

Special Specification 7244

Water Mains



1. DESCRIPTION

Furnish labor, materials, and equipment necessary to provide a complete water main system in conformance with the plans and specifications, and in compliance with the City of Colleyville. Construct water mains of the sizes, materials, and dimensions shown on the plans including pipe, joints, and connections to new and existing pipes, casing, valves, fittings, fire hydrants, meters, blocking, etc., as many as may be required to complete the work.

The abbreviations AWWA, ASTM, ANSI, AASHTO, ACI, and NSF used in this specification refer to the following organizations or technical societies:

- AWWA American Water Works Association
- ASTM American Society for Testing and Materials
- ANSI American National Standards Institute
- AASHTO American Association of State Highway and Transportation Officials
- ACI American Concrete Institute
- NSF National Sanitation Foundations

References to specifications of the above organizations mean the latest standard or tentative standard in effect on the date of the proposal.

The size and location of utility lines shown on the plans were obtained from field surveys and from the various utility companies. The Department does not assume responsibility for the accuracy of the information presented, nor does it warrant that every utility line is shown.

2. MATERIALS

- 2.1. **General.** Provide new and unused materials for this project unless otherwise stated on the plans or proposal. The type of pipe to be supplied shall be as shown on the plans and/or in the special provisions for each project.

If requested by the City, the manufacturer shall submit a successful experience record in the design and construction of the type of concrete pressure pipe involved. Each type of pipe shall have the complete approval of the Underwriters' Laboratories, Inc., for the manufacture of the pipe specified and diameters up to 96 inches. Pipe shall have NSF standard approval.

The pipe manufacturer shall furnish a factory trained, job experienced field representative who shall visit the project at least weekly during the course of installation and be present at the unloading of the pipe at delivery to insure proper handling. They will also be subject to call by the Contractor or Owner to advise and assist with the solution of field problems.

The City shall at all times have free access to the manufacturer's plant while production is in progress. The City may at any time refuse to accept pipe made when the plant is failing to follow the stipulations of the specifications in regard to workmanship, or failing in provisions to insure a uniform product coming within the permissible variations of the specifications as to size, thickness, position of reinforcing steel, and curing of pipe. The interior pipe surface shall be relatively smooth and free from pits, etc. No pipe with cracks in either the exterior or interior mortar coatings will be acceptable unless such cracks are minor hairline cracks as defined by the manufacturer.

Where designated, joints shall be bonded using an approved electrical conducting material to

insure continuity between sections of pipe for the application of cathodic protection measures in accordance with the latest industry standards. Bonding straps shall be provided past in-line valves to assure electrical continuity.

Test stations shall be provided at the appropriate locations as indicated on the plans to insure proper bonding and effectiveness of cathodic protection measures.

No cracks will be permitted in the lining of the pipe except for minor hairline cracks. Cracks in the vicinity of the spigot of prestressed pipe and those cracks in the vicinity of circumferential wrappers and outlets shall not be allowed, unless after inspection it is determined that they do not interfere with the performance of the pipe and they are accepted by the manufacturer so as to not void the warranty.

The Contractor shall furnish the City shop drawings of the pipe and fittings to be furnished which shall include a tabulated layout schedule referenced to plan stationing and grade lines as shown on the project drawings.

Such drawings shall be subject to the review of the City. Fabrication of pipe and fittings shall not commence until such review has been completed by the City or its authorized representative or such has been waived in writing. Three (3) copies of the preliminary drawings shall be submitted for approval. Six (6) copies of the final drawings will be required.

Unless otherwise noted on the plans or in the special provisions, all concrete pressure pipe shall be designed for 150 psi working pressure.

Unless otherwise directed by the Engineer or required in the project specifications, design stresses shall conform to the requirements of AWWA C304 for prestressed pipe or the design appendix of AWWA Manual M9 for Bar-Wrapped Pipe.

Fittings and specials shall comply in all respects with the requirements of AWWA C301 or AWWA C303 or AWWA C304 as applicable for the type and class of pipe required by the plans and project specifications.

Flanged outlets shall be insulated at all points where external valves, pipe, fittings, etc., are connected to the line. The Contractor shall furnish an insulating flange kit, flange gaskets, insulating sleeves, and two (2) plastic washers for each bolt approved by the Owner or his/her representative.

Bolts, nuts, and washers for flanged outlet connections shall be carbon steel. After installation they shall be encased with mortar in a pipe diaper.

Where taps are threaded, a brass or bronze bushing shall be used between the steel coupling affixed to the pipe and the corporation stop or other outlet device. The steel coupling shall be completely embedded in the pipe wall and covered with the mortar coating of the pipe. Nylon and galvanized bushings are not acceptable.

Pipe for installation in tunnels or conduits shall have a minimum of two 24-inch wide mechanically impacted mortar bands one and one-half (1½) inches thick placed at approximately the third points of each pipe length. The exterior of the joint recess of tunnel pipe shall be filled with an approved flexible pre-formed joint sealer.

When requested, the manufacturer shall furnish an affidavit of compliance that all pipe and fittings comply with the applicable portions of the appropriate AWWA standard and that all tests required by the standard have been performed. Copies of the test reports required by Section 1.9 of either AWWA C301, AWWA C303, or AWWA C304 shall be made available to the City, upon request.

In addition, the City may, at its expense, retain the services of an independent testing laboratory to certify or monitor the testing performed by the manufacturer.

Pipe will be rejected for failure to meet any of the requirements of these specifications. Pipe delivered which does not comply with the requirements of Section B 2.3, and which has defects which cannot be repaired using normal acceptable methods shall be rejected and shall be immediately removed from the construction site.

2.2. **C 1.5 Concrete Pipe and Fittings**

This specification governs the manufacture of concrete pressure pipe for use primarily in water supply and distribution systems. Except as otherwise specified, the pipe and fittings shall be designed and manufactured in accordance with the following AWWA standards:

Standard Product

AWWA C301 "Manufacture of Prestressed Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids"

AWWA C303 "Concrete Pressure Pipe, Bar-Wrapped Steel Cylinder Type"

AWWA C304 "Design of Prestressed Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids"

Brief descriptions of the various types of concrete pressure pipe to be manufactured under this specification are as follows:

2.2.1. **Prestressed Concrete Lined Cylinder Pipe**

This pipe has a welded sheet-steel cylinder, manufactured by the spiral or straight seam method, with steel joint rings welded to its ends. A core is then constructed which consists of lining the cylinder with concrete, either poured or centrifugally cast within the steel cylinder. High tensile strength prestressing wire is then wound around the outside of the steel cylinder at a predetermined stress and securely fastened at both ends. The core and wire are then covered with a Portland cement mortar coating. Pipe joints are self-centering with a preformed rubber gasket designed so that the joint will be watertight under all normal service conditions.

This pipe is manufactured in accordance with AWWA C301. The minimum nominal joint length is sixteen (16') feet. Normally used sizes of this pipe are from sixteen-inch (16") to 60-inch diameter.

2.2.2. **Prestressed Concrete Embedded Cylinder Pipe**

This pipe consists of a welded sheet-steel or plate-steel cylinder manufactured by the spiral or straight seam method with the joint rings attached. A cement mortar lining is centrifugally cast inside the steel cylinder. A mild steel rod is spirally wrapped under measured tension on the steel cylinder, and a protective Portland Cement mortar concrete coating is applied to the outside of the cylinder and rod. This pipe is manufactured in accordance with AWWA C303. This pipe is normally furnished in joint lengths of 24 feet to 40 feet with shorter length specials. Normally used sizes of this pipe are from ten-inch (10") to 60-inch diameters.

2.3. **C 1.6 Asbestos-Cement Pressure Pipe**

THIS MATERIAL SHALL NOT BE USED FOR NEW WATER LINE CONSTRUCTION, BUT IS INCLUDED FOR GUIDANCE FOR REPAIR, MAINTENANCE AND CONNECTION TO EXISTING WATER LINES.

This specification governs the manufacture of asbestos-cement pressure pipe for water distribution systems. This pipe is composed of a mixture of Portland cement, silica, and asbestos fiber and is completely free of organic or metallic substances.

All asbestos-cement pipe and couplings shall comply with AWWA C400 and ASTM C269, Type II.

Standard pipe lengths shall be thirteen (13') feet. Up to ten (10%) percent of the total footage of any one size and class of pipe may be furnished in random lengths. The maximum outside diameters for the various

sizes shall be limited to the following: 6"-7.60", 8"-9.62", 10"-12.12", and 12"-14.38".

To facilitate spotting of valves and fittings, short lengths may be furnished either machined overall (MOA) or machined each end (MEE). For ease of installation, the MOA may be made of PVC manufactured to the dimension of asbestos-cement pipe in the same pressure class as the pipe being furnished.

Pipe six (6") inches in diameter shall be Class 200. Pipe eight (8") inches and larger in diameter shall be Class 150.

Couplings shall be of the sleeve type suitable for use with a rubber or rubber-type sealing gasket. The gaskets shall be furnished with each coupling and shall be the Nonoil Resistant type as set forth in ASTM D 1869, "Rubber Rings for Asbestos-Cement Pipe". Fittings will be ductile iron and shall be cement mortar lined inside with seal coat in accordance with ANSI A21.4 (AWWA C104). The outside coating will be in accordance with ANSI A21.6 (AWWA C106).

Fittings shall be either mechanical joint or push-on joint in accordance with Section C 1.19. Asbestos-cement to ductile iron or P.V.C. adapters will be used where required. Bolts for flange connections shall be Type 304 stainless steel with nylon coated nuts and washers or silicon bronze nuts and washers.

Asbestos-cement water pipe shall be approved by the Underwriter's Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems in cities and towns of Texas.

Asbestos-cement water pipe shall also bear the seal of approval ("NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.

All service connections through two (2") inches shall be made using a factory made heavy tapped coupling with brass bushing which is threaded into the fitting body in combination with an epoxy seal. The outlets shall be AWWA taper thread for 3/4-inch and one-inch (1"). For two-inch (2") taps, iron pipe threads (I.P.T.) shall be used. For service taps made at locations other than tapped couplings, a service clamp conforming to the requirements set forth in Section C 1.17 shall be used.

Asbestos-cement pipe may be rejected for failure to meet any of the requirements of this specification.

2.4.

C 1.7 Polyvinyl Chloride (PVC) Water Pipe

(Four-inch (4") through twelve-inch (12") diameter)

This specification governs the manufacture of unplasticized polyvinyl chloride (PVC) plastic pipe with integral thickened wall bells for water distribution systems in sizes four-inch (4") through twelve-inch (12").

All pipe shall be Class 150 (DR 18) unless otherwise specified or shown on the plans.

All pipe shall meet or exceed the requirements of AWWA C900, latest revision, and have cast iron pipe outside dimensions.

All pipe shall have a rubber ring joint. Provisions must be made for contraction and expansion at each joint with a rubber ring.

An integral thickened bell will be a part of each joint. Minimum thickness through the pipe bell and ring seating areas shall be as specified in AWWA C900 or AWWA C905, latest revision.

Pipe and fittings must be assembled with non-toxic lubricant.

Laying lengths shall be twenty (20') feet plus or minus (\pm) one (1") inch. All pipe shall have physical dimensions as shown in Table 1.

All fittings shall be mechanical joint or push-on joint iron fittings complying with Section C 1.19.

Bolts, nuts and washers used in flange and mechanical joint connections shall be high strength, low alloy steel

similar to CORTEN or equal.

Service saddles shall be used for all taps. No direct tapped connections to PVC pipe will be allowed. Service saddles shall comply with Section C 1.17.

PVC water pipe shall be approved by the Underwriters' Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems in cities and towns of Texas.

PVC water pipe shall also bear the seal of approval ("NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.

Each length of pipe shall be tested to two (2) times the pressure rating of the pipe for a minimum dwell of five (5) seconds.

To assure high quality extrusion, the pipe produced by each extrusion outlet shall be tested by the acetone immersion method at least every eight (8) hours.

When requested, the manufacturer will furnish certification that the pipe furnished meets all requirements of this specification.

Pipe may be rejected for failure to meet any requirements of this specification. PVC WATER PIPE DIMENSIONS

Nominal Size (Inches)	Outside Diameter (Inches)	Class 150 (DR 18) Minimum Wall Thickness (Inches)
4	4.8	0.267
6	6.9	0.383
8	9.05	0.503
10	11.10	0.617
12	13.20	0.733

2.5. C 1.8 Polyvinyl Chloride (PVC) Water Pipe

(Fourteen-inch (14") through 48-inch diameter)

This specification governs the manufacture of unplasticized polyvinyl chloride (PVC) plastic pipe with integral thickened wall bells for water distribution systems in sizes fourteen-inch (14") through 48-inch.

All pipe shall be Pressure Rating 235 psi unless otherwise specified or shown on the plans.

All pipe shall meet or exceed the requirements of AWWA C905, latest revision, and have cast iron pipe outside dimensions.

All pipe shall have a rubber ring joint. Provisions must be made for contraction and expansion at each joint with a rubber ring.

An integral thickened bell will be a part of each joint. Minimum thickness through the pipe bell and ring seating areas shall be as specified in AWWA C900 or AWWA C905, latest revision.

Pipe and fittings must be assembled with non-toxic lubricant.

Laying lengths shall be twenty (20') feet plus or minus (\pm) one (1") inch.

All fittings shall be mechanical joint or push-on joint or flanged ductile iron fittings complying with Section C 1.19.

Bolts, nuts, and washers used in flange and mechanical joint connections shall be high strength, low alloy steel similar to CORTEN or equal.

Service saddles shall be used for all taps. No direct tapped connections to PVC pipe will be allowed. Service saddles shall comply with Section C 1.17.

PVC water pipe shall be approved by the Underwriters' Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems in cities and towns of Texas.

PVC water pipe shall also bear the seal of approval ("NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.

Each length of pipe shall be tested to four (4) times the class pressure of the pipe for a minimum dwell of five (5) seconds.

To assure high quality extrusion, the pipe produced by each extrusion outlet shall be tested by the acetone immersion method at the beginning of each production run for each size or when running conditions are changed that could affect extrusion quality.

When requested, the manufacturer will furnish certification that the pipe furnished meets all requirements of this specification.

Pipe may be rejected for failure to meet any requirements of this specification.

2.6.

C 1.9 Ductile Iron Pipe

All ductile iron pipe shall be asphaltic coated outside and manufactured in accordance with the latest revision of ANSI/AWWA C151/A21.51.

All pipe shall be new.

All ductile iron pipe for water service shall be cement mortar lined in accordance with the latest revision ANSI/AWWA C104/A21.4 and must be approved by the National Sanitation Foundation.

Ductile iron pipe shall be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50, for a minimum 150 psi (or project requirements, whichever is greater) rated water working pressure plus a 100 psi minimum surge allowance and a 2 to 1 factor of safety and a service allowance of 0.08 inches. Minimum external earth load shall be calculated assuming a prism load and a minimum soil density of 120 pcf, or project requirements, whichever is greater. Minimum external live load shall be the AASHTO H-20, or project requirements, whichever is greater. Laying condition and depth of cover shall be in accordance with the plans.

Ductile iron pipe shall have either push-on joints, flanged or mechanical joints in accordance with ANSI A21.11 (AWWA C111) entitled "American National Standard for Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings".

Bolts, nuts, and washers used in flange and mechanical joint connections shall be high strength, low alloy steel similar to CORTEN or equal.

Dimensions, coatings, linings, joint types, etc., shall conform to Section C 1.19, Ductile Iron Fittings, of these specifications. Only ductile iron fittings shall be used on ductile iron pipe. All fittings must be approved by the National Sanitation Foundation.

Ductile iron pipe shall be approved by the Underwriters' Laboratory and shall be accepted by the State Fire Insurance Commission for use in fire protection systems without penalty.

All ductile iron pipe and fittings shall be tested in accordance with the applicable provisions of the specifications relating thereto.

Ductile iron pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.7. **C 1.12 Fire Hydrants**

2.7.1. **General**

This specification governs the manufacture of fire hydrants used in the water distribution system. Except for supplementary details, changes, or additions set forth herein, fire hydrants shall comply with AWWA C 502, "Fire Hydrants for Ordinary Water Works Service."

Fire hydrants shall be post type with compression main valve closing with the line pressure. All hydrants shall be of the "traffic" type with easily replaceable frangible parts designed to break on traffic impact. Hydrants shall be designed for a working pressure of 150 psi.

Fire hydrants shall be Mueller Centurion or an equivalent as approved by the City.

2.7.2. **Main Valve Size.** Five and one-fourth (5¼") inches I.D. minimum.

2.7.3. **Inlet Connection.** Six- inch (6") mechanical joint or as otherwise shown on the contract drawings. Bolts, nuts and washers used in flange and mechanical joint connections shall be high strength. Low alloy steel similar to CORTEN or equal.

2.7.4. **Depth of Bury.** Normally four (4') feet unless otherwise shown on the plans or called for in the contract documents. The maximum permissible-depth of bury is six (6') feet. Fire hydrants installed between four (4') feet and six (6') feet depth shall be installed with Grade Loc fittings as manufactured by Assured Flow Sales, Inc., or standard ductile iron fittings as described in section C 1.19 of these specifications.

2.7.5. **Barrel Sections.** Hydrants shall have upper and lower barrel sections with the joint designed to be at least two (2") inches above finished grade. The union between the upper and lower barrels shall be made by a traffic safety device such as a two-part safety flange, four-part segmental coupling, or breakable lugs in combination with breakable bolts. The design will permit rotation of the upper barrel to position the nozzles in any direction. Upper and lower barrel flanges shall be integrally cast.

2.7.6. **Nozzles.** The upper barrel shall include two (2) hose nozzles and one (1) steamer nozzle located on the same plane. All nozzles shall be equipped with cap chains and gaskets for all nozzle caps. Nozzle caps to have one-inch (1") square nuts.

- Hose Nozzles. The two (2) hose nozzles shall be two and one-half (2½") inches I.D. with National Standard threads.
- Steamer Nozzle. The steamer nozzle shall be four and a half (4 1/2") inches I.D. (Mueller Gauge 4-482) with the following characteristics:
 - Major Diameter - 4.982".
 - Pitch Diameter - 4.820".
 - Minor Diameter - 4.632".
 - Root Diameter - 4.570".
 - Threads per Inch - 4".
 - 4.5" Hyro-Storz Adapter

2.7.7. **Direction to Open.** Turn to left (counter clockwise).

2.7.8. **Operating Nut.** The operating nut shall be one and one-half (1 1/2") inch pentagon measured flat to flat with a minimum of one (1") inch and shall have a weather shield cast integrally with the nut.

2.7.9. **Color of Finish Paint above Ground Line.** Two coats of safety red over a shop prime coat.

- Paint shall be brushed on and not sprayed.

2.7.10. **Stem.** Provision shall be made in the design of the stem to disconnect the stem from the hydrant parts above the standpipe breakpoint in the event of a traffic accident.

- The union between the upper and lower stems shall be made by a breakable coupling. The design shall be such that excessive turning torque on the stems in either the opening or closing cycle is not transmitted to the weakened section of the coupling.

2.7.11. **Drainway.** The drainway shall be all bronze. Drain water shall not come in contact with the internal cast iron parts of the shoe while exiting the hydrant through the drainway.

2.7.12. **Main Valve.** The main valve and seat ring shall be removable through the upper barrel from above ground. The main valve seat ring shall thread directly into a bronze insert.

2.7.13. **O-Rings.** O-rings shall be furnished instead of stem packing.

- The union between the upper and lower stems shall be made by a breakable coupling. The design shall be such that excessive turning torque on the stems in either the opening or closing cycle is not transmitted to the weakened section of the coupling.

2.7.14. **Approvals**

Only those manufacturers whose hydrants have been specifically approved by the City's Standard Water/Sewer Products Committee will be approved in the City's water system. This approval will be based on the following items; disqualification of project may occur at any time as a result of failure to comply with the following provisions.

Drawings. Each manufacturer of fire hydrants manufactured under these specifications shall have on file at the City certified assembly drawings of the hydrant proposed to be furnished. Any proposed exceptions, changes, or modifications of design must be accompanied by new detailed drawings and statement of changes made. Failure to meet this requirement is enough cause for disqualification. Drawings furnished shall show principal dimensions, including metal thickness, construction details, and materials used.

Experience Record. No hydrant manufacturer will be considered which has not been regularly manufactured and in continuous use for at least ten (10) years in the United States. User references must be provided outlining products use for at least five (5) years.

Affidavit of Compliance. An affidavit of compliance to the effect that the hydrant complies in all respects to these specifications shall accompany each request for approval.

Field Evaluation. The manufacturer shall provide a hydrant, at no cost to the City for a minimum one (1) year period of field evaluation and testing. The hydrant must perform in a manner acceptable to the City for the one (1) year trial period.

Parts Availability. The manufacturer shall guarantee that all repair parts shall be delivered to the City within two (2) working days of request.

The hydrostatic tests set forth in AWWA C 502 shall be fully met and complied with.

Failure to meet any of the requirements set forth in AWWA C 502 or these specifications shall be cause for rejection.

2.8. C 1.13 Gate Valves and Tapping Sleeves and Valves

2.8.1. **General:** This specification governs the manufacture of double disc gate valves, resilient seated gate valves and tapping sleeves and valves for use in the water supply and water distribution system. Except for supplementary details, changes, or additions set forth herein, gate valves and tapping valves shall conform to

AWWA C500, "Gate Valves for Water and Sewerage Systems.

Resilient seat (wedge) gate valves shall conform to the applicable portions of AWWA C509, "Resilient-seated Gate Valves for Water and Sewerage Systems."

All double disc gate valves shall be iron body, bronze mounted, parallel seat, non-rising stem, internal wedging type. All resilient-seated gate valves shall be iron body, bronze mounted, resilient-seated, non-rising stem.

All valves, unless otherwise shown, shall be installed in the vertical position.

2.8.2. **Bonnet Bolting.** Body bolts, studs, and nuts shall be plated with one of the following:

- ASTM A 165 Type NS (Heavy Cadmium Plated)
- ASTM A 164 Type LS (Electrodeposited Zinc)
- ASTM A 123 (Galvanized Hot Dip)

2.8.3. **Valve Ends.** Valves shall have, flanged, mechanical joint, or concrete cylinder ends (P-381) or any combination as may be specified. Bolts, nuts and washers used in flange and mechanical joint connections shall be high strength, low alloy steel similar to CORTEN or equal.

2.8.4. **Gates and Rings.** All gates four-inch (4") or larger shall be cast iron with bronze gate rings, and gates four-inch (4") and smaller than four-inch (4") may be solid bronze.

2.8.5. **Wedging Devices.**

- Gate valves four-inch (4") and smaller shall have solid bronze wedges.
- Valves above four-inch (4") may have solid bronze or cast iron bronze mounted wedges. The bronze mounting shall be built as an integral unit mounted over or supported on a cast iron base.
- Wedging surfaces on valves up to sixteen-inch (16") shall be bronze to cast iron.
- Wedging surfaces on valves sixteen-inch (16") and larger shall be bronze to bronze. Other moving surfaces integral to the wedging action shall be bronze to cast iron.

2.8.6. **Valve Seats-Resilient Seated:** Resilient seats shall be manufactured in accordance with the requirements of ANSI/AWWA C509, latest revision.

2.8.7. **Valve Stems and Nuts**

- Stem nuts shall be of non-galling, high grade red brass or bronze and shall have threads of enough length to develop the full strength of the stem.
- Stems as received shall meet the minimum strengths as specified. Upset stems on valves larger than sixteen-inch (16") will not be permitted.

2.8.8. **Stuffing Boxes.** All valves three-inch (3") through twelve-inch (12") shall be equipped with double O-rings, and provisions shall be made for this replacement of the upper O-rings when the valve is fully open. All geared valves will be equipped with conventional packing in the main stuffing box.

Stuffing box bolts and nuts shall be plated in accordance with ASTM A 165, Type NS (Heavy Cadmium Plated); ASTM A 164, Type LS (Electrodeposited Zinc); or ASTM A 123 (Galvanized Hot Dip).

2.8.9. **Hand Wheels and Operating Nuts.**

- All valves two-inch (2") and larger in diameter shall be nut operated unless otherwise specified.
- Hand wheels shall be furnished only when called for on the plans or in the contract documents.
- All valves shall open by turning left (counter clockwise).

2.8.10. **Gearing.** Spur gearing with gear cases shall be provided on all valves sixteen-inch (16") and larger.

- 2.8.11. **Gear Cases.** Gear cases shall be furnished on all geared valves and shall be of the extended type with cast iron side plates. Stuffing boxes shall be located on top of the bonnet and shall be outside the gear case. Gear cases shall be lubricated and enclosed with oil seal or O-rings at all shaft openings to prevent the entrance of water. Gear cases shall be cast iron.
- 2.8.12. **By-Pass Valves.**
- All gate valves fourteen-inch (14") and larger will be furnished and equipped with by- pass valves.
 - Properties, construction, and design requirements herein specified are applicable to by- pass valves with the additional requirement that the stems of by-pass valves larger than four- inch (4") shall have the same physical qualities set forth in AWWA C500 for valves 30-inch and larger.
- 2.8.13. **Valves for Installation in Vertical Pipe Lines:** Valves sixteen-inch (16") and larger ordered for installation in vertical pipe lines shall be equipped with bronze shoes and slides. Valves four-inch (4") through twelve-inch (12") shall be double disc, square bottom valves.
- 2.8.14. **Valve Stem Extensions.** Where circumstances require that the gate valve operating nut be installed at a depth greater than six (6') feet, it shall be equipped with a non-rising extension stem. The extension shall be one and one-quarter (1¼") inches solid core steel with the upper operating nut welded to the stem. The upper operating nut on the extension shall be four (4") inches to twelve (12") inches below the valve box. This stem shall have a coupling enough so that it will attach securely to the operating nut of the valve. The upper end of the extension stem shall terminate in a square wrench nut. A four and one-half-inch (4½") diameter steel plate, one-quarter-inch (¼") thick rock shield shall be welded to the stem two (2") inches below the bottom of the top operating nut.
- 2.8.15. **Tapping Sleeves.**
- Tapping sleeves shall be all stainless steel when available.
- Tapping sleeves four-inch (4") through twelve-inch (12") shall be either 21/45 strength cast iron, Grade 60-40-18 ductile iron or heavy welded steel with fusion bonded epoxy coating 12 mil thickness. The two sections shall be bolted together with high strength, low alloy, corrosion resistant steel CORTEN bolts and nuts or approved equal.
- The branch outlet of the tapping sleeve shall be flanged.
- 2.8.16. **Approval**
- Only those manufacturers (Mueller or approved equal) whose valves have been specifically approved by the City will be approved for use in the City's water system.
- Drawings.** Each manufacturer of valves manufactured under these specifications shall have on file at the City a detailed drawing of each type and size of valve proposed to be furnished. Any exceptions, changes, or modifications or design must be accompanied by new detailed drawings and statement of changes made. Failure to meet this requirement is enough cause for disqualification. Drawings furnished shall show principal dimensions, including metal thickness, construction details, and materials used.
- Affidavit of Compliance.** An affidavit of compliance to the effect that the valve complies in all respects to these specifications shall accompany each request for approval.
- Experience Record.** No valve manufacturer will be considered which has not been regularly manufactured and in continuous use for at least ten (10) years in the United States. User references must be provided outlining products use for at least 5 years.
- Field Evaluation.** The manufacturer shall provide a valve, at no cost to the City for a minimum one (1) year period of field evaluation and testing. The valve must perform in a manner acceptable to the City for the one (1) year trial period.

Parts Availability. The manufacturer shall guarantee that all repair parts shall be delivered to the City within two (2) working days of request.

All valves shall be tested by the manufacturer in accordance with AWWA C500 or C509. Any leaking at the test pressure through any castings or between the bronze ring and the cast iron body shall cause the casting to be rejected. No plugging or patching to stop leakage will be permitted.

Failure to meet any of the requirements set forth in AWWA C500, C509 or this specification shall be cause for rejection.

2.9. **C 1.14 Combination Air Valves**

This specification governs the manufacture of combination air valves (air release and air vacuum) for use in the water supply and water distribution systems and shall conform to ANSI/AWWA C512, latest revision "Air Release, Air/Vacuum and Combination Air Valves for Water Works Service."

Air valves shall be combination air valves. These valves are designed to fulfill the functions of an air and vacuum valve to intake and exhaust large quantities of air and an air release valve to permit the escape of air accumulated in a pipe line of the high point when the line is under pressure and in operation. Combination air valves eight (8") inches and smaller shall be self-contained in one unit. Combination air valves larger than eight (8") inches may be a combination of the two valves.

Valves shall have cast iron bodies and stainless steel floats. Seats shall be Buna-N synthetic rubber against bronze or stainless steel. All other internal parts such as float guides, bushings, baffle retaining screws, etc., shall be bronze or stainless steel.

Inlets shall be threaded for two inch (2") valves. Three-inch (3") valves may have either threaded or flanged inlets as shown on the contract drawings. Valves four-inch (4") and larger shall have flanged inlets.

Valves shall be designed for an operating pressure of 200 psi and shall be tested to 150 percent of that pressure.

Air valves may be rejected for failure to conform to the requirements of this specification.

2.10. **C 1.15 Miscellaneous Valves**

The valves governed by this specification are the following:

- Flap Valves.
- Non-Slam Check Valves. (externally weighted)
- Swing Check Valves.

These valves shall be manufactured to swing check valves (internally weighted) as designated in the list of approved materials.

2.10.2. **Flap Valves.** Flap valves shall have a cast iron body and shall be composed of three (3) parts: frame, flap, and connecting hinge pin. The flap and frame shall have a solid bronze seat and gate rings that are mated and matched. The hinge pin shall be bronze.

The valves shall close when hanging at a slight angle from vertical.

2.10.3. **Non-Slam Check Valves.** Non-slam check valves shall be cast iron and designed for 150 psi working pressure. Valves shall be tested to 200 percent of working pressure. Non-slam check valves shall have solid bronze seat and gate rings, pivot pins, and pivot pin bushings.

2.10.4. **Swing Check Valve (Externally Weighted).** Swing check valves shall be fully bronze mounted with cast iron body. If so designated on the contract drawings, swing check valves will be furnished with spring and lever or

lever and weight.

Swing check valves shall be for 150 psi working pressure and be tested to 200 percent of working pressure.

- 2.10.5. **Swing Check Valve (Internally Weighted).** Swing check valves shall be fully bronze or stainless steel mounted with cast iron or heavy steel body. All internally weighted check valves will be fusion bonded epoxy coated in accordance with AWWA C550.

Swing check valves shall be designed for 150 psi working pressure and be tested to 200 percent of working pressure.

2.11. **C 1.16 Service Saddles**

General. This specification governs the manufacture of bronze ductile iron and stainless steel service saddles used for tapping water service pipe under normal pressure.

Service saddles shall consist of a contoured saddle fastened to the pipe by two (2) "U" bolts for double strapped clamps or by stainless steel bands. The saddle shall be sealed against the pipe with a neoprene or Buna-N gasket and shall have a heavy hub tapped with a corporation stop thread. Clamps shall be designed for 150 psi working pressure.

2.11.1. **Saddles**

- **Shape.** Saddles shall be shaped so as to provide a minimum 180 degree coverage around the pipe.
- **Outlet.** The saddle hub shall have a wall thickness of not less than one-half-inch (1/2") including threads. The hub shall be tapped with corporation stop threads of the size specified. Threads shall be in accordance with AWWA C800.
- **Material.** Saddles shall be composed of bronze conforming to ASTM B 62,304 stainless steel, or ductile iron conforming to ASTM 536. Ductile iron saddles shall be covered by a black nylon fused coating or epoxy coating approximately 10 to 12 mils in thickness, with approximate dielectric strength of 1,000 V/mil.
- **Marking.** The clamp casting shall be clearly marked by letters and numerals cast thereon showing the manufacturer's name as well as the size and type of pipe for which the clamp is designed.

2.11.2. **Straps**

- **Shape.** Bronze straps shall be formed flat on one (1) side to fit uniformly against the wall of the pipe. Rod diameter shall be not less than five-eighths-inch (5/8") flattened to three-fourths-inch (3/4") on one side. Straps shall be threaded for enough distance so that at least one-half-inch (1/2") of the threads remain after the clamp is fully tightened on the pipe. Nuts shall be bronze of the same material as the saddle or straps and have minimum dimensions equal to or larger than heavy hexagon nuts. Stainless steel straps shall have a band at least two (2") inches in width, and bolts, shall be Type 304 stainless steel with Type 304 stainless steel nuts and washers, or nylon coated nuts and washers, or silicon bronze nuts and washers.
- **Material.** Bronze straps shall be constructed of material conforming to ASTM B 98 or ASTM B 124. Stainless steel bands shall be Type 304 (18-8) stainless steel.

Gaskets shall be composed of neoprene or Buna-N rubber cemented to the saddle to facilitate installation.

Each saddle shall be subjected to an air test to 85 psi while submerged in water by the manufacturer and shall show no evidence of leakage.

At the City's option, service clamps shall be subjected to a 300 psi hydraulic test and shall not leak or show signs of structural failure.

Failure to meet any of the requirements set forth in this specification shall be cause for rejection.

2.12. C 1.17 Copper Tubing and Brass Good for Water Service Connections

2.12.1. **General.** This specification governs the manufacture of seamless copper tubing and miscellaneous brass goods such as corporation stops, curb stops, couplings, unions, adapters, branch connections, etc., used to construct water service connections in the domestic water system, manufactured in accordance with ANSI/AWWA C800, latest revision, "Underground Service Line Valves and Fittings."

2.12.2. **Brass Goods.** Brass goods shall be all brass of 85-5-5-5 alloy, as defined in ASTM B 62, which has a normal composition of 85 percent copper and five (5%) percent each of tin, lead, and zinc, plus or minus one (1%) percent.

2.12.3. **Copper Tubing.** Copper tubing used for one- inch (1") water service lines shall be Type K, Soft (Annealed). Copper tubing for two-inch (2") water services shall be Type K Hard. All copper tubing shall conform to ASTM B 88, "Seamless Copper Water Tube," or Federal Specification WW-T-799. Two-inch (2") diameter service lines shall be straight lengths with compression fittings. For one-inch (1") water service lines, no joints will be allowed from the corporation stop to the curb stop.

All material used shall be approved by the National Safety Foundation.

2.12.4. **Brass Goods.** Brass shall have a tensile strength of not less than 30,000 psi when tested in accordance with Figure 5 of ASTM B 208.

Fittings shall be designed for 200 psi working pressure. When subjected to hydrostatic test pressures one and one-half (1½) times working pressure or when subjected to a minimum of 85 psi air pressure while submerged in water, fittings shall not leak or show signs of structural failure.

Brass goods containing brass to brass moving parts shall be shipped prelubricated with a light fluid lubricant between moving parts. Lubricant shall remain fluid indefinitely, either in storage or in service.

2.12.5. **Copper Tubing.** Copper tubing shall have a minimum ultimate tensile strength of 30,000 psi.

Seating surfaces of the ground key type shall be tapered and shall be accurately fitted together by turning the key and reaming the body. Seating surfaces shall be lapped together using suitable abrasives to insure accurate fit. The large end to the tapered surface of the key shall be reduced in diameter for a distance that will bring the largest end of the seating surface of the key into the largest diameter of the seating surface of the body. The taper seat in the body shall be relieved on the small end so that the small end of the key may extend through, to prevent wearing of a shoulder and to facilitate proper seating of the key. The stem end of the key, key nut, and washer shall be so designed that if the key nut be tightened to failure point, the stem of the key shall not fracture. The nut and the stem shall withstand a torque on the nut of at least three (3) times the manufacturer's recommended torque requirements.

Corporation stops shall be so designed as to rotate about the axis of the flow passageway within a circle of rotation small enough to properly clear the inside of any standard tapping machine of appropriate size.

Corporation stops shall be male AWWA thread on the inlet side and copper service thread on the outlet side and shall be used only for one-inch (1") taps.

The ball stop shall have a full port opening with straight-through flow, and Teflon coated, bronze ball with a minimum of 0.5 mil thickness coating. The operating stem shall be one piece construction. No roll pins will be allowed.

Plug type stop shall have full port opening with straight-through flow. Seating surfaces shall be brass (or Teflon coated brass) to rubber O-rings, providing positive pressure seal without mechanical means. Material for rubber O-rings should conform to requirements of ASTM D 200.

Inlet and outlet threads, of the types specified, shall conform to the applicable tables of AWWA C800, and threads shall be protected in shipment by a plastic coating or other equally satisfactory means.

The brass curb stop configuration shall be female iron pipe threaded on both ends. The maximum and minimum laying lengths for a three-quarter-inch (3/4") curb stop are three and three-eighths inches (3- 3/8") and three and one-half inches (3-1/2") respectively. The maximum and minimum laying lengths for a one-inch (1") curb stop are three and three-quarter inches (3-3/4") and four and one-quarter inches (4- 1/4") respectively. All curb stops shall be the less stop design.

Flanged angle valves shall be of inverted key style with "O" ring gaskets. Inlet to be compression type with a Buna N beveled gasket. Compression nut shall have an approved restraining device to lock down on the copper tubing. Outlet shall be flanged for drop-in gaskets with bolt holes for either one and one-half-inch (1 1/2") or two-inch (2") meters. Design is to include lock wings and flow directional arrow.

All castings shall be smooth, free from burrs, scales, blisters, sand holes, and defects of every nature. Nuts shall be smooth cast and shall have symmetrical hexagonal wrench flats. All thread fittings, of all types, shall have NPT threads, and male threaded ends shall be protected in shipment by a plastic coating or other equally satisfactory means. Compression tube fittings shall have a Buna N beveled gasket. Compression nut shall have an approved restraining device to lock down on the copper tubing.

Copper tubing shall be tested for material, tensile strength, and expansion in accordance with the applicable ASTM specifications. Brass goods included in this section shall be tested in accordance with the applicable provisions of the specifications relating thereto.

Copper tubing and brass goods may be rejected for failure to meet any of the requirements of these specifications.

2.13. C 1.18 Ductile Iron Fittings

2.13.1. **General.** This specification governs the manufacture of ductile iron fittings, for use with the various types of water pipe used for the conveyance of domestic water.

All fittings shall comply with AWWA A C110/A21.10 or AWWA C153/A21.53, latest revision, and shall be manufactured in the United States. All material used shall be approved by the National Sanitation Foundation.

Joints for ductile iron fittings shall be in accordance with ANSI/AWWA C111/A21.1.

2.13.2. **Mechanical Joint.** Mechanical joints shall comply in all respects to ANSI 21.10. The joint shall be furnished complete with accessories. All bolts used with mechanical joint connections shall be high strength, corrosion-resistant steel such as CORTEN or equal.

2.13.3. **Push-On Joint.** Push-on joints shall comply with ANSI/AWWA C111/A21.1.

2.13.4. **Flanged Joint.** Flange dimensions, bolt hole pattern, and flange bolt size shall comply with ANSI/AWWA C111/A21.1. All bolts, nuts, and washers used for flanged joints shall be high strength, low alloy steel similar to CORTEN or equal.

2.13.5. **Special Joint.** Special end condition fittings using combinations of bells, spigots, mechanical, push-on, or special internally locked joints will be to dimensions in accordance with ANSI A21.10.

All ductile iron fittings shall have a standard cement mortar lining in accordance with ANSI/AWWA C104/A21.4 and ANSI/AWWA C110/A21.10.

All fittings shall be installed with a double layer of polyethylene wrap. Polyethylene encasement shall comply with ANSI/AWWA C105/A21.5.

Ductile iron fittings may be rejected for failure to meet any of the requirements of this specification.

2.14. **C 1.19 Cast Iron Castings**

- 2.14.1. **General.** This specification governs the manufacture of all commercially designed or City of Colleyville designed cast iron castings. Specifically included are manhole rings and cover, cleanout castings with lids, valve boxes and covers, water meter covers, and meter box lids.

Material used in the construction of casting shall conform to the ASTM requirements shown:

Material	ASTM	Grade
Gray Iron Castings	A 48	Class 30 minimum
Gray Iron Castings	A 126	Class B

All cast iron castings shall be manufactured in United States.

Castings shall be of uniform quality and free from blow holes, porosity, hard spots, shrinkage defects, swells, cracks, or other injurious defects. All castings shall be free from fins, burrs, sand and slag. The surface of all castings shall be smooth and true to pattern.

All castings shall be stress relieved by shot blasting.

Surfaces shall be machined as indicated or where otherwise necessary to secure true flat surfaces. Covers and grates shall fit properly into frames and fit uniformly and solidly.

All manhole lids shall have pick bars.

All castings shall be painted with one coat of rust inhibitive coating as approved by the Engineer. Where appropriate, castings shall be coated with hot or cold applied tar.

All matching (bearing) surfaces of watertight manhole rings and covers shall be suitably machined so as to be free from any irregularities and shall incorporate a watertight gasket or "O" ring mounted in a retaining recess as standard design.

The manhole cover shall be held securely in place by stainless steel bolts and washers. Watertight manhole covers shall be furnished with pick bars.

Where applicable, bolts, fasteners, springs, and plungers shall be as shown on the drawings or as described in the contract documents.

The City normally incorporates standard commercial design castings into project specifications. However, some castings are of special design, and specific dimensions, materials, characteristics, etc., are in the contract drawings or specific job specifications. Any castings to be substituted for products specified in Part E must first be approved in writing by the City of Colleyville. All items must meet the specifications included herein and shall be interchangeable with the items specified.

Cast iron castings and/or appurtenances may be rejected for failure to meet any of the requirements of this specification.

2.15. **C 1.20 Polyethylene Wrap for Ductile Iron Pipe and Fittings**

- 2.15.1. **General.** These specifications govern the manufacture of polyethylene film to be used as a wrap to protect buried ductile iron pipe and fittings. Polyethylene wrap shall be used for all pipe, fittings and appurtenances to ductile iron water pipelines.

2.15.2. Polyethylene encasement for ductile iron piping shall conform to ANSI/AWWA C105/A21.5, latest revision. The polyethylene film shall be eight (8) mils thick, with minimum flat tube widths as shown in Table 1 for the specified pipe sizes. The film shall be extracted from polyethylene resin, Type 1, Class C, Grade E-1, and as specified in ASTM D 1248, with the following characteristics:

- Flow Rate - 0.4 maximum
- Tensile Strength - 1,200 psi
- Elongation - 300% minimum
- Dielectric Strength - resistivity 800 volts per mil thickness, minimum

Polyethylene tube seams and overlaps may be wrapped and held in place by means of two-inch (2") wide plastic backed adhesive tape with a minimum thickness of ten (10) mils. Maximum thickness shall be consistent with a pliable installation.

MINIMUM WIDTH OF FILM TUBE (FLAT WIDTH)

Nominal Pipe Size (Inches)	Flat Tube Width (Inches)
4	16
6	20
8	24
10	27
12	30
14	34
16	37
18	41
20	45
24	53

Polyethylene wrap may be rejected for failure to meet any of the requirements of this section.

2.16. **C 1.22 Embedment Materials**

2.16.1. **General.** This specification governs the quality of materials used for foundation and embedment materials in the construction of water lines.

2.16.2. **Rock Foundation**

- **Description.** Rock foundation is used to create a stable trench bottom in wet unstable or "spongy" conditions. Rock foundation shall be composed of sound and durable particles of crushed limestone.
- **Gradation.** Sizes shall be well graded from passing the one-inch (1") but retained on the seven-eighths inch (7/8") screen minimum size to a maximum size of five (5") inches in greatest dimension.
- **Wear.** The percent of wear shall not exceed 35 percent when tested in accordance with ASTM C 131.
- **Deleterious Substances.** Rock foundation shall contain no more than one (1%) percent by weight of organic matter, clays, loam, or pebbles and shall contain no more than five (5%) percent by weight of any one or combination of slate, shale, schist, or soft sandstone particles.

2.16.3. **Granular Embedment for Water Lines**

- **Description.** Granular embedment material shall be free flowing sand or like material or mixed sand and pea gravel. This material may be an inferior grade of "pit run" sand, not normally considered satisfactory for construction purposes, and may be used directly from pits without processing. Granular embedment material shall be such that, when wet, it will not form mud or muck.
- **Gradation**
 - **Retained on 2 inch sieve** 0%
 - **Retained on 1 inch sieve** 0 - 10%
 - **Retained on No. 40 sieve** 0 - 40%
 - **Retained on No. 100 sieve** 90 - 100%
- **Plasticity.** The plasticity index of the soil fraction passing the No. 40 sieve shall not be greater than two (2).
- **Deleterious Substances.** Granular embedment material shall be free from large stones, clay, and organic material and shall be a relatively uniform material.

2.16.4. **Select Materials.** Select materials will be defined as gravel, fine rock cuttings, sand, sandy loam or loam free of excessive clay. When wet, the material shall not form mud or muck.

Concrete for Foundation, Embedment and/or Encasement

Portland Cement concrete used for pipe foundation, embedment, and/or encasement shall comply in all respects to the requirements set forth in Section C 1.24, "Concrete," of these specifications. Concrete shall be Class "B".

Materials may be rejected for failure to meet any of the requirements of this section.

2.17. **C 1.23 Concrete**

2.17.1. **General.** This section governs all materials used and the handling, measuring, proportioning and mixing of such materials in producing concrete for structures or for incidental or miscellaneous construction.

Concrete shall be composed of Portland Cement, coarse aggregate, fine aggregate, admixtures as required, and water proportioned and mixed as hereinafter provided in these specifications.

Where the type or class of concrete is not shown on the plans or specifically designated in the specifications, concrete used shall be Class "A".

It is the intent of this specification to permit "ready mix," "central mix," or "transit mix" concrete. However, the Contractor will be required to submit evidence that the concrete to be furnished meets all requirements of these specifications including testing by an independent laboratory at the contractor's expense.

2.17.2. **Materials**

- **Cement.** Portland Cement shall be Type I (Normal), Type II (Sulfate Resistant), or Type III (High Early Strength) in accordance with ASTM C 150. Unless otherwise shown, all cement used shall be Type I.
- **Coarse Aggregate.** Coarse aggregate shall consist of gravel or crushed stone meeting the requirement of ASTM C 33 "Concrete Aggregate." Coarse aggregate with a wear exceeding 40 when tested in accordance with ASTM C 131 will not be acceptable.

- **Fine Aggregate.** Fine aggregate shall be composed of natural sand, conforming to ASTM C 33.

2.17.3. **Admixtures**

- **Air Entraining Admixture.** Air entraining admixtures shall conform with ASTM C 260. The total average air content shall be in accordance with American Concrete Institute 211.1.
- **Water Reducing Admixture.** Water reducing admixtures, if used, shall comply with ASTM C494. They shall be accurately measured and added to the mix in accordance with the manufacturer's recommendations.

2.17.4. **Water.** Water for concrete shall be clean and free from injurious quantities of oil, acid, alkali, salt, organic matter, or other deleterious substances. Water from the City's mains is acceptable with no testing required.

2.17.5. **Curing Materials**

- **Sheet Materials.** Waterproof paper, polyethylene film, and white burlap-polyethylene film shall conform to ASTM C 171.
- **Curing Compound.** Membrane curing compound shall conform to ASTM C 309. Curing compound shall either be Type 1, clear or translucent, or Type 2, white pigmented.

2.17.6. **Storage of Materials**

- **Storage of Cement.** Cement may be delivered in bulk or in bags which are marked plainly with the brand and name of manufacturer. Immediately upon receipt, cement shall be stored in a dry, weathertight and properly ventilated structure which excludes moisture. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification. Enough cement shall be in storage to complete any pour of concrete started. In order that cement may not become unduly aged after delivery, records of delivery dates shall be maintained, and the Contractor shall use any cement which has been stored at the site for 60 days or more before using cement of lesser age. No cement will be used which is lumped or caked, or has been stored more than 90 days, or when the cement temperature exceeds 170 degrees F.

- **Storage of Aggregates.** The handling and storage of concrete aggregate shall be such as to prevent the admixture of foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be grubbed, cleared of all weeds and grass, and leveled. The bottom layer of aggregate shall not be disturbed or used without recleaning.

Different sizes of aggregates shall be stored in such a manner as to prevent intermixing. Materials in all stockpiles shall be handled in such a manner that segregation of materials within the pile will be avoided and shall be built up in layers not over three (3') feet in depth. Should segregation occur, the aggregates shall be remixed to conform with the grading requirements. Unless otherwise authorized by the Engineer, all fine aggregates shall be stockpiled at least 24 hours before mixing to reduce the free moisture content.

2.17.7. **Measuring of Materials and Measuring Equipment**

All materials shall be measured separately and accurately and batches shall be uniform. The coarse and fine aggregate shall be measured, or weighed, loose and separately.

When volumetric proportioning is used, the Contractor shall furnish and use approved measuring boxes, pans, or mechanical devices which will give exact volumes of aggregates required for the several classes of concrete involved. Devices used shall be constructed and plainly marked so that the Engineer can conveniently and accurately check the exact quantity of each aggregate being used in any or all batches. A bag of cement as packed by the manufacturer and weighing 94 pounds will be considered as one (1) cubic foot. When proportion by weight is used, the capacity of the weighing equipment shall be adequate to permit required weighing of materials without delaying the production of the mixer. Scales to be used shall be approved by the Engineer and shall be certified in place.

Each scale installation shall be provided with standard 50 pound test weights made of high quality cast iron, cast and finished in such a manner that no foreign material will adhere to the surface, and sealed in the manner prescribed by the United States Bureau of Standards. The minimum number of test weights required shall be of a weight equivalent to ten (10%) percent of the net load capacity of the scales to the nearest greater 50 pounds, but in no case shall less than two (2) weights be furnished.

The device used for measuring the quantity of water shall indicate the quantity in gallons and fractions thereof. The operating mechanism shall regulate the quantity required for any given batch within one (1%) percent, and the supply inlet shall be cut off automatically when water is being discharged into the mixer.

2.17.8.

Concrete Proportions

- **General.** American Concrete Institute 211.1 shall be the basis for selecting the proportions for concrete made with aggregates of normal and high density and of workability suitable for usual cast-in-place structures.
- **Mix Design.** The Contractor shall be responsible for the design of concrete consistent with the minimum requirements of strength and proportions stated herein. The proportions of materials entering into mix to produce concrete of satisfactory quality shall be determined by laboratory tests before the beginning of concrete placement. Design shall be in accordance with ACI 211.1, "Recommended Practice for Selecting Proportions Concrete," subject to maximum water cement ratio, minimum cement content, and minimum strengths set forth herein.
- **Workability.** In general, the workability of any mix shall be that required for the specific placing conditions and method of placement. The concrete shall be of such workability that it can be worked readily into all corners and around reinforcing without segregation of materials or with free water collecting on the surface. Compliance with specified slump limitations shall not necessarily designate a satisfactory mix. The Engineer may require changes in proportions at any time as necessary to obtain a mix with satisfactory properties. The slump tests will be made in accordance with ASTM Method of Test for Slump of Portland Cement Concrete, Designation C-143.

In no case shall the quantity of coarse material be such as to produce harshness in placing or honeycombing in the structure when forms are removed.

2.17.9.

Concrete Classification

The following table sets forth the classification of concrete used for water and sewer construction in the City of Colleyville:

Class	f'c 28-day psi	Cement Bags/ C.Y.	Max. Water Content (Gal./Bag)	Max. Slump (In.)	Max. Size Aggr. (In.)	Use
A	3,000	5	6.5	5	1-1/2	General. All reinforced concrete structures unless otherwise specified.
B	2,000	4	8.0	4	1-1/2	Blocking, Cradle Concrete Bedding.
C	3,600	6	6.0	4	1-1/2	General. Top Slabs direct traffic structures.

The maximum quantity of coarse aggregate (dry loose volume) per cubic foot of finished concrete shall not exceed 0.82 cubic feet.

The maximum quantity of water as set forth in the table of concrete classification is based on the assumption that the aggregates are in a saturated, surface dry condition. If additional water is required to obtain the desired slump, a compensating quantity of cement will also be added. In no case will the maximum allowable water-content ratio be exceeded.

The concrete mix will be designed with the intention of producing concrete with compressive strengths equal to or greater than those shown when tested in accordance with ASTM C 39, "Compressive Strength of Cylindrical Concrete Specimens."

When tested at seven (7) days, concrete cylinders will have attained at least two-thirds (2/3) the required 28 day compressive strength in order for the strength of the concrete to be considered satisfactory.

2.17.10.

Mixing Conditions

- **General.** The concrete shall be mixed in quantities required for immediate use, and any concrete which is not in place within the time limits specified shall not be used. Retempering of concrete will not be permitted.
- **Concrete Temperature.** No concrete shall be placed when the temperature of the concrete to be placed is greater than 90 degrees for less than 50 degrees F. The temperature of the concrete to be placed will be taken using a thermometer immediately before placement with the point of measurement being in the chute or bucket.
- **Cold Weather.** No concrete shall be mixed without the approval of the City when the air temperature is at or below 40 degrees F (taken in the shade away from artificial heat) and falling. If authorized by the City, concrete may be mixed when the air temperature is at 35 degrees F and rising. All cold weather concreting shall be done in accordance with ACI-306.
- **Hot Weather.** Hot weather is defined as any combination of hot air temperature, low relative humidity, and wind velocity that in the judgment of the Engineer would impair the quality of the concrete. All hot weather concreting shall be in accordance with ACI 305. Concrete shall be placed in the forms without the addition of any more water than required by the design (slump). No excess water shall be added on the concrete surface for finishing. Control of initial set of the concretes and extending the time for finishing operations may be accomplished with the use of an approved water-reducing and set retarding admixture as specified above.

Maximum time intervals between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature Addition of Water to Placement	Maximum Time From (whichever higher)
Non-Agitated Concrete	
Up to 80 degrees Fahrenheit.....	30 minutes
Over 80 degrees Fahrenheit	15 minutes
Agitated Concrete	
Up to 75 degrees Fahrenheit.....	90 minutes
75 to 89 degrees Fahrenheit	60 minutes
Over 90 degrees Fahrenheit (maximum permissible concrete temperature)	45 minutes

The use of an approved set-retarding admixture will permit the extension of the above time maximums by 30 minutes, for agitated concrete only.

Under extreme hot temperature, wind, or humidity conditions, the City may require the use of the set-retarding agent, or may suspend concreting operations if quality of the concrete being replaced is not acceptable.

- 2.17.11. **Curing.** Careful attention shall be given to the proper curing of all concrete. Curing methods shall use sheet materials conforming to ASTM C 171 or membrane curing compound conforming to ASTM C309. Membrane curing compound will not be used on surfaces to be rubbed or on which additional concrete is to be placed.

All concrete shall be cured as set forth in Section C 30.14.

- 2.17.12. **Rejection.** Concrete may be rejected for failing to meet any of the requirements of this specification.

2.18. **C 1.24 Reinforcing Steel**

- 2.18.1. **General.** This specification governs the manufacture of all reinforcing steel used in the construction of reinforced concrete.

Reinforcing steel manufactured under these specifications shall conform to the following specifications of the American Society for Testing and Materials as follows:

ASTM A 82, "Cold-Drawn Steel Wire for Concrete Reinforcement."

ASTM A 185, "Welded Steel Wire Fabric for Concrete Reinforcement."

ASTM A 615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."

All bar reinforcement shall be Grade 60 open hearth, basic oxygen, or electric furnace new billet steel except that stirrups and tie bars may be Grade 40.

Wire for fabric reinforcement shall be cold-drawn from rods hot-rolled from open hearth, basic oxygen, or electric furnace billet steel.

Steel reinforcement shall be stored above the surface of the ground upon platforms skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

When placed in the work, reinforcement shall be free from dirt, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations.

Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross-sectional area, and tensile properties meet the physical requirements for the size and grade of steel specified.

Reinforcement shall be bent cold and true to the shapes indicated on the plans. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection.

2.19. **C 1.25 Street and Pavement Repair Materials**

2.19.1. **General.** This specification governs the quality of materials used to repair streets or other pavements after the installation of water lines.

Any Portland Cement concrete used for street or pavement repair shall comply in all respects to the requirements set forth in Item C 1.24, "Concrete," of these specifications for the class of concrete called for on the plans or set forth in the project documents.

2.19.2. **Cement Stabilized Backfill**

■ **2:27 Backfill or Cement Stabilized Sand.** Backfill material designated as "2.27 backfill material" shall be a lean concrete mix containing two (2) sacks of cement per cubic yard of material. Aggregate used for 2:27 backfill material shall be a free flowing well-graded granular material passing a 1 - 1/2 inch screen and free from sticks, lumps, clay balls and organic matter. The 2:27 backfill material shall be poured wet or dry as directed by the City, and all 2:27 backfill shall be mixed in a concrete mixer of a type approved by the City.

■ **Cement Treated Base.** Cement treated base shall consist of aggregate, cement, and water uniformly mixed in a central plant and hauled to the project site. Cement treated base shall have a minimum cement content by weight of four (4%) percent and a minimum compressive strength at seven (7) days of 300 pounds per square inch. If necessary, the minimum cement content shall be adjusted upward to provide the minimum required compressive strength.

■ **Storage and Use.** Cement treated materials shall be placed in ditch the same day that they are mixed and/or delivered to the jobsite.

2.19.3. **Crushed Stone Base**

■ **Description.** Crushed stone base shall consist of stone, argillaceous limestone, calcareous clay particles, with or without stone, or conglomerate, and shall not contain thin or laminated pieces or an excess of shale, dirt, organic matter or other injurious materials.

■ **Gradation.**

- Retained on 1 - 3/4 in sieve0%
- Retained on No. 4 sieve45 - 65%
- Retained on No. 40 sieve60 - 85%

Material passing the No. 40 sieve shall meet the following requirements when the test samples are prepared and tested in accordance with the applicable ASTM specifications:

The liquid limit shall not exceed 40. The plasticity index shall not exceed twelve (12).

- **Abrasion.** The material shall have a percentage of wear not exceeding 40 when tested in accordance with ASTM C 131.

2.19.4.

Hot Mix Asphaltic Concrete – Course Graded Binder Course

- **Description.** Coarse graded binder course hot mix asphaltic concrete used for street and pavement repair in the City of Colleyville is identical to Type "A" hot mix asphaltic concrete as set forth in TxDOT Item 340. This gradation is normally used as a "base" course on which a fine graded surface course is placed.
- **Gradation.**
 - Passing 1½ in. sieve100%
 - Passing 1¼ in. sieve95 - 100%
 - Passing 7/8 in. sieve70 - 90%
 - Passing ½ in. sieve50 - 70%
 - Passing No. 4 sieve30 - 50%
 - Passing No. 10 sieve20 - 34%
 - Passing No. 40 sieve5 - 20%
 - Passing No. 80 sieve2 - 12%
 - Passing No. 200 sieve1 - 6%

The asphaltic material shall form three (3%) to six (6%) percent of the mixture by weight unless otherwise specified.

- **Stability.** The Hveem stability shall be not less than 35.

2.19.5.

Hot Mix Asphaltic Concrete – Fine Graded Surface Course

- **Description.** Fine graded surface course hot mix asphaltic concrete used for street and pavement repair in the City of Colleyville is identical to Type "D" hot mix asphaltic concrete as set forth in TxDOT Item 340. This material is normally used as a "surface" course either on flexible base, concrete, or hot mix base courses.
- **Gradation.**
 - Passing ½ in. sieve.....100%
 - Passing 3/8 in. sieve. 85 - 100%
 - Passing No. 4 in. sieve..... 50 - 70%
 - Passing No. 10 sieve..... 32 - 42%
 - Passing No. 40 sieve..... 11 - 26%
 - Passing No. 80 sieve..... 4 - 14%
 - Passing No. 200 sieve..... 0 - 6%

The asphaltic material shall form from four (4%) to eight (8%) percent of the mixture by weight unless otherwise specified.

- **Stability.** The Hveem stability shall not be less than 35.
- **Tack Coat.** The unit bid prices for coarse graded base course and fine graded surface course shall include the application of a tack coat to each layer of asphaltic concrete before the next layer is applied and a tack coat shall also be applied to any exposed asphalt or concrete edges that shall abut any hot mix asphaltic concrete. The tack coat shall be a liquid asphalt complying with the specifications of the Asphalt Institute for Type RC-70 or RS-1.

2.20. C 1.26 Casing Pipe for Water Crossings

2.20.1. **General.** This specification governs the manufacture of reinforced concrete pipe, corrugated metal pipe, and steel pipe used as casing pipe for water lines.

2.20.2. **Reinforced Concrete Pipe.** Reinforced concrete pipe used for casing pipe shall conform to ASTM C 76. The pipe class shall be as shown on the project plans or set forth in the specifications. When not specified, the minimum pipe class used for casing pipe shall be Class III. The pipe joints shall be tongue and groove, but a rubber O-ring joint seal is not required for casing pipe.

2.20.3. Corrugated Metal Pipe

- **Products.** All corrugated metal pipe used for casing for water and sewer lines shall conform to AASHTO M 36. "Zinc Coated (Galvanized) Corrugated Iron for Steel Culverts and Underdrains." All pipe shall be Type I. Zinc coated iron or steel sheets used in the manufacture of the corrugated metal pipe shall conform to AASHTO M 218.
- **Corrugations.** Pipe corrugations may be either 2-2/3" x 1/2", 3" x 1", or 5" x 1".
- **Metal Thickness.** Unless otherwise specified on the plans or in the contract documents, pipe 36-inch in diameter and smaller shall have a wall thickness not less than 0.064 inches (16 Gage), pipe 42-inch through 54-inch in diameter shall have a minimum wall thickness of 0.079 inches (14 Gage), and pipe 60-inch and larger in diameter shall have a minimum wall thickness of 0.109 inches (12 Gage).
- **Couplings.** Couplings bands shall be of the same base metal and have the same coating as the pipe. Bands shall have a minimum metal thickness of 0.064 inches (16 Gage) and shall have a minimum width of ten and one-half (10-1/2") inches.
- **Pipe Coating.** All corrugated metal pipe used for pipe casing shall be bituminous coated in accordance with AASHTO M 190. The pipe coating shall be Type A, and the minimum thickness of the coating shall be 0.05 inches measured on the crest of the corrugations.

2.20.4. Steel Pipe

- **Products.** All steel pipe used for pipe casing for water and sewer lines shall conform to one of the following ASTM specifications:

ASTM Designation	Title
A 134	"Electric-Fusion (Arc) - Welded Steel Plate Pipe (sizes 16 in. and over)"
A 139	"Electric-Fusion (Arc) - Welded Steel Plate Pipe (sizes 4 in. and over)"
A211	"Spiral-Welded Steel or Iron Pipe."
- **Wall Thickness.** All pipe shall be designed to have a wall thickness enough to sustain the maximum expected overburden as well as the concentrated live loads without deflecting the pipe in excess of five (5%) percent. However, steel casing with wall thickness less than 0.250 inches will not be acceptable in any circumstances.
- **Joints.** Steel pipe for casing installations may be shop fabricated in convenient section lengths for transportation to the jobsite. These sections shall be combined by field welding to provide a single casing assembly over the limits set forth on the plans. Such casing pipe butt welds shall be continuous and free of slag holes.
- **Coatings.** All steel pipe casing shall be cleaned and shop coated inside and out. A uniform bituminous coating at least 0.05 inches in thickness shall then be applied inside and out to the casing. Touch-up after field welding shall be equal to required shop coatings.

Casting pipe may be rejected for failing to meet any of the requirements of this specification.

2.21. C 1.27 Materials for Erosion Control

2.21.1. **General.** This specification governs the quality of materials used for permanent and temporary erosion control after the installation of water lines.

2.21.2. **Hydromulching.** When water or sanitary sewer line construction is outside of proposed and/or existing pavement, the entire trench width shall be hydromulched after backfill and compaction operations have been completed. Areas outside the trench area which have been undermined by excavation or damaged during backfill operations shall also be hydromulched.

- **Description:** Seeding shall consist of preparing and planting seed or a mixture of seed of the kind specified along and across such areas as may be designated on the plans and in accordance with these specifications.
- **Planting Season:** All planting shall be completed between the dates specified for each type except when specifically authorized in writing by the Engineer. The seed planted shall be of a type specified with the mixture, rate and planting dates as follows:
 - Type I: Bermuda Grass (hulled) 2 pounds per 1,000 square feet - March 15 through September 15.
 - Type II: Mixture of Bermudagrass (unhulled) and Annual Rye Grass, 8 pounds per 1,000 square feet (Bermudagrass 2 pounds, Rye Grass 6 pounds) – September 15 through March 15.

2.21.3. **Fertilizer**

- **General:** Fertilizer shall be a commercial product, uniform in composition, free flowing and suitable for application with approved equipment. Fertilizer shall be delivered to the project site in fully labeled original containers. Fertilizer which has been exposed to high humidity or moisture or has become caked or otherwise damaged, shall be rejected.
- **Initial Planting Application:** Fertilizer for the initial planting application shall be of an organic base containing by weight the following (or other approved) ratio of nutrients: 1-2-1 (N-P-K); also containing ten (10%) to fifteen (15%) percent sulfur in sulfate form and traces of iron and zinc as required and approved by the Engineer.
- **Post Planting Application:** Fertilizer for the post planting application shall be a chemical base fertilizer containing by weight the following ratio of nutrients: 3-1-2 (N-P- K). Thirty (30) days after planting, turfgrass areas shall receive an application of the specified fertilizer at the rate of one (1) pound of nitrogen per one thousand (1000) square feet.

2.21.4. **Hyrdomulch**

- Mulch will be manufactured from hardwoods only and will be refined specifically for turf hydromulch applications. Three approved mulches are manufactured by Conwed, Weyerhaeuser and Texas Fiber Co.
- Following soil preparation, seed, fertilizer, mulch and water shall be mixed together and applied to the planting area in the following quantities and rates:

Item	Rate per 1000 Square Feet
Turfgrass	Seed as specified above
Fertilizer	9 Pounds
Water	23 Gallons
Mulch	46 Pounds

- **Maintenance:** Contractor will provide irrigation for at least 30 days after planting and for as much longer as necessary to provide a uniform stand of grass. A uniform stand of grass is defined as not less than 100 growing plants per square foot. Growing plants shall be defined as healthy grass plants of two blades or more at least 1½ inches tall. Growth shall be enough that at least one mowing is required before the grass areas are accepted by the Owner.
- **Replanting:** All areas that do not produce a uniform stand of grass must be replanted and maintained until a uniform stand of grass is established.

2.21.5.

Erosion Control Matting

- In addition to hydromulch seeding, erosion control matting will be required where existing or proposed side slopes are 3:1 or steeper within natural channels, drainage ditches, channel banks or embankments: and in areas where the engineer determines that the soil is erodible. Depending upon the type of soil, steepness of the slope and the channel velocity, either Curlex Blankets (Regular or Hi- Velocity) or Enkamat (7010 or 7020) erosion control matting (or their equivalent) shall be placed upon the areas which have been hydromulch seeded.

2.21.6.

Silt Fencing

- The fabric should conform to the following properties, as determined by the Federal Highway Administration Task Force 25 Guidelines, as measured in the weakest direction:

Test Designation	Topic	Average Roll Minimum Value
ASTM D 4632	Grab Strength	90 lbs @ 12"/min.
ASTM D 4632	Grab Elongation	15% @ 12"/min.
ASTM D 4751	Equivalent Opening Size (EOS)	U.S> Sieve No. 20
ASTM D 4491	Permittivity	>.01 sec. -1
ASTM D 4355	U.V. Resistance (500 Hrs Exposure)	70%

The Mullen burst strength shall be greater than 150 psi. The edges shall be treated to prevent unraveling.

- **Support:** Fence posts shall be spaced a maximum of six feet apart. Woven wire will be used to support the material. Fence posts are to be 4"x4" wood posts or fabricated steel posts.

2.21.7.

Gabion Structure Assembly. Gabions shall consist of rectangular, compartmented wire baskets filled with stone used for slope or bank protection and erosion control on open channels.

Gabion baskets shall consist of uniform hexagonal wire mesh woven in a double twist pattern with openings fabricated in such a manner as to be non-raveling and designed to provide the required flexibility and strength.

The perimeter edges of the twisted wire mesh shall be woven around a reinforcing wire in a

manner designed to prevent slippage. The edges of the mesh shall be securely selvaged. All corners shall be reinforced by heavier wire.

Gabions shall be so fabricated that the sides, ends, lid, base and diaphragms can be readily assembled at the construction site into rectangular baskets with a minimum thickness of one foot. Where the length of the gabion exceeds 1½ times its horizontal width, the gabion shall be divided, by diaphragms of the same mesh and gauge as the body of the gabion, into cells whose length does not exceed the horizontal width. Diaphragms shall be secured in the proper position on the base section.

All dimensions are subject to a tolerance of five (5) percent.

Wire shall conform to the following requirements in accordance with current Federal Specifications QQW-461 Class 3 - Finish 5 - Soft.

Wire for Fabric (Diameter)	3.00 mm plus or minus 2.5 percent
Wire for Selvedges and Corners (Diameter)	3.90 mm plus or minus 2.5 percent
Wire for Binding and Connecting (Diameter)	2.20 mm plus or minus 2.5 percent
Tensile Strength (PSI)	60,000 to 70,000
Weight of Zinc Coating for All Wire	0.80 oz/square foot

The stone shall be graded from three (3") to eight (8") inches. The stone shall have a specific gravity of at least 2.40 and shall have a percent of wear not more than 40 when tested in accordance with Texas Department of Transportation Test Method TEX-410-A.

Geotextile fabric for use as filter media shall be placed with a minimum overlap of eighteen (18") inches. Fabric shall be secured as necessary with pins or other suitable means before placing gabion baskets.

As an alternate to Geotextile fabric, a protective aggregate filter layer may be used. The filter shall be designed by a licensed professional engineer specializing in Geotechnical Engineering.

Gabions may be rejected for failure to meet any of the requirements of this specification.

3. CONSTRUCTION

3.1. C 2.2 Use of Valves in Existing System.

The contractor shall not operate any valve in the existing water system. The valves will be operated only by a City's employee. The City will inspect all valves before initial acceptance of the project. All repairs or replacements required to restore satisfactory operation of the valve shall be at the expense of the Contractor.

3.2. C 2.3 Removal and/or Adjustment of Existing Structures.

This section of the specifications covers the removal and/or adjustment of existing facilities and structures. The removal and satisfactory disposal, adjustment, and replacement of existing structures shall be in accordance with the plans and these specifications.

All structures which are to be salvaged shall be removed in such a manner as to prevent being unduly damaged.

Materials or parts of structures which are to be broken up, dismantled or removed, and which are to be salvaged shall be removed, loaded, cleaned up, hauled, and unloaded at the site designated on the plans or as directed by the City. Materials which are not designated to be salvaged shall become the property of the Contractor and shall be properly disposed of by the Contractor at the Contractor's cost and expense. Asbestos-cement pipe shall be left in the ground where practical. Asbestos-cement pipe removed shall be disposed of in accordance with E.P.A. requirements for the disposal of asbestos materials.

Existing concrete pavements, driveways, curbs, gutters, sidewalks, etc., to be removed shall be broken up and disposed of at approved sites. The limits for removal will be as specified and any excess removal and the replacement thereof shall be at the entire cost and expense of the Contractor. Where permanent paving (concrete or asphaltic concrete) is to be cut, the pavement shall be cut full depth before opening the ditch to insure a neat straightedge. An approved power driven concrete saw, manufactured especially for the purpose of sawing concrete, shall be suitable for the work to be performed, and the cut shall be vertical to the top and face. The exposed face of the cut shall be vertical for the full depth of the pavement. Saw blades shall be designed to make a clean, smooth cut and guides shall be used to provide true alignment of the cut.

The area where the pavement is to be removed by the use of a concrete saw shall be designated on the plans or as designated by the City's representative.

After the removal of structures, all excavations not to be occupied by new work, and all holes created, shall be backfilled with approved materials thoroughly compacted in place.

All damage done to adjacent property or structures shall be repaired by the Contractor at the Contractor's cost and expense to the satisfaction of the City. Any unsightly places created shall be cleaned up and the site left in a neat, clean and orderly condition.

3.2.1. Removal and Replacement of Fence

The Contractor shall do the necessary removing of fencing on the right of way and shall rebuild same after the pipe line work is completed. The fences shall be rebuilt of the same quality of materials or better than that which was removed. All posts, wires and other material shall be sound, straight, equal to or better than the materials removed. Gates shall be replaced in a manner acceptable to the Inspector, and all corner, gate and end posts shall be well braced.

Where fences are removed, the Contractor shall be responsible for the protection of livestock, etc. with temporary fencing.

3.2.2. Poles, Signs, Guy Wires, Etc.

The Contractor shall be responsible for all damage to street sign posts and signs within the limits of operations that remain in place or are removed and replaced. If street sign posts and signs are damaged or destroyed by the Contractor's operations, they shall be replaced at the Contractor's expense.

If requested by the Contractor, regulatory and street name signs which interfere with construction or repair work shall either be relocated or made portable by City traffic forces as needed to avoid undue interference with construction activities, provided that all such regulatory and street name signs remain visible to vehicular and pedestrian traffic.

3.2.3.

Other Utilities

All water mains, water services, sanitary sewers, sanitary sewer house laterals, storm sewers, power conduits, gas mains, gas service laterals telephone lines, cable television lines, and other appurtenances encountered during construction shall be supported or replaced as necessary to insure uninterrupted service.

Where the exact depth of a utility is not shown on a plan, or the utility is not shown, excavation shall be made before reaching the obstruction to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary, and extra compensation will not be paid for such delays.

When it is necessary to remove or adjust another utility, a representative of that utility will be notified to decide method and work to be done. The Contractor shall make satisfactory arrangements with other utilities for the cutting or adjustments required. No extra compensation will be paid due to delays caused by removal of public utility structures or for hand excavation required in or around such structures.

The Contractor will be held liable for any negligent or willful damage to any other utility and shall be expected to pay for the cost of all necessary repairs and any damages resulting to public or private property therefrom.

3.3.

C 2.4 Excavation, Embedment and Backfill

This section of the specifications contains detailed specifications and descriptions concerning the following items of work:

- The furnishing of all labor, materials, tools, equipment and machinery necessary for cleaning and removing from the site of the work, wherever located, all obstructions, trees, stumps, brush, vegetation, wood and debris, and all earth, rock, and other materials to be excavated.
- The removal of existing structures except where specifically paid for as set forth in Section C 2.3, "Removal and/or Adjustment of Existing Structures".
- The furnishing, placing, and maintaining of all sheeting, shoring, and bracing necessary to protect the work and adjacent properties and to support all adjacent structures above and below the ground.
- Providing for all pumping, bailing, and draining necessary to keep the excavation free from seepage water and water from other sources.
- Providing for the uninterrupted flow of sewers and surface waters during progress of construction including bypass pumping or temporary lines.
- Removing, after the completion of the work, of all sheeting, shoring, and bracing not necessary to support the sides of the excavation.
- The furnishing and placing of all embedment called for on the plans and contained in the specifications.
- The satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.
- Backfilling, tamping, compacting, and refilling, after settlement, of all excavation areas.
- The backfilling of all streets, alleys, rights-of-way, easements and other lands, private or public, damaged or occupied by the Contractor in the performance of the contract.
- The replacement of topsoil, where called for on the plans or set forth in the specifications, after backfilling operations have been completed.
- Sodding, sprigging, seeding, or hydromulching where required.
- There will be no classification of excavation. Excavation will include all materials encountered, including

rock, regardless of their nature or the manner in which removed.

3.3.2. **Borings and Subsurface Information**

Any subsurface information shown on plans shall not in any manner be construed as a warranty on the part of the City of the exact nature of the subsurface conditions that will be encountered during construction of the work. It is intended only as a guide to the Contractor in making investigations preliminary to submitting a bid for the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including, but not limited to depth, location, and sizes of pipes or conduits of various kinds in place.

3.3.3. **Excavation – General**

The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials. It is the intent of this specification to provide for the removal and disposal of all objectionable materials not specifically provided for elsewhere by the plans and specifications to a depth of not less than 1 foot below the foundation or subgrade. The removal of such items shall be accomplished before excavation operations. The removal and disposal of such items will not be measured or paid for as a separate contract pay item. Such items will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract.

In general, all excavations shall be made by open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. The quantity of excavation approximately to grade shall not exceed 100 feet from the end of the completed pipe, and no excavation shall be over 300 feet in advance of the completed pipe, unless otherwise authorized.

The sides of the excavation shall be cut and maintained as nearly vertical as practicable to one foot (1') above the top of the pipe and in accordance with current O.S.H.A. Standards. The entire foundation area in the bottom of all excavation shall be firm and stable and, unless necessary, materials shall not be disturbed below grade. "Grade" in this instance is the base of the embedment as will be called for on the plans and/or as detailed. However, any soft, spongy, disintegrated, or other unsuitable materials shall be removed to the depth below grade as directed by the City. Such materials removed shall be replaced with foundation materials as specified in Section C 1.22, "Embedment Materials", or with other material satisfactory to the City and thoroughly compacted in place to the finish grade elevation.

Where the character of the foundation material is such that a proper foundation cannot be prepared at the elevation shown on the plans, then when directed in writing by the City, the Contractor shall deepen the excavation so that a proper foundation can be prepared. If, in the opinion of the City, the condition is the result of the Contractor's negligence to make proper provisions for adequate drainage of the excavation, the cost of the foundation material will not be reimbursed. If the Contractor elects to undercut the trench and use gravel and drain pipe as an underdrain instead of, or in conjunction with, pumping, bailing, draining or well point, the additional work will be considered as incidental work and additional compensation will not be allowed.

Embedment for the pipe, or the pipe itself, will not be laid in water. If the Contractor overcuts the trench it will be brought back to grade by the use of compacted select material from the ditch excavation. The final cleaning and preparing of the foundation area shall be done immediately before the placing of the embedment materials or structures.

3.3.4. **Maximum Width of Trench**

The width of trench at a point one (1') foot above the top of the pipe being laid shall conform to the following table.

Pipe Type	Size (Inches)	Min Width of Trench	Max Width of Trench
Pipe With Bells	6" through 30"	O.D. + 12"	O.D. + 16"
Pipe With Bells	36" and larger	O.D. + 16"	O.D. + 24"
Pipe With Sleeves, Sockets or Couplings	4" through 12"	O.D. + 12"	O.D. + 16"
Pipe With Sleeves, Sockets or Couplings	15" and larger	O.D. + 16"	O.D. + 21"

The above widths are for trenches without sheeting, shoring, or bracing.

If the maximum allowable trench width is not maintained to a point one (1') foot above the top of pipe, the Contractor shall provide at his expense the next higher class of embedment as directed by the City which will provide adequate support for the pipe material being installed.

3.3.5. **Depth of Cut Show on Plans**

Profile elevations shown on plan-profile sheets for sanitary sewer lines are flow line elevations. Grade stakes placed in the field normally are measured from elevations of reference point hub to flow line of pipe to be installed. Payment for depth of cut will be measured from the actual ground elevation at the centerline of the pipe to the flow line of the pipe to be installed.

Profile elevations shown on plan-profile or profile sheets for water lines are top of pipe elevations.

3.3.6. **Bottom of Ditch in Rock**

Where rock is encountered in the ditch at the elevation where the bottom of the pipe rests, the ditch shall be undercut a minimum of six (6") inches or to the depth indicated on the plans or appurtenant drawings for any special type of bedding.

3.3.7. **Pipe Foundation in Wet Trench**

When ground water is encountered, six (6") inches of crushed stone shall be used instead of any other type embedment material. Where the only purpose of the crushed stone is to provide a dry, stable working surface for the convenience of the Contractor, no additional payment will be made for the use of crushed stone instead of lesser embedment material.

Rock foundation, as defined in Section C 1.22 of these specifications, is to be used only if the trench bottom is so unstable that normal construction will not be permitted. Rock foundation will be placed only at the direction and in the location indicated by the City.

3.3.8. **Blasting**

The use of explosives is discouraged. If the use of explosives is necessary and approval by the City is granted, the Contractor may elect to use explosives in the prosecution of the work. Utmost care shall be exercised so as not to endanger life or property. The Contractor shall use only such methods as are currently used by persons, firms, or corporation engaged in a similar construction business. The Contractor shall be solely responsible for the determination as to whether explosives shall be used. The Contractor shall indemnify the City of Colleyville whole and harmless against any claim of damage or injury to persons or property, real or personal, resulting from the use of explosives by the Contractor or any subcontractor. The Contractor shall furnish the City of Colleyville evidence of insurance enough to cover any such possibility. Insurance shall include the City of Colleyville as an additional insured.

All explosives shall be stored in a safe and secure manner, under the care of a competent guard at all times, and all such storage places shall be marked clearly "DANGEROUS- EXPLOSIVES." Blasting caps and explosives shall be stored separately, and not more than 50 pounds of explosives shall be stored on the site. The method of storing and handling explosives and highly inflammable materials shall conform with Federal

and State laws, City of Colleyville ordinances, and Colleyville Fire Department regulations. The Contractor shall notify each utility company with structures in proximity to the site of the work of the intention to use explosives, and such notice shall be given enough in advance to enable the companies to take such steps as they may deem necessary to protect their property for injury. Such notice shall not relieve the Contractor of responsibility for any damage resulting from blasting operations.

No blasting will be permitted within state highway right of way without written permission from the Texas Department of Transportation.

The blasting area will be covered with heavy timbers chained together, a rope mat, or some equally effective method of blast protection, reviewed by the City. In addition to the "DANGEROUS- EXPLOSIVES" sign displayed, two signs marked "EXPLOSIVES, TURN ALL RADIOS OFF" shall be placed in conspicuous locations readily visible to vehicular traffic and not less than 350' from the blasting cap storage area. During each blast, exposed pipe shall be covered with planking.

3.3.9. **Trench Safety, Sheeting, Shoring and Bracing**

The sides of all excavation shall be supported in accordance with O.S.H.A. regulations. In wet, saturated or flowing materials, where it is necessary to install tight sheeting of cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressure exerted and maintain the sides of the excavation properly in place and protect all persons or property from injury or damage. When excavations are made adjacent to existing building or other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of or settlement beneath the structures or pavement. Underpinning of adjacent structures or pavement shall be done by the Contractor at his own cost and expense. When required, the pavement shall be removed, the void satisfactorily refilled, compacted, and the pavement replaced. The entire expense of such removal and subsequent replacement thereof shall be borne by the Contractor.

The removal of all trench safety equipment, sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties, and so as to avoid cave-ins or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials.

3.3.10. **Pumping, Bailing and Draining**

The Contractor shall immediately remove all surface or seepage water from sewers, drains, ditches, and other sources which may accumulate during the excavation and construction work, by providing the necessary underdrains or otherwise, and by doing the necessary pumping, bailing or draining. The Contractor shall have available at all times enough equipment in proper working order for doing the work herein required. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions, cause environmental damage, nor to cause injury to persons or property, or damage to the work in progress, nor to interfere unduly with the use of streets, private driveways or entrances. No water shall be allowed to flow through or over unset concrete or through the completed line. Adequate plugs or night caps shall be properly installed on pipe ends when the work is unattended. No water removed from the site shall be discharged to the City's sanitary sewer system without prior approval of the City.

3.3.11. **Disposal of Excavated Materials**

Suitable excavated materials shall be piled adjacent to the work, in accordance with O.S.H.A regulations, to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the Contractor. The location of suitable disposal sites is solely the responsibility of the Contractor and must be suitable to the Texas Natural Resource Conservation Commission; the City shall in no way be responsible for the actions of the Contractor. No disposal shall be allowed in flood plains or below the 100-year flood elevation of drainage ways.

Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent

to or along the line of the work. The excavated material not suitable for bedding or backfill will be disposed of by the Contractor and suitable selected material will be provided at no cost to the City.

3.3.12. **Protection of Trees, Plants, Shrubbery, Etc.**

No trees shall be removed unless so noted on the plans or upon the specific approval of the City. Where trees, plants, shrubbery, etc., are adjacent to the line of the work and are not to be removed or removed and replaced, the Contractor shall protect such trees, plants, shrubbery, etc., by substantial guards; and if, in the opinion of the City, such trees, plants, shrubbery, etc., would be damaged by machinery, etc., hand excavation may be required. The Contractor shall be responsible for all damages to adjacent trees, plants, shrubbery, etc. All damaged limbs over one (1") inch in diameter shall be sawed clean adjacent to the damaged area or at the trunk and dressed with a suitable tree wound paint. The cost of such protection will not be paid for as a separate contract pay item, and the costs thereof shall be included in such pay items as are provided in the proposal and contract.

3.3.13. **Embedment**

Embedment describes the material in the area below, around, and above the pipe as described below. Embedment shall be one of the following types and conform to the requirements of Section C 1.22 "Embedment Materials":

- **Class "A" Embedment.** The trench shall be undercut to a point four (4") inches below the outside of the pipe. The pipe shall be laid to grade on concrete blocks or bricks and properly jointed. The pipe will then be restrained to prevent flotation. Class "B" Concrete will then be poured on either side of the pipe to form the bedding under the pipe and up the sides of the pipe to a depth of one-fourth (1/4) the outside diameter (O.D.) of the pipe. Before the placement of granular embedment, grades will be checked to insure that no flotation or settlement has occurred. Granular embedment material as defined in Section C 1.22 shall then be placed to a point six (6") inches above the top of the pipe barrel in three-inch (3") to six-inch (6") lifts and compacted to 95 percent \pm two (2%) percent of maximum dry density as defined in ASTM D 698, latest revision.
- **Class "B" Embedment.** The ditch shall be excavated to a minimum of six (6") inches below the finished grade. A minimum six (6") inches of crushed stone shall then be placed in the trench. The crushed stone shall then be compacted, graded and bell holes dug. The pipe shall then be placed on the firm trench bottom and jointed. Crushed stone embedment shall then be placed to six (6") inches above the top of the pipe and compacted.
- **Class "C" Embedment.** The trench shall be undercut to a point six (6") inches below the barrel of the pipe. Six (6") inches of granular embedment material as defined in Section C 1.22 shall then be placed in the ditch and compacted. Bell holes shall then be excavated in the embedment material and the pipe laid and jointed. Granular embedment material shall then be carefully placed around the pipe haunch area to a point six (6") inches above the top of the pipe. The embedment shall then be thoroughly consolidated by mechanical tamping to 95 percent \pm two (2%) percent of maximum dry density as defined in ASTM D 698, latest revision.
- **Class "D" Embedment.** The trench shall be undercut to a point six (6") inches below the barrel of the pipe. Six (6") inches of granular embedment material shall be placed in the ditch and compacted. Additional granular material shall then be placed alongside the pipe to a depth of one-fourth (1/4) the outside diameter of the pipe above the bottom of the pipe and compacted. Select material shall then be placed in the trench to a point six (6") inches above the top of the pipe and consolidated by mechanical tamping to 95 percent \pm two (2%) percent of maximum density as defined in ASTM D 698, latest revision.
- **Class "E" Embedment.** The ditch shall be excavated to a minimum of four (4") inches below the finished grade. A minimum four (4") inches or one-eighth (1/8) of the outside diameter of the pipe of crushed stone shall then be placed in the trench. The crushed stone shall then be compacted, graded and bell holes dug. The pipe shall then be placed on the firm trench bottom, and granular embedment material placed along the sides of the pipe to six (6") inches above the top of the pipe barrel. The granular embedment material shall be placed in three-inch (3") to six-inch (6") lifts and compacted to 95 percent \pm two (2%) percent of maximum dry density as defined by ASTM D 698, latest revision.
- **Class "F" Embedment.** The ditch shall be excavated to a minimum of four (4") inches below the

finished grade. A minimum four (4") inches or one-eighth (1/8) of the outside diameter of the pipe of crushed stone shall then be placed in the trench. The crushed stone shall then be compacted, graded and bell holes dug. The pipe shall then be placed on the firm trench bottom and jointed. Select material shall be placed under the haunch area of the pipe and along the sides to six (6") inches above the top of the pipe. The select material shall be placed in three-inch (3") to six-inch (6") lifts and compacted to 95 percent \pm two (2%) percent of maximum dry density as defined by ASTM D 698, latest revision.

3.3.14.

Backfill

The placing of backfill shall not begin until the pipe has been laid, jointed and embedded. The excavation shall be backfilled only with materials approved by the City. Normally, material excavated from the ditch will be used for backfill, except when granular material is used, provided that all hard rock, stones, or boulders with any dimensions greater than two (2") inches, debris and roots larger than two (2") inches, and any soil balls or clods greater than the maximum allowed lift are removed.

- **Tamped Native Material.** After free moisture is gone from the embedment material, the ditch shall be backfilled with native material and compacted by mechanical methods. If hand pneumatic tampers are used, the backfill shall be placed in layers not exceeding six (6") inches in loose thickness and thoroughly compacted to 95 percent Standard Proctor density at optimum moisture content, + two (2%) percent as determined by ASTM D698, latest revision. Backfill shall be placed in uniform layers completely across the trench, and compaction shall proceed in an orderly, uniform manner. If compaction is performed by the use of heavy tamping (sheep's foot) rollers, backfill shall be placed in layers not exceeding six (6") inches in loose thickness and compacted to 95 percent Standard Proctor density at optimum moisture content, + two (2%) percent as determined by ASTM D 698, latest revision.
- **Sand Backfill.** At the option of the Contractor, in areas where the PI of the native material is less than fifteen (15), and the PI of the native material has been verified by testing, granular embedment material (field sand) may be used as backfill material. If this option is selected, the granular embedment material shall be placed above the previously installed and compacted pipe embedment material shall be backfilled as described above.
- **Backfill in areas with new street construction.** The backfill as described above shall continue to within two (2') feet of the subgrade. At this point the trench shall be widened a minimum of one (1') foot on each side. The remaining two (2') feet shall be native material, mechanically compacted in six-inch (6") loose lifts at optimum moisture content, + two (2%) percent, to a density of 95 percent of maximum dry density, as determined at ASTM D698, latest revision.
- **Testing.** The City of Colleyville shall be responsible for testing during backfill operations. If a test does not meet the requirements as outlined above, the Contractor shall be responsible for the cost of additional testing until the compaction requirements are met.

3.3.15.

Backfill of Service Line Trenches

Backfill requirements for water or sewer house service lines shall be the same as that required for the line to which they connect unless otherwise specified.

3.3.16.

Backfill under Existing Conditions

When existing utility lines have soil or other backfill material removed from beneath them, they will be backfilled in accordance with these specifications before the remaining backfill is placed.

3.3.17.

Maintenance of Streets during Construction

The Contractor shall at all times maintain the surfaces of streets on which he/she is working or has worked. The maintenance required will include the filling of holes, blading or otherwise smoothing of the street surfaces (particularly the trench area), cleaning and removal of surplus excavation material, rubbish, etc., sprinkling of streets with water to abate dust nuisance, and the elimination of interference resulting from blocking the street to residents thereon. Any or all of such operations shall be performed by the Contractor upon demand by the City, but the Contractor shall not wait for instruction from the City before performing maintenance work obviously in need of being done to meet the requirements of these specifications. All costs of work covered by this paragraph shall be included in the prices bid for the various items of work, and no

separate payment will be made. If the Contractor fails or refuses to properly maintain the barricades and/or surfaces of streets on which work is being performed, the City after due notice to the Contractor's Superintendent, will perform the necessary maintenance, and all costs to the City incurred in the performance of such work will be deducted from any monies due or to become due to the Contractor for work performed, or the Contractor will be billed for such costs directly as the City shall elect. Notice to the Contractor to be given by the City shall be in writing, and it shall be delivered to the Contractor's Superintendent or authorized agent. Except in emergency cases, where immediate action is required, the Contractor shall have 24 hours in which to comply with the instructions of the City. Should the Contractor fail to do so, the City will proceed with the work as set forth above. The Contractor shall provide traffic protection as specified in the City of Colleyville's Work Area Traffic Control Manual.

Where traffic must cross open trenches, such as street intersections and driveways, the Contractor shall provide suitable backfill bridges, protective barricades and such other safety equipment as required. The use of machinery must be so regulated as to preclude any unnecessary interference with traffic, utilities, etc. The Contractor shall abide by all applicable Federal, State or Local laws governing excavation work including OSHA and E.P.A. regulations.

3.3.18.

Depth of Cover

- **Sewer Lines.** Sewer lines shall be laid to the grades shown on the plans.
- **Water Lines.** Unless otherwise shown on the plans or plan-profile sheets, water lines in the locations described shall have the following minimum depths of cover:
 - **City Streets.** Within the right of way of city streets, all water lines will be laid with the top of the pipe a minimum of 42 inches below the top of the existing or proposed curb, whichever is lower.
 - **County Type Roads.** Where water lines are installed within the right of way of county type roads (no curb and gutter), the top of the water line shall be at least 48 inches below the elevation of the lowest roadside (borrow) ditch existing on either side of the road.
 - **Open Country.** Across open country, cover over water lines shall be a minimum of 48 inches (48").

3.3.19.

Conditions of Pavement

- **Water Lines.** Trenching, embedment, and backfilling for the installation of water lines will be paid at the unit prices set forth on the plans and in the contract documents.
- **Sewer Lines.** Trenching, embedment, and backfilling for the installation of sewer lines will be paid at the unit prices set forth on the plans and contract documents for the various increments of depth of cut.
- **Trench Foundation Materials.** Trench foundation materials will not be paid for as a separate pay item unless its use is directed by the City.
- **Subsidiary Items.** The following items and/or others not covered by specific bid items will be included in the price bid per foot for the various sizes of water lines and sewer lines over twelve (12") inches in diameter or for "Trenching and Backfill" for sewer lines twelve (12") inches and smaller in diameter:
 - Excavation.
 - Furnishing, placing, and compacting embedment material.
 - Pumping, bailing, and draining as may be required.
 - Maintaining satisfactory condition of streets in work area.
 - Disposal of excess material from ditch (spoil).
 - Placing backfill above embedment.
 - Compaction of embankment above embedment layer by tamping, or other methods as required to obtain the densities specified.
 - Clean-up.
 - Finishing trench surfaces (not including pavement replacement to a condition satisfactory to the Owner).

3.4.

C 2.5 Installation of Concrete Pressure Pipe and Fittings

This section of the specifications covers the installation of any of the various types of concrete pressure pipe and fittings used primarily in the domestic water system.

Where plan-profile or profile sheets are included on the plans, concrete water lines shall be laid to the grades shown.

Where grades are not shown, minimum cover as set forth in Section C 2.4 shall be maintained.

3.4.1. **Embedment**

- **Prestressed Pipe.** The minimum permissible bedding for Prestressed Concrete Cylinder Pipe manufactured in accordance with AWWA C301 shall be Class "D" as set forth in Section C 2.4.
- **Bar-Wrapped Pipe.** The minimum permissible bedding for Bar-Wrapped Concrete Cylinder Pipe manufactured in accordance with AWWA C303 shall be Class "C" as set forth in Section C 2.4.
- **Pipe Cover in Excess of Ten (10') Feet.** Where the depth of backfill over the top of the pipe exceeds ten (10') feet, the embedment shall be of the class shown on the plans or set forth in the contract documents.

3.4.2. **Pipe Handling**

Pipe, fittings, valves and other accessories shall be 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 loading and unloading they shall be lifted by hoists, cranes or rolled on skidways in a manner which avoids sudden shock.

Under no circumstances shall pipe be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground. Pipe shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction in which the work will proceed.

Proper implements, tools, equipment and facilities shall be provided and used by the Contractor for the safe and correct prosecution of the work. All pipe, fittings, specials, valves, etc., shall be lowered into the trench by means of a suitable machine and shall not be rolled or dumped into the trench. The equipment shall have enough capacity to handle the pipe. The method of construction shall be subject to the City's approval. Before being lowered into the trench, each joint of pipe shall be inspected and any unsound or damaged pipe shall be repaired or rejected.

The pipe shall be kept free of all debris during the laying operation. The pipe shall be swept or swabbed before installation. The swab should be of a design acceptable to the City. At the close of each operating day the open end of the pipe shall be effectively sealed against the entrance of all objects, especially water. No pipe shall be laid in water or when the trench conditions or the weather are unsuitable for such work, except in an emergency and then only upon permission of the City.

All pipe shall be laid accurately to established lines and grades with valves and fittings at the required location and with joints centered and spigots pushed home.

Where it becomes necessary to make deflections in line of the pipe, sections of pipe with beveled ends or fabricated fittings shall be used. Minor deflection of the line of the pipe may be obtained in standard pipe joints; however, the maximum joint opening caused by such deflection shall not exceed the recommendations of the pipe manufacturer. Random length pipe and/or grade adapters may be used to make unforeseen changes in the field.

3.4.3. **Pipe Jointing**

Sections of pipe shall be tightly fitted together, and care shall be exercised to obtain true alignment and grade.

Before laying each joint of pipe, the bell and spigot rings shall be thoroughly cleaned by wire brushing and wiping until clean and dry. The gasket and the inside surface of the bell shall be lightly lubricated with a suitable solution (flax soap) which will facilitate the telescoping of the joint. When pipe is being laid, the gasket shall be placed on the spigot ring, and the spigot end of the pipe shall then be entered into the bell of the last,

previously laid pipe and telescoped into position. No "blocking up" of pipe or joints will be permitted.

- **Inside Cement Mortar Joints:** The inside joint recess of pipe shall be filled with mortar and finished smooth with a hand trowel after the joint is engaged. If approved by the City before the commencement of pipe laying operations, mortar for the inside joint of pipe 24-inch and smaller in diameter may be deleted provided that exposed steel in the inside joint recess is coated with a paint recommended by the pipe manufacturer and approved by the City.
- **Outside Cement Mortar Joint.** After the spigot has been telescoped into the bell and the joint checked and found satisfactory, a wrapper shall be placed around the pipe, covering the joint. The wrapper shall be of the quality manufactured by the Mar-Mac Manufacturing Company or approved equal, and shall be hemmed at each edge to allow threading with a steel strap to securely fasten the wrapper around the pipe by means of a stretcher and sealer. The wrapper shall have a minimum width of seven (7") inches for 33-inch pipe and smaller and nine (9") inches for pipe larger than 33-inch diameter and enough length to encircle the pipe, leaving enough space between the ends at the top to allow the cement mortar to be poured. The entire joint shall be poured with cement mortar and consolidated and rodded or agitated to eliminate voids. Before pouring the cement mortar, the joint shall be thoroughly cleaned. Any joint showing shrinkage or excessive cracking shall be cleaned and remade.

Cement Mortar. The mortar used at the joint shall consist of one (1) part Portland cement to two and one-half (2-1/2) parts fine, sharp clean sand mixed with water to the consistency of thickcream. The mortar required at the interior joint shall not be placed in freezing weather unless adequately protected from freezing.

Careful inspection shall be made of each joint to insure a smooth continuous interior surface. The interior of the pipe shall be thoroughly cleaned and cleared of any obstructions that may reduce its carrying capacity.

Where designated on the plans, joints will be electrically bonded and by-pass connectors installed past valves to maintain a continuous electrical circuit through the entire length of pipe.

3.4.4.

Welded Pipe Joints

Where indicated on the plans or specified in the specifications, the concrete pressure pipe shall have welded joints.

Pipe furnished for this type installation shall have joints trimmed or prepared for joint welding, as recommended by the manufacturer and approved by the Engineer.

Before laying, the bell and spigot rings shall be thoroughly cleaned for welding by wire brushing and wiping.

In placing the pipe, the sections shall be fitted together with care being taken to secure true alignment and grades as shown on the plans.

For lined cylinder prestressed pipe, welds will be skip welds as recommended by the manufacturer. For embedded cylinder prestressed pipe, welds will be made on the interior of the pipe and will be continuous.

Slag shall be removed from each welded joint and visually inspected for blow holes before application of grout.

3.4.5.

Protective Coating Applied in Field

The Contractor shall provide a one-inch (1") minimum thickness concrete or cement mortar coating in the field for the protection of all exposed steel such as flanges, caulked joints, threaded outlets, closures, etc. The cement mortar used shall consist of one part Portland cement to two and one-half parts of fine, sharp (plaster) sand. Where shown, coating is to be reinforced with wire mesh.

Any surface receiving a cement mortar coating shall be thoroughly clean and wetted with water just before placing the cement mortar coating. After placement, care shall be taken to prevent the cement mortar coating from drying out too rapidly by covering with damp earth or burlap. Cement mortar coating shall not be applied

during freezing weather.

3.4.6. **Tunnel Installation**

Concrete pressure pipe shall have uniform alignment and bearing when installed as a carrier pipe in a tunnel or encasement pipe. To provide straight alignment and grade, concrete paving within the encasement may be necessary. Concrete pressure pipe to be installed in an encasement pipe will be manufactured with one (1") inch thick x 24 inch wide bands of mechanically impacted mortar in addition to the normal coating as set forth in Section C 1.5 of these specifications. To prevent carrier pipe from floating, a minimum of one hold down jack per joint shall be placed on the pipe. Alternate means and methods for securing pipe in place may be submitted for consideration.

- Twenty-one (21") inch Pipe and Smaller. The first pipe shall be placed in the tunnel leaving the bell end extending outside the tunnel approximately one (1') foot. Interior joint protection shall be applied in a manner consistent with the requirements for all other portions of the pipeline. "Flex-Protex" joint filler as manufactured by the Mar-Mac Manufacturing Co., Inc., or approved equal, shall be placed over the spigot of the second pipe, the rubber gasket positioned in the spigot groove, joint lubricant applied to the joint surfaces, the joint engaged, and the gasket position checked. Both pipe shall then be moved into the tunnel, again leaving the bell end of the second pipe extending approximately one foot outside the tunnel. The above steps shall be repeated until all pipe are placed in the tunnel.
- Twenty-four (24") inch Pipe and Larger. "Flex-Protex" joint filler, or approved equal, shall be used for Bar-Wrapped Concrete Cylinder Pipe, and AWWA C301 Prestressed Concrete Lined Cylinder Pipe. Exterior joint protector placed according to its manufacturer's instructions shall be used for AWWA C304 Prestressed Concrete Embedded Cylinder Pipe. The joint filler shall be placed over the spigot, the rubber gasket positioned in the spigot groove, and joint lubricant applied to the joint surfaces before moving each pipe into the tunnel separately. The joint engagement shall be accomplished and the gasket position checked as each pipe is placed in its final position in the tunnel.

Casing pipe used with concrete pressure pipe shall generally be sized to provide a minimum of fifteen (15") inch clear space above the carrier pipe, with allowance made for bottom skid requirements. After the installation of the carrier pipe in the casing, each end of the casing pipe shall be sealed with brick and mortar or other approved means.

3.4.7. **Pipe Technician**

The pipe manufacturer shall furnish a factory trained, job experienced field representative who shall visit the project at least weekly during the course of installation and at the unloading of the pipe at delivery to insure proper handling. The technician will also be subject to call by the Contractor or City to advise and assist with the solution of field problems.

3.4.8. **Hydrostatic Test**

All taps and corporation stops necessary for the proper testing or chlorination of the main shall be furnished and installed by the Contractor.

Pressure testing of concrete pressure water mains shall be in accordance with Section C 2.31 of these specifications.

3.4.9. **Thrust Blocking**

Reaction or thrust blocking shall be provided at each hydrant, valve, bend, tapping sleeve, tee and at reducers or fittings where changes in pipe diameter occur. Thrust blocks shall be centered on the longitudinal axis of the pipe and extended to solid undisturbed ground. The size and shape of the thrust blocking shall be as shown on the drawings or as specified in the contract documents.

3.5. **C 2.6 Installation of Asbestos-Cement Pressure Pipe**

Asbestos-cement pressure pipe shall not be used for new water line construction, but is included for guidance for repair, maintenance, and connection to existing water lines.

Where plan-profile or profile sheets are included on the plans, asbestos-cement lines shall be laid to the grades shown.

Where grades are not shown, minimum cover as set forth in Section C 2.4 shall be maintained.

3.5.1. **Embedment**

The minimum permissible embedment for asbestos-cement pressure pipe with ten (10') feet or less cover shall be Class "C" as set forth in Section C 2.4 of these specifications. This embedment requires a six (6") inch envelope of granular embedment material completely around pipe.

When the depth of backfill over the top of the pipe exceeds ten (10') feet, the embedment shall be of the class shown on the plans or set forth in the contract documents.

3.5.2. **Storage**

Safe storage shall be provided for material until it has been incorporated into the completed project. The interior of all pipe, couplings, rings, fittings, and other accessories shall be kept free from dirt and other foreign matter at all times.

3.5.3. **Pipe Handling**

At all times material shall be handled with care to avoid damage. Whether moved by hand, skidways, or hoists, material shall not be dropped, bumped, or allowed to impact on itself. In distributing the material at the worksite, it shall be unloaded adjacent to or near the location where it is to be installed.

3.5.4. **Laying and Jointing of Pipe**

- **Lowering of Pipe and Accessories into Trench.** Pipe shall not be lowered into the trench until the pipe bed has been brought to grade. All pipe and accessories shall be inspected for defects. Dirt and other foreign matter shall be removed from the interior and the machined ends before lowering into the trench. Pipe and accessories shall be lowered carefully into the trench in a manner that will prevent damage to pipe and fittings or injury to the installers. The sealing surfaces of all materials shall be kept clean during installation.
- **Pipe Joints.** The machined ends of pipe to be jointed, coupling grooves, and rubber rings shall be cleaned immediately before assembly, and assembly shall be made as recommended by the manufacturer. Care should be taken not to reverse the gasket when placed in the bell. Each pipe joint shall be sealed with a coupling consisting of an asbestos-cement sleeve and two rubber rings or an equivalent coupling or joint of equivalent strength and performance. The pipe joint shall not be deflected either vertically or horizontally beyond the limits recommended by the manufacturer.
 - When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of trench water into the line.
 - Whenever water is excluded from the interior of the pipe, enough backfill shall be placed on the pipe to prevent flotation. Any pipe that has floated shall be removed from the trench and the bedding corrected. No pipe shall be laid when the weather is unsuitable for the proper installation as determined by the City.
- **Pipe Cutting.** Pipe-cutting methods that produce a smooth square cut end without damage to the pipe and that minimize or eliminate airborne particles shall be employed. Safety procedures as recommended by the manufacturers of asbestos-cement pipe shall be strictly adhered to.
- **End Preparation.** Whenever it is necessary to cut a length of pipe in the field, the end shall be prepared as follows:
 - The pipe end of random lengths shall be machined by commercially available field lathes designed for this purpose to ensure that the

diameter, profile, and roundness meet the pipe manufacturer's specifications. The machined surface which the compression ring seals shall be smooth and cylindrical to ensure joint integrity.

- The pipe end of machined overall lengths shall be beveled in accordance with the pipe manufacturer's specifications.

- **Length of Pipe at Fittings and Rigid Structures.** When rigid joints are formed by caulked materials or by bolts with rubber ring seals, such as at fittings, the length of eight (8") inch diameter and smaller pipe fitted into the bell of the fittings shall not exceed 3 ft. 3 in. and the length of ten (10") inch diameter and larger pipe shall not exceed 6 ft. 6 in. At least one flexible joint shall be used between two adjacent rigid joints. A coupling shall be cast in the wall of rigid structures at the point of entry of pipelines to provide flexibility at the wall. To provide additional flexibility, the pipe at the point of entry shall have a laying length of not more than 6 ft. 6 in.

3.5.5. **Thrust Blocking**

Reaction or thrust blocking will be provided at each hydrant, valve, bend, and tee and at reducers of fittings where changes in pipe diameter occur. Thrust blocks shall be centered on the longitudinal axis of the pipe and extended to solid undisturbed ground. This size and shape of the thrust blocking shall be as shown on the drawings or as specified in the contract documents.

3.5.6. **Plugging of Dead Ends**

Plugs shall be inserted into the bells of all dead-end fittings. Spigot ends of fittings and plain ends of pipe shall be capped. Thrust blocking shall be provided at all dead ends of pipe that are capped or plugged. Capped or plugged outlets to fittings shall be tied to the fittings and shall be restrained according to the fitting manufacturer's recommendations.

3.6. **C 2.7 Installation of Polyvinyl Chloride (PVC) Water Pipe**

This section of the specifications covers the installation of polyvinyl chloride (PVC) pressure pipe manufactured under AWWA C900 or AWWA C905 for use in the water distribution system.

Where plan-profile or profile sheets are included on the plans, PVC lines shall be laid to the grades shown. Where grades are not shown, minimum cover as set forth in Section C 2.5 shall be maintained.

3.6.1. **Embedment**

The minimum permissible Embedment for PVC pressure pipe with ten (10') feet or less cover shall be Class "C" as set forth in Section C 2.4 of these specifications. Basically, this Embedment requires a six (6") inch envelope of granular Embedment material completely around the pipe.

Where the depth of backfill over the top of the pipe exceeds ten (10') feet, the Embedment shall be of the class shown on the plans or set forth in the contract documents.

3.6.2. **Storage**

Safe Storage shall be provided for material until it has been incorporated into the complete project. The interior of all pipe, couplings, rings, fittings, and other accessories shall be kept free from dirt and other foreign matter at all times. The pipe shall be adequately protected, as recommended by the manufacturer, from damage from sunlight during Storage.

3.6.3. **Pipe Handling**

At all times material shall be handled with care to avoid damage. Whether moved by hand, skidways, or hoists, material shall not be dropped, bumped, or allowed to impact on itself. Any damaged pipe will be rejected.

In distributing the material at the worksite, it shall be unloaded adjacent to or near the location where it is to be installed.

3.6.4.

Pipe Curvature

If necessary, the trench may be curved to change direction or avoid obstruction within the limits of the curvature of the pipe as shown in the following table:

Pipe Size Minimum	Allowable Radius (Feet)
4	100
6	150
8	200
10	250
12	300

The approximate force and offset per twenty (20') feet length to accomplish these curvatures for Class 150 pipe are as follows:

Pipe Size (Inches)	Offset Per 20' Length (Inches)	Force per 20' Length (Pounds)
4	23	20
6	16	60
8	12	135
10	9	250
12	8	425

3.6.5.

Pipe Laying and Jointing

The pipe shall be laid and jointed in the following manner:

- **Clean Ring and Spigot.** The gasket, groove, and pipe spigot shall be wiped clean of all foreign materials.
- **Install Gasket.** Insert the ring in the groove taking care to see that the gasket is evenly seated and free from twists. Some pipe gaskets are installed at the factory.
- **Apply Lubricant.** Lubricate the spigot end of the pipe from the pipe end to the full insertion mark. The coating should be the equivalent of a brush coat of enamel paint. Use only the lubricant approved by the manufacturer. After the spigot end has been lubricated it must be kept clean and free of dirt, sand, or Embedment material. If foreign matter adheres to the lubricated end, the spigot must be wiped clean and relubricated.
- **Assembly.** After the pipe sections are aligned, the spigot end should be pushed into the bell or coupling until it hits the stop and/or the reference or insertion mark is in the proper location. The recommended assembly method is using a bar and a block. Pullers such as a "come along" may also be used if the pipe is protected from the chain or cable.
- **Use of Swab.** A swab shall be pulled through each joint after the joint is embedded in the trench.

3.6.6.

Pipe Cutting and Beveling

All field cuts must be square (perpendicular to the pipe centerline), and pipe shall be marked completely around its entire circumference before cutting to assure a square cut.

Using a factory finished end as a guide, all field cut pipe shall be beveled using a bevel tool, a coarse file, or a rasp.

3.6.7. **PVC Pipe in Casings**

When PVC pressure pipe is installed in casings, skids shall be used along the pipe barrel to insure that the pipe does not rest on its bells or couplings as recommended by the manufacturer. Skids may extend for the full length of a pipe - including bell and spigot portions - or may be spaced at intervals. Skids shall be fastened securely to the pipe with strapping, cables, or clamps. Raci spacers will not be allowed. Stainless steel straps with rubber gromets only.

3.6.8. **Thrust Blocking**

Reaction or Thrust Blocking shall be provided at each hydrant, valve, bend, tapping sleeve, tee and at reducers or fittings where changes in pipe diameter occur. Thrust blocks shall be centered on the longitudinal axis of the pipe and extended to solid undisturbed ground. The size and shape of the Thrust Blocking shall be as shown on the drawings or as specified in the contract documents. Joint restraining devices manufactured and installed in conformance with the requirements of UNI B-13 "Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride (PVC) Pipe" may be used for AWWA Standard C900 pipe.

3.7. **C 2.8 Installation of Ductile Iron Pipe**

This section of the specifications covers the installation of ductile iron pressure pipe. Except as modified below installation of ductile iron pipelines shall be in accordance with ANSI/AWWA C600.

Where plan-profile or profile sheets are included on the plans, ductile iron lines shall be laid to the grade shown.

Where grades are not shown, minimum cover as set forth in Section C 2.5 shall be maintained.

3.7.1. **Embedment**

The minimum permissible Embedment for ductile iron pressure pipe shall be Class "C" as set forth in Section C 2.4. of these specifications. This Embedment requires a six (6") inch envelope of granular Embedment material completely around the pipe.

3.7.2. **Polyethylene Wrapping**

All ductile iron pressure pipe used in the water distribution system shall be fully wrapped – including appurtenances - with polyethylene wrapping as set forth in Section C 1.20 of these specifications.

Ductile iron pressure pipe used in the sanitary sewer system shall also require a polyethylene wrapping unless specifically shown otherwise on the plans or called for in the project contract documents.

3.7.3. **Pipe Handling**

Ductile iron pipe and appurtenances shall be lowered into the trench in such a manner as to preclude damage to the pipe, appurtenance, their linings and the polyethylene wrap. Damage to the lining shall be repaired in accordance with provisions set forth in ANSI/AWWA C104/A21.4. Damage to the polyethylene wrap shall be repaired in accordance with provisions set forth in ANSI/AWWA C105/A21.5. The pipe is to be kept clean during laying operations and sealed against the entrance of all objects at the close of each operating day.

Where it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint shall be

made in accordance with the manufacturer's recommendations.

3.7.4. **Joint Making**

The type of joints will be mechanical joint or push-on joints as set forth in Section C 1.18 of these specifications. The methods of making each type of joint will be in accordance with the requirements of ANSI/AWWA C600.

3.7.5. **Ductile Iron Pipe in Tunnel**

Ductile iron pipe installed through casing pipe shall be of mechanical or push-on joint. Timber skids, or other types acceptable to the City, shall be furnished and installed as necessary. Each joint shall be made up complete, tightened, and gasket position gauged before the pipe being placed into final position in the casing pipe.

3.7.6. **Thrust Blocking**

Reaction or Thrust Blocking shall be provided at each hydrant, valve, bend, tee, tapping sleeve, and at reducers or fittings where changes in pipe diameter occur. Thrust block shall be centered on the longitudinal axis of the pipe and extended to solid undisturbed ground. The size and shape of the Thrust Blocking shall be as shown on the drawings or as specified in the contract documents.

3.8. **C 2.12 Installation of Ductile Iron Fittings**

This section of the specifications covers the installation of ductile iron fittings.

3.8.1. **Types of Fittings**

Ductile iron fittings shall consist of crosses, tees, bends, offsets, plugs, caps, sleeves, connecting pieces, etc. for use with PVC and ductile iron piping systems.

3.8.2. **Jointing**

- **Mechanical Joint.** Shall comply with procedure set forth in Section C 1.18 of these specifications
- **Push-On Joint.** Shall comply with procedure set forth in Section C 1.18 of these specifications.
- **Flanged Joints.** Flanged connections shall be made by means of erection bolts and drift pins without undue forcing and with no restraint on the ends of the pipe or fittings which would prevent pressure from being evenly and uniformly applied to the gasket. The gaskets shall be full face, manufactured true to shape from approved black neoprene rubber stock of a thickness not less than one-sixteenth (1/16") inch. The gasket shall be of virgin stock and shall conform to the physical and test requirements specified in ANSI WA C111. Finished gaskets shall have holes punched by manufacturer and shall match the flange pattern in every respect. Frayed cut edges resulting from jobsite gasket fabrication shall not be acceptable except under emergency conditions, and then only when specifically approved. The pipe or fitting must be free to move in any direction while bolting. Flanged bolts shall be installed with all bolt heads faced in one direction except specified otherwise.

3.8.3. **Polyethylene Wrapping**

All ductile iron fittings shall be fully wrapped (double wrapped) with polyethylene wrapping as set forth in Section C 1.20 of these specifications.

3.9. **C 2.13 Fire Hydrant Installation**

This section of the specifications covers the installation of fire hydrants.

3.9.1. **Fire Hydrant Leads**

All fire hydrant leads shall be at least six (6") inches in diameter. Where fire hydrant leads are stubbed from mains eight (8") inches and larger in diameter, a gate valve shall be installed in the hydrant lead between the fire hydrant and the main. Where fire hydrants are located along the major thoroughfares or streets with large volumes of traffic, a gate valve will be installed in the hydrant lead regardless of the size of the supply main if so directed by the City. On fire hydrant leads requiring gate valves the gate valve shall be restrained to the main.

3.9.2. **Fire Hydrant Location**

Where possible, fire hydrants shall be located so that the face of the fire hydrant is three (3) to five (5) feet behind the back of the curb with the steamer nozzle facing the street. Fire hydrants will be located outside of curb returns at intersections and outside of all sidewalks.

The City may vary this location somewhat if street paving procedures require it.

3.9.3. **Depth of Bury**

The normal depth of bury shall be four (4') feet unless otherwise shown. In no case shall the depth of bury exceed six (6') feet. Where main depths are greater than six (6') feet, offsets, bends, and fittings as required shall be used to reduce the depth of bury to no more than six (6') feet. Fire hydrants installed between four (4') feet and six (6') feet deep shall be installed with Gradeloc or ductile iron fittings.

3.9.4. **Installation**

The hydrant shall be set vertical and to a depth such that the center of the steamer nozzle is not less than sixteen (16") inches nor more than twenty (20") inches above curb grade.

Each fire hydrant shall be set on a concrete slab as shown in standard detail W-2.

Around the base of the hydrant there shall be placed not less than seven (7) cubic feet of washed gravel to provide reservoir capacity so that the hydrant will completely drain when closed.

The hydrant shall be carefully and firmly blocked against firm trench walls with Class "A" concrete. Provisions must be made to protect the hydrant drain from blockage.

3.10. **C 2.14 Gate Valve and Tapping Sleeve and Valve Installation**

This section of the specifications covers the installation of gate valves and tapping sleeves and valves.

3.10.1. **Handling Gate Valves**

Valves shall be carefully handled and lowered into position in such a manner as to prevent damage to any part of a valve. The valve shall be placed in the proper position and held securely until all connections have been made.

3.10.2. **Installing Gate Valves**

Where valves are to be placed in concrete vaults or structures, the floor or bottom shall be completed before installing the valve. The valve shall be securely blocked so that its weight is carried by the floor rather than being supported by the connected piping.

Valves not housed in concrete structures shall be supported on the bottom and sides by Class "A" concrete. An

adjustable cast iron valve box and cover shall be provided for each buried valve including by-pass valves. All valve boxes shall be two (2) piece screw type with the stem or extension (if required to bring operating nut to within four (4') feet of natural ground or finished grade) in a truly vertical position with the box centered over the operating nut.

The use of pieces of asbestos-cement, PVC, or cast or ductile iron pipe as valve boxes shall not be permitted. However, ductile iron pipe shall be used on valves deeper than six (6') feet, but in all cases the top portion shall be an adjustable screw type valve box. Ductile iron pipe shall not be in pieces, but shall be one solid piece.

When the valve box is in position and the top of the box adjusted to the proper elevation, select backfill material shall be placed around the valve box and thoroughly tamped. After compaction the contractor shall verify that the valve has remained in a vertical position for ease of valve operation.

3.10.3. **Installing Tapping Sleeves and Valves**

Mechanical joint and two (2) piece tapping sleeves shall be used. The use of caulked type tapping sleeves will not be permitted.

Before placement of the tapping sleeve, the surface of the pipe to be tapped shall be thoroughly cleaned.

Tapping sleeves shall be oriented so that the valve setting shall be truly vertical.

The procedure for installing tapping valves shall be identical to that described above for gate valves. Concrete blocking shall be placed in accordance with standard detail W-5. The tapping sleeve shall have thrust blocking placed as for a tee or plug.

3.11. **C 2.15 Combination Air Valves**

This section of the specifications covers the installation of combination air valves in the water supply and water distribution system.

3.11.1. **Valve Sizes**

Minimum size valves and fittings shall be in accordance with the following table or as indicated on the plans:

<u>Main Size</u>	<u>Valve Size</u>
16" through 36"	2"
39" and larger	3"

Equivalent sized taps shall be provided for the above sized valves.

3.11.2. **Access Manhole and Exhaust Piping**

All air and combination air valves shall be installed in manholes with a minimum inside diameter of 48 inches. Outside paved areas, Class III Reinforced Concrete Pipe (ASTM C 76) may be used for the access manhole with a 3/8-inch thick steel cover with a two-inch (2") rim sized to fit over the pipe.

Outside paved areas, the exhaust piping may penetrate the steel cover of the access manhole. Inside paved areas, the exhaust piping shall be sloped upward to a point outside the paved area.

3.12. **C 2.16 Installation of Miscellaneous Valves**

This section of the specifications covers the installation of miscellaneous valves, flap valves and check valves, in water systems.

3.12.1. Handling

Valves shall be carefully handled and lowered into position in such a manner as to prevent damage to any part of the valve. The valve shall be placed in the proper position and held securely until all connections have been made. Valves shall be wrapped with polyethylene wrap as described in Section C 2.17.

3.12.2. Installation of Flap and Check Valves

Where check valves are to be placed in concrete vaults or structures, the floor or bottom shall be completed and inspected before installing the valve. The valve shall be securely blocked so that its weight is carried by the floor rather than being supported by the connected piping.

When installing flap valves on the end of a pipe run, the valve shall be installed in a truly vertical position.

3.13. C 2.17 Installation of polyethylene Wrap

This section of the specifications covers the installation of polyethylene wrap on ductile iron pipe and all fittings and valves in accordance with ANSI A21.5/AWWA C105, latest revision.

To form a dielectric barrier against electrolytic soil action, polyethylene wrap shall be used on all ductile iron pipe fittings and appurtenances.

3.13.1. Installation on Pipe

To install polyethylene wrap on ductile iron pipe, the following procedure shall be followed:

- **Place Wrapping on Pipe:** By the use of a sling or pipe tongs, the pipe shall be raised a suitable working distance off the ground. A polyethylene tube approximately two feet longer than the pipe joint shall be slipped over the spigot end of the pipe, centered, and the excess length gathered near the hoisting sling. The wrapping shall be taped so that smooth unwrinkled wrapping extends one foot past the spigot end. The polyethylene tape furnished shall be in conformance with Section C 1.20.
- **Lower Pipe into Place.** The pipe shall be lowered into the trench and the joint made with the preceding pipe section. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.
- **Complete the Wrapping Installation.** After the pipe joint has been made, the bunched polyethylene from the preceding length of pipe shall be pulled over the new pipe length and taped or otherwise secured. The end of the polyethylene on the new pipe section shall be slipped over the first wrap until it overlaps the joint for one (1') foot the end of the preceding length of pipe. The overlap shall be secured in place.
- The slack width shall be taken up to make a snug, but not tight, fit along the pipe barrel and secured at the quarter points.
- **Repairs.** Any rips, punctures, or other damage to the polyethylene shall be repaired with polyethylene tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured in place.
- **Successive Pipe Runs.** Repeat steps Place Wrapping on Pipe bullet through The Slack width shall be taken bullet.

3.13.2. Installation on Fittings and Specials

Fittings, such as bends and reducers, shall be wrapped in a manner similar to that described in paragraph C 1.20. However, all bolts on mechanical joint and/or flanged fittings shall receive an extra (separate) wrapping of polyethylene in addition to that described herein. This wrapping shall be beneath the overall wrapping and shall be taped in place using the approved materials. Polyethylene wrapping shall have no bulges, large air gaps or pockets which can accommodate ground water left when the wrapping is completed.

Appurtenances such as valves, hydrants, crosses, etc., shall be wrapped by splitting, tucking and overlapping the polyethylene tube, then closing the field made splices with the required tape. All seams shall be folded twice before taping in accordance with AWWA C 105.

Material to cover valves may be acquired from the overlapping excess polyethylene tube on the adjacent pipe lengths. The tubing should be drawn over the bell of pipe on either side and insulated with field made seams as described above.

Hydrants shall be encased with the polyethylene tubing slipped over the hydrant and extended to a point two (2) to three (3") inches above the ground line. The wrap shall be perforated in the drain region to allow normal drain function of the hydrant.

All fittings and specials that require concrete blocking shall be completely wrapped before pouring the concrete blocking.

3.14. **C 2.18 Water Service Line Installation**

This section of the specifications governs the construction of water services used to connect the customer's water meter to the City main.

"Service" shall be defined as a service line to an individual customer consisting of a corporation stop, Type "K" copper tubing, quarter bend coupling, curb stop, meter coupling, threaded galvanized pipe nipple, and a second meter coupling. A meter box, furnished by the Contractor, shall be placed over the curb stop and connected threaded galvanized nipple spacer. Thread protector caps shall be placed on any exposed pipe threads.

"Bullhead" service shall not be allowed and is defined as an individual service line with branches at the end to serve two customers consisting of a corporation stop, Type "K" copper tubing, quarter bend coupling, U-branch connection and curb stops. Each leg of the U-branch connection shall have a curb stop, meter coupling and threaded galvanized nipple spacer and be enclosed in a City furnished meter box. All exposed pipe threads shall be protected with a thread protector.

3.14.1. **Taps**

All taps in ductile iron water mains shall be installed through a bronze double strap tapping saddle.

Taps in concrete cylinder water mains shall be made where possible at locations where factory fabricated threaded couplings exist. A bronze or brass bushing shall separate the corporation stop from the steel coupling. At locations other than where factory fabricated threaded couplings exist, taps shall be made through a double strap tapping saddle. Taps in PVC water lines shall be made using double strap tapping saddles.

Taps shall not be made at an angle of more than 45 degrees above the spring line of the pipe. All taps on PVC water mains shall be in accordance with Unibell standards.

3.14.2. **Location and Depth of Cover**

All water services shall be located so that the edge of the meter box nearest the street is located three (3') feet behind the back of the curb unless otherwise approved by the City. At the point where the water services cross beneath the curb, the minimum depth of cover from the bottom of pavement shall be three (3') feet. The end of the water service shall be located six (6") inches to ten (10") inches below the top of the meter box when the meter box is placed flush with the finish grade of the parkway.

Where meter banks are installed (three or more meters), permanent metal tags with addresses shall be installed on the service line at the curb stop to correlate the service with the address to be served. Where existing services are to be connected to for tie-ins or relocations, a compression coupling shall be used to make the connection. Only full length joints of pipe shall be used for connecting to an existing service or for a new service being installed within the pavement area of a street for services larger than one-inch (1") in diameter. No couplings shall be installed within the pavement area of the street for services one-inch (1") in diameter and smaller.

3.14.3. **Meter Box Installation**

After the curb and gutter and base courses of asphalt have been installed and the street contractor has restored to good condition the parkway area behind the curb, the contractor shall install a Contractor furnished meter box over the end of each water service.

3.14.4. **Testing**

Each water service line shall be checked for leaks and full flow at the time the water mains are pressure tested.

3.15. **C 2.19 Vault Construction**

This section of the specifications covers the construction of vaults for water valves, control devices, large meters, etc.

3.15.1. **Water Line Vaults**

Vaults may be of Class "A" reinforced concrete, precast reinforced concrete or as specifically shown on the project plans. If not shown on the project plans or appurtenant drawings, the following requirements shall govern:

- Cast-in-place vault walls shall be formed on both sides to the specified thickness. Unless shown otherwise on the project plans or in the contract documents, walls shall not be less than six (6") inches in thickness.
- The top slab, floor and inside walls of vaults shall be completely sealed with two coats of Thoroseal (off-white) as manufactured by Thoro System.

3.16. **C 2.22 Elevated Crossings**

This section of the specifications covers the installation of elevated crossings of water lines over creeks and waterways.

3.16.1. **Foundations**

Foundations for elevated crossings will be drilled shafts of a diameter enough to carry the dead and superimposed loads. Where rock is present, drilled shafts shall penetrate into sound rock at least 2 feet.

Where no rock is present, the minimum depth of drilled shafts shall be at least ten feet (10') below the bottom of the stream bed.

The use of spread footings as a foundation for elevated crossings is to be avoided.

All drilled shafts will be constructed of Class "A" concrete in accordance with the plans.

3.16.2. **Carrier Pipe**

Where the pipe acts as a structural beam and is not supported by a truss, I beam, etc., the pipe shall be either ductile iron or concrete cylinder pipe specifically manufactured and fabricated for the individual project. There shall be at least one foundation support for each joint of pipe. At each support, the carrier pipe shall be secured to the support with galvanized steel straps.

3.16.3. **Anchorage**

Elevated crossings shall be anchored at each end where the pipe structure enters the ground. Anchorages shall be constructed of Class "B" concrete and of such a size and configuration as shown on the plans and specifications.

3.17. **C 2.23 Construction of Bored, Jacked or Tunneled Crossings**

This section of the specifications governs the installation of encasement or carrier pipe for water mains by the methods of jacking, boring or tunneling.

Where encasement or carrier pipe is required to be installed under railroad embankments or highways, streets, or other facilities by jacking, boring or tunneling methods, construction shall be made in a manner that will not interfere with the operation of the railroad, highway, or other facility, and will not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and

pedestrians shall be furnished and maintained, as approved by the City, until the backfill has been completed and then shall be removed from the site. The Contractor shall notify the Railroad Company or Texas Department of Transportation at least 48 hours before construction. The Contractor shall provide insurance with limits as required by the governing authority.

The drilling of pilot holes for the alignment of pipe before its installation by jacking, boring or tunneling will not be a requirement but may be necessary to maintain grade. The drilling of pilot holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract.

The Contractor shall take the proper precautions to avoid excavating beyond the limits of excavation needed to install the pipe. All damages shall be repaired or replaced at the Contractor's expense.

The removal of any obstruction that conflicts with the placing of the pipe will not be measured for Payment or paid for as a separate contract pay item.

The removal of any such obstruction will be included in such contract pay items as are provided in the proposal and contract.

The Contractor shall dispose of all surplus materials at the Contractor's expense.

Jacking, boring, or tunneling may be used instead of open cut at the Contractor's discretion. No additional compensation will be provided.

All excavations shall be safely secured at all times to prevent unauthorized access to the excavation site.

3.17.1.

Construction by Jacking

If the grade of the pipe at the jacking end is below ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. This excavation shall not be carried to a greater depth than is required for placing of the guide and jacking timbers and no nearer the roadbed than the minimum distance shown on the plans.

At the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored in such a manner to adequately prevent caving or sliding of the walls into the trench or pit and be in accordance with OSHA standards for trench safety.

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head not less than 6 inches larger than the outside diameter of the pipe, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure uniformly will be applied to the pipe uniformly around the ring of the pipe. The jacking head shall be of such weight and dimensions that it will not bend or deflect when full pressure is applied at the jack. The jacking head shall be provided with an opening for the removal of excavated materials as the jacking proceeds. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides which are straight and securely braced together in such a manner to support the section of the pipe and to direct it in the proper line and grade. All timber and other materials used in the construction of the jacking assembly will be of such quality and dimensions that they will withstand all stresses to which they are subjected in such a manner as to insure even pressures on the pipe during jacking operations. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

As the jacking proceeds, the embankment materials shall be excavated slightly in advance of the pipe in such a manner to avoid making the excavation larger than the outside diameter of the pipe, with the excavated material being removed through the pipe. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the grade of the pipe. The excavation for the top half of the pipe shall conform closely to the outside diameter of the pipe and a clearance greater than two (2") inches will not be permitted. All voids between the pipe and the earth will be filled with grout proportioned one (1) part Portland cement to five (5) parts washed sand and an air entrainment agent to facilitate grout flow if necessary. Grout holes may be provided in the pipe or grouting may be made through drill holes from the ground surface if

practical. The grouting shall follow immediately upon completion of the jacking operation.

All carrier pipe installed by jacking shall be supported by quarter point cradle of Class "B" concrete across the jacking pit and to the first joint in the ditch section on each end.

The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two (2') feet in any case. Preferably, the pipe shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the plans will be permitted only to the extent of one (1") inch per ten (10') feet, provided that such variation shall be regular and only in one direction and that the final grade the flow line shall be in the direction indicated on the plans.

When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be repaired or removed and replaced at the Contractor's expense.

The pits or trenches excavated to facilitate jacking operations shall be filled immediately after the jacking of the pipe has been completed unless an encasement pipe only has been installed; in which case, the trenches and pits shall be left open until the carrier pipe has been laid through and manholes have been built if required. The pipe or trenches will then be backfilled.

3.17.2.

Construction by Boring

The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft will be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints. All carrier pipe installed by boring shall be supported by quarter point cradle of Class "D" concrete across the boring pit and to the first joint in the ditch section on each end. All bore pits and other excavations shall be completed in accordance with OSHA standards.

All voids will be grouted with a 1:5 minimum mix of Portland cement and clean washed sand with enough air entertainment to facilitate flow. Grout will be considered a part of the unit price of the boring operation.

3.17.3.

Construction by Tunneling

The tunnel shall be excavated in such a manner and to such dimensions which will permit placing of the proper supports necessary to protect the excavation in accordance with OSHA standards. The Contractor shall take proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation shown on the plans. All damages by excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced at the Contractor's cost and expense.

Adequate provisions shall be made for safety and health of the workers in accordance with OSHA standards. All equipment operated in the tunnel shall be powered by either air or electricity. No equipment will be permitted in the tunnel that uses a petroleum product for fuel. Electric lights shall be used for illumination of the tunnel construction.

The Contractor shall monitor the quality of air in the tunnel in accordance with OSHA standards.

An enough supply of fresh air shall be provided and maintained at all times in all underground places and provisions shall be made for the quick and complete removal of gases and dust resulting from blasting or other tunnel operations. Except when unnecessary due to natural ventilation, artificial ventilation shall be maintained in the tunnel by ventilating plants of ample capacity operated when needed to meet the preceding requirements.

If required by the plans or if required for safety, suitable steel or timber sheeting, shoring and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided that they clear the

encasement or carrier pipe. No separate Payment will be made for supports left in place. Nothing contained herein shall prevent the Contractor from placing such temporary or permanent supports as shall be deemed necessary, nor shall it be construed as relieving the Contractor from full responsibility for the safety of the work, and for all damages to persons and property.

If specified, the entire void between the outside of the pipe and the tunnel walls shall be backfilled with Class "D" concrete or grouted with 1:5 minimum mix grout of Portland cement and clean washed sand with enough entrained air to facilitate flow. The minimum thickness of concrete required for backfill in excess of the minimum dimensions shown on plan will be at the entire expense of the Contractor. The carrier pipe shall be inspected by televising or other means to insure that the pipe is constructed to proper line and grade before placement of grout.

All pipe damaged during operations shall be repaired or removed and replaced at the Contractor's expense.

3.17.4. **Joints**

When reinforced concrete pipe 24 inches and larger in diameter with tongue and groove joints is used for the encasement pipe, the interior joints for the full circumference shall be sealed and packed with mortar and finished smooth and even with the adjacent section of pipe.

3.18. **C 2.24 Removal and Replacement of Paved Surfaces**

This section of the specifications covers the removal of paved surfaces for the installation of water facilities and the replacement of these paved surfaces after the utilities have been installed.

3.18.1. **Detours and Barricades**

The Contractor shall deliver a construction traffic control plan to the City Transportation Department for approval. After approval, the Contractor shall, before closing any street or causing any obstruction to traffic on any street, furnish and erect suitable barricades and warning signs to protect the traveling public, as set forth in the Texas Municipal Uniform Traffic Control Devices (TMUTCD). The barricades and warning signs will be constructed, placed, and adequately maintained as directed by the City.

3.18.2. **Cuts of Sidewalk, Driveway, or Curb and Gutter**

When a sidewalk, driveway, or curb and gutter are cut, such cuts shall be made with a pavement saw. At the discretion of the Owner, the Contractor may break out sidewalks, driveways, curb and gutter, etc., to the nearest expansion joint, but no additional Payment will be made for the removal and replacement of the additional pavement unless previously approved by the City.

3.18.3. **Pavement Cuts**

Before removal, all existing pavement shall be cut with a pavement saw the full depth of the pavement to be removed. If the depth of cut is not enough and a ragged edge results, the pavement shall again be sawed and a neat straightedge established. The additional saw cut and pavement replacement shall be at the Contractor's expense.

In reinforced concrete streets, the reinforcement shall be cut at the centerline of the ditch and bent back.

3.18.4. **Pavement Replacement**

■ **Type 1.** Asphalt Street HMA - Hot Mix Asphaltic Concrete.

- The existing pavement shall be sawed to a neat straight line and removed. This line shall be as shown in the standard details for existing street backfill and repair.
- The pipe and Embedment shall be installed as shown in the standard Embedment details, and Embedment material shall extend to a point at least one (1') foot above the top of the pipe.

- Tamped native material shall then be placed in the ditch from the top of Embedment to the bottom of the 2:27 concrete or cement treated base as shown on the standard detail for existing street backfill and repair.
- This material shall be thoroughly compacted after placement.
- An eight-inch (8") layer of 2:27 concrete or cement treated base, extending twelve (12") inches outside the ditch line on each side shall be placed to a point six (6") inches below the existing surface
- A tack coat of MS-Z or SS-1 shall be applied to the surface of backfill material and the edge of the existing hot mix. The tack coat shall be applied to each layer at a rate not to exceed 0.05 gallons per square yard of surface.
- Six (6") of HMAC Type D or two (2") inches of HMAC Type D and four (4") inches of HMAC Type B or shall be placed and compacted.

■ **Type 2.** All Concrete Streets

- The existing pavement shall be sawed full depth to a neat straight line and removed. This line shall be at least twelve (12") inches back of the firm banks of the ditch when the ditch width conforms to maximum and minimum widths as set forth in Section C 2.4.
- The pipe and Embedment material shall be installed, as shown in the Embedment details and granular Embedment material or crushed stone shall extend to a point at least one (1') foot above the top of the pipe. This material shall be thoroughly tamped after placement.
- Tamped select native material shall then be placed in the ditch from top of Embedment to within one foot (1') below the bottom of the existing concrete surface.
- Eight (8") inches of 2:27 concrete or cement treated base backfill material shall be placed in the ditch to the bottom of the original pavement surface.
- Any material remaining between the sawed removal lines shall be removed to the bottom of the original pavement surface.
- Install No. 4 rebar doweled at least 30 inches in length on 24" inch centers into existing pavement. Steel rebar shall be No. 4 bars on 24" centers installed both ways.
- All concrete paving shall be replaced at a minimum thickness of six (6") inches or to match existing pavement thickness and shall be poured and finished by broom or burlap drag to match existing surface. Type 2 (white pigmented) curing compound shall be applied to the surface of the slab.

3.19.

C 2.25 Utilities Construction within Texas Department of Transportation Right of Way

This section of the specifications covers the construction of water lines within highway right of way under the jurisdiction of TxDOT.

Where proposed lines are in a state highway right of way, the work shall not be started until the Contractor has an approved permit from TxDOT, received through the City. In addition, the Contractor shall notify the TxDOT maintenance foreman at least 48 hours before commencing any work covered by the approved permit.

The Contractor shall provide and employ adequate warning signs, barricade, lights, watchman, etc., to fully protect workers and the traveling public in accordance with TxDOT requirements.

When the crossing of a highway is permitted by open cut, the Contractor shall prosecute the work in such a manner that one-half the traveled roadway is open to traffic at all times.

Highway crossings shall be tunneled and cased in accordance with Section C 2.34. However, in certain cases only where specifically shown on the plans, the Contractor shall make the crossing by open cut.

No changes shall be made in location as shown on the plans within the limits of a state highway right of way without prior authorization of TxDOT and the City.

3.19.1.

Backfill Requirements

All backfill requirements in this section shall conform to current TxDOT requirements.

After the installation of the pipe and the Embedment, the ditch shall be backfilled with Type 1 Backfill in all cases except the following:

Type 2 Backfill, when allowed by the permit, agreement, or by the TxDOT representatives, may be used only in trenches parallel and adjacent to right of way lines and in areas where there will be no earthwork construction or construction traffic except that this method may be used for placing backfill which will later be removed by highway construction.

Types 3 or 4 Backfill may be required for special conditions where the possibility of settlement or erosion of backfill must be eliminated or when, after backfill is started, it becomes apparent that Type 1 Backfill is unsuitable.

3.19.2.

Types of Backfill

- **Type 1 Backfill (Compacted Backfill)**. Type 1 Backfill shall consist of compacted material obtained from suitable soil excavated from the trench, or from sources outside the highway right of way. Material shall be free of rock, lumps, or clods that will not break down under compaction.

Backfill material shall be placed in the trench in layers not to exceed six (6") inches in depth and compacted. Water shall be added as required to facilitate compaction.

Compaction shall be done with rollers or mechanical tamps. Use of rollers will be permitted only when such use is not believed detrimental to any highway facility and the type roller used is acceptable to the TxDOT representative. When rollers are employed, mechanical tamps shall be used along sides of trench to compact any backfill that cannot be reached with rollers.

Compacting shall be continued until a backfill density equal to that of the adjacent undisturbed material has been obtained.

Where trenches lie within the limits of drainage ditches and channels which are in rock, the Type 1 Backfill used in trench shall be sealed with one (1') foot of concrete backfill struck off flush with the top of rock.

- **Type 2 Backfill (Water Jetted Backfill)**. Type 2 Backfill shall consist of suitable material excavated from the trench or other acceptable material obtained from sources outside the highway right of way.

Backfill shall be placed in the trench in layers not to exceed two (2') feet in depth by blading, dozing, or other approved means and then jetted with water delivered under pressure through a metal jet. After the trench is filled and jetted, additional material shall be mounded thereon and rolled with construction equipment.

- **Type 3 Backfill (Stabilized Sandy Soil or Washed Sand)**. Stabilized backfill shall consist of either sandy soil free of lumps and clods or washed concrete sand, stabilized with two sacks of Portland cement per cubic yard.

If aggregates are not moist enough to produce a mixture suitable for compaction, water shall be added as required. Either transit mix or stationary type mixers may be used.

After mixing, the stabilized material shall immediately be placed in the trench in uniform layers not to exceed six (6") inches in depth and compacted as specified for Type 1 Backfill.

Compaction shall be completed within two hours after mixing.

- **Type 4 Backfill (Lean Concrete).** Concrete backfill shall contain either one or two (2) sacks of Portland cement per cubic yard of concrete as may be specified by the agreement or permit or by the TxDOT representative.

Concrete aggregates shall be washed.

Concrete may be mixed on the project in an approved mixer or in an approved central mixing plant. Slump shall be between three (3) and six (6") inches as directed by the TxDOT representative.

Concrete shall be deposited in lifts not to exceed eighteen (18") inches in depth. Enough vibration shall be done to eliminate voids but care shall be exercised that contamination by adjacent soil does not occur during vibration. All concrete shall be placed within one hour after mixing.

3.20. **C 2.26 Connection to Existing Water Mains**

This section of the specifications governs the connection of repaired, renovated, or new water mains and/or facilities to existing water mains.

Connection to an existing water main shall include not only branch connections but in-line connections for the purpose of making required pipe adjustments as well. Any connections or series of connections required to be performed on an existing water main shall meet with the City's specific approval as to the seasonal period when the work can be performed, the length of time required for the work to be completed, the work procedures proposed, or any other facet that could affect curtailment of quality or quantity of water supply to the affected area. The work shall be performed with stringent built-in safeguards (such as adequate back-up equipment, labor and materials available) to insure that the time schedules are met without failure and subsequent setback. Every effort shall be made to accomplish as much of the work as possible before the actual tie-in is made into the existing main.

This is especially applicable where vertical and horizontal concrete thrust blocks are a necessity to impose proper restraint of the pipe when the main is returned to full service. A detailed schedule of operations for making such connections shall be approved by the City before any work commences. It shall be generally understood that water mains sixteen (16") inches in diameter and larger shall not be removed from service during the months of May through October unless specified otherwise in the project contract documents, and then only (since this work is so closely dependent on seasonal conditions) with the final approval of the City. The City is the final authority on all scheduled "shut-offs" or interruptions to service.

Where indicated on the plans and/or herein specified, the Contractor shall connect the new main with existing mains. The Contractor shall furnish all labor, materials, equipment, and services required for the locating and uncovering of the existing line, the making of cuts in the line, the removal, relocation, and/or lowering of existing lines as required, de-watering of the trench, connecting of the existing line into the new main and all appurtenant work required for a complete connection. Relocated mains or lines shall be laid so that all valve stems shall be set vertically.

Only such connections to existing mains as are necessary to load, test, and sterilize mains under construction with water from City mains will be permitted before the chlorination of new mains. All other connections to existing mains shall be made only after the new main has been satisfactorily disinfected and the City has authorized the connections. The Contractor will be required to plug and block lines, crosses, tees, or other fittings installed in the new main to permit testing and chlorination before the making of connections. Such plugs and blocking shall be adequate to withstand a test pressure of 150 p.s.i.g.

Where cut-ins are made immediately adjacent to valves which are under pressure, the Contractor shall take all necessary precautions to brace such valves with temporary blocking and bracing which shall be of ample size and properly placed to prevent movement or blowing off of any pipe, valves, or fittings due to water pressure on the main.

Notice to Businesses and Industries, Public Schools, and Other Water Customers before Stopping Water

Service for Scheduled Work

The Contractor will notify all business and industries in the affected area a minimum of 24 hours before disrupting water service due to scheduled water shut-offs. All water shut-offs will be scheduled through the City's representative. If the water shut-off will be a hardship on any business or industry, the Contractor will make tie-ins and other water shut-offs after hours (5:30 PM thru 6:00 AM and/or weekends) at a time convenient to the water customers. No additional Payment shall be made when after-hours work is necessary to accommodate water customers.

Failure to notify water customers may result in damage to equipment and could result in claims against the Contractor. In case of emergency shut-offs or repairs, the affected customers shall be notified immediately after repairs are made and/or service restored so that all facilities can be checked.

The Contractor shall notify all other water customers by giving a minimum of 24 hours notice before disruption of service. Residents shall be notified either in person or by placing a notice on the door of the dwelling. The notice shall contain the reason for the disruption or service, the time the water is to be turned off, and the approximate length of time the water is to remain off. Notices are available from the Public Works Department. The Contractor is responsible for proper completion of the form before distribution.

3.21. C.2.27 Cleaning and Sterilization of Water Mains

This section of the specifications covers the cleaning and sterilization of water mains before placing them into service in the City's water system.

Before any newly constructed water main is placed into service, it shall be cleaned, sterilized, and tested until the bacteria count in the water within the main meets the standards of purity established by the TCEQ and the City of Colleyville. No service from the main will be provided any customer until these standards are met.

3.21.1. Precautions during Construction

During the construction operations, workers shall use care to assure that all installed surfaces of the system which will come in contact with the City water supply are maintained in a sanitary condition.

Every effort must be made to keep the inside of the pipe, fittings, and valves free of all loose foreign matter. Any time that the pipe fittings or valves become contaminated with loose foreign matter, the Contractor shall, at no additional expense to the City, restore the pipe, fittings or valves to a sanitary condition. Sanitary condition will be defined as being free of any foreign substance. The final determination as to the sanitary condition of the pipe will be made by the City.

As each joint of pipe is being laid, it shall be swabbed with a clean and effective cleaning tool as approved by the City.

Exposed open ends of pipe shall be temporarily blocked or capped with a water tight cap during construction. Particular care shall be taken to protect pipe ends at any time actual laying is not in progress.

3.21.2. Cleaning

Cleaning shall be accomplished by passing an appropriate sized "Poly-Pig(s)" through the pipe. The "Poly-Pigs" shall be minimum five (5) pounds per cubic foot density and shall be the double spiral wrapped type. The "Poly-pigs" shall be operated in accordance with the manufacturer's recommendations. Soft or uncoated "Poly-Pigs" will not be acceptable. The procedure for "Poly-Pigging" shall be as follows:

- The Contractor shall prepare the main for the installation and removal of "Poly Pigs" as required.
 - In general, this will consist of furnishing all equipment, material, and labor to satisfactorily expose cleaning wyes, remove cleaning wye covers, etc., as directed by the City and to insert the "pigs" into the mains at points indicated on plans. On mains twelve (12") inches or smaller, the Contractor will insert the "Poly-Pig" into the pipeline at

- points indicated on plans while installing the water main.
 - At point of expulsion of the "Poly-Pig", the Contractor shall prevent back flow of purged water into the main after passage of the pig. On small pipe, through twelve (12") inches, back water can be prevented re-entry into the pipe by the temporary installation of mechanical joint bends and pipe joints to provide a riser out of the trench. Excavation of the trench may serve the same purpose. Where a trench is used, the excavation shall be lined with polyethylene and secured, and a ditch be cut to allow the water to drain from the excavation.
 - After passage of the "Poly-Pig" and flushing of all back water from the pipe, the Contractor shall continue to flush the main until the water runs clear and no noticeable sand or debris can be seen in a white sample cup or until notified by the City. The Contractor shall complete work at openings by plugging and blocking, installing cleaning wye blind flanges, etc., then backfill and complete all appurtenant work necessary to secure the system.
- Under direct supervision of the City Representative, the Contractor will shuttle "Poly-Pigs" through the main from point of insertion to exit. Where the pipe in the main forms a loop distribution system, every effort will be made to sweep the complete system.
- Short dead end pipe sections not swabbed by the pig shall be flushed.
- The procedure set forth below in section STERILIZATION shall be followed before any flushing or sampling taking place.
- Appropriate erosion control methods will be placed to prevent transportation of silt or other debris away from the worksite during flushing. This may include restricting flow to avoid damage to adjacent landscape and exposed earthen surfaces.

3.21.3.

Sterilization

The following procedure shall be used for sterilization:

- Chlorine will be injected into the section of line being sterilized so that its entire capacity will be filled with water containing chlorine in the quantity of 50 parts per million (p.p.m.) or in such other quantity as determined by the City. The contractor shall provide a service tap near the water source end of the line, minimum size 3/4-inch, for the injection of the chlorine solution. The sterilizing agent shall be introduced at one end of the section and the water released from the opposite end until the sterilizing agent is present at the discharge end in such quantity as to indicate a residual chlorine of 50 p.p.m. or as otherwise determined by the City. All valves shall then be closed and the sterilizing solution permitted remain in the pipe line section for not less than 24 hours. Chlorination shall be executed in accordance with "Procedures for chlorination and sampling of new water lines" published by the Pierce-Burch Water Treatment Plant and described below.
- At the end of the sterilizing period, the sterilizing solution shall be discharged from the pipe and replaced with City water direct from a City main. The solution may be discharged to the City sanitary sewer system under the direction of the City Engineer.
- A sample of water from the sterilized main shall be taken (not through a fire hydrant) from a suitable tap under the supervision of the City and submitted to the Pierce-Burch Water Purification Plant Laboratory. The Contractor shall provide a service tap near the discharge end of the line, minimum size 3/4-inch, for obtaining a water sample for analysis. If the test shows a satisfactory quality of water, the line so sterilized may then be placed in service. If the sample shows unsatisfactory quality of water, the process of sterilization shall be repeated until a satisfactory water sample is obtained.

3.21.4.

Authorization

Sterilization of the line or any section thereof shall not begin until the City's approval of the method, apparatus, sterilizing agent, and disposal of chlorinated water, for the section of the line has been obtained.

PROCEDURES FOR CHLORINATION AND SAMPLING OF NEW WATER LINES

To assist the contractor, the procedures for chlorination and sampling of new lines in Colleyville, are provided in this section.

3.21.5.

Contractor Responsibilities

Install a riser with a hose bib at the end of the new line for sampling purposes. It should be two (2) –three (3') feet above the ground. Fire hydrants are not the best place to obtain a sample.

- Using the following table, determine the quantity of HTH needed to disinfect the quantity of water mains you have laid and cleaned. Remember that the table is made for 100 ft. of pipe. To use it for any other lengths of pipe you must use the formula given below. The following procedure should be used to disinfect new water lines:

Pipe Size (Inches)	HTH per 100 LF (Pounds)	Time required to pull HTH Solution through 100 LF of pipe using a flow of 700 gpm from fire hydrant
6	0.10	15 seconds
8	0.16	22 seconds
10	0.25	35 seconds
12	0.37	50 seconds
16	0.65	1 minute, 30 seconds
18	0.82	2 minutes
20	1.02	2 minutes, 20 seconds
24	1.46	3 minutes, 20 seconds
27	1.85	4 minutes, 15 seconds
30	2.29	5 minutes, 15 seconds
33	2.77	6 minutes, 20 seconds
36	3.29	7 minutes, 30 seconds
42	4.48	10 minutes, 15 seconds

For quantities of pipe other than 100 LF:

$$= \frac{(\text{chart quantity}) \times (\text{actual LF})}{100 \text{ LF}}$$

Example: The following calculates the quantity of HTH needed for 867 LF of 12" line and 1,289 LF of 20" line, and also indicates the time required to pull the chlorine solutions through the pipe.

$$\text{HTH} = (0.37) \times (867 \text{ LF}) = 3.21 \text{ lbs of HTH} \\ (100 \text{ LF})$$

$$\text{HTH} = (1.02) \times (1,289 \text{ LF}) = 13.15 \text{ lbs of HTH} \\ (100 \text{ LF})$$

$$\text{Total lbs of HTH needed} = 3.21 + 13.15 = 16.36 \text{ lbs}$$

$$\text{Time} = (50 \text{ sec}) \times (867 \text{ LF}) = 7 \text{ min } 14 \text{ sec} \\ (100 \text{ LF})$$

$$\text{Time} = (2 \text{ min } 20 \text{ sec}) \times (1,289 \text{ LF}) = 30 \text{ min} \\ (100 \text{ LF})$$

Total time needed = 7 min 14 sec + 30 min = 37 min 14 sec

- Dissolve the HTH in a clean 55 gallon drum (used only for this purpose) or some other suitable container. Use caution when doing this since HTH can release strong chlorine fumes when the containers are first popped open, especially in warm weather. Mix the HTH with tap water and stir well. Complete mixing is important to the disinfection process. The vapor from the mixture should not be inhaled, especially in an enclosed environment!

Determine the number of 55 gallon drums that you will need to mix up by using the following:

$$\text{Drums} = \text{total time} / 10 \text{ min}$$

Example:

$$\text{Drums} = \frac{37 \text{ min}}{10} = 4 \text{ drums of chlorine solution} * 10 \text{ min}$$

* From the example in No. 1

Determine the pumping rate of the chlorine solution:

of 55 gal drums needed x 55 gal total minutes needed

Example:

$$\text{drums} \times 55 \text{ gal. drum} = 5.9 \text{ gal per min} \times 37 \text{ minutes}$$

To determine how many pounds of HTH you will need to add to each 55 gallon drum:

$$\text{lbs of HTH needed per drum} = \frac{\text{tot. lbs HTH needed}}{\# \text{ of 55 gal drums needed}}$$

Example:

$$\text{lbs of HTH/drum} = \frac{16.36 \text{ lbs}}{4} = 4.1 \text{ lbs/HTH per drum} \times 4 \text{ drums}$$

- Feed this SOLUTION until the chlorine solution from the drums is nearly gone. Then begin checking the residual at the opposite end of the line (as explained below). If the residual is not up to 50 ppm, continue feeding the chlorine solution. You may have to mix up an additional drum of chlorine and feed some more. Be sure to open the sample riser hose bib to allow it to be disinfected also.
- Check the chlorine residual. A chlorine test kit which may be purchased at any pool supply store and at many grocery stores is adequate. However, these kits are only designed to measure a chlorine concentration up to 3.0 to 3.5 ppm. You need to be able to measure a concentration of 50 ppm. To do this you must dilute the sample of water coming from the new line. To measure the concentration of chlorine in the new line:
 - Purchase an eye dropper (at any grocery store or pharmacy).
 - Put six (6) drops of sample into the test kit vial.
 - Fill to the mark with distilled water or normal Colleyville City tap water.
 - Proceed with the kit instructions.
 - Take the reading from the kit and multiply by twenty (20).

Example: $2.8 \times 20 = 56$ ppm chlorine in the new line

 - When a residual of 50 ppm of chlorine has been achieved valve off the line and allow it to sit for at least 24 hours.
 - Arrange a time with your inspector to flush the water from the line and have the inspector obtain a bacteriological sample.

3.21.6.

City's Responsibility

- Help the contractor during the chlorination process to insure that: the correct quantity of HTH is put into solution, it is fed through the new line properly, there is a chlorine level of 50 ppm in the entire line, it sits

for at least 24 hours, it is completely flushed before sampling, and there is an appropriate sample collection site.

- Obtain a bacteriological sample bottle from the Colleyville Public Works Water Division. Check the chlorine residual at the sample collection point. Check the chlorine residual at a representative site in the area, make sure that the two are similar. (If the residual in the new line is 3.5 ppm and the normal residual in the system in that area is 1.4 ppm, the new line has not been flushed entirely.) Be sure that the contractor remembers to flush the sample collection riser and hose bib.
- Disinfect the hose bib with chlorine bleach. Allow the bleach to remain in contact with the hose bib for five (5) minutes. Turn on the hose bib and allow it to run at a high rate for five (5) minutes. Adjust the flow to a steady slow stream. Remove the cap from the sample bottle and hold it in one hand with the inside of the cap facing down. Fill the sample bottle to the 100 mL mark. Return it to the laboratory as soon as possible before 3:00 p.m. (Monday- Friday, 8:00 a.m. - 3:00 p.m.) at the latest on the day that the sample is taken. Fill out the lab paperwork identifying the site, the date the sample was taken and the chlorine residual that was obtained before sampling.

No samples will be submitted to the laboratory for the two days before a City holiday or weekend associated with the holiday unless prior arrangements are made.

- The inspector will be provided with the results of the sample within 48 hours of submitting it to the lab or by 9 a.m. on Monday for samples that are submitted on a Thursday or Friday. A sample will be found to pass or fail. If the sample fails, the lab will also give recommendations to whether the new line needs to be rechlorinated or just flushed again.
- If the sample fails, the inspector will make sure that the contractor follows the recommendations of the lab. When the new line is ready for a bacteriological resample, the inspector will arrange a date and time with the lab. A laboratory technician will take the resample. The Contractor will be responsible for the cost of the re-test.

3.22. **C 2.31 Pressure Testing of Water Lines**

This section of the specifications covers the pressure testing of water lines before their sterilization and placement into service in the domestic water system.

After the pipe has been laid and backfilled, it shall be subjected to a hydrostatic pressure test by raising the pressure in the pipe to 150 psi at the low point of the test section.

3.22.1. **Duration of Test**

The duration of each test shall be three (3) hours.

3.22.2. **Test Procedures**

Tests shall be made against valves when available, or by placing temporary plugs and bulkheads in the pipe, and filling the line slowly with water. Care shall be used to see that all air vents are open during the filling.

If the Contractor proposes to test against an existing valve, the Contractor shall be satisfied that the valve is not leaking before making the connection. If the connection is made but a satisfactory pressure test cannot be accomplished because of valve leakage, the Contractor shall remove the connection and plug and block the new line to perform the pressure test necessary for City acceptance. No direct compensation will be made for this work, and it will be considered subsidiary to the various bid items.

After the line, or section thereof, has been completely filled, it shall be allowed to stand under a slight pressure for at least 48 hours to allow the escape of air from any air pockets. During this period, the bulkheads, valves, and connections shall be examined for leaks. The water necessary to maintain the test pressure shall be measured through a meter or by other means satisfactory to the City.

Before applying the specified test pressure, all air shall be expelled from the pipe. If it is necessary to expel air from high points other than where air valves are provided, the Contractor may tap the line for this purpose and afterwards tightly plug the tap.

3.22.3. **Visual Examination**

During the last two hours of the test, the entire route of the pipeline shall be inspected to locate any leaks or breaks. Any defective joints, cracked or defective pipe, fittings, or valves discovered in consequence of this pressure test shall be removed and replaced with sound material and the test shall be repeated until satisfactory results are obtained.

Any and all noticeable leaks shall be repaired regardless of whether the actual leakage is within the allowable.

3.22.4. **Permissible Leakage and Makeup Water**

No pipe installation will be accepted until or unless the makeup water is less than twelve (12) gallons per mile per 24 hours per inch of nominal diameter of pipe.

Makeup water is defined as the quantity of water to be pumped into the newly laid pipe, or any valved section of it, necessary to maintain the specified test pressure after the pipe has been filled with water and the air expelled.

3.22.5. **Permissible Leakage in Three Hour Period**

3-Hr. Leakage in Gallons

Size Main	per 100 Ft. of Main
6"	0.22
8"	0.29
10"	0.37
12"	0.44
14"	0.51
16"	0.59
18"	0.66
20"	0.74
24"	0.88
30"	1.10
36"	1.32
42"	1.54
48"	1.77
54"	1.99

3.23. **C 2.32 Concrete Structures and Concrete Blocking and Cradle**

This section of the specification shall govern the construction of concrete structures or concrete structural units as well as the construction of concrete cradles and blocking for pipelines.

Materials used in the performance of work described in this section of the specifications shall comply with Section C 1.23, "Concrete," and C 1.24, "Reinforcing Steel," of these specifications.

3.23.1. **Structural Excavation and Backfill**

This item shall govern the excavation for the placing of such structures as indicated or specified; for the disposal of all material from such excavation; and for the backfilling around completed structures to the level of the original ground. Unless otherwise provided, the work included hereunder shall provide for the removal of old structures or portions thereof, trees, and all other obstructions when such removal is necessary for the proper completion of the proposed construction. Excavation will be unclassified.

Excavation shall be done in accordance with the lines and depths indicated on the plans or as established by the Engineer. Unless written permission is given by the City, no excavation shall be more than three (3') feet from the footing in any direction.

The final elevation to which a foundation is to be constructed shall be as shown on the plans or as raised or lowered when such alterations are judged proper to satisfactorily comply with the design requirements for the structure. Should it be found necessary, in the judgment of the City, to increase or decrease the depth of footings from that shown on the plans, the necessary alterations in the details of the structure shall be accomplished in a manner as directed by the City.

When a structure is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of the foundation material to grade shall be performed just before the footing is to be placed.

The excavation shall be maintained in a dry condition. All pumping or bailing from the interior of any excavation shall be done in such a manner as to prohibit the movement of water through or alongside any concrete being placed.

As soon as practicable, the excavated areas around the structure shall be backfilled with approved material.

Backfill which will not support any portion of the completed structure shall be placed in layers not more than eight (8") inches in loose Measurement or as otherwise recommended and shall be compacted to a density equal to the adjacent undisturbed material. Material for backfill shall be composed of earth only and shall contain no wood, roots, other concrete, stones, trash, or debris of any kind.

Backfill which will support any portion of the structure shall consist, to maximum extent available, of the excess earth obtained from structure and trench excavations. Additional material may be obtained from borrow pits as necessary.

All materials placed in fills and embankments shall be free from rocks or stones larger than three (3") inches in their greatest dimension, brush, stumps, logs, roots, debris, and organic or other deleterious materials. No rocks or stones shall be placed in the upper eighteen (18") inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments provided they are distributed so that they do not interfere with proper compaction.

After preparation of the fill or embankment site, the subgrade shall be leveled and rolled so that the surface materials of the subgrade will be as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

All fill and embankment materials shall be placed in approximately horizontal layers not to exceed eight (8") inches in uncompacted thickness. Material which is deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Each layer of material being compacted shall have a uniform moisture content to insure satisfactory compaction. The Contractor will be required to add water and harrow, disc, blade, or otherwise work the material in each layer to insure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted by rolling or other method approved by the Engineer to 95 percent of the maximum density at optimum moisture content as determined by ASTM D 698. If the material fails to meet with the density specified, the compaction methods shall be altered as necessary to obtain the specified density. All compaction shall be accomplished at a moisture content from zero (0) to two (2%) percent above optimum.

No backfill shall be placed against any abutment or retaining wall until such structure has been in place at least seven (7) days. Backfill placed around abutment and piers shall be deposited on both sides to approximately the same elevation as at the same time.

3.23.2.

General Requirements

Before starting work the Contractor shall inform the City as to the methods of construction and the amount and

character of equipment he proposes to use, the adequacy of which shall be subject to the approval of the City.

Plans for forms and false work to be used in the construction of the various units of a structure shall be submitted if requested by the City. Such plans shall be enough to show all essential details of the proposed forms, false work, and bracing.

Forms for walls or columns shall not be erected on concrete footings until the concrete in the footing has cured at least two (2) curing days. Concrete may be placed in walls or columns as soon as the forms and reinforcing steel placement have been approved by the City. Approval by the City of any construction methods, equipment, or form and false work plans will not relieve the Contractor of responsibility for the safety or correctness of methods used, adequacy of equipment, or from carrying out the work in full accordance with the contract.

3.23.3. **Curing Day**

A curing day will be any calendar day on which the atmospheric temperature, taken in the shade and away from artificial heat, is above 50 degrees F. for at least eighteen (18) hours. Colder days may be counted if proper provisions are made, and the air temperature adjacent to the concrete is maintained above 50 degrees F. throughout the entire day.

3.23.4. **Construction Joints**

Construction joints shall be placed as shown on the plans unless otherwise specifically authorized. All construction joints shall be made on horizontal and vertical planes and formed with mortises of keys made in the concrete unless shown otherwise on the plans. Enough section shall be provided in horizontal and vertical keys to resist shear. Where construction joints are placed, forms shall be tightly framed around the reinforcing steel to prevent the escape of mortar, and the joint shall be so made that its trace in the exposed face of the finished structure will be an exactly vertical or horizontal line. Where, to accomplish this purpose, finishing strips are needed, they shall be nailed to the forms and the concrete carefully finished to them. The surface of finished concrete and forms shall be thoroughly cleaned and wetted immediately before resuming concreting. Care shall be exercised to obtain maximum density and insure against honeycomb, etc.

Special care shall be taken to remove all laitance and to roughen any smooth set surface with picks or by other approved methods before the plastic concrete is placed against the old concrete.

3.23.5. **Forms**

Except where otherwise specified, forms may be constructed of either timber or metal as elected by the Contractor.

Forms shall be designed for the pressure of a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete shall be taken into consideration in determining the depth of the equivalent liquid. An additional live load of 50 pounds per square foot shall be allowed on horizontal surfaces.

If at any stage of the work, the forms show signs of bulging or sagging, that portion of the concrete causing such conditions shall be removed immediately, if necessary, and the forms shall be reset and braced securely against further movement.

Nominal one inch lumber surfaced to a uniform width and thickness will be permitted for general use on the various portions of structures if backed by enough number of studs and wales. All forms shall be face lined with an approved type of form lining material. If desired by the Contractor, facing for such surfaces may be constructed of three-quarter (3/4") inch plywood backed by adequate studs and wales, in which case form lining will not be required.

Forms shall be built mortar tight and of material with enough strength to prevent bulging between supports and shall be set and maintained to the lines designated until the concrete is hardened enough to permit form removal. Forms shall be maintained in such a manner as to prevent warping and shrinking. All details of form construction shall be subject to the approval of the City, and permission to place concrete will not be given until

the form work is complete to its satisfaction.

Where corners occur, suitable chamfer strips shall be placed at the angle of the forms to round off or bevel them.

All forms shall be constructed so as to permit removal without injuring the concrete.

At the time of placing concrete, the forms shall be clean and entirely free of all chips, dirt, sawdust, and other extraneous matter.

For thin wall sections and other locations where access to the bottom of the forms by other methods would be cumbersome and inadequate, clean-out openings shall be provided.

Only approved form spreaders shall be used.

Metal form ties of an approved type shall be used to hold forms in place, and they shall have provision to permit ease of removal of the metal as hereinafter specified.

Metal ties shall be held in place by devices attached to walls. Each device shall be capable of developing the strength of the tie.

All metal appliances used inside of forms to hold them in correct alignment shall be removed to a depth of at least one-half (1/2") inch from the surface of the concrete and shall be so constructed that the metal may be removed without undue injury to the surface by chipping or spalling. Such devices, when removed, shall leave a smooth opening in the concrete. Burning off of rods, bolts, or ties will not be permitted. Where wire ties are used, all wires, upon removal of the forms, shall be cut back at least one-half (1/2") inch from face of the concrete with a sharp chisel or nippers.

All cavities produced by the removal of metal ties shall be carefully cleaned and completely filled with re-tempered sand cement mortar mixed in proportion of one to three, and the concrete shall be left smooth and even.

3.23.6.

Reinforcing Steel

When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Before being placed in the work, reinforcement shall be cleaned of all loose mill scale and rust. Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will no longer meet the physical requirements for the size and grade of steel specified. Reinforcement shall be placed in the position shown on the plans. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plane placement by more than one-twelfth of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than one-quarter (1/4") inch.

The reinforcing steel shall be spaced its required distance from the face of the forms by means of approved galvanized metal spacers or approved precast mortar or concrete blocks. All reinforcing steel shall be wired together at all intersections. Before any concrete is placed, all mortar shall be cleaned from the reinforcement.

Reinforcement shall be supported and tied in such manner that a practically rigid cage of steel is provided. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars, or movement in any direction during concrete placement operations, permission to continue concrete placement will be withheld until corrective measures are taken.

Enough measurements shall be made during concrete placement to insure compliance with spacing and clearance requirements herein specified. All reinforcing bars in all members shall be supported rigidly in their correct locations, in slabs, beams, walls, columns, drilled shafts, or footings.

No concrete shall be deposited until the City has inspected the final placement of the reinforcing metal and given permission to place concrete.

3.23.7.

Placing Concrete – General

The Contractor shall give at least 24 hours advance notice before pouring concrete in any unit of the structure to permit the inspection of forms, the placement of reinforcing steel, and the preparations for the mixing and placing of the concrete. The mixing of concrete and placing of same in the form shall not be commenced until the City has given its approval of the forms, the placing of reinforcing and miscellaneous steel, and the Contractor's arrangements for mixing and placing concrete. No concrete shall be placed in any unit before completion of the form work and the placement of the reinforcing and other steel. No concrete shall be placed before the completion of any other operation which might prove detrimental to the concrete.

Whenever it is necessary to continue the mixing, placing and finishing of concrete after the daylight hours, the site of the work shall be brilliantly lighted so that all operations are plainly visible. In general, however, concrete placing shall be so regulated as to permit finishing operations to be completed in the daylight hours.

The City reserves the right to order postponement of concrete placing operations when, in its opinion, impending weather conditions may result in rainfall or low temperatures which will impair the quality of the finished work. In case rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work. In case of drop in temperature, the provisions set forth herein shall be applied.

The sequence and manner of placing concrete shall be as provided on the plans. The operation of depositing and compacting the concrete shall be conducted so as to form a compact, dense, impervious mass of uniform textures which shall show smooth faces on all surfaces.

The method and manner of placing shall be such as to avoid the possibility of segregation of the aggregate or the displacement of the reinforcement. Concrete shall not have a free fall that is enough to cause segregation of materials. Tremies shall be used in order that the free fall of mix shall be held to a maximum of three (3') feet, unless otherwise approved by the Engineer.

Each part of the forms shall be filled by depositing concrete directly as near its final position as possible. The coarse aggregate shall be worked back from the face of the forms and the concrete shall be forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point in the forms and running or working it along the forms will not be allowed.

After the concrete has taken initial set, the forms or the reinforcing steel shall not be jarred or any strain placed on projecting reinforcement.

Chutes, troughs, or pipes used as aids in placing concrete shall be arranged and used so that the ingredients of the concrete will not be separated. Open troughs and chutes shall extend, if necessary, down inside the forms or through holes left in the forms, or the ends of such chutes shall terminate in vertical downspouts. All chutes, troughs, and pipes shall be kept clean and free from coating by hardened concrete by a thorough flushing with water before and after each placement. Water used for flushing shall be discharged clear of the concrete in place.

Where the Contractor's operations involve the placing from above, that is, directly into an excavated area in or through the completed forms, particularly in the case of abutments, piers, columns, retaining walls, walls, floors, footings, and deep girders, all concrete so placed shall be deposited through a vertical sheet metal or other approved pipe not less than six (6") inches nor more than ten (10") inches in diameter. The pipe shall be made in sections so that the outlet may be adjusted to proper heights during placing operations.

Concrete shall be placed in continuous horizontal layers approximately twelve (12") inches in thickness. The rate of delivery shall be so arranged that a cold joint is not allowed to form between loads. The Contractor shall avoid unauthorized construction joints by placing required portions of abutments, piers, walls, floors, slabs, columns or superstructures in one continuous operation. As a safety precaution, openings in the forms shall be provided for the removal of laitance and other foreign material.

All concrete shall be well compacted and the mortar flushed to the surface of the forms by continuous working with concrete spading implements and mechanical vibrators of an approved type. Vibrators of the type which operate by attachment to forms or reinforcement will not be permitted. The vibrators shall be applied to the concrete immediately after deposit and shall be moved throughout the mass, thoroughly working the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms until it has been reduced to a plastic mass. The mechanical vibrator shall not be operated so that it will penetrate or disturb layers placed previously which have become partially set or hardened. The vibration shall be of enough duration to accomplish thorough compaction and complete Embedment of reinforcement and fixtures but shall not be done to an extent that will cause segregation. Vibration shall be supplemented by hand spading to insure the flushing of mortar to the surface of all forms.

3.23.8.

Placing Concrete in Cold Weather

No concrete shall be placed when the atmospheric temperature is at or below 40 degrees F., taken in the shade away from artificial heat unless permission is given by the City. In cases where the temperature drops below 40 degrees F. after the concreting operations have been started, the Contractor shall furnish enough canvas and frame work or other type of housing to enclose and protect the structure in such a way that heated air around the forms and fresh concrete can be kept at a temperature not less than 40 degrees F. for a period of five days after the concrete is placed.

It is understood that the Contractor is responsible for the protection of concrete placed under any and all weather conditions. Permission given by the City to place concrete during low temperature or freezing weather will in no way relieve the Contractor of the responsibility for satisfactory results. Should concrete placed under such conditions prove unsatisfactory, it shall be removed and replaced by the Contractor at his expense.

The concrete shall be placed in horizontal layers of not more than twelve (12") inches in thickness extending from end to end or side to side of the section between walls or approved joints. A time interval of no longer than 30 minutes shall elapse between the placing of successive layers. The concrete shall be compacted, evenly distributed and placed around the reinforcement, openings and structure so that honeycomb and/or defective areas are eliminated.

Wall forms shall at all times during the placing of the concrete and until its initial set has occurred, be maintained in true alignment and grade. During the placing of the concrete, frequent inspection shall be made and the necessary corrective measures taken if forms or supports show any tendency to become displaced.

Forms shall be removed in accordance with a time schedule to be approved by the City, and all defective areas, tie pits, etc., shall be immediately treated in accordance with the requirement of other items of these specifications.

3.23.9.

Types of Finishing for Concrete

In general, except as elsewhere permitted in these specifications, special documents, specific plans, or by direction of the City, finishes shall be an integral part of a monolithic process. The following schedule of finishes shall apply according to their applicability unless otherwise specified, amended, or extended.

- **Screeding.** Screeding is an operation normally associated with horizontal concrete surfaces such as slabs. Screeding shall be done as soon as concrete has been approximately leveled. The screed shall be designed adaptable to the use intended, shall have provision for vertical adjustment, and shall be rigid enough to remain true to shape during use.
- The screed shall be vertically adjusted so as to leave the concrete surface at an elevation slightly above grade after the initial strike off to allow for consolidation and finishing. Continue screeding and tamping alternately or in unison until the concrete is properly consolidated and surface voids are eliminated. The surface shall then be brought to a smooth, true alignment by means of longitudinal screeding, then finished as specifically required.
- **Surface Rubbing.** Carborundum fluted surface stones provide an abrasive which, when applied in surface rubbing at the proper time in the concrete aging process, will remove form marks, surface imperfections, and otherwise smooth, shape, or finish the surface.

- **"First Surface Rubbing."** As soon as the forms are removed all necessary pointing shall be done. When the pointing has set enough to permit rubbing, all surfaces requiring surface finish shall be wet and given a first surface rubbing with a No. 16 Carborundum Stone or an abrasive of equal quality. The rubbing shall be continued enough to bring the surface to a paste, to remove all form marks and projections, and to produce a smooth dense surface without pits or irregularities. The material that has been ground to a paste shall be carefully spread or brushed uniformly over the surface and allowed to take a reset. The use of cement to form a surface will not be permitted.

In general, chamfered corners shall not be rubbed in the first surface rubbing.

- **"Final Finish."** The surface of the entire structure requiring finish shall be cleaned of all drip marks, dirt, and discolorations and shall be given a final finish rubbing with a No. 30 Carborundum Stone or an abrasive of equal quality. On completion of this rubbing, the finished surfaces shall be neatly stripped with a brush, and the mortar on the surface shall be allowed to take a reset. After the mortar has taken a reset, the surface shall be washed down with clean water. The entire structure shall be left with a clean, neat, and uniform appearing finish, and shall be uniform in color.

- **Wood Float Finish.** Surfaces shall be finished using a wood float to a true even plane with no coarse aggregate visible. Enough pressure shall be used on the wood float to bring all excess moisture to the surface so that it can be removed. The surface shall have a uniform appearance and shall meet straightness requirements.
- **Steel Trowel Finish.** After all surface moisture has disappeared following the wood float finish, surfaces shall be steel trowelled to a smooth, even, impervious finish, free from blemishes including trowel marks. Where indicated on the plans, a floor hardener shall be applied to slabs receiving a steel trowel finish.
- **Brush Finish.** Following the steel trowel finish, surface of the concrete shall be brushed lightly with a soft-bristled brush. The brush shall be kept clean and shall be dipped in water frequently so that it will be clean and wet at all times. Brushing shall be limited to that necessary to remove the glaze and produce a nonslip surface.
- **Power-Machine Finish (option).** Instead of hand finishing, surfaces of slabs may be finished by using an approved power finishing machine in accordance with the directions of the machine manufacturer. The preparation of concrete surfaces for finishing by machine shall in general be the same as required for hand finishing, and the finish shall be of the quality required for the specific surface.

3.23.10.

Finishing Slabs (Roofs, Tops, Etc.)

As soon as concrete placing operations have been completed for a slab section of enough width to permit finishing operations, the concrete shall be approximately leveled and then struck off, tamped, and screeded using a longitudinal screed. The surface shall then be brought to a smooth, true alignment by means of longitudinal screeding, floating, belting, and/or other methods. When templates are used, they shall be of such design as to permit early removal to avoid construction joints and to permit satisfactory finishing at and adjacent to the site of the template.

While the concrete is still plastic, the surface shall be straightedged by the use of a standard ten (10') foot metal straightedge. Deviations in excess of permissible variations shall be corrected. The final surface finish of the slab shall be done after the initial straightedging, and corrective adjusting, if required, is completed.

3.23.11. **Finishing Exposed Surfaces**

All tie wires shall be cut back below the surface and then pointed over. All imperfections such as fins shall be removed and local surface depressions pointed over. Exposed interior surfaces, excluding vaults unless otherwise specified, and exterior surfaces to an elevation of one (1') foot below planned grade, which will be exposed to view after backfilling, shall be surface rubbed with Carborundum fluted surface stones.

3.23.12. **Curing Concrete**

All upper surfaces not formed shall be cured by one of the following methods:

- **Wet Covering.** The surface shall be covered by wet burlap, cotton mats or canvas covering immediately following the finishing operations and shall be kept thoroughly wet for a period of four (4) curing-days after the concrete is placed. Covering shall be held in direct contact with the concrete. Water used for curing shall be free from injurious quantity of oil, acid, alkali, salt, or other deleterious substances.

Immediately following the finishing operations, concrete slabs, including roof slabs, shall be covered with wet cotton mats or with a temporary covering of canvas or burlap. The temporary covering will be required when the size of slab, size of mats, or other factors are such that the mats cannot be placed immediately following the finishing operations without marring the finish of the slab.

Canvas or burlap covering material shall weigh not less than twelve (12) ounces per square yard, and the sections shall be placed with a lap at the edges of at least eight (8") inches. Cover material shall be saturated with water before placing and shall be kept saturated as long as it remains in place. Care shall be exercised in the placing of the cover material to prevent marring the concrete surface.

When temporary coverings are used, they shall remain in place only until the slab has hardened enough that a cotton mat covering can be substituted without marring or disturbing the slab finish. Cotton mats shall be thoroughly saturated before placing and shall be kept on the slab in a saturated condition for a period of at least four (4) curing- days after the concrete is placed.

- **Impervious Coating.** Immediately after finishing, the surface of the concrete shall be covered with a continuous, uniform, water impermeable coating of curing compound. Immediately after removal of the side and end forms, the sides and ends of all concrete shall receive a like coating. The solution shall be applied under pressure with a spray nozzle in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film.

The rate of application shall be such as to insure complete coverage, but the area covered shall not exceed 200 square feet per gallon of curing compound.

Under normal conditions, the curing compound, after application, shall dry to touch within one (1) hour and shall dry thoroughly and completely within four (4) hours. When thoroughly dry, it shall provide a continuous flexible membrane free from cracks or pinholes and will not disintegrate, check, peel, or crack during the required curing period. If for any reason the seal is broken during the curing period, it shall be immediately repaired with additional sealing solution.

3.23.13. **Blocking and Cradle**

Concrete blocking including vertical tie-down and horizontal blocking and cradle shall be Class "B" concrete unless specified otherwise or shown on the Standard Details. Concrete cradles shall be placed under the pipe as directed by the City in areas of unsatisfactory foundation conditions or when there is an excessive cover over the pipe.

Blocking at bends shall be computed based upon pipe thrust at bends, or tees, with internal pressure of 150 psi. Where upward thrusts are to be blocked, the concrete blocking shall be of enough weight to resist the thrust and the concrete shall be reinforced as directed. Other blocking sizes shall be computed based upon a maximum safe allowable soil bearing pressure of 2,500 pounds per square foot of undisturbed earth.

The concrete blocking shall be placed against undisturbed trench walls, with a minimum of eighteen (18") inches between trench wall and pipe. Blocking shall extend a minimum of 0.75 X pipe diameter below and above the centerline of pipe and shall not extend beyond any joints. If requested by the Engineer, the ends of the thrust blocks shall be contained in wood or metal forms. Where upward thrusts are to be blocked, the concrete shall be formed from the centerline of pipe upward.

Concrete blocking shall be considered subsidiary to the various items. No additional Payment will be made for concrete blocking.

4. MEASUREMENT

This Item will be measured as follows:

- 4.1. **Water Main Pipe.** Measured by the foot, of the various sizes and types specified. Water mains will be measured along the axis of the pipe and no deductions will be made for valves or fittings.
- 4.2. **Install Water Service Lines.** Measured by Each service line installed.
- 4.3. **Reconnect Existing Water Service.** Measured by Each service line reconnected.
- 4.4. **Fire Hydrant Assembly.** Measured by Each assembly, including a 6-in. gate valve and box, regardless of depth.
- 4.5. **Remove Fire Hydrants.** Measured by Each assembly removed and disposed of properly.
- 4.6. **Install Fire Hydrant.** Measured by each, it is the Contractor's responsibility to install the fire hydrant assembly such that it meets the standard installation requirements of this specification and the manufacturer's specifications.
- 4.7. **Install Fire Hydrant Extension.** Measured by Each extension added to new and/or existing fire hydrant.
- 4.8. **Gate Valve and Box (Complete).** Measured by Each assembly constructed, of the various sizes specified.
- 4.9. **Gate Valves.** Measured by Each assembly constructed, of the various sizes specified.
- 4.10. **Flowable Backfill.** Measured by the Cubic Yard of flowable backfill material for water main trench.
- 4.11. **Connect to Existing Water Lines.** Measured by Each connection, of the various sizes specified.
- 4.12. **Remove Water Valves and Boxes.** Measured by Each assembly removed and disposed of properly.
- 4.13. **Removing Water Meters.** Measured by Each assembly removed and disposed of properly.
- 4.14. **Remove Water Meter and Vaults.** Measured by Each assembly removed and disposed of properly.
- 4.15. **Cut and Plug Water Mains.** Measured by Each location a water main is cut and plugged, of the sizes indicated.
- 4.16. **Water Line Fittings (General).** Measured by Ton for general water line fittings needed, of the various sizes specified.
- 4.17. **Water Line Fittings (TEE).** Measured by Each for general water line Tees needed, of the various sizes specified.
- 4.18. **Procoder T-10 Neptune Model Water Meter.** Measured by Each specified model water meter.
- 4.19. **Post Construction Television Inspection.** Measured by the foot, of the various sizes and types specified along the axis of the pipe and no deductions will be made for valves or fittings.
- 4.20. **Vacuum Excavation.** Measured by the Hour.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for the items of work described below. These prices are full compensation for furnishing, hauling, placing, and installing the materials; for inspecting and testing; and for other materials, labor, equipment, tools, and incidentals.

- 5.1. **Water Main Pipe.** Payment for water main pipe will be made at the unit prices bid for "Water Main (PVC) (DR 18 C900)," of the various sizes and types specified.
- Unless otherwise shown on the plans or specifications, excavating, disposing of unsuitable excavated material, backfilling, for the complete installation of the water main system, are subsidiary to this bid Item.
- 5.2. **Install Water Service Lines.** Payment for install water service lines will be made at the unit price bid for "Install Water Service Line". This price is full compensation for labor, materials, excavation, and backfill required to install the facility of the various sizes and types found.
- 5.3. **Reconnect Existing Water Service.** Payment for reconnecting water service lines will be made at the unit price bid for "Reconnect Existing Water Service". This price is full compensation for labor, materials, excavation required to reconnecting the customer's water service line of the various sizes and types found.
- 5.4. **Fire Hydrant Assembly.** Payment for fire hydrant assemblies will be made at the unit price bid for "Fire Hydrant Assembly," including 6 in. gate valve and box.
- 5.5. **Remove Fire Hydrants.** Payment for removing fire hydrants will be made at the unit price bid for "Remove Fire Hydrant." This price includes removing valves from the existing location, disposing of the valves, and plugging at the tee. Excavation and backfill required for removing fire hydrants are subsidiary to this bid Item.
- 5.6. **Install Fire Hydrant.** Payment for installing a fire hydrant assembly will be made at the unit price bid for "Install Fire Hydrant." This price is full compensation for labor, materials, excavation, and backfill required to install the fire hydrant assembly regardless of barrel depth.
- Any adjustment required either in the flow line of the water main or to the barrel length of the fire hydrant is subsidiary to this bid Item.
- 5.7. **Install Fire Hydrant Extension.** Payment for installing a fire hydrant extension will be made at the unit price bid for "Install Fire Hydrant Extension," This price is full compensation for labor, materials, excavation, and backfill required to install the fire hydrant extension to the proposed water line location.
- 5.8. **Gate Valve and Box (Complete).** Payment for complete Gate Valve and Box will be made at the unit price bid for "Gate Valve and Box (Complete)" constructed. This price is full compensation for labor, materials, excavation, and backfill required to install the new gate valve and box of the various sizes and types specified.
- 5.9. **Gate Valves.** Payment for gate valves of various sizes specified will be made at the unit price bid for "6" Gate Valve", "8" Gate Valve", "10" Gate Valve". This price is full compensation for labor, materials, excavation, and backfill required to install new gate valves.
- 5.10. **Flowable Backfill.** Payment for flowable backfill will be made at the unit price bid for "Flowable Backfill" used. This price is full compensation for labor, extra materials, and excavation required installing the flowable backfill within the water line trench.
- 5.11. **Connect to Existing Water Lines.** Payment for connecting to existing water lines will be made at the unit price bid for "Connect to Existing Water Lines". This price is full compensation for labor, extra materials, and excavation required to connect proposed water lines to existing water lines of various sizes specified and found.

- 5.12. **Remove Water Valves and Boxes.** Payment for removing water valves and boxes will be made at the unit price bid for "Remove Water Valve and Box." Excavation and backfill required for removing water valves and boxes are subsidiary to this bid item.
- 5.13. **Removing Water Meter.** Payment for removing water meters will be made at the unit price bid for "Removing Water Meter."
- 5.14. **Remove Water Meter and Vault.** Payment for removing meters and vaults will be made at the unit price bid for "Remove Meter and Vault." This includes salvaging the meter strainers and valves and delivering them to their owner at the location shown on the plans or as directed.
- 5.15. **Cut and Plug Water Mains.** Payment for cutting and plugging water mains will be made at the unit price bid for "Cut and Plug Water Main (6")," of the sizes indicated. This price is full compensation for performing excavation, backfill, finish grading, and other incidental items required to abandon or cut and plug the water main as set forth this specification. Where grout is required, as shown on the plans, it is subsidiary to this bid item.
- 5.16. **Water Line Fittings (General).** Payment for general water line fittings will be made at the unit price bid for "Water Line Fittings (General) (6)", "Water Line Fittings (General) (8)", "Water Line Fittings (General) (12)", "Water Line Fittings (General) (Service Line)", of the sizes indicated. This price is full compensation of any water line fitting material needed for installation of proposed water line.
- 5.17. **Water Line Fittings (TEE).** Payment for Tee water line fittings will be made at the unit price bid for "Water Line Fittings (TEE) (6"X6)", "Water Line Fittings (TEE) (12"X6)", of the sizes indicated. This price is full compensation of any water line fitting tee material needed for installation of proposed water line.
- 5.18. **Procoder T-10 Neptune Model Water Meter.** Payment for procoder T-10 Neptune Model water meter will be made at the unit price bid for "Procoder T-10 Neptune Model Water Meter". This price is full compensation of water meter model and installation needed for existing and/or new water service line.
- 5.19. **Post Construction Television Inspection.** Payment for post construction television inspection of water line will be made at the unit price bid for "Post Construction Television Inspection". This price is full compensation for labor and materials needed to perform the inspection.
- 5.20. **Vacuum Excavation.** Payment for vacuum excavation of water line will be made at the unit price bid for "Vacuum Testing". This price is full compensation for labor and materials needed to perform the excavation.