SECTION 02510 – WATER SYSTEM SPECIFICATIONS

SECTION 1 – WATER DISTRIBUTION SYSTEM MATERIALS

ARTICLE 1 - GENERAL

Materials for use at any location in the water distribution system (extensions or existing) shall meet the requirements as set forth in the following Articles under this Section.

ARTICLE 2 – PIPE, PIPE JOINTS AND FITTINGS

2.1 Ductile Iron Pipe, Joints & Fittings: Pipe for use under this heading shall consist of durable, solid, cast iron materials with the matrix being predominately ferrite. This material shall meet the following minimum physical strength requirements of: 60,000 psi, tensile, 42,000 psi, yield, and ten (10) percent maximum elongation. Each piece of pipe shall have the: weight, thickness, class manufacturer's mark, the year of manufacture, and the letters DI or word "DUCTILE" clearly stamped on the pipe. The pipe materials and construction shall be in accordance with all the requirements of A.S.A. Standard A21.51 (A.W.W.A. C-151). Minimum thickness class shall be Class 52 (Class 53 for flanged pipe). The pipe may be furnished with mechanical, push on, or flange joint ends as required.

A. Mechanical Joint Pipe & Fittings: Pipe and fittings of this joint type shall be furnished complete with all glands, gaskets, tee head bolts, hex nuts, etc., all properly sized and manufactured for the required pipe and fitting sizes. All fittings and bends shall be constructed of cast or ductile iron. Materials for this service shall consist of durable, solid, cast or ductile iron meeting the minimum physical requirements of 18,000 psi. tensile strength of 40,000 psi. modulus of rupture. Fittings and bend items shall be designed and tested to permit a minimum working pressure of 250 psi. prior to being shipped from the factory. All mechanical joint fittings, bends, and joint accessory materials shall conform to A.S.A. Standard A21.10 and A21.11.

B. Slip Joint Pipe & Fittings: Slip joint pipe shall be made of ductile iron as previously specified. The plain end of the pipe shall be tapered to permit easy assembly. The pipe joint gasket shall meet all applicable requirements of A.S.A. Standard A21.10 with joints in accordance with Section 11-2.3 of A.S.A. Standard A21.11. Fittings and bends for use with slip joint piping shall be mechanical joint as previously specified.

C. Flanged Pipe & Fittings: Pipe for use with flanged ends shall be ductile iron as previously specified. Threads for the screwed-on flanges shall be designed in accordance with A.S.A. Standard B2.1 Flanges for use shall be faced and drilled in accordance with A.S.A. Standard B16.1, 125 lb. All joint and joint materials shall be designed and tested for a minimum working pressure of 250 psi. Flanged branch fittings and bends shall meet or exceed the pipe and joint materials requirements. The flange joint bolt circle and drilled holes shall match those of A.S.A. Standard B16.1, 125 lb. All pipe and fittings shall be furnished with the properly sized; bolts, nuts, and best quality, ⅛-inch thick rubber gaskets.

The pipe and fittings shall be cement-lined and seal-coated in conformance with A.S.A. Standard A21.4 (A.W.W.A. C-104).

2.2 Rigid Plastic Pipe, Joints & Fittings – Pipe for use under this heading shall be approved and accepted by Underwriter' Laboratories, Inc.

A. Class 200, standard dimension ratio (S.D.R.) 21, P.V.C.:

1. Materials: Pipe for use under this heading shall be manufactured from clean, virgin, N.S.F. approved, Type 1, Grade 1, 1120 P.V.C. conforming to A.S.T.M. specification D2241. The pipe shall be pressure rated for a hydrostatic working pressure of 200 psi. at 73.4 degrees F. and shall meet all applicable requirements as set forth under Commercial Standard (CS) 256-63. The pipe shall also conform to the following tests conducted at 73.4 degrees F.

a. Hydrostatic Integrity: The pipe shall withstand without failure, a pressure of 420 psi. for at least 1,000 hours, in accordance with A.S.T.M. Specifications 1598-63T. The pipe shall withstand without failure, a pressure of 630 psi. applied in 60 to 90 seconds in accordance with Specifications 2599-62T.

b. Vice Flattening Test: A 2-inch wide ring of pipe shall be flattened in less than one minute, to 100% without showing evidence of shattering or splitting at 73.4 degrees F.

c. Pipe Wall Thickness – Rigid plastic pipe shall be manufactured to provide a minimum pipe wall, and bell or coupling thickness in accordance with the following schedules:

I.D. Size	Minimum Wall Thickness Barrel	Bell or Coupling
2 in.	.113 in.	.146 in.
4	.214	.258
6	.316	.376
8	.410	.481
10	.511	.607
12	.606	.735

Concentricity: The outer diameter of the pipe shall be concentric within .003 of an inch.

2. Slip Joint Pipe: All pipe shall be joined by means of a rubber ring slip joint. Cement weld or glued joints will not be permitted. The slip joint may be formed by either a bell joint or a double ring coupling. The bell joint where used, shall be an integral and homogenous part of the pipe formed by extrusion, with a ring groove for seating the rubber ring gasket. The rubber ring gasket shall be partially split or perforated to permit expansion and contraction with respective increased or decreased pressure in the main. The double ring coupling shall be extruded from pipe materials as previously specified. The coupling interior shall be machined for two square-bottom gaskets and a center tapered stop. The double ring coupling shall be used with plain end pipe on which all ends are tapered to permit pushing the pipe into the coupling. The rubber ring gasket to be used with this coupling shall have a squared seating edge for placement in the coupling grooves. The rubber ring gasket shall also be partially split or perforated to permit expansion and contraction with main pressure changes.

3. Markings: Pipe markings shall include the following, marked continuously down the length:

   a. Manufacturer's name.

   b. Nominal Size.

   c. Class Pressure Rating

   d. Dimension Ratio Number.

   e. PVC 1120.

   f. NSF Logo.

   g. Identification Code.

4. Lubrication: Lubrication shall be water soluble, non-toxic, be non-objectionable in taste and odor imparted to the fluid, be non-supporting of bacteria growth and have no deteriorating effect on the PVC or rubber gaskets.

5. Pipe Fittings: Branch, bend, transition, or cap type fittings to be used with rigid plastic shall be flanged or mechanical joint cast or ductile iron as previously specified. The fitting item shall be furnished with and include all; bolts, glands, transition gasket, etc., as required to fully make up the fitting connection joints.

2.3 Fusible Polyvinyl Chloride Pipe Materials

A. MANUFACTURER REQUIREMENTS

1. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.

B. WARRANTY

1. The pipe shall be warranted for one year per the pipe supplier's standard terms.

2. In addition to the standard pipe warranty, the fusion services shall be warranted for one year per

the fusion service provider's standard terms.

C. FUSIBLE POLYVINYLCHLORIDE PRESSURE PIPE FOR POTABLE WATER

1. Fusible polyvinylchloride pipe shall conform to AWWA C900, AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.
2. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
3. Fusible polyvinylchloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
4. Fusible polyvinylchloride pipe shall be blue in color for potable water use.
5. Pipe shall be marked as follows:
    a. Nominal pipe size
    b. PVC
    c. Dimension Ratio, Standard Dimension Ratio, or Schedule
    d. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
    e. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
    f. NSF-61 mark verifying suitability for potable water service
    g. Extrusion production-record code
    h. Trademark or trade name
    i. Cell Classification 12454 and/or PVC material code 1120 may also be included
6. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

D. FUSION JOINTS

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

E. DELIVERY AND OFF-LOADING

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

F. HANDLING AND STORAGE

1. Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the owner or engineer.
2. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.
3. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
4. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.
5. If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
6. Pipe shall be stored and stacked per the pipe supplier's guidelines.

G. FUSION PROCESS

1. GENERAL
    a. Fusible polyvinylchloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
    b. Fusible polyvinylchloride pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.
    c. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
    d. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
        i. HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
        ii. CARRIAGE – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
        iii. GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
        iv. DATA LOGGING DEVICE – An approved datalogging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
    e. Other equipment specifically required for the fusion process shall include the following:
        i. Pipe rollers shall be used for support of pipe to either side of the machine
        ii. A weather protection canopy that allows full machine motion of the heat plate, fusion

assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.

iii. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.

iv. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

v. Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

2. JOINT RECORDING

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

H. GENERAL INSTALLATION

1. Installation guidelines from the pipe supplier shall be followed for all installations.
2. The fusible polyvinyl chloride pipe will be installed in a manner so as not to exceed the recommended bending radius.
3. Where fusible polyvinylchloride pipe is installed by pulling in tension, the recommended Safe Pulling Force, according to the pipe supplier, will not be exceeded.

2.4 Restrained Joint PVC Pipe

A. Restrained joint PVC pipe shall meet the performance requirements of ASTM D2241. The PVC compound shall meet cell classification 12454 per ASTM D1784. All joints shall meet the requirements of ASTM D3139. O-rings shall meet the requirements of ASTM F477 "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.)

B. Restrained joint PVC shall be installed using a "permanent" joint system. Joint system shall provide a noncorrosive restrained joint by using machined grooves on the pipe and in the coupling which, when aligned, allow a spline to be inserted locking the pipe and coupling together. Provide an o-ring in the coupling to create a hydraulic seal.

2.5 Copper Pipe & Fittings: Copper pipe for all underground use as service or main lines, shall be "Type K". All copper pipe produced for this service shall be in accordance with A.W.W.A. Specifications 75-CR. Fittings for use with the copper pipe material shall be constructed of brass or bronze, of the joint type as required for the specific connections and are subject to District approval.

ARTICLE 3 – VALVES AND VALVE BOXES

3.1 Gate Valves:

A. All gate valves shall be non-rising stem, cast-iron body and wedge, bronze trim and stem, resilient seat gate valves conforming to AWWA C515, unless otherwise indicated. The disc shall have a resilient rubber seat ring mounted securely with stainless steel screws. All internal parts shall be epoxy coated. The valve stem seal shall be double "O"-ring and shall contain an anti-friction washer. The valve shall be as supplied by Mueller, Clow, American or approved equal.

B. Valve ends shall be compatible with the pipe in which they are installed. Tapping valves shall be flanged by mechanical joint and shall be compatible with the specified tapping sleeve.

C. All valves shall open left (counterclockwise) and have an operating nut capable of being turned by a standard gate valve key for buried valves and a handwheel for exposed valves.

D. Each buried valve shall have a cast-iron (bituminous coated) valve box. Valve box shall be Tyler Pipe 564-S or approved equal.

E. Each buried valve shall include a valve box alignment device such as a BoxLok by EMMA Sales, LLC, or approved equal.

F. Each buried valve, which is not located within pavement, shall have a carsonite glass fiber/resin reinforced composite utility stake with the words “Water Valve”. The utility stake shall be “white” in color with “blue” lettering.

ARTICLE 4 – CONCRETE FOR THRUST BLOCKING AND PIPE ENCASEMENT

Concrete to be used for thrust blocking with various bends, tees, valves, fire hydrants, etc. shall consist of ingredients designed to produce a mixture having a 3,500 psi. compressive strength of 28 days curing item. The mix shall be a “dry” as possible using only sufficient water to permit mixing and placement. Excessive water will not be permitted. Cement for use shall be the “high early” type to provide initial set as soon as possible. Concrete may be placed and covered with earth fill to prevent freezing during periods of cold weather. However, frozen ingredients will not be permitted for use. All concrete used and placed for this purpose shall be given at least three (3) days curing time before being placed under stress. Installation shall be in strict accordance with the applicable Articles under the following Section of these specifications.

Concrete for pipe encasement shall be of similar mix and design. Placement of the concrete shall be performed in such a manner so as to insure provision of a bed or cradle under the entire pipe length.

Where joints are to be encased, the piping shall be tested prior to concrete placement to maintain a pressure 50 percent greater than normal working pressure for a period of 4 hours. The Contractor shall provide all necessary equipment for conducting the pressure test as directed by the Water District. All necessary precautions shall be taken to prevent flotation of the piping during or following placement of the encasement materials.

ARTICLE 5 – PIPE BEDDING & ENCAPSULATION

Materials to be used for this purpose shall consist of fine, clean, durable particles of crushed stone. Crushed stone used for this purpose shall consist of well graded materials passing a 1-inch sieve to dust.

ARTICLE 6 – WATER MAIN TRACER TAPE

Water main tracer tape shall be installed with all water main. The materials to be installed for this purpose shall consist of three (3) inch wide tape made of bonded layer plastic with a metallic foil core. Tape splices shall be knotted to prevent tensile pressure on the splice. The material to be used for this service shall be “Terra Tape D” as manufactured by the Griffolyn Company of Houston, Texas, or approved equal. The metallic tape shall be colored to contrast with the soil and shall bear an imprint identifying the line below, such as, “ Caution, Water Main Buried Below”.

Installation of the tracer tape shall be in accordance with applicable Articles of these specifications.

ARTICLE 7 – WATER MAIN LOCATOR WIRE

Water main locator wire shall be installed with all water main, fittings, and valve installation. The material to be installed for this purpose shall consist of standard electric service wire, a single No. 12 U.L. approved copper wire of the solid type with insulation for 600 volts. Insulated wire for this service shall be provided in standard rolls of not less than five hundred (500) foot lengths.

7.1 Splices: Splices shall only be allowed where accessible. Buried splices will not be allowed.

7.2 Wire Contact: In order to make use of the wire for water main location purposes, a splice point shall be placed adjacent to a valve box location. If valve box locations are spaced more than 500 feet apart, Contractor shall install a vertical piece of 6-inch diameter Schedule 40 PVC adjacent to the water main, topped with a Clay and Bailey Model 2194-01-1009 cast iron cover, to maintain the required maximum distance between wire contact points. The wire shall be brought to the ground surface at these locations so a power source can be connected.The wire shall run outside up along side the valve box, then through a hole into the valve box just below ground level. The spliceconnector shall be left exposed at the top of the valve box at the wire contact locations. Wire contact points shall be provided at not more than 500-foot intervals. Wire shall also be run to allow for the location of water services. Wire shall be installed with service line from main to meter.

Water main locator wire installation shall be in accordance with applicable Articles of these specifications.

Prior to final acceptance by Owner, Contractor shall demonstrate that the locator wire works to the satisfaction of the Owner and/ or his representative.

ARTICLE 8 – CONNECTION TO PRESENT SYSTEM

Materials to be used for connections to the present water distribution system shall be in accordance with the preceding Articles as applicable, under this Section of these specifications. Installation, testing and sterilization of all items shall be in strict accordance with the following Section of these specifications. Under all circumstances, extreme care must be exercised when connecting to the present system. Foreign materials of whatever nature, must not be permitted to enter the system. All direct connection fittings and valves shall be thoroughly rinsed or washed with a chlorine solution just prior to installation and connection. The chlorine solution to be used shall be mixed as stated in the following Section of the specifications.

If at all possible hot taps should be used to prevent system shut down.

Tapping sleeves for water lines shall be Smith-Blair Model 665, with stainless steel full circumference band and stainless steel flanged outlet as manufactured by the Smith-Blair Company or approved equal.

Tapping valves for water lines shall be Mueller flanged to mechanical joint Model T-2360-16, non-rising stem, resilient wedge seat, tapping valves or approved equal. Each valve shall include the required Mueller transition glands (A-3999). Said valves shall be of the size required in the approved plans. All valves shall be manufactured in accordance with AWWA Standards C-515.

Hot taps will require the new branch line be of smaller diameter than the main being tapped. Like size on like size hot taps will not be allowed.

The Contractor shall notify the District when system shutdown is required so that proper notification to those affected by the shutdown can be provided. Where system segment shutdown is required, the actual shutdown is not to be done until all connection materials, equipment, and personnel are at the site, and the existing system point of connection has been exposed, thoroughly cleaned, and prepared for immediate installation of the connection materials. All personnel shall be thoroughly instructed as to the procedure to be followed and ready for work. All connections are then to be made in an efficient manner requiring the least amount of time and maximum amount of care.

ARTICLE 9 – ROAD CROSSING MATERIALS

State highway and permanent surfaced County road crossings shall be made in strict accordance with the State and County Highway Department rules and regulations. The required excavation permit shall be provided and displayed for each location. At a minimum, materials to be used for all crossings shall meet the following requirements.

9.1 Water Main: Pipe used for this purpose shall be as previously specified in this Section of these specifications. Fittings for use in the right-of-ways shall be of the joint type as shown and as detailed on the plans. All fittings shall meet the requirements as previously stated in this Section of these specifications.

9.2 Pipe Encasement: All water main for use at the crossing locations shall be placed in or through an encasement tube consisting of over-sized steel pipe. New encasement tube inside diameter shall be eight (8) inches larger than the inside diameter of the water main to be placed through the encasement tube. Materials to be used for this purpose shall consist of new steel pipe in not less than ten (10) foot lengths. The materials used for the encasement tube construction shall have a minimum yield strength of 35,000 psi and a minimum tensile strength of 60,000 psi, per A.S.T.M. A139-Grade B. All joint ends shall be cut at 90 degrees to the longitudinal axis of the pipe. Each end shall be beveled and joints shall be butt welded around the entire perimeter of the pipe. The encasement tube shall have a minimum wall thickness of 0.250 inches.

Encasement spacers shall be used between the water main and the encasement tube in accordance with applicable sections of these specifications.

All encasement tube installation shall be in accordance with applicable Articles of these specifications. Concrete for thrust blocking where required, shall be in accordance with applicable Articles of these specifications.

9.3 Encasement Spacers: Casing spacers shall be projection type, totally non-metallic, constructed of preformed sections of high-density polyethylene. Spacers shall be ISO 9002 certified for strength and quality, and spaced along carrier pipe as shown in the approved plans. Spacers shall be manufactured by RACI, or approved equal.

ARTICLE 10 – FIRE HYDRANTS

Fire and flush hydrants permitted for use on all water system mains shall be the Mueller "Centurion" Model or approved equal unless otherwise specified on drawings. Each hydrant shall be of the traffic model type and manufactured to withstand a working pressure of 150 psi. in full compliance with the A.W.W.A. standard specifications C-502 or the latest revision. Two-way hydrants shall have two (2) hose nozzle connections. Three-way hydrants shall have two (2) hose connections and one (1) pumper nozzle; and shall only be used where specified on the plans. Three-way hydrants, where permitted, shall be the Mueller Model A-423 or approved equal. All hydrants shall have 5 ¼-inch valve openings for mechanical joint connection to minimum six (6) inch water main unless otherwise noted. All hydrants shall be "red" in color.

10.1 Auxiliary Valves: Fire hydrants are to be installed with auxiliary valves. Valves to be used for this purpose shall meet the requirements as stated in these specifications, and shall be sized as detailed on the approved plans. If the auxiliary valve is not directly connected to the main tee branch and hydrant, anchor couplings shall be used to secure the connection. Each valve shall be furnished with a valve box, lid and all joint accessories as required.

10.2 Blow-Off Hydrants: Blow-off hydrants shall be two (2) inch post type flushing hydrants. The hydrant shall be Eclipse No. 2 as manufactured by Kupferle Foundry, or Model A-411 as manufactured by the Mueller Company, with a two (2) inch mechanical joint inlet and a single, two and one half (2 ½) inch threaded outlet nozzle. Hydrant shall incorporate a dry barrel design to prevent freezing, and shall be "red" in color.

All fire hydrants, auxiliary valves and blow-off hydrants shall be furnished and installed in accordance with the plan details, the detail notations, and applicable Articles of these specifications.

ARTICLE 11 – POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE

This Article covers materials for polyethylene encasement to be applied to underground installations of ductile iron pipe, fittings, valves, and other appurtenances.

Polyethylene film shall be manufactured of virgin polyethylene material conforming to the following requirements of A.S.T.M. Standard Specifications D-1248-78 for Polyethylene Plastics Molding and Extrusion Materials:

11.1 Raw material used to manufacture polyethylene film:

Type: 1
Class: A (natural) or B (black)
Grade: E-1
Flow rate: 0.4 maximum
Dielectric strength: Volume resistivity, minimum ohm-cm^3=10^{15}

11.2 Polyethylene film:
Tensile strength: 1200 psi (8.3 Mpa) minimum
Elongation: 300 percent minimum
Dielectric strength: 800 V/mil. (31.5 um) thickness minimum

11.3 Thickness:
Polyethylene film shall have a minimum thickness of 0.008-in. (8 mil. or 200 um). The minus tolerance on thickness shall not exceed 10 percent of the nominal thickness.

11.4: Tube size or sheet width:
Tube size or sheet width for each pipe diameter shall be as listed below.

Nominal Pipe Diameter (in.)	Minimum Polyethylene Width in. (cm) Flat Tube	Sheet
4	16 (41)	32 (82)
6	20 (51)	40 (102)
8	24 (61)	48 (122)
10	27 (69)	54 (137)
12	30 (76)	60 (152)
14	34 (86)	68 (172)
16	37 (94)	74 (188)
24	41 (104)	82 (208)

ARTICLE 12 – ¾-INCH AND 1-INCH RESIDENTIAL SERVICES

12.1 Service Saddles:
- Ford S70-XXX, sized for appropriate service.
- Mueller H-13XXX, sized for appropriate service.

12.2 Corp Stops:
- Ford F1000-X, sized for appropriate service.
- Mueller B-25008, sized for appropriate service.

12.3 Service Lines:
- Type K copper
- HDPE CTS SDR 9, 200psi
- Stiffeners for HDPE shall be Ford Series 50

12.4 Curb Stop/Box:
- Curb Stop: Ford Minneapolis pattern valve, B44-XXX-GSWM, sized for appropriate service.
- Curb Box: Ford EM2-XX-46

12.5 Meter Setter:
- Ford VBH72-12W-XX-XX, sized for appropriate service.

12.6 Meter Pit:
- 20” Diameter, 30” Tall, PVC, Old Castle Model 0020B

12.7 Pit Frame/Cover:
- 20” Diameter frame and cover with touch read

12.8 The District will provide the meters.

12.9 Locate wire, meeting these specifications, shall be installed with HDPE service lines, running from the main to the inside of the meter pit, and terminating just below the pit lid.

SECTION 2 – WATER DISTRIBUTION SYSTEM INSTALLATION

ARTICLE 1 - GENERAL

The work covered by this Section of the specifications, shall consist of furnishing all previously specified materials with all necessary equipment, machinery, tools, and labor, and performing all work required to install and/or construct the water system extensions or changes with all connections and appurtenances as required; in accordance with all directives or modifications and these specifications, all to be complete, in place, accepted and ready for use.

ARTICLE 2 – SITE AND WORK PREPARATION

Prior to starting the various water main route installations, connections, and/or changes as required, the Contractor shall notify the District a minimum of twenty-four (24) hours prior to the start of construction. After so doing, the Contractor shall clear the route of all trees, shrubs, and other objects or materials, which may directly interfere with the construction. All other utility companies or organizations shall be notified for location of their respective facilities prior to starting any work. All trees, shrubs, bushes, etc., which will not interfere with the construction shall be protected from damage. Work preparations shall include having all necessary material items, equipment, and an adequate labor force at the site in working condition, and completely instructed and prepared to perform the work to completion as required.

ARTICLE 3 - DRAINAGE

The Contractor shall control the grading in the vicinity of the pipe trenches so that the surface of the ground will be properly sloped to prevent water from running into the excavated areas. Any water or other liquid wastes which accumulate in the excavated areas shall be promptly removed.

ARTICLE 4 – TRENCH EXCAVATION

4.1: General: The Contractor shall perform all excavation necessary for or incidental to the proper installation and construction of the work shown and detailed on the drawings, or as described by the District. No trench shall be backfilled or mains concealed prior to inspection by the District or the District's Representative. Mains concealed prior to inspection shall be excavated and exposed at the Contractor's expense. Excavation shall include the removal of trees, shrubs, paving, and undesirable materials. Excavation shall be done along the lines as indicated on the plans and shall be continuous without improper bends, kinks or flexing of the pipe. Trenches shall be of sufficient width to provide a working space on each side of the materials being installed. During excavation, materials to be used for backfill shall be stock piled, in an orderly manner, a sufficient distance from the edge of the excavation to avoid overloading which might cause slides or cave-ins, and in such manner so as not to interfere with public travel whenever possible. The Contractor shall provide all barricades, lights, temporary crossing, warning signs, etc., that may be necessary to protect the public and the work from injury or damage.

4.2 Depth: Trenches for water main and appurtenances shall be excavated to a sufficient depth to obtain a minimum of forty-two (42) inches of cover over the top of the pipe, except as otherwise required to make taps and connections to existing mains. The bottom of trenches shall be free from rocks, clods, debris, and all other unsuitable materials, and shall consist of properly shaped earth. The Contractor shall take care not to excavate below grade except to remove undesirable material, or as directed by the District.

4.3 Pipe Bedding and Encapsulation: All trench installed mains shall have granular material placed to depth four (4) inches below the pipe bottom to six (6) inches above the top of pipe. All granular bedding shall be placed so as to provide a continuous bearing for the barrel of the pipe. Holes of sufficient size shall be excavated to permit ample room for making joints. Granular material shall be per previous sections of these specifications. Granular material shall be compacted to prevent settlement and as required by the project specifications.

4.4 Rock Excavation: Where rock is encountered in the trenching operation, the excavation shall be carried to a depth of four (4) inches below the pipe bottom depth assuming proper cover as specified under the preceding paragraph. Solid rock is defined as any material which cannot be removed by an excavator with an operating weight of at least 52,600 pounds and a flywheel horsepower of at least 153 horsepower. Where solid rock is encountered and it is necessary to drill and blast same, the Contractor shall provide all suitable equipment and personnel for carrying out the operation in a safe and sensible manner. The Contractor shall have Insurance that includes specific coverage for this and directly or indirectly related items.

When solid rock is encountered, the Contractor shall not refill any trench until told to do so by the District. Excess materials resulting from the rock excavations shall be spread over or adjacent to the trench area where acceptable, or shall be picked up and removed from the site for disposal at a suitable location. It may also be necessary to place a thin layer of earth over the rock backfill areas. This may be hauled in from a stockpile location. This earth layer must be of sufficient depth to support the growth of vegetation. All loose rock and debris shall be thoroughly cleaned up and disposed of. The excavated areas shall be left in a neat, clean, acceptable condition.

ARTICLE 5 – HANDLING OF MATERIALS

All pipe, fittings, valves, and other accessories, shall be unloaded, stored re-handled, and installed by methods in such a manner as to insure their final location in a sound and undamaged condition, conforming in all respects to specified requirements. Under no circumstances shall pipe, fittings, valves, or other accessories, be dropped to the ground, or otherwise subjected to possible damage from impact or shock. Such materials shall be loaded by lifting with machine or hoist, or by skidding, Pipe handled on skidways shall not be skidded or rolled against other pipe.

Under all circumstances, all materials for use shall be handled in a workman-like manner, using the necessary manpower and equipment to perform the task in accordance with the manufacturer's recommendations.

5:1 Protection of Materials, Coatings, and/or Linings: All materials shall be handled in such manner that neither the coatings or the linings are damaged. Hooks for insertion into the ends of the pipes, fittings, valves, and other accessories, shall have broad, well-padded contact surfaces, and shall be of such design and size that uniform support will be provided. Under most circumstances, damage to outside coatings are repairable, and the necessary repairs shall be properly made prior to installation. Damage to interior linings is not considered repairable, and therefore, the damaged items shall be replaced at the Contractor's expense.

5:2: Handling Materials Into Trench: Proper equipment, tools, facilities, and methods satisfactory to the District, shall be provided and used by the Contractor for the safe handling, of all materials. Fittings, valves, and other accessories shall be carefully lowered into the trench or excavation, piece by piece to protect coatings and linings. Under no circumstances shall any materials be dropped or dumped into the trench.

ARTICLE 6 – PIPE LAYING

Laying of the pipe shall commence immediately after the excavation is started, and the Contractor shall use every possible means to keep the completed pipe installation closely behind the trenching. The District may stop the trenching if it appears that the trench is open too far in advance of the pipe laying operation. The Contractor may lay pipe in thebest manner adapted to securing speed and good results.

6:1 Pipe Joints: The Contractor shall have the necessary equipment and tools available for making the joints for the specific materials being used. In accordance with applicable items under the previous Section of these specifications, acceptable joints for the various pipeline and fitting materials are listed as follows:

Cast or Ductile Iron Pipe: Ring or fluid-tite joint with mechanical joint for fittings, valves, and adapters.

P.V.C. Pipe: Ring-tite joint with necessary transition gaskets for connection to mechanical joint fittings, valves, and adapters.

A. Pipe Joint Adapters: The Contractor shall provide the necessary adapters for all connection changes from ring-tite, slip, or mechanical joint to flanged joint as and where required.

All pipe spigot ends shall be visibly marked to fully “make-up” the joint. With exception of field cut pipe, all “make-up” marks shall be placed on the pipe at the factory. Field cut pipe shall be marked for full joint depth prior to insertion.

6:2: Pipe Cutting: Cutting of pipe for closure pieces with installation of valves or fittings, or for any other reason, shall be done in a neat and workman-like manner without damage to the pipe or linings. The cutting operation shall leave a smooth cut end at right angles to the longitudinal axis of the pipe. The exterior surface of the cut end shall be beveled, and the interior surface shall be reamed or filed free of all rough edges and protrusions. All pipe cutting shall be done by saw or mechanical pipe cutters of an approved type. Upon completion of the cutting and trimming operation, the pipe end or ends shall be marked for “make-up” depth. Prior to insertion, the pipe shall be thoroughly cleaned of all foreign materials, including filing and cutting debris.

6:3: Pipe Alignment: Pipelines intended to be straight shall be laid straight. Deflections from a straight line shall not exceed the manufacturer’s recommendations for joint deflections. Pipe shall be deflected at the joints only. Pipe barrel shall not be deflected. Should the planned or specified alignment require deflections in excess of the maximum recommended for the type of pipe being installed, when using a standard pipe length within the limits of available space, then either shorter pipe sections, or additional bends shall be installed. Under no circumstances shall PVC pipe be deflected except at the joint. PVC pipe shall not be placed under strain.

6:4: Thrust Blocking: All mechanical or push-on (ring-tite) joint water main and connection installations, shall be thrust blocked for all bends of 22 ½ degree or more. All bends, tees, crosses, valves, tapping sleeve, and fire hydrant locations shall be thrust blocked in accordance with District requirements. Bearing areas are determined on the basis of bearing against solid undisturbed earth. Concrete to be used for this purpose shall be designed for compressive strength as described in the previous Section of these specifications. All joint and fitting bolts shall remain accessible. Forming for thrust blocks to obtain the necessary bearing area shall be provided as required. All accessible form materials shall be removed from the trench prior to backfill.

6:5: Existing Utilities: Existing utilities shall be protected during the construction period. Where necessary, the existing utility shall be removed or temporarily relocated, and replaced upon completion of that phase of the work creating this requirement. Under all circumstances, the utility involved and the parties being affected by the disrupted service shall be notified in advance of the proposed operation. All changes and work shall be subject to the approval and acceptance of the utility involved and the District.

6:6: Quality: Damaged or unsound pipe, fittings, and accessories of whatever nature shall be rejected and removed from the work. All joints shall be made as previously specified. Each piece of pipe and all fittings, valves, etc., shall be checked and cleared of debris prior to being put in place. All gaskets shall be checked and cleaned of oil, grease, dirt, etc., before being inserted. All bolted joints shall be rechecked for operation and bolt tightness prior to installation. All open ends of pipe, fittings, etc., shall be carefully plugged or

sealed at the end of each days work to prevent entrance of animals, water, and other foreign matter. All excavation shall be made to neat line and grade.

All personnel involved in any way with the work must be made aware of the fact that the work shall result in a first-class, professional job.

ARTICLE 7 – POLYETHYLENE ENCASEMENT INSTALLATION

The Contractor shall furnish all materials and install the polyethylene encasement as specified in the previous of Section of these specifications. The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

This Article includes three different methods of installation of polyethylene encasement on pipe. Methods A and B are for use with polyethylene tubes and method C is for use with polyethylene sheets.

7.1 Method A – One length of polyethylene tube for each length of pipe: The Contractor shall cut the polyethylene tube to a length of approximately two (2) foot longer than that of the pipe section. The tube shall then be placed around the pipe, centered to provide one (1) foot of overlap on each adjacent pipe section, and bunched accordion-fashion lengthwise until it clears the pipe ends.

The pipe shall be lowered into the trench and the joint made up with the preceding section of pipe. A shallow bell hole shall be made at joints to facilitate installation of the polyethylene tube.

After assembling the pipe joint, the bunched polyethylene shall be pulled from the preceding length of pipe, slipped over the end of the new length of pipe, and secured in place. The end of the polyethylene from the new pipe section shall be placed over the end of the first wrap until it overlaps the joint at the preceding length of pipe. The overlap shall next be secured in place by taking up slack width to make a snug, but not tight, fit along the barrel of the pipe and securing the fold at quarter points.

All rips, punctures, or other damage to the polyethylene shall be repaired with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured in place. Proceed with installation of the next section of pipe in the same manner.

7.2: Method B – Separate pieces of polyethylene tube for barrel of pipe and for joints: The Contractor shall cut the polyethylene tube to a length of approximately one (1) foot longer than that of the pipe, centered to provide six (6) inches of bare pipe at each end. Make polyethylene snug, but not tight; secure ends as described for Method A.

Prior to making up a joint, a three (3) foot length of polyethylene tube shall be placed over the end of the preceding pipe section, bunched accordion-fashion lengthwise. After completion of the joint, the three (3) foot length of polyethylene shall be pulled over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least one (1) foot, made snug and secure at each end as described for Method A.

All rips, punctures, or other damage to the polyethylene shall be repaired as described in Method A. Proceed with installation of the next section of pipe in the same manner.

7.3 Method C – Flat polyethylene sheet encasement: Contractor shall cut polyethylene sheet to a length of approximately two (2) foot longer than that of the pipe section. The cut length shall be centered to provide a one (1) foot overlap on each adjacent pipe section, bunching it until it clears the pipe ends. The polyethylene shall be wrapped around the pipe so that it circumferentially overlaps the top quadrant of the pipe. The cut edge of the polyethylene shall be secured at intervals of approximately three (3) foot.

The wrapped pipe shall be placed into the trench and the pipe joint made up with the preceding section of pipe. A shallow bell hole shall be made at the joints to facilitate installation of the polyethylene. After completion of the joint, the overlap shall be described for Method A.

All rips, punctures, or other damage to the polyethylene shall be repaired as described for Method A. Proceed with installation of the next section of pipe in the same manner.

Bends, reducers, offsets, and other pipe-shaped appurtenances shall be covered with polyethylene in the same manner as the pipe. When valves, tees, crosses, and other odd-shaped pieces cannot be wrapped

practically in a tube, they shall be wrapped with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bring it up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Width and overlaps at joints shall be handled as described for Method A. Polyethylene shall be taped securely in place at valve stem and other penetrations,

Where encountered, the Contractor shall provide openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, the slack shall be securely taped at the appurtenance and the cut repaired, as well as any other damaged areas in the polyethylene, with tape.

Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, the Contractor shall extend the polyethylene wrap to cover the adjacent pipe for a distance of at least two (2) foot. The end shall be secured with circumferential turns of tape.

The Contractor shall use the same backfill material as that specified for pipe without polyethylene wrapping, exercising care to prevent damage to the polyethylene wrapping when replacing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other materials that could damage the polyethylene.

ARTICLE 8 – WATER MAIN TRACER TAPE INSTALLATION

The Contractor shall furnish all materials and install the water main tracer tape as specified in the previous Section of these specifications. The three (3) inch wide detectable tape shall be installed directly above the water main locations as the trench backfill progresses, to permit an earth cover of 12 to 18 inches over the tape. The tape material shall be installed in accordance with the manufacturer's recommendations. The tape is to be placed in a manner such that trench backfill settlement will not place an excessive tensile stress on the material.

ARTICLE 9 – WATER MAIN LOCATOR WIRE INSTALLATION

The Contractor shall furnish all materials and install the water main and service locator wire as specified under the previous Section of these specifications. The No. 12 insulated wire shall be placed on top of the water main and secured with tape at 8 foot intervals. The wire shall be brought up along the outside of a valve box and brought through a hole drilled in the side of the box, 6- inches below finish grade. The wire shall be spliced at these locations using a standard plastic or rubberized wire connector. This will permit placing a power source on the wire for both directions in order to use same for locating the water main. Underground splices are not allowed. The wire shall be laid slack in the trench so same will not be subject tensile stress as the trench is being backfilled. A sufficient length of wire shall be coiled in meter pit to bring wire to grade.

Prior to final acceptance by Owner, Contractor shall demonstrate that the locator wire works to the satisfaction of the Owner and/orhis representative.

ARTICLE 10 – VALVE INSTALLATION

Prior to installation, all valves shall be checked for bolt tightness and operation. All foreign matter, dirt, and debris, shall be removed form inside the valve body. The valve gate and guide shall be cleaned free of grease and dirt. After thoroughly cleaning and checking the valve for operation, the valve gate shall be closed, and the valve shall be installed in place. Following placement and connection to both sides of the valve, excavation for the valve bearing thrust block shall be made. The thrust block shall then be poured of concrete, in accordance with the previous Section of these specifications. The valve holding clamps, No. 4 reinforcing bars, shall then be placed over the valve with embedment in the concrete thrust block.

Following initial set of the concrete, the valve box and valve box alignment device as specified under the previous Section of these specifications shall be place over the valve body. The valve box shall be set plumb and earth shall be thoroughly tamped around the box to maintain the plumb position. The top of the valve box shall be adjusted for height to the level of the adjacent pavement if in a paved area, or shall be adjusted to stand four (4) inches above ground level, if located in an unpaved area. The lid or cover shall then be placed on the valve box. The valve box may require vertical adjustment from time to time as trench settling occurs. It is intended that upon final project completion, all valve boxes shall be left ina vertical plumb, usable position.

ARTICLE 11 – WORK ADJACENT TO-AND/OR CROSSING STATE OR COUNTY HIGHWAYS

11.1 : General: All work to be performed within the right-of-way limits of the State and/or County Highways shall be performed in strict accordance with the respective Highway Department requirements. The Contractor shall obtain the necessary permits for all work prior to starting any construction. All permits must be displayed as required. The Contractor shall comply with all requirements such as; signals, flagmen, and watchmen; performance of work in such a manner so as not to interfere with traffic, highway entrances, highway maintenance, highway drainage, etc., and methods of placing materials, backfill compaction, and all such other requirements, which may differ from or may be in addition to those specified for work other than that within the highway right-of-way limits.

11:2 Highway Crossings: Highway crossings shall be constructed in accordance with all permit requirements. The Contractor will be held responsible for any and all expense incurred by the Highway Department in protecting the highway while construction is in progress, or as a result of said construction. The Contractor will also be held responsible for all damages to the highway due to operations during construction of the crossings including replacement of damaged pavement. Encasement shall extend from ditch line to ditch line, toe of slope to toe of slope.

A. Boring and Jacking: The crossing shall be machine bored with simultaneous installation of the encasement. Boring without the concurrent installation of the encasement tube will not be permitted. All joints of the encasement tube shall be welded as specified and the encasement tube shall extend to the required dimensions.

B. Open Trench Encasement: Water main encasement may be place in open trench where allowed or permitted. Encasement shall be installed to grade as shown on the plan profile sections. It is recommended that the cut installation be coordinated with the road construction to rough sub-grade. The entire encasement length shall be excavated to subgrade. The encasement pipe shall then be placed over 4 to 6 inches of crushed stone. Following placement, the entire trench shall be backfilled with minus crushed stone compacted in 6 to 8 inch lifts to the road sub-grade level or to the top of the trench.

C. Backfill: Following completion of the machine bored crossing, all bore pit or other required excavation shall be suitably backfilled to grade. All debris, of whatever nature, shall be picked up and removed from the site. After clean-up, the disturbed area shall be smooth to grade, seeded, and covered with straw. The entire work area shall be left in an orderly and acceptable condition.

ARTICLE 12 – TESTING WATER LINES

All newly laid water lines shall be tested prior to flushing and sterilization. Trenches may be backfilled as the pipe and accessories are installed, or where practicable and at the option of the Contractor. Trenches over the joint locations may be left open for visual inspection during tests. Prior to making tests, all air shall be expelled from thelines. If hydrants or blow-offs are not available, suitable taps shall be provided by the Contractor for this purpose at or near the end points of the installation.

12.1 Hydrostatic Tests: A two (2) hour test shall be made on each segment of the water lines between end points at a test pressure of at least 50% in excess of normal maximum operating pressure, not to exceed 200 psi. The test pressure shall be determined by the District and suitable gauges for checking same shall be supplied and connected by the Contractor. A gate valve or pressure relief valves shall be supplied and connected by the Contractor. A gate valve or pressure relief fitting shall be placed at each end of the segment being tested unless otherwise directed. Allowable pressure drop during the two (2) hour test shall be limited to 3%of the test pressure.

Any leaks evident at the surface shall be uncovered, repaired, and/or replaced. All leaking joints shall be tightened, or remade, or replaced, and re-tested. All pipe, fittings, valves, or other accessories found defective under this test shall be removed and replaced at the Contractors expense.

12.2 Leakage Test: In the event that the pressure test indicates leakage, a leakage test shall be conducted as follows:

The Contractor shall furnish the gauge and measuring device for the leakage test, as well as the pump, pipe, connections and all other necessary apparatus, and shall furnish all necessary labor to conduct the test. The duration of each leakage test shall be one hour, and during the test, the piping shall be subjected to a hydrostatic pressure of 1.5 times the working pressure or rated pressure of the pipe, whichever of is greater. No pipe installation will be accepted until the leakage is less than ten (10) gallons per mile of pipe per inch diameter per 24 hours. Should any tests of pipe laid disclose leakage greater than that specified, the

Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

ARTICLE 13 – FLUSHING AND STERILIZING WATER LINES

After an acceptable hydrostatic test, the lines shall again be flushed. After flushing the lines, the pressure valves shall be closed, and enough water drained from segment to permit replacement of a chlorine solution. The chlorine solution shall consist of a powdered chlorine compound such as H.T.H. (calcium hypochlorite 65% available chlorine) thoroughly mixed with water. The chlorine solution shall be poured into the upstream test connection point. The amount of the chlorine compound to be used shall be determined by the District if the Contractor so desires. The chlorine solution shall yield 50 p.p.m. available chlorine. After pumping the required amount of solution into the water line segment with a positive displacement type pump, the connection shall be plugged, and the pressure valve opened. Water shall be flushed through the line until chlorine odor is detected at the opposite end of the installation. At this time, the pressure valve shall be closed and the segment shall be allowed to stand for a period of 24 hours.

Following the 24 hour period, a chlorine residual level of a minimum of 10 p.p.m. must remain in the segment. If an acceptable residual level is determined, the pressure valve shall again be opened and the segment flushed until all traces of chlorine over and above normal line levels have been eliminated.
Should a leak occur during the sterilization procedure, it will be repaired and the sterilization and flushing will be repeated.

Upon successful completion of the testing and sterilization of each water main segment, and prior to placing same in service, the Contractor shall collect and submit two (2) separate standard bacteriological samples, taken a minimum of 24 hours apart, for analysis to a State of Missouri certified laboratory. Upon receipt of satisfactory test results, the water main segment may be placed in permanent service.

ARTICLE 14 – TRENCH BACKFILL

After placing the piping in the trench on top of (4) inches of granular bedding, the Contractor shall backfill around the pipe simultaneously filling and tamping on both sides with sufficient granular material to firmly hold the pipe in position. Extreme care must be exercised with the backfill operations to ensure that no sizable stones or rocks come into contact with the pipe surfaces. After carefully placing and tamping the granular backfill in place to at least six (6) inches over the top of the pipe barrel, the remaining approved trench spoils may be pushed into the trench. No boulders, broken pavement, or large pieces of blasted rock shall be used in the trench backfill. Any trench improperly bedded or backfilled shall be excavated, examined, and replaced at the Contractor's expense. All non-usable materials shall be picked up and removed from the site to an acceptable disposal location. Upon completion of the initial backfill, the backfill surface shall be neatly mounded to allow for settlement. As the work progresses and settlement occurs, the trenching surface shall continue to be graded and shaped so as to secure a final condition where no further settlement shall occur.

In areas where pavement or permanent surfacing is removed and is to be replaced, the entire backfill shall be made using minus crushed stone in accordance with the previous Section of these specifications. Same shall be placed in six (6) inch layers and compacted to maximum density.

Initial clean-up, in accordance with this Section of these specifications shall occur as the trench backfill operation proceeds. Before final acceptance of the work is made, the Contractor shall travel the lines with the District, and any settlement or unsightly areas shall be repaired or corrected as directed. Upon acceptance, the Contractor shall proceed with the final clean-up, grading, and seeding operation, in accordance with this Section of these specifications.

ARTICLE 15 – FIRE HYDRANT AND AUXILIARY VALVE INSTALLATION

The fire hydrants, valves, and all connection items shall be furnished and installed by the Contractor. All materials used for this purpose shall be as specified under the previous Section of these specifications. The installation shall include all; excavation as required, installation of the water main tee fitting, auxiliary valve, connection pipe, hydrant, gravel fill, thrust or kick block, backfill, and surface replacement as required. The fire hydrants shall be installed to the proper "bury" depth, to stand in an exactly "plumb" position. Hydrant extension pieces may be used to adjust to proper grade as required. Clean gravel fill as specified and detailed, shall be placed to the proper depth and dimension to provide the necessary "weep" volume for water contained in the hydrant thrust or kick block, to assure that cement paste does not plug or block the hydrant weep hole or the gravel fill under and around the weep hole.

The earth backfill shall be hand tamped around the hydrant base and barrel to assure the plumb position. The hydrants may be braced or wired in place until sufficient settlement has occurred to retain the plumb position. Upon completion, all bracing and debris shall be removed from the site. Each site shall then be thoroughly cleaned-up and restored equal to or better than its original condition. All installation sites shall be left in a neat, clean, acceptable

condition.

ARTICLE 16 – SURFACE WATER CROSSINGS

16.1 Above-water crossings. The pipe shall be adequately supported and anchored, protected from damage and freezing and accessible for repair or replacement.

16.2 Water crossings.

a. Flowing streams.

A minimum cover of four feet shall be provided over the pipe. When crossing water courses are greater than 15 feet in width, the following shall be provided.

1. The pipe shall be of special construction, having flexible watertight joints. Steel or ductile iron ball-joint river pipe shall be used for open cut crossings. Restrained joint pipe may be used for open cut crossings, provided it is encased in a welded steel casing. Restrained joint or fusion weld pipe shall be used for bored crossings.
2. Valves shall be provide at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and should not be subject to flooding; and the valve closest to the supply source shall be in an accessible location.
3. Permanent taps shall be provided on each side of the valve within the manhole to allow insertion of a small meter to determine leakage and for sampling purposes.
4. The stream crossing pipe or casing shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

b. Intermittent flowing streams.

1. Restrained joint pipe shall be used for all stream crossings;
2. The pipe shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

ARTICLE 17 – SEPARATION OF WATER MAINS, SANITARY SEWERS AND COMBINED SEWERS

17.1 Parallel installation (Horizontal Separation): Water mains shall be laid at least ten feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and in either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing.

17.2 Crossings (Vertical Separation): Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than then feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing.

17.3 Force mains: There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the waterline or the sewer line shall be cased in a continuous casing.

17.4 Sewer manholes: No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.

17.5 Disposal facilities: No waterline shall be located closer than 25 feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.

ARTICLE 18 – INITIAL CLEAN UP, GRADING, AND REPLACEMENT

The Contractor shall provide the necessary labor and equipment to permit initial clean-up as the water main is being installed. Immediately following trench backfill, all areas disturbed by excavation shall be graded to conform to the adjacent ground levels. Earth shall be neatly mounded over the trench location. All debris, of whatever nature, due to the water main and service installation, shall be picked up and disposed of. All walks, driveways, roads, streets, etc., shall be replaced to original condition.

ARTICLE 19 – FINAL CLEAN-UP, FINISH GRADING, SEEDING AND STRAW

Following completion of the various routes and initial trench settlement, the Contractor shall go over the routes and clean-up all remaining debris. Following completion of the final clean-up, all areas in any way disturbed by the installation, shall be graded to conform to the adjacent ground areas. After final grading, the graded areas shall be sodded or seeded and covered with straw. In areas of rock excavation, it may be necessary to place a four-inch layer of earth over the exposed areas to form a seed bed for vegetation. The earth shall be applied as part of the final grading operation.

Upon completion of the final grading and seeding, the Contractor shall locate and paint the tops of all valve boxes the color “blue”, and other accessories having covers, so that they are plainly visible for use.

All service boxes for valves, future connection items, etc., be firmly in placed in a plumb position, ready and usable for the intended service. Following final completion of all items, the Contractor and District shall again go over the various routes to determine final acceptance.

ARTICLE 20 - GUARANTEE

The Contractor shall guarantee all materials and workmanship in any way involved with this project for a period of one year from the date of final acceptance. Date of final acceptance is hereby defined as the date on which the Board of Directors accepts the new water mains.

END OF SECTION