

2021
SANITARY AND STORM SEWER CONSTRUCTION SPECIFICATIONS

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SECTION 1.00 - SCOPE

1.01 GENERAL

It is the intent of these specification requirements to provide the requirements for sanitary and storm sewer construction in the City of Chanhassen, Minnesota.

1.02 WORK INCLUDED

The contractor shall, unless specified otherwise, furnish all materials, equipment, tools and labor necessary to do the work required under his/her contract and unload, haul and distribute all pipe, castings, fittings, manholes and accessories. The contractor shall also remove any street surfacing as required; excavate the trenches and pits to the required dimensions; construct and maintain all bridges for traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or ground water; provide barricades, guards and warning lights; lay and test the pipe, castings, fittings, manholes and accessories, backfill and consolidate the trenches and pits; maintain the street or other surface over the trench until surface restoration; restore the roadway surface unless otherwise stipulated; remove surplus excavated material; and clean the site of the work.

The contractor shall also furnish all equipment, tools, labor and materials required to rearrange sewers, conduits, ducts, pipes or other structures encountered in the installation of the work. All the above work to completely construct the sewer facilities shall be done in strict accordance with the project's contract documents to which these specifications are a part thereof.

1.03 LOCATION OF WORK

The location of this work is as shown on the plans.

1.04 COORDINATION OF WORK

The contractor shall be responsible for the satisfactory coordination of the construction of the sewer facilities with other construction and activities in the area affected. Delays in work resulting from lack of such harmony shall not in any way be a cause for extra compensation by any of the parties.

1.05 WORKING HOURS

Refer to Section 7.02 of the General Conditions.

1.06 REFERENCE REQUIREMENTS

In the specification requirements, reference is made to "MnDOT Specifications" which shall mean the "Standard Specifications for Highway Construction" of the Minnesota Department of Transportation, most current edition, and all subsequent amendments, and the most current version of the City Engineers Association "Standard Utilities Specifications" for Watermain and

Service Line Installation and Sanitary Sewer and Storm Sewer Installation, and all subsequent amendments shall apply.

SECTION 2.00 - MATERIALS

2.01 GENERAL

The materials used in this work shall be all new, and conform to the requirements for class, kind, size and material as specified below. All materials permanently incorporated in the work shall be made in America in accordance with Minnesota State Statute 16B.101 PREFERENCE FOR AMERICAN-MADE MATERIALS. The contractor shall submit in writing a list of materials showing the manufacturer and designation of all materials. This list must be approved by the engineer.

2.02 REINFORCED CONCRETE PIPE (RCP)

Reinforced concrete pipe and fittings including bends, tee sections and specials shall conform to the requirements of the Standard Specification for Reinforced Concrete Sewer Pipe, ASTM Designation C76 Wall B with circular reinforcing for the class of pipe specified. Pipe required for piling shall be reinforced concrete pipe furnished in eight-foot (8') lengths and shall be of special design in accordance with Section 10, ASTM Designation C76, latest revision. Concrete pipe to be jacked shall be Class V or greater. Reinforced concrete pipe less than 15" will not be allowed.

Concrete pipe bends called for on the plans shall be 7½° pipe bends with a 4'-0" center line laying length and a 30.5' radius of curve, and with wall thicknesses and steel reinforcing in accordance with ASTM Specifications C76. The bends shall be of the same pipe class as the pipe on either side of the bend.

2.03 HIGH DENSITY POLYETHYLENE (HDPE)

- A.** HDPE smooth interior, dual-walled pipe may be used for storm sewer sizes up to and including 18 inches in diameter, EXCEPT for paved street areas. Pipe to be N-12 as manufactured by Advanced Drainage Systems or approved equal.
- B.** General Requirements: ASTM F894 & AASHTO M-294 (Type S)
- C.** Materials: PE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P-34 as defined in ASTM D1248 with an established hydrostatic design basis (HDB) of not less than 1250 psi for water at 73.48F determined in accordance with ASTM D2837.
- D.** Each pipe shall be identified with the manufacturer's name, trade name or trademark and code from plant location, machine, and date of manufacture; nominal pipe size, in inches; the Ring Stiffness Constant Classification and ASTM F894.

- E. No polyethylene fittings (tees, elbows, flared-end sections, etc.) will be allowed. Flared-end sections are required to be reinforced concrete pipe. Bell-to-bell pipe couplers must be water tight, non-cleated with an o-ring gasket.

2.04 CORRUGATED METAL PIPE (CMP)

There will be no corrugated metal pipe allowed within public right-of-way unless reviewed and pre-approved by the City Engineer.

2.05 PIPE FITTINGS

Fittings shall be Class 250 for sizes up to and including 12" and Class 150 for sizes 14" and larger. Fittings shall conform to the requirements of AWWA Specification C110. Ductile Iron Fittings shall have mechanical joints and shall be Class 350 for sizes up to and including 12" diameter and shall conform to AWWA Specification C153, covering compact fittings.

All pipe and fittings shall be epoxy coated and furnished with either 316 stainless or NSS Cor-Blue nuts and bolts.

2.06 DUCTILE IRON PIPE (DIP)

Ductile iron pipe shall be designed for a minimum working pressure of 150 pounds per square inch and shall conform to the applicable dimensions, weights and tolerances of Federal Specification WW-P-421b for cast iron pipe. Ductile iron shall be Grade 60-42-10 with 40/90 metal strength and shall be tested in accordance with ASTM Specification A339-55. All pipe shall be cement-lined inside and tar-coated outside.

The class of ductile iron pipe shall be as specified by the engineer.

2.07 POLYVINYL CHLORIDE SEWER PIPE (PVC)

Polyvinyl chloride sewer pipe shall be produced by a continuous extrusion process using Type 1, Grade 1 material, material as defined in the latest revision of ASTM Specification D-1784. The design, dimensions and wall thickness shall conform to ASTM Standard Specifications D-3034, SDR 35. Pipe classification by burial depth from finish grade to pipe invert shall conform to the following:

<u>Burial Depth</u>	<u>Pipe Class</u>
0-16 feet	SDR 35
16-26 feet	SDR 26
> 26 feet	C900

2.08 STEEL CASING PIPE FOR JACKING-BORING

Steel casing pipe for jacking-boring shall conform to ASTM Designation A252, Grade 2 or ASTM Designation A139, Grade B. The casing pipe shall have minimum thickness as follows:

Nominal Casing Size	Outside Diameter (Inches)	Minimum Shell Thickness (Inches)
12	12-3/4	0.250
14	14	0.282
16	16	0.282
18	18	0.312
20	20	0.343
22	22	0.375
24	24	0.403
26	26	0.438
28	28	0.469
30	30	0.469
32	32	0.500
34	34	0.532
36	36	0.532
38	38	0.532
40	40	0.563
42	42	0.563

2.09 JOINTING MATERIAL

The jointing material for each type of pipe specified here before shall be as follows:

- A. **Reinforced Concrete Pipe.** Reinforced concrete pipe joints shall be Type R-4, and the gasket shall be circular in cross section. The joint shall be constructed in accordance with ASTM C-361.
- B. **Corrugated Metal Pipe.** If corrugated metal pipe is pre-approved by the City Engineer, corrugated metal pipe joints shall employ coupling bands as per MnDOT Specification 3226.
- C. **High Density Polyethylene (HDPE).** Joints shall conform to ASTM D3212. Joints shall be push-on type only with the bell-end grooved to receive a gasket. Elastomeric seal (gasket) shall have a basic polymer of synthetic rubber conforming to ASTM F477 and be factory installed and chemically bonded to the bell-end of the pipe. Natural, field installed rubber gaskets will not be accepted. Joints must provide a water tight connection.
- D. **Ductile Iron Pipe.** Ductile iron pipe joints shall be of the push-on type which complies with AWWA Specification C-111, latest revision. If used as a pressure line, an electrical contact must be provided through every joint.

- E. Polyvinyl Chloride Pipe (PVC) and Fittings.** Polyvinyl chloride pipe joints shall be the bell and spigot type using solvent cement supplied by the pipe manufacturer and applied according to his/her instructions. Rubber gasketed push-on type joints are permitted only on mainline sewers. Typical sanitary house services shall be SDR 26, solvent, non-gasketed weld joints.

2.10 MANHOLES AND CATCH BASINS

Manholes and catch basins shall be constructed using precast sections conforming to ASTM Specification C-478. Manhole section joints shall be Type R-4.

Sanitary sewer manholes shall be supplied with pre-formed inverts and flexible sleeve connections for all lateral lines 15" in diameter or less unless otherwise noted on the construction plans. The flexible connection shall be an interface boot as manufactured by Elk River Concrete, or Kore-N-Seal Boot as manufactured by North Star Concrete or equal. No speed crete will be allowed for manhole sealing. Precast joints shall be sealed using "Cretex" internal manhole joint seals or equal in high ground water areas.

When approve by the engineer and shown on the detail plates or drawings, manholes may be built using blocks laid up on full mortar beds and vertical joints shall be completely filled with mortar. The base of the unit shall be shaped to form a smooth transition section from inlet to outlet either formed directly in the concrete or built up of brickwork and mortar or by running a half section of pipe through the manhole. The exterior of all block manholes shall be plastered with one half inch (1/2") mortar.

2.11 MANHOLE AND CATCH BASIN - FRAMES AND COVERS

Cast iron for both manholes and catch basin frames and covers shall be of the best grade of cast iron, free from all injurious defects and flaws, and shall conform to the following specifications: Federal AA-1-652, ASTM A48-56, AASHO M105-49 and ASA 6.25101948.

The standard manhole casting shall be Neenah #R-1642 with "self-sealing" lids and two concealed pick holes as shown on standard plate #2111, or approved equal.

All castings shall be adjusted in accordance with standard detail plate #2110 prior to acceptance by the City of any utilities on the project.

Adjusting rings shall be precast concrete or HDPE rings as manufactured by Ladtech, Inc. or approved equal. HDPE adjusting ring sealant shall be a butyl caulk as manufactured by Ladtech sealant or approved equal and shall be installed as per the manufacturer's specifications.

The manufacture's specifications for wear course steel adjusting insert shall be provided to the Engineer for review and approval.

Lettering on the manhole castings shall be as shown on the standard plate.

Storm sewer inlet castings shall be Neenah Foundry No. R-3067 V or R3067VB (at low points) as shown on the standard plates. Inlet casting R-3501TB may be used if approved by the Engineer on a low point inlet that lies within a driveway. All castings shall conform to the requirements and dimensions shown on the drawings. All covers must fit closely in the rings in any and all positions and, when placed in the rings, must fit the ring solidly in all positions so that there will be no rocking from pressure applied on any point of the cover.

2.12 MANHOLE STEPS

Manhole steps are prohibited within sanitary sewer manholes. All manhole steps in storm sewer structures shall conform to Neenah Foundry Step No. R-1981J in dimension and strength. Manhole steps shall be spaced 16" on center on the downstream face of the manhole unless specified otherwise.

Cast iron manhole steps shall be manufactured from high test metal having a minimum tensile strength of 35,000 pounds per square inch.

Aluminum. Aluminum manhole steps of a design similar to the cast iron steps specified may be used. Aluminum manhole steps shall be made of Apex Ternalloy No. 5 aluminum alloy.

Plastic. Copolymer Polypropylene plastic manhole steps (PSI-PF) may be used or equal.

2.13 MORTAR

Mortar shall be Spec Mix Masonry Cement and Sand Mortar Type M, or approved equal. The mortar shall be mixed to the manufacturer's specifications.

2.14 INFILTRATION BARRIERS

- A. Conetop Infiltration.** An internal infiltration barrier preapproved by the engineer shall be supplied for all sanitary sewer manholes. The barrier shall be a u.v. stabilized low-density polyethylene meeting the latest ASTM standards for low-density polyethylene materials.

The barrier shall be equipped with a drip edge to direct water to the outside of the manhole. Ram-neck or material as recommended by the manufacturer shall be used to seal the barrier to the concrete manhole cone top. The barrier shall be no more than 24" tall by ¼" thick wall and cut to fit on site.

- B. Manhole Joint Wrap.** All sanitary manholes and only storm manholes directed by the engineer shall have joints sealed with an external 6" rubber sleeve as manufactured by Infi-Shield Seal Wrap, Sealing Systems, Inc. (763-478-2057) or approved equal. The seal shall be made of EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 30 mils. The back side of each unit shall be coated with mastic. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of 85 mils. The seal shall be designed to prevent leakage of water through the joint sections of a manhole, catch basin or concrete pipe.

- **Seal Wrap 6"**

Height	6 inches
Length	16 or 50 foot rolls
Thickness	125 Mils
Height tolerances	6 inches +/- .188"
Length tolerances	50 feet + 6" /- .000
Rubber Thickness tolerances	30 mils
Mastic Thickness	85 mils
Mastic Width	5 1/2"
Mastic off set from edge	1/4"

- **EPDM Rubber E70-6614-4B Color Black**

Physical Properties	ASTM Test Method	Typical Value
Durometer, Shore A	D2240	61
Tensile, PSI	D412	1510 PSI
Elongation %	D412	460 %
Compression set %	D395 22 Hrs @ 77 degrees C	26 %
Tear Resistance PPI	D624 Die B	165 ppi
Heat Aging	D573 70 Hrs. @ 70 degrees C	
Change in hardness (Durometer)		65 (+4 pts)
Change in Tensile %		1390 psi (-14 %)
Change in Elongation %		345 % (-25 %)
Ozone Resistance	D1149 72 Hrs @ 50 pphm	no cracks
Water Resistance (Volume)	D471 70 Hrs @ 100 degrees C	+ 1.8 %
Low Temperature Brittleness	D2137 -40 degrees C	Pass

Material: Rubber meets ASTM C923 / Mastic meets ASTM C990

All costs for furnishing and installing barriers shall be included in the unit price bid for storm or sanitary manholes.

2.15 PRE-CAST SEGMENTAL BLOCK

Eight-inch (8") pre-cast segmental radial block may be used for the lower portion of manhole over large diameter pipe and for shallow manholes and catch basins. Concrete used in the manufacturing of these blocks shall conform to the requirements of ASTM "Specifications for Concrete & Masonry Units for Construction of Catch Basins & Manholes", Serial Designation C-139.

The exterior of all block manholes shall be plastered with one-half inch (1/2") of mortar.

2.16 CONCRETE

Concrete to be used shall be MnDOT 3F52 Mix Design, or approved equal.

2.17 STEEL REINFORCING BARS

Steel reinforcing bars shall be deformed steel bars for concrete reinforcement to conformance with ASTM Designation A-305 and ASTM Designation A-15 Intermediate Grade Billet Steel.

2.18 SOIL MATERIALS

- A. Normal Fill Material.** Is defined under the Sewer Specification No. 13.05.
- B. Select Granular Material.** MnDOT Specification 3149 shall be used for select granular material as shown and specified under the pipe bedding classification or an equivalent natural granular soil (100% passing a ¾" sieve and maximum of 10% passing a #200 sieve);
- C. Granular Borrow Fill Material.** MnDOT Specification 3149 shall be used for granular borrow material as shown and specified under the pipe bedding classification or an equivalent natural granular soil (100% passing a ¾" sieve and a maximum of 20% passing a #200 sieve);
- D. Class 5 Aggregate.** Class 5 crushed aggregate shall be in conformance with MnDOT Specification 3138.
- E. Crushed Rock.** The material shall consist of durable crushed quarry rock of which 100% passes a two-inch (2") sieve and of which 95% is retained on a #4 sieve size. It shall not contain soil overburden, sod, roots, plants, and other organic matter, or any other materials considered objectionable by the engineer.
- F. Pit Run Gravel.** The material shall consist of sound, durable particles of gravel and sand with which may be included limited amounts of fine soil particles as binding material, and of which 100% passes a two-inch (2") sieve and of which 90% is retained on the #200 sieve size. It shall not contain sod, roots, plants and other organic matter, or any other objectionable materials.
- G. Coarse Filter Aggregate.** Coarse granular pipe bedding material shall be a well-graded crushed rock or pea gravel and shall meet the requirements of MnDOT Specification 3149 of which 100% passes a one-inch (1") sieve and a maximum of 10% passes a #4 sieve. It shall not contain sod, roots, plants and other organic matter, or any other objectionable materials.

- H. **Rock Stabilization.** Rock stabilization shall consist of three-fourth inch (3/4") minus rock installed in the trench bottom at the discretion of the engineer.
- I. **Lightweight Aggregate.** Lightweight aggregate shall consist of an aggregate having a density of 48 to 54 pounds per cubic foot installed in the trench bottom at the direction of the engineer.

2.19 SUBSURFACE DRAINTILE

Subsurface drains shall be in accordance with the applicable provisions of MnDOT 2502 and 3245 and in accordance with the City's standard detail plates 5232 and 5233, whichever is applicable. This drain is intended to collect and discharge infiltration that may accumulate in the bottom of granular backfilled subcuts.

Subsurface drain pipe shall be 4-inch perforated thermoplastic (TP) pipe. To prevent infiltration into the perforated pipe, the trench shall be wrapped with geotextile, MnDOT 3733, Type I. Trench backfill shall be Coarse Filter Aggregate, MnDOT 3149.

Subcut drains shall connect directly to permanent drainage structures (catch basins). Connections to drainage structures shall be incidental work and shall meet the approval of the Engineer.

Pipe shall generally be placed according to the standard details, but other configurations may be approved by the Engineer to accomplish the desired results. Unless otherwise specified, drain grades shall conform to subcut grades having positive drainage throughout the line to the drainage structure (no high or low points). When dRAINTILE outlets exceed 100 feet, cleanouts shall be provided at 200-foot intervals and at the upper end of the pipe as per standard Detail Plate No. 5234.

The Contractor shall place 4-inch perforated TP pipe in the bottom of the subcut according to the design typical. The coarse filter aggregate and at least 12 inches of subcut backfill shall be placed above the pipe and wrapped in MnDOT 3733 Geotextile (Type 1) before any compactive effort is applied. Perforations shall be laid down. Connections to drainage structures shall be composed of angle fittings not to exceed 22-1/2 degrees. Openings in structures to receive the fitting shall be fabricated at the plant or core drilled in the field. The use of jackhammers or sledge hammering will not be allowed.

2.20 TRACE WIRE

A. Materials.

1. General:

All system components, including tracer wire, connectors, ground rods and access points, must be compatible. The specification written below is utilizing all

Copperhead Industries components and note that an approved equal can be utilized if approved by the Engineer.

The component parts of the Copperhead® Complete Utility Locating System™ have been designed and engineered for compatibility to ensure end-to-end conductivity for the purpose of detecting underground utility assets.

All trace wire and trace wire products shall be domestically manufactured in the USA.

All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

* denotes color (B=blue, G=green, P=purple)

** spool size (500', 1000', 2500')

2. Tracer wire:

- a) Open Trench – Trace wire shall be Copperhead #12 AWG Copper-Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness (1230*-HS-**).
- b) Directional Drilling/Boring – Trace wire shall be Copperhead #12 AWG Copper-Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness (1245*-EHS-**).
- c) Pipe Bursting/Slip Lining – Trace wire shall be Copperhead 7x7 Stranded Copper-Clad Steel SoloShot, Xtreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness (PBX-50*-**).

3. Connectors:

- a) All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way SnakeBite Lockable Connector (LSC1230C). At crosses, the four wires shall be joined using two, 3-way Copperhead SnakeBite Locking Connectors (LSC1230C) with a short jumper wire between them.
- b) Direct Bury Wire Connectors – Shall include 3-way Copperhead SnakeBite Locking Connectors (LSC1230C) and Copperhead Mainline-to-Service Connectors (3WB-01) specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and

shall be installed in a manner so as to prevent any uninsulated wire exposure.
DryConn 3-way Direct Bury Lug

c) Non-locking friction fit, twist on or taped connectors are prohibited.

4. Grounding:

a) Tracer wire must be properly grounded at all dead-ends/stubs.

b) Grounding of tracer wire shall be achieved by using a 1.5-lb, drive-in, magnesium Copperhead Ground Rod (ANO-12) with a minimum 20-feet, #12 red HDPE insulated copper-clad steel wire connected to the rod specifically manufactured for this purpose.

5. Termination/Access:

a) All trace wire termination points must utilize an approved trace wire access box (grade level/in-ground access box as applicable), specifically manufactured for this purpose.

b) All grade level/in-ground boxes shall be appropriately identified with “sewer” or “water” cast into the cap and be color coded per APWA Standards.

c) All two-terminal tracer wire access points must include a manually interruptible conductive/connective link between the terminal for the tracer wire connection and the terminal for the ground rod wire connection.

d) All two-terminal tracer wire access points must have external direct connection points to both the tracer wire and ground rod wire from top of lid.

e) All at-grade access points shall include an encapsulated magnet molded into the portion of the tube, to allow for detection by a ferrous metal detector.

f) All at-grade access points shall be supplied with anti-corrosion wax/gel to protect wires.

g) Service laterals on public property – Tracer wire shall terminate at an approved at-grade, two-terminal switchable Copperhead SnakePit® Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2T-ADJ-SW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway(CD14*2TP-SW) Access Point located at the edge of the road right-of-way, and out of the roadway.

h) Service laterals on private property – Tracer wire shall terminate at an approved Copperhead single-terminal access point (when grounding isn't required) affixed

to or near the building exterior directly above where the utility enters the building, or at a two terminal access point (when grounding is required) located within two linear feet of the building being served by the utility.

- (1) Single-terminal access points may include:
 - (a) Above-grade, Cobra™ Access Point (T1-*)
 - (b) Above-grade, SnakeSkin™ Access Point (SNSK-*-01)
 - (c) At-grade, SnakePit® Lite Duty (LD14*TP), Lite Duty Adjustable (LD14*TPADJ), Lite Duty XL (LDXL36*TP), or Concrete/Driveway (CD14*TP) Access Point

- (2) Two-terminal access points may include:
 - (a) Above-grade, Cobra™ Access Point (T2-*) Copperhead Industries 2018 | v_10.10.18 | copperheadwire.com | 877-726-5644 3
 - (b) At-grade SnakePit Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2TADJ-SW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway (CD14*2TSW) Access Point

- i) Hydrants – Tracer wire shall terminate at an approved above-grade Copperhead Cobra Access Point properly affixed to the hydrant-grade flange (T2-*-FLPKG-5/8 for hydrants with 5/8” bolts, and T2-*-FLPKG-3/4 for hydrants with 3/4” bolts). Affixing with tape or plastic ties shall not be acceptable. Tracer wire may also terminate at an approved at-grade Copperhead SnakePit Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2T-ADJSW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway (CD14*2TP-SW) Access Point.

- j) Long-Runs, In Excess of 2500 Linear Feet Without Service Laterals or Hydrants – Trace wire access must be provided utilizing an approved at-grade Copperhead SnakePit Access Point and grounded at dead-ends utilizing a drive in magnesium Copperhead Ground Rod (ANO-12). This access box is to be located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a minimum 48” polyethylene marker post, color coded per APWA standard for the specific utility being marked.

B. Installation.

1. General:

- a) Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, property locating of wire without loss or deterioration of low frequency (512Hz) signal, and without distortion of

signal caused by more than one wire being installed in close proximity to one another.

- b) Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- c) Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- d) Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at five foot intervals.
- e) Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end ground using an approved waterproof connector to a Ground Rod driven into virgin soil beneath and in line with the utility.
- f) All service lateral tracer wire shall be a single wire, connected to the mainline tracer wire using a three-way mainline-to-service connector, installed without cutting/splicing the mainline tracer wire.
- g) In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved connectors.
- h) Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access point located directly above the utility, at the edge of the road right-of-way, but out of the roadway.
- i) One foot of excess/slack wire is required in all tracer wire access points after meeting final elevation.
- j) Tracer wire must be properly grounded as specified.
- k) At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium ground rod.
- l) When grounding the tracer wire at dead-ends/stubs, the Ground Rod shall be driven into virgin soil directly beneath and in line with the utility.
- m) Ground rod wire shall be connected to the ground rod terminal on the two-terminal SnakePit Access Point Lid or to the bottom terminal on the two-terminal Cobra Access Point.

- n) Where the Ground Rod wire will be connected to a tracer wire access point, one foot of excess/slack wire is required after meeting final elevation.

2. Sanitary Sewer System:

- a) A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to promote tracing/locating capabilities from a single connection point.
- b) Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures on the north or east side.
- c) Tracer wire on all sanitary service laterals must terminate at an approved tracer wire access point color coded green and located directly above the service lateral at the edge of road right-of-way.

3. Water System:

- a) A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to promote tracing/locating capabilities from a single connection point.
- b) Lay mainline tracer wire continuously, by-passing around the outside of valves and fittings on the north or east side.
- c) Tracer wire on all water service laterals must terminate at an approved tracer wire access point, color coded blue and located directly above the service lateral at the edge of road right-of-way.
- d) Tracer wire access points will be installed at all fire hydrants.
- e) All conductive and non-conductive service lines shall include tracer wire.

4. Storm Sewer System:

- a) All PVC draitile must have trace wire as shown in Standard Detail Plate Nos. 5232 & 5233 and per this specification.

C. Prohibited Products and Methods

The following products and methods shall not be allowed or acceptable:

- Uninsulated trace wire.
- Stainless steel tracer wire
- Trace wire insulations other than HDPE.

- Trace wires not domestically manufactured.
- Non-locking, friction fit, twist-on or taped connectors.
- Brass or copper ground rods.
- Wire connections utilizing taping or spray-on waterproofing.
- Looped wire or continuous wire installations that have multiple wires laid side-by-side or in close proximity to one another.
- Trace wire wrapped around the corresponding utility.
- Brass fittings with trace wire connection lugs.
- Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
- Connecting trace wire to existing conductive utilities.

D. Testing

All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.

This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

Continuity testing in lieu of actual line tracing shall be not accepted.

SECTION 3.00 - INSPECTION AND TESTING OF MATERIALS

3.01 SHOP INSPECTIONS AND TESTING

All materials furnished by the contractor are subject, at the discretion of the engineer, to inspection and/or testing by accepted methods at the plant of the manufacturer. This inspection and/or testing is to be made at the cost of the Owner. The material supplier shall provide the City with copies of test results on materials that are furnished to the contractor.

3.02 FIELD INSPECTION AND TESTING

All materials furnished by or for the contractor for incorporation into the work under contract shall, at the discretion of the engineer, be subject to inspection and/or testing by methods acceptable to the engineer and at the expense of the contractor.

3.03 DISPOSITION OF DEFECTIVE MATERIAL

All material found during the process of inspecting and testing to be defective, or defective material encountered at any time during the progress of the work, will be rejected by the engineer and the contractor shall promptly remove from the site all such material.

3.04 CONCRETE TEST CYLINDERS

The contractor shall furnish without charge all concrete samples needed for concrete test cylinders, slump tests, air entertainment tests, and any other tests ordered by the engineer

On all types of concrete construction, up to 4 test cylinders may be taken from each section of the structure cast in one pouring operation. The actual cost of testing shall be paid by the owner.

SECTION 4.00 - CONTRACTOR'S RESPONSIBILITY FOR MATERIALS

4.01 MATERIAL FURNISHED BY CONTRACTOR

The contractor shall be responsible for all material furnished, and shall replace at his/her own expense all such material that is found to be defective in manufacture or that has become damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work or during the warranty period.

4.02 MATERIAL FURNISHED BY THE OWNER

The contractor's responsibility for material furnished by the owner shall begin at the point of delivery by the manufacturer, or owner, and upon acceptance of the material by the contractor. The contractor shall examine all material furnished by the owner at the time and place of delivery and shall reject all defective material. The point of delivery shall be stated in the special provisions.

4.03 REPLACEMENT OF DAMAGED MATERIAL

Any material furnished by the owner that becomes damaged after acceptance by the contractor shall be replaced by the contractor at his/her own expense.

4.04 RESPONSIBILITY FOR SAFE STORAGE

The contractor shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times.

SECTION 5.00 - MATERIAL HANDLING, ALIGNMENT AND GRADE

5.01 MATERIAL HANDLING

Pipe and other accessories shall, unless otherwise directed in the special provisions, be unloaded at the point of delivery, hauled to and distributed at the site of the project by the contractor. They shall at all times be handled with care to avoid damage. In distributing the material at the site, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Any adjustments to pipe lengths including R.C.P. shall be accomplished by the use of a saw or cutting device. The use of hammers or mauls will not be permitted. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the lining or coating is damaged, the repair shall be made by the contractor at his/her expense in a manner satisfactory to the engineer.

5.02 PIPE ALIGNMENT AND GRADE

All pipe shall be laid and maintained to the required lines and grades, with manholes, catch basins and fittings at the required locations. The owner will furnish one set of line and grade stakes necessary for the work. It shall be the contractor's responsibility to preserve these stakes from loss or displacement. The engineer may order replaced any stakes s/he deems necessary for the proper prosecution of the work. Any replacements shall be at the contractor's expense. All pipes shall be laid to the grade shown on the contract drawings.

5.03 DEVIATION WITH ENGINEER'S CONSENT

No deviation shall be made from the required line or grade except with the written consent of the engineer.

SECTION 6.00 - UNDERGROUND SURFACE AND OVERHEAD UTILITIES

6.01 EXISTING UTILITIES

Existing water and sewer mains, and other underground utilities, are shown on the plans only by general location. The owner does not guarantee the locations as shown on the plans, and the contractor shall be solely responsible for verifying the exact location of each of these utilities, without additional compensation. Prior to the start of any construction, the contractor shall notify all utility companies having utilities in the project area.

The contractor shall have sole responsibility for providing temporary support and for protecting and maintaining all existing utilities in the project area during the entire period of construction, including but not limited to the period of excavation, backfill and compaction. In carrying out this responsibility, the contractor shall exercise particular care, whenever gas mains or other utility lines are crossed, to provide compacted backfill or other stable support for such lines to prevent any detrimental displacement, rupture or other failure.

6.02 SUBSURFACE EXPLORATION

It shall be the contractor's responsibility to determine and verify the location of existing pipes, valves or other underground structures as necessary to progress with the work with no additional compensation allowed. The engineer shall make all known records available. All known utilities are designated on the plans in a general way only as stated above.

6.03 OVERHEAD UTILITIES AND OBSTRUCTIONS

Overhead utilities, poles, etc. shall be protected against damages by the contractor and if damaged by the contractor, shall be replaced by him. Should it become necessary during the progress of the work to remove or relocate existing poles, overhead utilities and obstructions, the contractor shall cause the same to be done at no expense to the owner unless otherwise provided for in the special provisions. This requirement is not intended to allow utility companies to charge for expenses incurred for work performed where their utilities lie within the street right-of-way or dedicated easement.

It will be the duty of the contractor to visit the site and make exact determination of the existence of any such facilities prior to the submission of his/her bid.

SECTION 7.00 - EXCAVATION AND TRENCH PREPARATION

7.01 GENERAL

The trench shall be so dug that the pipe can be laid to the alignment and depth required and shall be excavated only so far in advance of pipe laying as the Engineer shall specify. The trench shall be so braced and drained that the workmen may work wherein safely and efficiently. All trenches shall be sheeted and braced as per Chapter Sixty-Six: Trench bracing of the Minnesota Regulations relating to industrial safety to a safe angle of repose. Such angle of repose shall be no less than that repose required by the Accident Prevention Division of the Minnesota State Industrial Commission or the requirements of the Occupational Safety and Health Act (OSHA), whichever is more restrictive.

It is essential that the discharge of any required trench dewatering pumps FOLLOW Best Management Practices and be conducted to natural public drainage channels, drains or storm sewers. **This dewatering must be approved by the engineer prior to dewatering activities.**

All utility installations under existing "collector" roads or newly constructed (less than 5 years old) residential streets shall be jacked or directional bored as appropriate. No open trenching will be allowed.

7.02 PIPE BEDDING

Pipe bedding as shown on the standard plates shall be used as directed on the plans or specified in the special provision. PVC, HDPE, and ABS pipe shall be bedded in accordance with the specifications described below. Any special bedding shall be in accordance with the special provisions.

A. Polyvinyl Chloride Pipe (PVC)

All PVC pipe shall be installed and bedded in accordance with ASTM Specification D-2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." Embedment materials shall be in accordance with MnDOT specification 3149 as shown on standard plate #2203. Embedment materials shall be compacted in six-inch (6") lifts to a point twelve inches (12") above the pipe and to a density of at least 95% of standard proctor density as described by ASTM methods D698. All embedment materials shall be tested for compliance with the above specification and test results shall be supplied to the Engineer. If materials are purchased, weight slips should also be provided.

The contractor shall check for excess deflection in all portions of the PVC sanitary sewer line after placement of the backfill materials in the trench. The deflection will be checked by means of a Mandrel prior to final acceptance of the sanitary sewer line and after 30 days of its installation, whichever is the greater. The owner reserves the right to measure pipe deflection at any time during the warranty period. Deflections greater than 5% of the inside diameter of the pipe shall be considered failure of the bedding procedure. The test shall be performed without using mechanical pulling devices.

The contractor shall be required to re-excavate the trench, recompact the backfill material and restore the surface at no additional compensation with the re-laid pipe meeting the 5% requirement. An air pressure retest should be performed if applicable.

B. High Density Polyethylene (HDPE)

All HDPE pipe shall be installed and bedded in accordance with ASTM Specification D-2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." Embedment materials shall be in accordance with MnDOT specification 3149 as shown on standard plate #2203. Embedment materials shall be compacted in six-inch (6") lifts to a point twelve inches (12") above the pipe and to a density of at least 95% of standard proctor density as described by ASTM methods D698. All embedment materials shall be tested for compliance with the above specification and test results shall be supplied to the Engineer. If materials are purchased, weight slips should also be provided.

The contractor shall check for excess deflection in all portions of the HDPE storm sewer line after placement of the backfill materials in the trench. The deflection will be checked by means of a visual, lamping inspection prior to final acceptance of the storm sewer line and after installation is complete. The owner reserves the right to measure pipe deflection at any time during the warranty period. Deflections greater than 5% of the inside diameter of the pipe shall be considered failure of the bedding procedure. The test shall be performed without using mechanical pulling devices.

The contractor shall be required to re-excavate the trench, recompact the backfill material and restore the surface at no additional compensation with the re-laid pipe meeting the 5% requirement.

C. Reinforced Concrete (RCP) or Ductile Iron (DIP)

When existing soil conditions are not acceptable for backfill and/or compaction in the pipe zone, pipe bedding and backfill shall be used as shown on standard plate #2201. Otherwise, backfill as shown on standard plate #2202 may be used.

7.03 TRENCH WIDTH AND DESCRIPTION

The trench width at the top of the excavation may vary depending upon the depth of the trench and the nature of material encountered. However, the maximum allowable width of trench shall be in strict accordance with MnDOT Specifications. The width of the trench shall also be kept at a minimum to prevent excess destruction of the existing street or highway pavement.

For trench width at the top of pipe greater than specified in the paragraph above, the contractor may propose alternate strength of pipe to depth of cover relationships other than those listed on the form of proposal, or shown on the plans. Such proposals must be submitted to the engineer for approval in writing and with pertinent pipe strength and soil weight data at least 14 days prior to the desired construction date. No extra compensation shall be allowed for any increase in material or construction costs created by alternate plans.

7.04 CORRECTING FAULTY GRADE

Any part of the trench excavated below grade shall be corrected with approved material and thoroughly compacted without additional compensation to the contractor.

7.05 PIPE FOUNDATION IN POOR SOIL

When the bottom at subgrade is soft and in the opinion of the engineer cannot adequately support the pipe, a further depth and/or width shall be excavated and refilled to pipe foundation grade with approved material and thoroughly compacted; or other approved means, such as piling, shall be adopted to assure a firm foundation for the pipe with extra compensation allowed the contractor as provided elsewhere in these specifications.

The contractor shall furnish, drive, and place piling if ordered by the engineer. Piles shall be driven in exact position at locations determined by the engineer. The contractor at his/her own expense must replace piles not correctly positioned at the completion of driving.

7.06 PIPE FOUNDATION IN ROCK

The space between the bottom of the trench and rock and the bottom of the pipe shall be backfilled with granular base material thoroughly tamped. Generally speaking the material from the trench excavation, other than rock or boulders, shall be considered suitable material. No additional compensation for placing or tamping this material shall be allowed. However, in the event that additional material must be hauled in, the hauling of the suitable granular material for the pipe bed shall be paid for on a weight basis when ordered by the engineer. Weight slips shall be delivered to the engineer daily.

7.07 BRACED AND SHEETED TRENCHES

The contractor shall adequately brace and sheet excavations wherever necessary to prevent caving or damage to nearby property. The cost of this temporary sheeting and bracing, unless provided for otherwise, shall be considered as part of the excavation costs without additional compensation to the contractor. Trench sheeting shall remain in place until pipe has been laid, tested for defects and repaired if necessary, and the earth around it compacted to a depth of one foot (1') over the top of the pipe. Sheeting, bracing, etc. placed in the "pipe zone", that part of the trench below a distance of one foot (1') above the top of the pipe, shall not be removed without the written permission or written order of the engineer; that sheeting thereby left in place shall be paid for at the unit price bid. Sheeting ordered left in place by the engineer in writing shall be paid for at the unit price bid. The contractor may also leave in place, at his/her own expense, to be embedded in the backfill of the trench, any sheeting or bracing in addition to that ordered left in place by the engineer for the purpose of preventing injury or damage to persons, corporations, or property, whether public or private, for which the contractor under the terms of this contract is liable.

7.08 PILING OF EXCAVATED MATERIAL

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

7.09 BARRICADES, GUARDS AND SAFETY PROVISIONS

To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, flashers, and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the highway. All material piles, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local authorities respecting safety provisions shall be observed.

7.10 TRAFFIC AND UTILITY CONTROLS

Excavations for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the contractor shall provide suitable bridges at street intersections and driveways. The contractor shall post, where directed by the engineer, suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire or police call boxes, or other utility controls shall be left unobstructed and accessible during the construction period.

7.11 PRIVATE PROPERTY PROTECTION

Trees, fences, poles and all other private property shall be protected unless their removal is authorized; and any property damage shall be satisfactorily restored by the contractor, or adequate compensation therefore shall be the responsibility of the contractor.

7.12 TUNNELING, JACKING, BORING OR EXCAVATION OTHER THAN OPEN TRENCH

Where pipe cannot be placed by open trench excavation, the method for placing and payment therefore shall be stated in the special provisions.

7.13 RAILROAD AND HIGHWAY CROSSINGS

When any railroad is crossed, all precautionary construction measures required by the railroad shall be followed and as specified in the special provisions and/or details. The contractor shall be responsible for the securing of necessary crossing permits.

Before any construction is started, the successful bidder shall meet with the Minnesota Department of Transportation, County Highway Department, Railroad Maintenance Engineer, and the consulting engineers to determine the construction procedure to be followed, methods of

rerouting traffic, placing of barricades, flares, signs, flagmen, etc., and methods of preventing damage to the highway or railroad. If required by the railroad or highway department, the contractor shall deposit with them a certified check in the amount specified by them to cover the required repair work.

SECTION 8.00 - LAYING OF PIPE

8.01 TRENCH PREPARATION

Prior to the laying of the pipe, the trench shall be excavated and prepared in accordance with the previous specifications and the class of bedding specified.

8.02 TYPE, SIZE AND CLASS OF PIPE

The type, size and class of pipe installed shall be in conformance with that specified on the bid proposal, plans and/or detail plates.

8.03 CLASS OF BEDDING

The class of bedding shall be in conformance with that specified on the plans or Standard Detail Plates.

8.04 CLEANING PIPE

All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying. The outside of the tongue or spigot end of the pipe shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

8.05 LAYING PIPE

The contractor shall plug the pipe under construction at any existing manhole until the system is finalized. Pipe laying shall proceed with the tongue or spigot ends pointed in the direction of flow. The laying of pipe shall conform to the class of bedding specified. Pipe shall not be laid in water or when the trench conditions are unsuitable for such work except by written permission of the engineer. The excavation of trenches shall be fully completed a sufficient distance in advance of the pipe laying and the exposed ends of all pipe shall be fully protected with a board or approved stopper to prevent earth or other substances from entering the pipe.

The interior of the sewer shall be carefully cleaned from all dirt, cement, or superfluous material of every description as the work progresses. If necessary, pipe shall be thoroughly flushed at the completion of the work at the expense of the contractor as directed by the engineer.

8.06 GRADE CONTROL

The contractor shall maintain the line and grade of the pipe in the trench by means of the laser. The batter board method will not be allowed.

SECTION 9.00 - PIPE JOINTING

9.01 GENERAL

Joints for concrete pipe shall be made by wiping the joints clean, applying the manufacturer's recommended lubricant compound over the entire joint surface and then inserting the spigot end into the bell with sufficient force to properly seal the pipes. Joints for poly-vinyl chloride pipe on mainline sewer shall be made by the use of a solvent cement or push-on rubber gaskets. Fernco fittings will not be allowed. Typical residential or commercial sanitary services shall be solvent weld joints. All jointing procedures shall be in accordance with the recommendations of the pipe manufacturer.

9.02 PIPE JOINTS

Pipe joints shall be made using the materials specified under Section 2.00. All sliding surfaces of the joint shall be cleaned and lubricated immediately before the pipe is brought home.

9.03 STORM SEWER RCP PIPE - TIES ON STEEP GRADES

RCP storm sewer pipe joints shall be tied using 2 tie bolt fasteners per joint and installed at 60 degrees from top of pipe when the pipe being laid is on a grade greater than 7%.

SECTION 10.00 - HOUSE CONNECTIONS, WYES

10.01 GENERAL

As indicated on the plans and detail plates, six-inch (6") wyes shall be installed for building connections at such intervals as the size of the lots may demand. Where the depth of the trench exceeds sixteen (16') feet, the contractor shall use a riser, and shall be extended to a minimum of nine (9') feet below the surface at the property line (see standard plate No. 2001), or as shown on the plan for the invert of sewer services. **No Fernco fittings will be allowed.** Sewer service material including pipe, wyes and fittings shall be SDR 26.

The joints and bedding shall be made as previously specified. The tops of all risers and openings to wye and/or tee branches shall be capped by solvent weld plug to prevent any water from entering the service until the connection is placed in service.

10.02 RECORD AND LOCATION OF SERVICE CONNECTIONS

It shall be the duty of the contractor to keep an accurate record of service connections as to location at lateral, vertical and horizontal bends and right-of-way, depth to top of riser, type of connection provided, etc. Location shall be made in respect to the nearest manhole center downgrade from the service. Curb stops shall be tied to definable landmarks such as manholes, catch basins, gate valves, hydrants and building corners. The length of ties shall be no longer than 100 feet between tie points. If a permanent structure is not available within the 100-foot length, a third tie point of not more than 150 feet shall be supplied. Property corners, trees, power poles, light poles, telephone or utility boxes are not acceptable ties. This record shall be turned over to the engineer for his/her records at time intervals specified by the engineer.

At the end of all house connections, the contractor shall furnish and set a steel t-post vertically to three feet (3') above the ground surface in accordance with Detail Plate 2001. In areas of newly platted land where the houses have not yet been built on the lots serviced, the contractor shall furnish and set steel fence posts and extend three feet (3') above the ground surface. The t-post shall extend from the invert of the service stub to three feet (3') above the ground surface.

SECTION 11.00 - SANITARY SEWER LEAKAGE TESTING

11.01 GENERAL

Disposition of abandoned facilities and reconnection of existing facilities shall be as provided for in the Plans, Specifications, and Special Provisions.

11.02 SANITARY SEWER LEAKAGE TESTING

All sanitary sewer lines, including service connections, shall be substantially watertight and shall be tested for excessive leakage upon completion and before connections are made to the service by others. Each test section of the sewer shall be subjected to exfiltration testing, either by hydrostatic or air test method as described below and at the Contractor's option. The requirements set forth for maximum leakage shall be met as a condition for acceptance of the sewer section represented by the test.

If the ground water level is greater than three feet above the invert elevation of the upper manhole and the Engineer so approves, infiltration testing may be allowed in lieu of the exfiltration testing, in which case the allowable leakage shall be the same as would be allowed for the Hydrostatic Test.

All testing shall be performed by the Contractor without any direct compensation being made therefore, and the Contractor shall furnish all necessary equipment and materials, including plugs and standpipes as required.

11.03 AIR TEST METHOD

The sewer pipe section under test shall be clean at the time of testing but the pipe may be wetted. Pneumatic balls shall be used to plug the pipe ends at manholes. Low pressure air shall be introduced into the plugged line until the internal air pressure reaches 4.0 psi greater than the average back pressure of any ground water pressure that may submerge the pipe. At least two minutes shall be allowed for the air temperature to stabilize before readings are taken and the timing started. During this time the Contractor shall check all plugs with soap solution to detect plug leakage. If plugs are found to leak, air shall be bled off, the plugs shall be retightened, and the air shall be reintroduced into the line.

The sewer section under test will be accepted as having passed the air leakage test if it does not lose air at a rate to cause the pressure to drop from 3.6 to 3.0 psi in less time than one-half minute per inch in diameter of the pipe tested.

Pipe Diameter in Inches	Minutes
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
15	7.5
18	9.0
21	10.5

11.04 HYDROSTATIC TEST METHOD

After bulkheading the test section, the pipe shall be subjected to a hydrostatic pressure produced by a head of water at a depth of three feet above the invert elevation of the sewer at the manhole of the test section. In areas where ground water exists, this head of water shall be three feet above the existing water table.

The water head shall be maintained for a period of one hour during which time it will be presumed that full absorption of the pipe body has taken place, and thereafter for an extended period of one hour the water head shall be maintained as the test period. During the one hour test period, the measured water loss within the test section, including service stubs, shall not exceed the Maximum Allowable Loss (in Gallons Per Hour per 100 Feet of Pipe) given below for the applicable Main Sewer Diameter.

Main Sewer Diameter (In Inches)	Maximum Allowable Loss* (In Gallons Per Hour Per 100 Feet)
6	0.5
8	0.6
10	0.8
12	1.0
15	1.2
18	1.4
21	1.7
24 & Larger	1.9

*Based on 100 Gallons Per Day Per Pipe Diameter Inch Per Mile

If measurements indicate exfiltration within a test action section is not greater than the allowable maximum, the section will be accepted as passing the test.

11.05 DEFLECTION TEST

Deflection tests shall be performed on all plastic gravity sanitary sewer pipes. The test shall be conducted after the sewer trench has been backfilled to the desired finished grade and has been in place for 30 days.

The deflection test shall be performed by pulling a rigid ball or pointed mandrel through the pipe without the aid of mechanical pulling devices. The ball or mandrel shall have a minimum diameter equal to 95% of the actual inside diameter of the pipe. The maximum allowable deflection shall not exceed five percent of the pipe's internal diameter. The time of the test, method of testing, and the equipment to be used for the test shall be subject to the approval of the Engineer. The contractor shall check for excess deflection in all portions of the PVC sanitary sewer line after placement of the backfill materials in the trench. The deflection will be checked by means of a Mandrel prior to final acceptance of the sanitary sewer line or after 30 days of its installation, whichever is the greater. The owner reserves the right to measure pipe deflection at any time during the warranty period. Deflections greater than 5% of the inside diameter of the pipe shall be considered failure of the bedding procedure. The test shall be performed without using mechanical pulling devices.

The contractor shall be required to re-excavate the trench, recompact the backfill material and restore the surface at no additional compensation with the re-laid pipe meeting the 5% requirement. An air pressure retest to be performed if applicable.

All testing shall be performed by the Contractor at his/her expense without any direct compensation being made therefore, and s/he shall furnish all necessary equipment and materials required.

11.06 TEST FAILURE AND REMEDY

In the event of test failure on any test section, testing shall be continued until all leakage has been detected and corrected to meet the requirements. All repair work shall be subject to approval of the Engineer. Introduction of sealant substances by means of the test water will not be permitted.

Unsatisfactory repairs or test results may result in an order to remove and replace pipe as the Engineer considers necessary for test conformance. All repair and replacement work shall be at the Contractor's expense.

SECTION 12.00 - SETTING MANHOLES AND CATCH BASINS

12.01 GENERAL

Manholes and catch basins shall be set and jointed to the line in the manner specified for laying and jointing pipe.

12.02 LOCATION

Manholes shall be located as shown on the plan or as directed by the engineer. Catch basins shall be located a minimum of 10 feet away from any pedestrian ramp as shown on the plan or as directed by the engineer

12.03 TYPE OF CONSTRUCTION

Wherever possible, and unless otherwise specified, the manholes and catch basins shall be constructed of precast sections. Where precast sections cannot be used, the Engineer may dictate these sections be constructed of brick, block, concrete, or a combination of such materials. Unless otherwise specified, the manholes and catch basins if necessary shall be constructed with steps in accordance with the standard plate of this specification.

12.04 CONSTRUCTION DETAILS

The details of construction of each individual structure shall conform to the drawings and specifications as designated. Frames and covers shall be set to the designated elevation in a full mortar bed. The bottom of all manholes shall be constructed of half section of equivalent size pipe shaped to conform to the inlet and outlet pipe so as to allow a free, uninterrupted flow.

12.05 ADJUSTING RINGS AND BLOCKS

A minimum of two 2" rings and a maximum of three adjusting rings shall be provided between the cast iron cover frame and the top concrete manhole section. The rings shall be adjusted per Detail Plate No. 2110.

12.06 WATERPROOFING AND PRECAST SECTION JOINT CONSTRUCTION

Manholes and catch basins shall be constructed in such a manner that they are waterproof. Joints between manhole sections shall be made using confined O-ring rubber gaskets as specified previously.

12.07 LIFTING HOLES

Not more than two (2) lifting holes will be allowed in any precast manhole section. All lifting holes shall be plugged with non-shrinking mortar to ensure a waterproof installation.

12.08 MANHOLE AND CATCH BASIN BASE

Concrete base shall be of size and depth as shown on the drawings. Concrete used shall have a 28-day compressive strength of at least 3,000 pounds per square inch.

Precast base must be placed on a minimum of six inches (6") of granular material which has been thoroughly compacted and leveled off across the entire width of the base.

Where the foundation is unstable, the Engineer may order the contractor to install manholes on piling. Manhole base reinforcement and timber piles shall be as shown on the drawings.

12.09 MANHOLE INSIDE DROP SECTIONS

Inside drop sections are required if pipe inverts differential is greater than 20".

Manhole drop sections shall be constructed where shown on the plans according to detail #2104 and #2104A and shall be the following:

Forterra IntraFlow Low-Profile Inside Drop System, or approved equal.

Anchoring of drop sections shall utilize stainless steel anchor bolts.

If manhole drop sections cannot be constructed due to minimum drop section constraints, they shall be constructed according to detail drawing #2104B.

SECTION 13.00 - BACKFILLING

13.01 GENERAL

All excavation in trenches shall be backfilled to the original ground surface or to such grades as specified or shown on the plans. The backfilling shall begin as soon as practicable after the pipe has been placed. Prior to any backfilling, the excavation shall be cleaned of all trash, debris, organic material and other undesirable material.

13.02 BACKFILL PROCEDURE AT PIPE ZONE

Backfilling and compacting shall be done as thoroughly as possible so as to prevent after settlement. Depositing of the backfill shall be done so the shock of falling material will not injure the pipe or structures. Grading over and around all parts of the work shall be done as directed by the engineer.

Bedding material as specified in Sewer Specification 7.02 or other suitable material as determined by the engineer, free from rocks and boulders, shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench to a height above the top of the pipe as specified shovel placed and hand tamped to fill completely all spaces under and adjacent to the pipe. In the event that natural, suitable, granular material is not encountered during the normal excavation of the trench, or when the material encountered is determined unsuitable by the engineer, for backfilling around the pipe as required above; the contractor shall provide and place such approved material obtainable from other sources. (This procedure and specification is applicable to all sanitary sewer and storm sewer installations.)

13.03 BACKFILL PROCEDURE ABOVE THE PIPE ZONE

Unless otherwise specified, suitable backfill material shall be furnished and the following backfill procedures shall apply and be used above the "pipe zone" to either the existing surface elevation or design grade, as specified, with the cost of such considered incidental to the installation of the pipe unless specified for a particular section of the project by the special provisions and/or plans, or allowed in writing by the engineer, and a unit price has been established.

A. Type I.

The trench shall be backfilled to obtain the necessary compaction, with the lift thickness as required, dependent upon type of roller. The backfill material shall be compacted to 95% of the standard moisture density relationship of soils (ASTM D698-70) except the top three feet (3') of the trench which shall be compacted to 100% density. The moisture contents of these backfill materials shall be within a range of $\pm 3\%$ of optimum moisture content. If the existing moisture content of the backfill material below three feet of subgrade is greater than 3 percentage points above the optimum moisture content, the soil shall be compacted to a minimum density of 3 pounds per cubic feet less than the standard Proctor curve at that moisture content. At no time shall the density be less than 90 percent of the standard Proctor density. This modification of the compaction specification shall at no time be

used or applied to the upper 3 feet of the subgrade or the aggregate base. In the event the contractor fails to meet these compaction requirements, corrective measures such as spreading/discing/farming, etc. shall be undertaken or the Contractor may elect to backfill with a more suitable material taken from another source. All of these corrective measures shall be at the Contractor's expense.

Any settlements greater than one inch (1") as measured with a string line from one edge of the settlement to the other within the warranty period of this contract shall be considered failure of the mechanical compaction and all street surfaces, driveways, boulevard and ditch areas shall be repaired by the contractor at no cost to the City.

B. Type II.

Under state or county highways and road, the contractor shall obtain the necessary permits at his/her expense after commencing any type of work upon a state or county highway or roadway. All such work, especially backfilling, shall conform to state and county standards and specifications.

13.04 DISPOSAL OF EXCESS MATERIALS AND DEBRIS

Unless otherwise specified, excavated material either not suitable or not required for fill material shall be disposed of by the contractor outside of the right-of-way at his/her expense in any manner s/he may elect subject to the provisions of the following paragraph.

Before dumping such materials or debris on a private or public land, the contractor must obtain from the owner of such land written permission for such dumping and a waiver of all claims against the owner for any damage to such land which may result therefore together with all permits required by law for such dumping. A copy of such permission, waiver of claims and permit shall be filed with the engineer before said disposal is made.

13.05 FILL MATERIAL

Normal, allowable "fill material" used in backfilling outside of the pipe zone encasement shall be sand, gravel, or clay free from pieces of rock, concrete or clay lumps more than 1/3 cubic foot in volume, roots, stumps, organic soil, vegetation, tin cans, rubbish, frozen materials, and similar articles and substances whose presence in the backfill would cause excessive settlement. In that portion of the backfill which is within six inches (6") of a road subgrade, there shall be no stones which will be retained on a three-inch (3") sieve.

13.06 DENSITY TESTS

Density tests will be performed by an approved soils testing firm at various locations and depths throughout the project as directed by the engineer. The contractor shall cooperate fully and provide assistance as necessary to complete these tests with no additional compensation being made to the contractor. A minimum of one test at an elevation approximately two feet above the top of pipe, one test in the top three feet and one test at an intermediate elevation per 100 feet of

pipe. A minimum of 50% of the individual water and sewer service trenches shall be tested at elevations listed above.

13.07 TEST & PROOF ROLLING

Test and proof rolling when requested by the Engineer shall be in accordance with MnDOT Specification 2111 except as modified herein under Sections 1.03 and 1.04 Subgrade Preparation & Correction of the Street Construction Specifications.

SECTION 14.00 - SURFACE RESTORATION, CLEANUP AND GUARANTEE

14.01 RESTORATION OF SURFACE

All surfaces disturbed during the construction period, including adjacent streets used to access the project, whether caused by actual excavation, deposition of excavated material, or by the construction equipment, shall be returned to its original conditions or better. Exceptions to the above, if any, or special instructions pertaining to any particular section of the project will be outlined in the special provisions. Any excess dirt shall be removed by the contractor in accordance with Section 13.04 of these specifications.

14.02 DUST CONTROL DURING CONSTRUCTION

The contractor shall at his/her own expense maintain dust control as necessary and in a manner satisfactory to the engineer until final acceptance of the project or until restoration has been completed.

14.03 MAILBOX RESTORATION

The contractor, at his/her expense, shall replace and restore mailboxes disturbed by the work unless specified by the engineer.

14.04 MAINTENANCE OF STREETS UNTIL SURFACED

After backfilling according to the above specifications, the contractor shall maintain the streets as required and blade as necessary to provide a passable surface for traffic until the surfacing is completed or to the date of final acceptance.

14.05 CLEANING UP

Surplus pipe material, tools, and temporary structures shall be removed by the contractor, and all dirt and/or rubbish caused by his/her operations and excess earth from excavations shall be hauled to a dump provided by the contractor, and the construction site shall be left in a condition satisfactory to the engineer.

14.06 GUARANTEE

The contractor shall be held responsible for any and all defects in workmanship and materials which may be developed in any part of the entire installation furnished by him and upon written notice from the engineer shall immediately replace and make good, without expense to the owner, any such faulty part or parts and damage done by reason of same, during the two-year period as prescribed in the conditions of the contract.

14.07 FAILURE TO REPLACE DEFECTIVE PARTS

Should the contractor fail to make good the defective parts within a period of 30 days of such notification, after written notice has been given him, the owner may replace these parts, charging the expense of same to the contractor.

SECTION 15.00 - TURF ESTABLISHMENT

15.01 GENERAL

All turf establishment shall be in accordance with Section 4.14, Turf Establishment, of the street specifications which is included as part of this Standard Specification.

SECTION 16.00 - OPEN DITCH CONSTRUCTION

16.01 GENERAL

The work covered by this specification may be performed with any means and equipment capable of doing a proper job.

16.02 EXCAVATION

The contractor shall excavate whatever substances are encountered to the size and dimensions shown by the drawings, plans, profiles, and cross-sections, or as instructed by the engineer.

Wherever seeding or sodding has been specified, the topsoil shall be selectively stripped and stockpiled to both sides of the right-of-way or use as topsoil for the seeding and sodding portion of the project.

The side slopes and bottom of the ditch are to be dressed as smooth and even as can be done by the skillful operation of the machinery employed to do the work. All waste material shall be removed therefrom to the satisfaction of the engineer.

During the course of construction, the contractor shall conduct his/her operation in such a way that the completed work shall be in reasonable facsimile to that shown on the plans for any particular section. Extra excavation and cost incurred for this purpose shall be at the expense of the contractor.

16.03 WASTE BANKS

Unless otherwise directed, the contractor shall place the waste banks on both sides of the ditch and level them to correspond with the slope of the ground surface as closely as possible. The material shall be finished smooth by a bulldozer, grader or dragline to the satisfaction of the engineer. Openings shall be left in the waste banks for the drainage of adjacent land, crossings or waterways.

16.04 OBSTRUCTIONS

The contractor shall remove all bridges, trees, stumps, rocks, brush, culverts, and other obstruction to his/her work within the right-of-way. Bridge or culvert material which may be usable again shall be piled outside of the right-of-way.

16.05 SILT REMOVAL

The ditch will be checked for grade and widths as the work progresses. Any work not to grade or of proper width shall be corrected. All work shall be maintained to the proper depth and width in which that part of the ditch is constructed until the end of the working season.

In case silt washes into the ditch or the banks cave into it later, the silt or cave in shall be removed, if necessary, for which the contractor shall be paid on an equipment rental basis, or some other method of compensation, if the same is agreed upon by the contractor, engineer, and representative of the owner.

SECTION 17.00 - RIPRAP AND EROSION CONTROL MATERIALS

17.01 GENERAL

The contractor shall furnish and install riprap as designated by the plans or as directed by the engineer to prevent the possibility of erosion.

17.02 RIPRAP MATERIALS

The riprap material shall conform to Minnesota Department of Transportation Standard Specifications 3601. The stone shall be durable field or quarry stone of approved quality, sound, hard, and free from seams, cracks or other structural defects. Unless otherwise specified, the stone may be round, flat, or other shapes in between.

A. Class or Size of Hand Placed and Grouted Riprap

The individual stones, except those used for chinking, shall not weigh less than 50 pounds each.

B. Size of Rock Versus Weight.

As a guide, the following table is included which compares the approximate average diameter with the various weights of round stone. Of course, flat stones of an equivalent weight would have a greater diameter.

Weight (Lbs.)	Average Diameter (Inches)	Weight (Lbs.)	Average Diameter (Inches)
10	6	150	15
30	9	180	16
50	10	250	18
80	12	300	19
110	14	400	21

17.03 RANDOM RIPRAP

This work shall conform to MnDOT Specification 2511.

17.04 HAND PLACED RIPRAP

This work shall conform to MnDOT Specification 2511.

17.05 GROUTED RIPRAP

This work shall conform to MnDOT Specification 2511.

17.06 EROSION CONTROL

The contractor shall install and maintain fabric fences, conforming to special provisions or as approved by the City Engineer or other appropriate erosion control materials at all storm sewer outlets and other potential erosion problem areas along lakes, streams or ponds as noted on the plans or as directed by the engineer.

The BMPs shown on the plans are the minimum requirements for the anticipated site conditions. As construction progresses and unexpected or seasonal conditions dictate, the contractor shall anticipate that more BMPs will be necessary to ensure erosion and sediment control on the site. During the course of construction it is the responsibility of the contractor to address any new conditions that may be created by construction activities and/or climatic events and to provide additional BMPs over and above the minimum requirements shown on the plans that may be needed to provide effective protection of soil and water resources.

17.07 FILTER BLANKET MATERIAL

Filter blanket material shall conform to MnDOT Specification 3601, and shall be placed beneath the riprap material at each storm sewer outlet.

17.08 LINER MATERIAL

Erosion control liner material shall be placed beneath the filter blanket material at each storm sewer outlet as described on the standard plate.

SECTION 18.00 - FORCEMAIN

18.01 HIGH DENSITY POLY ETHYLENE (HDPE)

High Density Poly Ethylene pipe (HDPE) used for a forcemain shall be installed and tested per Section 21.00, Directional Bore of High Density Poly Ethylene, of this specification.

18.02 POLYVINYL CHLORIDE PIPE (PVC)

Polyvinyl chloride pressure pipe (PVC) for a forcemain shall conform to A.W.W.A. C900 and shall be installed per Section 2.04, Polyvinyl Chloride Pipe, of the Watermain Specifications which is included as part of this Standard Specification. All pipe shall have a minimum dimension ratio (DR) of 18 corresponding to a working pressure of 150 PSI for PVC type 1120 pipe. The pipe shall be manufactured to ductile iron outside dimensions in accordance with A.W.W.A. C900.

A. Rubber Gasket Joints.

Joint restraint for C900 PVC pipe and fitting systems shall be effected by an internal self-restraining system such as RieberLok or an approved equal. Such a system shall be rated by the manufacturer to pressures that meet or exceed the rating of the C900 PVC pipe being restrained (e.g. DR 18 is rated for service at 235 psi). No degradation of the pipe's performance is allowed.

The pipe bell shall consist of an integral wall section with a factory-installed RieberLok gasket. The bell section shall be designed to be at least as hydrostatically strong as the pipe wall and meet the requirements of AWWA C900. Gasket material shall be SBR or approved equal. Installation shall be in accordance with ANSI/AWWA C605 and the restraint manufacturer's recommendations. Joints shall be kept clean and properly lubricated prior to installation.

B. Fittings.

Fittings shall be epoxy coated ductile iron, having a minimum working pressure rating of 150 PSI and shall conform to the requirements of AWWA C110 (ANSI A21.10) or AWWA C153 (ANSI 21.53) Ductile Iron Compact Fittings. Valves, tees, crosses, hydrant barrels or any other ductile iron fitting shall be wrapped with a flat sheet or split length polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Make seams by bringing the edges of the polyethylene sheet together, folding over twice and taping down. All buried nuts and bolts shall be Cor-Blue or stainless.

18.03 AIR AND VACUUM VALVES

Sewage automatic air and vacuum valves shall be 2" H-TEC sewage valves, Model Number 986, or approved equal.

The valve shall be furnished with a two-inch (2") inlet, a two-inch (2") stainless shut off (ball valve) and all other accessories needed for back flushing such as blow off valve, a stainless shut off (ball valve) and a quick disconnect coupling with back flushing hose.

An operating and maintenance instruction manual shall be included with the valve.

18.04 AIR RELIEF MANHOLE

Air relief manholes shall be constructed of precast concrete sections with R-4 joints as designated on the plans and shown on the detail plate in accordance with ASTM designation C-139.

18.05 PIPE INSTALLATION

All pipes shall be laid to the depth shown on the contract drawings. The contractor shall satisfactorily maintain the specified cover by means he/she deem necessary. If additional bends are required, where not shown on the drawings to maintain alignment around curves, the contractor shall provide the required number to the Engineer for approval and be compensated at the unit price as proposed on the bid form.

18.06 LAYING PIPE

A. Handling of Force Main Material Into Trench.

Proper tools and facilities satisfactory to the engineer shall be provided and used by the contractor for the safe and convenient prosecution of the work. All pipe, fittings and valves shall be carefully lowered into the trench in such a manner as to prevent damage to force main materials and protective coatings and linings. Under no circumstances shall force main materials be dropped or dumped into the trench.

B. Jointing.

All types of joints shall be made in strict accordance with manufacturer's specifications. All pipe ends shall be brushed, wiped clean, and kept clean until joints are made.

C. Cutting Pipe.

Untapered spigot ends may be encountered when pipes are cut in the field. Before assembly, the cut end should be beveled with a heavy file or other suitable apparatus, removing any sharp or rough edges to protect the gasket from injury and ensure ease of assembly.

D. Blocking.

All fittings, at points of bends in the line, shall be solidly braced against the end or sides of the trench. All fittings shall be blocked with concrete. The concrete to have a minimum compressive strength of 2000 psi and the block to be of sufficient size so as not to exert more than 2000 lbs. per square foot pressure against the soil.

18.07 TESTING FORCEMAINS

A. Hydrostatic Tests Required.

A pressure test shall be required for all installations of force main and all appurtenances.

B. Pressure Test.

The pressure test for HDPE pipe shall be per Section 6.12, Field Quality Control, of the Watermain Specifications. PVC pipe pressure tests shall be completed as per section 10.01, Pressure Testing, of the Watermain Specifications.

C. Procedure.

Each valved section of pipe shall be slowly filled with water from a safe source, and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a water pump connected to the pipe in a manner satisfactory to the engineer. Where valves do not exist the contractor shall plug the end of the line in a manner satisfactory to the engineer. The pump, pipe connections, gauge and all necessary apparatus shall be furnished by the contractor and shall be approved by the engineer before any test is made. All necessary pipe taps shall be made by the contractor as may be directed by the engineer.

D. Expelling Air Before Test.

Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this in those instances where air relief manholes exist, the pipe shall be filled with water until all air has been expelled through the air relief valve. Then the shut off valve between the force main and air relief valve shall be closed and the air relief valve disconnected from the system. The pressure test on the force main can then proceed as outlined above.

E. Examination Under Pressure.

Any cracked or defective pipes, valves and fittings discovered in consequence of the pressure test shall be removed and replaced by the contractor with sound material and the test shall be repeated until satisfactory to the engineer. The pressure test shall be performed in a manner approved by the engineer. The contractor shall correct all faulty materials or workmanship discovered during the tests and all such corrections shall be made to the satisfaction of the engineer at the contractor's expense.

SECTION 19.00 - TELEVISION INSPECTION

Televising shall be performed on all newly constructed or repaired gravity sanitary sewer lines after successful leak testing has been completed and accepted. Contractors and developers shall follow all requirements for televising as outlined in current City specifications at the time of project.

19.01 TELEVISION EQUIPMENT

Television equipment shall include television camera, television monitor, cables, power source, lights, and other equipment. The television camera shall be specifically designed and constructed for operation in connection with sewer rehabilitation inspection. The Contractor shall utilize a self-propelled type camera where shown on the plans or required by the Engineer.

The camera, television monitor, and other components of the recording system, will be capable of producing a color picture in high definition resolution.

The camera will be mounted so as to center the lens for each pipe diameter to be investigated. The camera will have measurement devices to accurately measure pipe diameters of both main and service laterals as well as pipe defects.

The camera will be operative in 100% humidity conditions. Lighting for the camera will minimize reflective glare. Lighting and camera quality will be suitable to provide a clear, in-focus picture of the entire inside periphery of the sewer pipe for all conditions encountered during the work. Focal distance will be adjustable through a range of from 6" to infinity.

The remote reading footage counter will be accurate to one percent over the length of the particular section being inspected and will appear superimposed on the image shown on the television monitor.

At the Contractor's option, a push-type camera can be used to televise laterals.

19.02 TELEVISION INSPECTION PROCEDURES

The camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition. In no case will the television camera traverse the line being inspected for the line length at an average speed greater than 30 feet per minute. The contractor will stop at each service or defect a minimum of 10 seconds and using the pan and tilt of the camera fully view each service connection/defect. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor will reset their equipment in a manner so that the inspection can be performed from the opposite manhole. A reset or back out charge due to debris in the lines will be considered incidental to the televising pay item.

All lines shall be jetted and vacuumed so that all debris has been removed prior to televising.

A small quantity of water is to be introduced into the line prior to televising. The amount shall be determined by the Engineer and coordinated with the City's Water and Sewer Department. The amount of water shall be sufficient enough to distinguish any sags or alignment problems with the pipe.

A fan/vacuum shall be utilized if steam given off by the sanitary sewer affects the camera visibility.

Examine starting and ending doghouses for quality of mortar work.

While at the bottom of the manhole, the camera will examine all joints as high as it can see around the entire manhole circumference. Joints shall be examined for infiltration and excessive gaps.

All outside drops shall be noted and visually examined looking down from the top.

Provide starting and ending manhole depths to the nearest 0.5'.

Include the location relative to the zero starting point, the side (left of right), and the clockwise position of the wye (i.e. 10:00). Note any problems associated with the service wye.

In the event the section being televised has substantial flow entering the sewer between manholes, such that 20% or 25% of the pipe diameter is flowing for 6"-10" pipe and 12"-24" pipe, respectively, the Contractor will be responsible to have such flow temporarily stopped or bypassed, and/or reschedule television inspection of the particular section to a time when such flow is reduced to permit proceeding with the television inspection. Temporary by-passing shall be coordinated with the City Engineer. Any required by-passing or "pigging" is considered incidental.

When sewer line depth of flow at the upstream manhole of the section being televised is above the maximum allowable for television inspection, the Contractor will reduce the flow to permit proceeding with the television inspection.

Accuracy of the measurement meters will be checked daily. Footage measurements will begin at the sewer line point of penetration of the upstream manhole, unless specific permission is given to do otherwise. Footage will be shown on the data view/monitor at all times.

19.03 DOCUMENTATION OF THE TELEVISION RESULTS

Television inspection logs will be typed in format acceptable to the City. Samples of the video and inspection log and PACP certification shall be submitted prior to bid acceptance, unacceptable submittals shall be rejected. Two written reports are required along with a brief summary report of noted items in each segment recorded on the project at the front of the report log. Printed location reports will clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. In addition, other data of significance, including the location of buildings and house service connections, joints, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible

features, will be recorded. A voice recording embedded in the digital video recording will make brief and informative comments on the sewer conditions at the time of recording.

Color digital video recordings of the data on the television monitor will be made by the Contractor. One copy of each video, in certified PACP format, on a digital hard drive containing all video, printable reports and still photos will be provided to the City.

Digital video recording playback will be the same speed that it was recorded.

Title and ownership of the digital hard drive will remain with the City. The Contractor will have all video and necessary playback equipment readily accessible for review by the City during the project. Recording speed will be noted on the recorded digital video.

Digital hard drive submittals will include the following information:

A. Data view:

1. Report number.
2. Date and time of TV inspection.
3. Upstream and downstream manhole numbers.
4. Current distance along reach (distance counter footage).
5. Printed labels on DVD hard case and DVD disk with location information, date, format information, and other descriptive information.
6. All televising data must match the GIS asset ID's provided by the City.

B. Audio:

1. Date and time of TV inspection, operator name and name of adjacent streets or descriptive narration of easement.
2. Verbal confirmation of upstream and downstream manhole numbers and TV viewing direction in relation to direction of flow.
3. Verbal or electronic description of pipe size, type, and pipe joint length.

C. Typed logs: will include, but are not limited to, the following information:

1. Location of each point of leakage.
2. Location of each service connection.
3. Location of any damaged sections, nature of damage, and location with respect to pipe axis.
4. Deflection in alignment of grade of pipe.
5. Record of repairs and quantity of sealing material used (if applicable).
6. Date, time, city, street or easement, basin, manhole section, reference manhole number, name of operator, inspector, and weather conditions.
7. Pipe diameter, pipe material, section length, and corresponding DVD identification.

SECTION 20.00 - METHOD OF PAYMENT

The work shall be measured and the compensation determined in the following manner:

20.01 SEWER PIPE

Sewer pipe shall be paid for at the contract price per lineal foot, which shall include the cost of furnishing all pipe, pipe bend sections, jointing material, tie bolt fasteners, bedding material and other material and of delivering, handling, laying, dewatering, trenching, sheeting and backfilling, testing, restoring of the surface, necessary permits, and all material or work necessary to install the pipe complete in place at the depth specified. The length of pipe for which payment is made shall be the actual overall length measured along the axis of the pipe to the centerline of the manhole. Lengths of branches will be measured from the centers of connecting manholes to the center of manhole. All lengths will be measured in a horizontal plane unless the grade of the pipe is more than 15%. The depth of cut for payment shall be defined as the distance between the invert of the pipe at a particular point and the intersection of a vertical or plumb line extended from the said point to the point of intersection of the line with the ground surface as it exists at time of construction.

20.02 DUCTILE IRON PIPE IN LIEU OF OTHER SEWER PIPE

D.I.P. not shown on the plans but placed upon direction of engineer in lieu of other sewer pipe shall be paid for as sewer pipe in accordance with Section 20.01 above plus the contract unit price per lineal foot bid as "Additional cost per foot for substituting D.I.P. in lieu of other sewer pipe" as listed on the proposal form for the diameter of pipe furnished.

20.03 MANHOLES

The standard manholes and drop manholes shall be paid for at the contract unit price which shall include the cost of furnishing all pipe, tees, horseshoes, precast sections, sewer block, concrete slabs, granular foundation material, adjusting rings, mortar, castings, chimney seals, water proofing, jointing and other material and of delivering, handling, excavating, sheeting, backfilling, dewatering, restoring of the surface and all material or work necessary to install the units complete in place at the depth specified on the plans.

A. Drop Section for Drop Manholes.

The risers for drop manholes, including pipe support and all appurtenances, will be paid for at the contract unit price per lineal foot. Length of riser shall be computed as distance from access opening invert to invert of lowest pipe entering manhole.

20.04 WYES, TEES AND SPECIAL FITTINGS

Wyes, tees and special fittings will be paid for at the contract price for each unit furnished of the size and classification specified in the proposal form.

20.05 CATCH BASINS

Catch basins will be paid for at the contract unit price, including precast base, granular foundation material and casting.

20.06 FLARED-END SECTIONS IN PLACE

End sections will be paid for at the contract unit price for each size furnished and shall include placing costs, trash guard and marker post. Riprap materials will be paid at the contract unit price. Flared-end sections will not be included in the lineal footage of pipe being measured.

20.07 PILING

Piling up to 20-feet long including caps shall be paid for at the contract unit price for each single pile bent in place. No additional payment will be made for cradles.

Any piling required over 20 feet in length shall be paid for as excess length of piling. Payment will not be made for cut off lengths.

Double pile bents shall be paid for according to the length of each individual pile. There shall be no additional compensation for lumber or hardware used to tie the piles together.

20.08 FOUNDATION MATERIAL

Material used for refilling to pipe foundation grade to assure firm foundation for pipe shall be paid for at the contract unit price per ton in place. Payment shall include cost of excavation and placement.

20.09 SPECIAL SECTIONS

Special sections will be paid for at the contract price on a lump sum basis for all work and material necessary for the complete installation or construction.

20.10 PILING FOUNDATION FOR MANHOLES

Payment for "Piling Foundation for Manholes" will be paid at the unit price bid and shall include steel reinforcement of the base, together with four (4) 20-foot piles each.

Piling over 20 feet in length will be paid at the contract unit price per linear foot for each foot of length over 20 feet driven in place below cut-off.

20.11 SHEETING ORDERED IN PLACE

Sheeting ordered left in place shall be paid for at the contract unit price per 1000 board feet.

20.12 JACKING

Payment for jacking will be paid for at the contract unit price per lineal foot. Sewer used in jacking will be paid at the bid unit price for that diameter sewer in the 0-8' cut category or as otherwise specified.

20.13 INCIDENTAL ITEMS

The cost of all material and labor required to complete this project as specified as shown on the plans, but not specifically included as a pay item, shall be incidental to the various unit prices bid.

20.14 TELEVISION INSPECTION

Payment for televising of sanitary and/or storm sewer lines will be paid for at the contract unit price per linear foot.

20.15 SUBSURFACE DRAINTILE

Measurement will be made by the length of furnished and satisfactorily installed Subsurface Drintile approved by the Engineer. Payment will be made at the contract bid price per linear foot which shall be full compensation for trenching, fabric wrapped trench and installation, cleanouts, aggregate backfill, cap, fittings, compaction, connecting to catch basins/manholes, and all other associated work.

SECTION 21.00 – DIRECTIONAL BORE OF HIGH DENSITY POLY ETHYLENE

21.01 GENERAL

This section covers the directional bore of High Density Poly Ethylene pipe (HDPE). The HDPE pipe shall be designed, furnished, and installed complete with all fittings, jointing materials, anchors, blocking, encasement, and other necessary appurtenances. All materials and equipment used in the drilling systems shall be of high quality and generally accepted in the industry. The services furnished by the contractor shall be performed in accordance with standard HDD industry practice and these documents and shall include all labor, equipment, and consumables necessary to accomplish the following tasks:

- Clearing, grading, and general site/access preparation necessary for construction operations.
- Transportation of all equipment, labor, materials, and consumables to and from the jobsite.
- Erection of horizontal drilling equipment at the rig site indicated on the drawings.
- Drilling of a pilot hole to a diameter suitable for installation of the prefabricated pull section.
- Reaming the pilot hole along the path indicated on the drawings.
- Prefabrication of the pull section including thermal butt fusion of the individual HDPE pipes in accordance with the applicable specification.
- Installation of the prefabricated pull section in the reamed hole.
- Fusion of HDPE fittings to the ends of each individual HDPE pipe following installation of the pull section.
- Pre-installation and post-installation hydrostatic testing of each individual HDPE pipe in accordance with the applicable specification.
- Clean-up and restoration of all work areas.

21.02 GOVERNING STANDARD

Except as modified or supplemented herein, all HDPE pressure pipe shall conform to the applicable requirements of ANSI/AWWA C906.

The supplementary information required in the foreword of the governing standard is as follows:

Affidavit of Compliance (Sec. 6.3)	Required
Plant Inspection (Sec. 5.9)	Not Required
Special Markings (Sec. 6.1.4)	Not Required
Special Preparation for Shipment (Sec. 6.2)	Not Required
Special Quality Assurance Testing (Sec. 5)	Required

21.03 SUBMITTALS

All procedures or material descriptions requiring the engineer's approval shall be submitted not less than 3 weeks prior to commencing any horizontal directional drilling activities. Submittals shall include but are not limited to the following:

1. Composition of drilling fluid.
2. Description of the drilling fluid solids control system (plan for minimization and disposal of excess drilling fluids).
3. Buoyancy control plan (if applicable).
4. Drilling fluid disposal plan.

21.04 PROTECTION OF UNDERGROUND FACILITIES

The contractor shall undertake the following steps prior to commencing drilling operations.

1. Contact the utility location/notification service and all other utilities not covered by this service for the construction area.
2. Positively locate and stake all existing lines, cables, or other underground facilities including exposing any facilities which are horizontally located within 10 feet of the designed drilled path.
3. Modify drilling practices and downhole assemblies to prevent damage to existing facilities.

The contractor shall be responsible for locating any and all underground facilities regardless of the engineer's previous efforts in this regard. The contractor shall be responsible for all losses and repairs to underground facilities resulting from drilling operations.

21.05 PERMITS AND APPROVALS

The Contractor shall obtain all other necessary permits and approvals. All work performed shall comply with the requirements of the permits obtained.

21.06 QUALITY ASSURANCE

A. Qualifications.

The pipe manufacturer shall provide the services of an experienced, competent, and authorized representative to visit the site of the work to advise and consult with the contractor during joining and installation of the pipe. The manufacturer's representative shall not directly supervise the contractor's personnel, and the contractor shall remain responsible for the pipeline work.

B. Storage and Handling.

Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Pipe shall not be stored uncovered in direct sunlight.

21.07 DESIGN

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21.08 MATERIALS

- A. **Pipe/Fittings.** Chevron "Plexco" or Phillips "Driscopipe", ANSI/AWWA C906; material designation (ASTM D3350), PE 3408, minimum cell classification 334434C, DIPS (Ductile Iron Pipe Size) OD, SDR 11.0.
- B. **Joints.** Thermal butt fusion joints, ASTM D3261.
- C. **Couplings.** Electrofusion Couplers.
- D. **Connections with DIP.** Connections shall be made using fittings suitable for such purposes. Mechanical joining to the ductile iron pipe shall be made using polyethylene flange adapter and metal backup ring. The adjoining ductile iron fitting shall be of an equivalent internal diameter as the polyethylene piping.

21.09 TRACE WIRE

A. **Materials.**

1. **General:**

All system components, including tracer wire, connectors, ground rods and access points, must be compatible. The specification written below is utilizing all Copperhead Industries components and note that an approved equal can be utilized if approved by the Engineer.

The component parts of the Copperhead® Complete Utility Locating System™ have been designed and engineered for compatibility to ensure end-to-end conductivity for the purpose of detecting underground utility assets.

All trace wire and trace wire products shall be domestically manufactured in the USA.

All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

* denotes color (B=blue, G=green, P=purple)

** spool size (500', 1000', 2500')

2. Tracer wire:

- a) Open Trench – Trace wire shall be Copperhead #12 AWG Copper-Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness (1230*-HS-**).
- b) Directional Drilling/Boring – Trace wire shall be Copperhead #12 AWG Copper-Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness (1245*-EHS-**).
- c) Pipe Bursting/Slip Lining – Trace wire shall be Copperhead 7x7 Stranded Copper-Clad Steel SoloShot, Xtreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness (PBX-50*-**).

3. Connectors:

- a) All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way SnakeBite Lockable Connector (LSC1230C). At crosses, the four wires shall be joined using two, 3-way Copperhead SnakeBite Locking Connectors (LSC1230C) with a short jumper wire between them. DryConn 3-way Direct Bury Lugs may be used in place of LSC1230C.
- b) Direct Bury Wire Connectors – Shall include 3-way Copperhead SnakeBite Locking Connectors (LSC1230C) and Copperhead Mainline-to-Service Connectors (3WB-01) specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure. DryConn 3-way Direct Bury Lugs may be used in place of LSC1230C.
- c) Non-locking friction fit, twist on or taped connectors are prohibited.

4. Grounding:

- a) Tracer wire must be properly grounded at all dead-ends/stubs.
- b) Grounding of tracer wire shall be achieved by using a 1.5-lb, drive-in, magnesium Copperhead Ground Rod (ANO-12) with a minimum 20-feet, #12 red HDPE insulated copper-clad steel wire connected to the rod specifically manufactured for this purpose.

5. Termination/Access:

- a) All trace wire termination points must utilize an approved trace wire access box (grade level/in-ground access box as applicable), specifically manufactured for this purpose.
- b) All grade level/in-ground boxes shall be appropriately identified with “sewer” or “water” cast into the cap and be color coded per APWA Standards.
- c) All two-terminal tracer wire access points must include a manually interruptible conductive/connective link between the terminal for the tracer wire connection and the terminal for the ground rod wire connection.
- d) All two-terminal tracer wire access points must have external direct connection points to both the tracer wire and ground rod wire from top of lid.
- e) All at-grade access points shall include an encapsulated magnet molded into the top portion of the tube, to allow for detection by a ferrous metal detector.
- f) All at-grade access points shall be supplied with anti-corrosion wax/gel to protect wires.
- g) Service laterals on public property – Tracer wire shall terminate at an approved at-grade, two-terminal switchable Copperhead SnakePit® Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2T-ADJ-SW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway(CD14*2TP-SW) Access Point located at the edge of the road right-of-way, and out of the roadway.
- h) Service laterals on private property – Tracer wire shall terminate at an approved Copperhead single-terminal access point (when grounding isn’t required) affixed to or near the building exterior directly above where the utility enters the building, or at a two terminal access point (when grounding is required) located within two linear feet of the building being served by the utility.

- (1) Single-terminal access points may include:
 - (a) Above-grade, Cobra™ Access Point (T1-*)
 - (b) Above-grade, SnakeSkin™ Access Point (SNSK-*-01)
 - (c) At-grade, SnakePit® Lite Duty (LD14*TP), Lite Duty Adjustable (LD14*TPADJ), Lite Duty XL (LDXL36*TP), or Concrete/Driveway (CD14*TP) Access Point

- (2) Two-terminal access points may include:
 - (a) Above-grade, Cobra™ Access Point (T2-*) Copperhead Industries 2018 | v_10.10.18 | copperheadwire.com | 877-726-5644 3
 - (b) At-grade SnakePit Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2TADJ-SW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway (CD14*2TSW) Access Point

- i) Hydrants – Tracer wire shall terminate at an approved above-grade Copperhead Cobra Access Point properly affixed to the hydrant-grade flange (T2-*-FLPKG-5/8 for hydrants with 5/8” bolts, and T2-*-FLPKG-3/4 for hydrants with 3/4” bolts). Affixing with tape or plastic ties shall not be acceptable. Tracer wire may also terminate at an approved at-grade Copperhead SnakePit Lite Duty (LD14*2T-SW), Lite Duty Adjustable (LD14*2T-ADJSW), Lite Duty XL (LDXL36*2T-SW), or Concrete/Driveway (CD14*2TP-SW) Access Point.

- j) Long-Runs, In Excess of 2500 Linear Feet Without Service Laterals or Hydrants – Trace wire access must be provided utilizing an approved at-grade Copperhead SnakePit Access Point and grounded at dead-ends utilizing a drive in magnesium Copperhead Ground Rod (ANO-12). This access box is to be located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a minimum 48” polyethylene marker post, color coded per APWA standard for the specific utility being marked.

B. Installation.

1. General:

- a) Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, property locating of wire without loss or deterioration of low frequency (512Hz) signal, and without distortion of

signal caused by more than one wire being installed in close proximity to one another.

- b) Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- c) Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- d) Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at five foot intervals.
- e) Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end ground using an approved waterproof connector to a Ground Rod driven into virgin soil beneath and in line with the utility.
- f) All service lateral tracer wire shall be a single wire, connected to the mainline tracer wire using a three-way mainline-to-service connector, installed without cutting/splicing the mainline tracer wire.
- g) In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved connectors.
- h) Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access point located directly above the utility, at the edge of the road right-of-way, but out of the roadway.
- i) One foot of excess/slack wire is required in all tracer wire access points after meeting final elevation.
- j) Tracer wire must be properly grounded as specified.
- k) At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium ground rod.
- l) When grounding the tracer wire at dead-ends/stubs, the Ground Rod shall be driven into virgin soil directly beneath and in line with the utility.
- m) Ground rod wire shall be connected to the ground rod terminal on the two-terminal SnakePit Access Point Lid or to the bottom terminal on the two-terminal Cobra Access Point.

- n) Where the Ground Rod wire will be connected to a tracer wire access point, one foot of excess/slack wire is required after meeting final elevation.

2. Sanitary Sewer System:

- a) A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to promote tracing/locating capabilities from a single connection point.
- b) Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures on the north or east side.
- c) Tracer wire on all sanitary service laterals must terminate at an approved tracer wire access point color coded green and located directly above the service lateral at the edge of road right-of-way.

3. Water System:

- a) A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to promote tracing/locating capabilities from a single connection point.
- b) Lay mainline tracer wire continuously, by-passing around the outside of valves and fittings on the north or east side.
- c) Tracer wire on all water service laterals must terminate at an approved tracer wire access point, color coded blue and located directly above the service lateral at the edge of road right-of-way.
- d) Tracer wire access points will be installed at all fire hydrants.
- e) All conductive and non-conductive service lines shall include tracer wire.

4. Storm Sewer System:

- a) All PVC draitile must have trace wire as shown in Standard Detail Plate Nos. 5232 & 5233 and per this specification.

C. Prohibited Products and Methods

The following products and methods shall not be allowed or acceptable:

- Uninsulated trace wire.
- Stainless steel tracer wire

- Trace wire insulations other than HDPE.
- Trace wires not domestically manufactured.
- Non-locking, friction fit, twist-on or taped connectors.
- Brass or copper ground rods.
- Wire connections utilizing taping or spray-on waterproofing.
- Looped wire or continuous wire installations that have multiple wires laid side-by-side or in close proximity to one another.
- Trace wire wrapped around the corresponding utility.
- Brass fittings with trace wire connection lugs.
- Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
- Connecting trace wire to existing conductive utilities.

D. Testing

All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.

This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

Continuity testing in lieu of actual line tracing shall be not accepted.

21.10 ACCESS

The contractor shall work within the designated Right of Way. Resident access and access to the work site shall be acceptable to all governing agencies.

21.11 INSTALLATION

A. Laying Pipe.

Pipe shall not be laid in water or under unsuitable weather or trench conditions, and shall be protected against entry of foreign matter.

During cold weather, particular care shall be taken in handling and laying pipe to prevent damage by impact.

Whenever pipe laying is stopped, the open end of the line shall be closed with a tight-fitting end board to keep out sand and earth. The end board shall have several perforations near its center to permit water into the pipe, thus preventing flotation in the event that the trench is flooded. Standing water in the trench shall be removed before the end board is removed.

Pipe shall be protected from exposure to sunlight, shall be kept as cool as possible during installation, and shall be covered with backfill immediately after installation.

B. Cleaning.

The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until work has been accepted.

C. Directional Tolerance.

The pilot hole shall be drilled along the path shown on the drawings to the tolerances listed below:

1. Alignment - Plus or minus 5 feet.
2. Entry Point Location - The pilot hole shall initially penetrate the ground surface at the exact location shown on the drawings. The contractor shall determine the entry side of the pilot hole drilling depending on the pipe grade, availability of right-of-way, room to string the pipeline, and other factors.
3. Exit Point Location - The pilot hole shall finally exit the ground surface at the exact location shown on the drawings.

In all cases, right-of-way restrictions shall take precedence over the listed tolerances. Regardless of the tolerance achieved, no pilot hole will be accepted if it will result in any or all of the pipeline being installed in violation of right-of-way restrictions. In all cases, concern for adjacent utilities and/or structures shall take precedence over the listed tolerances. Listing of tolerances does not relieve the contractor from responsibility for safe operations or damage to adjacent utilities and structures.

D. Cutting Pipe.

Cutting shall comply with the pipe manufacturer's recommendations. Cuts shall be smooth, straight, and at a right angle to the pipe axis. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and shall be beveled in accordance with the manufacturer's instructions.

E. Jointing.

Jointing shall conform to the instructions and recommendations of the pipe manufacturer. Sections of HDPE pipe shall be joined into continuous lengths above ground by the thermal butt fusion method in accordance with the pipe manufacturer's recommendations for the specified service. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but shall not be limited to, temperature requirements of 400° F, alignment, and 75 psi interfacial fusion pressure. Butt fusion joining shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe.

Socket fusion and extrusion welding or hot gas welding will not be acceptable.

All joining procedures shall be acceptable to the engineer.

F. Inspection.

Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation, with special attention to pipe ends. All defective pipe and fittings shall be removed from the site of the work.

G. Connections with Other Piping.

Connections between HDPE pipe and other piping shall be made using suitable fittings. Each connection with other piping shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by the City. The pipe shall remain in the drilled hole at least 24 hours before any connections or cutting of pipe shall be made. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination of potable water lines when dewatering, cutting into, and making connections with other pipe. No trench water, mud, or other contaminating substances shall be permitted to get into the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then swabbed with, or dipped in, a 200 mg/L chlorine solution.

H. Reaction Anchorage and Blocking.

All tees and plugs installed in piping subject to internal hydrostatic heads in excess of 30 feet shall be provided with suitable reaction blocking, anchors, joint harnesses, or other acceptable means of preventing movement of the pipe caused by internal pressure.

Concrete blocking shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking shall be as indicated on the drawings or as directed by the engineer.

Reaction blocking, anchorages, or other supports for fittings installed in fill or other unstable ground shall be provided as indicated on the drawings or as directed by the engineer.

I. Protective Coating.

All steel clamps, rods, bolts, and other metal components of tapping saddles or reaction anchorages subject to submergence, or in contact with earth or other fill material, and not encased in concrete, shall be protected from corrosion. The first coat shall be dry and hard before the second coat is applied.

21.12 REAMING AND PULL BACK

A. Pre-reaming.

Pre-reaming operations shall be conducted at the discretion of the contractor. The contractor shall insure that a hole sufficient to accommodate the pull section has been produced. Any damage to the pipe resulting from inadequate pre-reaming shall be the

responsibility of the contractor. All provisions of this specification relating to simultaneous reaming and pulling back operations shall also pertain to pre-reaming operations.

B. Pulling Loads.

The maximum allowable tensile load imposed on the pipe section shall be equal to 50 percent (50%) of the product of the HDPE pipe's specified tensile yield strength and the area of the pipe section.

C. Torsional Stress.

A swivel shall be used to connect the pull section to the reaming assembly to minimize torsional stress imposed on the section.

D. Pull Section Support.

The pull section shall be supported as it proceeds during pull back so that it moves freely and the pipe is not damaged.

E. External Collapse Pressure.

The pull section shall be installed in the reamed hole in such a manner that external pressures are minimized and an appropriate counter-balancing internal pressure is maintained. Any damage to the pipe resulting from external pressure during installation shall be the responsibility of the contractor.

F. Buoyancy Modification.

Buoyancy modification shall be used at the discretion of the contractor. Any buoyancy modification procedure proposed for use shall be submitted to the engineer for approval. No procedure shall be used which has not been reviewed and approved by the engineer. The contractor is responsible for any damage to the pull section resulting from buoyancy modification.

21.13 DRILLING FLUIDS

A. Composition.

The composition of all drilling fluids proposed for use shall be submitted to the engineer for review and approval. No fluid will be approved or utilized that does not comply with permit requirements or environmental regulations.

B. Water.

The contractor is responsible for obtaining, transporting, and storing any water required for drilling fluids. Connecting to fire hydrants is not acceptable. Contact the City to determine acceptable water locations.

C. Recirculation.

The contractor shall maximize recirculation of drilling fluid surface returns. The contractor shall provide solids control and fluid cleaning equipment of a configuration and capacity that can process surface returns and produce drilling fluid

suitable for reuse.

A description of solids control and cleaning equipment proposed for use shall be submitted to the engineer.

D. Disposal.

Disposal of excess drilling fluids is the responsibility of the contractor and shall be conducted in compliance with all environmental regulations, right-of-way and workspace agreements, and permit requirements. Drilling fluid disposal procedures proposed for use shall be submitted to the engineer.

Control of drilling fluids on the site is very critical. Spills of drilling fluids will not be allowed or permitted.

E. Inadvertent Returns.

The contractor shall employ his best efforts to maintain full annular circulation of drilling fluids. Drilling fluid returns at locations other than the entry and exit points shall be minimized. In the event that annular circulation is lost, the contractor shall take steps to restore circulation. If inadvertent surface returns of drilling fluids occur, they shall be immediately contained with hand placed barriers (i.e. hay bales, sand bags, silt fences, etc.) and collected using pumps and other suitable equipment. If the amount of the surface return exceeds that which can be contained with hand placed barriers, small collection sumps, drilling operations shall be suspended until surface return volumes can be brought under control.

21.14 FIELD QUALITY CONTROL

A. Instrumentation.

The contractor shall at all times provide and maintain instrumentation which will accurately locate the pilot hole, measure drill string axial and torsional loads, and measure the drilling fluid discharge rate and pressure. The Engineer will have access to these instruments and their readings at all times. A log of all recorded readings shall be maintained and will become part of the "As Constructed" information to be supplied by the contractor.

B. Cleaning and Disinfection.

Cleaning and disinfection is described in Section 10.00 of the Watermain Specifications.

C. Testing.

Prior to installation, a low pressure air test shall be performed on each run to be pulled. After installation the pipe will be subjected to a Hydrostatic Pressure Test and a Trace Wire Test. The Trace Wire Test is described above in Section 21.09 and the Hydrostatic Testing Procedures are described below:

Fill the pipeline with water after it has been laid; bleed off any trapped air. Subject the lowest element in the system to a test pressure that is 1.5 times the design pressure or 150 PSI, whichever is greater, and check for any leakage. When, in the opinion of the engineer, local conditions require that the trenches be backfilled immediately after the pipe has been laid, apply the pressure test after backfilling has been completed but not sooner than a time which will allow sufficient curing of any concrete that may have been used. Typical minimum concrete curing times are 36 hours for early strengths and 7 days for normal strengths.

The test procedures consist of two steps; the initial expansion and the test phase. When test pressure is applied to a water filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system at hourly intervals for 3 hours to maintain the test pressure. After a minimum of 4 hours, initial expansion will be considered complete and the actual test can start.

When the test is to begin, the pipe is full of water and is subjected to a constant test pressure of 1.5 times the system design pressure or 150 PSI, whichever is greater. The test phase should not exceed 3 hours, after which time any water deficiency must be replaced and measured. Add and measure the amount of make-up water required to return to the test pressure and compare this to the maximum allowance in the table below.

ALLOWANCE FOR EXPANSION UNDER TEST PRESSURE							
NOMINAL PIPE SIZE	U.S. GALS/100FT. OF PIPE			NOMINAL PIPE SIZE	U.S. GALS/100FT. OF PIPE		
	1 HOUR	2 HOURS	3 HOURS		1 HOUR	2 HOURS	3 HOURS
2"	0.08	0.12	0.15	20"	2.80	5.50	8.00
3"	0.10	0.15	0.25	22"	3.50	7.00	10.50
4"	0.13	0.25	0.40	24"	4.50	8.90	13.30
5"	0.21	0.41	0.63	28"	5.50	11.10	16.80
6"	0.30	0.60	0.90	30"	6.20	12.60	19.10
8"	0.50	1.00	1.50	32"	7.00	14.30	21.50
10"	0.75	1.30	2.10	36"	9.00	18.00	27.00
12"	1.10	2.30	3.40	42"	12.00	24.00	36.00
14"	1.40	2.80	4.20	48"	15.00	27.00	43.00
16"	1.70	3.30	5.00	54"	18.00	30.00	50.00
18"	2.20	4.30	6.50	-	-	-	-

NOTES:

Under no circumstances shall the total time under test exceed 8 hours at 1.5 times the system pressure rating or 150 PSI. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section shall be permitted to “relax” for 8 hours prior to the next test sequence.

Air testing is not recommended. Additional safety precautions may be required. Additional testing may be required at the discretion of the Engineer.

It shall be the responsibility of the contractor to ensure that appropriate safety precautions are observed during hydrostatic testing.

All HDPE piping shall be watertight and free from leaks. Each leak that is discovered within the correction period specified in the General Conditions shall be repaired by and at the expense of the contractor.