevent clear resolution.

The videographer shall retain the original unedited video DVD for five (5) years after the date of final acceptance. During this period, the photographer shall fill orders by the Engineer for extra copies of DVD priced at prevailing local commercial rates.

**PART 4 METHOD OF MEASUREMENT AND PAYMENT**

No measurement or direct payment will be made for pre and post construction videos.

**\*\*END OF SECTION\*\***

## SECTION 2.1

### TECHNICAL SPECIFICATIONS FOR FUSIBLE POLYVINYL CHLORIDE (PVC) WATER/WASTEWATER PIPE

#### PART 1: GENERAL

##### 1.1 Scope of Work

This section specifies fusible polyvinyl chloride (PVC) pipe, including standards for dimensionality, testing, quality, acceptable fusion practice, safe handling and storage.

##### 1.2 Pipe Description

Pipe supplier shall furnish fusible PVC pipe as manufactured by Underground Solutions, Inc. or approved equal conforming to all standards and procedures, and meeting all testing and material properties as described in this specification.

#### PART 2 QUALITY ASSURANCE

##### 2.1 References

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ANSI/AWWA C110/A21.10	American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
ANSI/AWWA C111/A21.11	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100mm Through 300mm), for Water Distribution

AWWA C905	Standard for Polyvinyl Chloride (PVC Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350mm Through 1200mm), for Water Distribution and Transmission
AWWA M23	AWWA Manual of Supply Practices PVC Pipe-Design and Installation, Second Edition
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D1784	Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
ASTM D1785	Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2152	Test Method for Degree of Fusion of Extruded Poly vinyl Chloride (PVC) Pipe and Molded Fittings by Acetone Immersion
ASTM D2241	Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR)
ASTM D2665	Polyvinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F1057	Standard Practice for Estimating the Quality of Extruded Polyvinyl Chloride (PVC) Pipe by the Heat Reversion Technique
ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
UNI-PUB-08	Tapping Guide for PVC Pressure Pipe
NSF-14	Plastics Piping System Components and Related Materials
NSF-61	Drinking Water System Components--Health Effects
PPI TR-2	PVC Range Composition Listing of Qualified Ingredients

## 2.2 **Manufacturer Requirements**

- All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.
- Fusible PVC pipe shall be tested at the extrusion facility for properties required to meet all applicable parameters as outlined in AWWA C900, AWWA C905, and applicable sections of ASTM D2241. Testing priority shall be in conformance with AWWA C900 and AWWA C905.

## 2.3 **Fusion Technician Requirements**

- Fusion Technician shall be fully qualified by the pipe manufacturer to install fusible PVC pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

## 2.4 **Warranty**

- A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the fusing contractor shall provide in writing a warranty for a period of one year for all the fusion joints, including formation, installation, and pressure testing.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the contract.

## 2.5 **Pre-Construction Submittals**

The following product data is required from the pipe supplier and/or fusion provider:

- Name of pipe manufacturer
- Pipe diameter
- Dimension Ratio (DR 14 or as per plans)
- Pressure Class per applicable standards
- Color
- Confirmation/ Recommended minimum bending radius
- Confirmation/ Recommended maximum safe pull force
- Fusion technician qualification indicating conformance with this specification

## 2.6 **Post –Construction Submittals**

The following as-recorded data is required from the contractor and/or fusion provider to the owner or pipe supplier upon request:

- Approved data logger device reports
- Fusion joint documentation containing the following information:
  - Pipe diameter and thickness
  - Machine diameter
  - Fusion technician identification
  - Job identification
  - Fusion joint number
  - Fusion, heating, and drag pressure settings
  - Heat plate temperature
  - Time stamp
  - Heating and cool down time of fusion
  - Ambient temperature



## PART 3 PRODUCTS

### 3.1 Fusible PVC Pressure Pipe for Potable Water

- Fusible PVC pipe shall conform to AWWA C900, AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.
- Pipe shall be manufactured with 100% virgin resin. Pipe shall also have 0% recycled plastics content, and shall not consist of any rework compound, even that obtained from the manufacturer's own production using the same formulation.
- Fusible PVC pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
- Fusible PVC pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified in the plans.
- Fusible PVC pipe shall be blue in color for potable water use.
- Pipe shall be marked as follows:
  - Nominal pipe size
  - PVC
  - Dimension Ratio (DR), Standard Dimension Ratio (SDR), or Schedule
  - AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
  - AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
  - NSF-61 mark verifying suitability for potable water service
  - Extrusion production-record code
  - Trademark or trade name
  - Cell Classification 12454 and/or PVC material code 1120 may also be included
  - Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

### 3.2 Fusible PVC Pressure Pipe for Wastewater Not Conforming to AWWA C905 Dimensionality

- Fusible PVC pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable. Testing shall be in accordance with the referenced AWWA standard.
- Fusible PVC pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or spigot of any kind incorporated into the pipe.
- Fusible PVC pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
- Fusible PVC pipe shall be green in color for wastewater use.
- Pipe shall be marked as follows:
  - Nominal pipe size
  - PVC
  - Dimension Ratio (DR), Standard Dimension Ratio (SDR), or Schedule
  - AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
  - AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
  - Extrusion production-record code
  - Trademark or trade name
  - Cell Classification 12454 and/or PVC material code 1120 may also be included
  - Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

### 3.3 Fusible PVC Pressure Pipe for Wastewater Conforming to AWWA C905 Dimensionality

- Fusible PVC pipe shall conform to AWWA C905 standard.
- Fusible PVC pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
- Fusible PVC pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
- Fusible PVC pipe shall be green in color for wastewater use.

- Pipe shall be marked as follows:
  - Nominal pipe size
  - PVC
  - Dimension Ratio (DR), Standard Dimension Ratio (SDR), or Schedule
  - AWWA pressure class
  - AWWA standard designation number
  - Extrusion production-record code
  - Trademark or trade name
  - Cell Classification 12454 and/or PVC material code 1120 may also be included
  - Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

### **3.4 Fusion Joints**

Unless otherwise specified, fusible PVC pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

### **3.5 Connection and Fittings for Pressure Applications**

#### **3.5.1 Connection:**

Connections shall be defined in conjunction with the coupling of project piping, as well as the tie-ins to other piping systems.

#### **3.5.2 Ductile Iron Mechanical and Flanged Fittings**

Acceptable fittings for use with fusible PVC pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.

- Connections to fusible PVC pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.
- Bends, tees and other ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.
- Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

### 3.5.3 Sleeve-Type Couplings

- Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe, and may be restrained or unrestrained as necessary.
- Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

### 3.5.4 Expansion and Flexible Couplings

- Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as necessary.
- Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

### 3.5.5 Connection Hardware

- Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

## 3.6 **Connections for Gravity Sanitary Sewer and Non-Pressure Applications**

The following connections are to be used in conjunction with tie-ins to other non-pressure, gravity sewer piping and/or structures, and shall be as indicated in the construction documents.

### 3.6.1 PVC Gasketed, Push-On Couplings

- Acceptable couplings for joining fusible PVC pipe to other sections of fusible PVC pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings as necessary.
- PVC gasketed, push-on fittings and/or restraint hardware must be installed per the manufacturer's guidelines.

### 3.6.2 Sleeve-Type Couplings

Sleeve-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as necessary.

### 3.6.3 Expansion and Flexible Couplings

Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as necessary.

### 3.6.4 Connection Hardware

Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

### 3.6.5 Connection to Sanitary Sewer Manholes and Structures

- Fusible PVC pipe shall be connected to manholes and other structures to provide a leak-free, properly graded flow into or out of the manhole or structure.
- Connections to existing manholes and structures shall be as indicated in the construction documents.
  - For a cored or drilled opening provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
  - For a knock out opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
  - Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening. Provide flexible pipe joint or flexible connector within 2 feet of the collar.
- Connections to a new manhole or structure shall be as indicated in the construction documents.
  - A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast manhole and structures.
  - Drop connections shall be required where shown on drawings.
  - Grout internal joint space with non-shrink grout.

**3.7 Maximum Allowable Pull-in Force**

Adhere to the following data regarding maximum allowable pull-in force for fusible PVC pipe used for trenchless application. The confirmation of proposed radius of each bore has to be part of the required submittal prior to construction.

Pipe Diameter (in)	Dimension Ratio (DR)	Max. Working Pressure (psi)	DIPS Series			
			Pipe O.D. (in)	Min. Wall (in)	Pipe I.D. (in)	Max. Pull-in Force (lbs.)
4	14	305	4.80	0.34	4.07	13,400
6	14	305	6.90	0.49	5.85	27,700
8	14	305	9.05	0.65	7.68	47,700
10	14	305	11.10	0.79	9.42	71,800
12	14	305	13.20	0.94	11.20	101,600

**3.8 Minimum Bending Radius**

Adhere to the following data regarding radius of curvature for fusible PVC pipe used for trenchless application. The confirmation of proposed radius of each bore has to be part of the required submittal prior to construction.

Pipe Diameter (in)	DIPS Series	
	Critical Buckling Pressure (lbs.)	Minimum Allowable Bending (ft.)
4	426	100
6	426	144
8	425	189
10	426	231
12	426	275

In any case, the deflection radius must not exceed 75% of the maximum allowable curvature allowed for standard C-900 PVC pipe.

## **PART 4 EXECUTION**

### **4.1 Delivery and Off-Loading**

- All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.
- Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify owner or engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.
- Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.
- Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
- During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.
- If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to insure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

### **4.2 Handling and Storage**

- Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the owner or engineer.
- Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.
- Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
- Pipe shall be handled and supported with the use of woven fiber pipe slings or

approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.

- If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
- Pipe shall be stored and stacked per the pipe supplier's guidelines.

### 4.3 Fusion Process

#### 4.3.1 General

4.3.1.1 Fusible PVC pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.

4.3.1.2 Fusible polyvinylchloride pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.

4.3.1.3 Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.

4.3.1.4 Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

- Heat Plate - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
- Carriage – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
- General Machine - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
- Data Logging Device – An approved data logging device with the current version of the pipe supplier's recommended and compatible software shall be used. Data logging device operations and maintenance manual shall be with the unit at



all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

4.3.1.5 Other equipment specifically required for the fusion process shall include the following:

- Pipe rollers shall be used for support of pipe to either side of the machine
- A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.
- An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
- Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
- Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

4.3.2 Joint Recording

Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

**4.4 General Installation**

- Installation guidelines from the pipe supplier shall be followed for all installations.
- The fusible PVC pipe will be installed in a manner so as not to exceed the recommended bending radius.
- Where fusible PVC pipe is installed by pulling in tension, the recommended Safe Pulling Force established by the pipe supplier shall not be exceeded.

**4.5 Preparation Prior to Making Connections Into Existing Piping Systems**

Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:

- Field verify location, size, piping material, and piping system of the existing pipe.

- Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
- Have installed all temporary pumps and/or pipes in accordance with established connection plans.
- Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

#### **4.6 Pipe System Connections**

Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

#### **4.7 Tapping for Potable and Non-Potable Water Applications**

- Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. **NO DIRECT TAPPING WILL BE PERMITTED.** Tapping shall be performed in accordance with the applicable sections for saddle tapping as per "Uni-Pub-8: Tapping Guide for PVC Pressure Pipe by Uni-Bell PVC Pipe Association".
- All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.
- Equipment used for tapping shall be made specifically for tapping PVC pipe:
  - Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
  - Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap,) or when the pipeline is not filled with water and not under pressure ('dry' tap).

#### **4.8 Testing**

Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

##### **4.8.1 Hydrostatic Testing and Leakage Testing for Pressure Piping**

All hydrostatic and leakage testing shall be in accordance to Sec 506.5 COD (Hydrostatic Test) as specified in City of Dallas Addendum to the North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards, Latest Edition.

##### **4.8.2 Deflection Testing for Non-Pressure Piping**

- After completion of the backfill, the engineer or owner may require that a deflection test be performed.
- Deflection tests should be conducted using a go/no-go mandrel. The mandrel's outside dimension shall be sized to permit no more than 7.5 percent deflection. The percent deflection shall be established from the base inside diameter of the pipe. If the internal beading of the fused joints for the pipe is not required to be removed, the mandrel shall account for this clearance as well. The mandrel shall be approved by the owner or engineer prior to use. Lines that permit safe entry may allow other deflection test options, such as direct measurements.

#### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 2.2

### TECHNICAL SPECIFICATION FOR RESTRAINED JOINT POLYVINYLCHLORIDE (PVC) WATER PIPE

#### PART 1: GENERAL

##### 1.1 Scope of Work

This specification covers restrained joint polyvinyl chloride (PVC) Pipe to be used for pressure-rated potable water distribution system.

##### 1.2 Pipe Description

Pipe supplier shall furnish restrained joint PVC pipe as manufactured by CertainTeed Corporation, or approved equal conforming to all standards and procedures, and meeting all testing and material properties as described in this specification.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM D 1784	Standard Specification for Rigid PVC Compounds and Chlorinated PVC Compounds
ASTM D 2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM F 477	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
AWWA C900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 12 In. (100 mm through 300 mm), for Water Distribution
NSF 61	Drinking Water System Components – Health Effects

## 2.2 Warranty

- A one-year warranty for the pipe shall be provided from the Contractor and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the contract.

## 2.3 Pre-Construction Submittals

The following product data is required from the pipe supplier identifying or verifying following items:

- Name of pipe manufacturer
- Pipe diameter
- Dimension Ratio (DR) of 14 or as per plans
- Pressure Class per applicable standards
- Color
- Confirmation/ Recommended minimum bending radius
- Confirmation/ Recommended maximum safe pull force

## PART 3: PRODUCTS

### 3.1 Pipe

- The pipe material must meet AWWA C900 standards for PVC pressure pipe and fittings with a dimension ratio of DR14. PVC pipe that is intended for use as a casing pipe may have the dimension ratio of 18.
- Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D 1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4 degrees F, in accordance with the requirements of ASTM D 2837. Restrained joint water pipe shall carry the UL1285 listing.
- Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading.
- Cut exposed splines 3/4" from coupling to reduce soil drag.

- Couplings shall be beveled as part of the manufacturing process on the leading edges so as to minimize soil friction.

### 3.2 Maximum Allowable Pull-in Force

Adhere to, using Certa-Lok C900/RJ pipe or approved equal, the pipe manufacturer's most current data regarding tensile load limitations for trenchless application. Generally, the maximum pull in force must not exceed the following values.

Pipe Dia. (in)	Dimension Ratio (DR)	Max. Working Pressure (psi)	Pipe O.D. (in)	Coupling O.D. (in)	Max. Pull-in Force Tightest (Bending) (lbs.)	Max. Pull-in Force Straight (No Bending) (lbs.)
4	14	305	4.800	5.964	8,000	10,300
6	14	305	6.900	8.366	9,300	14,700
8	14	305	9.050	10.947	18,900	28,800
10	14	305	11.100	13.361	24,900	38,300
12	14	305	13.200	15.836	28,300	48,300

### 3.3 Minimum Bending Radius

Adhere to the following data regarding radius of curvature for Certa-Lok C900/RJ pipe used for trenchless application. The confirmation of proposed radius of each bore has to be part of the required submittal prior to work.

Pipe Diameter (in)	Minimum Radius of Curvature (ft.)	Change in Pitch per 10 ft. (%)
4	100	10.0
6	150	6.7
8	200	5.0
10	250	4.0
12	375	3.3

In any case, the deflection radius must not exceed 75% of the maximum allowable curvature allowed for standard C-900 PVC pipe.

## **PART 4: REQUIREMENTS**

### **4.1 General**

Products delivered under this specification shall be manufactured only from new water distribution pipe and couplings conforming to AWWA C900. The restrained joint pipe system shall also meet all short and long term pressure test requirements of AWWA C900. Pipe, couplings, and locking splines shall be completely non-metallic to eliminate corrosion problems.

### **4.2 Materials**

Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D 1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D 2837.

### **4.3 Approvals**

Restrained joint PVC pipe products shall be tested by an independent third party laboratory for continuous use at rated pressures. Copies of agency approval reports or product listings shall be provided to the Owner. Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF 61 by an acceptable certifying organization.

### **4.4 Dimensions**

Nominal outside diameters and wall thicknesses of restrained joint pipe shall conform to the requirements of AWWA C900. Unless otherwise specified on the plans restrained joint pipe shall be furnished in 4", 6", 8", 10" and 12" sizes Class 305 (DR14). Pipe shall be furnished in standard lengths of 20 feet.

### **4.5 Joints**

- Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading.
- Couplings shall be designed for use at or above the pressure class of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F 477. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139 or the Owner's requirements which is more stringent.

**4.6 Workmanship**

Pipe and couplings shall be homogeneous throughout and free from voids, cracks, inclusions and other defects, and shall be as uniform as commercially practicable in color, density and other physical characteristics.

**4.7 Quality Control**

Pipe and machined couplings must pass AWWA C900 hydrostatic proof test requirements. Test frequency to be in accordance with C900 and/or UL requirements.

Dimension Ratio (DR)	Pressure Class (psi)	Hydrostatic Test Pressure (psi)
4	305	610

**4.8 Marking**

Pipe and couplings shall be legibly and permanently marked in ink with the following minimum information:

**Pipe**

- Nominal size (for example, 4")
- PVC
- Dimension ratio (for example, DR14)
- AWWA/UL pressure class (for example, PC 235)
- AWWA C900-07 (or latest edition)
- Manufacturer’s name or trademark and production record code
- Seal(mark) of the testing agency verifying the suitability of the pipe Material for potable water service
- Seal (mark) of the certifying agencies that have tested and approved the pipe for use in fire protection systems

**Couplings**

- Nominal size (for example, 4")
- PVC
- AWWA/UL pressure class (for example, PC 305)
- AWWA C900-07 (or latest edition)
- Manufacturer’s name or trademark
- Seal (mark) of the testing agency verifying the suitability of the pipe material for potable water service
- Seal (mark) of the certifying agencies which have tested and approved the pipe for use in fire protection systems.



**PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 2.3 TECHNICAL SPECIFICATIONS FOR STEEL WATER PIPE

### PART 1: GENERAL

#### 1.1 Scope of Work

Provide and install steel pipe of the sizes and in the locations shown on the plans and as specified herein.

### PART 2: QUALITY ASSURANCE

#### 2.1 Reference Standards

Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced therein shall apply.

ANSI/AWS D1.1	Structural Welding Code- Steel
ANSI/AWS B2.1	Specification for Welding Procedure and Performance Qualification
ANSI/AWWA C200	Steel Water Pipe—6 In. (150 mm) and Larger
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 In. (100 mm) and Larger- Shop Applied
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
ANSI/AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipe
ANSI/AWWA C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
ANSI/AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines

ANSI/AWWA C215	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
ANSI/AWWA C216	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fitting
ANSI/AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
ASME Section IX	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications
AWWA M11	Steel Water Pipe: A Guide for Design and Installation
SSPC-PA 2	Systems and Specifications SSPC Painting Manual, Volume 2 Chapter 7: Measurement of Dry Coating Thickness with Magnetic Gages

## 2.2 Qualifications

- Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished shall furnish all steel pipe and fittings. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.
- Pipe cylinders, lining, coating and fabrication of specials shall be the product of one manufacturer that has at least five (5) years of successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001:2000 or other equivalent nationally recognized program as approved by the Owner.

## 2.3 Warranty

- A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the welding contractor shall provide in writing a warranty for a period of one year for all the welded joints, including formation, installation, and pressure testing.
- Unless otherwise specified, the warranty periods shall begin Certificate of Acceptance is issued for the contract.

## **2.4 Submittals**

### **2.4.1 Shop Drawings**

Drawings shall be submitted to the Owner for approval and shall include the following:

- Pipeline layout showing stations and elevations.
- Thickness of steel pipe wall, lining and coating
- Details of standard pipe, joints, specials and fittings.
- Type of joint and joint restraint, if any

### **2.4.2 Design**

- Calculations for pipe and fittings including, but not limited to
  - Wall thickness based on external earth and live loading
  - Pressure class based on internal pressure
- Details of joint bonding and field welded joint restraint calculations.

### **2.4.3 Certifications**

- The Contractor shall furnish a certified affidavit of compliance that meets or exceeds the requirements of these specifications for all pipe and fittings furnished.
- Linings for potable piping shall be NSF certified.

## **2.5 Verification**

### **2.5.1 Inspections**

- All pipes shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

### **2.5.2 Tests**

- Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA coating and lining standards.
- The Contractor shall perform required tests at no additional cost to the Owner. The Owner shall have the right to witness all testing conducted by the Contractor,

provided that the Contractor's schedule is not delayed for the convenience of the Engineer.

### 2.5.3 Welding Requirements

- All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

### 2.5.4 Welder Qualifications

- Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

## 2.6 Handling, Storage and Shipping

- Pipe shall be stulled as required to maintain roundness of +/- 1% during shipping and handling.
- Coated pipe shall be shipped on bunks with nylon belt tie-down straps or padded banding located approximately over stulling.
- Coated pipe shall be stored on skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.
- Coated pipe shall be handled with wide belt slings. Chains, cables or other equipment likely to cause damage to the pipe or coating shall not be used.

### 2.6.1 *For Tape Coated Pipe*

Prior to shipment, tape coated pipe shall be visually inspected for damage to the coating by the following procedure:

- When visual inspection shows a dielectric coating system has sustained physical damage, the area in question shall be subjected to an electrical holiday test. Voltage shall be per AWWA C214.
- When the area is tested and there are no holidays or no tearing of the material, (wrinkling or bruising of tape may be permitted) then the area shall be noted "OK" and shipped with no patching required.

### 2.6.2 *For Polyurethane Coated Pipe*

Prior to shipment, polyurethane coated pipe shall be visually inspected for damage to the coating by the following procedure:

- When visual inspection shows a dielectric coating system has sustained physical damage, the area in question shall be subjected to an electrical holiday test. Voltage shall be per AWWA C222.
- When the area is tested and there are no holidays, the area shall be noted “OK” and shipped with no patching required.

### 2.6.3 *For Tape or Polyurethane Coated Pipe*

When the damaged area does show damage going clear to the steel from either a visual inspection or a jeep from a holiday detector, the area shall be repaired as per manufacturer’s recommendations.

## 2.7 **Markings**

The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word “top” or other suitable markings shall be painted or marked on the outside top spigot end of each pipe section.

## **PART 3: PRODUCT**

### **3.1 Material**

#### 3.1.1 Pipe

- Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of AWWA C200. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.
- Pipe design shall be in accordance with AWWA M11 considering the followings:
  - Internal pressure
  - External pressure
  - Special physical Loading
  - Practical requirements

- Practical design Considerations for steel stresses with various lining and coating
  - Minimum wall thickness of 0.25-inch
- Pipe shall be bedded and backfilled per the Plan details or manufacturer's recommendations utilizing an E' value for design check per AWWA M11 Chapter 6.
  - Pipe is to be furnished principally in 50-foot net laying lengths with shorter lengths, field trim pieces and closure pieces as required by Plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

### 3.1.2 Fittings

- Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 ½ times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 ¼-degrees (one cut elbow up to 22 ½-degrees). If elbow radius is less than 2 ½ times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.
- Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the Plans, shall be made of segmental welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

### 3.1.3 Joints

#### 3.1.3.1 *Rolled Groove Rubber Gasket Joint*

- The standard joint shall be a rolled groove rubber gasket joint unless otherwise noted on the Plans. Rolled groove rubber gasket joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.

- The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed  $1.00/D$  where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.
- Rolled groove rubber gasket joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

### 3.1.3.2 *Lap Weld*

- Lap weld joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The standard bell shall provide for a 2 ½-inch lap. The minimum lap shall be 1-inch. The maximum joint deflection or offset shall be a 1-inch joint pull.
- Lap welded joints shall be welded either externally or internally. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings. “Weld-after-backfill” of interior welds may be performed any time after joint completion and backfilling has been completed.
- Unless otherwise shown on the Plans, all field joints shall be lap welded for diameters 78-inches and greater.

### 3.1.3.3 *Mechanical Couplings*

- Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.
- Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.
- (*For Cement-mortar OR Tape coated pipe*) Couplings for buried service shall have all metal parts painted with epoxy paint and conform to AWWA C210.
- (*For Polyurethane coated pipe*) Couplings for buried service shall have all metal parts painted with polyurethane paint and conform to AWWA C222.



- Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. The shop applied outside coating shall be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings.
- *(For Cement-mortar OR Tape coated pipe)* Harness lugs or rings and pipe ends shall be painted with one shop coat of epoxy conforming to AWWA C210.
- *(For Polyurethane coated pipe)* Harness lugs or rings and pipe ends shall be painted with one shop coat of polyurethane conforming to AWWA C222.
- Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

#### 3.1.3.4 *Flanges*

- Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches.
- Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250).
- Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.
- Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

#### 3.1.3.5 *Bolts and Nuts for Flanges*

Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

#### 3.1.3.6 *Unwelded Pipe*

All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

## 3.2 Linings and Coatings

### 3.2.1 Cement-mortar Lining

- Interior surface of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C205.
- *(For Cement-mortar coated pipe)* The pipe ends shall be left bare where field welded joints occur as shown on the Plans. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- *(For Tape OR Polyurethane coated pipe)* Holdbacks shall be left bare and be provided as shown on the approved shop drawings. Holdbacks shall be filled with cement mortar after joint completion per AWWA C205.
- Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.
- Fittings shall be cement-mortar lined per AWWA C205. Pipe and fittings too small to cement-mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.
- Cement-mortar lining shall be kept moist during storage and shipping. The Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

### 3.2.2 Cement-Mortar Coating

- All pipes shown on the Plans to be cement-mortar coated shall be coated with  $\frac{3}{4}$ -inch minimum thickness of reinforced cement-mortar coating in accordance with AWWA C205.
- Coating of Fittings, Specials and Joints:

Fittings shall be lined and coated per AWWA C205. Fittings too small to cement mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.

### 3.2.3 Polyethylene Tape Coating

3.2.3.1 The prefabricated multi-layer cold applied tape coating system for straight-line pipe shall be in accordance with AWWA C214. The system shall consist of a three-layer system totaling 80 mils.

- An acceptable alternate is a two-layer extruded polyolefin coating system in accordance with AWWA C215.

#### 3.2.3.2 Coating of Fittings, Specials and Joints

- Fittings, specials and joints that cannot be machine coated, shall be coated in accordance with AWWA C209. Prefabricated tape shall be Type II and shall be compatible with the tape system used for straight-line pipe. The system shall consist of 2 layers totaling 70 mils.
- Alternate coating methods for fittings, specials and field joints are shrink sleeves per AWWA C216, liquid epoxy per AWWA C210, or polyurethane per AWWA C222.
- Joint bonds shall be completely encapsulated by the coating system as per manufacturer's recommendations.
- Coating repair for fittings and specials shall be in accordance with the procedure described below for straight-line pipe.

3.2.3.3 Coating repair shall be made using tape and primer conforming to AWWA C209 Type II and manufacturer's recommendations. The tape and primer shall be compatible with the tape system used for straight-line pipe.

- An alternative repair method shall be to install heat shrink sleeves in accordance with AWWA C216 and manufacturer's recommendations.

### 3.2.4. Polyurethane Coating

- Polyurethane coating shall be per AWWA C222 to a minimum thickness of 25 mils, measured in accordance with SSPC-PA 2. Coating shall be continuous to the ends of the pipe except where field welding is indicated. Exterior field joints shall be completed utilizing heat-shrink sleeves per AWWA C216.
- Coating repairs shall be per AWWA C222 and paint manufacturer's recommendations.

## **PART 4: EXECUTION**

### **4.1 Installation**

The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.

### **4.2 Installing Buried Piping**

- Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.
- Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
- Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section of the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.
- At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.
- Keep the trench in a dewatered condition during pipe laying.
- When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

### **4.3 Joints Assembly**

#### **4.3.1 Rolled Groove Rubber Gasket Joint**

- Clean exposed ends of joint surfaces.
- Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.
- Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.

- Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.
- It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise required in the Plans.
- (*For Cement-mortar coated pipe*) Grout the interior and exterior of the joints with cement mortar per AWWA C205.
- (*For Tape OR Polyurethane coated pipe*) Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeves per AWWA C216 and manufacturer's recommendations.

#### 4.3.2 Field Welded Lap Joints

- Clean exposed end of joint surfaces.
- Provide a minimum overlap of 1-inch at any location around the joint circumference.
- Field welders and field weld procedures shall be certified in accordance with AWS D1.1.
- At the Contractor's option, provide a full fillet weld per AWWA C206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.
- Testing of field welds shall be in accordance with AWWA C206.
- (*For Cement-mortar coated pipe*) Grout the interior and exterior joints with cement mortar per AWWA C205.
- (*For Tape OR Polyurethane coated pipe*) Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeves per AWWA C216 and manufacturer's recommendations.

#### 4.3.3 Flanged Joints

- Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.
- Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints.

#### 4.4 **Field Testing**

- Perform hydrostatic pressure test in the presence of the Engineer in accordance with the DWU requirements as specified in Sec 506.COD of City of Dallas Addendum to North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards, Latest Edition.
- Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- Provide dished heads, blind flange or bulkheads as necessary to isolate and test pipeline.
- Methods and scheduling of tests to be approved by the Engineer.
- Protect pipes and provide thrust restraint as required to complete test.
- Provide for proper legal disposal of test water.

### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

**SECTION 2.4**  
**TECHNICAL SPECIFICATIONS FOR**  
**REHABILITATION OF EXISTING WATER MAIN**  
**BY CURED-IN-PLACE PIPE**

**PART 1: GENERAL**

**1.1 Scope of Work**

Furnish all materials, labor, equipment, tools including barricading, temporary water, excavation, pre-televising, testing and chlorination fittings, tie-ins, service reinstatements and all other required incidentals for the reconstruction of existing water mains by the installation of a resin-impregnated flexible tube that is inflated within the existing pipe to form a hard, impermeable, corrosion resistant pipe within a pipe. When cured, the cured in place pipe (CIPP) will be formed to the original water main.

Contractor shall reconstruct existing water mains by the insertion of a flexible lining tube consisting of two concentric, tubular, woven and seamless polyester jackets with a watertight polymeric membrane bonded to the interior that has been saturated with a thermosetting resin.

- Inversion Method (ASTM F1216)

Liner shall be inserted into existing water main by direct inversion using a head of water.

- Pulling Method (ASTM F1743)

Line shall be inserted into the existing water main by pulling the tube into place by winching and then inflating.

The shaping of the liner may be achieved by pushing a pig through the hose using water pressure. The thermosetting resin shall then be cured only by circulating hot water through the tube to cure the resin into a hard impermeable pipe.

- Other curing methods may be used as approved by the product manufacturer.

## PART 2: QUALITY ASSURANCE

### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM D638	Standard Test Method for Tensile Properties of Plastics.
D790	Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
F1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
F1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).
NSF/ANSI 61	Drinking Water System Components--Health Effects

\*Manufacturer's standards are also hereby made a part of this specification.

### 2.2 Qualification Requirements:

#### 2.2.1 Manufacturer/Installer:

No work by other than the CIPP manufacturer that involves this rehabilitation process will be accepted, unless such installers or companies are certified and licensed by the CIPP manufacturer for such work and are approved by the Owner. Unless otherwise approved, the Manufacturer/Installers must meet the following criteria to be deemed commercially acceptable:

- Must satisfy all insurance, financial, and bonding requirements of the Owner, and must have had at least 5 (five) years active experience in the commercial installation.
- Must have successfully installed at least 25,000 feet of the cured-in-place product intended for use on this project in water distribution systems in the U.S. with at least 10,000 feet installed in the State of Texas.
- Manufacturer/ Installer's project manager must have a minimum of 3 years of CIPP installation experience, while under the employment of the Manufacturer/ Installer's company.



### 2.2.2 Product:

- The product installed shall be certified by NSF to ANSI/NSF Standard 61 and shall be listed on the NSF website accordingly. The product installed shall meet the requirements of (Sec 4.01) and shall have been commercially proven with a 5 year history of installations in North America and a minimum footage installed of 250,000 linear feet.

### 2.3 **Warranty**

- A one year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the CIPP contractor shall provide in writing a warranty for a period of one year for all the CIPP work including material, installation, and pressure testing at no additional cost to the owner.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

### 2.4 **Submittals**

The Contractor shall furnish all necessary catalogs cut sheets, technical literature, shop drawings and engineering data to address the following documentations:

#### 2.4.1 Material Data:

Type of resin tube material and its physical properties

#### 2.4.2 Process Demonstration

- Submit detailed installation procedures including curing methods, curing temperatures, inversion methods, inversion or pull-in pressures, etc.
- Method of sealing liner at services, fittings, valves or other appurtenances.

#### 2.4.3 Engineering Calculations:

Provide diameter, length, wall thickness and all structural design calculations for each water main segment to be rehabilitated. All design calculations must be sealed by a State of Texas Registered Professional Engineer.

#### 2.4.4 Testing/TV Inspection Report

- Copies of certified independent laboratory tests on the proposed resin impregnated tube showing values for short term Flexural Modulus of Elasticity, Flexural Strength, Tensile Strength and other related properties. The testing laboratory must be a certified independent facility and not affiliated with the proposed CIPP manufacturer/installer. In addition, submit field test results from one previous CIPP project over the last three years using the same values shown on the questionnaire.
- Television inspection reports along with video made after new pipe installation.
- Copies of test reports for QA/QC of installation and curing process.

#### 2.4.5 References

- Provide three references of projects completed within last five years by the manufacturer in which a water main was successfully rehabilitated using the proposed materials. Include contact names, addresses and phone numbers of agencies involved.

### **PART 3: PRODUCT**

#### 3.1 **Liner Size and Length:**

- The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the water main to be lined. The liner thickness shall be designed to adequately resist the full internal pressure including allowances for surge pressure and all external pressures and conditions (e.g. deflection, ring bending, buckling and minimum stiffness). The length of the liner shall be of sufficient length to effectively span the distance and carry out the insertion and seal of the liner at the end points. The Contractor shall verify the lengths in the field before cutting the liner to length. Prior to the start of work the manufacturer of the cured-in-place-pipe liner will be required to submit design calculations for wall thickness to the Engineer. Allowance for circumferential and longitudinal stretching of the liner during insertion shall be made as per the manufacturer's standards.

#### 3.2 **Color:**

- CIPP wall coloring after installation must be a white color that can give a clear detail examination or encapsulated television inspection equipment.

**PART 4: STRUCTURAL REQUIREMENTS**

**4.1 Liner Material**

The cured in place pipe liner shall be composed of two concentric, tubular, woven and seamless polyester jackets with a seamless polymeric membrane bonded to the interior. The polymeric inner membrane shall be designed to ensure water tightness. The full cured in place pipe lines shall conform to the minimum structural standards as follows:

Tensile Strength @ Yield	3,000 psi	(ASTM D638)
Flexural Strength	4,500 psi	(ASTM D790)
Flexural Modulus	250,000 psi	(ASTM D790)

The Contractor shall furnish, prior to use of the lining materials, satisfactory written guarantee of his compliance with these specifications and the line manufacturer’s standards for all materials and techniques being used in the method.

**4.2 Design Parameters**

The following design parameters shall be used in the design of pipe liners in addition to the manufacturer’s standards and ASTM 1216:

- Ovality of Existing Pipe 2% Minimum
- Existing Pipe Condition Fully Deteriorated
- Modulus of Soil Reaction 700 psi Minimum
- Factor of Safety Against Buckling 2 Minimum
- Live Load AASHTO HS20-44 Loading Under Roadways AASHTO E-80 Loading under Railroads
- Soil Unit Weight 120pcf Minimum (If no Boring Data is available in vicinity)
- Creep Reduction Factor 50% Maximum
- Internal Pressure System Working Pressure
- Depth of Cover As per plan

Liner material shall be tested in accordance with ASTM F1216, Section 8 – Inspection Practices. Certificates of tests shall be provided to the Engineer.

## **PART 5: EXECUTION**

### **5.1 Preparatory Procedure**

#### **5.1.1 Excavation of Insertion/Extraction Pits, Removal of Pipe, and Route Survey**

The length and width of insertion/extraction pits shall as recommended by the pipe liner manufacturer and as approved by the Engineer.

The Contractor shall excavate the insertion/extraction pits at the locations and to the dimensions specified and approved.

The Contractor shall excavate and remove the minimum length of pipe necessary for the liner insertion and receiving operations as per manufacturer's recommendations and as ordered by the Engineer.

The existing main shall be cut square using an approved cutting machine, leaving no split or fractured ends. All cut faces of the existing main shall be chamfered on the inside surface to a suitable profile to prevent damage to the liner pipe during or after insertion.

Edge guards or other means of protecting the liner from host pipe edges at insertion points must be submitted to the Engineer for review and approval.

A thorough examination of the route of the existing water main shall be made after cutting of the main. This should include a pipeline location survey with equipment for locating any changes in direction, valves, bends, intrusions, and other fittings that may impede the insertion and/or proper inflation of the cured-in-place-pipe liner.

#### **5.1.2 Safety**

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements. Emphasis shall be placed upon safety requirements for entering confined spaces and working with hot water.

The Contractor shall erect such signs and other devices as are necessary for the safety of the work site and shall secure the site and perform all work to the safety requirements of all pertinent regulatory agencies.

#### **5.1.3 Cleaning**

The cleaning of the existing water main is a critical step in the reconstruction of the existing water main with a cured-in-place-pipe liner method. It is anticipated that the existing water main will have a fair amount of rust and scale deposits on the inside walls of the pipe.

The Contractor shall clean the existing water mains using a cleaning method that is approved by the Engineer. The cleaning method shall remove all rust, scales, tuberculation, deposits, loose or deteriorated remains of any original coatings and

other foreign materials from the inside of the pipe so as to produce a smooth metal surface finish that will allow the new composite liner to adhere to the existing host pipe.

After cleaning, and again immediately before pipe liner insertion the main shall be plunged with a tight fitting rubber plunger and foam swab to clear the pipe bore of debris and water.

#### 5.1.4 Air Quality

The Contractor is advised that all liner installation work shall be carried out in full compliance with all City, State, and Federal laws, rules, and regulations regarding Air Quality and Safety.

#### 5.1.5 Pre-Construction Television Inspection

The Contractor shall perform a television inspection and video recording of the existing water main after the cleaning of the water main is completed. This inspection will be performed, utilizing a radial eye camera, to determine that the rust and scale deposits have been adequately removed, that the latest condition of the water main makes lining feasible, to check for leaking service connections, and to accurately identify the location of service connections. Each service connection location shall be logged for use when re-opening of service connections is required.

#### 5.1.6 Temporary Water Service

Prior to the start of construction the Contractor shall submit to the Engineer for approval his method of providing temporary water service to customers and to emergency fire crews. This shall include the Contractor's method to provide maintenance and protection during the entire length of the contract to ensure continued water service.

The temporary water line shall be disinfected and acceptable samples obtained and approved by the Engineer prior to connection to the customers.

### 5.2 **Locating Service Connections**

- Prior to installation of the cured-in-place-pipe liner the Contractor shall locate all existing water service laterals, and plug the service laterals as recommended by the manufacturer and approved by the Engineer. The insertion of plugs into the service connections may be done simultaneous with the above mentioned television inspection. The plugs are inserted so as to prevent any accumulation of epoxy inside the service line thus blocking them, and to prevent any water infiltration from a customer's leaking shut-off valve. Furthermore, special plugs shall be inserted so as to make visible any non-penetrating service connections in the lined pipe, and allow the operators to locate the non-penetrating service connections after they have been covered with the composite liner.

- The Contractor shall plug the customer's service lateral and provide temporary water service to the customers.
- Upon completion of installation of liner and pressure testing the Contractor shall re-open the existing service laterals to the customers from within the pipeline.

### 5.3 Delivery, Storage and Handling

- The Contractor shall transport, handle, and store liner and thermosetting resin as recommended by manufacturer.
- The Contractor shall deliver, store and handle other materials as recommended by the manufacturers to prevent damage.
- Liner materials that are defective or damaged prior to installation shall be rejected and replaced at the Contractor's expense. Liner materials damaged during installation shall be repaired or replaced as recommended by the manufacturers and approved by the Engineer.

### 5.4 Installation

#### 5.4.1 Preparing and Inserting the Liner

The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated liner will be impregnated prior to installation. The Contractor shall allow the Engineer and/or his representative to inspect the materials and chemical impregnation "wet out" procedure. A resin and catalyst system recommended by the liner manufacturer and approved by the Engineer shall be used. The quantities of the liquid thermosetting materials inserted into the lining tube shall be as per manufacturer's standards so as to fully saturate the liner material and provide the lining thickness specified.

Immediately after cutting and prior to installation of liner, the ends of the adjacent existing water main that are not to be lined at the insertion/extraction points shall be covered/plugged so that no debris shall enter into them during reconstruction work.

The chemical impregnated liner material shall be inserted into the water main being reconstructed through the insertion point by either the direct inversion method or by the pull-in-place method, as recommended by the manufacturer. The head used to extend the liner tube shall be sufficient enough to fully extend the tube both circumferentially and longitudinally. The shaping of the liner may be achieved by pushing a pig through the hose using water pressure. The head used will fall within the manufacturer's guidelines to insure that a proper finished thickness is achieved and that the liner fit snug to the existing pipe wall producing dimples and/or at service connections and flared ends at the entrance and exit points.

Puller unit/winch cable shall be equipped with a tension gauge to measure tension during pull through.

Inflation of liners used shall be accomplished in accordance with manufacturer's standards and specifications.

#### 5.4.2 Curing of Liner

After inflation or inversion is completed, the Contractor shall supply a hot water heat source. The equipment shall be capable of delivering hot water to the far end of the liner to uniformly raise the temperature in the entire liner above the temperature required to initiate and effect curing of the resin system. The temperature shall be determined by the resin/catalyst system employed. The heat source shall be fitted with suitable monitors to gauge the temperature and pressure of the incoming and outgoing heat exchanger circulating heating medium. Thermocouples or temperature gauges or infra-red gun shall be used at insertion and extraction points so as to determine and record the temperature of the liner and time of exotherm.

Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner show it to be hard and sound; and when temperature reading(s) at the interface of the liner with the host pipe indicate sufficient heating has occurred. The cure period shall be of a duration recommended by the resin manufacturer; modified for the site specific conditions at the time curing is effected. During this cure time, the temperature inside the liner will be continuously maintained in the range required.

Once the cure is complete, the Contractor shall cool the hardened liner to a temperature below one hundred degrees Fahrenheit (100°F) before relieving the internal pressure. Cool down shall be accomplished as recommended by the manufacturers. Care shall be taken in the release of the internal pressure so that a vacuum will not develop that could damage the newly installed liner.

The finished lining shall be continuous over the entire length and be free from visual defects such as foreign inclusions, dry spots, pinholes and delaminations. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.

If at the insertion/extraction ends the lining fails to make a tight seal, the Contractor shall apply a seal of a resin mixture compatible with the liner.

## 5.5 Preliminary Television Inspection of Installed Liner

After the liner is sufficiently cool (below one hundred degrees Fahrenheit (100°F)) and before opening the service laterals, a preliminary television inspection and video recording of the newly installed liner shall be performed to determine if the liner is properly installed. If no services are involved then this will become the final TV inspection.

## 5.6 Testing

After installation and curing of the new liner, the lined existing water main shall be pressure tested as per ASTM F1743 Section 8.3. Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws. All necessary fittings to complete hydrostatic testing and chlorination shall be supplied and installed by the contractor.

### 5.6.1 Hydrostatic Testing and Leakage Testing for Pressure Piping

All hydrostatic and leakage testing shall be in accordance to Sec 506.5 COD (Hydrostatic Test) as specified in City of Dallas Addendum to the North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards, Latest Edition.

## 5.7 Service Connections

After the pressure testing is completed, the Contractor shall re-open all existing service connections as ordered by the Engineer. These service connections shall be re-opened and paid for as applicable unless otherwise specified.

Whenever possible the re-opening of connections shall be done without excavation and from the interior of the newly installed liner by the use of a remote controlled cutting device. A closed circuit television system shall be used for monitoring the operation. All connections that are to be re-opened shall be satisfactorily opened to the size of the original opening, and to the depth required to completely open the water service connection to the customer. Opening shall be smooth and flush.

## 5.8 Final Television Inspection

A final television inspection and video recording of the newly lined water main including the restored service connections shall be performed immediately after work is completed. Televising equipment shall be dedicated potable water equipment. Equipment previously use in a wastewater system shall not be allowed. Should the results of this final inspection reveal any defects that are determined by the Engineer to be repairable the Contractor will be required to repair these defects as ordered by the Engineer at the sole expense of the Contractor. Should the results of this final inspection reveal any defects that are determined by the Engineer not to be repairable the Contractor will be required to remove and replace the existing water main as



ordered by the Engineer at the sole expense of the Contractor.

Payment for this final television inspection will be made under the contract bid item labeled “Television Inspection and Video Tape Recording”, unless otherwise specified.

### **5.9 Pipeline Re-assembly**

After final television inspection is completed the removed sections of the existing pipeline (e.g. at insertion/reception pits, valves, connections, etc.) shall be reconstructed in accordance with the contract plans and specifications and/or as ordered by the Engineer. No end seals shall be used to seal the extremities of the liner. The necessary end pieces shall be installed so as to make proper connection to the cut and lined existing water main pipe.

### **5.10 Disinfection/ Chlorination**

Once all pipe work is completed to the satisfaction of the Construction Manager, Dallas Water Utilities shall perform, as required, chlorine disinfection, sampling and analysis of the newly installed liner in accordance with the specifications and/or as ordered by the Engineer.

### **5.11 Recommissioning**

Recommissioning of water main shall be done in accordance with AWWA Standards or as ordered by the Owner. Customer service shall be restored after acceptable samples have been obtained and approved by the Owner.

### **5.12 Limitation and Constraints**

If wet-out is done at the site, confine the operations to one lane of traffic if possible and provide adequate devices and facilities for containing any chemical spills. In addition the Contractor will be required to follow all policies and requirements for traffic at the controlling jurisdiction. The Contractor may be required to submit a traffic control plan for approval (No Separate Payment).

## **PART 6: ACCEPTANCE**

### **6.1 Finish**

- The finished pipe must be continuous and free from significant defects.
- Any defects which will affect the integrity or strength of the pipe in the opinion of the Owner in the foreseeable future or warranty period, must be repaired at the Contractor's expense, in a manner agreed upon by the Owner.

### **6.2 Inspection**

After the work is completed, the contractor will provide the Owner with a video showing the before and after condition, including the reinstated water line and building lateral connections.

### **6.3 Failure to Meet Requirements**

- The Owner will view the inspection video tape and determine if all required work is complete. Any deficiencies noted by the Owner must be corrected to his satisfaction.
- Any section failing the hydrostatic pressure test must be corrected or modified by the Contractor until it passes.

### **6.4 Cleanup**

Clean up the entire project area after the work is completed and all testing accepted. Remove and dispose of all excess material and debris not incorporated into the permanent installation.

## **PART 7: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 2.5

### TECHNICAL SPECIFICATION FOR REHABILITATION OF EXISTING WATER MAIN BY PIPE BURSTING (PB)

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all materials, labor, equipment, tools, and required incidentals for the replacement of water mains by Pipe Bursting method. The Pipe Bursting process is defined as the trenchless reconstruction of existing water mains by the simultaneous insertion of liner pipe within the bore of the existing pipe, by breaking and expanding the existing pipe. The scope includes reconnection of existing water service connections television inspection of the newly rehabilitated pipe and complete installation in accordance with the contract documents. Only hydraulically and pneumatically operated equipment will be allowed for this method.

##### 1.2 Liner Pipe Description

Unless otherwise specified in the plans and/or specifications, one of the following pipes or approved equal can be considered for horizontal directional drilling contingent upon approval by the Owner:

- Fusible Polyvinylchloride (PVC) Water Pipe as manufactured by Underground Solutions, Inc.
- Restrained Joint Polyvinylchloride (PVC) Water Pipe as manufactured by CertainTeed Corporation.

The pipe to be used must be certified for use as a pressure-rated water delivery system and fire protection piping applications conforming to all standards and procedures, and meeting all testing and material properties as described in applicable pipe specifications and/or plans.

##### 1.3 Related Works

- Technical Specification for Fusible Polyvinylchloride (PVC) Water Pipe
- Technical Specification for Restrained Joint Polyvinylchloride (PVC) Water Pipe

## PART 2:QUALITY ASSURANCE

### 2.1 Reference Standards

This section below contains references to the following documents. They are a part of this section as specified and modified.

ANSI/AWWA C110/A21.10	American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
ANSI/AWWA C111/A21.11	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C153/A21.53	AWWA Standard for Ductile-Iron Compact Fittings for Water Service
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100mm Through 300mm), for Water Distribution
AWWA C905	Standard for Polyvinyl Chloride (PVC Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350mm Through 1200mm), for Water Distribution and Transmission
AWWA M23	AWWA Manual of Supply Practices PVC Pipe—Design and Installation, Second Edition
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D2152	Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)

ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F1057	Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
UNI-PUB-08	Tapping Guide for PVC Pressure Pipe
NSF-14	Plastics Piping System Components and Related Materials
NSF-61	Drinking Water System Components--Health Effects

**2.2 Qualification Requirements (Check with Underground Solution)**

- The Contractor shall be certified by the manufacturer of the pipe bursting system that it is a fully trained, licensed installer of their pipe bursting system. Contractor must provide a letter to the Owner documenting this requirement.
- The Contractor shall have at minimum of at least three (3) years verifiable experience using the pipe bursting method while meeting the following criteria:
  - A minimum total of 25,000 LF of completed pipe bursting footage.
  - A minimum total of 10,000 LF of upsizing where similar sized diameter increases have been successfully completed in pipe diameters of 8-inch to 12-inch range.
- Personnel performing pipe bursting must be certified by manufacturer of pipe bursting system having successfully completed training in:
  - Operating bursting equipment to be used
  - Installing proposed replacement pipe.
  - Operation and maintenance of all equipment to be used
- Personnel performing fusing of liner pipe and fittings must be certified by manufacturer of fusing equipment having successfully completed training in:
  - Handling replacement pipe materials.
  - Butt fusion of pipe joints, saddle fusion of fittings for water services
  - Operation and maintenance of all equipment to be used.

## 2.3 Warranty

- A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the pipe bursting Contractor shall provide in writing a warranty for a period of one year for all the pipe bursting work including material, installation, and pressure testing at no additional cost to the owner.
- Unless otherwise specified, the warranty period shall begin after the Certificate of Acceptance is issued for the Contract.

## 2.4 Submittals

The Contractor shall furnish the following documents made in a timely manner so that project schedule can be met:

### 2.4.1 Material Data

- Shop drawings, catalog data and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings.
- Manufacturer's recommendation for handling, storage, and repair of pipe and fittings damaged.

### 2.4.2 Process Demonstration

- Detailed installation procedure including pipe bursting method to be used.
- Method of construction and restoration of existing water service connections. This shall include detail drawings and the written description of the entire construction procedure to install pipe.

### 2.4.3 Testing Documentations

Television inspection reports along with video made after new pipe installation.

### 2.4.4 Reference

Provide a list of at least three projects completed in the last three years by the contractor/installer where a water main was successfully rehabilitated using the pipe bursting method. Include contact names, addresses and phone numbers of agencies involved.

#### 2.4.5 Pre-Construction Submittals

The following Product Data is required from the pipe supplier and/or fusion provider:

- Pipe Size
- Dimensionality
- Pressure Class per applicable standard
- Color
- Recommended Minimum Bending Radius
- Recommended Maximum Safe Pull Force
- Fusion technician qualification indicating conformance with this specification

The following work plan and information is required from the Contractor and/or pipe bursting Contractor, if requested. This work plan and information shall also be supplied to the pipe supplier, should it be requested:

- Pipe bursting equipment information and certification indicating the applicability of equipment, operator, and methods commensurate with the size and scope of the project, including any proposed lubricants to be used in the operation.
- Contingency plan, including the following:
  - Unforeseen obstructions that stop or delay the operation
  - Unforeseen deflections that would over bend the fusible polyvinylchloride pipe
  - Excessive surface heaving or subsidence
  - Damage to existing utility installations
  - Required spot repairs of the existing line
- Shop drawings shall include for each pipe bursting operation all excavation locations, interfering utilities, excavation dimensions, temporary water and traffic control schematics.
  - Work schedule identifying construction sequencing, daily work hours and working dates for each installation.

#### 2.4.6 Post-Construction Submittals

The following as recorded data is required from the contractor and/or fusion provider (if applicable) to the owner or pipe supplier upon request:

- Approved data logger device reports
- Fusion joint documentation containing the following information:
  - Pipe Size and Thickness

- Machine Size
- Fusion Technician Identification
- Job Identification
- Fusion Joint Number
- Fusion, Heating, and Drag Pressure Settings
- Heat Plate Temperature
- Time Stamp
- Heating and Cool Down Time of Fusion
- Ambient Temperature

### **PART 3: PRODUCT**

#### **3.1 Liner Pipe**

As specified in Section 1.2 of this specification.

#### **3.2 Pipe Bursting Equipment**

##### **3.2.1 General**

The pipe bursting system shall be designed and manufactured to force its way through the existing line by fragmenting the pipe and compressing the broken pieces into the surrounding soil as it progresses. The bursting unit shall generate sufficient force to burst and expand the existing pipeline and allow for the insertion of the liner pipe.

##### **3.2.2 Allowable Types of Pipe Bursting System**

###### **3.2.2.1 Static Pipe Bursting Systems**

- Static pipe bursting systems shall be characterized by a tapered or blunt nosed bursting head being pulled through the host pipe and breaking the host pipe by applying radial pressure to the host pipe. The host pipe fails by ‘hoop’ tensile stress applied by the bursting head, and is fragmented and pushed into the surrounding bedding and soil as the bursting head progresses.
- The bursting head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the liner pipe behind it. Under no circumstances shall the pipe pull head, which is attached directly to the liner pipe, be used to expand or otherwise increase the diameter of the host pipe, or fragmented host pipe.
- The pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.



### 3.2.2.2 Hydraulic Pipe Bursting Systems

- Hydraulic pipe bursting systems shall be characterized by a pull head that is equipped with hydraulically actuated ‘petals’ that break the host pipe by applying radial pressure to the host pipe. The host pipe fails by ‘hoop’ tensile stress applied by the head, and is fragmented and pushed into the surrounding bedding and soil as the pull head progresses.
- The pull head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the liner pipe behind it. Under no circumstances shall the pipe pull head, which is attached directly to the liner pipe, be used to expand or otherwise increase the diameter of the host pipe, or fragmented host pipe.
- The pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

### 3.2.2.3 Pneumatic or Percussion Pipe Bursting System

UNDER NO CIRCUMSTANCES SHALL PNEUMATIC OR PERCUSSIVE BURSTING SYSTEMS BE ALLOWED.

### 3.2.3 Bursting Lubricants

- Bursting lubricants shall be used at the request of the pipe bursting contractor and at the discretion of the Owner and Engineer.
- Lubricants shall be compatible for long term use with PVC pipe.

### 3.2.4 Pipe Pull Heads

- Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- Pipe pull heads shall be specifically designed for use with liner pipe, and shall be as recommended by the pipe supplier.

### 3.2.5 Pipe Rollers

- Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- A sufficient quantity of rollers and spacing, per the pipe supplier’s guidelines shall be used to assure adequate support and resist excessive sagging of the product pipe.

## **PART 4: EXECUTION**

### **4.1 Delivery, Storage and Handling**

Transport, handle and store pipes and fittings as recommended by manufacturer. If new pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Owner, at the Contractor's expense, before proceeding further. Deliver, store and handle other materials as required to prevent damage.

### **4.2 Cleaning and TV Inspection of Existing Pipeline**

- The host pipe shall be cleaned and inspected by TV prior to the bursting operation in accordance with, and if required by the contract documents.
- Cleaning and TV inspection of the host pipe shall indicate condition of host pipe and suitability of host pipe for liner pipe insertion by pipe bursting methods.
- Obstructions considered detrimental to the pipe bursting operation which may include corporation taps, valves and valve bodies, and collapsed piping shall be remedied prior to bursting and liner pipe insertion.
- Spot repairs shall be made in accordance with the drawings and these specifications.

### **4.3 Obstruction Removal**

- Identify any point repairs required, such as dropped joints, intruding service connections, collapsed pipe, sags in main or any other obstructions prior to the pipe bursting process. The Contractor shall remove all obstructions to perform pipe bursting operation, as necessary.
- The contractor shall notify the inspector for approval to make an excavation after having exhausted all other options to remove any obstruction or retrieve any pipe bursting tool or camera from the water main.

### **4.4 Location and Protection of Underground Utilities**

- Correct locations of all underground utilities that may impact the installation is the responsibility of the Contractor.
- Utility location and notification services shall be contacted by the Contractor prior to the start of construction.
- All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of the bursting operation as determined for the project specific site conditions. It is the Contractor and pipe burst system operator's responsibilities

to determine this envelope of safe burial depth and offset from existing utilities. This will include, but is not limited to soil conditions and layering, utility proximity and material, pipe bursting system and equipment, and foreign subsurface material.

#### **4.5 Excavation and Access Pits**

- The location of access pits shall be submitted to the Engineer prior to construction.
- Access pit length shall be such that the minimum bending radius for the liner pipe, per the pipe supplier is maintained. Sheeting, shoring and bracing requirements shall be in accordance with these specifications and applicable jurisdictional standards.
- Access pit excavations shall be performed at all points where the liner pipe will be inserted into the existing pipeline. When possible, access pit excavations shall coincide with host pipe service connection points or other appurtenance installations.
- The liner pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to or during installation.

#### **4.6 Pipe Bursting Operation**

- Any known pre-existing concrete encasements shall be excavated and broken out prior to the bursting operation to allow the steady and free passage of the pipe bursting head.
- The new pipe shall be inserted immediately behind the bursting head in accordance with the pipe supplier's recommended procedures. The bursting equipment shall be specifically designed and manufactured for the type of insertion process being used.
- Immediately following the completion of a pipe bursting installation, if possible, the pipe should be pushed back into the location of the insertion, at the pulling head, until a small amount of movement is realized at the insertion pit on the other side of the installation from the pulling equipment.

#### **4.7 Preparation Prior To Making Connections Into Existing Piping Systems**

- Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:
  - Visit the field to verify location, size, piping material, and piping system of the existing pipe.

- Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
- Have installed all temporary pumps and/or pipes in accordance with established connection plans.
- Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

#### **4.8 Pipe System Connection**

- Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

#### **4.9 External Service Connections**

- In re-connection or reconstruction of existing water services, selected service connection pipe diameter must match existing service.
- All water service connections shall be identified, located and excavated prior to the pipe any construction.
- Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with the use of tap saddles or sleeves. **NO DIRECT TAPPING WILL BE PERMITTED.** Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub-8.
- All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.
- Equipment used for tapping shall be made specifically for tapping PVC pipe:
  - Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
  - Manually operated or power operated drilling machines may be used.
- Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap,) or when the pipeline is not filled with water and not under pressure ('dry' tap).

#### **4.10 Testing**

Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

##### **4.10.1 Hydrostatic Testing and Leakage Testing for Pressure Piping**

All hydrostatic and leakage testing shall be in accordance to Sec 506.5 COD (Hydrostatic Test) as specified in City of Dallas Addendum to the North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards, Latest Edition.

- In preparation for pressure testing the following parameters must be followed:
  - All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by ‘flushing’ the pipeline in accordance with the parameters and procedures as described in AWWA C605.
  - The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer’s guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.
  - Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to minimize the amount of potentially trapped air in the pipeline.

##### **4.10.2 Partial Testing**

- Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the Owner and Engineer.

#### **4.11 Disinfection of the Pipeline for Potable Water Piping**

Once all pipe work is completed to the satisfaction of the Construction Manager, Dallas Water Utilities shall perform, as required, chlorine disinfection, sampling and analysis of the newly installed liner in accordance with the specifications and/or as ordered by the Engineer.

**4.12 Final Acceptance**

Upon completion of installation, testing and inspection, clean and restore project area affected by work of this section.

**PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 2.6

### TECHNICAL SPECIFICATION FOR SLIPLINING OF WATER MAIN

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all materials, labor, equipment, tools, and required incidentals for the replacement of water mains by Sliplining method. Sliplining is defined as the trenchless reconstruction of existing water mains by subsequently inserting pipe lengths, which are joined into a continuous tube, within the bore of the existing pipe and grouting the annular spacing between the new pipe and the existing pipe.

The scope includes standards for dimensionality, testing, quality, acceptable fusion practice, safe handling, storage and installation of the pipe by sliplining.

##### 1.2 Pipe Description

Unless otherwise specified in the plans and/or specifications, the following pipes or approved equal can be considered for sliplining contingent upon approval by the Owner:

- Fusible Polyvinylchloride (PVC) Water Pipe as designated by C900 (DR 14) or C905 (DR 14) and manufactured by Underground Solutions, Inc. or approved equal.
- Restrained Joint Polyvinylchloride (PVC) Water Pipe as manufactured by CertainTeed Corporation.

The pipe to be used must be certified for use as a pressure-rated water delivery system and fire protection piping applications conforming to all standards and procedures, and meeting all testing and material properties as described in applicable pipe specifications.

##### 1.3 Related Work

- Technical Specification for Fusible Polyvinylchloride (PVC) Water Pipe
- Technical Specification for Restrained Joint Polyvinylchloride (PVC) Water Pipe

## PART 2: QUALITY ASSURANCE

### 2.1 Reference Standards

- This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- Unless otherwise specified, references to documents shall mean the documents in effect at the time of design, bid, or construction, whichever is earliest. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
- Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

ANSI/AWWA C110/A21.10	American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
ANSI/AWWA C111/A21.11	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C153/A21.53	AWWA Standard for Ductile-Iron Compact Fittings for Water Service
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100mm Through 300mm), for Water Distribution
AWWA C905	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350mm Through 1200mm), for Water Distribution and Transmission



AWWA M23	AWWA Manual of Supply Practices PVC Pipe—Design and Installation, Second Edition
UNI-PUB-08	Tapping Guide for PVC Pressure Pipe
NSF-14	Plastics Piping System Components and Related Materials

## 2.2 Qualification Requirements

### 2.2.1 Installer

All sliplining operations shall be performed by a qualified sliplining company who has at least three (3) years experience involving work of a similar nature. The company must have installed a minimum of 10,000 linear feet of pipe (6-inch diameter or greater) using sliplining and supply a list of project references, prior to job commencement.

- Schedule all work through the Owner. Notify the Owner a minimum of ten (10) working days in advance of the start of work.
- Perform all work in the presence of the Owner, or his representative.
- All applicable permits and applications must be in place prior to start of work.

### 2.2.2 Fusion Technician Requirements

- If applicable, fusion technician shall be fully qualified by the pipe supplier to install fusible polyvinylchloride pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

## 2.3 Warranty

- A one year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the Sliplining contractor shall provide in writing a warranty for a period of one year for all the Sliplining work including material, installation, and pressure testing at no additional cost to the owner.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

## **2.4 Submittals**

### **2.4.1 Product Data**

The following product data is required from the pipe supplier and/or fusion provider:

- Pipe Size
- Dimensionality
- Pressure Class per applicable standard and as shown on plans
- Color
- Recommended Minimum Bending Radius
- Recommended Maximum Safe Pull Force
- Fusion technician qualification indicating conformance with this specification

### **2.4.2 Work Plan**

The following work plan and information is required from the contractor and/or slipline installer. This work plan and information shall also be supplied to the pipe supplier, should it be requested:

- Work plan shall include for each sliplining installation all excavation locations, interfering utilities, excavation dimensions, temporary water and traffic control schematics.
- At least 2 weeks prior to the start of work, the Contractor shall submit its sliplining schedule identifying daily work hours and working dates for each installation.
- Grout design mixes, installation plan, and contingency plan for the annular space grout to be used, if grout is to be used for annular space fill.

## **PART 3: PRODUCT**

### **3.1 Pipe**

As specified in Section 1.2 of this specification.

### **3.2 Grout**

- Grout for use as a filler of the annular space between the new pipe and the host pipe shall be a low-density, highly flowable mix. Grout shall meet the compressive strength requirements for the installation per the contract documents.
- Testing requirements shall be in accordance with the contract documents. Contractor may incorporate grout additives to improve its flow properties, provided that strength property requirements are met.

### **3.3 Pipe Pull Heads**

- Pipe pull heads, if utilized, shall employ a positive through-bolt design assuring a smooth walled bolt against the pipe cross-section at all times.
- Pipe pull heads shall be specifically designed for use with the new pipe, and shall be as recommended by the pipe supplier.

### **3.4 Pipe Rollers**

- Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and resist excessive sagging of the product pipe.

## **PART 4: EXECUTION**

### **4.1 Delivery and Off-Loading**

- All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Owner or Engineer.
- Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify Owner or Engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.
- Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.
- Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
- During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.
- If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to insure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

### **4.2 Handling and Storage**

- Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the

suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the Owner or Engineer.

- Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the Owner or Engineer.
- Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
- Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.
- If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe, which allows for temperature build-up, is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
- Pipe shall be stored and stacked per the pipe supplier's guidelines.

#### **4.3 Pipe Cleaning**

- Host pipe shall be cleaned in accordance with all applicable standards and guidelines. Unless otherwise specified, all interior pipe surfaces shall be cleaned per AWWA M28.
- Hazardous materials shall be removed and disposed of per all applicable regulations.
- All pipelines shall be cleaned with as many passes as necessary to create a uniform interior host pipe surface free of all loose material and sharp edges. Any potentially deleterious areas of the host pipe should be removed or secured in place, prior to the insertion of the new pipe.

#### **4.4 TV Inspection**

- The host pipe shall be inspected by TV after and possibly during the cleaning process in accordance with these specifications.
- TV inspection after host pipe cleaning shall indicate condition of host pipe and suitability of host pipe for new pipe insertion.
- Obstructions such as corporation taps, valves and valve bodies, and collapsed piping shall be remedied prior to insertion. Spot repairs shall be made in accordance with the drawings and these specifications.

## 4.5 Pipe Insertion and Installation

### 4.5.1 Excavation and Access Pits

- Location of the excavation pits shall be submitted to the Engineer prior to construction.
- Access pit length shall be such that the minimum bending radius for the new pipe, per the pipe supplier is maintained. Sheet piling, shoring and bracing requirements shall be in accordance with these specifications and applicable jurisdictional standards.
- Access pit excavations shall be performed at all points where the new pipe will be inserted into the existing pipeline. When possible, access pit excavations shall coincide with host pipe lateral connection points or other appurtenance installations.

### 4.5.2 Pulling Equipment

- The pulling mechanism shall be properly connected to the end of the new pipe via a pulling head or arrangement approved by the pipe supplier.
- The maximum pulling tension on the new pipe shall not exceed the pipe supplier's safe pulling force as submitted for this project.
- Immediately following the completion of an installation by sliplining, if possible, the pipe should be pushed back into the location of the insertion, at the pulling head, until a small amount of movement is realized at the insertion pit on the other side of the installation from the pulling equipment.

### 4.5.3 Pipe Care

- The pipe shall be handled with care to minimize the possibility of it being cut, kinked, gouged, or otherwise damaged. The use of cables or hooks will not be permitted.
- Sections of the pipe damaged, cut, or gouged shall be repaired by cutting out the section of damaged pipe and rejoining.

## 4.6 Annular Space Grouting

- If required, the annular space between the outside of the new pipe and the inside of the existing host pipe shall be filled with a flowable grout in accordance with the contract documents.
- Samples of grout shall be obtained in accordance with ASTM C495. One set of four standard cylinders shall be cast for each batch. Special handling and sampling procedures shall be followed if indicated by the grout manufacturer. The samples must meet the design compressive strength of the grout as outlined

in this specification and per the grout manufacturer. Samples shall be tested in accordance with ASTM C495.

- Grouting of the annular space shall be done in such a manner as to prevent damage, floating, or collapse of the new pipe. Grouting operations shall be properly vented. If the distance between grout points exceeds the Contractor's pumping capability additional grouting points shall be excavated. The new pipe at access pits, service connections, and grouting points shall not be grouted above the springline of the existing host pipe.
- The new pipe shall be filled with water prior to the grouting procedure. This shall aid in keeping the new pipe from floating or collapsing during grouting operation and also aid in dissipating the heat of hydration and its effects on the new pipe as the grout cures. This can be done in coordination with the testing performed on the new pipe.

#### **4.7 Preparation Prior to Making Connections Into Existing Piping Systems**

Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:

- Field verify location, size, piping material, and piping system of the existing pipe.
- Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
- Have installed all temporary pumps and/or pipes in accordance with established connection plans.
- Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

#### **4.8 Pipe System Connections**

Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents.

#### **4.9 Tapping for Potable Water Applications**

- Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. **NO DIRECT TAPPING WILL BE PERMITTED.** Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub-8.
- All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.

- Equipment used for tapping shall be made specifically for tapping PVC pipe:
- Tapping bits shall be slotted “shell” style cutters, specifically made for PVC pipe. ‘Hole saws’ made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
- Manually operated or power operated drilling machines may be used.
- Taps may be performed while the pipeline is filled with water and under pressure (‘wet’ tap,) or when the pipeline is not filled with water and not under pressure (‘dry’ tap).

#### **4.10 Testing**

Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

##### **4.10.1 Hydrostatic Testing and Leakage Testing for Pressure Piping**

All hydrostatic and leakage testing shall be in accordance to Sec 506.5 COD (Hydrostatic Test) as specified in City of Dallas Addendum to the North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards, Latest Edition.

- In preparation for pressure testing the following parameters must be followed:
- All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by ‘flushing’ the pipeline in accordance with the parameters and procedures as described in AWWA C605.
- The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer’s guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.
- Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to minimize the amount of potentially trapped air in the pipeline.

4.10.2 Disinfection of the Pipeline for Potable Water Piping

Once all pipe work is completed to the satisfaction of the Construction Manager, Dallas Water Utilities shall perform, as required, chlorine disinfection, sampling and analysis of the newly installed liner in accordance with the specifications and/or as ordered by the Engineer.

4.10.3 Partial Testing

Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer.

**PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***



## SECTION 2.7

### TECHNICAL SPECIFICATIONS FOR TEMPORARY WATER MAIN

#### PART 1: GENERAL

##### 1.1 Scope of Work

This specification covers the requirements for the complete installation and removal of temporary water mains including all necessary labor, materials, and equipment as necessary.

##### 1.2 Applicability

- Temporary water mains will be required as specified on the plans, specifications or as required by the Owner in order to maintain adequate water supply and fire protection.
- The temporary water main shall be maintained and repaired at all times by the Contractor until the new permanent main is placed in service.
- Temporary water mains may be reused in other phases as construction continues and as directed by the Owner.

#### PART 2: QUALITY ASSURANCE

##### 2.1 References

Temporary water mains shall conform to all applicable requirements of authorities having jurisdiction, including the followings:

- DWU Standard Technical Specifications for Water & Wastewater Construction, latest edition
- City of Dallas NCTCOG Addendum, latest edition
- Public Works Construction Standards by NCTCOG, Latest Edition
- DWU Standard Drawings for Water and Wastewater Construction, latest edition
- 30 TAC §290: Public Drinking Water

## 2.2 Submittals

The Contractor shall furnish the following documents prior to install any temporary water mains:

### 2.2.1 Material Data:

- Type and size of pipe and appurtenances to be used.

### 2.2.2 Design Data:

- Depth of cover or embedment to be used, if applicable. Consideration must be given regarding loads, public safety and protection of the pipe when placed in high traffic areas and exposed to freezing temperatures.

### 2.2.3 Layout Plan:

- Temporary water main layout plan based on proposed construction sequence as approved by the Owner.

## PART 3: PRODUCT

All temporary water main and appurtenance shall be new or acceptable used as approved by the Owner

### 3.1 Water Mains

- All temporary water mains shall be NSF/ANSI 61 approved.
- Contractor may selected one of the following pipe materials based on the traffic, weather condition, and construction sequence, as approved by the Owner:
  - PVC (Restrained Joint)
  - HDPE
  - Copper
  - Galvanized Iron
  - Other approved equal

### 3.2 Fitting and Appurtenances

- All the fitting, valves, fire hydrants and other appurtenances shall be NSF/ANSI 61 approved.
- Glued fittings shall not be permitted.
- Fittings are to be suitable and compatible with the specified pipe materials and class with which they are used.

### **3.3 Design Data**

- Temporary water main of 2" (or smaller) can be above ground or buried as approved by the Owner.
- Temporary water mains of larger than 2" shall be buried a minimum depth of 2 feet in order to protect from traffic and freezing conditions.
- Temporary water service shall be connected to the temporary water main for each building or single residential unit. Bull heads shall not be permitted unless otherwise approved by the Owner.
- Each temporary water service shall be supplied with its own individual corporation cock where it connects to the temporary water main.

### **3.4 Sizing**

- Minimum size of the temporary main shall be 2" as shown on the plans or as required by the Owner unless otherwise approved.
- Larger than 2" mains may also be required in order to provide interrupted and adequate water supply and fire protection in specific project sites. The sizing of the temporary mains shall depend on the number water services, water demand and fire protection requirements of the services being interrupted.

### **3.5 Valves**

- Valves shall be furnished and installed by the contractor on the temporary mains at locations designated by the Owner, so that the temporary mains can be isolated.
- Valves shall be installed at each branch of a temporary water main.
- Before permanently shutting down an existing water main, the valves shall be tested to ensure that they are in proper working order.
- 3/4" corporation stop copper shall be installed at the end of the temporary mains.

## **PART 4: EXECUTION**

### **4.1 Placement and Operation**

- Water mains shall be placed parallel to each side of the street and as close as possible to the area being serviced.
- When a street must be crossed with temporary water mains, installation will either be by open-cut or surface mount.
- Temporary water mains smaller than 2” in diameter may be surface mounded with temporary cold mix asphalt at all driveways and street crossings or where applicable, as long as it does not pose a safety concern. The Contractor may choose to utilize Pipe and Hose Ramps as manufactured by RubberForm Recycled Products, LLC or approved equal, to meet the safety requirements for small mains, per the manufacturer’s specifications.
- The Contractor shall furnish, place and connect temporary water services from the temporary main to a point beyond each meter box. The services will consist of a service clamp, corporation cock, sufficient length of copper pipe to reach beyond each meter box, copper to iron pipe union, street ell and bushing.
- Temporary water services range from ¾” to 2” in diameter. Temporary water services over 30 feet shall be a minimum of 1” in diameter.
- In the event the temperatures fall, the Contractor shall take steps to prevent temporary mains and services from freezing. Mains that do freeze shall be thawed by the Contractor utilizing an outside heat source. If flushing is done, the run-off shall be directed such that the street or sidewalk icing does not occur.
- Temporary water mains larger than 2” in diameter shall require open-cut or by other than open cut (BOTOC) across any driveways and streets/alleys.
- The following detail illustrates open-cut temporary asphalt paving for water mains larger than 2” in diameter.

### **4.2 Flushing, Disinfection, Sampling & Service Transfer**

- After installation, the temporary water main shall be flushed and chlorinated by the Owner and sampled by the Owner. Services shall not be transferred until the temporary main has been checked and approved by the Owner. There will be no additional compensation for delaying in obtaining approval to transfer services.

- Care shall be given during the installation process of temporary potable water supply services to avoid contamination.

#### **4.3 Removal of Temporary Water Mains**

- After the new permanent main services are in place and in service, the Contractor shall remove and dispose of the temporary mains, services, pipe hose ramps and/or temporary paving as necessary.
- All associate temporary paving and moundings shall be removed from the existing street surfaces.

#### **4.4 Site Restoration**

- Following construction operations, the contractor shall restore the work site to the original conditions or better. Backfill and compact all excavations according to these specifications.

### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

No measurement or direct payment will be made for temporary water mains unless otherwise specified by the plans and specifications.

**\*\*END OF SECTION\*\***

## SECTION 3.1

### TECHNICAL SPECIFICATION FOR REHABILITATION OF EXISTING WASTEWATER MAIN BY CURED-IN-PLACE PIPE (CIPP)

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all materials, labor, equipment, tools, and required incidentals for providing and installing a flexible tube saturated with a thermosetting, sulfuric acid corrosion resistant, polyester, vinyl ester, or epoxy resin, either inverted or pulled into the existing wastewater main such that when properly cured, extends from one manhole to the next in a continuous, tight-fitting, corrosion resistant, watertight pipe.

- Inversion Method

Insertion of a resin impregnated tube into the existing wastewater main using an inversion standpipe under a hydrostatic head or air pressure.

- Pulling Method

This method consists of pulling a resin impregnated tube into the existing wastewater main and expand with a calibration hose through the center and under pressure.

##### 1.2 Related Works

- Technical Specification for Wastewater Flow Control and Bypass Pumping
- Technical Specification for Wastewater Main Cleaning
- Technical Specification for Television Inspection of Wastewater Mains

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM F1216      Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube

ASTM D638      Standard Test Method for Tensile Properties of Plastics

ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
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 D5813	Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems
ASTM D2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

## 2.2 Qualification Requirements

### 2.2.1 Manufacturer/Installer:

No work by other than the CIPP manufacturer that involves this rehabilitation process will be accepted, unless such installers or companies are certified and licensed by the CIPP manufacturer for such work and are approved by the Owner. In addition, Manufacturer/Installers must meet the following criteria to be deemed commercially acceptable:

- Must satisfy all insurance, financial, and bonding requirements of the Owner, and must have had at least 5 (five) years active experience in the commercial installation.
- Must successfully installed at least 100,000 feet of the cured-in-place product intended for use on this project in wastewater collection systems in the U.S. with at least 50,000 feet installed in the State of Texas.
- Manufacturer/ Installer's project manager must have a minimum of 3 years of CIPP installation experience, while under the employment of the Manufacturer/ Installer's company.

### 2.2.2 Product:

- For a product to be considered commercially proven, a minimum of 20 successful wastewater collection system projects of a similar size and scope of work and 200,000 linear feet shall have been completed in the U.S. with the exact product intended for use on this project and documented to the satisfaction of the Owner to assure commercial viability.
- Both the rehabilitation manufacturing and installation processes shall operate under a quality management system which is third-party certified to ISO 9000 or

other recognized third-party certified organization standards. Proof of certification shall be required for approval.

- Sewer rehabilitation products submitted for approval must provide third party test results supporting the structural performance (short-term and long-term) of the product and such data shall be satisfactory to the Owner. No product will be approved without independent third party testing verification.

### **2.3 Warranty**

- A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the CIPP contractor shall provide in writing a warranty for a period of one year for all the CIPP work including material, installation, and pressure testing at no additional to the owner.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

### **2.4 Submittal**

The Contractor shall furnish all necessary catalogs cut sheets, technical literature, shop drawings and engineering data to address the following documentations:

#### **2.4.1 CIPP Questionnaire**

The Contractor must fill out and submit with his product submittal the questionnaire at the end of this section. Upon approval by the Engineer all information filled out in the questionnaire becomes part of the Contract, therefore, binding the Contractor/manufacturer/installer to meet or exceed the values set forth in the questionnaire.

#### **2.4.2 Material Data:**

Type of resin tube material and its physical properties

#### **2.4.3 Process Demonstration**

- Submit detailed installation procedures including curing methods, curing temperatures, inversion methods, inversion or pull-in pressures, etc.
- Method of sealing liner at manholes.



#### 2.4.4 Engineering Calculations:

Provide diameter, length, wall thickness and all structural design calculations for each wastewater main segment to be rehabilitated. All design calculations must be sealed by a State of Texas Registered Professional Engineer.

#### 2.4.5 Testing/TV Inspection Report

- Copies of certified independent laboratory tests on the proposed resin impregnated tube showing values for short term Flexural Modulus of Elasticity, Flexural Strength, Tensile Strength as listed in the questionnaire. The testing laboratory must be a certified independent facility and not affiliated with the proposed CIPP manufacturer/installer. In addition, submit field test results from one previous CIPP project over the last three years using the same values shown on the questionnaire.
- Television inspection reports along with video made after new pipe installation.

#### 2.4.6 References

- Provide three references of projects completed within last five years by the manufacturer in which a wastewater main was successfully rehabilitated using the proposed materials. Include contact names, addresses and phone numbers of agencies involved.

### **PART 3: PRODUCTS**

#### **3.1 Resin**

The resin system shall be a corrosion resistant polyester, vinyl ester or epoxy including all required catalysts, initiators that when cured within the tube create a composite that satisfies the requirements of ASTM F1216, Section 5.1 or ASTM F1743, Section 5.2.1 or ASTM D 5813, Sections 5 and 6. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

#### **3.2 Lining Tube**

##### 3.2.1 Inversion Flexible Felt Tube

- A sewn tube consisting of one or more layer of a non-woven felt material meeting the provisions of ASTM F1216, Section 5.1, can be used. The tube shall be lined on one side with a translucent waterproof coating such as polyurethane or polyvinylchloride (PVC) and fully impregnated with a sulfuric acid corrosion resistant liquid thermosetting polyester, vinyl ester, or epoxy resin and catalyst system compatible with the inversion process. The resin must meet ASTM F1216, Section 5.2. Any fiberglass stranded mattes are not acceptable.

- Size the tube to the existing wastewater pipe circumference and length between manholes as shown on drawings so it will stretch to fit irregular pipe sections; have sufficient strength to bridge missing pipe sections; and invert smoothly around bends. Allow for circumferential stretching during inversion.

### 3.2.2 Pulled-in Felt Fabrication

- A lining tube impregnated with a sulfuric acid corrosion resistant liquid thermosetting polyester, vinyl ester, or epoxy resin and catalyst system meeting ASTM F1216, Section 5.2 and compatible with the process, can be used.
- Size the tube to the existing wastewater pipe circumference and length between manholes shown on drawings so it will stretch to fit irregular pipe sections; have sufficient strength to bridge missing pipe sections; and invert smoothly around bends.

### 3.2.3 Thickness:

Tubes must have a uniform thickness that when compressed at installation pressures will meet or exceed the design thicknesses noted in the Questionnaire.

### 3.2.4 Material Homogeneity:

The tubes must be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric delamination or dry unsaturated layers.

### 3.2.5 Color:

CIPP wall coloring after installation must be a white color that can give a clear detail examination with the closed circuit television inspection equipment.

### 3.2.6 Seams:

Seams in the tube must be stronger than the unseamed felt. Sewn joints must be spirally formed and sewn with no perpendicular joint to the long axis.

### 3.2.7 Markings:

The Tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 feet. Such markings shall include the manufacturers name or identifying symbol. The tubes must be manufactured in the USA.

## PART 4: STRUCTURAL REQUIREMENTS

### 4.1 Design Standards:

The CIPP shall be designed as per ASTM F1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall.

### 4.2 Roughness Coefficient:

Resin liner must be smooth and have an average “n” factor of 0.013 or lower.

### 4.3 Design Parameters:

The resin liner material and thickness must be designed by the manufacturer to meet the following minimum parameters:

- The existing pipe condition is classified as a Partially Deteriorated Gravity Flow Pipe Condition (ASTM F1216 X 1.2.1).
- Resin Impregnated Liner Design Properties:
 

Minimum Design Flexural Modulus of Elasticity	250,000 psi
Minimum Flexural Strength	4,500 psi
Design Creep Reduction Factor	50%
Design Life	50 years
- Design Factors
 

Enhancement Factor	7.0
Poisson's Ratio	0.3
Ovalness	5%
Minimum Safety Factor	1.5

### 4.4 Special Considerations:

The manufacturer may propose design figures different from those above but they must be included on the Questionnaire and supported with documentation from independent laboratory tests backing the reason for the deviation. The Owner must approve any changes.

## **PART 5: EXECUTION**

### **5.1 Preparatory Procedure**

Adhere to the following conditions, unless approved otherwise by the Owner. After reviewing all television inspection videos and reports, but prior to starting any liner inversion process, make a plan of all work activities. All point repairs must be satisfactorily completed, equipment and material mobilized, and the Owner furnished a copy of the impending work schedules for liner installations.

#### **5.1.1 Safety**

Carry out operations according to all OSHA and manufacturer's safety requirements, drawing particular attention to those safety requirements involving working with scaffolding and entering confined spaces.

#### **5.1.2 Cleaning**

It is the responsibility of the Contractor to clean the existing wastewater pipe, specified elsewhere in these Specifications, by removing all internal debris out of the wastewater main immediately before the television inspection.

#### **5.1.3. Pre-Construction Television Inspection**

A pre-construction television inspection of wastewater mains shall be performed to locate or /confirm the breaks, obstacles and service connections as per Technical Specification for "Television Inspection of Wastewater Mains". Carefully inspect the interior of the wastewater main to determine the location and extent of any structural failures. Note any locations of any conditions which may prevent proper installation so that such conditions can be corrected. The Owner must review and approve the television inspection video prior to proceed with any rehabilitation.

#### **5.1.4 Flow Control**

The Contractor is to provide wastewater flow diversion around the section or sections of pipe designated for effective TV inspection and CIPP rehabilitation, specified elsewhere in these Specifications, at a cost incidental to the CIPP rehabilitation. Submit a flow control implementation plan for the Owner's approval prior to starting work. DO NOT pump wastewater into the streets, alleys, storm drains, rivers, creeks, or drainage channels (man-made or natural). The pump and bypass lines must be of adequate capacity and size to handle the flow. Take all necessary steps to prevent flooding of any residence or business. Contractor is liable for any damages incurred by same.

### 5.1.5 Line Obstructions

Identify any point repairs required, such as dropped joints, intruding service connections, collapsed pipe, sags in main or any other obstructions which prevents completion of the inversion process and remove prior to the lining process. This work must be approved in writing by the Owner and is to be done by the Contractor. The Owner reserves the right to approve or disapprove of any point repairs identified. The Owner also can decide if the point repair identified is needed or not.

### 5.1.6 Water

Water for the rehabilitation work is to be furnished by the City from the nearest fire hydrant. The Contractor must provide piping and connections for getting water to the site. Hauling, if required, is the Contractor's expense. Use a double-check valve assembly to prevent backflow in the event of a pressure failure. Backflow prevention must be approved by the Owner.

## 5.2 **Installation**

The manufacturer's written instructions and procedures for installing CIPP submitted as part of "Section 2.4 Submittal" above will be used as a basis of quality control by the Owner.

## 5.3 **Sealing Pipe in Manholes**

Cut the liner flush with the existing pipe at the manhole walls. Rework the invert (smoothed and built up) to match the flow line of the new liner pipe. If due to broken or misaligned wastewater pipe at the manhole, the installed pipe fails to make a tight seal, apply a sealant at that point. The sealant must be compatible with materials used in the lining process and approved, in writing, by the Owner.

## 5.4 **Service Connections**

- In providing re-connection of existing wastewater services, select (cut) service connection to match existing service diameter of minimum 6". Any existing service smaller than 6" shall be upsize to minimum of 6".
- It is the intent of these specifications that all service laterals be re-opened without excavation within 24 hours of beginning the inversion process, utilizing a remotely controlled cutting device, monitored by a CCTV.
- The Contractor shall certify a minimum of two complete functional cutters plus key spare components are on the job site before each installation or are in the immediate area of the jobsite and can be quickly obtained.
- Unless otherwise directed by the Owner or his authorized representative, all laterals will be reinstated with no less than 90% of their original capacity. No additional payment will be made for excavations for the purpose of reopening

connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

## **5.5 Post-Rehabilitation Television Inspection**

Upon completion of CIPP operation and reconnection of the service laterals, the Contractor shall perform television inspection of the rehabilitated wastewater main as outlined in the technical section "Television Inspection of Wastewater Mains".

## **5.6 Limitation and Constraints**

If wet-out is done at the site, confine the operations to one lane of traffic and provide adequate devices and facilities for containing any chemical spills.

## **5.7 ACCEPTANCE**

### **5.7.1 Finish**

- The finished pipe must be continuous over the entire length of an inversion run between two manholes and free from significant defects.
- Any defects which will affect, in the foreseeable future, or warranty period, the integrity or strength of the pipe in the opinion of the Owner must be repaired at the Contractor's expense, in a manner agreed upon by the Owner.

### **5.7.2 Testing of In-Place Material Properties**

- Prepare flat plate samples according to ASTM F1216, Section 8.1 for each section of line between manholes. Samples should be taken in an area (at manholes) designated by the Owner. Prepare at least two samples per section between manholes.
- The Owner will collect the samples and have them tested by a laboratory at his own choosing and expense. Samples will be tested for compliance with the specified liner thickness, flexural strength and flexural modulus of elasticity stated in the approved Questionnaire.

### **5.7.3 Inspection**

After the work is completed, the contractor will provide the Owner with a video showing the before and after condition, including the reinstated wastewater line and building lateral connections.

#### 5.7.4 Failure to Meet Requirements

- The Owner will view the inspection video tape and determine if all required work is complete. Any deficiencies noted by the Owner must be corrected to his satisfaction.
- Any section failing the water tightness test must be corrected or modified by the Contractor until it passes.
- The Owner will evaluate in-place material tests for each section between manholes and if the test results show the liner does not meet the stated criteria in the approved Questionnaire, a penalty or deduction from the Contract will be assessed as follows:

**C** = Bid Item Cost for CIPP per Linear Foot in the Bid Proposal

**L** = Length of Line between Manholes where the deficiencies occurred.

All adjustments are cumulative for Modulus, strength and thickness. These results will apply to all test values which fall between 95% and 100% of the stated Questionnaire value. If the results are below 95% for flexural Modulus and strength, the Contractor must submit a proposal to remedy the problem. The Owner may accept, at an adjusted price based on the formula above, thicknesses less than 95% of minimum stated in the attached Questionnaire only if the thickness provided exceeds the calculated modified design thickness (i.e. the thickness required with the actual flexural Modulus of elasticity and actual depth). No credit or extra pay will be given for any test results over the values listed in the Questionnaire.

#### 5.8 **Cleanup**

Clean up the entire project area after the work is completed and all testing accepted. Remove and dispose of all excess material and debris not incorporated into the permanent installation.

### **PART 6: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**CIPP QUESTIONNAIRE  
(To Be Filled by Contractor)**

Manufacturer/Installer \_\_\_\_\_

Trademark Name for the Process \_\_\_\_\_

Type and Brief Description of Installation Process (Inversion, Pull-in, or Other)

\_\_\_\_\_  
\_\_\_\_\_

Submit detailed installation procedures including curing methods, curing temperatures, inversion methods, inversion or pull-in pressures, etc.

Type and Description of the Liner: \_\_\_\_\_

Type and Brief Description of The Resin (polyester, vinyl ester, or epoxy resin):

\_\_\_\_\_  
\_\_\_\_\_

Submit laboratory analysis of the proposed resin(s) showing chemical makeup and concentrations. Samples will be taken in the field and tested to verify this chemical makeup.

**Engineering Properties of the Resin:**

Short Term Flexural Modulus of Elasticity \_\_\_\_\_

Short Term Flexural Strength \_\_\_\_\_

Short Term Tensile Strength \_\_\_\_\_

**\*\*END OF SECTION\*\***



## SECTION 3.2

### TECHNICAL SPECIFICATION FOR REHABILITATION OF EXISTING WASTEWATER MAIN BY PIPE BURSTING (PB)

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all materials, labor, equipment, tools, and required incidentals for the replacement of wastewater mains by Pipe Bursting method. The Pipe Bursting process is defined as the trenchless reconstruction of existing wastewater mains by the simultaneous insertion of liner pipe within the bore of the existing pipe, by breaking and expanding the existing pipe. The scope includes reconnection of existing wastewater service connections, television inspection of the newly rehabilitated pipe and complete installation in accordance with the contract documents. Only hydraulically and pneumatically operated equipment will be allowed for this method.

##### 1.2 Related Works

- Technical Specification for "Wastewater Flow Control and Bypass Pumping"
- Technical Specification for "Wastewater Main and Manhole Cleaning"
- Technical Specification for "Television Inspection of Wastewater Mains"

#### PART 2: QUALITY ASSURANCE

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM D1248	Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
ASTM D2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

ASTM D618	Standard Practice for Conditioning Plastics for Testing
ASTM D2657	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

## 2.1 Qualification Requirements

- The Contractor shall be certified by the manufacturer of the pipe bursting system that it is a fully trained licensed installer of their pipe bursting system. Contractor must provide a letter to the Owner documenting this requirement.
- The Contractor shall have a minimum of three (3) years verifiable experience using the pipe bursting method while meeting the following criteria:
  - A minimum total of 100,000 LF of completed pipe bursting footage.
  - A minimum total of 50,000 LF of upsizing where similar sized diameter increases have been successfully completed in pipe diameters of 8-inch to 12-inch range.
  - A minimum total of 25,000 LF of pipe bursting experience on diameters 18-inch and larger.
- Personnel performing pipe bursting must be certified by manufacturer of pipe bursting system having successfully completed training in:
  - Operating bursting head
  - Installing proposed replacement pipe.
  - Operation and maintenance of all equipment to be used
- Personnel performing fusing of liner pipe and fittings must be certified by manufacturer of fusing equipment having successfully completed training in:
  - Handling replacement pipe materials.
  - Butt fusion of pipe joints, saddle fusion of fittings for service laterals
  - Operation and maintenance of all equipment to be used

## 2.2 **Warranty**

- A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the pipe bursting Contractor shall provide in writing a warranty for a period of one year for all the pipe bursting work including material, installation, and pressure testing at no additional to the owner.
- Unless otherwise specified, the warranty period shall begin after the Certificate of Acceptance is issued for the Contract.

## 2.3 **Submittals**

The Contractor shall furnish the following documents made in a timely manner so that project schedule can be met:

### 2.3.1 Material Data

- Shop drawings, catalog data and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings.
- Manufacturer's recommendation for handling, storage, and repair of pipe and fittings damaged.

### 2.3.2 Process Demonstration

- Submit detailed installation procedure including pipe bursting method to be used.
- Method of construction and restoration of existing sewer service connections. This shall include detail drawings and written description of the entire construction procedure to install pipe, bypass wastewater flow and reconnection of sewer service connections.

### 2.3.3 Testing Documentations

Television inspection reports along with video made after new pipe installation.

### 2.3.4 Reference

Provide a list of minimum three previous projects completed in the last three years by the contractor/installer in where a wastewater main was successfully rehabilitated using the pipe bursting method. Include contact names, addresses and phone numbers of agencies involved.

**PART 3: PRODUCT**

**3.1 Liner Pipe:**

Liner Pipe shall be high-density polyethylene pipe and meet the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, ASTM D1248, and ASTM D3350.

- Sizes of the insertions to be used shall be as shown on the plans or to renew the wastewater main to its original or greater than original flow capacity.
- All pipes shall be made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation shall be used.
- The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters or other deleterious faults.
- Material color shall be white, gray or light colored, suitable for TV inspection.
- Unless otherwise specified plan or specification, the minimum wall thickness of the polyethylene pipe shall meet the following:

Typical Application	Depth of Cover (ft.)	Separation Distance from Water Main (ft.)	SDR (DIPS* HDPE)	Min. Pressure (psi)
Gravity	< 10.0	≥ 9	17	100
		< 9	11	160
	> 10.0	As Required	11	160
Force Main	As Required	As Required	11	160

*\*Note: Only Ductile Iron Pipe Size (DIPS) shall be used unless otherwise specified in the plans and/or specifications.*

## **PART 4: EXECUTION**

### **4.1 Delivery, Storage and Handling**

Transport, handle and store pipe and fittings as recommended by manufacturer. If new pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Owner, at the Contractor's expense, before proceeding further. Deliver, store and handle other materials as required to prevent damage.

### **4.2 Pre Pipe-Bursting Television Inspection**

A pre pipe-bursting television inspection of wastewater mains shall be performed to locate or /confirm the breaks, obstacles and service connections as per Technical Specification for "Television Inspection of Wastewater Mains". The Owner must review and approve the television inspection video prior to proceed with any rehabilitation.

### **4.3 Obstruction Removal**

Identify any point repairs required, such as dropped joints, intruding service connections, collapsed pipe, sags in main or any other obstructions prior to the pipe bursting process. The Contractor shall remove all obstructions to perform pipe bursting operation, as necessary.

The contractor shall notify the inspector for approval to make an excavation after having exhausted all other options to remove any obstruction or retrieve any pipe bursting tool or camera from the wastewater main.

### **4.4 Diversion Pumping**

- The Contractor, when and where required, will divert wastewater flows for the cleaning, pipe bursting, television inspection, point repairs, obstruction removals, or other related work in this project as required to complete the work. All works to be done as per as per Technical Specification for "Wastewater Flow Control".
- The Contractor shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer during the execution of the work.
- If sewage backup occurs and enters buildings, the Contractor shall be responsible for clean up, repair, property damage cost and claims.

#### 4.5 Insertion Pit or Access Pit

- Insertion or access pits shall be efficiently located so that total number of pits are minimized and footage of liner pipe installed in a single pull is maximized. Where possible, use existing manholes and excavations at point repair locations for insertion pits.
- To facilitate long insertion runs, intermediate insertion pits may be allowed at the most advantageous location to provide for replacement pipe to be installed in both directions. When insertion pits are required in the lanes of traffic, the operation shall be limited to one (1) lane of traffic or one-half (1/2) of the roadway, whichever is less.
- Insertion pits shall be only as large as required to accommodate the equipment. All pit dimensions and locations shall be approved by the Owner in writing, prior to beginning work.
- Manholes may be placed at insertion pit location as directed by the Owner.
- In the event the pipe bursting process requires the excavation of an insertion pit, the pipe through the pit shall be bedded in the required bedding material.

#### 4.6 Pipe Bursting and Liner Insertion

- Equipment used to perform the work shall be located away from buildings so as to minimize noise impact. Provide silencers or other devices to reduce machine noise as required to meet requirements.
- The Contractor shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances will the pipe be stressed beyond its elastic limit.
- The installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines, sealing of the annulus or backfilling of the insertion pit. Sufficient excess length of new pipe, but not less than four (4) inches, shall be allowed to protrude into the manhole to provide for occurrence.
- Following the relaxation period, the annular space may be sealed. Sealing shall be made with materials approved by the Engineer and/or his representative and shall extend a minimum of eight (8) inches into the manhole wall in such a manner as to form a smooth, uniform, watertight joint.

- The new wastewater pipe shall be placed without damaging the pipe joints or completed pipe sections. Any pipe which has been damaged during installation shall be replaced by the Contractor.

#### **4.7 Pipe Joining**

- The polyethylene pipe shall be assembled and joined at the site using the thermal butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.
- The butt-fused joint shall be true alignment and shall have uniform roll-back-beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. When cool, all weld beads shall then be removed from both the inside and outside surface such that the joint surfaces shall be smooth. The fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Engineer and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the City. Any section of the pipe with a gash, blister, abrasion, nick, scar or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Engineer and/or his representative shall be discarded and not used.
- Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp. The butt gap between pipe ends shall not exceed one-half (1/2) inch.

#### **4.8 External Service Connections**

- In providing re-connection of existing wastewater services, select service connection pipe diameter must match existing service with a minimum diameter of 6". Any existing service smaller than 6" shall be upsize to minimum of 6".
- All wastewater service connections shall be identified, located and excavated prior to the pipe insertion to expedite reconnection. Upon commencement, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the Owner. Upon completion of insertion of the new pipe, the

Contractor shall expedite the reconnection of services to minimize any inconvenience to the customers.

- Mechanical saddles shall be made of polyethylene pipe compound that meets the requirements of ASTM 01248, Class C; have stainless steel straps and fasteners, neoprene gasket and backup plate. Mechanical saddles shall be heat fusion saddles, Strap-On-Saddle Type as manufactured by Driscoplex™ or Tapping Saddle Manufactured by Fernco Joint Sealer Company, DFW Plastics, Inc. or approved equal. Once the saddle is secured in place; drill hole full inside diameter of saddle outlet in pipe liner.
- At all points where the polyethylene pipe has been exposed, as in starter excavations, at service connection fittings, outside of manholes, etc., the Contractor shall encase the pipe and fittings in minimum of 6-inches of concrete or flowable backfill. If flowable backfill is used, the Contractor shall remove all debris, and create a void along each side of the pipe at the spring line to undisturbed soil, in preparation for the flowable backfill. Width of the void shall not exceed (main outside diameter + 2ft.) or (service line outside diameter + 2ft.).

#### **4.9 Field Testing**

Tests for compliance with this specification shall be made as specified herein and in accordance with the applicable ASTM Specification. A certificate with this specification shall be furnished, upon request, by the manufacturer for all material furnished under this specification. Polyethylene plastic pipe and fittings may be rejected for failure to meet any requirements of this specification.

#### **4.10 Post-Pipe Bursting Television Inspection**

Upon completion of pipe bursting operation and reconnection of the service laterals, the Contractor shall perform television inspection of the rehabilitated wastewater main as outlined in the technical section "Television Inspection of Wastewater Mains".

#### **4.11 Final Cleanup**

Upon completion of installation, testing and inspection, clean and restore project area affected by work of this section.

### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***



## SECTION 3.3

### TECHNICAL SPECIFICATION FOR RECYCLED/ RECLAIMED WATER PIPE

#### PART 1: GENERAL

##### 1.1 Scope of Work

This specification is for all recycled/reclaimed water lines.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

- Public Works Construction Standards for North Central Texas by North Central Texas Council of Governments (NCTCOG), Edition as adopted by DWU
- Addendum to the NCTCOG Standards by DWU, Latest Edition
- §217.69: Reclaimed Water Facilities by Texas Commission on Environmental Quality (TCEQ)
- AWWA C105, Class C

##### 2.2 Submittals

Submittals shall be as described in the pertinent pipe or appurtenance specifications.

#### PART 3: PRODUCT

##### 3.1 Materials

Pipe materials shall be as specified in the plan and will meet all the applicable specification requirements.

##### 3.1.1 Pipe

Recycled water pipe must be purple in color. For concrete cylinder pipe a purple dye shall be added to the outside mortar coating concrete mix. For PVC pipe purple dye shall be added during fabrication. As an alternative and for metal pipes the recycled water pipe may be encased inside an 8.0-millimeter purple polyethylene sleeve conforming to AWWA C105, Class C.

### 3.1.2 Detector Tape:

A detector tape must be laid in the same trench as the recycled water pipe and shall be located above and parallel to the pipe. The detector tape shall bear the label “PRESSURIZED WASTEWATER” continuously repeated in letters at least one and one-half inches high.

### 3.1.3 Valves

All valves on the recycled water line must open clockwise and valve covers must have the lettering “REUSE” or “NPW” cast onto the face of the lids.

### 3.1.4 Manholes, Vaults, and Meter Boxes

All manholes, vaults, and meter boxes on the recycled water line shall have a permanent sign affixed inside which is labeled “NON-POTABLE WATER, DO NOT DRINK” in both English and Spanish. All manhole lids must have the lettering “REUSE” or “NPW” cast onto the face of the lids.

## **PART 4: METHOD OF MEASUREMENT AND PAYMENT**

There are no separate pay items for these requirements. The cost for these items should be included as incidental to the bid price for the related pipe and appurtenance items.

**\*\*END OF SECTION\*\***

## SECTION 3.4

### TECHNICAL SPECIFICATION FOR SLIPLINING OF WASTEWATER MAIN

#### PART 1: GENERAL

##### 1.1 Scope of work

Furnish all materials, labor, equipment, tools, and required incidentals for the replacement of wastewater mains by Sliplining method. Sliplining is defined as the trenchless reconstruction of existing wastewater mains by subsequently inserting pipe lengths, which are joined into a continuous tube, within the bore of the existing pipe and grouting the annular spacing between the new pipe and the existing pipe.

The scope includes standards for dimensionality, testing, quality, acceptable fusion practice, safe handling, storage and installation of the pipe by sliplining.

##### 1.2 Pipe Description

Unless otherwise specified in the plans and/or specifications, the following pipes or approved equal can be considered for sliplining contingent upon approval by the Owner:

- Fusible Polyvinylchloride (PVC) pipe and manufactured by Underground Solutions, Inc. or approved equal.
- Other pipeline including Reinforced Thermosetting Resin Pipe (RPRT), Reinforced Polymer Mortar Pipe (RPMP), High Density Polyethylene (HDPE), as approved by DWU.

##### 1.3 Related Work

- Technical Specification for Fusible Polyvinylchloride (PVC) Wastewater Pipe
- Other related specifications as applicable

## PART 2: QUALITY ASSURANCE

### 2.2 Reference Standards

- This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- Unless otherwise specified, references to documents shall mean the documents in effect at the time of design, bid, or construction, whichever is earliest. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
- Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2152	Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large

### Diameter Plastic Gravity Sewer Pipe and Fittings

ASTM F1057	Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

## 2.2 Qualification Requirements

### 2.2.1 Installer

All sliplining operations shall be performed by a qualified sliplining company who has at least three (3) years of experience involving work of a similar nature. The company must have installed a minimum of 10,000 linear feet of pipe (6-inch diameter or greater) using sliplining and supply a list of project references, prior to job commencement.

- Schedule all work through the Owner. Notify the Owner a minimum of ten (10) working days in advance of the start of work.
- Perform all work in the presence of the Owner, or his representative.
- All applicable permits and applications must be in place prior to start of work.

### 2.2.2 Fusion Technician Requirements

If applicable, fusion technician shall be fully qualified by the pipe supplier to install fusible polyvinylchloride pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

## 2.3 Warranty

- A one year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the Sliplining contractor shall provide in writing a warranty for a period of one year for all the Sliplining work including material, installation, and pressure testing at no additional cost to the owner.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

## **2.4 Submittals**

### **2.4.1 Product Data**

The following product data is required from the pipe supplier and/or fusion provider:

- Pipe Size,
- Wall Thickness
- Dimensionality
- Pressure Class or Pipe Stiffness per applicable standard and as shown on plans
- Color
- Recommended Minimum Bending Radius
- Recommended Maximum Safe Pull Force
- Fusion technician qualification indicating conformance with this specification

### **2.4.2 Work Plan**

The following work plan and information is required from the contractor and/or slipline installer. This work plan and information shall also be supplied to the pipe supplier, should it be requested:

- Work plan shall include for each sliplining installation all excavation locations, interfering utilities, excavation dimensions, bypass pumping and traffic control schematics.
- At least 2 weeks prior to the start of work, the Contractor shall submit its sliplining schedule identifying daily work hours and working dates for each installation.
- Grout design mixes, installation plan, and contingency plan for the annular space grout to be used, if grout is to be used for annular space fill.

## **PART 3: PRODUCT**

### **3.1 Pipe**

As specified in Section 1.2 of this specification.

### **3.2 PVC Gasketed Push-on Fittings**

Acceptable fittings for use with new pipe shall include standard PVC pressure fittings conforming to applicable standards.

- Acceptable fittings for use joining new pipe other sections of fusible polyvinylchloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the drawings.

- Bends, tees and other PVC fittings shall be restrained with the use of thrust blocking or other restraint products as indicated in the construction documents.
- PVC gasketed, push-on fittings and mechanical restraints, if used, must be installed per the manufacturer's guidelines.

### **3.3 Connections for Gravity Sanitary Sewer and Non-Pressure Applications**

The connections are to be used in conjunction with tie-ins to other non-pressure, gravity sewer piping and/or structures, and shall be as indicated in the construction documents or approved by the Owner.

### **3.4 Grout**

- Grout for use as a filler of the annular space between the liner pipe and the host pipe shall be a low-density, highly flowable mix. Grout shall meet the compressive strength requirements for the installation per the contract documents.
- Testing requirements shall be in accordance with the contract documents. Contractor may incorporate grout additives to improve its flow properties, provided that strength property requirements are met.

### **3.5 Pipe Pull Heads**

- Pipe pull heads, if utilized, shall employ a positive through-bolt design assuring a smooth walled bolt against the pipe cross-section at all times.
- Pipe pull heads shall be specifically designed for use with fusible polyvinylchloride pipe, and shall be as recommended by the pipe supplier.

### **3.6 Pipe Rollers**

- Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and resist excessive sagging of the product pipe.

## **PART 4: EXECUTION**

### **4.1 Delivery and Off-Loading**

- All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.
- Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify owner or engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.
- Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.
- Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
- During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.
- If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to insure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

### **4.2 Handling and Storage**

- Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the owner or engineer.
- Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.
- Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
- Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.



- If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
- Pipe shall be stored and stacked per the pipe supplier's guidelines.

#### **4.3 Pipe Cleaning**

- Host pipe shall be cleaned in accordance with all applicable standards and guidelines. Unless otherwise specified, all interior pipe surfaces shall be cleaned per AWWA M28.
- Hazardous materials shall be removed and disposed of per all applicable regulations.
- All pipelines shall be cleaned with as many passes as necessary to create a uniform interior host pipe surface free of all loose material and sharp edges. Any potentially deleterious areas of the host pipe should be removed or secured in place, prior to the insertion of the new pipe.

#### **4.4 TV Inspection**

- The host pipe shall be inspected by TV after and possibly during the cleaning process in accordance with these specifications.
- TV inspection after host pipe cleaning shall indicate condition of host pipe and suitability of host pipe for replacement pipe insertion.
- Obstructions such as corporation taps, valves and valve bodies, and collapsed piping shall be remedied prior to insertion. Spot repairs shall be made in accordance with the drawings and these specifications.

#### **4.5 Pipe Insertion and Installation**

##### **4.5.1 Excavation and Access Pits**

- Access pit length shall be such that the minimum bending radius for the replacement pipe, per the pipe supplier is maintained. Sheeting, shoring and bracing requirements shall be in accordance with these specifications and applicable jurisdictional standards.
- Access pit excavations shall be performed at all points where replacement pipe will be inserted into the existing pipeline. When possible, access pit excavations shall coincide with host pipe lateral connection points or other appurtenance installations.

##### **4.5.2 Pulling Equipment**

- The pulling mechanism shall be properly connected to the end of the newer pipe via a pulling head or arrangement approved by the pipe supplier.

- The maximum pulling tension on the new pipe shall not exceed the pipe supplier's safe pulling force as submitted for this project.
- Immediately following the completion of an installation by sliplining, if possible, the pipe should be pushed back into the location of the insertion, at the pulling head, until a small amount of movement is realized at the insertion pit on the other side of the installation from the pulling equipment.

#### 4.5.3 Pipe Care

- The pipe shall be handled with care to minimize the possibility of it being cut, kinked, gouged, or otherwise damaged. The use of cables or hooks will not be permitted.
- Sections of the pipe damaged, cut, or gouged shall be repaired by cutting out the section of damaged pipe and rejoining.

#### 4.6 **Annular Space Grouting**

- If required, the annular space between the outside of the replacement pipe and the inside of the existing host pipe shall be filled with a flowable grout in accordance with the contract documents.
- Samples of grout shall be obtained in accordance with ASTM C495. One set of four standard cylinders shall be cast for each batch. Special handling and sampling procedures shall be followed if indicated by the grout manufacturer. The samples must meet the design compressive strength of the grout as outlined in this specification and per the grout manufacturer. Samples shall be tested in accordance with ASTM C495.
- Grouting of the annular space shall be done in such a manner as to prevent damage, floating, or collapse of the replacement pipe. Grouting operations shall be properly vented. If the distance between grout points exceeds the Contractor's pumping capability additional grouting points shall be excavated. The replacement pipe shall not be grouted above the springline of the existing host pipe at access pits, service connections, and grouting points.
- The replacement pipe shall be filled with water prior to the grouting procedure. This shall aid in keeping the replacement pipe from floating or collapsing during grouting operation and also aid in dissipating the heat of hydration and its effects on the new pipe as the grout cures.

#### 4.7 **Preparation Prior to Making Connections Into Existing Piping Systems or Manhole**

Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:

- Field verify location, size, piping material, and piping system of the existing pipe.
- Obtain all required appurtenances or wastewater fittings as shown in the construction documents.
- Have installed all temporary pumps and/or pipes in accordance with established connection plans.
- Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

#### **4.8 Pipe System Connections**

Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

#### **4.9 Testing**

Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws as adopted DWU.

### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 3.5

### FIBERGLASS WASTEWATER PIPE

#### PART 1: GENERAL

##### 1.1 Scope of Work

This specification designates the requirements for Fiberglass (Glass-Fiber- Reinforced Thermosetting-Resin) Sewer Pipe (RTRP). Centrifugally Cast or Filament Wound manufacturing process is acceptable.

#### PART 2: QUALITY ASSURANCE

All Pipes, joints, and fittings supplied under this specification to, as a minimum, conform to the requirements of ASTM D-3262 or ASTM D-3754.

##### 2.1 Reference Standards

This specification references American Society for Testing and Materials (ASTM) standard specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.

ASTM D-3681 Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.

ASTM D-3262 Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

ASTM D-3754 Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.

ASTM D-4161 Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

ASTM F-477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

ASTM D-2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

## 2.2 Submittals

- Contractor shall submit load and pipe calculations confirming selected pipe behavior. Load calculations shall include jacking load resistance, buckling resistance, pipe deflection, pipe wall strain cracking and wall crushing load. All design calculations shall be sealed by a Registered Professional Engineer of the State of Texas.
- Product data submittals to include the following as a minimum:
  - Details of the proposed pipe.
  - Details of proposed manholes.
  - Properties, strengths, etc. of the pipe.
  - Joint detail drawing, including maximum interior joint gap opening, in the deflected position and in the straight alignment.
  - Instructions on storage, handling, transportation, and pipe installation.
  - Standard catalog sheets.
  - Gasket type and composition showing ability to withstand the chemicals and conditions within sanitary sewers.
  - Pipe laying schedule.
  - Connections to all proposed structures including water stop.
  - Special fittings.
  - Methods of maintaining grade and position during installation and grouting.
  - Methods of testing pipe deflection after installation.
  - Methods for achieving designed buoyancy resistance, assuming empty pipe.

## PART 3: PRODUCTS

### 3.1 Materials

3.1.1 Resin Systems

The manufacturer to use only approved quality polyester resin systems for which he can provide a proven history of performance in this particular application. The historical data to have been acquired from a composite material of similar construction and composition as the proposed product.

3.1.2 Glass Reinforcements

The reinforcing glass fibers used to manufacture the components to be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

3.1.3 Fillers

Sand may be used. Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.

3.1.4 Additives

Resin additives, such as pigments, dyes, and other coloring agents, if used, to be in no way detrimental to the performance of the product nor are they to impair visual inspection of the finished product.

3.1.5 Rubber Gaskets

The gasket shall meet the requirements of ASTM F-477 and the chemical composition of the Gasket shall be compatible with the environment found in sanitary sewers.

**3.2 Design**

- All RTRP or RPMP sewer pipe shall be in accordance with ASTM D-3262 or ASTM D-3754. The stiffness is to be measured in accordance with ASTM D-2412 and in no case shall the stiffness be less than SN46.
- The design calculations shall be based on the following loading conditions:

Soil Density	132 lb./ft <sup>3</sup> (min.)
Live Loading	Negligible
Max. Depth of Soil Cover Above Pipe Crown	See Profile
Max. Hydrostatic Head Above Pipe Crown	25 feet
Min. Internal Pressure	18 psi
Max. Modulus of Soil Reaction (E') for Initial Pipe Deflection	750
Surge Pressure	0 psi

## **PART 4: EXECUTION**

### **4.1 Manufacture and Construction**

#### **4.1.1 Pipes**

The pipes to be furnished in the diameters specified and within the tolerances specified herein. They must be manufactured by the centrifugal casting or filament wound process to result in a dense, nonporous, corrosion-resistant, consistent composite structure to meet the operating conditions. Stiffening ribs or rings are not to be used.

#### **4.1.2 Joints**

Unless otherwise specified, the pipe to be field connected with fiberglass sleeve couplings that utilize elastomeric sealing rings as the sole means to maintain joint water tightness. The joints must meet the performance requirements of ASTM D-4161. The joint sleeves on jacking pipe shall have a maximum outside diameter no greater than the outside diameter of the pipe.

#### **4.1.3 Fittings**

Flanges, elbows, reducers, tees, wyes and other fittings, when installed, to be capable of withstanding all operating conditions. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays.

#### **4.1.4 Jacking Load**

The contractor must control the jacking loads within the safe limits of the pipe as recommended by the pipe manufacturer.

### **4.2 Dimensions**

#### **4.2.1 Wall Thickness**

The average wall thickness of the pipe shall not be less than the nominal wall thickness published in the manufacturer's literature and the minimum wall thickness at any point shall not be less than 87.5% of the nominal wall thickness when measured in accordance to test method of stiffness of ASTM D-3262 or ASTM D-3754.

#### **4.2.2 End Squareness**

All pipe ends to be square to the pipe axis. ( $\pm 1/4"$  or  $\pm 0.5\%$  of the nominal diameter of the pipe, whichever is greater)

#### 4.2.3 Tolerance of Fittings

The tolerance of the angle of an elbow and the angle between the main and leg of a wye or tee to be  $\pm 2$  degrees. The tolerance on the laying length of a fitting to be  $\pm 2$  inches.

#### 4.3 **Deflection**

A pipe submittal will be required from the manufacturer indicating the inside diameter of the pipe to be installed and the manufacturing tolerances. Maximum allowable deflection is 3% (30 days after installation) and 5% long term deflection; allowable deflection will include manufacturing tolerances and will not be in addition to. If the pipe is over deflected in an "other than open cut" section, either before or after grouting, it shall be removed and new pipe will be installed, or a quality, structurally sound repair agreed upon by the owner will be made.

#### 4.4 **Testing**

- The physical properties and characteristics of the pipes used in the project to have been determined by prototype testing of the manufactured product. These tests need not be conducted specifically for this project if prior tests on similar product of the same stiffness class and diameter have been previously completed. The Contractor is to obtain copies of all test results which must be retained and are to be made available to the Engineer.
- Joints - Coupling joints to be qualified per the tests of Section 7 of ASTM D-4161.
- Installed Pipe - Joints are to be individually tested in accordance with section 507 of the NCTCOG Public Works Construction Standards and the City of Dallas Addendum thereto. Total seepage in infiltration of ground water for both the pipe and the joint shall be zero (0).
- Rejected pipe must be identified by the manufacturer in a manner that will insure it will not be used on this project. The owner must agree to the method of identification of rejected pipe.

#### 4.5 **Marking**

Each pipe shall be clearly marked on the exterior surface of the pipe barrel with the nominal diameter, pipe stiffness, date of manufacture, the name or trademark of the manufacturer and the manufacturer's Quality Assurance stamp of approval in accordance with ASTM standards. Marking shall be indented on the pipe sections or painted thereon with waterproof paint.



**PART 5: METHOD FOR MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 4.1

### TECHNICAL SPECIFICATION FOR REMOVAL, HANDLING, CUTTING, DISTURBANCE AND DISPOSAL OF ASBESTOS CEMENT PIPE

#### PART 1: GENERAL

##### 1.1 Scope of Work

This item shall govern the removal, handling, disturbance, cutting, and disposal of asbestos cement (AC) pipe and other asbestos containing materials (ACM) related to the AC pipe work. AC pipe is also known as transite pipe. Any buried pipe typically containing approximately 15 to 20 percent chrysotile and crocidolite asbestos, is considered to be ACM. The material is classified as non-friable unless broken, at which time its classification changes to friable ACM. The removal and/or disturbance of this material is governed by the National Emissions Standards for Hazardous Air Pollutants (NESHAP) and the Occupational Safety and Health Administration (OSHA).

##### 1.2 Description:

This item shall consist of the removal, handling, cutting, disturbance, and disposal of AC water pipe, joints, wrappings, and other ACM. To comply with NESHAP and OSHA regulations, this project requires workers with specialized training using wet work procedures to cut and remove AC pipe, AC pipe joints, valves (any type) containing ACM, and surrounding soils containing ACM. A Texas Department of Health (TDH) licensed Asbestos Consultant shall develop the asbestos work practices and the monitoring in the Contractor's Health and Safety Plan to be reviewed by the Owner's Representative. It is the Contractor's responsibility to obtain the services of a licensed Asbestos Consultant authorized in the State of Texas; this work shall be considered subsidiary to this item.

To meet and/or exceed NESHAP and OSHA guidelines, the Contractor shall subcontract the AC water pipe handling to an Environmental Protection Agency (EPA) accredited and TDH licensed Asbestos Abatement Contractor, and TDH Licensed Asbestos Consultant.

NESHAP guidelines apply to projects when at least 260 linear feet or 35 cubic feet or 160 square feet of AC pipe becomes or will become "regulated asbestos containing material" or RACM. If the threshold limits are exceeded, the Contractor shall be responsible for the TDH administrative fee. The Asbestos Consultant shall also be

responsible for submitting the TDH notification and copying the Owner's Representative.

During the disjoining operation of AC pipe removal, if the debris caused by the disjoining operation is cleaned up so that it does not contaminate a greater length of pipe, only the portion that has become RACM shall be counted toward the threshold amount. However, if the generated AC pipe debris is not properly cleaned up, then the entire pipe shall be considered contaminated and the whole length shall be treated as asbestos containing waste material (ACWM). If the scope of this project involves a threshold amount, then a Demolition/Renovation Notification Form shall be sent to TDH by the Contractor. This form shall be post-marked no later than 11 working days prior to the start of any asbestos disturbance.

All AC pipe projects require that NESHAP and OSHA guidelines be met and/or exceeded in areas where AC pipe is to be disturbed. Thus, all AC pipe disturbances require a third party TDH licensed Asbestos Consultant and an Asbestos Contractor on-site during AC pipe disturbance. An asbestos abatement work plan shall be provided to the Owner's Representative by both the licensed Asbestos Consultant and the Asbestos Contractor. Upon completion of the AC pipe project, an air monitoring abatement report shall be prepared by the Contractor's Asbestos Consultant. Copies of the final abatement report shall be provided to the Owner's Representative by the Contractor's consultant. OSHA requires that during any ACM disturbance, regardless of amount, the asbestos worker(s) shall be properly protected during potential asbestos exposure, 29 CFR, Subpart Z, 1910.1101.

### 1.3 Definitions:

The following terms are defined for the nature of this work:

- **Air Monitoring:**

The process of measuring the fiber concentration of a known volume of air collected during a specific period of time. The analysis procedure utilized for asbestos is the NIOSH Standard Analytical Method for Asbestos in Air, Method 7400. Transmission electron microscopy (TEM) may be utilized for lower detection limits and/or specific fiber identification.
- **Air Monitoring Technician:**

The person licensed by TDH to conduct air monitoring for an asbestos abatement project or related activity. The air monitoring technician may only obtain air samples and may only perform analysis of air samples with an upgraded Air Monitoring Technician License, which includes completion of the NIOSH-582 equivalent course.

The air-monitoring technician shall be an employee of a licensed asbestos laboratory or a licensed asbestos consultant agency.

- Amended Water:  
Water to which a surfactant has been added
  
- Asbestos:  
The asbestiform varieties of serpentines and amphiboles. Specifically: chrysotile, crocidolite, grunerite, amosite, anthophyllite, actinolite, and tremolite.
  
- Asbestos Containing Material (ACM):  
Material or products that contain more than 1.0 percent of any kind of asbestos
  
- Asbestos Containing Waste Material (ACWM):  
Asbestos containing material or asbestos contaminated objects requiring disposal
  
- Authorized Personnel:  
Any person authorized by the Contractor and required by work duties to be present in the work area or other regulated areas
  
- Authorized Visitor:  
Owner's representatives and any representative of a regulatory or other agency having jurisdiction over the project
  
- Asbestos Consultant:  
That person licensed by TDH to perform the following asbestos related functions:
  - Project design
  - Asbestos surveys and condition assessment of ACM
  - Asbestos Management Planning
  - The collection of bulk material samples and airborne substance samples, and the planning of sampling strategies
  - Owner-representative services for asbestos abatement projects or O&M programs, including air monitoring and project management

- Consultation regarding regulatory compliance, and all aspects of technical specifications and contract documents;
- The selection, fit testing, and appropriate use of personal protective equipment, and the development of asbestos related engineering controls.
- Abatement Contractor:  
The company, agency, or entity licensed by TDH that has been retained by the Contractor to perform asbestos abatement and other associated functions.
- Class II Asbestos Work (OSHA Standard):  
Activities involving the removal of ACM that is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of AC pipe and appurtenances.
- Competent Person:  
One who is capable of identifying existing asbestos hazards in the work-place and selecting the appropriate control strategy for asbestos exposure, and who has the authority to take prompt corrective measures to eliminate them.
- Encapsulant:  
A specific adhesive designed to lock down and minimize the fiber release of ACM and asbestos-contaminated materials.
- Friable Asbestos:  
ACM, which can be crumbled to dust, when dry, under hand pressure, and includes previously non-friable material after such previously non-friable material becomes damaged to the extent that, when dry, it may be crumbled, pulverized, or reduced to powder by hand pressure.
- HEPA Filter:  
A high efficiency particulate air filter capable of removing particles >0.3 microns in diameter with 99.97 percent efficiency.
- NESHAP:  
The National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61)

- NIOSH:  
The National Institute for Occupational Safety and Health
  
- OSHA:  
The Occupational Safety and Health Administration
  
- PEL:  
Permissible exposure level
  
- Regulated Area:  
An area established by the Contractor to demarcate areas where asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the PEL.
  
- Regulated Asbestos Containing Material (RACM):
  - Friable asbestos material
  - Category I non-friable ACM that has become friable
  - Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading;
  - Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by forces expected to act on the material in the course of the demolition or renovation operations regulated by 40 CFR Part 61, Subpart M.
  
- Staging Area:  
A pre-selected area where containerized ACWM will be placed prior to removal from the project site.
  
- Surfactant:  
A chemical wetting agent added to water to improve penetration
  
- TWA:  
Time weighted average

## **PART 2: QUALITY ASSURANCE**

### **2.1 Reference Standards**

All work under these specifications shall be done in strict accordance with all applicable Federal, State, and local regulations, standards, and codes governing asbestos abatement, and any other trade work done in conjunction with the asbestos abatement. Work activities shall also comply with these and other City of Dallas Specifications related to health and safety.

The most recent edition of any relevant regulation, standard, or code shall be in effect. Where a conflict exists between the regulations, standards, codes, or these specifications, the most stringent requirements shall be utilized.

The Contractor shall comply with, at minimum, the following specific regulations:

#### **2.1.1 OSHA including but not limited to:**

- Title 29 Code of Federal Regulations Section 1910.1001 - General Industry Standard for Asbestos
- Title 29 Code of Federal Regulations Section 1910.134 - General Industry Standard for Respiratory Protection
- Title 29 Code of Federal Regulations Section 1926 - Construction Industry
- Title 29 Code of Federal Regulations Section 1910.2 - Access to Employee Exposure and Medical Records
- Title 29 Code of Federal Regulations Section 1910.1200 - Hazard Communication

#### **2.1.2 EPA including but not limited to:**

- Title 40 Code of Federal Regulations Part 61 Subpart M - National Emission Standard for Asbestos

#### **2.1.3 TDH including but not limited to:**

- Texas Administrative Code, Title 25, Chapter 295, Subchapter C - Texas Asbestos Health Protection
- Texas Administrative Code, Title 25, Chapter 325 Texas Solid Waste Regulations

- Texas Civil Statutes, Article 4477- A, Section 12, General Provisions 295.31 to 295.73

2.1.4 American National Standards Institute (ANSI)

2.1.5 American Society for Testing and Materials (ASTM)

2.1.6 Department of Transportation - HM 181

## **2.2 Submittals**

2.2.1 At the Pre-construction Meeting, all training records, certifications, medical records, and laboratory qualifications shall be submitted for review to Owner's Representative as well as the following:

- The Contractor shall be responsible for developing and implementing an asbestos removal work plan in accordance with NESHAP, OSHA, these specifications, and State requirements. The Contractor must have a TDH licensed Asbestos Consultant to provide detailed asbestos specific safety and work plans for ensuring worker and community protection. Plans submitted by the Asbestos Consultant shall include the person's or firm's name, address, phone number and TDH certification. Health and safety plans for working with ACM shall address the requirements in these specifications. However, these specifications are not intended to be and do not constitute asbestos abatement project design as described under TAC 25, Chapter 295.47, TDH asbestos regulations.
- The Contractor shall submit documentation satisfactory to Owner's Representative that an Initial and/or Negative Exposure Assessment in accordance with OSHA Standard 29 CFR 1911 has or will be performed (as applicable).
- The Contractor shall submit documentation satisfactory to Owner's representative that the Contractor's employees, including foremen, supervisors, and any other company personnel or agents, who may be exposed to airborne asbestos fibers or who may be responsible for any aspect of asbestos disturbance activities, have received adequate training in compliance with applicable rules and regulations.
- The Contractor shall submit documentation to Owner's Representative of a respiratory protection program for affected employees as per OSHA Standard 29 CFR 1910.134.
- The Contractor shall submit documentation to Owner's Representative from a physician that all personnel, who may be required to wear a respirator, are



medically monitored to determine whether they are physically capable of working while wearing the required respiratory protection without suffering adverse health effects. In addition, the Contractor shall submit document that personnel have received medical monitoring as is required in compliance with applicable rules and regulations.

- The Contractor shall submit to Owner's Representative documentation of respirator fit testing for all Contractor's employees and agents, who must enter the work area. This fit testing shall be in accordance with qualitative procedures as detailed in the OSHA Standard 29 CFR 1910.134.
- The Contractor shall submit the name of the OSHA monitoring consultant/lab. The Contractor shall be responsible for air monitoring as required to meet OSHA requirements.
- The Contractor shall submit proof satisfactory to Owner's Representative that required permits, site location, and arrangements for transport and disposal of ACWM have been made.

#### 2.2.2 During Asbestos Disturbance Activities:

- Submit copies to Owner's Representative of all transport manifests, trip tickets, and disposal receipts for all ACWM removed from the work area during the project. The Contractor shall sign manifests as the generator of the ACWM and provide copies to Owner's Representative.
- Upon completion of the AC pipe project, an abatement report shall be prepared by the Contractors' Asbestos Consultant. Copies of the final abatement report shall be provided to the Owner.

### **PART 3: EXECUTION**

#### **3.1 Delivery, Storage and Handling**

##### **3.1.1 Construction Requirements:**

- The Work includes all work specified herein, to include mobilization and demobilization, labor, materials, overhead, profit, taxes, transportation, disposal fees, administrative fees, incidental cost, etc. Estimating areas, quantities, weight, etc., are the sole responsibility of the Contractor.

- The Contractor shall remove, seal, transport and dispose of all impacted ACM in compliance with all current Federal, State, and local regulations, laws, ordinances, rules, standards and regulatory agency requirements. Asbestos disturbance and/or removal activities shall be conducted by properly trained, accredited, and licensed personnel using proper personal protective equipment.
- The Contractor shall notify Owner's Representative at least 72 hours in advance prior to beginning removal and/or disturbance of AC pipe.
- Time is of the essence in removing ACM from the project area. All work must be completed within the time period specified.
- All required notifications to State regulatory agencies shall be made by the Contractor with copies provided to Owner's Representative, including but not limited to the TDH Demolition/Renovation Notification Form. If 260 linear feet or greater of AC pipe is crushed, crumbled or pulverized, then the project is subject to NESHAP regulations and a Demolition/Renovation Notification Form shall be sent to TDH by the Contractor. This form shall be post-marked no later than 11 working days prior to the start of any asbestos disturbance.
- The Contractor shall have an on-site supervisor, who is an OSHA Competent Person, present on the job site at all times the work is in progress. This supervisor shall be thoroughly familiar and experienced with asbestos disturbance and other related work, and shall be familiar with and shall enforce the use of all safety procedures and equipment. The supervisor shall be knowledgeable of all applicable EPA, OSHA, NIOSH and TDH requirements and guidelines.
- Prior to commencing any preparation of the work areas for asbestos disturbance, the Contractor shall post all required documents, warning signs, and as necessary, erect physical barriers to secure the work area.
- The Contractor has sole and primary responsibility for the "means and/or methods" of the work, for the inspection of the work at all stages, and for the supervision of the performance of the work.
- The Contractor shall be responsible for site safety and for taking all necessary precautions to protect the Contractor's workers, City of Dallas personnel, and the public from asbestos exposure and/or injury. The Contractor shall be responsible for maintaining the integrity of the work area.
- The Contractor shall confine operations at the site to the area requiring disturbance of AC pipe and the general site area associated with the proximity of

the project. Portions of the site beyond areas, in which the indicated work is required, are not to be disturbed. The Contractor shall not unreasonably encumber the site with materials or equipment. If ACWM is required to be stored overnight, it shall be properly labeled, secured, and containerized to preclude unauthorized disturbance of the waste materials.

- The Contractor shall be responsible for the transport and disposal of ACWM to a duly licensed landfill facility permitted to accept asbestos waste. The Contractor shall be responsible for obtaining and coordinating waste disposal authorization from a TCEQ licensed landfill. Waste manifests shall be used to transport the AC pipe from the project site to the final landfill disposal site. The Contractor shall sign manifests as the generator of the AC pipe and shall provide copies to the Owner's Representative for final payment.

### 3.1.2 Site Security:

- The Contractor shall demarcate the area of AC pipe disturbance ("regulated area") with barrier tape and warning signs, as per OSHA regulation 29 CFR 1926.1101. Access to the regulated area shall be limited only to authorized personnel. Authorized personnel shall have asbestos awareness training, respiratory training, etc., including City of Dallas personnel.
- Entry into the work area by unauthorized individuals shall be reported immediately to the Owner's Representatives by the Contractor.
- A logbook shall be maintained immediately outside the regulated area. Anyone who enters the regulated area must record name, affiliation, time in, and time out for each entry.

### 3.1.3 Personal Protective Equipment:

#### 3.1.3.1 *General:*

All work which will or may disturb ACM shall be accomplished utilizing, as a minimum, disposal suits with protective head cover, gloves, boots, eye protection, proper respiratory protection, decontamination by HEPA vacuuming and/or wet methods, and wet wiping all equipment. The Contractor shall provide hard hats and/or other protection as required for job conditions or by applicable safety regulations. Disposal suits consisting of material impenetrable by asbestos fibers shall be provided to all workers and authorized visitors in sizes adequate to accommodate movement without tearing. Workers shall be provided protective clothing from the time of first disturbance of ACM until final cleanup is completed.

### 3.1.3.2 *Respiratory Protection:*

The Contractor shall use removal techniques, methods and equipment that will not permit the fiber count to exceed the OSHA Permissible Exposure Level (PEL) of 0.1 fibers per cubic centimeter (f/cc) of air as detected by personal air sampling methods. Any remedial measures taken by the Contractor to meet this requirement shall be at the Contractor's expense.

- The Contractor's Competent Person shall ensure use of the appropriate respiratory protection for the work being performed. For minimum legal respiratory requirements, see OSHA Standards 29 CFR 1910.134, 29 CFR 1910.1001, and 29 CFR 1926.1101. All respiratory equipment, such as respirators, filters, etc., shall be certified by NIOSH for use in asbestos contaminated atmospheres.
- The Contractor's Competent Person shall perform an Initial and/or Negative Exposure Assessment, which shall be performed on employees who have been trained in compliance with the OSHA regulations. Employee's exposures shall be collected using objective data that is to demonstrate whether the materials specified for removal can release airborne fibers in concentration levels exceeding 0.1 f/cc during an 8-hour time weighted average (TWA) and the excursion limit of 1.0 f/cc. For the purpose of the assessment, the work conditions shall be those having the greatest potential for releasing asbestos fibers. Removal methods using conventional hand tools shall be performed in an area that requires a minimum of a 7-hour work shift with employees performing functions normally required for a total project. Removal, for the purposes of the assessment, shall be performed with methods most likely to release fibers and that do not render the ACM friable. Properly trained employees shall wear proper protective clothing and respirators during the assessment. Initial and/or Negative Exposure Assessments shall be performed in accordance with OSHA Standard 29 CFR 1926.1101.
- The development of the Health and Safety Plan by the Contractor's TDH licensed Asbestos Consultant shall include determining the adequacy of the Contractor's air monitoring data (which must be performed within the previous 12 months of the project start date) for the Initial and/or Negative Exposure Assessment, based in part on site-specific factors such as changes in personnel or work methods used during AC pipe removal. If the type of air monitoring data needs to be reviewed during the course of a project, the Contractor's Asbestos Consultant shall review the data in order to determine adequacy. Any downgrade in personal protective equipment related to asbestos exposure shall be requested in writing to the Owner's Representative, and approved by a TDH licensed Asbestos Consultant. This request may be granted only when all regulations and pertinent sections of this specification for respiratory protection are met.

- The Contractor shall begin AC pipe removal operations (i.e., breaking, sawing, cutting, or repairing the pipe) in powered air purifying respirators (PAPRs) equipped with dual HEPA filters. PAPRs shall be utilized until such time that air monitoring results indicate half-face respirators may be used. Any changes (downgrade or upgrade) in respiratory protection shall be based upon an 8-hour TWA of fiber concentrations in the regulated area. For personal samples, the 8-hour TWA's shall be calculated daily by the Contractor's OSHA monitoring firm. The highest calculated 8-hour TWA shall be used to determine the type of respirator to be worn. The type of respirators worn shall be selected in accordance with 29 CFR 1926.1101 (h)(3).

The Contractor may request a respiratory protection downgrade, approved by a TDH licensed Asbestos Consultant, in writing to the Owner's Representative when all regulations and pertinent sections of this specification for respiratory protection are met.

- Workers shall be provided with personally issued, individually identified respirators.
- No one wearing a beard shall be permitted to wear a respirator.

#### 3.1.4 Air Monitoring:

- **Personal Air Monitoring:** The Contractor shall provide personal air sampling as required by OSHA regulations. The OSHA TWA PEL for asbestos (0.1 f/cc) shall not be exceeded. Personal air samples shall be obtained by a TDH licensed Asbestos Air Monitoring Technician and analyzed by an accredited, independent TDH licensed Phase Contrast Microscopy (PCM) laboratory. OSHA monitoring results shall be posted at the project site and made available to all affected Contractor personnel on a daily basis.
- The Contractor shall provide, as a minimum, personal air monitoring on each worker who is cutting, (wet) sawing, breaking, or repairing AC pipe.
- **Area Air Monitoring:** At any time that visible airborne fibers are generated or that wet work procedures are not used, all work shall immediately cease until air monitoring by a TDH licensed Asbestos Consultant Agency has started. The Contractor's on-site Competent Person shall be responsible for making this determination; however, periodic, random site visits by the Owner's representative will field-verify the objectivity of the Competent Person in these matters. Once initiated, the sampling and frequency of the area air monitoring shall be dependent upon on the specific work practices being used by the workers at that time. However, the area air monitoring shall include, as a minimum,

samples collected inside the regulated area, and upwind and downwind of the regulated area. The TDH licensed Asbestos Consultant Agency hired by the Contractor shall determine the need for additional samples and shall amend the Health and Safety Plan to include sampling protocols. A copy shall be provided to the Owner's Representative.

- Area air monitoring shall be conducted in accordance with applicable Federal, State, and local requirements. The cost of area air monitoring due to failure to use adequate wet work procedures shall be borne by the Contractor. Copies of all results shall be provided to the Owner's Representative.
- Area air sampling shall be mandatory in high density areas such as schools, residential areas, and certain other locations as determined by the Owner's Representative and dictated by the bid documents/plans.

### 3.1.5 Employee Training:

- Training shall be provided by the Contractor to all employees or agents who may be required to disturb ACM for AC pipe handling and auxiliary purposes, and to all supervisory personnel who may be involved in the planning, execution or inspection of such projects. The training shall be in accordance with OSHA Standard 29 CFR 192.1101 for "Class II asbestos work".
- At a minimum, Contractor's employees who will be potentially exposed to asbestos shall have completed within the last 12 months, an 8-hour Asbestos Awareness training course taught by a TDH licensed Asbestos Training Provider. The training course shall cover topics including, but not be limited to: the health effects of asbestos and work practices related to the handling of AC pipe.
- The Contractor's Competent Person shall have completed within the last 12 months, a 40-hour Asbestos Contractor Supervisor training course taught by a TDH licensed Asbestos Training Provider. The training course shall cover topics including, but not be limited to: the health effects of asbestos, employee personal protective equipment, medical monitoring requirements for workers, air monitoring procedures and requirements for workers, work practices for asbestos abatement, personal hygiene procedures, special safety hazards that may be encountered, and other topics as required.

### 3.1.6 AC Pipe Handling:

#### 3.1.6.1 *General:*

The Contractor shall properly remove, handle, transport and dispose all AC pipe specified in the bid documents/plans for this project. All work involving AC pipe and other ACM products shall be addressed in the Health and Safety Plan documents submitted to the Owner's Representative. The Contractor shall hire a TDH licensed Asbestos Consultant to provide detailed asbestos specific safety and work plans for ensuring worker and community protection. Health and Safety Plan documents are to include provisions for the discipline of any worker failing to use wet work procedures or failing to use designated personnel protective equipment.

The Contractor shall remove ACM with wet methods or by other controlled techniques approved by the TDH, EPA and OSHA, and in accordance with these specifications and the Contractor-provided Health and Safety Plan. Alternative removal methods will be considered at the time of the Contractor's submittals. The Contractor shall take special care to prevent damage to structures and materials not requiring demolition to access the ACM.

The Contractor shall limit work to the area indicated. Access to the work area shall be controlled by the Contractor. All electrical equipment, etc., shall have ground limit circuit interrupter (GFCI) protection. The Contractor shall properly demarcate, barricade, and contain the work and/or regulated areas.

The AC pipe work consists of providing GFCI protection, using approved equipment with engineering controls, sufficiently wetting the ACM using a surfactant or lock-down encapsulant, removing the ACM, HEPA vacuuming the work area, wet wiping the work area, double-bagging/double-wrapping the waste, and removing carefully as indicated herein and in accordance with the Contractor-provided Health and Safety Plan.

#### 3.1.6.2. *Equipment:*

Equipment used to cut, break, or otherwise disturb AC pipe and associated ACM may include, but are not limited to: wet-cutting saws, saws equipped with point of cut ventilator (saw equipped with a water mister) or enclosures with HEPA filtered exhaust air, snap cutters, manual field lathes, and pressure and non-pressure tapping devices.

Equipment used to control visible emissions of fibers, contain the work area, or facilitate the clean-up of debris may include, but are not limited to: airless spray equipment, pump-up sprayers, surfactant, lock-down encapsulant, HEPA vacuums, brushes, brooms, shovels, disposable rags, polyethylene sheeting of 6-mil thickness,



moisture resistant duct tape, asbestos warning signs, notices, and barrier tape. Alternative dismantling equipment may be substituted for the materials indicated herein, but must be approved by the Owner's Representative.

### 3.1.6.3 *Prohibited Work Practices and Engineering Controls:*

The following work practices and engineering controls shall not be used for work related to asbestos or for work that disturbs ACM, regardless of asbestos exposure or the results of Initial Exposure Assessments:

- High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air
- Other high-speed abrasive tools, such as disk sanders
- Carbide-tipped cutting blades
- Electrical drills, chisels, and rasps used to make field connections in AC pipe
- Shell cutters used to cut entry holes in AC pipe
- A hammer and chisel used to remove couplings or collars on AC pipe
- Compressed air used to remove asbestos or ACM, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud generated by the compressed air
- Dry sweeping, dry shoveling, or other dry clean-up of dust and debris containing ACM.
- Employee rotation as a means of reducing employee exposure to asbestos

### 3.1.6.4 *General Removal Work Practices:*

AC pipe has been identified as a non-friable ACM with the potential to become friable ACM. The material is classified as non-friable unless broken, at which time its classification changes to friable. NESHAP guidelines apply to projects when at least 260 linear feet or 35 cubic feet or 160 square feet of AC pipe becomes or will become "regulated asbestos containing material" or RACM. Therefore, if at least 260 linear feet of AC pipe is crushed, crumbled, or pulverized, then the project is subject to NESHAP. During the disjoining operation of AC pipe removal, only the portion that has become RACM shall be counted toward the threshold amount, if the debris caused by the disjoining operation is cleaned up so that it does not contaminate a



greater length of pipe. If the generated AC pipe debris is not properly cleaned up, however, then the AC pipe shall be considered contaminated and the whole length is treated as ACM. If the scope of this project involves the threshold amount (260 linear feet or greater), then a Demolition/Renovation Notification Form shall be sent to TDH by the Contractor. This form shall be post-marked no later than 11 working days prior to the start of any asbestos disturbance.

All AC pipe projects require that NESHAP and OSHA guidelines be met and/or exceeded in areas where AC pipe is to be disturbed. Therefore, all AC pipe disturbances require a third party TDH licensed Asbestos Consultant and Asbestos Contractor on-site during AC pipe disturbance. An asbestos abatement work plan shall be provided to the Owner's Representative by both the licensed Asbestos Consultant and the Asbestos Contractor. Upon completion of the AC pipe project, an air monitoring abatement report shall be prepared by the Contractor's Asbestos Consultant. Copies of the final abatement report shall be submitted to the Owner's Representative by the Contractor's consultant. During any ACM disturbance, OSHA requires that, regardless of amount, the asbestos worker(s) be properly protected during potential asbestos exposure, 29 CFR, Subpart Z, 1910.1101.

The Contractor shall be responsible for developing and implementing an asbestos removal work plan in accordance with NESHAP, OSHA, and State requirements. As such, Contractors submitting bids for the project shall have a TDH licensed Asbestos Consultant provide detailed asbestos specific safety and work plans for ensuring worker and community protection. Health and Safety Plans for working with ACM shall address the requirements of these specifications.

- 3.1.6.5 A sufficient supply of disposable rags for work area decontamination shall be available.
- 3.1.6.6 Disposal bags for RACM shall be of true 6-mil polyethylene, pre-printed with labels as required by EPA regulation 40 CFR 61.152 (b)(i)(iv) or OSHA requirement 29 CFR 1926.1101 (k)(8).
- 3.1.6.7 Stick-on labels identifying the Generator's name and address, and the project site location shall be applied to any asbestos waste bags that contain RACM, as per EPA or OSHA and Department of Transportation HM 181 requirements.
- 3.1.6.8 *Work Area Preparation:*  
The Contractor shall post warning signs and barrier tape meeting the specification of OSHA 29 CFR 1910.1001 and 40 CFR 61 at any location and approaches to a location where airborne concentrations of asbestos may exceed the PEL. Signs shall be posted at a distance sufficiently far from the work area to permit an employee to read the sign and to take the necessary protective measures to avoid exposure. The

Contractor shall maintain constant security against unauthorized entry past warning signs and barrier tape. Signs shall be post in both English and Spanish at the site.

### 3.1.6.9 *Personnel Exit Procedures*

- Before leaving the work area, all personnel shall remove gross contamination from the outside of respirators and protective clothing by brushing and/or wet wiping procedures. Small HEPA vacuums with brush attachments may be utilized for this purpose. Adequate washing facilities shall be provided and utilized on-site.
- Upon completion of the work, contaminated gloves shall be disposed as ACWM. Disposable cloth gloves may be substituted for leather gloves, at the Contractor's discretion. Rubber boots shall be decontaminated at the completion of the project.

### 3.1.6.10 Specific Removal Work Practice Requirements

- The Contractor has sole and primary responsibility for the “means and/or methods” of the work, for inspection of the work at all stages, and for supervision of the performance of the work.
- The Contractor shall isolate the regulated area with barrier tape and asbestos warning signs.
- The Contractor shall lay and secure 6-mil polyethylene sheeting on the ground on both sides of the AC pipe for the length of the work area.
- Working within the regulated area and using wet removal methods, the Contractor shall thoroughly soak each section of AC pipe to be disturbed, prior to any removal activity, with a surfactant or lock-down encapsulant. The Contractor shall use equipment capable of producing a “mist” application to reduce the potential for release of fibers. The Contractor shall take care to use as much encapsulant or surfactant as needed to lockdown possible fallout debris from edges and joints during removal. Continuous wetting of the materials throughout the entire removal process shall be provided. The Contractor shall take care to limit the breakage of ACM and to remove these materials as intact as possible.
- Any AC pipe debris on adjacent surfaces shall be removed. The Contractor shall promptly clean up asbestos wastes and debris following AC pipe disturbance. All visible accumulations of ACM and asbestos contaminated debris shall be removed and containerized by hand. Asbestos debris mixed with soil shall be picked up with shovels. The contaminated soil shall be containerized as a regulated ACWM. Clean-up activities may also involve vacuum cleaners equipped with

HEPA filtration or wet-wiping surfaces with disposable rags. Contaminated rags shall be containerized as regulated ACWM.

- After disturbance and clean-up activities but prior to removal of the AC pipe from the regulated area, the Contractor shall encapsulate damaged and exposed areas and ends of the AC pipe with a lock-down encapsulant.
- The Contractor shall then remove the Category II non-friable ACM “that is not in poor condition and is not friable,” as defined in NESHAP regulations. The Contractor shall remove all AC pipe “intact” and in whole complete sections by carefully lifting the AC pipe to the disposal container using approved equipment. The Category II non-friable AC pipe shall not be made “friable” (crumbled, pulverized, or reduced to a powder). The Contractor shall not drop, break and/or otherwise make the AC pipe susceptible to releasing asbestos fibers. If these procedures are followed and debris is cleaned up properly, then the Category II non-friable AC pipe shall be disposed as non-regulated ACM.
- Pieces of AC pipe debris shall be handled as RACM waste. The debris shall be placed in two 6-mil asbestos bags or double wrapped, with proper labeling.

*3.1.6.11* Abandonment of AC water mains/pipes: The Contractor shall be responsible for isolating the existing mains to remain in service by capping, plugging, and blocking as necessary. The opening of an abandoned AC water main and all other openings or holes shall be blocked off by manually forcing cement grout or concrete, into and around the openings, in sufficient quantity to provide a permanent watertight seal. Abandonment of old, existing AC water mains shall be considered subsidiary to the required work and no direct payment shall be made.

*3.1.6.12* Abandonment of valves that contain ACM: Valves to be abandoned in the execution of the work shall have the valve box and extension packed with sand to within 8-inches of the street surface. The remaining 8-inches shall be filled with 2,500 psi concrete or an equivalent sand-cement mix, and finished flush with the adjacent pavement or ground surface. The valves covers shall be salvaged and return to DWU. The abandonment of valves containing ACM shall be considered subsidiary to the required work and no direct payment shall be made.

*3.1.6.13* Verification of Removal & Clean-up Procedures: The Contractor’s on-site Competent Person shall inspect the work area and ensure that all surfaces are free of AC pipe dust and debris.

### 3.1.6.14 *Disposal Procedures*

- If a dumpster/trailer is used for temporary storage, it shall be secured and closed at all times except when loading. It shall be properly marked and critical barrier tape shall be in place.
- AC pipe debris and asbestos-contaminated items shall be properly double bagged; labeled; loaded in a fully enclosed, lined, locked, placard-identified transport container; transported; and disposed in compliance with all regulatory requirements as RACM.
- After being removed from the regulated area, Category II non-friable AC pipe shall be transferred to a polyethylene-lined container. The Contractor shall remove all containers as soon as practical, but no later than the end of the work shift.
- When a dumpsters/trailer is full, it shall be hauled away to the closest EPA approved landfill for proper disposal. The Contractor may dispose of Category II non-friable AC pipe waste material as non-regulated waste in a municipal solid waste landfill, as defined in the NESHAP and TCEQ Rule (Type I Landfill). Prior to disposal, written approval to transport and to accept the Category II non-friable material shall be obtained from a pre-approved transporter and landfill, and shall be submitted to the Owner's Representative.
- The Contractor shall submit copies of all transport manifests, trip tickets, and disposal receipts for all ACWM removed from the work area during the project to the Owner's Representative. The Contractor shall sign manifests as the generator of the AC pipe and provide copies to Owner's Representative for final payment.

## **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 4.2

### TECHNICAL SPECIFICATIONS FOR HORIZONTAL DIRECTIONAL DRILLING OF WATER PIPE

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all labor, materials, tools, and equipment required to install a new water main using the directional drilling method to the sizes and limits as shown on the plans, and as specified by these technical specifications herein. Work includes, but not limited to, proper installation, testing, restoration of underground utilities and environmental protection and restoration.

The directional drilling method involves first drilling a pilot hole as shown on the approved pilot bore plan, and then enlarging the pilot hole no larger than 1.5 times the outer diameter of the pull-in pipe, pipe joint or coupling and pull back the pipe through the enlarged hole.

##### 1.2 Pipe Description

Unless otherwise specified in the plans and/or specifications, one of the following pipes can be considered for horizontal directional drilling contingent upon approval by the Owner:

- Fusible Polyvinylchloride (PVC) Water Pipe as manufactured by Underground Solutions, Inc.
- Restrained Joint Polyvinylchloride (PVC) Water Pipe as manufactured by CertainTeed Corporation

The pipe to be used must be certified for use as a pressure-rated water delivery system and fire protection piping applications conforming to all standards and procedures, and meeting all testing and material properties as described in applicable pipe specifications.

##### 1.3 Related Works

- Technical Specification for Fusible Polyvinylchloride (PVC) Water Pipe
- Technical Specification for Restrained Joint Polyvinylchloride (PVC) Water Pipe

## **PART 2: QUALITY ASSURANCE**

### **2.1 References**

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

- Public Works Construction Standards for North Central Texas by North Central Texas Council of Governments (NCTCOG), Edition as adopted by DWU
- City of Dallas Addendum to the NCTCOG Standards, Latest Edition

### **2.2 Qualification Requirements**

All directional drilling operations shall be performed by a qualified directional drilling company who has at least three (3) years experience involving work of a similar nature. The company must have installed a minimum of 25,000 linear feet of pipe (6-inch diameter or greater) using directional drilling operations or supply a list of project references, prior to job commencement.

- Schedule all work through the Owner. Notify the Owner a minimum of ten (10) working days in advance of the start of work.
- Perform all work in the presence of the Owner, or his representative.
- All applicable permits and applications must be in place prior to start of work.

### **2.3 Warranty**

- A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
- In addition to the standard pipe warranty, the fusing contractor shall provide in writing a warranty for a period of one year for all the fusion joints, including formation, installation, and pressure testing, if applicable
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

## 2.4 Submittals

### 2.4.1 Contractor's Experience Record:

Furnish document(s) supporting the directional drilling Contractor's qualifications and experience.

### 2.4.2 Material:

Submit all applicable pre and post-construction pipe submittals as per applicable technical specifications of the pipe to be used for this project.

### 2.4.3 Work Plan:

Prior to beginning work, submit a work plan detailing the procedure and schedule to be used to execute the project. The Work plan is to include a description of all equipment to be used, down-hole tools, a list of personnel and their qualification and experience (including backup personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), an environmental protection plan, and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for this particular project. The plan should document the thoughtful planning required to successfully complete the project.

### 2.4.4 Bore Plan:

Prior to beginning work, submit a signed and sealed, scaled drawing of the pilot bore plan for review and approval (Max. Vertical Scale 1" = 2' and Max. Horizontal Scale 1" = 20'). Show finished grade, deflection and radiuses of the pilot bore, all existing utilities with minimum vertical and horizontal clearances. Address the location of the drill rig setups and for multiple bores, the lengths of each bore based on soil condition, equipment used, topography, etc. The proposed vertical and horizontal clearances between the bored pipe and any existing/proposed conflicting pipes, conduits or obstructions cannot exceed the guidance system accuracy tolerance by a minimum of 100%.

### 2.4.5 Equipment:

Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment list is to include but not be limited to: drilling rig, mud system, mud motors (if applicable), down-hole tools, guidance system, and rig safety systems. Include calibration records for guidance equipment. Submit any specifications for any drilling fluid additives that might be used.

## **PART 3: PRODUCTS**

### **3.1 Pipe**

As specified in Section 1.2 of this specification.

### **3.2 Directional Drilling Equipment**

#### **3.2.1 General:**

The directional drilling equipment is to consist of a directional drilling rig of sufficient capacity to perform the bore and pull back the pipe, a drilling, fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a Magnetic Guidance System (MGS) or "walkover" system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, and trained and competent personnel to operate the system. All equipment must be in good, safe condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

#### **3.2.2 Drilling Rig:**

The drilling shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. Anchor the machine to the ground sufficiently to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system must be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system must be free of leaks. The rig is to have a system to monitor and record maximum pullback pressure during pull-back operations. A system to detect electrical current from the drill string must be in place with an audible alarm that automatically sounds when an electrical current is detected.

#### **3.2.3 Drill Head:**

The drill head shall be steerable by changing its rotation with the necessary cutting surfaces and drilling fluid jets.

#### **3.2.4 Mud Motors (if required):**

The mud motor shall have adequate power to turn the required drilling tools.



### 3.2.5 Drill Pipe:

The drill pipe shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tools joints should be hardened to 32-36 RC.

## 3.3 **Guidance System**

### 3.3.1 General:

Use an electronic "walkover" tracking system or a Magnetic Guidance System (MGS) probe or proven (non-experimental) gyroscopic probe and interface for a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance system must be capable of tracking at all depths up to fifty feet and in any soil condition, including hard rock. It should enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system has to be accurate and calibrated to manufacturer's specifications of the vertical depth of the borehole at sensing position at depths up to fifty feet and accurate to 2-feet horizontally.

### 3.3.2. Components:

Supply all components and materials to install, operate, and maintain the guidance system.

### 3.3.3 Operation:

Set up and operate the Magnetic Guidance System (MGS) with personnel trained and experienced with the system. Be aware of any geo-magnetic anomalies and consider such influences in the operation of the guidance system.

## 3.4 **Drilling Fluid (Mud) System**

### 3.4.1 Mixing System:

A self-contained, closed, drilling fluid mixing system of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water, and appropriate additives. The mixing system must be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank must be a minimum of 1,000 gallons. Agitate the drilling fluid during drilling operations.

### 3.4.2 Drilling Fluids:

Use drilling fluid composed of potable water and bentonite clay. Supply water from an authorized source with a pH of 8.5-10. Treat any water of a lower pH or with excessive calcium with the appropriate amount of sodium carbonate or equal. No additional material may be used in drilling fluid without prior approval from the Owner. The bentonite mixture used must have the minimum viscosities as measured by a March funnel:

Rocky Clay	60 seconds
Hard Clay	40 seconds
Soft Clay	45 seconds
Sandy Clay	90 seconds
Stable Sand	80 seconds
Loose Sand	110 seconds
Wet Sand	110 seconds

These viscosities may be varied to best fit the soil conditions encountered, or as determined by the operator. No additional fluid shall be used without prior approval from the Owner.

### 3.4.3 Delivery System:

Fluid pumping system with a minimum capacity of 35-500 GPM and capable of delivering drilling fluid at a constant minimum pressure of 1200 psi. Employ filters on the delivery system in-line to prevent solids from being pumped into drill pipe. Contain all used drilling fluid and drilling fluid spilled during operations convey to the drilling fluid recycling system or remove by vacuum trucks or other methods acceptable to the Owner. Maintain a berm, minimum of 12-inches high, around drill rigs drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills into the surrounding environment. Furnish pumping equipment and/or vacuum truck(s) of sufficient size to convey drilling fluid from containment areas, to storage and recycling facilities or disposal.

## 3.5 **Other Equipment**

### 3.5.1 Pipe Rollers:

Use pipe rollers for pipe assembly during final product pull back.

### 3.5.2 Restrictions:

Do not use other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections unless approved by the Owner prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated by the Owner without undue delay and maintain line and grade within the tolerances prescribed by the particular conditions of the project.

## **PART 4: EXECUTION**

### **4.1 General**

- Notify the Owner a minimum of ten (10) working days in advance of starting work. All necessary permits and approvals must be in place prior to commencement of work. Do not begin the directional drilling until the Owner is present at the job site and agrees that proper preparations for the operation have been made. The Owner's approval for beginning the installation does not in any way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.
- All equipment used on the Owner's property and right-of-ways may be inspected by the Owner or his representatives and removed if considered unsatisfactory.

### **4.2 Directional Drilling Operation**

- Provide all material, equipment, and facilities required for directional drilling. Maintain proper alignment and elevation of the borehole throughout the directional drilling operation. The method used to complete the directional drill must conform to the requirements of all applicable permits.
- Survey the entire drill path with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, survey drill path for any surface geo-magnetic variations or anomalies. In addition, open cut, "pothole" or "daylight" areas along the proposed alignment at 200 foot intervals before and during the drilling operation to make sure proper alignment and grade are maintained. It may become necessary, if so determined by the Owner, to open excavate, "pothole" or "daylight" other areas to determine location of existing facilities and utilities. In this particular case payment will be made from Bid Item 20500 (Investigation). Costs of open cutting, "potholing" or "daylighting" for the purposes of determining proper alignment and grade are considered incidental to the base bid item (No Separate Pay Item).

- Place a silt fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection if required by documents, state, federal, and local regulations. Put in place any additional environmental protection necessary to contain any hydraulic or drilling fluid spills, including berms, liners, turbidity curtains, and other measures.
- Record readings after advancement of each successive drill pipe (no more than 10'), and plot on a scaled drawing of 1" = 2' vertical and 1" = 20' horizontal. Make all recorded readings and plan and profile information available at all times. At no time can the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.
- Submit a complete list of all drilling fluid additives and mixtures to be used in the directional operation, along with their respective Material Safety Data Sheets. Contain all drilling fluids and loose cuttings in pits or holding tanks for recycling or disposal, no fluids should be allowed to enter any unapproved areas or natural waterways. Dispose of all the drilling mud and cuttings after job completion at an approved dumpsite.
- Drill the pilot hole on the bore path with no deviations greater than 5% of depth over the length of the bore unless previously agreed to by the Owner. In the event that pilot does deviate from the bore path more than 5% of depth over the length of the bore, the pilot must be pulled back and re-drilled from the location along bore path before the deviation. In the event of a drilling fluid fracture, inadvertent returns, or returns loss during pilot hole drilling operations, stop drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel and wait another 30 minutes. If mud fracture or returns loss continues, notify the Owner.
- Upon completion of pilot hole phase of the operation, submit a complete set of "as-built" records. Include in these records copies of the pilot bore path plan and profile record drawing, as well as directional survey reports as recorded during the drilling operation.
- Upon approval of the pilot hole location, begin the hole opening or enlarging phase. Increase the bore hole diameter to accommodate the pullback operation of the required size of carrier pipe. The type of hole opener or back reamer to be utilized in this phase is to be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. Select the proper reamer type with the final hole opening being a maximum of 1.5 times the largest outside diameter pipe system component to be installed in the bore hole.

- Stabilize the open bore hole by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. The drilling slurry must be in a homogenous/ flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. Calculate the volume of bentonite mud required for each pullback based on soil conditions, largest diameter of the pipe system component, capacity of the bentonite mud pump, and the speed of pullback as recommended by the bentonite drilling fluid manufacturer. Contain the bentonite slurry at the exit or entry side of the directional bore in pits or holding tanks. The slurry may be recycled at this time for reuse in the hole opening operation, or hauled off to an approved dumpsite for proper disposal.
- Fuse or join all pipe sections together according to manufacturer's specifications as applicable. The pipe must be free of any chips, scratches, or scrapes. All piping shall be installed with a continuous, insulated TW, THW, THWN, or HMWPE insulated copper, 8 gauge or thicker wire for pipeline location purposes by means of an electronic line tracer:
  - The wires must be installed along the entire length of the pipe.
  - The insulation color shall match the color of the pipe being installed.
  - Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

### 4.3 Handling Pipe

- Take care during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.
- Use ropes, fabrics or rubber protected slings and straps when handling pipes. Do not use chains, cables or hooks inserted into the pipe ends. Use two slings spread apart for lifting each length of pipe. Do not drop pipe or fittings into rocky or unprepared ground.
- Store pipe on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Limit the stacking of the pipes to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions store the pipe on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

- Handle assembled pipe in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Position slings for handling at pipe joints. Remove sections of the pipes with cuts and gouges or excessive deformation and replace.

#### **4.4 Personnel Requirements**

- All personnel must be fully trained in their respective duties as part of the directional drilling crew and in safety.
- Supply references of previous projects using this type of installation process that this directional drilling crew has been involved.
- A competent and experienced supervisor of the Contractor must be present at all times during the actual drilling operations. A responsible representative who is thoroughly familiar with the equipment and type of work to be performed must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continually present at the job site during the actual directional drilling operation. Furnish a sufficient number of competent workers on the job at all times to insure the directional drilling is made in a timely and satisfactory manner.
- Remove any personnel who are unqualified, incompetent or otherwise not suitable for the performance of this project from the job site and replace with suitable personnel.

#### **4.5 Testing**

- Clean and flush all equipment and the surrounding site after completion. Use only potable water for flushing and pressure testing.
- Test directional drilling pipe after pullback. The average pressure should be maintained at 150 psi for two hours. Arrange the test pump and water supply to allow accurate measurements of the water required to maintain the test pressure. Replace any material showing seepage or the slightest leakage as directed by the Owner at no additional expense to the Contract.
- Observe and adhere to the pipe manufacturer's or Owner's, (whichever is more stringent) recommendations on pipe stretch allowances, bending radius, tensile strength, allowable test leakage allowance, and magnitude and duration of test pressure.

- Test pipeline end to end.
- Connect all new service lines and test along with the newly installed main.
- Pressure testing the drilled pipe is not necessary if the pipe is intended to be used as a casing for a finished product pipe.

#### **4.6 Site Restoration**

Following drilling operations de-mobilize equipment and restore the work site to the original conditions or better. Backfill and compact all excavations according to these specifications.

#### **4.7 Record Keeping**

- Maintain a daily project log of drilling operations and a guidance system log with a copy available to the Owner at the completion of project.
- Record the guidance system data during the actual crossing operation. Furnish "as-built" plan and profile drawings based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. Certify the guidance data to the capability of the guidance System.

### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 4.3

### TECHNICAL SPECIFICATION FOR ELECTRICAL CONTINUITY TESTING OF WATER MAINS

#### PART 1: GENERAL

##### 1.1 Scope of Work

Work performed under this specification shall consist of providing all supervision, labor, equipment and materials as well as providing all operations necessary to perform electrical continuity testing of water mains as shown on the drawing and specified herein.

##### 1.2 Purpose and Schedule of Testing:

The purpose of the electrical continuity testing is to verify and document effective electrical conductance.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

AWWA M9	Manual - Concrete Pressure Pipe
NEC 70	National Electrical Code
NACE SP-0169	Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
UL 467	Bonding and Grounding Equipment
UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors



## 2.2 Requirements

- The testing company, or agency, proposed by the Contractor must be a firm regularly engaged in the field of corrosion control testing. The employees assigned to the project are to be personnel familiar with corrosion control electrical testing procedures, electrical instrumentation and general electrical networks. Personnel must be capable of modifying procedures to suit actual field conditions should such modifications become necessary.
- The number of readings taken to determine an electrical constant or property must be sufficient to assure that random factors due to human error in reading the instruments and transient disturbances in the electrical network have negligible influence on the final results. The adequacy of the data can generally be established by the tester and is subject to review and approval by Owner.
- Testing results shall be provided confirming all electrical discontinuities have been located and repaired.
- All continuity testing results and bonding is subject to inspection and testing by the Owner.

## 2.3 Submittals

The Contractor shall furnish following documents made in a timely manner so that project schedule can be met:

### 2.3.1 Testing Group:

The contractor shall submit the name of the testing agency to be employed on the project as a subcontractor, if applicable. This submittal shall include:

- Full background data of the testing agency
- References to prior work or projects having similar requirements and/or complexities with this project.

### 2.3.2 Testing Methods:

Prior to the start of the field work, the contractor shall submit a detailed written description of the proposed testing procedures to verify electrical continuity, for review and approval by the Owner. This should include:

- Step by Step Testing Procedures, including schematics showing typical electrical instrumentation hook-ups and data reporting form(s)

- Maximum pipeline lengths to be used for testing
- Criteria to determine continuity
- References for Testing Procedures
- Materials and methods for attaching joint bonding cables to joint rings and configuring the cables so they are not exposed within the pipe bore after concrete/mortar repairs

### 2.3.3 Instrumentation:

The contractor shall submit a list of instruments to be used for the electrical testing. The list shall include manufacturer's name, model number, and serial number. All instrumentation shall bear evidence of certified calibration within the prior year.

### 2.3.4 Report:

The contractor shall submit a report including, but not limited to the following:

- Testing spans start station number and end station number
- Electrical measurements before and after any repairs
- Tabular documentation identifying each joint found to be electrically discontinuous and each joint bonded
- All calculations and collected data, including raw data using approved data reporting forms
- Photographic documentation shall be provided to illustrate testing procedures, and record of every joint repaired. The photos shall be referenced to the tabular documentation as furnished.

### 2.3.5 Safety:

The contractor shall be responsible for personnel performing work in compliance with all applicable OSHA and Owner's safety requirements and procedures, for all persons entering the pipelines.

## **PART 3: EXECUTION**

Owner shall be present to observe all testing, joint bonding, and concrete/mortar repair work performed by the contractor. This observation shall in no way relieve the contractor from fully complying with the work set forth in these specifications.

### **3.1 Locating Discontinuous Joints**

- Testing shall not begin until testing methods have been submitted and approved by the Dallas Water Utilities or its designated representative.
- Testing Electrical Contact Points: Use only pipe contact points (i.e. test stations), including temporary vault connections, which have been demonstrated to provide a reliable, low resistance, electrical connection to the pipe.
- Pipe Dewatering: The dewatering of the pipe shall be performed by the Dallas Water Utilities Distribution Department, or approved contractor.
- Concrete/Mortar Removal & Repair: The contractor shall be responsible for all concrete/mortar removal and repair at joint rings necessary to facilitate the electrical testing and bonding of electrically discontinuous joints.
  - The contractor shall remove a window at each joint suitable to perform electrical testing and bonding, if necessary.
  - The contractor shall perform pipe joint repairs including attaching bonding straps and replacing mortar.

### **3.2 Discontinuous Joint Bonding**

- The Contractor shall be responsible for the electrical bonding of each discontinuous joint, including the documentation of same per Section 2.3 of this specification.
- Bonding:
  - If a discontinuity is found, two bond cables will be installed across the joint, one in the 3 to 5 O'clock position and the second in the 7 to 9 O'clock position.
  - The window created for bonding will extend across the joint, exposing the joint ring on the bell and spigot sides.

- A #4 AWG stranded copper wire with THHN insulation shall be used to make each bond. The cable length shall be kept to the minimum necessary.
- The contractor will submit connection techniques (e.g. Arc Welding, Pin Brazing) for approval. Means and methods shall be such that an effective electrical bond is maintained once the pipe is returned to service and so no metallic connection or cable remains exposed and extends into the pipe bore.

### 3.3 Post Joint Bonding Electrical Continuity Testing

- All discontinuous joint locating and bonding must take place before this testing begins. This testing shall take place before the pipe is refilled with water.
- For a given section between manholes the Contractor shall determine and record the longitudinal resistance of the pipe for the entire section.
  - The resistance shall be determined using Ohm's Law by impressing a direct test current across individual pipe spans of no longer than 1,000 feet and measuring the resultant voltage drop across the same span.
  - Test lengths (not exceeding 1,000 feet) shall be such that there are at least two spans tested between consecutive manholes.
  - Test connections can be test wires previously installed and determined to provide a reliable, low resistance, electrical contact to the pipe or temporary connections made internally to a joint ring.
  - For temporary connections to the joint rings, current injection points shall be at least 5 pipe diameters "outside" the corresponding voltage measuring points.
  - Contractor shall repair all pipe damaged to make temporary connections.
- The contractor shall compare the calculated longitudinal resistance with a theoretically derived resistance using procedures and formulae in AWWA M9 (Chapter 12, Design Considerations for Corrosive Environments). The theoretical resistance shall account for the resistance of the pipe cylinder, the resistance of the joint bonding, and electrical fringing effects.
- Calculated resistances that are greater than 120% of the corresponding theoretical resistance shall be evaluated further by the Contractor and DWU to determine if additional pipe joint bonding within the particular span is warranted.

- If additional pipe joint bonding is deemed necessary, the resistance tests shall be repeated after completion of the work until accepted by DWU or its designated representative
- The Contractor's data submittal shall include raw data sheets for each pipe span along with an Excel spreadsheet showing the field measured values (voltage and current), and comparing the calculated span resistance with the corresponding theoretically derived resistance. The submittal shall include an electronic version of the spreadsheet (excel) with no hidden formulae, constants, etc.

#### **PART 4: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for providing the Electrical Continuity Testing of Water Mains as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

**\*\*END OF SECTION\*\***

## SECTION 4.4

### TECHNICAL SPECIFICATION FOR WATER METER VAULT PROTECTIVE LINING

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all the necessary materials, labor, equipment, tools, and associated appurtenances to install a protective lining on the interior walls, floor and ceiling of all new and selected existing water meter vaults.

##### 1.2 Acceptable Manufacturers

SprayWall as manufactured by SprayRoq, Raven AquataPoxy A-6 Series as manufactured by Raven Lining Systems or pre-approved equal shall be used.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ANSI/NSF 61	Drinking Water Components
ACI 506.2-77	Specifications for Materials, Proportioning, and Application of Shotcrete by the American Concrete Institute (ACI)
ASCE Manual 52	Manuals and Reports on Engineering Practice, Manhole Inspection and Rehabilitation
ASTM D638	Tensile Properties of Plastics
ASTM D790	Flexural Properties of Unreinforced and Reinforced Plastics
ASTM D695	Compressive Properties of Rigid Plastics
ASTM D4541	Pull-off Strength of Coatings Using a Portable Adhesion Tester

ASTM D7234	Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D2584	Volatile Matter Content
ASTM D543	Resistance of Plastics to Chemical Reagents
ASTM D4258	Standard Practice for Surface Cleaning Concrete
ASTM D4259	Standard Practice for Abrading Concrete
ASTM C109	Compressive Strength Hydraulic Cement Mortars
ASTM C579	Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars
ICRI Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays by International Concrete Repair Institute (ICRI)
NACE RPO 188-99	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates by National Association of Corrosion Engineers (NACE)
SSPC-SP 1	Solvent Cleaning by standards of the Society of Protective Coatings (SSPC)
SSPC-SP 5	White Metal Blast Cleaning by SSPC
SSPC-SP 10	Near White Metal Blast Cleaning by SSPC
SSPC-SP 12	Surface Preparation and Cleaning of Metals by Water Jetting prior to Recoating by SSPC
SSPC SP-13/NACE No. 6	Surface Preparation of Concrete by SSPC

SSPC-PA 9	Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages by SSPC
SSPWC 210-2.3.3 & 211-2	Chemical Resistance Test (Pickle Jar Test) Standard Specifications for Public Works Construction (SSPWC) (Greenbook)
SSPWC 500-2	Manhole and Structure Rehabilitation by SSPWC

## 2.2 **Qualification Requirements**

### 2.2.1 Manufacturer

- Manufacturer shall be certified in compliance with ISO 9001/14001 Quality standards for formulation, manufacturing and technical support.

### 2.2.2 Product

- For a product to be commercially acceptable, the product must have a minimum 2,000,000 square feet and ten (10) year history of successful water/wastewater system installations in the United States.
- The products must be verified by third party test results supporting the long-term performance and structural strength of the product and such data shall be satisfactory to the Owner.

### 2.2.3 Installer

- For an installing Contractor to be considered commercially acceptable, the Contractor must satisfy all insurance, financial and bonding requirements of the Owner.
- The Contractor must have a certification from the manufacturer as a licensed and fully trained installer of the product.
- The Contractor must have a minimum 1,000,000 square feet of successful water/wastewater system installations and five (5) years of rehabilitation experience.

## 2.3 **Warranty**

- Contractor shall provide five (5) years of warranty (including labor) from the manufacturer against any defects in materials and workmanship.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.



## 2.4 Submittal

Following submittals shall be provided by the contractor:

### 2.4.1 Product

- Technical data sheet showing the physical and chemical properties
- Material Safety Data Sheet (MSDS)
- Physical properties of third party test results within five (5) years of submittal including the following:

Description	Method
- Tensile Strength	ASTM D 638
- Tensile Ultimate Elongation	ASTM D 638
- Compressive Strength	ASTM D 695
- Flexural Strength	ASTM D 790
- Hardness, Shore D	ASTM D 2240
- Taber Abrasion, CS-17 Wheel	ASTM D 4060
- Adhesion, Concrete	ASTM D 7243

- Surface preparation and application method
- Copies of field test data
- Verification of minimum installation requirements set forth in section 2.2.2.

### 2.4.2 Installer

- Verification of “certified applicator” status
- Verification of minimum installation requirements set forth in section 2.2.3.

## PART 3: PRODUCTS

### 3.1 **Repair/Resurfacing Product**

#### 3.1.1 General:

- Repair/ resurfacing product(s) shall be used for all existing and new structures to fill voids or bugholes, smooth transitions between components, replace lost mortar

in masonry structures, smooth rough surfaces, and rebuild severely deteriorated substrates and/or to remediate infiltration prior to the installation of the coating product(s).

- All repair/ resurfacing product(s) must be supplied by the coating product manufacturer or shall be approved by the coating product manufacturer in writing for compatibility with the specified coating product. It shall also be handled, mixed, installed and cured in accordance with manufacturer's guidelines.

### 3.1.2 Acceptable Types

#### 3.1.2.1 Cementitious Repair Material (CRM)

- The Cementitious Repair Material (CRM) shall be a factory blended, rapid setting, high early strength, calcium aluminate corrosion resistant non-shrink grout that is specifically formulated for use in the underground environment.
- The CRM shall be capable of being trowelled or pneumatically spray applied.
- The CRM shall be mixed with water only and applied according to manufacturer recommendations.
- The CRM must be compatible with the Protective Coating Material (PCM) that is going to be used. The CRM manufacturer must certify compatibility.
- The physical properties of the CRM shall meet the following minimum requirements:

Compressive Strength (24 hours)	2,500 psi
Compressive Strength (28 days)	8,000 psi
Tensile Strength (28 days)	600 psi
Flexural Strength (28 days)	1,500 psi

3.1.2.2 Epoxy Mastic Repair Materials (EMRM)

- The Epoxy Mastic Repair Material (EMRM) shall be a two part, highly thixotropic
- Epoxy system formulated specifically for trowel or a heated plural system application. EMRM shall be formulated with special additives and modifiers to enhance the water resistance, chemical resistance, and bond strength to a variety of substrates as well as its own internal strength.
- The EMRM shall be compatible with the Protective Coating Material that is going to be used. EMRM manufacturer must certify compatibility.
- The physical properties of the EMRM shall meet the following minimum requirements:

Compressive Strength	11,000 psi
Tensile Strength	4,500 psi
Flexural Strength	4,500 psi

3.1.2.3 Chemical Grout Material

- The chemical grout shall be a semi ridged injection grout designed for sealing larger volume leaks in concrete cracks and fissures.
- The chemical grout shall be capable of filling voids, stabilize soils or gravel.
- The chemical grout shall be a two part system (grout and accelerator) that, when it makes contact with water, is designed to set-off and cut-off gushing water. Set times must be adjustable.
- The water used to activate the chemical grout must be in the range of pH3-10 for proper cross-linking of the materials and optimum foam quality.
- Once cured, the chemical grout shall become closed cell polyurethane foam that is resistant to most organic solvents, mild acids, alkali, petroleum and micro-organisms.
- The chemical grout physical properties when cured shall meet the following minimum requirements:

Density	8.75-9.17 lbs./gal
Tensile Strength	56 psi
Compressive Strength	895 psi
Bending Strength	213 psi
Bond Strength to Bending Bond Strength	28 psi
Mortar Joints Shearing Bond Strength	255 psi
Toxicity	Non-Toxic
Absorption (6 month immersion)	15 %

#### 3.1.2.4 Hydraulic Cement Material (HCM)

- The Hydraulic Cement Material (HCM) shall be specifically designed to stop minor water infiltration and develop high-early strengths.
- The HCM shall be capable of being hand mixed and applied in either a “wet” or “dry” state.
- The water used to mix the HCM should be clean and free of contaminants.
- The HCM should be formulated with calcium silicate, calcium aluminate cements, mineral fillers, and specially selected additives for set control.
- The HCM should be used according to the manufacturer recommendations.
- The physical properties of the HCM shall meet the following minimum requirements:

Compressive Strength (1 hour)	1000 psi
Compressive Strength (24 hours)	2500 psi
Pull out Strength	14,000 lbs.
Set Time	<1.0 mins

## 3.2 Protective Coating Material (PCM)

### 3.2.1 General:

- The Protective Coating Material (PCM) product shall be applied to all interior surfaces to provide a permanent impermeable, high strength; monolithic lining for concrete structures that is sulfuric acid corrosion, abrasion and impact resistant.
- 100% solids, solvent-free, ultra-high build epoxy, polyurethane or similar PCM to be applied to all interior surfaces of exposed brick/concrete as per manufacturer's guidelines.
- The material must be suitable for overhead, vertical and horizontal surfaces, and capable of being applied at a specified thickness of minimum 125 mils in a single application.
- PCM must be designed for temperatures up to 200 degrees F.
- PCM product physical properties shall be substantiated through submittal of accredited third party testing results and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field.
- All protective coating material (PCM) shall be ANSI/NSF 61 approved.

### 3.2.2 Acceptable Types:

#### 3.2.2.1 Polyurethane PCM

- The PCM shall be a spray applied, ultra-high-build, self-priming polyurethane system.
- The PCM shall be 100% solids and VOC-free.
- The PCM shall have the ability to reinstate structural integrity, provide infiltration control, and supply chemical resistance to the structure.
- The PCM shall be a two component (A and B) resin system that uses a heated plural component spray system.
- The physical properties of the PCM shall meet the following minimum requirements:

Property	Polyurethane
Flexural Modulus	735,000 psi
Compressive Strength	7,450 psi
Elongation	18,000 psi
Hardness, Shore D	4% at break
Tensile Strength	85
Adhesion to concrete	Substrate Failure

### 3.2.2.2 Epoxy PCM:

- The PCM shall be a spray applied, ultra high-build, self-priming epoxy resin system.
- The PCM shall be 100% solids and VOC-free.
- The PCM shall have the ability to reinstate structural integrity, provide infiltration control, and supply chemical resistance to the structure.
- The PCM shall be a two component (A and B) resin system that uses a heated plural component spray system.
- The physical properties of the PCM shall meet the following minimum requirements:

Property	Epoxy
Flexural Strength	9,400 psi
Compressive Strength	10,000 psi
Tensile Ultimate Elongation	1.3%
Hardness, Shore D	87
Tensile Strength	6,000 psi
Adhesion to concrete	Substrate Failure

## PART 4: CONDITION STANDARDS AND REPAIR METHODS

The Engineer or Owner shall categorize each structure in the following manner:

### 4.1 Condition 1: New or Like New

- Condition Standard: A new, like new or existing structure that is considered structurally sound with no indications of settlement, cracking or other signs of fatigue. Infiltration or exfiltration through pre-cast joints, mortar joints, or around the pipe connections may exist and structure may be experiencing inflow, infiltration, mild erosion, aggregate exposure or deterioration.
- Repair Method: Pressure wash and clean structure per Surface Prep section, 5.3 in the specification. Stop any inflow/infiltration using appropriate products and methods (injection grout/hydraulic cement). Fill bug holes, joints, mortar joints, honeycombs and around pipe penetrations with a Cementitious Repair Material (CRM) as needed. Apply a minimum of 125 mils average thickness of approved Protective Coating Material (PCM).

### 4.2 Condition 2: Fair

- Condition Standard: An existing structure that is exhibiting early signs of structural fatigue evidenced by minor cracks, loss of mortar or brick, moderate to moderately severe erosion, aggregate exposure or deterioration due to age (less than ½ inch in depth), minor cross sectional distortion (less than 10 %); however, it is currently supporting the soil and live load.
- Repair Method: Pressure wash and clean structure per Surface Prep section, 5.3 in the specification. Stop any inflow/infiltration using appropriate products and methods (injection grout/hydraulic cement). Fill bug holes, joints, mortar joints, honeycombs and around pipe penetrations with a Cementitious Repair Material (CRM) as needed. Apply the specified Cementitious Repair Material (CMR) to the structure at a minimum thickness of one half inch (1/2") in order to bring the vault back to an acceptable profile for application of the Protective Coating Material (PCM). CMR shall have at least a forty eight (48) hour initial curing time prior to the application of a minimum of 125 mils average thickness of approved Protective Coating Material (PCM).

### 4.3 Condition 3: Poor

- Condition Standard:** An existing concrete or brick structure that is exhibiting moderate to severe deterioration due to age, erosion, aggregate exposure and/or ground movement. Conditions indicating this degree of deterioration may include very severe erosion (loss of original profile of one half inch or greater), cross sectional distortion beyond 10 percent, exposed reinforcing steel, loose or missing bricks, missing mortar.
- Repair Method:** Pressure wash and clean structure per Surface Prep section, 5.3 in the specification. Fill voids with a Cementitious Repair Material (CRM) or Epoxy Mastic Repair Material as necessary. Stop any infiltration using appropriate products and methods (injection grout/hydraulic cement). Apply the specified Cementitious Repair Material (CRM) to the structure at a minimum thickness of one inch (1”) to bring structure back to an acceptable profile. Cementitious Repair Material (CRM) shall have at least a forty eight (48) hour initial cure time, prior to application of a minimum of 125 mils average thickness of approved Protective Coating Material (PCM).

Condition Type	Min. Repair or Resurfacing Material	Min. Protective Coating Material	
	Cementitious, Epoxy Mastic, Chemical Grout or Hydraulic Cement Material	Polyurethane Liner	Epoxy Liner
Type 1: New or Like New	As Needed	125 mils	125 mils
Type 2: Fair	½ inch	125 mils	125 mils
Type 3: Poor	1 inch	125 mils	125 mils



## **PART 5: EXECUTION**

### **5.1 General**

- Appropriate actions shall be taken by Contractor to comply with local, state, and federal regulatory and other applicable agencies with regard to environment, health, and safety during work.
- Limits of Application - The interior walls and ceiling of structures, exposed part of water meter vault frame/opening/hatch and floor.
- The repair and coating materials must be applied by factory trained and/or fully qualified technicians only. Contractor shall have a manufacturer's representative must present at the start of the installation procedure.
- Remove all steps, protrusions or other such obstructions prior to beginning the lining process as directed by the Owner.
- The Contractor will coordinate with the Owner on appropriate traffic control measures and working times.
- Prior to man entry into any structure to be rehabilitated, proper ventilation and strict confined space OSHA regulations shall be followed. Failure to do so shall be grounds for removal from the project.

### **5.2 Examination**

- Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces conditions that are different than the original assessment and designated condition.
- New Portland cement (not quick setting, high strength) concrete manhole or structures shall have endured a minimum of 28 days since manufacture prior to commencing coating installation.

### 5.3 Surface Preparation

- Proper surface preparation is required for new and selected existing water vaults prior to receive any repair and coating materials.
- Excessive debris, sediment, root intrusion or other foreign materials which may impact the effectiveness of the surface preparation process shall be removed prior to the commencement thereof.
- Offset structural components, lids, covers, frames, etc. shall be repaired, replaced, or reset prior to the commencement of surface preparation.
- Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed using a water based biodegradable emulsifying/ saponin product(s) as necessary.
- Choice of surface preparation method(s) should be based upon the condition of the concrete or masonry surface, potential contaminants present, access to perform work, and the required cleanliness and profile of the prepared surface to receive the repair and/or coating product(s).
- Surface preparation method, or combination of methods, that may be used include high-pressure water blasting (5,000 psig at the nozzle) using a zero degree, rotating nozzle, water jetting, dry abrasive blasting along with other additional method(s) in accordance with following industry accepted standards:
  - SSPC SP-13/NACE No. 6: Surface Preparation of Concrete,
  - ASTM D-4258: Standard Practice for Surface Cleaning Concrete for Coating and ASTM-D-4259: Standard Practice for Abrading Concrete,
  - ICRI Technical Guideline No. 03732: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
  - NACE/SSPC Standards for the surface preparation of steel.
- Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound, clean, and neutralized surface suitable for the specified coating product(s). Resulting concrete surface profile (CSP) shall be at least a CSP-4 in accordance with ICRI Technical Guideline No. 03732 as referenced in section 2.1 prior to application of Protective Coating Material (PCM). Typically, CSP ranges from CSP 1 (nearly flat) through CSP 9 (very rough) as indicated through ICRI Guideline No. 03732.

## 5.4 Water Infiltration Prevention and Repair

The applicator shall determine the locations where infiltration is occurring and the process to use for stopping the active flow. For small leaks, a quick setting hydraulic cement product may be used. The process is as follows:

- The area should be free from all debris, loose brick, mortar, or concrete.
- Small cracks should be enlarged by chipping with a hammer and chisel to facilitate filling the crack with slurry or dry material.
- The product should be mixed in quantities such that placement can be made in less than one minute. Mixing may be done in a gloved hand, trowel, or any other means that is convenient.
- The placement or working time is related to the amount of water used in making the mix. High water usage increases the set time, but in general, one minute should be considered maximum.
- The product shall be placed in areas of active infiltration by hand or by trowel within the setting time and without further addition of water.
- Repetitive applications of dry material will gradually establish a damming effect when held in place with maximum hand pressure until stiffening takes place.
- Reduction of infiltration will be caused by a gradual build-up of hydrated product, which creates a barrier that is impermeable to infiltrating water. This may require multiple applications.
- Once infiltration is stopped, the product should be brushed and cleaned to remove any loose material.

If the Applicator determines that the flow is too significant for hydraulic cement, a hydrophobic polyurethane injection chemical grout shall be used. The applicator shall follow manufacture recommendations.

- The applicator shall determine the location(s) of the infiltration.
- Injection ports shall be drilled through the wall near the leak and filled with a packer.
- Prior to mixing, both the grout and accelerator must be agitated separately before combining by vigorously shaking the containers. The applicator shall follow the manufacturer recommendation for mix ratios.
- Care should be taken during the mixing. Excess acceleration will cause vigorous expansion that may be prone to shrinkage.

- Before the grout is injected, it shall be tested for appropriate set-time with the actual leaking water from inside the structure.
- Once the product is mixed and ready for injection, an electric airless pump shall be used to pump product through the port and behind the structure.
- During injection the grout will follow the path of least resistance. Existing ground water flow is used to carry the grout to leaking locations.
- When the material has stopped penetrating it will continue to expand against the confines of the crack/joint and compress within itself, forming a very dense, closed cell material stopping the leak.
- For larger leaks or voids, the use of Oakum soaked in the mixed product may be used. The Oakum is forced into the crack/joint/leak using a pointed blunt object. Once exposed to the existing water, the grout will set-off and stop the leak.
- Once the leak is stopped, excess grout (foam) shall be trimmed away and removed from the structure.

## **5.5 Application of Repair/ Resurfacing Product**

- Prior to repair operations, the Engineer, Owner, and/or the Applicator shall review and confirm the designated condition of the structure and agree on the appropriate repair method.
- Once all active infiltration, voids, and proper surface preparation have been addressed, the installation of the CRM can begin.
- Place covers over the inverts or flow lines to prevent extraneous materials from entering the pipelines.
- The applicator must use approved equipment for mixing and spraying the product. The machine shall consist of a progressive cavity pump and air system for low velocity spray application. Equipment should be completely self-contained with water storage and a metering system.
- The product shall be mixed with water as per the manufacturer recommendations. Only enough water will be used to produce a mix consistency to allow the application of the CRM up to one inch thick in a single application without the material “sagging” or “slumping” on the vertical surface.
- Factory blended bagged material shall be placed in the mixing chamber and water added. Prepared mix shall be discharged into a hopper and another batch prepared to occur in such a manner as to allow spraying continuously without interruption until intended thickness is achieved.
- The surface shall be damp without noticeable free water droplets or running water, but totally saturated just prior to the application.

- The CRM shall be applied up to one (3) inch thick in one pass; however, minimum total thickness shall not be less than 1 inch.
- The surface will then be trowelled to a relatively smooth finish. Care should be taken to not “over trowel”.
- Once the initial cure has taken place, the exposed surface area should be given a broom finish.
- Because curing times will vary depending on thickness and ambient temperatures, a minimum curing time of 48 hours shall take place prior to Protective Coating installation.

## 5.6 Application of Coating Product

- Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment, and methods.
- Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.
- Prepared surfaces shall be coated via spray application of the coating product(s) described herein unless otherwise recommended by the coating product manufacturer.
- The intended thickness of applied materials shall be determined by the designated condition and repair method of the structure as per §4.0.
- The spray equipment shall be specifically designed to accurately ratio and apply the specified PCM and shall be regularly maintained and in proper working order.
- The 100% solids, resin-based polyurethane or epoxy liner shall be manually sprayed on to all surfaces by a trained technician who is experienced in the application of the specific PCM and has been certified by the manufacturer.
- Appropriate personal protection equipment shall be utilized. The spray technician shall be on supplied air at all times while in the structure.
- The structure shall be completely dry prior to PCM application. The use of a heater with a high velocity air blower may be used. An approved HCM may also be used to dry suspect areas.
- Prior to the PCM application, a test panel shall be sprayed to inspect the quality of the product. The technician shall check the test panel for appropriate color and mixing of the components. This will also insure that all equipment is functioning properly

- All of the interior surfaces of the manhole/structure shall be coated including the invert, regardless of flow conditions. This will provide monolithic coverage of the PCM on the entire structure.
- The spray technician will begin spraying product at the bottom of the structure one side at a time.
- Once the product has “tacked-off” the technician can move to the opposite side and repeat the process.
- The trained spray technician may now spray the PCM to the required thickness.
- The process is repeated from the bottom of the structure to the top. Although not harmful to the PCM, the use of a ventilating system or ripcord will help to minimize “dusting” or “over-spray”.
- Achieving the specified thickness during application shall be determined using a formula based on the density of the product. The fully trained technician will calculate the appropriate amount of material needed to cover the intended area. A counter on the pumping system shall be used to determine the amount of product actually used.
- Once the PCM is applied, any and all flow may be reinstated to the structure.

## **5.7 Testing and Inspection**

### **5.7.1 Visual**

The Engineer, Owner, or Owners Representative shall make a final visual inspection. Any deficiencies in the finish coating shall be marked and repaired according to the manufacturer recommendations.

### **5.7.2 Thickness Testing**

PCM--Thickness testing of the PCM shall be done during the application by the use of a wet film thickness gauge. During application of epoxy coatings, Contractor shall regularly perform and record thickness readings with a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, to ensure a monolithic coating and uniform thickness during application. A minimum of two readings every four (4 vf) vertical feet, two (2) readings on the Bench (one on each side of the invert) area and one (1) reading in the chimney area shall be recorded. Contractor will submit all documentation on thickness readings to Inspector on a daily basis when coating application occurs.

Due to the rapid cure of the approved polyurethane PCM, the use of a wet film thickness gage is not practical. Therefore, thickness testing for the polyurethane PCM will be done by cutting coupons at random locations on a minimum of (10%) one out of every ten of the total structures coated with the PCM in each basin and or subdivision, as directed by the inspector. Using test samples from the adhesion testing (dollies) is acceptable. All repairs shall be made by Contractor in strict accordance with manufacturer's recommendations using the manufacturer's approved patching material to repair the structure where test coupons were taken.

### 5.7.3 Adhesion Testing

PCM - Adhesion Testing will be required on a minimum of (10%) one out of every ten of the total structures coated with the PCM in each basin and or subdivision will be subjected to random adhesion (bond) testing per this section. Measurement of bond strength of the epoxy coating to the substrate may be examined in accordance with ASTM D7234. Any areas detected to have inadequate bond strength shall be evaluated by the Owner.

If a test manhole fails, then owner shall randomly select two additional structures of the remaining nine and they will be subjected to adhesion (bond) testing. If one of the two structures fails, then all of the remaining 7 structures of the original ten in that basin and or subdivision will be tested. Upon completion of testing, owner will make repair recommendations.

The adhesion (bond) testing shall be conducted by using 3 test dolly's per structure with a DeFelsko PosiTest Pull-Off Adhesion Tester – "AT". One test dolly shall be affixed within 2 ft. of the bench area/bottom of structure, one test dolly shall be affixed in the middle of the structures wall area and the final test dolly shall be affixed within two foot of the top of the chimney area/top of the structure. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations using the manufacturer's approved patching material to repair the structure where test samples were taken.

### 5.7.4 Bond Strength

PCM bond strength shall be measured in accordance with ASTM D4541, adhesion tester type IV and combined bond strength between the three test dolly's from each structure tested, shall need to average greater than 200 psi. The test should also show 100% concrete failure. Test dolly should have coating with concrete struck to it.

### 5.7.5 Holiday Detection Testing

Contractor shall perform holiday detection testing on all surfaces coated with the PCM in the presence of Inspector, with test equipment appropriate for the PCM.

After the PCM has set hard to the touch, surfaces 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 PCM film thickness (i.e., 12,500 volts for 125 mils) applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). Retest until no holidays are identified or until it is determined that a holiday test cannot be performed due to unreliable or faulty readings. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional PCM can be hand applied to the repair area. All touch-up/repair procedures shall follow the PCM manufacturer's recommendations. (Note: This procedure is sometimes difficult or impossible to perform in tight manhole or vault structures or may provide unreliable readings when testing coatings applied to concrete).

## **PART 6: METHOD OF MEASUREMENT AND PAYMENT**

Payment for Water Meter Vault Protective Lining as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

**\*\*END OF SECTION\*\***



## SECTION 4.5

### IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM FOR WATER TRANSMISSION LINES

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all the necessary materials, labor, tools, equipment and associated appurtenances, as well as providing all operations necessary to install and test the required cathodic protection system components.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM C 94	Ready Mixed Concrete
ASTM B 348	Titanium and Titanium Alloy Bars and Billets
ASTM D 1248	Polyethylene Plastics Extrusion Material for Wire Cable
ASTM D 3359	Standard Test Method for Measuring Adhesion by Tape Test
CSA	Canadian Standards Association, Standard C22.2, No. 66 and No. 107
NEC 70	National Electrical Code
Dallas Electrical Code	
NACE RP-0169	Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
AWWA M9 Manual	Concrete Pressure Pipe

NACE RP-0572	Recommended Practice for Design, Installation, Operation and Maintenance of Impressed Current Deep Groundbeds
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC9	Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
NEMA 4	TYPE 3R Enclosures
UL 83	Thermoplastic-Insulated Wires
UL 467	Bonding and Grounding Equipment
UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 506	Specialty Transformers

## 2.2 Requirements

- Certification: Provide manufacturer's certification that all components of the cathodic protection system meet the requirements of the drawings and specifications. The certification shall reference the applicable section of the specifications and the applicable standard detail.
- Drawings: The drawings for the cathodic protection system are diagrammatic and not scaled for exact locations unless scales are explicitly stated on the specific drawing. Determine exact locations by field conditions and non-interference with other utilities or mechanical and structural features. Note other existing utilities in the area and do not damage these utilities during excavation. Repair any damaged utilities to the satisfaction of the City of Dallas at the Contractor's expense.
- Inspection: All materials, fabrication and installations are subject to inspection and testing by the City of Dallas or its designated representative.

## 2.3 Submittals

Following submittals shall be provided by the contractor:

### 2.3.1 Catalog Cuts

Manufacturer's catalog cuts shall be submitted for each item. The catalog cuts shall include the manufacturer's name and shall provide sufficient information to show that the materials meet the requirements of the drawings and specifications. Where more than one item or catalog number appears on a catalog cut, clearly identify the item proposed.

### 2.3.2 Electrical Permits

Provide electrical permits for all transformer-rectifier locations.

### 2.3.3 Logs

The Dallas Water Utilities representative shall be given a minimum of 48 hours notice prior to drilling the anode bore. Copies of detailed geological and resistance logs of each deep anode bore shall be typed by Contractor and submitted to the Dallas Water Utilities or its designated representative.

### 2.3.4 Rectifier Operation and Maintenance Manual

The rectifier manufacturer shall include a complete operation and maintenance manual with each rectifier shipped to the job site. In addition to operating instructions, the manual shall include a circuit diagram and spare parts list. The rectifier shall be operated under full load conditions at the factory and shall be thoroughly inspected and tested by the manufacturer prior to delivery to the job site. Results of this testing shall be reported on a manufacturer's quality control form and shall be included in the operation manual. The rectifier manufacturer shall reference each operating manual by rectifier model number and individual serial number.

### 2.3.5 Report

Submit six (6) operating, monitoring and maintenance reports for the cathodic protection systems. Included shall be all test data as required by Section 4.6, under *Method* section. The manuals shall include operating instructions, maintenance data, product data and test procedures.

### 2.3.6 Drawings

As-built drawings of the cathodic protection installation shall be maintained by the Contractor during installation and construction. Drawings shall be revised to show exact locations of all rectifiers, anodes, wiring, connections and terminal boxes. All items of equipment and material shall be properly identified. The original as-built drawings shall be submitted to the Dallas Water Utilities or its designated representative.

## **PART 3: PRODUCT**

### **3.1 Impressed Current Anodes**

#### **3.1.1 Description:**

The anodes shall be mixed metal oxide coated titanium tubes.

##### **3.1.1.1 Anode Substrate**

The anode substrate shall be Grade 2 Titanium per ASTM B-348. The substrate shall be cleaned and the surface roughened. The cleaning shall remove all organic materials such as cutting oils, which could interfere with coating adhesion. Surface roughness shall be achieved by chemically etching the substrate as a minimum. Blasting the substrate may be used in addition to chemical etching, but not as a substitute. An anti-passivation layer shall be applied to the substrate prior to application of the mixed metal oxide coating.

##### **3.1.1.2 Mixed Metal Oxide Coating**

The prepared titanium substrate shall have an electro catalytic coating applied. Coating composition shall be iridium oxide and tantalum oxide. Total coating loading requirements shall be coordinated with the manufacturer's proprietary information to achieve the required performance. The average gain rate for catalyst application shall not exceed  $0.16 \text{ g/ft}^2$  ( $1.7 \text{ g/m}^2$ ) and the maximum gain rate for any single coat shall not exceed  $0.25 \text{ g/ft}^2$  ( $2.7 \text{ g/m}^2$ ). Coating loading shall be measured using an X-ray gauge which is calibrated at least once per shift for the specific coating type. This test directly measures precious metal loading. Simple weight gain is not an acceptable measure. Adhesion of the catalytic coating shall be tested according to ASTM D 3359. The manufacturer shall certify conformance with these requirements.

##### **3.1.1.3 Size**

The tubular anode dimensions shall be 1.25" diameter x 48" long.

### 3.1.2 Anode Lead Wire Connection:

- The anode lead wires shall comply with the following:

Size:	No. 8 AWG
No. of Strands:	7
Conductor O.D:	0.146"
Insulation:	Halar <sup>®</sup>
Insulation Thickness:	0.020 min.
Jacket:	HMWPE (black)
Jacket O.D.:	0.360" ± 0.018"

- The anode lead wire shall be attached internally in the longitudinal center of the tubular anode by use of a brass, wedge connector:
  - The end of the lead wire shall be stripped and soldered to the designated half of the wedge connector using Kester 44 rosin cored solder.
  - The connector halves shall be inserted from both ends of the anode tube and placed in the longitudinal center of the anode tube.
  - The wedge shall be secured to the inside surface of the anode tube by tightening the expansion screw.
  - Heat shrink tubing shall be applied to seal the end of the tube where the anode lead exits. The anode shall be inverted and a 6" length of No. 4 neoline textured polyester rope shall be inserted in the opposite end of the anode with a loop extending beyond the end of the tube.
  - The entire tube shall be filled with SPL epoxy as supplied by Corrpro to form a positive moisture seal.
- The resistance of the finished connection shall not exceed 0.001 ohms.
- The pull-out strength of the connection shall not be less than the breaking strength of the No. 8 AWG wire or 520 pounds.

### 3.1.3 Anode Backfill

SC 3 calcined petroleum coke, as manufactured by Loresco Inc., shall be used to backfill the impressed current anodes. Anode backfill shall conform to the following:

- Typical Chemical Analysis

<u>Component</u>	<u>Percent Composition</u>
Carbon (fixed)	99.35 minimum
Ash	0.6 maximum
Volatiles	0 (950 ° C)
Moisture	0.05

- Physical Properties

Bulk Density	64 pounds/cubic foot
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- Particle Analysis

Dust free with a maximum particle size of 1 mm.

### 3.2 Deep Anode Components

Supply the following miscellaneous deep anode components:

#### 3.2.1 Surface Casing

- The deep anode shall be equipped with a Schedule 40 PVC casing.
- The casing shall be 10 inches diameter, and 10 feet long.
- Casing sealant shall be Aqua Plug or Perma Plug.
- The casing shall be terminated with a 10” diameter, Schedule 40 PVC cap.

#### 3.2.2 Vent Pipe

- Plastic vent pipe shall be used from the bottom anode to the surface for dissipating gases to the atmosphere.
- The plastic vent pipe shall be 1-inch diameter slotted piping (AllVent™) as manufactured by Cathodic Engineering Equipment Company or approved equal. The vent pipe above the coke breeze shall not be perforated.
- The plastic vent pipe shall extend above grade and the vent outlet shall be screened and installed in an inverted manner.

### 3.2.3 Exterior Grout for Surface Casing

- Standard grout designed for sealing around monitor or water well casing such as Aquaguard by Halliburton Energy Services. Product shall be submitted and must be approved as part of the drilling permitting process.

## 3.3 **Transformer-Rectifier**

Cathodic protection transformer-rectifier shall be air cooled, tap adjust Custom model as manufactured by Corppower or approved equal and listed in CSA File No. 45382.

### 3.3.1 DC Output Ratings

- Rectifiers shall be rated at 20 volt, 20 amperes D.C. Rectifiers shall be capable of supplying continuous, full rated output at an ambient temperature of 45° C, in full sunlight with an expected life in excess of 10 years.

### 3.3.2 AC Input Ratings

- Full rated DC output shall be obtainable with an AC input voltage at 5% below the nominal value. Continuous AC input voltage at 10% above the nominal value shall not damage the transformer, the diode bridge assembly, or exceed any component ratings. (Note: This shall apply provided that the rectifier has not been previously adjusted to exceed the maximum DC voltage or amperage rating of the unit.)

### 3.3.3 Cooling

- Cooling shall be by natural air convection. Cabinets shall be vented for natural air convection and shall be screened against insects.

### 3.3.4 Voltage Adjustments

- The output voltage shall be adjustable by means of not less than 25 approximately equal steps of secondary taps from 5 percent of rated voltage to full-rated voltage.

### 3.3.5 Rectifying Elements

- Rectifying elements shall be silicon diodes sized as follows:
  - The Peak Inverse Voltage (PIV) of the diode shall be 300% of the maximum impressed voltage on the diode or 400 volts, whichever is greater.

- Diodes shall be configured into a full-wave bridge assembly. Diodes shall be sized to carry an average current of no more than 55% of the manufacturer's recommended maximum current rating.
- Heat sinks shall be sized to keep diode case temperatures less than 100° C at rated rectifier output and at maximum rated ambient temperature.
- Diodes shall be overload protected by means of semiconductor fuses, located in the transformer secondary leg to the diode bridge assembly.
- Diodes shall be equipped with supplemental Metal Oxide Varistor (M.O.V.) surge arrestors at the diode bridge assembly sized to provide protection against secondary over-voltage surges.

### 3.3.6 AC Circuit Breakers

Input overload and short circuit protection shall be provided by magnetic trip circuit breakers. The circuit breaker shall be sized to hold 100 percent of rated load. It may trip between 101 percent and 125 percent of rated load and must trip at 125 percent and above.

### 3.3.7 Surge Protection

Separate AC and DC surge protection shall be provided by means of high energy Metal Oxide Varistors rated at 500 joules on D.C. output and 1000 joules on the AC input.

### 3.3.8 Electrical Panels

Electrical panels shall be minimum thickness of 0.187" NEMA Grade "XX" laminated phenolic, rated for Class "B" operation (105° C maximum). Rectifier front instrument panel identifications shall either be permanently silk-screened onto the panel or be 1/16" lamicaid (plastic laminate) adhesive labels permanently engraved with white lettering on a black background. The adhesive labels shall be mechanically affixed to the panel via stainless steel rivets or screws.

### 3.3.9 Connection Hardware

All electrical hardware shall be copper or high conductivity brass, suitably sized, and finished with an electroless nickel plating for superior corrosion resistance. All connections shall be tightly secured with lock washers and nuts torqued to manufacturer's recommended specifications. All electrical connections shall use the "double nut" method to ensure that any compression of the panel material will not affect the electrical conductivity of the connection.



### 3.3.10 Cathodic Protection Cabinet

- Mount transformer-rectifier unit, disconnect switch and anode junction panel in a single enclosure.
- Enclosure to be free standing, NEMA 3R, 36" wide x 48" high x 24" deep, 12 gauge, type 304 stainless steel with lifting eyes.
- Equip with single, louvered door with provisions for padlocking. Provide drip shield and inside insect screen.
- Include ground lug, sized for No. 6 AWG wire.
- Place stickers on all four sides that read "Danger, High Voltage, Keep Out."
- Provide permanent engraved nameplate with black letters on white background that reads "Cathodic Protection Cabinet, Property of the City of Dallas."

### 3.3.11 Rectifier Instrumentation

- Rectifier shall be equipped with separate analog ammeter and voltmeter.
- Meters shall be a minimum of 3-1/2" size, with a minimum scale length of 2-7/8".
- Meters shall be 0 - 50 millivolts full-scale deflection, taut-band movement with four-to-one swamping (i.e. internal meter resistance comprised of 25% winding resistance and 75% fully temperature compensated dropping resistor for superior, wide temperature range performance).
- Meter accuracy shall be  $\pm 2\%$  full-scale deflection at 25° C., temperature compensated to 0.85% per 10 degrees C.
- Rectifier meters shall be scaled to have rated output no less than 70%, or greater than 85% of full-scale deflection.
- Meter shunts shall be panel-mounted Holloway type "SW" style, with an accuracy of  $\pm 0.25\%$ .

### 3.3.12 Transformers

Transformers shall meet UL 506, Specialty Transformers and the following:

- Transformer designed as full isolation with separate isolated primary and secondary windings with a minimum efficiency of 95%.

- Transformer secondary shall be equipped with a minimum of 25 steps of secondary voltage adjustment (5-COARSE, 5-FINE). Tap adjustment shall be by means of tap bars.
- Transformer materials and construction shall be rated for Class "H" operation (180° C). Insulation materials shall be further enhanced by dipping in thermosetting varnish and baking.
- Transformer shall be rated for a minimum dielectric strength of 2250 volts applied for one minute between the windings, and between the windings and the core.

### 3.3.13 Potential Monitoring Connections

Two, five way binding posts shall be provided on the front of the rectifier instrument panel. One will be labeled "Reference" and one will be labeled "Structure".

### 3.3.14 Remote Monitoring Connection

The rectifier shall be provided with a terminal block for possible connection to a Corrpower remote monitoring unit. The terminal strip shall have two separate terminals each for monitoring of the rectifier DC output voltage and DC output current. Terminals for connecting to an internal interrupter coil (interrupt contactor to be supplied with rectifier), monitoring of structure potential, and monitoring of the rectifier AC shall also be provided.

### 3.3.15 Miscellaneous

- All rectifiers shall be capable of operating from either a 115 or 230 volt, single phase, 60 hertz AC input.
- Cathodic Protection Rectifier shall be 100% quality control tested as outlined in this specification.
- During manufacture, the rectifier shall be subjected to frequent visual and performance testing to ensure a high degree of quality acceptance level.
- Rectifiers shall be subjected to 100% testing of the following rectifier electrical parameters:
  - AC input voltage, current, apparent power and true power.
  - DC output current, voltage and power.

- AC power factor.
- AC to DC conversion efficiency.
- Output ripple.

### **3.4 Anode Junction Panel**

#### **3.4.1 Enclosure**

Mount the anode junction panel in the stainless steel rectifier enclosure as shown on the drawing. Provide positive terminal, 0.01 ohm type RS Holloway shunts, and a minimum 3/16" thick, NEMA Grade "XX" phenolic panel. For size and terminal configurations, see drawings.

#### **3.4.2 Positive Cable**

Use single No. 4 AWG, conductor, seven strand copper with HMW/PE insulation.

### **3.5 Negative Cables**

#### **3.5.1 Cables**

Rectifier negative cables shall be No. 4 AWG, single conductor, seven strand copper with medium density, HMW/PE insulation. The polyethylene shall conform to ASTM D 1248, Type I, Class C, Grade 5.

#### **3.5.2 Test Lead**

The test lead shall be No. 12 AWG, solid copper wire with white, TW, THW, or THHN insulation and shall be of sufficient length to extend from the pipe connection to the rectifier without splicing.

### **3.6 Reference Electrode**

- The electrode shall be equipped with No. 14 AWG stranded copper wire with blue HMW/PE insulation of suitable length to extend from near the pipe (see drawings) to the rectifier without splicing.
- The reference electrode shall be copper/copper sulfate Permacell Plus, double membrane, and ceramic cell in a geomembrane package, as manufactured by Corpro or approved equal.

### 3.7 Thermite Weld Equipment

- Charges and Molds- Cadweld molds and charges shall be used. Charges and mold size shall be as specified by Erico for the specific surface configuration.
- For high strength steel pipelines, use only 15 gram Cadweld charges.
- Weld Coating- Coating for welds shall be Kop-Coat as manufactured by Carboline.
- Weld Cap- The coated weld shall be covered with a plastic weld cap.

### 3.8 AC Power Service

- Products- All AC power components shall meet local power company requirements.
- Meter Base- Meter base shall be 120/240-volt, single phase, 100-ampere.
- Disconnect Switch- Provide fused disconnect in NEMA 1 enclosure. Supply with circuit breakers sized for 100 to 135 percent of the AC current flow at maximum rectifier output. Mount in cathodic protection cabinet with transformer-rectifier.
- Ground Rod- Ground rod shall conform to the requirements of the utility company having jurisdiction.
- Ground Wire and Clamp- Ground wire shall be bare, No. 6 AWG solid copper wire. Use a bronze, bolt-on ground rod clamp.
- Service Pole- Service Pole for rectifier shall be a 25 foot, Class 5, treated wood pole.

### 3.9 Power Supply Protection

Cathodic protection transformer-rectifiers require extra protection from traffic and vandalism at specified locations.

- Fence- Ornamental iron fencing shall be installed where indicated on drawings. Fencing materials shall be as shown drawings.

- Bollards- Steel bollards shall be installed where indicated on drawings. Bollards materials shall conform to DWU Standard number 236.

## **PART 4: INSTALLATION**

### **4.1 Deep Anode**

- Permits- The Contractor will obtain well drilling permits as required by City, County and/or State agencies.
- Field Location- Location of the deep anodes are approximate. Exact placement shall be determined and verified in the field by the Contractor and the Dallas Water Utilities or its designated representative.
- Anode Hole Drilling-The anode hole shall be 8 inches diameter to a depth of 250 feet. Drilling shall be accomplished with rotary bit. Driller shall use standard techniques (i.e. trough and vacuum truck) to capture and contain the drilling fluids, mud and cuttings at the top of the hole. The driller shall select the type and consistency of drilling fluids to be consistent with soil characteristics. The drilling rig shall be leveled to provide a round, straight and plumb anode hole.
- Casing-Install an 8” diameter surface casing to a depth of 10 feet.
- Anode Hole Geological Logs- As the hole is drilled, the driller shall maintain a record describing the depth and type of geological formations encountered. Copies of the log shall be submitted as required by Section 2.3.
- Anode Hole Resistance Log- Record electric log of the hole using one of the anodes. The anode lead wire shall have been previously marked in five-foot increments. The anode lead wire shall be marked for a distance equaling or exceeding the maximum anticipated depth of the hole. As the anode is lowered into the hole, measure the resistance by impressing a minimum of 12-volts DC between the anode and a very well-grounded structure such as the AC power ground. Nilsson type soil resistance meters shall not be used to perform this test. A recommended 12-volt DC power source is a heavy-duty lead acid automobile battery. Lower the anode into the hole and at ten-foot increments, hold in place while the voltage and current output of the DC current source are measured and recorded. This information shall be recorded and submitted as required under Section 2.3.
- Vent Pipe Installation- The vent pipe (1-inch Allvent to the top of the coke breeze column) shall be installed in the hole with the first anode. One-inch PVC non-perforated pipe will be installed from the top of the coke breeze column to three

feet above the top of the hole. The bottom of the vent pipe shall be capped. The top of the vent pipe shall be capped throughout the anode and coke breeze backfill installation procedure to prevent intrusion of foreign material. Drilling mud shall not be allowed to enter in the vent pipe.

- Anode Installation- The deep anode shall consist of 10 – 1.25” x 48” long mixed metal oxide tubular anodes spaced at 10-foot intervals. The anodes shall be centered in the hole using anode centralizers. The anodes shall be installed by lowering individually into the hole by the lead wire. The lead wires shall be pre-marked for the nominal anode depth. The final depth shall be recorded with the first anode in the hole (i.e. the bottom anode) identified as anode number one (1). The anode lead wires shall not be damaged during handling or lowering into the hole. Under no circumstances shall the anode lead wires be clamped or pinched around another object while lowering. If the insulation for any anode lead wires are cut, broken, or nicked, the complete anode shall be rejected and shall be removed from the job site. Contractor shall replace all damaged anodes at no additional expense to Dallas Water Utilities
- Anode Column Coke Backfill- The coke backfill shall be slurried above-grade and then pumped into the hole after the anodes are installed. The coke shall be pumped from the bottom of the hole up using a pipe that is the length of the anode hole. The pipe used to pump the coke into the hole shall not be the vent pipe. The pipe shall be raised as the anode column is filled with coke. The pipe shall be removed from the hole after the coke installation is complete. A sufficient amount of backfill shall be used such that the coke breeze column will extend a minimum of five feet above the top of the uppermost anode and no closer than 30-feet from the top of the hole. Installation of the coke backfill shall be uniform with no voids around the anodes.
- Vent Pipe Conditions- The 1-inch diameter internal vent pipe shall terminate with a gooseneck fitting. The top end of the vent pipe shall be left open to allow gases from the anode hole to exit.
- Pea Gravel- Pea gravel shall be installed in the borehole from the top of the coke backfill to 5 feet below the bottom of the surface casing.
- Environmental Seal- A bentonite plug 10-feet in length shall be installed using AquaPlug or PermaPlug material. The plug shall extend 5 feet into the bottom of the casing and 5 feet below the bottom of the casing.
- Precautions- Contractor shall take all necessary precautions to avoid entrance of foreign matter into the hole, movement of soil strata, or collapsing of the hole during the progress of the work. Should movement of soil strata or collapse of the

drilled hole interfere with proper completion of the anode grounded, Contractor will recover the wires, anodes and any vent pipe and ream or re-drill the hole.

- Mud and Cuttings- Drilling mud, cuttings and other waste shall be disposed of onsite in a manner which complies with the rules and regulations of the State, City and County.

#### 4.2 Installation of Cathodic Protection Cabinet

- Contents- The cathodic protection cabinet is to contain the transformer-rectifier, anode junction panel and disconnect switch.
- Codes- Comply with the latest edition of the National Electrical Code (NEC) and with all City of Dallas and local power company codes and standards.
- Mounting- Mount rectifiers on reinforced concrete pad as shown on the drawings. Place at elevation above the 100-year flood plain.
- Identification- Equip rectifiers with permanent engraved nameplates to identify the units as "Cathodic Protection Cabinet, Property of City of Dallas."
- Conduit- Place all wiring to the rectifier in rigid galvanized steel conduit when run above grade.
  - Use insulating bushings at the ends of all conduits
  - Extend steel conduit 12 inches below grade.
- Electrical Service- Provide AC electrical service for each rectifier unit. Furnish and install the necessary wiring, conduits, wires, meter sockets, splice boxes and equipment to the service connection as required by the local power company.
- Completion- The installation is not considered complete until the AC and DC wiring is installed and the rectifier is capable of operating at full rated load. Install AC power such that the rectifier can be activated for test purposes. Leave the power off after test.

### 4.3 Cables and Test Lead

- General- Connect the No. 4 AWG HMW/PE negative cable and No. 12 AWG test lead to the water transmission line and route to the cathodic protection panel. Route No. 4 AWG HMW/PE positive cable from junction box to transformer-rectifier.
- Excavation- Carefully excavate the water transmission line for wire and cable connection. The excavation on steel pipe can be anywhere along the line. For prestressed concrete cylinder pipe, a joint must be exposed for welding the "L Bracket" as shown on the drawings.
- Alternate Connection- As an alternate to direct connection to the pipe, where approved by the City, the Contractor may elect to connect the negative cable and test lead inside a concrete vault by welding a plate to the top of a flange, as shown on the drawings.
- Method- Attach negative cables and test leads to the water transmission lines by thermite welding at the location shown on the drawings.
- Preparation- Clean and dry the steel surface to which the negative cable is to be attached. Use a grinding wheel to remove all dirt, coating, oxide and mill scale from the surface. Use a solvent or file to remove oil and grease, if necessary. Clean the surface to bright metal. Repeat preparation for the test lead attachment. Remove approximately 1 inch of insulation from each end of the wires to be thermite welded to the steel surface, exposing clean, oxide-free copper.
- Welding- Thermite weld the negative cable and the lead as follows:
  - Using the proper size thermite weld mold as recommended by the manufacturer, place the wire between the graphite mold and the prepared metal surface.
  - Place the metal disk in the bottom of the mold.
  - Remove the cap from the weld charge container and pour the contents into the mold. Squeeze the bottom of the weld charge container to spread ignition powder over the charge.
  - Close the mold cover and ignite the starting powder with a flint gun. Firmly hold the mold in place until all of the charge has burned and the weld has cooled slightly.



- Remove the thermite weld mold and gently strike the weld with a hammer to remove the weld slag. Pull on the wire to assure a secure connection. If the weld is not secure or the wire breaks, repeat the procedure.
- When the weld is secure, coat all bare metal and weld metal and cover with a thermite weld cap.

#### 4.4 Permanent Reference Cell

- Location- Locate the permanent reference cell near the negative pipeline connection as shown on the drawings.
- Placement- Remove the permanent reference cell from the shipping package and place below the springline and one foot away from the pipeline if in the excavation for the negative connection, and no more than three feet away if in a separate augured hole.
- Backfill- Backfill the reference electrode with six inches of select, native soil and compact by hand. Moisten soil with 5 gallons of water to achieve good compaction.
- Wiring- Run continuous lengths of the blue reference cell wiring, and the white test lead to the rectifier unit in the same trench as the negative cable. Do not nick or otherwise damage the wire insulation.

#### 4.5 Wire and Cable

- Depth- Install all underground wires and cables a minimum of 36 inches below final grade with a minimum separation of 6 inches from other underground structures.
- Conduit- Place all DC positive cables, negative cables, test leads and permanent reference cell leads in rigid, galvanized steel conduit when above-grade. Extend the conduit 12 inches below grade.
- Bushings- Use insulating bushings at the ends of all conduits.

#### 4.5 AC Power

- Permit- Contractor is responsible for obtaining an electrical permit by a Licensed Electrician.
- Installation- The AC power and grounding assembly for the transformer-rectifiers, including weatherhead, conduit, meter loop and ground rod, shall comply with local, state and federal code.

- Power Supply- Contractor shall provide permanent AC service from the power company to the transformer-rectifiers.
- Account- Contractor shall transfer power company account to the City of Dallas at the end of the project. This is a requirement for project completion.

#### 4.6 Power Supply Protection

Cathodic protection transformer-rectifiers require extra protection from traffic and vandalism at specified locations.

- Fence- Ornamental iron fencing shall be installed where indicated on drawings. Fencing shall be constructed as shown drawings.
- Bollards- Steel bollards shall be installed where indicated on drawings. Bollards shall be constructed in accordance with DWU Standard number 236.

#### 4.6 Post-Installation Testing of the Cathodic Protection Systems

- General- Inspect, energize, and adjust the cathodic protection as soon as possible after the equipment has been installed.
- Commissioning- The commissioning of the cathodic protection system shall be performed by a Corrosion Engineer hired by the Contractor to achieve compliance with the referenced corrosion control standards set forth by NACE International and AWWA. The Corrosion Engineer shall be registered in the State of Texas as a Professional Engineer and, through experience and education, qualified in cathodic protection of prestressed concrete cylinder pipe.
- Notice- Prior to native state and polarized potential testing, the Contractor shall give a minimum of 72 hours notice to Dallas Water Utilities to facilitate observation of the tests by its designated representative.
- Method- The Corrosion Engineer shall:
  - Measure native state pipe-to-soil potentials at all test stations, permanent reference cells, and locations of exposed pipe prior to energizing the cathodic protection system.
  - Measure foreign line potentials, prior to energizing the cathodic protection system.

- Energize the cathodic protection system and adjust the DC current output such that the pipe-to-soil potentials near the cathodic protection current source (either transformer-rectifier or sacrificial anodes) is approximately -900 millivolts to a copper sulfate electrode (CSE). Record the DC voltage and current of the power supply.
  - Allow sufficient time for the pipeline to polarize.
  - Using synchronized current interrupters in all rectifiers influencing the test point, cycle the power supplies “On” and “Off”.
  - Record “On” and “Instant Off” potentials at all water pipeline test stations, permanent reference cells, locations of exposed pipe, casings and foreign pipelines.
  - Adjust the cathodic protection power supplies to achieve a minimum 100 millivolts of polarization without any “Instant Off” potentials more negative than -900 millivolts CSE.
  - Record all adjustments of the DC power supplies.
  - Verify that interference does not exist with foreign pipelines. Perform joint tests and mitigate any interference detected.
- After initial energizing, perform a walk-through inspection with Dallas Water Utilities or its designated representative to verify that all corrosion control components have been installed in accordance with project drawings and specifications.
  - A punch list of outstanding work identified during walk-through inspection shall be made. Once Contractor has completed all work on punchlist, pipeline will be allowed to polarize for 30 days before final testing. Final testing and adjustment shall be performed after 30-day polarization period.
  - During final testing, adjust the system to achieve 100 millivolts polarization with no polarized potential more negative than -900 millivolts CSE.
  - Deficiencies discovered during final testing shall be repaired at Contractor’s expense and at no additional cost to Dallas Water Utilities. Should additional testing be required after final testing, cost of additional testing shall be paid by Contractor and will be charged at a rate of \$1,500 per day.

- Equipment- All cathodic protection testing instruments shall be in proper working order and calibrated according to factory specifications.
- Report- A written report shall be submitted in accordance with Section 1.05, Submittals. Included shall be all test data, interference test results, resistance and geologic logs, the rectifier O&M Manual and the As-Built Drawings.

## **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Payment for Impressed Current Cathodic Protection System as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

**\*\*END OF SECTION\*\***

## SECTION 4.6

### CORROSION CONTROL TEST STATIONS

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all labor, materials, tools, and equipment required to install and test the required corrosion control test station components. The test station construction shall include but not be limited to, electrical connections to the pipelines and setting of test boxes.

Specifications for test station wiring, terminal boxes, reference electrodes and electrical connections.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM D1248	Polyethylene Plastic Molding and Extrusion Material
NACE RP-0169	Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
AWWA M9 Manual	Concrete Pressure Pipe
UL 83	Thermoplastic Insulated Wires
UL 486A	Wire Connectors for Use with Copper Conductors

##### 2.2 Submittals

Following submittals shall be provided by the contractor:

###### 2.2.1 Catalogue Cuts

Manufacturer's catalog cuts shall be submitted for each item. The catalog cuts shall include the manufacturer's name and shall provide sufficient information to show that the materials meet the requirements of the drawings and specifications. Where more than one item or catalog number appears on a catalog cut, clearly identify the item proposed.

### 2.2.2 Drawings

As-built drawings of the corrosion control test stations shall be maintained by the Contractor during installation and construction. Drawings shall be revised to show exact locations of all wiring, connections, and terminal boxes. All items of equipment and material shall be properly identified. The original as-built drawings shall be submitted to Dallas Water Utilities or its designated representative.

## **PART 3: PRODUCTS**

### **3.1 Flush Mount Test Stations**

- Test stations shall consist of test wires, a terminal box and a traffic box as shown on the drawings.
- The terminal box shall be a five terminal Big Fink as manufactured by Cott Manufacturing Company or approved equal.
- The concrete traffic box shall be an 8.75-inch diameter I-RT with a cast iron cover marked "CP Test" as manufactured by Brooks Products, Inc or approved equal.

### **3.2 Above-Grade Test Stations**

- At test station locations where flush mounted structures cannot be installed, an above-grade test station shall be used, and placed such that possible damage from vandalism, traffic, etc. is minimized.
- The test station shall be a five terminal Big Fink as manufactured by Cott Manufacturing or approved equal.
- Terminal boxes shall have a lockable, corrosion-proof plastic cover and shall be mounted on a 5-foot length of 3-inch diameter UV-resistant plastic conduit.
- The test station shall be installed adjacent to a permanent structure, if available, for physical protection.

### **3.3 Test Station Lead Wires**

- Test station lead wires shall be No. 12 AWG, solid copper with white TW, THW or THHN insulation.
- All terminal boards shall be wired by the installer as shown on the drawings.

### 3.4 Thermite Weld Equipment

- Charges and Molds- Weld charges and mold size shall be specified by the manufacturer for the specific surface configuration. Use only the correct charges for the specific application. Welding charges and molds shall be Erico, Cadweld or Continental Industries, Thermoweld.
- Weld Coating- Coating for all welds shall be Kop-Coat as manufactured by Carboline or approved equal. Cover coated weld with a plastic weld cap.

## PART 4: EXECUTION

### 4.1 Applications

- Required applications of corrosion control test stations include locations where future testing is anticipated for the following reasons:
  - Testing to determine the effectiveness of the installed cathodic protection systems and to allow for startup adjustments.
  - Testing to determine interference effects from and on adjacent or crossing foreign underground structures.
  - Testing to determine sources and magnitude of stray d-c currents and required mitigative measures.
  - Periodic monitoring to determine status of existing cathodic protection systems, stray current, and foreign line influence.
- Install test stations at each of the locations scheduled on the drawings.

### 4.2 General

- Attach leads in manholes as shown on the drawings. If a flush mounted test station is not feasible in a particular location, then an above-grade test station may be used, subject to approval by Dallas Water Utilities or its designated representative.
- Use continuous test station lead wires without cuts or tears in the insulation.
- Attach test lead wires to the steel plate by thermite welding.
- Use color coded test wires as indicated on the drawings.
- Wire test station terminal board configurations as shown on the drawings.

### 4.3 Flush –Mount Test Stations

- Install flush-mount test stations as shown on the drawings.

- Sufficient slack shall be coiled beneath the test station to allow for soil settlement and to prevent damage to the leads during backfilling. Additional slack shall be left to allow for withdrawal of the terminal board a minimum of 18 inches for test purposes.
- Set test stations installed outside areas of permanent paving materials in a Portland Cement concrete pad. The concrete pad shall be a minimum of 24 inches square and no less than 4 inches thick.

#### **4.4 Above-Grade Test Stations**

- Install above-grade test stations where a flush mounted test station cannot be located. Use and location of above-grade test stations shall be approved by the Dallas Water Utilities or its designated representative.
- Locate test station adjacent to a permanent structure (e.g. a power pole), if available, for physical protection.
- Coil sufficient slack beneath the test station to allow for soil settlement and to prevent damage to the leads during backfilling.
- Set test stations in a Portland cement concrete anchor. The concrete anchor shall be a minimum of 12 inches in diameter and no less than 2 feet thick.

#### **4.5 Test Lead Wire Attachment**

- Attach test leads to the pipe by thermite welding to a steel plate as shown on the drawings.
- The steel surface to which the wires are to be attached shall be clean and dry.
- The wires to be thermite welded to the pipe shall have approximately 1 inch of insulation removed from each end, exposing clean, oxide-free copper for welding.
- Using the proper size thermite weld mold as recommended by the manufacturer, place the wire between the graphite mold and the prepared metal surface. Use a copper sleeve crimped over the wire for all No. 12 AWG wires.
- Place the metal disk in the bottom of the mold.
- Pour the thermite weld charge into the mold. Squeeze the bottom of the cartridge to spread ignition powder over the charge.
- Close the mold cover and ignite the starting powder with a flint gun.
- After the exothermic reaction, remove the thermite weld mold and gently strike the weld with a hammer to remove the weld slag. Pull on the wire to assure a secure connection. If the weld is not secure or the wire breaks, repeat the procedure.



- If the weld is secure, coat all bare metal and weld metal with Kop-Coat. Cover the coated weld with a plastic weld cap.

#### **4.6 Post Installation Backfilling of Test Station-Lead Wires**

- Protect test station wires to prevent damage to the wire insulation and conductor integrity during backfilling.
- After completion of the test station installation, verify the connection by recording a pipe-to-soil potential.
- Replace any test wire found to have a high resistance connection.

### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Payment for Impressed Corrosion Control Test Station as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

**\*\*END OF SECTION\*\***

## SECTION 5.1

### TECHNICAL SPECIFICATION FOR WASTEWATER FLOW CONTROL AND BYPASS PUMPING

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all the necessary materials, equipment, tools, labor, and associated appurtenances to control the wastewater flow in conjunction with cleaning, television inspection, point repairs, obstruction removal and other related works. Wastewater flow diversion must not cause flooding or damage to public or private property. The wastewater flow shall be bypassed while plugging the upstream manhole for the section of main being worked in areas to receive cured-in place, pipe bursting and other trenchless or open cut applications as necessary.

##### 1.2 Related Works

- Technical Specification for Wastewater Main and Manhole Cleaning
- Technical Specification for Television Inspection of Wastewater Mains
- Technical Specification for Rehabilitation of Existing Wastewater Main by Pipe Bursting (PB)
- Technical Specifications for Rehabilitation of Existing Wastewater Main by Cured-in-Place Pipe (CIPP)

#### PART 2: METHODS OF WASTEWATER FLOW CONTROL

The Contractor shall coordinate with the Owner regarding the method of wastewater flow control to be used. All methods to be utilized must be pre-approved prior to any construction.

##### 2.1 Plugging or Blocking

Plugging or blocking typically includes insertion of a plug into the upstream manhole of the line section being worked. A plug in the downstream manhole also may be required to prevent any backflow.

## **2.2 Bypassing Pumping**

Bypass pumping typically includes flow diversion from the upstream manhole to the downstream manhole of the line section being worked.

## **PART 3: PRODUCTS**

### **3.1 Plugs**

The plugs must be so designed that all or any portion of the wastewater can be released.

### **3.2 Bypass Pumps**

When total bypassing and pumping are required, the pumps, conduits, and other equipment shall be supplied to divert the flow of wastewater around the line section where construction or rehabilitation work is to be performed. The total bypass system must have sufficient capacity to handle peak flow during a rainstorm. The Contractor is responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing. If pumping is required on a 24 hour basis, engines with hospital rated noise suppression equipment shall be used.

## **PART 4: EXECUTION**

### **4.1 Flow Control Precautions**

When flow in a wastewater main is plugged, blocked, or bypassed; sufficient precautions shall be taken to protect the wastewater main from damage that might result from wastewater surcharging. Further, precautions shall be taken to insure that wastewater flow control operations do not cause flooding or damage to public or private property being served by the wastewater mains involved. The Contractor is advised to schedule his work in section lengths such that in the event of a rainstorm that might cause an increase in the wastewater flow, the work can be adequately secured, flow diversion stopped and flow resumed back in the existing main, without any damage to the new work.

### **4.2 Limitations and Constraints**

- The flow diversion equipment and facilities must be located such that local traffic, private property access, or any public activities are not interrupted.
- Where diversion piping crosses side streets, alleys, and driveways, provide asphalt ramps and covers over the piping to facilitate any traffic. Provide pedestrian cross-over ramps and walkways where needed or requested by the Owner. Do not open cut streets, alleys, or driveways to bury piping.

- It is the Contractor's responsibility to divert incoming flow from all service connections and laterals. Provide all the necessary materials and equipment to tie this flow into the main diversion system.
- Flow diversion materials and equipment must be in place and successfully operating for a period of four hours prior to starting any rehabilitation work requiring flow diversion.
- Reduce flow to within the limits required for TV inspection. After the work has been completed, restore flow to normal.
- The Contractor is responsible for keeping pumping engine noise complaints from the citizens to a minimum. The Owner will terminate all pumping activities if noise control is not adequately addressed.

#### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for providing the Wastewater Flow Control and Bypass Pumping as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

**\*\*END OF SECTION\*\***

## SECTION 5.2

### TECHNICAL SPECIFICATION FOR WASTEWATER MAIN AND MANHOLE CLEANING

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all the necessary materials, equipment, tools, labor, and associated appurtenances for cleaning the wastewater mains and manholes to be rehabilitated as shown on the drawings and specified herein. Cleaning includes, but not limited to, removing foreign materials from the mains and manholes in preparation for cured-in place pipe (CIPP), pipe bursting (PB), manhole coating and other trenchless or open cut applications as necessary.

##### 1.2 Related Work

- Technical Specification for Television Inspection of Wastewater Mains
- Technical Specification for Rehabilitation of Existing Wastewater Main by Pipe Bursting (PB)
- Technical Specifications for Rehabilitation of Existing Wastewater Main by Cured-in-Place Pipe (CIPP)

#### PART 2: PRODUCTS

##### 2.1 Cleaning Equipment

Selection of cleaning equipment and method of cleaning must be based on the condition of the wastewater mains at the time work commences and subject to the Owner's approval. All cleaning equipment and devices shall be operated by experienced personnel. The Owner may require the Contractor to demonstrate the performance capabilities of the proposed cleaning equipment. If the cleaning equipment does not give the desired results required by the Owner, different equipment shall be used to achieve the desired result. More than one type of equipment/attachments may be required at any particular location(s).

## **PART 3: EXECUTION**

### **3.1 Wastewater Main Cleaning**

Base selection of the equipment on the conditions of mains at the time work commences. The equipment and methods selected are subject to the Owner's approval. The equipment must be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the wastewater mains and manholes.

### **3.2 Repair and Damaged Main**

If the main is damaged and requires repair prior to rehabilitation, make such repairs as directed by the Owner. Any pavement cut excavation and repair must comply with the City of Dallas Street Cut and Repair Manual, Latest Edition. If the main is damaged through the negligence of the contractor, make adequate repairs as approved by the Owner at no additional cost to the Owner.

### **3.3 Final Acceptance**

The final inspection of the main will be either a television inspection, onsite inspection, or a combination of both methods as determined by the Owner. The cleaning must be to the satisfaction of the Owner. If inspection shows the cleaning to be insufficient, re-clean and re-inspect the main until cleaning is approved by the Owner.

## **PART 4: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for providing the Wastewater Main and Manhole Cleaning as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

**\*END OF SECTION\*\***

## SECTION 5.3

### TECHNICAL SPECIFICATION FOR TELEVISION (TV) INSPECTION OF WASTEWATER MAINS

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all the necessary materials, equipment, tools, labor, and associated appurtenances for television inspection of wastewater mains as shown on the drawings and specified herein.

##### 1.2 Purpose and Schedule of Television Inspection

###### 1.2.1 Pre-Construction Television Inspection:

A pre-construction television inspection shall be performed for all wastewater mains to be rehabilitated and considered as “No Separate Pay Item”. The purpose of this television inspection is to locate or confirm the breaks, obstacles and service connections. In addition, this also verifies if the wastewater mains are properly cleaned in preparation for rehabilitation and identifies areas in the existing main that may require repair. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled as specified in the Wastewater Flow Control and Bypass Pumping section of these specifications.

###### 1.2.2 Post Construction Television Inspection:

A post-construction television inspection shall be performed for all wastewater mains including new installation, replacement or rehabilitation. This television inspection shall be performed upon reconnection of all service laterals along with installation or rehabilitation of wastewater main.

1.2.3 Television Inspection Schedule:

TV inspection schedule for water/wastewater main project is shown below:

Construction Type	TV Inspection Schedule	
	City Contract	Joint Contract (In Advance of Paving)
Open Cut	Post-Construction	Post-Construction Pre-Permanent Paving (Blue Top)
Trenchless Rehabilitation	Pre-Construction Post-Rehabilitation	Pre-Construction Post-Rehabilitation Pre-Permanent Paving (Blue Top)

**1.3 Related Work**

- Technical Specification for Wastewater Main and Manhole Cleaning
- Technical Specification for Wastewater Flow Control and Bypass Pumping
- Technical Specification for Pipe Bursting of Wastewater Mains
- Technical Specifications for Cured-in-Place of Wastewater Mains

**PART 2: EQUIPMENT**

**2.1 Television Camera**

The television camera used for the inspection shall be specifically designed and constructed for such inspection. Lighting for the camera shall allow a clear picture of the entire periphery of the pipe above the existing flow. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall produce a picture quality to the satisfaction of the Engineer, and if the picture quality is not satisfactory, TV inspection equipment shall be removed. No payment will be made for an unsatisfactory inspection.

**2.2 Communication Equipment**

When manually operated winches are used to pull the television camera through the main, two-way radio or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.



## **PART 3: EXECUTION**

### **3.1 Camera Movement**

The camera shall be moved through the main in either direction at a moderate rate, panning for laterals and stopping when necessary to permit proper documentation of the wastewater main's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the wastewater main's conditions shall be used to move the camera through the wastewater main.

### **3.2 Distance Measurements**

The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable or the like, which would require interpolation for depth of manhole will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Engineer.

### **3.3 Documentation:**

Documentation of the television results shall be as follows:

#### **3.3.1 Television Inspection Logs**

Printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of building wastewater mains, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, and other discernible features will be recorded and a copy of such records will be supplied to the Owner.

#### **3.3.2 Photographs**

Photographs of the television inspection, if required, shall be made with instant developing 35 mm or other standard size photographic film. Photographs shall be at the request of the Engineer, as long as such it does not interfere with the Contractors operations.

#### **3.3.3 DVD Recordings**

The purpose of DVD recording shall be to supply a visual and audio record of problem areas of the mains that may be replayed. DVD recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features will be supplied. The Contractor shall have all DVD and necessary playback equipment readily accessible for review by the Engineer during the Project, after which time the DVD will be turned over to the Owner at the completion of the project.

**PART 4: METHOD OF MEASUREMENT AND PAYMENT**

Payment for providing pre-construction television inspection as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

Payment for providing post-construction television inspection as specified in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 5.4

### TECHNICAL SPECIFICATION FOR MANHOLE FRAME SEAL

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all materials, labor, equipment, tools, and required incidentals for providing and installing a frame seal and required extension in all new wastewater manholes. The frame seal and extension shall span the entire adjustment area of the manhole by connecting to the bottom of the frame casting and top of the manhole cone.

##### 1.2 Definitions

- Chimney:  
The chimney is the cylindrical variable height portion of the manhole which extends from the top of the cone to the base of the manhole frame.
- Cone:  
The Cone is the inclined portion of the manhole structure which slopes upward and inward from the barrel of the manhole to the required chimney or frame diameter.

##### 1.3 Acceptable Manufacturers

Internal Chimney Seal by Cretex Specialty Products or approved equal.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Standard Specification for Stainless Steel Nuts

## 2.4 Warranty

- A one-year warranty for the manhole frame seal shall be included from the Contractor, and shall cover the cost of replacement and freight to project site, should the frame seal have any defects in material or workmanship.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

## PART 3: PRODUCTS

### 3.1 General

The manhole frame seal shall be designed to prevent leakage of water through the manhole frame throughout a 50-year design life. It shall also be capable of allowing repeated vertical movement of not less than 2 inches and/or repeated horizontal movement of not less than 1/2 inch after installation and throughout its design life.

Frame seals shall consist of a flexible internal rubber sleeve, extensions and stainless steel expansion bands, all conforming to the following requirements:

### 3.2 Rubber Sleeve and Extension

The flexible rubber sleeve and extensions shall be extruded or molded from a high grade rubber compound conforming to the applicable material requirements of ASTM C-923, with a minimum 1500 psi tensile strength, maximum 18% compression set and a hardness (durometer) of 48±5.

The rubber sleeve shall be double, triple or quadruple pleated with a minimum unexpanded vertical height of 8 inches, 10 inches or 13 inches respectively and a minimum thickness of 3/16 inches. The top and bottom section of the sleeve that compresses against the manhole frame casting and the chimney/cone shall have an integrally formed expansion band recess and a series of sealing fins to facilitate a watertight seal.

Any splice used to fabricate the sleeve and extension shall be hot vulcanized and have a strength such that the sleeve shall withstand a 180 degree bend with no visible separation.

### 3.3 Expansion Bands

The expansion bands used to compress the sleeve against the manhole shall be integrally formed from 16 gauge stainless steel conforming to the applicable material requirements of ASTM C-923, Type 304, with no welded attachments and shall have a minimum width of 1-3/4 inches.

The bands shall have a minimum adjustment range of 2-1/2 diameter inches and a positive locking mechanism which secures the band in its expanded position after tightening.

#### **PART 4: EXECUTION**

- The Contractor shall field measure the required dimension of the manholes prior to ordering frame seals and other appurtenances.
- All sealing surfaces shall be reasonably smooth, clean and free of any form offsets or excessive honeycomb.
- The internal frame seals and extensions shall be installed in accordance with the manufacturer's instructions.

#### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for providing Manhole Frame Seal as specified in this section shall be incidental and inclusive in the applicable unit price bid item.

**\*\*END OF SECTION\*\***

## SECTION 5.5

### TECHNICAL SPECIFICATION FOR MANHOLE PROTECTIVE LINING

#### PART 1: GENERAL

##### 1.2 Scope of Work

Furnish all the necessary materials, labor, equipment, tools, and associated appurtenances to install a protective lining on the interior walls and bench of all new and selected existing wastewater manholes.

##### 1.2 Acceptable Manufacturers

Raven 405 as manufactured by Raven Lining Systems or approved equal shall be used.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ACI 506.2-77	Specifications for Materials, Proportioning, and Application of Shotcrete by the American Concrete Institute (ACI)
ASCE Manual 52	Manuals and Reports on Engineering Practice, Manhole Inspection and Rehabilitation
ASTM D638	Tensile Properties of Plastics
ASTM D790	Flexural Properties of Unreinforced and Reinforced Plastics
ASTM D695	Compressive Properties of Rigid Plastics
ASTM D4541	Pull-off Strength of Coatings Using a Portable Adhesion Tester

ASTM D7234	Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D2584	Volatile Matter Content
ASTM D543	Resistance of Plastics to Chemical Reagents
ASTM D4258	Standard Practice for Surface Cleaning Concrete
ASTM D4259	Standard Practice for Abrading Concrete
ASTM C109	Compressive Strength Hydraulic Cement Mortars
ASTM C579	Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars
ICRI Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays by International Concrete Repair Institute (ICRI)
NACE RPO 188-99	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates by National Association of Corrosion Engineers (NACE)
SSPC-SP 1	Solvent Cleaning by standards of the Society of Protective Coatings (SSPC)
SSPC-SP 5	White Metal Blast Cleaning by SSPC
SSPC-SP 10	Near White Metal Blast Cleaning by SSPC
SSPC-SP 12	Surface Preparation and Cleaning of Metals by Water Jetting prior to Recoating by SSPC
SSPC SP-13/NACE No. 6	Surface Preparation of Concrete by SSPC

SSPC-PA 9 Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages by SSPC

SSPWC 210-2.3.3 & 211-2 Chemical Resistance Test (Pickle Jar Test) Standard Specifications for Public Works Construction (SSPWC) (Greenbook)

SSPWC 500-2 Manhole and Structure Rehabilitation by SSPWC

## 2.2 Qualification Requirements

### 2.2.1 Installer

- For an installing Contractor to be considered commercially acceptable, the Contractor must satisfy all insurance, financial and bonding requirements of the Owner.
- The Contractor must have a certification from the manufacturer as a licensed and fully trained installer of the product.
- The Contractor must have a minimum 50,000 square feet of successful wastewater system installation and three (3) years of rehabilitation experience.

### 2.2.2 Product

- For a product to be commercially acceptable, the product must have a minimum 500,000 square feet and five (5) year history of successful wastewater collection system installation in the United States.
- The products must be verified by third party test results supporting the long-term performance and structural strength of the product and such data shall be satisfactory to the Owner.

## 2.3 Warranty

- Contractor shall provide five (5) years of warranty (including labor) from the manufacturer against any defects in materials and workmanship.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.



## 2.4 Submittal

Following submittals shall be provided by the contractor:

### 2.4.1 Product

- Technical data sheet showing the physical and chemical properties
- Material Safety Data Sheet (MSDS)
- Physical properties of third party test results within five (5) years of submittal including the following:

Description	Method
- Tensile Strength	ASTM D 638
- Tensile Ultimate Elongation	ASTM D 638
- Compressive Strength	ASTM D 695
- Flexural Strength	ASTM D 790
- Hardness, Shore D	ASTM D 2240
- Taber Abrasion, CS-17 Wheel	ASTM D 4060
- Adhesion, Concrete	ASTM D 7243

- Surface preparation and application method
- Copies of field test data

### 2.4.2 Installer

- Verification of certified applicator's status

## PART 3: PRODUCTS

### 3.1 **Repair/Resurfacing Product**

- Repair/ resurfacing product(s) shall be used for all existing and new manholes to fill voids or bugholes, smooth transitions between components, replace lost mortar in masonry structures, smooth rough surfaces, and rebuild severely deteriorated substrates and/or to remediate infiltration prior to the installation of the coating product(s).
- All repair/ resurfacing product(s) must be supplied by the coating product manufacturer or shall be approved by the coating product manufacturer in writing

for compatibility with the specified coating product. It shall also be handled, mixed, installed and cured in accordance with manufacturer's guidelines.

### **3.3 Coating Product**

- Coating product shall be applied to all interior surfaces to provide a permanent impermeable, high strength; monolithic lining for concrete structures that is sulfuric acid corrosion, abrasion and impact resistant.
- 100% solids, solvent-free, ultra-high build epoxy or similar coating to be applied to all interior surfaces of exposed concrete as per manufacturer's guidelines.
- The material must be suitable for overhead, vertical and horizontal surfaces, and capable of being applied at a specified thickness of minimum 200 mils in a single application.
- Coating must be designed for temperatures up to 200 degrees F.
- Coating product physical properties shall be substantiated through submittal of accredited third party testing results and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field.

## **PART 4: EXECUTION**

### **4.1 General**

- Appropriate actions shall be taken by Contractor to comply with local, state, and federal regulatory and other applicable agencies with regard to environment, health, and safety during work.
- Limits of Application - The interior walls and ceiling of structures, exposed part of manhole frame and manhole benches.
- The repair and coating materials must be applied by factory trained and/or fully qualified technicians only. Contractor shall have a manufacturer's representative must present at the start of the installation procedure.
- Remove all steps, protrusions or other such obstructions prior to beginning the lining process as directed by the Owner.

### **4.2 Examination**

- Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

- New Portland cement (not quick setting, high strength) concrete manhole or structures shall have endured a minimum of 28 days since manufacture prior to commencing coating installation.

### 4.3 Surface Preparation

- Surface preparation is required for new and selected existing manholes prior to receive any repair and coating materials.
- Excessive debris, sediment, root intrusion or other foreign materials which may impact the effectiveness of the surface preparation process shall be removed prior to the commencement thereof.
- Offset structural components, lids, covers, frames, etc. shall be repaired, replaced, or reset prior to the commencement of surface preparation.
- Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed using a water based biodegradable emulsifying/ saponin product(s) as necessary.
- Choice of surface preparation method(s) should be based upon the condition of the concrete or masonry surface, potential contaminants present, access to perform work, and the required cleanliness and profile of the prepared surface to receive the repair and/or coating product(s).
- Surface preparation method, or combination of methods, that may be used include high-pressure water blasting (3500 psig at the nozzle), water jetting, dry abrasive blasting along with other additional method(s) in accordance with following industry accepted standards:
  - SSPC SP-13/NACE No. 6: Surface Preparation of Concrete,
  - ASTM D-4258: Standard Practice for Surface Cleaning Concrete for Coating and ASTM-D-4259: Standard Practice for Abrading Concrete,
  - ICRI Technical Guideline No. 03732: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
  - NACE/SSPC Standards for the surface preparation of steel.
- Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound, clean, and neutralized surface suitable for the specified coating product(s). Resulting concrete surface profile (CSP) shall be at least a CSP-4 in accordance with ICRI Technical Guideline No. 03732 as referenced in section 2.1. Typically, CSP ranges from CSP 1 (nearly flat) through CSP 9 (very rough) as indicated through ICRI Guideline No. 03732.

#### 4.4 Application of Repair/ Resurfacing Product

- Repair/ resurfacing products as per section 3.1 shall be used to fill voids, bugholes, and other surface defects which may affect the performance or adhesion of the coating product(s).

#### 4.5 Application of Coating Product

- Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment, and methods.
- Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.
- Prepared surfaces shall be coated via spray application of the coating product(s) described herein unless otherwise recommended by the coating product manufacturer.
- **For all new and selected existing concrete manholes, the coating product(s) shall be applied to a minimum dry film thickness (DFT) of 125 mils with minimum surface profile of CSP-4 in accordance with ICRI Technical Guideline No. 03732.**

#### 4.6 Testing and Inspection

- Coating system thickness shall be inspected to ensure compliance with the specifications herein.
  - During application a wet film thickness gauge, meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, documented, and attested to by Contractor for submission to Owner.
  - After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness may be measured according to SSPC-PA 9 - Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.
- After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays as per NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates or ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates. All detected holidays shall be

marked and repaired according to the coating product(s) manufacturer's recommendations.

- Test voltage shall be a minimum of 100 volts per mil of coating system thickness.
  - Detection of a known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
  - All areas repaired shall be retested following cure of the repair material(s).
  - In instances where high voltage holiday detection is not feasible a close visual inspection shall be conducted and all possible holidays shall be marked and repaired as described above.
  - Documentation of areas tested, equipment employed, results, and repairs made shall be submitted to the Owner/Engineer by Contractor.
- 
- Adhesion of the coating system to the substrate shall be confirmed in a minimum of 10% of the manholes coated. After the coating product(s) have cured in accordance with manufacturer recommendations, testing shall be conducted in accordance with ASTM D7234 Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers. Owner's representative shall select the manholes or areas to be tested.
  - Visual inspection shall be made by the Project Engineer and/or Inspector. Any deficiencies in the finished coating affecting the performance of the coating system or the operational functionality of the structure shall be marked and repaired according to the recommendations of the coating product(s) manufacturer.

## **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Payment for Protective Lining for new manhole shall be incidental and inclusive in the applicable unit price bid item.

Payment for Protective Lining System for existing manhole as specified in the plans will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 5.6

### TECHNICAL SPECIFICATION FOR PRECAST CONCRETE ADDITIVE FOR WASTEWATER MANHOLE

#### PART 1: GENERAL

##### 1.1 Scope of Work

A protective additive can be used during concrete mixing of new pre-cast concrete wastewater manholes and similar structures in order to prevent microbiologically induced corrosion (MIC).

Precast concrete additive can only be used in lieu of protective lining if specified by the plans or specifications as approved by the Owner.

##### 1.2 Approved Manufacturer

- “Precast Concrete Additive along with Con-Tint Identifier” as manufactured by Conshield Technologies, Inc and A+ Engineering, respectively, shall be used.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM C478      Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C76      Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

##### 2.2 Sample Testing

The precaster shall retain two labeled specimens from each production run. One set shall be retained by the precaster and the other set shall be sent to manufacturer or independent laboratory as directed by the Owner for verification on a random or as needed basis.

### **2.3 Warranty**

- The Contractor shall warrant all work against any defects in materials and workmanship for a period of one (1) year.
- Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

### **2.4 Submittal**

Following submittals shall be provided by the contractor:

- Technical data sheet showing characteristics of the additive to be used by the precaster.
- A letter of certification from the precaster stating that the correct amount and correct mixing procedure as recommended by the manufacturer were followed for all antimicrobial concrete.
- Copy of sample test result as specified in Section 2.2.

## **PART 3: PRODUCTS**

### **3.1 Concrete Additive**

- Antimicrobial additive shall be used to render the concrete uninhabitable for bacteria growth.
- The liquid antibacterial additive shall be an EPA registered material and the registration number shall be submitted for approval prior to use in the project.
- The amount to be used shall be as recommended by the manufacturer of the antibacterial additive. This amount shall be included in the total water content of the concrete mix design.
- The additive shall be added into the concrete mix water to insure even distribution of the additive throughout the concrete mixture.
- The antibacterial additive shall have successfully demonstrated prevention of MIC in sanitary sewers for ten or more years.
- The antibacterial additive shall be used by factory certified precast concrete plants.

**PART 4: EXECUTION****4.1 General**

- Concrete additive shall only be used during concrete mixing process of precast manhole strictly in accordance with the product manufacturer's recommendation.

**4.2 Product Surface Marking**

- The "brick-red" color of the concrete surface from the Con-Tint Identifier will indicate that Conshield has been added. No other markings or labels are necessary.

**4.3 Field Repair**

- Field repairs to the precast concrete shall be made using Con<sup>mic</sup>Shield<sup>®</sup> Joint Set Grout pre-portioned and factory packaged that requires the addition of no other components. This repair grout may be used for filling joints, lift holes, and damaged areas.

**PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Payment for Corrosion Protection Epoxy Liner System for new manhole shall be incidental and inclusive in the applicable unit price bid item.

**\*\*END OF SECTION\*\***



## SECTION 6.1

### TECHNICAL SPECIFICATION FOR CEMENT STABILIZED SAND BACKFILL

#### PART 1: GENERAL

##### 1.1 Scope of Work

This section specifies cement stabilized sand for use as backfill and any other work that requires stabilized material, and will be placed at the direction of the Engineer.

#### PART 2: QUALITY ASSURANCE

##### 2.2 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM C150	Standard Specification for Portland Cement
ASTM C117	Standard Test Method for Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D558	Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures

##### 2.3 Submittals

Mix design shall be submitted to the Owner for approval.

**PART 3: PRODUCT**

Stabilized sand shall consist of approximately one to one and half sacks of type I/II cement and 27 cu. ft. of cushion sand. Concrete sand is not permitted.

**3.1 Cement**

Type I Portland Cement conforming to ASTM C150 shall be used.

**3.2 Sand**

Sand shall be free from organic or otherwise deleterious materials and shall conform to the following requirements:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING (%)</u>
3/8-Inch	100
#200	0-20

The Plasticity Index (P.I.) shall not exceed six (6).

**3.3 Water**

Potable water shall be free of oils, acids, alkalis, organic matter, or other deleterious Substances.

**PART 4: EXECUTION****4.1 Design Requirements**

The cement stabilized sand shall have a comprehensive strength of 50 to 150 psi in 28 days. Backfill that exceeds the maximum compressive strength shall be removed by the contractor.

**4.2 Mixing**

The cement, aggregate and water shall be thoroughly mixed in an approved processing plant. The mixer shall be a stationary Twin Shaft Pugmill. The plant shall be equipped with feeding and metering devices, which will add the aggregate, cement and water into the mixer in the specified quantities. The moisture content of the mixture shall be maintained between one percent below and two percentage points above optimum moisture or shall be maintained within the range established by the Engineer. The amounts of cement are expressed as percentage of dry weight of aggregate.

### 4.3 Placement and Compaction

- Placement of cement stabilized sand shall be in 8-inch-thick lifts and to be compact to 95% of ASTM D558 unless other specified by the engineer. Compaction shall continue until the entire depth of the mixture is uniformly compacted.
- Compaction shall be within four (4) hours of the addition of water to the dry mixed material.
- Cement stabilized sand shall not be placed or compacted in standing or free water.
- Material will be delivered in tandem or trailer trucks. Any material left in stockpile after four (4) hours should be discarded.

## PART 5: METHOD OF MEASUREMENT AND PAYMENT

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 6.2

### TECHNICAL SPECIFICATION FOR TEMPORARY PAVING

#### PART 1: GENERAL

##### 1.1 Scope of Work

This section specifies the materials and general procedure for placement of temporary paving in conjunction with utility construction by Dallas Water Utilities and its Contractors. Temporary paving is defined as asphaltic pavement that will be in place for up to 6 months within a project located in City of Dallas Right-of-Way until permanent pavement can be placed in the area. It must be placed over all compacted, (95% proctor) backfilled utility ditches in areas with paved surfaces. Temporary pavement consists of two major items: Flexible Base and High Performance Mix Asphalt.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference

Reference specified in this section refers to following documents, unless otherwise mentioned:

- Public Works Construction Standards for North Central Texas by North Central Texas Council of Governments (NCTCOG), Edition as adopted by DWU
- City of Dallas Addendum to the NCTCOG Standards, Latest Edition

#### PART 3: PRODUCTS

##### 3.1 Flexible Base (Flex Base)

Temporary paving shall consist of 6" minimum thickness flexible base with material properties as specified in 301.5.1.COD of City of Dallas Addendum to the NCTCOG Standards, Latest Edition.

### **3.2 High Performance Mix Asphalt. (Hot Mix-Cold Laid Asphaltic Concrete Pavement)**

Temporary Paving shall consist of 2” thick high performance mix asphalt as specified in 403.2.3 of Public Works Construction Standards for North Central Texas by NCTCOG, Latest Edition.

## **PART 4: EXECUTION**

### **4.1 Placing Temporary Pavement**

Prior to placement of flex base the sub grade must be prepared in accordance to 301.5.2.1 of Public Works Construction Standards for North Central Texas by NCTCOG, Latest Edition. Flex base must be placed in accordance with 301.5.2.2 of Public Works Construction Standards for North Central Texas by NCTCOG, Latest Edition. Placement of High Performance Mix Asphalt must be consistent with 403.3 of Public Works Construction Standards for North Central Texas by NCTCOG, Latest Edition.

### **4.2 Limitations and Constraints**

- The Owner may by-pass the necessity of temporary paving if the location of the filled ditch does not obstruct traffic and can be adequately barricaded for safety until the installation of permanent pavement. In such a case, the Contractor shall be paid only for the temporary pavement installed per Unit Price bid. No additional pay for extra barricading.
- If an alternate route is required, the placement and removal of Flex Base and Asphalt Paving as approved by the Owner will be entirely at the Contractors expense.

## **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal. The contractor may exceed these limits of measure for payment; however all cost associated with this increase will be at the contractors expense. If the Contractor concludes the Temporary Pavement is not adequate in thickness or width for the conditions, this should be taken into account when preparing the bid.

**\*\*END OF SECTION\*\***

## SECTION 6.3

### TECHNICAL SPECIFICATION FOR HEAVY VEHICULAR PAVING BRICK

#### PART 1: GENERAL

##### 1.1 Scope of Work

This section specifies the materials and general procedure for placement of heavy vehicular paving bricks on sand setting bed.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Unless otherwise stated, the latest editions of the following documents are applicable for this specification:

ASTM C33	Standard Specification for Concrete Aggregates
ASTM 43	ASTM C43-02 Standard Terminology of Structural Clay Products
ASTM 67	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM 144	Standard Specification for Aggregate for Masonry Mortar
ASTM C410	Standard Specification for Industrial Floor Brick
ASTM C418	Standard Test Method for Abrasion Resistance of Concrete by Sandblasting
ASTM C902	Standard Specification for Pedestrian and Light Traffic Paving Brick

ASTM C1272	Standard Specification for Heavy Vehicular Paving Brick
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft.- lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup>
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

## 2.2 Qualification Requirements

- Manufacturer shall be specialized in the manufacturing of heavy vehicular paving brick for a minimum of three (3) years.
- Installation shall be by a Contractor and crew with at least three (3) years of experience in placing heavy vehicular paving brick on projects of similar nature.
- Installation Contractor shall conform to all local, state/provincial licensing and bonding requirements.

## 2.3 Sampling and Testing

- The expense of inspection and testing shall be borne by the Contractor.
- Manufacturer shall provide access to lots ready for delivery to the Owner or his authorized representative for testing or sampling of material prior to commencement of paving brick placement.
- Manufacturer shall provide a minimum of three (3) years testing backup data showing manufactured products that meet manufacturer's specifications when tested in compliance with ASTM C 1272.
- Sampling shall be random with a minimum of nine (9) specimens per 20,000 sq. ft. per product shape and size with repeated samples taken every additional 20,000 sq. ft. or a fraction thereof.

## 2.4 Rejection

- In the event shipment fails to conform to the specified requirements, the manufacturer may sort it, and new test units shall be selected at random by the Owner's representative from the retained lot and tested at the expense of the Contractor. If the second set of test fails to conform to the specified requirements, the entire lot shall be rejected.

## 2.5 Submittals

The Contractor shall furnish following documents:

### 2.5.1 Material Data:

- Product drawing and data showing characteristics of bricks, dimensions, and special shapes
- Full size samples of each brick color, illustrating style, size, color, and surface texture of units being provided
- Sieve analysis for grading of bedding and joint sand.

### 2.5.2 Testing Documentations:

- Test results from an independent testing laboratory for compliance of bricks requirements to manufacturer's specifications.
- All additional sampling and testing data

## 2.6 Warranty

All work performed or repaired under this Contract will be warranted to be free from defects in material and workmanship for a period of one year from the date of acceptance. If Owner determines that the process has failed during the warranty period, the Contractor will perform any and all repairs at no additional cost to the owner.

## PART 3: PRODUCT

### 3.1 Heavy Vehicular Paving Bricks

Unless otherwise specified, the paving bricks shall meet the following requirements:

- Paving bricks shall be manufactured by Acme Brick Company, or approved equal.
- Red paving bricks shall be Tulsa Blend 2 Garnet Modular Solid, or approved equal.
- Dark paving bricks shall be Tulsa Blend 20 Amaretto Modular Solid, or approved equal.
- Paving brick shall meet the requirements of ASTM C 1272, Standard Specification for Heavy Vehicular Paving Bricks, Type F.



- Paving brick will have the following dimensions: 7-5/8 inches (long), 3-5/8 inches (wide), and 2-5/8 inches (thick).
- All paving bricks shall be sound and free of defects that would interfere with the proper placing of brick or impair the strength or permanence of the construction.
- Minor cracks incidental to the usual methods of manufacture, or chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

### 3.2 Sand

Bedding and joint sand shall be clean, non-plastic, free from deleterious or foreign matter. The sand shall be natural or manufactured from crushed rock. Limestone screening or stone dust shall not be used. When paving bricks are subject to vehicular traffic, the sands shall be as hard as practically available.

#### 3.2.1 Bedding Sand

- The type of sand used for bedding is often sand that is suitable for the manufacturing of concrete. Contractor shall confirm that the selected sand(s) have been successfully used in previous similar applications. Limestone sand should not be used for bedding sand. Mason sands are typically acceptable only for joint sand, provided they meet grading requirements as shown in Table 2 of this section.
- Grading of sand samples for the bedding course and joints shall be done according to ASTM C 136. The bedding sand shall conform to the grading requirements of ASTM C33 as shown in **Table 1**.

**Table 1**  
Grading Requirements for Bedding Sand

ASTM C33	
Sieve Size	Percent Passing
3/8in. (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (600 um)	25 to 60
No. 50 (300 um)	10 to 30
No. 100 (150 um)	2 to 10

### 3.2.2 Joint Sand

- Bedding sand may be used for joint sand. However, extra effort in sweeping and compacting the paving bricks may be required in order to completely fill the joints. If joint sand other than bedding sand is used, the gradations shown in Table 2 are recommended. Joint sand should not be used for bedding sand.
- The joint sand shall conform to the grading requirements of ASTM C 144 as shown in **Table 2** below.

**Table 2**  
Grading for Joint Sand

ASTM C 144	
Sieve Size	Natural Sand Percent Passing
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	95 to 100
No. 16 (1.18 mm)	70 to 100
No. 30 (600 um)	40 to 75
No. 50 (300 um)	10 to 35
No. 100 (150 um)	2 to 15
No. 200 (75 um)	0

### 3.2.3 Sealer/Joint Sand Stabilizer

The sealer / joint sand stabilizer shall meet brick paver manufacturer's requirements.

## **PART 4: EXECUTION**

### **4.1 Delivery, Storage and Handling**

- Deliver paving brick to the site in steel banded, or plastic wrapped cubes capable of transfer by forklift or clamp lift. Unload paving brick at job site in such a manner that no damage occurs to the product.
- Sand shall be covered with waterproof covering to prevent exposure to rainfall or removal by wind. The covering shall be secured in place.
- Coordinate delivery and paving schedule to minimize interference with normal use of buildings, walks and pavements adjacent to brick paving.

## 4.2 Preparation of Base

For installations on a concrete base, the contractor should be aware that the top surface of the pavers may be 1/8 to 1/4 in. (3 to 6mm) above the final elevations after compaction. This difference in initial and final elevations is to compensate for possible minor settling.

- Verify location, type, installation and elevations of edge restraints around the perimeter area to be paved.
- Verify that base is dry, uniform, even and ready to support sand, pavers, and imposed loads.

The sand shall be spread evenly over the 8 inch thick reinforced concrete base and screed to a nominal 1 in. (25 mm) thickness, not exceeding 1 1/2 in. (40 mm) thickness. The screed sand should not be distributed. Sufficient sand shall be placed to stay ahead of the laid paving brick. Bedding sand shall not be used to fill depressions in the concrete base surface.

## 4.3 Paving Brick Installation on Prepared Setting Bed

- Ensure that paving bricks are free of foreign materials before installation.
- Lay the paving bricks in the pattern(s) as shown on the drawings or match the patterns of existing adjacent bricks.
- Joint between the paving bricks on average shall be between 1/16 in. and 3/16 in. wide.
- Fill gaps at the edge of the paved area with saw cut brick pavers. Unit cuts no smaller than one-third of a whole paving brick are recommended along edges subject to vehicular traffic.
- Cut paving bricks to be placed along the edge with a mounted motor driven masonry saw.
- Use a vibrator to vibrate the paving bricks into the sand. Vibrator shall meet brick paver manufacturer's requirements.
- Vibrate the paving bricks, sweeping dry joint sand into the joints and vibrating until they are full. This will require at least two or three passes with the vibrator. Do not vibrate within 4 ft. of the unrestrained edges of the brick pavers.

- All work to within 4 ft. of the laying face must be left fully compacted with sand-filled joints at the completion of each day.
- After initial vibration, washed joint sand shall be spread over the paving brick surface, allowed to dry, and vibrated into the joints with additional vibrator passes.
- Sweep off excess sand so that the sand level is 1/16<sup>th</sup> of an inch below the surface.
- The final surface elevations shall not deviate more than ¼ inch under a 10-foot long straight edge.
- The surface elevations of paving bricks shall be 1/8 inch to ¼ inch above adjacent drain inlets, concrete collars or channels.
- The resanding of paver joints shall be performed by the contractor for a period of ninety (90) days after completion of work as necessary.

#### **4.4 Field Quality Control**

- After removal of excess sand, check final elevations for conformance to drawings.

#### **4.5 Application of Sealer/Joint Sand**

- The joint sand shall be 1/16<sup>th</sup> of an inch below the paving brick surface and shall be dry for its full depth and free any contamination.
- The surface shall be clean and free of any oil, laitance, dust and any loose material.
- The sealer/joint sand stabilizer shall be applied evenly per manufacturer's requirements.

### **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***

## SECTION 6.4

### TECHNICAL SPECIFICATION FOR TREE PLANTING

#### PART 1: GENERAL

##### 1.1 Scope of Work

Furnish all materials, transportation, labor, equipment, tools, supervision and required incidental for tree planting, complete in accordance with these specifications. All miscellaneous items such as wrapping materials, tree stakes, peat moss, fertilizer, manure, sharp sand, and topsoil required for planting trees shall be included in the scope with no separate pay item.

#### PART 2: QUALITY ASSURANCE

##### 2.1 Reference Standards

Latest editions or revisions of following documents are applicable:

- American Standard for Nursery Stock, Current Edition as published by the American Association of Nurseryman. (ANSI Z60.1)
- American Joint Committee on Horticulture Nomenclature, 1942 Edition of Standardized Plant Names.

#### PART 3: PRODUCTS AND MATERIALS

##### 3.1 Plant Material

Provide plant material grown in a recognized nursery in accordance with good horticultural practice, with healthy root systems developed by transplanting or root pruning. Provide only healthy stock free of disease, insects, eggs, larvae and defects such as knots, sun scald, injuries, abrasions or disfigurement. Trunks will be centered in the root ball. Fresh pruning cuts larger than 1/2" can be cause for rejection of plant material.

##### 3.1.1 Size:

Provide plant material of the sizes indicated in planting list and in accordance with dimensional relationship requirements of ANSI Z60.1 for kind and type of plant material required. Plant material of larger size than specified may be used if acceptable

to the Owner; in which case, increase size of root balls proportionately and at no additional cost to the Owner. It is the Contractor's responsibility to verify plant quantities.

### 3.1.2 Deciduous Trees

Provide trees of height and caliper indicated (2" caliper for trees). Where shade trees are required, provide single stem trees with straight trunk and intact leader.

Where small trees of upright or spreading type are required, provide trees with single stem, branched or pruned naturally according to species and type, and with relationship of caliper and branching recommended by ANSI Z60.1, unless otherwise indicated.

### 3.1.3 Requirements for Balled and Burlapped (B&B) Stock

Where indicated to be balled and burlapped (B&B), provide trees dug with firm, natural ball of earth in which they are grown. Provide freshly dug trees to the greatest extent possible. Provide ball size of not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree required. Increase ball size or modify ratio of depth to diameter as required to encompass fibrous and feeding root system necessary for full recovery of trees subject to unusual or non-typical conditions of growth, soil conditions or horticultural practice. Wrap and tie earth ball as recommended by ANSI Z60.1 for size of balls required. Drum-lace balls with a diameter of 30" or greater.

### 3.1.4 Requirements for Container Grown Stock

Provide healthy, vigorous, well-rooted plant materials established in container in which they are sold. Provide balled and burlapped (B&B) stock, when required trees exceed maximum size recommended by ANSI Z60.1 for container grown stock. Established container stock is defined as a tree grown in or transplanted into a container and grown in the container for a length of time sufficient to develop new fibrous roots, so that root mass will retain its shape and hold together when removed from container.

Use rigid containers that will hold ball shape and protect rootmass during shipping. Provide trees established in containers of not less than minimum sizes recommended by ANSI X60.1 for kind, type, and size of trees required.

## 3.2 **Miscellaneous Materials**

### 3.2.1 Mulch

Provide shredded cypress bark mulch or hardwood bark mulch to a depth of at least 3” in the planting basin to cover root ball. Do not place mulch directly against the trunk of the tree.

### 3.2.2 Stakes and Guys

Unless specified otherwise by the Owner, stake trees as shown on planting detail sheets. Provide 2” x 2” untreated wood stakes to secure tree root ball. All other materials not specifically described but required for a complete and proper installation may be selected by the Contractor subject to the approval of the City of Dallas.

### 3.2.3 Post Emergent Herbicide

“Round Up” or approved equal may be utilized in the planting basin to control weeds until final acceptance of the project. All chemicals must be applied by a Licensed Chemical Applicator.

- Tree shall have normal, well-developed branches and a vigorous root system. They shall be healthy, vigorous plants free from defects, decay, disfiguring growth habits, sun-scald injuries, abrasions of the bark, plant diseases, insect nests and eggs, borers and all forms of infestations or objectionable disfigurements.
- Tree may be inspected by the Owner's representative at the grower's nursery at the site of collections. Approval of plants at the source does not alter the right of rejection at the project site.
- The Owner reserves the right to inspect backfill material and to take test samples as deemed necessary. The Owner may arrange to have an independent testing laboratory conduct tests to verify the quality of the backfill materials. Backfill materials which fail to meet the requirements of these specifications may be rejected and the Contractor shall immediately remove rejected materials from the premises.

### 3.2.4 Fertilizer

Fertilizer shall be organic base, uniform in composition, dry and free-flowing. Deliver fertilizer to site in original unopened containers, each bearing manufacturer's guaranteed statement of analysis. Fertilizer shall contain 12% nitrogen, 12% phosphoric acid, and 6% potash.

### 3.2.5 Wrapping Materials

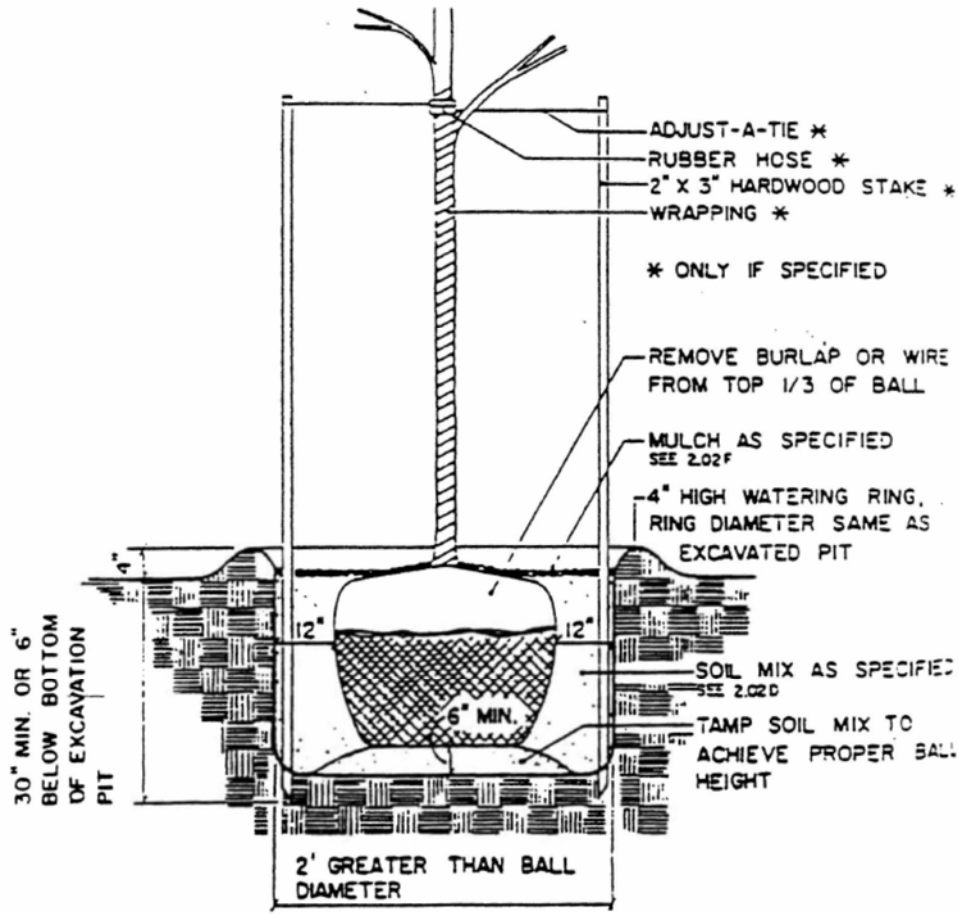
Materials used in wrapping tree trunks shall be waterproof crepe paper or burlap strips as made and sold for this purpose.

## **PART 4: EXECUTION**

### **4.1 Tree Pits and Planting**

- Excavate tree pits to a depth of six (6) inches greater than the depth of the ball and 2' -0" greater than the diameter of the ball as shown in **Exhibit 1** below.
- Soil for use in back-filling tree pits shall be the excavated soil from the planting pit unless otherwise specified by the City of Dallas.
- Existing topsoil shall be free of all rocks and rock chips over  $\frac{3}{4}$  in diameter, as well as all trash, vegetation, and other debris.
- Before backfilling, clean soil off roots, plants, sod, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth, and dispose of offsite. Use only existing soil from the site as back-fill.
- Set balled and burlapped stock on undisturbed soil, plumb and in center of pit or trench with top of ball 1"-2" above finished landscape grades. Remove burlap from top of root-ball but do not remove from sides or under root-ball. Completely remove any nylon, plastic, or wire materials from the top half of the root-ball. Remove pallets, if any, before setting. Do not use stock if ball is cracked or broken before or during planting operation. When set, place back-fill (existing native soil) around base and sides of ball, and work each layer to settle back-fill and eliminate voids and air pockets. When excavation is approximately  $\frac{2}{3}$  full, water thoroughly before placing remainder of backfill.
- Repeat watering until no more is absorbed. Water again after placing final layer or back-fill.
- Place the trees and backfill with the soil mixture hereinbefore specified. The tree shall have the same relationship to finish grade in this new location as it bore to finish grade in the previous location.
- Provide a 4" watering ring and 1" depth of pine bark mulch and thoroughly water to insure saturation of the root system.





TYPICAL TREE PLANTING DETAIL  
NO SCALE

EXHIBIT 1

4.2 Pruning

- Each tree shall be pruned in accordance with the American Association of Nurserymen standards to preserve the natural character of the plants.
- All dead wood or suckers and all broken or badly bruised branches shall be removed. In addition, one-fourth to one-third of the wood shall be removed, after planting, to compensate for the loss of roots as a result of transplanting operations.

- Pruning shall be done with clean, sharp tools, and in a manner as not to change the natural habit or shape of the plants. All cuts shall be made flush, not leaving cut stubs over 3/4" in diameter shall be painted with an approved tree paint. Scars on the bark shall be traced back to living tissue and removed in a manner that wounds shall be smoothed and shaped so as not to retain water. Flowering trees shall be pruned only to remove dead or broken branches or branches that rub. Paint shall cover all exposed cambium, as well as other exposed living tissue.

#### **4.3 Fertilizer**

The contractor shall fertilize, at time of planting, each tree at the rate of 3 pounds per inch of tree trunk caliper.

#### **4.4 Tree Wrapping**

Wrap all trees. Extend wrapping from ground to a point immediately below lowest branches of each tree as directed. Spirally wrap from bottom up when trees are being planted. Securely fasten wrapping material in place, to itself, with tacks or staples so that the wrapping will remain in place for two years

### **PART 5: MAINTENANCE AND WARRANTY PERIOD**

#### **5.1 Maintenances of Planting Materials**

The Contractor shall maintain all plant materials until final acceptance. Such maintenance shall include pruning, spraying, weeding, cultivation, fertilizing, watering, disease and insect control, application of antidesiccants, tightening and repairing stakes and guys, resetting and straightening plants to proper grade and vertical position, replacing damaged wrapping, restoring plant saucers, replenishment to levels specified of any soil mixture or mulch that has been lost to erosion or settling, replacement of any and all unacceptable materials, plus any procedures consistent with good horticultural practice necessary to insure normal, vigorous and healthy growth.

#### **5.2 Warranty Period and Replacement**

- Warranty period for all plant material shall be for one (1) year. Warranty period begins at the date of final acceptance of the project by the Owner. Trees not meeting standards stated in this specification shall be immediately removed and replaced-as directed by DWU.
- Replace, without cost to the Owner, and as soon as weather conditions permit, all dead plants and all plants not in a vigorous and thriving condition, as determined by the Owner during and at the end of Warranty Period.

- Plants shall be free of dead or dying branches and branch tips, and shall bear foliage of a normal density, size, and color. Replacement shall closely match adjacent specimens of the same species and shall be subject to all requirements of this specification.

## **PART 5: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**\*\*END OF SECTION\*\***